USGS
science for a changing world

Introduction to the DOI Southeast Climate Science Center

Jerry McMahon
First Friday All Climate Change Talks (FFACCTs)
USFS Eastern Forest Environmental Threa
Assessment Office
December 2, 2011

U.S. Department of the Interior
U.S. Geological Survey

Today's talk

- Overview of DOI SE Climate Science Center functions and mission
- Key science activities
- Issues to consider and discuss moving forward

USGS

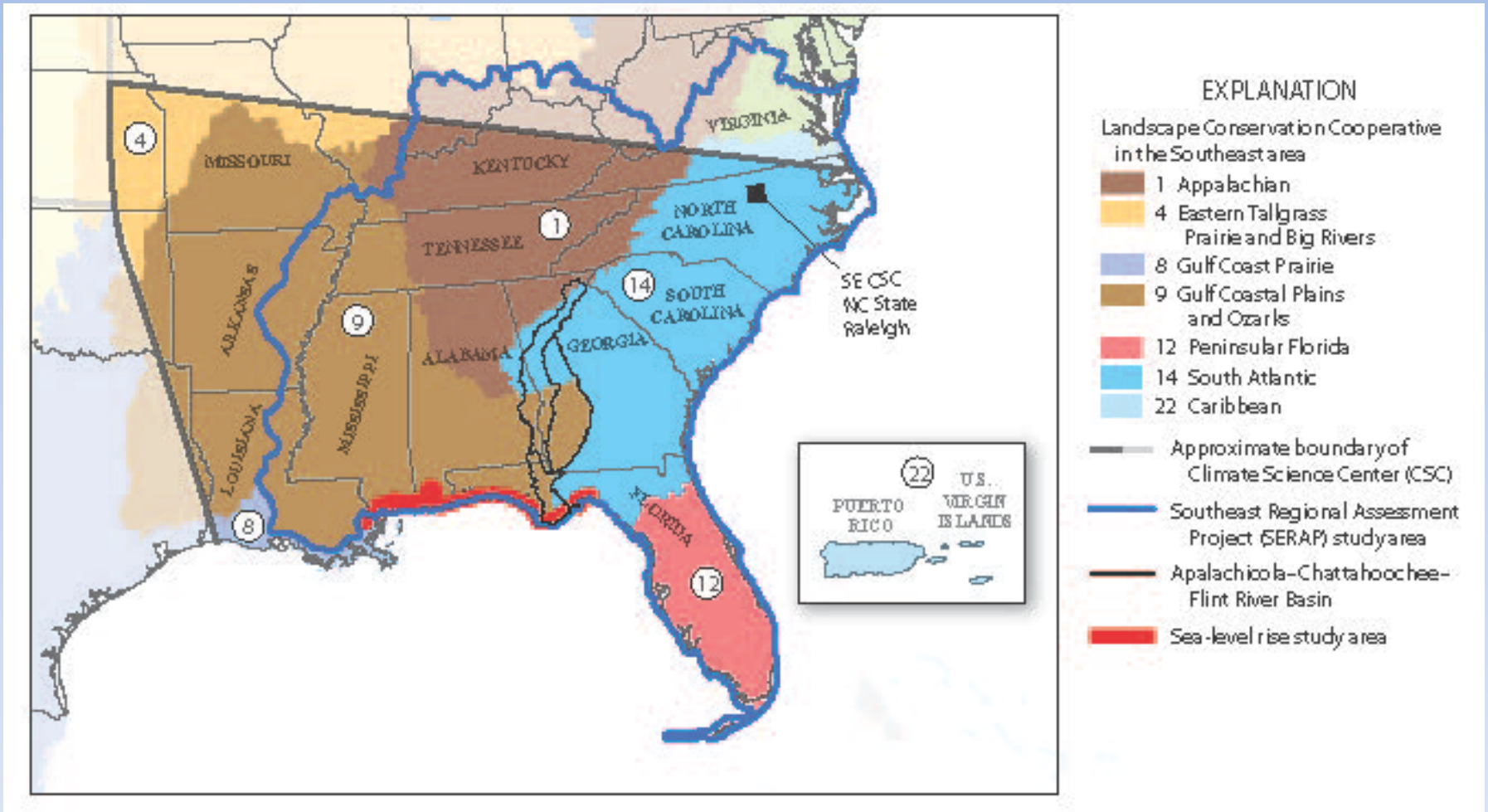
Importance of Landscape Scale Conservation and Adaptive Approach

- We're facing challenges that are immense in scale and cross political boundaries.

- Cross agency coordination is critical to assuring the most – efficient use of limited resources to address issues that cross agency missions.

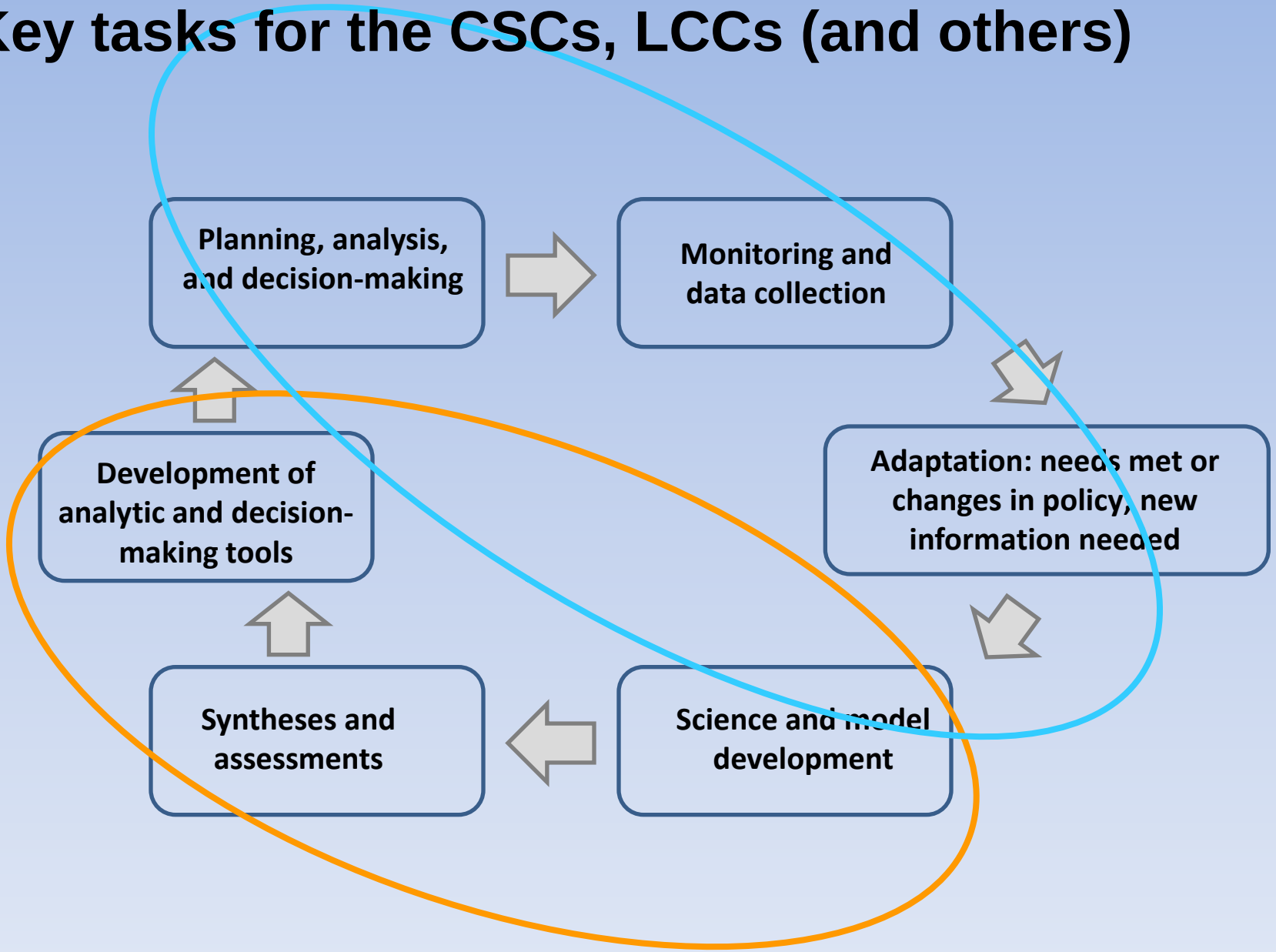
- Learning by doing or adaptive approaches provides the best chance to addressing large issues effectively.

DOI Southeast Climate Science Center



USGS

Key tasks for the CSCs, LCCs (and others)




Global change processes: Climate and Land Use change
Physical response to global change processes
Ecological response To global change processes
Adaptive management strategies
Vulnerability assessment
Connecting climate change and resource management
USGS

Southeast CSC: Status

- NCSU selected as host Sep 2010
- Sonya Jones, acting SECSC Director 2010-2011
- Jerry McMahon, SECSC Director July 2011
- Draft Science Plan June 2011
- Co-op Agreement funds 12 graduate students, partial support for 2 Post-docs, and infrastructure. No direct support for faculty research.
- Supports new NCSU Master Degree (Climate Change & Society)
- Website: theglobalchangeforum.org

USGS

Southeast CSC: Research priorities

- Characterizing key global change processes associated with coupled human-environmental systems that affect terrestrial and aquatic resources in the SE
- Characterizing biophysical outcomes associated with these processes
- Linking biophysical outcomes with response of key focal taxa
- Supporting vulnerability assessment and adaptive management activities on behalf of societal goals/values
- Key operating principles
  - Uncertainty Analysis – quantify and explain uncertainty associated with models and additive models
  - Serving data–web-based access to climate projections, biophysical data (hydrology, vegetation succession, occupancy model results, etc.)
  - Collaboration/transparency in planning and implementation of science

