Multi-Agency Ecological Models for Everglades Restoration

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Introduction

Collaborative efforts to develop ecological models have resulted in a suite of models to evaluate Everglades restoration strategies.

Central Everglades Planning Project (CEPP)

- Restore habitat in the central Everglades and Everglades National Park (ENP)
- Deliver new sources of clean water to the central Everglades and ENP
- Reduce damaging discharges to east and west coast estuaries

Hydrologic Scenarios

The SFWMD is providing hydrologic model output based on the Regional Simulation Model (RSM) for two 'baseline' and six alternative restoration plans. These alternative plans will be used as inputs to ecological models to help with evaluating ecological impacts.


Daily Water Depths 1965 - 2005
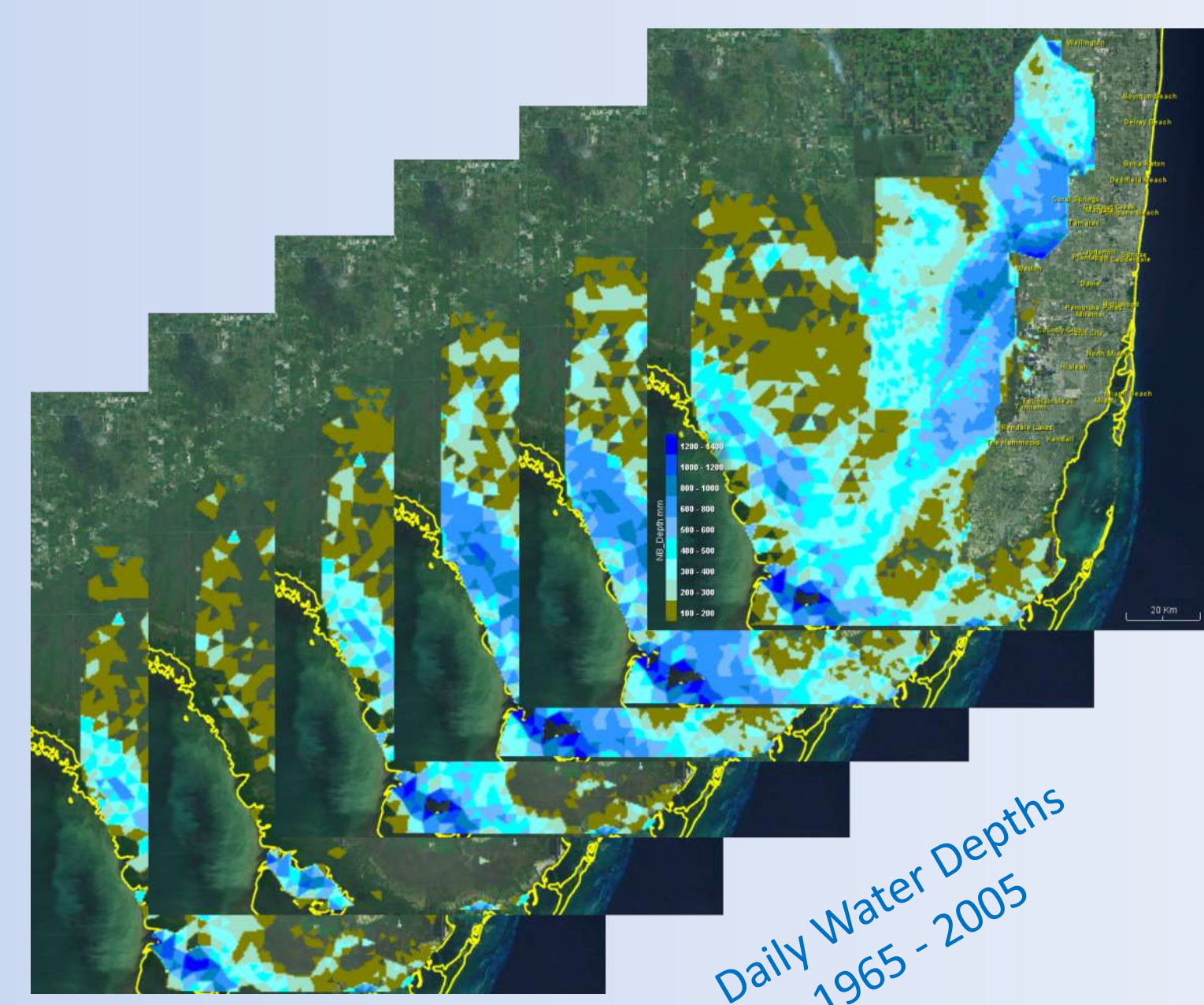
CEPP Ecological Planning Tools

