

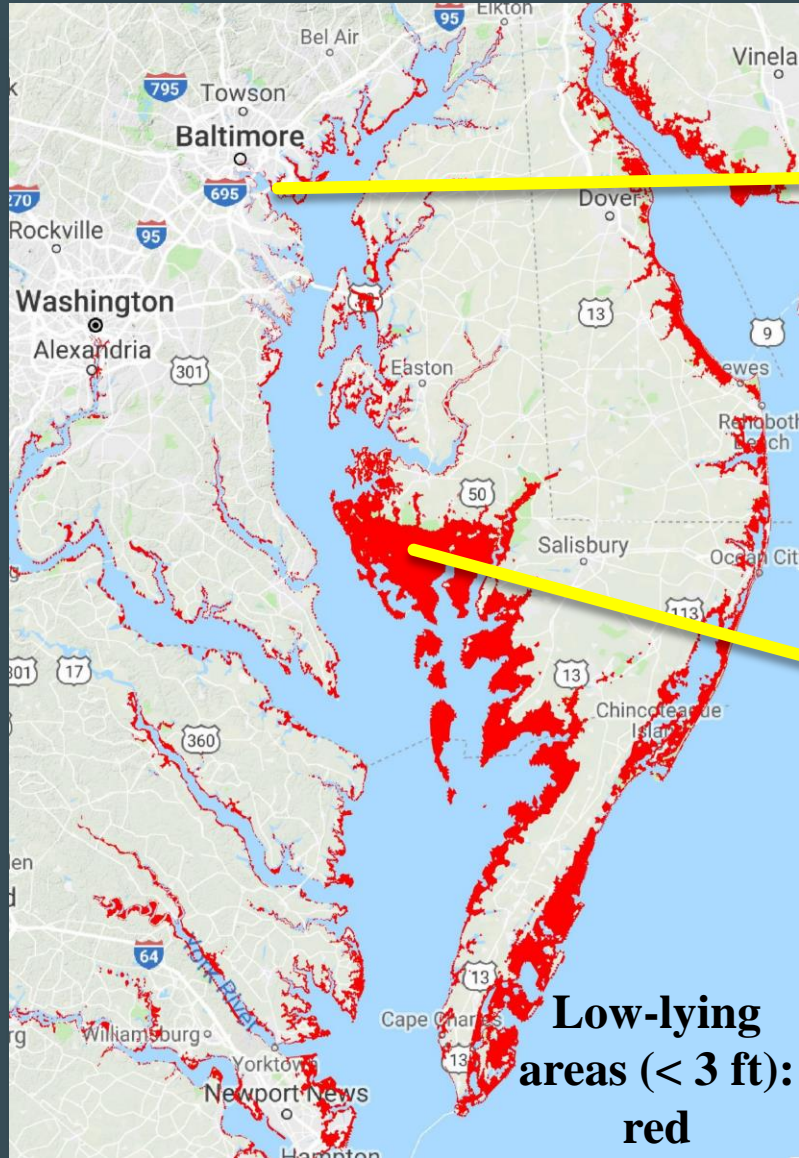
Coastal Inundation Predictions and Visualization for Maryland

Sam Barnes

Horn Point Laboratory

- ▶ Located in Cambridge, Maryland
- ▶ Programs range from oceanography, water quality, restoration of seagrasses, marshes and shellfish and ecosystem modeling
- ▶ Contains five different labs on campus

Low-lying areas in Maryland (around Chesapeake Bay)



