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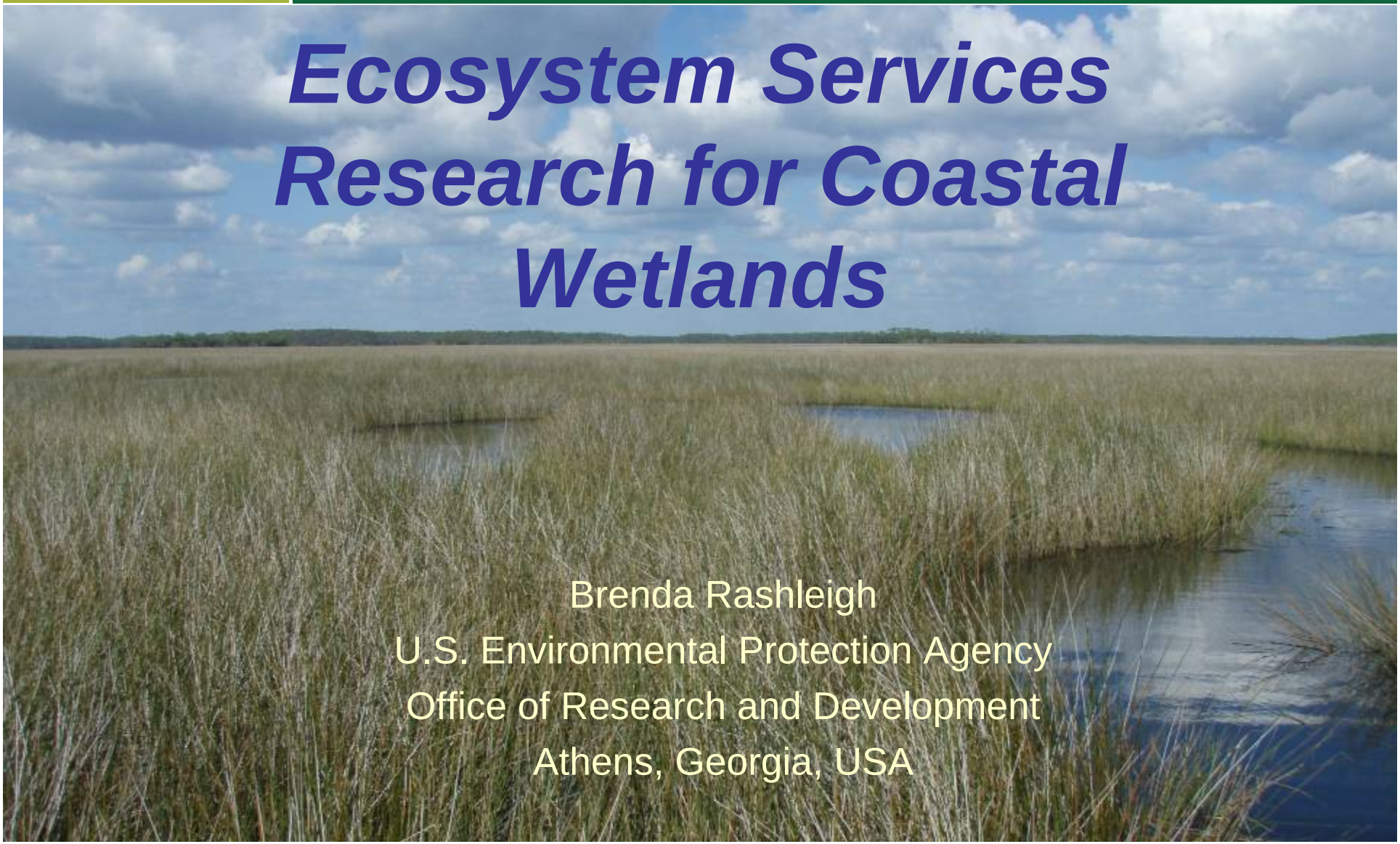
ECOSYSTEMS SERVICES RESEARCH PROGRAM

BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

Ecosystem Services Research for Coastal Wetlands



Brenda Rashleigh
U.S. Environmental Protection Agency
Office of Research and Development
Athens, Georgia, USA

Outline

- **Goals and Objectives**
- Conceptual Model
- Strategy
- Examples

Ecosystem Services

- The services (benefits) provided by ecosystems to humans
  - Provisioning
    - Food, water, fuel
  - Regulating
    - Filtering, pollination
  - Cultural
    - Biodiversity, recreation, sense of place

Coastal Wetlands Provide Many Services

EPA Program Goal

Conduct the science to support management actions and decision-making to maintain and increase the ecosystem services provided by wetlands



Objectives

- Map coastal wetland services and identify service indicators
- Assess drivers/stressors that influence the delivery of wetland ecosystem services
- Provide maps, models, and decision support tools to forecast sustainability of wetland ecosystem services
- Apply wetland ecosystem services tools to valuation and decision-making for resource management

Science Questions

What is the relationship between the abundance, distribution, and condition of wetlands and the delivery of ecosystem services?

How do drivers/stressors affect wetland function and services at multiple spatial scales?

What tools are needed to protect/restore the delivery of wetland services?

Outcomes

Wetland restoration and protection will consider all services provided by wetlands and their monetary (and non-monetary) value

Wetland management decisions will be based on knowledge of ecosystem services using:

- Interactive maps
- Models
- Decision-support tools

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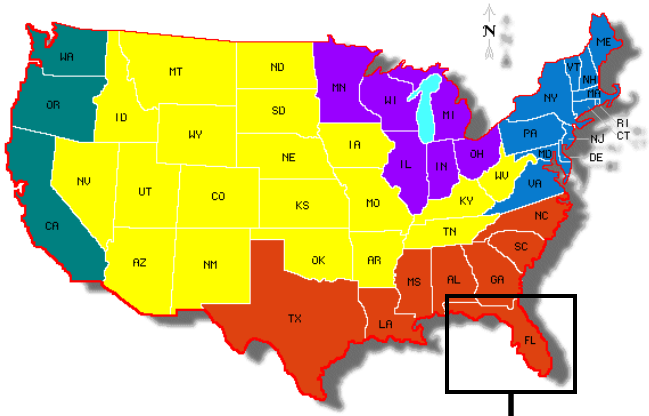
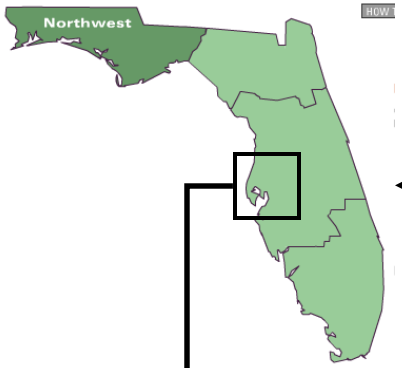
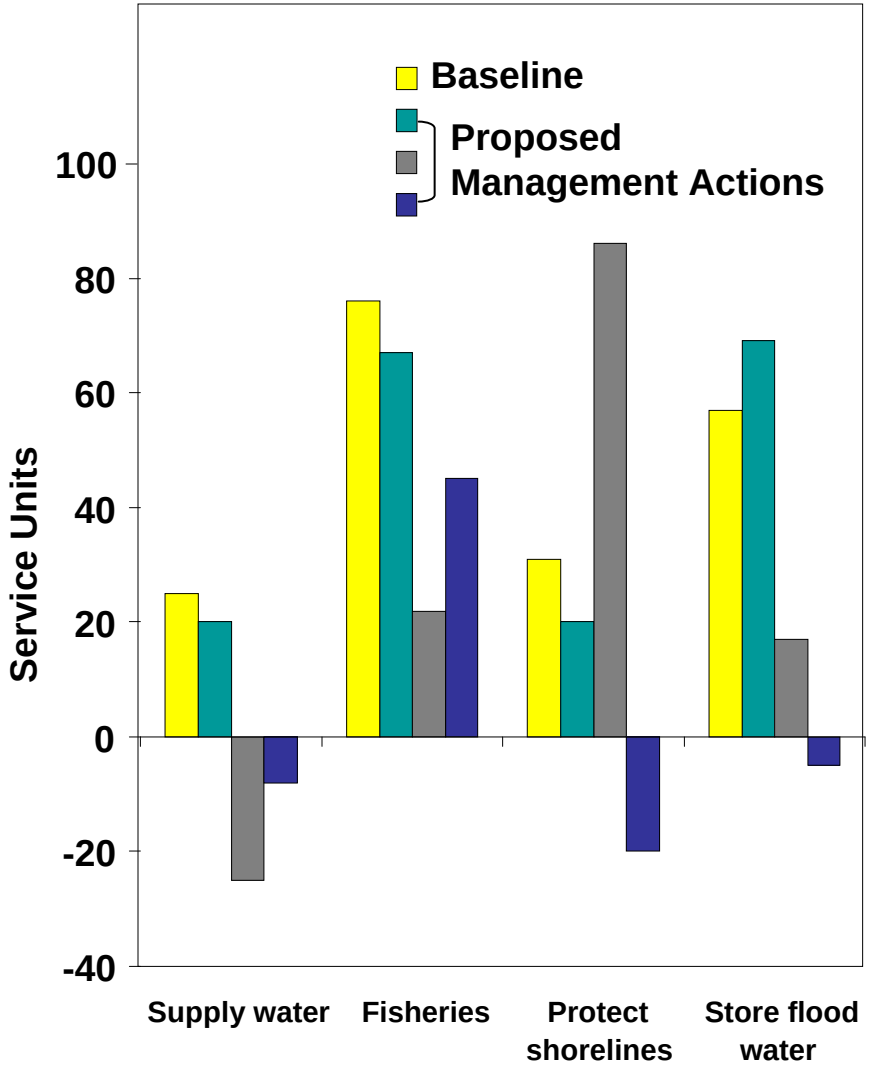






