COASTAL RESILIENCE 2.0 DECISION SUPPORT TOOLS

TRAINING ACTIVITIES

The Nature Conservancy's Coastal Resilience program has been working to demonstrate that governments and communities can enhance their resilience to coastal hazards and climate change by developing and re-developing smarter using a combination of built infrastructure and protecting, restoring, and effectively managing their marine and coastal ecosystems. When coastal habitats such as oysters, marshes, coral reefs and mangroves are restored and protected for risk reduction they are called natural defenses or natural infrastructure. When coastal habitats are incorporated into adaptation solutions for sea level rise it is termed ecosystem-based adaptation (EBA). Natural defenses and ecosystem based adaptation are important strategies for addressing disaster risk reduction and sea level rise adaptation. The Nature Conservancy is demonstrating the potential for nature to reduce risk from hazards and sea level rise around the world through its Coastal Resilience program and project sites. The Nature Conservancy's Coastal Resilience approach includes 4 critical elements: raise awareness, assess risk, identify choices, and take action.

With recent events like Sandy, many coastal communities are now focused on reducing vulnerability and improving the adaptive capacity of their residents. Using the Coastal Resilience approach, anyone can design and implement solutions that integrate nature's infrastructure –mangroves, forests, wetlands, coral reefs – with socioeconomic needs to reduce risk and increase community resilience.

One of the most difficult barriers to overcome in promoting resiliency planning at the local level is empowering community decision makers, citizens, grassroots and neighborhood organizations and other stakeholders with the data and mapping tools to engage in resiliency planning activities. But even more fundamentally, these data and tools are critical to help local communities more fully recognize and visualize the nature of their exposure to potential hazards and the consequences of future decisions and planning activities. The Nature Conservancy and partners recently released Coastal Resilience 2.0; a suite of tools for coastal communities, government agencies and other stakeholders that informs hazard mitigation, risk reduction, climate adaptation and conservation decisions. The tools start with visualizations of the current situation – socially, economically and ecologically. To these we add reasonable storm surge and sea level rise scenarios. Using these interactive tools backed by the best available science, we enable planners, elected officials, managers and citizens to visualize current and future risk and then help identify a suite of solutions that reduce social and economic risks while maximizing the benefits that nature provides.

Solutions to date include: protecting or restoring area salt marshes as buffers; developing hybrid approaches that link natural and built defense structures; removing incentives to build in high-risk areas (i.e., often on top of low-lying wetlands); and even designing oyster reefs to reduce the impacts of waves and reduce coastal erosion.

Coastal Resilience 2.0 has improved speed, is open source, works globally, operates on tablets, and makes sharing results and data easy. Core partners involved in the

development of these tools include The Nature Conservancy, University of Southern Mississippi, The Natural Capital Project at Stanford University, NOAA Coastal Services Center, and the Association of State Floodplain Managers. This section provides details on the Coastal Resilience website and tools.

Figure 1. Coastal Resilience Home Page www.coastalresilience.org
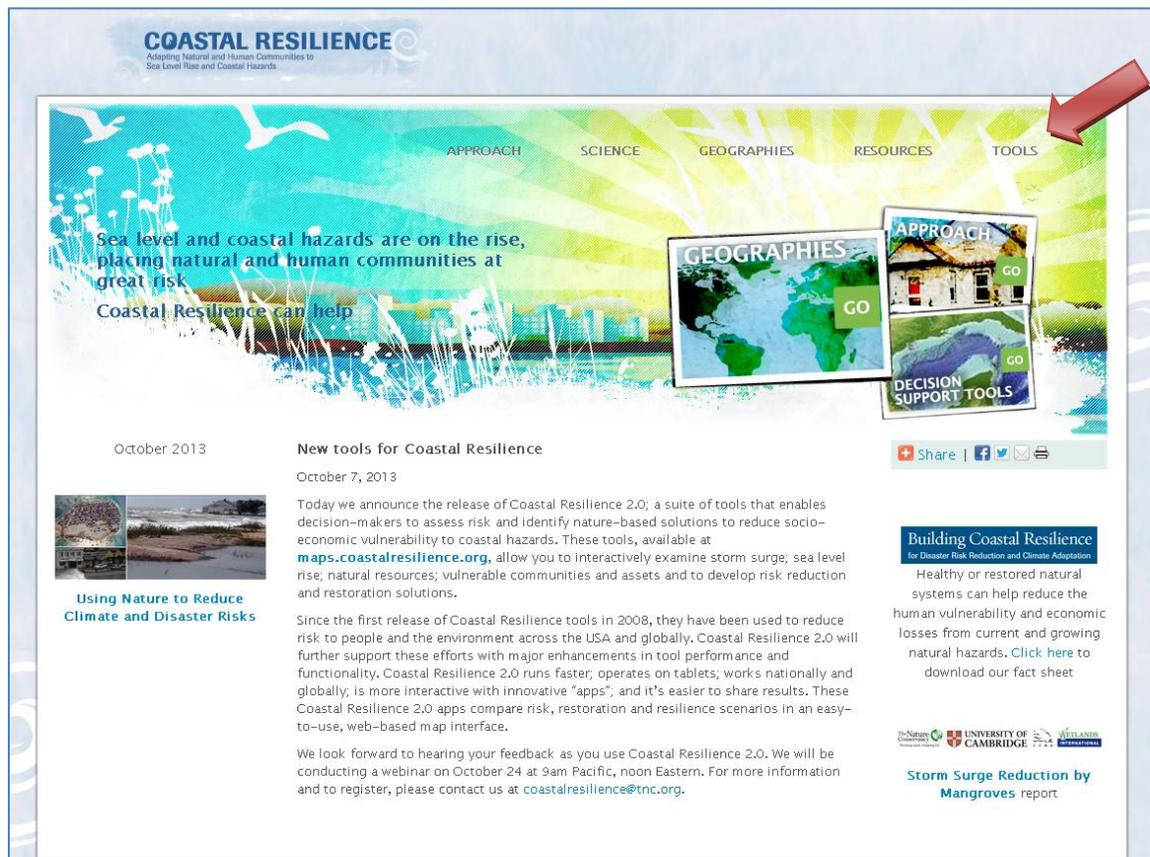
The principle access point for the website is through www.coastalresilience.org –pictured in Figure 1. The user clicks on the "Tools" button on the top right corner of the webpage. Once that button is clicked, the Tools webpage opens offering a description of the decision support tools. Click on maps.coastalresilience.org to open up Coastal Resilience 2.0. The tool is open and free to the public.

