Climate-based distribution models for the American Crocodile, *Crocodylus acutus*: Illustration of methodological challenges and management opportunities

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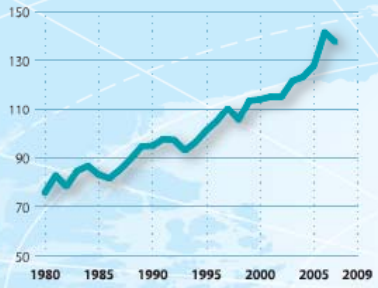
GLOBAL CHANGE
IGBP International Geosphere-Biosphere Programme

ICSU International Council for Science

IGBP CLIMATE-CHANGE INDEX

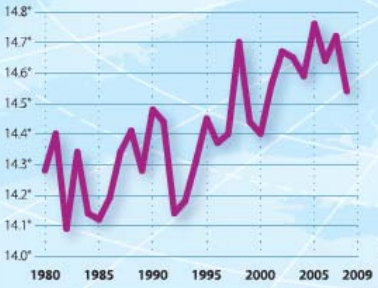
Global-change trends for the public and policymakers

SEA LEVEL
(millimetres)



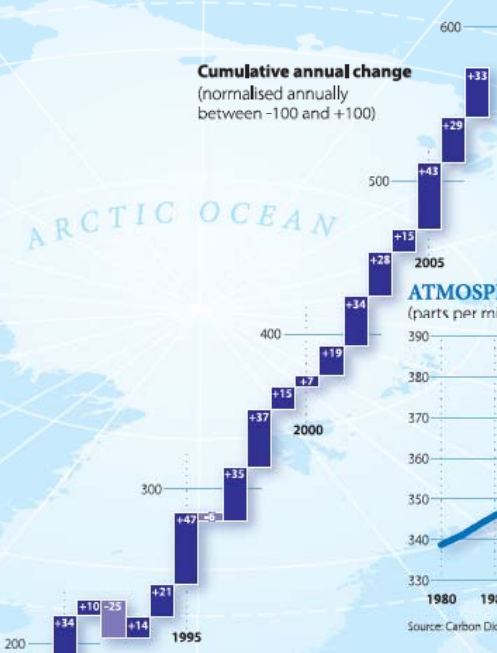
Source: Church and White global mean sea-level reconstruction (CSIRO), using data from the Permanent Service for Mean Sea Level, Proudman Oceanographic Laboratory, Natural Environment Research Council

GLOBAL AVERAGE TEMPERATURE
(degrees C)



Source: NASA

Cumulative annual change
(normalised annually between -100 and +100)

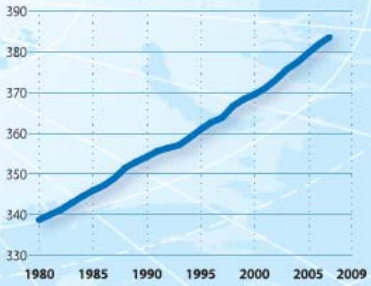


The IGBP climate-change index combines the four key metrics that help unravel what is happening to the planet: temperature, carbon dioxide levels, sea level and Arctic sea ice. The index combines annual changes in each of these directly-measured parameters. Each year's change is added to the previous year. Natural variability sometimes obscures general trends in these metrics. By drawing together the four metrics as a single figure, the IGBP climate-change index exposes the underlying trend.

Rising index
A shift away from a relatively stable climate

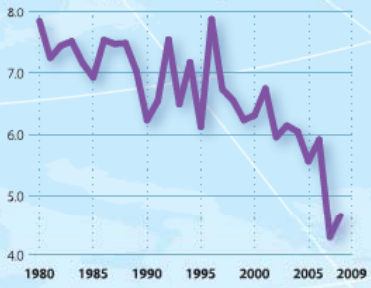
Falling index
A shift towards a relatively stable climate

ATMOSPHERIC CO_2
(parts per million by volume)



