



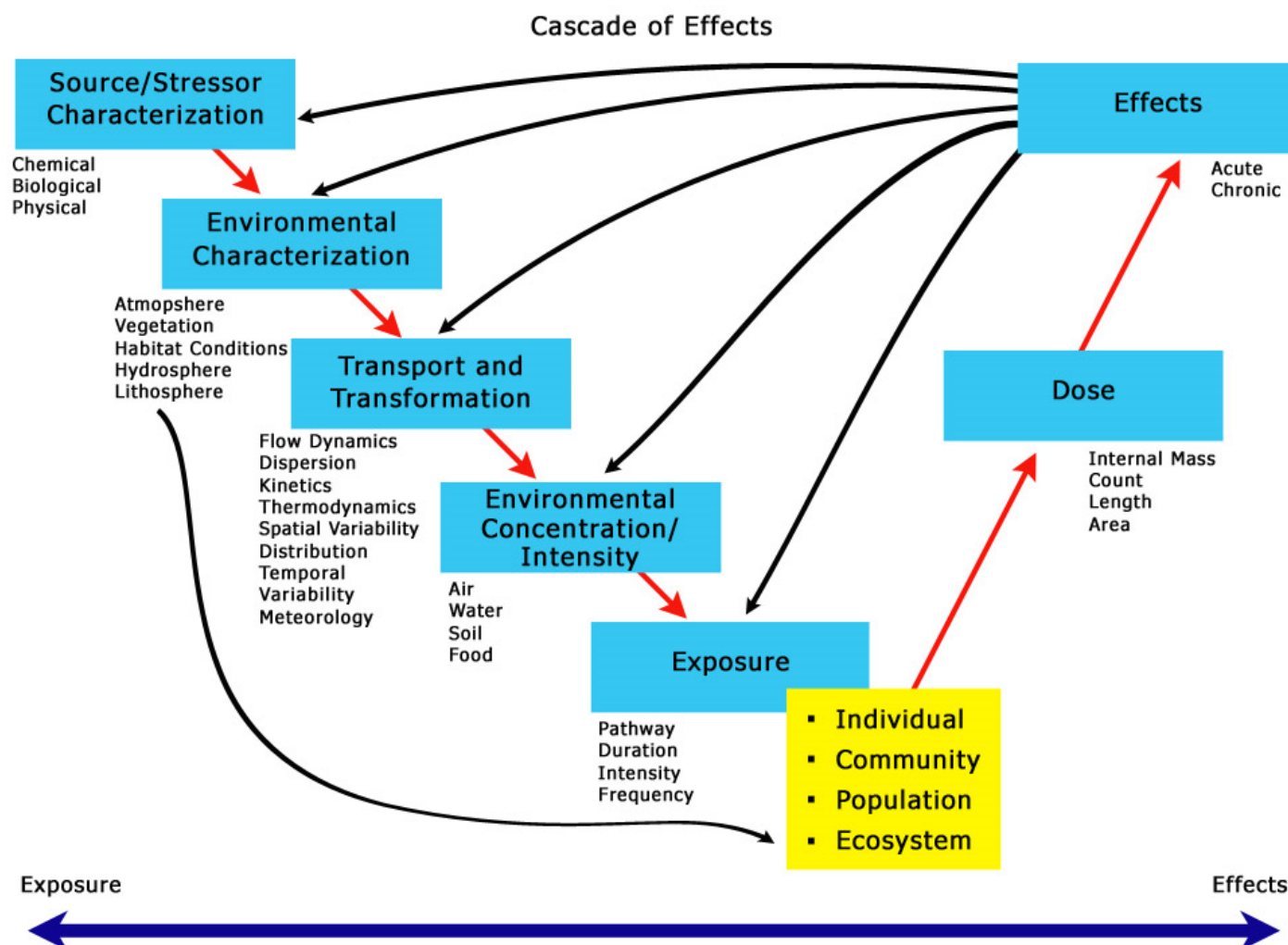
# Ecosystem services and climate change considerations for Long Island (NY) planning post hurricane Sandy

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# National Exposure Research Laboratory





# Why modeling?

- Modeling as synthesis and **integration**
- Modeling as pre-specification and structured approach to complex **problem solving**
- Modeling as necessary **science**
- Modeling as a **community of practice**