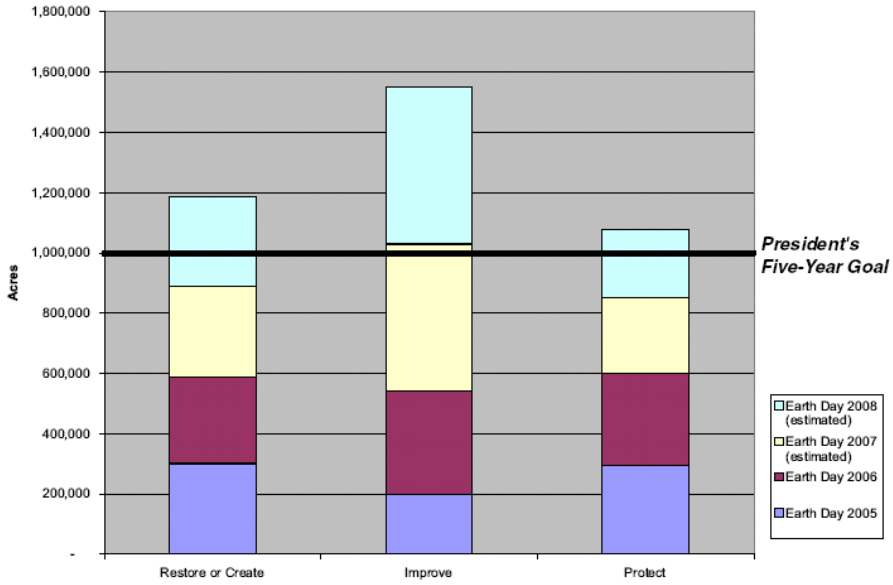
Ecosystem services

Improve Decision-making

- Permitting losses of natural wetlands
- Regulating activities that impact wetlands
- Targeting wetland creation and restoration
- Incorporating wetlands into watershed planning

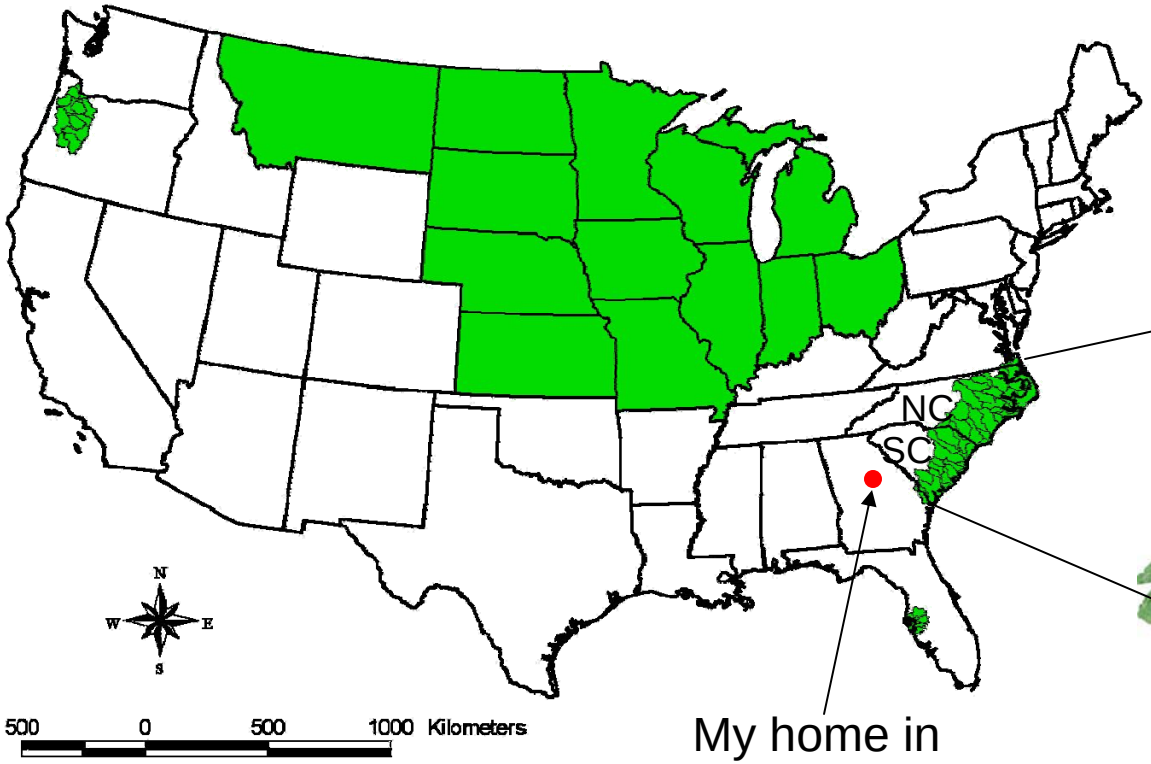
Example Management Decisions

Where should we invest $994M in wetland programs to improve wetland services?



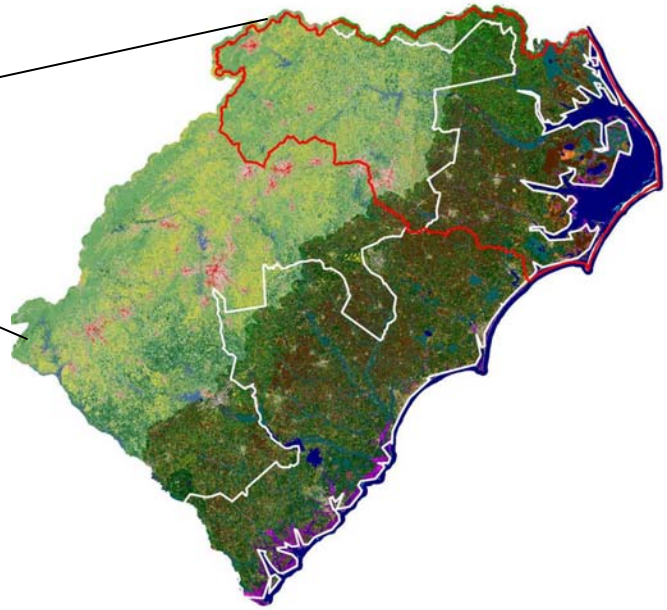
Where should Louisiana restore wetlands to optimize storm protection?