The Coastal Resilience tools cover different regions including: a U.S. National and Global application, eight U.S. States (Florida, Alabama, Mississippi, Louisiana, Texas, New York, Connecticut, New Jersey), two specific U.S. locations (Puget Sound, WA, and Ventura County, CA), four countries in Latin America (Mexico, Belize, Guatemala, Honduras) and three island nations in the Caribbean (Grenada, St. Vincent and the Grenadines, U.S Virgin Islands). The Gulf of Mexico Coastal Resilience Tool offers a host of data for all coastal counties to enable users to undertake physical, social and environmental risk and vulnerability analyses. The

Community Planning App provides users interested in a specific community refined data down to the parcel level to facilitate resiliency planning activities. In addition, there are additional Apps used to explore future habitats, coastal risk and solutions to reduce risk, such as placement of oyster reefs to reduce erosion. The following will provide a brief tour of the Gulf of Mexico Coastal Resilience Tool. To access the tool, click on **Gulf of Mexico** and then click on **Map this site** (shown in Figure 2).

Figure 2. Coastal Resilience network site maps.coastalresilience.org

Access to the main Gulf of Mexico Coastal Resilience Tool can also be can be gained by simply typing in www.maps.coastalresilience.org/gulfmex/ . Figure 3 displays a visual representation of the main Gulf of Mexico maps page. This webpage displays the different Apps (yes, just like on your phone) on the left side of the screen. These apps are used to simplify complex data or models, convey a specific ecological or social concept, or to

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compare different future condition scenarios. A short description of each app built for Coastal Resilience 2.0 is below.

Figure 3. Coastal Resilience Gulf of Mexico www.maps.coastalresilience.org/gulfmex/
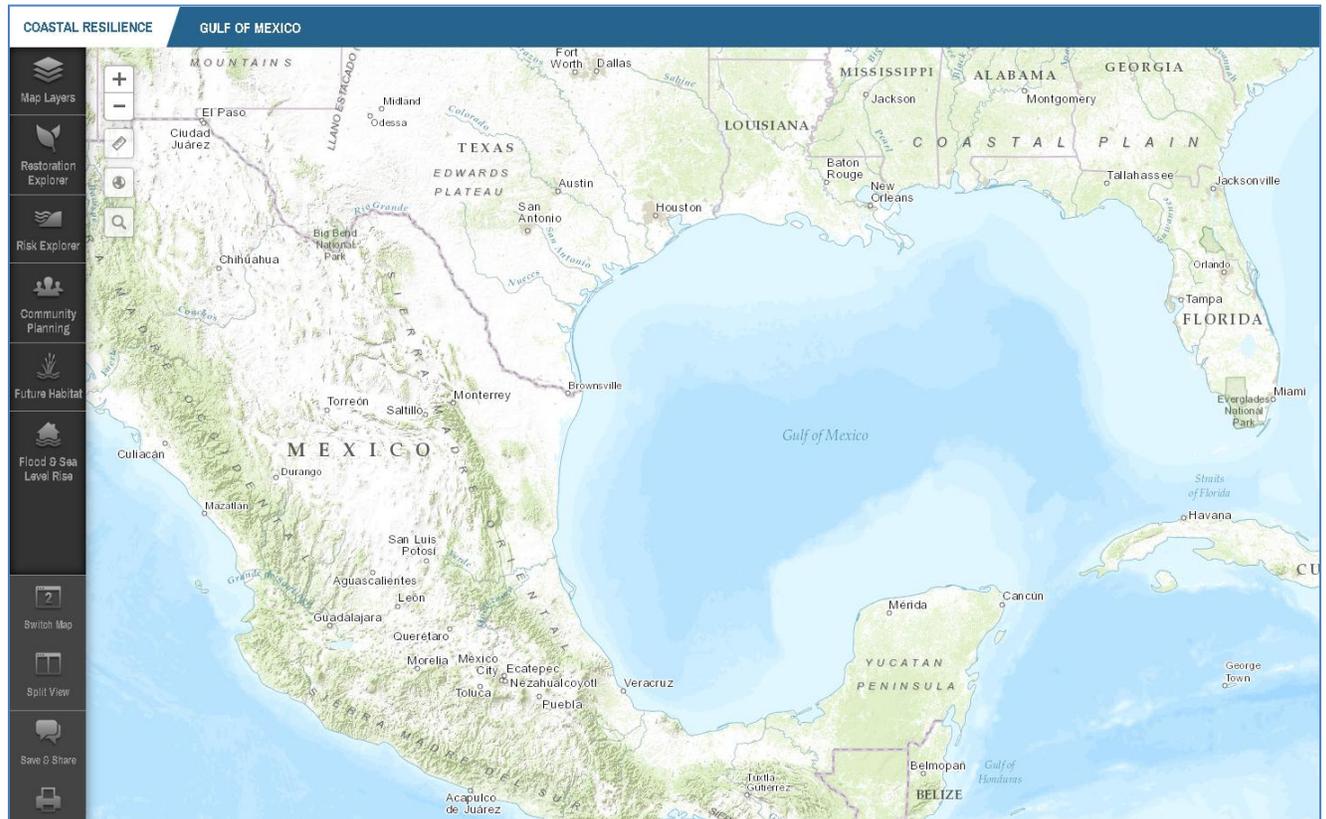
Restoration Explorer

The Restoration Explorer allows stakeholders to examine ecological and socio-economic factors for restoration suitability. In this app an oyster reef index was compiled for restoration scenario planning where individual factors can be weighted for importance when identifying potential restoration sites.