USGS

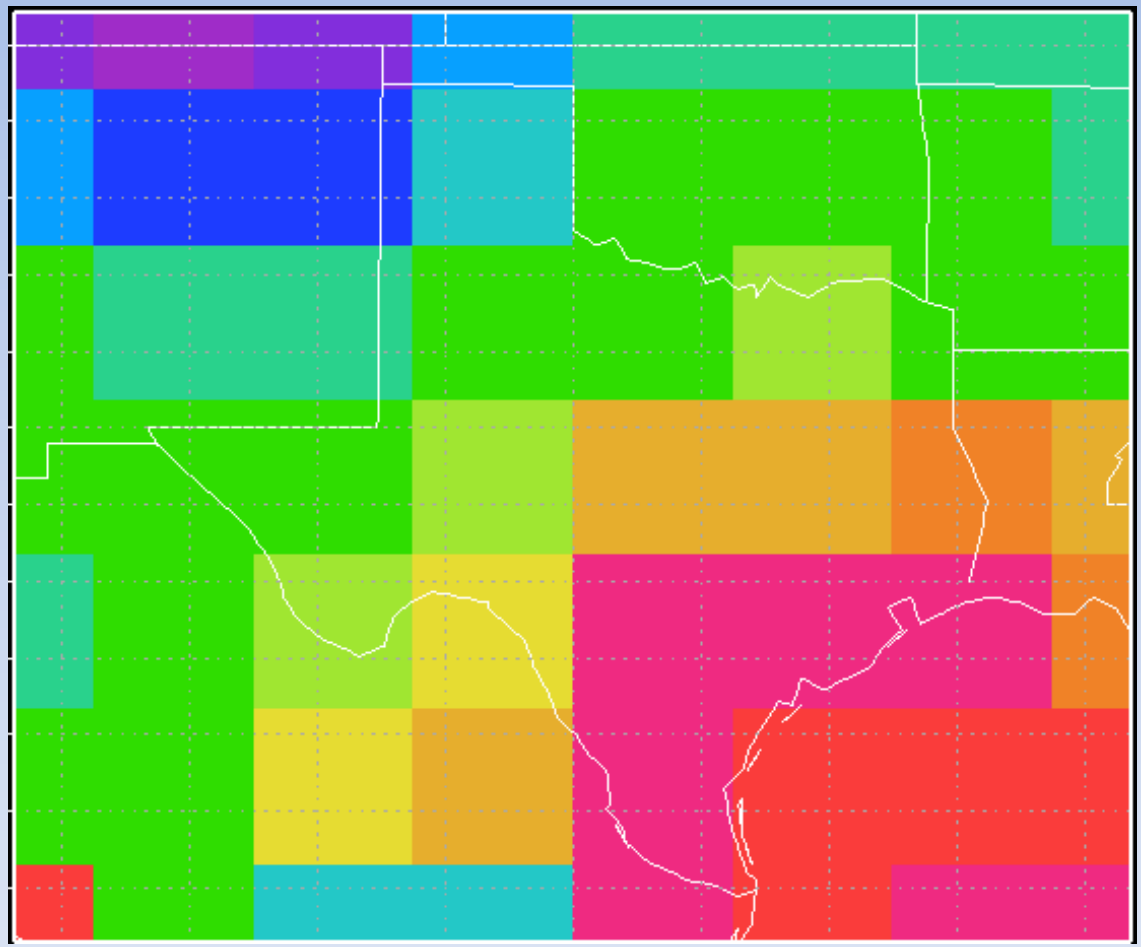
1. Global change processes: Climate and land use change

- SE CSC focuses on two important global change processes that shape coupled human-environmental systems in the SE
  - Downscaled climate information
  - Urban development projections

USGS

Downscaled Regional Probabilistic Climate Change Projections

Downscaling and translation models can transform large-scale projections…



Average summer temperature
GFDL CM2.1 (2.8º resolution)

USGS

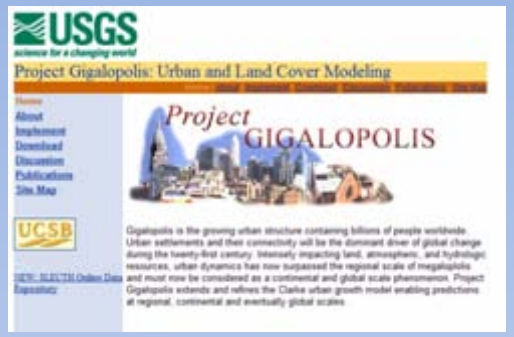
Downscaled Regional Probabilistic Climate Change Projections

Downscaling and translation models can transform large-scale projections…

into impact-relevant scales and variables

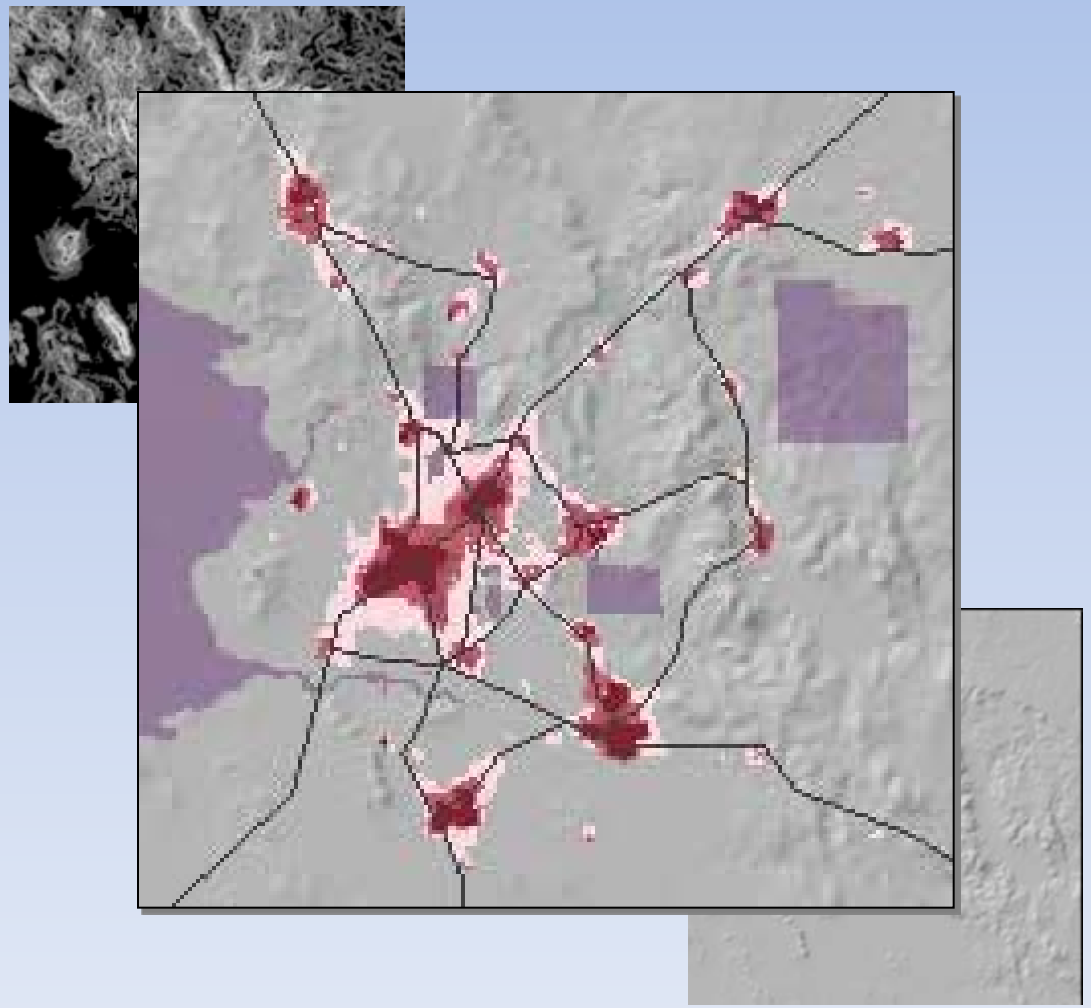
Days per year > 100°F downscaled (0.125° resolution)

USGS



Urban Growth Model Gigalopolis
SLEUTH-R (Jantz et al 2009)

- Slope,
- Land Cover,
- Exclusion,
- Urbanization,
- Transportation, and
- Hillshade



