E0170: Hazus for Hurricanes

Student Manual Date Released: 08/2020



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Handouts: Reference Materials

Handouts Outline

The table below contains the type, number, and description of each handout. The data needed column identifies major datasets required to complete the activity. The data provided column identifies if that dataset is provided in the zip folder E0170_ActivityData for download.

Туре	Number	Description	Data Needed	Data Provided?
Exercise	1.2	Build a hurricane study region.	ТХ	No
Activity	2.1	Explore the Comprehensive Data Management System (CDMS).	FL	No
Exercise	2.2	Update state database using CDMS and create a new study region.	FL; GBS.mdb,MedicalCareFacilities.mdb	No; Yes
Activity	3.2	Explore the Hazus inventory.	N/A	N/A
Exercise	4.1	Create multiple historic storm scenarios and review the results.	1916-6.pdf, 1919-2.pdf, harvey2017.pdf	Yes
Activity	4.2	Import Hurricane Harvey data using HURREVAC.	N/A	N/A
Exercise	4.3	Create a	Harvey_Winfield_HazusReady.dat	Yes

Туре	Number	Description	Data Needed	Data Provided?
		scenario with .dat data.		
Activity	4.4	Import Hurricane Irma data using a .bin file.	Hurricane Irma data using a .bin	
Activity	5.2	Run a probabilistic scenario.	Probabilistic.hpr	Yes
Demonstration	6.1	Review and discuss curve viewers.	Irma_Hurricane.hpr	Yes
Exercise	6.2	Modify the surface roughness parameters in order to see the effect on the damages and losses.	N/A	N/A
Demonstration	7.1	View results and reports from a hurricane analysis.	reports from a nurricane	
Exercise	7.2	Learn methods for displaying hurricane results.	HurricaneMichael.hpr, TotalExposure.mdb	Yes
Exercise	8.2	Run a historic scenario and modify the economic loss parameters.	FL; case1.pdf, case2.pdf, case3.pdf, case4.pdf, case5.pdf, case6.pdf	No; Yes

Туре	Number	Description	Data Needed	Data Provided?
Demonstration	9.1	Show how to view shelter and tree parameters	HurricaneMichael.hpr	Yes
Exercise	9.2	Explore the impact of altering tree and sheltering parameters	N/A	N/A
Activity	10.2	Create a combined Flood/Hurricane study region.	FL	No
Exercise	10.3	Explore the Surge menu items in the hurricane model and flood model. Discuss the reports and tables from the combined losses.	Irma_Surge.hpr	Yes
Discussion	11.1	Discuss mitigation options.	N/A	N/A
Exercise	11.2	Run various mitigation scenarios. Compare and contrast the results.	FL	No
Demonstration	12.1	Discuss and demonstrate Forecast	Demo12.1_Forecast39.hpr, Demo12.1_Forecast44.hpr	Yes

Туре	Number	Description	Data Needed	Data Provided?
		Advisory Uncertainties.		
Exercise	12.2	Run various user-defined scenarios. Compare the results.	TX; forecast advisory 21 global summary report.pdf, Harve Forecast Advisory 21.pdf, Harvey_Windfield_HazusReady.dat, hurrevac gloval summary report.pdf, hwind global summary report.pdf	No; Yes
Exercise	13.1	Modify uncertain and sensitive variables in Hazus. Run multiple scenarios. Compare the results.	FL; IrmaLandfallTrack.bin	No; Yes

Data Dictionary

The table below contains the type, number, and data file name for each exercise. The data provided can be found in the zip folder E0170_ActivityData for download.

Туре	Numbe r	Data Folder Name	Data Provided
Exercis e	1.2	N/A	N/A
Activit y	2.1	Activity_2.1	N/A
Exercis e	2.2	Exercise_2.2	GBS.mdb, MedicalCareFacilities.mdb

Туре	Numbe r	Data Folder Name	Data Provided
Activit y	3.2	N/A	N/A
Exercis e	4.1	Exercise_4.1/Results	1916-6.pdf, 1919-2.pdf, harvey2017.pdf
Activit y	4.2	N/A	N/A
Exercis e	4.3	Exercise_4.3	Harvey_Winfield_HazusReady.dat
Activit y	4.4	Activity_4.4	IrmaLandfallTrack.bin
Activit y	5.2	Activity_5.2	Probabilistic.hpr
Demon stration	6.1	Demonstration_6.1	Irma_Hurricane.hpr
Activit y	6.2	N/A	N/A
Demon stration	7.1	Demonstration_7.1	Irma_ResultsReport.hpr
Exercis e	7.2	Exercise_7.2	HurricaneMichael.hpr, TotalExposure.mdb
Exercis e	8.2	Exercise_8.2/Results	case1.pdf, case2.pdf, case3.pdf, case4.pdf, case5.pdf, case6.pdf
Demon stration	9.1	Demonstration_9.1	HurricaneMichael.hpr
Exercis e	9.2	N/A	N/A

Туре	Numbe r	Data Folder Name	Data Provided
Activit y	10.2	N/A	N/A
Exercis e	10.3	Exercise_10.3	Irma_Surge.hpr
Discus sion	11.1	N/A	N/A
Exercis e	11.2	Exercise_11.2	N/A
Demon stration	12.1	Demonstration_12.1	Demo12.1_Forecast39.hpr, Demo12.1_Forecast44.hpr
Exercis e	12.2	Exercise_12.2	forecast advisory 21 global summary report.pdf, Harve Forecast Advisory 21.pdf, Harvey_Windfield_HazusReady.dat, hurrevac gloval summary report.pdf, hwind global summary report.pdf
Exercis e	13.1	Exercise_13.1	IrmaLandfallTrack.bin

A Note on Understanding Images

Please note that many of these documents contain images that assist in the completion of the activities. These images are explained both by the surrounding text and by the alt text provided with the image. For individuals accessing the course with the relevant technology, please read the surrounding text and the alt text to gain a full understanding of the image.

Lesson 1: Hazus for Hurricanes

Visual 1: Lesson 1: Introductions and Overview



Visual 2: Let's Get Acquainted!

- Participant introductions
 - Name
 - Organization
 - Role in organization
 - Hazus, GIS, and hazard analysis experience
 - Goals and expectations for this class
- Instructor introduction

Visual 3: Course Agenda

Day One:

- Lesson 1: Introduction and Overview
- Lesson 2: Hazus Inventory
- Lesson 3: Hurricane Wind Model
- Lesson 4: Deterministic Scenarios
- Lesson 5: Probabilistic Scenarios

Day Two:

- Lesson 6: Damage Models
- Lesson 7: Hurricane Model Results
- Lesson 8: Economic Loss Methodology

Visual 4: Course Agenda

Day Three:

- Lesson 9: Hurricane Surge Model
- Lesson 10: Shelter and Debris Models
- Lesson 11: Mitigation Analysis
- Lesson 12: Hazus Response and Recovery Applications

Day Four:

- Lesson 13: Uncertainty and Sensitivity
- Lesson 14: Capstone Exercise
- Lesson 15: Course Wrap Up

Visual 5: Course Prerequisites

- Have a broad understanding of the goals of loss estimation and hurricane hazards
 - This course will provide an introduction to assessing risks associated with natural hazards and orients participants to Hazus capabilities
 - This course will focus on Basic and Intermediate analyses
- Have familiarity with ArcGIS
- Have successfully completed E0313: Basic Hazus



Course Prerequisites

Information from <u>National Preparedness Course Catalog Website</u>. (https://www.firstrespondertraining.gov/frt/npccatalog/EMI#anc-search-results)

Student Manual

Visual 6: Course Tasks

- Lecture
- Discussion
- Demonstration: Instructor-Only
 - Students observe instructor completing task
- Activity: Instructor-Led
 - Guided Practice
 - Students follow along and complete task with Instructor
- Exercise: Student-Led
 - Individual or Small Group Practice
 - Hands-on
 - Shows how to apply material from this course to an actual incident

Visual 7: Hints for Success

Ask LOTS of questions! There are NO "silly" questions.

Share your experiences with the rest of the class - they will learn from you and you from them.

Try to apply the concepts presented in class to your own needs. If you don't see applicability, ask for an example.

Practice the skills that you learn in class right away.

- In class (exercises and activities)
- After class (use it or lose it)

Visual 8: Lesson 1: Goal and Objectives

Goal: To provide an overview of Hazus and review the Hazus Hurricane Model.

After completing this lesson you will be able to:

- Describe Hazus and the various hazards it supports.
- Differentiate between the Hazus Hurricane Model and Surge Model.
- Explain the differences in Hazus analysis levels as they pertain to the hurricane model.

Visual 9: What is Hazus?

- A package of software tools and support system designed by FEMA for the purpose of providing communities with the means to identify and reduce risk from natural hazards
- Used by a variety of communities and organizations
- Available from FEMA free of charge (requires ArcGIS license with Spatial Analyst extension)

Visual 10: Supported Hazards





Riverine and Coastal Flooding



Earthquake



Visual 11: History

HAZUS		0			
1992 Hazus Program initiated.	1997 Earthquake Model first released.	1998 Hurricane and Flood Model development initiated.	2004 Hazus-MH released.	2011 Storm surge added to the Hurricane Model.	2017 Tsunami Model released.
			CATINGUARI - WIND - FLOOD		

Visual 12: FEMA Hazus Website

Primary FEMA resource for updated information related to Hazus: <u>FEMA Hazus Website</u> (www.fema.gov/hazus)

Navigation
Search
Eanguages
205
> Software
> Detail
User Groups
> Training
Conferences
Hazus Quarterly Newsletter
Summary of Databases
Resources and Solutions

🐮 FEMA

5

Hazus	
intended for H informed decis	sses FEMA's Hazus program and related news updates. This page is acus users and other parties interested in using Hazus to support risk- ion making efforts by extramating posterical losses from earthquakes, floads futurestic and valuations the effects of the hazards.
	5715
	tus Today: Users can download the Hazus software for free from 1 Map Service Center (MSC) at https://msc.fema.eov/portal/resources/hazus
the <u>FEMA Hoos</u>	1 Map Service Center (MSC) # https://msctema.gov/portai/resources/hazus
Have any interv	esting Hazus research or success stories to share? Want to get involved with the Hazus program by attending the
monthly Nation	al Hazus User Group call? Reach out to the Hazus Outreach Team at hazus-outreach@riskmapcds.com with questions
comments, or t	to be added to the monthly call invitation.
Sign up to re	eceive updates regarding the Hazus program. training opportunities, and conferences.
Hazus News	
Hazus 4.2 Nov	v Available: On January 29, 2018, the Hazus Team deployed release 4.2. This Hazus version is available on the 💢
MSC Download	page. This release is a full-versioned software release with a number of key highlights, including:
Hazus 4.2	is compatible with ArcGIS 10.5.1
 Major pro 	cessing time reductions for hydrology and hydraulics within level 1 flood.
Additional	I supported formats for level 2 flood depth grid import
• High reso	lution ShakeMaps now compatible, with faster import times
Restoratio	on of the Fire Following Earthquake (FFE) module
 Improvem 	sents to the Comprehensive Data Management System (CDMS) for easier import of user data
Hazus 4.2 also	includes an update from North American Datum 1983 (NAD83) to the World Geodetic System 1984 (WGS84) in order to
better support	U.S. territories and long-term goals for international hazard modeling. For more information on this update please see

NOTE: You must uninstall any existing versions of Hazus and all Microsoft SQL components from your con downloading and ensure that you have ArcGIS 10.5.1 on your computer. As a result of the datum update, a databases need to be replaced with new State data, also available on the MSC.

Lesson 1: Hazus for Hurricanes

Visual 13: Using Hazus to Support Emergency Management

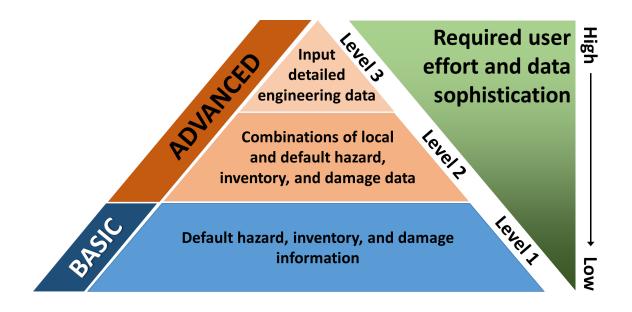
- Identify vulnerable areas
- Estimate potential impacts of hazards
- Inform resource allocation
- Prioritize mitigation measures
- Assess level of readiness and preparedness
- Inform response and post-disaster recovery efforts



Visual 14: Who is a Hazus User?

- Hazus is used by a variety of communities and organizations across the United States:
 - Local and State Government
 - Federal Agencies
 - Educational Institutions
 - Private Industry
 - Others
- Considerable international interest

Visual 15: User Levels



Visual 16: Hurricane Levels of Analysis

- Level 1: Analysis Based on Default Information
 - Default general building stock and essential facility databases
 - Default database of surface roughness and tree coverage
- Level 2: Analysis with User-Supplied Inventory
 - Modify the general building stock and essential facility databases based on local expertise
 - Develop maps of tree coverage
 - Use local data concerning direct economic analysis parameters
- Level 3: Analysis with Advanced Data
 - Supply local terrain (surface roughness data)

Visual 17: Inventory (Exposure)

General building types and occupancies

- Lifelines
- Replacement costs
- Demographics

Hazard-specific

- Specific building types
- First floor elevations
- Building configurations

Visual 18: Loss Estimation Process

- Identify hazard
- Identify physical landscape
- Consider what is at risk
- Produce maps, tables, and reports
- Analyze social and economic impacts



Visual 19: Integrating User-Provided Data

Non-Hazard Data Integration Tools

- Comprehensive Data Management System (CDMS) enables integration of locally developed non-hazard data
- CDMS validates that user data are compliant with Hazus requirements

Hazard Data Integration

- ShakeMap (for EQ) and Hurrevac (for HU) hazard data integration
- Each model includes tools for integrating user-provided hazard data

Techniques for integrating user-provided data are covered in other courses

Visual 20: Hazus 4.2 Capabilities

Hazus 4.2 Capabilities	Earthquake	Flood	Hurricane	Tsunami
Inputs	Ground Shaking Ground Failure	Frequency Depth Riverine Coastal Surge	Wind Surge	Depth Momentum Flux Runup Velocity
Historic	х	x	х	
Deterministic	х	х	х	х
Probabilistic	х	х	х	
User-supplied	х	х	х	x
Other supported inputs	Real-time & scenario USGS ShakeMaps	Risk MAP, User- supplied depth grids (ArcGRID, GeoTIFF, IMAGINE), HEC-RAS (.FLT)	Hurrevac, User- supplied wind files (.dat)	NOAA PMEL SIFT, State models

Visual 21: Hardware and Software Requirements

- Memory: 4 GB or higher
- Disk space: 10GB for one multi-hazard large urban study region, plus inventory data size (varies by state), or 70 GB to store entire U.S. inventory data
- Graphics Adaptor: 24-bit capable video card with at least 128 MB of video memory, resolution of 1078 x 768 or higher
- Operating Systems: Windows 10 Pro and Enterprise, Windows 8.1*, and Windows 7 Pro* (64-bit); only U.S. English version are supported for use**
- Supporting Software: Appropriate version of Esri ArcGIS for Desktop and the Spatial Analyst extension for the flood and tsunami models

*Hazus is no longer supported but still operates on these platforms

**Hazus can be installed on other windows operating systems/service packs, but Hazus may not operate as expected with those operating systems/service packs.

Visual 22: Installation

- Log in with a full Administrator account
- Download Hazus from the <u>Map Service Center</u> website. (msc.fema.gov/portal/resources/hazus)
- Unzip the downloaded file
- Right-click on setup.exe file and select "Run as Administrator" option
- "Administrator Rights" can vary consult the "Getting Started.pdf" document to ensure a proper installation

Visual 23: Study Region Location

- All study regions will be created in the folder specified in this window
- All data related to the Study Region will be stored in this location
- Default location is C:\HazusData\Regions

lazus-MH 4.2	
Choose Regions Path Select folder where study regions will be.	24
Please enter the location where Hazus-MH stores the stud new folder name or click the Browse button to find a new I	ly regions data. You may type a location.
C:\HazusData\Regions	
	Browse
stallShield	
< Bac	k Next > Cancel

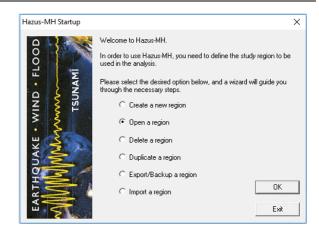
Visual 24: Study Region Size

- Size limit of 10 GB per database for SQL Server 2014 Express
- The success of a Hazus analysis will depend on the available system resources of the PC
- Large flood (riverine or coastal) and combined flood/wind analyses require large amounts of system resources even for small geographic areas (e.g., a single county)

Visual 25: Study Region Options

Hazus Startup Dialog

- Create a new region
- Open a region
- Delete a region
- Duplicate a region
- Export/Backup a region
- Import a region



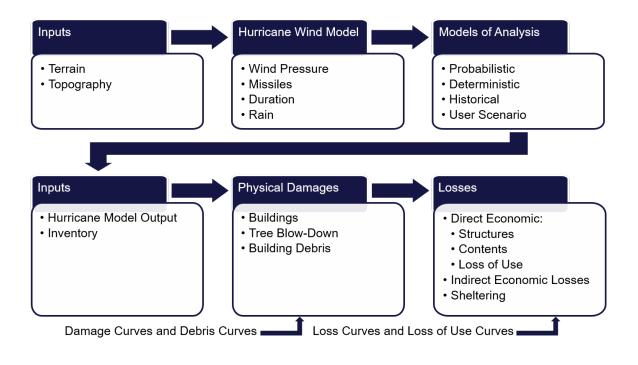
Visual 26: Study Region Creation by Scenario

- Unique to a hurricane-only study region
- When a user creates a hurricane-only study region, it can be defined by a scenario (historic, user-defined, etc.).
- The counties that would experience damage by intersecting with hurricane windspeeds are included in the region.

reate New Region		\times
Hazard Type The hazard type controls the type an affects the analysis options that will b	id amount of data that will be aggregated. The hazard type selected e available.	
Your study region can include one o hazard(s) you are interested in.	r more of the following hazards. Check below the	
Earthquake		
Flood		
✓ Hurricane		
🔲 Tsunami		
Notes: 1. Selection of hazards listed above	depends upon the hazard modules installed.	
	i given hazard(s), it cannot be modified later on, in er hazard to it. Alternatively, you may re-create a	
 If you are creating a Near Source Earthquake checkbox. 	only Tsunami region, please also check	
	Hazus-MH	×
	 Do you wish to create a study region using the Hurrican Scenario Wizard? 	•
	Yes No	

NOTE: After clicking "Yes" the screen takes you to the scenario wizard.

Visual 27: Components of Hazus Hurricane Wind Model



Visual 28: Hazus Combined Hurricane Wind and Storm Surge Model

- User works in Hurricane Wind model then runs the surge using the Flood model
- Utilizes industry standard models:
 - SLOSH Sea, Lake, and Overland Surges from Hurricanes; National Weather Service's Meteorological Development Laboratory.
 - SWAN Simulating Waves Nearshore; Delft University of Technology
- Modified WHAFIS to propagate waves inland from the shoreline
- Allows for estimation of combined economic losses to general building stock for hurricane scenarios on coastal flood regions
- Avoids double counting of flood and wind losses
- Service Pack 3 allows users to import and run a combined wind/surge with user-defined surge products*

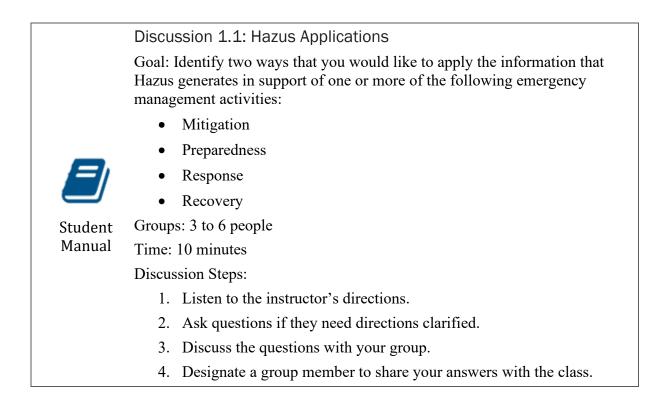
*for user-defined flood hazard information, please reach out to the help desk at <u>hazus-support@riskmapcds.com</u>

Visual 29: Discussion 1.1: Hazus Applications

Goal: Identify two ways that you would like to apply the information that Hazus generates in support of one or more of the following emergency management activities:

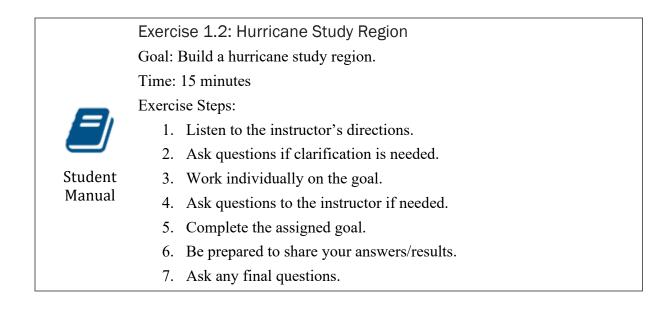
- Mitigation
- Preparedness
- Response
- Recovery

Groups: 3 to 6 people Time: 10 minutes



Visual 30: Exercise 1.2: Hurricane Study Region

Goal: Build a hurricane study region. Time: 15 minutes



Visual 31: Exercise 1.2: Tasks

Task 1: Create a New Study Region.

Task 2: Select Areas Affected by Hurricane Harvey.



Exercise 1.2: Tasks

• Refer to Activities Document "01.2_Exercise_Hurricane Study Region."

Student Manual

Exercise 1.2: Hurricane Study Region

Type: Instructor-Led Exercise Time: 15 minutes Goals: Build a hurricane study region.

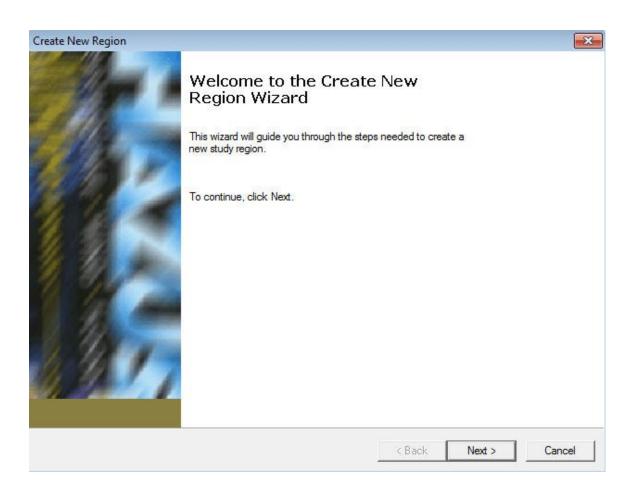
Task 1: Create a New Study Region.

1. Open Hazus from your desktop and select "Create a new region."

2. Click "OK."

Hazus-MH Startup		×
0	Welcome to Hazus-MH.	
FLOOD	In order to use Hazus-MH, you need to define the sturused in the analysis.	dy region to be
	Please select the desired option below, and a wizard through the necessary steps.	will guide you
THQUAKE - WIND -	 Create a new region 	
* *	C Open a region	
¥ \$	C Delete a region	
YN S	C Duplicate a region	
PH C	Export/Backup a region	
RT	C Import a region	OK
M ST		Exit

3. Click "Next" on the Create New Scenario Wizard.



4. Enter a name and a brief description (optional) for your study region. Click "Next."

udy Region Name			100
Each study region needs to be identified with a unique name.			2
Enter below a name which uniquely identifies your region. The name can be characters long.	up to 1	8	
HumicaneHarvey_CO			
Region description (optional):		_	
Hurricane model for Aransas and Nueces counties located in Texas.		*	
1			

5. Select "Hurricane" as the Hazard type. Click "Next."

Create New Region			X
Hazard Type The hazard type controls the type and amount of data that will be aggree affects the analysis options that will be available.	g <mark>a</mark> ted. The haza	ard type selected	
Your study region can include one or more of the following hazards. Che hazard(s) you are interested in.	eck below the		
T Earthquake			
T Flood			
F Hunicane			
T Tsunami			
Notes: 1. Selection of hazards listed above depends upon the hazard modules	installed.		
 Once a study region is built with a given hazard(s), it cannot be modif other words, you cannot add another hazard to it. Alternatively, you may similar region with different hazard(s). 			
 If you are creating a Near Source only Tsunami region, please also c Earthquake checkbox. 	heck		
	< Back	Next >	Cancel
	< васк	<pre>< pxeivi</pre>	Cancel

6. Select "No" when prompted to create the study region using the Hurricane Scenario Wizard. By continuing to create the study region only, you will be able to use the study region for multiple scenarios later. If you create a study region using the Hurricane Scenario Wizard, the study region will be used for ONLY that scenario.

zus-M	н			5
?	Do you wish Wizard?	to create a study regio	on using the Hurrica	ne <mark>S</mark> cenario

Task 2: Select Areas Affected by Hurricane Harvey.

- 1. Select "County" as the aggregation level.
- 2. Click "Next."

Create New Region Aggregation Level The aggregation level defines the procedure by which the study is def	fined.
You can define your study region at one of the geographic levels. We a aggregation level. Please select below the aggregation level you want	
C State	
County	
C Census tract	
C Census block	
C Community (NFIP)	
C Watershed	
	< Back Next > Cancel

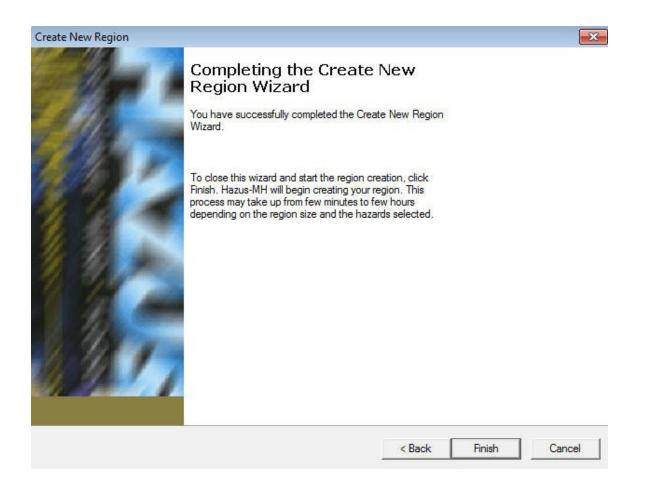
- 3. Select "Texas" from the list of states.
- 4. Click "Next."

Please select the state(s) for the States (1 selected):	study region yo	u want to create.		
Massachusetts (MA) Mississippi (MS) New Hampshire (NH) New Jersey (NJ) New York (NY) North Carolina (NC) Pennsylvania (PA) Rhode Island (RI) South Carolina (SC) Texas (TX) Vermont (VT) Virginia (VA) West Virginia (WV)	E	Show map		
Twest vilginia (w v)				

5. Select "Aransas" and "Nueces" from the list of counties and click "Next."

States:		Counties (2 selec	ted):	
Texas (TX)	*	Anderson	^	Select all counties
		Angelina Aransas		Deselect all counties
		Archer Amstrong Atascosa Austin Bailey Bandera Bastrop	Ŧ	Show map
	*	Total: 2		T Auto select all

6. Click "Finish" to complete the Create New Region Wizard.



7. After a few minutes, a dialog box will appear indicating that your region was aggregated successfully. Click "OK."

Hazus-MH S	tartup	23
FLOOD	Welcome to Hazus-MH. In order to use Hazus-MH, you need to def used in the analysis.	ine the study region to be
HQUAKE - WIND - FI	Hazus-MH Region aggregation successful. Please use "Open a region" option to open the	Je you e region.
ARTHO	C Export/Backup a region	OK

Visual 32: Lesson 1: Review

- 1. What is Hazus?
- 2. What are the four hazards supported by Hazus?
- 3. Explain the Hazus Hurricane Model. Then, explain The Surge Model.
- 4. Provide an example of a basic and advanced analysis using the Hazus hurricane model.

Visual 33: Capstone Exercise Preview

Goal: Use Hazus to help a county assess hurricane risk in order to develop hurricane mitigation OR response and recovery strategies.

Planning:

- Day 2 afternoon
- Day 3 afternoon
- Day 4 morning

Presentation:

• Day 4 afternoon

Visual 34: Capstone Exercise Preview

- There is no written final exam for this course
- Participants will be evaluated based on:
 - Completeness of the final presentation
 - Use of the ideas learned in this class

Visual 35: Capstone Exercise Explanation

- The county planning board has hired your team to give a 20-minute PowerPoint presentation at its next public meeting on the severity of hurricane hazards in the county and the possible methods for mitigating or responding to future hurricane damage in that county.
- You, as the consultants and Hazus experts, have decided to use Hazus to analyze the county's hurricane risk.
- The results of your study will be presented at the monthly commissioners meeting.
 - Each group will present while the remaining participants assume the role of the commissioners.

Visual 36: Capstone Exercise Explanation

Required issues to be addressed:

- Which major hurricane(s) have impacted this region in the past?
- What damage would the worst of these storms produce if it happened again today?
- What is the approximate return period for the worst historic winds?
- Summarize the number and value of buildings at risk to hurricanes.
- Provide a map of essential facilities, high potential loss facilities, and any additional features you deem important for risk communication.
- What are potential benefits of mandating shutters on all new single-family dwellings? Summarize the assumptions made in your benefit analysis.

Visual 37: Capstone Exercise Explanation

Presentation Guidelines:

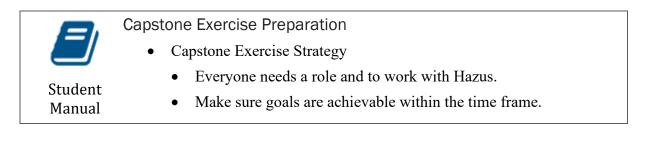
- Prepare using PowerPoint.
- Include maps, tables, or other media you deem appropriate and helpful for conveying your message.
- Information should be primarily derived from Hazus, but may be supplemented by other sources.
- 10-15 minutes in length, allowing 5 minutes for questions

Commissioner Guidelines:

- Class will assume the role of commissioners.
- Commissioners may ask questions related to the presentation.

Visual 38: Capstone Exercise Preparation

- Capstone Exercise Strategy
- Past Presentation Examples
- Preparation
 - Discuss strategies.
 - Select a state to use for the analysis.



Visual 39: Questions?

Lesson 2: Hazus Inventory

Visual 1: Lesson 2: Hazus Inventory



Visual 2: Lesson 2: Goals and Objectives

Goal: To provide an overview of the data included with Hazus, emphasizing hurricane-specific inventory, and of the tools and processes to update the data.

After completing this lesson you will be able to:

- Describe the types of aggregate and point inventory supported by the Hazus hurricane model.
- List the options that Hazus provides for updating inventory.

Visual 3: Inventory Components: Aggregate Inventory

Aggregate Inventory

- Demographics
- General Building Stock broken down by type (how constructed) and occupancy (how used)

Hazard-Specific Inventory (both aggregate and site-specific)



Visual 4: Inventory Components: Site Specific Inventory

Site-Specific Inventory

Hazard-Specific Inventory (both aggregate and site-specific)



Visual 5: Inventory Update Tools

State and Study Region Updates

• Comprehensive Data Management System (CDMS)

Study Region Only Updates

- Access databases use import tools in Hazus
- ArcGIS editing tools

NOTE: E0317: CDMS provides considerably more detail about inventory updates.

Visual 6: Comprehensive Data Management System

- System for integrating user provided site-specific and aggregate data into the Hazus state databases.
- CDMS supported data includes:
 - Site-specific / Aggregate
 - Data Types
 - xls
 - shp
 - mdb

🚨 Comprehensive Data Management System (6	CDMS)						
File Tools 🤬 Help							
😵 FEMA	Comp			ne HAZUS- Manageme	MH ent System		
Please select one of the following:	CDMS	Reposito	ry (Not yet trans	aferred into Statewide	Layers)		
Import into CDMS Repository from File			Category	Layer	Records	Upload Date	Uploaded By
Import into CDMS Repository from HAZUS-MH Study Region							
Building-Specific Data							
Query:Export Statewide Datasets						(Northern	Statewide Dataset
Update Study Region with HAZUS-MH Data						Transfer to	statewide Dataset
	Statewi	de Layer	Modificatio		y last 10 updates are display rt on the right)	ed below. To view al	records run the
Current State		State	Category	Layer	Records	Upload Date	Uploaded By
Please select HAZUS statewide							
Please select fuzzo's statewide							
Exit CDMS							

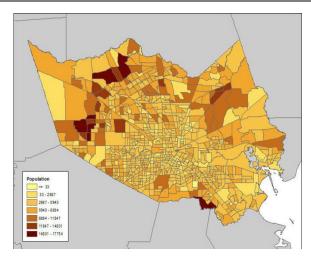
Visual 7: Comprehensive Data Management System

Functions:

- Validates user provided data
- Parses data into appropriate Hazus tables
- Provides historical tracking of database updates
- Can import/export data from/to a variety of formats

Visual 8: Demographic Data

- Aggregated at census tract (hurricane and earthquake) level
- Detailed by:
 - Age
 - Income
 - Ethnicity
 - Ownership
 - Gender



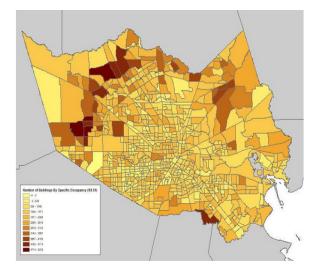
Visual 9: What is the General Building Stock?

An engineering based estimation of buildings for the US represented by:

- Floor area (Sq Ft)
- Value (\$)
- Count of all structures by occupancy type

Data Sources:

- Residential: from US Census Data
- Commercial / Industrial: from Dun & Bradstreet



Visual 10: Aggregate Inventory: General Building Stock

Specific Occupancy Categories

- 33 Specific Occupancy Types
- You can view the categories from the Inventory menu

Specific Occupancy	General Occupancy	Description
AGR1	Agriculture	Agriculture
COM1	Commercial	Trade
COM2	Commercial	Wholesale Trade
СОМЗ	Commercial	Personal and Repair Service
COM4	Commercial	Professional/Technical Service
COM5	Commercial	Banks
COM6	Commercial	Hospital

Visual 11: GBS: Building Count

Square Footage Factors

- Average square footage for each specific occupancy determined during model development
- Building counts computed by dividing floor area by average square footage

	pancy By Building T	ype					
able	Туре:			_			
lumb	er of Buildings By Spe	cific Occupar	юу 🕥	1			
	ng Count:						
ullair	Census Tract	RES1	BES2	RES3A	RES3B	RES3C	1
1	48007950100	3,103	781	11	23	26	
2	48007950200	1,116	12	0	24	29	
3	48007950300	2,316	618	14	10	35	
4	48007950400	1,292	351	29	30	16	
5	48007950500	2,191	1,430	0	2	7	
6	48355000500	494	18	9	41	9	
7	48355000600	2,103	46	55	22	13	
8	48355000700	1,043	435	5	43	11	
9	48355000800	491	450	31	39	12	
10	48355000900	1,567	0	14	19	2	
11	48355001000	960	22	71	34	4	
12	48355001100	588	0	0	0	19	-
13	48355001200	901	0	152	114	31	₹
14	48355001300	1,504	0	56	5	0	Y
•							

NOTE: RES1 (single family homes) and RES2 (manufactured housing) are derived from census housing unit counts.

Visual 12: Activity 2.1: Comprehensive Data Management System

Goal: Explore the Comprehensive Data Management System. Time: 30 minutes

Visual 13: Activity 2.1: Tasks

Task 1: How to Use CDMS to Update Inventory.

Activity 2.1: Comprehensive Data Management System

Type: Student Activity Time: 30 minutes Goal: Explore the Comprehensive Data Management System.

Task 1: How to Use CDMS to Update Inventory.

- 1. Double click the CDMS icon on the desktop to start CDMS.
- 2. Navigate to Tools and then select "Specify Hazus Data Location".

Tools	🕢 Help
Sp	ecify Hazus-MH Data Location
Pa	ackage Statewide HAZUS Data
C	ear Statewide Modification History

3. Click "Browse" and navigate to C:\HazusData\Inventory\FL to set the Hazus State Data location to "Florida".

DB Configuration	
Statewide Database	
Specify the Statewide DB folder that you want	t to connect to:
C:\HazusData\Inventory\FL	Browse
Example: \\server\sha	
	111
	Statewide Database Specify the Statewide DB folder that you wan

- 4. Click OK.
- 5. Click "Query/Export Statewide Datasets".
- 6. Under Search By Geographic Area, select "County" from the drop down selection.
- 7. Click to highlight Broward county and select the right arrow to move it to the selected list.
- 8. Choose "Essential Facilities" from the drop down under Search by Data Layer.

9. Click to highlight the Fire Station Facilities and select the right arrow to move it to the selected list.

- 10. Click the checkbox next to Hurricane Wind for this exercise.
- 11. The CDMS screen should appear as below:

Comprehensive Data Management System (File Tools @ Help	CDMS)				
FEMA		Icome to the Hazus sive Data Managem		System	
Please select one of the following:	Query/Export Statew	ide Datasets			
Import into CDMS Repository from File	Search By Geographi	ic Area			
Import into CDMS Repository from Hazus-MH Study Region	Select All	*		Selected Geographical Areas	
Building-Specific Data	Alachua Baker Bay Bradford	^		County Broward	
Query/Export Statewide Datasets	Brevard Broward	•	4		
	Search By Data Laye	r			
	Category	Data Layer		Selected Data Layers Category Data La	
	Essential Facilities	Emergency Operatio			yer tion Facilities
Current State	Essential Facilities	Fire Station Facilities		Essenual racinges The Ju	non racinaes
Florida	Essential Facilities	Medical Care Facilit			
	Essential Facilities	Police Station Facili			
	Select Hazards	iake 📄 Flood 🔍 Hu	urricane \	Nind	
🕘 Exit CDMS	* Additional fields corres	ponding to the hazards selected abo	ove will be	e displayed in the search results if availabl	CDMS Home

- 12. Click "Search" at the bottom of the screen to find all of the fire stations in the county.
- 13. Click "Export to Excel" to export the fire stations to an Excel file.

Note: If you are unable to export to Excel, export to a geodatabase first. Then, convert it to an .xls. The .xls can be edited and imported back into CDMS.

ile Tools @ Help	W	elcome to the	Hazus-MH		
FEMA	Comprehe	nsive Data Ma	nagement System		
ease select one of the following:	Search Statewide	Datasets			
Import into CDMS Repository from File	Search Summary Geographic Area:	County	Counties Selected: Broward		
Import into CDMS Repository from Hazus-MH Study Region					
Building-Specific Data	Search Results				
		Fire Station Facilities		Brow(s)	
Query/Export Statewide Datasets	* Please select a lay	er to display the results	Export to Ex	cel 🌒 Export to G	eodatabase
	HazusID	Address	Area (Sq feet)	Back-up Power (Yes or No	o) Buil
	Delete FL00000	7 6000 Hiatus RD		No	
	Delete FL00000	8 17220 Griffin RD		No	
	Delete FL00008	1 7501 NW 88 AVE		No	
	Delete FL00008	2 3461 NW 43rd AVE		No	
urrent State	Delete FL00008	3 2100 NW 39 ST		No	
Florida	Delete FL00008	4 121 SW 3 ST		No	
	Delete FL00008	5 14801 SW 27 ST		No	
	Delete FL00015	5 10550 Stirling RD		No	
	•		1	Provide Automation and Automation an	,
	Delete All Record	s for Selected Inventory			

14. Choose the radio button next to "Export currently selected layer" and click Submit.

	Comprehensive Da	ta Management System (CDMS)
 Export currently selected layer Export all layers Spreadsheet will display only the first 65,000 records available 		Export Options:
 Export all layers Spreadsheet will display only the first 65,000 records available 		Please specify the layers to export
* Spreadsheet will display only the first 65,000 records availa		Export currently selected layer
		C Export all layers
	1	* Spreadsheet will display only the first 65,000 records available
Submit Cancel	1 9	Submit Cancel

15. Navigate to the C:\E0170_ActivityData\Activity_2.1 folder and name the folder "Broward_FireStations" and click "Save".

16. Click OK once complete.

17. Click Delete All Records for Selected Inventory to delete all of the fire stations for the county.

18. Click "Yes" on the warning that it cannot be undone.

19. Minimize CDMS.

20. Open the Excel file saved to C:\E0170_ActivityData\Activity_2.1 and change the address of the first fire station.

21. Save the changes to the Excel table (be sure not to save to the Office 2007 format) and close Excel.

22. Maximize CDMS and click CDMS Home.

23. Click Import into CDMS Repository from File to import the edited Excel file.

🏂 Comprehensive Data Management System (CI	DMS)						
File Tools 🥝 Help							
FEMA	Comprel		e to the H Data Man				
Please select one of the following:	CDMS F	Repository	(Not yet transf	erred into Statewide	Layers)		
		C	ategory	Layer	Records	Upload Date	Uploaded By
Import into CDMS Repository from File							
Import into CDMS Repository from Hazus-MH Study Region							
Building-Specific Data							
Query/Export Statewide Datasets							
						Transfer to	Statewide Dataset
Update Study Region with Hazus-MH Data							
	Statewic	de Layer M	odification I		Only last 10 updates are displaye eport on the right)	d below. To view all rec	cords run the
		State	Category	Layer	Records	Upload Date	Uploaded By
Current State							
Florida							
🕘 Exit CDMS							

24. Select "Browse" and navigate to C:\E0170_ActivityData\Activity_2.1 to import the edited Excel file. You may need to change the file type at the bottom of the screen to Microsoft Excel File (*.xls) in order for the file to appear.

Open File							×
→ 👻 🛧 📙 > This	PC > Desktop > E0170_ActivityData	» Activity_2.1	ڻ ~	Search A	ctivity_2.1		Q
ganize 👻 New folder							0
🔜 Desktop 🛛 🖈 ^	Name	Date modified	Туре		Size		
 Downloads Documents Pictures Google Drive Activity_2.1 Demonstration_ Exercise_7.2 HPRs 	hefer Broward_FireStations.xls	3/24/2020 10:52 AN	I Microsof	t Excel 97	67 KB		
 OneDrive This PC 3D Objects Desktop Documents File nar 	ne:		~	Microsof	ft Excel File (*.x it Access/Geod ft Excel File (*.x	atabase	∽ e File (*.r
Florida					pe File (*.shp)		

- 25. Uncheck the boxes next to Earthquake and Flood.
- 26. From the Inventory Category drop down, select "Essential Facilities".
- 27. From the Inventory Dataset (Layer) select "Fire Stations".

🤰 Comprehensive Data Management System	n (CDMS)	- 🗆 X
File Tools @ Help	Welcome to the Hazus-MH Comprehensive Data Management System	
Please select one of the following:	Import into CDMS Repository	
Import into CDMS Repository from File	Point Line For Tsunami select both Earthquake and Flood Select a file for Import:	
Import into CDMS Repository from Hazus-MH Study Region	C.\Users\Hazus\Desktop\E0170_ActivityData\Activity_2.1\Broward_FireStations.xls Specify hazards importing data for: Earthquake Hurricane Wind Fields corresponding to the hazards selected will be displayed in the Field Match	Browse
Building-Specific Data	If importing an excel document, please make sure the first row contains field nam If importing a mdb file, please make sure file names have four (4) or more charac	
Query/Export Statewide Datasets	Select Hazus-MH Inventory Category: Essential Facilities	
Current State Florida	Select Hazus-MH Inventory Dataset (Layer): Fire Station Facilities	
u Exit CDMS	Back Continue	😭 CDMS Home

- 28. Click "Continue".
- 29. Change the Import table to "Fire Station Facilities."
- 30. From the drop down menu under Select Hazus ID-Field select No HAZUS ID.

31. Select "Latitude" from the Latitude (Y) Field drop down menu and select "Longitude" from the Longitude (X) Field drop down menu.

Comprehensive Data Management System	■ 200 69000 €				1000	×
FEMA	Welcome to the Haz Comprehensive Data Manage					
Please select one of the following:	Import into CDMS Repository					
Import into CDMS Repository from File	Input File Name: Broward_FireStations.xts Data Category: Essential Facilities Dataset Name: Fire Station Facilities					
Hazus-MH Study Region Building-Specific Data	Data Import Type: Site Specific Select Import Table:					
Query/Export Statewide Datasets	Fire Station Facilities Select HAZUS-ID Field ** (if available): No HAZUS ID		The HAZUS-ID is th Hazus-MH to unique data for performing a analysis tasks. This unique and must har XX000000. (2 alpha	ly identif aggregati field mu ve the fo	y invent ion and st be rmat	ory
	Select Latitude (Y) Field: Select Longitu	ude (X) Field:	Additionally when tra HAZUS-ID is used to records to existing n statewide database.	ecords in	source d the	
Current State Florida	Latitude Congitude Please verify that data provided is in Geographic Coordinate System	• WGS 84.	contained in this fiel required format (XXC empty values. Records not found it database will be add HAZUS-ID if an emp which does not mee format was provided	d must m 000000) d n the sta ded and g ty value t the req	tewide given a or a val	ue
Exit CDMS		Back	Continue	4	CDMS Ho	ome

32. Click "Continue".

33. Click OK to Categorize Fields. These data values are already matched to the proper Hazus fields since they were exported from Hazus.

- 34. Click continue on the following screens until the import is successfully completed.
- 35. Click OK on the message stating the import was successful.
- 36. In the CDMS Repository click on the View/Edit button.
- 37. Notice that the address of the first record reflects the changes you made in Excel.
- 38. Click Close.
- 39. Click Transfer to Statewide Dataset.
- 40. Select the radio button next to the Append/Update option and click Submit.
- 41. Query the county for which you imported the fire stations and look for the updated
- 42. Click Yes to confirm you want to transfer the layer.
- 43. Close CDMS.

Visual 14: GBS: Damage States

GBS results for damage can be mapped by occupancy and building type

- Damage represented by damage states (moderate, severe, etc.)
- Damage state values represent the expected fraction of building square footage in each damage state

) All) Ge) Sp	Results By: Occupancies eneral Occupancy Clas ecific Occupancy Clas			~	Return Period				
ama	ge State Probabilities: - Census Tract	No Damage	Minor	At Least Minor	Moderate	At Least Moderate	Severe	At Least Severe	Destruction
1	48007950100	0.01	0.08	0.99	0.22	0.90	0.30	0.68	0.38
2	48007950200	0.02	0.13	0.98	0.28	0.85	0.30	0.57	0.26
3	48007950300	0.06	0.20	0.94	0.32	0.74	0.23	0.42	0.19
4	48007950400	0.07	0.22	0.93	0.34	0.71	0.21	0.38	0.16
5	48007950500	0.10	0.22	0.90	0.30	0.67	0.18	0.37	0.19
6	48355000500	0.75	0.21	0.25	0.04	0.04	0.00	0.00	0.00
7	48355000600	0.77	0.20	0.23	0.03	0.03	0.00	0.00	0.00
8	48355000700	0.80	0.17	0.20	0.03	0.04	0.00	0.00	0.00
9	48355000800	0.82	0.14	0.18	0.03	0.04	0.00	0.00	0.00
10	48355000900	0.81	0.17	0.19	0.02	0.02	0.00	0.00	0.00
11	48355001000	0.79	0.18	0.21	0.03	0.03	0.00	0.00	0.00
12	48355001100	0.74	0.21	0.26	0.05	0.05	0.00	0.00	0.00
13	48355001200	0.76	0.19	0.24	0.05	0.05	0.00	0.00	
14	48355001300	0.81	0.17	0.19	0.02	0.02	0.00	0.00	0.00

Visual 15: General Occupancy Categories

Seven general occupancy classes:

- Majority of Building Stock
 - 1. Residential
 - 2. Commercial
 - 3. Industrial
- Others
- 4. Agriculture
- 5. Religion
- 6. Government

7. Education

Table	Contents Total				
Gen	eral Occupancy	\sim			
Expo	sure (Thousands of Dol	lars):			
	Census Tract	RES	COM	IND	AGR 🔺
1	48007950100	1,118,721	105,232	45,016	4 🚔
2	48007950200	680,540	67,433	9,828	-
3	48007950300	917,223	197,529	27,656	3
4	48007950400	495,310	42,977	13,399	1
5	48007950500	896,410	78,435	20,796	3
4					

Visual 16: Specific Occupancy Categories

33 Specific Occupancy Types:

- 11 Residential Classes
- 10 Commercial Classes
- 6 Industrial Classes
- 2 Government Classes
- 2 Education Classes
- 1 Agriculture Class
- 1 Religious Class

Visual 17: General Building Types

Five General Building Types:

- 1. Wood
- 2. Steel
- 3. Concrete
- 4. Masonry
- 5. Manufactured Housing (Mobile Home)

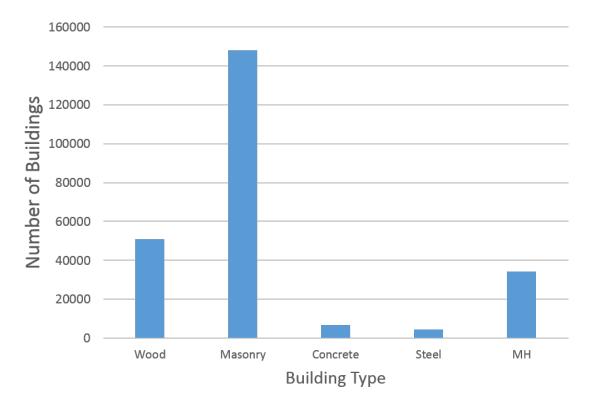
Visual 18: General Building Type Mapping

- Mapping Scheme Management:
 - View
 - Copy
 - Edit
 - Delete
 - Import
 - Export

					TX1-							
						TX1						
					Gener	al Occupancy By G	eneral Buildin	g Type				
						Occupancy	Total	Wood	Masonry	Concrete	Steel	MH 1(
					1	RES1	100	89	11	0	0	
					2	RES2	100	0	0	0	0	- 10
					3	RES3A	100	75	25	0	0	
					4	RES3B	100	75	25	0	0	
al Building Type Mappin	a			×	5	RES3C	100	75	25	0	0	
roononig type moppin	9				6	RES3D	100	75	25	0	0	
Mapping Schemes:				/	7	RES3E	100	75	25	0	0	
BS:	Counties:	Mapping Schemes: TX1	~	Apply	8	RES3F	100	75	25	0	0	
ð\$	Aransas, TX	Census Tract	Mapping Scheme		9	RES4	100	50	50	0	0	
		48007950100	TX1		10	RES5	100	20 90	35 10	45	0	
		48007950200	TX1		11	RESE	100	30	30	0	30	
		48007950300 48007950400	TX1 TX1		12	COM1 COM2	100	30	30	30	30	
		48007950500	TX1		13	COM2 COM3	100	30	30	30	30	
					14	COM3 COM4	100	30	30	10	30	
					15	COM5	100	30	30	10	30	
					16	COM6	100	30	20	70	30	
					17 18	COM6 COM7	100	30	30	10	30	
					19	COM8	100	30	30	10	30	
		 Census Block List (●) 	Census Tract List O County L	t .	20	COM9	100	0	15	45	40	
ing Scheme Managemen	t				20	COM10	100	0	0		30	
eme Name	Туре	Date Created	Date Modified	View	22	IND1	100	Ő	5	25	70	
	System	12/13/2002	12/13/2002	CORY	23	IND2	100	10	30	30	30	
					24	IND3	100	10	30	30	30	
				Delete	25	IND4	100	0	5		70	
				Import	26	IND5	100	10	30	30	30	
					27	IND6	100	30	30	10	30	
				Export	4		100			10		

Visual 19: Aggregated Building Stock

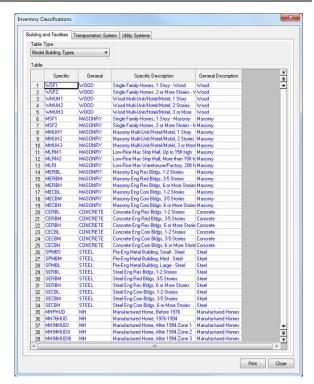
Building Count: By building type



Visual 20: Specific Building Types (SBT)

Thirty-nine Specific Building Types:

- 5 Wood
- 9 Steel
- 6 Concrete
- 14 Masonry
- 5 Manufactured Housing (Mobile Home)



Visual 21: Specific Building Type Mapping

- Mapping Scheme Management:
 - View
 - Copy
 - Edit
 - Delete
 - Import
 - Export

				Sou	theast_Inland .theast_Inland cific Occupancy B	General Building WOOD WOOD MASONRY CONCRETE	Туре	~			
					Occupancy	STEEL		2	WMUH1	WMUH2	WMUH
				1	RES1	MH		37	0	0	
				2		100	100	0	0	0	
				3		100	0	n n	21	79	
				4		100	0	0	15	65	-
				4		100	0	0	15	73	- 1
c Building Type Map	ping										_
				6		100	0	0	9	73	
V Mapping Schemes:				7		100	0	0	9	73	
88:	Counties:	Mapping Schemes: Florid	a_Central ~	8		100	0	0	0	0	- 10
as	Aransas, TX	Census Tract	Mapping Scheme	9		100	0	0	0	50	
		48007950100	Southeast_Coastal	10) RES5	100	0	0	0	0	- 10
		48007950200	Southeast_Coastal	11	RES6	100	0	0	100	0	
		48007950300	Southeast_Coastal	12	COM1	100	0	0	62	38	
		48007950400	Southeast_Coastal	13	COM2	100	0	0	100	0	
		48007950500	Southeast_Coastal	14		100	0	0	100	0	
				15		100	ŏ	Ō	72	28	
				16		100	ő	0	100	20	
						100	0	0	001	0	
				17			-			-	
				18		100	0	0	100	0	
		🔘 Census Block List 🔘	Census Tract List O County L	19		100	0	0	66	17	
ng Scheme Manager	ment			20		100	0	0	0	100	
me Name	Туре	Date Created	Date Modified	21		100	0	0	0	0	10
heast Inland	System	03/13/2003	03/13/2003	22		100	0	0	0	100	
east_manu east_Coastal	System	03/13/2003	03/13/2003	23	IND2	100	0	0	60	40	
east_Inland	System	03/13/2003	03/13/2003	24	IND3	100	0	0	0	100	
east_Coastal	System	03/13/2003	03/13/2003	25	i IND4	100	0	0	0	100	
_Southeast	System	03/13/2003	03/13/2003	26		100	0	0	72	28	
	System	03/13/2003	03/13/2003	27		100	Ő	0	100	0	
a_South	System	03/13/2003	03/13/2003	4		100	-		100		•
a_South a_North a_Central	System	03/13/2003									

Visual 22: Hurricane-Specific Inventory

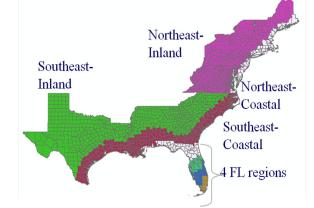
Wind-Building Mapping Schemes

Florida: 4 Regions

Hawaii: 4 Regions

Other States: 4 Regions

- 1. Northeast Inland
- 2. Northeast Coastal
- 3. Southeast Inland
- 4. Southeast Coastal



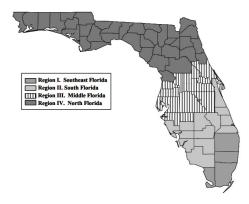
A map of the different Wind-Building Mapping Schemes for the "Other" states and Florida.