Risk Explorer

The Risk Explorer is organized by state and permits users to easily visualize coastal hazards exposure, social vulnerability and overall risk. The app allows users to explore where people and properties benefit most from the risk reduction benefits provided by habitats.

Community Planning

The Community Planning app is the location where resilient communities host their locally specific data to inform their decisions and track their successes. It is also where the community comes to view their information alongside and with the other Coastal Resilience data layers. This app provides information for a community-level engagement process over

time.

Future Habitats

Certain ecosystems like coastal wetlands will change and may move landward as sea level rises. The app shows where and how coastal wetlands are likely to change and where they are likely to move landward over time as sea level rises. Coastal wetlands may become submerged, or may change from a type that is more protective from storm surge to a type that is less protective of storm surge (for example from forested wetlands to marsh). Whether coastal wetlands move landward in response to sea level rise depends on several factors including the rate of land accretion or the amount of sediment accumulating in the coastal area, the rate sea level is rising, and whether or not there are physical obstacles preventing wetlands from moving landward. The Future Habitat app categorizes various coastal habitat change scenarios from spatial model outputs.

Flood & Sea Level Rise

Flooding is increasing along the coast and certain rivers. Use this app to view areas affected today and in the future due to increased sea level rise, surge from storms and hurricanes, and inland flooding.

There is also a set of operative GIS tools that are located in the upper left hand corner, just to the right of the Apps. These tools include zoom in and out, a measurement tool and an address search bar. The buttons below the Apps offer tools that allow the user to split screens to compare scenarios. One can also select the "Save and Share" button to create a link to the map which will retain whatever map layers are displayed or select the

The "**Map Layers**" App contains Gulfwide and State information important for resiliency planning (Figure 4). Users can use these map layers in combination with the other Apps to develop scenarios and evaluate solutions to reduce risk and adapt to sea level rise. When assessing your community it is important to look at its hazard exposures, ecological vulnerabilities and social vulnerabilities in order to identify solutions that maximize social, ecological and economic benefits. We will take a closer look at how to spatially evaluate each piece.

Figure 4. Map Layers on Coastal Resilience
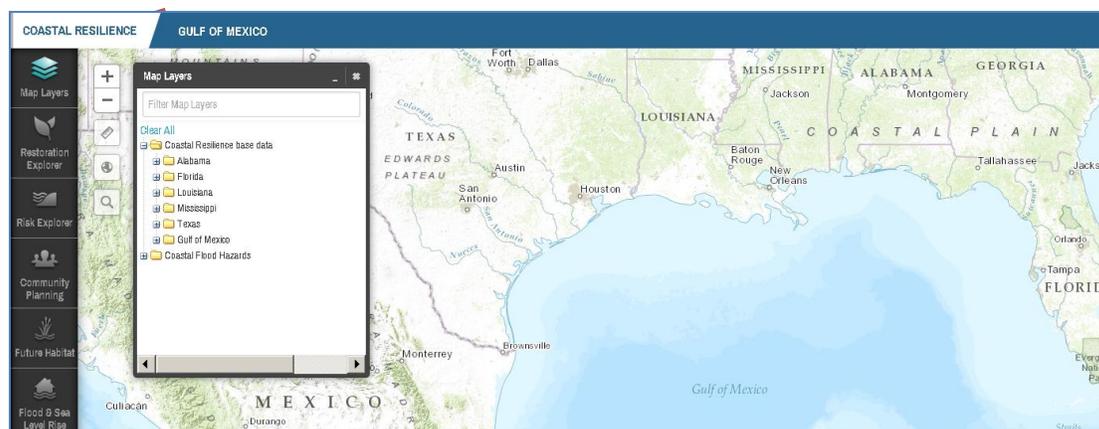
ACTIVITY 1: HAZARD EXPOSURE

Geographical areas can be affected by disaster impacts in part because of their exposure to hazard elements. Most people are exposed to some sort of hazard. Hazard exposures can include:

- Natural hazards: Flood, Wind, Surge, Earthquake,
- Technological or man-made hazards

It is important to identify the potential hazards your community is likely to be exposed to and to assess the likelihood of disaster impact. Some examples would be to identify:

- Hurricane risk zones (slosh models, surge zones)
- Flood zones (Flood insurance Rate Maps –FIRM)
- Coastal erosion/accretion
- Hazardous sites
- Wildfire
- Drought

This, of course, is not an exhaustive list. The important piece for a community is to visualize this through mapping. For this tutorial we will evaluate the exposure of your community to some of these hazards. We will look at hurricane surge zones and flood hazards.

Storm Surge. In the Menu panel at left side of screen, click on the **Flood and Sea Level Rise** App and click on the "+" beside the Coastal Flood Hazards Folder and then click on the "+" beside the Coastal Flood Atlas . Expand the CFLA MOM Storm Surge Footprints (Category 1-5) by clicking on the "+".These show you a maximum potential storm surge footprint for each Hurricane Category. Now zoom to the City in which you work and identify which Category of Storm Surge your City lies within. See Figure 5 for an example.

Self-Check:

- ✓ Most of my city or town, _____, lies within a Category _____ Storm Surge.

