

An aerial photograph showing a coastal town with houses and a marina, surrounded by green marshland and a large body of water. The town is situated on a peninsula or a narrow strip of land. The water is calm, and the sky is overcast. The marshland is lush green, and there are some trees scattered throughout. The overall scene depicts a coastal environment that is vulnerable to sea level rise.

Local Planning for Sea Level Rise Adaptation in a Social Environment of Scientific Uncertainty

**Dave Carter, Environmental Program Manager
Gabrielle Lyons, Coastal Services Center Fellow**

Delaware Coastal Programs

Department of Natural Resources & Environmental Control

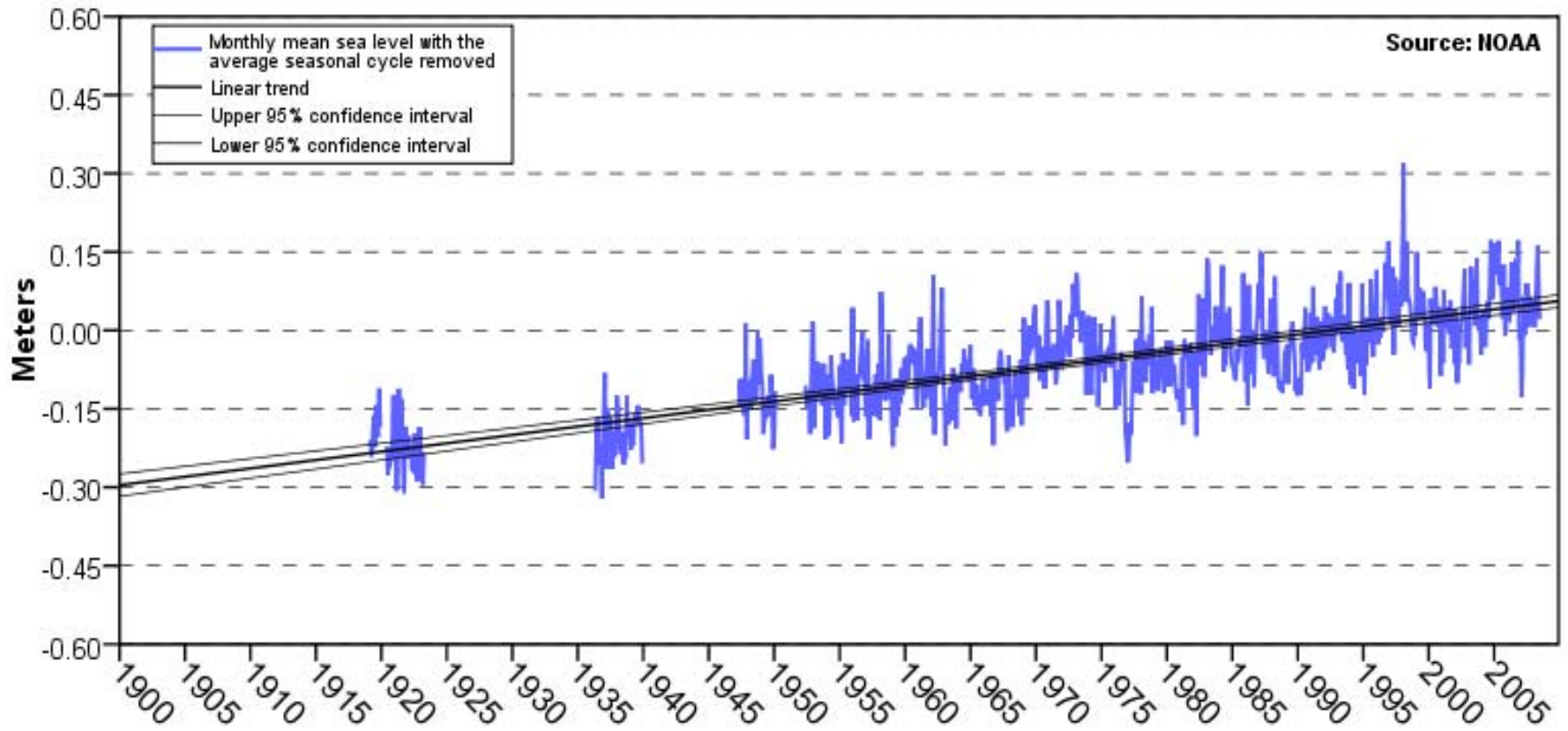
Outline

- Concerns for initiating state-wide planning
- A look at future Sea Level Rise (SLR)
- Why Plan?
 - SLR Impacts in the state
- Vulnerability assessment in Delaware
- Goal of a SLR Adaptation Plan
- The process