Visual 23: Hurricane-Specific Inventory

Wind-Building Mapping Schemes

Florida building stock regions

- Different building codes
 - Southeast Florida has historically stronger wind provisions for past decade
- Different building practices
 - More wood frame in northern portion of Florida than southern Florida





Key Points

Florida is divided into 4 regions.

- Southeast Florida
- South Florida

Student Manual

- Middle Florida
- North Florida

Visual 24: Hurricane-Specific Inventory

Wind-Building Mapping Schemes

Hawaii Building Stock Regions

- Different wall construction type
 - Single wall vs. double wall
- Different roof deck construction
 - Metal roof deck
- Different foundation type
- Applies only to single-family models
- All other SBT models are identical to mainland US.



Key Points

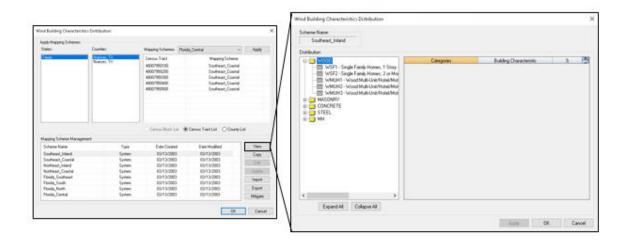
Hawaii is divided into 4 regions:

- Hawaii Hawaii Island of Hawaii
- Hawaii Honolulu Island of Oahu
- Student Manual
- Hawaii Maui Islands of Maui, Kaho'olawe, Lanai, and Molokai
- Hawaii Kauai Islands of Kauai and Ni'ihau

Hawaii has different construction types, therefore different building mapping schemes were developed.

Visual 25: Hurricane-Specific Inventory: Wind-Building Mapping Schemes

- Eight Mapping Schemes
- Consider:
 - Roof type
 - Secondary water resistance
 - Roof deck attachment
 - Roof wall connection
 - Shuttering



Visual 26: Pre-FIRM Sub-Assembly Replacement Values

Reference your manual for the table of Pre-FIRM Sub-Assembly Replacement Values

Sub-Assembly Replacement Values

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
RES1: Single	6%	2%	13%	5%	5%	20%	49%	100%
RES2: MH	6%	2%	10%	3%	5%	20%	54%	100%
RES3A: Duplex	6%	2%	13%	5%	5%	20%	49%	100%
RES3B: 3-4 units	6%	2%	13%	5%	5%	20%	49%	100%
RES3C: 5-9 units	5%	1%	10%	2%	3%	10%	69%	100%
RES3D: 10-19 units	5%	1%	10%	2%	3%	10%	69%	100%
RES3E: 20-49 units	5%	1%	13%	1%	3%	10%	67%	100%
RES3F: 50+ units	3%	0%	13%	1%	1%	13%	69%	100%
RES4: Temp. Lodging	3%	1%	9%	1%	2%	10%	74%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
RES5: Instituti onal Dormito ry	4%	0%	14%	1%	3%	14%	64%	100%
RES6: Nursing Home	5%	0%	10%	3%	2%	13%	67%	100%
COM1: Retail	6%	1%	10%	5%	5%	10%	63%	100%
COM2: Wholesa le	20%	1%	7%	9%	7%	11%	45%	100%
COM3: Personal & repair services	10%	1%	8%	7%	3%	10%	61%	100%
COM4: Professi onal/Bu siness	4%	1%	11%	1%	3%	17%	63%	100%
COM5: Banks	6%	0%	10%	4%	9%	8%	63%	100%
COM6: Hospital	2%	0%	7%	1%	4%	7%	79%	100%
COM7: Medical	5%	1%	5%	3%	2%	12%	72%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
Office								
COM8: Entertai nment	9%	1%	10%	4%	3%	8%	65%	100%
COM9: Theaters	6%	1%	10%	5%	6%	10%	62%	100%
COM10 : Parking	12%	0%	40%	0%	10%	9%	29%	100%
IND1: Heavy	14%	1%	3%	7%	3%	10%	62%	100%
IND2: Light	15%	1%	4%	9%	7%	11%	53%	100%
IND3: Food/Ch emical	11%	1%	4%	8%	6%	11%	59%	100%
IND4: Metals/ Mineral Processi ng	7%	0%	25%	2%	6%	8%	52%	100%
IND5: High Technol ogy	11%	0%	5%	4%	4%	4%	72%	100%
IND6:	20%	1%	7%	9%	7%	11%	45%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
Constru ction								
AGR1: Agricult ure	26%	0%	8%	9%	9%	12%	36%	100%
REL1: Church	10%	1%	12%	4%	17%	10%	46%	100%
GOV1: General Services	10%	1%	12%	6%	4%	8%	59%	100%
GOV2: Emerge ncy Respons e	6%	0%	15%	2%	2%	12%	63%	100%
EDU1: School	4%	1%	12%	3%	6%	10%	64%	100%
EDU2: College	4%	1%	10%	2%	3%	8%	72%	100%
Wood	6%	1%	13%	4%	4%	16%	56%	100%
Steel	4%	0%	12%	1%	2%	15%	66%	100%
Masonr y	7%	1%	14%	3%	3%	18%	54%	100%
Concret e	4%	0%	12%	1%	2%	15%	66%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
MH	6%	2%	10%	3%	5%	20%	54%	100%

Visual 27: Post-FIRM Sub-Assembly Replacement Values

Reference your manual for the table of Post-FIRM Sub-Assembly Replacement Values

Sub-Assembly Replacement Values

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
RES1: Single	11%	3%	10%	5%	5%	19%	47%	100%
RES2: MH	8%	2%	10%	3%	5%	20%	52%	100%
RES3A: Duplex	11%	3%	10%	5%	5%	19%	47%	100%
RES3B: 3-4 units	11%	3%	10%	5%	5%	19%	47%	100%
RES3C: 5-9 units	10%	1%	9%	2%	3%	9%	66%	100%
RES3D: 10-19 units	10%	1%	9%	2%	3%	9%	66%	100%
RES3E: 20-49 units	10%	1%	12%	1%	3%	10%	63%	100%
RES3F: 50+ units	8%	0%	12%	1%	1%	12%	66%	100%
RES4: Temp. Lodging	8%	1%	8%	1%	2%	9%	71%	100%

Post-FIRM Sub-Assembly Replacement Values

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
RES5: Instituti onal Dormito ry	9%	0%	13%	1%	3%	13%	61%	100%
RES6: Nursing Home	10%	1%	9%	3%	2%	12%	63%	100%
COM1: Retail	11%	1%	9%	5%	5%	9%	60%	100%
COM2: Wholesa le	25%	1%	6%	9%	7%	10%	42%	100%
COM3: Personal & repair services	15%	1%	7%	7%	3%	9%	58%	100%
COM4: Professi onal/Bu siness	9%	1%	10%	1%	3%	16%	58%	100%
COM5: Banks	11%	0%	9%	4%	9%	7%	60%	100%
COM6: Hospital	7%	0%	6%	1%	4%	6%	76%	100%
COM7: Medical	10%	1%	4%	3%	2%	11%	69%	100%

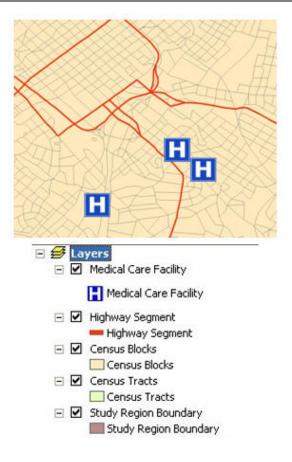
Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
Office								
COM8: Entertai nment	14%	1%	9%	4%	3%	7%	62%	100%
COM9: Theaters	11%	1%	9%	5%	6%	9%	59%	100%
COM10 : Parking	17%	0%	39%	0%	10%	8%	26%	100%
IND1: Heavy	19%	1%	2%	7%	3%	9%	59%	100%
IND2: Light	20%	1%	3%	9%	7%	10%	50%	100%
IND3: Food/Ch emical	16%	1%	3%	8%	6%	10%	56%	100%
IND4: Metals/ Mineral Processi ng	12%	0%	24%	2%	6%	7%	49%	100%
IND5: High Technol ogy	16%	0%	4%	4%	4%	3%	69%	100%
IND6:	25%	1%	6%	9%	7%	10%	42%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
Constru ction								
AGR1: Agricult ure	31%	0%	7%	9%	9%	11%	33%	100%
REL1: Church	15%	1%	11%	4%	17%	9%	43%	100%
GOV1: General Services	15%	1%	11%	6%	4%	7%	56%	100%
GOV2: Emerge ncy Respons e	11%	0%	14%	2%	2%	11%	60%	100%
EDU1: School	9%	1%	11%	3%	6%	9%	61%	100%
EDU2: College	9%	1%	9%	2%	3%	7%	69%	100%
Wood	11%	1%	12%	4%	4%	15%	53%	100%
Steel	9%	0%	11%	1%	2%	14%	63%	100%
Masonr y	12%	1%	13%	3%	3%	17%	51%	100%
Concret e	11%	0%	11%	3%	2%	11%	62%	100%

Specific Occupa ncy or General Building Type	Foundat ion	Below First Floor	Structur e Frame	Roof Coverin g	Roof Framing	Exterior Wall	Interiors	Total
MH	8%	2%	10%	3%	5%	20%	52%	100%

Visual 28: Site-Specific Inventory

- Includes essential facilities, high potential loss facilities, user-defined facilities, transportation systems, utility systems, hazardous material sites
- Represents discrete points of facilities and systems of inventory
- Provides site-to-site results versus an aggregated table of damages and losses



Visual 29: Essential Facilities

- Fire Stations
- Police Stations
- Schools
- Emergency Operations Centers (EOC)
- Medical Care Facilities

dical	Care Facilities	Fire Stations	Police	Stations	Emergency Res	ponse Centers	Schools	
Table: Schools								
	ID	Census Tract	Class		Name			*
1	NC000116	37019020100	EFS1	LELAND	MIDDLE		927 OLD	
2	NC000117	37019020100	EFS1	LINCOLI	VELEMENTARY	,	1664 LIN	
3	NC000118	37019020100	EFS1	NORTH	BRUNSWICK H	IGH	114 SCO	
4	NC000119	37019020200	EFS1	BOLIVIA	ELEMENTARY		4036 BUS	
5	NC000120	37019020200	EFS1	SOUTH	BRUNSWICK HI	GH	280 COU	
6	NC000121	37019020200	EFS1	BELVILL	E ELEMENTAR	ŕ	575 RIVE	
7	NC000122	37019020200	EFS1	SOUTH	BRUNSWICK M	IDDLE	100 COU	
8	NC000123	37019020301	EFS1	SOUTH	PORT ELEMENT	ABY	701 WES	
9	NC000124	37019020301	EFS1	BRUNS	VICK LEARNING	G CENTER	705 NOR	
10	NC000125	37019020301	EFS1	VIRGINI	A WILLIAMSON	ELEM	1020 ZIO	
11	NC000126	37019020501	EFS1	SHALLO	TTE MIDDLE		225 VILL	
12	NC000127	37019020501	EFS1	UNION B	LEMENTARY		180 UNIC	
13	NC000128	37019020501	EFS1	JESSIE	MAE MONROE B	LEMENTARY	250 PEA	
14	NC000129	37019020600	EFS1	CHARTE	R DAY SCHOOL	_	7055 BA0	-
15	NC000130	37019020600	EFS1	SUPPLY	ELEMENTARY		51 BENT	Ţ
16	NC001878	37019020100	EFS1	NEW JE	RUSALEM CHR	ISTIAN ACA	102 TRIN	ż
•	m						4	Ē
								-

Visual 30: Essential Facility Classes

Class	Category	Description	Occupancy
MDFLT	DEFAULT	Default for Medical	COM6
EFHL	Medical Care	Large Hospital (greater than 150 beds)	COM6
EFHM	Medical Care	Medium Hospital (50 to 150 Beds)	COM6
EFHS	Medical Care	Small Hospital (less than 50 Beds)	COM6
EFMC	Medical Care	Medical Clinics and Labs	COM7
PDFLT	DEFAULT	Default for Police	GOV2
EFPS	Emergency Response	Police Station	GOV2
FDFLT	DEFAULT	Default for Fire Station	GOV2
EFFS	Emergency Response	Fire Station	GOV2
EDFLT	DEFAULT	Default for Emergency Response Facility	GOV2
EFEO	Emergency Response	Emergency Operation Centers	GOV2
SDFLT	DEFAULT	Default for School	EDU1
EFS1	School	Grade Schools (Primary/High Schools)	EDU1

Class	Category	Description	Occupancy
EFS2	School	Colleges/Universities	EDU2

Note the links between site-specific and GBS

Visual 31: User-Defined Facilities

- Used to perform site-specific analysis of types of buildings found in the General Building Stock
- Required fields for hurricane:
 - ID
 - Census Tract
 - Occupancy
 - Wind Building Type
 - Wind Building Scheme Name
 - Location

		Census Tract	Class	Name	Address	
1	JS000001	37019020601	RES1	HUUDF001	100 Main St	A IN N

Visual 32: Other Inventory Table Options

- Metadata
- Data Dictionary
- Export
- Map

Select	ted County				
All		~			
Squar	e Footage Distribution (I	thousand sq. ft.)			
	Census Tract	RES1	RES2	RES3A	RES3B Z
1	12045960100	2,512.22	1,441.58	132.30	34.0 📹
2	12045960200	2,801.02	398.18	71.82	52.9 4
3	12045960300	4,572.19	512.11	85.05	219.2
4	12057000101	908.40	0.00	56.70	98.2
5	12057000102	1,820.61	0.00	109.62	192.7
6	12057000201	771.14	62.04	147.42	86.9
7	12057000202	1,754.98	0.00	13.23	166.3
8	12057000300	3,337.56	7.90	355.32	102.0
9	12057000401	1,062.99	38.35	3.78	37.8
10	12057000402	1,254.25	247.03	0.00	15.1
11	12057000500	2,824.07	12.41	0.00	0.0
12	12057000601	1,569.91	41.74	0.00	83.1
13	12057000602	1,490.47	15.79	18.90	139.8
14	12057000700	2,887.03	0.00	351.54	86.9

Visual 33: Inventory Table Features: Metadata

- Metadata can be accessed through context menu.
- Metadata is essentially reference information.
 - Includes description, source, spatial reference, etc.

this database u	
this database u	
	under contract to the
ent Agency (FE	IMAJ.
Occupancy	
,	
	Occupancy

Visual 34: Inventory Table Features: Data Dictionary

- The data dictionary can be accessed through the context menu.
- The data dictionary describes the table (name, field definitions, etc.)
- Also used to build a table for import.

DATABASE INFORMATION	
Table name:	hzCareFity
Number of records:	11
Number of fields:	19
INDEX INFORMATION	
RLNEF_CL2_FK	
EfClass	Ascending Order
RLNTRACT_EF2_FK	
Tract	Ascending Order
PK_HZCAREFLTY	
CareFltyId	Ascending Order
FIELD INFORMATION	
T	0

Visual 35: Inventory Table Features: Export

- The option to export can be accessed through the inventory menu.
- Inventory can be exported to two file formats: txt and csv.
 - Used to manipulate data outside of Hazus.

dical	Care Faci	ilities Fire Stations	Police St	ations	Emergen	cy Response (Centers Sch	ools
able:	Medical	Care Facilities						
	ID	Census Tract	Class	Na	ame		Address	
1	TX0003	48355001200	EFHS	SURGI	CARE SF	718 ELIZABE	TH STREET	1
2	TX0003	48355001200	EFHS	IHS HO	SPITAL	1310 THIRD	STREET	
3	TX0003	48355001200	EFHL	CHRIS'	TUS SPC	600 ELIZABE	TH STREET	
4	TX0003	48355002101	CCUI	DDICCI	ні сын	SESS COLITE	ALAMEDA S	1
5	TX0003	48355002101	Inse	rt New	Record		LAMEDA S	1
6	TX0003	48355002900	Dal	مام؟ مام	cted Rec	orde	ET	
7	TX0003	48355001000	Den	ette Selei	Lieu Neu	0103	BOULEVA	1
8	TX0003	48355001000	Imp	ort Dat	а		BOULEVA	
9	TX0005	48355003203					ADRE ISLA	i -
10	TX0005	48355003306	Exp	ort Data		2	A	
11	TX0005	48355005802	Dat	a Dictio	narv	- 0	VEST BOU	i 📮
					,			Ì
	_		Met	tadata			Þ	
•								

Visual 36: Inventory Table Features: Map

- Click on the column heading to select the field you wish to map.
- Click "Map."
- Inventory item map layer is created and symbology is automatically populated.

				Cations Emolgon	cy Response Centers Sc	hool
able:	Fire Stati	ons				
	ID	Census Tract	Class	Name	Address	A
1	T×0002	48007950100	EFFS	Port O'Connor V	101 S. 6th	
2	TX0002	48007950100	EFFS	Lamar VFD	Hagy LN	
3	T×0006	48355005601	EFFS	Robstown Fire D	516 E AVE B	
4	T×0006	48355005802	EFFS	Nueces County	5781 FM 666	
5	T×0006	48355001100	EFFS	Corpus Christi Fir	2406 Leopard ST	
6	T×0007	48355000700	EFFS	Refinery Termina	4802 Up River RD	
7	T×0007	48355002900	EFFS	NAS Corpus Chr	10800 D ST BLDG 7	
8	T×0007	48007950300	EFFS	Rockport Volunt	702 W Concho	
9	TX0011	48355003601	EFFS	Annaville Volunt	11551 Leopard ST	
10	TX0011	48355003002	EFFS	Nueces County	1201 Laguna Shores RD	
11	TX0014	48355005802	EFFS	Agua Dulce Volu	1510 Second ST	
						H AII A
4						

Visual 37: Exercise 2.2: Comprehensive Data Management System

Goals:

- Update state database using CDMS.
- Create a new study region.

Time: 35 minutes

Visual 38: Exercise 2.2: Tasks

Part 1: Update State Database

Task 1: Start CDMS and Set State Database to be Updated.

Task 2: Delete Existing Medical Care Facilities in State Database.

Task 3: Import New Medical Care Facilities into CDMS Repository.

Task 4: Transfer Medical Care Facilities to Statewide Database.

Part II: Update the Aggregate Inventory:

Task 1: Import the assessor's data into the CDMS repository.

Exercise 2.2: Comprehensive Data Management

System

Type: Student-Led Exercise Time: 35 minutes Goals:

- Update state database using CDMS.
- Create a new study region.

Background:

Hazus provides a vast amount of information that can be used to complete a Level 1 analysis. However, this information is compiled based upon best available national data sources and frequently is not complete. This exercise will introduce you to some of the tools Hazus provides for improving the inventory data with your own data. The exercise is not intended to serve as a detailed exploration of inventory update tools and processes, but rather an overview. In addition, note that the inventory data used in this exercise, while very similar to actual data, has been modified explicitly for this course and should not be considered representative of actual conditions in the community used in the examples.

Part I: Update State Database

Use the Comprehensive Data Management System (CDMS) to update two types of inventory data in the state databases from which Hazus study regions are derived.

Task 1: Start CDMS and Set State Database to be Updated

1. Double-click the CDMS icon on your desktop to start CDMS. You can also choose "All Programs > FEMA RISK Assessment System > CDMS" from the Start menu.

2. From the Tools menu, choose "Specify Hazus Data Location." This specifies to CDMS which state data you are updating. You can only update data for one state at a time.

3. Click "Browse" and navigate to the C:\HazusData\Inventory\FL folder. This folder contains the state data for Florida. You may elect to store your state data elsewhere for your own purposes.

4. Click "OK" once you have selected the appropriate folder.

	Statewide Database	
	Specify the Statewide DB folder that you wa	ant to connect to:
110	C:\HazusData\FL\	Browse
	Example: \\server\s	share\

5. Click "OK" to close the CDMS Statewide DB Configuration window.

Task 2: Delete Existing Medical Care Facilities in State Database

Note: There are several approaches available for updating inventory data. This exercise will lead you through replacing the entire set of existing medical care facilities in Sarasota County, FL with a new set of medical care facilities. You also could add new medical care facilities or remove only medical care facilities that have been

1. Click "Query/Export Statewide Datasets."

2. Select "County" as the Geographic Area option.

3. Scroll through the list of counties, highlight "Sarasota" and then click the right arrow to move it to the Selected Geographic Areas list.

4. Select "Essential Facilities" from the list of options under the Search By Data Layer label. It is possible to select more than one type of inventory at a time.

5. Click on the "Medical Care Facilities" category and then click the right arrow to move it to the Selected Data Layers list.

6. Select the "Hurricane Wind" hazards.

Comprehensive Data Management Systen	(CDMS)	:
FEMA	Welcome to the Hazus-MH Comprehensive Data Management System	
lease select one of the following:	Query/Export Statewide Datasets	
Import into CDMS Repository from	Search By Geographic Area	
File	County ~	
Import into CDMS Repository from Hazus-MH Study Region	Select All Selected Geographical Areas	
Building-Specific Data	Santa Rosa Sarasota Seminole Seminole Sarasota	
Query/Export Statewide Datasets	St. Lucie Sunter	
Current State Florida	Essential Facilities Emergency Operatio Essential Facilities Fire Station Facilities Essential Facilities Medical Care Facilit Essential Facilities Police Station Facili Select Hazards Select Hazards	Data Layer Medical Care Facilitie
Exit CDMS	Earthquake Flood Hurricane Wind *Additional fields corresponding to the hazards selected above will be displayed in the search results Q Search	if available

7. Click "Search." CDMS will take just a moment to find the 6 medical care facilities.

File Tools 🥥 Help						
FEMA	Com		lcome to the H sive Data Man			
ease select one of the following	: Search S	tatewide Da	atasets			
Import into CDMS Repository from File	Search Seograph	Summary nic Area: Co	unty	Counties Se Sarasota	elected:	5
Import into CDMS Repository from Hazus-MH Study Region						
Building-Specific Data	Search F		dical Care Facilities		× 6.rov(())	
Query/Export Statewide Datasets	* Please s	select a layer t	o display the results		Export to Excel	Export to Geodatabase
		HazusID	Address	AHA ID	Back-up Power (Yes or No)	
		FL000320	540 THE RIALTO		No	47128.06800000
	Delete	FL000321	5731 BEE RIDGE RD 700 MEDICAL BLVD		No	23412.98300000
	Delete	FL000322	6150 EDGELAKE DR		No	15105.15000000 6042.06000000
	Delete	1	6400 EDGELAKE DR		No	14500.94400000
Current State	Delete		1700 S TAMIAMI TRL		No	123711.17900000
Florida	< Delete	e All Records fi	or Selected Inventory			
Exit CDMS						

8. Click "Delete All Records for Selected Inventory" and click "Yes" when prompted to indicate that you recognize that you are deleting all of the selected records. It may take a few moments to complete the process. When the process is complete the window will show No Records Found. Please try another layer.

9. Click "CDMS Home."

Task 3: Import New Medical Care Facilities into CDMS Repository

1. Click "Import into CDMS Repository from File" to view the Import into CDMS Repository options.

2. Click "Browse" on the right side of the screen. Browse to the

C:\E0170_ActivityData\Exercise_2.2 folder, double-click the "MedialCareFacilities.mdb" and click "Open."

Note: This database contains updated medical care facility records for Sarasota County, Florida. The replacement costs have been increased by 10% to reflect an increase in materials costs over 5 years (created solely for the purposes of this course). The structure that this database must follow to be Hazus compliant is discussed in detail in the Comprehensive Hazus-Data Management course.

3. Select "Essential Facilities" from the Select Hazus Inventory Category list.

4. Select "Medical Care Facilities" from the Select Hazus Inventory Dataset (Layer) list.

5. Click "Continue" in the lower right corner of the CDMS window.

6. Verify that "MedicalCareFacilities" is identified as the Select Import table. The MedicalCareFacilities table automatically appears since it is the only table in the database.

7. Select "No Hazus ID" for the Select Hazus-ID field option. All site-specific inventory records must have a unique identifier. This can either be created by Hazus or it can be provided by the user if it is in a Hazus compliant format.



8. Click "Continue" to view the Data Field Mapping window:

File Tools 🞯 Help								
FEMA		elcome to t sive Data		s-MH nent System				
lease select one of the following:	Import into CDMS	Repository - Da	a Field Matc	hing				
Import into CDMS Repository from	Define Source(from) and Destination	(to) Field Mate	ches				
File	Source (from) Field			Destination (to) Field	ls (click to select)			
Impact into CDMC Repository from	(click to select)	Field	Name I	Field Type F	ield Length	Default	Value	1
Import into CDMS Repository from Hazus-MH Study Region		Eartho	uake Desi 1	ext 2		PC		
		the second se	3 71	fext 4		URML		
Building-Specific Data				ext 1		0		
				lumber		0		
Query/Export Statewide Datasets		Soil T		lumber Text 1		0 D		-
		LEGENI	2000 - 11 St. 101	e Flood	Hurricane Wind			
Current State				REEN are required. A defa		led if the fi	eld is not ma	atch
Florida	Default building ar		t costs will be pro	vided based on RS Means	tables and building are	a when no	t provided b	y us
	Field Matches	Add Match						
Input File Name: MedicalCareFacilities.mdb	Source	Destination	Field Type	Field Length	Default Value	^		
ta Import Type: Site Specific	Address	Address	Text	40			Load	
Data Category: Essential Facilities	AHAID	AHA ID	Text	7				
Dataset Name: Medical Care Facilities	BackupPower						Save	
	BuildingRepla		Currency		0	_	Jave	
	CensusTract	Census Tract	Text	11		_		
	City	City	Text	40		_	× Remov	e
		Contact Person	Text	40				
	FacilityClass	Facility Class	Text	5	MDELT	~		

Note: Field matching is the process of telling CDMS how the fields in your table match up to those required by Hazus. CDMS will attempt to match fields that are similar in name. You can then manually match any fields that do not auto-match or you can un-match fields that are incorrectly matched. Observe there are several fields in the top half of the window that are shaded green. These are required fields, but CDMS will populate these with a default value if you do not provide a field in your table that contains the required information.

9. Click "Continue."

10. CDMS will produce a window that states that default values will be used for the fields not matched. Click "Yes" to accept the default values.

11. The Categorize fields window will appear showing the fields that need to be categorized. Categorizing is a process that involves telling CDMS how the values in your table related to the Hazus required values.

categorized into Hazus-MH specific continue.	
Back-up Power (Yes or No) Facility Class	ОК
	2

12. Click "OK" to move to the Back-up Power category value matching window.

13. Back-up Power (Yes or No) was automatically matched to the correct value in the destination field by CDMS. Click "Continue".

14. EFHL and EFHM were already automatically matched to the correct value in the destination field by CDMS. Click "Continue" to move to the Facility Class category value matching window.

15. Click "OK" when the window appears reporting Data was imported into CDMS Repository.

16. When the process has completed, the CDMS Repository window will appear listing the essential facilities medical care facilities table that you just imported.

17. Click "View/Edit" to open a window that shows each of the medical care facilities that you imported. From this window you can remove individual medical care facilities that you do not want to import into the state database.

Number J Festeries 6 Image HazusiD Address AHA ID Back-up Power (Yes or No) Building Replacement Cost (thous.s) Census Tract City Contant Remove Edd C0000001 540 THE RIALTO No 51840.8748 12115002401 VENCE VE	Number	- C D								
Remove Edd CD000001 540 THE RIALTO No 51840.8748 12115002401 VENCE Remove Edd CD000002 5731 BEE RIDGE RD No 25754.2813 12115001505 SARASOTA Remove Edd CD000002 570 IMEDICAL BLVD No 16615.6650 12115002718 ENGLEWOOD Remove Edd CD000005 6150 EDGELAKE DR No 6646.2660 12115001401 SARASOTA Remove Edd CD000005 6400 EDGELAKE DR No 15951.0384 12115001401 SARASOTA				Address	AHA ID	Back-up Power (Yes or No)	Building Replacement Cost (thous, \$)	Census Tract	City	Contac
Remove Edt CD000003 700 MEDICAL BLVD No 16615.6650 12115002718 ENGLEWOOD Remove Edt CD000004 6150 EDGELAKE DR No 6664.2660 12115001401 SARASOTA Remove Edt CD000005 6400 EDGELAKE DR No 15951.0384 12115001401 SARASOTA	Remove	_	1							
Remove Edit CD000004 6150 EDGELAKE DR No 6646.2660 12115001401 SARASOTA Remove Edit CD000005 6400 EDGELAKE DR No 15951.0384 12115001401 SARASOTA	Remove	Edit	CD000002	5731 BEE RIDGE RD		No	25754.2813	12115001505	SARASOTA	
Remove Edit CD000005 6400 EDGELAKE DR No 15951.0384 12115001401 SARASOTA	Remove	Edit	CD000003	700 MEDICAL BLVD		No	16615.6650	12115002718	ENGLEWOOD	
	Remove	Edit	CD000004	6150 EDGELAKE DR	-	No	6646.2660	12115001401	SARASOTA	1
Remove Edit CD000006 1700 S TAMIAMITRL No 136082.2969 12115000501 SARASOTA	Remove	Edit	CD000005	6400 EDGELAKE DR		No	15951.0384	12115001401	SARASOTA	0
	Remove	Edit	CD000006	1700 S TAMIAMI TRL		No	136082.2969	12115000501	SARASOTA	

18. Click "Close" to close the CDMS Detail Information window.

Task 4: Transfer Medical Care Facilities to Statewide Database

1. Click "Transfer to Statewide Dataset" to view Statewide Data Transfer Options. There are two options at this point: The "Append/Update Data" option adds new data to the statewide database. The "Replace data" option replaces everything in the statewide database with the new information that you select.

2. Select the "Append/Update Data" option and then click "Submit."

3. Click "Yes" when prompted to indicate that you are sure you want to transfer this layer to the Statewide Datasets. It may take a minute or two to complete the update process.

4. Click "OK" when prompted to acknowledge that the Statewide Data Transfer is complete.

Note: The medical care facilities have now been moved from the CDMS Repository window to the Statewide Layer Modification History window. You can query the medical care facilities again to verify. You could also build a study region that includes the updated inventory at this point. However, you will use CDMS to update an aggregate inventory database prior to doing so.

Part II: Update the Aggregate Inventory:

In this part of the exercise we will update the general building stock inventory in the state database inventory using information about individual structures that could be acquired from a local assessor's office or some other source. The goal is to introduce you to the tools that Hazus

provides for managing this type of inventory. However, the detailed steps that you would need to prepare your own data for importing in this fashion are covered in the Comprehensive Data Management course.

Task 1: Import the assessor's data into the CDMS repository

1. Click "Import into CDMS Repository from File."

2. Click "Browse" on the right side of the screen.

3. Browse to the C:\E0170_ActivityData\Exercise_2.2 folder and double-click the "GBS.mdb" geodatabase.

Note: As noted above, this database was prepared specifically for this exercise. Keep in mind that creating a Hazus compliant database can be a time-consuming process. The detailed steps for completing this process are discussed in the Comprehensive Data Management course.

4. Uncheck the "Earthquake" and "Flood" hazard importing option. Since you are only running a hurricane model analysis in this course it is not necessary to import information unique to the earthquake hazard.

5. Select "Aggregated Data" from the Select Hazus Inventory Category drop-down list.

6. Select "Import Site Specific Data to Aggregate Data."

e Tools 🔞 Help					
FEMA		Welcome to ensive Data		s-MH nent System	
ase select one of the following:	Import into CDM	IS Repository			
mport into CDMS Repository from	Point	O Line	For Tr	sunami select both Earthquake and Flood	
File	Select a file for	Import:			
mport into CDMS Repository from	C:\Users\Hazus\Des	sktop\E0170_ActivityData	Exercise_2.2\GBS.m/	db	Browse
Building-Specific Data		lf im	nporting an excel docu	e hazards selected will be displayed in the F ment, please make sure the first row contain aase make sure file names have four (4) or n	ns field names
Query/Export Statewide Datasets	Select Hazus-MH II	nventory Category:	~	Required Fields: * The following fields are requinformation. Please make sur	
	Select Hazus-MH II Select	nventory Dataset (Laye	er): ~	required fields below: Area Building Value Content Value Building Type Occupancy Class Height of the structure OR it:	
urrent State Florida	Import Site Sp	ecific Data to Aggregat	e Data	Age OR Year of Construction Census Tract OR Census Blo	

- 7. Click "Yes" to acknowledge updating the aggregate layers in the CDMS repository.
- 8. Select the GBS table from the input table section drop-down menu and click "OK."

9. Select "BldgRepCost" in the Source from Fields box and find and highlight the matching field in the Destination box which should be called "Building Replacement Cost". Click "Add Match".

10. Select "ContentRplcCost" in the Source from Fields box and find and highlight the matching field in the Destination box which should be called "Content Replacement Cost". Click "Add Match".

- 11. Click "Continue".
- 12. Click "OK" to categorize the fields that require categorization:

FIE Tools @ Help		Velcome to ensive Data		us-MH ement Syste	em			
lease select one of the following:	Import from Build	lings/Parcels: D	ata Field Mat	ching				
Import into CDMS Repository from	De Categorize Fields				1			
File					ds (click to seler	:0		
Import into CDMS Repository from		The data values I		eed to be ic data, Prese OK to	Field	Field	Default	Group
Hazus-MH Study Region	BUS	continue.	hazus-win speci	ie data. Prose OK to	Num	0	1	
		Area		OK	Text	1	7	
Building-Specific Data		BldgValue			Text	1		3
		ContentValue		Alle	Text	100		
Query/Export Statewide Datasets		YearBuilt		Contraction in the local division in the loc	Text	10		
Carrent State Florida		fDesignLevel Occupancy		~	proup #1) are req sof matched, the ips #2,3,4), at lear	default va	lue will be	used.
lata Import Type: Aggregate	Fie				1	lue A	1	
Data Category: Appregated Data					Default Va	lue		
					Masonry		Gale	bad
	NUMSTORIES	Num Stories	Number		-		54	we
	Occupancy	Occupancy	Text	5			1000	
	tract	Census Tract	Text	5			X Ret	move

13. Click "OK" for the Area Field Type categorization.

Note: This value was already in thousands of square feet in the GBS file. It is important to know what the units of your data are in before you enter the categorization process. If you enter in the wrong value, CDMS will not know and you imported data will be incorrect.

14. Click "OK" for the Building Value Field Type categorization.

15. Click "OK" for the Content Value Field Type categorization.

16. Click "OK" for the Number of Stories Value Field Type to indicate "Field is numeric. Use as is."

17. Click the radio button next to "Year is in 4-digit format (e.g. 1995)" for the Year Built Field Type and then click "OK."

18. Click "Continue". You do not have to match any fields in the next step. CDMS recognizes the value and has automatically matched it.

19. Click "OK" to acknowledge the data was imported into the CDMS repository to return to the CDMS Repository window. Aggregated data now appears as an entry under the CDMS Repository heading.

💈 Comprehensive Data Management System ((CDMS)						- 0
File Tools 🥝 Help							
			me to the H	and the second			
FEMA	Compreh	ensiv	e Data Man	agement Sys	tem		
lease select one of the following:	CDMS F	eposito	OFY (Not yet transfe	rred into Statewide Layers)			L
			Category	Layer	Records	Upload Date	Uploaded By
Import into CDMS Repository from File	view/Edi	Remove	Aggregated Data	Aggregated Data	70	3/27/2020	ASRDEV/VM01\Hazus
Import into CDMS Repository from Hazus-MH Study Region Building-Specific Data							
Building-Specific Data							
Query/Export Statewide Datasets						Transforte	Statewide Dataset
Update Study Region with Hazus-MH Data						Transfer to	State wide Dataset
	Statewid	e Layer	Modification H		10 updates are displayed he right)	I below. To view all rec	ords run the
		State	Category	Layer	Records	Upload Date	Uploaded By
	Remove	L	Essential Facilitie	s Medical Care Facilitie	is 6	3/27/2020	ASRDEVVM01\Hazı
Current State							
Florida							

20. Click "View" to view the Aggregate Data Results. The data that you imported is organized by census block and tract. The number of records reflects the number of census blocks and tracts that you are updating in the state database.

21. Click "Close."

22. Click "Transfer to Statewide Dataset" and click "Yes" when prompted to indicate that you understand that your action cannot be undone. This process will take approximately one minute to complete.

23. In order to update the entire aggregated inventory, click "Select All" on the Transfer Aggregated Data to Statewide Databases window.

24. Click "Process only imported tracts/blocks" and check the box to "Update General Building Mapping Schemes."

25. When finished click "OK."

26. The first selection updates all of the blocks you are updating (69). The second step updates all of the blocks in the county you are updated. In blocks where you are not importing data, they will keep the default inventory.

27. Click the radio button next to "Replace all occupancies for this statewide transfer." Click "Continue." This assumes that for the blocks you are updating you have accounted for every building and have classified it correctly.

28. When the Statewide Data Transfer process is complete, click "OK" to move the Aggregated data entry to the Statewide Layer Modification History. This process may take a minute or two to complete.

29. Exit CDMS.

Visual 39: Lesson 2: Review

- 1. What is the purpose of the wind building characteristics distribution mapping scheme?
- 2. What two states have their own set of mapping schemes?
- 3. What types of buildings are considered by Hazus to be essential facilities?
- 4. What is the tool provided by Hazus for updating the state databases?
- 5. What are the only two site-specific dataset groups that are analyzed by the hurricane model?

Visual 40: Questions?

Lesson 3: Hurricane Wind Model

Visual 1: Lesson 3: Hurricane Wind Model



Visual 2: Lesson 3: Goal and Objectives

Goal: To provide an overview of the hurricane wind model within Hazus.

After completing this lesson you will be able to:

- List the key components of hurricane development.
- Describe the areas of the U.S. mainland that have the highest risk to major hurricanes.
- Provide four scenario types that a user can select to run the hurricane model.
- Understand two databases unique to the hurricane model.

Visual 3: Hurricane Basics

- Rotate counter-clockwise in the Northern Hemisphere
- Require ocean temperatures around 80° F or 27° C or above
- Occurs between 5°N and 40°N in the Atlantic Ocean
- Hurricane season: June 1 through November 30 (Atlantic Basin)



Visual 4: Tropical System Basics

Type of Tropical Cyclone	Maximum Sustained Winds
Tropical Depression	38 mph (33 knots) or less
Tropical Storm	39-73 mph (34-63 knots)
Hurricane Category 1	74-95 mph (64-82 knots)
Hurricane Category 2	96-110 mph (83-95 knots)
Hurricane Category 3	111-129 mph (96-112 knots)
Hurricane Category 4	130-156 mph (113-136 knots)
Hurricane Category 5	157 mph (137) knots or greater
Tropical Cyclone Category 1	77 mph (67 knots) or less
Tropical Cyclone Category 2	78-102 mph (68-89 knots)
Tropical Cyclone Category 3	103-139 mph (90-121 knots)
Tropical Cyclone Category 4	140-173 mph (122-150 knots)
Tropical Cyclone Category 5	174 mph (151 knots) or greater
Super Typhoon	150 mph (130 knots) or greater

Visual 5: Hurricane Intensity

Saffir-Simpson Hurricane Wind Scale for the Continental United States

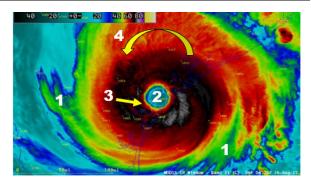
Scale Number (Category)	Sustained Winds (MPH)	Typical of Damage Due to Hurricane Winds	Hurricanes
1	74-95	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.	Florence (2018), near Wilmington, North Carolina
2	96-110	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.	Frances (2004) in coastal Port St. Lucie, Florida
3	111-129	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.	Irma (2017) second landfall near Marco Island, Florida
4	130-156	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.	Harvey (2017) near Aransas, Texas
5	>157	Catastrophic damage will occur: A high	Andrew (1992)

Scale Number (Category)	Sustained Winds (MPH)	Typical of Damage Due to Hurricane Winds	Hurricanes
		percentage of framed homes will be destroyed with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.	in coastal parts of Cutler Ridge, Florida

http://www.weather.govfos/hurricane/resources/TropicalCyclones11.pdf

Visual 6: Hurricane Anatomy

- 1. Rain bands or "feeder bands"
- 2. Eye
- 3. Eye wall
- 4. Counterclockwise rotation



Hurricane Harvey. Source: NOAA

*NOTE: A second outer eye wall may develop, but it can be difficult to differentiate from the inner eye wall.

Visual 7: Hurricane Anatomy: Symmetry

- Each quadrant is symmetric
- Strongest winds and highest surge (without coastline effects) occur in the right-front quadrant of hurricane
- Forward speed of the hurricane + Rotational winds of the hurricane = highest wind speeds

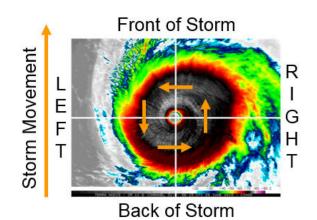
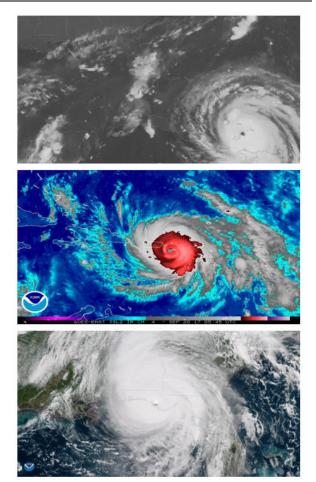


Image: Satellite image of Celia (2010) Cooperative Institute for Meteorological Studies (CIMSS), University of Wisconsin

Visual 8: Hurricane Irma, Maria, and Michael

- Hurricane Irma, 2017
 - Approaching the coast of Florida
- Hurricane Maria, 2017
 - At its strongest point, approaching Puerto Rico.
- Hurricane Michael, 2018
 - Making landfall in Florida's Panhandle.



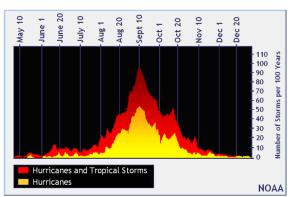
Visual 9: Hurricane Climatology

Atlantic Hurricane Season: June 1st – November 30th Peak of the hurricane season

- Peak September 10th
- Second peak approx. October 15th

Peaks are related to:

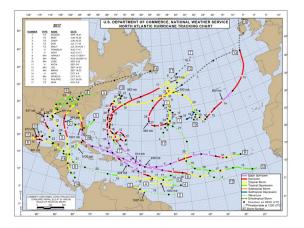
- Peak ocean temperatures
- Peak of ideal weather patterns



NOAA, National Hurricane Center (NHC)

Visual 10: Hurricane Geography

- Hurricanes impacting the US mainland often follow one of two general paths:
 - Staying in the Atlantic and tracking up the East Coast
 - Tracking west of Florida and entering the Gulf of Mexico



Visual 11: Hurricane Geography

Major hurricane U.S. strikes:

- Florida has the greatest number
- North Carolina, Louisiana, Mississippi, Alabama, and Texas are also high frequency areas



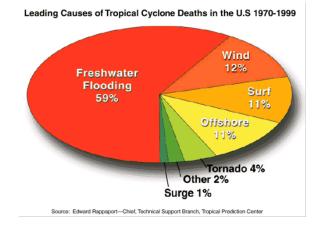
Visual 12: Hurricane Damages and Losses

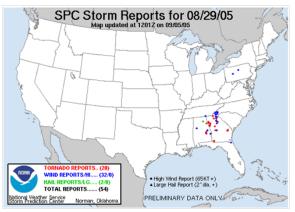
Possible hurricane effects:

- Hurricane Winds*
- Hurricane Storm Surge*
- Rainfall / Inland Riverine Flooding*
- Tornadoes
- Rip Currents and High Waves

Hurricane and Tropical Storms winds can extend far inland from the coast.

* Modeled by Hazus

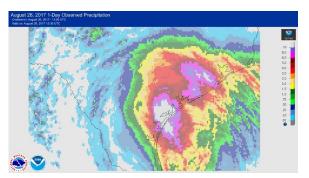




NOAA, National Hurricane Center (NHC), Storms Prediction Center (SPC)

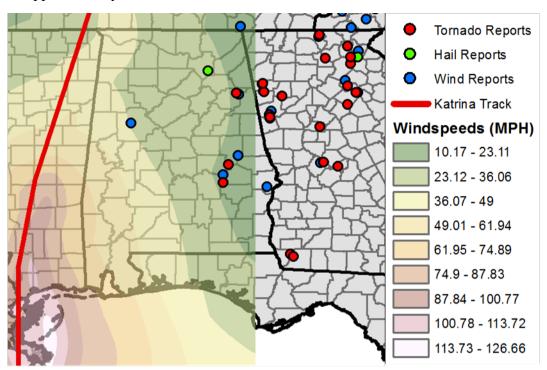
Visual 13: Additional Hazards

- Tornadoes and severe thunderstorms are common for tropical systems.
- Heavy rainfall produces additional riverine and coastal flooding.
- Hurricane effects are felt much further inland.



Hurricane Harvey (2017) Rainfall

Visual 14: Additional Hazards



Katrina: approximately 53 tornadoes in 6 states

Storm Reports and Hurricane Winds

Visual 15: Discussion 3.1: Hurricane Hazard

Goal: Review the Hurricane Hazard and the Hazus Hurricane Model. Groups: 3-5 Time: 15 minutes

Visual 16: Discussion 3.1: Hurricane Hazard

Questions:

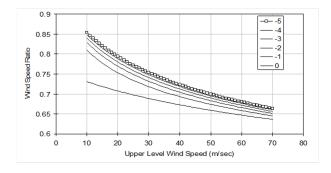
1. What are the implications of not modeling some of the hazards not traditionally generated by a hurricane, such as tornadoes, severe thunderstorms, rip currents?

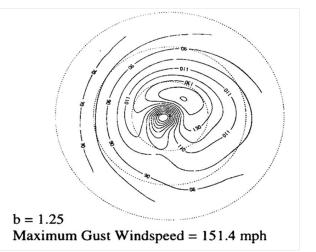
2. Given what we have seen in the previous slide, where (geographically) in relationship to the hurricane path are communities at greatest risk of a landfalling hurricane?

Visual 17: Wind Field Model

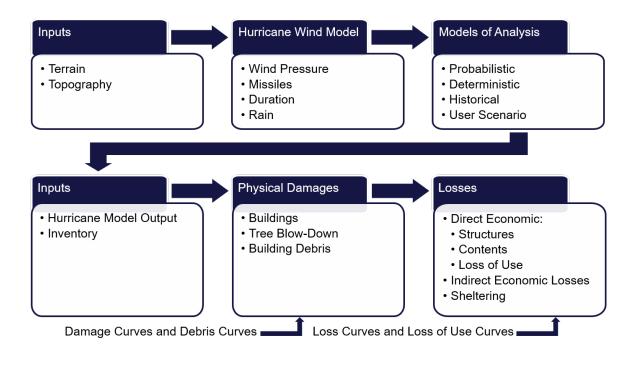
Solves full non-linear equations of motion for translating hurricane; then establishes parameters for fast running simulation

- Storm asymmetries
- Changing sea-surface roughness
- Air-sea temperature difference





Visual 18: Components of Hazus Hurricane Wind Model



Visual 19: Building Damage and Loss Methodology

Hazard				
Wind Speed	Damages			
Wind Loads	Exterior Physical	Dollar Losses		
Resistances	Damage Interior/Contents Physical Damage	Building Loss Content Loss By Occupancy and Building Type		

Visual 20: Hurricane Model States

- Hurricane model only applies to 23 coastal states
- These are the only states which can be modeled by the Hurricane Wind model AND surge model
- Puerto Rico and US Virgin Islands wind model is in development and may be provided in a future update.



Visual 21: Components of Hurricane Model

- Hurricane Database/Model
- Inventory with Wind-Specific Features
- Surface Roughness (Terrain) Database*
- Tree Database*
- Damage/Loss/Debris Functions
- Shelter Model

*NOTE: The surface roughness (terrain) and tree databases are unique to the Hurricane model.

Visual 22: Hurricane Wind Hazard Model: Track

Track Model

- Affecting Gulf Coast, Atlantic Coast, or Hawaii
- Storm curvature
- Multiple landfalls
- Changes in intensity



NOAA, National Hurricane Center (NHC

Visual 23: Hurricane Wind Hazard Model

Wind Field Model

- Updated version of model used for design wind speeds in ASCE-7-98
- Used in International Building Code Series
- Allows for asymmetries (or unevenly distributed wind fields)



Asymmetric Hurricane Irene - 2011, NOAA

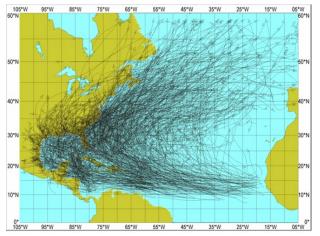
Visual 24: Hurricane Wind Model Scenarios

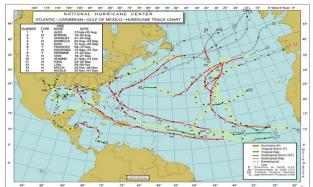
Probabilistic wind speed database:

• 100,000 years of simulated storms

Deterministic

- Historical
- Forecast/Advisory
- User-defined





Visual 25: Damage and Loss Modeling

Damage includes effects of

- Wind pressures
- Wind-borne debris
- Tree blow-down
- Rainfall
- Storm duration

Models damage explicitly to

- Roof cover
- Roof deck
- Whole roof failures
- Window and door failures
- Wall damage



Hurricane Irene (2011) damage in Washington, NC

Visual 26: Damage and Loss Modeling

Loss model based on:

- Insurance loss data
- Correlation of financial damage with water infiltration and building damage

Current model now includes storm surge:

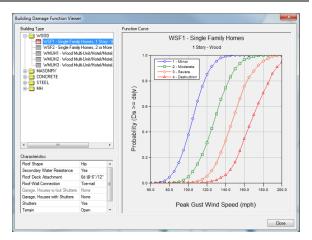
• Hurricane wind and flooding analysis is coupled



Debris from Hurricane Irma in Marathon, Florida has been scheduled for removal to clear waterway in this canal, which is surrounded by a full time commercial trailer park.