Figure 5. Storm Surge Exposure
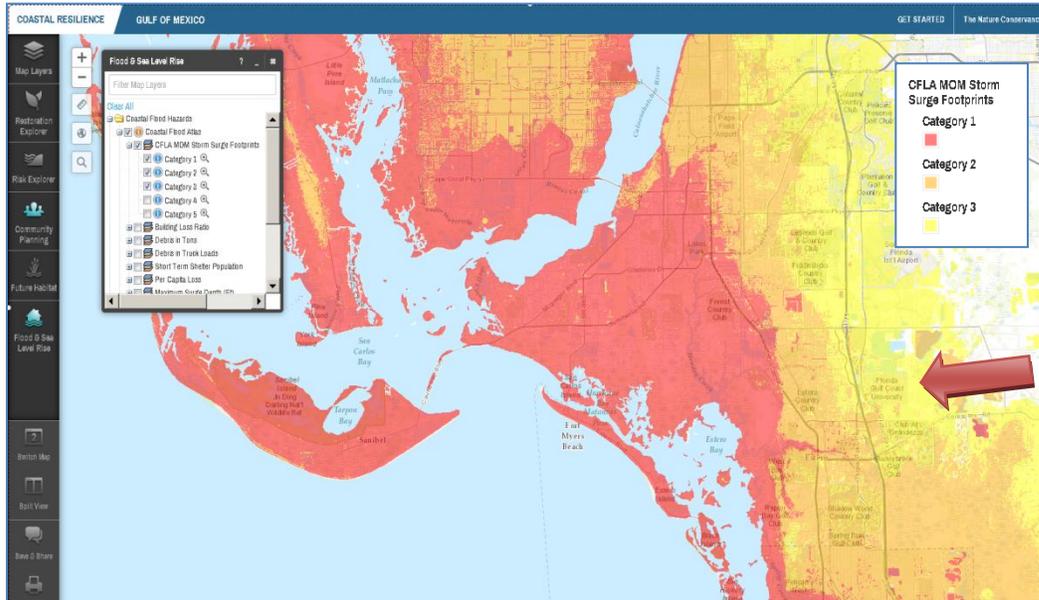
Example: Most of my area of interest, **_FGCU_ ,** lies within a Category **_3_** Storm Surge.

Sea Level Rise. Uncheck the previous layers. Minimize the **Flood and Sea Level Rise App**. Click on the "search" icon on the left side of the map. Type in Port Charlotte , click enter and select Port Charlotte, Florida from the drop down menu. Once the map zooms to Port Charlotte, scroll the map to center the 41 Bridge crossing the Peace River on your screen. Move your mouse to the upper right portion of the map and hover over the button that says "Topographic". From the Drop down menu, click on "Imagery".   Go back to the **Flood and Sea Level Rise App** and expand the "NOAA Sea Level Rise" folder. Click on the 3 foot sea level rise scenario. See Figure 6.

Self-Check:

✓   On the Port Charlotte side of the Peace River, parcels on which side of the bridge are more vulnerable to sea level rise (East or West)?
_____

Figure 6. Sea Level Rise Exposure
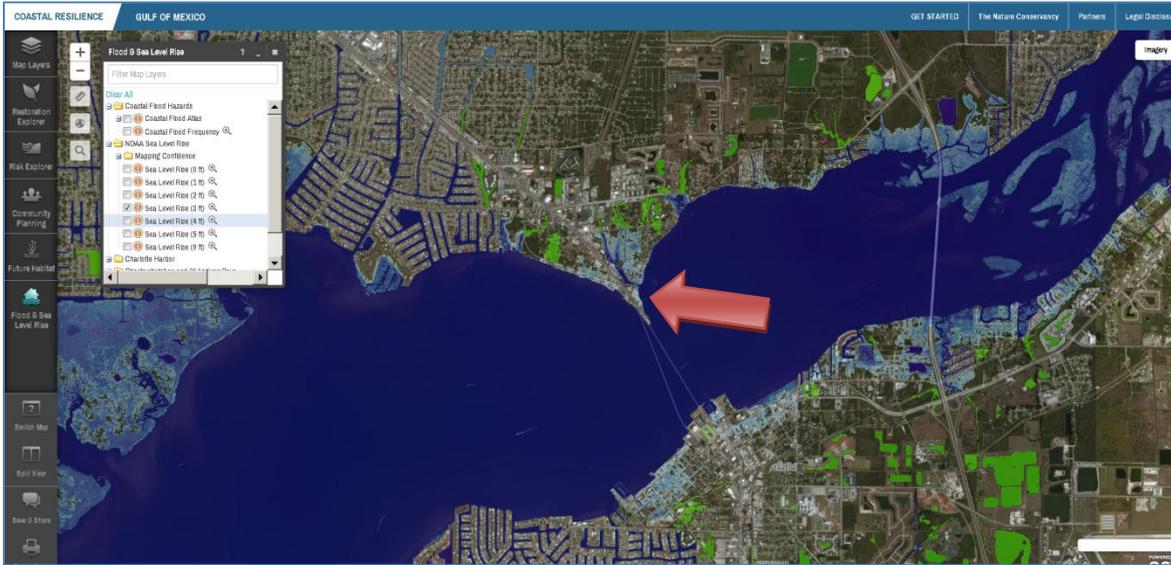
Sea Level Rise Scenarios. To compare different SLR scenarios side by side, click on the "Split View" button below the Apps. Change the background of the second map from Topographic to Imagery.   Click on the "Link Maps" button between the two maps. Open the **Flood and Sea Level Rise App** on the second map and turn on the 5 foot sea level rise scenario in the NOAA Sea Level Rise folder. You can scroll around each map simultaneously to explore the two future sea level scenarios (Figure 7).