Urban Growth Modeling To Date

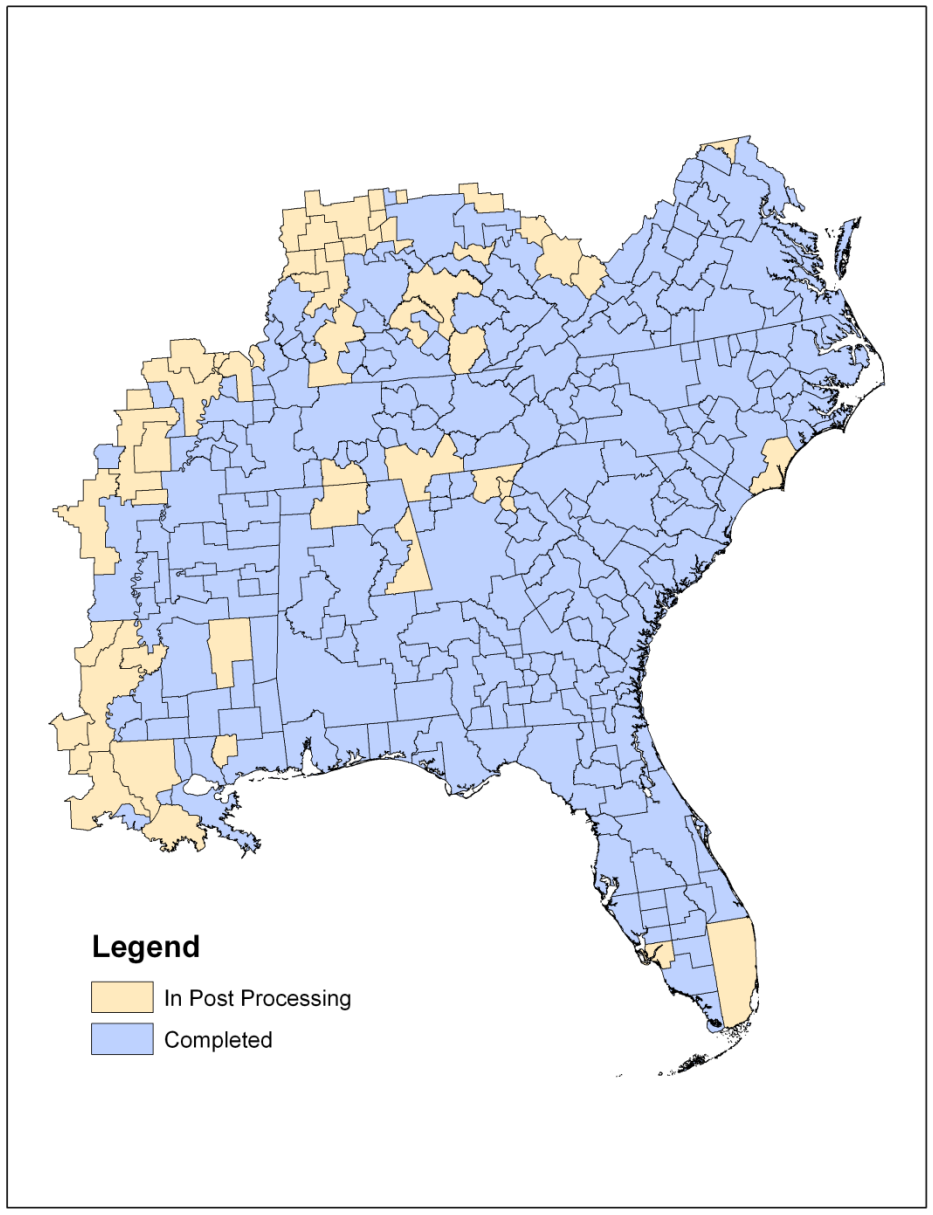
Projections

- **Southeast-wide**
  December 2011

- **Next Steps**
  Projections
  - **Appalachian LCC**
  - **Gulf Coastal Plain & Ozarks LCC**

Land-use use scenarios.

Sensitivity analysis.



USGS

2. Physical responses to global change processes

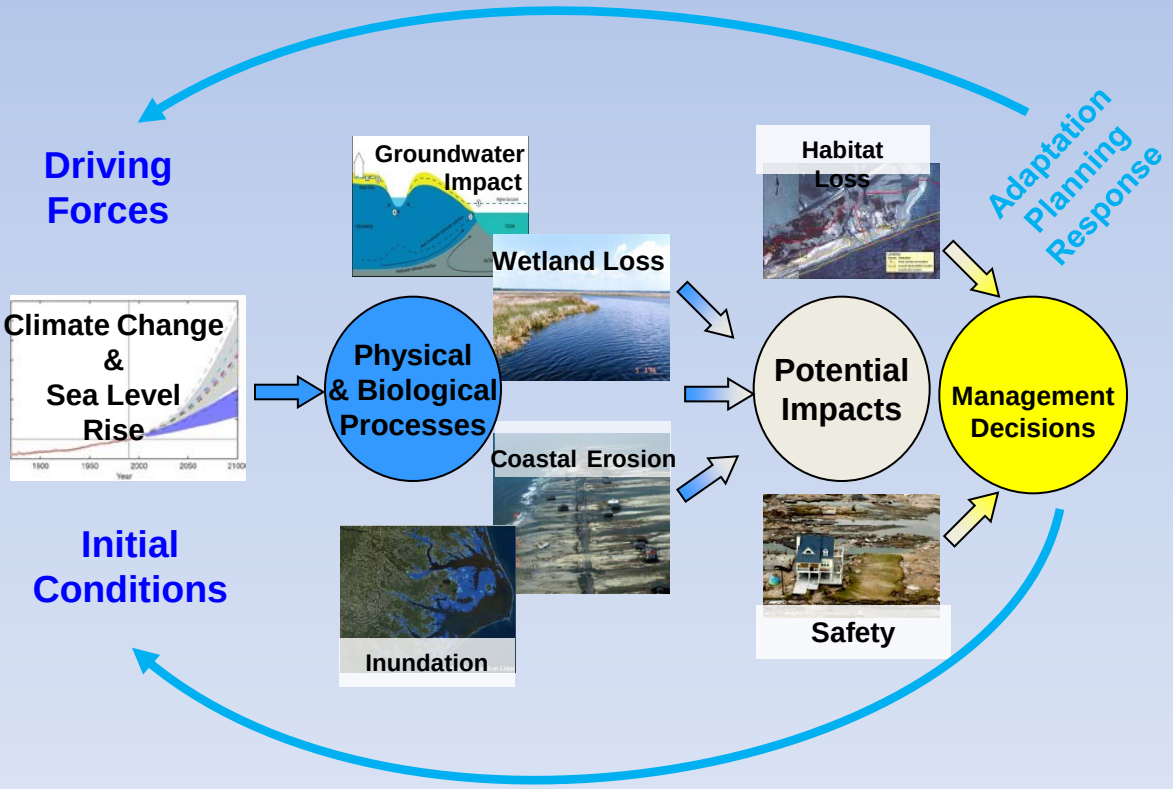
- Coastal outcome: sea-level rise and habitat loss
- Terrestrial outcome: Vegetation dynamics
- Terrestrial outcome: Habitat availability for priority species
- Aquatic outcome: stream flow and temperature

USGS

Coastal outcome: sea-level rise and habitat loss

Coastal processes such as sea level rise, subsidence, and erosion will be modeled to support coastal resource management

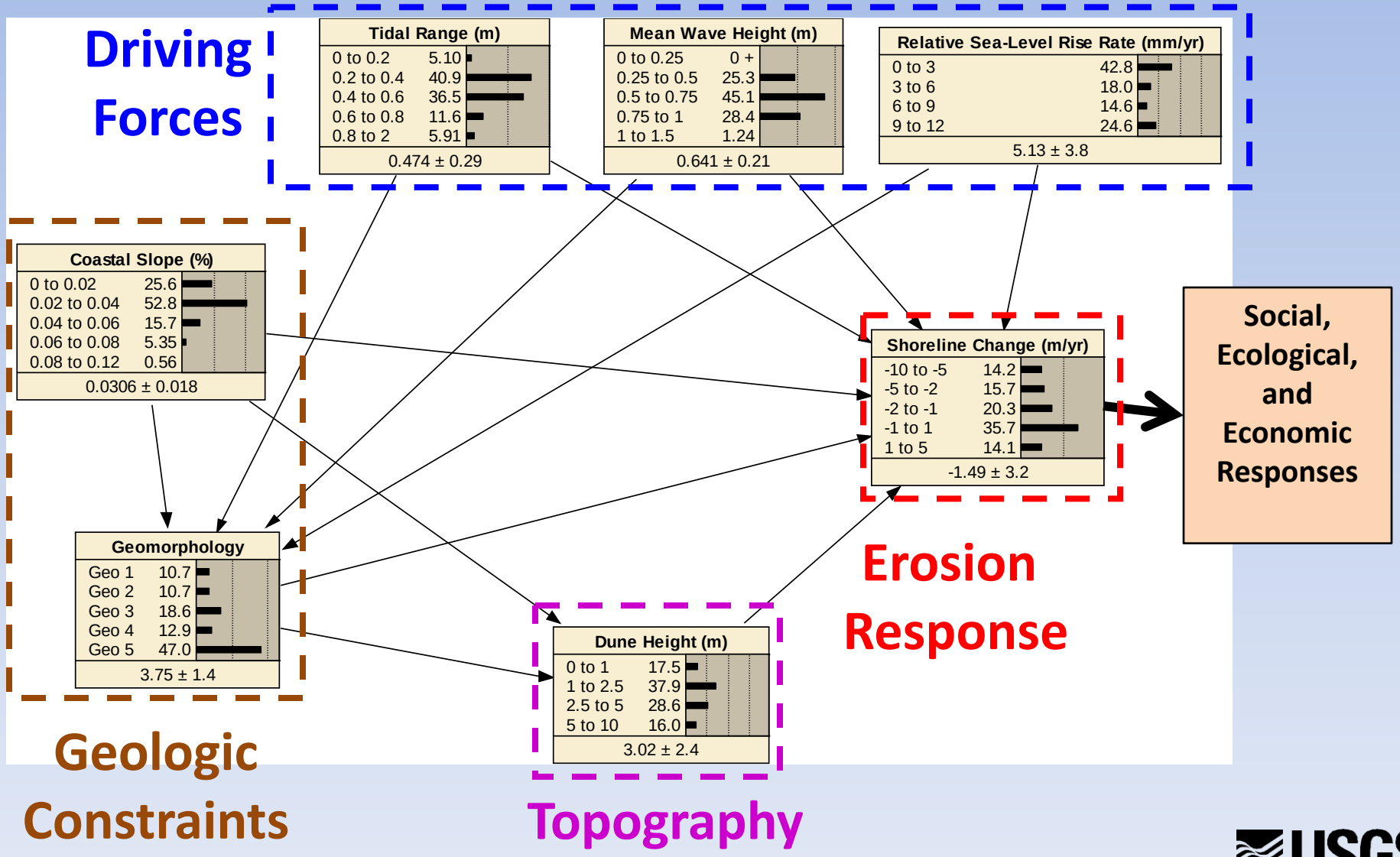
- **Develop Bayesian statistical framework for predicting coastal erosion and inundation**
- **Assess affects of sea level rise on coastal ecosystems and wildlife**
- **Direct observations**
- **Develop visualization tools for resource managers**



