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ECOSYSTEMS SERVICES RESEARCH PROGRAM

BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

The National Atlas of Ecosystem Services: Spatially Explicit Characterization of Ecosystem Services

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Coastal and Estuarine Research Federation:
Estuaries and Coasts in a Changing World
Portland, OR
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Presentation Outline

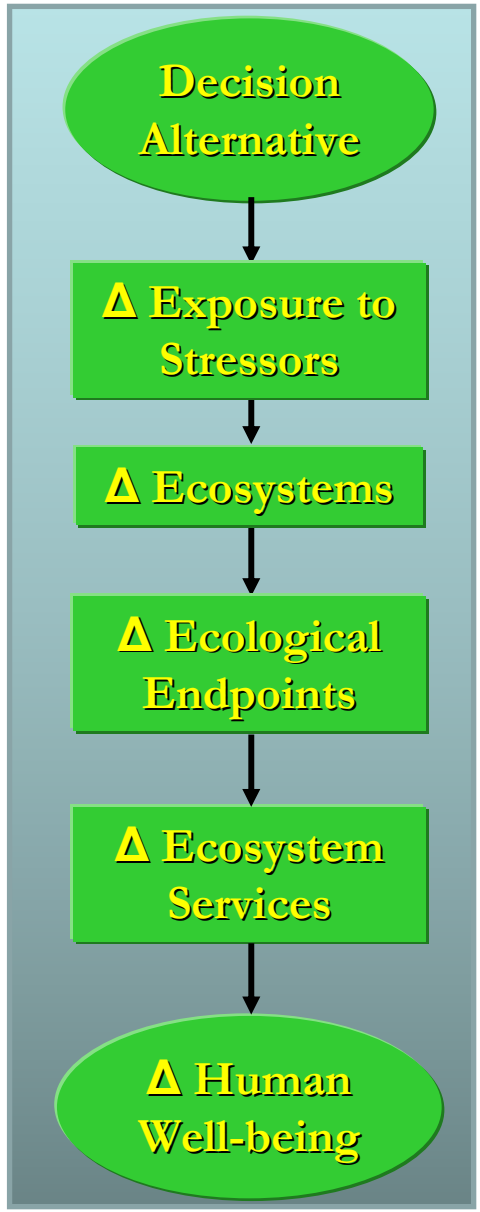
- Vision / overview of the National Atlas of Ecosystem Services
- Coastal Wetland Ecosystem Services
- Questions

Ecosystems Services Research Program Goal:

To transform the way we understand and respond to environmental issues by

making clear the ways in which our choices affect the type, quality and magnitude of the services we receive from ecosystems –

such as clean air, clean and abundant water, protection from flood events, productive soils, and food, fiber, and fuels.



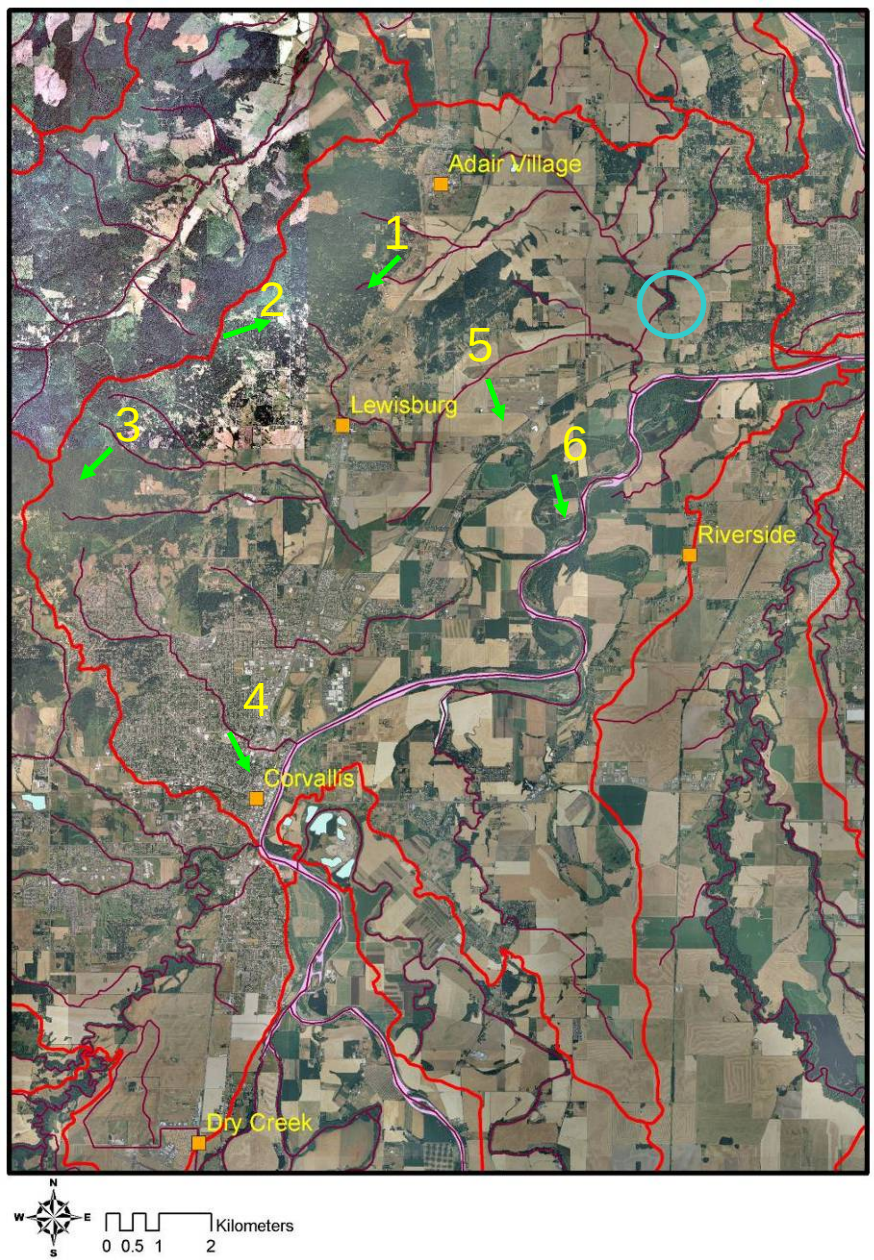
Vision for the National Atlas of Ecosystem Services

How many ecosystem services can you visualize in this image?