# Integrated Environmental Modeling

## Purpose and Benefits

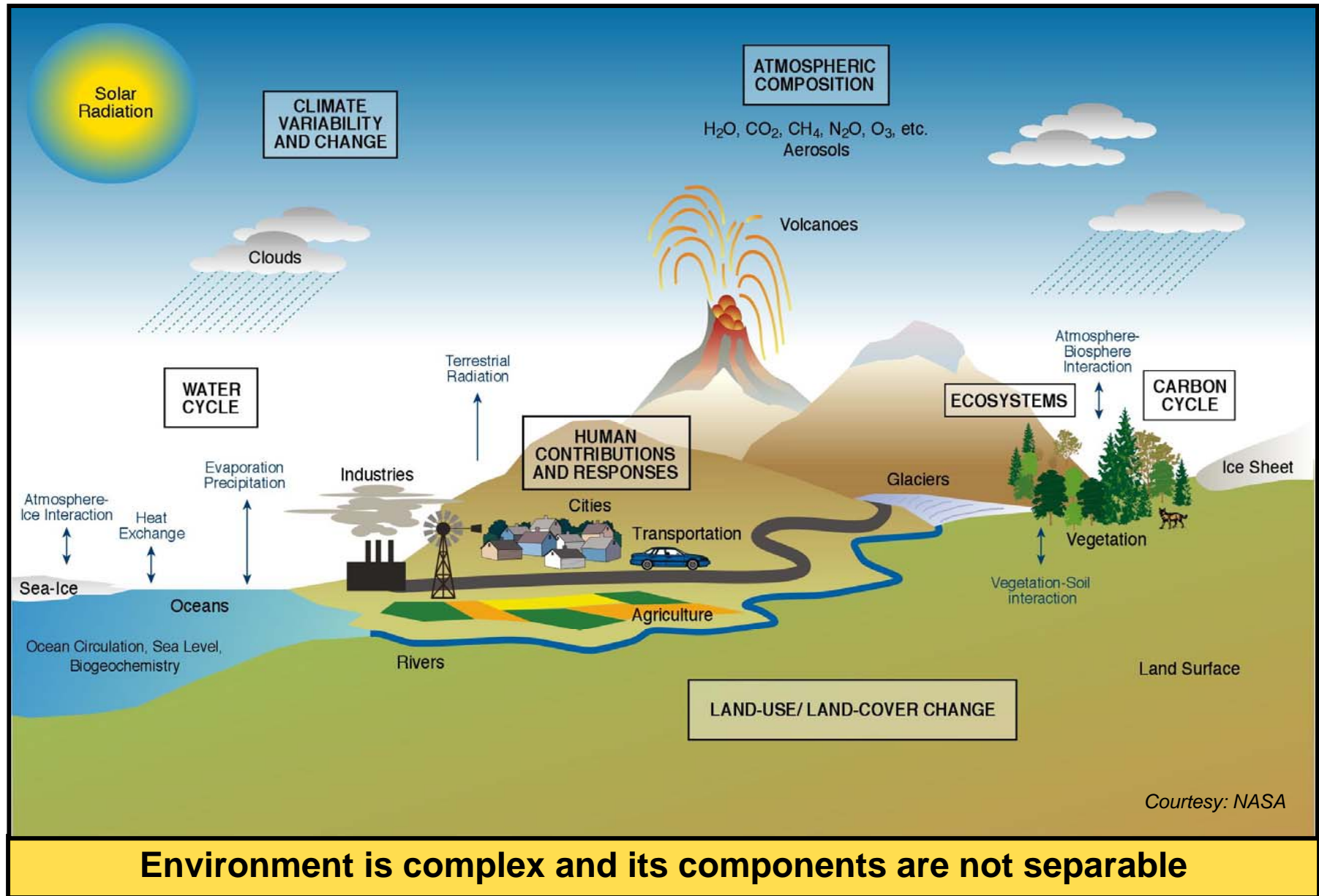
- Facilitate the development and application of integrated systems
- Standards based
- Facilitates collaboration and additional dimensions of research
- Minimizes production of non-science software (more resources focused on science components)

## Elements and Functionality

- Execution management
- Data flow management
- User interfaces (hierarchical – system levels down to components)
- Modeling support software (data access/retrieval/processing, visualization, quality assurance)