Figure 7. Sea Level Rise Scenarios
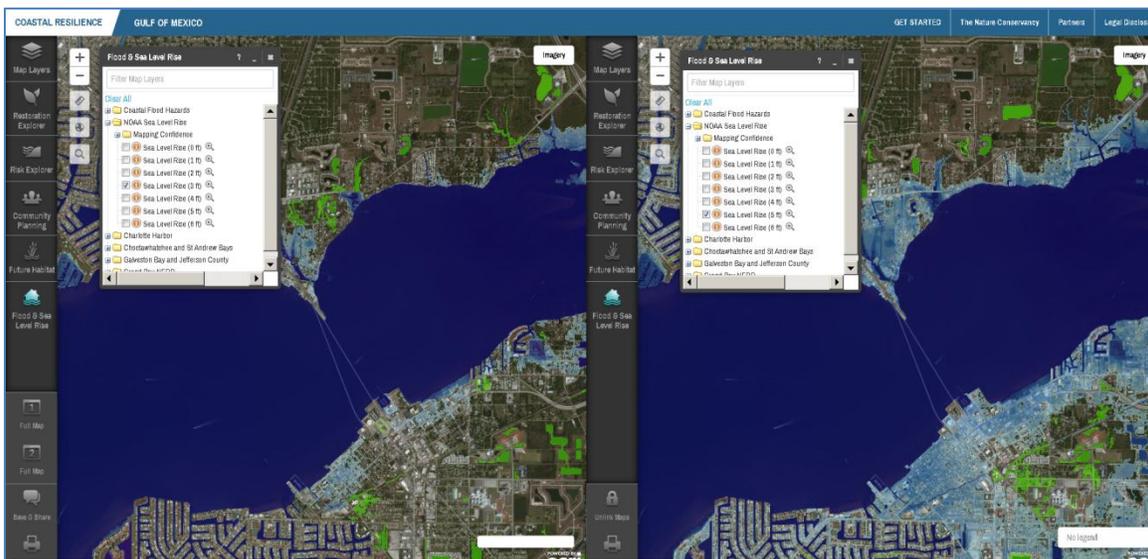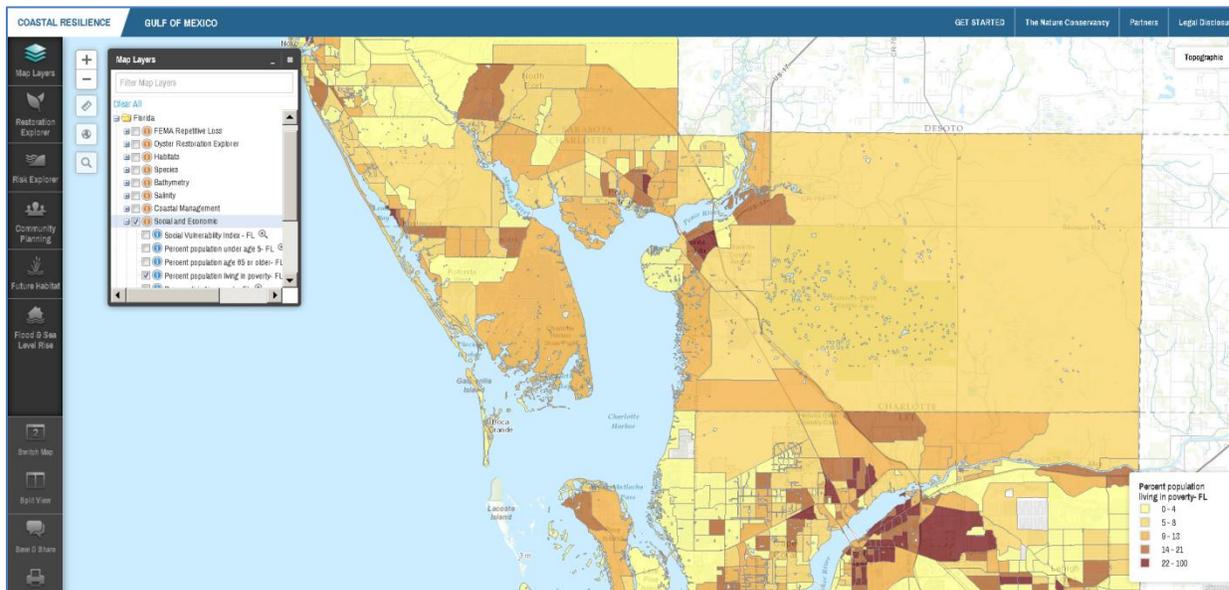
ACTIVITY 2: SOCIAL VULNERABILITY

Social vulnerability is much like physical vulnerability, except it is focused on social factors and processes that generate vulnerability in terms of a person's or group's capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. These factors include:

- Race/ethnicity,
- gender,
- education,
- poverty,
- age, and
- housing tenure

Social vulnerability will rarely be uniformly distributed among the individuals, groups, or various populations in a community. As a consequence we can develop mapping tools to identify areas with higher concentrations of socially vulnerable populations. Socially vulnerable populations are more likely to suffer from the damaging effects of hazards.

Poverty. Click on the **Map Layers App** and expand the "Florida" folder by clicking on the (+). Check the box next to "Social and Economic" and expand the "Social and Economic" layer. Check the box next to "Percent population living in poverty" and zoom into the Charlotte Harbor area. See Figure 8 below.

**Figure 8. Percent Population living below the poverty line**

Self-Check:

✓ Which Charlotte Harbor region contains block groups with higher percentages of poverty: Peace River, Charlotte Harbor, Barrier Islands or Caloosahatchee River ? _____

Social Vulnerability Index. Uncheck Poverty and check the box next to the "Social Vulnerability Index". The Social Vulnerability Index is a composite indicator of social vulnerability and is based on a suite of social vulnerability indicators. Next turn on the Category 3 MOM Storm Surge Footprint located in the **Flood and Sea Level Rise App** by clicking on the "+" beside the Coastal Flood Hazards Folder and then click on the "+" beside the Coastal Flood Atlas . Expand the CFLA MOM Storm Surge Footprints and check the box next to Category 3. The Storm Surge footprint is overlayed on top of the Social Vulnerability Index (Fig. 9)