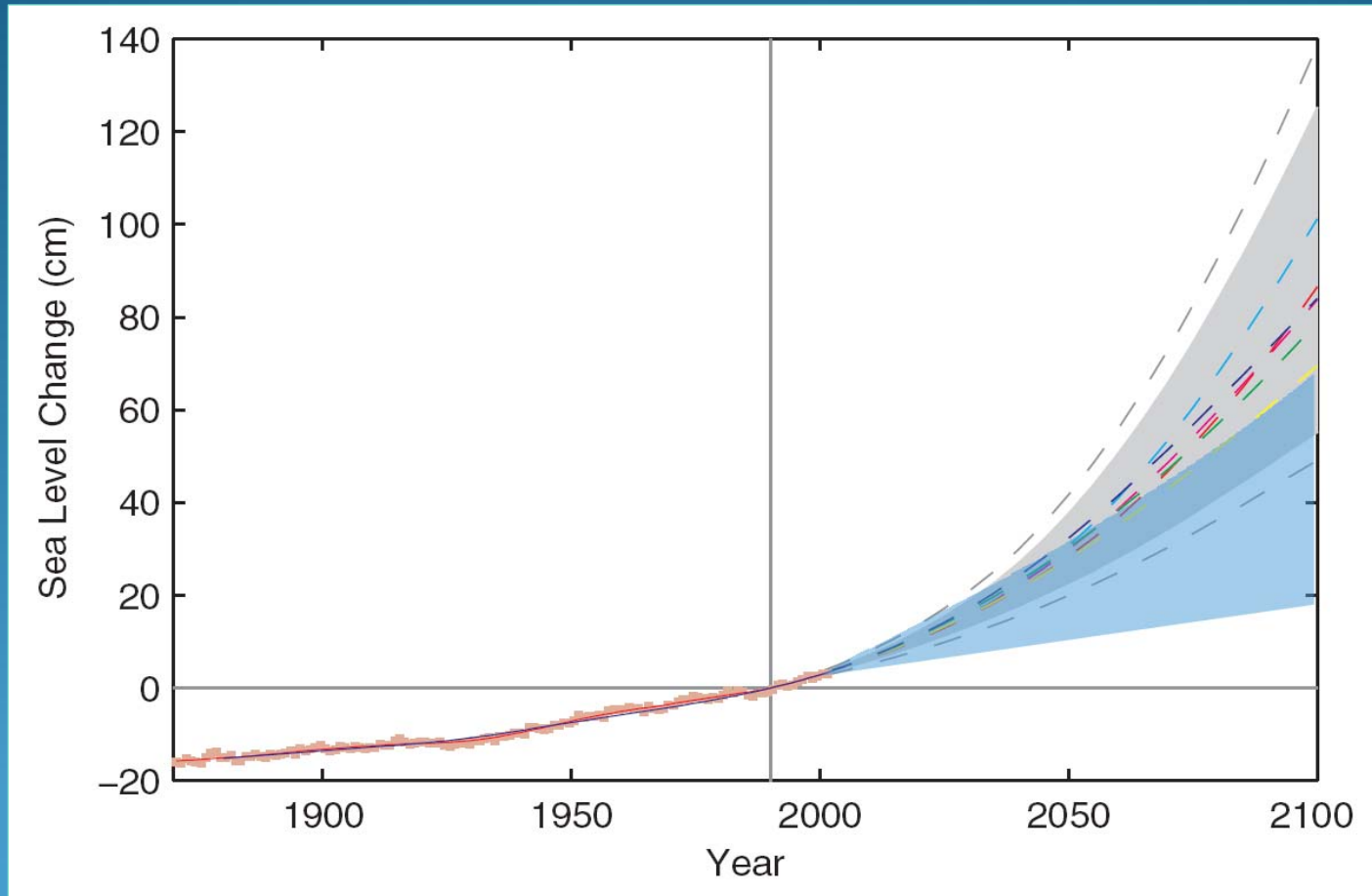


Concerns

Lewes, DE 3.20 ± 0.28 mm/yr



Past, Current and Projected Sea-level Rise



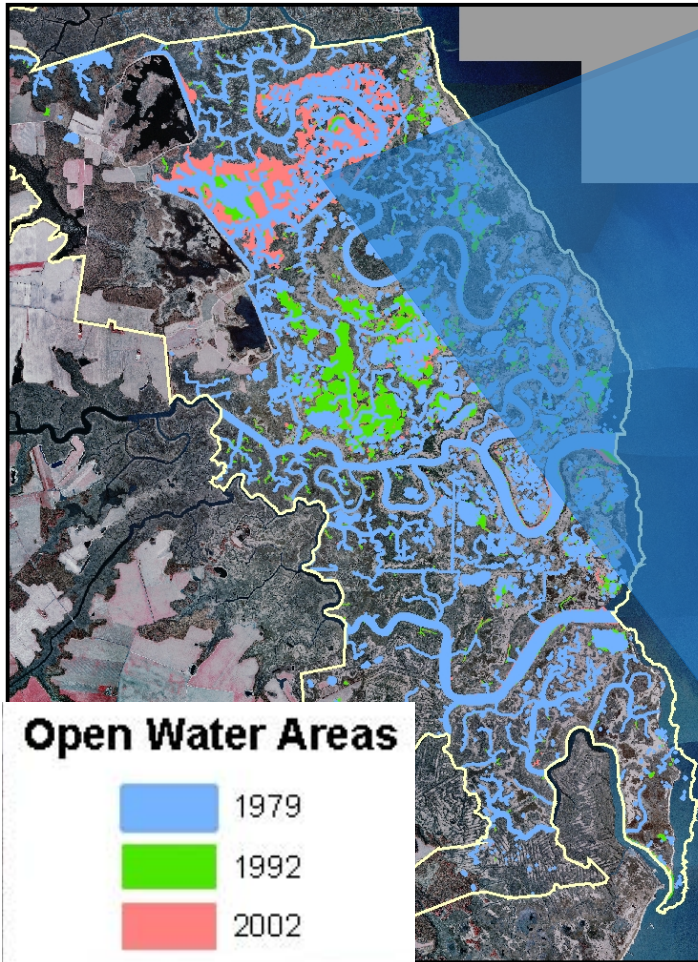
(From Thieler, 2008 USGS Briefing: modified after Bindoff, 2007; Rahmstorf, 2007)

Low Relief Coastal Regions – Most Susceptible to SLR Impacts.