Imagine the flow of services into and out of this area

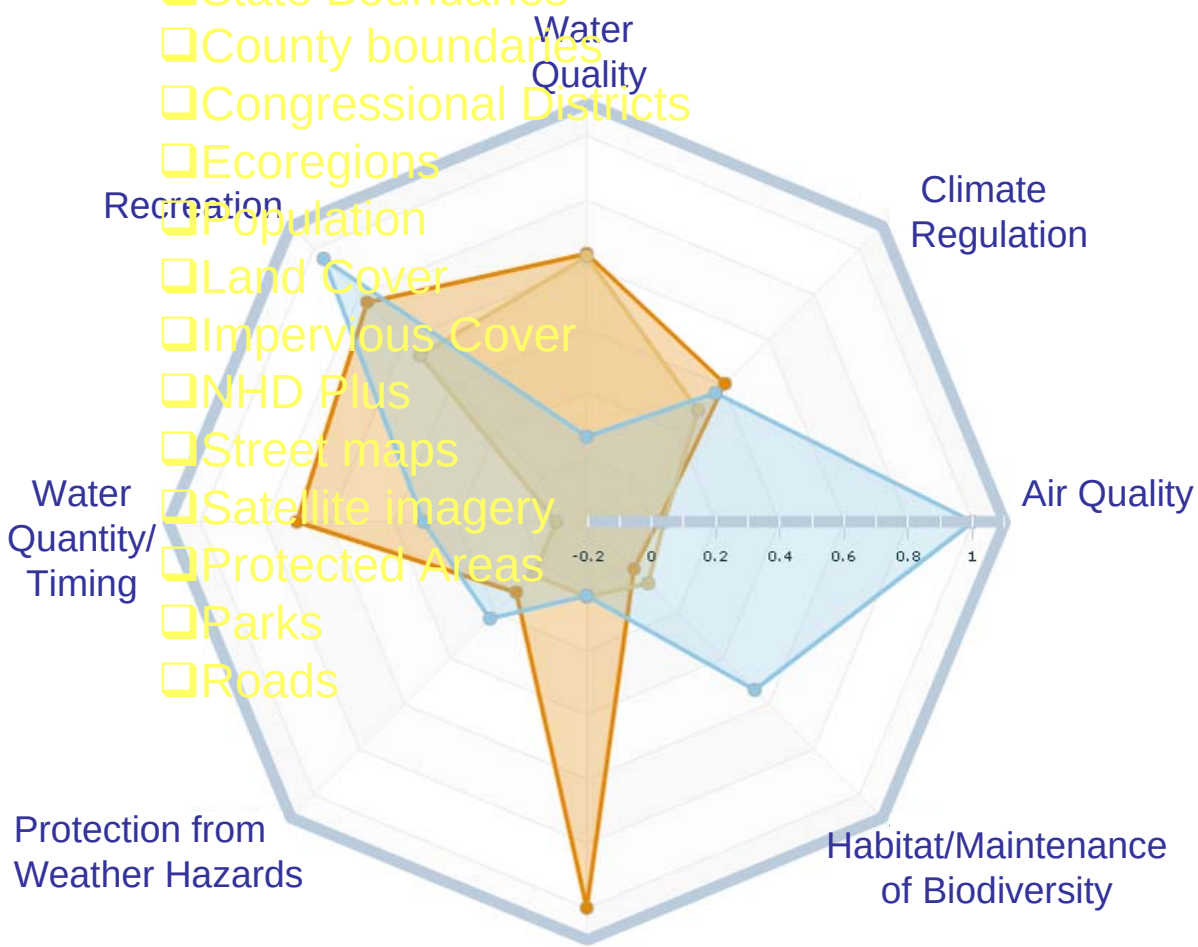
Now, imagine summarizing all of this somehow and mapping for nation!

Location, Location, Location!
(Spatial Pattern Matters)