Visual 27: Fast-Running Damage & Loss Functions

- Includes 1,884 unique building models
- 45 damage/loss functions for each building model
- Total of ~240,000 unique damage/loss curves



Visual 28: Mitigation of Buildings

- Hazus:
 - Uses a load and resistance approach to estimate damage and ensuing loss
 - Is able to model effects of mitigation
- Hurricane model includes mitigation options for all building types
- Mitigation methods include:
 - Addition of hurricane straps
 - Application of window protection
 - Effects of re-nailing roof sheathing on damage/loss
 - Application of secondary water resistance
 - Combinations of the above

Visual 29: Hurricane Wind Simulation

Why Hurricane Categories Make a Difference: https://www.youtube.com/watch?v=lqfExHpvLRY



Why Hurricane Categories Make a Difference - The Weather Channel

Visual 30: Hurricane Damage Simulation

Н	urricane Damage Simulation
	• The video demonstrates the benefits of mitigation by showing how hurricane winds interact with a house un-protected by mitigation efforts vs. a house that has mitigation efforts.
	• The animation shows:
	• A house situated along the coast that is subjected to a hurricane that produces roughly the design wind speed.
	• Not long after the winds begin, damage to the roof cover begins to accumulate.
	• Next, a piece of wind borne debris breaches a window.
Student Manual	• The rapid build-up of pressure inside the house quickly causes additional windows and doors to fail.
	• Now, the roof panels are beginning to fail.
	• As the wind shifts directions, the loads on the roof change and more panels fail.
	• Finally, the entire roof frame collapses, and the house is a total loss. As the video pans over to an identical, but mitigated house exposed to the same winds, we see only roof cover damage.
	 This damage can be easily repaired at only a small fraction of the total replacement value of the house.

Visual 31: Terrain Database

- Surface Roughness = Terrain
 - Higher Roughness = Lower Damage (generally)
- Hazus terrain database
 - Derived from Land Use Data
 - National Land Cover Data (NLCD) database
 - Florida Water Management District (FWMD) data
- Roughness parameters averaged for each census tract

Visual 32: Tree Database

Trees:

- Increases roughness but also increases damage
- Building/content loss
- Debris removal

Tree Coverage Database is derived from:

- MRLC land use coverage database
- Forest Inventory Analysis Database



Visual 33: Shelter Models

Two estimates for each census tract

- Number of displaced households
- Number of people requiring short-term public shelter
 - Function of income class, ethnic class, ownership class, population age class

Similar to model used for earthquake model

• Uses building loss ratios instead of building damage states to estimate proportion of uninhabitable housing units

Visual 34: Hurricane Loss Estimation Outputs

Building damage state probabilities

- General Building Stock
- Essential facilities
- User-defined facilities

Capital-related loss (\$)

- Building
- Contents

Income-related losses (\$)

- Relocation
- Business Income
- Rental Income
- Wages

Social losses

- Displaced households
- Short-term shelter requirements

Debris (tons)

- Building debris
- Tree debris

Summary reports

- Inventory
- Damage
- Loss

Visual 35: Activity 3.2: Explore the Inventory

Goals:

• Explore Inventory

Time: 15 minutes

Visual 36: Activity 3.2 – Explore the Inventory

Task 1: Explore the General Building Stock (GBS) inventory.

Activity 3.2 – Explore the Inventory

Type: Instructor-Led Activity Time: 15 minutes

Goals: Explore Inventory

Background:

Hazard-specific inventory is inventory that is specific to one of the models. For instance, the hurricane-specific building types are specific to the hurricane model. There is aggregate inventory (demographics and General Building Stock (GBS)), Site-specific inventory and Hazard-specific inventory. In this activity, we will look at aggregate and Site-specific inventory.

Task 1: Explore the General Building Stock (GBS) inventory

- 1. Start Hazus and open the "HurricaneHarvey_CO" study region created in Exercise 1.2.
- 2. From the Inventory menu click on General Building Stock > Building Count:

Inventory Hazard Analysis Results	Bookmarks Insert Selection Geo	processing Customize		
General Building Stock	Square Footage			
Essential Facilities	Building Count	<u>}~</u>		
High Potential Loss Facilities	Dollar Exposure			
Hazardous Material Facilities User Defined Facilities	General Building Type Mapping Specific Building Type Mapping	View Building Count View Building Count		
Transportation Systems	Wind Building Characteristics Distribution			
Utility Systems				
Demographics				
View Classification				

3. On the Building Count window, note that you can show data by Building Type or By Occupancy. Data is shown at Census tract level by default. Note you can display by specific or general building types.

	upancy By Building T	ypc								
Table	Type:									
Numb	per of Buildings By Spe	cific Building 1	Гуре	~						
D:L.	ng Count:									
bullali	ng Count.									-
	Census Tract	WSF1	WSF2	WMUH1	WMUH2	WMUH3	MSF1	MSF2	MMUH1	MMUH2
1	48007950100	1,740	1,022	53	50	13	273	68	2	
2	48007950200	626	367	24	36	9	98	25	1	
3	48007950300	1,299	763	57	49	13	204	51	2	
4	48007950400	724	425	33	52	12	114	28	5	
5	48007950500	1,228	721	30	14	5	193	48	0	
6	48355000500	277	163	16	32	8	43	11	3	
7	48355000600	1,179	693	52	61	7	185	46	9	
8	48355000700	585	343	44	48	17	92	23	2	
9	48355000800	275	162	71	57	12	43	11	6	
10	48355000900	879	516	30	28	5	138	34	3	
11	48355001000	538	316	41	68	8	84	21	12	1
12	48355001100	330	194	21	13	5	52	13	0	
13	48355001200	505	297	100	177	29	79	20	26	3 -
14	48355001300	843	495	35	41	1	132	33	9	
15	48355001400	1,108	651	62	91	11	174	43	14	1 -
•										•

4. Click "OK" when done.

5. From the Inventory menu click on General Building Stock>Dollar Exposure.

6. On the Dollar Exposure window, note the tabs to display the data by building, contents, and the totals by occupancy or building type.

×

Doll	arl	Exp	osure

	Туре:								
Spec	fic Occupancy	\sim							
	fic Occupancy								
	ral Occupancy fic Building Type								
	ral Building Type	RES1	RES2	RES3A	RES3B	RES3C	RES3D	RES3E	F≖
1	48007350100	647,442	34,941	1,870	6,856	23,635	17,100	0	
2	48007950200	406,119	537	0	7,159	26,363	10,260	0	-
3	48007950300	494,510	27,632	2,380	2,982	31,817	8,550	13,623	
4	48007950400	240,537	15,701	4,929	8,946	14,544	17,100	4,541	
5	48007950500	516,232	63,977	0	596	6,363	3,420	0	
6	48355000500	62,102	809	1,530	12,225	8,181	1,710	0	
7	48355000600	321,435	2,059	9,346	6,564	11,817	6,840	4,541	
8	48355000700	179,661	19,459	850	12,830	9,999	17,100	9,082	
9	48355000800	74,612	20,136	5,266	11,638	10,909	1,710	4,541	
10	48355000900	241,070	0	2,380	5,663	1,818	11,970	4,541	
11	48355001000	135,070	985	12,064	10,143	3,636	5,130	0	
12	48355001100	73,916	0	0	0	17,271	0	0	
13	48355001200	137,379	0	25,819	34,006	28,180	8,550	13,623	
14	48355001300	238,969	0	9,519	1,490	0	1,710	0	
15	48355001400	451,571	0	14,102	14,903	8,181	11,970	0	
16	48355001500	140,803	0	4,759	29,243	55,453	0	0	
17	48355001601	282,467	0	340	1,192	5,454	0	0	
18	48355001602	273,531	0	3,229	0	3,636	0	4,541	
19	48355001701	330,818	3,220	2,210	16,117	16,365	1,710	0	
20	48355001702	110,432	4,562	0	298	0	0	0	-
21	48355001801	284,020	583	3,229	4,173	0	1,710	0	₹
22	48355001802	138,817	539	3,568	1,789	909	0	0	T
•									

7. Click "OK" when done.

8. From the Inventory menu click on Essential Facilities > Inventory.

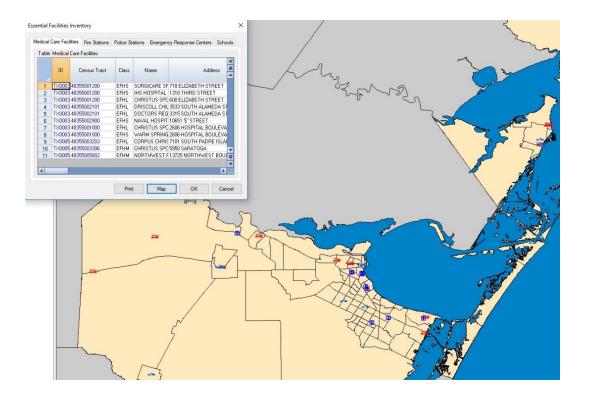
9. On the Essential Facilities window, note there are multiple tabs to view the different inventories: Medical Care Facilities, Fire Stations, Police Stations, etc.. Scroll through the table and note the fields that list each facility's attribute information.

Essential Facilities Inventory

×

	ID	Census Tract	Class	Name	Address	
1	TX0003	48355001200	EFHS	SURGICARE SP	718 ELIZABETH STREET	CORI
2	TX0003	48355001200	EFHS	IHS HOSPITAL	1310 THIRD STREET	CORI
3	TX0003	48355001200	EFHL	CHRISTUS SPC	600 ELIZABETH STREET	CORI
4	TX0003	48355002101	EFHL	DRISCOLL CHIL	3533 SOUTH ALAMEDA STREET	CORI
5	TX0003	48355002101	EFHL	DOCTORS REG	3315 SOUTH ALAMEDA STREET	CORI
6	TX0003	48355002900	EFHS	NAVAL HOSPIT	10651 'E' STREET	CORI
7	TX0003	48355001000	EFHL	CHRISTUS SPC	2606 HOSPITAL BOULEVARD	CORI
8	TX0003	48355001000	EFHS	WARM SPRING	2606 HOSPITAL BOULEVARD	CORI
9	TX0005	48355003203	EFHL	CORPUS CHRIS	7101 SOUTH PADRE ISLAND DRIVE	CORI
10	TX0005	48355003306	EFHM	CHRISTUS SPC	5950 SARATOGA	CORL
11	TX0005	48355005802	EFHM	NORTHWEST F	13725 NORTHWEST BOULEVARD	CORI
						3

Note: You can click on "Map" and the facilities/inventory you are viewing will display on the map. This feature is available for most inventory categories.



10. Click "OK" when done.

11. From the Inventory menu click on Transportation Systems.

12. On the Transportation Systems Inventory window, note there are multiple tabs to view the different types: Highway, Railway, Bus, etc.

13. Scroll through the table and note the fields that list each facility's attribute information.

Transportation Systems Inventory

lighv	way Segments	\sim						
able	;							
	ID	SegmentClass	CountyFips	Name	Owner	Length	Traffic	
1	TX000026	HRD1	48355	C3386		2.37	0	
2	TX000027	HRD1	48355	OCEAN DR		1.03	0	
3	T×000028	HRD1	48355	SHORELINE DR		1.07	0	
4	T×000064	HRD2	48007	S35		5.32	0	
5	T×000065	HRD2	48007			2.96	0	
6	TX000228	HRD1	48355	U181	State Highway A	1.93	0	
7	TX000253	HRD1	48355	S286	State Highway A	0.28	0	
8	TX000254	HRD1	48355	LAREDO ST		0.22	0	
9	T×000255	HRD1	48355	S44 B		0.20	0	
10	TX000256	HRD1	48355	LAREDO ST		0.57	0	
11	TX000257	HRD1	48355	S44 B		0.61	0	
12	T×000258	HRD1	48355	S286	State Highway A	0.10	0	
13	TX000374	HRD2	48007			12.67	0	
14	TX000395	HRD2	48355	S624		0.04	0	
15	T×000458	HRD2	48007	S35		12.82	0	
16	TX000462	HRD1	48007	S35		1.86	0	
17	T×000463	HRD1	48007	S35		0.15	0	
18	T×000464	HRD1	48007	S35		0.15	0	
19	T×000583	HRD2	48355	S624		22.70	0	
20	T×000588	HRD1	48355	C1074		2.92	0	
21	T×000589	HRD1	48355	C1074		1.46	0	
22	T×000687	HRD1	48355	137	State Highway A	0.22	0	
1								•

14. Click "OK" when done.

15. From the Inventory menu click on Utility Systems.

16. On the Utility Systems Inventory window, note there are multiple tabs to view the different types: Potable Water, Oil, Electric Power, etc.

17. Scroll through the table and note the fields that list each facility's attribute information.

Note: The Potable Water facilities, Potable Water Pipelines, and Waste Water pipeline tables are empty because there are no records in the state data to aggregate for these inventory categories.

×

	ID	UtilFcltyClass	Census Tract	Name	Address	City	Statea	Zip Cod
1	TX000011	EDFLT	48355006300	CENTRAL POW	539 N CARANC	CORPUS CHRIS	TX	78403
2	TX000014	EDFLT	48355006300	CENTRAL POW	2002 NAVIGATI	CORPUS CHRIS	TX	78403
3	TX000015	EDFLT	48355000700	CENTRAL POW	2002 NAVIGATI	CORPUS CHRIS	TΧ	78350
4	TX000016	EDFLT	48355003601	CENTRAL POW	3501 CALLICOA	CORPUS CHRIS	TX	78350
5	TX000017	EDFLT	48355003101	CENTRAL POW	4301 WALDRON	CORPUS CHRIS	TX	78418
6	TX000026	EDFLT	48355000600	COASTAL REFI	1300 CANTWEL	CORPUS CHRIS	TX	78407
7	TX000030	EDFLT	48355003601	CPL LON C HILL	3501 CALLICOA	CORPUS CHRIS	TX	78410
8	TX000086	EDFLT	48355005601	ROBSTOWN UT	1100 N 4TH ST	ROBSTOWN	TΧ	78380
•								

18. Click "OK" when done.

19. From the Inventory menu click on Demographics.

20. On the Demographics window, note there are multiple tabs to view the population attributes by the selected aggregate level.

21. Scroll through the table to view the available data breakdowns.

Demographics

	Census Tract	Population	Households	GroupQuarters	MaleLess16	Male16to65	MaleOver65	FemaleLess16
1	48007950100	5,495	2,500	11	458	1,453	796	469
2	48007950200	1,163	588	0	73	251	240	52
3	48007950300	6,609	2,668	364	674	1,841	750	593
4	48007950400	3,583	1,474	78	448	979	307	400
5	48007950500	6,308	2,565	6	704	1,862	649	652
6	48355000500	1,661	601	0	219	537	77	222
7	48355000600	6,823	2,283	0	940	2,103	364	874
3	48355000700	4,783	1,717	191	694	1,315	248	675
Э	48355000800	4,340	1,190	792	581	1,498	183	565
0	48355000900	4,695	1,602	0	693	1,397	260	649
1	48355001000	3,452	1,178	133	474	995	178	525
2	48355001100	1,969	621	318	282	682	85	242
3	48355001200	4,259	1,749	497	413	1,540	296	370
4	48355001300	4,312	1,419	0	657	1,260	223	630
5	48355001400	4,973	2,186	43	545	1,678	227	486
6	48355001500	4,328	1,564	2	747	997	195	763
7	48355001601	4,738	1,585	0	625	1,482	255	639
8	48355001602	4,020	1,355	0	561	1,146	254	531
9	48355001701	6,695	2,140	1	1,044	1,826	322	945
0	48355001702	1,839	546	0	298	547	57	274
1	48355001801	5,987	1,989	55	801	1,625	468	768
2	48355001802	2,310	733	0	353	733	65	345
3	48355001902	7,930	2,490	0	1,257	2,312	244	1,290
4	48355001903	3,618	1,147	34	578	1,077	176	516
5	48355001904	4,790	1,512	138	684	1,360	272	670
6	48355002001	4,311	1,502	0	625	1,308	213	568
-	40055000000	1.010	1.010		550	4.400	047	

22. Click "OK" when done.

23. Save the map document and exit Hazus.

Х

Visual 37: Lesson 3: Review

- 1. What are the key components for hurricane development?
- 2. What areas of the US mainland have the highest risk to major hurricanes?
- 3. List four scenario types that a user can select to run the hurricane model.
- 4. Which two databases are unique to the hurricane model?

Visual 38: Questions?

Lesson 4: Deterministic Storm Parameters

Visual 1: Lesson 4: Deterministic Storm Parameters



Visual 2: Goal and Objectives

Goal: To provide an overview of the set of storm scenarios available to users in Hazus.

After completing this lesson, you will be able to:

- Describe the Historical Scenario options.
- Understand the process for creating a user-defined scenario in Hazus.
- Discuss the differences in the probabilistic analyses in Hazus.

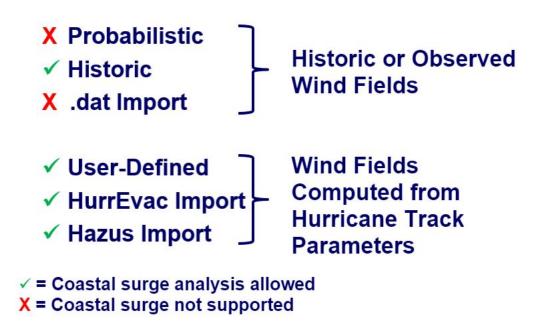
Visual 3: Scenario Operations

Hazus has six choices for defining hurricane scenarios:

- <u>Historic</u>
- Probabilistic
- Create New:
 - Define Storm Track Manually
 - Import from Exported File (storm created in previous Hazus Study Region)
 - Import Census Tract Data File
 - Import a Hurrevac Storm Advisory

Scenario O	peration		
This page allows you to	o select an operation to perform on a scena	nio.	
	Hurricane Scenarios		
	Prohabilistic Historic < Create New Scenario >		
		Copy	
		O <u>D</u> elete O E <u>x</u> port	
	L		
			· · · · · · · · · · · · · · · · · · ·

Visual 4: Hurricane Scenario Definition Options

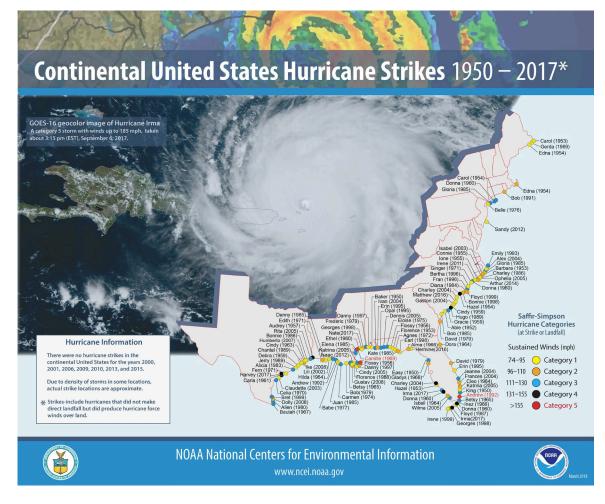


Visual 5: Determining Risk

Typically the risk of hazard occurrence is translated into a probabilistic recurrence interval (e.g., 1% annual change or 100-year event).

Two approaches:

- Historic record
- Modeling methods



Visual 6: Using the Historic Record for Risk

Recurrence Interval = (n+1)/m

- n: number of years on record
- m: rank of the event being considered

When a good historical record exists, the Recurrence Interval and its annual chance probability can be computed.

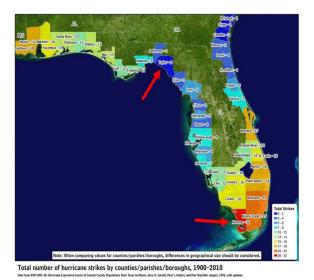
Year	Maxi mum Wind s (kt)	Rank	Recu rrenc e Inter val
1989	120	3	7.00
1991	90	8	2.63
1992	145	1	21.00
1993	100	6	3.50
1995	100	6	3.50
1996	100	6	3.50
1997	70	12	1.75
1998	95	95 7	
1999	100	6	3.50
2002	80	10	2.10
2003	90	8	2.63
2004	130	2	10.50
2005	110	5	4.20
2007	80	10	2.10
2008	95	7	3.00
2011	75	11	1.91

2012	70	12	1.75
2014	85	9	2.33
2016	75	11	1.91
2017	115	4	5.25

Visual 7: Using the Historic Record for Risk

Potential Problems:

- The historic record has a short timescale (e.g. Atlantic hurricane records collected from 1851-2019 and Northeast and North Central Pacific hurricane records collected from 1949-2019).
 - This map shows the total number of hurricane strikes by county from 1900-2010.
- Some hazards have wide geographic variations.
 - EX: County X has been missed by landfalling hurricanes since 1900, but adjacent County Y has had 14.



Using the Historic Record for Risk



- This image illustrates the total number of hurricane strikes by county (1900-2010).
 - Some areas have had a high number of landfalling hurricanes others have had few landfalls.

Student Manual

- The upper arrow points to Taylor County which has had 2 landfalls.
- The lower arrow points to Monroe County which has had 32 landfalls.

Visual 8: Historic Storm Scenario

Potential Problems:

- Pre-computed wind fields and storm tracks
- Only storms that affected the study region can be selected



Visual 9: Historic Storm Region Filter

- Region Filter button: Filters to select only the storms in which the storm track intersects the study region.
- Peak Gust: Largest modeled gust speed over land anywhere in US.

This pag	e allows you	u to select a historic storm s	cenario.Choose	the storm you w	ant to analy	e and click next.	1. C.
	halam Estal	historic storms that made la	والمراد والمرادية			alaa (1900 - 2010)	
	Delow Ists	historic storms that made la	nurainin me onic	eu states as cal	legoly 5 of h	gner (1500 · 2010)	
	Year	Name	Peak Gust (mph)	States Alfected	Landfall States	Â	Show Al
1	1965	BETSY	138	AL MS LA FL	LA		
2	2004	CHARLEY	147	C NC FL VA	FL		
3	1960	DONNA	156	IA FL DE VA	FL		
4	1950	EASY	141	AL GA FL	FL		
5	2004	FRANCES	106	A GA FL WV	FL	=	
6	2004	JEANNE	110	GA FL	FL		
7	1910	UN-NAMED-1910-5	119	C NC GA FL	FL		
8	1921	UN-NAMED-1921-6	119	FL	FL		
9	1926	UN-NAMED-1926-6	149	AL MS LA FL	FL		
10	1928	UN-NAMED-1928-4	156	IC GA FL VA	FL		
11	1929	UN-NAMED-1929-2	124	AL GA FL	FL		
12	1935	UN-NAMED-1935-2	201	IC GA FL VA	FL		
13	1936	UN-NAMED-1936-5	97	AL FL	FL		
14	1944	UN-NAMED-1944-11	127	IA GA FL VA	FL		
	1045	Internet source		Li ei e e u			

Visual 10: Exercise 4.1: Historic Scenarios

Goal:

- Create multiple historic storm scenarios
- Review the results

Time: 45 minutes

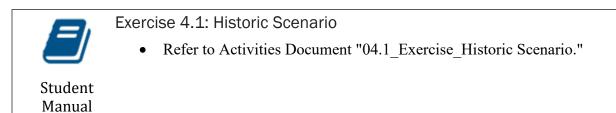
	Exercise 4.1: Historic Scenario
	Goal:
	Create multiple historic storm scenarios
	• Review the results
	Time: 45 minutes
	Exercise Steps:
	1. Refer to Activities Document "04.1_Exercise_Historic Scenario."
Student	2. Listen to instructor's directions.
Manual	3. Ask questions if clarification is needed.
	4. Work individually on the goal.
	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share your answers/results.
	8. Ask any final questions.

Visual 11: Exercise 4.1: Tasks

Task 1: Open the Region and Define a Historic Scenario.

Task 2: Run the Analysis.

Task 3: View the Results.



Exercise 4.1: Historic Scenario

Type: Student-Led Activity

Time: 45 minutes

Goals:

- Create multiple historic storm scenarios
- Review the results

Background:

Hazus comes with a substantial library of historical storms. You can use the tracks and other characteristics of storms that occurred in the past to understand what the impact would be on a community if a storm of the past were to occur today given the way that buildings are constructed, how they are used, and where they are located. This exercise will help you explore the process of defining a historic storm scenario, and it will also help you explore the study region inventory to provide a context for understanding the impact of the hurricane on the exposed buildings and population.

Task 1: Open the Region and Define a Historic Scenario

1. Start Hazus and open the "HurricaneHarvey_CO" study region.

- 2. From the Hazard menu, choose "Scenario" to open the Scenario wizard.
- 3. Click "Next" to move past the initial window of the wizard.
- 4. Verify that this Historic option is highlighted and the Activate radiobox is checked.
- 5. Click "Next". A list of historical storms that are in the Hazus database will appear.

6. Click "Region Filter" to search only for the storms that impacted the area in which your study region is located.

7. Select the UN-NAMED-1916-6 scenario.

8. Click "Next" on the remaining windows of the wizard until you reach the last screen of the wizard where you should click "Finish". This will activate the selected historic storm.

Task 2: Run the Analysis

- 1. From the Analysis menu choose "Run" to open the Analysis Options window.
- 2. Choose "Select all" but uncheck the box for "Automated Output Options".
- 3. Click "Run Analysis" to begin the analysis.
- 4. The analysis should take around 2-3 minutes.

5. After the analysis is complete, the application will display the Analysis Completed message box.

6. Click "OK" to close the box.

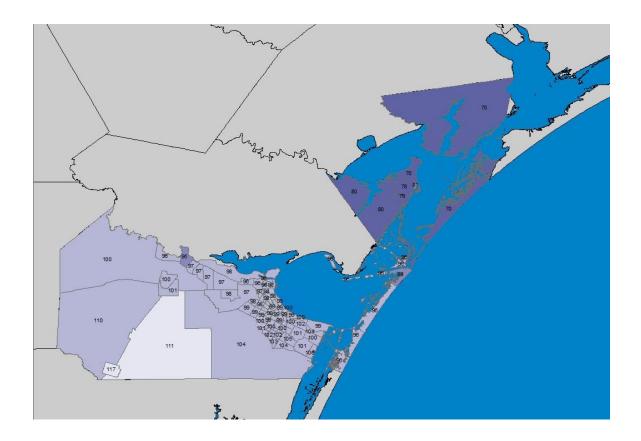
Task 3: View the Results

You will explore some of the analysis output in the following steps and continue your exploration of the results in the next exercise.

1. When the analysis is complete, navigate to the Results menu and choose "Wind Speeds."

	Census Tract	Peak Gust (mph)	Maximum Sustained (mph)	
1	48007950100	70	55	
2	48007950200	81	64	
3	48007950300	78	61	
4	48007950400	79	62	
5	48007950500	80	63	
6	48355000500	96	75	
7	48355000600	96	75	
8	48355000700	96	75	
9	48355000800	97	76	
10	48355000900	97	76	
11	48355001000	97	76	
12	48355001100	96		
13	48355001200	98	77	
14	48355001300	98		
15	48355001400	98	77	
16	48355001500	98	77	

2. Click the "Peak Gust (mph)" column and then click "Map" to add the 1916-6 historic storm path and windspeeds as a map layer. The "Wind Speeds – Peak Gust (mph)" layer should be added to the map.



3. Click Close.

4. Right click on the "Wind Speeds – Peak Gust (mph)" layer and open the attribute table.

5. Use the attribute table to answer Questions A through C in the table at the end of this exercise.

6. Close the Wind Speeds attribute table window.

7. Refer to the map and describe the location of the highest windspeeds in relationship to the coastline and to the storm path.

8. Click on the Results menu and then Summary Reports.

9. Click on the Other Reports tab, select "Global Summary Report", and then click "View". This will take a few minutes to create.

10. Use this report to answer Questions D - I in the table at the end of this exercise.

Task 4: Complete Additional Scenarios

1. Follow the steps you completed earlier in Tasks 1-3 (without opening the study region) for historic storm UN-NAMED-1916-6 for the following storms: UN-NAMED-1919-2 and Hurricane Harvey.

2. Complete the table below and answer the question that follows.

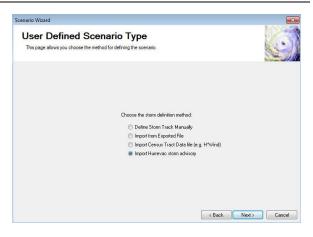
Question	UN-NAMED 1916-6	UN-NAMED 1919-2	Hurricane Harvey 2017
a. What is the highest peak wind gust in the study region?			
b. What is the highest sustained wind in the region?			
c. Based on the highest sustained wind in the region, what is the Saffir- Simpson Category?			
d. How many buildings will be at least moderately damaged?			
e. How many residential buildings will be at least moderately damaged?			
f. How many households will be displaced?			
g. What is the total economic loss?			
h. What is the building related residential economic loss? (Property Damage)			

Question: UN-NAMED-1919-2 and UN-NAMED-1916-6 had similar peak gust windspeeds and the same category storm but had different results. Why did this occur?

Answer:

Visual 12: User-Defined Scenario

- Import from
 - Hurrevac
 - .dat file
 - Exported file (other Hazus users)
- Define manually*



*Define manually should only be used if data are not available anywhere else, including Hurrevac.

Visual 13: Hurricane Data Sources: Hurrevac

- HURRicane EVACuation storm tracking and decision support tool developed off Hurricane Evacuation Studies and NHC data.
- Translates forecast track and wind extent information from NHC text-based products into interactive maps and produces storm files.
- Best available data for Hurricane Wind Loss estimation prior to landfall and until observed wind fields are developed.
- Direct dynamic link within Hazus
- Hurrevac can be used to create exercise scenarios

Visual 14: Hurrevac Import

- Hurrevac data is integrated into the Hazus interface
- Click on the hurricane of interest and click "Next"

orm Selection						1. A.
						Ref. Con
ect the storm from the list and clic	k Next	. I o download addition	hal storm files	, click on the FTP	download button	
						to the second
Calcatella desarro del terrori					الالب والمتناوين والا	a dam ban
Select the storm you wish to acti the HURREVAC ftp site, click or			u cannot loc	ate the storm or wi	sh to download tr	ne storm from
🖾 🐼 🔨						Download
						Dominoda
Storm Files(Local Machine		Storm Name 🔺	Year	File Name	File Size (KB)	Number o Advisories
Central Facilic	125	HARVEY	2005	h_2005.stm	9	
	126	HELENE	2006	H_2006.stm	9	
	127	HUMBERTO	2007	h_2007.stm	3	
	128	HANNA	2008	h_2008.stm	35	
	129	HERMINE	2016	h 2016.stm	29	
	130	HARVEY	2017	h_2017.stm	33	
	131	INIKI	1992	i_1992.stm	5	20
	132	IRIS	1995	i_1995.stm	7	
	Contraction of the local division of the	ISIDORE	1996	i_1996.stm	3	
	134	IVAN	1998	i_1998.stm	5	
	135	IRENE	1999	i_1999.stm	5	
• III •		have a second				Þ

Visual 15: Hurrevac Download

- Hazus is dynamically linked to Hurrevac FTP site to provide real-time data availability
- Advisories are available in Hazus as they become available in Hurrevac
- Searching for the year and first letter of the storm's name will provide download options
- Continuous update of advisories is crucial during response phase
- Make sure to click the refresh button before selecting the updated Hurrevac advisory for an active storm

Hurrevac Download Site	
Region	Select Storm Letter: Select Year:
Atlantic	
Central Pacific	
	Please choose the storm letter and the year to view the download link
	Download Close

Visual 16: Activity 4.2: HURREVAC Scenario – Hurricane Harvey

Goals:

• Import Hurricane Harvey data using HURREVAC.

Time: 10 minutes

Activity 4.2: HURREVAC Scenario – Hurricane Harvey Goals: Import Hurricane Harvey data using HURREVAC. • Time: 10 minutes **Exercise Steps:** 1. Refer to Activities Document "04.2 Activity HURREVAC Scenario - Hurricane Harvey." 2. Listen to instructor's directions. Student 3. Ask questions if clarification is needed. Manual 4. Work individually on the goal. 5. Ask questions to the instructor if needed. 6. Complete the assigned goal. 7. Be prepared to share your answers/results. 8. Ask any final questions.

Visual 17: Activity 4.2: Tasks

Task 1: Import the HURREVAC file.



Exercise 4.2: Tasks

• Refer to Activities Document "04.2_Activity_HURREVAC Scenario - Hurricane Harvey."

Student Manual

Activity 4.2: HURREVAC Scenario – Hurricane Harvey

Type: Instructor-Led Activity

Time: 10 minutes

Goals: Import Hurricane Harvey data using HURREVAC.

Background:

This exercise will help you learn to import Hurrevac to create a user defined storm. In this exercise we will import the final Hurricane Harvey track. During hurricane season, the forecast advisories for current storms will be pre-processed and you can import them into Hazus without having to enter values from the advisories. This can be a particularly useful capability at times when you are trying to determine the potential impact of an oncoming storm, or when you are considering what impact a past storm might have based on currently exposed inventory. In this exercise we will import the final Hurricane Harvey track.

Task 1: Import the HURREVAC file.

- 1. Open the HurricaneHarvey_CO study region.
- 2. From the Hazard menu choose Scenario to open the scenario wizard.
- 3. Click "Next" to advance to the scenario operation window.
- 4. Click on Create New Scenario and click "Next".
- 5. Click Import Hurrevac storm advisory and click "Next".
- 6. Click on Atlantic in the Storm Files Window.

orm Selection						
						6635
lect the storm from the list and clic	k Nex	t. To download additio	onal storm files	, click on the FTP	download button	
						- Tomo
Select the storm you wish to acti the HURREVAC ftp site, click or			ou cannot loc	ate the storm or w	ish to download th	ne storm from
the file file was the area of	ruic -	Domiloda Dattori.				
🖾 😳 📲						Download
						Download
🖃 Storm Files(Local Machine					File Size (KB)	Number o
Atlantic		Storm Name	Year 🔻	File Name	The Size (RD)	Advisories
i Central Pacific	1	NATE	2017	n 2017.stm	21	
	2	IBMA		i 2017.stm	43	
	3	HARVEY		h_2017.stm	33	
	4	CINDY		c_2017.stm	9	
	5	MARIA		m_2017.stm	41	
	6	JULIA		j 2016.stm	8	
	7	BONNIE		b_2016.stm	13	
	8	COLIN		c 2016.stm	7	
	9	HERMINE		h_2016.stm	29	
	10	MATTHEW		m 2016.stm	41	
	11	BILL	2015	b_2015.stm	3	-
< >					-	

- 7. Scroll through the list and select HARVEY with the date of 2017.
- 8. Click "Next" to move to the Edit Storm Track window.

×

Scenario Wizard

Latitude

Edit Storm Track

0	ction 9.3.2.1 on th	ne "Storm		
	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland	
1	40.00	1004.00		
	40.00	1005.00		
	40.00	1005.00		

This page allows you to edit the humcane track data. For help refer to User Manual section 9.3.2.1 on the "Stom Track Definition Method" and the "Edit Stom Track" page of the Scenario Wizard.

Longitude - a, Radius to 64/50/34

(Degrees)	(Degrees)	Time (Hours)	Knot Winds (miles)	Radius Typ	e	(mph @ 10m)	(mBar)	Inland
13.00	-55.80	6.00	23.12	34Kt Winds	~	40.00	1004.00	
12.90	-56.50	9.00	23.12	34Kt Winds	~	40.00	1005.00	
13.00	-57.40	12.00	38.76	34Kt Winds	~	40.00	1005.00	
13.00	-58.10	15.00	38.76	34Kt Winds	~	40.00	1005.00	
13.10	-59.10	18.00	38.76	34Kt Winds	~	40.00	1004.00	
13.00	-60.30	21.00	38.76	34Kt Winds	~	40.00	1005.00	
13.10	-61.30	24.00	46.92	34Kt Winds	~	40.00	1005.00	
13.20	-62.10	27.00	46.92	34Kt Winds	~	40.00	1005.00	
13.40	-62.90	30.00	46.92	34Kt Winds	~	40.00	1005.00	
13.70	-64.10	36.00	46.92	34Kt Winds	~	40.00	1005.00	
13.80	-65.90	42.00	46.92	34Kt Winds	~	40.00	1005.00	
13.90	-68.10	48.00	46.92	34Kt Winds	~	40.00	1007.00	
22.60	-92.60	159.00	30.00	34Kt Winds	~	40.36	1001.00	
23.20	-92.80	162.00	78.20	34Kt Winds	~	41.40	995.00	
23.80	-93.00	165.00	78.20	34Kt Winds	~	53.82	986.00	
24.00	-93.30	168.00	62.56	34Kt Winds	~	56.92	982.00	
24.40	-93.60	171.00	17.71	64Kt Winds	~	77.63	979.00	
				Мар		< Back	Next >	Cance

- - -

9. Click "Next" again to move to the Windfield Calculation window. Validating the storm track may take up to 10 minutes to complete.

10. Once it completes, hit "Next" four times and then "Finish".

11. Save your map document and keep Hazus open for the next activity.

Visual 18: Import Census Tract Data File

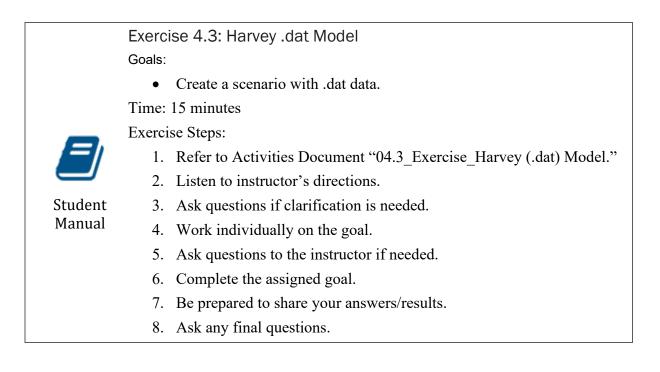
- User-defined scenario option.
- Import a hurricane wind data file in the .dat format with information at the census tract level.
- Storm track data table will not populate because wind speeds are assigned to census tracts directly.
- Also known as H*Wind.

Visual 19: Exercise 4.3: Harvey .dat Model

Goals:

• Create a scenario with .dat data.

Time: 15 minutes



Visual 20: Exercise 4.3: Tasks

• Refer to Activities Document "04.3_Exercise_Harvey (.dat) Model."

Exercise 4.3: Tasks

Task 1: Create a scenario from a .dat file.

Student Manual

Exercise 4.3: Harvey .dat Model

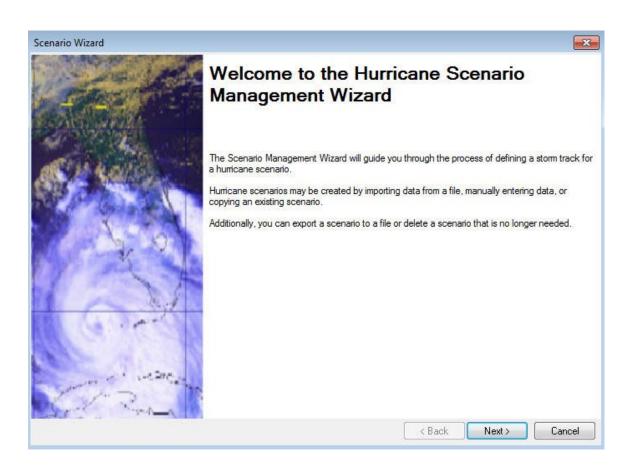
Type: Student-Led Activity Time: 15 minutes Goals: Create a scenario with .dat data.

Task 1: Create a scenario from a .dat file.

1. Return to the HurricaneHarvey_CO study region, it should already be open from the previous activity.

2. In the top menu, navigate to "Hazard > Scenario." This prompts the Hurricane Management Window to open.

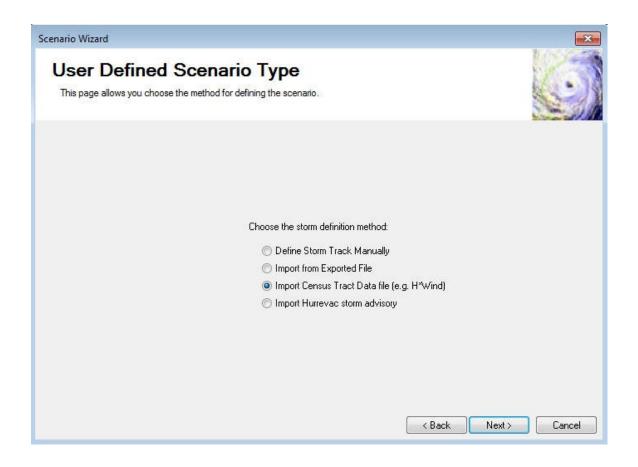
3. Click "Next" on the welcome screen.



4. Select "Create a New Scenario." Click "Next."

Scenario Wizard Scenario Operation This page allows you to select an operation to perform on a scenario		
Hurricane Scenarios Probabilistic Historic < Create New Scenario > HARVEY_2017_stm_1859PM	 Activate Edit Copy Delete Export 	
	<	Back Next> Cancel

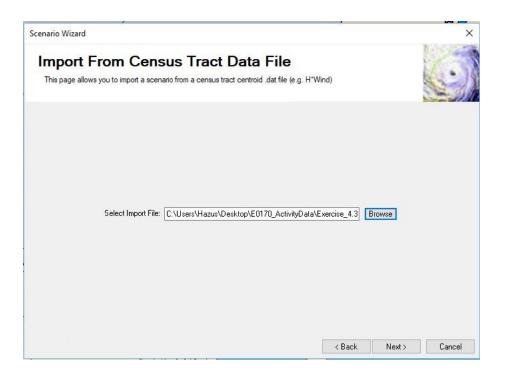
5. In the User Defined Scenario Type, select "Import Census Tract Data file (e.g. H*Wind)." Click "Next."



6. Enter a name for the new scenario.



7. Click "Browse" to navigate to and select the "Harvey_Windfield_HazusReady.dat" file saved in the C:\E0170_ActivityData\Exercise_4.3 folder.



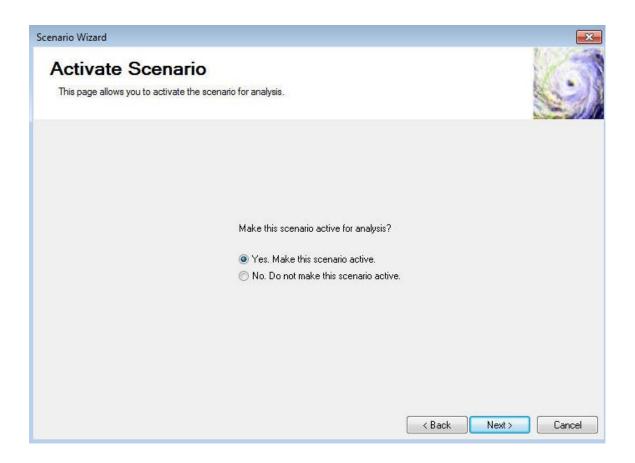
- 8. Click "Next."
- 9. Click "Next" on the Storm Track Data Review.

Sele	ct the "Bac	k" button to n	w the validate nake any char Translation	d hurricane tra nges.	ick data for this si		2	1911	
	Latitude Degrees)	Longitude (Degrees)	Speed (miles/hr)	Time (Hours)	Radius to Max Winds (miles)	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Profile Parameter	Inland

10. Click "Next" on the Scenario Review.

		×
	io Review plays information specific to the scenario.	0
Scenario Name:	Harvey.dat	
Scenario Type:	H*Wind Import	
File Information	n	
UN JOURS CL. 1		N.C. KILLI D. L.L.
HWIND file in	nport: C:\Users\Hazus\Desktop\E0170_ActivityData\Exercise_4.3\Har	rey_Windfield_HazusReady.dat
HWIND file in	nport: C:\Users\Hazus\Desktop\E0170_ActivityData\Exercise_4.3\Har	rey_Windfield_HazusReady.dat
HWIND file in	nport: C:\Users\Hazus\Desktop\E0170_ActivityData\Exercise_4.3\Har	/ey_Windfield_HazusReady.dat

11. Select "Yes. Make this scenario active". Click "Next."



- 12. Click "Finish" to exit the Hurricane Scenario Management Wizard.
- 13. Save your map document and exit Hazus.

Visual 21: Import from Exported File

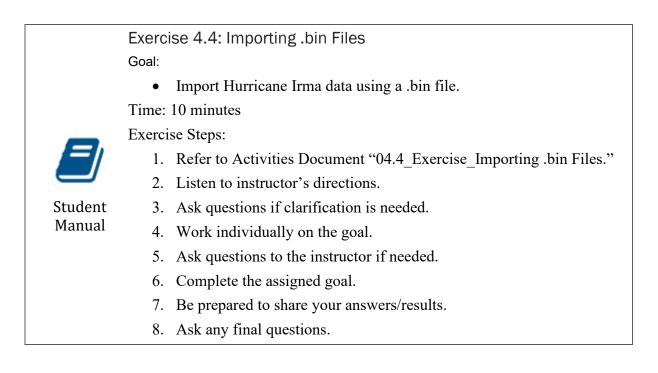
- User-defined scenario type
- Previously saved file from prior Hazus run
- Default name will be the date of import but scenario can be renamed
- Storm track input
- Wind field calculation will run before activating the scenario

Visual 22: Exercise 4.4: Importing .bin Files

Goal:

• Import Hurricane Irma data using a .bin file.

Time: 10 minutes



Visual 23: Exercise 4.4: Tasks

Task 1: Create the Study Region.

Task 2: Import the .bin File.



Exercise 4.4: Tasks

• Refer to Activities Document "04.4_Exercise_Importing .bin Files."

Student Manual

Exercise 4.4 – Importing .bin Files

Type: Instructor-Led Activity

Time: 10 minutes

Goals: Import Hurricane Irma data using a .bin file.

Background:

This exercise will help you learn to import .bin files to create a user defined storm. This can be a particularly useful capability at times when you are trying to ascertain the potential impact of an oncoming storm, or when you are considering what impact a past storm might have based on currently exposed inventory.

Task 1: Create the Study Region.

- 1. Start Hazus and select Create a New Region.
- 2. Click OK.
- 3. Name the study region "Irma_Hurricane" and click Next.
- 4. Check the boxes next to the hazards for Flood and Hurricane and click Next.
- 5. Select County and click Next.
- 6. Select Florida and click Next.

7. Choose the following counties to create the study region: Hillsborough, Manatee, Pinellas, and Sarasota. Remember to hold the "Ctrl" key down while clicking on the county names to select multiple counties.

- 8. Click Next when all four counties are highlighted.
- 9. Click Finish.
- 10. Once the aggregation is successful, click OK.
- 11. Select Open a region and click OK.
- 12. Click Next.
- 13. Select Irma_Hurricane and click Next.
- 14. Choose the radio button next to Hurricane and click Next.
- 15. Click Finish.

Task 2: Import the .BIN File

- 1. From the Hazard menu choose Scenario.
- 2. Click "Next" to advance the scenario wizard.
- 3. Select Create New Scenario and click the "Next" button.
- 4. Select Import from Exported File and click the "Next" button.

5. Name the new scenario Irma Landfall Track.

nario Wizard				>
Scenario Name				122
This page allows you to provide a name for the scenario so that	you can retrieve it for a	nalysis at another	rtime.	
Enter a mana fas tha mana accuria	Less to a KellTess th			
Enter a name for the new scenario:	jirmaLandraiii rackj			

6. Click the Next button.

7. Click on the Browse button and navigate to the C:\E0170_ActivityData\Activity_4.4 folder.

8. Select the import file named IrmaLandfallTrack.bin and click the "Open" button.

9. Click the "Next" button to complete the import process and to perform the wind field calculation.

10. Click "Next" after the application has finished computing the wind speeds.

11. Click "Next" to move beyond the Storm Track Data window and "Next" to move through the Scenario Review.

12. Continue to click "Next" again and then "Finish".

13. Save your map document and exit Hazus.

Visual 24: Define Storm Track Manually

How fast is the storm moving?

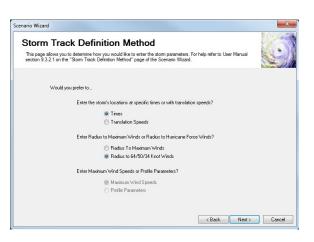
- Elapsed time for each point along the storm track
- Forward translation speed of the storm at each point

What is the size of the storm?

- Radius to maximum winds
- Radius to hurricane force (64kt, 50kt, or 34kt winds)

What is the intensity of the storm?

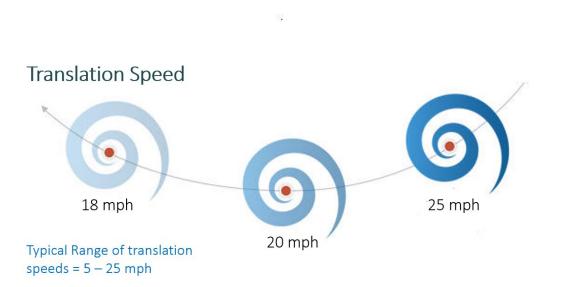
- Maximum wind speed
- A Holland B profile parameter



NOTE: Answers to these questions will depend on the format of the information you have.

Visual 25: Parameters - Translation Speed

How fast is the storm moving?

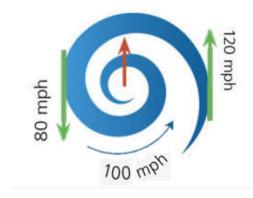


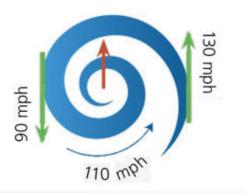
Visual 26: Translation and Rotation Speeds

Increase in rotation speed means different % increase on right and left side of storms.

For example below:

- 10 mph increase in rotation speed (100 to 110 mph)
- 8% increase in windspeed on right side of storm (120 to 130 mph)
- 12% increase in windspeed on left side of storm (80 to 90 mph)





Visual 27: Converted Wind Speeds

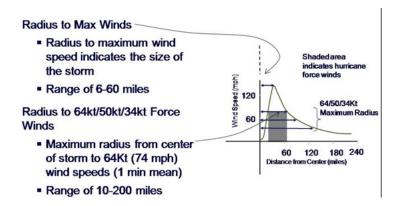
Typical Storm Parameters

Saffir Simpson Scale	1 Min Mean (mph)	3 sec Gust (mph)	Min Central Pressure (mb)
1	74-95	90-116	980 and up
2	96-110	117-134	965-979
3	111-129	135-159	945-964
4	130-156	160-189	920-944
5	157+	189+	920 and below

1 min mean = Hazus Input Windspeeds

3 sec gust = Hazus Output Windspeeds

Visual 28: Parameters: Storm Size



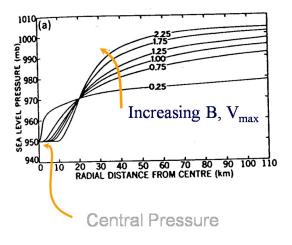
Radius to max winds and radii can be adjusted in the settings.xml

Visual 29: Parameters: Storm Intensity

Maximum Wind Speed

Profile Parameter (B)

- Parameter that describes the rate of pressure drop in the storm
- Pressure drop determines the maximum wind speed



Visual 30: Typical Storm Parameters

Hurricane and Station	Measured Peak Gust at 10m (m/sec)	Anemomet er Height (m)	Wind Speed Averaging Time (sec) Mean	Wind Speed Averaging Time (sec) Gust	Holland's B Parameter	Radius to Maximum Winds (km)
Fran (1996), FPSN7	48.3, 37.7	44.2	600	5	.95	85
Fran (1996), DSLN7	29.6	46.6	600	5	.95	85
Bertha (1993), FPSN7	45.1	44.2	600	5	1.2	70
Emily (1993) DSLN7	51.0, 56.7	46.6	600	5	1.7	39
Andrew (1992), NGW LMS	58.6	13.7	120	5	1.6	19
Bob (1991), 41001	30.6	5.0	600	5	1.4	35
Hugo (1989), FPSN7	31.7	42.2	600	5	1.0	40

Visual 31: Storm Track Definition

• Manually enter storm parameters

Latitude (Degrees)	Longitude (Degrees)	Translation Speed (miles/hr)	Radius to Max Winds (miles)	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland	Forecast
17.00	-68.90	16.12	21.23	40.00	1004.00	17	(C)
17.40	-69.20	15.52	20.43	40.00	1004.00		
17.70	-69.50	12.50	20.53	46.92	995.00		
17.90	-70.30	11.25	22.30	45.23	995.00		
18.00	-71.00	12.62	18.92	47.81	1000.00	100	
18.35	-71.40	11.51	21.12	44.67	1001.00		
18.60	-71.90	11.03	20.34	43.23	1001.00		

Visual 32: Hurricane Data Sources: Hurdat

• Good to manually define storm track

National Hurricane Center's HURricane DATabase: https://www.nhc.noaa.gov/data/#hurdat

- Enhanced collection of historical meteorological data
- HURDAT2: Best Track Data
 - Atlantic and Pacific
 - Comma-delimited, text format
 - Six-hourly information on location, maximum winds, central pressure, and size of all known tropical and subtropical cyclones

Visual 33: Show Current Scenario

Select Hazard > Show Current

Current Hazard		×
Info		
Scenario Name: Scenario Type:		
		Close

Visual 34: Lesson 4: Review

- 1. What are the deterministic options for hurricane scenarios in Hazus?
- 2. Where (geographically within a hurricane) are the greatest hurricane windspeeds located and why?