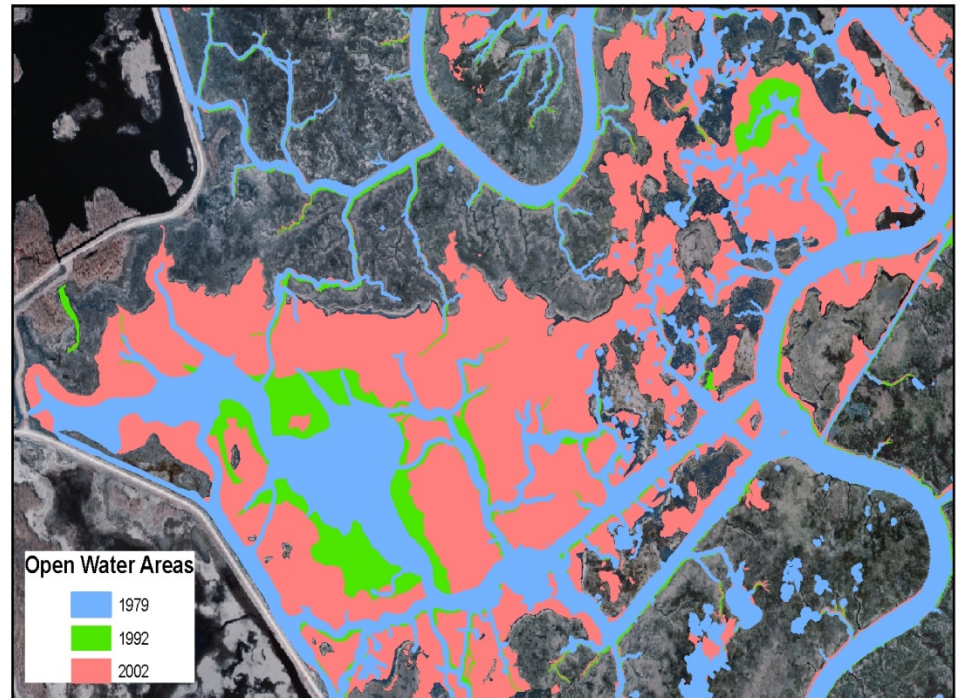




Bombay Hook NWR Marsh Loss 1979-2002



Collins Island - Money Marsh - Leatherbury Flats



- **Total loss of 1,340 Acres (12%). Approx. 58 Acres per year.**

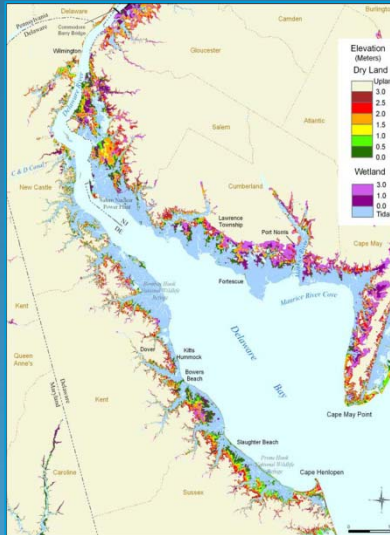
Why Plan?