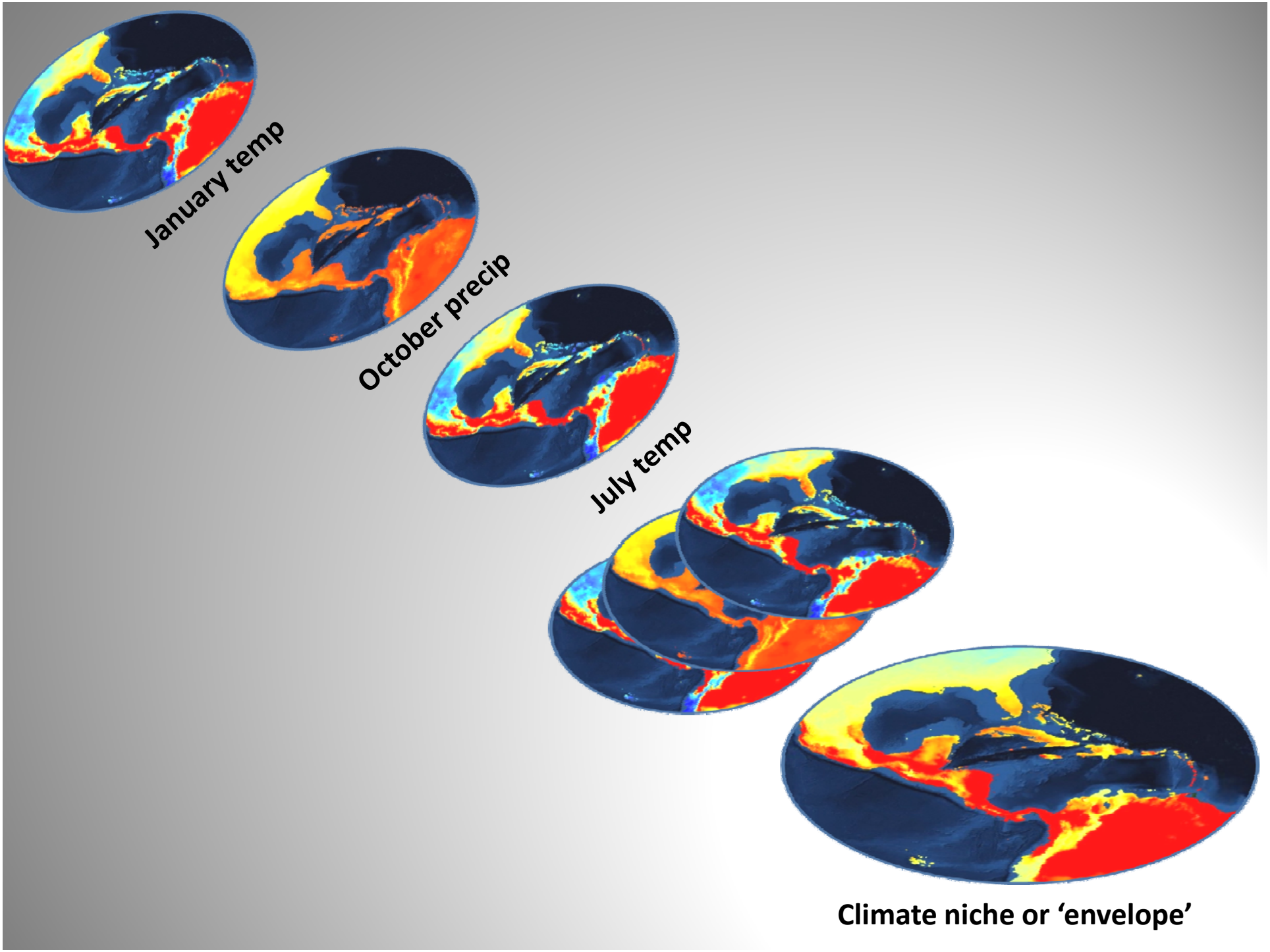
Source: Carbon Dioxide Information Analysis Center, Mauna Loa