Visual 35: Questions?

Lesson 5: Probabilistic Storm Parameters

Visual 1: Lesson 5: Probabilistic Storm Parameters



Visual 2: Goal and Objectives

Goal: To provide an overview of the set of probabilistic storm scenarios available to users in Hazus.

After completing this lesson, you will be able to:

• Discuss the differences in the probabilistic analyses in Hazus

Visual 3: Scenario Operations

Hazus has six choices for defining hurricane scenarios:

- Historic
- Probabilistic
- Create New:
 - Define Storm Track Manually
 - Import from Exported File (storm created in previous Hazus Study Region)
 - Import Census Tract Data File
 - Import a Hurrevac Storm Advisory

Scenario O	peration		
This page allows you to	o select an operation to perform on a scena	nio.	
	Hurricane Scenarios		
	Probabilistic Historic < Create New Scenario >		
		Copy	
		O <u>D</u> elete O E <u>x</u> port	

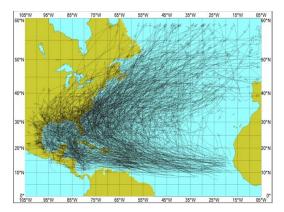
Visual 4: Probabilistic vs. Deterministic

Probabilistic wind speed database (Left)

• 100,000 years of simulated storms

Individual Storms (Right)

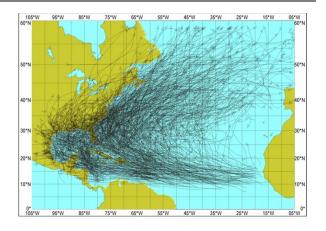
- Historical
- Forecast/Advisory
- User-defined





Visual 5: Modeling Risk

- The hurricane wind model was run to simulate 100,000 hurricane seasons.
 - Storms can vary in size, strength, speed, direction
- Provides objective way to compare risk of different areas



Visual 6: Probabilistic Windspeeds

- The probabilistic windspeeds in the Table of Contents window (next slide) show the overall wind risk to the US and are the same windspeeds as in Figure 4.28
- These layers were created from the 100,000 years worth of simulated storms.
- Windspeeds were ranked for each tract and recurrence intervals were determined.

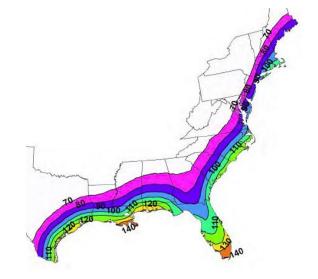
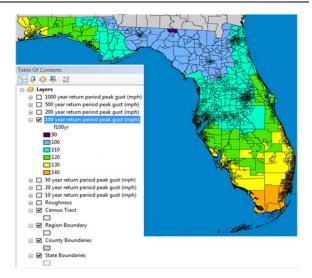


Figure 4.28 in Hurricane Technical Manual

Visual 7: Probabilistic Windspeeds (Cont'd.)

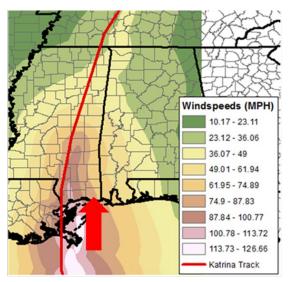
These layers answer the question:

- What is the windspeed for this tract that equates to a given recurrence interval?
- For example, 115 MPH winds for tract 12103024901 for the 1% annual chance



Visual 8: Probabilistic Windspeeds

- For an actual hurricane:
 - Windspeeds are not uniform across the storm.
 - Windspeeds are higher at eyewall and lower farther away.
- Using these layers:
 - Assume the recurrence interval (100 year) at every location in the study region
 - Good for building codes, but may not be best for planning



For a given county the windspeeds will vary geographically across the region during an actual hurricane event.

Visual 9: Probabilistic Scenario: Scenario Driven

- Table of Contents windspeed probabilities should not be confused with the probabilistic scenario.
- Table of Contents layers:
 - Provide communities with the recurrence interval windspeed for each tract.
- Probabilistic scenario:
 - Provide communities with a representative recurrence interval event based on loss for the study region.
 - Losses are representative of the specific event, not the recurrence interval windspeeds.

Scenario Wizard	×
Scenario Operation This page allows you to select an operation to perform on a scenario.	
Hurricane Scenarios	1
Historic	 Activate
< Create New Scenario > FRAN_1996_stm_2024PM	🔘 Edit
	🔘 Сору
	🔘 Delete
	C Export
	<back next=""> Cancel</back>

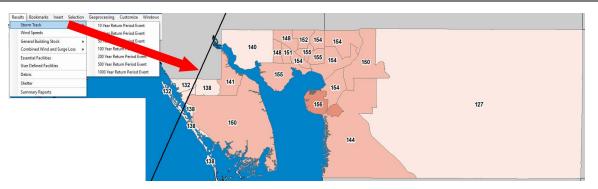
Visual 10: Probabilistic Scenario: Scenario Driven

For planning purposes:

- A community needs to understand damages and losses from an actual hurricane for each recurrence interval.
- This method answers questions such as "What would the damages and losses be for our community from a return period (e.g. 100-year) hurricane event?"

esults	Bookmarks	Insert	Selection	Geoprocessing	Customize	Windows
Sto	rm Track		•	10 Year Ret	urn Period Ev	ent
Wir	nd Speeds			20 Year Ret	urn Period Ev	ent
Ger	General Building Stock			50 Year Return Period Event		
Ess	ential Facilities			100 Year Re	turn Period E	vent
Use	User Defined Facilities		200 Year Return Period Event 500 Year Return Period Event			
Deb	Debris					
She	lter			1000 Year R	leturn Period	Event
Bui	Iding Econom	ic Loss	٠			
Cor	mbined Wind a	and Surg	e Loss 🕨			
Sun	nmary Reports	;				

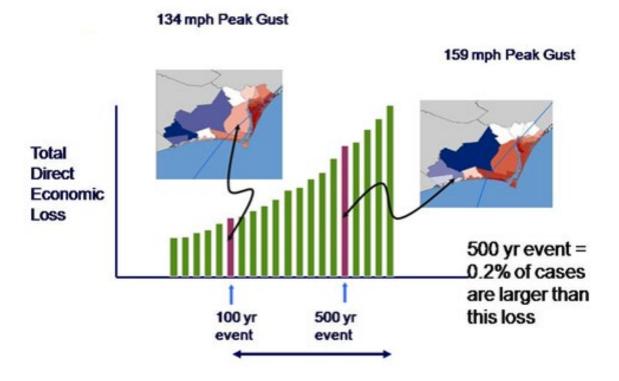
Visual 11: Probabilistic Scenario: Scenario Driven



- Hazus searches through 100,000 year simulated database for all storms that intersect the study region.
- The total losses for the region based on each storm are ranked.
- Loss is selected, then the hurricane event is used to generate damages and losses.

Visual 12: Seven Return Period Events

Events Sorted by Total Loss for the study region

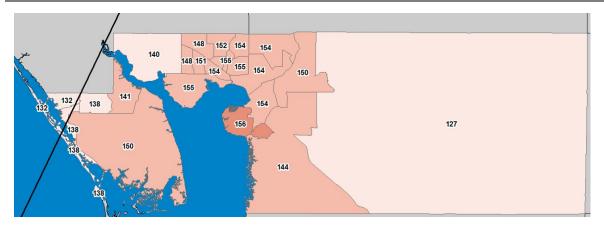


Visual 13: Discussion 5.1: 500-Year Event

Goal: Discuss the windspeed distribution for this 500 year event.

Time: 5 minutes

Visual 14: Discussion 5.1: 500-Year Event



Discuss the windspeed distribution for this 500 year event.

- Where do you expect the highest and lowest losses?
- Is every Census tract experiencing a 500 year event (individually)?

Visual 15: Outputs: Return Period Event

Seven Return Period Events

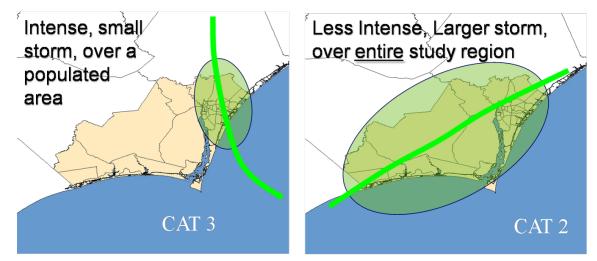
- Seven single storm scenarios from 100,000 year storm database
- Representation of the return period losses for study region: 10, 20, 50, 100, 200, 500, 1,000 years
- Return periods are based on total direct economic loss for entire study region

Full set of results provided

- Damage, debris, shelter, etc.
- Dollar losses

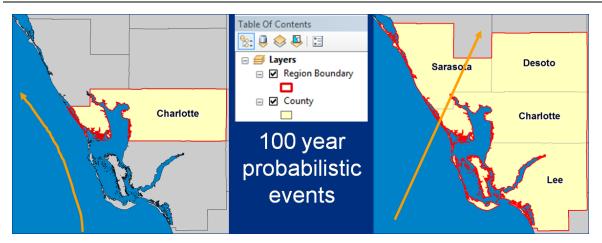
Visual 16: Study Region Characteristics & Losses

There are many different ways to produce a 100-year loss for a given study region.



*These very different storms can produce identical dollar losses for the same study region.

Visual 17: Study Region Characteristics & Losses



Even though both of these study regions contain Charlotte County, Florida, they will have very **different** probabilistic scenarios because the events are selected by finding all probabilistic events that intersect the study region and ranked based upon the losses to the **study region**.

Visual 18: Uses of Probabilistic Layers

Wind speed Maps in Table of Contents window

- Mitigation plan: identifies the windspeed each location individually plans for with respect to each probabilistic interval (10 yr, 100 yr, etc.)
- Construction design: identifies the windspeed buildings should be able to withstand

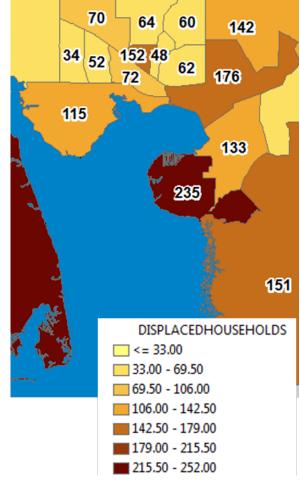
NOTE: Wind building characteristics distributions can model changes in construction wind resistance.

Categories	Building Characteristic	%
Roof Shape	Hip	5
	Gable	95
	Total	100
Secondary Water Resistance	Yes	0
	No	100
D (D) An 1	Total	100
Roof Deck Attachment	6d @ 6"/12"	44
Hoor D Cox Andonino In	8d @ 6"/12"	34
	6d/8d Mix @ 6"/6"	0
	8D @ 6"/6"	22
	Total	100
Roof-Wall Connection	Toe-nail	37
	Strap	63
	Total	100
Garage, Houses w/out Shutters	None	48
	Weak	26
	Standard	26
	Total	100

Visual 19: Uses of Probabilistic Layers

Probabilistic Event Scenarios

- Layers used in mitigation and planning situations to understand overall losses to the jurisdiction for each recurrence interval event.
- Demonstrate the damages and losses if an actual hurricane affected the area
- Example: debris planning, sheltering planning, and response and recovery exercises



Visual 20: Probabilistic Losses

Building Economic Losses

- Seven Return Period Events
- Annualized: the estimated long-term value of losses to the general building stock averaged on an annual basis for a specific hazard type

All other results

• Seven Return Period Events

	Period:									
00 Y	ear Event	*								
	ar Event									
	ar Event ar Event									
	ear Event	Brick/		Eligible	Eligible Tree		Tree	ž d		
	ear Event	Wood	Concrete/	Tree Weight	Volume	Trees	Volume			
	ear Event Year Event	(tons)	Steel (tons)	(tons)	(cubic	(tons)	(cubic vards)			
	1201501		55	5.558	yards) 55.575		5.557.55	-		
1 2	1201501			5,558	55,575 48,390	21.039	210.39			
	1201501			4,033	46,350	6 800	67.99			
Bu	ilding Eco	onomic Loss By Occ	pancy							
I r		conomic Loss Outrout		-						
		outpu	& Employment	nt						
	View I	Results By:						Return Period		
	Al	Occupancies								
	O Ge	neral Occupancy Clas	3				-	100 Year Eve	ent 🔻	
	O Sp	ecific Occupancy Clas	5							
								10 Year Even		
								20 Year Even	nt	
	Estima	eted Losses (Thousand	s of Dollars):					20 Year Even 50 Year Even	nt nt	
		Census Tract	Total		ilding	Content		20 Year Even 50 Year Even 100 Year Even 200 Year Even 500 Year Even	nt nt ent ent	×
	1	Census Tract	Total	550	11,084	3	.668	20 Year Even 50 Year Even 100 Year Even 200 Year Even 500 Year Even 1000 Year Even	nt nt ent ent	H
	1 2	Census Tract 12015010100 12015010200	Total 17,5 26,6	550 675	11,084 16,903	3,	.668 .551	20 Year Even 50 Year Even 100 Year Eve 200 Year Eve 500 Year Eve 1000 Year Eve Annualized	nt ent ent vent	
	1 2 3	Census Tract 12015010100 12015010200 12015010300	Total 17,5 26,6 89,3	550 675 326	11,084 16,903 50,047	3, 5, 19,	.668 .551 .056	20 Year Even 50 Year Even 200 Year Even 200 Year Even 500 Year Even 1000 Year Even Annualized 451	nt ent ent vent 9,495	
	1 2 3 4	Census Tract 12015010100 12015010200 12015010300 12015010400	Total 17.5 26.6 89,1 128,4	550 575 326 250	11,084 16,903 50,047 82,816	3, 5, 19, 26,	668 551 056 605	20 Year Even 50 Year Even 200 Year Even 200 Year Even 500 Year Even 1000 Year Even 4000 Year Even 451 140	nt ent ent ent 9,495 12,462	
	1 2 3 4 5	Census Tract 12015010100 12015010200 12015010300 12015010400 12015010500	Total 17,5 26,6 89,1 128,4 87,5	550 675 326 250 947	11,084 16,903 50,047 82,816 52,196	3, 5, 19, 26, 20,	.668 551 056 605 183	20 Year Even 50 Year Even 200 Year Even 200 Year Even 500 Year Even 1000 Year Eve	nt ent ent ent 9,495 12,462 9,039	
	1 2 3 4 5 6	Census Tract 12015010100 12015010200 12015010200 12015010300 12015010400 12015010500 12015020100	Total 17,5 26,6 89,3 128,2 87,5 73,5	550 675 326 250 347 943	11,084 16,903 50,047 82,816 52,196 48,158	3, 5, 19, 26, 20, 14,	668 551 056 605 183 186	20 Year Even 50 Year Even 200 Year Even 200 Year Even 500 Year Even 1000 Year Eve	nt ent ent 9,495 12,462 9,039 7,287	
	1 2 3 4 5 6 7	Census Tract 12015010100 12015010200 12015010300 12015010400 12015010500 12015020100 12015020100 12015020201	Total 17,5 26,6 89,3 128,2 87,9 73,9 73,9 44,6	550 575 326 250 347 343 535	11,084 16,903 50,047 82,816 52,196 48,158 29,061	3, 5, 19, 26, 20, 14, 8,	668 551 056 605 183 186 701	20 Year Ever 50 Year Ever 100 Year Eve 200 Year Eve 500 Year Eve 500 Year Eve 1000 Year Eve 451 140 492 173 66	nt ent ent 9,495 12,462 9,039 7,287 4,967	
	1 2 3 4 5 6 7 8	Census Tract 12015010100 12015010200 12015010300 12015010400 12015020100 12015020100 12015020100 12015020201	Total 17,5 26,6 89,2 128,2 87,5 73,5 73,5 44,6 44,0	550 575 326 250 947 943 535 030	11,084 16,903 50,047 82,816 52,196 48,158 29,061 28,662	3, 5, 19, 26, 20, 14, 8, 8,	668 551 056 605 183 186 701 423	20 Year Ever 50 Year Ever 100 Year Eve 500 Year Eve 500 Year Eve 1000 Year Eve 1000 Year Eve 451 140 492 173 66 57	tt tt ent ent 9,495 12,462 9,039 7,287 4,367 5,065	
	1 2 3 4 5 6 7 8 9	Census Tract 12015010100 12015010200 12015010200 12015010400 1201500500 12015020100 12015020201 12015020202 12015020301	Total 17,5 26,6 89,2 128,2 87,5 73,5 44,6 44,0 44,0 44,0	550 575 326 250 347 943 535 030 750	11,084 16,903 50,047 82,816 52,196 48,158 29,061 28,662 26,233	3, 5, 19, 26, 20, 14, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8,	668 551 056 605 183 186 701 423 557	20 Year Ever 50 Year Ever 100 Year Eve 500 Year Eve 500 Year Eve 1000 Year Eve 1000 Year Eve 1000 Year Eve 1000 Year Eve 451 140 492 173 68 57 246	tt tt ent ent 9,495 12,462 9,039 7,287 4,967 5,065 4,457	
	1 2 3 4 5 6 7 8	Census Tract 12015010100 12015010200 12015010300 12015010400 12015020100 12015020100 12015020100 12015020201	Total 17,5 26,6 89,2 128,2 87,5 73,5 73,5 44,6 44,0	550 575 326 250 347 943 535 030 750 534	11,084 16,903 50,047 82,816 52,196 48,158 29,061 28,662	3, 5, 19, 26, 20, 14, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8,	668 551 056 605 183 186 701 423	20 Year Ever 50 Year Ever 100 Year Eve 500 Year Eve 500 Year Eve 1000 Year Eve 1000 Year Eve 451 140 492 173 66 57	tt tt ent ent 9,495 12,462 9,039 7,287 4,367 5,065	4 4 4

Visual 21: Exercise 5.2: Probabilistic Scenario

Goal: Run a Probabilistic Scenario.

Time: 45 Minutes

	Exercise 5.2: Probabilistic Scenario
	Goal:
	Run a Probabilistic Scenario
	Time: 45 minutes
	Exercise Steps:
	 Refer to Activities Document "05.2_Exercise_Probabilistic Scenario."
	2. Listen to instructor's directions.
Student Manual	3. Ask questions if clarification is needed.
Manual	4. Work individually on the goal.
	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share your answers/results.
	8. Ask any final questions.

Visual 22: Exercise 5.2: Tasks

Task 1: Open the Region and Define a Probabilistic Scenario.

Task 2: Run the Analysis.

Task 3: View the Results.



Exercise 5.2: Tasks

• Refer to Activities Document "05.2_Exercise_Probabilistic Scenario."

Student Manual

Activity 5.2: Probabilistic Scenarios

Type: Student-Led Activity Time: 45 minutes Goal: Run probabilistic scenario.

Background:

Hazus comes with a substantial library of historical storms. You can use the tracks and other characteristics of storms that occurred in the past to understand what the impact would be on a community of a similar storm were to occur today given the way that buildings are constructed, how they are used, and where they are located. This exercise will help you explore the process of defining a probabilistic storm scenario and it will also help you explore the study region inventory to provide a context for understanding the impact of the hurricane on the exposed buildings and population.

Task 1: Run the Probabilistic Analysis.

1. Start Hazus and select "Import a region". Import the "Probabilistic" HPR from the C:\E0170_ActivityData\Activity_5.2 folder.

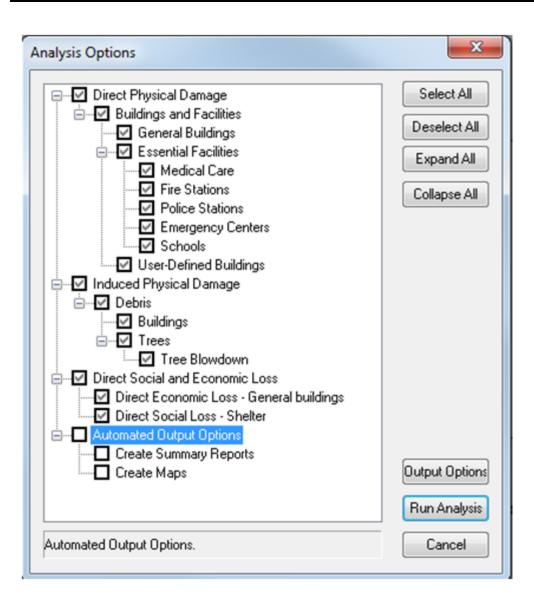
2. Name the imported region, "Probabilistic_HU"

3. Once complete, select Open a Region from the Hazus startup menu and select the "Probabilistic_HU" region.

- 4. From the Hazard menu choose "Scenario" to open the Scenario wizard.
- 5. Click Next to move past the initial window of the wizard.
- 6. Select Probabilistic and click "Next".

Scenario Wizard			X
Scenario Opera This page allows you to select a	ation In operation to perform on a scenar	io.	
	Hurricane Scenarios Probabilistic Historic < Create New Scenario >	 Activate Edit Copy Delete Export 	Next > Cancel

- 7. Click "Next" to make the scenario active and then click Finish.
- 8. From the Analysis menu choose "Run" to open the Analysis Options window.
- 9. Uncheck the Automated Output Option radio boxes and click "Run Analysis".



10. When the analysis is complete, click OK.

11. From the Results menu, choose "Wind Speeds".

12. Find the 200 Year Event Peak Gust (mph) column. Question: What is the highest peak wind gust? Answer: Peak Wind Gust: 135

13. Click on the 200 Year Event Peak Gust (mph) column and then "Map" to add the probabilistic storm path and windspeeds as map layers.

14. "Close" this window.

15. Right-click on the StormTrack - 200 year return period event layer in the Table of Contents window on the left and choose Zoom to Layer.

16. View the probabilistic storm being used to create the 200 year event for the study region. The storm's winds are modeled for each tract of the study region based on the speed, size, and

intensity of the probabilistic hurricane. Based on the peak wind gusts for each tract, damage and losses are calculated within each tract.

17. Right-click on the Wind Speeds-200 Year Event Peak Gust (mph) layer and choose Zoom to Layer.

Question: What is the geographic distribution of windspeeds for the probabilistic event of this study region?

Answer:

Question: Explain why this pattern exists.

Answer:

18. Click the check box next to the StormTrack - 200 year return period event and Wind Speeds - 200 Year Event Peak Gust (mph) to turn off each layer.

19. Click the box next to the 200 year return period peak gust (mph) layer which was created and populated when the study region was created, to turn it on.

Note: Notice there is no storm track associated with this layer. This is because it was not created from a hurricane event.

20. Right-click on the 200 year return period peak gust (mph) layer and select Label Features.

21. Answer the following questions:

Question: What is the peak wind gust for this probabilistic layer?

Answer:

Question: What is the geographic distribution of windspeeds for this probabilistic layer for this study region?

Answer:

Question: Explain why this pattern exists.

Answer:

Question: What are the major differences between the two windspeed layers?

Answer:

22. Right-click on the Wind Speeds - 200 Year Event Peak Gust (mph) layer and choose Open Attribute Table.

23. Find tracts 48355003001 and 48355005802. (The wRtnP5 column contains the 200-year gusts.)

Question: What are the peak wind gusts for these two tracts? Answer:

Task 2: View and Compare the Results.

You just completed an analysis of the impact to the study region from the perspective of individual census tracts. At the beginning of this exercise you ran the probabilistic event analysis where you generated seven return period events. We looked at the 200-year event, which was selected from the 100,000-year probabilistic storm database located in Hazus. The storm will affect each individual census tract in the study region differently depending on the characteristics (size, speed, intensity) and the proximity to the storm path of each tract.

- Scenario 1: If you lived in tract **48355003001** and this probabilistic event actually occurred, you would experience a 200-year event. This is determined by opening the attribute tables of the seven different return period layers, locating the census tract records, and determining which column the peak wind gust falls into. The peak wind gust for this tract is 123 mph and this falls into the "f200yr" column for this census tract record in each of the attribute tables of the return period layers.
- Scenario 2: If you lived in census tract **48355005802**, you would experience a 500-year event. In this scenario, the peak wind gust in the tract is 119 mph and this value falls into the "f500yr" column in each of the attribute tables of the seven return period layers.

Question: As a county emergency manager, how would you explain the event the county as a whole is experiencing?

Answer:

2. Locate tract 48355003001.

Question: What are the peak wind gusts for each return period?

Answer:

- wRtnP1 (10 year):
- wRtnP2 (20 year):
- wRtnP3 (50 year):
- wRtnP4 (100 year):
- wRtnP5 (200 year):
- wRtnP6 (500 year):
- wRtnP7 (1000 year):
- 3. Close the attribute table.
- 4. Answer the following questions:

Question: Why doesn't the winsdpeed steadily increase as the return periods get longer? Answer:

Question: What might you expect for the damages and losses for this tract as the return periods increase? What about for the study region?

Answer:

- 5. From the Results menu select "Summary Reports".
- 6. Select the "Direct Losses" tab.
- 7. Click to highlight the "Direct Economic Losses for Buildings" report.
- 8. Click View to view the report.

9. Reports for every return period are listed. Note: To view other return period reports you can click the arrows in the top left of the report window.

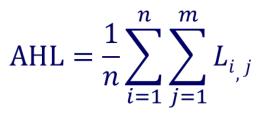
10. In the table below, record the Cost Building Damage for each return period:

Results Table

Return Period	Cost Building Damage
Annualized	
10	
20	
50	
100	
200	
500	
1000	

Visual 23: Annualized Hurricane Loss (AHL)

- The expected value of future losses averaged on an annual basis
- Formula expression
 - m = events
 - n = years
- Formula description
 - Sum of expected loss for each event, divided by number of years in simulation (n= 100,000 years)
- Uses
 - Fundamental measure of the risk for mitigation strategy
 - Unbiased basis for relative ranking and resource allocation
 - Benefit-cost analysis of mitigation options



Visual 24: Annualized Hurricane Loss (AHL)

Annualized Hurricane Losses are provided for

- Building Economic losses (\$)
- Output and Employment losses (\$)

Not provided for

- Damage
- Debris
- Shelter

Called "Annualized" in direct economic results tables

Visual 25: Probabilistic Return Intervals vs. AHL

- Probabilistic scenarios work inherently different from event based AHL estimates
 - Probabilistic scenarios look at a specific return interval
 - AHL looks at all potential events and is a combined value of events and years
 - Probabilistic scenarios are not calculating the impact of an event in all regions; it is specific to whatever is defined

Visual 26: Review

- 1. Where can you find the two different types of probabilistic datasets?
- 2. What return periods are used in probabilistic hurricane scenarios in Hazus?

Visual 27: Questions?

Lesson 6: Damage Models

Visual 1: Economic Loss Methodology



Visual 2: Lesson 6: Goal and Objectives

Goal: To provide an overview of the damage and loss methodology for hurricane wind models in Hazus.

After completing this lesson you will be able to:

• Discuss the wind damage and loss methodology in Hazus.

Visual 3: The Building Envelope

- Damages and losses begin with the building envelope performance, the amount of resistance to hurricane force winds.
 - Walls
 - Roofing
 - Windows
 - Doors
- Failures to these components lead to more extensive damage.



Mitigation Assessment Team Report: Hurricane Ivan in Alabama and Florida (FEMA 489)

Visual 4: Sub-Assembly Inventory Wind Model

- Sub-assembly cost ratios separate the individual building components.
- Represents the percentage of the replacement cost for each component
 - EX: if Hazus modeled a roof 100% damaged on a \$100,000 one story residential structure, the total loss would be \$3,000.

Table of Default Residential Subassembly Cost Ratios

Subassembly	1 Story	2 Story	3 Story
Site Work	1%	1%	1%
Foundation	13%	8%	5%
Framing	13%	11%	14%
Exterior Wall	22%	25%	26%
Roofing	3%	2%	1%
Interiors	32%	38%	39%
Specialties	4%	4%	4%
Mechanical	9%	8%	7%
Electrical	3%	3%	3%
Total	100%	100%	100%

Hurricane winds do not affect all components equally, and therefore individual components must be modeled

Visual 5: Sub-Assembly Inventory Flood Model

- Sub-assembly cost ratios were created for the surge model for combined losses.
- 5 categories were created, but they are different than the hurricane model.
- Therefore the hurricane sub-assemblies were aggregated into the same 5 categories, which prevents double counting of losses.

Pre-FIRM

Specific Occupancy or General Building Type	Foundation	Below First Floor	Structure Frame	Roof Covering	Roof Framing	Exterior Wall	Interiors	Total
RES1: Single	6%	2%	13%	5%	5%	20%	49%	100%
RES2: MH	6%	2%	10%	3%	5%	20%	54%	100%
RES3A: Duplex	6%	2%	13%	5%	5%	20%	49%	100%
RES3B: 3- 4 Units	6%	2%	13%	5%	5%	20%	49%	100%
RES3C: 5- 9 Units	5%	1%	10%	2%	3%	10%	69%	100%

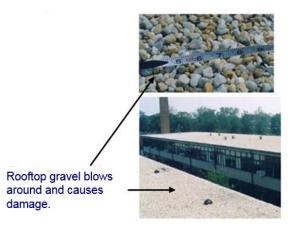
Visual 6: Sub-Assembly Inventory Flood Model

Post-FIRM

Specific Occupancy or General Building Type	Foundation	Below First Floor	Structure Frame	Roof Covering	Roof Framing	Exterior Wall	Interiors	Total
RES1: Single	11%	3%	10%	5%	5%	19%	47%	100%
RES2: MH	8%	2%	10%	3%	5%	20%	52%	100%
RES3A: Duplex	11%	3%	10%	5%	5%	19%	47%	100%
RES3B: 3- 4 Units	11%	3%	10%	5%	5%	19%	47%	100%
RES3C: 5- 9 Units	10%	1%	9%	2%	3%	9%	66%	100%

Visual 7: Damages from Hurricane Winds

- Wind pressure: the effect of the force of the wind on a building
- Windborne Debris (Missiles): damage caused by building debris being airborne and damaging other structures
- Roof types are referred to as "ballasted."



Visual 8: Damages from Hurricane Winds

Duration: longer durations (more damage) vs. shorter durations (less damage) of hurricanes when the windspeeds are equal

Rainfall: after roofing materials or openings fail, water can damage the inside of a structure

Atmospheric pressure: difference in atmospheric pressure causing damage

4" wide (minimum) self-adhering modified bitumen tape at sheathing joints (see step 2) \sim One layer of ASTM D 226 4' x 8' roof sheathing Type II (#30) felt (see step 4) 12" on center Metal drip edge 6 Stagge Fascia Metal drip edge Low-profile capped-head nails One layer of self-adhering modified bitumen complying with ASTM D 1970 over the #30 felt throughout the roof area (see step 7) or metal disks ("tincaps") (see step 5) FEMA - Recovery Advisory No. 1, Hurricane Recovery Advisory

Secondary water resistance

Visual 9: Damage States

Damage results are reported by average percentage of buildings in each damage state:

- None
- Minor
- Moderate
- Severe
- Destruction

Damage state:

• Function of amount of damage to key components



Damage State 1

Visual 10: Damage States

- Different damage state definitions for each building type
- See the Hazus Hurricane Model Technical Manual

Damage State	Qualitativ e Damage Descripti on	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
0	No Damage or Very Minor Damage Little or no visible damage from the outside. No or very limited water penetratio n.	Less than or equal to 2%	No	No	No	No	No
1	Minor Damage Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring	Greater than 2% and less than or equal to 15%	One window, door, or garage door failure	No	<5 Impacts	No	No

Damage State	Qualitativ e Damage Descripti on	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
	painting or patching for repair						

Damage States for Residential Construction Classes

Visual 11: Damage States

- Different damage state definitions for each building type
- See the Hazus Hurricane Model Technical Manual

Damage State	Qualitativ e Damage Descripti on	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
2	No Damage or Very Minor Damage Little or no visible damage from the outside. No or very limited water penetratio n.	>15% and less than or equal to 50%	Greater than 1 and less than or equal to the larger of "20%" and "3"	1 to 3 panels	Typically 5 to 10 impacts	No	No
3	Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	>50%	greater t han the larger of "20%" and "3" and less than or equal to 50%	>3 panels an d Less than or equal to 25%	Typically 10 to 20 impacts	No	No

Damage State	Qualitativ e Damage Descripti on	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
4	Destructi on Complete roof failure and/or failure of wall frame. Loss of more than 50% of roof sheathing.	Typically > 50%	>50%	>25%	Typically >20 impacts	Yes	Yes

Damage States for Residential Construction Classes

Visual 12: Examining Damage and Loss Curves

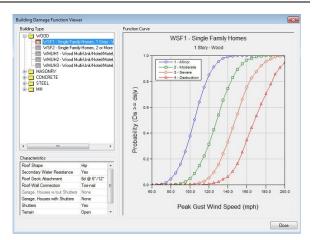
Analysis Menu

- Damage
- Loss
- Loss of use
- Debris

File Edit View Inventory Hazard A	nalysis	Results	Bookmarks	Insert	Select
🔚 🏸 🖨 Save As 🎭 👘 🛍 🗙	Building Damage Functions				
€ € 🥙 🥥 💥 53 🗢 ⇒ 🕅 -	Building Loss Functions Building Loss of Use Functions				
Table Of Contents					
See 0 ≤ 0 ≤ 0	Building Debris Functions				
Eayers	Para	meters			
	Set (Optimized	Analysis Mod	e Ol	F
500 year return period peak gust	Run				
🗉 🔲 200 year return period peak gust	Show Coastal Surge Status				
100 year return period peak gust		W COastai	surge status		
💿 🔲 50 year return period peak gust (mp					
10 year return period peak gust (mp	h)				
Roughness					
Census Tract					
E Region Boundary					
County Boundaries					
State Boundaries					
- V state boundaries					

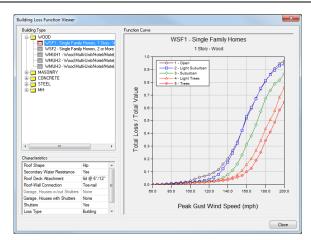
Visual 13: Damage Curve Viewer

- Select a Building Type
- Click to Select different parameters
- For 140 mph speed, there is a 35 percent chance that the building will have at least severe damage



Visual 14: Four Curve Viewers

- Building Damage
- Building Loss
- Building Loss of Use
- Debris



Loss curves for variety of terrains

Visual 15: Demonstration 6.1: Curve Viewers

Goal: Review and discuss curve viewers Time: 10 minutes

Demonstration 6.1: Curve Viewers

Type: Instructor-Led Activity

Time: 10 minutes

Goal: Review and discuss curve viewers

Background:

In order to show the losses from hurricane winds and storm surge, the sub-assembly losses were created. Sub-assembly loss curves for flooding were developed. After the damages to these components have been calculated, the % damage is then applied to the % of the replacement cost from the cost ratios. The losses for each component are totaled to get a total loss.

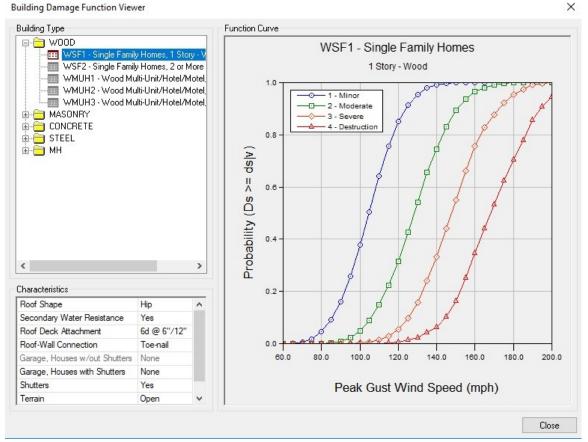
Task 1: Show Damage and Loss Curve viewers

1. For this demonstration, open the "Irma_Hurricane" study region created in Exercise 4.4.

Note: If you did not create this study region, the HPR is provided in the C:\E0170_ActivityData\Demonstration_6.1 folder.

2. Choose the Hurricane hazard.

- 3. To view the damage and loss curves click on Analysis.
- 4. Then click on each loss, damage and debris viewers and discuss how the GUIs work.



Building Damage Function Viewer

Task 2: Discuss Damage and Loss Curve modification examples

1. Provide some examples of changing the wind building characteristics and how the curves change.

ates:	Counties:	M	apping Schemes:	Florida_Central	~ Apply	har
lorida	Hillsborough, FL Manatee, FL		ensus Block		lapping Scheme	
	Pinellas, FL		20810001011000		Florida Central	
W	ind Building Characteristics Distribu	ition				
	Scheme Name:					
	Southeast Inland					
	_					Hip 5 able 95 able 95 adal 100 Yes 0 No 100 otal 100 r12" 44 r12" 34 r12" 34 r12" 34 r12" 34
T	Distribution			· · · · · · · · · · · · · · · · · · ·		
	📮 📛 WOOD		Cat	egories	Building Characteristic	
	WSF1 - Single Family Hor			Roof Shape	· · · · · · · · · · · · · · · · · · ·	
	WSF2 - Single Family Hor					tic % Hip 5 Gable 95 Total 100 Yes 0 No 100 Total 100 @ 6"/12" 44 @ 6"/12" 34 x @ 6"/6" 0) @ 6"/6" 22 Total 100 Total 100 Total 100 None 48
	WMUH1 - Wood Multi-Ur					
	WMUH2 - Wood Multi-Ur WMUH3 - Wood Multi-Ur		Seconda	ry Water Resistance		
appin	MASONRY	III/HOLEI/MOL				
Scher			P	of Deck Attachment		
			RC	or Deck Attachment		
South			-		6d/8d Mix @ 6''/6''	
South					8D @ 6"/6"	
lorth Iorth						
Iorida			В	oof-Wall Connection	Toe-nail	37
Florida					Strap	63
lorida					Total	100
Florida			Garage, Ho	ouses w/out Shutters	None	
IONIG					Weak	26
			2		Standard	26
			-		Total	100
			Garage, H	Houses with Shutters	None	48
	<	>			SFBC 1994	52
	Expand All Collapse A					100

- 2. Switch the hazard to the Flood model.
- 3. Go to Analysis > Damage Functions > Buildings.
- 4. In the bottom left corner click Library.
- 5. View the depth damage curves for RES1 structures.

Riverine	~	Static c2 RES1		~						
1 2	RES1 RES1	SpecificOc R11N R11B	US	Source SACE - IWR CAR - Jan 2011	Description one story, no base one story, w/ base		R/			
Struct	ture Damage Functior	ıs								
(Occupancy: RESI		~		4 tt -3 ft 0.00 0.00	2 ft -1 ft 0 ft 0.00 3.00 13.00		3 ft 4 ft 5 ft 0.00 47.00 53.		9 ft 71.00
1	specific0ccuplo	Stories 1 Story	Basement	<u>^</u> 2	0.00 0.00	0.00 0.00 18.00		8.00 30.00 31.		
2		1 Story		3						
3		2 Story		4						
4		2 Story	\checkmark							
5		3 Story		Defau	alt Source: USACE - IV	/R Cum	ent Source: FIA		Selected Source:	
6	6 R13B	3 Story		Defau	It Source: USACE - IV	/R Cum	ent Source: FIA		Selected Source:	
6	6 R13B 7 R1SN	3 Story Split Level		Defau	ult Source: USACE - IV	/R Cum	ent Source: FIA		Selected Source:	
6	6 R13B 7 R1SN	3 Story		Defau	Ilt Source: USACE - IV	/R Curr source		ID	Selected Source:	
6	6 R13B 7 R1SN	3 Story Split Level		Defau	Cccupancy RES1		DamageFn	ner 105		
6	6 R13B 7 R1SN	3 Story Split Level			Cccupancy RES1	source	DamageFn	ner 105		
6	6 R13B 7 R1SN	3 Story Split Level			Cccupancy RES1 RES1 RES1 RES1	Source FIA USACE - Chicago USACE - Galveston	DamageFn one floor, no basem one story, no basen	ner 105 ne 132 ne 139		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4	Occupancy RES1 RES1 RES1 RES1 RES1	source FIA USACE - Chicago USACE - Galveston USACE - IWR	DamageFn one floor, no basem one story, no basen one story, no basen one story, no basen	ner 105 ne 132 ne 139 ne 129		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3	Cccupancy RES1 RES1 RES1 RES1 RES1 RES1	source FIA USACE - Chicago USACE - Galveston USACE - IWR USACE - New Orlea	DamageFn one floor, no basem one story, no basen one story, no basen one story, no basen n one story, Pier foun	ner 105 ne 132 ne 139 ne 129 da 142		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 6	Coccupancy RES1 RES1 RES1 RES1 RES1 RES1 RES1	Source FIA USACE - Chicago USACE - Galveston USACE - NwR USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one story, no basen one story, no basen one story, no basen one story, Pier foun o one story, Pier foun	ne 105 ne 132 ne 139 ne 129 da 142 da 141		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 6 7	Occupancy RES1	FIA USACE - Chicago USACE - Galveston USACE - IWR USACE - New Orlea USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one story, no basen one story, no basen one story, no basen one story, Pier foun o one story, Pier foun o one story, Pier foun	ner 105 ne 132 ne 139 ne 129 da 142 da 141 da 153		
6	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 5 6 7 7 8	Occupancy RES1	Source FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one story, no basen one story, no basen one story, no basen n one story, Pier foun o one story, Pier foun o one story, Slab four	ner 105 ne 132 ne 139 da 129 da 142 da 141 da 153 nd 144		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 6 7 7 8 9	Occupancy RES1	FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea USACE - New Orlea USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one story, no basen one story, no basen one story, Pier foun n one story, Pier foun n one story, Pier foun n one story, Slab four one story, Slab four	ne 105 ne 132 ne 139 de 142 de 142 de 141 de 153 nd 144 nd 143		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 6 7 7 8 9 9 10	Cocupancy RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1 RES1	source FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one story, no basen one story, no basen no estory, Pier foun one story, Pier foun one story, Slab four no ene story, Slab four no ene story, Slab four	ne 105 ne 132 ne 139 de 142 de 142 de 141 de 153 nd 144 nd 143 nd 154		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 1 2 3 3 4 4 5 5 6 6 7 7 8 9 9 10 11	Occupancy RES1	FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one stoy, no basen one stoy, no basen one stoy, no basen one stoy, Pier foun one stoy, Pier foun one stoy, Slab four one stoy, Slab four one stoy, Slab four one stoy, Slab four one stoy, Slab four	ne 105 ne 132 ne 139 ne 129 da 142 da 153 nd 144 nd 143 nd 154 , 150		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 2 3 4 5 6 6 7 7 8 9 10 111 12	Occupancy RES1	FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea	DamageFin one floor, no basen one stoy, no basen one stoy, no basen one stoy, no basen one stoy, Pier foun o ne stoy, Pier foun o ne stoy, Silab four no ne stoy, Silab four no ne stoy, Silab four o ne stoy, Silab four o ne stoy, Silab four o ne stoy, Silab four o ne stoy, Silab four	net 105 ne 132 ne 139 ne 129 da 142 da 141 da 153 nd 144 nd 143 nd 154 td 150 t, 150		
6 7 8	6 R13B 7 R1SN	3 Story Split Level		1 1 2 3 3 4 4 5 5 6 6 7 7 8 9 9 10 11	Cocupancy RES1 R	FIA USACE - Chicago USACE - Galveston USACE - New Orlea USACE - New Orlea	DamageFn one floor, no basen one stoy, no basen one stoy, no basen one stoy, no basen one stoy, Pier foun one stoy, Pier foun one stoy, Slab four one stoy, Stucture one stoy, Structure one stoy, Structure	Instruction Instruction ne 132 ne 132 ne 129 dat 142 dat 141 dat 153 nd 144 nd 143 nd 154 t, 150 t, 143		

- 6. Discuss how these curves change with water depth.
- 7. Exit Hazus.

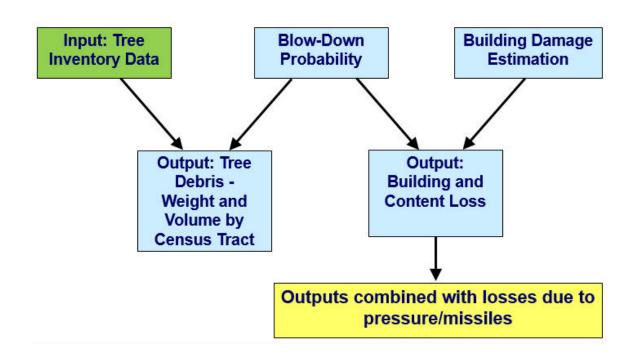
Visual 16: Tree Blow-Down Model

Tree effects during wind storms:

- Positive
 - Provide shelter to structures
 - Reduces wind pressure
- Negative
 - Falling trees produce strike hazard to structure
 - Fallen trees add to amount of debris to dispose of after storm



Visual 17: Tree Model



Visual 18: Hazus Tree Coverage Database

- Tree Inventory Database is derived from:
 - Multi-Restoration Land Consortium (MRLC) land use coverage database
 - Same data used for terrain database
- Forest Inventory Analysis (FIA) Database
 - Developed by U.S. Forest Service (USFS)
 - Updated every 5 years
 - Nationwide inventory by species
 - Field survey and statistical analysis
 - Contains tree count and tree diameter distribution

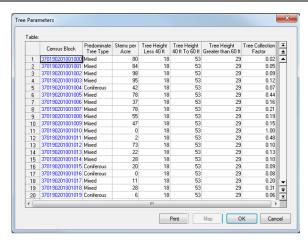
Visual 19: Tree Database in Hazus

Tree types

- Deciduous
- Coniferous
- Mixed Tree Density (stems per acre)

Tree height

- Distribution between 3 broad categories:
 - 30 40 ft
 - 40 60 ft
 - 60 + ft



Residential = 10-50 stems per acre Forest = approx. 100 stems per acre

Visual 20: Damage Resulting from Trees

Simulations of amount of damage:

- Tree drop tests at Clemson University
- Derived relationship of impact energy and damage severity
- Cost estimated using data from RSMeans 2018



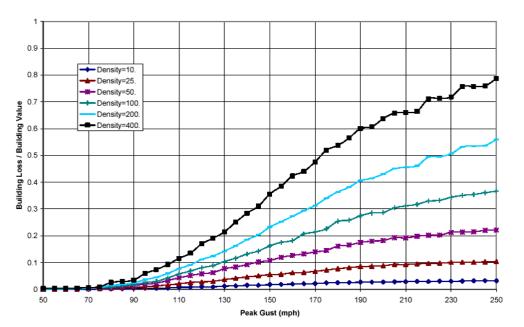
Visual 21: Tree Damage from Hurricane Irma (2017)

Hazus tree model accounts for different types of tree damage that may occur.



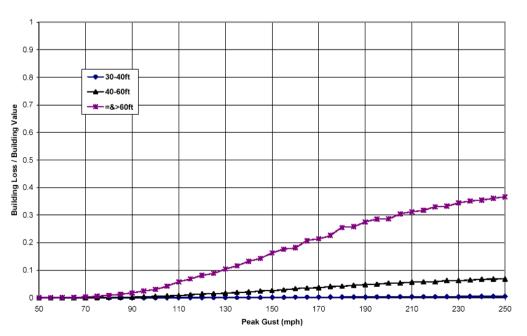
Photo taken in Gospel Island, FL after Hurricane Irma, September 2017

Visual 22: Loss Curves as Function of Tree Density



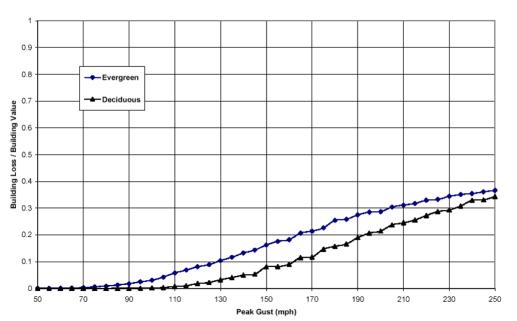
Building parameters: 50.x 24.x 9 Wood; Tree parameters: Evergreen =&>60ft

Visual 23: Loss Curves as Function of Tree Height



Building parameters: 50.x 24.x 9 Wood; Tree parameters: Evergreen Density=100.

Visual 24: Loss Curves as Function of Tree Type



Building parameters: 50.x 24.x 9 Wood; Tree parameters: =&>60ft Density=100.

Visual 25: Exercise 6.2: Surface Roughness

Goal:

• Modify the surface roughness parameters in order to see the effect on the damages and losses.

Time: 30 minutes

Visual 26: Exercise 6.2: Tasks

- Task 1: Define the default scenario.
- Task 2: Adjust the Surface Roughness to a Rural setting.
- Task 3: Adjust the Surface Roughness to an Urban setting.
- Task 4: View and Compare Results.
- Task 5: Restore the Census Tract to the default setting.

Exercise 6.2: Surface Roughness

Type: Student-Led Activity

Time: 30 minutes

Goal: Modify the surface roughness parameters in order to see the effect on the damages and losses.

Background:

Hazus comes with a substantial library of damage functions. Many of these functions depend on surface roughness. In areas with high surface roughness the damages from winds decrease because of the easing of the winds as a result of friction. In the areas with lower surface roughness, damages are generally greater because there is less friction. In this short exercise you will explore the impact of the surface roughness values by altering those values and then recording the changes in the damages.

Task 1: Define the default scenario

- 1. Start Hazus and select Open a region, click Next.
- 2. Select HurricaneHarvey_CO and click Next.
- 3. Click Finish.
- 4. Once the study region is open in Hazus, navigate to Hazard and then Scenario.
- 5. Click Next on the Scenario Wizard.
- 6. Select Historic and then click Next.

7. Click the Region Filter box to limit the historic storm options to only those that intersected the study region.

s nage	allows you	to select a historic storm	scenario Choose	the storm you w	ant to analyz	e and click next	5	1.
o page	, ano no you			uno dionin you n	and to analys			3.
					1. 100	0	23	and the
		notable storms that made hay be found under the Hu				U.		
				-				
	Year 🔺	Name	Peak Gust (mph)	States Affected	Landfall States		Re	gion Filt
1	1900	UN-NAMED-1900-1	122	A MS NY TX	TX			
2	1906	UN-NAMED-1906-6	123	AL FL LA MS	AL			
3	1906	UN-NAMED-1906-8	130	FL GA SC	FL			
4	1906	UN-NAMED-1906-5	93	GA NC SC	SC			
5	1909	UN-NAMED-1909-8	126	LA MS	LA			
6	1909	UN-NAMED-1909-4	118	TX	TΧ			
7	1910	UN-NAMED-1910-5	129	L GA NC SC	FL			
8	1915	UN-NAMED-1915-2	134	LA TX	TΧ			
9	1915	UN-NAMED-1915-6	126	LA MS WV	LA			
10	1916	UN-NAMED-1916-6	121	TX	TX			
11	1916	UN-NAMED-1916-2	132	AL FL LA MS	AL			
12	1917	UN-NAMED-1917-4	129	L GA LA MS	FL			
13	1918	UN-NAMED-1918-1	100	LA MS TX	LA			
14	1919	UN-NAMED-1919-2	137	FL TX	FL			
	*	LUNIALLUNCO HOOM O	4.04					

- 8. Select the 2017 Hurricane Harvey Observed FEMA storm and click Next.
- 9. Click next on the scenario review window.
- 10. Click next to make the scenario active.
- 11. Click Finish.
- 12. Select "Analysis > Run" to open the Analysis Options window.
- 13. Uncheck the Automated Output Options radio box.

Analysis Options	×
 Direct Physical Damage Buildings and Facilities General Buildings Essential Facilities Medical Care Fire Stations Police Stations Emergency Centers Schools User-Defined Buildings Induced Physical Damage Buildings Buildings Trees Tree Blowdown Direct Social and Economic Loss Direct Social Loss - General buildings Direct Social Loss - Shelter Create Summary Reports Create Maps 	Select All Deselect All Expand All Collapse All Output Options Run Analysis
Automated Output Options.	Cancel

14. Click "Run Analysis".

15. Click "OK" when the analysis completes.

16. From the Results menu click Wind Speeds.

17. Click on the column header for Peak Gust (mph) and then click "Map".

18. In the table under the Peak Gust (mph) column find census tract 48355003001.

19. In the table located at the end of this exercise, record the Peak Wind Gust in the row for Scenario 1.

20. Close the Wind Speeds by Census Tract window.

21. Navigate to Results and Summary Reports.

22. Click on the Direct Losses tab and view the Direct Economic Loss for Buildings report.

23. Record the Total Direct Economic Loss in the row for Scenario 1 in the table at the end of the exercise.

24. Close the Summary Reports window.

Task 2: Adjust the Surface Roughness to a Rural Setting

1. From the Analysis menu choose "Parameters" then "Terrain".

2. Find census tract 48355003001 and change the surface roughness from 0.34 to 0.04. This value (0.04) simulates an agricultural setting.