Inner Harbor, Baltimore



Economically important

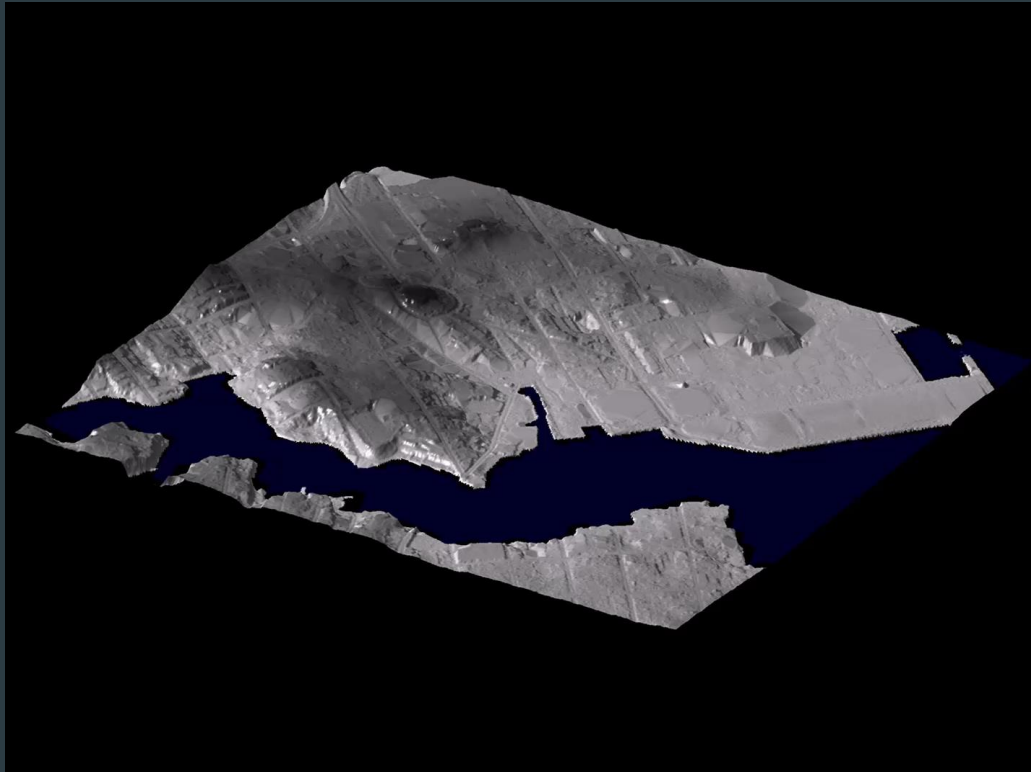
Blackwater Refuge, Dorchester County



Ecologically important

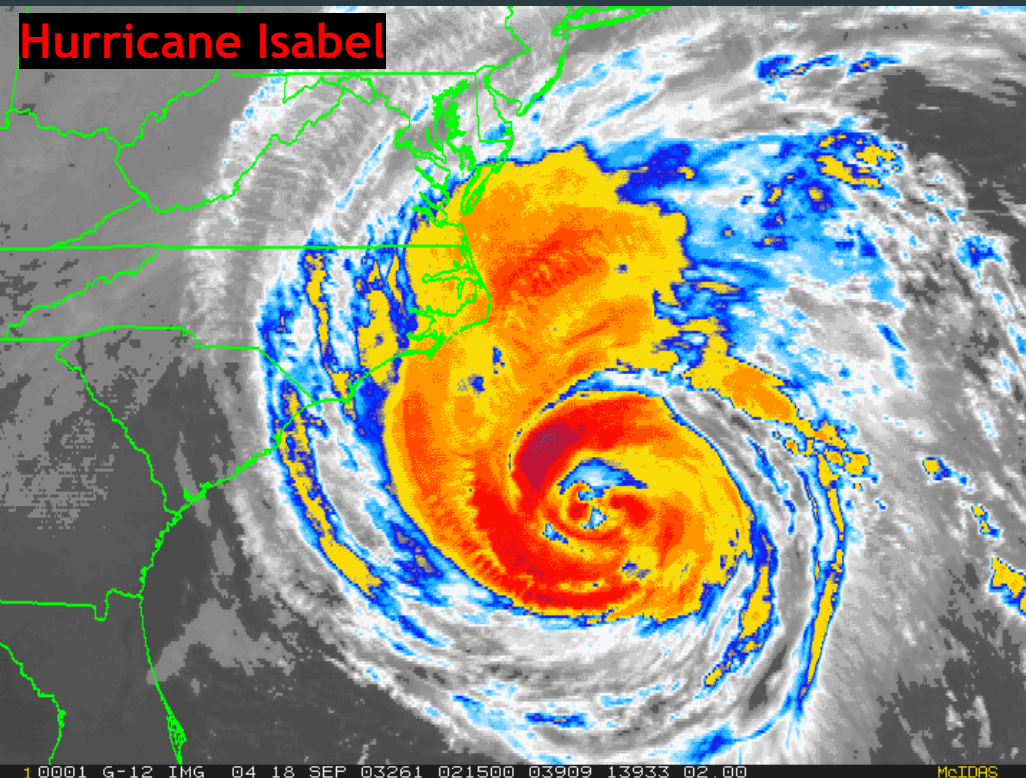
Nuisance Flooding induced by tides

- ▶ Caused by high tides during normal weather condition.