USGS

Coastal outcome: sea-level rise and habitat loss

Bayesian Sea Level Rise Model

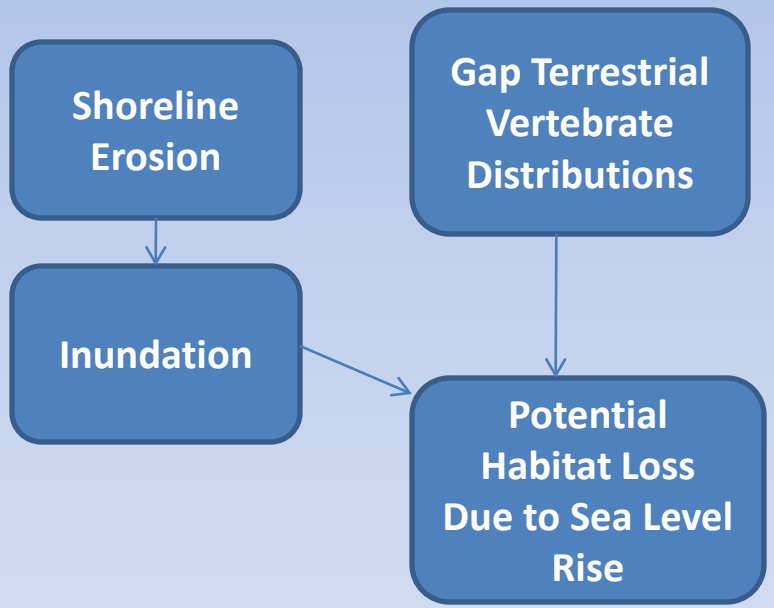


Coastal outcome: sea-level rise and habitat loss

Modeling Habitat Loss

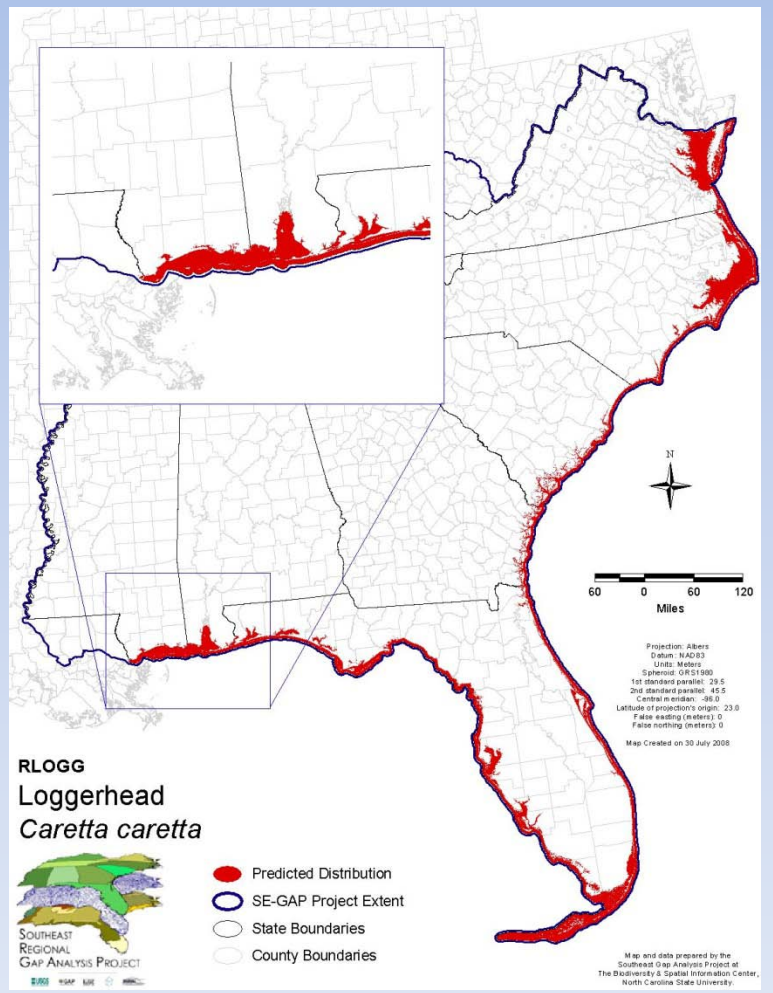
Developed 606 terrestrial vertebrate species models for the Southeastern U.S.

Relationships



Products

Maps and summaries potential habitat loss by species under a variety of SLR projections.



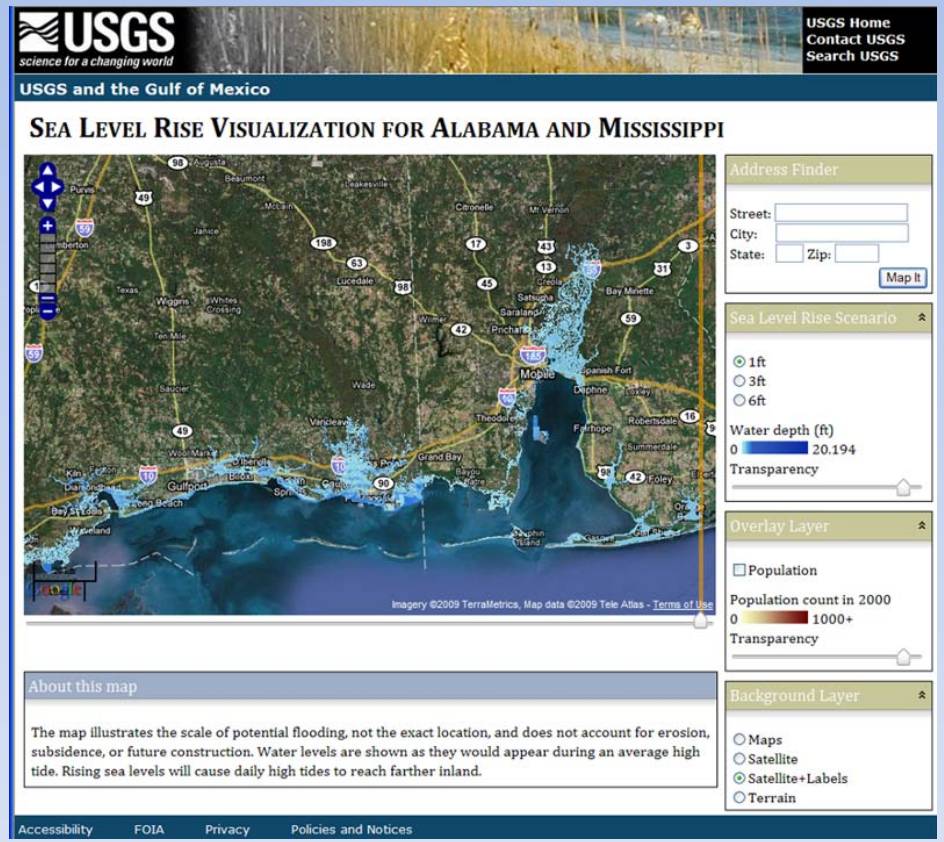
USGS

Coastal outcome: sea-level rise and habitat loss

Sea Level Rise Viewer

- **Developing Google™ Thematic Mapper based map view that depicts inundation as sea level rises**
- **User friendly environment for resource managers and public to visualize impacts of sea-level rise**
  - **Interactive map displays elevations of 1, 3, and 6 feet above Mean Higher High Water datum**

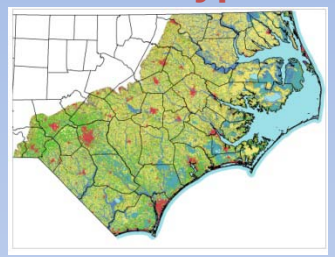
- **http://gom.usgs.gov/slr/index.html**



USGS

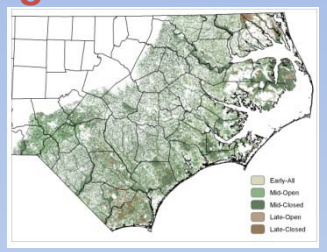
Terrestrial outcome: Vegetation Dynamics