Study Areas



My home in Athens, Georgia

Coastal Carolinas



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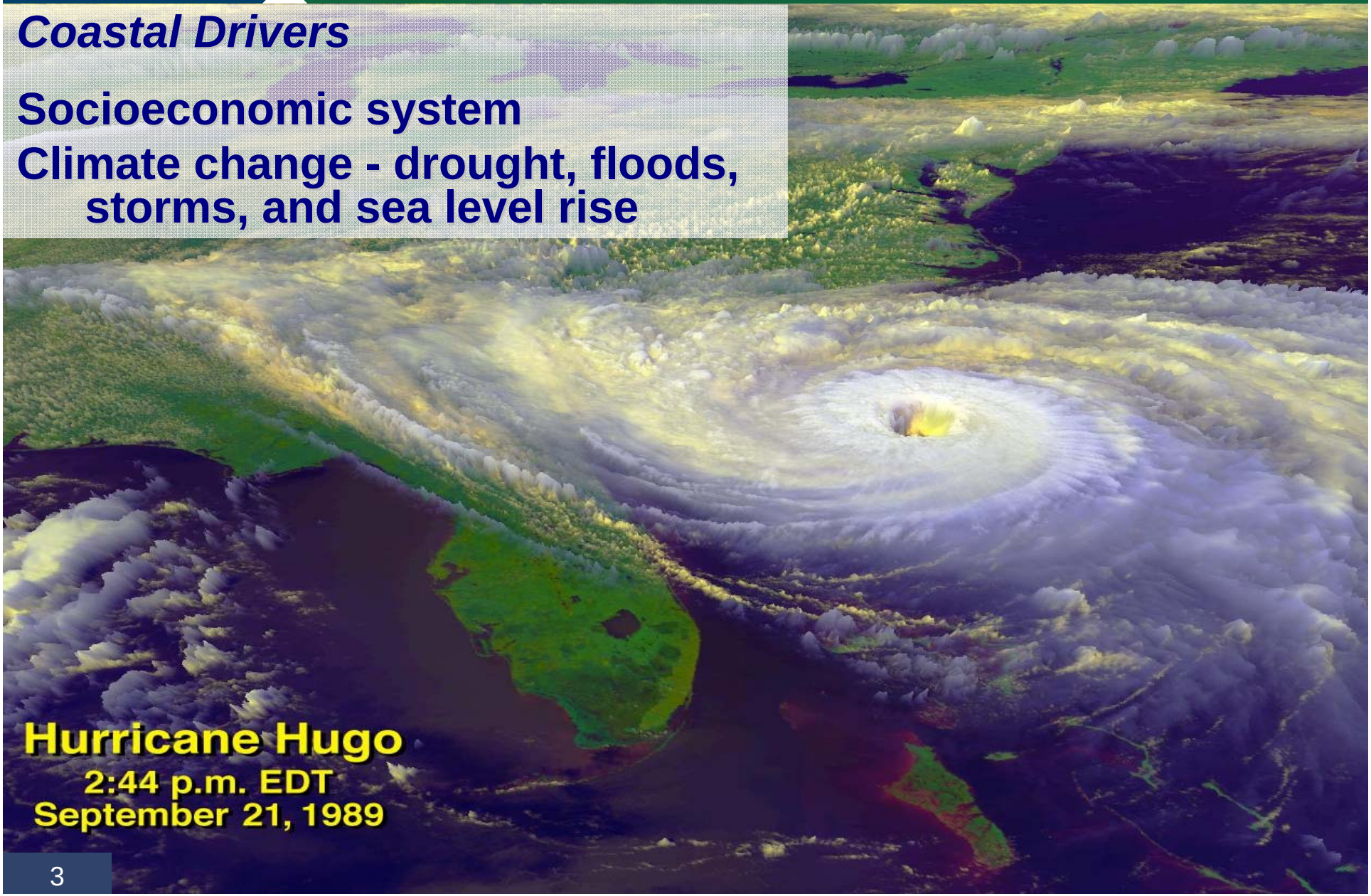
Coastal Drivers