Severe flooding induced by Storms

- ▶ Storm surge: High water level driven by strong storms (e.g., hurricane).



Changing climate in Maryland

► Higher mean sea level

1. Land subsidence

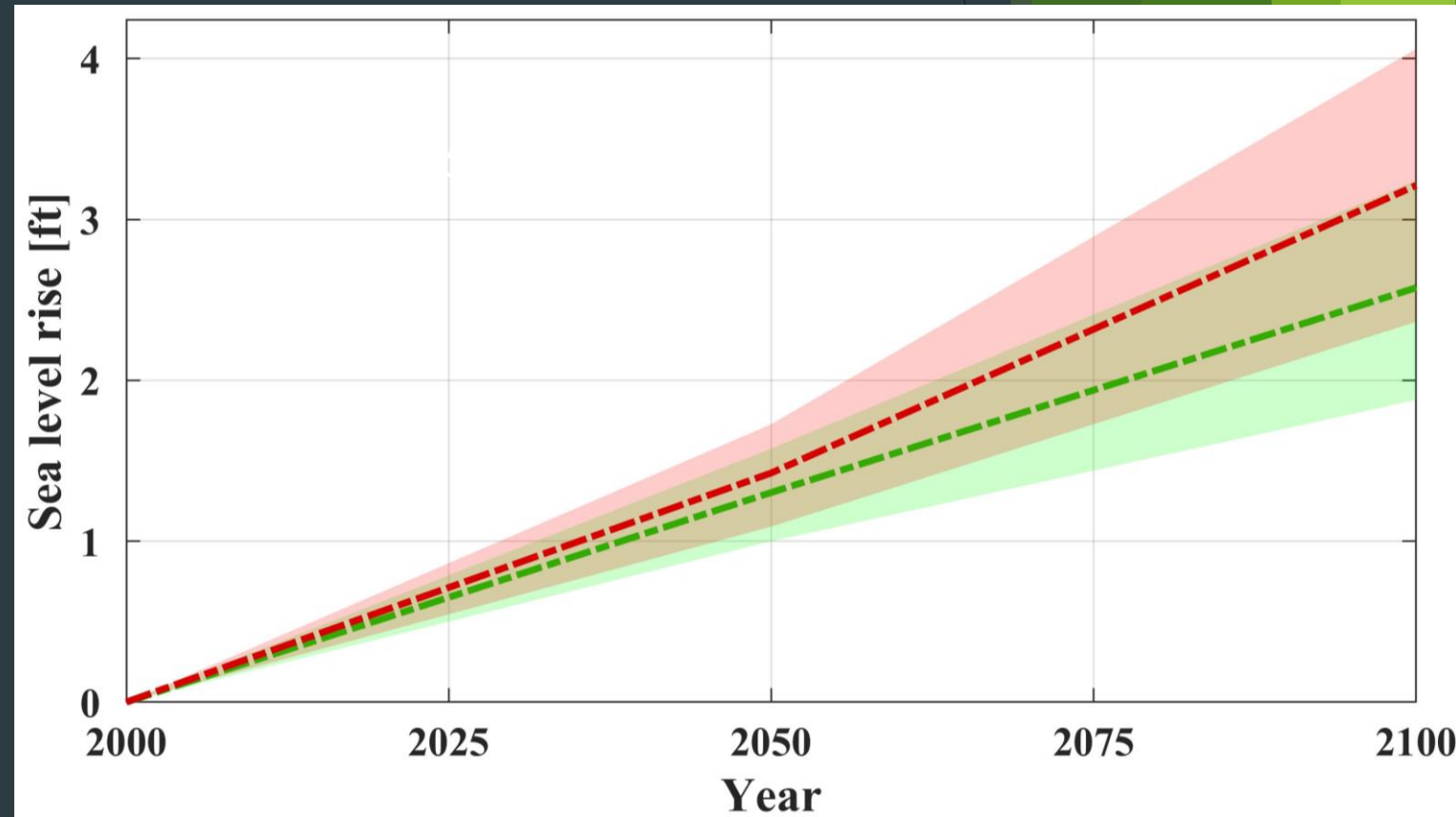
Soil compaction
(Underground water
extraction)