Amphibian Communities

Example habitat Suitability Output   Hydroperiod input
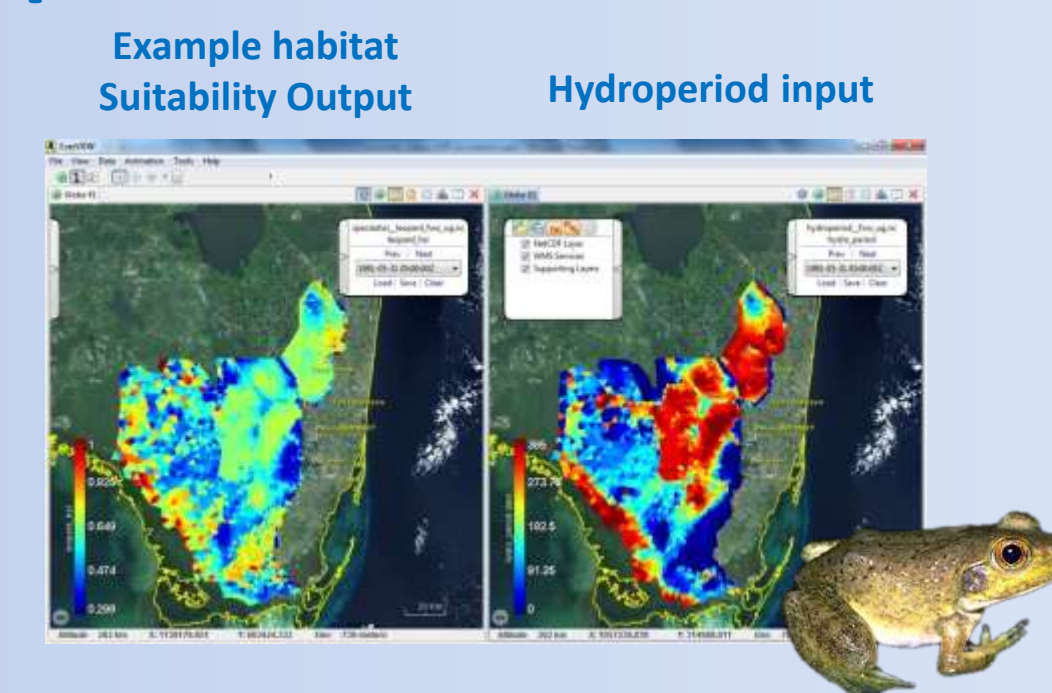
- Examines occurrence of 12 Frogs and toads as function of:
  - Habitat Type
  - Hydrology
  - Human Disturbance
- Estimates relationship in each habitat type between probability of occurrence of each anuran species and hydroperiod
- Based on data collected at 205 sites in the Greater Everglades