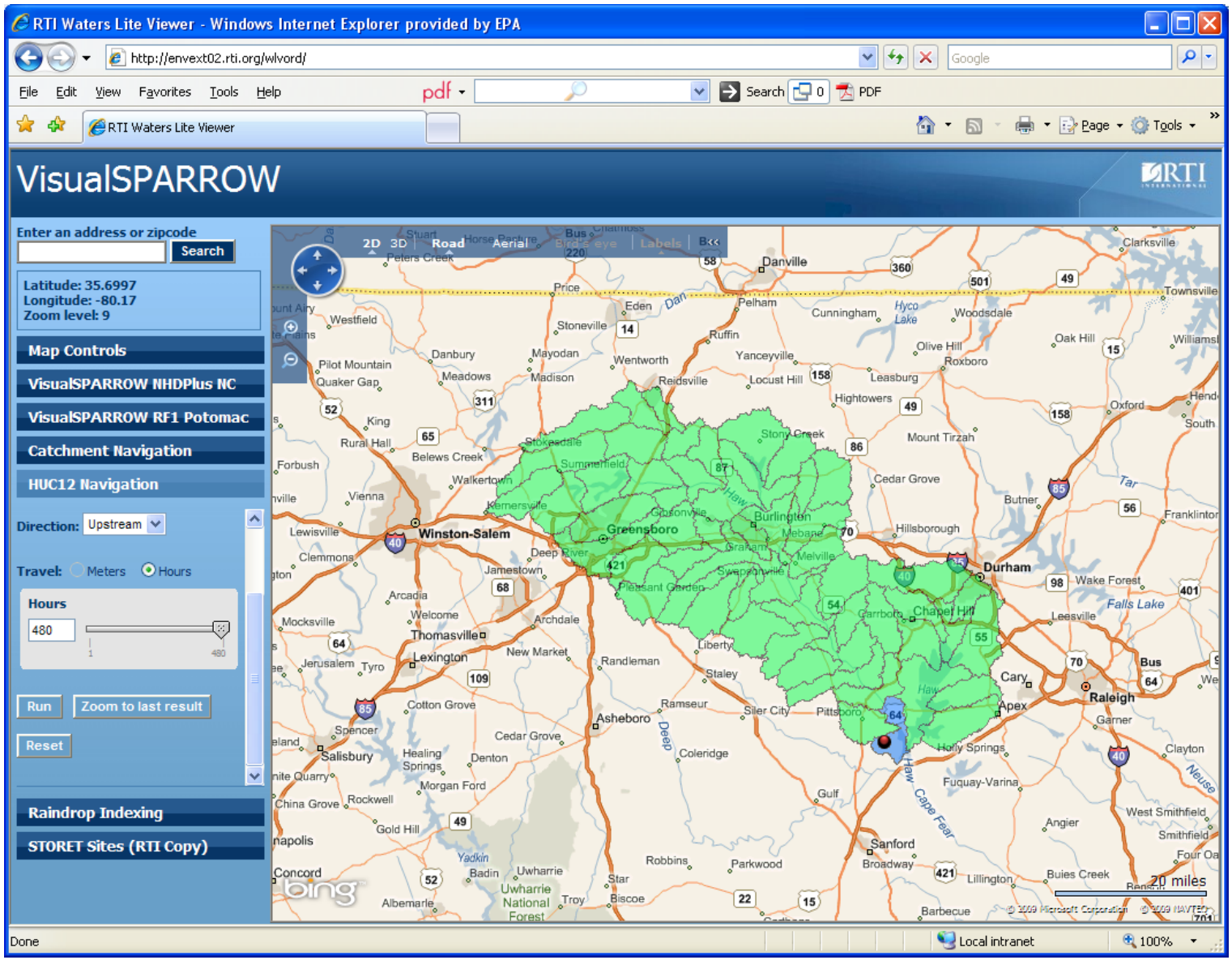
Atlas Implementation

- ❑State Boundaries
- ❑County boundaries
- ❑Congressional Districts
- ❑Ecoregions
- ❑Population
- ❑Land Cover
- ❑Impervious Cover
- ❑NHD Plus
- ❑Street maps
- ❑Satellite imagery
- ❑Protected Areas
- ❑Parks
- ❑Roads



- User will zoom to geographic area
- Contain series of clickable background maps
- Select ecosystem services from Table of Contents
- Scalable
- Ancillary data
- Allow analysis of multiple services
- Multiple metrics for each category
- Include change and future scenarios
- Allow user to place their “area” in context of others

Atlas Implementation



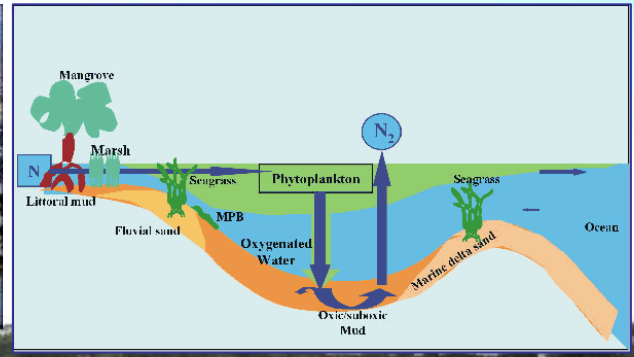
Summarizing services by HUCS

Maintain upstream/ downstream Connectivity

Maintain land to sea connectivity

Atmospheric and Climate Regulation

Flood Attenuation/ Coastal Protection



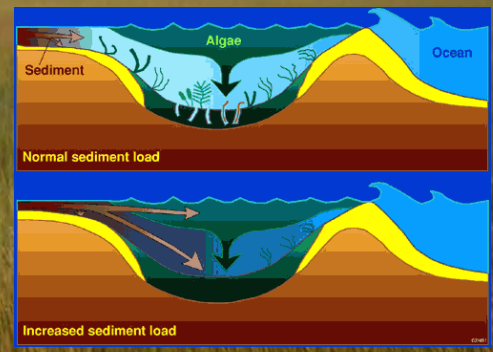
Biogeochemical Cycling

Recreation and Aesthetics

Wetland Biology, Geochemistry & Ecological Processes/Functions

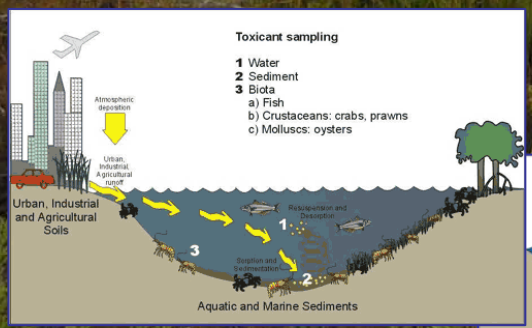
Coastal Wetland Ecosystem Services

Food and Fiber



Soil and Sediment Regulation

Water Quality and Supply



Waste Regulation

Habitat/Fisheries

Human Health

Overview of Coastal Wetland Ecosystem Services being Mapped/Modeled:

Supporting Ecosystem Services

Carbon cycling (above- and below-ground vegetation, soil carbon)
Societal need: regulation of global climate change through sequestration and release of fixed carbon. Carbon is contained in the standing crops of vegetation, litter, and in organic soil/sediments. Unregulated global climate change has been identified as a threat to coastal communities and habitats, interacting with development and pollution (IPCC, 2007).

