



# Coastal Resilience 2.0: Training Activities

## Coastal Resilience 2.0

### Background

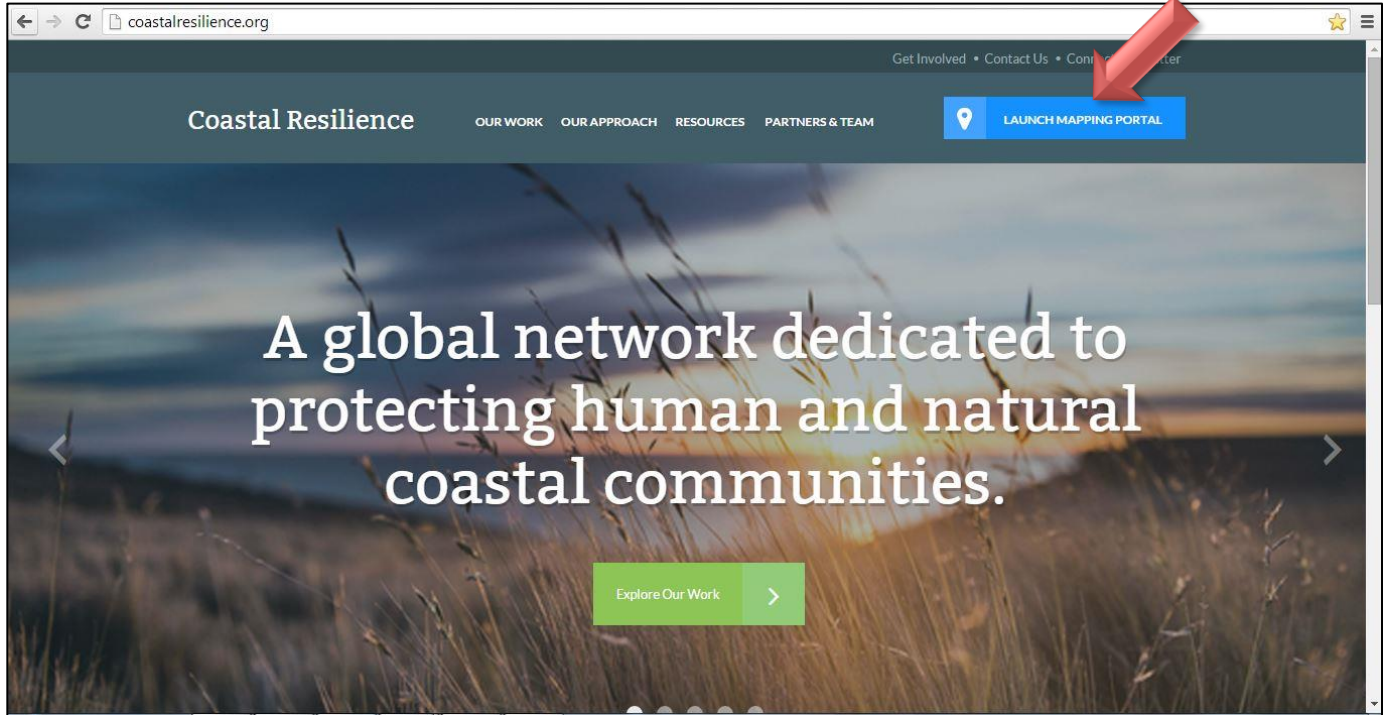
Governments and communities can enhance their resilience to coastal hazards and climate change by using a combination of built infrastructure and protecting, restoring, and effectively managing their marine and coastal ecosystems. When coastal habitats such as oysters, marshes, coral reefs, and mangroves are restored and protected for risk reduction they are called natural defenses or natural infrastructure. The Nature Conservancy is demonstrating the potential for nature to reduce risk through its Coastal Resilience program and project sites. The Coastal Resilience approach includes 4 critical elements: raise awareness, assess risk, identify choices, and take action.

With recent events like Hurricane 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 is empowering community decision makers, citizens, and neighborhood organizations with the data and mapping tools to engage in resiliency planning activities. These data and tools are critical to help local communities more fully recognize their exposure to potential hazards and the consequences of future decisions. The Nature Conservancy and partners have developed Coastal Resilience 2.0; a suite of applications for coastal communities, government agencies, and other stakeholders that informs hazard mitigation, risk reduction, climate adaptation, and conservation decisions. The applications 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 apps backed by the best available science, we enable stakeholders to visualize current and future risk and help identify 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](http://www.coastalresilience.org))