Habitat types



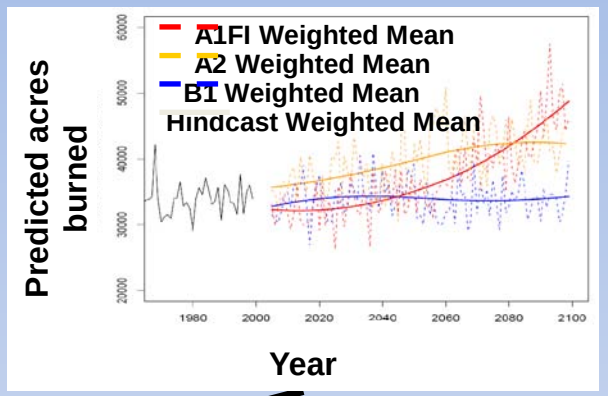
GAP 2001 land cover

Stage and structure

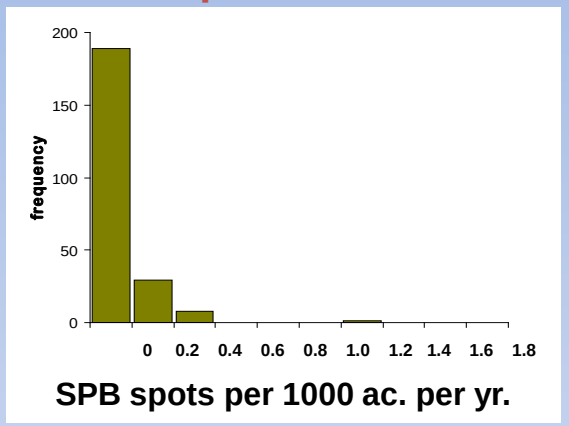


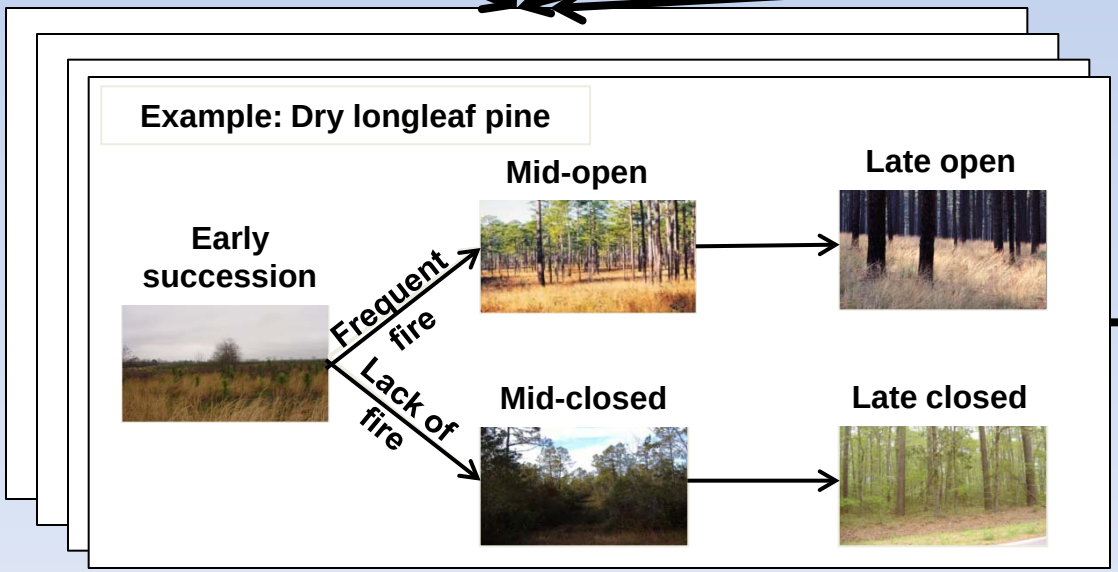
USFS FIA data

Climate effect on fire



Southern pine beetle effects



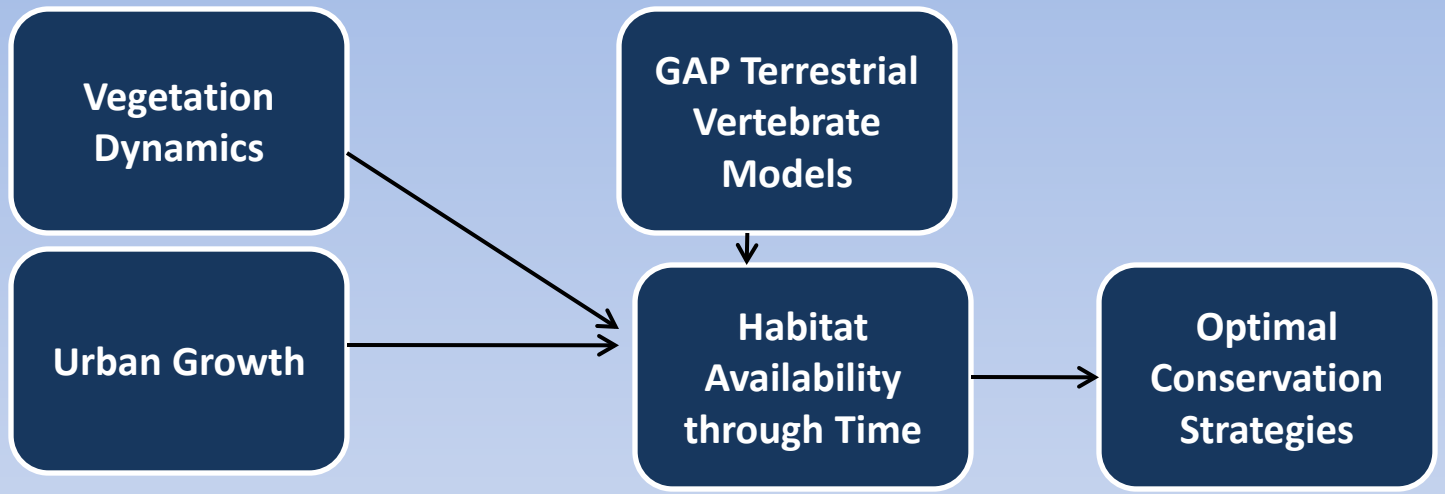


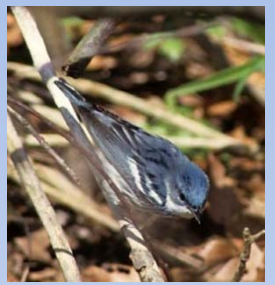
Future landscape conditions
Input for habitat distribution models: priority species

Habitat-specific succession and disturbance models

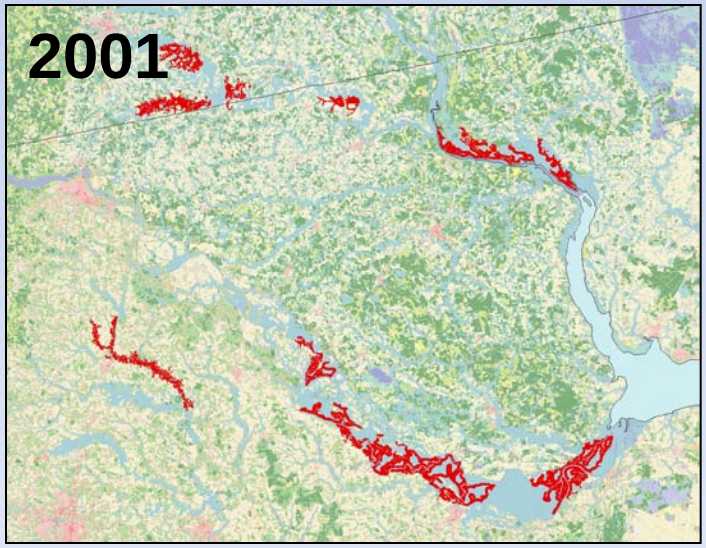
USGS

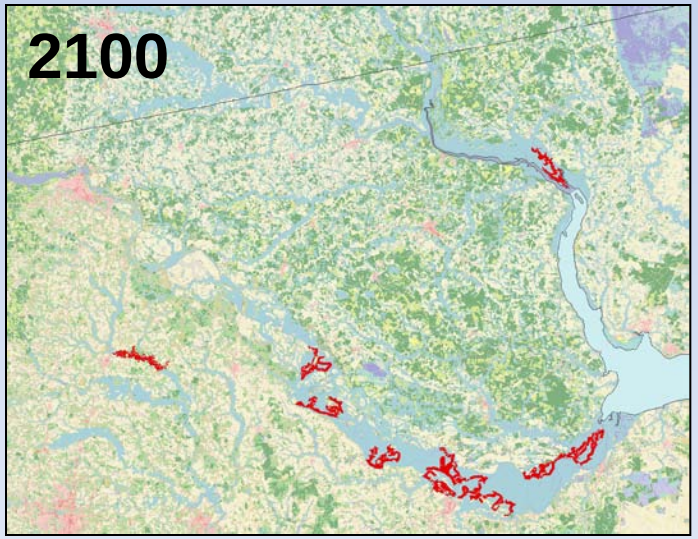
Terrestrial outcome: Habitat availability for priority species