Socioeconomic system

Climate change - drought, floods, storms, and sea level rise



Stressors


Infrastructure Development


Hydrologic Modification


Invasive Species


Pollution

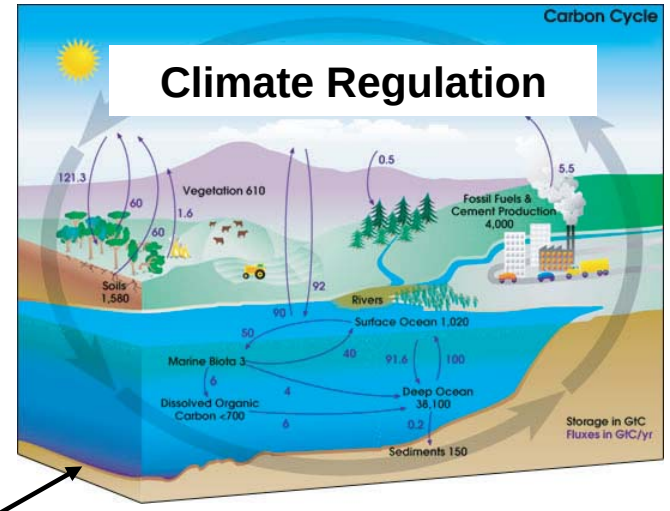

Land Use Change


Resource Exploitation

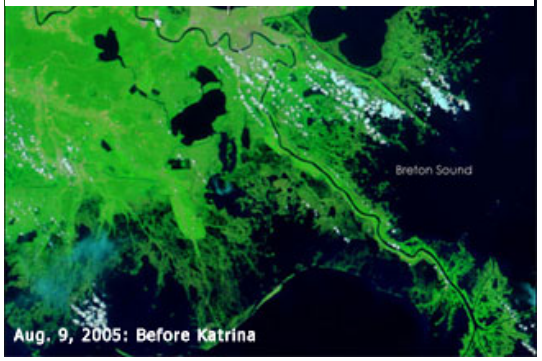
Wetland Services

Wildlife Habitat

Fisheries Support



Flood Control & Storm Surge Protection



Water Quality & Quantity

Recreation

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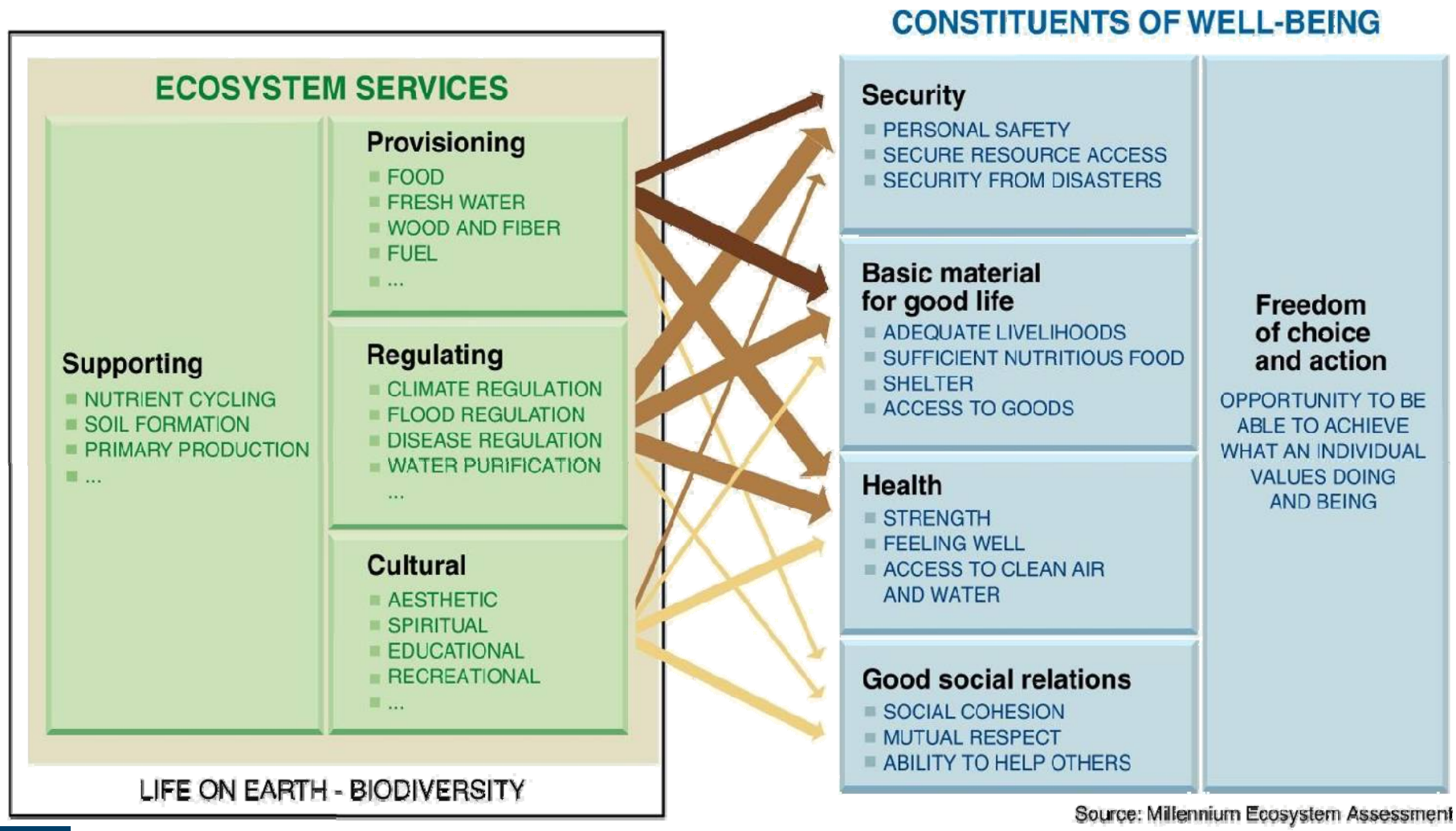
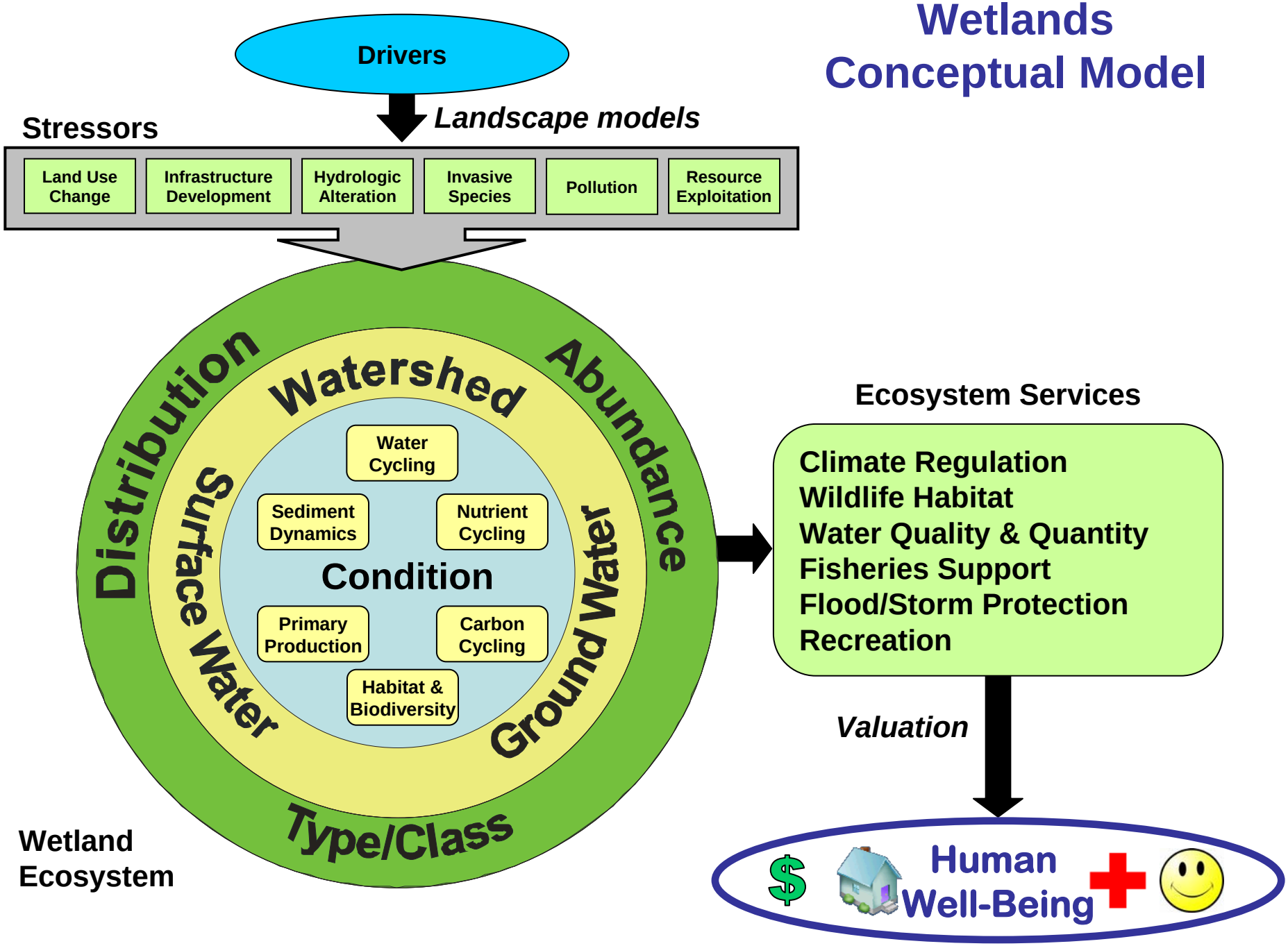


Source: Millennium Ecosystem Assessment

Wetlands Conceptual Model



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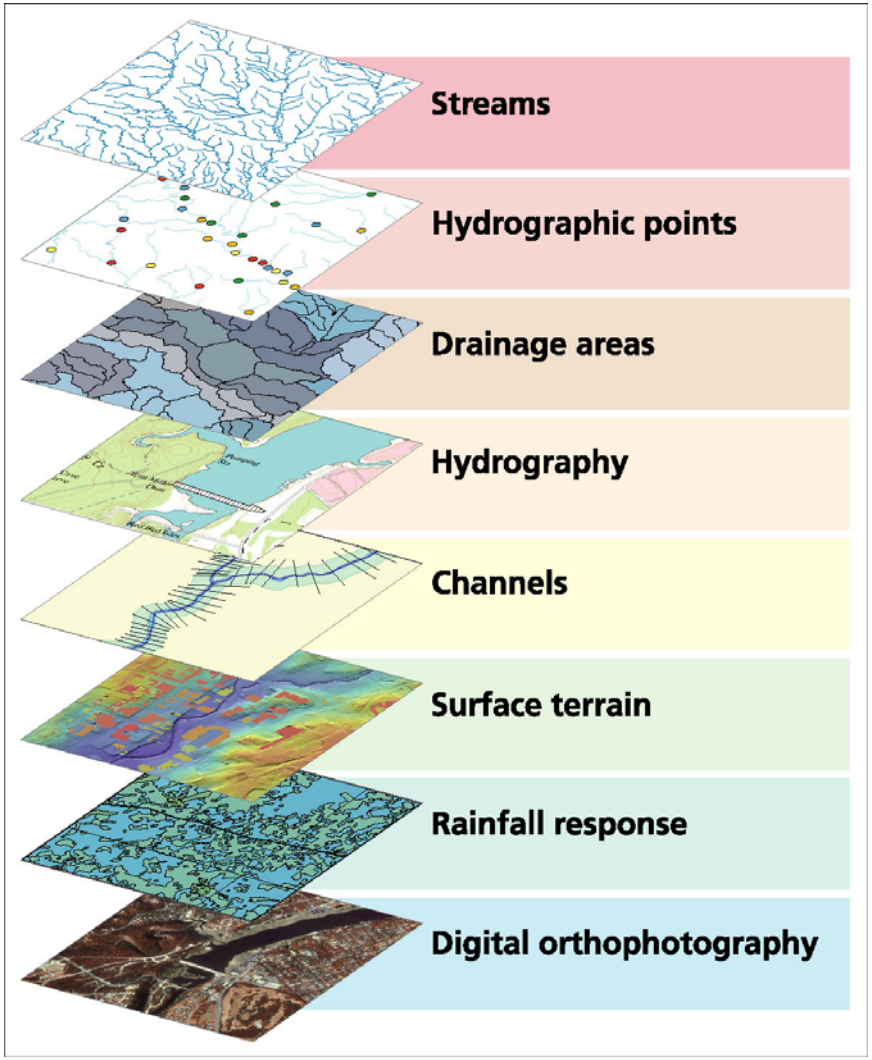
Coastal Wetland Mapping