Wildlife habitat (vegetation type/cover and structure)
Societal need: support of commercially and recreationally important fish, shellfish, crustaceans, waterfowl, and certain mammal populations. Because wetlands are among the most diverse ecosystem types they function as an immense reservoir for global biological diversity.

Overview of Coastal Wetland Ecosystem Services being Mapped/Modeled:

Regulating Ecosystem Services

Coastal Protection (wave, surge, and tidal energy dissipation potential)

Societal need: protection of humans and their property/structures from flooding from the sea, principally by way of the physical impediment that trees, root mats, and other wetland vegetation contribute to absorbing the energy from flood waters, distributing energy more slowly over the coastal plain, lowering flood heights, and affecting erosion/accretion in the surrounding landscape. Coastal wetlands also decrease the area of open water (fetch) for wind to form waves, which increases drag on water motion, thereby decreasing the amplitude of waves, storm surges, or seiches in large lakes.

Overview of Coastal Wetland Ecosystem Services being Mapped/Modeled:

Provisioning Ecosystem Services

Water quality (denitrification potential and sediment retention)
Societal need: wetland plants, microbes, and soils improve water quality for human consumption and recreational use (e.g., fishing, swimming, and boating) by removing excess nutrients, sediment, and toxic chemicals.

Fisheries (wetland biophysical characteristics, vegetation type/cover and structure)
Societal need: maintenance of the nation's fish and shellfish industries harvest of wetland-dependent species. Most commercial and game fish breed and raise their young in coastal marshes and estuaries. Menhaden, flounder, sea trout, spot, croaker, and striped bass are among the more familiar fish that depend on coastal wetlands. Shrimp, oysters, clams, and blue and Dungeness crabs likewise need these wetlands for food, shelter, and breeding grounds.

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Overview of Approach

Monitoring Components: Carbon, Nitrogen, Vegetation/Habitat

Applying denitrification rates from existing literature and field collection of rates; above/below-ground vegetational and soil carbon; and vegetation type/structure measurements at selected focal locations nationwide to extrapolate to coastal wetland ecosystems of the US

Modeling Drivers of Ecosystem Services Change: Integrating Sea Level Rise and Urbanization

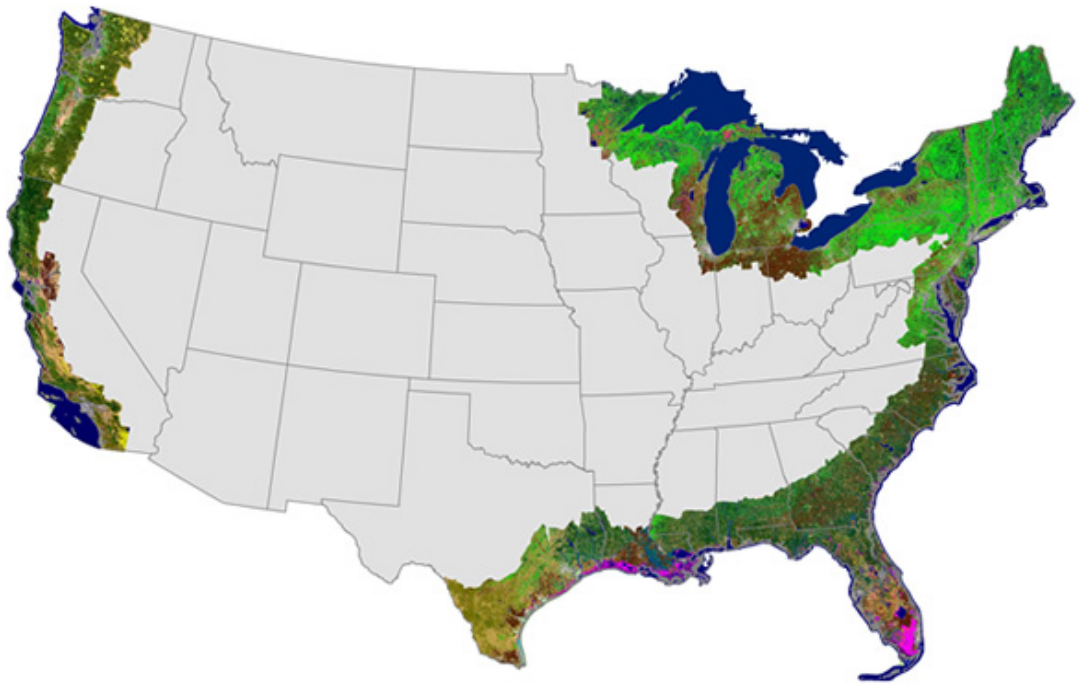
- New and existing SLAMM models for applicable regions of the coastal US – with focal landscape-scale studies at selected locations nationwide
- ICLUS, FORE-SCE and other urban change models

Mapping Components

NOAA Coastal Change Analysis Program data and modified remote-sensing approaches to map temporal/spatial change of coastal wetlands from 1970s-present, and the future to approximately 2100

Overview of data types, extent, and resolution:

- Broad scale mapping of CZMA “Coastal Zone” for US (approx. 30m x 30m resolution):
  - existing GIS datasets (e.g., C-CAP, NLCD, GAP)
  - multispectral satellite data (e.g., Landsat)
- Fine scale mapping/modeling of selected coastal wetland sites (approx. 4-10m resolution)
  - Existing GIS datasets (e.g., NWI)
  - multispectral, LIDAR, SAR, and other airborne/satellite data