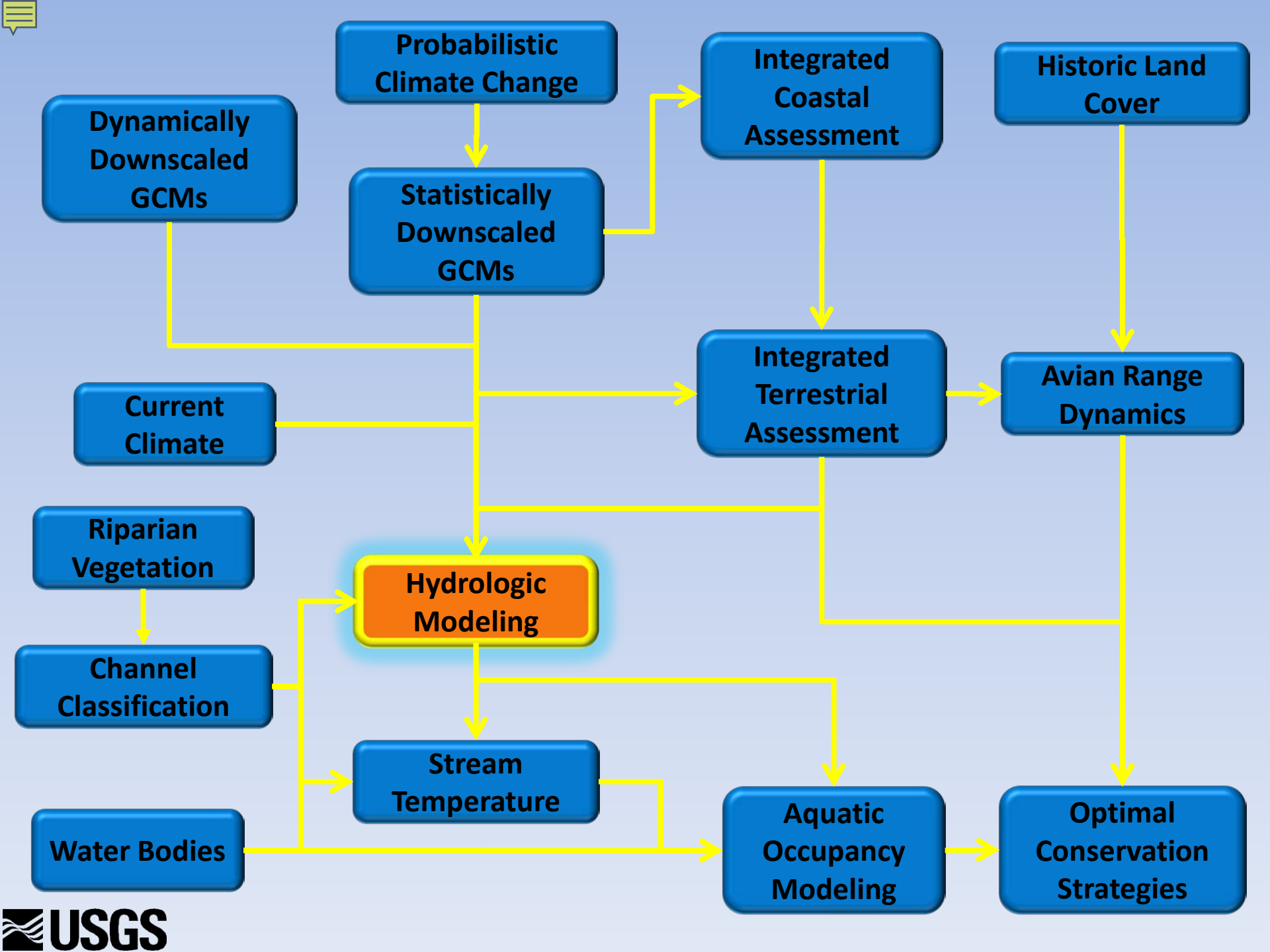
Cerulean Warbler
Dendroica cerulea





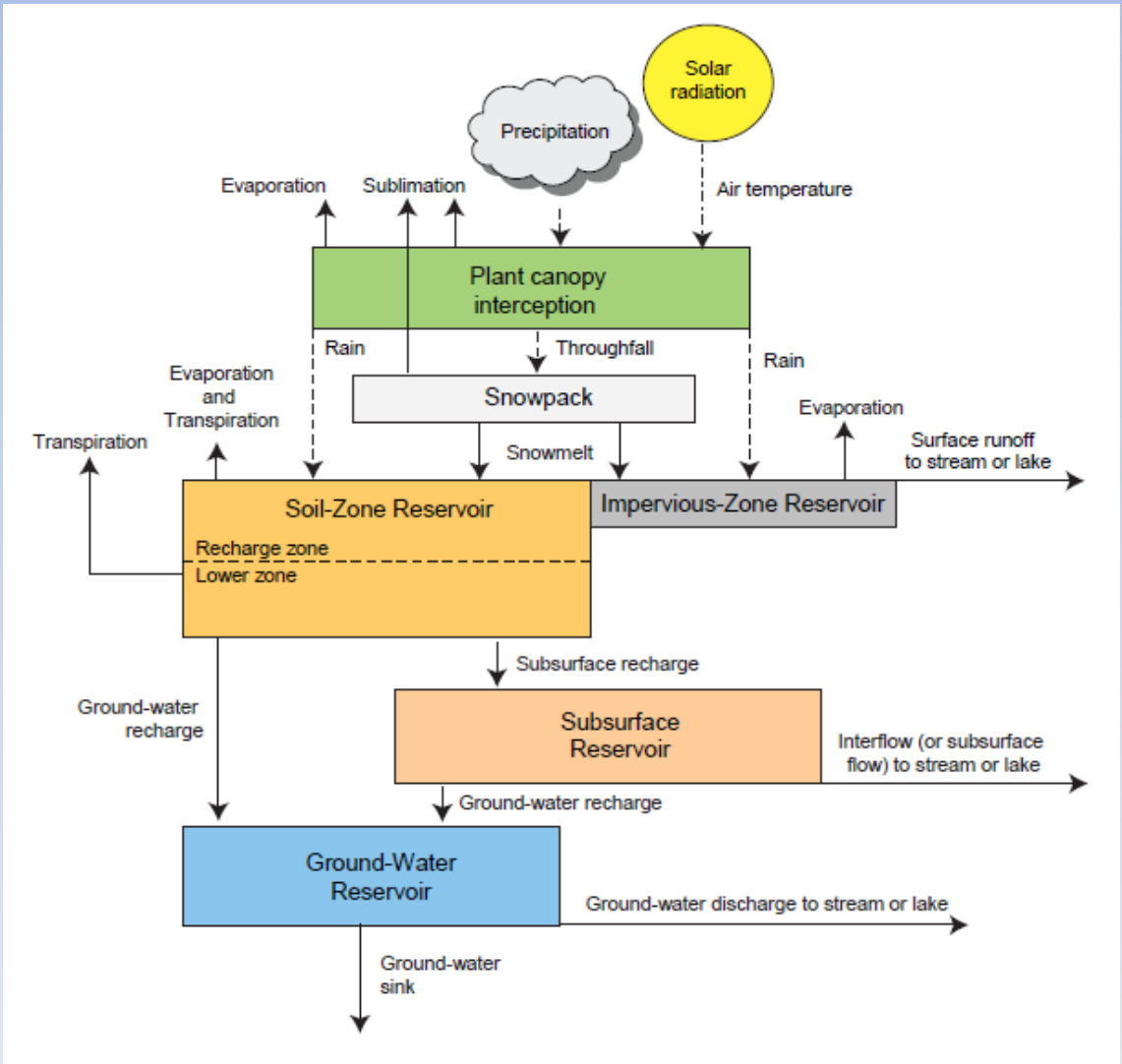
USGS

Suitable habitat


Probabilistic Climate Change
Integrated Coastal Assessment
Historic Land Cover
Dynamically Downscaled GCMs
Statistically Downscaled GCMs
Integrated Terrestrial Assessment
Avian Range Dynamics
Current Climate
Riparian Vegetation
Hydrologic Modeling
Channel Classification
Stream Temperature
Water Bodies
Aquatic Occupancy Modeling
Optimal Conservation Strategies
USGS

Aquatic outcome: stream flow and temperature
Precipitation Runoff Modeling System

- **Deterministic**
- **Distributed parameters**
- **Physical process based**



USGS

Aquatic outcome: stream flow and temperature

- PRMS is being used to develop coarse- and fine-scale watershed models
- Fine-scale models will include stream temperature modeling
- Both coarse and fine scale models will incorporate probabilistic downscaled climate change projections

USGS

3. Ecological response to global change processes

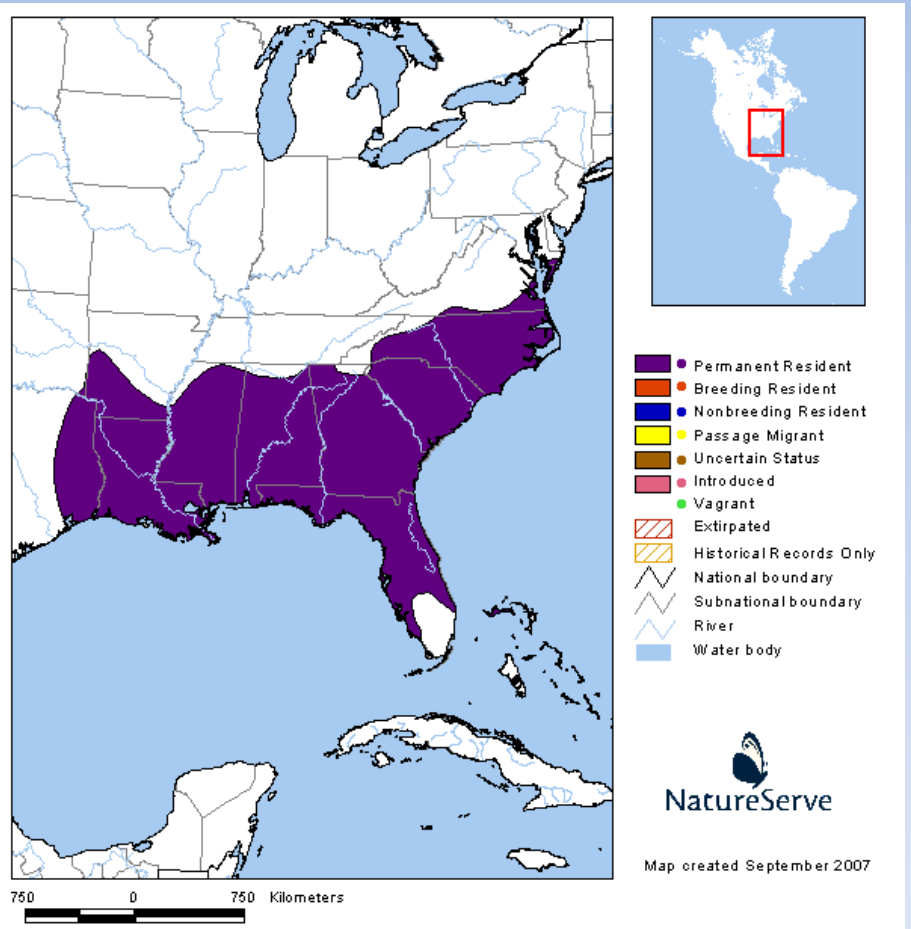
- Terrestrial taxa: birds
- Aquatic taxa: fish and mussels

USGS

Ecological response

Modeling North American land bird range dynamics

- Avian populations will respond to changes in temperatures and precipitation, and ensuing changes in habitat.
- Expectation – shifts in range (e.g., north-south), or contraction (refugia).
- Shifts (or lack thereof) will be typified by varying rates of extinction and colonization.
- Opportunity to assess resistance and resilience to climate indicators and habitat change