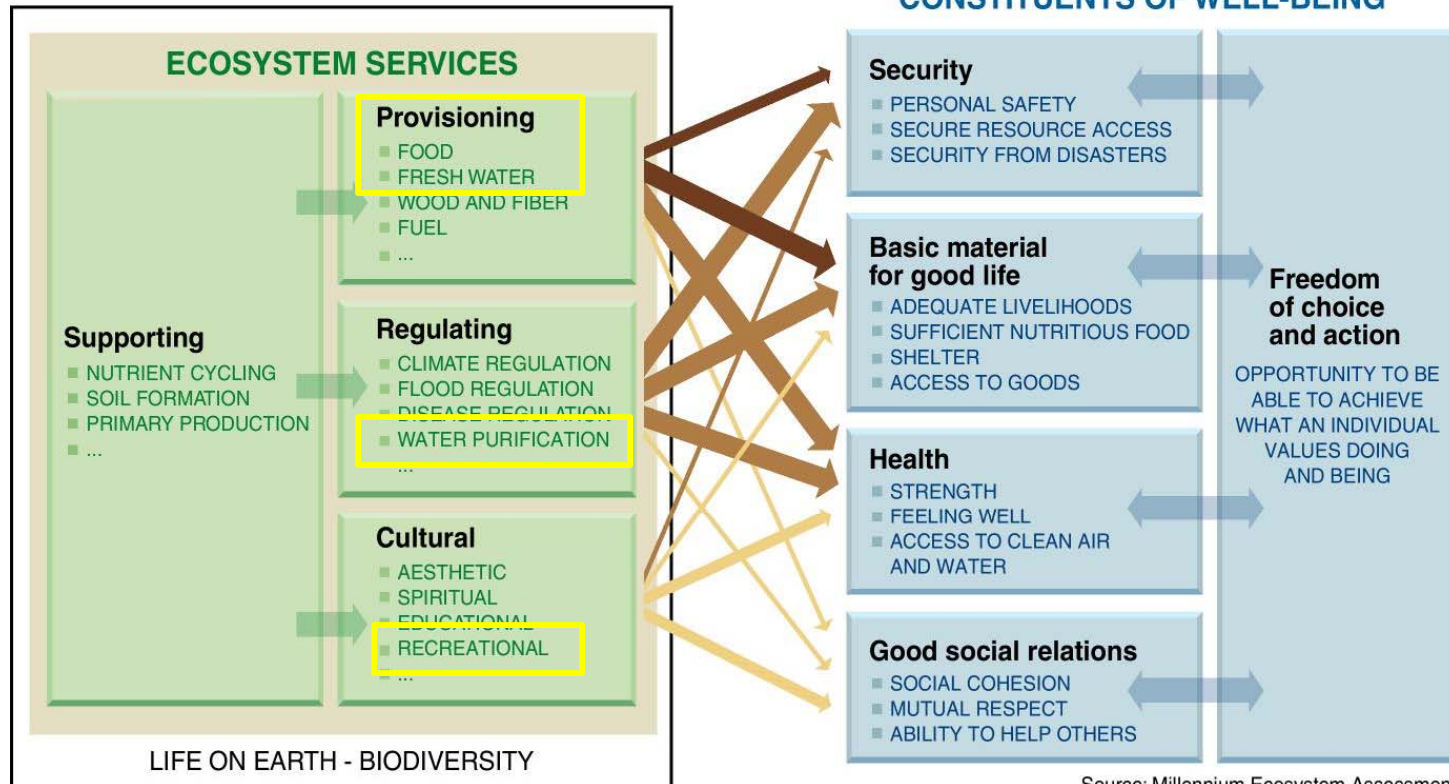
## Limitations and Issues

- Standards (multiple frameworks need community wide standards)
- Ongoing maintenance of large software systems is challenging
- Misperception that infrastructures solve science integration problems



# Ecosystem Services (MEA, 2005)

## CONSTITUENTS OF WELL-BEING



Source: Millennium Ecosystem Assessment

**ARROW'S COLOR**  
Potential for mediation by  
socioeconomic factors

- Low
- Medium
- High

**ARROW'S WIDTH**  
Intensity of linkages between ecosystem  
services and human well-being

- Weak
- Medium
- Strong



# Long Island Considerations

- **Community recovery includes resilience and sustainability of both natural and built capital**
  - **Decisions and values drive the design and approach**
  - **No “handbook” exists and not a linear process**
- **Environmental Justice goals**
- **Long Island Estuary (Nassau Co. and Office of Water)**
- **Wetlands**
- **Sole source aquifer for drinking water**
- **Flooding**
- **Waste water and sewerage, including storm flows**