3. Click OK.

4. Click "Yes" you want to update modified data.

	Census Tract	Surface Roughness Length (m)	
37	48355002706	0.34	
38	48355002900	0.29	
39	48355003001	0.04	
40	48355003002	0.33	
41	48355003101	0.32	
42	48355003102	Terrain X	
43	48355003202		
44	48355003203		
45	48355003204		
46	48355003303	Update modified data?	
47	48355003304		
48	48355003305		
49	48355003306	No. No. Consul	
50	48355003401	Yes No Cancel	=
51	48355003402	0.47	₹ ¥

- 5. From the Analysis menu choose "Run" to open the Analysis Options window.
- 6. Uncheck the Automated Output Options and then "Run analysis".
- 7. Click "OK" when the analysis completes.
- 8. From the Results menu click Wind Speeds and "Map" the Peak Wind Gusts.
- 9. In the attribute table of the Wind Speeds Peak Gust (mph) layer, find census tract 48355003001.

10. In the table at the end of this exercise, record the Peak Wind Gust in the row for Scenario 2.

11. Close the Wind Speeds by Census Tract window.

12. Navigate to Results and Summary Reports.

13. Click on the Direct Losses tab and view the Direct Economic Loss for Buildings report.

14. Record the Total Direct Economic Loss in the row for Scenario 2 in the table at the end of the exercise.

15. Close the Summary Reports window.

Task 3: Adjust the Surface Roughness to an Urban Setting.

1. From the Analysis menu choose "Parameters" then "Terrain".

2. Find census tract 48355003001 and change the surface roughness to 0.70. This is to simulate a highly urban landscape.

3. Click "OK" and indicate "Yes" you want to update your modified data.

4. Go to "Analysis" then "Run".

5. Uncheck the Automated Output Options and "Run analysis".

6. Click "OK" when the analysis completes.

7. From the Results menu click Wind Speeds and "Map" the Peak Wind Gusts.

8. In the attribute table of the Wind Speeds – Peak Gust (mph) layer find census tract 48355003001.

9. In the table at the end of this exercise, record the Peak Wind Gust in the row for Scenario 3.

10. Close the Wind Speeds by Census Tract window.

11. Navigate to Results and Summary Reports.

12. Click on the Direct Losses tab and view the Direct Economic Loss for Buildings report.

13. Record the Total Direct Economic Loss in the row for Scenario 3 in the table at the end of the exercise.

14. Close the Summary Reports window.

Task 4: View and Compare Results

Results Table for Census Tract 48355003001

Scenario	Peak Gust	Total Direct Economic Loss
1. Default Surface Roughness: 0.34		
2. Surface Roughness: 0.04		
3. Surface Roughness: 0.70		

Task 5: Restore the Census Tract to the default setting

- 1. To return the census tract's surface roughness to the default value click on the Analysis menu.
- 2. Choose "Parameters" then "Terrain".
- 3. Find census tract 48355003001 and change the surface roughness back to 0.34.
- 4. Click "OK" and indicate "Yes" you want to update your modified data.
- 5. Save your map document and exit Hazus.

Visual 27: Lesson 6: Review

- 1. What parameters define the Hazus wind damage models?
- 2. How does Hazus display damage curves?

Visual 28: Questions?

Lesson 7: Hurricane Model Results

Visual 1: Lesson 7: Hurricane Model Results



Visual 2: Goal and Objectives

Goal: To provide an overview of the set of results and how they can be viewed in Hazus.

After completing this lesson, you will be able to:

- Understand the damage and loss outputs.
- Interpret the meaning of the results.

Visual 3: Results Formats

- Tables
- Maps
- Reports



Visual 4: Viewing Results

• Results menus are enabled once a hurricane scenario has been run and "Analysis > Run" has been selected.



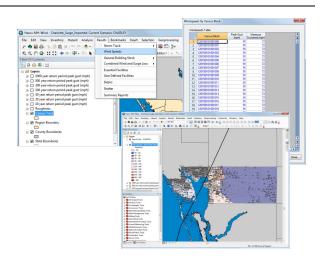
Visual 5: Tables

] 100 year return period peak gust (mph) f100yr ⊂ < 50 50 - 65 65 - 80												
80 - 95												
110 - 125												
125 - 140				<i>c</i> 1								×
<u>140 - 155</u>		Damage	e States By Occupano	y Class								
155 - 170		View	Results By:				Return Period	ł				
170 - 185			Occupancies				i lotari i chot					
185 - 200		ÖG	eneral Occupancy Clas			~	100 Year Ev	ent ~				
> 200			pecific Occupancy Clas									
50 year return period peak gust (mph)												
20 year return period peak gust (mph) 10 year return period peak gust (mph)	X	Dama	age State Probabilities:					411				
Roughness			Census Tract	No Damage	Minor	At Least Minor	Moderate	At Least Moderate	Severe	At Least Severe	Destruction 0.00	
Census Tract		1	12085001200	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		2	12099006202	1.00	0.00		0.00	0.00	0.00		0.00	
Region Boundary		3	45045003705	1.00	0.00		0.00	0.00	0.00		0.00	
	We l	4	37081015902	1.00	0.00		0.00	0.00	0.00		0.00	
County Boundaries		5	45045002606 12086014400	1.00	0.00		0.00	0.00	0.00		0.00	
	10 S	1 7	12105014201	0.21	0.23		0.33	0.57	0.00		0.02	
State Boundaries		8		1.00	0.00		0.00	0.00	0.00		0.00	
				1.00	0.00		0.00	0.00	0.00		0.00	
123	N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		37141920102	1.00	0.00		0.00	0.00	0.00		0.00	
	THE POST	11	45073030300	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
) F	
												_

- Results align with inventory and analysis.
- Tables populate only for damaged inventory / tracts.
- Fields can be thematically mapped.

Visual 6: Hazard Maps

- To show the hazard map choose "Results > Wind Speeds."
- Click on the column you wish to map.
- Click "Map."



Visual 7: Windspeed Results

Peak wind gust: 3 second gust speeds

• Hazus damages and losses are given as a function of the gust speed.

Sustained winds: one minute average

• Used for hurricane category determination

NOTE: In study regions that have hurricane and flood hazards, the windspeeds are displayed on the block level; however, windspeeds are only calculated at the tract level and every block in each tract is assigned the same value.

Visual 8: Demonstration 7.1: Viewing Results & Reports

Goal:

• View results and reports from a hurricane analysis.

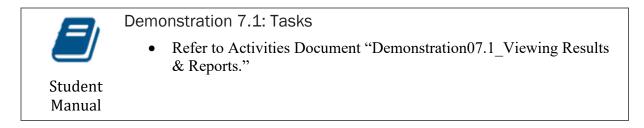
Time: 40 Minutes

	Demonstration 7.1: Viewing Results & Reports
	Goal: View results and reports from a hurricane analysis.
	Time: 40 minutes
	Exercise Steps:
Student	1. Listen to instructor's directions.
Manual	2. Ask questions if clarification is needed.
	3. Watch the instructor's demonstration.

4. Ask any final questions.

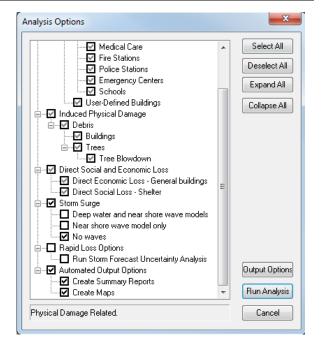
Visual 9: Demonstration 7.1: Tasks

- Task 1: Import HPR
- Task 2: View General Building Stock Damage
- Task 3: View Essential Facilities Losses
- Task 4: View Debris
- Task 5: View Shelter Needs
- Task 6: Overview of Viewing Reports
- Task 7: Toolbar
- Task 8: Inventory Reports
- Task 9: Building Reports
- Task 10: Induced Losses
- Task 11: Direct Losses Reports
- Task 12: Other Report Options



Visual 10: Automated Output Options

- Automatically saves reports
- Creates thematic maps of results
- Drawback: Increases analysis processing time (up to an hour increase in some cases)



Visual 11: Automated Output Options

- Output reports are automatically saved in the study region folder.
- Four different output formats:
 - PDF
 - Word
 - Excel
 - HTML

File Type	Report Export File Type: Acrobat	Format (*.pdf)	
Report Type	Report Name	Export	~
nventory	Building Stock Dollar Exposure by Building Type		
	Building Stock Dollar Exposure by Occupancy		
Buildings	Building Damage by Count by Occupancy		- 11
o on on an ego	Building Damage by Count by Building Type	Π Π	-111
	Building Damage by Building Type	Π	-111
	Building Damage by General Occupancy	Π	-
	Emergency Response Facilities Functionality	П	=
	Hospital Functionality		
	Schools Functionality		
	Police Station Functionality	Π	
	Fire Station Functionality		
Direct Losses	Direct Economic Loss for Buildings	v	
	Shelter Requirements	V	
nduced Losses	Debris Generated	~	_
Single Storm Results	Quick Assessment	v	-
	Global Summary Report	V	
Probabilistic Results	Quick Assessment	V	-

Visual 12: Automated Output Options

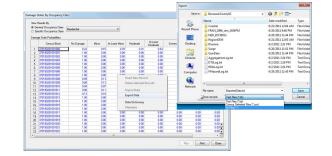
- Select Results: When the analysis is complete a thematic map is automatically created.
- Layer(s): automatically appears in the table of contents window.

Results Type			List of Columns		
By Sp By Ge By Sp By Sp By Sp Site-Speci Direct Ecc	heral Occupancy Class certific Occupancy Class neral Building Type certific Building Type fic Facilities momic Loss imployment Loss 	4 III	Column Name No Damage Minor At Least Minor Moderate At Least Moderate Severe At Least Severe Destruction	Add Map Layer	E
Map Layer Summar				Delete L	200
Selected Mapping	Layers d Speeds\Historic\Peał	Gunt	(mph)	Delete L	aye
	d Speeds Vision of Perined			Delete	All

Visual 13: Results Table: Export

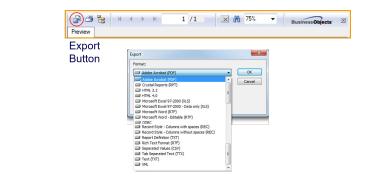
Formats

- TXT
- CSV



Visual 14: Summary Report: Export

- PDF •
- RTF •
- DOC •
- XLS •
- CSV
- •
- TXT •
- XML •
- Etc. •



Visual 15: Exercise 7.2: Hurricane Results

Goal:

• Learn methods for displaying hurricane results.

Time: 30 minutes

[
	Hurricane Results
	Goal: Learn methods for displaying hurricane results.
	Time: 30 minutes
	Exercise Steps:
	1. Refer to Activities Document "07.2_Exercise_Hurricane Results"
	2. Listen to instructor's directions.
	3. Ask questions if clarification is needed.
Student Manual	4. Work individually on the goal.
Manual	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share their answers/results.
	8. Ask any final questions.

Visual 16: Exercise 7.2: Tasks

Task 1: Import the Hurricane Michael HPR.

Task 2: Open the Scenario.

Task 3: Prepare the Results in the Map.

Task 4: Visualize Building Damage and Dollar Losses.

Exercise 7.2: Tasks

• Refer to Activities Document "07.2_Exercise_Hurricane Results"

Student Manual

Exercise 7.2: Hurricane Results

Type: Student-Led Activity

Time: 30 minutes

Goal: Learn methods for displaying hurricane results.

Background:

Understanding, interpreting, and communicating the results in Hazus is vital. This exercise will examine results in Hazus to allow you to become more familiar with where they are stored. Additionally, this exercise will help you focus on how to interpret the information that Hazus generates.

Task 1: Import the Hurricane Michael HPR.

1. Start Hazus and import the HurricaneMichael HPR from the

- C:\E0170_ActivityData\Exercise_7.2 folder.
- 2. Name the region Hurricane_Michael.

3. Once the import is complete, click Open a Study region, select the study region name and click Next.

4. Click Finish.

Task 2: Open the Scenario.

1. Navigate to the Hazard menu and then click Show Current to ensure the historic Michael scenario is the active scenario.

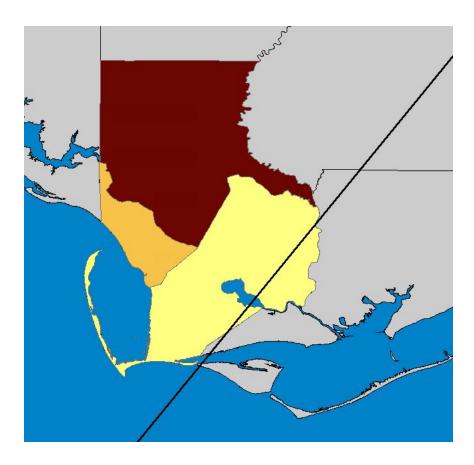
×
Close
Hurricane Michael - Observed FEM Historic

Task 3: Prepare the Results in the Map.

- 1. From the Results menu choose "Shelter" to open the Shelter Analysis Results.
- 2. Click on the Short Term Shelter Needs column and click "Map".

	Census Tract	Displaced Households	Short Term Shelter Needs	
1	12045960100	494	540	
2	12045960200	250	139	
3	12045960300	22	13	

3. Click "Close" to close the Shelter Analysis Results.



- 4. Right-click on the Shelter Short Term Shelter Needs layer and select Properties.
- 5. Select the Symbology tab.
- 6. In the Show window on the left side of the Layer Properties window, select Quantities.
- 7. Under Quantities select "Dot density".

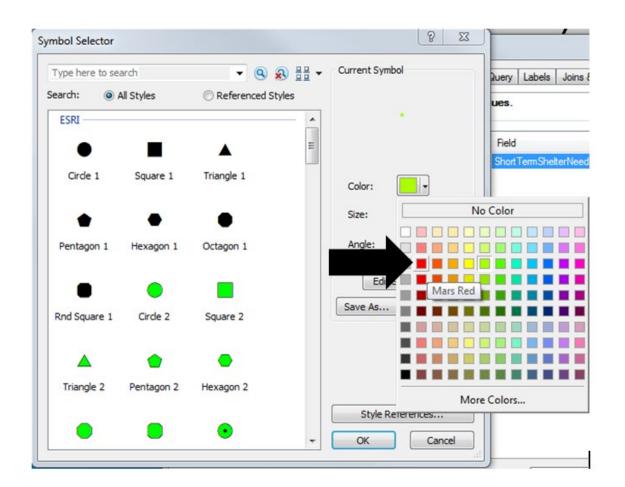
General	Source	Selection	Display	Symbology	Fields	Definition Qu	uery Lab	els Joins & R	elates Tim	e HT	ML Popup
how:											
Feature	s		-		g dots to	o show valu	es.		Import		
Catego			ield Select	ion							
Grad	luated col luated sym	ors S bols			>	Symbol	Field			1	
Prop Dot Charts	ortional sy density		Current		<						
Multiple	e Attribut		•	•	<<						
	- 1)ensities — ot	Min	Mean	Max				•	
9 9		s [2						ground	Propertie	s)	
		F	U.	Dot Value	. 0		🔽 Ma	intain Density	Exclusion	n	

8. In the Field Selection window choose ShortTermShelterNeeds and then click the right arrow.

9. Double-click on the Circle symbol to the left of ShortTermShelterNeeds.



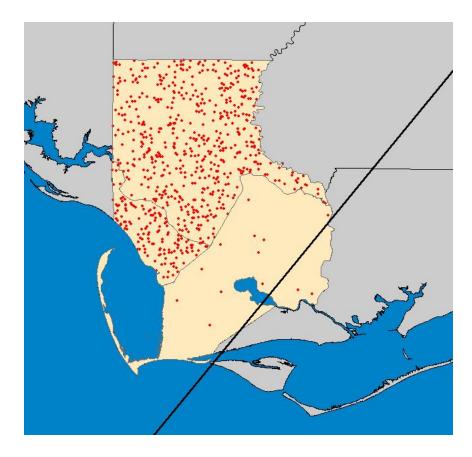
10. Click on the down arrow next to the color and select Mars Red.



- 11. Click "OK".
- 12. Change the Dot Value to "1".



13. Click "OK". The dot density map provides a slightly different view of the results. This helps find clusters with the data and identifying areas of the greatest concern.



- 14. From the Results menu choose Essential Facilities.
- 15. Click on the Schools tab and map the schools with minor damage.
- 16. Close the Essential Facilities window.
- 17. Right click on the Schools Minor Damage in the Table of Contents and click Properties.
- 18. Click on the Symbology tab and choose Features: Single Symbol.
- 19. Click on the Symbol to activate the symbol selector and search for "School".

eneral Source Selectio	on Display Symbology Fields Definition Query Labels Joins & Relates Time HTI	ML Popup
ow:		
eatures	Draw all features using the same symbol.	
Single symbol aregones	Symbol	
luantities	Advanced 🗸	
harts Aultiple Attributes		
	1	
	Legend	
	Label appearing next to the symbol in table of contents:	
La Frank	Description	
The state	Description Additional description appearing next to the symbol in your map's legend	

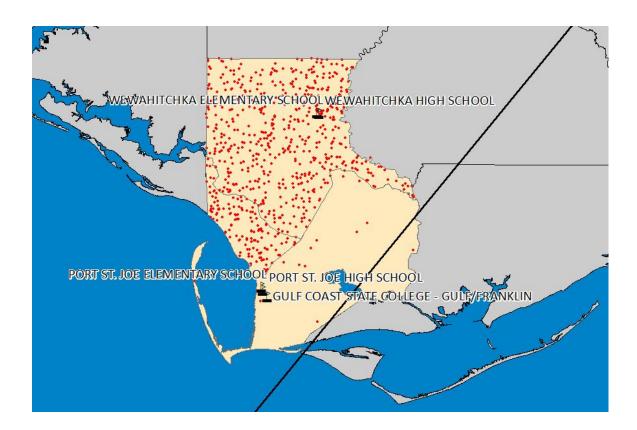
- 20. Click on the Labels tab and check the box next to Label features in this layer.
- 21. Change the label field to Name.
- 22. Change the font to Calibri and size 16.
- 23. Click the "Symbol..." button under Text Symbol.

Label features in this layer					
thod: Label all the fe	atures the same way.		•]		
Il features will be labeled using the Text String Label Field: Name	options specified.		•	Expression	
Text Symbol	Do H.		10		
AaBbYyZz	Calibri	ΙU		▼	
Other Options		Pre-defin	ned Labe	l Style	
Placement Properties	Scale Range		Labe	el Styles	

- 24. Click the "Edit Symbol" button.
- 25. Choose the Mask tab and then the radio button next to Halo.
- 26. Change the Size to 1.

Editor	
Preview	Properties: Type: Text Symbol Units: Points General Formatted Text Advanced Text Mask Style: None Halo Size: 1.0000 Symbol
	OK Cancel

27. Click "OK" through the next three screens to display the schools with labels on the map.



28. Answer the following question.

Question: How could this information be used?

Task 4: Visualize Building Damage and Dollar Losses.

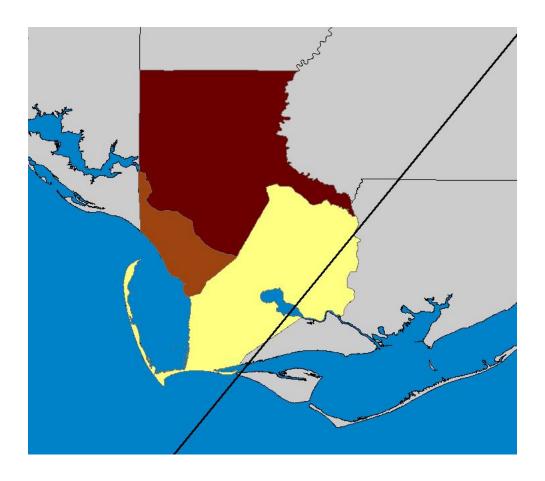
1. Turn off or remove the Shelter - Short Term Shelter Needs and the Schools-Minor Damage layers.

2. From the Results Menu, choose General Building Stock > Building Economic Loss > By Occupancy.

3. Click on the All Occupancies radio button under View Results By and then select the Building column and click "Map".

	conomic Loss Out	put & Employment			
View	Results By:				
	Occupancies				
OG	eneral Occupancy C	lass		~	
OSp	pecific Occupancy C	lass			
Entire	ated Losses (Thousa	unda of Diallara):			
LSum	Census Tract	Total	Building	Content	Invento 🛣
1	12045960100	208,347	123,915	53,407	
2	12045960200	180,193	103,083	46,543	-
3	12045960300	35,891	24,445	7,475	2
					-
					▼ ₹
					±

4. Once finished click "Close".



5. Click the "Add Data" button, navigate to C:\E0170_ActivityData\Exercise_7.2 folder and double click on the TotalExposure.mdb. This database was prepared for this activity by exporting the Total Exposure values from the General Building Stock inventory in Hazus.

6. Click to highlight the TotalExposure table and click Add.

Add Data				1.53				>
ook in: 📑	TotalExposur	re.mdb	~	仓 🟠	•		6	
TotalExpos	ure							-
2								
lame:	TotalExpos	sure				Γ	Add	

- 7. Click on the "List by Drawing Order" button at the top of the table of contents window.
- 8. Right-click on the Building Loss All (\$K) layer and select Joins and Relates > Join.
- 9. Select "Join Attributes" from a table from the "What do you want to join to this layer" option.
- 10. Under Option 2 select TotalExposure using the drop down arrow.
- 11. Select Tract from the drop down arrow in Option 1 and Tract in Option 3.
- 12. Select "Keep all records".

	>
loin lets you append additional data to for example, symbolize the layer's feat	this layer's attribute table so you can, tures using this data.
What do you want to join to this layer	?
Join attributes from a table	~
1. Choose the field in this layer that	at the join will be based on:
- Contraction	V
2. Choose the table to join to this	
2. Choose the table to join to this	layer, or load the table from disk:
TotalExposure	- 6
Show the attribute tables of	lavers in this list
3. Choose the field in the table to	base the join on:
Tract	~
Join Options	
O	a see also as in the see dates to be
	e are shown in the resulting table. ain null values for all fields being
	ble from the join table.
Unmatched records will cont	ble from the join table.
Unmatched records will cont appended into the target ta O Keep only matching records If a record in the target tabl	ble from the join table. le doesn't have a match in the join d from the resulting target table.
Unmatched records will cont appended into the target ta O Keep only matching records If a record in the target tabl	e doesn't have a match in the join
Unmatched records will cont appended into the target ta O Keep only matching records If a record in the target tabl	le doesn't have a match in the join d from the resulting target table.
Unmatched records will cont appended into the target ta O Keep only matching records If a record in the target tabl	le doesn't have a match in the join d from the resulting target table.

13. Click "OK" when finished and select "Yes" if asked if you want to index the table.

14. Right-click on the Building Loss - All (\$K) layer and select Properties.

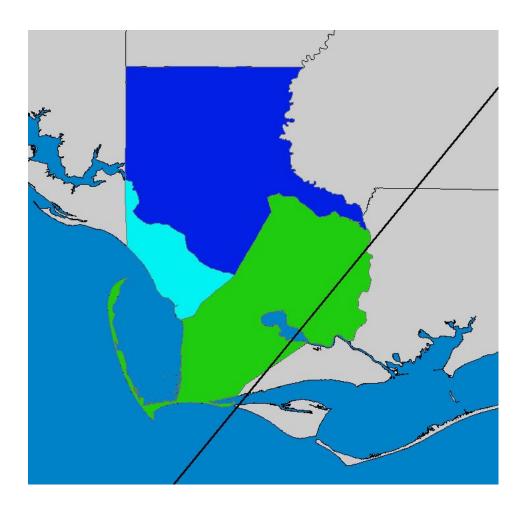
15. Select the Symbology tab, if it is not already selected, and then select Quantities > Graduated colors, if not already selected.

16. Under Value select Building.

17. Under Normalization select TotalExposure.

eneral Source Select	ion Display	Symbology	Fields	Definition Quer	v Labels	Joins & R	elates	Time	HTML Popup	
ow:			In the second				_			
Features Categories Quantities Graduated colors Graduated symbols	Fields Value:	Buildina	g color t	o show value	Classifica	tion ural Breaks		nport		
	Normalization		osure	~	Classes:		-	s/ isify		
Proportional symbols Dot density	Color Ramp:			~						
Aultiple Attributes	0.03	nge 30552886 30552887 - 12351143 -		0.0	ibel)3055)3056 - 0.21 ?125 - 0.251					
12780										
	Show class	ranges usin	ng feature	values			Adva	inced -		
	Show class	ranges usin	ng feature	values			Adva	nce <u>d</u> •		
	Show class	ranges usin	ig feature	values			Adva	ince <u>d</u> -		

18. Click "OK". The layer you have created is Total Building Loss over Total Building Exposure for each tract. This is a building loss ratio map.



19. You have just created a building loss ratio layer. This represents the percentage of the total building exposure that is damaged for each census block. Answer the following:

Question: What are some uses for this layer?

20. Save your map and exit Hazus when you are finished.

Visual 17: Lesson 7: Review

- 1. How are the general building stock damages reported?
- 2. What is the Rapid Loss Assessment?
- 3. What are the three main formats a user can use to display his/her results?

Visual 18: Questions?

Lesson 8: Economic Loss Methodology

Visual 1: Lesson 8: Economic Loss Methodology



Visual 2: Lesson 8: Goal and Objectives

Goal: To provide an overview of the economic loss methodology in the hurricane wind model.

After completing this lesson you will be able to:

- Discuss the economic loss outputs.
- Understand the parameters associated with this methodology.
- Describe the appropriate use of these outputs.

Visual 3: Direct Economic Loss Outputs

- Building Loss
- Contents Loss
- Business Inventory Loss
- Relocation Expense
- Loss of Income
- Rental Income
- Wage Income
- Output Loss
- Employment Loss

Visual 4: Building/Content Loss Model: Development

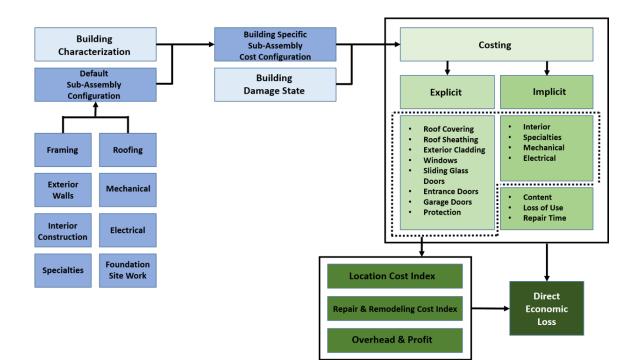
- Physically-based damage-to-loss model
- Computes direct economic losses using
 - Explicit costing
 - Windows, doors, sheathing, roof cover, etc.
 - Implicit costing
 - Estimates of volume of water entering through failed windows, doors, etc.
- Details of loss models found in Section 8 of the Hurricane Technical Manual

Visual 5: Loss Model

Hazus loss models are based upon building types:

- Residential
 - Exterior vs. interior losses
- Manufactured homes
 - Includes damage to foundation and frame
 - Includes serviceability replacements (85% of ultimate capacity)
- Commercial buildings
 - Total cost distributed differently
 - Sub-assembly costs used instead of unit costs

Visual 6: Residential Damage-to-Loss Methodology



Visual 7: Loss of Use

- Building Loss Ratio: Loss to the building divided by the replacement cost of the building.
- Building loss ratio is used as an indicator of reconstruction time.
- A multiplier is applied to the total reconstruction time to determine the loss of use to a structure.

Occupancy	0% Building Loss Ratio	2% Building Loss Ratio	10% Building Loss Ratio	50% Building Loss Ratio	100% Building Loss Ratio
RES1	0	0	0.5	1	1
COM1	0.05	0.1	0.1	0.3	0.4

Visual 8: Loss of Use

Loss of Use Multiplier

- Reflects ability of business to relocate and thus minimize impact on income loss
- At low levels of loss, business continues to operate in existing facility
- At high levels of loss, business will decide to relocate and resume operation

usiness	Inventory Loss	of Use Multipliers	Income Loss				
T able:							
	Occupancy	0 % Loss	2 % Loss	10 % Loss	50 % Loss	100 % Loss	Ā
1	AGR1	0.00	0.00	0.05	0.10	0.20	
2	COM1	0.50	0.10	0.10	0.30	0.40	
3	COM10	0.50	0.10	1.00	1.00	1.00	
4	COM2	0.10	0.10	0.20	0.30	0.40	
5	COM3	0.50	0.10	0.20	0.30	0.40	
6	COM4	0.50	0.10	0.10	0.20	0.30	
7	COM5	0.50	0.10	0.05	0.03	0.03	
8	COM6	0.50	0.10	0.50	0.50	0.50	
9	COM7	0.50	0.10	0.50	0.50	0.50	
10	COM8	0.50	0.10	1.00	1.00	1.00	
11	COM9	0.50	0.10	1.00	1.00	1.00	
12	EDU1	0.50	0.10	0.02	0.05	0.05	
13	EDU2	0.50	0.10	0.02	0.03	0.03	
14	GOV1	0.50	0.10	0.02	0.03	0.03	
15	GOV2	0.50	0.10	0.02	0.03	0.03	
16	IND1	0.50	0.50	1.00	1.00	1.00	
17	IND2	0.50	0.10	0.20	0.30	0.40	
18	IND3	0.50	0.20	0.20	0.30	0.40	
19	IND4	0.50	0.20	0.20	0.30	0.40	
20	IND5	0.50	0.20	0.20	0.30	0.40	
21	IND6	0.50	0.10	0.20	0.30	0.40	
22	REL1	1.00	0.20	0.05	0.03	0.03	
23	RES1	0.00	0.00	0.50	1.00	1.00	
24	RES2	0.00	0.00	0.50	1.00	1.00	
25	RES3A	0.00	0.00	0.50	1.00	1.00	
26	RES38	0.00	0.00	0.50	1.00	1.00	
27	RES3C	0.00	0.00	0.50	1.00	1.00	
28	RES3D	0.00	0.00	0.50	1.00	1.00	
29	RESSE	0.00	0.00	0.50	1.00	1.00	
30	RESOF	0.00	0.00	0.50	1.00	1.00	
31	RES4	0.00	0.00	0.50	1.00	1.00	•
32	RES5	0.00	0.00	0.50	1.00	1.00	
33	RES6	0.00	0.00	0.50	1.00	1.00	Ŧ
•			m				F T

Peak Gust Wind Speed (mph)

Visual 9: Loss of Use Model

Loss	Occupancy			WSF1 - Single Family Homes, 1 Story - Wood			
Ratio	RES1	IND1	Loss of Use or Recovery Time (days)	000.0 −−1.0pen −−2.Ught Suburban −−5.5.Suburban −−−4.Ught Trees −−4.Ught Trees −−5.5.Trees			
0%	0	0		(x 500.0 (x 50.			
2%	5	10		Q 400.0- ₩ Ω			
10%	120	90		5 300.0 - S			
50%	360	240		- 200.0			
100%	720	360					
				0.0 + 0.0 +			

Visual 10: Business Inventory Losses

- Function of contents loss ratio and square footage
- Estimated for following occupancies:
 - COM1: Retail Trade
 - COM2: Wholesale Trade
 - IND1: Heavy
 - IND2: Light
 - IND3: Food/Drugs/Chemicals
 - IND4: Metals/Minerals Processing
 - IND5: High Technology
 - IND6: Construction
 - AGR1: Agriculture

INV = FA x SALES x BI x CL

- FA: Floor Area
- SALES: Annual gross sales per square foot
- BI: Business Inventory %
- CL: Content Loss Ration (0-1)

Visual 11: Business Inventory Losses

- National Averages
 - May not apply to your community
 - Updates can be obtained from U.S. Department of Commerce's Bureau of Economic Analysis or local state.

		of Use Multipliers	Income Loss			Type:	of Use Multipliers Inco	me Loss
Table Type: Annual Gross Sales (\$ per sq. ft.)			Business Inventory (% of gross annual sales)					
able					Table			
	Occupancy	Annual Sales				Occupancy	Business	2
1	AGR1	156.00					Inventory	4
2	COM1	56.00			1	AGR1	8.00	
3	COM2	81.00			2	COM1	13.00	
4	IND1	750.00			3	COM2	10.00	
5	IND2	238.00			4	IND1 IND2	5.00	
6	IND3	733.00			5	IND2 IND3	5.00	
7	IND4	690.00			5	IND3	3.00	
8	IND5	459.00			8	IND4 IND5	4.00	
9	IND6	808.00			9	IND6	2.00	
				▼ ▼ ▼		Intere	2.00	E E
				Y				
4				•	•			•

Visual 12: Discussion 8.1: Loss Estimates

Goal: Participate in a class discussion about loss estimates.

Time: 10 minutes

Questions:

1. How are loss of use estimates and business inventory losses used in mitigation planning or response and recovery planning?

2. Where are potential sources from which we might obtain credible values to put in the analysis tables?

Visual 13: Rental Income Loss

Addresses the remainder of population in census tract that is not owner-occupied.

 $RY_i = FA_i \times (1-00\%_i) \times RENT_i \times LOU_i$

$$\label{eq:FAi} \begin{split} FA_i &= Floor \ Area \\ 1\text{-}00\%_i &= \% \ of \ Renter\text{-}Occupied \\ RENT_i &= RENT \ (sq.ft/day) \\ LOU_i &= Loss \ of \ Use \ in \ Days \end{split}$$

Visual 14: Relocation Loss

Costs associated with moving out of an unusable building:

- Disruption costs: cost of shifting business to new facility
- Rental costs: cost of renting new facility while old facility is repaired

Assumptions:

- Building owners incur expense of moving tenants
- Renter has no new rental expenses
- The following occupancies will not relocate
 - COM8: Entertainment & Recreation
 - COM9: Theaters
 - COM10: Parking
 - IND1: Heavy Industry

Visual 15: Relocation Loss

REL_i = FA_i x DC_i x p_i(damage > Minor) + FA_i x 00%_i x RENT_i x LOU_i

 $FA_i = Floor Area$

 $DC_i = Disruption \ cost \ per \ square \ foot$

 $p_i(\text{damage} > \text{Minor}) = \text{Fractino of buildings with damage state of at least moderate}$

 $00\%_i = \%$ of Owner-Occupied

 $RENT_i = RENT (sq.ft/day)$

 $LOU_i = Loss of Use in Days$

Visual 16: Loss of Income

- Business income (profit) loss occurs when building damage disrupts economic activity.
- Data is based on IMPLAN system from U.S. Department of Commerce Bureau of Analysis.

 $YLOS_i = (1-RF_i) \times FA_i \times INC_i \times LOU_i \times MOD_i$

 RF_i = Recapture Factor FA_i = Floor Area INC_i = Income per day (per sq. ft.) LOU_i = Loss in Use in Days

 $MOD_i = Loss of Use Multiplier$

Visual 17: Loss of Income

Occupancy	Description	Recapture Factor
RES1 -3	Private Residences	0
RES4 -6	Hotel/Motel Institutions	0.6
СОМ1 -2	Retail/Wholesale Trade	0.87
COM3	Personal & Repair Service	0.51
СОМ4 -5	Financial	0.9
СОМ6 -10	Hospital, Entertainment, Parking	0.6
IND1 -6	Industrial	0.98
AGR1	Agricultural	0.75
EDU1	Education	0.6
EDU2	College/university	0.6
GOV1	General Service	0.8
GOV2	Emergency Response	0
REL1	Churches	0.6

Visual 18: Wage, Employment, and Output Losses

Same as business income loss:

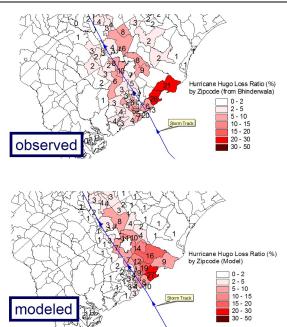
 $LOSS_{i,n} = (1-RF_i) \times FA_i \times INC_i \times LOU_i \times MOD_i$

Replace INCi with:

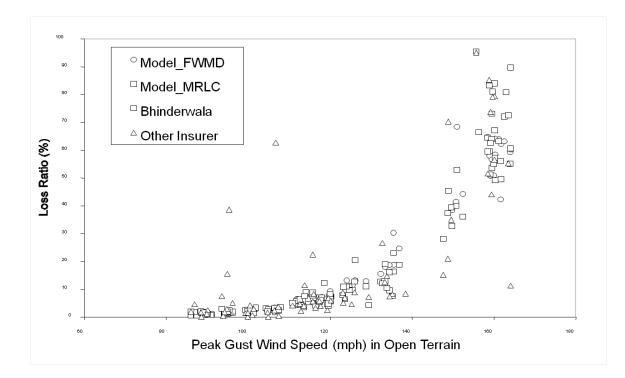
Wage Losses: $WAGE_i = \$/SF/day$ Employment Losses: $EMPLOY_i = work \ day/SF/day$ Output Losses: $OUTPUT_i = \$/SF/day$

Visual 19: Loss Model Validation

- Comparison to insurance claim data
- Five sets of insurance loss data from three insurance companies
 - Bhinderwala (1995)
 - Two proprietary data sets



Visual 20: Loss Model Validation



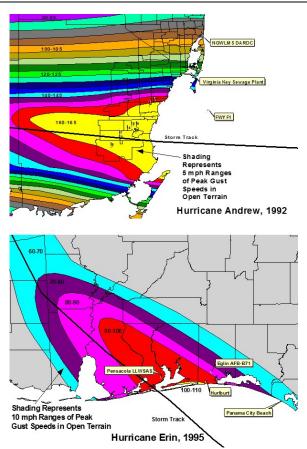
Visual 21: Loss Model Validation: Comparison

Validation completed by performing analysis of specific storms:

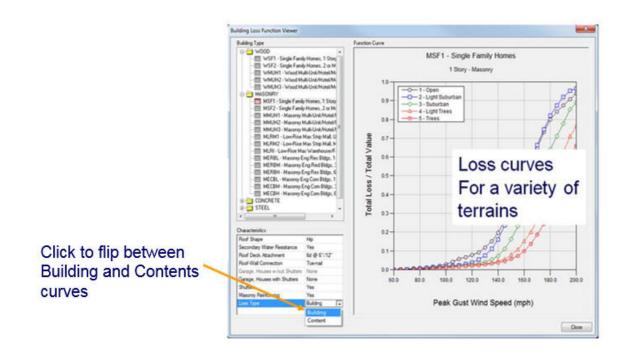
- Hurricane Andrew
- Hurricane Hugo
- Hurricane Erin
- Hurricane Opal

Simulation:

- Wind field and wind loads
- Terrain model
- Damage, loss models
- Inventory



Visual 22: Loss Function Viewer



Visual 23: Exercise 8.2: Economic Loss Parameter

Goals:

- Run a historical scenario.
- Modify the economic loss parameters.

Time: 60 minutes

Visual 24: Exercise 8.2: Tasks

- Task 1: Run the default Historic Hurricane Michael Scenario.
- Task 2: Modify Annual Gross Sales Parameter.
- Task 3: Modify the Business Inventory Parameter.
- Task 4: Modify the Rental and Disruption Costs Parameter.
- Task 5: Modify the Percent Owner Occupied Parameter.
- Task 6: Modify the Wages and Capital Related Income Parameter.
- Task 7: Compare the Results of Modifying the Economic Loss Parameters.

Exercise 8.2: Economic Loss Parameter

Type: Student-Led Activity

Time: 60 minutes

Goals:

- Run a historical scenario.
- Modify the economic loss parameters.

Background:

In this exercise you are going to use current values to update the parameters responsible for calculating economic losses. Many of the default values in Hazus are out-of-date and the values are based on national averages. If you are interested in the economic outputs from Hazus, it is important you update the appropriate inputs. In this exercise you will update the economic loss parameters.

Note: If you have trouble generating any of the Global Summary Reports for the six cases, the reports are provided in the C:\E0170_ActivityData\Exercise_8.3\Results folder.

Task 1: Run the default Historic Hurricane Michael Scenario.

1. Open Hazus.

2. Create a new region with the following paramenters:

- Name: Economic_Parameter
- Hazard: Hurricane
- Aggregation level: County
- State: Florida
- Counties: Bay and Gulf
- 3. Open the region.
- 4. From the Hazard menu choose Senario.
- 5. Click Next.
- 6. Choose Historic and click Next.
- 7. Click Region Filter.
- 8. Select "2018 Hurricane Michael Observed FEMA" and click Next.

9. Click Next.

- 10. Click Next to make the scenario active.
- 11. Click Finish.
- 12. From the Analysis menu select "Run".
- 13. Choose Select All except for "Automated Output Options"
- 14. Click "Run Analysis".
- 15. When the analysis has finished, click "OK" to close the window.

- 16. From the Results menu click on "Summary Reports".
- 17. Select the Other tab, and click to highlight the "Global Summary Report" .
- 18. Click View to view the report.
- 19. Use the Global Summary report to fill out the table at the end of this exercise for Case 1.

Task 2: Modify Annual Gross Sales Parameter

The parameters in the Building Economic Data table were created many years ago and are out of date. Furthermore, many of the values are based upon national averages. To get accurate results for the economic loss parameters you must update these tables. State workforce development, trade agencies, and labor statistics offices may provide you with more up-to-date information. As is the case with most input data in Hazus, the more local the economic information you acquire, the more precise your results will be.

1. From the Analysis menu choose "Parameters" > "Building Economic".

2. Select the Business Inventory tab. Make sure Annual Gross Sales (\$ per sq. ft.) is selected from the drop-down menu.

		s of Use Multipliers	icome Loss
Table	Туре:		
Annu	al Gross Sales (\$	per sq. ft.)	~
Table	:		
1	Occupancy	Annual Sales	X
1	AGR1	156.00	▲ ▲
2	COM1	56.00	· · · · · · · · · · · · · · · · · · ·
3	COM2	81.00	
4	IND1	750.00	
5	IND2	238.00	
6	IND3	733.00	
7	IND4	690.00	
8	IND5	459.00	
9	IND6	808.00	
			₹

3. Change the values of COM1 and COM2 to "100". Based on national averages, the default Hazus values are too low. The values you will enter represent bottom end values for national averages today.

Buildings	Economic	Data
-----------	----------	------

able:			
abie.	Occupancy	Annual Sales	1
1	AGR1	156.00	
2	COM1	100.00	
3	COM2	100,00	
4	IND1	750.00	
5	IND2	238.00	
6	IND3	733.00	
7	IND4	690.00	
8	IND5	459.00	
9	IND6	808.00	

- 4. Click "OK" and then "Yes" to save your changes.
- 5. From the Analysis menu select "Run".
- 6. Choose Select All except "Automated Output Options".
- 7. Click "Run Analysis".
- 8. When the analysis has finished, click "OK" to close the window.
- 9. From the Results menu click on "Summary Reports".
- 10. Select the Other tab, and open the "Global Summary Report".
- 11. Click View to view the report.
- 12. Use the report to fill out the table at the end of this exercise for Case 2.

Task 3: Modify the Business Inventory Parameter

- 1. From the Analysis menu choose "Parameters" > "Building Economic".
- 2. Select the Business Inventory tab.
- 3. Select Business Inventory (% of gross annual sales) from the Table Type drop-down menu.

×

4. Based on national averages, the default Hazus values appear to be too low. The % of gross annual sales for retail and whole sale trade is nearly all of these industries total sales in today's market

Buildings Economic Data

	Type: ess Inventory (% o	f gross appual sale	(13)	
DUSIN	ess inventory (% o	gioss annual sale	is) •	
Table:				
	Occupancy	Business Inventory		
1	AGR1	8.00		-
2	COM1	13.00		
3	COM2	10.00		
4	IND1	5.00		
5	IND2	4.00		
6	IND3	5.00		
7	IND4	3.00		
8	IND5	4.00		
9	IND6	2.00		-
				▼ ₹
				•

- 5. Change the values of COM1 and COM2 to "90".
- 6. Click "OK" and then "Yes" to save your changes.
- 7. From the Analysis menu select "Run".
- 8. Choose Select All except for "Automated Output Options"
- 9. Click "Run Analysis".
- 10. When the analysis has finished, click "OK" to close the window.
- 11. From the Results menu click on "Summary Reports".
- 12. Select the Other tab, and open the "Global Summary Report".
- 13. Click View to view the report.
- 14. Use the report to fill out the table at the end of this exercise for Case 3.

Task 4: Modify the Rental and Disruption Costs Parameter

1. From the Analysis menu choose "Parameters" > "Building Economic".

2. Select the Income Loss tab and "Rental and Disruption Costs (\$ per sq ft): from the Table Type drop-down menu.

×

3. Change the values of COM1 and COM2 to "1.25" for Rental Costs/month and "0.04" for Rental Costs/day.

	Type:	of Use Multipliers			
		Costs (\$ per sq. ft.)	~		
Table:					
	Occupancy	Rental Costs (/month)	Rental Costs (/day)	Disruption Cost	▲
1	AGR1	0.83	0.03	0.83	
2	COM1	1.25	0.04	1.32	
3	COM10	0.41	0.01	0.00	
4	COM2	1.25	0.04	1.16	
5	COM3	1.65	0.06	1.16	
6	COM4	1.65	0.06	1.16	
7	COM5	2.07	0.07	1.16	
8	COM6	1.65	0.06	1.65	
9	COM7	1.65	0.06	1.65	-
10	COM8	2.07	0.07	0.00	▼ ₹
11	COM9	2.07	0.07	0.00	X
•					•

- 4. Click "OK" and then "Yes" to save your changes.
- 5. From the Analysis menu select "Run".
- 6. Choose Select All except for "Automated Output Options"
- 7. Click "Run Analysis".
- 8. When the analysis has finished, click "OK" to close the window.
- 9. From the Results menu click on Summary Reports.
- 10. Select the Other tab, and open the "Global Summary Report".
- 11. Click View to view the report.
- 12. Use the report to fill out the table at the end of this exercise for Case 4.

Task 5: Modify the Percent Owner Occupied Parameter

1. From the "Analysis" menu choose "Parameters > Building Economic".

2. Select the Income Loss tab and "Percentage Owner Occupied" from the Table Type dropdown menu.

3. Scroll down and change the values of RES1 to "82.6" for % Owner Occupied. This is an opportunity for you or other local officials to integrate more detailed data.

usiness	s Inventory Loss	of Use Multipliers	Income Loss
Table	Type:		
Perce	entage Owner Occ	upied	~
Table	:		
	Occupancy	% Owner Occupied	
19	IND4	75.00	
20	IND5	55.00	
21	IND6	85.00	
22	REL1	90.00	
23	RES1	82.60	
24	RES2	85.00	
25	RES3A	35.00	
26	RES3B	35.00	
27	RES3C	35.00	T
28	RES3D	35.00	▼ ₹ ×
29	RES3E	35.00	X
•			•

- 4. Click "OK" and then "Yes" to save your change.
- 5. From the Analysis menu select "Run".
- 6. Choose Select All except for "Automated Output Options".
- 7. Click "Run Analysis".
- 8. When the analysis has finished, click "OK" to close the window.
- 9. From the Results menu click on" Summary Reports".
- 10. Select the Other tab, and open the "Global Summary Report".
- 11. Click View to view the report.
- 12. Use the report to fill out the table at the end of this exercise for Case 5.

Task 6: Modify the Wages and Capital Related Income Parameter

1. From the Analysis menu choose "Parameters" > "Building Economic".

2. Select the Income Loss tab and "(Wages and Capital Related Income)" from the Table Type drop-down menu.

- 3. Change the values of COM1 and COM2 to the following:
 - Income/year to 40.000

- Income/day to 0.109
- Employment to 0.000

usiness	s Inventory Los	s of Use Multipliers	Income Loss				
Table	Type:						
Wage	es and Capital Re	lated Income	\sim				
Table	:						
1	Occupancy	Income (/year)	Income (/day)	Wage (/day)	Employment	Output (/day)	
1	AGR1	102.224	0.280	0.111	0.004	1.045	
2	COM1	40.000	0.109	0.258	0.000	0.546	
3	COM10	0.000	0.000	0.000	0.000	0.000	
4	COM2	40.000	0.109	0.318	000 p	0.710	
5	COM3	58.248	0.160	0.375	0.004	0.837	
6	COM4	458.975	1.257	0.447	0.004	1.222	
7	COM5	523.745	1.435	0.728	0.006	3.968	
8	COM6	72.811	0.199	0.470	0.005	1.045	
9	COM7	145.621	0.399	0.939	0.010	2.090	
10	COM8	267.053	0.732	0.582	0.007	1.318	-
11	COM9	87.373	0.239	0.564	0.006	1.255	-
12	EDU1	72.811	0.199	0.470	0.005	4.050	Y
	1996-1997 - Paris - Pa					•	

- 4. Click "OK" and then "Yes" to save your changes.
- 5. From the Analysis menu select "Run".
- 6. Choose Select All except for "Automated Output Options".
- 7. Click "Run Analysis".
- 8. When the analysis has finished, click "OK" to close the window.
- 9. From the Results menu click on" Summary Reports".
- 10. Select the Other tab, and open the "Global Summary Report".
- 11. Click View to view the report.
- 12. Use the report to fill out the table at the end of this exercise for Case 6.

13. When you are finished filling out the table and answering the questions below, save your map document and exit Hazus.

Task 7: Compare the Results of Modifying the Economic Loss Parameters.

Case	Scenario Description	Inventory Losses	Income Losses	Relocation Losses	Rental Losses	Wage Losses
------	----------------------	---------------------	------------------	----------------------	------------------	----------------

Case	Scenario Description	Inventory Losses	Income Losses	Relocation Losses	Rental Losses	Wage Losses
1	Hazus Default Building Economics					
2	Set COM1 and COM2 Sales/SQFT to 100					
3	Set COM1 and COM2 business inventory to 90.					
4	Set COM1 and rental costs to \$1.25/SQFT/Month					
5	Set Owner Occupied to 82.6%					
6	Set Income(40, 0.109) and Employment (0.000)					

Questions

Use the technical manuals or presentation slides to answer the following questions

1. Why did the Rental Losses decrease when the Owner Occupied values were increased to 82.6%?

- 2. Why didn't the Wage Losses ever change?
- 3. Why did the relocation loss results change?

Visual 25: Lesson 8: Review

- 1. Why are the Building Loss of Use results important for planning?
- 2. Where can you find the input parameters that determine the economic loss results?
- 3. What confidence should you place on results that use the default inputs for economic losses? Why?

Visual 26: Questions?

Lesson 9: Shelter and Debris Models

Visual 1: Lesson 9: Shelter and Debris Models



Visual 2: Lesson 9: Goal and Objectives

Goal: To describe the shelter and debris models.

After completing this lesson, you will be able to:

- Understand the shelter and debris parameters.
- Demonstrate how to modify the parameters.

Visual 3: Shelter Model

Follows model used for earthquake hazard.

• Uses building loss ratios instead of building damage states to estimate proportion of uninhabitable housing units

Two estimates for each census tract

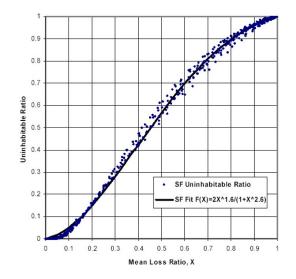
- Number of displaced households
- Number of people requiring short-term public shelter
 - Function of income class, ethnic class, ownership class, population age class

NOTE: Discussed in Technical Manual (Chapter 11)

Visual 4: Shelter Model Methodology

<u>Step 1:</u> Estimate number of uninhabitable households resulting from wind damage.

- Mean loss ratio (loss/building value) used to predict fraction of uninhabitable units
- Function derived from simulations of damage and loss for single-family and multi-family buildings
- Analyzed for each census tract



Visual 5: Shelter Model Methodology

Step 2: Calculate number of displaced households.

- Add displaced houses from previous step
- Multiply by occupancy rate
 - Estimated from census data

Step 3: Repeat for each census tract.

Visual 6: Shelter Model Methodology

Step 4: Estimate number of people in shelters.