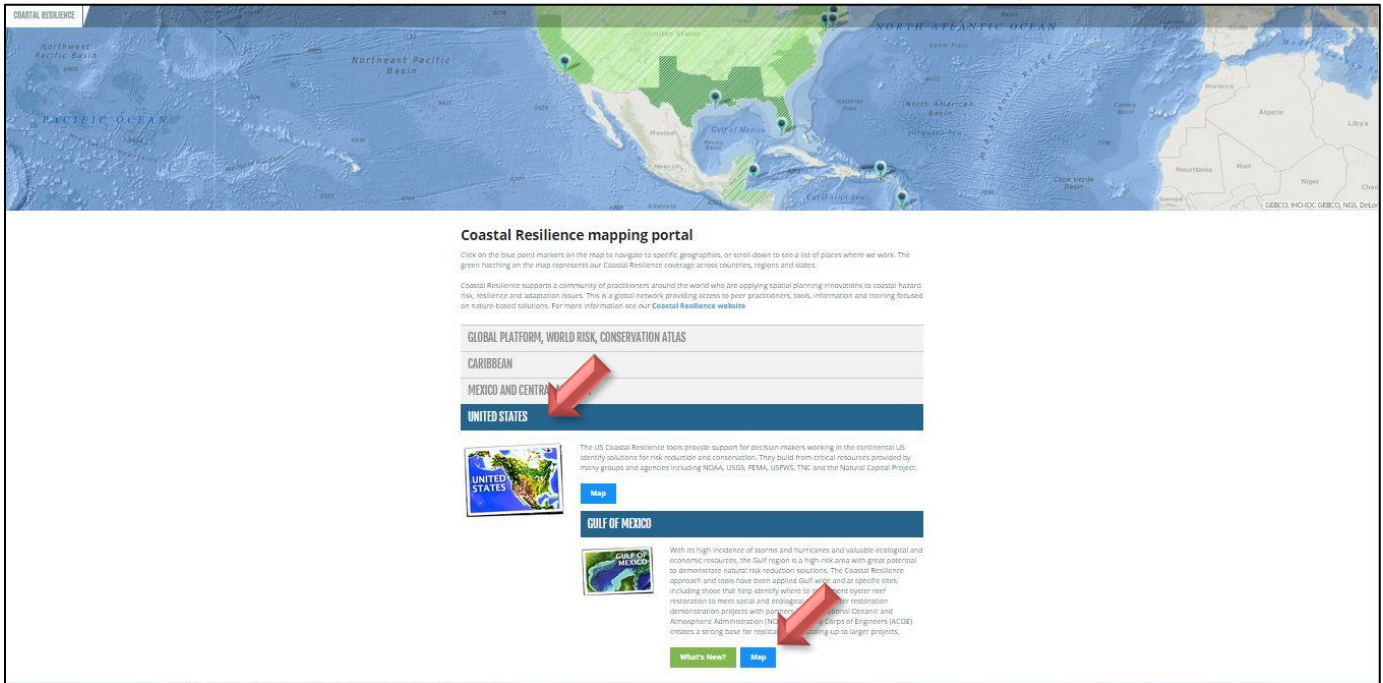


The principle access point for the website is through [www.coastalresilience.org](http://www.coastalresilience.org) –pictured in Figure 1. The user clicks on the “**Launch Mapping Portal**” button on the top right corner of the webpage.

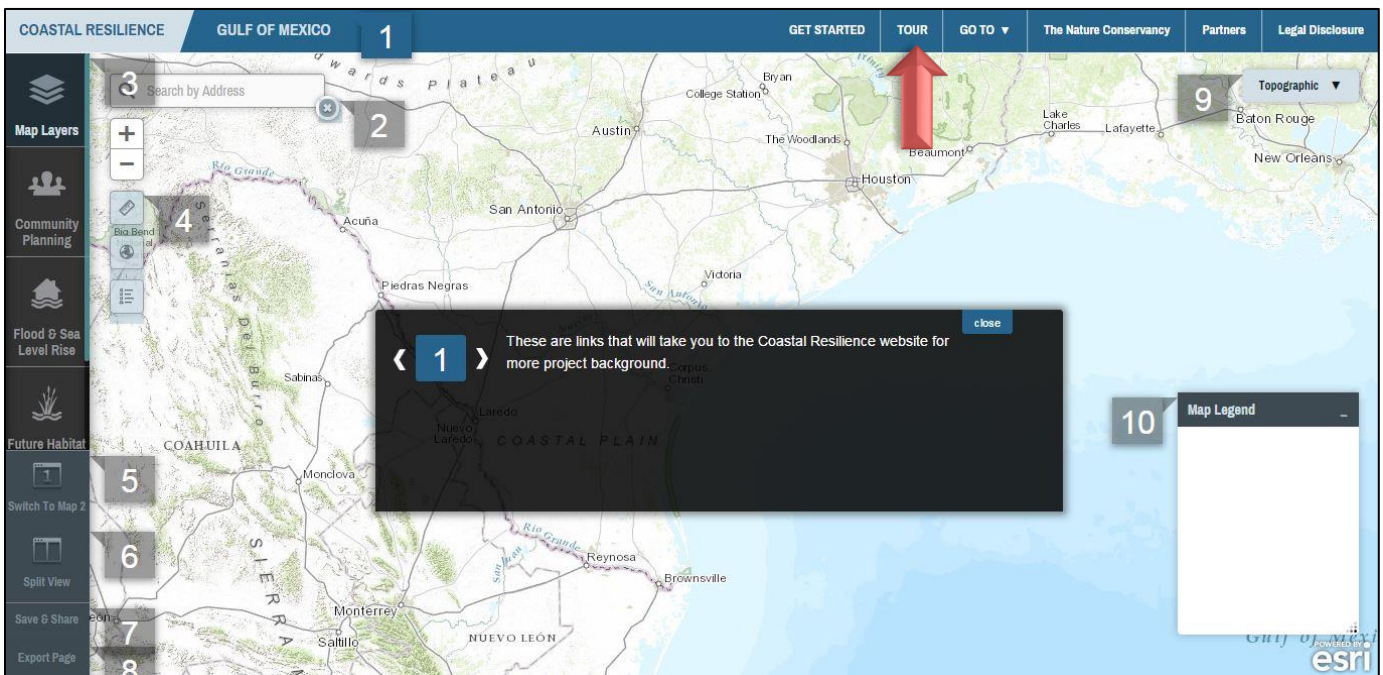
The Coastal Resilience tools cover different regions including: a U.S. National and Global application, eight U.S. States (Florida, Alabama, Mississippi, Louisiana, Texas, New York, Connecticut, New Jersey), two specific U.S. locations (Puget Sound, WA, and Ventura County, CA), four countries in Latin America (Mexico, Belize, Guatemala, Honduras) and three island nations in the Caribbean (Grenada, St. Vincent and the Grenadines, U.S Virgin Islands). The following will provide a brief tour of the Gulf of Mexico Coastal Resilience Tool.

To access the tool, click on **“United States”**, then **“Gulf of Mexico”** and then click on **“Map”** (Figure 2). Figure 3 shows 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 compare different future scenarios. A **“Tour”** button is provided in the navigation bar for a brief description of other Coastal Resilience functionalities (Figure 3).

**Figure 2: Coastal Resilience network site**



**Figure 3: Coastal Resilience Gulf of Mexico**



## [Map Layers](#)

**Map Layers** contains Gulf-wide and State information important for resiliency planning. You can use these map layers in combination with the other Apps to develop overlay scenarios and evaluate various solutions. 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.

## [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.

## [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.

## [Future Habitat](#)

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 and 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.