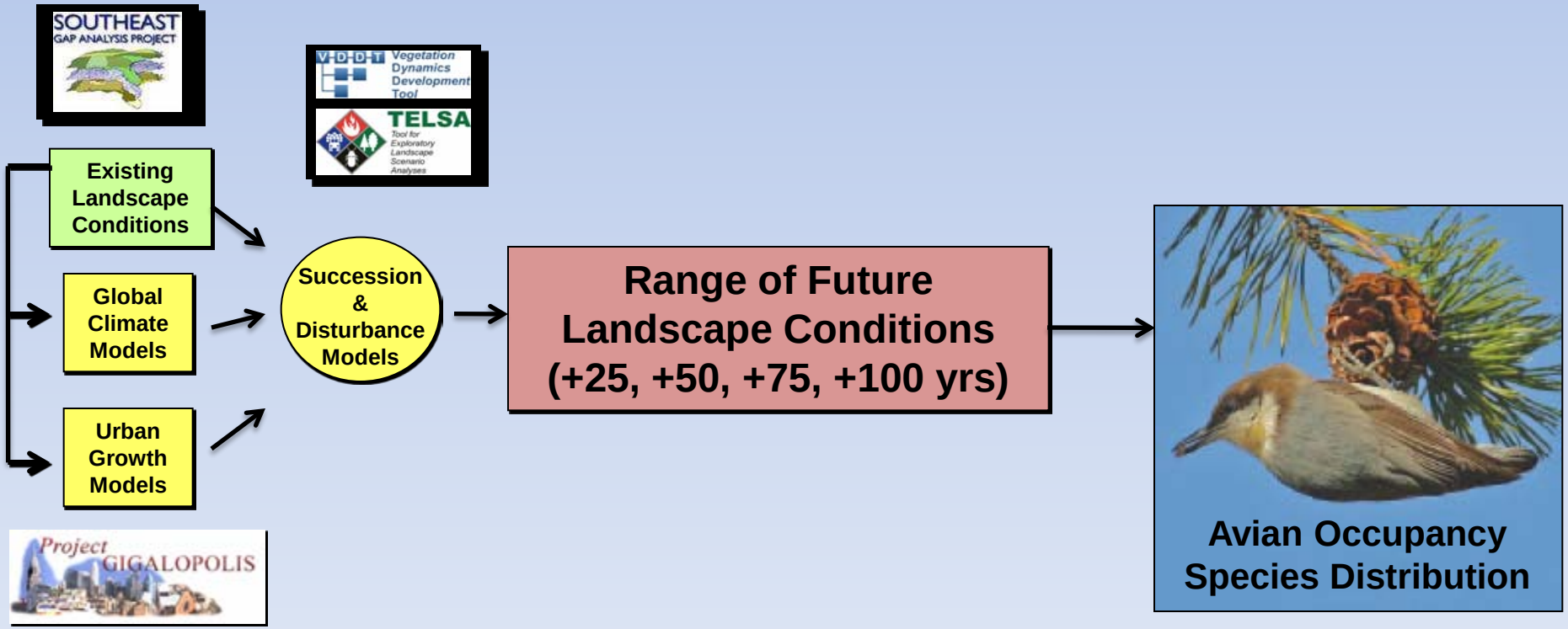


USGS

Ecological response

Linking landscape, climate, and urbanization models

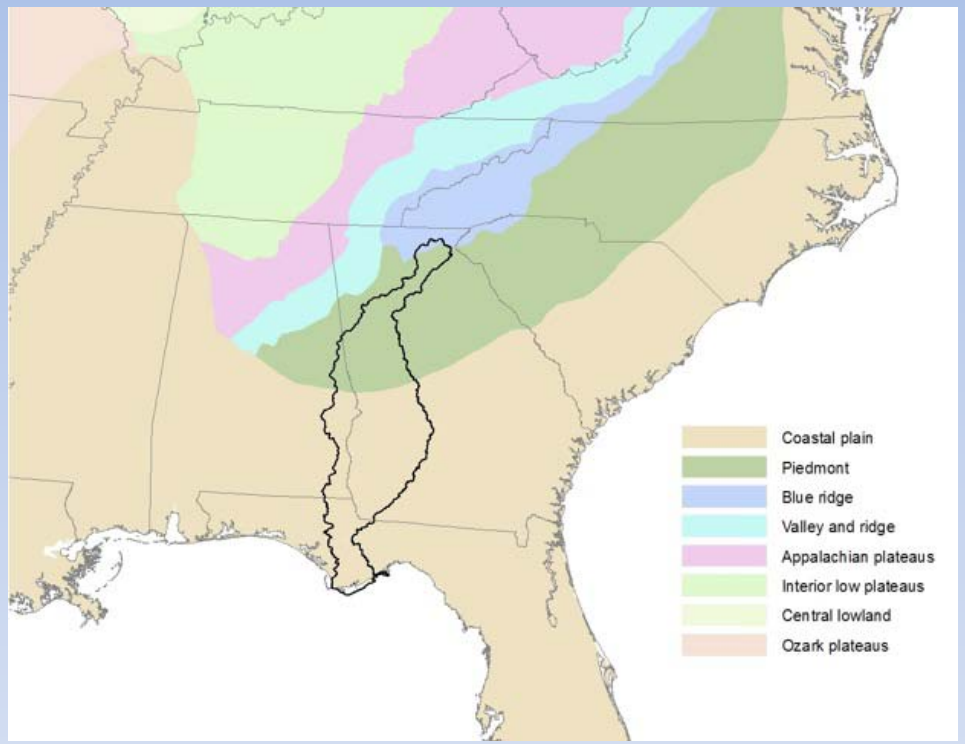
A decision making process that accounts for the uncertainty associated with predicting environmental dynamics and population responses, and the uncertainty associated with conservation policies and whether they will be effective.



USGS

Ecological response

Prototype fish/mussel models in The Apalachicola-Chattahoochee-Flint basin (ACF)



- **51,000 sq km**
- **Blue Ridge, Piedmont, Coastal Plain**

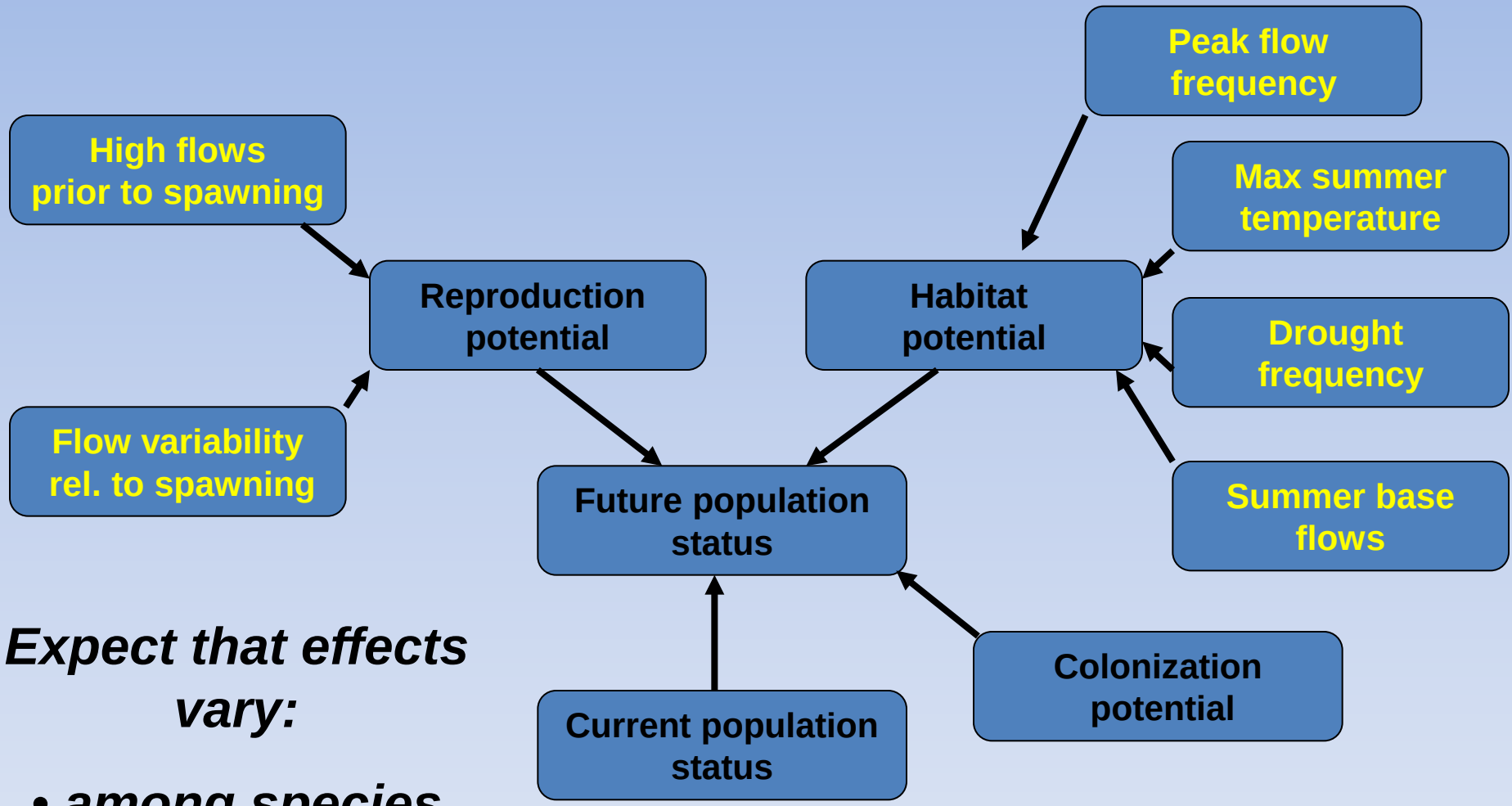
- **ca. 110 fish species (10 endemic species)**

- **ca. 27 extant freshwater mussel species (6 federally listed)**

USGS

Ecological response

Major climate drivers on reproduction, persistence



Expect that effects vary:

- ***among species***
- ***among HRU's***

USGS

4. Supporting vulnerability assessment and adaptive management activities on behalf of societal goals/values

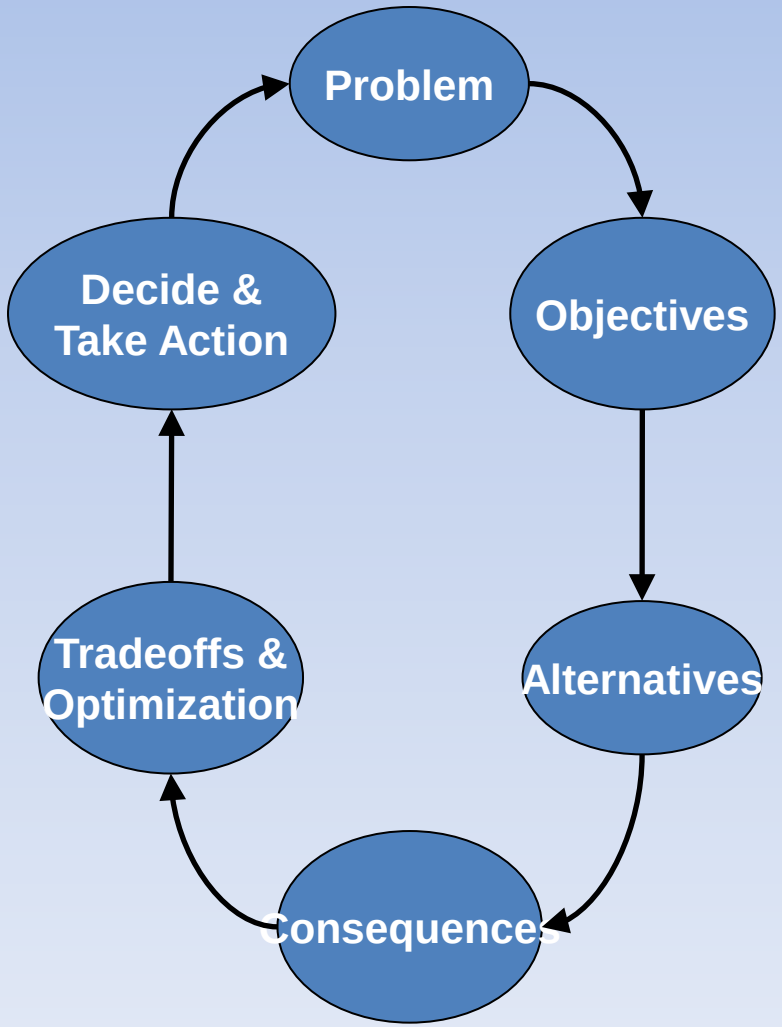
- Determine **Optimal Conservation Strategies:**
  - Implementation of Strategic Habitat Conservation using Adaptive Management
  - Incorporation of potential effects of climate change on fish and wildlife population
  - Develop ecoregion-scale strategies.