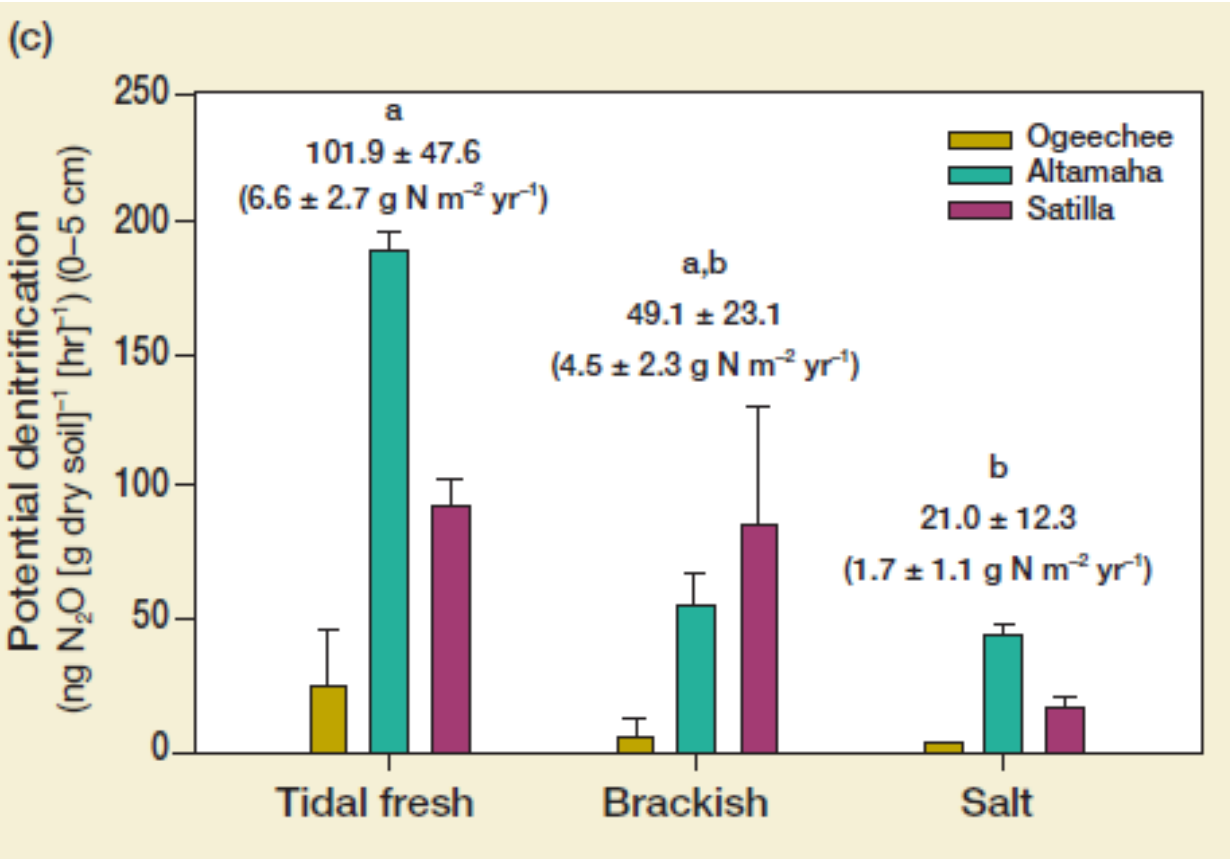
Extrapolation of Potential Denitrification Rates *after Craft et al.* 2009

- Goal: Predict how tidal marsh areas and delivery of water quality ecosystem services of denitrification may respond to different future scenarios of sea-level rise (SLR), after Craft et al., 2009.

- SLR may dramatically affect nitrogen (and other) related coastal marsh ecosystem services, particularly at upper and lower ends of salinity ranges, depending on geomorphology and potential for wetland accretion/migration

Extrapolation of Potential Denitrification Rates
Craft et al. 2009

- Recent example of extrapolation results

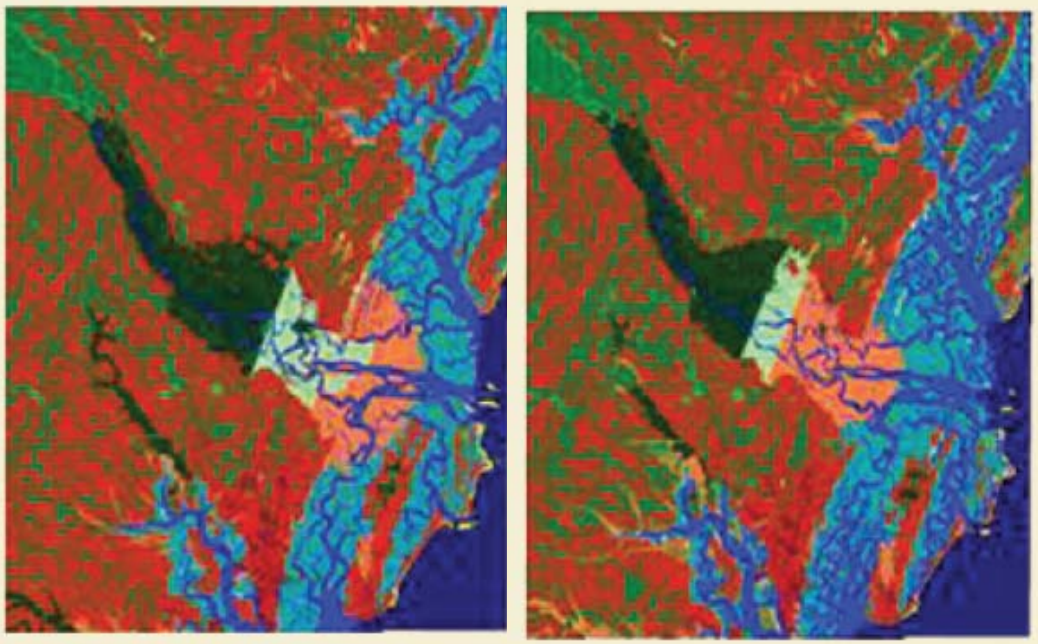


Extrapolation of Potential Denitrification Rates
Craft et al. 2009

- Results: SLAMM

Habitat Change (km^2)