Glacial isostatic
adjustment

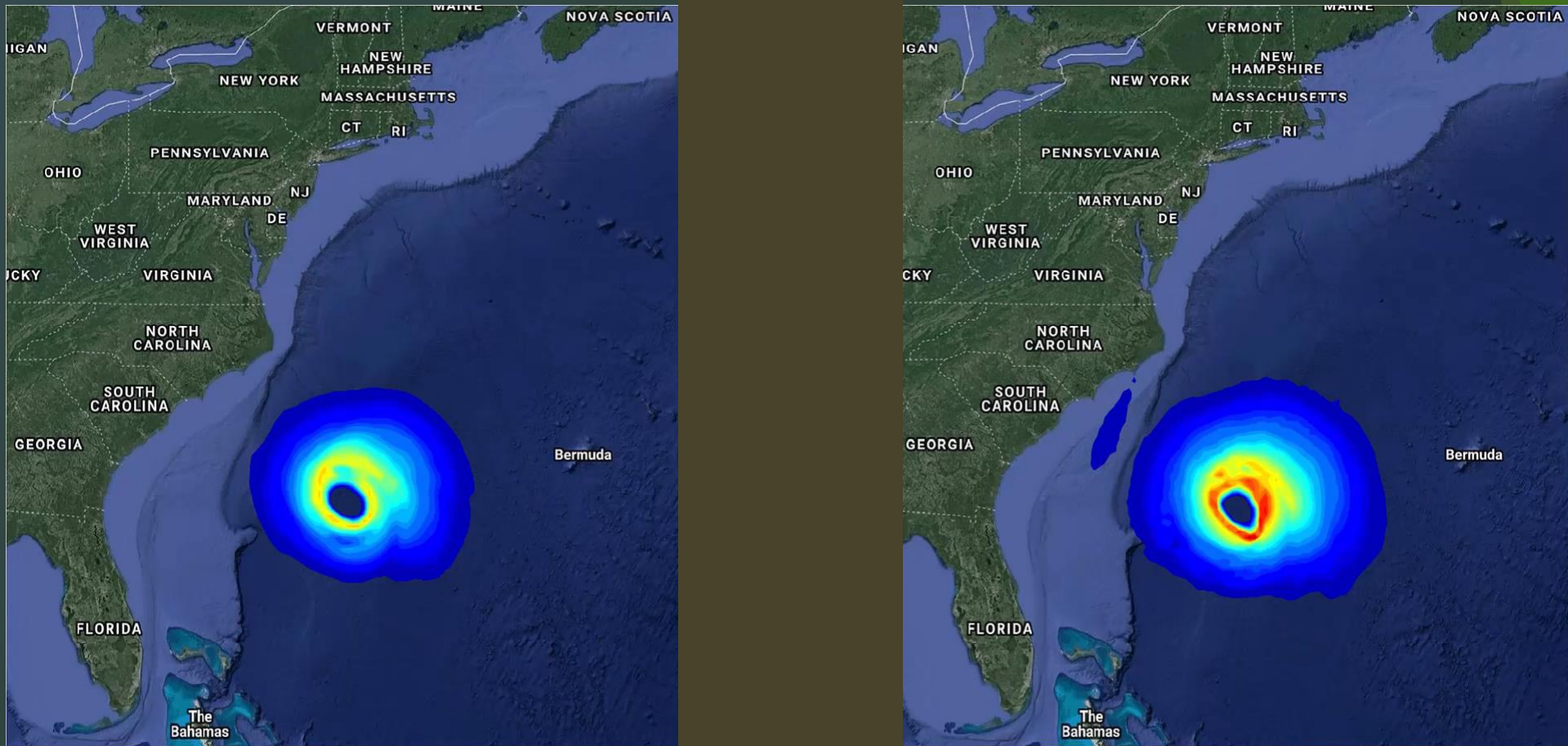
Global sea level rise

2. Rising coastal ocean

Regional ocean dynamics

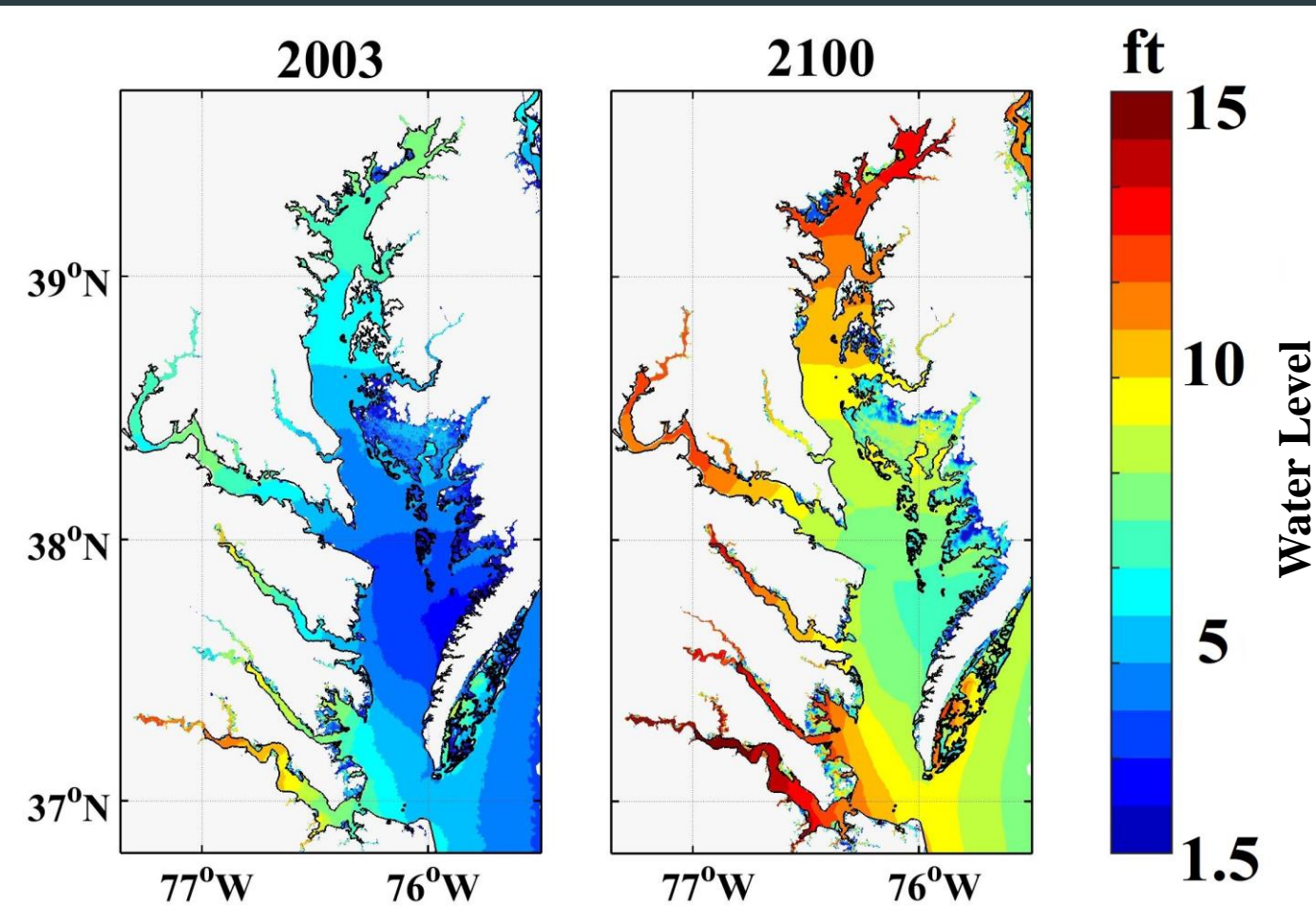


Changing climate in Maryland



20% increase in hurricane intensity in the future

Storm induced flooding



Flooding area in Chesapeake Bay
(mostly in Maryland):

2003: 770 mi²

2100: 1260 mi²

Maptiler

- ▶ Application used for overlaying an image onto a map
- ▶ Places a map and the desired overlay side by side and uses reference points to fit the image to the map
- ▶ Output is several files of the overlaid image on different maps including google maps and openlayers openstreet maps

Two Dimensional Maps

- ▶ Originally used openlayers platform to successfully display future flooding for the Chesapeake Bay
- ▶ Uses different clipped images to show the area that is displayed on the map
- ▶ Used the "legende" div to add the color bar legend to the map
- ▶ Faced a problem of using satellite images

Displaying Satellite Imagery