American Alligator

Habitat   Breeding   Courtship & Mating

Nest Building   Nest Flooding   Overall Suitability
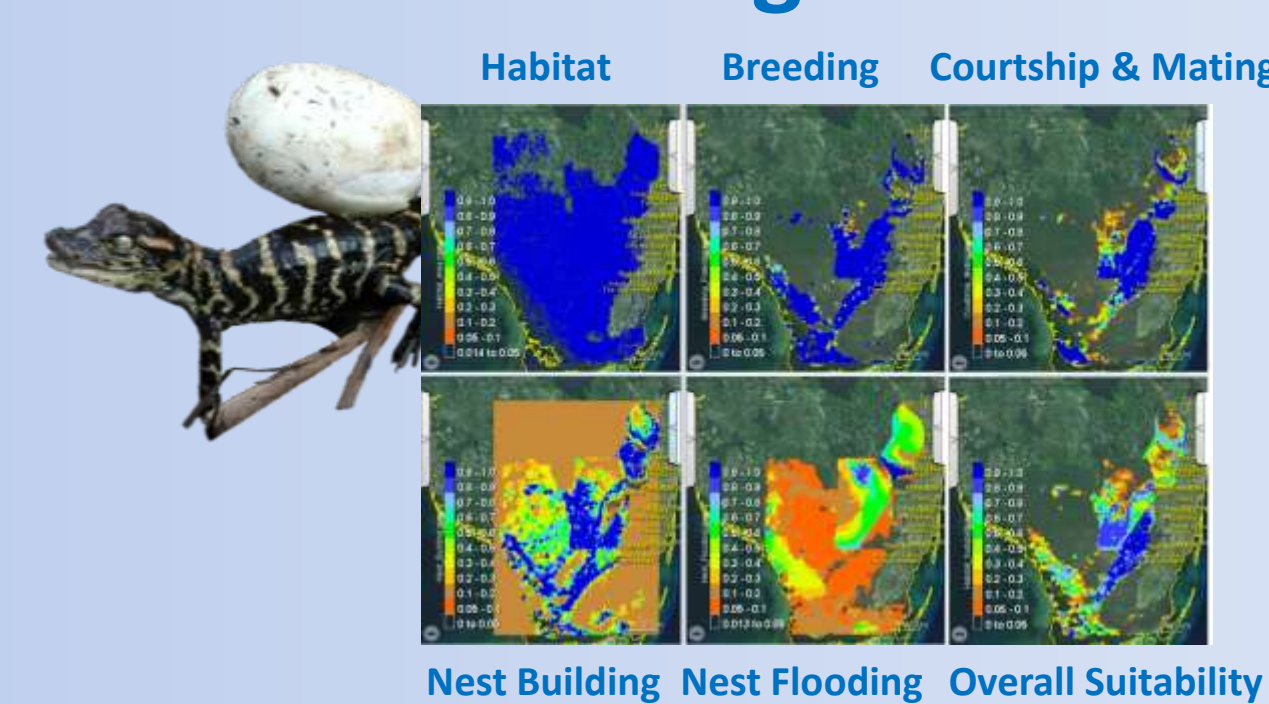
- Overall index is the geometric mean of 5 components
  - Habitat availability
  - Breeding
  - Courtship & Mating
  - Nest building
  - Nest flooding
- Daily time step

Freshwater Fish Density
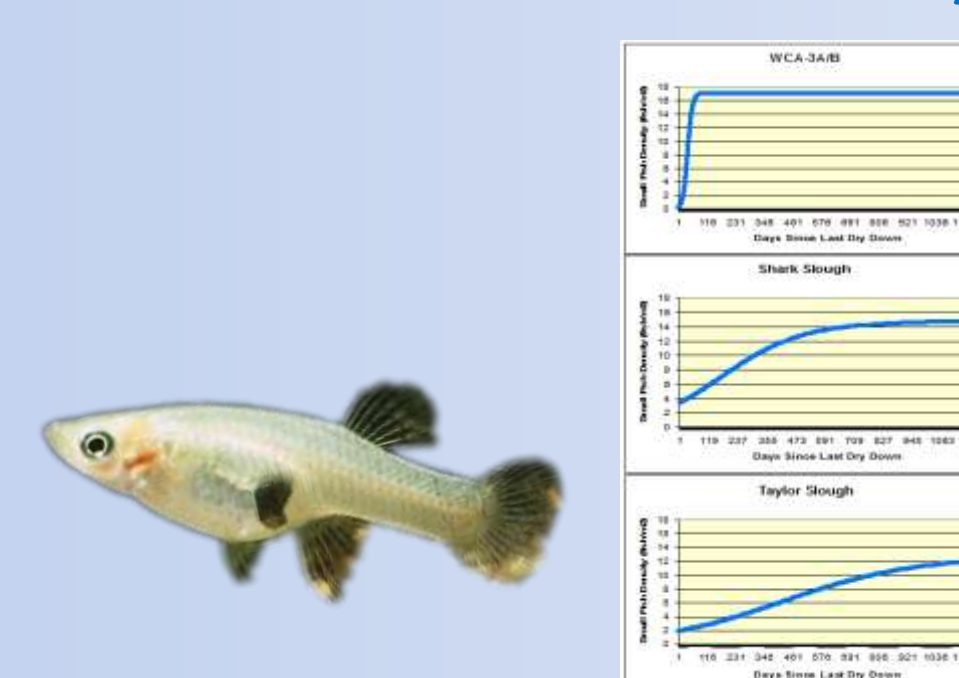
- Estimates small fishes biomass per m²
- Logistic regressions use Trexler *et al.* throw trap data: 1996 through 2006
- Chose a set of 500m cells that completely surrounded each set of 3 field sites
- Statistical uncertainty made expanding the coverage unwise