Marsh Type	52cm	82cm
Tidal Fresh (light green)	+1	-32
Brackish (pink)	+41	-4
Salt (turquoise)	-226	-496

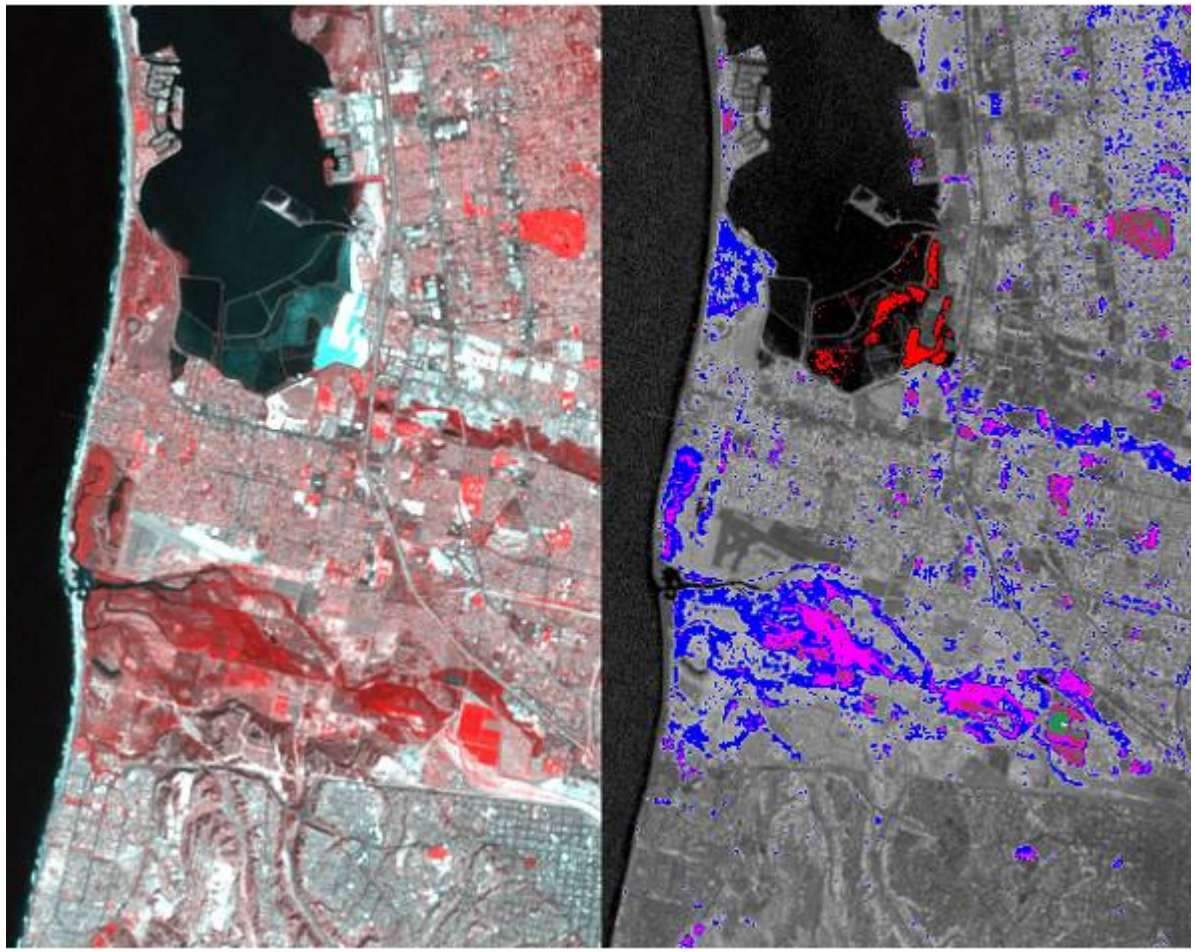


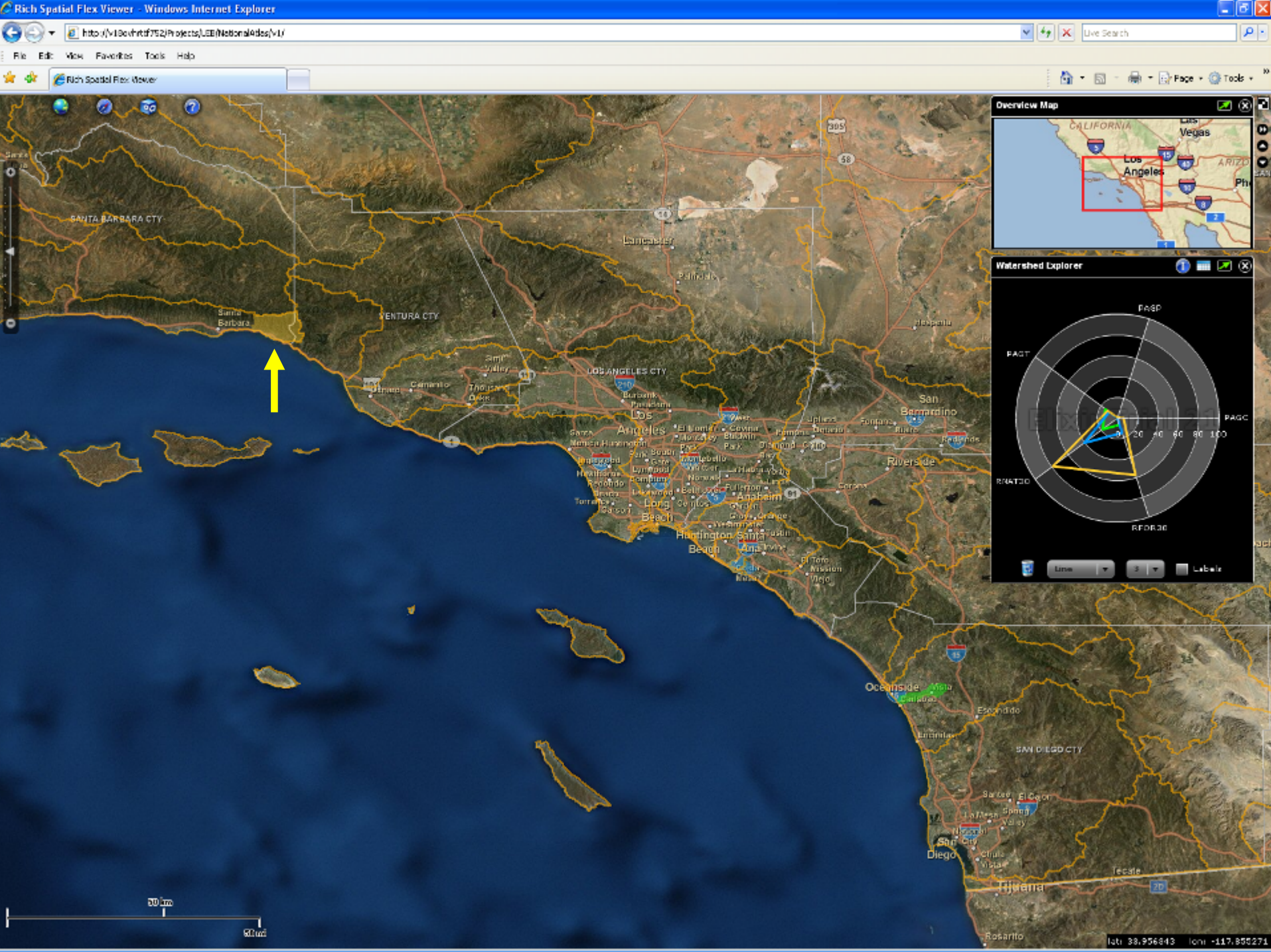
Extrapolation of Potential Denitrification Rates