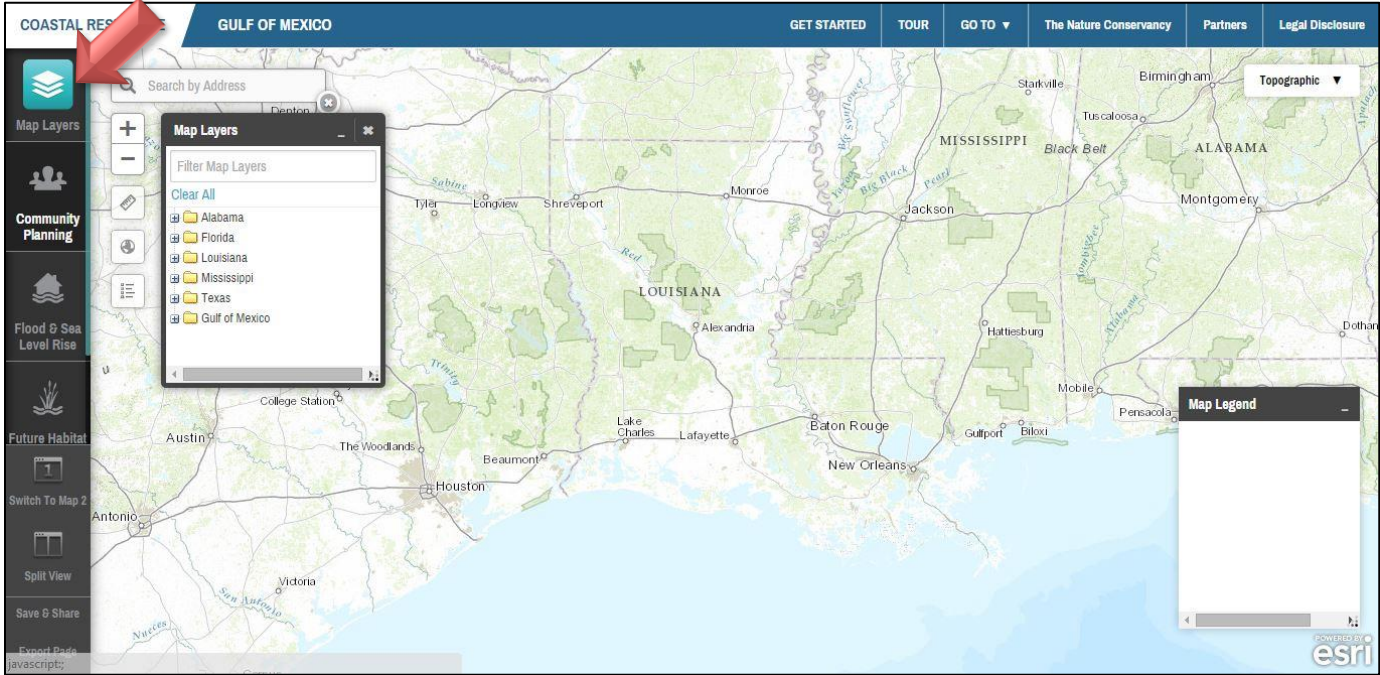
## [Coastal Defense](#)

**Coastal Defense** quantifies how natural habitats (oyster reefs, tidal marshes, mangroves, coral reefs...) protect coastal areas by reducing wave-induced erosion and inundation. It uses standard engineering techniques to help you estimate how and where to restore or conserve critical coastal habitat, and increase the resilience of your community and infrastructure.

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.

The **Map Layers** App contains Gulf-wide 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 app**



## SESSION 1: ASSESSING RISK TO COASTAL HAZARDS

### APPS: Flood & Sea Level Rise Explorer, Map Layers

The scale of impact from a disaster depends in part on a community's exposure to hazard elements. It is important to consider both natural hazards (Flood, Wind, Surge, Earthquake) and technological or man-made hazards. A first critical step is to identify the potential hazards your community may be exposed to and assess the likelihood of disaster impact. An effective way to get this conversation started is to visual your community's vulnerability to various hazards through mapping. Some examples would be to identify:

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



### Activity 1: Assess Risk to Storm Surge

1. In the Menu panel at left side of screen, click on the **Flood and Sea Level Rise** App. The first thing you will see is a box called an “infographic” (Figure 5). These are meant to provide users with a visualization of the functions of that app. To continue onto the app click the “continue” button. If you do want that infographic to pop up every time you open the app place a “✓” in the box “do not show on start”. If at any time you want to see the infographic again you can click on the ( ? ) in the right top corner of the next box.
2. Click on the (+) beside the Coastal Flood Hazards Folder and then click on the (+) beside the Coastal Flood Atlas.
3. Expand the CFLA MOM Storm Surge Footprints by clicking on the (+). These layers represent a maximum potential storm surge footprint for each Hurricane Category. Click the boxes next to each Category to make them all visible (Category 1-5).
4. Now zoom to the City in which you work/live or an area of interest and identify which Category of Storm Surge your area of interest lies within.