• Based on fraction of displaced households

$$N = D \frac{P}{H} \sum_{i=1}^{5} \sum_{j=1}^{5} \sum_{k=1}^{5} \sum_{l=1}^{5} (\alpha_{ijkl} \cdot I_i E_j O_k A_l)$$

D: Displaced Households

 $\frac{p}{H}$ Number of People per Household (census data)

ijkl:Weighting Factors

IEOA: Proportion of population in certain categories of: Income (I), Ethnicity (E), Ownership (O), Age (A)

Visual 7: Shelter Estimates: Weighting Factors

- Same factors as earthquake model
- Defaults to only income and ethnicity affecting shelter estimates

	Utility Factors Weighting Fact	ors Modification Factors		
	Table:			
	Class	Description	Value	×
	1 AW Age Weight		0.00	-
	2 EW Ethnic Weig 3 IW Income Wei		0.27	-
		/eight Factor	0.00	
w,	Income Factor Weighting	0.73		
vv,				
w _i w _E	Ethnic Factor Weighting	0.27	-	U U U
	Ethnic Factor Weighting Ownership Factor Weighting	0.27		
W _E			int OK (Cancel

Visual 8: Shelter Estimates: Income Weighting Factors

Proportion of people in a given class that will go to a public shelter:

Excerpt of Table 11.2-2 for Household Income weighting factors

Symbol	Description	Default Value
(Fi)1	Income < \$10000	0.62
(Fi)2	\$10000 < Income < \$15000	0.42
(Fi)3	\$15000 < Income < \$25000	0.29
(Fi)4	\$25000 < Income < \$35000	0.22
(Fi)5	\$35000 < Income	0.13

Visual 9: Shelter Estimates: Ethnicity Weighting Factors

Excerpt of Table 11.2-2 for Ethnicity weighting factors

Symbol	Description	Default Value		
(Fe)1	White	0.24		
(Fe)2	Black	0.48		
(Fe)3	Hispanic	0.47		
(Fe)4	Asian	0.26		
(Fe)5	Native American	0.26		

Visual 10: Shelter Estimates: Weighting Factors

Weight factor is a product of two sets of factors

- Weighting Factors
- Modification Factors

	α_{ij}	$w_{I} = w_{I} \left(F_{I} \right)_{i}$	+1	$_{E}(F_{E})$, +	- w _c	$F_{0}(F_{0})$	$(v_0)_k + w_A ($	F_A	1	
Utility Fa	ctors		ation F	ns S	_	er Para		rs Weighting Factors	Modifie	cation F	actors
- Table:	-					Table:					
	Class	Description	Value				Class	Description		Value	
1	IM1	Income < 10,000	0.62			1		Age Weight Factor		0.00	
2	IM2	10,000 < Income < 20,000	0.42				AW				
3	IM3	20,000 < Income < 30,000	0.29			2	EW	Ethnic Weight Fac		0.27	
4	IM4	30,000 < Income < 40,000	0.22			3	IW.	Income Weight Fac		0.73	
5	IM5	40,000 < Income	0.13			4	0W	Ownership Weight	Factor	0.00	

Visual 11: Debris Model

Eleven categories of debris resulting from wind events (Public Assistance Program and Policy Guide, 2018):

- Vegetative Debris
- Construction and Demolition Debris
- Hazardous Waste
- Household Hazardous Waste
- White Goods
- Electronic Waste
- Soil, Mud, and Sand
- Vehicles and Vessels
- Putrescent Debris
- Infectious Waste
- Chemical, Biological, and Nuclear Contaminated Debris

NOTE: Chapters 10 and 12 in the Hurricane Model Technical Manual

Visual 12: Building Debris Model

Development of debris curves

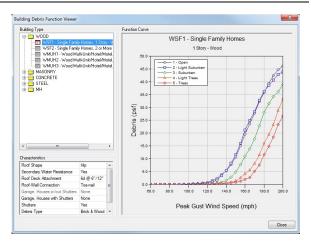
- Based on load-resistance damage states
- Component unit weights
- Typical density of debris type
- Debris type distribution of damaged components

Visual 13: Component Unit Weight

- Exterior building components: Weights from RS Means 2018
- Interior building components: Weights from RS Means 2018
- Contents: Estimated based on sustained live loads from ASCE 7-98

Visual 14: Viewing Building Debris Curves

- Each specific building type has a set of debris functions related to terrain.
- Rougher terrains: Less building debris



Visual 15: Debris Model: Validation

Storm	Region	Actual Weight (tons)	Actual Volume (cubic yards)	Modeled Weight (tons)	Modeled Volume (cubic yards)	Model/Actu al Weight	Model/Actu al Volume
Hugo	South Carolin a	-	15,500,00 0	951,009	9,130,843	-	0.59
Hugo	USAC E Admin. Region	-	4,589,559	782,480	7,366,394	-	1.61
Andre w	Dade County	2,900,00 0	40,000,00 0	3,396,99 1	35,323,08 0	1.17	0.88

- Statistics reported in published papers
- Limitations of comparisons
 - Hugo South Carolina comparison region may be larger than assumed from paper
- Hazus debris model = $\sim +/-30\%$

Visual 16: Tree Debris Model

- Estimates based on
 - Tree coverage database
 - Tree blow-down model
- Expected green weight of tree stems for trees greater than 30 ft. tall
- Eligible tree debris
 - Debris estimates made for all areas.
 - Unpopulated areas may not be collected.
- Volume based on 10 cubic yards / ton.

Visual 17: Demonstration 9.1 – Shelter and Tree Parameters

Goal:

• Show how to view shelter and tree parameters

Time: 10 Minutes

	Demonstration 9.1: Shelter and Debris Parameters						
	Goal: Show how to view shelter and tree parameters						
Student Manual	Time: 10 Minutes						
	Demonstration Steps:						
	1. Listen to instructor's directions.						
	2. Ask questions if clarification is needed.						
	3. Watch the instructor's demonstration.						

4. Ask any final questions.

Demonstration 9.1 – Shelter and Tree Parameters

Type: Instructor-Led Demonstration

Time: 10 minutes

Goal: Show how to view shelter and tree parameters

Background:

In this demonstration you will explore the shelter and tree parameters. The default values for the sheltering parameters are based upon national assumptions. In this exercise you will investigate the role these parameters play in the calculations of the sheltering results. Tree parameters are also based upon national datasets and you will modify the tree parameters to explore the changes to the results.

Task 1: Review Shelter Parameters

1. Navigate to the C:\E0170_ActivityData\Demonstration_9.1 folder and import the HurricaneMichael HPR.

2. Name the study region "ShelterTree".

- 3. Open the study region and go to Analysis > Parameters > Shelter
- 4. Discuss the Weighting Factors (Age, Ethnic, Income, Ownership) and their values.

able	c			
X	Class	Description	Value	-
1	AW	Age Weight Factor	0.00	
2	EW	Ethnic Weight Factor	0.27	
3	IW	Income Weight Factor	0.73	
4	OW	Ownership Weight Factor	0.00	

5. Discuss the Modification Factor classes (Income, Ethnicity, Ownership, Age) and the values associated with each of the factors.

Income Table:	Class:		Veighting Factors Modification Factors		
Class Description Value 1 IM1 Income < 10,000 0.62 2 IM2 10,000 < Income < 20,000 0.42 3 IM3 20,000 < Income < 30,000 0.29 4 IM4 30,000 < Income < 40,000 0.22 5 IM5 40,000 < Income 0.13					
Class Description Value 1 IM1 Income < 10,000 0.62 2 IM2 10,000 < Income < 20,000 0.42 3 IM3 20,000 < Income < 30,000 0.29 4 IM4 30,000 < Income < 40,000 0.22 5 IM5 40,000 < Income 0.13	Incon	le	•)		
3 IM3 20,000 < Income < 30,000 0.29 4 IM4 30,000 < Income < 40,000 0.22 5 IM5 40,000 < Income 0.13	Table	:			
3 IM3 20,000 < Income < 30,000 0.29 4 IM4 30,000 < Income < 40,000 0.22 5 IM5 40,000 < Income 0.13		Class	Description	Value	-
3 IM3 20,000 < Income < 30,000	1	IM1	Income < 10,000	0.62	
4 IM4 30,000 < Income < 40,000	2	IM2	10,000 < Income < 20,000	0.42	
5 IM5 40,000 < Income 0.13	3	IM3	20,000 < Income < 30,000	0.29	
	4		and the first of the first of the state of the first of the second state of the		
	5	IM5	40,000 < Income	0.13	

6. Demonstrate that you can modify these values.

Task 2: Review Tree Parameters

1. Go to Analysis > Parameters > Trees.

	Census Tract	Predominate Tree Type	Stems per Acre	Tree Height Less 40
1	12045960100	Mixed	135	
2	12045960200	Mixed	119	
3	12045960300	Mixed	120	

2. Discuss tree parameters including predominant tree type, stems per acre, tree height, and tree collection factor.

3. Demonstrate that you can modify these values.

Question for the participants: Where can you as a user obtain information that can improve the shelter parameter?

Visual 18: Exercise 9.2: Tree and Sheltering Parameters

Goal:

• Explore the impact of altering tree and sheltering parameters.

Time: 45 Minutes

Exercise 9.2: Tree and Sheltering Parameters
Goal: Explore the impact of altering tree and sheltering parameters.
Time: 45 Minutes

Refer to Activities Document "09.2_Exercise_Tree and Sheltering Parameters."
Listen to instructor's directions.
Ask questions if clarification is needed.
Work individually on the goal.
Ask questions to the instructor if needed.
Complete the assigned goal.
Be prepared to share your answers/results.
Ask any final questions.

Visual 19: Exercise 9.2: Tasks

Task 1: Open the Study Region

Task 2: Explore Sensitivity to Shelter Parameters.

Task 3: Compare Shelter Parameter Modification Results.

Task 4: Explore Sensitivity of Debris to Tree Damage.

Task 5: Compare Tree Density Modification Results.

Exercise 9.2: Tasks
 Refer to Activities Document "09.2_Exercise_Tree and Sheltering Parameters."
 Student Manual

Exercise 9.2: Tree and Sheltering Parameter

Type: Student-Led Activity

Time: 45 minutes

Goals: Explore the impact of altering tree and sheltering parameters.

Background:

In this exercise you will explore the sheltering and tree parameters in Hazus. The default values for the sheltering parameters are based upon national assumptions. In this exercise you will investigate the role these parameters play in the calculations of the sheltering results. Tree parameters are also based upon national datasets and you will modify the tree parameters to explore the changes to the results.

Task 1: Open the Study Region

- 1. Open Hazus.
- 2. Select Open a region and click OK.
- 3. Click Next.
- 4. Select the Economic_Parameter study region (created in Exercise 8.2) and click Next.
- 5. Click Finish.
- 6. From the Hazard menu choose Show Current.
- 7. The Historic Hurricane Michael should be the active scenario.

Current Hazard		×
Info		
Scenario Name: Scenario Type:	Hurricane Michael - Observed FEM Historic	
		Close

8. Click "Close".

Task 2: Explore Sensitivity to Shelter Parameters

In this section of the exercise you will explore the impacts that the shelter parameters have on estimation of shelter needs. As you explore these impacts, you will fill in the table named Shelter Parameters Comparison which is found at the end of the exercise. The first row of this table, which shows the results of the Hurricane Michael scenario using default shelter estimation parameters, has been filled in for you.

1. From the Inventory menu choose "Demographics" to open the demographics table.

2. Click on the FemaleOver65 field name and then click "Map".

3. Click on the MaleOver65 field name and then click "Map".

4. Click "OK" to exit the demographics window.

5. Toggle between the Demographics – MaleOver65 and Demographics – FemaleOver65 layers, and in the space below describe where the over 65 populations reside in this study region.

Answer:

6. From the Analysis menu choose "Parameters" > "Shelter" to open the Shelter Parameters window.

7. Click the Weighting Factors tab. The default values show no consideration is given to either age or home ownership. Also notice that income is the most important factor by default.

	aramete			1	X
Utility	Factors	Weighting Facto	rs Modification Factors		
- Tab	ile:				
	🔟 Cla	ss	Description	Value	
1		Age Weight F		0.00	
2		Ethnic Weigh		0.27	▲
3		Income Weig		0.73	
4	. 0W	Ownership W	eight Factor	0.00	
•					▼ ▼ ▼
				Print OI	K Cancel

8. Change the value for the Age weight factor to 1.0.

9. Change all other weighting factors to zero. This will make the age the only factor considered for sheltering.

	actors V	Veighting Factors	Modification Factors		
Table	e:				
	Class	De	escription	Value	*
1	AW	Age Weight Fact	or	1.00	
2	EW	Ethnic Weight Fa	ctor	0.00	-
3	IW	Income Weight F	actor	qloo	
4	0W	Ownership Weigh	nt Factor	0.00	
					× 4

- 10. Click "OK" on the Shelter Parameters window.
- 11. Click "Yes" to indicate you want to save the changes.
- 12. From the Analysis menu choose "Run".
- 13. Choose Select All.
- 14. Uncheck the Automated Output Options.
- 15. Click "Run Analysis".
- 16. When the analysis has finished, click "OK" to close the window.
- 17. From the Results menu click on Shelter.
- 18. Click on the Short Term Shelter Needs column, click "Map.
- 19. Close the Shelter Results window.
- 20. Label the map to show the number of people requiring shelter.
- 21. Write down which census tract has the most people requiring shelter.

Answer:

22. Record the number of displaced households and the number of people requiring shelter in the row labeled Case 2 of the Shelter Parameters Comparison table at the end of the exercise.

23. From the Analysis menu choose "Parameters" > "Shelter" to open the Shelter Parameters window.

- 24. Click the Modification Factors tab.
- 25. Select Age from the Class drop down menu.

26. Change the value for Population Over 65 yrs to 1.00. This will mean that 100% of this age group that is displaced from the hurricane will require shelter.

27. Do not alter the other factors.

Shel	ter Para	meters			×		
Ī	Utility Fac	ctors W	Veighting Factors Modification Factors				
	Class: Age						
	- Table:						
	-	Class	Description	Value			
	1	AM1	Population Under 16 yrs	0.40			
	2	AM2	Population between 16 yrs and 65 yrs	0.40			
	3	АМЗ	Population Over 65 yrs	1.00			
	1				▼ ₹ ¥		
				Print O	K Cancel		

- 28. Click the "OK" button and then "Yes" when prompted to save your changes.
- 29. From the Analysis menu choose "Run".
- 30. Select all of the outputs except the Automated Output Options.
- 31. Click "Run Analysis".
- 32. When the analysis is done click OK.

33. Record the number of displaced households and the number of people requiring shelter in the row labeled Case 3 of the Shelter Parameters Comparison table.

34. Open the Shelter Parameters Weighting Factors table and change the value for the Ethnicity weight factor to 1.0.

35. Change all other weighting factors to zero.

tility Fa	actors V	Weighting Factors	Modification Factors		
Table	e:				
. 2	Class	D	escription	Value	X
1	AW	Age Weight Factor		0.00	
2	EW	Ethnic Weight Fa	actor	1.00	L
3	IW	Income Weight F	actor	0.00	
4	0W	Ownership Weig	ht Factor	0.00	
					K 41 K

36. Click "OK" and then "Yes" when prompted to indicate whether you want to save your changes.

37. From the Analysis menu choose Run.

38. Select all of the outputs except the Automated Output Options.

39. Click "Run analysis".

40. Record the number of displaced households and the number of people requiring shelter in the row labeled Case 4 of the Shelter Parameters Comparison table at the end of the exercise.

41. Open the Shelter Parameters Weighting Factors table and change the value for the Income weight factor to 1.0.

42. Change all other weighting factors to zero.

	actors V	Veighting Factors	Modification Factors		
Table	x				
	Class	D	escription	Value	X
1	AW	Age Weight Factor		0.00	
2	EW	Ethnic Weight F	actor	0.00	-
3	IW	Income Weight I	Factor	1.00	
4	0W	Ownership Weig	ht Factor	0.00	
					* *

43. Click the "OK" button and then "Yes" when prompted to save your changes.

- 44. From the Analysis menu choose "Run".
- 45. Select all of the outputs except the Automated Output Options.
- 46. Click "Run analysis".

47. Record the number of displaced households and the number of people requiring shelter in the row labeled Case 5 of the Shelter Parameters Comparison table at the end of the exercise.

48. Open the Shelter Parameters Weighting Factors table and change the value for the Ownership weight factor to 1.0.

49. Change all other weighting factors to zero.

ty Fa	actors V	Veighting Factors	Modification Factors		
able	×				
	Class	D	escription	Value	2
1	AW	Age Weight Fac	tor	0.00	
2	EW	Ethnic Weight Fa	actor	0.00	
3	IW	Income Weight F	actor	0,00	
4	OW	Ownership Weig	ht Eactor	1.00	
,					

50. Click "OK" and then "Yes" when prompted to save your changes.

51. Run the analysis and record the number of displaced households and the number of people requiring shelter in the row labeled Case 6 of the Shelter Parameters Comparison table at the end of the exercise.

Task 3: Compare Shelter Parameter Modification Results.

1. Review the results of modifying the different weighting factors. Consider how modifying these factors might help you better represent the impacts of a hurricane in your community.

Task 4: View and Compare Results

Case	Shelter Parameters	Displaced Households	People in Shelter
1	Hurricane Celia Hazus Default	8,018	4,816
2	Set Age Weight Factor to 1.0 and all others to 0		
3	Set the Over 65 Age Modification Factor to 1.00		
4	Set Ethnic Weight Factor to 1.0 and all others to 0		

Shelter Parameters Comparison

Case	Shelter Parameters	Displaced Households	People in Shelter
5	Set Income Weight Factor to 1.0 and all others to 0		
6	Set Ownership Weight Factor to 1.0 and all others to 0		

Questions

- 1. Which weighting factor(s) change had the greatest impact on the shelter results.
- 2. Why didn't the displaced households values change in any case?
- 3. Why did Case 2 and Case 6 have the exact same sheltering result?
- 4. Why did the income weight make little difference in this study region?

2. Once you are finished, replace the values with the Original Sheltering Parameters. Use the following graphics as a guide. You have made changes to only the Weighting factors table and the Age Modification Factors table.

muy re	ictors V	Veighting Factors	Modification Factors		
Table	¢				
	Class	D	escription	Value	X
1	AW	Age Weight Facl	tor 🕐	0.00	
2	EW	Ethnic Weight Fa	actor	0.27	-
3	IW	Income Weight F	Factor	0.73	
4	0W	Ownership Weig	ht Factor	0,00	
					₩ 41

tility Fa		Veighting Factors Modification Factors		
Class:				
Age		~		
Table	:			
	Class	Description	Value	*
1	AM1	Population Under 16 yrs	0.40	
2	AM2	Population between 16 yrs and 65 yrs	0.40	-
3	3 AM3 Population Over 65 yrs		0.4 <u>0</u>	

Task 4: Explore Sensitivity of Debris to Tree Damage.

In this section of the exercise you will explore the impact that changing input parameters has on estimation of tree debris. As you explore these impacts, you will fill in the table named Tree Density Parameters Comparison which is found at the end of the exercise. The first column of this table, which shows the results of the Hurricane Michael scenario using default parameters, has been filled in for you.

1. From the Analysis menu choose "Parameters" > "Trees" to open the Tree Parameters window.

2. Change all of the values in the Stems per Acre column to 400. • Note: You can copy (CTRL + C) and paste (CTRL + V) values to save time.

	Tree Type	Stems per Acre	Tree Height Less 40	
12005000201	Mixed	400		
12005000202	Mixed	400		
12005000300	Mixed	400		
12005000400	Mixed	400		
12005000500	Mixed	400		
12005000600	Mixed	400		
12005000700	Mixed	400		
12005000803	Mixed	400		
12005000804	Mixed	400		
12005000805	Mixed	400		
12005000806	Mixed	400		
12005000900	Coniferous	400		
12005001000	Coniferous	400		
12005001100	Mixed	400		-
12005001200	Mixed	400		₹
12005001301	Mixed	400		Y
	1200500202 1200500300 1200500400 1200500500 12005000600 12005000803 12005000804 1200500806 1200500806 1200500806 1200500900 12005001000 12005001000 12005001000	12005000202 Mixed 12005000300 Mixed 12005000400 Mixed 12005000500 Mixed 12005000500 Mixed 12005000500 Mixed 12005000800 Mixed 12005000803 Mixed 12005000805 Mixed 12005000805 Mixed 12005000806 Mixed 12005000806 Mixed 12005000900 Coniferous 12005001000 Coniferous 12005001100 Mixed 1200500100 Kixed	12005000202 Mixed 400 12005000300 Mixed 400 12005000400 Mixed 400 12005000500 Mixed 400 12005000500 Mixed 400 12005000500 Mixed 400 12005000800 Mixed 400 12005000803 Mixed 400 12005000805 Mixed 400 12005000805 Mixed 400 12005000806 Mixed 400 12005000800 Coniferous 400 12005001000 Coniferous 400 12005001000 Mixed 400 12005001000 Mixed 400	12005000202 Mixed 400 12005000300 Mixed 400 12005000400 Mixed 400 12005000500 Mixed 400 12005000803 Mixed 400 12005000805 Mixed 400 12005000805 Mixed 400 12005000806 Mixed 400 12005000805 Mixed 400 12005001000 Coniferous 400 12005001100 Mixed 400 12005001100 Mixed 400

3. This change will illustrate an example where the default tree inventory has been severely underestimated.

4. Click "OK" to close the Tree Parameters window and click "Yes" when asked if you want to update the modified data.

5. From the Analysis menu choose "Run".

6. Select all of the outputs except the Automated Output Options

7. Click Run Analysis.

8. Explore the results and fill in the column labeled 400 Stems Per Acre of the Tree Density Parameters Comparison table located at the end of the exercise.

9. Change all of the values in the Stems per Acre column of the Tree Parameters table to 50.

10. This change will illustrate an example where the default tree inventory has been slightly underestimated.

able:				
	Census Tract	Predominate Tree Type	Stems per Acre	Tree Height Less 4
1	12005000201	Mixed	50	2
2	12005000202	Mixed	50	
3	12005000300	Mixed	50	
4	12005000400	Mixed	50	
5	12005000500	Mixed	50	
6	12005000600	Mixed	50	
7	12005000700	Mixed	50	
8	12005000803	Mixed	50	
9	12005000804	Mixed	50	
10	12005000805	Mixed	50	
11	12005000806	Mixed	50	
12	12005000900	Coniferous	50	
13	12005001000	Coniferous	50	
14	12005001100	Mixed	50	
15	12005001200	Mixed	50	
16	12005001301	Mixed	50	2
4				•

11. Run the analysis and use the results to fill in the 50 stems per acre column of the Tree Density Parameters Comparison table.

12. Change all of the values in the Tree Collection Factor column of the Tree Parameters table to 0.90.

1	Census Tract	Tree Height Greater than 60 ft	Tree Collection Factor	
1	12005000201	23	0.90	
2	12005000202	23	0.90	
3	12005000300	23	0.90	
4	12005000400	23	0.90	
5	12005000500	23	0.90	
6	12005000600	23	0.90	
7	12005000700	23	0.90	
8	12005000803	23	0.90	
9	12005000804	23	0.90	
10	12005000805	23	0.90	
11	12005000806	23	0.90	
12	12005000900	23	0.90	
13	12005001000	23	0.90	
14	12005001100	23	0.90	
15	12005001200	23	0.90	
16	12005001301	23	0.90	

13. Run the analysis and fill in the Tree Collection Factor 0.90 column of the Tree Density Parameters Comparison table. Since you didn't change the inventory to the default amounts, you can only compare the results from this step with the ones from the previous step (50 stems per acre).

14. When the exercise is complete, save your map document and exit Hazus.

Task 5: Compare Tree Density Modification Results.

Parameter	Hurricane Michael Hazus Default	400 Stems per Acre	50 Stems per Acre	Tree Collection Factor 0.90
Displaced Households	8,018			
Residential Property Damage Total	\$3.2 B			
Debris: Trees (tons)	2,774,289			
Debris: Eligible Tree Debris (tons)	29,446			

Questions

1. Why was there a change to the number of displaced households due to changes in the stems per acre?

Answer:

2. Why did the amount of Tree Debris decrease from the 50 steps per acre analysis to the Tree Collection Factor analysis?

Answer:

Visual 20: Lesson 9: Review

- 1. What are the four factors modeled in Hazus that impact sheltering estimates?
- 2. What are the only types of debris modeled in the Hazus Hurricane Model?

Visual 21: Questions?

Lesson 10: Hurricane Surge Model

Visual 1: Lesson 10: Hurricane Surge Model



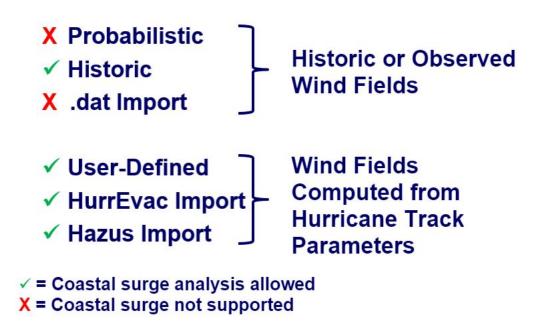
Visual 2: Lesson 10: Goal and Objectives

Goal: To provide an overview of the storm surge model within Hazus.

After completing this lesson, you will be able to:

- Discuss the causes for storm surge.
- Describe the Hazus surge model components.
- Understand the procedure for running a hurricane surge in Hazus.

Visual 3: Hurricane Scenario Definition Options



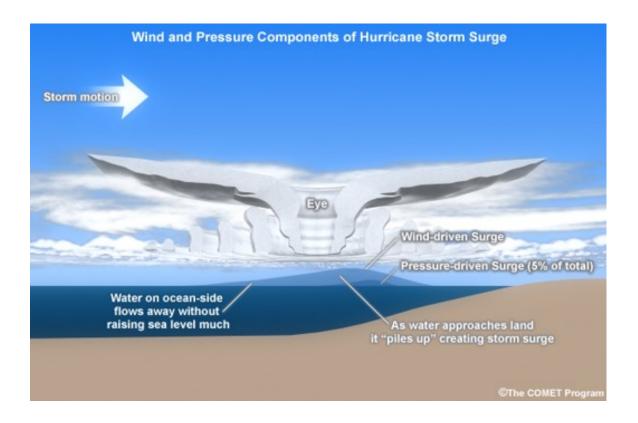
Visual 4: Sources of Storm Surge

- 1. Hurricanes (i.e. Hurricane Katrina)
- 2. Extratropical Cyclones and Nor'easters
 - Edmund Fitzgerald (1975): 15-20 foot waves in Great Lakes
 - Storm of the Century (1993): 12 foot waves in Atlantic
- 3. Subtropical Storms



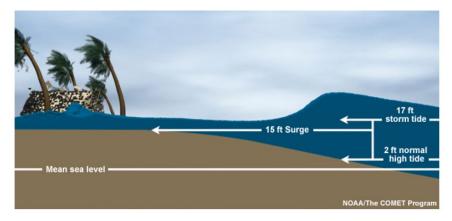
https://earthobservatory.nasa.gov/IOTD/view.php?id=46662

Visual 5: What Causes a Storm Surge?



Visual 6: Factors Influencing a Surge's Size

- Storm surge: abnormal rise of water generated by a storm, over and above the predicted astronomical tides
- Storm tide: water level rise due to the combination of storm surge and the astronomical tide



Visual 7: Factors Influencing a Surge's Size

• Wave breaking can increase the height of the surge and is dependent on the continental shelf.

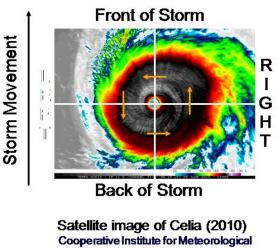


©The COMET Program

Visual 8: Factors Influencing a Surge's Size

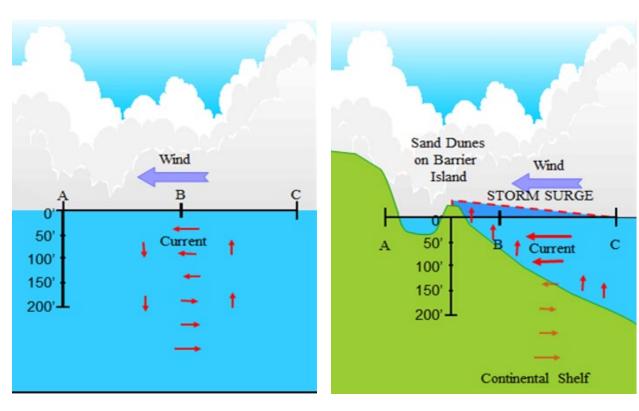
Wind and Storm Motion

- Strongest winds and thus highest surge (without coastline effects) occur in the right front quadrant of hurricane
- Here the forward speed of the hurricane is added to the rotational winds of the hurricane to achieve the highest wind speeds



Studies (CIMSS), University of Wisconsin

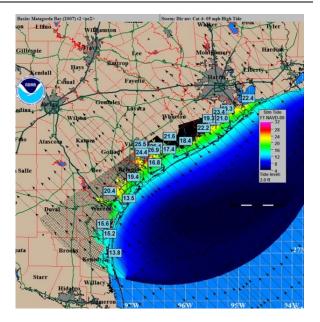
Visual 9: Storm Surge Dynamics



The hurricane's surface winds push against the water, and water from below moves upward to replace the displaced water. The bulge of water and current slam into the continental shelf and are forced upward and inward.

Visual 10: Coastline Effects and Surge Size

- Orientation of the hurricane with respect to the coastline can influence the surge magnitude.
- Water can 'pile up' with favorable orientations. If hurricane winds are pushing against the coastline, water is caught along the coast.
- Water can also be trapped in bays.



Visual 11: Surge Demonstration

Hurricane Dennis Surge:

https://www.nhc.noaa.gov/surge/HistoricalRuns/?large&parm=2005_dennis#contents



Hurricane Dennis (2005)

Hurricane Dennis (2005)

Visual 12: Discussion 10.1: Storm Surge

Goal: Discuss the previous animation and answer the questions.

Time: 10 Minutes

Questions:

- 1. How does the orientation of the coastline effect the storm surge depth?
- 2. Where are the highest storm surges?
- 3. How can a surge affect an area (geographically) that is not in close proximity to the hurricane path?

Discussion 10.1: Storm Surge

Goal: Discuss the previous animation and answer the questions.



Time: 10 minutes

Discussion Steps:

1. Listen to instructor's directions.

Student Manual

- 2. Ask questions if they need directions clarified.
- 3. Discuss the questions with your group.
- 4. Designate a group member to share your answers with the class.

Visual 13: Hurricane Storm Surge Overview

Hurricane Model

• Windspeed and direction

Surge Model

- SLOSH (sea, land, ocean)
- SWAN (near shore)

Wind and Surge are combined for aggregate inventory damages and losses only.

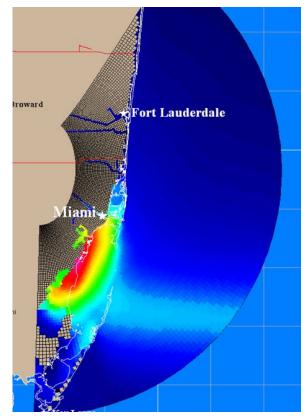


Visual 14: SLOSH

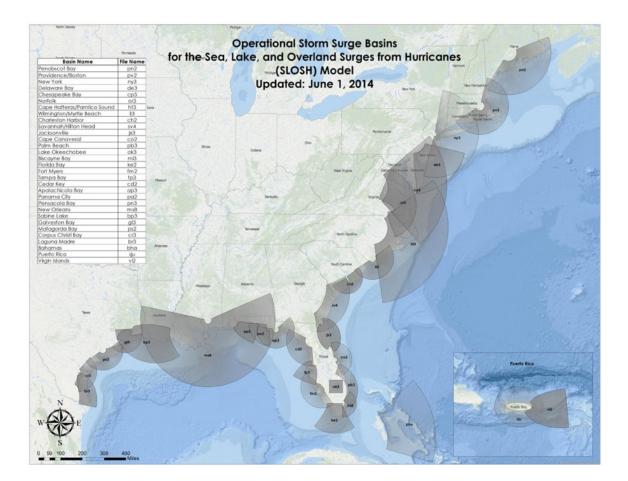
- SLOSH = Sea, Lake, and Overland Surge from Hurricanes
- Numeric Model initialized on a grid that requires the following inputs:
 - Basin selection: SLOSH is packaged with pre-defined basins that have bathymetry (NGDC) and elevation information (USGS) for each grid cell.
 - Hurricane characteristics: direction of movement, radius to maximum winds, pressure, location, direction, and speed

Visual 15: SLOSH

- Produces reasonably accurate estimates of surge and runs quickly
- Emergency management community is familiar and comfortable with using this model.
- Does not explicitly model tide.
 - Tide is generalized by treating it as a fixed increase or decrease in initial water level based on predicted tide at time of landfall in the absence of storm surge and waves.



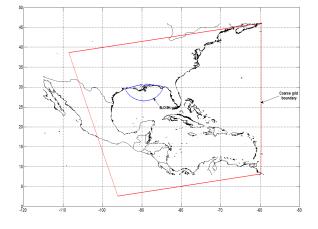
Visual 16: SLOSH Basins



Visual 17: Domains in SWAN Runs

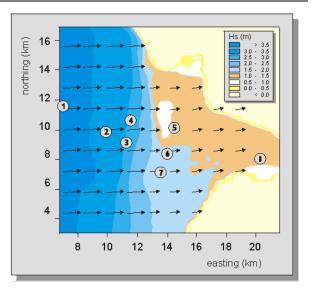
Domains

- Deep Water: Red
- Near Shore: Blue



Visual 18: SWAN

- Simulating Waves Nearshore
- Created by Delft University of Technology
- Models:
 - Wave propagation
 - Wave generation from wind
 - Wave interactions, dissipation, transmission, and diffraction
 - Others



http://www.wldelfi.nl/soft/swan/

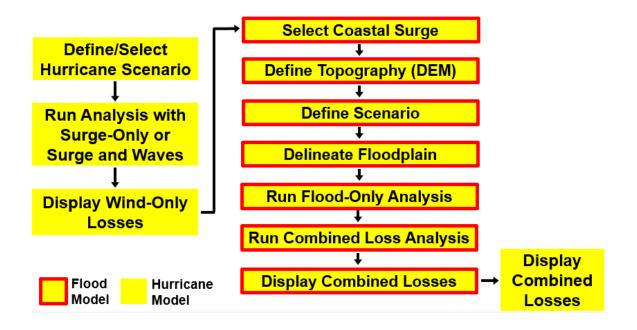
Visual 19: Coupled Surge and Wave Modeling

- SLOSH and SWAN codes have been coupled together.
- Methodology bridges gap between existing Hazus Hurricane Wind and Hazus Coastal Flood models
- SLOSH is run first to update water elevations.
 - SWAN uses water elevations produced by SLOSH.
 - Result is larger modeled wave heights in areas where waves are depth-limited.
- SWAN is run to update wave stresses.
 - Wave stresses are added to wind stress in SLOSH.
 - Increases modeled storm surge due to wave setup

Visual 20: Overland Waves

- Model uses 1-D transects and simplified WHAFIS-like methodology to propagate waves inland from the shoreline.
- Where each transect intersects the coastline, use the modeled significant wave height from SWAN to estimate the controlling wave height, Hc = min(0.78 ds, 1.6 Hs) where ds = still water depth at the coast line.
- Wave crest elevation = SWEL + 0.7 Hc
 - Neglect wave regeneration and wave dissipation
 - Neglect wave run-up and dune erosion
- Use V-zone damage functions where $Hc \ge 1.5$ ft

Visual 21: User Work Flow



Visual 22: Activity 10.2: Hurricane Storm Surge

Goal:

• Create a combined Flood/Hurricane study region.

Time: 10 minutes

	Storm Surge
	Goal: Create a combined Flood/Hurricane Study Region
	Time: 10 minutes
	Exercise Steps:
	 Refer to Activities Document "10.2_Activity_Hurricane Storm Surge"
	2. Listen to instructor's directions.
Student	3. Ask questions if clarification is needed.
Manual	4. Work individually on the goal.
	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share their answers/results.
	8. Ask any final questions.

Visual 23: Exercise 10.2: Tasks

Task 1: Create a Surge Study Region

Task 2: Create a Surge Scenario

Task 3: Run a Surge Analysis



Activity 10.2: Tasks

• Refer to Activities Document "10.2_Activity_Hurricane Storm Surge"

Student Manual

Activity 10.2 – Hurricane Storm Surge

Type: Instructor-Led Activity

Time: 10 minutes

Goals: Create a combined Flood/Hurricane study region

Background:

The storm surge model is a powerful application that allows users to understand the combined losses from hurricane winds and storm surge. This application provides a more realistic set of losses than can be produced by separately analyzing flood and wind losses. By using this approach, mitigators and planners can have a more comprehensive look at what to expect and prepare for in their community.

In this exercise you will build a study region for Pinellas, Florida. You will go through the steps of running the analysis based on the Hurricane Irma historical scenario. In your next activity, you will then import a study region for which the storm surge analysis has already completed in which you will move to the flood model, run the analysis, and view the results.

Task 1: Create a new Surge scenario

- 1. Create a new study region based on the following parameters:
 - Study Region Name: IrmaStormSurge
 - Hazard Type: Hurricane and Flood
 - State: Florida
 - County: Pinellas
- 2. Open the "IrmaStormSurge" study region
- 3. Select the radio button next to the hurricane hazard and click Next.
- 4. Click Finish.

Task 2: Create a Surge Scenario

- 1. From the Hazard menu select Scenario to open the scenario wizard.
- 2. Click "Next" to advance beyond the welcome screen.

3. Select "Historic" from the Hurricane Scenario options and make sure the radio button is selected next to "Activate".

4. Click "Next" to advance the wizard.

5. Click on the Region Filter button. This will only list the hurricanes that affected your study region.

		toric Storm						
iis page	e allows you	to select a historic storm :	scenario.Choose	the storm you w	ant to analy	ze and click r	next.	2
								time of
		notable storms that made I)0.		
er histo	nic storms n	nay be found under the Hu	arrevac storm adv	/isory scenario o	ption.			
	Year 🔹	Name	Peak Gust (mph)	States Affected	Landfall States		Ê	Region Filt
1	1900	UN-NAMED-1900-1	122	A MS NY TX	TX			
2	1906	UN-NAMED-1906-6	123	AL FL LA MS	AL			
3	1906	UN-NAMED-1906-8	130	FL GA SC	FL			
4	1906	UN-NAMED-1906-5	93	GA NC SC	SC			
5	1909	UN-NAMED-1909-8	126	LA MS	LA			
6	1909	UN-NAMED-1909-4	118	TX	TX			
7	1910	UN-NAMED-1910-5	129	L GA NC SC	FL			
8	1915	UN-NAMED-1915-2	134	LA TX	TX			
9	1915	UN-NAMED-1915-6	126	LA MS WV	LA			
10	1916	UN-NAMED-1916-6	121	TX	TX			
11	1916	UN-NAMED-1916-2	132	AL FL LA MS	AL			
12	1917	UN-NAMED-1917-4	129	L GA LA MS	FL			
13	1918	UN-NAMED-1918-1	100	LA MS TX	LA			
14	1919	UN-NAMED-1919-2	137	FL TX	FL		-	
	4004	LINE ALLER ADDA D		C)	<i>m</i>			

6. Select "Hurricane Irma – Observed FEMA" and click "Next".

	1000	storic Storm u to select a historic storm si		12	ant to analy:	ze and click next.	4.
	1 1 2 1		W III - 11 - 11		1.1	2	
		notable storms that made la may be found under the Hur				U.	
	Year	r Name	Peak Gust (mph)	States Affected	Landfall States	A	Show A
1	2017	Hurricane Irma - Obser	160	SAISCIPRIVI	FL		
2	2004	FRANCES	110	NY PA WV	FL		
3	2004	JEANNE	116	FL GA	FL		
4	1960	DONNA	152	IY RESCIVA	FL		
5	1950	EASY	135	AL FL GA	FL		
6	1949	UN-NAMED-1949-2	139	OVA VT WV	FL		
7	1947	UN-NAMED-1947-4	122	L LA MS TX	FL		
8	1944	UN-NAMED-1944-11	132	A NC SC VA	FL		
9	1936	UN-NAMED-1936-5	97	AL FL	FL		
10	1935	UN-NAMED-1935-2	194	A NC SC VA	FL		
11	1933	UN-NAMED-1933-12	141	FL	FL		
12	1929	UN-NAMED-1929-2	120	AL FL GA	FL		
13	1928	UN-NAMED-1928-4	148	A NC SC VA	FL		
14	1926	UN-NAMED-1926-6	161	L GA LA MS	FL		
	4004	UNIVERSION O	4.04		m 1		

7. On the scenario review screen make sure you have selected the correct storm and then click "Next".

cenario Wizard			×
Scenar	io Review		
This page disp	lays information specific to the scenario.		
Scenario Name:	Hurricane Irma - Observed FEMA		
Scenario Type:	Historic		
		< Back Nex	t> Cancel

- 8. Select "Yes. Make this scenario active" and then click "Next".
- 9. Exit the wizard by clicking "Finish" on the final screen.

Task 3: Run a Surge Analysis

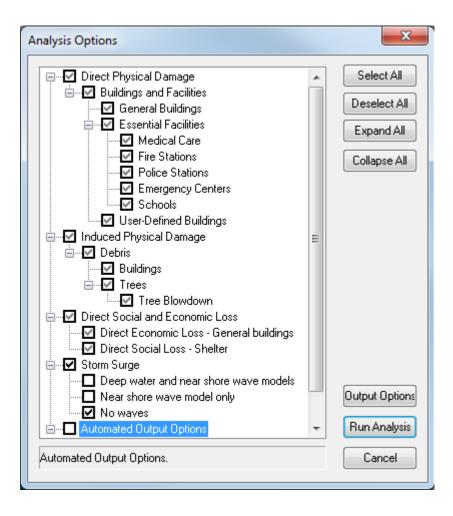
1. From the Analysis menu make sure the "Set Optimized Analysis Mode" is set to OFF.

An	alysis	Results	Bookmarks	Insert	Selectio
	Dam	age Funct	tions		t,
	Loss	Functions	5		
	Loss	of Use Fu	nctions		
	Debr	ris Functio	ns		
	Para	meters			
	Set 0	Optimized	Analysis Mode	e OF	F
	User	Supplied	Coastal Surge	Grid N	0
	Run.				
	Show	v Coastal	Surge Status		

2. When set to ON Hazus will calculate the wind hazard on the tract level. Since we are running the storm surge model, we want this set to OFF so it will run on the block level to combine block level wind results with block level flood results.

3. Open the Analysis menu by choosing "Analysis > Run". This is the step that you would take to begin the damage and loss calculations for the Hurricane Wilma scenario.

4. Click Select All and then uncheck Automated Output Options. Make sure to select "No Waves" for Storm Surge.



5. Click on "Run Analysis".

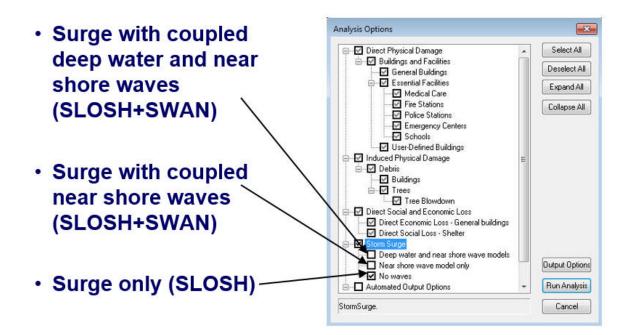
6. The Initial Water Level window will appear. For this activity we estimated 2 feet. Instead of entering a value and running the analysis, click cancel on this window.

7. Click "Cancel" on the analysis options window.

8. Running the storm surge model can take > 1 hour to complete. Instead we will exit this region and import one that has completed already. The only step you are missing by not running the analysis is watching the status bars progress as the surge model completes.

9. Exit Hazus.

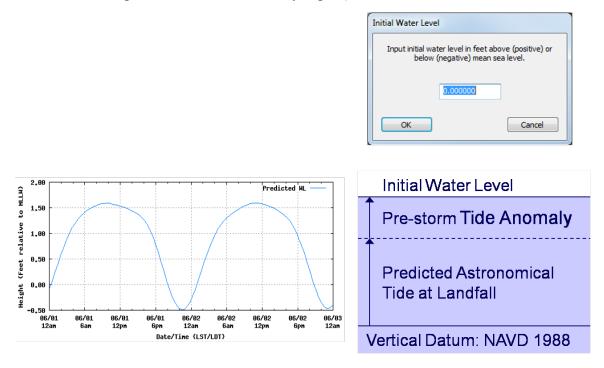
Visual 24: Coastal Surge Hazard Modeling Options



Visual 25: Initial Water Level

Pre-storm tide anomaly is the difference between:

- The observed tide
- The predicted tide approximately two days before landfall (i.e., before the effects of storm surge or waves reach the study region)



Visual 26: Flood Hazard Type and User Data

DEM Coastal Surge	
Surge Elevation Grid (SLOSH)	
C:\HAZUSregions\NC_Test\surge.flt	
Significant Wave Height Grid (SWAN)	
C:\HAZUSregions\NC_Test\waveht.flt	

Visual 27: Depth Grids

- Depict variable flood depths throughout the determined flood extent for an event
- May be produced for a range of flood events
 - Most commonly the 0.2-percent, 1percent, 2-percent, 4-percent, and 10-percent annual chance flood events
- Many are available for download from FEMA MSC
- Can be created from raw data



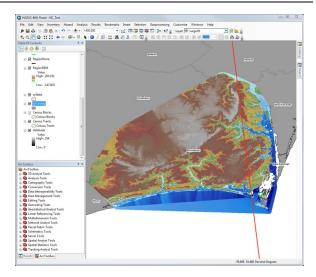
Visual 28: Defining Topography

- Required DEM extents automatically determined by Hazus
- You can use USGS national map DEM or provide your own more detailed DEM
- Terrain Data in Esri GRID format (Ex. High resolution community/county specific LiDAR, NED 10m or NED 30m)

FIT	Depth Grid	HEC-RAS	
Imeta	data		
Verti	cal units	Meters	•
Verti	cal datum	NAVD88	•
Othe	r vertical datum		
ICT DEP	n dataset(s)		Browse
			Remove
		Determine required DEM extent	
	Verti Verti Othe	t metadata Vertical units Vertical datum Other vertical datum ect DEM dataset(s)	Vertical units Meters Vertical datum NAVD88 Other vertical datum ext DEM dataset(s)

Visual 29: Delineate Floodplain

- Inundation limits
- Transects
 - Depth-limited wave heights
- Zone determination
 - A-zone
 - Coastal A-zone
 - V-zone



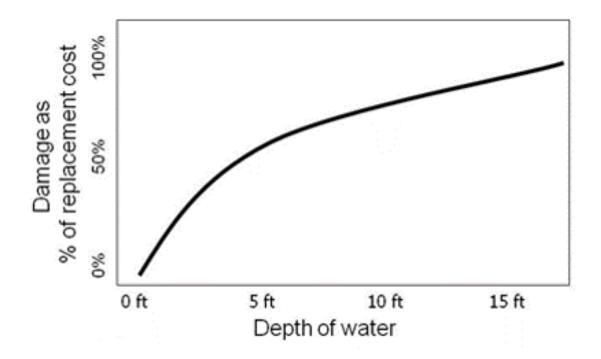
Visual 30: Surge Model

- Wind losses created first in the hurricane model.
- Storm surge depths are input into the flood model.
- Flood (surge) damages and losses utilize the flood depth damage curves.
- The combined analysis utilizes a new set of curves that combine the flood and wind losses.

uilding Type		Function Curve					
🛛 🔁 W000		1	VSF1 - Single Far	nily Homes			
	Family Homes, 1 Story - V e Family Homes, 2 or More		1 Story - Wo				
	ood Multi-Unit/Hotel/Motel		1 5001 - 110	~			
	ood Multi-Unit/Hotel/Motel ood Multi-Unit/Hotel/Motel	0.8-	- 1 - Minor - 2 - Moderate - 3 - Severe - 4 - Destruction	P P P			
	Structure Damage Functions	(Nsp		6	1		
		Stories Rasement A	4R 3R	28 -18 08	1 R 2 R 3 R	4R 5R 6	100 4100 4100 4500
	specific@ccupid	1 Story	1 000 000 2 000 000 3 000 000	0.00 300 1300		47.00 53.00 52 47.00 53.00 52	00 63.00 67.00 71.00
	3 R12N 4 R12R	2 Shey					
	4 H128 5 R13N 6 R13R	3 Story	Defeuil Source: FIA	Ourse	N Source: USACE - IMR	Select	ed Source: USACE - IN/R
varacteristics	6 H1/8 7 R15N 0 R15R	Spik Level					
Roof Shape	@_KT58	Spit Level	0ccupancy 1 RES1	powce FLA	DanageFn one floor, no bacemer	10	conneri
econdary Water Resista			2 RES1	USACE - Chicago	one story, no baceme	132	
			3 RES1	USACE - Galveston	one story, no baceme	139	
			\$ REST	USACE - New Orlean	one story. Pier founds	142	
oof-Wall Connection			6 RES1		one story. Pler founds	741	
ocf-Wal Connection arage, Houses w/out S							
oof-Wall Connection arage, Houses w/out S arage, Houses with Sh			7 RES1 8 RES1		one story, Slab found	144	
loof-Wall Connection iarage, Houses w/out S iarage, Houses with Shi huttens			8 RES1 9 RES1	USACE - New Orlean USACE - New Orlean	one story, Slab found one story, Slab found.	143	
Roof-Wall Connection liarage, Houses w/out S liarage, Houses with Shi ihutters			0 REST 9 REST 10 REST 11 REST	USACE - New Orlean USACE - New Orlean USACE - New Orlean USACE - New Orlean	one stoy, Slab lound one stoy, Slab lound one stoy, Slab lound one stoy, Shuchure,	143 154 150	
Roof Deck Attachment Roof-Wall Connection Sanage, Houses w/out S Sanage, Houses with Shu Shutters Ternain			RES1 S1 RES1 IO RES1 IO RES1 II RES1 IZ RES1	USACE - New Orlean USACE - New Orlean USACE - New Orlean USACE - New Orlean USACE - New Orlean	one stoy. Stab tound one stoy. Stab tound one stoy. Stab tound one stoy. Structure, one stoy. Structure,	143 154 150 149	
Roof-Wall Connection Sarage, Houses w/out S Sarage, Houses with Shi Shutters			8 RES1 9 RES1 10 RES1 11 RES1 12 RES1 13 RES1	USACE - New Orlean USACE - New Orlean	one stoy. Stab tound one stoy. Stab tound one stoy. Stab tound one stoy. Structure, one stoy. Structure, one stoy. Structure	143 154 150 140 173	
Roof-Wall Connection liarage, Houses w/out S liarage, Houses with Shi ihutters			RES1 S1 RES1 IO RES1 IO RES1 II RES1 IZ RES1	USACE - New Orlean USACE - New Orlean	one stoy. Stab tound one stoy. Stab tound one stoy. Stab tound one stoy. Structure, one stoy. Structure,	143 154 150 149	

Visual 31: Flood Depth-Damage Curves

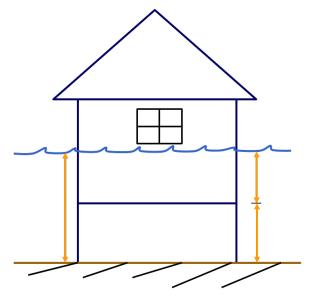
Damage to buildings and infrastructure is estimated using depth-damage curves.



Visual 32: Depth-Damage Functions

Depth-damage functions are applied to relevant depth.

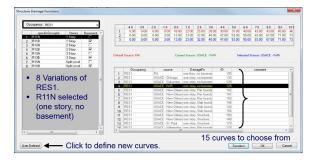
- Buildings: first-floor height
- Coastal Buildings: Bottom of first finished floor
- Equipment: height above first floor



Visual 33: Viewing Depth Damage Curves

Damage Functions	t Selection Geoprocessing Custo Buildings	Riverine	~	RES1	~			
Restoration Functions	Essential Facilities							
Parameters +	Transportation Systems		Occupancy	SpecificOccupId	Source	Description	Stories	
10-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-		1	RES1 RES1	R11N R11B	USACE - IWR BCAR - Jan 2011	one story, no baseme one story, w/ baseme		R/
Flood Warning	Utility Systems	3	REST	R12N	FIA	two floors, no baseme		- INA
	Agricultural Products	4	RES1	B128	FIA (MOD.)	two floors, w/ baseme		-
Average Annualized Loss	Agriculturar roudees	5	RES1	R13N	FIA	three or more floors, n		
Combined Wind and Flood	Vehicles	6	RES1	R13B	FIA (MOD.)	three or more floors, w		
		7	RES1	RISN	FIA	split level, no baseme		
Quick Analysis		8	RES1	R1SB	FIA (MOD.)	split level, w/ baseme	Split Level	-
Run								

Visual 34: Viewing Depth Damage Curves



Visual 35: FEMA Flood Zone A

The Special Flood Hazard Area (except coastal V Zones) shown on a community's Flood Insurance Rate Map. There are five types of A Zones:

Zone	Description
А	SFHA where no base flood elevation is provided.
A#	Numbered A Zones (e.g., A7 or A14), SFHA where the FIRM shows a base flood elevation in relation to NGVD.
AE	SFHA where base flood elevations are provided. AE Zone delineations are now used on new FIRMs instead of A# Zones.
АО	SFHA with sheet flow, ponding, or shallow flooding. Base flood depths (feet above grade) are provided.
АН	Shallow flooding SFHA. Base flood elevations in relation to NGVD are provided.