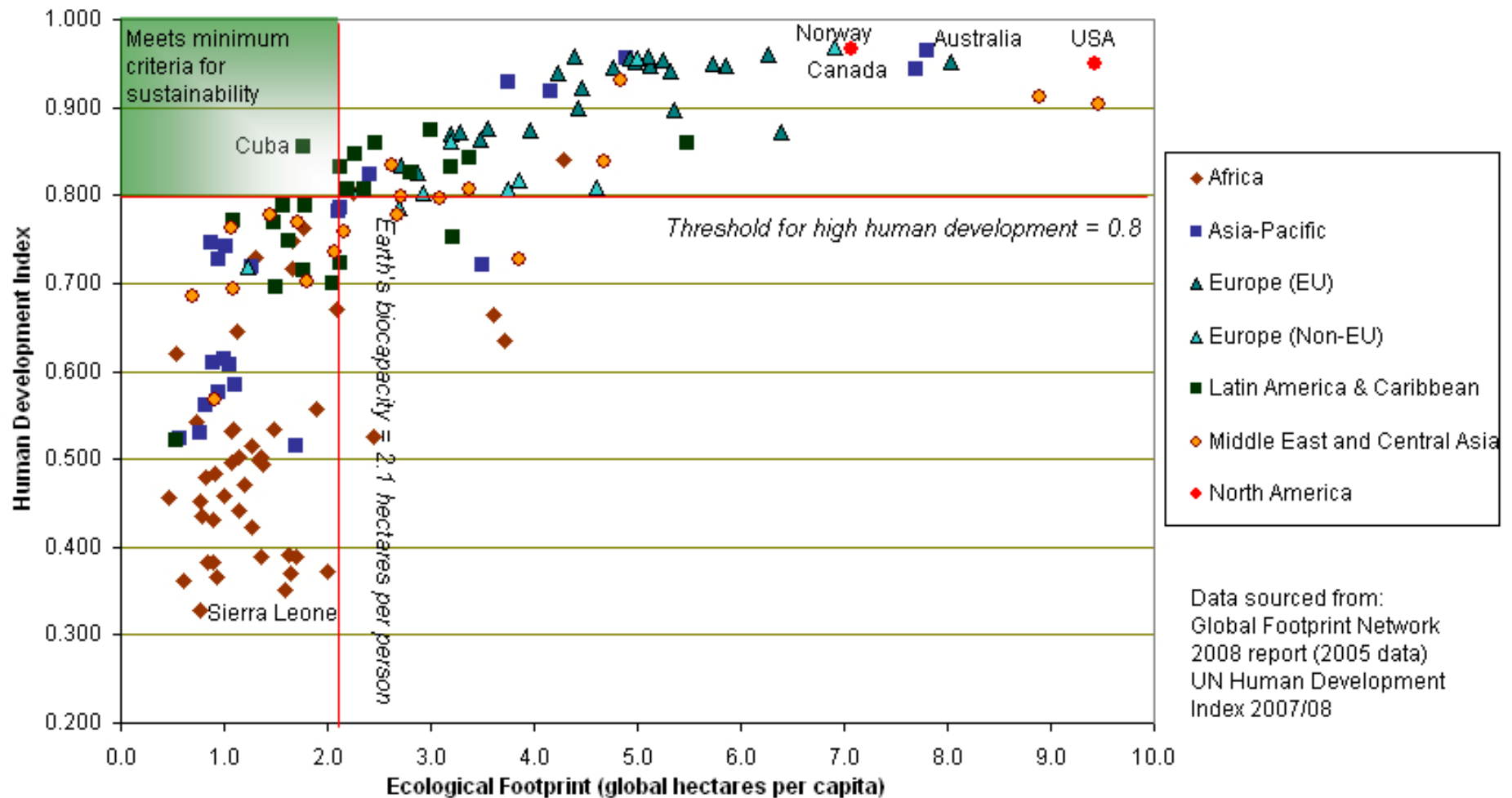
# Community Planning

- **Tools and Methods:**
  - **Cost Benefit (state)**
  - **CommunityViz (Place Matters)**
  - **Health Impact Assessment (HIA) process**
  - **Ecosystem Services modeling**
- **Multiple scales of governance:**
  - **Local**
  - **County**
  - **State**
  - **Region**



# Decision Making Goals and Indicators

## Human Welfare and Ecological Footprints compared



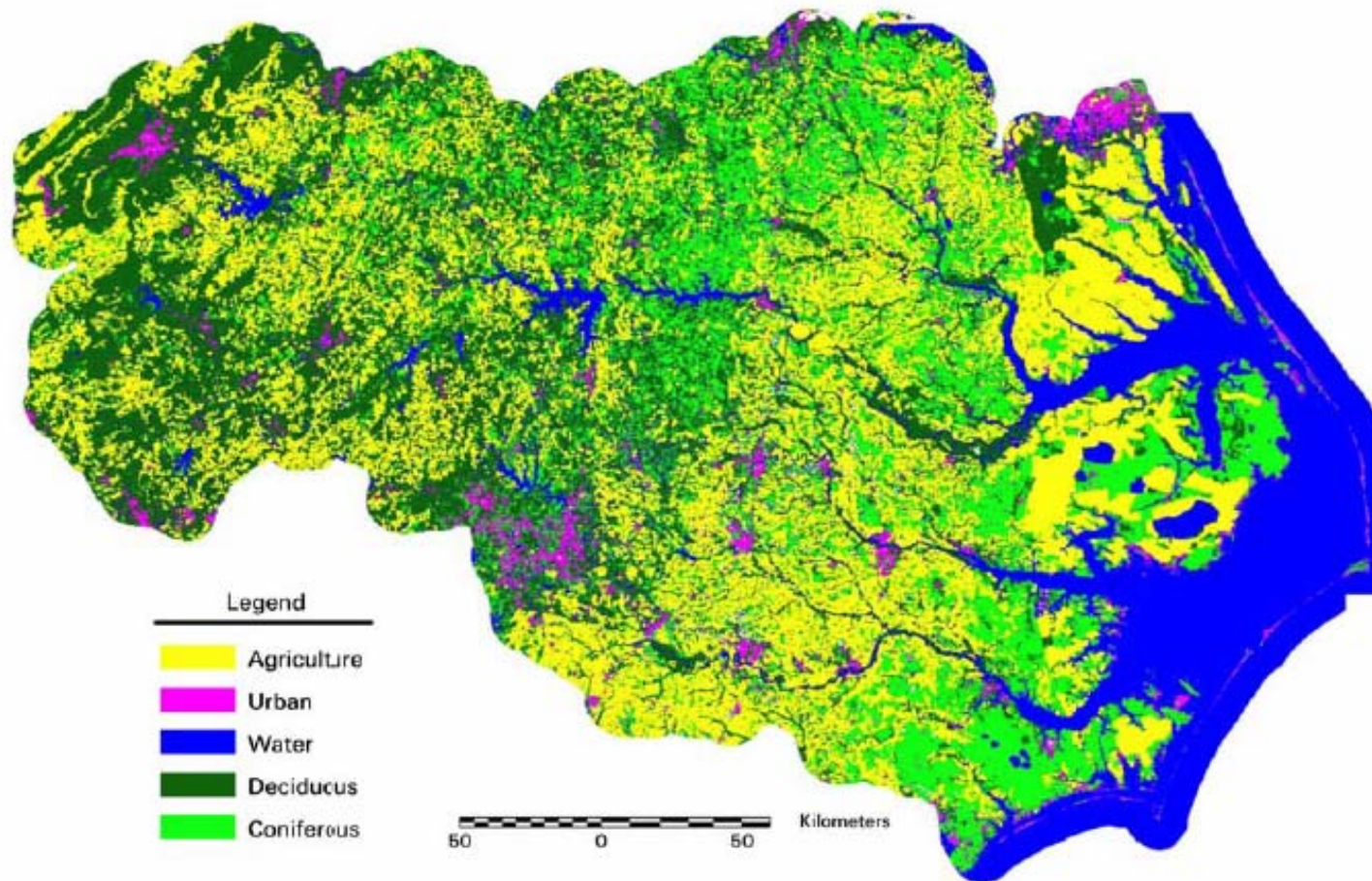


# Long Island Study Area (Boundary and System Description)





# Example: Albemarle Pamlico (NC,VA) USA



# REGIONAL SCALE ASSESSMENT OF AQUATIC ECOSYSTEM SERVICES

## Regional Landscape Characterization

Specification of HUC12 Watersheds  
Fish Community Characterization

## Scenario Definitions

Baseline/Alternative Futures  
Source/Stressor Characterization

- LU Distribution
- N,P,Pesticide Loadings per LU
- Hg Deposition
- Climate/Meteorology
- Ag Management Strategy