#### Self-Check:

1. Most of my city/town or area of interest, \_\_\_\_\_, lies within a Category \_\_\_\_\_ Storm Surge.

Figure 5: Storm Surge Exposure – Flood and Sea Level Rise app

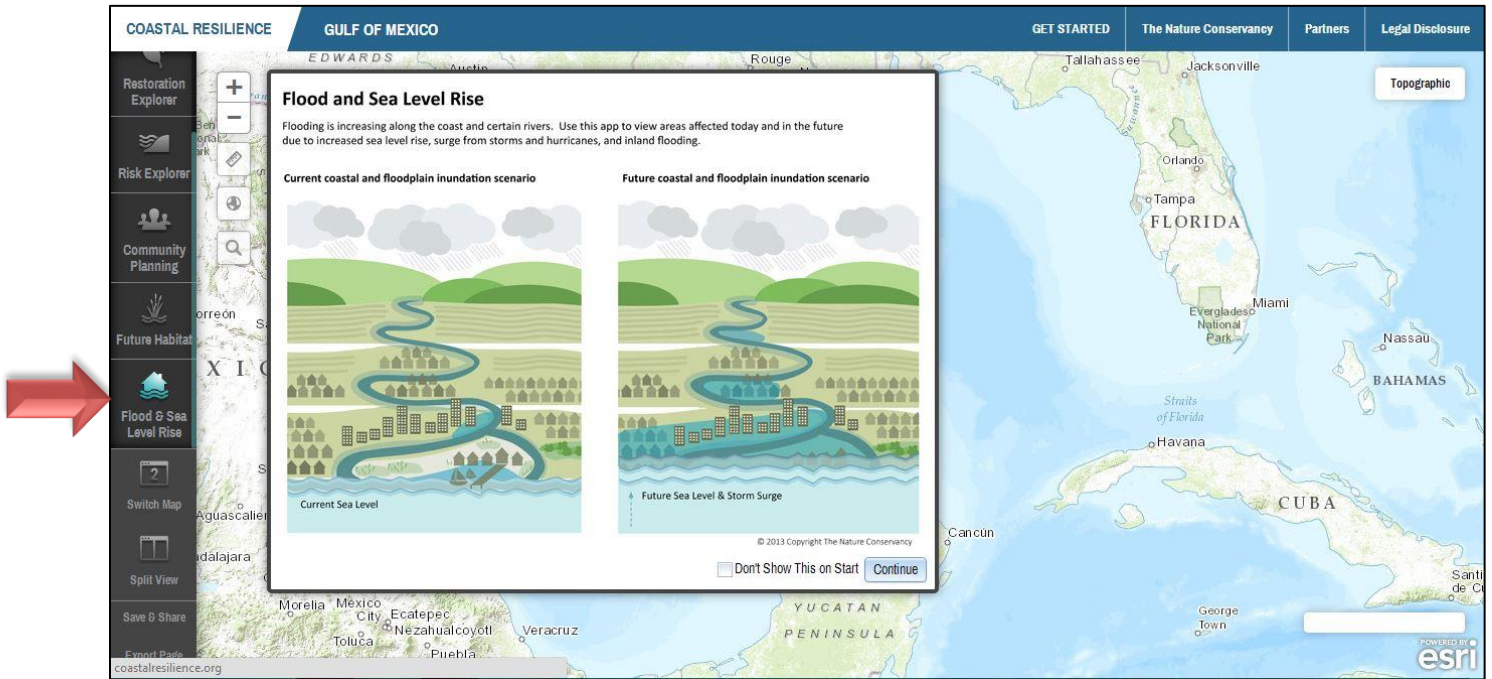
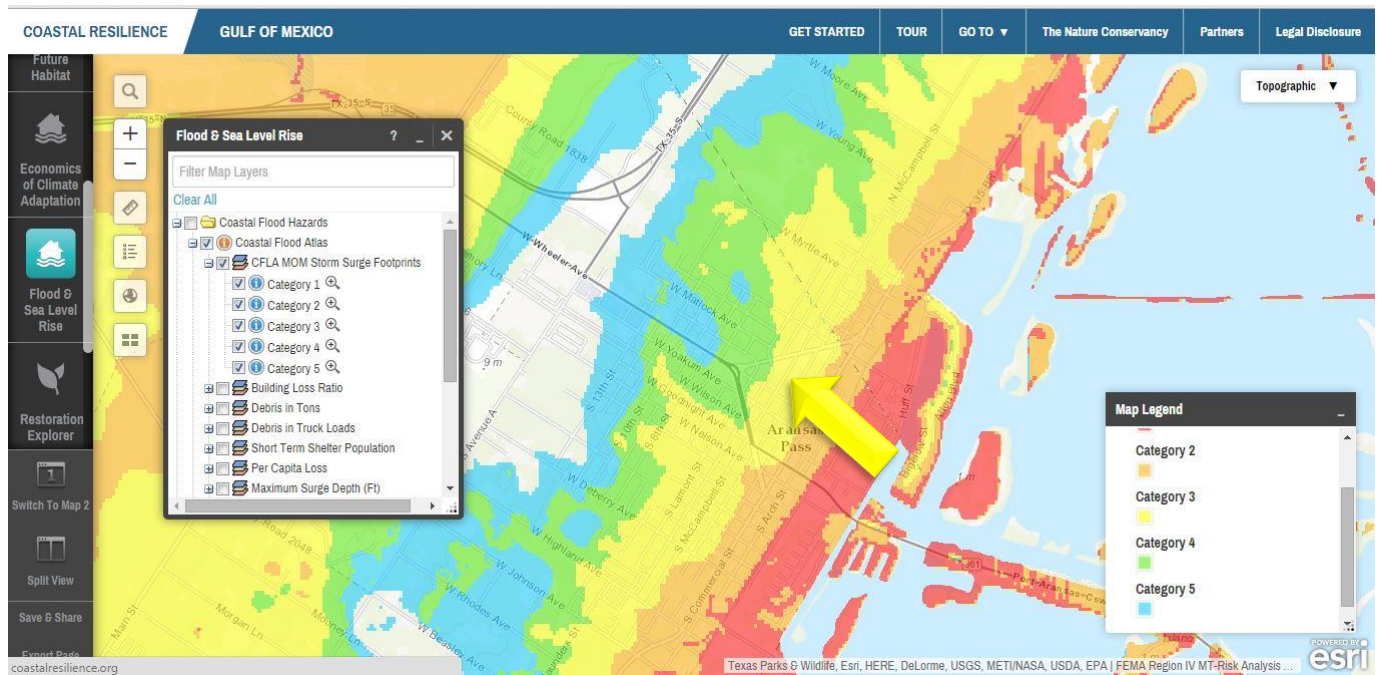


Figure 6: Storm Surge Exposure – Flood and Sea Level Rise App (Self-check Example)

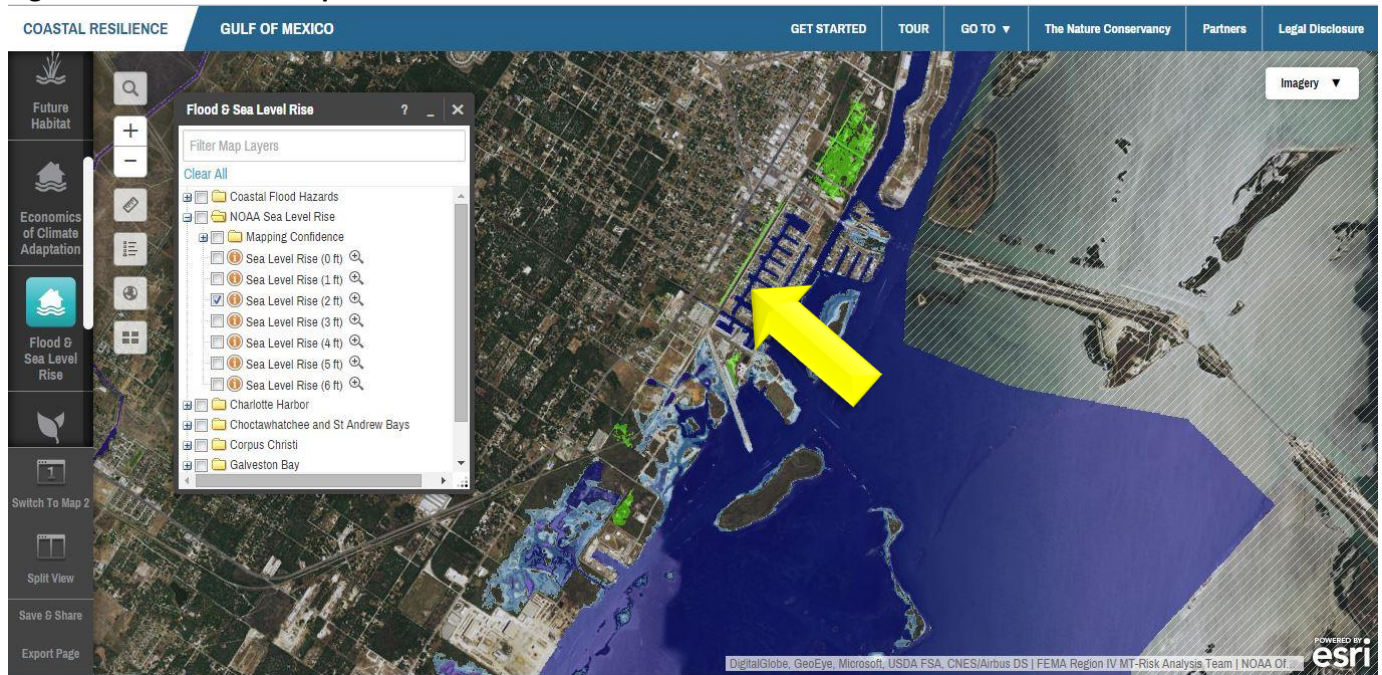
1. Most of my area of interest, **Aranzas Pass Civic Center**, lies within a Category **4** Storm Surge (green).