Craft et al. 2009

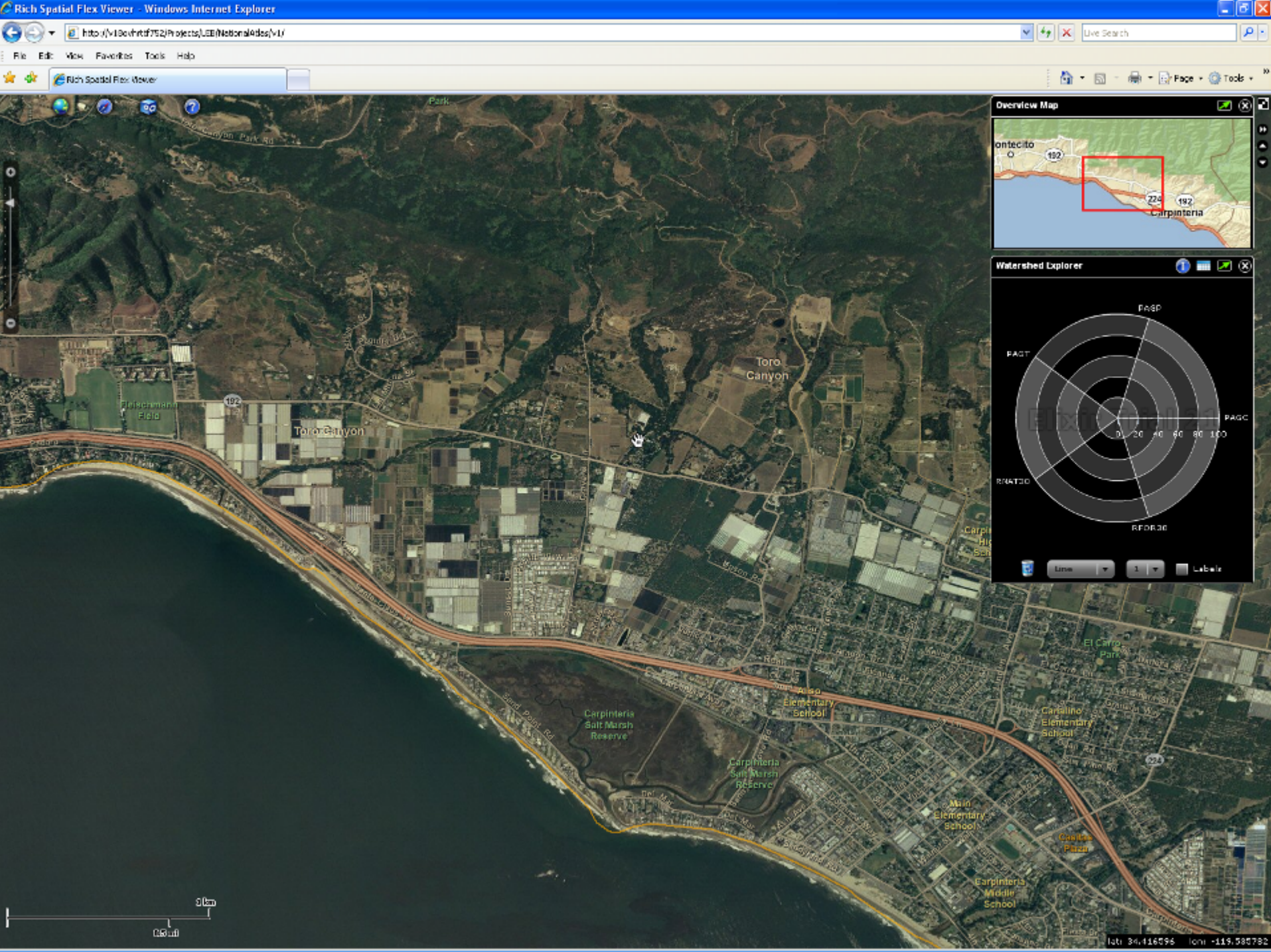
- Results: Changes in Potential Denitrification
  - Multiplication of change in acreage and aerial estimates of potential denitrification