Figure 9. Social Vulnerability Index
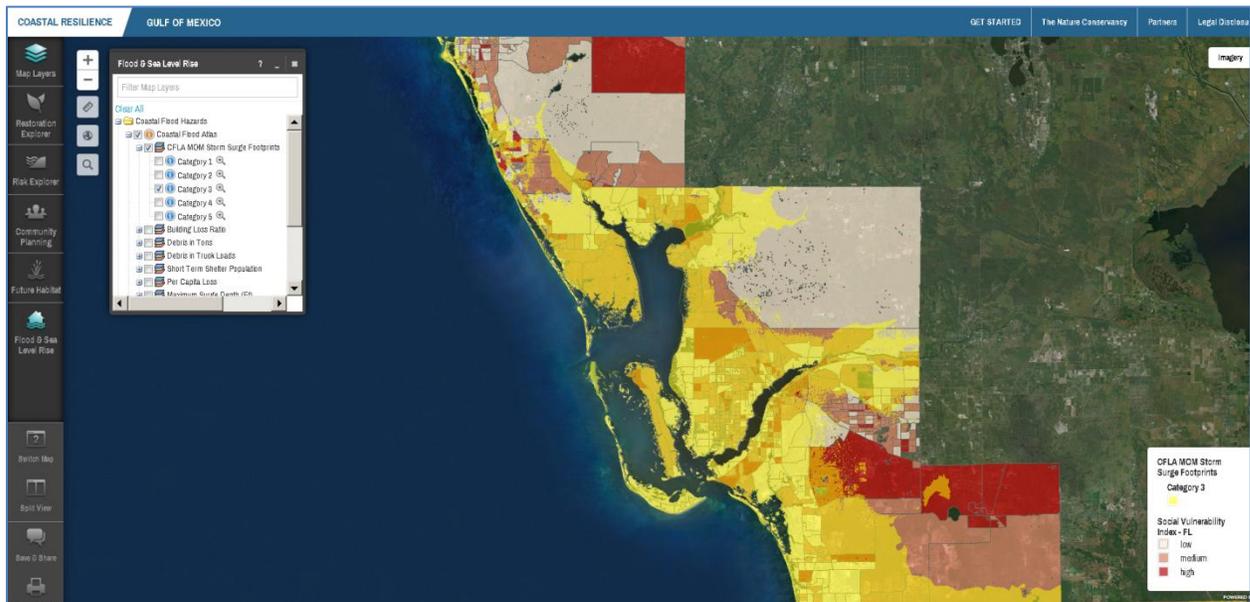
Self-Check:

✓ Are there areas of high social vulnerability located in the Category 3 Storm Surge? _____

✓ Do you see concentrations of Social Vulnerability in any particular areas?

_____

✓ Which island has socially vulnerable areas?

_____

ACTIVITY 3: ECOLOGICAL VULNERABILITY

Future Habitat – Understanding likely changes to coastal habitats to make better decisions now

Sea level is rising and the rate of this change is projected to accelerate over the next century. Both natural and human communities along the coast will be impacted. The Future Habitat maps illustrate predicted future changes to coastal wetlands and adjacent uplands at several large bay systems across the Gulf of Mexico. The Future Habitat maps were created through application of the Sea Level Affecting Marshes Model (SLAMM) using three sea level rise scenarios through the year 2100. The Future Habitat maps can assist coastal managers with identifying which habitats are disappearing most rapidly, which areas of natural and human communities are most vulnerable to SLR effects and which species may be especially vulnerable to these changes. This information will be useful during development of land acquisition, species management, shoreline management and restoration plans.

For this activity, we will examine the Future Habitat information available for the Charlotte Harbor Area and how it can be used to inform natural areas, species, shoreline and land use management.

Future Habitat Change. Click on the **Future Habitat** App and expand the Charlotte Harbor list by clicking on the (+). Zoom to Charlotte Harbor on the map by holding down the Control button while drawing a box around Charlotte Harbor using the left mouse button. Check the box next to "Existing Habitat" under Coastal Wetland Change. Click the "Split View" button below the Apps menu. Then click on "Link maps" to ensure that the split view maps retain the same extent and zoom. Open the Future Habitats App in your second map window and select the 1 meter scenario, year 2100 (Figure 10).

Self-Check:

- ✓ Which coastal habitat appears to change the most in the Charlotte Harbor area under a 1 meter sea level rise scenario?
  _____