### Sea-level Rise Exposure

Uncheck the previous layers. Minimize the **Flood and Sea Level Rise App** by clicking on the ( ) at the top right. Click on the “search” icon on the left side of the map. Type in Aransas Pass, TX, press the enter key on your keyboard and select Aransas Pass, TX from the drop down menu. Once the map zooms to Aransas Pass area, 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 2 foot sea level rise scenario. (Figure 7)

Figure 7: Sea-level Rise exposure




Here you can see that with 2ft of sea-level rise the S. Euclid Street will be inundated with water.



### Activity 3: Social Sensitivity Index – Mission-Aransas Estuary watershed

Texas Sea Grant and the Mission-Aransas Reserve collaborated on the development of a social sensitivity index for the Census block groups located in the Mission-Aransas Estuary watershed, which includes the Aransas Pass area. The goal of the index is to provide communities with valuable information on their social sensitivity and increase their ability to plan for and respond to upcoming environmental changes and potentially disastrous episodic events associated with climate change. The social sensitivity index was developed by performing a Principal Component Analysis (PCA), using resulting factor scores to create an index by Census block group, and translating the index scores into a Geographic Information System (GIS). The PCA was conducted using 36 socioeconomic, demographic, and infrastructure variables at the census block group level. PCA factor scores were then put into an

additive model and summed for each Census block group - higher values indicate increased social sensitivity, while lower values indicate lower sensitivity. Index scores for Census block groups were grouped into quantiles based on the additive score and were conveyed in GIS. This approach allows the user to identify areas of the landscape where there is uneven capacity for preparing for and responding to potential climate change impacts.

1. Close the Flood and SLR app. Click the Zoom Out icon for a broader view of Aransas Pass and surrounding areas.
2. Click on the Community Planning app and expand the “Aransas Pass” folder by clicking on the (+).
3. Expand the “Sensitivity Index” folder by clicking on the (+). Check the box next to “Aransas Pass Social Sensitivity Index.” (Figure 8)
4. Next click on the ( \_ ) at the top right of the Map Layers window to minimize it.
5. Then click on the Flood and Sea Level Rise App to open it. Click the (+) beside the Coastal Flood Hazards Folder, click on the (+) beside the Coastal Flood Atlas, click (+) to expand CFLA MOM Storm Surge Footprints, and check the box next to Category 2. The Storm Surge footprint is overlaid on top of the Social Sensitivity Index (Figure 9). To see both data sets you may have to change the opacity (or transparency) of a layer. To do this click on the  beside the layer you wish to make more or less transparent. This will bring up a “description” box. Scroll down to the end of the box where you will find an “opacity” slider bar.