	Potential denitrification ($t\ yr^{-1}$)	
	52 cm	*82 cm*
Tidal fresh marsh	+7	–211
Brackish marsh	+184	–18
Salt marsh	–384	–843
Cumulative (km^2)	–193	–1072
Cumulative (%)	–4%	–25%

Using Wetland Vegetation Maps for Modeling Carbon Cycling and Habitat for Commercially and Recreationally Important Species




Rich Spatial Flex Viewer - Windows Internet Explorer
Rich Spatial Flex Viewer
Overview Map
Watershed Explorer
PASP
PAGT
PAGC
RNAT30
REDR30
SANTA BARBARA CTY
VENTURA CTY
LOS ANGELES CTY
SAN DIEGO CTY
Lancaster
Santa Barbara
Los Angeles
San Bernardino
Riverside
Anaheim
Long Beach
Huntington Beach
Oceanside
Escondido
San Diego
Tijuana
Las Vegas
CALIFORNIA
ARIZONA
Labels


Rich Spatial Flex Viewer - Windows Internet Explorer
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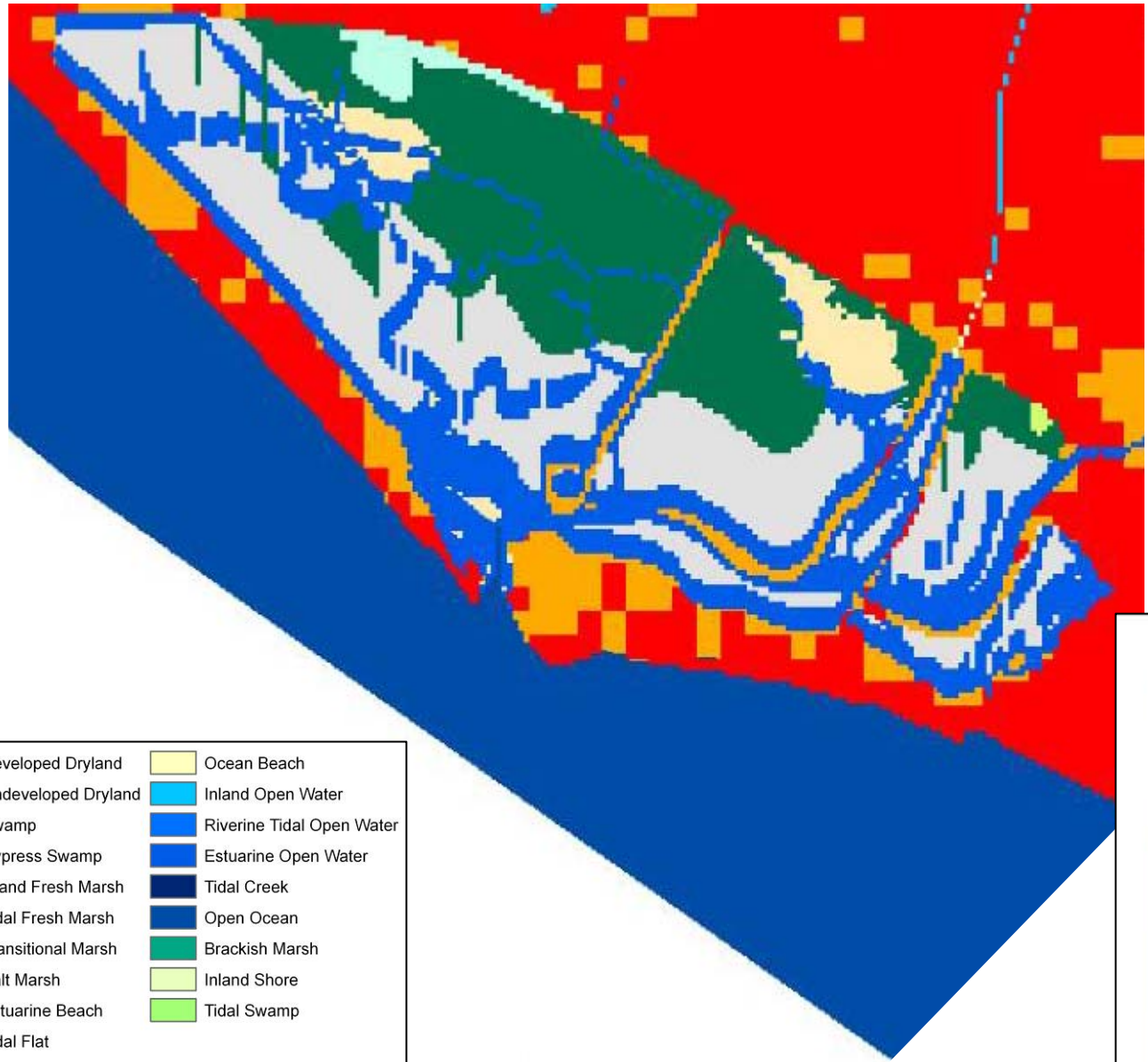
RFOR30
Toro Canyon
Carpinteria Salt Marsh Reserve
Main Elementary School
Carpinteria Middle School
Carpinteria

Drivers of Change in Coastal Wetland Ecosystem Services: Sea Level Rise 2006-2100



Carpinteria Marsh, CA

2100, A1B (IPCC) Mean

Carpinteria Marsh 2001


Questions
Thank you!
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1 km
1 mi
lat: 41.441952
lon: -98.658987