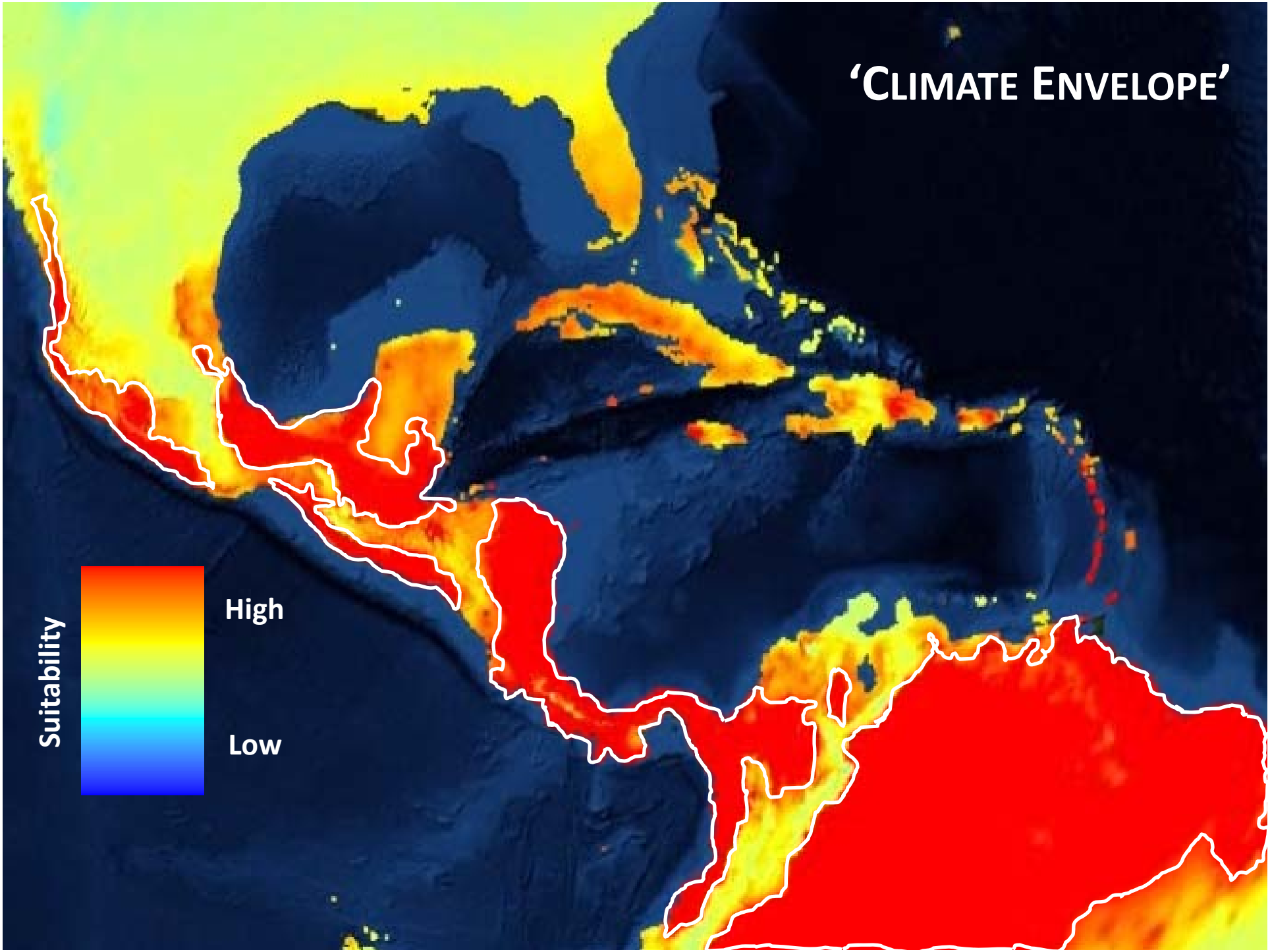
ARCTIC SEA-ICE COVER
Northern hemisphere summer sea-ice minimum
(millions of square kilometres)