Mapping wetland services at multiple scales with geographic data layers (GIS)

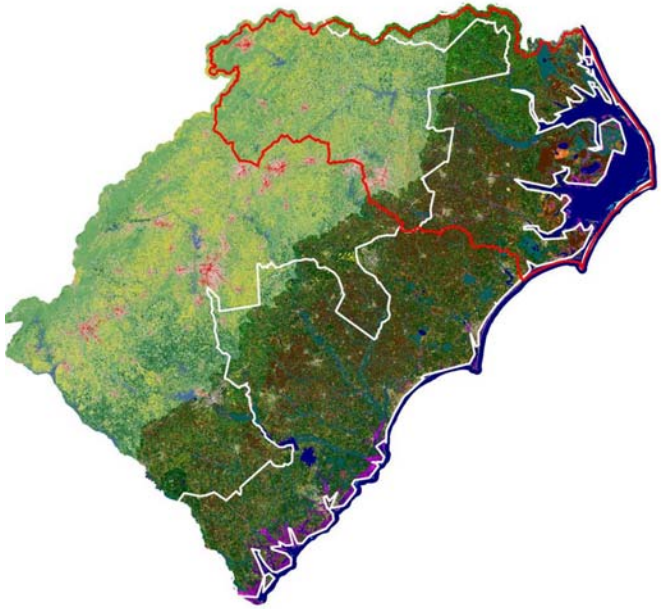
Interactive mapping tools that allow manipulation of wetland sizes, functional types, condition, setting, and placement in the watershed, and show how these change wetland services and value

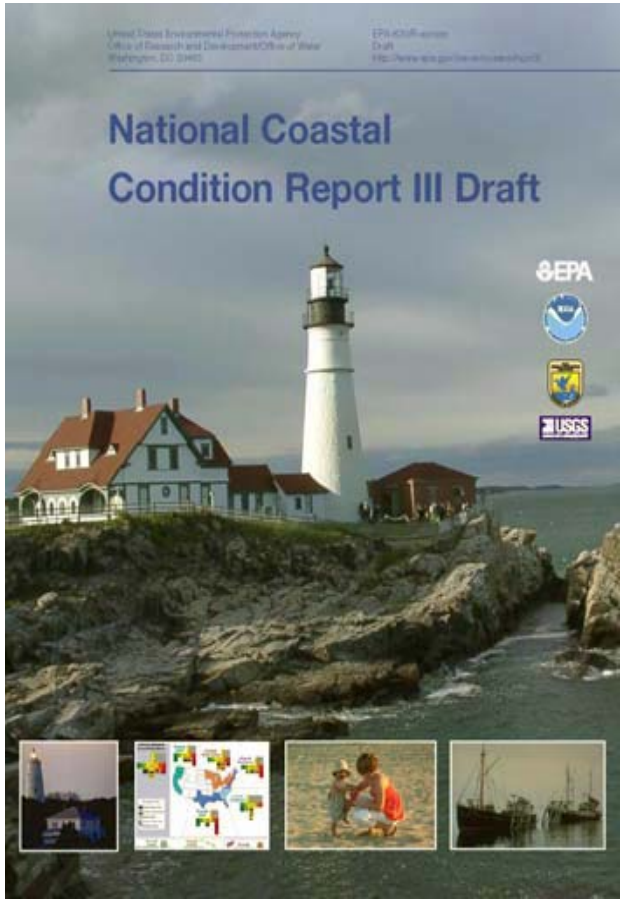


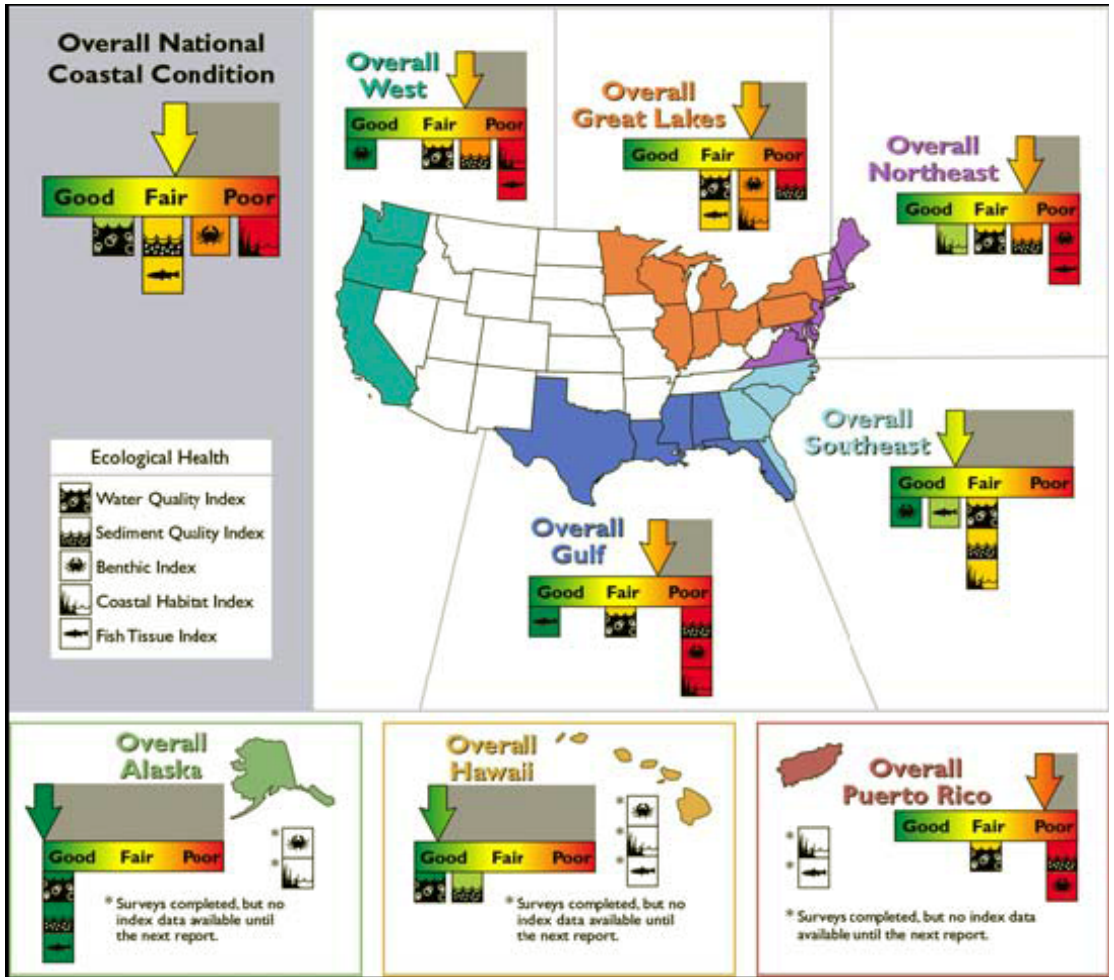
Ecosystem Service Indicators

Inventory of indicators of wetland function from national, regional, & state assessments of wetland condition