**Figure 8: Social Sensitivity Index**

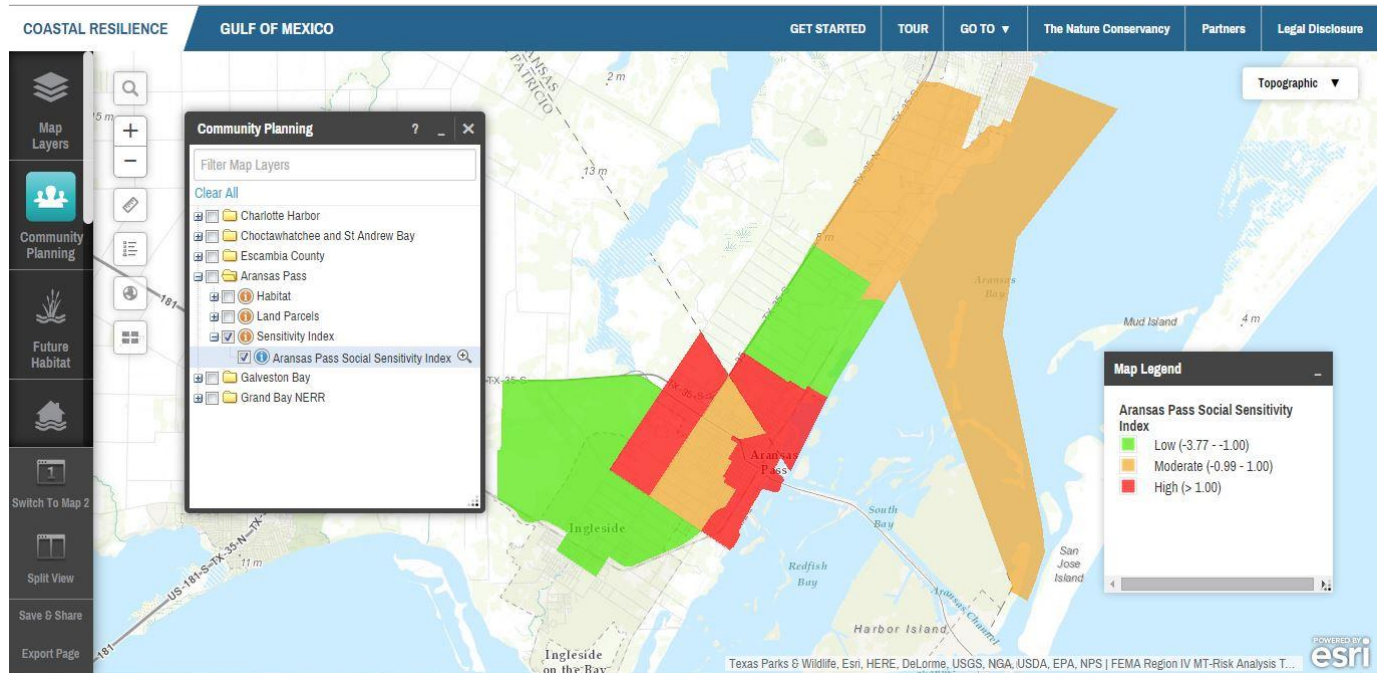
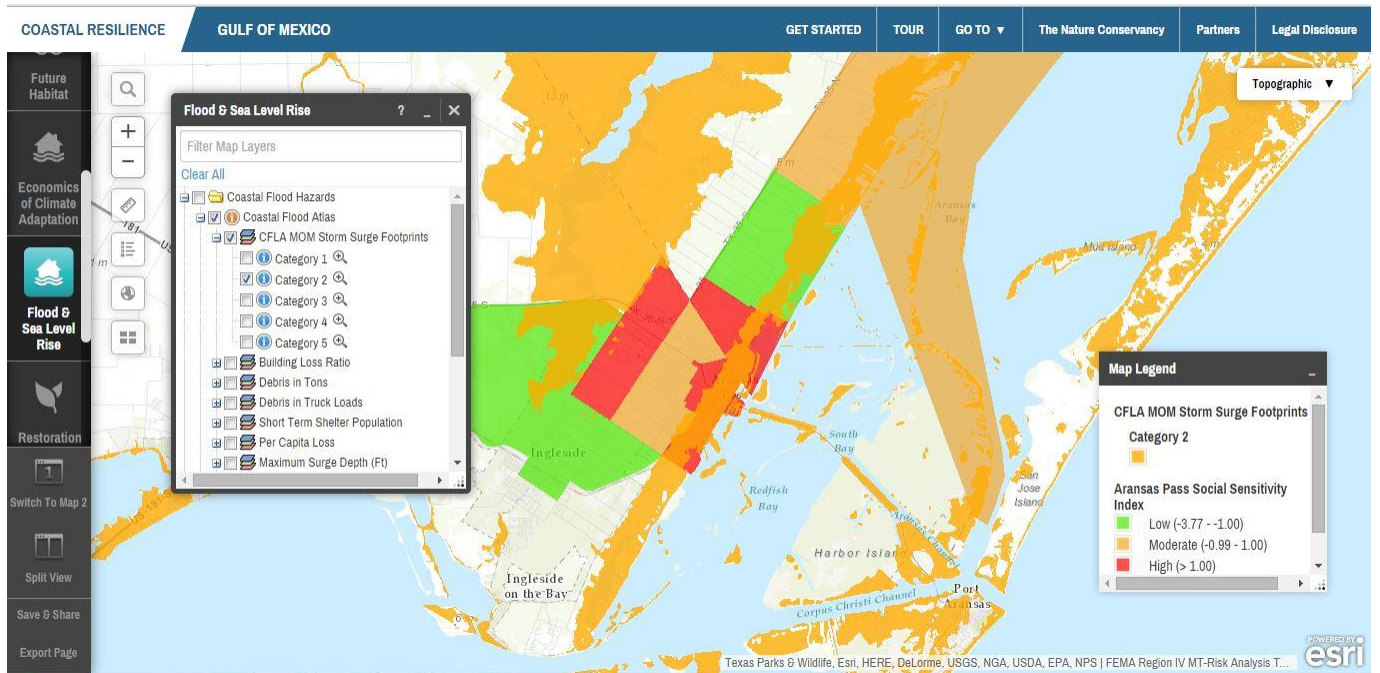


Figure 9: SSI and Storm Surge



**Self-Check:**

2. Are there areas of high social vulnerability located in the Category 2 Storm Surge?
3. Do you see concentrations of social vulnerability in any particular areas? Why do you think that is?

## SESSION 2: ASSESSING ECOLOGICAL VULNERABILITY

### APP: Future Habitat

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 app illustrates predicted future changes to coastal wetlands and adjacent uplands. The maps were created through application of the Sea Level Affecting Marshes Model (SLAMM) using three sea level rise scenarios through the year 2100. These 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, 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.



### Activity 3: Ecological Vulnerability – Future Habitat – Corpus Christi

1. Close out of all previous apps and clear data layers. Click on the **Future Habitat App**. Expand the “Choose a Region” dropdown and select “Texas – Corpus Christi” region. This is the current condition for the area. (Figure 10)
2. To compare different SLR scenarios side by side, click on the “Split View” button below the Apps. (Figure 11)
3. Click on the “Link Maps” button between the two maps. Click and drag the legends out of the way if needed or minimize each one by clicking on the ( \_ ) at the top right of each box.
4. Open the **Future Habitat** app on the second map and again choose “Texas – Corpus Christi” region, move the slider bar to an SLR scenario and a scenario year. You can scroll around each map simultaneously to explore the two future sea level rise scenarios (Figure 11).
5. To explore the other features of the **Future Habitat** app, click “Switch to map 2” on the left side under the apps. This will bring up in, full screen, the map on the right-hand side.
6. If you have minimized the **Future Habitat** app, click on the blue highlighted app button to bring up the app again. You can now click on the “Results & Chart” tab. Here you can hover over the pie chart to see the acreage of each habitat type and the percentage of that habitat in to the overall study area. (Figure 12)

*Note: You may have to increase the size of your app box to see the entire pie chart. To do this click and drag the right lower corner of the box.*

7. Next click on the “Compare & Chart” tab. Here you can see a bar chart with the percent change from the current condition to the scenario you have chosen.
8. Go back to the “Choose Parameters” tab and click in the box next to “Marsh” under the “Filter Results by Habitat/s of Interest”. Choosing one of these groups will filter your results by different habitat types that are listed under that group. In this case, 4 different marsh layers are encompassed within the “marsh” block group (see Legend). Once you have selected a habitat group you can go to the “Results & Chart” or “Compare & Chart” tabs to view the numbers for the habitat group you have chosen. (Figure 13)
9. Uncheck the “Marsh” habitat group. Under “Filter Results by a User Defined Area”, select the “click to draw an area” button. This feature allows the user to identify their desired area of interest by drawing a polygon. You can then perform all of the above comparing and filtering functions listed above for the defined area.