- SLR Impacts in Delaware include:
 - **Inundation and Shoreline recession**
 - Habitat loss (marine animals, coastal wetlands, etc.)
 - Loss of recreational resources (beaches)
 - **Increased Flooding from intense weather events**
 - Infrastructure (sewer, roadway, utilities) damage
 - **Saltwater contamination of groundwater and surface water supplies (wells, septic systems)**
 - Elevated water tables
 - Change in estuarine and groundwater salinity
 - **Changing ecosystems amongst coastal habitats**
 - Increased harmful algal blooms
 - Species migration due to habitat loss

Bridging the Gap



Global



Regional

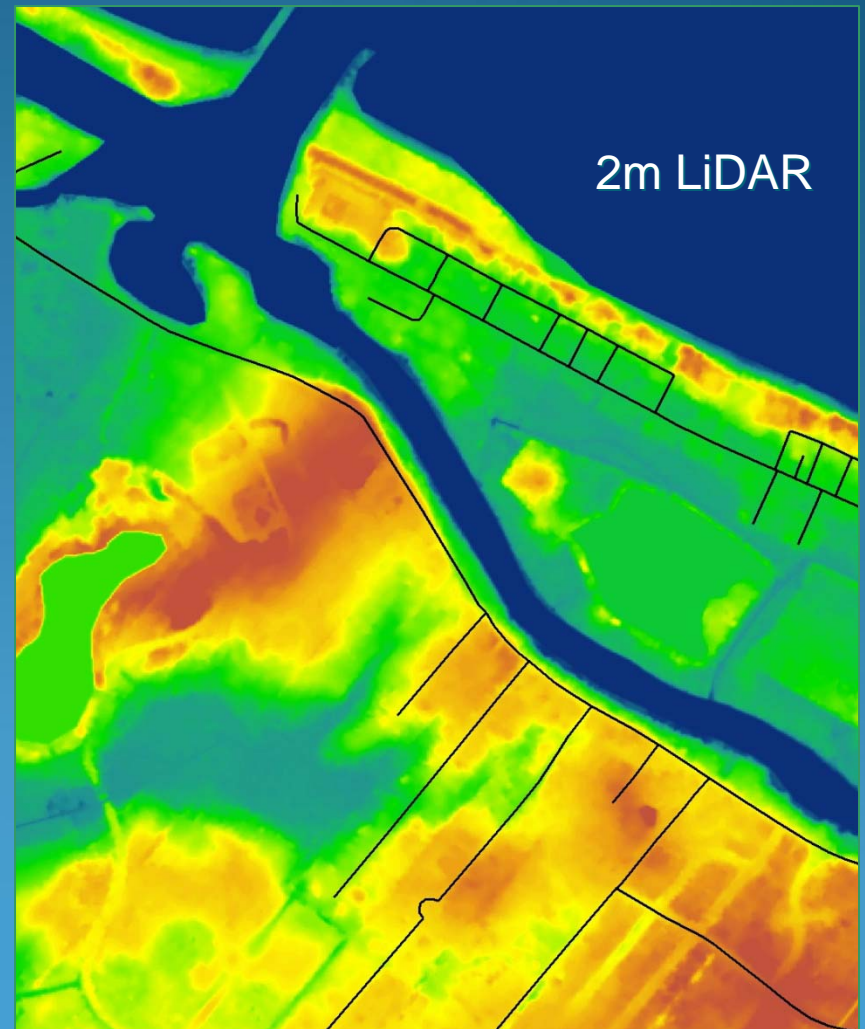
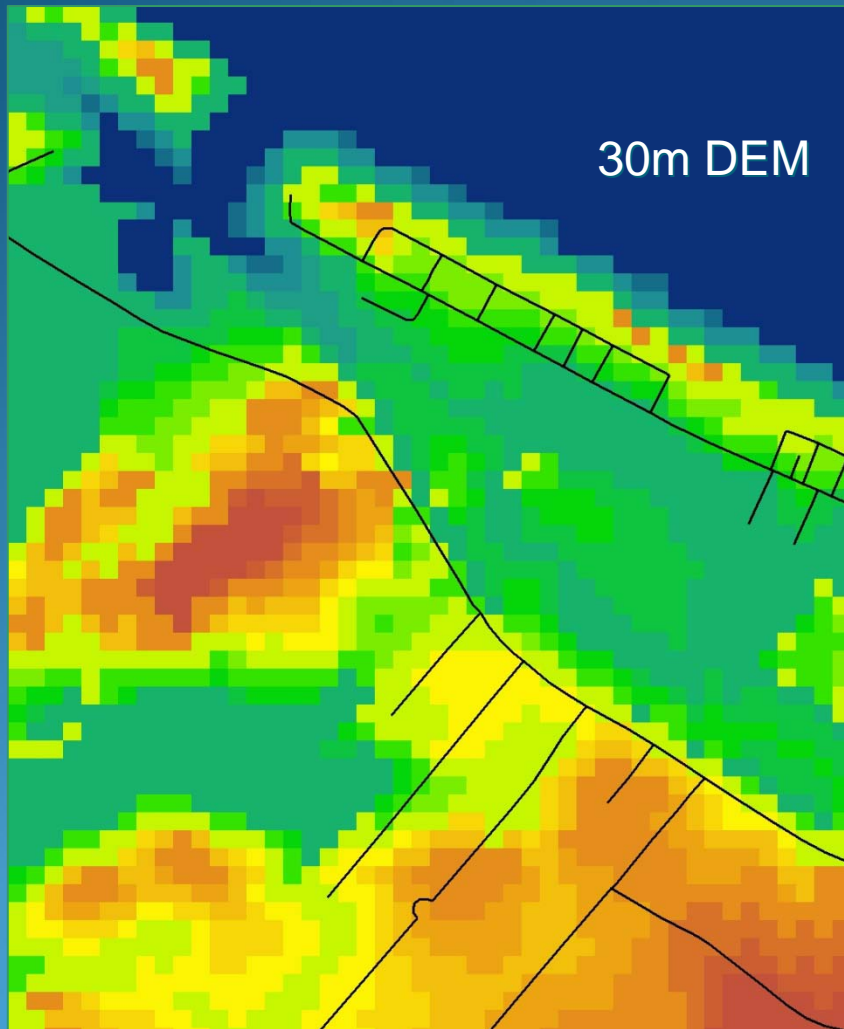