Wood Stork Foraging

Foraging Suitability at each cell   Foraging Suitability In 23.4km radius
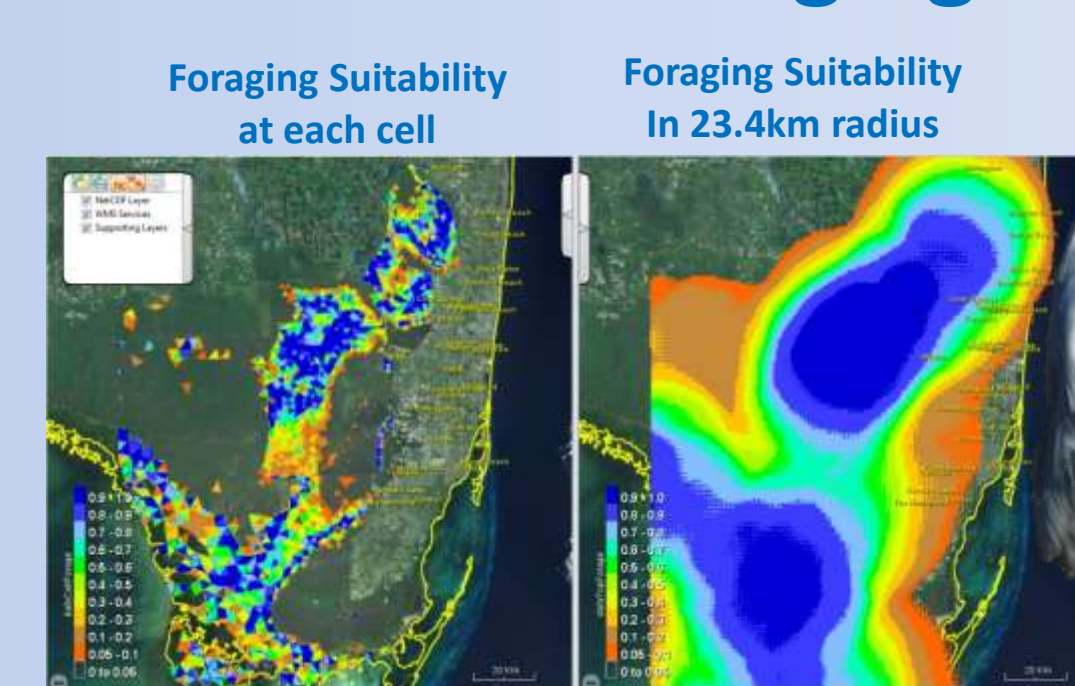
- $Foraging(p) = \{water\ depth(p)*recession\ rate(p)\}$
- Water depth probability calculated daily based on Herring and Gawlik (2011)
- Recession rate: assigned value of 0 or 1, dependent on 7 day water depth increase of 20%
- Model output scored during wood stork breeding season (1 December – 15 July)
- Foraging probability (p) scored in all cells within a 23.4 km radius of a wood stork colony (Herring and Gawlik, 2007)