Figure 10. Charlotte Harbor Area under current conditions (left) and future conditions with 1 meter of sea level rise in Year 2100 (right).
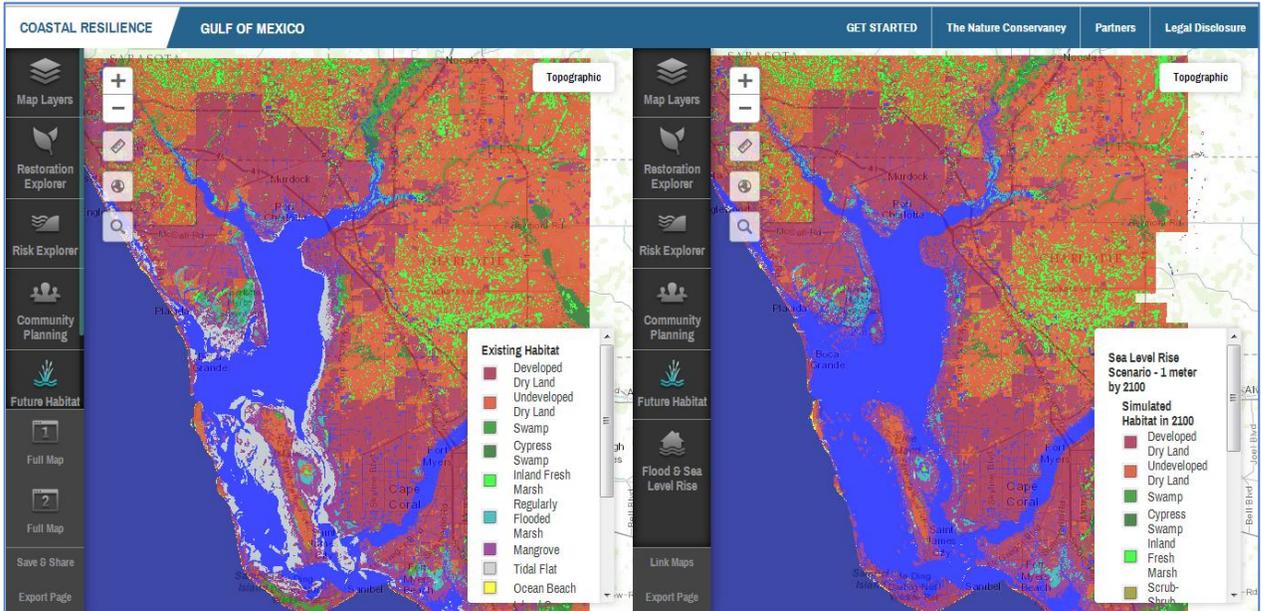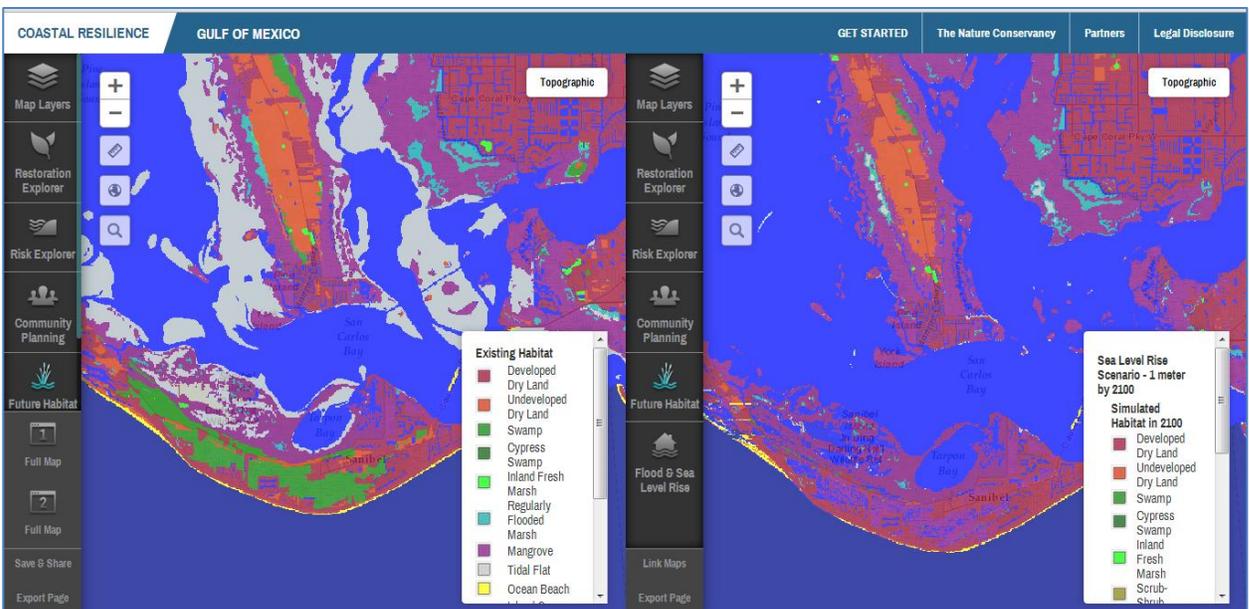

Next, zoom into Sanibel Island on each map (Figure 11).

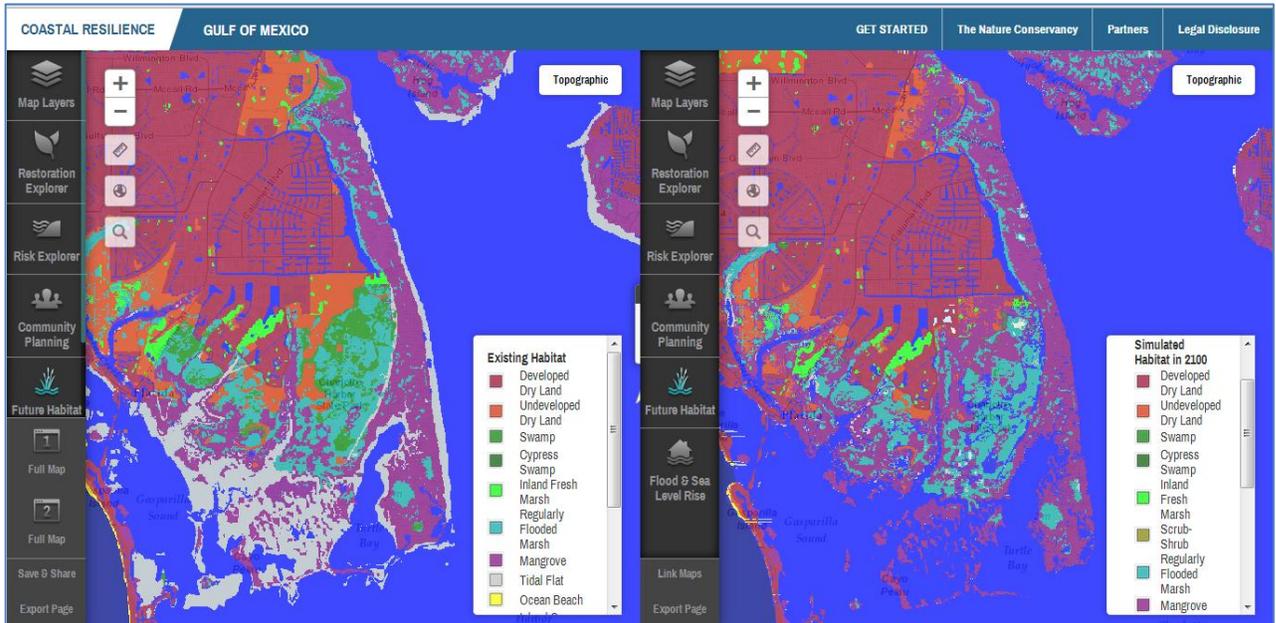**Self-Check:**

✓ What happens to the swamp (aka coastal forest) in the center of Sanibel Island under a 1 meter sea level rise scenario?

_____

Figure 11. Sanibel Island under current conditions (left), right under 1 meter SLR year 2100 (right)

Next zoom to the Cape Haze area of Charlotte Harbor shown in Figure 12.

Figure 12. Cape Haze under current conditions (left) and year 2100 with 1 meter of sea level rise (right)

Self-Check:

✓ Are swamp dependent species at the south end of the Cape Haze Peninsula vulnerable to the effects of sea level rise under 1 meter sea level rise by the year 2100?