Local

High Resolution Data Collection & Analysis in Delaware

- LiDAR (Light Detection And Ranging) - High Resolution Elevation Data
- SLAMM (Sea Level Rise Affecting Marsh Migration) Model
- Mike 21 Model
- SET – (Sediment Elevation Tables)
- Near Shore Bathymetry (Multibeam) & Geology (Chirp Sonar)

Higher Resolution Equals Better Data



Inundation Model Using LiDAR Data: Cape Henlopen, DE - 1962 Storm Flood Elevation + 2 Feet with Outline of 100 Year Flood Plain



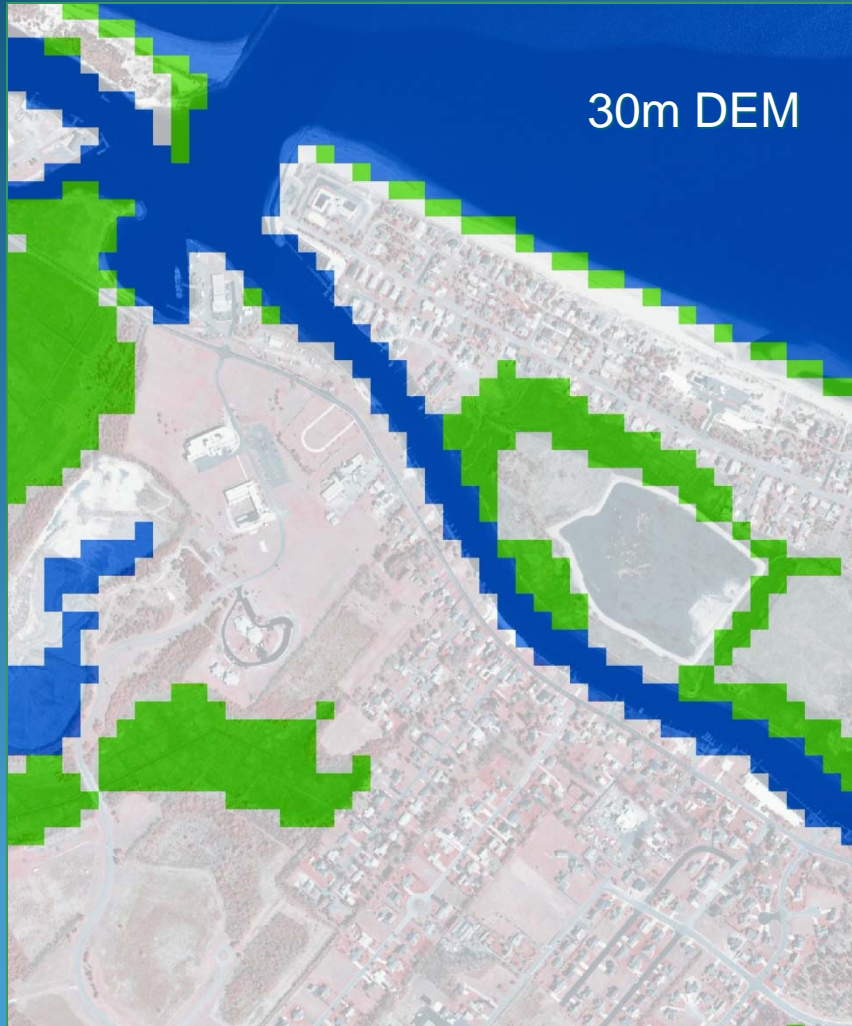
SLAMM Model Overview

Sea Level Rise Affecting Marsh Migration

- **Inundation:** Calculated based on the minimum elevation and slope of the cell.
- **Erosion:** Triggered given a maximum fetch threshold and proximity of the marsh to estuarine water or open ocean.
- **Overwash:** Barrier islands undergo overwash at a fixed storm interval. Beach migration and transport of sediments are calculated.
- **Saturation:** Migration of coastal swamps and fresh marshes onto adjacent uplands-- response of the water table to rising sea level.
- **Accretion:** Vertical rise of marsh due to buildup of organic and inorganic matter on the marsh surface. Rate differs by marsh-type.