**Figure 10: Existing habitat layer for Corpus Christi area**

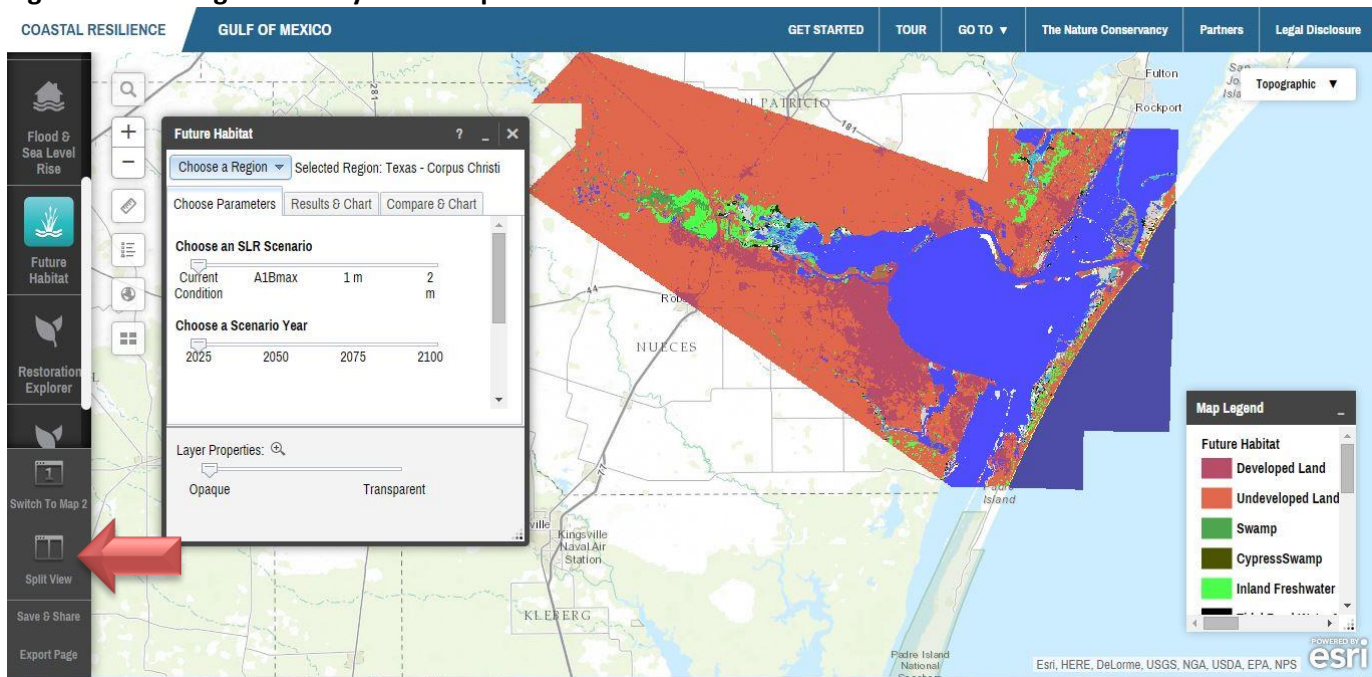
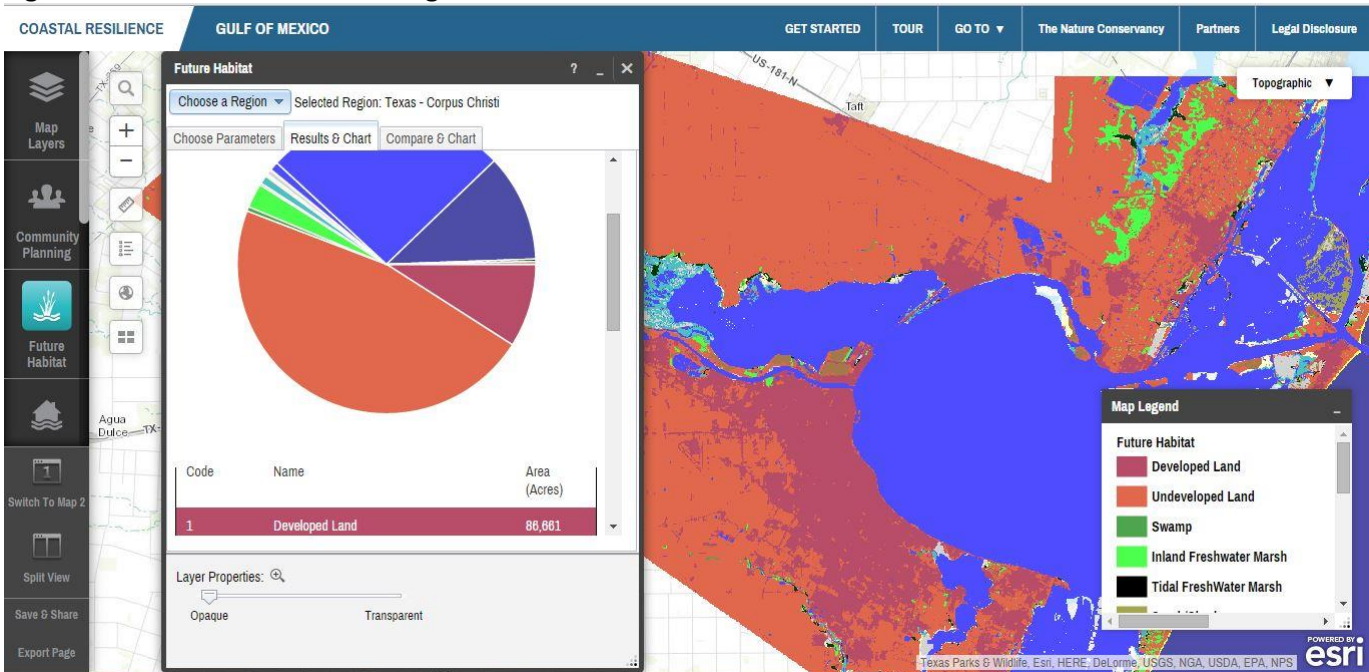