Cape Sable Seaside Sparrow
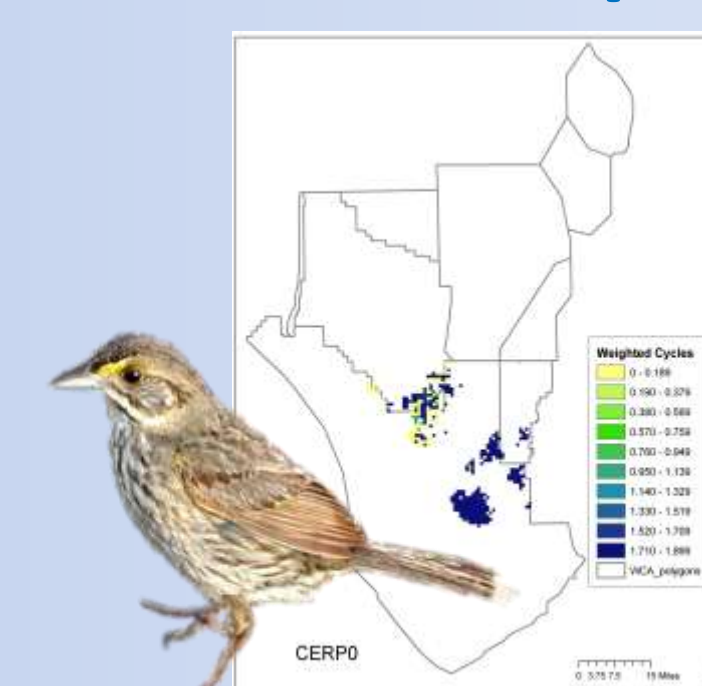
- Applied in CSSS monitoring sites
- Breeding season: March 15 – August 1
- Breeding cycle begins when water depth drops below 5 cm
- Nest flooding at 16 cm
- 45 consecutive days without flooding provides one breeding cycle
- First cycle requires 45 days, second cycle requires 40 days to complete
- Maximum of three nesting cycles per breeding season

Apple Snail Population

Run on two hydrologic regimes

Adult population numbers

Egg numbers
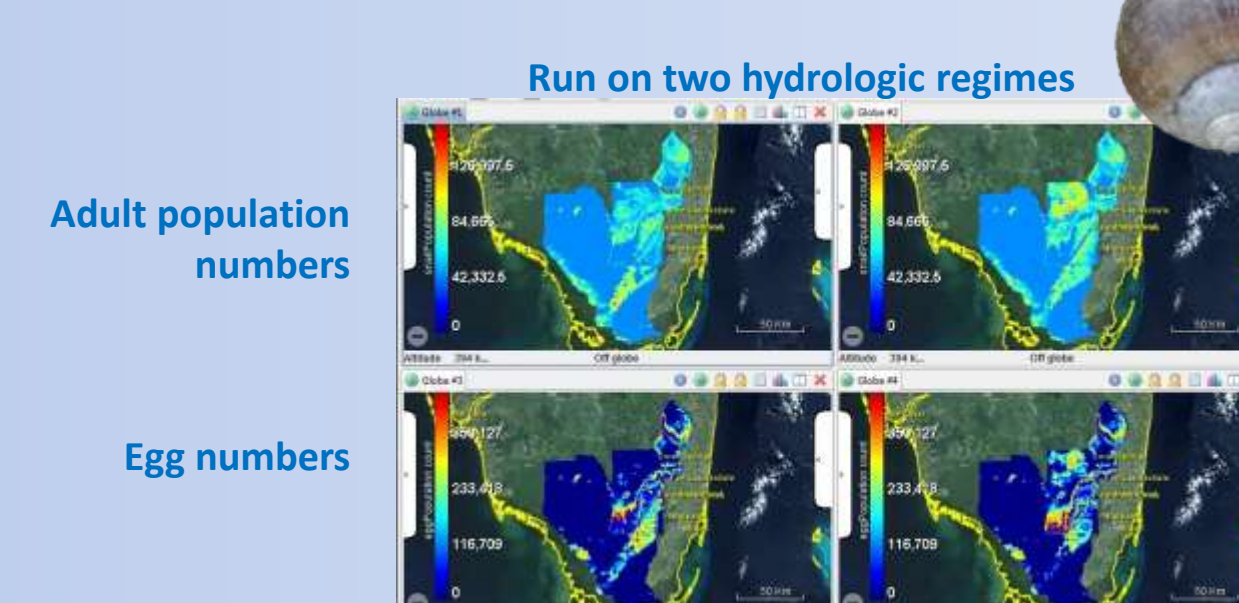
- Size-structured population model
- Simulates response of native apple snails to hydrologic conditions
- Inputs
  - Water depth
  - Air temperature
- Output on a daily time step