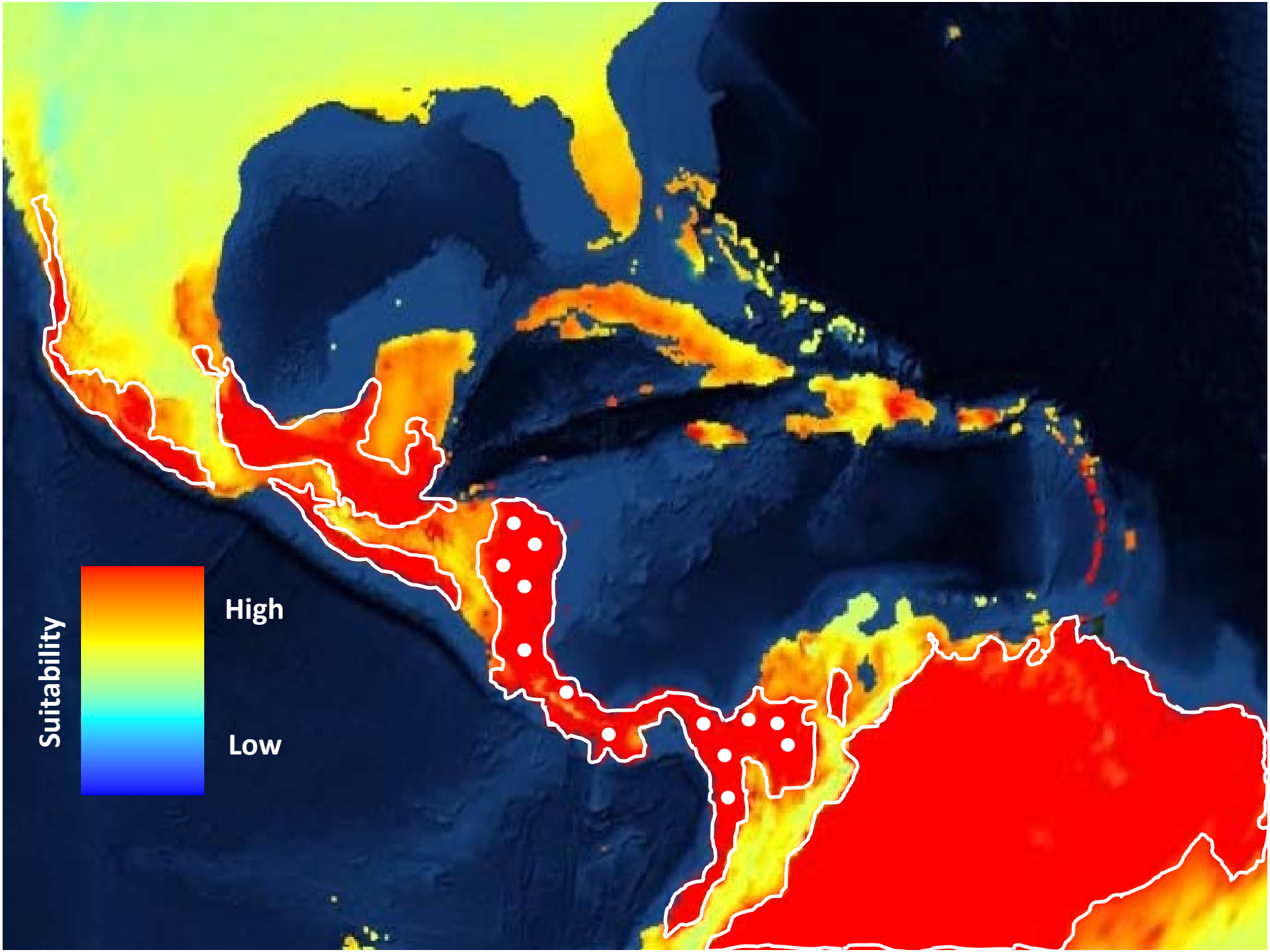


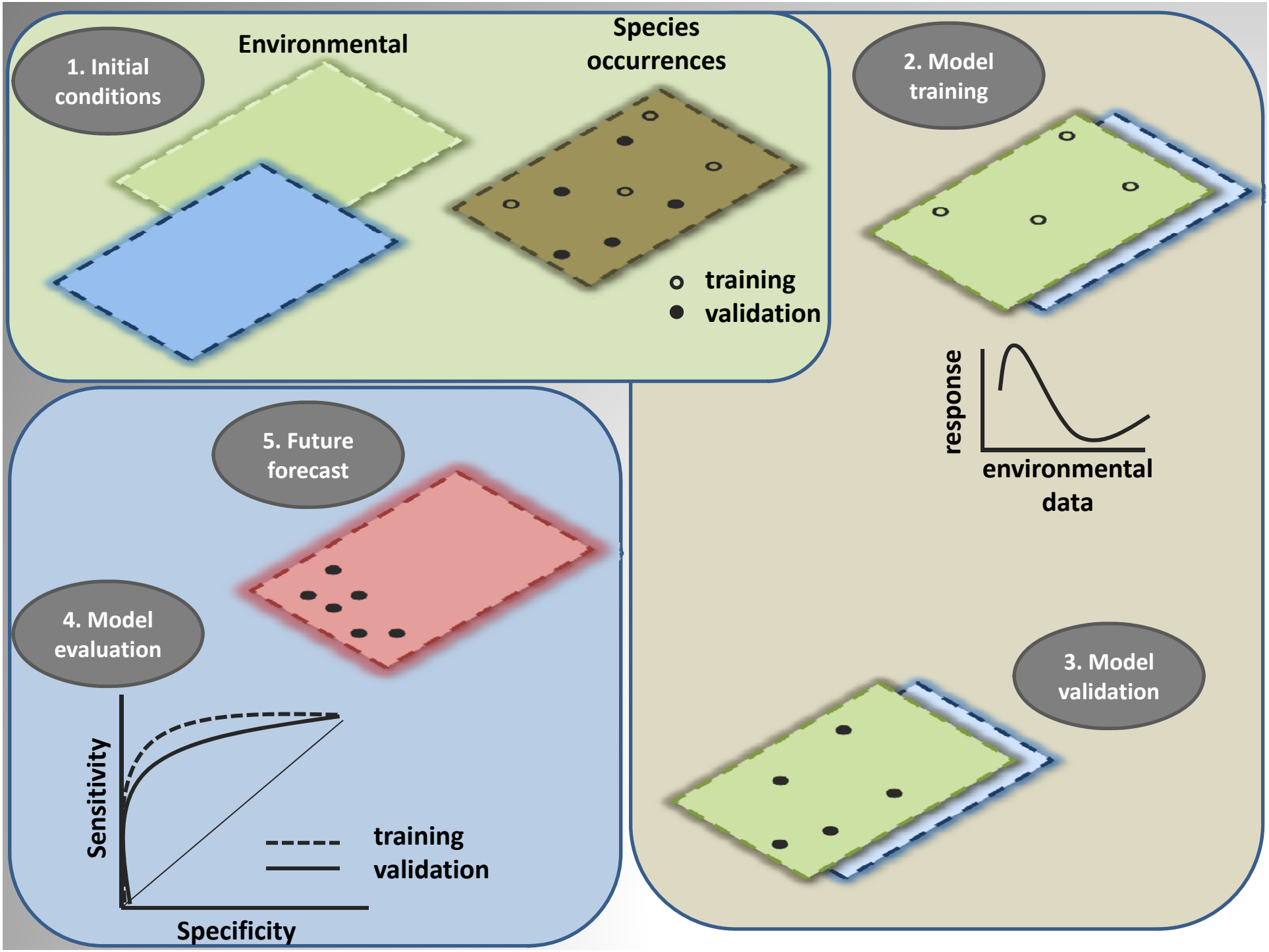
Source: NOAA

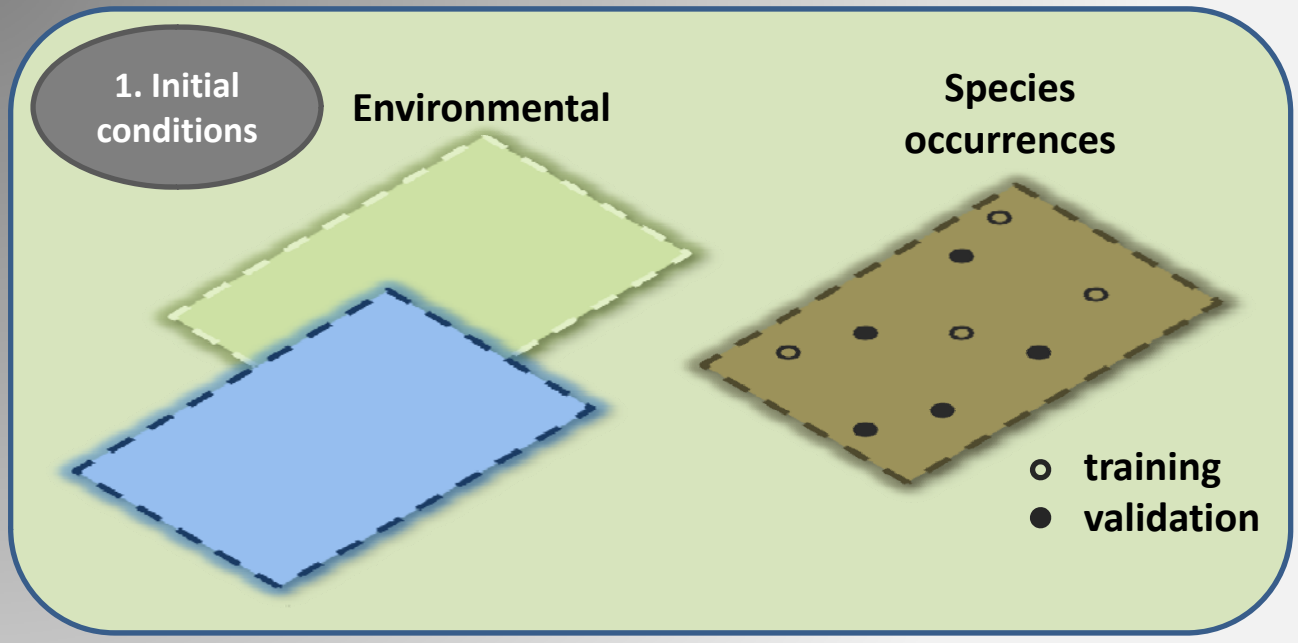
Developed by the International Geosphere Biosphere Programme


January temp
October precip
July temp
Climate niche or 'envelope'

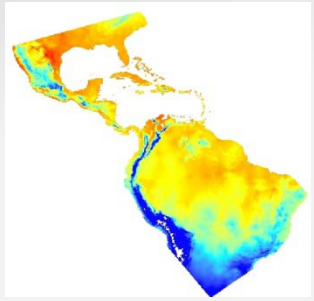

‘Climate Envelope’
Suitability
High
Low


Suitability
High
Low

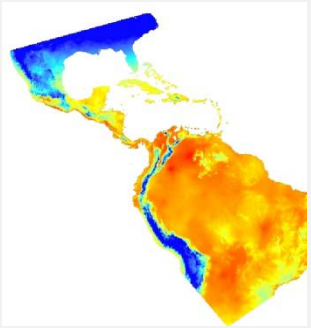

1. Initial conditions
Environmental
Species occurrences
training
validation
2. Model training
response
environmental data
3. Model validation
4. Model evaluation
Sensitivity
Specificity
training
validation
5. Future forecast