USGS

Supporting vulnerability assessment and adaptive management activities on behalf of societal goals/values

SERAP objectives

1. **Identify focal species for planning conservation actions.**
2. **Assess the state of populations of focal species based on the best available information.**
3. **Determine population objectives and habitat objectives for focal species.**
4. **Identify and quantify the effects of management and policy alternatives on the conservation of focal species.**

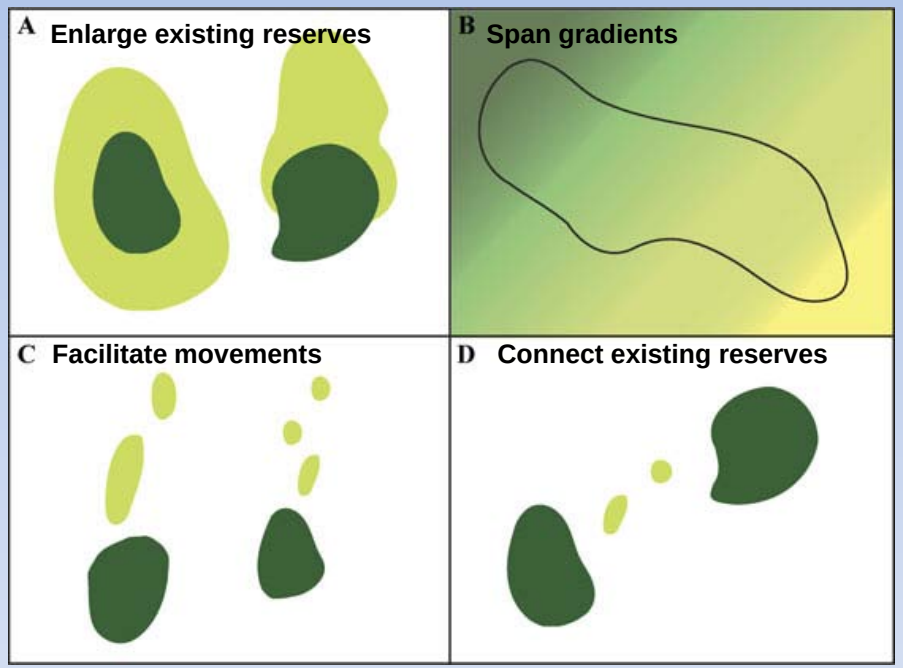


USGS

Supporting vulnerability assessment and adaptive management activities on behalf of societal goals/values

SERAP objectives

5. **Develop habitat relationship models for focal species.**
6. **Determine optimal conservation strategies based on alternatives identified by stakeholders.**
   - **Where conservation is needed**
   - **What actions should work best**
   - **When action should be taken**
7. **Identify key elements for monitoring.**
   - **Learn more about direction and effects of climate**
   - **Measure progress towards objectives**



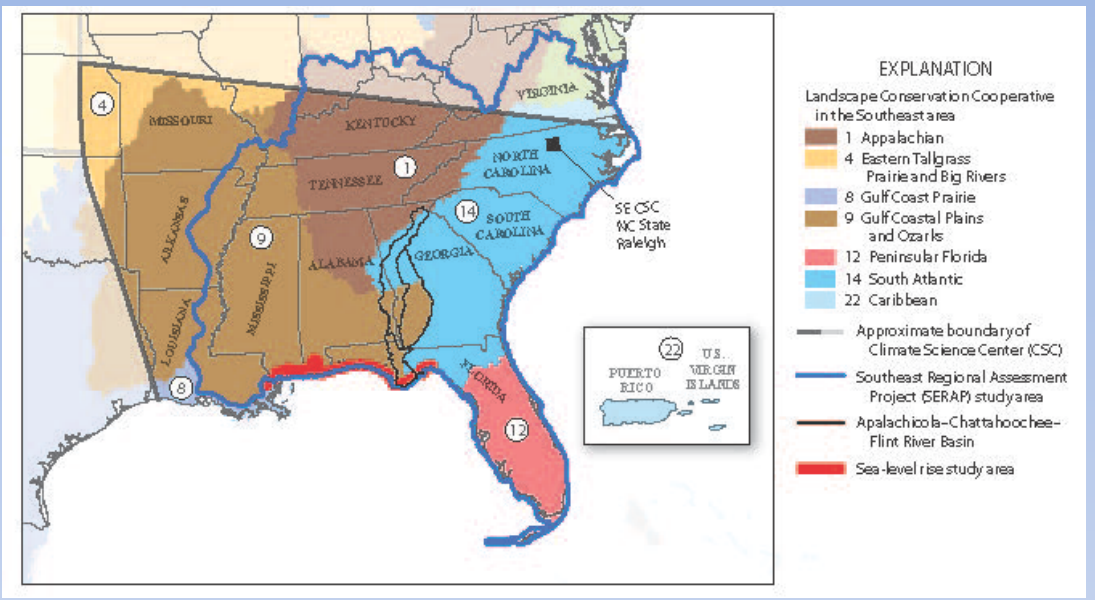
USGS

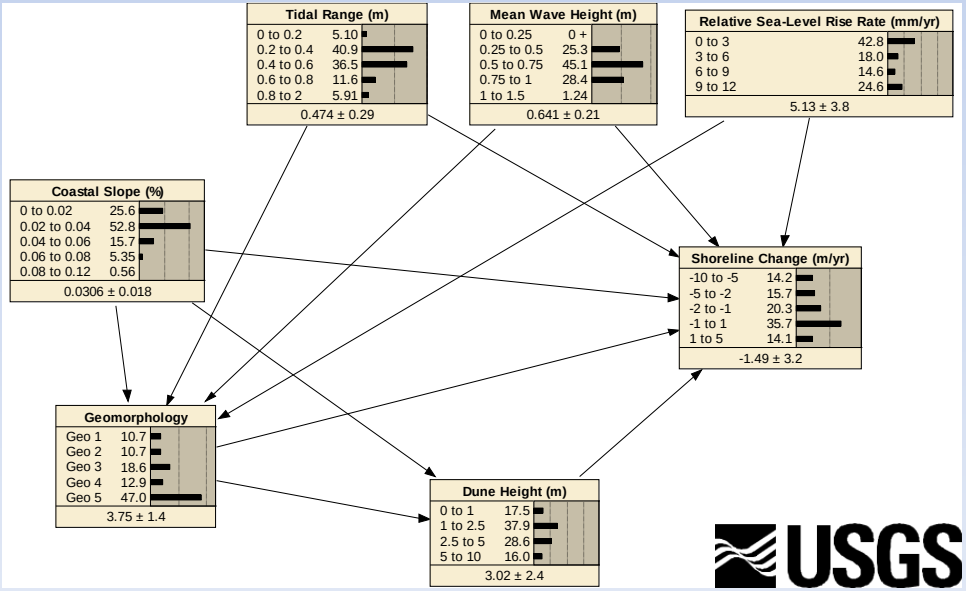
Supporting vulnerability assessment and adaptive management activities on behalf of societal goals/values

Final Optimal Conservation Strategy Products

Spatially explicit decision support tool to allow management agencies to prioritize conservation actions based on a range of predicted future habitat conditions, including:

- Portfolio of best conservation actions
- Locations of sites with greatest marginal gain
- Incorporates land-use projections, climate change projections, and vegetation succession


EXPLANATION
Landscape Conservation Cooperative in the Southeast area
1 Appalachian
4 Eastern Tallgrass Prairie and Big Rivers
8 Gulf Coast Prairie
9 Gulf Coastal Plains and Ozarks
12 Peninsular Florida
14 South Atlantic
22 Caribbean
Approximate boundary of Climate Science Center (CSC)
Southeast Regional Assessment Project (SERAP) study area
Apalachicola-Chattahoochee-Flint River Basin
Sea-level rise study area
SE CSC
NC State
Raleigh
MISSOURI
KENTUCKY
VIRGINIA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
ARKANSAS
FLORIDA
PUERTO RICO
U.S. VIRGIN ISLANDS


Tidal Range (m)
0 to 0.2 5.10
0.2 to 0.4 40.9
0.4 to 0.6 36.5
0.6 to 0.8 11.6
0.8 to 2 5.91
0.474 ± 0.29
Mean Wave Height (m)
0 to 0.25 0 +
0.25 to 0.5 25.3
0.5 to 0.75 45.1
0.75 to 1 28.4
1 to 1.5 1.24
0.641 ± 0.21
Relative Sea-Level Rise Rate (mm/yr)
0 to 3 42.8
3 to 6 18.0
6 to 9 14.6
9 to 12 24.6
5.13 ± 3.8
Coastal Slope (%)
0 to 0.02 25.6
0.02 to 0.04 52.8
0.04 to 0.06 15.7
0.06 to 0.08 5.35
0.08 to 0.12 0.56
0.0306 ± 0.018
Shoreline Change (m/yr)
-10 to -5 14.2
-5 to -2 15.7
-2 to -1 20.3
-1 to 1 35.7
1 to 5 14.1
-1.49 ± 3.2
Geomorphology
Geo 1 10.7
Geo 2 10.7
Geo 3 18.6
Geo 4 12.9
Geo 5 47.0
3.75 ± 1.4
Dune Height (m)
0 to 1 17.5
1 to 2.5 37.9
2.5 to 5 28.6
5 to 10 16.0
3.02 ± 2.4
USGS