Visual 36: FEMA Flood Zone V

The Special Flood Hazard Area subject to coastal high hazard flooding.

There are three types of V Zones:

Zone	Description
V	SFHA where no base flood elevation is provided.
V#	Numbered V Zones (e.g., V7 or V14), SFHA where the FIRM shows a base flood elevation in relation to NGVD.
VE	SFHA where base flood elevations are provided. VE Zone delineations are now used on new FIRMs instead of V# Zones.

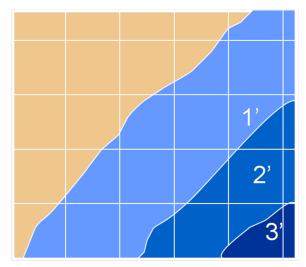
Visual 37: FEMA Flood Zone C

- Area of minimal flood hazard.
- Usually depicted on Flood Insurance Rate Maps as above the 500-year flood level.
- B and C Zones may have flooding that does not meet the criteria to be mapped as a Special Flood Hazard Area.
 - Especially ponding and local drainage problems.

Visual 38: GBS Flood Loss Estimation

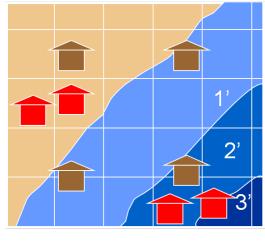
Hazus performs an area weighted assessment of damage for aggregate inventory.

- Number of grid cells at a given depth is counted and then divided by total number of cells within census block.
- Result is used to "weight" damage at that flood depth for each occupancy.
- This approach is most appropriate for large areas.



Visual 39: GBS Loss Estimation Methodology

- Assumes that inventory is evenly distributed across each census block.
 - EX: If 25% of the block has 2 feet of water, it is assumed that 25% of the 4 single family dwellings in the block are in 2 feet of water.
- Losses reported as totals for each occupancy and building type rather than for each building.





Hazus assumed location (even distribution)



Actual location

Visual 40: Combined Flood and Wind Losses

Table 8.132 in the Hurricane Technical Manual

Sub-Assembly	Pre-FIRM Foundation A Zone Conditions	Pre-FIRM Foundation CA/V Zone Conditions
Foundation	Start damaging foundation at 80% (first non-zero value is at 90%) damage and max damage at 50% Pre-FIRM value (e.g. 3% if foundation represents 6% of the structure value)	Start damaging foundation at 50% damage (first non-zero value is at 60%) and max at 80% Pre-FIRM value (e.g. 5% if foundation represents 6% of the structure value)
Below First Floor	Start damaging BFF at 0% damage (first non-zero value is 10%) and achieve 100% pre-FIRM value by 40% building damage	Start damaging BFF at 0% damage (first non-zero value is 10%) and achieve 100% pre-FIRM value at 20% building damage
Structure Frame	Start damaging structure frame at 70% damage (first non-zero value is 80%) and achieve 100% Pre-FIRM value at 100% building damage	Start damaging structure frame at 10% damage (first non-zero value is 20%) and achieve 100% Pre-FIRM value at 90% building damage
Roof Cover	Same as Structure	Same as Structure
Roof Frame	Same as Structure	Same as Structure
Exterior Walls	Start damaging exterior walls at 0% damage (first non-zero value at 10%) and reach maximum (100%) at 100% building damage. Ensure that exterior is always below interior.	Start damaging exterior walls at 10% damage (first non-zero value is 20%) and reach maximum (100%) pre-FIRM value at 90% building damage.
Interiors	Start damaging interior at 0% damage (first non-zero value at 10%) and reach maximum Pre-FIRM value (100%) at	Start damaging interiors at 0% damage (first non-zero value at 10%) and reach maximum Pre-FIRM value (100%) at

Sub-Assembly	Pre-FIRM Foundation A Zone Conditions	Pre-FIRM Foundation CA/V Zone Conditions		
	80% building damage.	80% building damage.		

Visual 41: Combined Flood and Wind Losses

- Losses from wind and surge are combined using the combined losses tables.
 - EX: When wind losses are 50% and flood losses are 20%, the combined loss is 62.5%.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
10%	10%	19.5 %	28.7 %	37.9 %	47.1 %	56.2 %	65.3 %	74.5 %	84.4 %	94.3 %	100%
20%	20%	29.1 %	37.5 %	45.9 %	54.3 %	62.5 %	70.9 %	79.4 %	89.1 %	98.9 %	100%
30%	30%	38.8 %	46.7 %	54.5 %	62.3 %	70.0 %	77.8 %	85.7 %	95.0 %	100.0 %	100%
40%	40%	48.4 %	55.7 %	62.8 %	69.9 %	76.9 %	84.0 %	91.2 %	100.0 %	100.0 %	100%
50%	50%	58.0 %	62.6 %	71.1 %	77.5 %	83.8 %	90.3 %	96.9 %	100.0 %	100.0 %	100%
60%	60%	67.6 %	73.5 %	79.3 %	85.0 %	90.6 %	96.4 %	100.0 %	100.0 %	100.0 %	100%
70%	70%	77.2 %	82.4 %	87.5 %	92.5 %	97.3 %	100.0 %	100.0 %	100.0 %	100.0 %	100%
80%	80%	86.8 %	91.4 %	95.7 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100%
90%	90%	96.4 %	100.0 %	100%							
100 %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Column Headers represent Wind-Only Building Loss percentages, Row Labels represent Flood-Only Building Loss percentages.

Visual 42: Combined Flood and Wind Losses

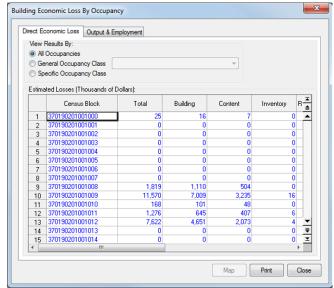
- The flood model (surge) calculates losses on the census block level: in a combined hurricane/flood model the hurricane wind model will calculate losses on the block level.
- Combined losses can only be calculated on the GBS inventory: user-defined facilities and site-specific facilities cannot be analyzed using the combined analysis.

Anal	Analysis Results		Bookmarks	Insert	Selecti			
	Build	ding Dama	ge Functions					
	Build	ding Loss F	unctions					
	Build	ding Loss o	of Use Function	ns				
	Build	ding Debri	s Functions					
	Parameters +							
	Set 0	Optimized	Analysis Mode	e OF	F			
	Run							
	Show	v Coastal S	Surge Status					

NOTE: The Set Optimization option is only available in flood/hurricane regions. If you are not interested in combined surge/wind, select this to run the hurricane model at the tract level (faster).

Visual 43: Wind-Only Economic Loss Table

Results	Bookmarks	Insert	Selection	Geoprocessing	Customize
Sto	rm Track		•	ja 🗔 🚳 🖂	►? _
Wir	nd Speeds				असे हुन्द्र
Ger	neral Building	Stock	•		
Ess	ential Facilities			<u> </u>	
Use	r Defined Faci	lities			
Del	oris				
She	lter				
Bui	Iding Econom	ic Loss	+	by Occupa	ncy
Co	mbined Wind a	and Surge	e Loss 🔹 🕨	by Building	ј Туре
Sur	nmary Reports	;			



Visual 44: Combined Wind & Flood Loss Table

esults Bookmarks Insert Selection (Combined FL	/HU Surge Direct Eco	nomic Losses For Fu	II Replacement Va	lue		• ×
View Current Scenario Results By							
Flood Hazard Maps	By General Occ	upancy By Specific O	ccupancy By Genera	l Building Type Tol	al		
General Building Stock	Results for					_	
Combined Wind and Flood Loss	Scenario: Su	rge				Return p	eriod: Mix0
Essential Facilities							
User Defined Facilities	Residential	•	Pre-Firm	-			
Advanced Building Analysis							
Transportation Systems							
		CensusBlock	BldgFloodLoss	BldgWindLoss	BldgCombLoss	ContFloodLoss	ContW 🗠
Utility Systems	1	370190201001000	6.00	8.37	14.37	3.00	
Agricultural Products	2	370190201001008	0.00	466.05	466.05	0.00	
2	3	370190201001009	0.00	2,941.58	2,941.58	0.00	
Vehicles	4	370190201001011	0.00	136.03	136.03	0.00	
Debris	5	370190201001012	0.00	1,951.88	1,951.88	0.00	
	6	370190201001050 370190201001051	0.00	328.83 430.38	328.83 430.38	0.00	
Casualties	7	370190201001051	0.00	430.38	430.38	0.00	
Shelter	8	370190201001052	0.00	315.42	315.42	0.00	
Shelter	10	370190201001054	13.00	253.80	266.80	7.00	
Indirect Economic Loss	10	370190201001055	92.00	251.49	343.49	47.00	
	12	370190201001059	130.00	472.82	602.82	68.00	
Quick Analysis Report	13	370190201001060	13.00	150.51	163.51	6.00	
Summary Reports	14	370190201001065	0.00	143.49	143.49	0.00	
, reportant	15	370190201001069	0.00	1,196.96	1,196.96	0.00	
Flood Model	•						۶.
					Close	Map	Print

Visual 45: Combined Wind & Flood Loss Table

Results	Bookmarks	Insert	Selection	Geoprocessing	Customize
Sto	rm Track		•	ji 🗟 🔯 🔁	₽• k?
Wir	nd Speeds				
Ger	neral Building S	Stock	•		_
Ess	ential Facilities			<u> </u>	<u> </u>
Use	er Defined Facil	ities			
Del	oris				
She	lter				
Bui	Iding Economi	c Loss	•		
Cor	mbined Wind a	and Surge	e Loss 🔹 🕨	by Occupa	ncy
Sur	nmary Reports			by Building	Туре

Hurricane Model

o Al	Occupancies				
© Ge	eneral Occupancy Class			_	
🔘 Sp	ecific Occupancy Class				
Estim	ated Losses (Thousands of D	ollars):			
	Census Block	Total	Building	Content	Inven
1	370190201001000	35	26	9	
2	370190201001001	0	0	0	
3	370190201001002	0	0	0	
4	370190201001003	0	0	0	
5	370190201001004	0	0	0	
6	370190201001005	0	0	0	
7	370190201001006	0	0	0	
8	370190201001007	0	0	0	
9	370190201001008	0	0	0	
10	370190201001009	0	0	0	
11	370190201001010	0	0	0	
12	370190201001011	0	0	0	
•					Þ

Visual 46: Combined Loss Summary Report

Inventory Buildings Induced Losses Other Reports Select the summary report below to view: Direct Economic Loss for Buildings Shelter Requirements Combined Wind and Surge Loss	Inventory Buildings Induced Losses Direct Losses Of	har Darasta						
	Select the summary report below to view: Direct Economic Loss for Buildings Shelter Requirements	· · ·						2 X
Results Bookmarks Insert Selection Storm Track June 1, 2011 All values are in mousaness of dollare		Preview Combined Wind and F			15:	All values are in th		ts 🛛
Wind Speeds Capital Stock Losses General Building Stock Cost Building Damage Combined Wind and Surge Loss Cost Building Damage	General Building Stock		Cost Building Damage		Inventory Loss	Total Loss	Ratio	
Essential Facilities North Carolina 2.002.094 060.791 10.577 2.871.842 3433 User Defined Facilities Debris 2.003.094 056.793 10.577 2.871.842 3433	Essential Facilities User Defined Facilities	Brunswick						
Shelter Study Region Total 2,003,694 856,731 10,377 2,071,062 34.31 Summary Reports		Study Region Total	2,003,694	856,791	10,577	2,871,062	34.31	

Visual 47: Exercise 10.3: Surge Menu

Goals:

• Explore the Surge menu items in the hurricane model and flood model. Discuss the reports and tables from the combined losses.

Time: 45 Minutes

	Exercise 10.3: Surge Menu
	Goals:
	• Explore the Surge menu items in the hurricane model and flood model.
	• Discuss the reports and tables from the combined losses.
	Time: 45 minutes
Ci di ci	1. Refer to Activities Document "10.3_Exercise_Surge Menu."
Student Manual	2. Listen to instructor's directions.
- Trantaan	3. Ask questions if clarification is needed.
	4. Follow along to complete the task with the instructor.
	5. Complete the goal assigned.
	6. Ask any final questions.

Visual 48: Exercise 10.3: Tasks

- Task 1: Define User Data
- Task 2: Create a New Scenario
- Task 3: Run the Surge Analysis
- Task 4: View Reports and Discuss Map Options

Activity 10.3: Surge Menu

Type: Instructor-Led Activity

Time: 45 minutes

Goal: Explore the Surge menu items in the hurricane model and flood model. Discuss the reports and tables from the combined losses.

Background:

This activity is a continuation of the previous activity in which you created a combined Flood/Hurricane study region and defined your analysis. This activity begins as if the analysis had just finished. Using an imported study region, you will move to the flood model, run the analysis, and view the results in table and report forms.

Task 1: Define User Data

- 1. Open Hazus.
- 2. Select Import a region and then click OK.

3. Navigate to C:\E0170_ActivityData\Activity_10.3 folder and select the Irma_Surge.hpr and click "Open".

4. Name the imported region "Irma_Surge". If you receive a duplicate log file error for "Irma_Surge" name this study region "Irma_Surge_HUFL".

5. Click "OK".

6. When the import finishes, "Open" the region and when prompted, indicate that you wish to open the Hurricane hazard.

7. From the Analysis menu select "Show Coastal Surge Status".

Coastal Surge Status	X
Coastal surge hazard ana delineate the floodplain a	lysis is complete. Switch to the Flood Model to and compute losses.
	ОК

8. Click "OK".

9. Click the Switch Hazard button and change the hazard to Flood. You can also find the switch hazard option in the File menu.

- 10. Click "Yes" if you are asked to save changes to HazusHu.mxd.
- 11. Open the Hazard menu to choose Flood Hazard Type.
- 12. Select "Coastal Surge" and click "OK".

Flood Hazard Type
Study region flood hazard type
Riverine only
Coastal only
Riverine and coastal
- Combined wind and flood
Coastal surge
OK Cancel

- 13. From the Hazard menu choose User Data and select the DEM tab.
- 14. Click Determine required DEM extent.
- 15. Once complete, click Download and Unzip All.
- 16. Click OK when complete.
- 17. Click Yes to incorporate the DEM data into the study region.

18. Click OK.

- 19. Click Yes on the Process window. This should take less than a minute.
- 20. Click OK when complete.
- 21. Navigate to the Hazard menu and choose User Data again.
- 22. Click the Coastal Surge tab.

23. This window specifies the location of the surge grids that will be used in the analysis. You can view these datasets in ArcGIS. Note that the location of your data may be different than the example shown below if your software was installed to point to a different location for study regions.

	12 222 1				
DEM	Coastal Surge				
Su	irge grids				
	urge Elevation Gr				
С	:\HazusData\Regio	ons\Irma_Sur	ge\surge.fit		
Si	ignificant Wave H	eight Grid (S	SWAN)		
С	:\HazusData\Regio	ons\Irma_Sur	ge\wavehtfit		
ogress	5			ОК	Cancel
gress	5			ОК	Cancel
ogress	5			ОК	Cancel

24. Click "OK" to process the DEM and click "Yes" to acknowledge you want to proceed. This will take less than a minute to complete.

25. Click "OK" once the DEM processing is complete.

Task 2: Create a New Scenario.

1. From the Hazard menu choose "Scenario > New".

2. Name the scenario Irma_Surge and click OK. This prompts the shoreline wizard to populate.

tionally draw shoreline startline, endli add a vertex and double click to finish eaklines only, right click a line to remo	n drawing the line. For
urrent shoreline	
< Previous Shoreline 1 c	of 1 Next Shoreline >
<u>limit type</u>	Action
Startline	Draw
Endline	
🔘 Breakline	Use Default
Breakline	Use Default

3. Accept the default shoreline limits by clicking "Next". We will use the default assumptions for the shoreline.

4. Choose "Open Coast (full exposure)" for the Wave exposure. We are choosing this for speed. Many of the shorelines are actually protected from wave exposure.

Char		of 1	Next Shoreline	
Shor	eline Type			
	Shoreline characterization			
	Wave exposure			
	Open coast (full exposu	le)	<u> </u>	

5. Click "Finish".

6. From the Hazard menu choose "Coastal > Delineate Floodplain". This will take approximately 5 minutes to complete.

7. Once completed, click "OK". You should now see the storm surge flood depth grid appear on the map.

Task 3: Run the Surge Analysis

1. From the Analysis menu choose "Run".

2. Click Select All and then unselect the "What-If" option. If you do not unselect the What-If option the combined losses may not populate.

3. Click "OK" to start the analysis. This will take approximately 10 minutes to complete. If you have not taken a break, this is a good time for a short break.

4. When prompted enter September 12 as the flood date and click "OK".

5. Click "OK" once the flood analysis has completed.

6. From the Analysis menu choose Combined Wind and Flood...This initializes the combined hurricane wind and surge analysis.

7. Click OK to begin the analysis.

8. Click "OK" when you are informed that the combined analysis has completed.

Combined Coastal Surge analysis
The Combined Hurricane Flood Coastal Surge analysis has finished.
ОК

Task 4: View Reports and Discuss Map Options

- 1. From the Results menu choose View Current Scenario Results By...
- 2. Under Available Results choose "Mix0".

Scenario Name: Irma_Surge Scenario Description: Available Results: Mix0 What-If Options:	X
Scenario Description: Available Results: Між0	
Available Results: Mix0	
МіжО	
What-If Options:	×
OK Cancel	

3. Click "OK".

4. From the Results menu choose Combined Wind and Flood Loss. This table contains the flood only, wind only, and combined losses for each census block.

y General Oci	cupancy	By Specific O	ccupancy By General	l Building Type T	otal		
Results for Scenario: Ir	ma_Surge	1				Return pe	eriod: Mix0
Residential		~	Pre-Firm	~			
	Ce	nsusBlock	BidgFloodLoss	BldgWindLoss	BldgCombLoss	ContFloodLoss	ContW
1		0228022027	0.00	1.9		0.00	
2	121030	0253051012	0.00	6.0	6.00	0.00	
3	121030	0254172005	0.00	0.0	5 0.05	0.00	
4	121030	0269042010	0.00	0.7	5 0.75	0.00	
5	121030	0273101007	0.00	0.1	2 0.12	0.00	
6	121030	0240043024	0.00	3.8	3.89	0.00	
7	121030	0227001024	0.00	0.7	2 0.72	0.00	
8	121030	0242002029	0.00	4.3	4.30	0.00	
9	121030	0244102010	0.00	0.4	5 0.45	0.00	
10	121030	0244131000	0.00	1.0	3 1.08	0.00	
11	121030	0250113001	0.00	0.8	2 0.82	0.00	
12	121030	0270003018	0.00	4.1		0.00	
13	and the second second	0234002016	0.00	3.0		0.00	
14	121030	0246013043	0.00	0.2	2	0.00	
	121030	0250043042	0.00	1.5	6 1.56	0.00	
15				10.73			>

5. Close the Combined FL/HU Surge Direct Economic Losses For Full Replacement Value window.

- 6. From the Results menu choose Summary Reports.
- 7. Click on the Losses tab.

8. Click on the "Combined Wind and Surge Loss" report and then click "View". This is the combined losses report.

nventory	Buildings	Lifelines	Induced	Losses	Other	
	select the su					
Combin	lized Direct E ned Wind an ciated Direct	d Surge Lo:	88			
Direct Direct Direct Direct	Economic Lo Economic Lo Economic Lo Economic Lo Economic Lo Economic Lo	osses For B osses For T osses For U osses For U	uildings ransportatio DFs	n		
Direct Indirec Indirec	Economic Lo t Economic I t Economic I Requiremer	osses For V mpact With mpact With	ehicles (Nig hAid	ĥt)		
Direct Indirec Indirec	Economic Lo t Economic I t Economic I	osses For V mpact With mpact With	ehicles (Nig hAid	ht)		
Direct Indirec Indirec	Economic Lo t Economic I t Economic I	osses For V mpact With mpact With	ehicles (Nig hAid	ht)		

- 9. "Close" the report.
- 10. Click the Switch Hazard button and go back to the Hurricane hazard.
- 11. When prompted, click "Yes" to save your changes.
- 12. Under the Results menu choose Combined Wind and Surge Loss > By Occupancy.
- 13. The table shows the combined losses. "Close" the window when you have viewed the layout.
- 14. From the Results menu choose Summary Reports.
- 15. Click on the Direct Losses tab.

16. Click on the Combined Wind and Surge Loss report and then click "View". Notice that the losses reported in this report are identical to the report that you viewed in the flood model. This report is provided in both the hurricane and flood models for the user's convenience.

- 17. Close the Summary Report.
- 18. When you are finished click "Save".
- 19. Exit Hazus.

Visual 49: Lesson 10: Review

- 1. What are the causes of a storm surge?
- 2. What are the Hazus surge model components?
- 3. What is the procedure for running a hurricane surge in Hazus?
- 4. How do the hurricane and flood model damage and loss analyses differ (not combined)?

Visual 50: Questions?

Lesson 11: Mitigation Analysis

Visual 1: Lesson 11: Mitigation Analysis



Visual 2: Lesson 11: Goal and Objectives

Goal: To provide an overview of the mitigation analysis provided in Hazus.

After completing this lesson you will be able to:

- Understand the common mitigation practices for hurricanes.
- Explain how mitigation is modeled in Hazus.

Visual 3: Applying Mitigation

- In Hazus: Modifying wind building mapping scheme
- Can be applied:
 - One technique at a time
 - Many techniques at once
- Can be applied geographically:
 - Entire region
 - Specific census tracts
- Applies to all building classes

Visual 4: Possible Uses of Mitigation Options

Identify mitigation options with best return on investment.

- Answers depend on local hurricane climatology and building stock
- Additional information required: mitigation cost data

Predict impact of building stock changes:

- New building codes
- New construction trends

Visual 5: Mitigation of Damage: Options for...

Single-Family or Multi-Family Residential:

- Roof covering
- Secondary water resistance
- Roof sheathing attachment
- Roof framing attachment
- Opening protection

Manufactured Homes:

- Tie-downs
- Opening protection

Mapping Scheme	
Southeast_Inland	
Single Family Multi-Family Commercial Industrial	
Single Family Homes	Mitigate
Shutters on All Windows and Entry Doors	0 🔪 %
Roof-wall Connection Clips/Straps	0 🔹 %
Superior Wood Roof Deck Attachment	0 🔹 🗶 🗖
Secondary Water Resistance	0 🔿 🗶 🔳
Manufactured Homes	
Shutters on All Windows and Entry Doors	0 🚔 % 📃
Tie Downs	0 🔪 %
	OK Cancel

Visual 6: Mitigation of Damage: Options for...

Commercial buildings (low-rise strip mall buildings):

- Shutters on all windows and entry doors
- Roof-wall connection clips/straps
- Superior wood roof deck attachment
- Superior metal roof deck attachment

Commercially engineered buildings, low rise industrial buildings, and pre-engineered metal buildings:

- Superior metal roof deck attachment
- Opening protection

Visual 7: Roof Covering

- Best solution to mitigate loss of roof cover:
 - Replacement of inferior products with superior ones
- Consider life span of roof:
 - Shingles: 10-25 years
 - Tiles: 50+ years
- Consider cost of replacement:
 - Shingles: Approx. \$3,000-5,000 (relatively cheap)
 - Tiles: Approx. \$20,000 (relatively expensive)
- Hazus model does not include models for concrete tiles or metal roofs (except Hawaii)

Visual 8: Shingle Roof Covering Standards

Testing Standards:

- ASTM D7158 (modified to 115 mph)
- SFBC PA 107 or PA 108: Dade County test for wind resistance of shingles
- UL 997 modified to 110 mph: Make sure it is high wind version of test

Visual 9: Secondary Water Resistance (SWR)

Applied on all plywood joints

Applied on all plywood joints



Visual 10: Secondary Water Resistance (SWR)

- Roof cover loss is likely.
- SWR serves as backup in event of roof covering losses.
 - Self-adhering waterproof underlayment
 - Meets ASTM D 1970
 - Apply at time of normal re-roofing



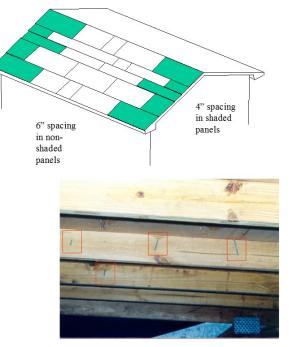
Visual 11: Roof Sheathing Attachment

Re-nail with tighter nail spacing:

- SSTD 10-99: Latest code requirements are 6"x6" spacing in high wind areas
- Re-nail during re-roofing option

Re-nail with stronger fasteners:

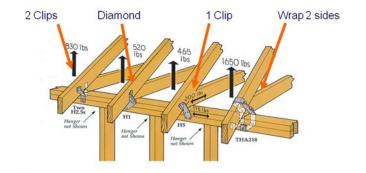
- Larger nails
- Ring shank nails
- Screws



Not a good option for expensive roof coverings such as tile or slate

Visual 12: Roof Framing Attachment

Typical hurricane strap



Visual 13: Opening Protection

Openings include:

- Windows
- Doors (including patio and French doors)
- Sliding glass doors
- Garage doors
- Skylights

Protection takes two forms:

- Replace existing fenestration with one that is impact-resistant
- Install external protection devices that are impact-resistant

Visual 14: Opening Protection

Large Missile Impact Test:

- Firing a 2x4 at approximately 50ft/s at product
- Product passes if it remains operable after resisting impacts

Four Dominant Impact Standards:

- ASTM E 1996 9lm missile
- SBCCISSTD 12-97
- Dade County South Florida Building Code PA 201
- Florida Building Code TAS 201

Small Missile Impact Test:

• Approx. 20 pieces of gravel are fired with a cannon at the product

NOTE: These tests also include a pressure cycling component

Visual 15: Opening Protection

	Opening Protection
	• Transcript of the video:
	• 00:01 "Ready"
Student Manual	• 00:03 "Fire"
	• The video demonstrates a large missile impact test where a 9lb 2x4 is shot from an air cannon at a shutter specimen. The shutter withstands the impact of the missile.

Visual 16: External Protection Devices (Shutters)



Visual 17: Shutters vs. Impact Resistant

Replacement of doors/windows vs. external protection devices Exceptions:

- Garage doors: Large spans make shuttering difficult
- Entry doors: One entry door to the building is replaced with an impact resistant product to allow for egress regulations in building code
- Skylights: Very few external protection devices exist

Visual 18: Replacement Garage Door

Impact door features:

- Ribs to reinforce panel
- Heavy track

Alternative retrofit:

• Post system



Visual 19: Other Information

Fortified for Safer Living:

- By Institute for Business and Home Safety
- For more information visit: disastersafety.org

Blueprint for Safety:

• By Federal Alliance for Safe Homes

For more information visit: www.flash.org

Coastal Construction Manual:

- Principles and Practices of ... Residential Buildings in Coastal Areas
- FEMA P-55, 4th Edition (2011)
- For more information visit: <u>https://www.fema.gov/media-library/assets/documents/3293</u>







Coastal Construction Manual Process and Protoces of Perving, Sting, Designing, consistories and Management Buildings in Coastar Association Broath Galloos IEBMAP55 (Volume 1/ August 2011

€FEMA

Visual 20: Mitigation Benefits (SE Florida)

Single-Family Homes	Reduction in Annualized Hurricane Losses (AHL)
Install Shutters	17% to 46%
Upgrade Roof	3% to 49%
Add Secondary Water Resistance	3% to 35%
Upgrade Roof and Add SWR	4% to 57%
Install Shutters and Upgrade Roof	46% to 71%
Shutters, Upgrade Roof and SWR	51% to 85%
Manufactured Homes	Reduction in AHL
Foundation Tie-Down	9% to 25%

Visual 21: Discussion 11.1: Mitigation Options

Goal:

• Discuss mitigation options.

Time: 10 minutes

Visual 22: Exercise 11.2: Mitigation Actions

Goals:

- Run various mitigation scenarios.
- Compare and contrast the results.

Time: 45 minutes

Visual 23: Exercise 11.2: Tasks

- Task 1: Create a Study Region
- Task 2: View the Pre-Mitigation Annualized Loss Estimates.
- Task 3: Create and Apply a Mitigation Mapping Scheme.
- Task 4: View the Post-Mitigation Annualized Loss Estimates.
- Task 5: Compare the Estimated Losses

Exercise 11.2: Mitigation Actions

Type: Student-Led Activity

Time: 45 minutes

Goals:

- Run various mitigation scenarios.
- Compare and contrast the results.

Background:

This exercise illustrates the type of strategies you can pursue for evaluating the risk posed by hurricanes. To examine this risk, you will import a completed probabilistic analysis, examine its losses, implement mitigation strategies to the building stock, and examine the reduction in annualized losses from the hurricane. This type of approach is often useful when developing mitigation strategies since communities work with limited resources and they must use the best information available, often prepared with tools such as Hazus, to apply those resources in the most effective manner possible.

Task 1: Create a Study Region.

- 1. Double-click the Hazus icon on your desktop.
- 2. Click Create a New Region and click OK.
- 3. Click Next.
- 4. Enter Michael_Mitigation as the study region name.
- 5. Check the box next to the Hurricane hazard.
- 6. Click Next.
- 7. Click No to using the Hurricane Scenario Wizard to create the study region.
- 8. Select County and click Next.
- 9. Choose Florida and then click Next.
- 10. Select Gulf county and then click Next.
- 11. Click Finish and open the region

Task 2: View the Pre-Mitigation Annualized Loss Estimates.

- 1. From the Hazard menu choose Scenario.
- 2. Click Next.
- 3. Choose Probabilistic and make sure radio button next to Activate is filled.
- 4. Click Next.
- 5. Click Next on the Activate Scenario window.
- 6. Click Finish.

7. Go to Analysis and then Run.

8. Select all except for the Automated Output Options and click Run Analysis.

9. From the Results choose General Building Stock > Building Economic Loss > by Occupancy to open the Building Economic Loss by Occupancy window.

10. Click the Direct Economic Loss tab and verify that View Results by All Occupancies is selected.

11. Change the Return Period to "Annualized".

	conomic Loss	Output & E	mployment				
	Results By:					Return Perio	od:
⊖ Ge	Occupancies eneral Occupan pecific Occupan				~	Annualized	
_	ated Losses (Th		Dollars):				
1	Census T	ract	Total	Building	Content	Inventory	Relocati 🔺
1	12045960100)	356	243	77	1	
2	12045960200)	445	291	99	1	-
3	12045960300)	623	425	135	0	

12. Select the Total column and click the "Map" button. This will add the layer "Total Loss - All - Annualized (\$K)" to the map.

13. Click "Close" to close the Building Economic Loss by Occupancy window.

14. Right-click the Total Loss - All Annualized (\$K) layer and choose "Data" > "Export Data" to open the Export Data window. Note: This layer will be used to compare the pre-mitigation losses with the post mitigation losses to calculate the savings associated with applying the mitigation actions.

15. In the Export Data window click on the "Browse" folder icon.

16. Navigate to C:\E0170_ActivityData\Exercise_11.2 and name the file "Total_Loss_Annualized_Before".

17. Change the Save as type drop-down menu to "Shapefile".

bok in:	Exercise_11.2		~	仓 🟠	•	2		9
lame:	Total_Loss_A	Annualized_Be	efore.shp			[Save	e

- 18. Click "Save" to close the Saving Data window.
- 19. Click "OK" to close the Export Data window.
- 20. Answer "Yes" to add the exported data to the map as a layer.

Task 3: Create and Apply a Mitigation Mapping Scheme.

1. From the Inventory menu choose General Building Stock > Wind Building Characteristics Distribution to open the Wind Building Characteristics Distribution window.

2. At the bottom of the window click on Florida_North and then click "View".

3. Double-click on the Wood folder and then click on WSF1 - Single Family Homes, 1 Story – Wood.

4. Scroll down to the Shutters Category. Note: The percentage of homes with shutters (8%) and the percentage without (92%). We will apply a mitigation scheme that will increase this percentage later.

5. Click "OK" to close the Wind Building Characteristics Distribution Window.

6. Click on "Gulf, FL" from the Counties selection box. Notice all of the census tracts in Gulf, FL are assigned the Florida_North mapping scheme.

tates:	Counties:	Mapping Schemes:	Florida_Central	~	Apply
lorida	Gulf, FL	Census Tract	Mapping	Scheme	
		12045960100	Florida	_North	
		12045960200	Florida_North		
		12045960300	Florida_North		
anning Scheme Manag	ement	Census Block Lis	st Census Tract List () County Lis	ł
	ement:	Census Block Lis) County Lis	t View
Scheme Name	Туре		Date Modified) County Lis	View
Scheme Name Southeast_Inland		Date Created	Date Modified	County Lis	View Copy
Scheme Name Southeast_Inland Southeast_Coastal	Type System	Date Created 03/13/2003	Date Modified 03/13/2003 03/13/2003	County Lis	View
Southeast_Inland Southeast_Coastal Northeast_Inland	Type System System	Date Created 03/13/2003 03/13/2003	Date Modified 03/13/2003 03/13/2003 03/13/2003	County Lis	View Copy
Scheme Name Southeast_Inland Southeast_Coastal Northeast_Inland Northeast_Coastal	Type System System System	Date Created 03/13/2003 03/13/2003 03/13/2003	Date Modified 03/13/2003 03/13/2003 03/13/2003 03/13/2003	County Lis	View Copy Edit Delete
Scheme Name Southeast_Inland Southeast_Coastal Northeast_Inland Northeast_Coastal Florida_Southeast	Type System System System System	Date Created 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003	Date Modified 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003	County Lis	View Copy Edit Delete Import
apping Scheme Manag Scheme Name Southeast_Inland Southeast_Coastal Northeast_Coastal Florida_Southeast Florida_North	Type System System System System System	Date Createc 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003	Date Modified 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003	County Lis	View Copy Edit Delete

7. Select the Florida_North mapping scheme on the bottom half of the window and indicate that you want to create a new Mapping scheme by clicking "Mitigate".

8. Name the new Mapping Scheme Florida_North_Mitigated and change the percentage of Shutters on All Windows and Entry Doors for Single Family Homes to 100%.

Note: This will simulate a program that would provide incentives to existing residential housing to shutter and require all new housing to be constructed with shutters.

9. Click the check box to Mitigate next to the 100% increase.

lorida_North_Mitigated		
ingle Family Multi-Family Commercial Industrial		
Single Family Homes Shutters on All Windows and Entry Doors	100 🚔 %	Mitigate
Roof-wall Connection Clips/Straps	0 🔹 %	
Superior Wood Roof Deck Attachment	0 . ↓ %	
Secondary Water Resistance	0 🔺 %	
Manufactured Homes		
Shutters on All Windows and Entry Doors	0 🔺 %	
Tie Downs	0 🔹 %	

10. Click "OK" to close the Mitigate Hurricane Building Characteristics Scheme window. In the next few steps you will apply the new mitigated mapping scheme to the whole study region.

11. Select Gulf, FL from the counties in the middle box. Select the County List radio button.

- 12. Under the County column in the window to the far right select Gulf, FL.
- 13. Choose Florida_North_Mitigated from the Mapping Schemes drop-down box.
- 14. Click "Apply" to ensure the mitigation options are applied.

lorida		Mapping Schemes:	Florida_North_Mitigated	~	Apply	
	Gulf, FL	County	Mapping S	cheme		
		Gulf, FL	Florida_North_Mitigated			
apping Scheme Management	85455	Census Block Lis		County List	t	
			Date Modified		12	
Scheme Name	Туре				View	
Southeast_Inland	System	03/13/2003	03/13/2003		View Copy	
Southeast_Inland Southeast_Coastal	System System		03/13/2003 03/13/2003			
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Southeast_Inland Southeast_Coastal Northeast_Inland Northeast_Coastal Florida_Southeast	System System System System System	03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003	03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003 03/13/2003		Copy Edit Delete	
Southeast_Inland Southeast_Coastal	System System	03/13/2003 03/13/2003	03/13/2003 03/13/2003		Co	

15. Click "OK" to close the Wind Building Characteristics Distribution window.

16. Navigate to the Analysis menu and click on "Analysis > Run". Select all of the options except the Automated Output Options and then click "Run Analysis".

17. Once the analysis has finished click "OK".

Task 4: View the Post-Mitigation Annualized Loss Estimates.

1. From the Inventory menu choose General Building Stock > Wind Building Characteristics Distribution to open the Wind Building Characteristics Distribution window.

2. At the bottom of the window click on Florida North Mitigated and then "View."

3. Double-click on the Wood folder and click on WSF1 – Single Family Homes, 1 Story – Wood.

4. Scroll down to the Shutters Category. The percentage of shutters should have increased to 100%.

5. Click "OK" to close the Florida_North_Mitigation mapping scheme.

6. Click "OK" to close the Wind Building Characteristics Distribution window.

7. From the Results menu choose General Building Stock > Building Economic Loss > By Occupancy to open the Building Economic Loss by Occupancy window.

8. Click the Direct Economic Loss tab and verify that View Results by All Occupancies is selected.

9. Click Annualized from the Return Period drop down selection.

10. Select the Total column and click on "Map". This will add the layer "Total Loss - All - Annualized (\$K)" to the map.

		& Employment				
	Results By: Occupancies				Return Perio	od:
Ge	eneral Occupancy Class		Annualized			
⊖ Sp	ecific Occupancy Class	B ^{ala}				
Estima	ated Losses (Thousands	of Dollars):				
1	Census Tract	Total	Building	Content	Inventory	Relocati 🔼
1	12045960100	327	226	69	1	
2	12045960200	385	258	81	1	
3	12045960300	535	374	109	0	
						× = ×

11. Click "Close" to close the Building Economic Loss by Occupancy window.

12. Right-click the Total Loss - All - Annualized (\$K) layer and choose Data > Export Data from the layer context menu to open the Saving Data window.

13. In the Saving Data window click on "Browse".

14. Navigate to C:\E0170_ActivityData\Exercise_11.2 and name the file Total_Loss_Annualized_After.shp

15. Select Shapefile from the Save as type drop-down menu.

16. Click "Save" to close the Saving Data window.

ook in: 🛛 🛅	Exercise_11.2	`	~ 💪	6	a 🗊	-	21	EII	
	Annualized_Befor								
aj lotal_coss_	Annualized_beron	ersub							
lame:	Total_Loss_Annu	alized_After					Γ	Sav	e

- 17. Click "OK" to close the Export Data window.
- 18. Answer "Yes" to add the exported data to the map as a layer.

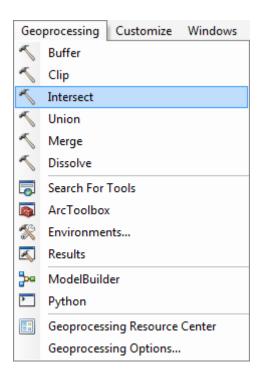
Task 5: Compare the Estimated Losses

In the following section you will be using ArcGIS tools to compare the total annualized losses pre and post mitigation. You should have exported two layers:

- Total annualized losses calculated by Hazus without mitigation options applied
- A layer of total annualized losses calculated by Hazus with all of the mitigation options applied.

The Intersect tool in the ArcToolbox will be used to combine the results into one layer. Once this layer has been created you will then calculate the differences in losses within each census tract.

1. From the Geoprocesssing menu choose "Intersect".



2. For Input feature class select both the Total_Loss_Annualized_After layer and the Total_Loss_Annualized_Before layer.

3. For Output feature class, click "Browse" and navigate to the

C:\E0170 ActivityData\Exercise 11.2 folder and enter "Savings".

4. Click "Save". Leave all of the other default settings as they are.

Note: If necessary, use the arrows to move the position of the before and after layers. They must be in the order shown for the process to work correctly. The Intersect window should appear as shown below.

					- 6
Features				Rank	s 🕇
Total_Loss_Annu	ualized_Before				×
Total_Loss_Annu	ualized_After				
					1
					+
<					>
Output Feature Class					
C:\Users\Hazus\Des	ktop\E0170_A	ctivityData\Exer	cise_11.2\\$	avings.shp	2
IoinAttributes (option	ial)				0
ALL					~
(Y Tolerance (optiona	al)				
	2380		D	ecimal degrees	~
Dutput Type (optiona INPUT	l)				
INPUT					~

5. Click "OK" to complete the intersect process.

6. Right-click on the Savings layer (which should have appeared at the top of the table of contents) and choose "Open Attribute Table" to view the attributes of the data.

Tip: If the Savings layer does not appear in the Table of Contents window, use the Add Data button and add it to the table of contents window.

7. Click Table Options in the Savings table and select "Add Field".

8. Enter "Savings" as the field name and select "Double" as the field type.

Add Field	2X 8
Name:	Savings
Type:	Double 💌
- Field Prop	erties
Precisio	n 0
Scale	0
	OK Cancel

9. Click "OK" to add the new field which should appear at the end of the table.

BCurrent_1	Total_1	Building_1	Content_1	Inventor_1	Relocati_1	Income_1	Rental_1	Wage_1	huScenar_1	RPString_1	Savings	
	326.942748	226.299957	68.660932	0.696812	18.11244	1.524326	7.963281		Probabilistic	Annualized		
	385.424676	257.53712	81.416568	1.235144	24.361998	4.128442	11.094114		Probabilistic	Annualized		
	534.633166	373.827577	108.645194	0.411538	29.065071	3.765254	12.866305	6.052248	Probabilistic	Annualized		1

10. Right-click on the Savings field and select "Field Calculator".

Tip: If asked, click "Yes" when prompted to indicate that you know that your edits cannot be undone. The field calculator allows calculations on fields in the attribute table.

11. Create an expression that says [Total] - [Total_1] as shown below. This expression produces an output that reflects the savings resulting from your mitigation action.

Field Calculator			2 ×	
Parser VB Script Fields: SHAPE_Ar_1	Python	Type:	Functions:	
TRACT_1_13 Occupanc_1 Return_P_1 BCurrent_1 Total_1 Building_1 Content_1 Inventor_1	T	 Number String Date 	Atn () Cos () Exp () Fix () Int () Log () Sin () Sqr () Tan ()	
Show Codeblock Savings = [Total] - [Total_1]		*	/ & + - =	
	Clear	Load	Save Help OK Cancel	

- 12. Click "OK" to run the calculation and to update the Savings field.
- 13. Close the Savings table by clicking Close in the upper right corner of the table window.

14. Right-click on the Savings layer and choose "Properties" to open the Layer Properties window.

- 15. Click the Symbology tab to view the Symbology options.
- 16. Select the Graduated colors option under the Quantities menu.
- 17. Select "Savings" as the value field.
- 18. Select "Total" as the field by which to normalize.

Note: Normalizing data is very important since it establishes a foundation by which to compare values. For instance, population totals are often normalized by the area in which the population is located, thus creating a population density.

eneral	0	C 1	D: I	Symbology	E 11	D.C	1.1.1	1	T		
	Source	Selection	n Display	Symbology	Fields	Definition Query	Labels	Joins & Relates	Time	HTML Popup	
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atego		-	Fields		Classification						
Quantities Graduated colors Graduated symbols		Value:	Savings		~	Na	tural Breaks (Jenk	s)			
	ors					Classes:	2 (1-	ssify			
	IDUIS	Norm <mark>a</mark> lizati	on: lotal		~	Classes:		solly			
	ortional sy										
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	e Attribut		Symbol	Range		Lab	el				
unpro			0	0.081955880		0.08	196				
				.081955881 -	0.13432	8188 0.08	197 - 0.1	343			
			0	.134328189 -	0.14242	5645 0.13	44 - 0.14	24			
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2	E.	-									
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3412	A.		Show cla	ss ranges usir	a festure	a valuee		Ada	anced .	-	
		The second									

19. Click on the Labels tab.

20. Click in the check box next to Label features in this layer to turn the labeling on in this layer.

21. Click Expression to open the Label Expression window and enter "Round (100*[Savings]/ [Total],2)" as the label expression. This expression produces a label that shows the percentage of savings and rounds the value to two decimal places.

Label Expression	x
Expression	
Fields	_
Double-click to add a field into the expression Show <u>Type</u>	
FID	-
FID_Total_	
OBJECTID	
tract	
SHAPE_Leng	
SHAPE_Area	
Append Show Values Visplay coded value description	
Append Show Values Visplay coded value description	
Expression	51
Write the expression in the language of the selected parser.	
Round (100*[Savings]/ [Total] ,2)	
Round (100*[Savings]/[Total],2)	
Verify Reset Help Load Save	
Parser: VBScript	
OK Cance	
OK Cance	3

22. Click "OK" to close the Label Expression window and then "OK" to close the Layer Properties window and to update the map. The values shown on the map represent percentage reduction of total losses that were achieved through the mitigation measures that you imposed on the region. Notice the spatial differences in these reductions.

23. Use the layer to answer the following questions:

This exercise demonstrates what the overall reduction in annual losses would be for only Single Family Residential homes if every home in the community had shutters or an increase of 92% of shuttering (8% was already assumed to have shuttering).

Question	Answer

Question	Answer
What is the minimum percentage of savings after mitigating the study region?	
What is the maximum percentage of savings after mitigating the study region?	
What was the total savings (in dollars)?	

24. Exit Hazus and select "Yes" when prompted to indicate whether you wish to save your changes.

Visual 24: Lesson 11: Review

- 1. What are the four occupancy types that can be mitigated in Hazus?
- 2. What are two types of opening protection?
- 3. What is the potential reduction in loss from shuttering a structure?

Visual 25: Questions?

Lesson 12: Hazus for Response and Recovery

Visual 1: Lesson 12: Hazus for Response and Recovery



Visual 2: Lesson 12: Goal and Objectives

Goal: To provide an overview of how to set up Hazus for response and recovery operations.

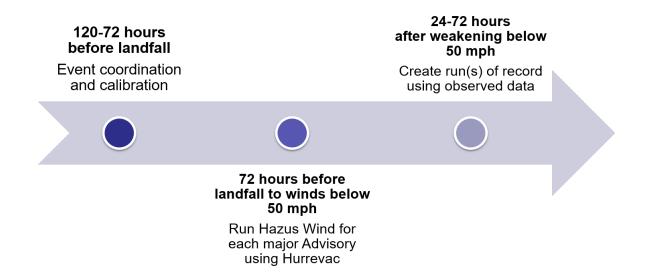
After completing this lesson, you will be able to:

- Read and understand a Tropical Forecast Advisory.
- Understand how to input a Tropical Forecast Advisory into Hazus.

Visual 3: Hazus for Response and Recovery

- Predicting effects of hurricanes: Warning time of hurricanes is typically 3-5 days
- During hurricane season: Advisories are issued every six hours for all tropical storms with intermediate advisories for landfalling for rapidly changing storms
- Current position/strength and predicted position/strength can be used to make estimates of likely damage.

Visual 4: When to Start Running Hazus



Visual 5: Obtaining Storm Data

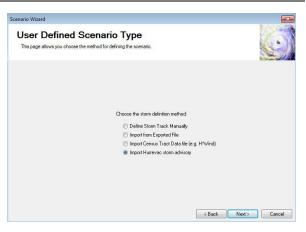
- Tools for manual entry of storm data:
 - Designed to allow users to run analysis in Hazus based on forecast advisories.
 - National Hurricane Center of the National Weather Service offers several products.
 - Forecast advisories contain all information needed for Hazus.

Home Mobile Site Text Version RSS			Local Forecast	City, St. or ZIP code
S NATIONAL HUR	RICANE CENTI	ER		
ANALYSES & FORECASTS * DATA & TOOLS *	EDUCATIONAL RESOURCES *	ARCHIVES .	ABOUT NHC .	SEARCH .
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ontents				
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Tropical Cyclone Reports

Visual 6: User Defined (Single Storm) Scenario

- User-Defined Scenario Type offers four options for data
- Hurrevac or Census tract data file should be used for recovery once observed data are available



Visual 7: Typical Storm Parameters

Typical Storm Parameters

Saffir Simpson Scale	1 Min Mean (mph)	3 sec Gust (mph)	Min Central Pressure (mb)
1	74-95	90-116	980 and greater
2	96-110	117-134	965-979
3	111-129	135-159	945-964
4	130-156	160-189	920-944
5	157+	189+	920 and below

1 min mean = Hazus Input Windspeeds

3 sec gust = Hazus Output Windspeeds

Visual 8: Using Forecast Advisories

- Forecast advisories: Text files that are available for download.
- Contain storm data:
 - Lat/Long
 - Central pressure
 - Radius to hurricane winds
 - Translation speed of storm
- Units:
 - Times UTC.
 - Distances nautical miles.
 - Wind speeds knots.

ZCZC MIATCMAT2 ALL TTAA00 KNHC DDHHMM HURRICANE KATRINA FORECAST/ADVISORY NUMBER 25 NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL122005 0300Z MON AUG 29 2005

A HURRICANE WARNING IS IN EFFECT FOR THE NORTH CENTRAL GULF COAST FROM MORGAN CITY LOUISIANA EASTWARD TO THE ALABAMA/FLORIDA BORDER...INCLUDING THE CITY OF NEW ORLEANS AND LAKE FONTCHARTRAIN. PREPARATIONS TO PROTECT LIFE AND PROFERTY SHOULD BE RUSHED TO COMPLETION.

A TROPICAL STORM WARNING AND A HURRICANE WATCH ARE IN EFFECT FROM EAST OF THE ALABAMA/FLORIDA BORDER TO DESTIN FLORIDA...AND FROM WEST OF MORGAN CITY TO INTRACOASTAL CITY LOUISIANA.

A TROPICAL STORM WARNING IS ALSO IN EFFECT FROM DESTIN FLORIDA EASTWARD TO INDIAN PASS FLORIDA...AND FROM INTRACOASTAL CITY LOUISIANA WESTWARD TO CAMERON LOUISIANA.

HURRICANE CENTER LOCATED NEAR 27.6N 89.4W AT 29/0300Z POSITION ACCURATE WITHIN 10 NM

PRESENT MOVEMENT TOWARD THE NORTH-NORTHWEST OR 335 DEGREES AT 9 KT

ESTIMATED MINIMUM CENTRAL PRESSURE 904 MB MAX SUSTAINED WINDS 140 KT WITH GUSIS TO 170 KT. 64 KT......90NE 90SE 50SW 80NW. 50 KT.....110NE 100SE 75SN 100NW. 34 KT.....200NE 200SE 150SW 180NW. 12 FT SEAS..32SNE 250SE 250SW 22SNW. WINDS AND SEAS VARY GREAILY IN EACH QUADRANT. RADII IN NAUTICAL MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.

REPEAT...CENTER LOCATED NEAR 27.6N 89.4W AT 29/0300Z AT 29/0000Z CENTER WAS LOCATED NEAR 27.2N 89.1W

FORECAST VALID 29/12002 29.2N 89.7W MAX WIND 135 KT..GUSTS 165 KT. 64 KT.. 90NE 90SE 50SW 60NW. 50 KT..110NE 110SE 75SW 75NW. 34 KT..200NE 200SE 150SW 150NW.

Visual 9: Using Forecast Advisories

To run the uncertainty analysis, user must enter the times in standard advisory format (0, 9, 21, 33, 45, 69).

```
HURRICANE CENTER LOCATED NEAR 27.6N 89.4W AT 29/0300Z
POSITION ACCURATE WITHIN
                        10 NM
PRESENT MOVEMENT TOWARD THE NORTH-NORTHWEST OR 335 DEGREES AT 9 KT
ESTIMATED MINIMUM CENTRAL PRESSURE 904 MB
MAX SUSTAINED WINDS 140 KT WITH GUSTS TO 170 KT.
64 KT..... 90NE 90SE 50SW 80NW.
50 KT.....110NE 100SE 75SW 100NW.
34 KT..... 200NE 200SE 150SW 180NW.
12 FT SEAS... 325NE 250SE 250SW 225NW.
WINDS AND SEAS VARY GREATLY IN EACH QUADRANT. RADII IN NAUTICAL
MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.
REPEAT...CENTER LOCATED NEAR 27.6N 89.4W AT 29/0300Z
AT 29/0000Z CENTER WAS LOCATED NEAR 27.2N 89.1W
FORECAST VALID 29/1200Z 19.2N 89.7W
MAX WIND 135 KT...GUSTS 165 KT.
64 KT... 90NE 90SE 50SW 60NW.
50 KT...110NE 110SE 755W 75NW.
34 KT...200NE 200SE 150SW 150NW.
FORECAST VALID 30/0000Z 11.8N 89.5W...INLAND
MAX WIND 85 KT...GUSTS 105 KT.
64 KT... 50NE 50SE 30SW
                          50NW.
50 KT... 75NE 75SE 50SW 75NW.
34 KT...125NE 175SE 75SW 100NW.
FORECAST VALID 30/1200Z 4.8N 88.1W...INLAND
MAX WIND 45 KT...GUSTS
                        55 KT.
34 KT... 75NE 75SE 25SW 50NW.
FORECAST VALID 31/0000Z 17.7N 85.9W...INLAND
MAX WIND 30 KT...GUSIS 40 KT.
FORECAST VALID 01/0000Z 43.5N 78.5W...INLAND
MAX WIND 25 KT... GUSTS
                       35 KT.
```

Times in Standard Advisory Format	Day of Current Month	Forecast Time
0 hours Start Time	29	0300Z

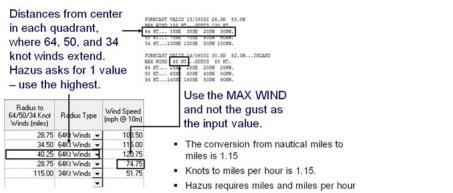
Times in Standard Advisory Format	Day of Current Month	Forecast Time
9 hours from Start Time	29	1200Z
21 hours from Start Time	30	0000Z
33 hours from Start Time	30	1200Z
45 hours from Start Time	31	0000Z
69 hours from Start Time	01	0000Z

Visual 10: Editing Storm Information

- Delete rows by right-clicking on header.
- Make sure there is only one blank row at bottom before clicking "Next."
- "Time (hours)" format needed for Uncertainty Analysis.
- "Central Pressure (mbar)" and "Inland" taken from Advisory.