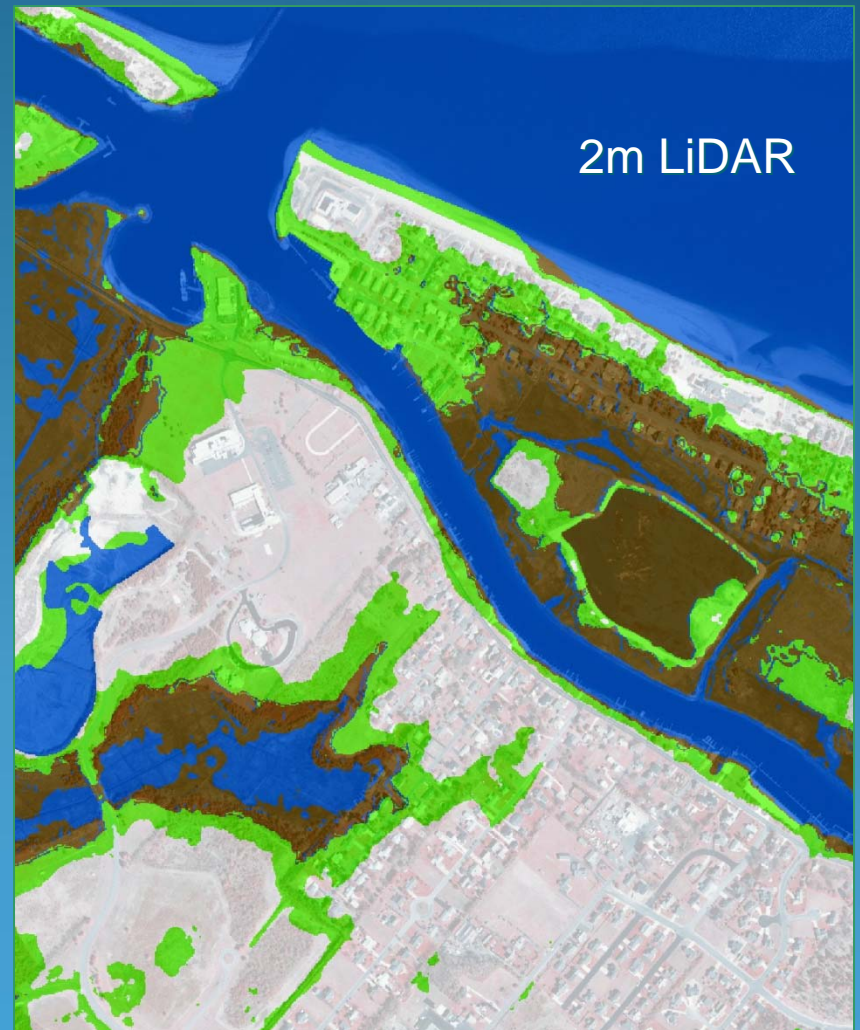
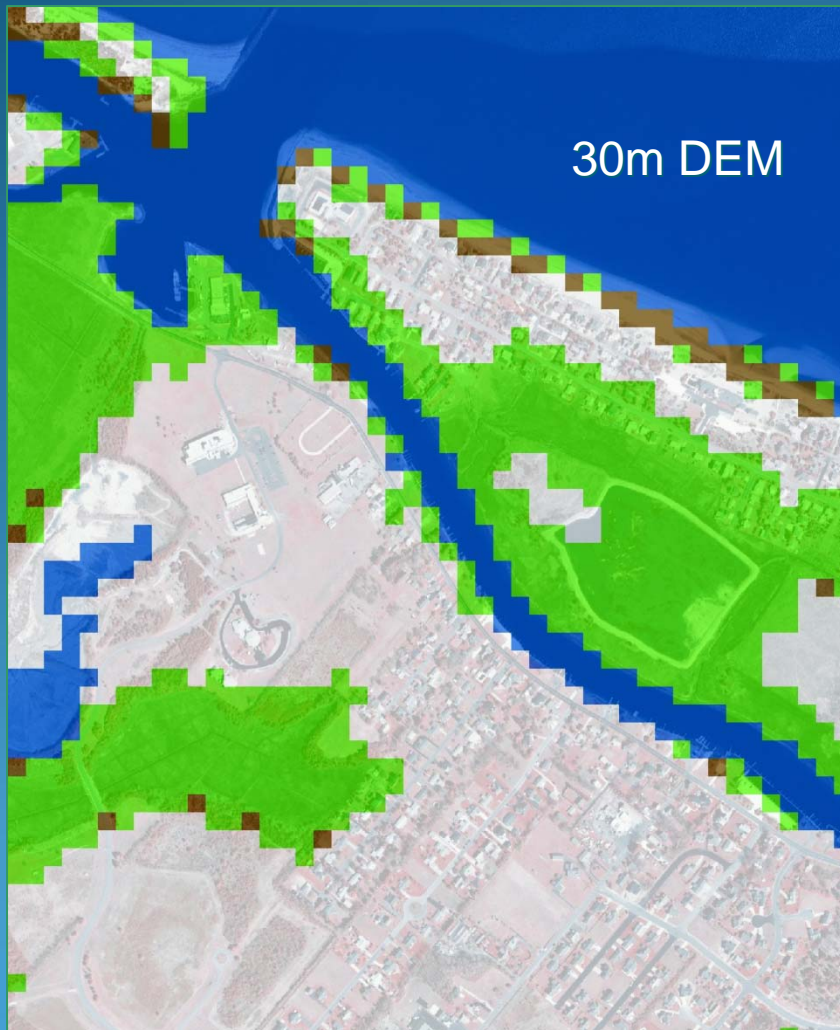
SLAMM Model - Year 2000