_____

✓ In the Cape Haze Area, which area of undeveloped dry land is likely to exhibit changes due to sea level rise and what type of habitat is it likely to become in the future?

_____

On your second map (right side of screen), turn off the "Simulated Habitat in 2100" layer and turn on the "Future Mangrove area" layer to display areas likely to become mangrove areas under a 1 meter sea level rise scenario. Zoom out to the Charlotte Harbor area and explore where mangrove migration is likely to occur with sea level rise. Note: You can evaluate which parcels may contain mangroves in the future by also turning on the Lee or Charlotte County parcel layer within the **Community Planning App**.

Self-Check:

- ✓ What land use decisions impact whether or not the undeveloped dry land will become a mangrove area as sea level rises?
  _____

ACTIVITY 4: IDENTIFYING SOLUTIONS USING THE COASTAL RESILIENCE TOOL

The **Map Layers** and **Apps** within the Coastal Resilience Tool can be used to identify opportunities to use natural defenses to reduce risk and/or adapt to sea level rise.   Let's explore two Apps, the **Restoration Explorer** and the **Risk Explorer**.

The **Restoration Explorer** is organized by state and permits users to easily visualize locations most appropriate for oyster restoration investment using a suite of ecological, social and economic criteria. The suitability criteria vary somewhat between states due to differences in data availability, however all states include basic ecological measures such as depth, salinity and historic oyster distribution.

When a user interacts with the Oyster Restoration Dashboard for a particular state they have the ability to assign a number of weights to the various criteria or individual parameters. These weights are assigned through the interface by sliding a bar to select a value between 0 and 10. Therefore, the user is deciding which parameters are important and weighting them accordingly.

Click on the **Restoration Explorer App** and click on Florida. You can see that the App has both ecological and socioeconomic variables that you can adjust as you see fit. For a detailed description of the methods and scoring for each variable you can click on the "Methods" button and a pdf document will open up in a new tab.

Zoom into SW FL (Figure 13) and explore several scenarios using the Restoration Explorer.

Figure 13. Restoration Explorer App in SW Florida
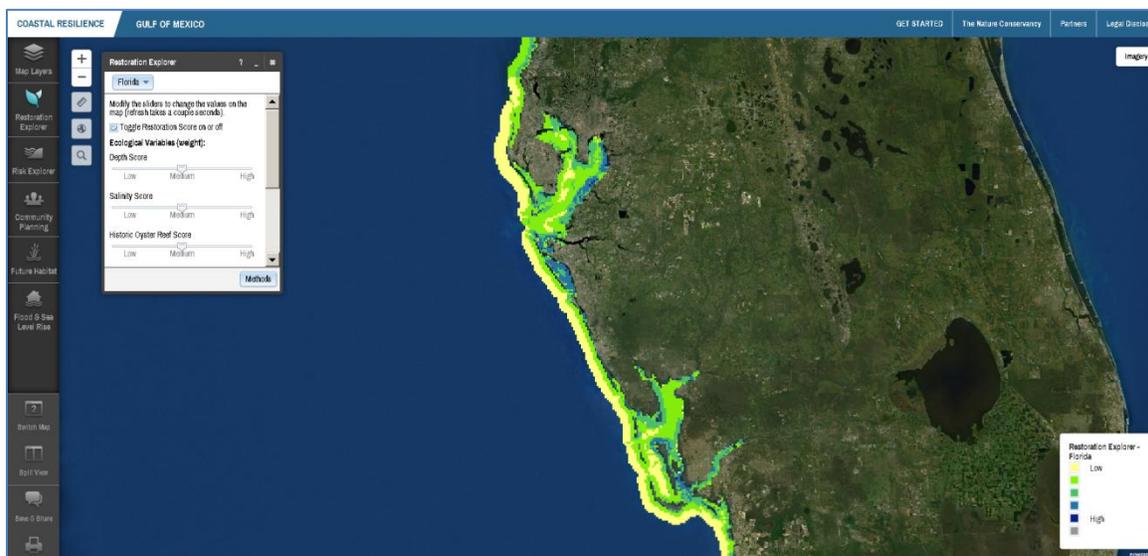
Self-Check:

✓ Which areas or bays are indicated as high suitability when all variables are set to medium?

_____

✓ How do the high suitability areas change when the socioeconomic variables are set to zero (hint: use split screens)?

_____

_____

The **Risk Explorer App** allows decision makers (i) **to assess risk and vulnerability** to waves, storms and sea level rise and (ii) **identify habitat restoration and management priorities** that may be most useful for risk reduction. The Explorer provides both Answers (i.e., a static map) and a dynamic exploration tool.

The Risk Explorer is organized by state and permits users to easily visualize coastal hazards risk as a function of both coastal exposure and social vulnerability. In the "Show Me" section of the Risk Explorer, the user can quickly view where habitat loss may have the greatest impacts on risk and thus where management (including for example restoration to enhance the condition of existing marshes and reefs) is most important for risk reduction (and thus should be proactively managed and protected to reduce risk). The "Show Me" section also includes maps showing where oyster restoration is most likely to reduce risk and maps showing the variation in median owner-occupied housing values across each state.

We have developed a training module for the Risk Explorer that can be found by clicking on the "Get Started" button at the top right of your Coastal Resilience Tool map window. Scroll down to Try Me: Risk Explorer and click on the large icon to start the simulation.

The simulation walks the user through the App and demonstrates how the tool can be used. After you have completed the interactive module, please complete the questions below.

Self-Check:

✓ On the Risk Explorer App, uncheck the box marked "Toggle Risk Score on or off". Turn on the first "Show Me" map and zoom into the Charlotte Harbor area. Why do you think that mangrove areas along much of the east wall of the Harbor are indicated as high value for risk reduction?

_____

_____

- ✓ Use the oyster restoration "Show Me" map to identify two locations that may be appropriate for an oyster reef project with risk reduction benefits.
_____and _____

Congratulations! You have now completed your Coastal Resilience 2.0 Training Activities. For more information and updates, please visit www.coastalresilience.org.