Linking condition to service indicators - Identify wetland condition indicators that can be used directly or modeled to quantify ecosystem services




National Coastal
Condition Report III Draft
EPA
USGS


Overall National Coastal Condition
Good Fair Poor
Ecological Health
Water Quality Index
Sediment Quality Index
Benthic Index
Coastal Habitat Index
Fish Tissue Index
Overall West
Good Fair Poor
Overall Great Lakes
Good Fair Poor
Overall Northeast
Good Fair Poor
Overall Southeast
Good Fair Poor
Overall Gulf
Good Fair Poor
Overall Alaska
Good Fair Poor
* Surveys completed, but no index data available until the next report.
Overall Hawaii
Good Fair Poor
* Surveys completed, but no index data available until the next report.
Overall Puerto Rico
Good Fair Poor
* Surveys completed, but no index data available until the next report.

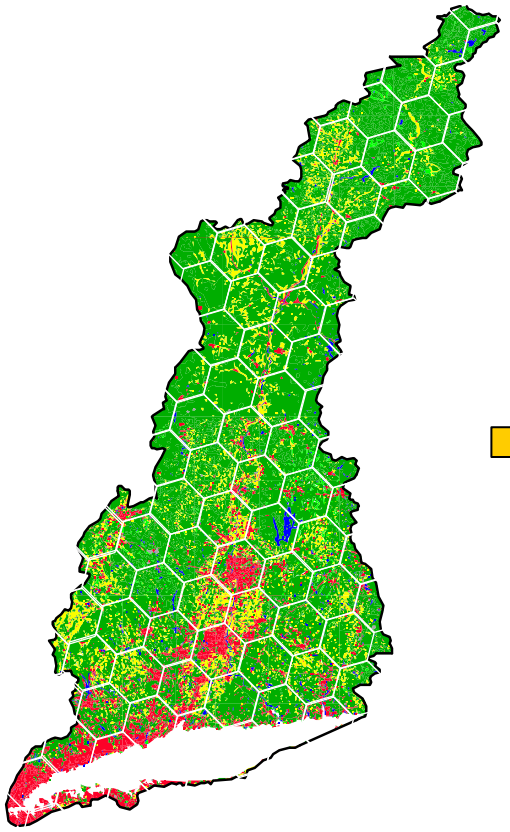
Models

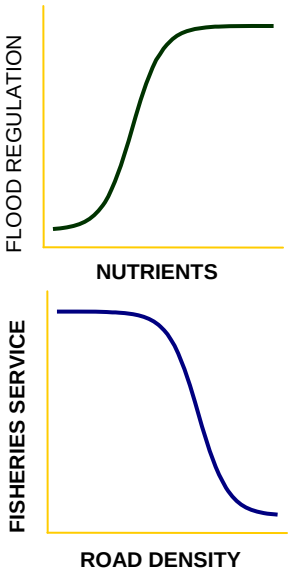
Empirical stressor-response models to link wetland ecosystem stressors and responses that affect provisioning of core ecosystem services

Wetland ecosystem service models for forecasting wetland ecosystem service responses to drivers

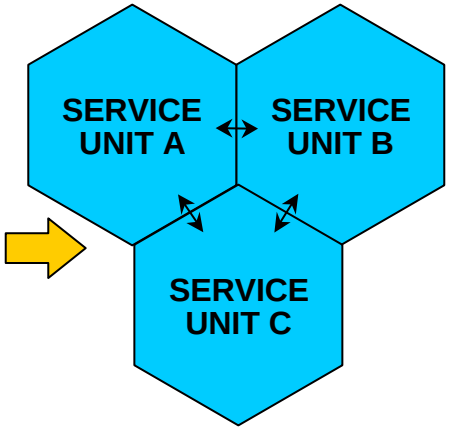
Bundled wetland services in models

Relative risk models to predict the consequences (relative risks) of optimizing for particular services