Initial Conditions

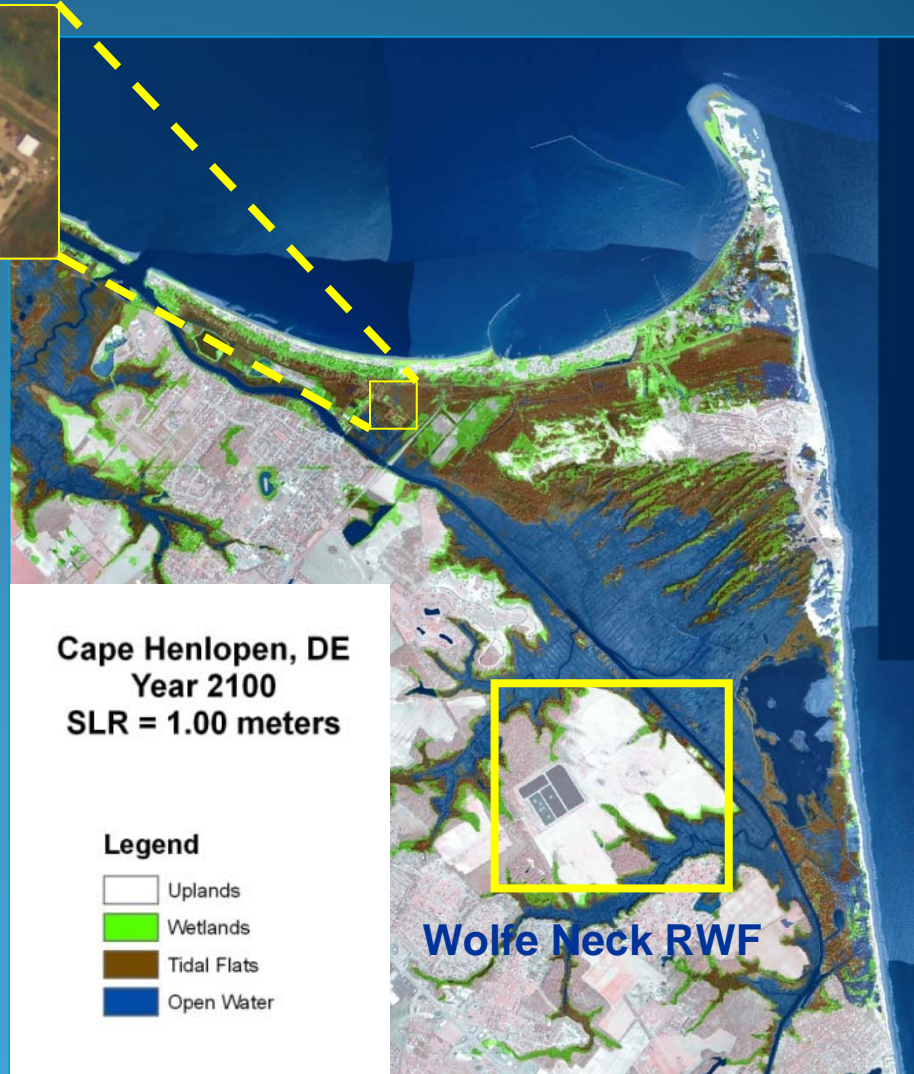


SLAMM Model - Year 2100

Sea Level Rise – 1 meter



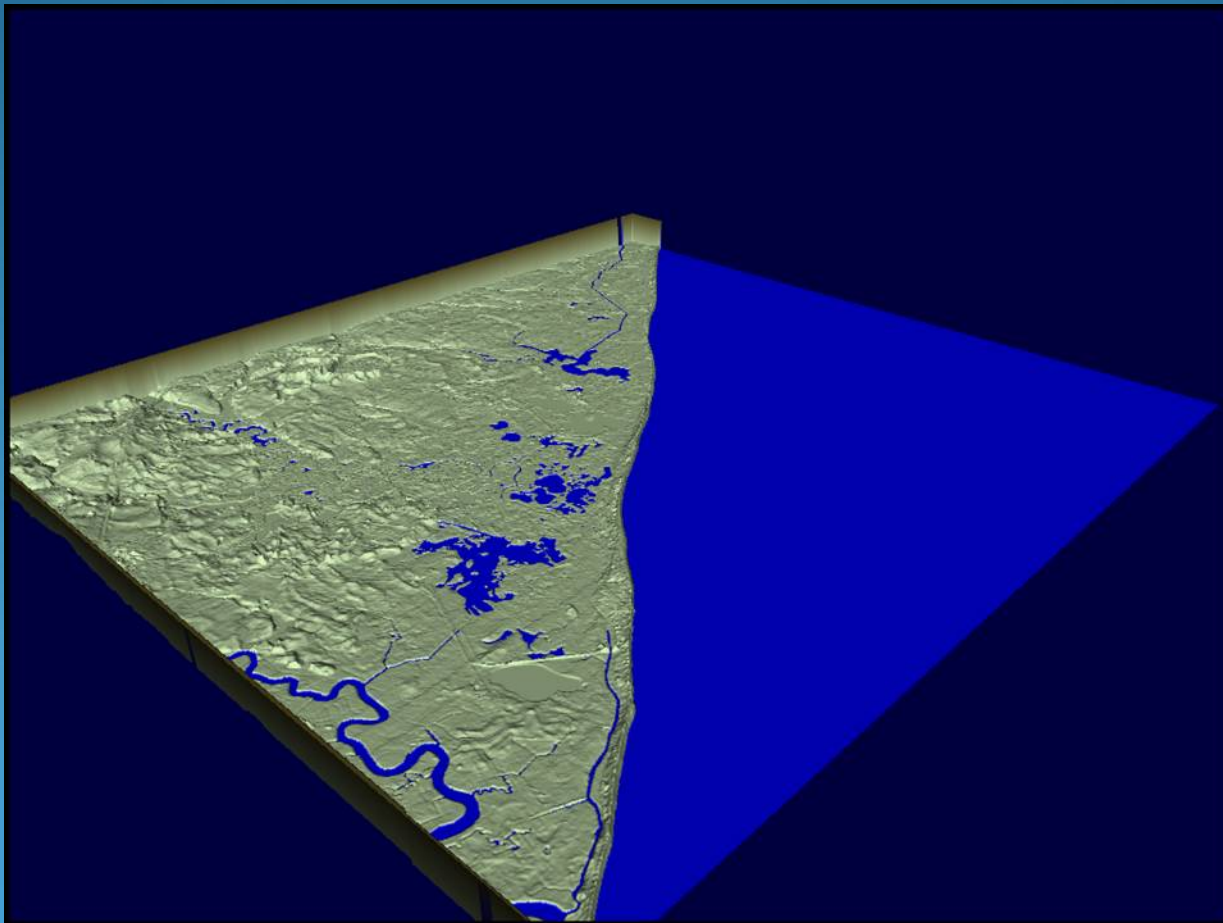
Local Impact Prediction / Vulnerability Assessment



DHI Mike Flood Model

- MIKE FLOOD integrates flood plains, streets, rivers and sewer/storm water systems into one model
- Coupled 1D/2D
- Applications for riverine, urban and coastal flood mapping
- Can incorporate tides and storm surge
- Dynamic representations of flooding

MIKE 21 Simulation of May 11-13 Storm at Prime Hook Beach & NWR



Goal

- **Development of an Adaptation Plan for Sea Level Rise for the State of Delaware.**
 - Research and evaluate SLR strategies used in other states at the federal level
 - Characterize and prioritize SLR issues in DE
 - Development and implementation of recommendations for comprehensive SLR adaptation planning and management strategies

The Process



PHASE 1

- Issue Identification: Identify and initial set of Strategy Development efforts for the adaptation plan.
 - Review, issue specific targets.
 - Identify Action Plans, complete issue characterization, draft strategies to meet target.
 - Analyze, draft implementation mechanisms.
 - Prioritize strategies, identify requirements.
 - Develop/draft Adaptation Plan.
 - Formal approval process.
 - Develop principal operational details.
- Jan. -09 -09 -09 -09
Apr. -09 -09 -09 -09
Sept. -09 -09 -09 -09
Mar. '10 '10

Treading Water

- Identifying key players
 - Transitioning to a new administration in January 2009
 - All new appointees and cabinet secretaries
- Technical difficulties
 - Modeling
 - Sampling

Conclusions

- In order to plan at local level, efficient and adequate data collection and analysis resources must be set in place.
- Sea Level Rise is increasingly a threat to Delaware's coastal resources → formulation and implementation of a State Sea Level Rise Response Strategy is necessary to allow the state to move forward, within the context of scientific uncertainty.

Thank You!

Questions???



*For further information please contact Dave Carter,
Gabrielle Lyons, Delaware Coastal Programs at
David.Carter@state.de.us
Gabrielle.Lyons@state.de.us.*