Th		you to edit th	ne hurricane tra	ck data. For help refer to n Track "page of the Sce			tion 9.3.2.1 on th	ne "Storm	
	Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Typ		Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland
	13.00	-55.80	6.00	23.12	34Kt Winds		40.00	1004.00	[71]
	12.90	-56.50	9.00	23.12	34Kt Winds		40.00	1005.00	(FT)
	13.00	-57.40	12.00	38.76	34Kt Winds		40.00	1005.00	1
	13.00	-58.10	15.00	38.76	34Kt Winds		40.00	1005.00	[77]
	13.10	-59.10	18.00	38.76	34Kt Winds		40.00	1004.00	
	13.00	-60.30	21.00	38.76	34Kt Winds	-	40.00	1005.00	E1
	13.10	-61.30	24.00	46.92	34Kt Winds	-	40.00	1005.00	[7]
	13.20	-62.10	27.00	46.92	34Kt Winds		40.00	1005.00	
	13.40	-62.90	30.00	46.92	34Kt Winds		40.00	1005.00	177
	13.70	-64.10	36.00	46.92	34Kt Winds		40.00	1005.00	[11]
	13.80	-65.90	42.00	46.92	34Kt Winds	-	40.00	1005.00	[7]
	13.90	-68.10	48.00	46.92	34Kt Winds	-	40.00	1007.00	(FT)
	22.60	-92.60	159.00	30.00	34Kt Winds		40.36	1001.00	
	23.20	-92.80	162.00	78.20	34Kt Winds		41.40	995.00	1
	23.80	-93.00	165.00	78.20	34Kt Winds	-	53.82	986.00	(m)
	24.00	-93.30	168.00	62.56	34Kt Winds		56.92	982.00	(ff)
	24.40	-93.60	171.00	17.71	64Kt Winds	-	77.63	979.00	
1						_			

Visual 11: Entering in Forecast Advisories



 Hazus requires miles and miles per hour and advisories are in knots and nautical miles.

Visual 12: Using NHC Advisories

Forecast advisories:

- Conservative estimates
- Don't update central pressure
- Don't update radius to wind speeds realistically

Hazus model enforces a realistic relationship between radius, central pressure, and wind speeds.

Visual 13: Hurrevac

- HURRicane EVACuation
- Taken from NHC advisory information
- Historical storms database
- Eliminates entering information from the text-based advisories

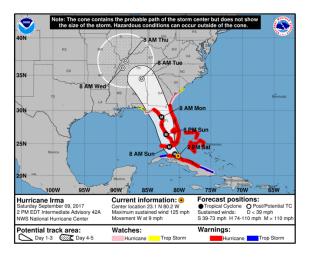
Choose the storm definition method:

- 🔘 Define Storm Track Manually
- Import from Exported File
- Import from H*Wind File
- Import Hurrevac storm advisory

						1000
Nect the atom from the list and cli	ck Neo	d. To download additor	nal atom Nes	, dick on the FTP	download button	
Select the storm you wish to act the HURREVAC tip site, click of	ivate t n the ¹	ion the list below. If yo "Download" button	u cannot loc	ale the storm or w	sh to download th	se storm from
						Download
Storm Files[Local Machine Attente Central Pacific		Storm Name	Year	File Name	File Size (KB)	Number o Advisories
- Certia Pacific	1	ALPHA	2005	1_2005.stm	4	
	2	BETA	2005	2 2005 stm	8	
	3	GAMMA	2005	3_2005 stm	7	
	4	DELTA	2005	4_2005 stm	5	
	5	EPSILON	2005	5_2005 stm	9	
	6	ALPHA	2005	a2_2005.stm	4	
	7	ANDREW	1992	a_1992 stra	9	
	8	ALLISON	1995	a_1995.stm	2	
	9	ARTHUR	1996	a_1996.stm	2	
	10	ANA	1997	a_1997.stm	2	
	11	ALEX	1998	4_1998.stm	5	
4 10 1	4				in the second second	

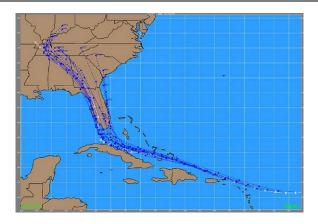
Visual 14: Response and Recovery Points

- There are uncertainties within Hazus.
- Forecasts are subject to changes in track and intensity.
 - Causes changes in damage and loss estimations.
- Damages and losses are based on windspeeds.
 - If these change, damage and loss calculations also change.



Visual 15: Track Comparison

- Changes in position of a hurricane track can make significant changes to results.
- Discussed further in the next section

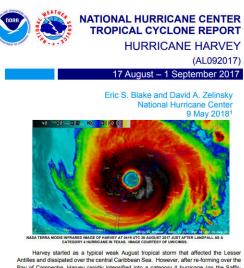


NHC official track forecasts (dashed blue lines) for Hurricane Irma from 0000 UTC 5 September 2017 to 0000 UTC 12 September 2017. The best track is given by the white line with positions given at 6 hour intervals.

Visual 16: **Errors in Forecasts**

"Official forecast intensity errors were above the mean official errors for the previous 5-year period through 48 hours, then considerably lower than average after that through 5 days. A homogenous comparison of the official intensity errors with selected guidance models is given in Table 7b. The NHC intensity forecast performed better than all of the intensity model guidance at 12, 96, and 120 hours, but was worse than all of guidance at 36 and 48 hours. This unusual dichotomy appears to be due to the cyclone weakening faster than expected over land at 36 and 48 hours, but NHC correctly forecasting Harvey to stay a weak cyclone at long range, with almost every forecast point verifying over land."

NHC Tropical Cyclone Report - Hurricane Harvey, May 2018



Antilles and dissipated over the central Caribbean Sea. However, after re-forming over the Bay of Campeche, Harvey rapidly intensified into a category A hurricane (on the Saffir-Simpson Hurricane Wind Scale) before making landfail along the middle Texas coast. The storm then stalled, with its center over or near the Texas coast for four days, dropping historic amounts of rainfail of more than 60 inches over southeastern Texas. These rains caused catastrophic flooding, and Harvey is the second-most costly hurricane in U.S. history, after accounting for infailen, behind only Katrina (2005). At least 66 people died from the direct effects of the storm in Texas, the largest number of direct deaths from a trained ancheane 1910.

Original report date 23 January. Updated Montgomery county damage, tornado totals, corrected some typos, and added a picture of Nederland, Texas, rain gauge location.

tropical cyclone in that state since 1919.

NHC Tropical Cyclone Report – Hurricane Harvey, May 2018

https://www.nhc.noaa.gov/data/tcr/AL092017 Harvey.pdf

Visual 17: Demonstration 12.1: Forecast Advisory Uncertainties

Goal: Discuss and demonstrate Forecast Advisory uncertainties. Time: 45 Minutes

	Demonstration 12.1: Forecast Advisory Uncertainties					
	Goal: Discuss and demonstrate Forecast Advisory uncertainties					
	Time: 45 minutes					
	Exercise Steps:					
Student	1. Listen to instructor's directions.					
Manual	2. Ask questions if clarification is needed.					
	3. Watch the instructor's demonstration.					
	4. Ask any final questions.					
<u>L</u>						

Visual 18: Exercise 12.2 Forecast Advisory

Goals:

- Run various user-defined scenarios.
- Compare the results.

Time: 30 Minutes

	Exercise 12.2: Forecast Advisory
	Goals:
	• Run various user-defined scenarios.
	• Compare the results.
	Time: 30 minutes
	1. Refer to Activities Document "12.2_Exercise_Forecast Advisory."
	2. Listen to instructor's directions.
Student	3. Ask questions if clarification is needed.
Manual	4. Work individually on the goal.
	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share your answers/results.
	8. Ask any final questions.

Visual 19: Exercise 12.2: Tasks

- Task 1: Investigate Hurricane Harvey Scenarios.
- Task 2: Import the Final Track using HURREVAC.
- Task 3: Explore the use of H*Wind files.
- Task 4: Compare the results.

Exercise 12.2 - Forecast Advisory

Type: Student-Led Activity

Time: 30 minutes

Goals:

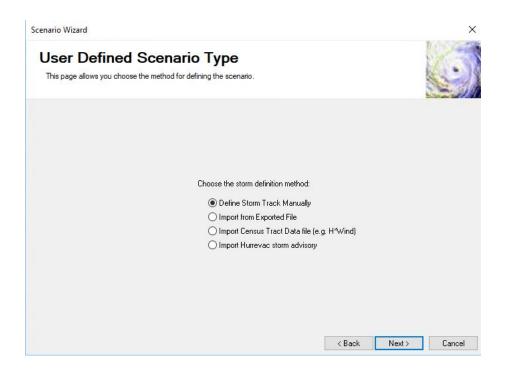
- Run various user-defined scenarios
- Compare the results

Background: This exercise will help you learn to use forecasts and advisories available from the National Weather Service to create a user defined storm. This can be a particularly useful capability at times when you are trying to ascertain the potential impact of an oncoming storm, or when you are considering what impact a past storm might have based on currently exposed inventory.

Task 1: Investigate Hurricane Harvey Scenarios

1. Start Hazus.

- 2. Create a study region with the following parameters:
 - Name: Harvey_Forecast
 - Hazard: Hurricane
 - County Level State: Texas
 - Counties: Aransas and Nueces
- 3. Open the Study region, and from the Hazard menu choose Scenario.
- 4. Click Next to advance the scenario wizard.
- 5. Select Create New Scenario and then Next.
- 6. Select Define Storm Track Manually and click Next.



7. Name the new scenario ForecastAdvisory21 and click Next. This forecast is for Hurricane Harvey Forecast Advisory 21.

8. Select the values shown below (Times and Radius to 64/50/34 Knot Winds).

Scenario Wizard	×
Storm Track Definition Method This page allows you to determine how you would like to enter the storm parameters. For help refer to User Manual section 9.3.2.1 on the "Storm Track Definition Method" page of the Scenario Wizard.	
Would you prefer to	
Enter the storm's locations at specific times or with translation speeds?	
Times	
Translation Speeds	
Enter Radius to Maximum Winds or Radius to Hurricane Force Winds?	
🔘 Radius To Maximum Winds	
Radius to 64/50/34 Knot Winds	
Enter Maximum Wind Speeds or Profile Parameters?	
Maximum Wind Speeds	
Profile Parameters	
	Connect
< Back Next>	Cancel

9. Click Next to view the Interactive Storm Track Definition window.

10. The first portion of Forecast Advisory 21 is on the next page. You can view the full advisory as a PDF located at C:\E0170 ActivityData\Exercise¬ 12.2\Harvey Forecast Advisory 21.pdf.

11. The beginning of the advisory contains descriptive information about the hurricane as well as the current location. Review this information. Try to interpret the information in the forecast on your own. Compare your results with the graphic after the advisory. Ensure that your values match those in the graphic.

HURRICANE CENTER LOCATED NEAR 26.7N 96.0W AT 25/1500Z POSITION ACCURATE WITHIN 10 NM PRESENT MOVEMENT TOWARD THE NORTHWEST OR 315 DEGREES AT 9 KT ESTIMATED MINIMUM CENTRAL PRESSURE 947 MB EYE DIAMETER 15 NM MAX SUSTAINED WINDS 95 KT WITH GUSTS TO 115 KT. 64 KT..... 30NE 20SE 10SW 20NW. 50 KT..... 50NE 40SE 405W 30NW. 34 KT.....120NE 905E 80SW 100NW. 12 FT SEAS..150NE 1205E 905W 120NW. WINDS AND SEAS VARY GREATLY IN EACH QUADRANT. RADII IN NAUTICAL MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.

12. Numbers have been added to the Forecast Advisory and the Edit Storm Track window to show where you can find the information required in the Hazus Edit Storm Track window.

1 2 3
HURRICANE CENTER LOCATED NEAR 26.7N 96.0W AT 25/1500Z
POSITION ACCURATE WITHIN 10 NM
PRESENT MOVEMENT TOWARD THE NORTHWEST 7 315 DEGREES AT 9 KT
ESTEMATED MINICUL CENT 6 PRESSURE 947 MB
MAX SUSTAINED WINDS 95 KT WITH GUSTS TO 115 KT.
64 KT 30NE 20SE 10SW 20NW.
50 KT 50NE 40SE 40SW 30NW.
34 KT120NE 90SE 80SW 100NW.
12 FT SEAS150NE 120SE 90SW 120NW.
WINDS AND SEAS VARY GREATLY IN EACH QUADRANT. RADII IN NAUTICAL
MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.

Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Type	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inlan
1	2	3	4	5	6	7	8
_	-		-	-			U

- Note the longitude should include a negative sign
- The radius must be converted from nautical miles to miles (*1.15)
- The wind speed must be converted from knots to miles per hour (*1.15).
- If the storm is inland, the words INLAND will appear on the advisory.

13. Note the following key points:

- Longitude should include a negative sign.
- The radius must be converted from nautical miles to miles (multiply number in forecast by 1.15).
- The wind speed must be converted from knots to miles per hour (multiply number in forecast by 1.15).
- If the storm is inland, the words INLAND will appear on the advisory.
- 14. Enter these values into the Edit Storm Track window.
- 15. When completed, the Edit Storm Track window should look like the graphic below.

	Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Typ	e	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland
1	26.70	-96.00	0.00	34.50	64Kt Winds		109.25	947.00	
1						-	ei		

16. For the Central Pressure parameter, only the initial pressure is provided in the forecast advisory. You can create a reasonable central pressure number for the following advisories by using the table below.

Saffir-Simpson Category	Minimum Central Pressure mb	Maximum Sustained Wind Speed (Over water) m/s	Maximum Sustained Wind Speed (Over water) mph
1	>= 980	33.1-42.0	74-94
2	979-965	42.0-49.6	94-110
3	964-945	49.6-58.1	110-130
4	944-920	58.1-69.3	130-155
5	<920	>69.3	>155

17. Use the following portion of the Forecast Advisory to complete the next line of the storm track.

FORECAST VALID 26/0000Z 27.6N 96.8W MAX WIND 105 KT...GUSTS 130 KT. 64 KT... 30NE 25SE 15SW 20NW. 50 KT... 60NE 50SE 40SW 40NW. 34 KT...120NE 100SE 90SW 100NW.

18. The Edit Storm Track window should now look like the following graphic.

- The forecast box has been checked since this is a forecasted location of the hurricane.
- Time indicates 9 hours. This is derived by counting the number of hours from the time of the first forecast point of the hurricane (1500Z) to the current time of the forecast point (0000Z) using a 24 hour scale.

Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Typ		Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inlan
26.70	-96.00	0.00		64Kt Winds		109.25		
27.60	-96.80	9.00	34.50	64Kt Winds	•	120.75	955.00	

19. Continue to add the rows to the storm track window using the rest of the forecast advisory below.

17. Continue to add the rows to the storm track window using the rest of the forecast advisory below.

FORECAST VALID 26/1200Z 28.4N 97.3W...INLAND MAX WIND 90 KT...GUSTS 110 KT. 64 KT... 30NE 30SE 20SW 20NW. 50 KT... 60NE 50SE 40SW 40NW. 34 KT...120NE 1205E 1005W 100NW. FORECAST VALID 27/0000Z 28.8N 97.5W...INLAND MAX WIND 70 KT...GUSTS 85 KT. 64 KT... 20NE 20SE 0SW ONW. 405W 50 KT... 50NE 50SE 30NW. 34 KT...100NE 120SE 90SW 80NW. FORECAST VALID 27/1200Z 28.9N 97.6W...INLAND MAX WIND 55 KT...GUSTS 65 KT. 50 KT... 40NE 40SE 30SW 20NW. 34 KT...100NE 1105E 805W 50NW. FORECAST VALID 28/1200Z 28.3N 96.8W...INLAND MAX WIND 35 KT...GUSTS 45 KT. 34 KT...120NE 70SE 50SW ØNW.

20. Your final Edit Storm Track window should look the same as the one below.

18. Your final Edit Storm Track window should look the same as the one below.

Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Typ	e	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inlar
26.70	-96.00	0.00	34.50	64Kt Winds	-	109.25	947.00	177
27.60	-96.80	9.00	34.50		here we wanted	120.75	955.00	100
28.40	-97.30	21.00	34.50	64Kt Winds	-	103.50	970.00	1
28.80	-97.50	33.00	23.00	64Kt Winds	-	80.50	990.00	1
28.90	-97.60	45.00	46.00	50Kt Winds	-	63.25	1000.00	1
28.30	-96.80	69.00	138.00	64Kt Winds	-	40.25	1013.00	V
					-			1000

Scenario Wizard

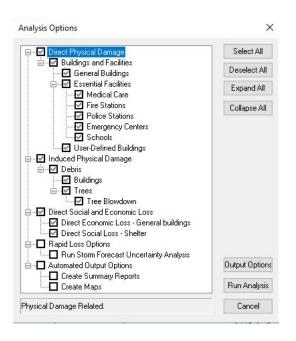
21. Click Next to move to the windfield calculations window.

22. Click Next until prompted to indicate you would like to make this the active scenario.

23. Click Next and then Finish to complete the wizard.

24. From the Analysis menu select Run to open the Analysis Options menu.

25. Click Select All to choose all of the analysis options except the Rapid Loss Options and the Automated Output Options.



26. Click Run Analysis to begin the analysis.

27. Click OK when prompted to acknowledge that the analysis has completed.

28. Open the Global Summary Report. This report is also provided in the folder C:\E0170_ActivityData\Exercise_12.2\Forecast Advisory 21 Global Summary Report.pdf.

29. Use the report to complete the questions for the Forecast Advisory column in the table found at the end of the exercise.

30. When you have completed the questions, close the Summary Reports window.

Task 2: Import the Final Track using HURREVAC.

In the next portion of the exercise you will import the final track for the same storm but this time using input generated from Hurrevac. The intent of this step is to demonstrate the difference between using a forecast advisory and a final storm track. The final storm track represents the actual track of the storm, whereas the forecast track is a projection of where the storm is forecasted to go.

- 1. From the Hazard menu choose Scenario to open the scenario wizard.
- 2. Click Next to advance to the scenario operation window.
- 3. Click on Create New Scenario and click Next.
- 4. Click Import Hurrevac storm advisory and click Next.
- 5. Click the Download button.
- 6. From the dropdown menu for Select Storm Letter, choose "H". For the year select "2017".

Hurrevac Download Site		
Region	Select Storm Letter: h	Select Year: 2017 -
Atlantic		
Central Pacific		
	http://data.hurrevac.com/STMFiles/A	Atlantic//h_2017.stm
	Download	Close

- 7. Click Download.
- 8. When downloaded successfully click OK and then Close.
- 9. Scroll through the list and select HARVEY with the date of 2017.
 - There are multiple Harvey entries, make sure you select the one from 2017.

						6.63
ect the storm from the list and cl	ick Nex	t. To download addition	nal storm files	, click on the FTP	download button	
						51. Tam
Select the storm you wish to ac the HURREVAC ftp site, click (u cannot loc	ate the storm or w	sh to download th	e storm from
🖾 😳 🔨						Download
⊡ Storm Files(Local Machine Atlantic Central Pacific	e	Storm Name 🔺	Year	File Name	File Size (KB)	Number o Advisories
	125	HARVEY	2005	h 2005.stm	9	1
		HELENE	CONTRACTOR OF TAXABLE	H 2006.stm	9	
	and a state of the local division of the loc	HUMBERTO		h_2007.stm	3	
	Constant of the local division of the local	HANNA		h 2008.stm	35	
	129	HERMINE	2016	h 2016.stm	29	
	130	HARVEY	2017	h_2017.stm	33	-
	131	INIKI	1992	i_1992.stm	5	2
	132	IRIS	1995	i_1995.stm	7	
	133	ISIDORE	1996	i_1996.stm	3	
	134	IVAN	1998	i_1998.stm	5	
	135	IRENE	1999	i_1999.stm	5	
• III •	4					

10. Click Next to move to the Edit Storm Track window.

11. Click Next again to move to the Windfield Calculation window.

12. Once it completes hit Next four times and then Finish. Validating the storm track may take up to 2 minutes to complete.

13. Run the analysis with all options selected except the Rapid Loss Options and the Automated Output Options.

14. From the Results menu choose Summary Reports.

15. Click the Other Reports tab, view the Global Summary Report. This report is also provided in the folder C:\E0170_ActivityData\Exercise_12.2\Hurrevac Global Summary Report.pdf.

16. Use the report to complete the questions for Hurrevac Import in the table found at the end of the exercise.

17. When you have completed the questions, close the Summary Reports window.

Task 3: Explore the use of H*Wind files

H*Wind files formatted for Hazus are special products and not widely circulated. They are produced by the Hurricane Research Division. This is a great dataset because it provides observational data recorded during the hurricane's movement over land. This analysis compares track data with windfield computed by Hazus to observational data of actual winds measured from the hurricane.

- 1. From the Hazard menu choose Scenario to open the scenario wizard.
- 2. Click Next to advance to the scenario operation window.
- 3. Click on Create New Scenario and click Next.
- 4. Click Import from H*Wind File and click Next.
- 5. Name the scenario Harvey_Hwind and click Next.
- 6. Click browse and navigate to the C:\E0170 ActivityData\Exercise 12.2 folder.
- 7. Select Harvey Windfield HazusReady.dat.
- 8. Click Open and Next until you can click Finish.

9. Run the analysis with all options selected except the Rapid Loss Options and the Automated Output Options.

10. From the Results menu choose Summary Reports.

11. Click the Other Reports tab, view the Global Summary Report. This report is also provided in the C:\E0170_ActivityData\Exercise_12.2\Hwind Global Summary Report.pdf.

12. Use the report to complete the questions for H*Wind Import in the table found at the end of the exercise.

13. Click Save and then close Hazus.

Task 4: Compare the results.

Observe the difference in the results obtained by using updated forecast advisories. Due to the complex nature of hurricanes it is important that you consider early forecast advisories as general approximations of what may happen if a hurricane retains its current path and if it follows predictions exactly as they are defined in the forecast. However, due to the possibility of significant changes that might occur during the course of a hurricane's evolution, information produced from early forecast advisories should be carefully used and distributed with caution.

Question	Forecast Advisory	Hurrevac Import	H*Wind Import
What is the peak wind gust (mph) for the study region?			
How many Residential Buildings have been damaged? (minor, moderate, severe, and destroyed)			
What is the total estimated economic loss?			
How many people will require short term shelter?			
What is the total amount of debris generated?			

Visual 20: Hurricane Recovery Timeline

Length of recovery operations:

- Days (Short-term): Resource Allocation
- Weeks/Months (Intermediate): Clean up operations
- Months/Years (Long-term): Rebuilding
- Recovery groups: Economic, Health and Social Services, Housing, Natural and Cultural Resources

Visual 21: Lesson 12: Review

- 1. How many hours are between the current location of a hurricane and the first forecast point?
- 2. What is the elapsed time sequence required to run the uncertainty analysis when entering values into Hazus from a forecast advisory?
- 3. What is the conversion factor from nautical miles to miles?

Visual 22: Questions?

Lesson 13: Considerations When Reviewing Results

Visual 1: Lesson 13: Considerations When Reviewing Results



Visual 2: Lesson 13: Goal and Objectives

Goal: To provide an overview of considerations when reviewing results in the Hazus wind model.

After completing this lesson you will be able to:

• Understand forecast errors for landfalling hurricanes.

Visual 3: Sources of Uncertainty

Wind Speed Estimates	Only 116 years of storm data Incomplete/noisy observations
Rainfall Model	Simplified model based on limited data
Terrain Roughness	Land use is used to calculate surface roughness. Changes in land use Direction and transition effects.
Load & Resistance Model	Pressure coefficients Missile debris sources & transport Fatigue effects not modeled

Visual 4: Sources of Uncertainty

Damage-to-Loss Model	Limited validation of implicit loss models	
Building Stock Distribution	Model building types Incomplete or incorrect inventory data	
Fast-Running Loss Functions	Average loss as function of peak gust	
Business Interruption	Analysis parameters based on national averages	

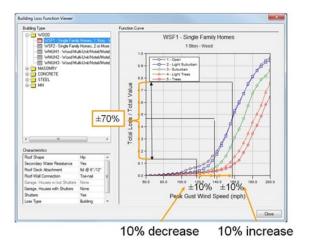
Visual 5: Treatment of Uncertainties

- Hazus produces "best estimate results," but there is no explicit treatment or estimation of uncertainty.
- Potential impact of uncertainties can be assessed through multiple sensitivity analyses.
 - Intensity, size, speed, and track of scenario storms
 - Distributions of construction characteristics
 - Building valuation
 - Terrain and tree coverage
 - Economic and shelter model parameters

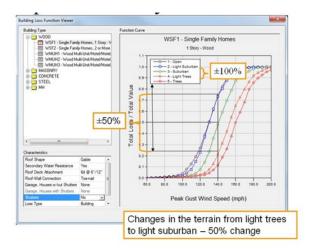
Visual 6: Uncertainty in Hazus

- As a hurricane approaches landfall, the amount of uncertainty on its landfalling location decreases.
- In Hazus, as you import forecast advisory information (Hurrevac or from NHC) over time in the days before a hurricane landfall, the uncertainty ranges will narrow, indicating it is too close for the hurricane to miss the study region.

Visual 7: Example: Sensitivity to Wind Speed



Visual 8: Example: Sensitivity to Terrain



Visual 9: Ranking of Uncertainties

Smaller storms and/or smaller study regions will generally have greater uncertainties.

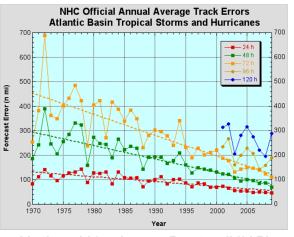
- Individual building / single storm
- Regional loss / single storm
- Regional return period losses / probabilistic
- Regional annualized losses / probabilistic

(Ranked from most to least uncertain)

Visual 10: Real-Time Hurricane Modeling

While hurricane forecasts are improving, errors still exist.

- 24 hour forecasts have a positional error of approximately 40 miles.
- When compared to a city or county, this can have major consequences for damage and loss modeling.



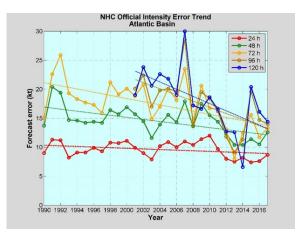
National Humicane Center (NHC) http://www.nhc.noza.gov/verification/verify5.shtml

https://www.nhc.noaa.gov/verification/verify5.shtml

Visual 11: Real-Time Hurricane Modeling

Intensity forecasts also have errors: 24 hour forecasts (10 mph)

- 120 to 130 mph
 - 10 mph increase, 8% increase
 - WSF1 goes from 10% loss to 25%
- 130 to 140 mph
 - Changes from 25% to 50% loss
 - See Building Loss Function Viewer



While the positional forecasts have improved considerably, the intensity forecasts have remained nearly the same.

Visual 12: Recommendations

- Understand dependency of modules and analysis parameters.
- Enhance inventory data:
 - Building value, square footage, count
 - Occupancy mapping schemes
 - Wind building characteristics
- Enhance terrain modeling using recent remote sensing data and/or local land use databases.
- Develop local estimates for economic and shelter parameters.
- Run sensitivity cases to see range of results.
- Present results with appropriate caveats.

Visual 13: Exercise 13.1: Sensitivity of Hurricane Storm Parameters

Goal:

- Modify uncertain and sensitive variables in Hazus.
- Run multiple scenarios.
- Compare the results.

Time: 45 minutes

	Exercise 13.1: Sensitivity of Hurricane Storm Parameters
	Goal:
	• Modify uncertain and sensitive variables in Hazus.
	• Run multiple scenarios.
	• Compare the results.
	Time: 45 Minutes
	 Refer to Activities Document "13.1_Exercise_Sensitivity of Hurricane Storm Parameters."
Student Manual	2. Listen to instructor's directions.
	3. Ask questions if clarification is needed.
	4. Work individually on the goal.
	5. Ask questions to the instructor if needed.
	6. Complete the assigned goal.
	7. Be prepared to share your answers/results.
	8. Ask any final questions.

Visual 14: Exercise 13.1: Tasks

Task 1: Create an Irma Study Region

Task 2: Run the default landfall track scenario

Task 3: Run the scenario with a modified speed.

Task 4: Run the scenario with a modified size.

Task 5: Run the scenario with a modified intensity.

Exercise 13.1 - Tasks
 Refer to Activities Document "13.1_Exercise_Sensitivity of Hurricane Storm Parameters."

Exercise 13.1: Sensitivity of Hurricane Storm

Parameters

Type: Student-Led Activity

Time: 45 minutes

Goals:

- Modify uncertain and sensitive variables in Hazus.
- Run multiple scenarios.
- Compare the results.

Background:

This exercise will explore the impact of changing various parameters that define the course, speed, and strength of a hurricane. It is very important that you are aware of the differences that these types of inputs can produce with respect to predicted damages. This exercise only alters the hurricane parameters just slightly and illustrates the impact on the damage and loss estimates.

Task 1: Create an Irma Study Region

- 1. Start Hazus
- 2. Create a new study region with the following parameters:
 - Name: Irma Landfall
 - Aggregation level: County
 - State: Florida
 - Counties: Hillsborough and Pinellas
 - Hazard type: Hurricane

Task 2: Run the default landfall track scenario

- 1. From the Hazard menu choose "Scenario".
- 2. Click "Next" to advance the Scenario wizard.
- 3. Select Create New Scenario and click "Next".
- 4. Select Import from Exported File and click "Next".

5. Name the new scenario Irma Landfall Track. This storm was created by entering latitude, longitude, wind speed, and central pressure information from forecast advisory information.

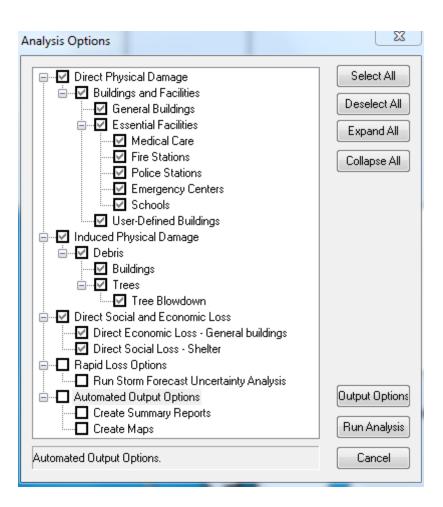


- 6. Click "Next".
- 7. Click on Browse and navigate to the C:\E0170_ActivityData\Exercise_13.1 folder.
- 8. Select the import file named IrmaLandfallTrack.bin and click "Open".
- 9. Click "Next" to complete the import process and to perform the wind field calculation.
- 10. Click "Next" after the application has finished computing the wind speeds.
- 11. Click "Next" to move beyond the Storm Track Data window.
- 12. Click "Next" to move through the Scenario Review.
- 13. Click "Next" again
- 14. Click Finish.
- 15. From the Hazard menu choose Show Current.

16. Click the Data tab. The data tab of the Current Hazard box should show the following information.

0	Data							
2	Latitude (Degrees)	Longitude (Degrees)	Translation Speed (miles/hr)	Time (Hours)	Radius to Max Winds (miles)	Radius to 64/50/34 Knot Winds (miles)	Radius Type	Wind Speed (mph @ 10m)
	16.40	-30.30	10.02	0.00	14.71	23.12	34Kt Winds 💌	46.5
	16.40	-31.20	10.58	6.00	12.28	23.12	34Kt Winds 💌	51.7
	16.40	-32.20	9.50	12.00	20.19	38.76	34Kt Winds 💌	56.9
	16.50	-32.90	9.43	18.00	11.22	15.64	50Kt Winds 💌	62.1
	16.90	-33.80	11.48	24.00	6.69	13.09	64Kt Winds 💌	87.9
	17.30	-34.80	11.25	30.00	6.21	13.09	64Kt Winds 💂	103.5
	17.80	-35.60	10.71	36.00	6.21	13.09	64Kt Winds 💂	103.5
	18.20	-36.50	12.79	42.00	6.21	13.09	64Kt Winds 💂	103.5
	18.50	-37.80	14.67	48.00	6.21	13.09	64Kt Winds 💂	98.3
	18.80	-39.10	15.17	54.00	6.78	17.71	64Kt Winds 💂	108.6
	19.10	-40.50	14.97	60.00	7.12	17.71	64Kt Winds 💂	103.5
	19.00	-41.80	15.41	66.00	7.48	17.71	64Kt Winds 💂	98.3
	18.80	-43.30	15.61	72.00	7.95	17.71	64Kt Winds 💂	98.3
	18.50	-44.60	16.18	78.00	7.79	17.71	64Kt Winds 💂	98.3
	18.30	-46.20	16.20	84.00	7.79	17.71	64Kt Winds 💂	98.3
	18.00	-47.50	12.60	90.00	7.28	17.71	64Kt Winds 💂	103.5
	17.70	-48.40	12.99	96.00	7.28	17.71	64Kt Winds 💂	103.5
1								0

- 17. Click "Close" to close the Current Hazard window.
- 18. From the Analysis select "Run" to open the Analysis Options menu.
- 19. Select all of the options except the Rapid Loss Options and the Automated Output Options.



20. Click "Run Analysis" to begin the analysis. The analysis will take a few moments to complete.

21. Click "OK" when prompted to acknowledge that the analysis has completed.

22. Answer the questions for the column titled Irma Landfall Track found in the Results Table located at the end of the exercise.

Note: Hints for answering these types of questions can be found in earlier exercises. You can also ask your instructor for assistance.

Task 3: Run the scenario with a modified speed.

In this task of you will copy the Irma Landfall Track scenario and modify the parameters to explore the impact of changing the speed of the storm.

- 1. From the Hazard menu choose Scenario to start the Scenario Wizard.
- 2. Click "Next".
- 3. Select the Irma Landfall Track scenario and select "Copy".
- 4. Click "Next".

- 5. Name the new scenario Irma Change of Speed.
- 6. Click "Next".
- 7. Edit the new scenario by selecting the Irma Change of Speed scenario, selecting "Edit".
- 8. Click "Next".

Scenario Op This page allows you to s	peration elect an operation to perform on a scenario.		
	Hurricane Scenarios Harvey.dat_25May2018 Harvey.dat1 HARVEY_2017_stm_1741PM HARVEY_2017_stm_1917PM Ima Landfall Track IRMA_2017_stm_1414PM_1 IRMA_2017_stm_1414PM_1_2 IRMA_2017_stm_1414PM_1_2 IRMA_2017_stm_1414PM_1_2	 Activate Edit Copy Delete Export 	Next > Cancel

9. Click next until you reach the Edit Storm Track table.

10. Scroll down to the bottom of the table where the boxes are checked in the Inland column.

11. Edit the Time (Hours) column in the data table by increasing the times as shown below. This shows a faster moving hurricane than the previously modeled hurricane.

- C							1.00
50	20	O PI	0	W	1.77	1.0	a .
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Edit Storm Track

This page allows you to edit the humcane track data. For help refer to User Manual section 9.3.2.1 on the "Storm	
Track Definition Method" and the "Edit Storm Track" page of the Scenario Wizard.	

Inland	Central Pressure (mBar)	Wind Speed (mph @ 10m)	e	Radius Typ	Radius to 64/50/34 Knot Winds (miles)	Time (Hours)	Longitude (Degrees)	Latitude (Degrees)
0	933.00	108.67	-	64Kt Winds	53.13	252.00	-81.00	23.50
0	931.00	116.95		64Kt Winds	53.13	255.00	-81.30	23.70
0	928.00	119.02	-	64Kt Winds	61.60	258.00	-81.50	24.10
0	929.00	116.95		64Kt Winds	61.60	261.00	-81.50	24.50
0	933.00	119.02		64Kt Winds	61.60	264.00	-81.50	25.00
0	936.00	107.64	-	64Kt Winds	61.60	267.00	-81.80	25.60
1	938.00	107.64	-	64Kt Winds	61.60	270.00	-81.80	26.20
1	942.00	107.64	-	64Kt Winds	61.60	271.00	-81.70	26.70
V	952.00	101.17	-	64Kt Winds	61.60	272.00	-81.90	27.50
1	960.00	88.08		64Kt Winds	61.60	273.00	-82.20	28.20
1	965.00	77.37		50Kt Winds	109.48	274.00	-82.60	28.90
V	970.00	72.61	-	50Kt Winds	109.48	275.00	-82.90	29.50
1	975.00	65.46		34Kt Winds	281.52	276.00	-83.10	30.30
1	980.00	61.89		34Kt Winds	281.52	277.00	-83.60	30.80
1	985.00	53.56		34Kt Winds	281.52	278.00	-84.00	31.50
1	986.00	46.42	-	34Kt Winds	281.52	279.00	-84.40	31.90
(m)			-	64Kt Winds		4		
1								
Cance	Next >	K Back		Мар				

11. Complete the scenario wizard. Make the scenario active.

12. Navigate to the Analysis menu and click "Run." Select all of the options except the Rapid Loss Options and the Automated Output Options.

13. Answer the questions in the **Results Table** at the end of this exercise in the column entitled Irma Change of Speed.

14. Return to this page and continue with the exercise after you have filled in the Irma Change of Speed column.

- 12. Complete the scenario wizard and make the scenario active.
- 13. Navigate to the Analysis menu and then click Run.
- 14. Select all of the options except the Rapid Loss Options and the Automated Output Options.
- 15. When the analysis is complete, click OK.

16. Answer the questions in the Results Table at the end of this exercise in the column titled "Irma Change Speed".

17. Return to this page and continue with the exercise after you have filled in the Irma Change of Speed column.

Task 4: Run the scenario with a modified size.

In this part of the exercise you will copy the Irma Landfall Track scenario and modify the parameters to explore the impact of changing the size of the storm.

- 1. From the Hazard menu choose Scenario to start the scenario wizard.
- 2. Click "Next".
- 3. Select the Irma Landfall Track scenario and "Copy". Then click "Next".
- 4. Name the new scenario Irma Change of Size and click "Next".

5. Edit the new scenario by selecting the Irma Change of Size scenario, selecting "Edit", and then clicking "Next" until you get to the data table.

6. Scroll down to the bottom of the table where the boxes are checked in the Inland column.

7. Edit the Radius to 64/50/34 Knot Winds (miles) column in the data table by increasing the miles as shown below. This shows a larger hurricane than the previously modeled hurricane.

100 Parts action	R	rm Tra		ck data. For help refer to	Liese Manual		tion 0.2.2.1 on th	"Cham	1.
				n Track" page of the Sce			aon 5.5.2.1 on a	ie stoin	and and
Latitude (Degree		Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Typ	e	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland
23	50	-81.00	252.00	53.13	64Kt Winds		108.67	933.00	100
23	.70	-81.30	255.00	53.13	64Kt Winds		116.95	931.00	100
24	.10	-81.50	258.00	61.60	64Kt Winds		119.02	928.00	100
24	50	-81.50	261.00	61.60	64Kt Winds	-	116.95	929.00	100
25	.00	-81.50	264.00	61.60	64Kt Winds	-	119.02	933.00	1077
25	60	-81.80	267.00	61.60	64Kt Winds	-	107.64	936.00	1000
26	.20	-81.80	270.00	80.00	64Kt Winds	-	107.64	938.00	1
26	.70	-81.70	273.00	80.00	64Kt Winds	-	107.64	942.00	1
27	50	-81.90	276.00	80.00	64Kt Winds	-	101.17	952.00	1
28	.20	-82.20	279.00	80.00	64Kt Winds	-	88.08	960.00	1
28	.90	-82.60	282.00	120.00	50Kt Winds		77.37	965.00	1
29	50	-82.90	285.00	120.00	50Kt Winds		72.61	970.00	1
30	.30	-83.10	288.00	300.00	34Kt Winds		65.46	975.00	1
30	.80	-83.60	291.00	300.00	34Kt Winds	-	61.89	980.00	1
31	.50	-84.00	294.00	300.00	34Kt Winds	-	53.56	985.00	1
31	.90	-84.40	297.00	300.00	34Kt Winds	-	46.42	986.00	1
					-3 S	-			100

8. Complete the Scenario wizard and make the scenario active.

9. Navigate to the Analysis menu and then click Run. Select all of the options except the Rapid Loss Options and the Automated Output Options.

10. Answer the questions in the Results Table at the end of this exercise in the column titled

"Irma Change Size".

8. Complete the Scenario wizard and make the scenario active.

9. Navigate to the Analysis menu and then click Run.

10. Select all of the options except the Rapid Loss Options and the Automated Output Options.

11. Answer the questions in the Results Table at the end of this exercise in the column titled "Irma Change Size".

Task 5: Run the scenario with a modified intensity.

In the final portion of the exercise you will copy the Irma Landfall Track scenario and modify the parameters to explore the impact of changing the intensity of the storm.

1. From the Hazard menu choose Scenario to start the Scenario Wizard. Click "Next".

2. Select the Irma Landfall Track scenario and select Copy. Then click "Next".

3. Name the new scenario Irma Change of Intensity and click "Next".

4. Edit the new scenario by selecting the Irma Change of Intensity scenario, selecting "Edit", and then clicking "Next" until you get to the data table.

5. Scroll down to the bottom of the table where the boxes are checked in the Inland column.

6. Edit the Wind Speed column in the data table by increasing the wind speeds, by approximately 10 mph, as shown below. This shows a stronger hurricane than the previously modeled hurricane.

Scenario Wizard

Edit Storm Track

This page allows you to edit the hurricane track data. For help refer to User Manual section 9.3.2.1 on the "Storm	
Track Definition Method" and the "Edit Storm Track" page of the Scenario Wizard.	

Latitude (Degrees)	Longitude (Degrees)	Time (Hours)	Radius to 64/50/34 Knot Winds (miles)	Radius Type	Wind Speed (mph @ 10m)	Central Pressure (mBar)	Inland
23.50	-81.00	252.00	53.13	64Kt Winds 🖉	108.67	933.00	
23.70	-81.30	255.00	53.13	64Kt Winds 🖉	116.95	931.00	1000
24.10	-81.50	258.00	61.60	64Kt Winds 🗣	119.02	928.00	
24.50	-81.50	261.00	61.60	64Kt Winds 🗣	116.95	929.00	
25.00	-81.50	264.00	61.60	64Kt Winds 🗣	119.02	933.00	
25.60	-81.80	267.00	61.60	64Kt Winds 🗣	107.64	936.00	
26.20	-81.80	270.00	61.60	64Kt Winds 🗣	117.00	938.00	1
26.70	-81.70	273.00	61.60	64Kt Winds 🗣	117.00	942.00	1
27.50	-81.90	276.00	61.60	64Kt Winds 🖉	111.00	952.00	1
28.20	-82.20	279.00	61.60	64Kt Winds 🖉	98.00	960.00	1
28.90	-82.60	282.00	109.48	50Kt Winds 🖉	87.00	965.00	1
29.50	-82.90	285.00	109.48	50Kt Winds 🖉	82.00	970.00	1
30.30	-83.10	288.00	281.52	34Kt Winds 🖉	75.00	975.00	1
30.80	-83.60	291.00	281.52	34Kt Winds 🖉	71.00	980.00	1
31.50	-84.00	294.00	281.52	34Kt Winds 💂	63.00	985.00	1
31.90	-84.40	297.00	281.52	34Kt Winds 💂	56.00	986.00	1
				Мар	< Back	Next >	Canc

7. Complete the Scenario wizard. Make the scenario active.

8. Navigate to the Analysis menu and then click Run. Select all of the options except the Rapid Loss Options and the Automated Output Options.

9. Answer the questions in the Results Table at the end of this exercise in the column titled "Irma Change Intensity".

Results Table

Question	Irma Landfa 11 Track	Irma Change Speed	Irma Change Size	Irma Chang e Intensity
a) What is the maximum peak gust wind speed on land in the study area?				
b) How many Residential Buildings have been damaged? (minor, moderate, severe, destroyed)				

Question	Irma Landfa ll Track	Irma Change Speed	Irma Change Size	Irma Chang e Intensity
c) What is the Total Direct Economic Loss for the region?				
d) How many expected displaced households are there in the region?				
e) What is the total estimated debris in tons?				

Observe the difference in the results that you can obtain by using altered forecast advisories. Due to the complex nature of hurricanes, you must consider early forecast advisories as general approximations of what may happen if a hurricane retains its current path and if it follows predictions exactly as they are defined in the forecast. However, due to the possibility of significant changes that might occur during the course of a hurricanes evolution, information produced from early forecast advisories should be carefully used and distributed with extreme caution.

10. Save your map document and exit Hazus.

Visual 15: Lesson 13: Review

1. What are two types of forecast errors for landfalling hurricanes?

Visual 16: Questions?

Lesson 14: Capstone Exercise

Visual 1: Lesson 14: Capstone Exercise



Visual 2: Lesson 14: Goal and Objectives

Goal: To complete and present the Capstone Exercise Objectives:

- Develop hurricane mitigation plan for chosen county OR
- Develop hurricane response and recovery plan for chosen county.
- Create PowerPoint presentation
- Present to class in groups of 3-4

Visual 3: Capstone Exercise Explanation

- The county planning board has hired your team to give a 20-minute PowerPoint presentation at its next public meeting on the severity of hurricane hazards in the county and the possible methods for mitigating or responding to future hurricane damage in that county.
- You, as the consultant and a Hazus expert, have decided to use Hazus to analyze the county's hurricane risk.
- The results of your study will be presented at the monthly commissioners meeting.
 - Each group will present while the remaining participants assume the role of the commissioners.

Visual 4: Capstone Exercise Explanation

Required issues to be addressed:

- Which major hurricane(s) have impacted this region in the past?
- What damage would the worst of these storms produce if it happened again today?
- What is the approximate return period for the worst historic storm?
- Summarize the number and value of buildings at risk to hurricanes.
- Provide a map of essential facilities, high potential loss facilities, and any additional features you deem important for risk communication.
- What are potential benefits of mandating shutters on all new single-family dwellings?
- Summarize the assumptions made in your benefit analysis.

Visual 5: Capstone Exercise Explanation

Presenter Guidelines:

- Prepare using PowerPoint
- Include maps, tables, or other media you deem appropriate
- Information should be primarily derived from Hazus, but may be supplemented by other sources
- 10-15 minutes in length

Commissioner Guidelines

- Class will assume the role of commissioners
- Commissioners may ask questions related to the presentation

Visual 6: Capstone Exercise

- Allow groups time to work on their presentation.
- Break as needed.
- Additional work time will be provided after lunch.
- Presentations will begin at 2:30pm.

Lesson 15: Course Wrap-Up

Visual 1: Lesson 15: Course Wrap Up



Visual 2: Lesson 15: Goal and Objectives

Goal: To review the major themes of the course and discuss opportunities for learning more about Hazus.

After completing this lesson you will be able to:

- Identify courses and other opportunities for training available to enhance your Hazus skills.
- Identify additional resources available to explore to enhance your Hazus experience.

Visual 3: Hazus Training

Courses to Consider:

- E0190: ArcGIS for Emergency Managers
- E0172: Hazus for Floods
- E0174: Hazus for Earthquake and Tsunami
- E0317: Comprehensive Data Management for Hazus
- E0177: Advanced Hazus Applications
- E0179: Application of Hazus for Disaster Operations

Visual 4: Become A Hazus Expert!

Hazus Trained User

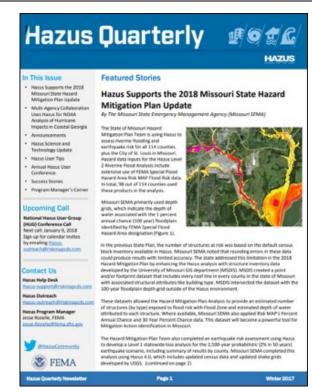
- E0190 ArcGIS for Emergency Managers (or prior GIS experience may substitute)
- E0313 Basic Hazus
- E0317 Comprehensive Data Management (CDMS)
- Minimum of two of the following:
 - E0170 Hazus for Hurricanes
 - E0172 Hazus for Floods
 - E0174 Hazus for Earthquakes and Tsunami

Hazus Practitioner

- E0190 ArcGIS for Emergency Managers (or prior GIS experience may substitute)
- E0313 Basic Hazus
- E0317 Comprehensive Data Management (CDMS)
- Minimum of two of the following:
 - E0170 Hazus for Hurricanes
 - E0172 Hazus for Floods
 - E0174 Hazus for Earthquakes and Tsunami
- E0179 Application of Hazus for Disaster Operations
- E0177 Advanced Hazus Applications

Visual 5: Hazus Community Participation

- Hazus User Conference
- Quarterly Newsletter
- National Hazus User Group calls
- Local Hazus User Groups
- <u>Hazus Outreach Email</u>: hazusoutreach@riskmapcds.com



Visual 6: FEMA Hazus Website

Primary FEMA resource for updated Hazus information: <u>FEMA Hazus Website</u>: https://www.fema.gov/hazus

🐮 FEN	AI
Navigat	ion
Q Search	
🕄 Langua	ges
Hazus	
> Software	
> Detail	
User Groups	
> Training	
Conferences	
Hazus Quarteri	y Newsletter
> Summary of	Databases
> Resources an	nd Solutions

	is page discusses FEMA's Hazus program and related news updates. This page is
in	tended for Hazus users and other parties interested in using Hazus to support risk-
In	tended for Hazus users and other parties interested in using Hazus to support risk- formed decision making efforts by estimating potential losses from earthquakes, floods, HAZUS
h	urricanes, and tsunamis and visualizing the effects of such hazards. EARTHQUAKE - WIND - FLOOD - TSUNAMI
D	ownload Hazus Today: Users can download the Hazus software for free from
th	e FEMA Flood Map Service Center (MSC) at https://msc.fema.gov/portal/resources/hazus
	ave any interesting Hazus research or success stories to share? Want to get involved with the Hazus program by attending the
	onthly National Hazus User Group call? Reach out to the Hazus Outreach Team at hazus-outreach@riskmapcds.com with questio
cc	imments, or to be added to the monthly call invitation.
	Sign.up to receive updates regarding the Hazus program, training opportunities, and conferences.
н	azus News
н	azus 4.2 Now Available: On January 29, 2018, the Hazus Team deployed release 4.2. This Hazus version is available on the 🔢
M	SC Download page. This release is a full-versioned software release with a number of key highlights, including:
	Hazus 4.2 is compatible with ArcGIS 10.5.1
	 Major processing time reductions for hydrology and hydraulics within level 1 flood.
	 Additional supported formats for level 2 flood depth grid import
	 High resolution ShakeMaps now compatible, with faster import times
	Restoration of the Fire Following Earthquake (FFE) module
	Improvements to the Comprehensive Data Management System (CDMS) for easier import of user data
	azus 4.2 also includes an update from North American Datum 1983 (NAD83) to the World Geodetic System 1984 (WGS84) in orde
	etter support U.S. territories and long-term goals for international hazard modeling. For more information on this update please s
th	e "Hazus Coordinate Change" document.
N	OTE: You must uninstall any existing versions of Hazus and all Microsoft SQL components from your computer before
d	swnloading and ensure that you have ArcGIS 10.5.1 on your computer. As a result of the datum update, any existing Stat

Visual 7: Additional Resources

Hazus YouTube Videos – http://bit.ly/HAZUS

• 21 short (3-7 min) tutorials on all parts of Hazus.

Hazus GitHub - https://github.com/nhrap-hazus

- Site of published Hazus Open Source tools, such as Hazus FAST.
- Hazus Training Data and Student Guides Site TBD

New Natural Hazards Risk Assessment Program website - https://www.fema.gov/nhrap

• <u>Document Container</u> of methods and research applications - https://www.fema.gov/medialibrary/assets/documents/180915

Visual 8: Getting Help

- Email <u>Hazus Help Desk</u>
 - hazus-support@riskmapcds.com
- Consult the User Manuals and Technical Manuals

https://www.fema.gov/hazus-mh-user-technical-manuals

Visual 9: Questions?

Appendix: Activity Data Zip File Hurricane

E0170 Activity Data