## Environmental Characterization

- Land cover/use
- Integrated Watershed/Stream Delineations
- Aquatic habitat
- Watershed Soils/Topography
- Fish Assemblage per watershed pour-point

## Chemical Properties

- Environmental media/conditions
- N,P, pesticides, Hg

## D4EM

(Technology to facilitate data access, retrieval, processing)

## FRAMES

(Technology to facilitate standards-based integrated multi-media and exposure assessment modeling)

Air Deposition N, Hg  
(CMAQ)

Watershed Hydrology and Loading Module  
(SWAT)

Water Quality Module  
(WASP)

Aquatic Community Module  
(BASS)

Watershed Hg Module  
(WHg)

Habitat Suitability Module  
(HSI)

Simulation Post Processing

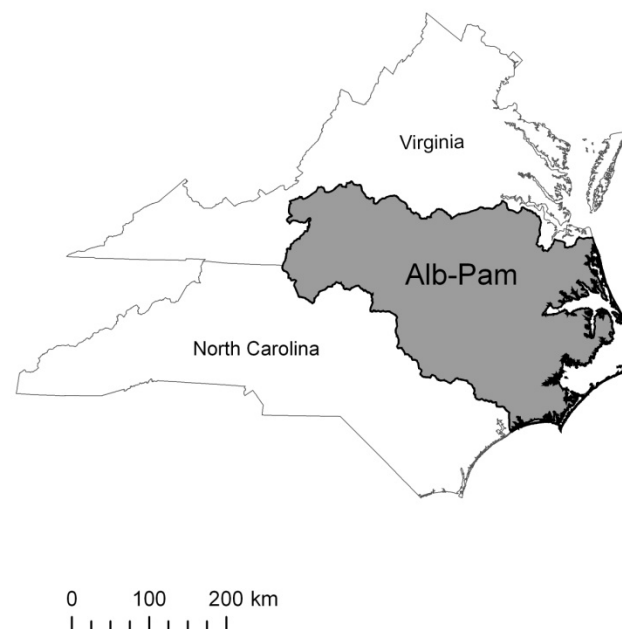
Regional Scale Representation of Ecosystem Services

- Statistical roll up of watershed specific results
- Uncertainty analysis
- Graphical presentation

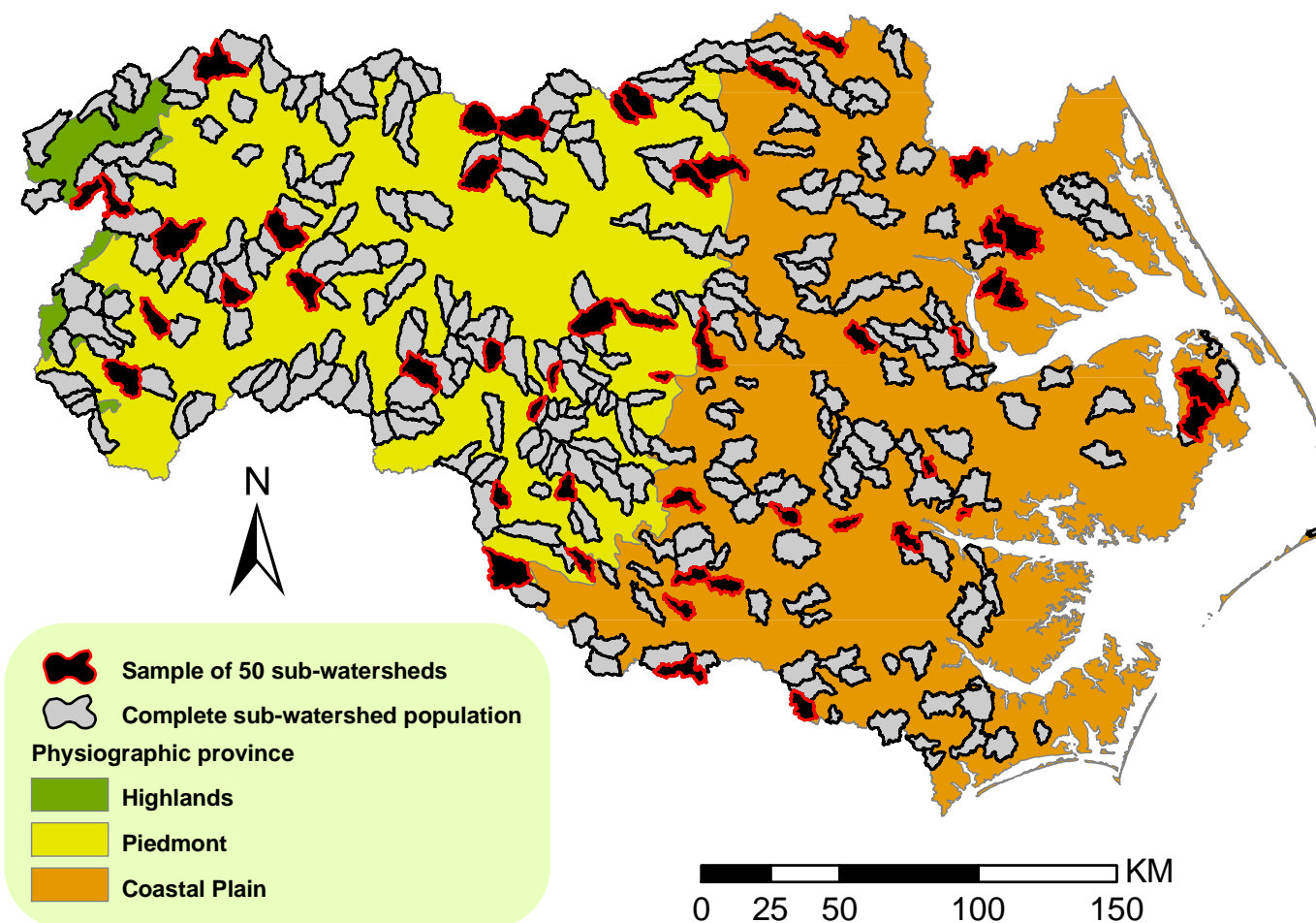
Ecosystem Services Characterization per Watershed