$$n_{t0} = Mn_{t1}$$



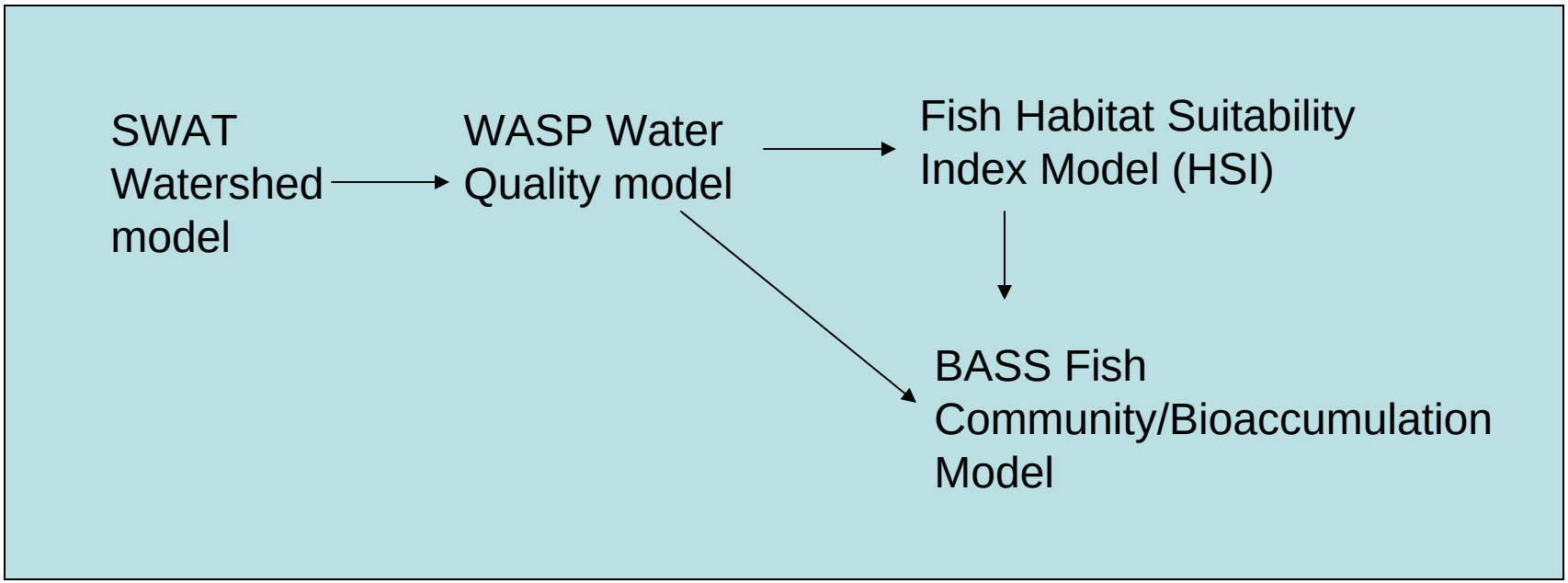
Ecosystem Services Monitoring

Ecosystem Response Functions

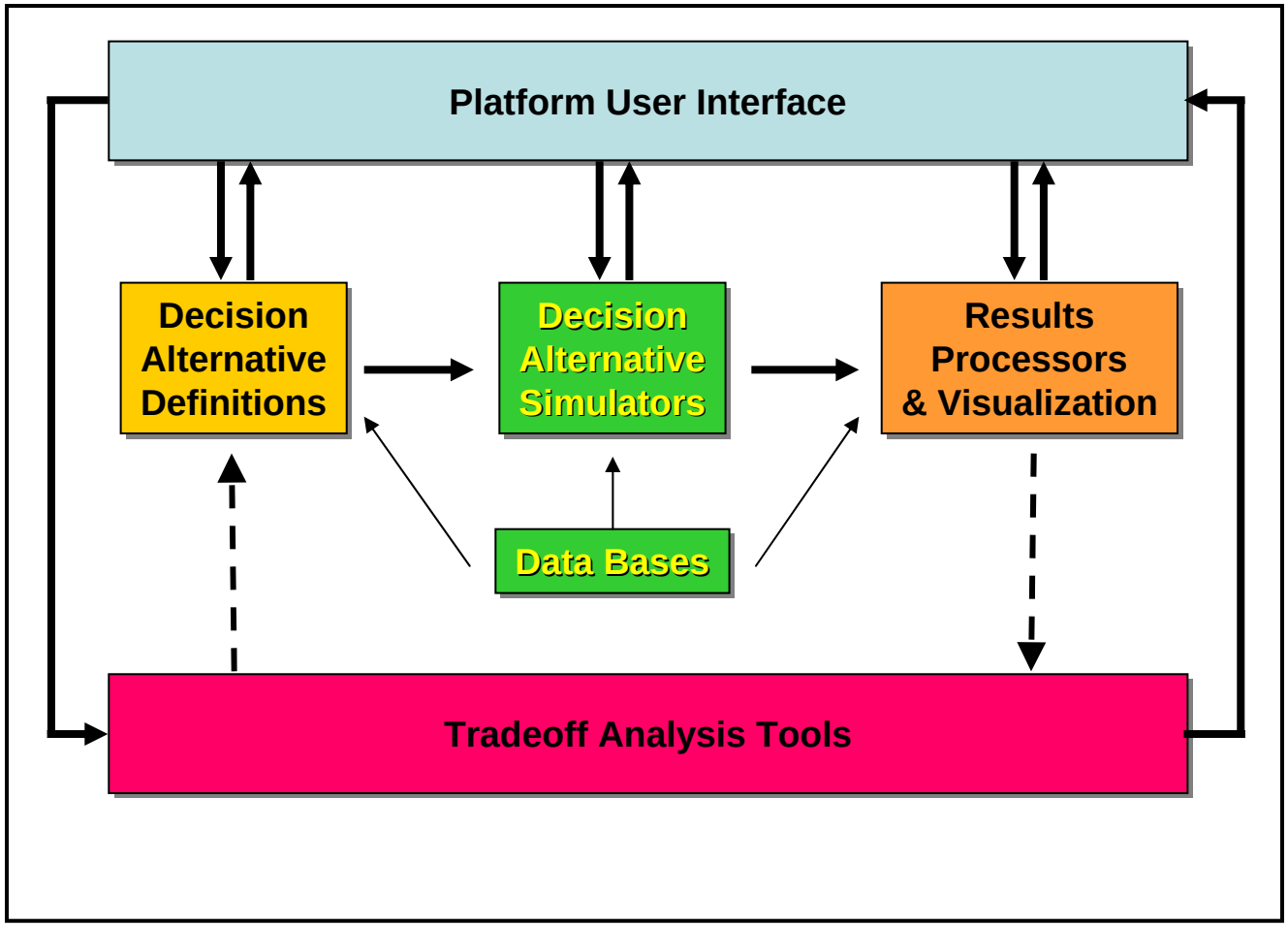
Ecosystem Services Forecasting

Ecosystem Services Mapping

Modeling Framework



Decision Support Tools



Disease Risk Models

Develop spatially-explicit landscape models of disease risk due to mosquito vectors in Coastal Carolinas wetlands

Model the effect of global climate change on disease risk (Dengue fever) at multiple spatial scales

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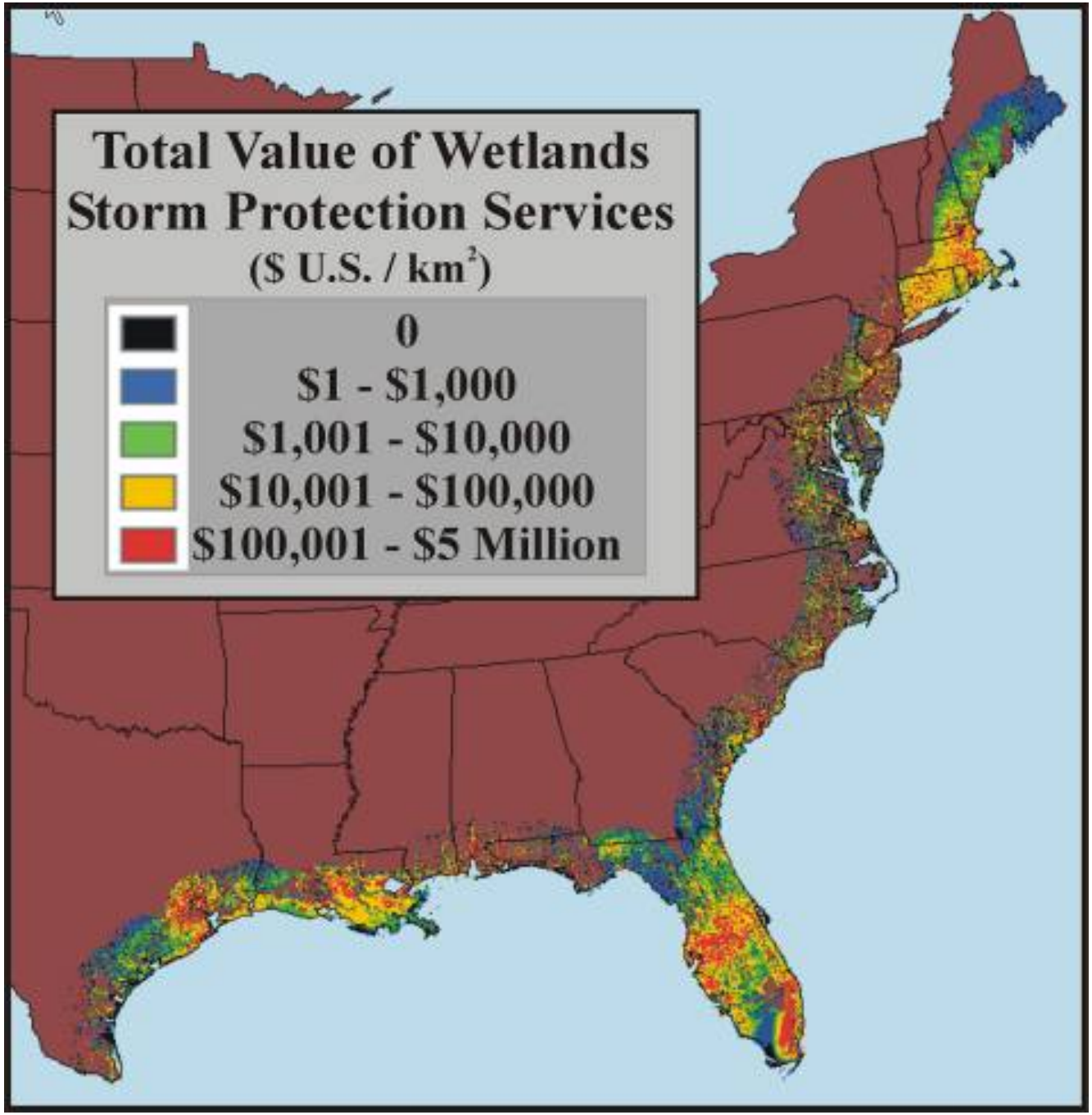


Costanza, R., O. Pérez-Maqueo, M. L. Martinez, P. Sutton, S. J. Anderson, and K. Mulder 2008. The Value of Coastal Wetlands for Hurricane Protection. Ambio 37:241-8.