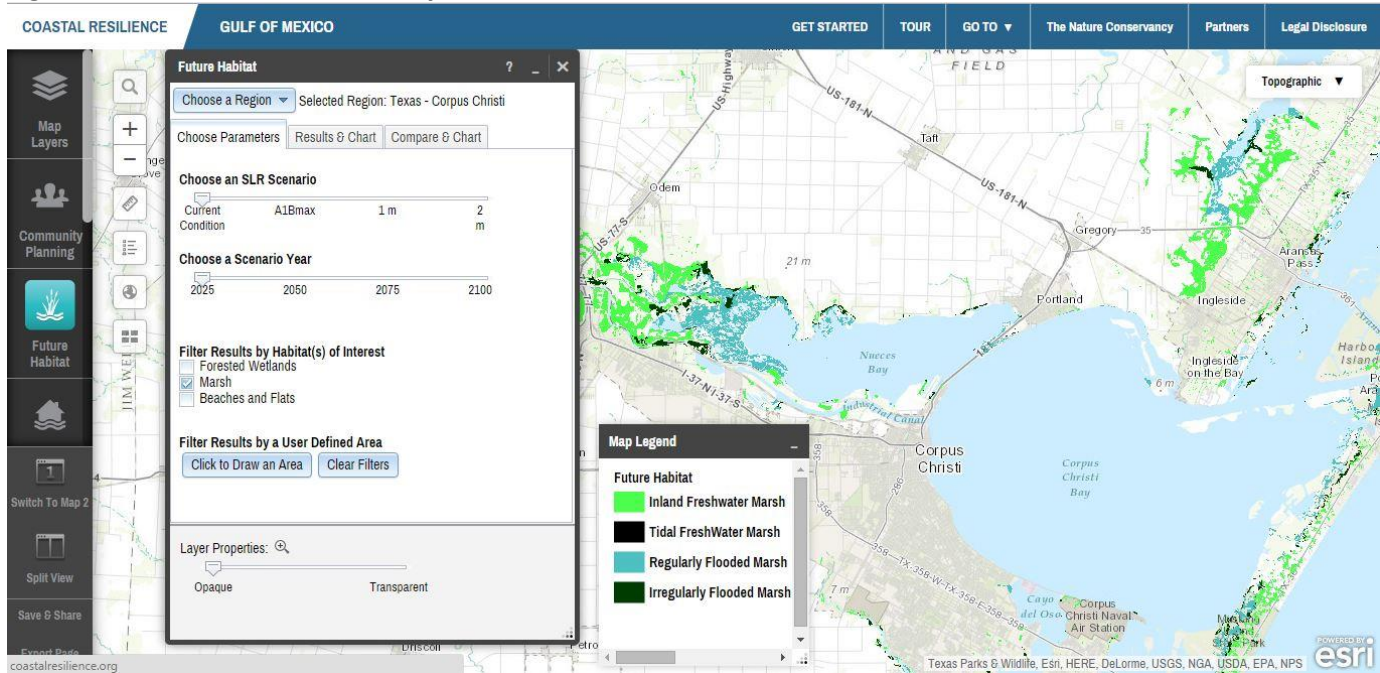
Figure 11: Future Habitat comparison – split screen view



Figure 12: Future Habitat – Charting



**Figure 13: Future Habitat – Filter by Habitats of Interest**



**Self-Check:**

4. With the change in wetland habitats shown in a simulation of 1 meter of sea level rise, which area is most likely to be vulnerable to economic loss from SLR?
  
5. Which coastal habitat appears to change the most in the area under a 1 meter sea level rise scenario by 2050?

*Hint!!! To help you answer the self-check question #4, 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.” You will also have to change the opacity (transparency of your future habitat layer) by moving the slider bar under “Layer Properties” in the app dialog box.*



## **Activity 4: Identifying Solutions Using the Coastal Resilience Tool**

The **Map Layers** app 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 the Risk Explorer.

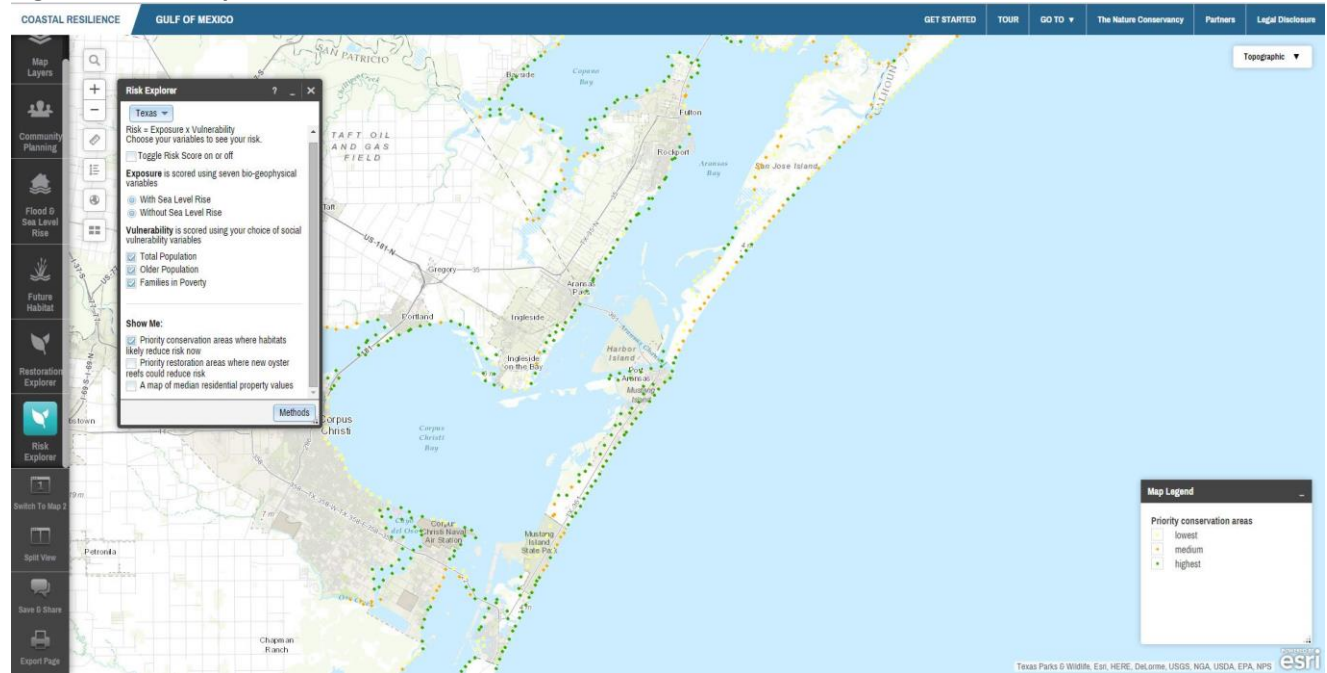
The **Risk Explorer** App allows decision makers (i) to assess risk and vulnerability to waves, storms and sea level rise and (ii) identify habitat restoration and management priorities that may be most useful for risk reduction. The Explorer provides both Answers (i.e., a static map) and a dynamic exploration tool (Figure 14).

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.

Figure 14: Risk Explorer



**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 Aransas Pass/Rockport area. Why do you think that habitat areas along the bayside 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.

**Congratulations!!**

**You’ve completed Training – Coastal Resilience 2.0**

**For more information, please visit:**

[www.coastalresilience.org](http://www.coastalresilience.org)