- Water Quality
- Water Quantity
- Habitat Suitability
- Fish Biomass
- Fish Burden (Hg)

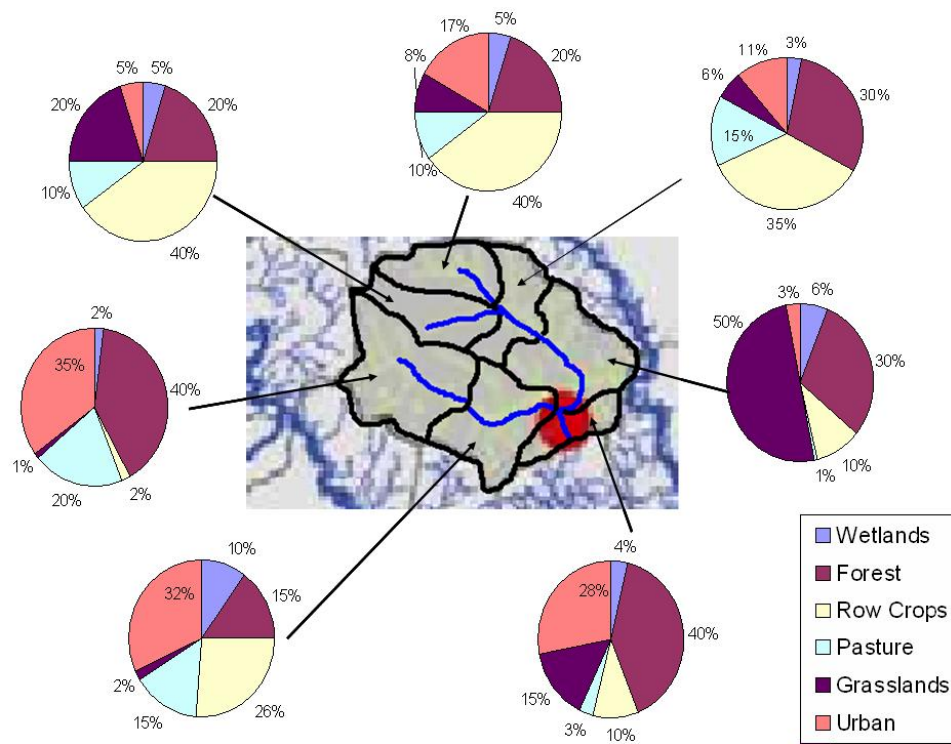
# Study Area



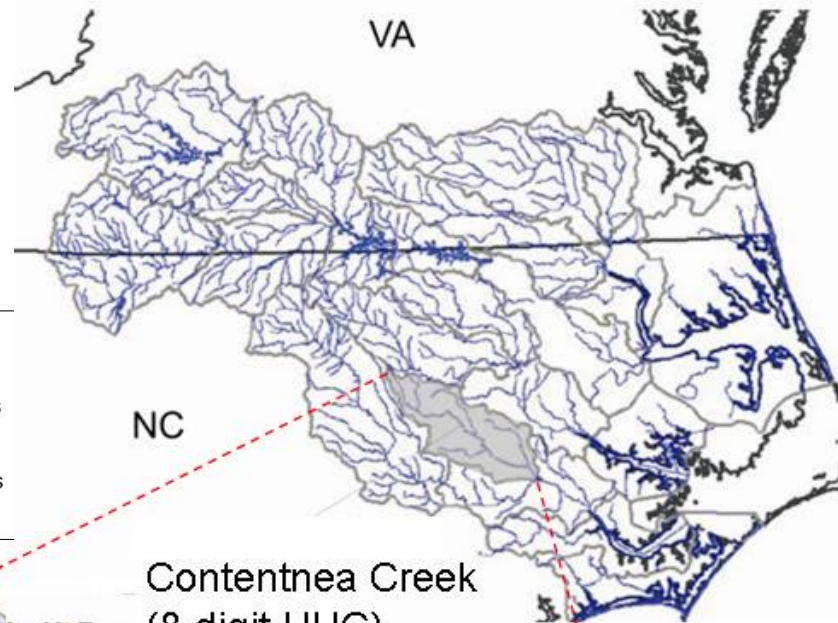
## Study Area (cont.)