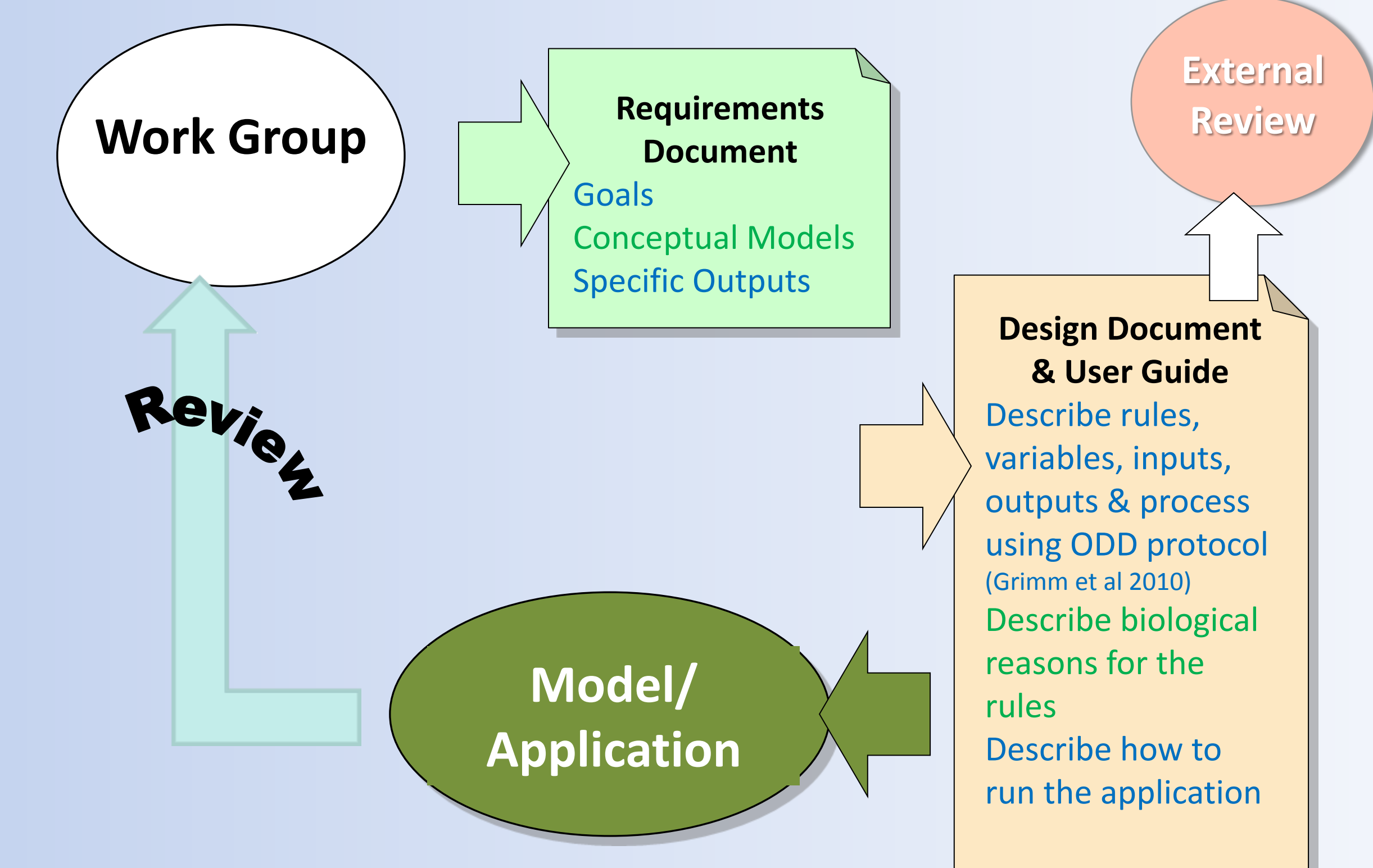Potential dynamic habitat input to species models