- ▶ Wanted the two dimensional maps to show real land features such as houses and buildings for flood awareness
- ▶ After digging discovered that openlayers did not offer a satellite supported map
- ▶ Other options included Google Maps, Google Earth(already in use), Klokan Tech Google Maps, MapBox, and OL3-Cesium

Google API

- ▶ Offers over 100 different types of API used for various web development tools
- ▶ Google Maps API
 - ▶ Allows an overlay on any google map
 - ▶ Requires a key to monitor the usage of the google map services
 - ▶ Keys are easily obtainable
 - ▶ Gives feedback on usage of each key obtained
- ▶ Free \$200 credit every month

Google Maps Klokan Tech

- ▶ First attempted resolution to satellite issue faced
- ▶ Offered a library to easily adapt different tools to the maps such as an opacity slider
- ▶ Ended up causing issues with:
 - ▶ Versioning
 - ▶ API keys

Working With Google Maps Directly

- ▶ Does not come with built in features such as opacity slider and legend functions
- ▶ Image disappears at a certain zoom level
- ▶ What is currently being used and worked on to be perfected
- ▶ Currently developing code to add opacity slider and fix the bug deleting the overlay at specific zoom

Three-Dimensional Flood Maps

- ▶ Uses KMZ files that display certain areas of Baltimore City
- ▶ Renders the most realistic visualization of future flooding
- ▶ Each tile contains a specific "depth" that shows how tall the water is in an exact location
- ▶ Areas currently displayed are: Curtis Bay, Winans Cove, Middle Branch, and Inner Harbor

Animations

- ▶ Uses several image captures of flooded areas over time simulating a storm
- ▶ Puts the images together as a slideshow and plays to appear as a time lapse of a storm
- ▶ Covers the following areas: Baltimore City, Annapolis, Dorchester County

Classroom Help

- ▶ Classroom taught me how to work efficiently with others
- ▶ Correct ways to go about problem solving
- ▶ Efficient design skills to improve overall appearance

Link to Website

- ▶ <http://Geronimo.hpl.umces.edu/mingli>