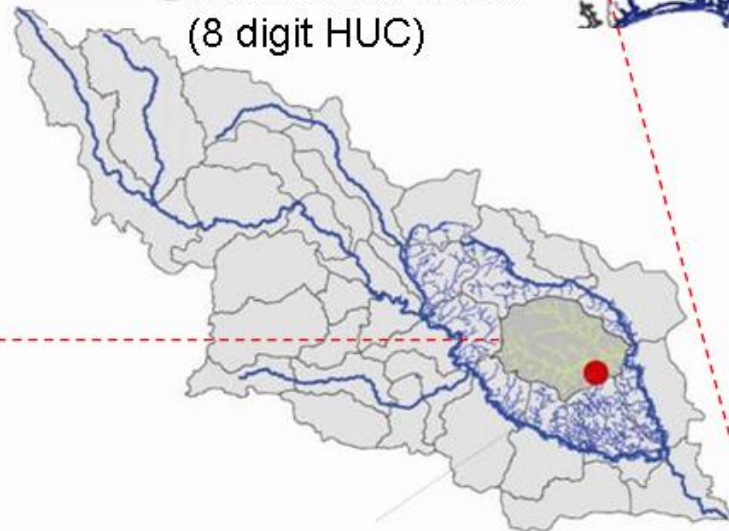




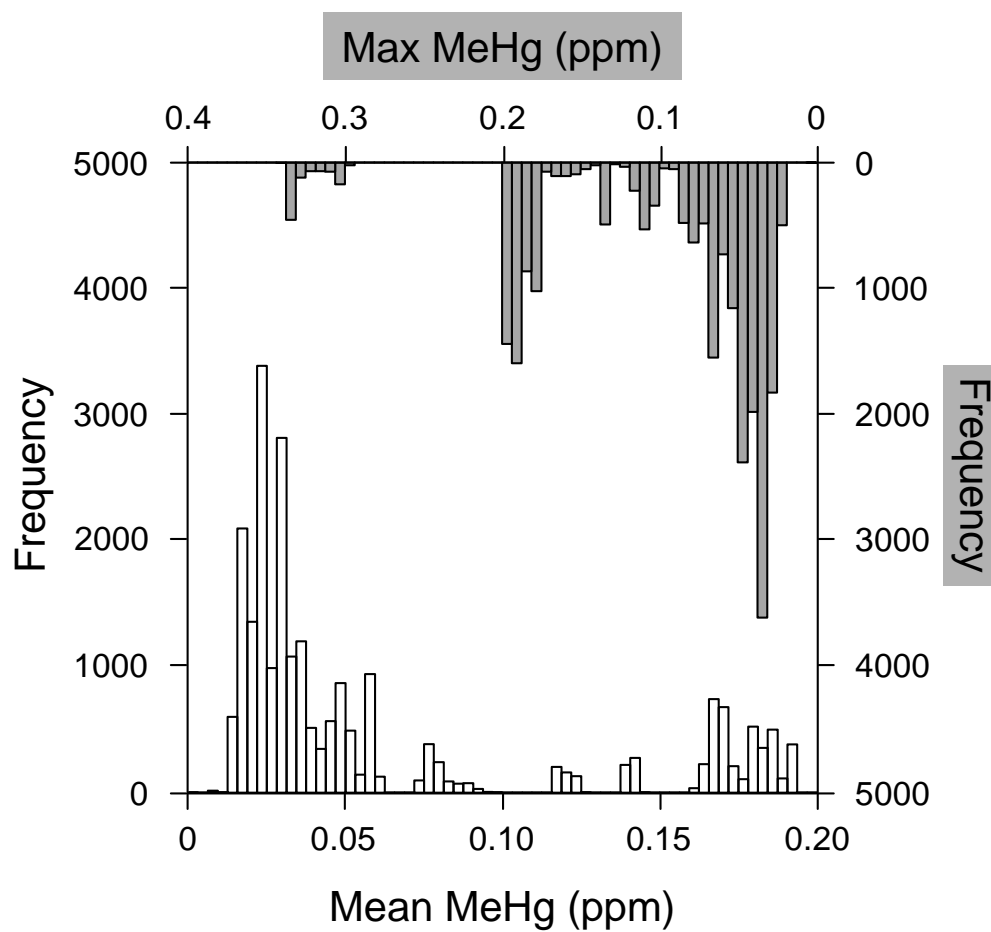
## Albemarle Pamlico Estuary System



Middle Swamp (14 digit HUC)