Everglades Landscape Vegetation Succession
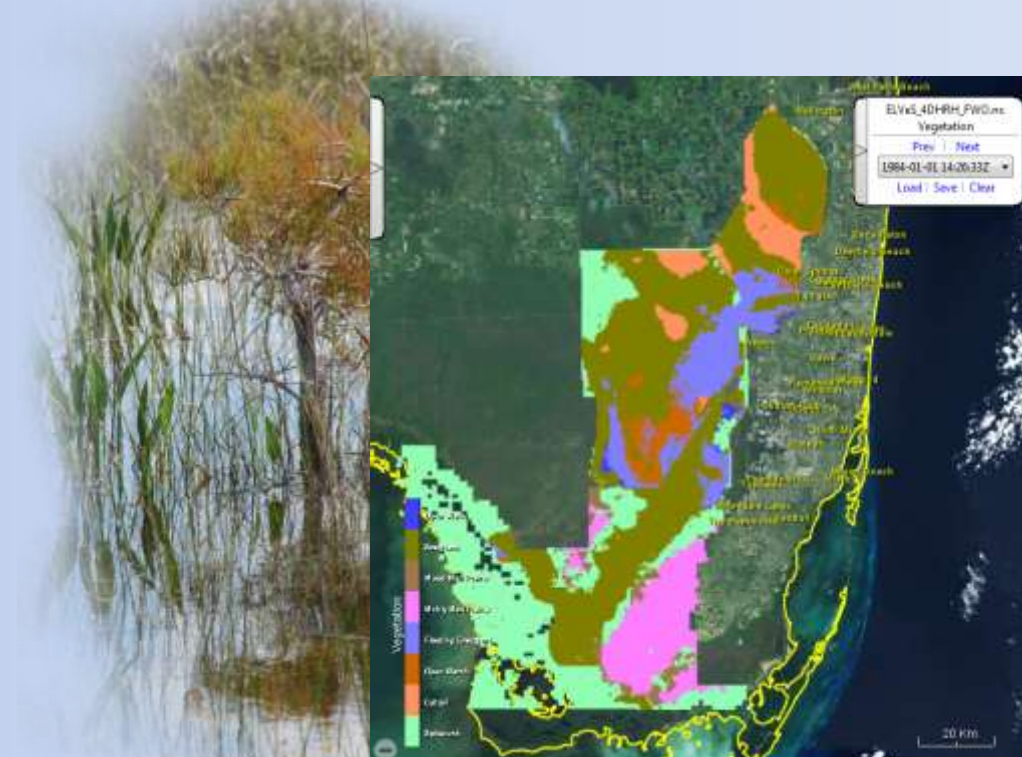
- Empirically-based probabilistic functions of vegetation community responses to changing environmental conditions.
- Annual output of probability of vegetation community given each hydrologic & soil variable, joint probability of vegetation community given all the variables, and the dominant vegetation community at a site.
- Linking ELVeS with wildlife planning tools provides a dynamic land cover layer for habitat.
- Designed to encourage updating as new information becomes available.
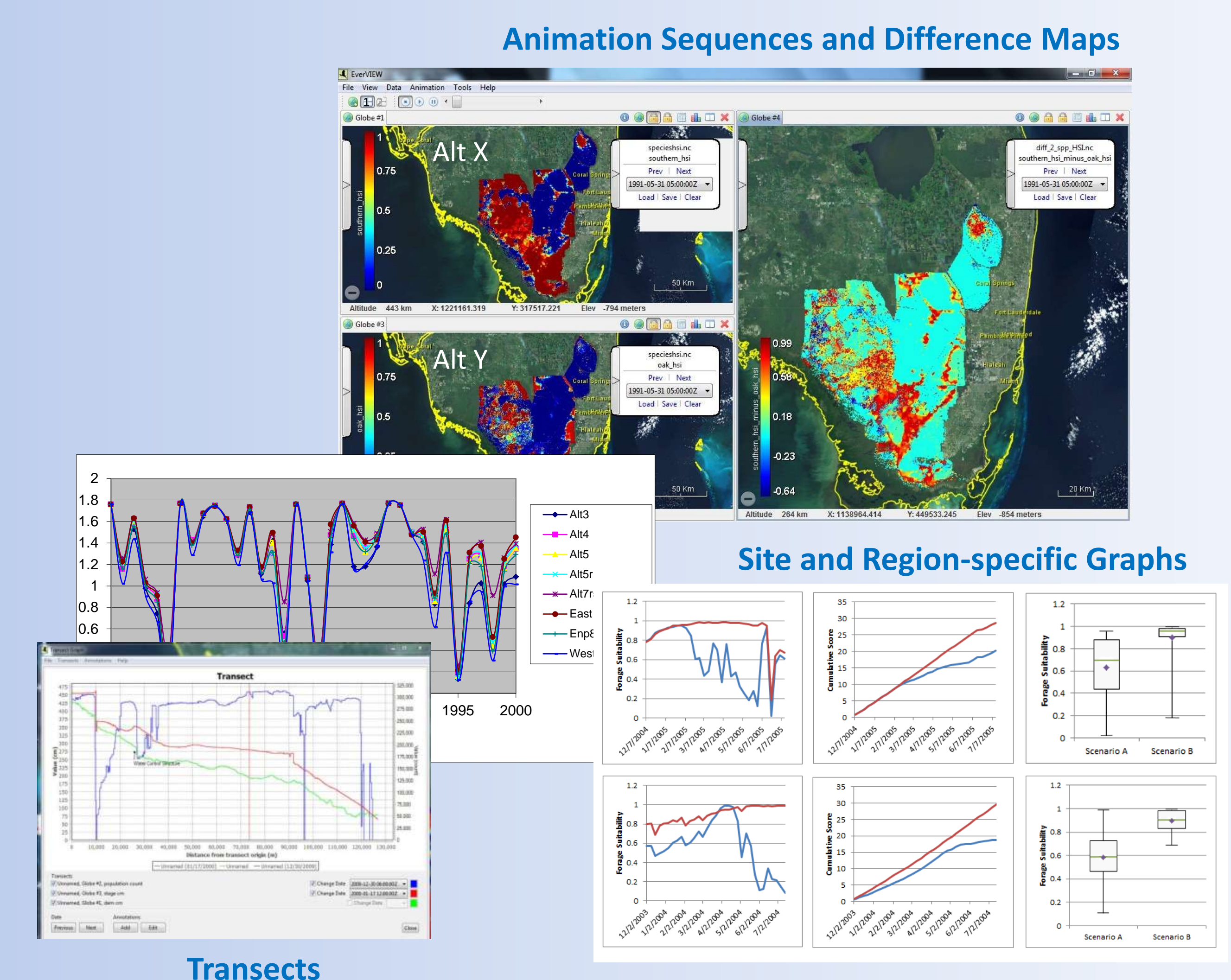
Documentation

Standardized procedures aid model development with collaborative workflow that promotes fully documented and transparent methods.

Work Group

Review

Model/ Application

Requirements Document
Goals
Conceptual Models
Specific Outputs

External Review

Design Document & User Guide
Describe rules, variables, inputs, outputs & process using ODD protocol (Grimm et al 2010)
Describe biological reasons for the rules
Describe how to run the application

Decision Support

Huge spatial & temporal output needs post-analysis and visualizations that make it useful for decision support.

Animation Sequences and Difference Maps

Alt X

Alt Y

Site and Region-specific Graphs

Transects

EverVIEW and EverVIEW compatible presentation results

Distribution

Open source distribution of applications, code and documentation is at JEM.gov & simGlades.org