Example – Mississippi River Outlet

Stressors
Dredging
Erosion
Altered Salinity

→

Function & **Structure**
> 50K wetland acres lost or altered

→

Ecosystem Services
Fisheries
Waterfowl & fur-bearers
Storm Protection

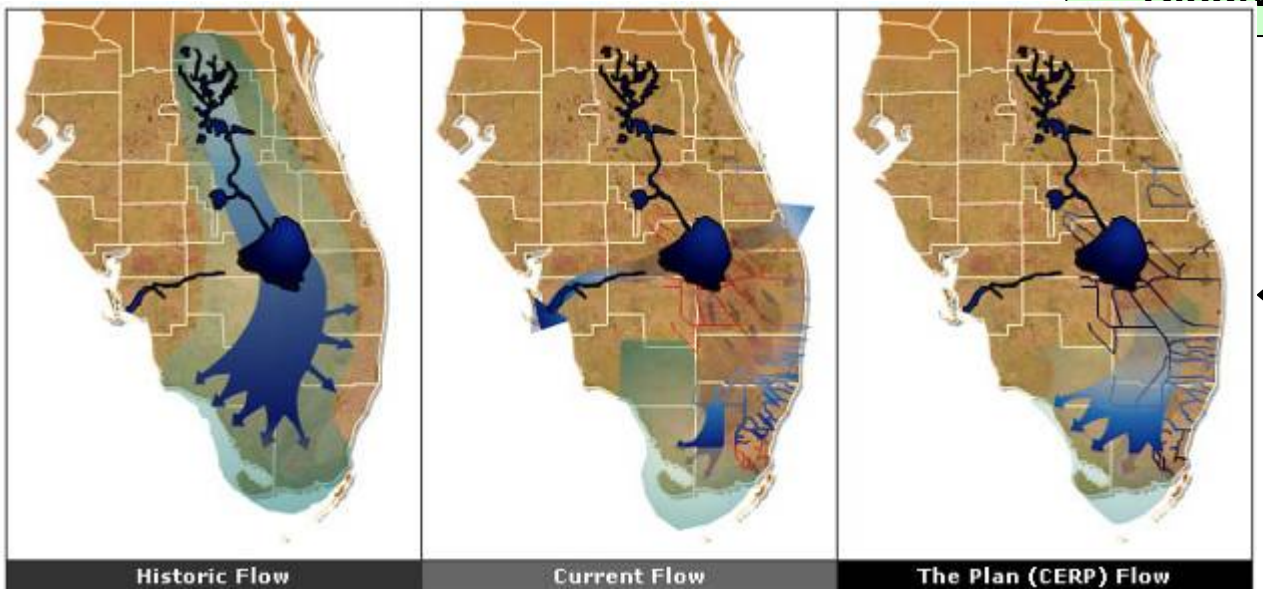
↓

Value lost – $250M to $2B since 1960

Example - Florida Everglades Restoration

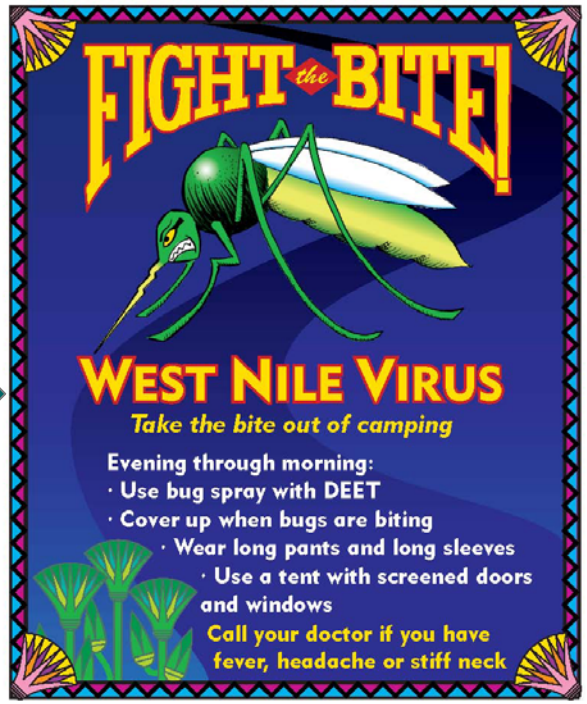
Condition
Degraded Water Quality
Loss of Connectivity
Habitat Loss
Soil Loss
Invasive Species

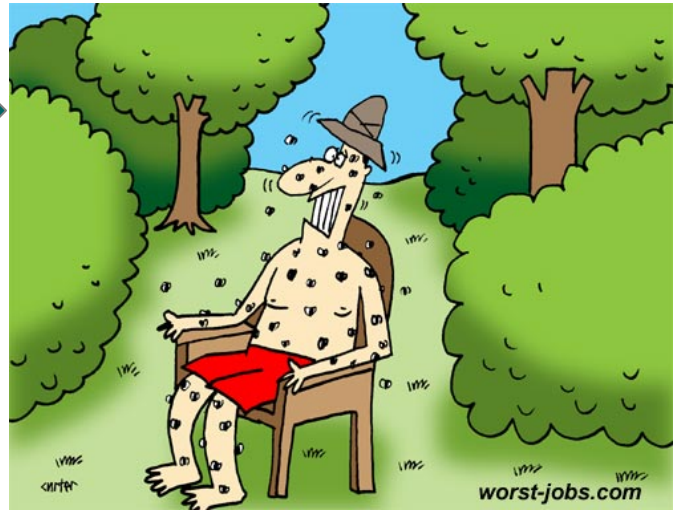
Services
1° Production
Freshwater availability
Flood Protection
Recreation
Nutrient Cycling
Habitat
Biodiversity



Restoration Plan
to restore services

Example - Disease Risk

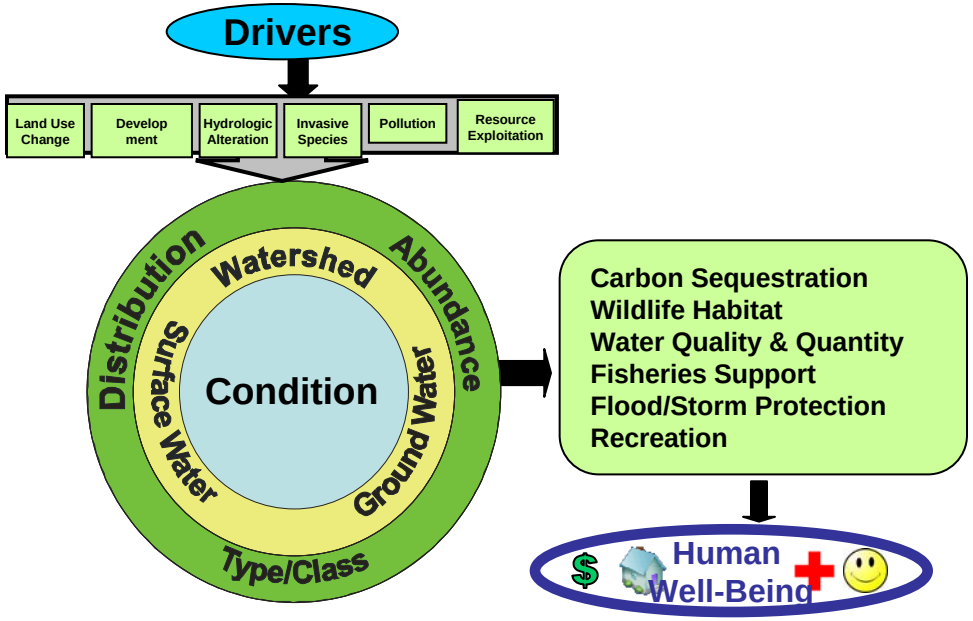




Summary: EPA's Ecosystem Services Research in Coastal Wetlands

- Strategy
  - Interactive maps
  - Models
  - Decision support tools

- Conceptual model
  - Six services
  - Multiple stressors
  - Range of scales



- Goal: to support decision-making and management
  - Ensure that decisions account for the value of coastal wetland ecosystem services

Acknowledgements

- This presentation is based on work by the National Wetlands ESRP team, Office of Research and Development, U.S. EPA