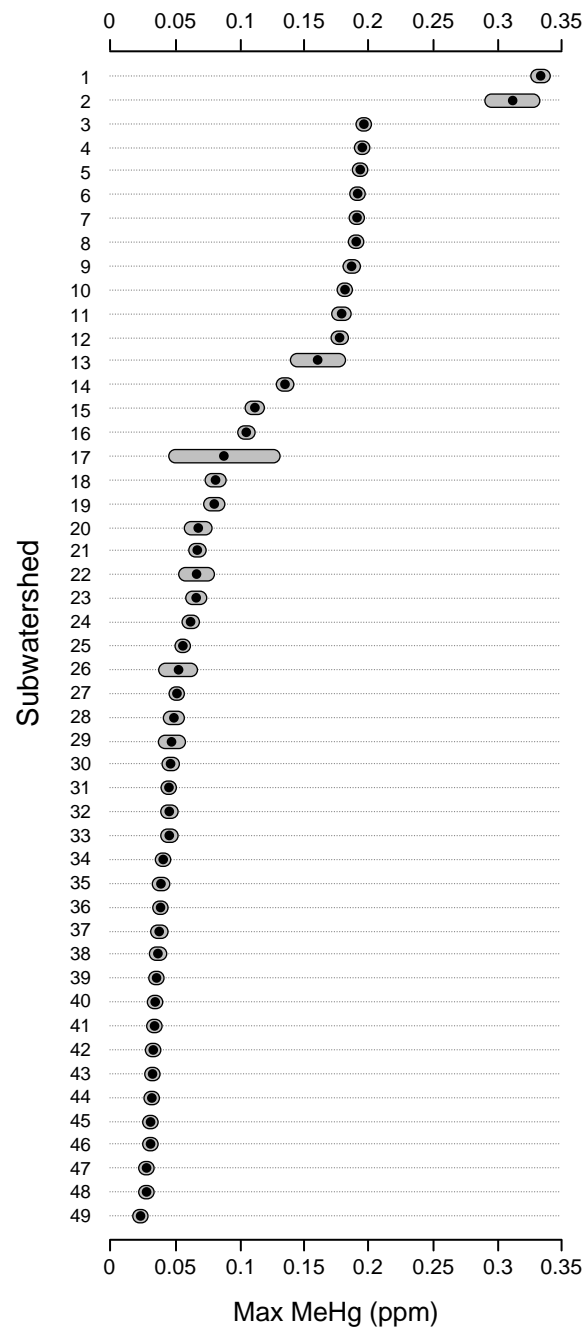


# Results – Methylmercury in game fish

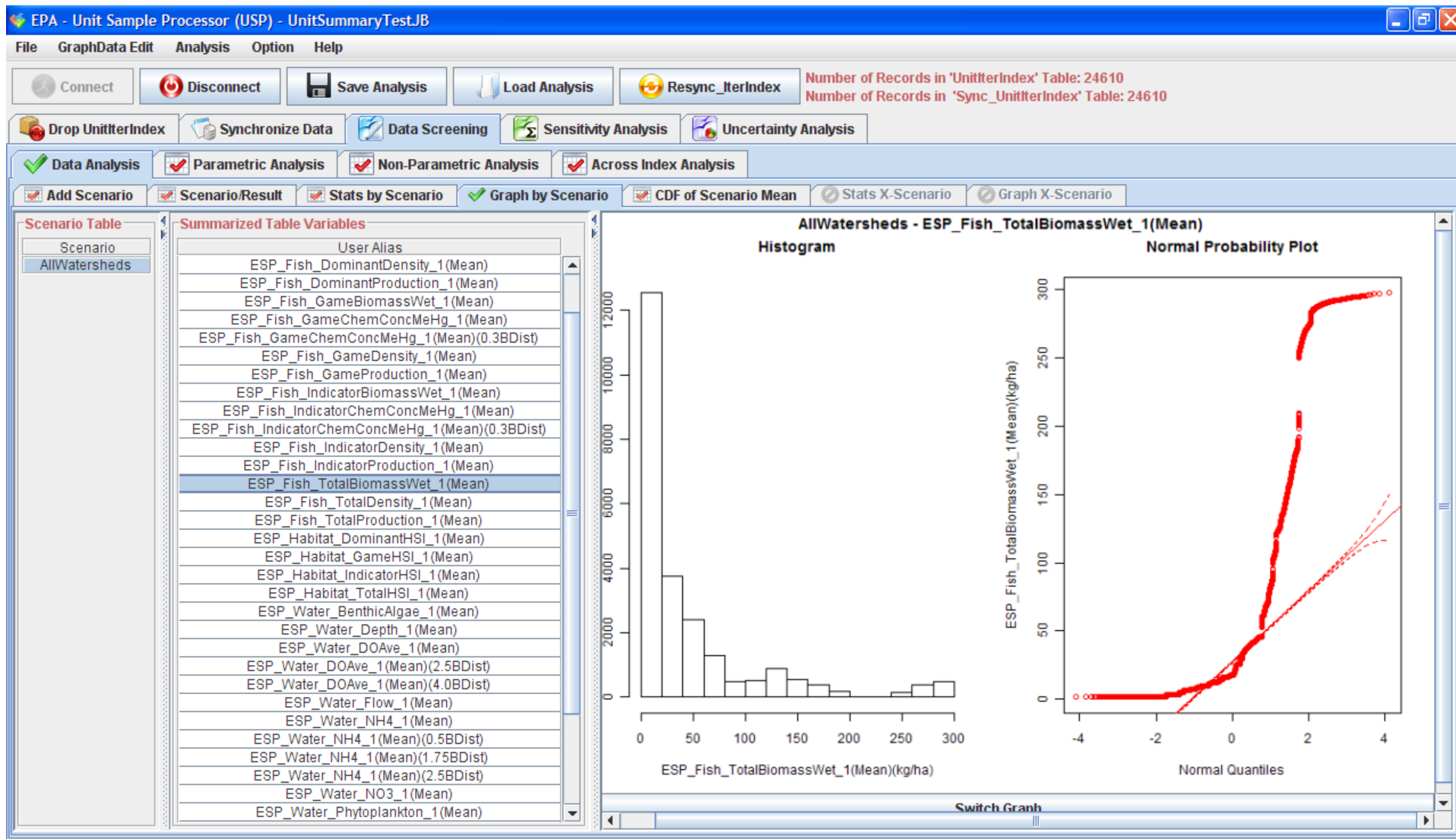




## Results (cont.)



# Results at multiple scales



## Summary

- **Ecosystem services support LI communities: sole source drinking water aquifer, collapse of clam industry, storm surge protection**
- **Threats to LI include sea level rise, saltwater intrusion, increased storm frequency and intensity, nutrient pollution**
- **Insufficient funds for all infrastructure projects (sewerage)**
- **Partnership with the environment to leverage natural capital (including Green Infrastructure)**
- **Ecosystem Service modeling complements toolset with necessary science, forecasting alternative futures and uncertainty analysis for decision making**

# Questions?