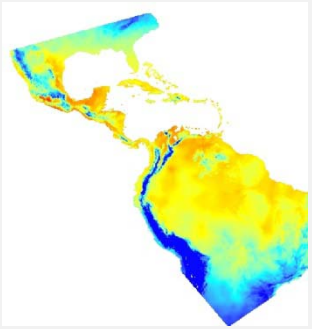
Predictor variables



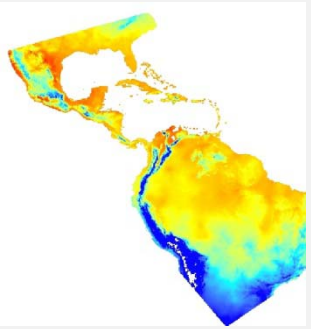
January temp



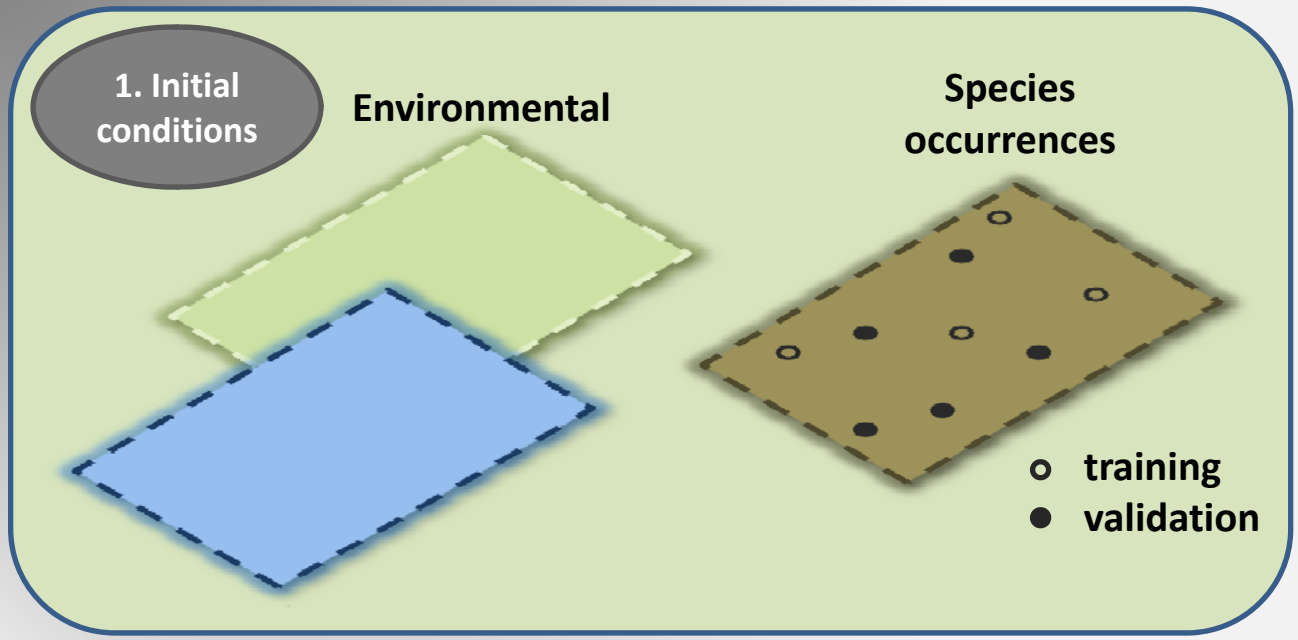
July precip



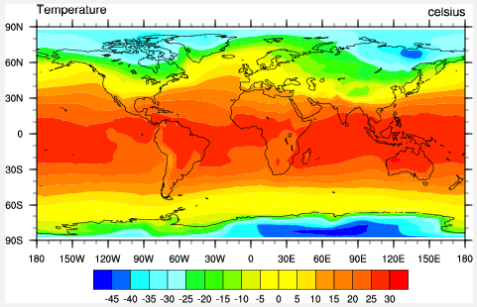
October precip



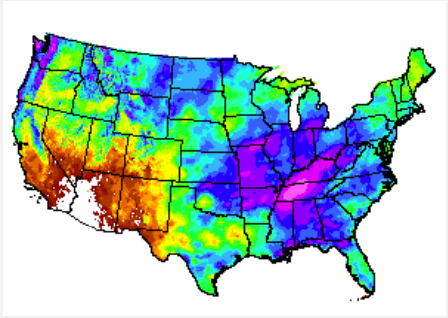
April temp



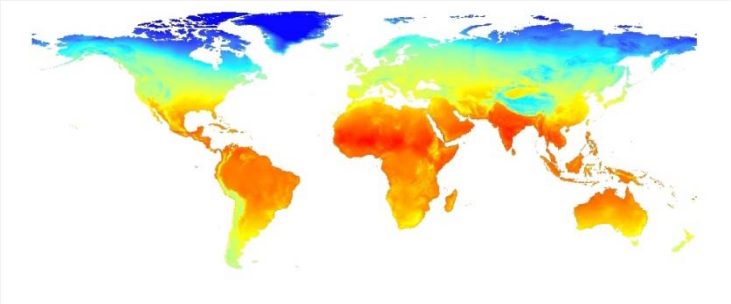
Climate dataset



Climate Research Unit



PRISM



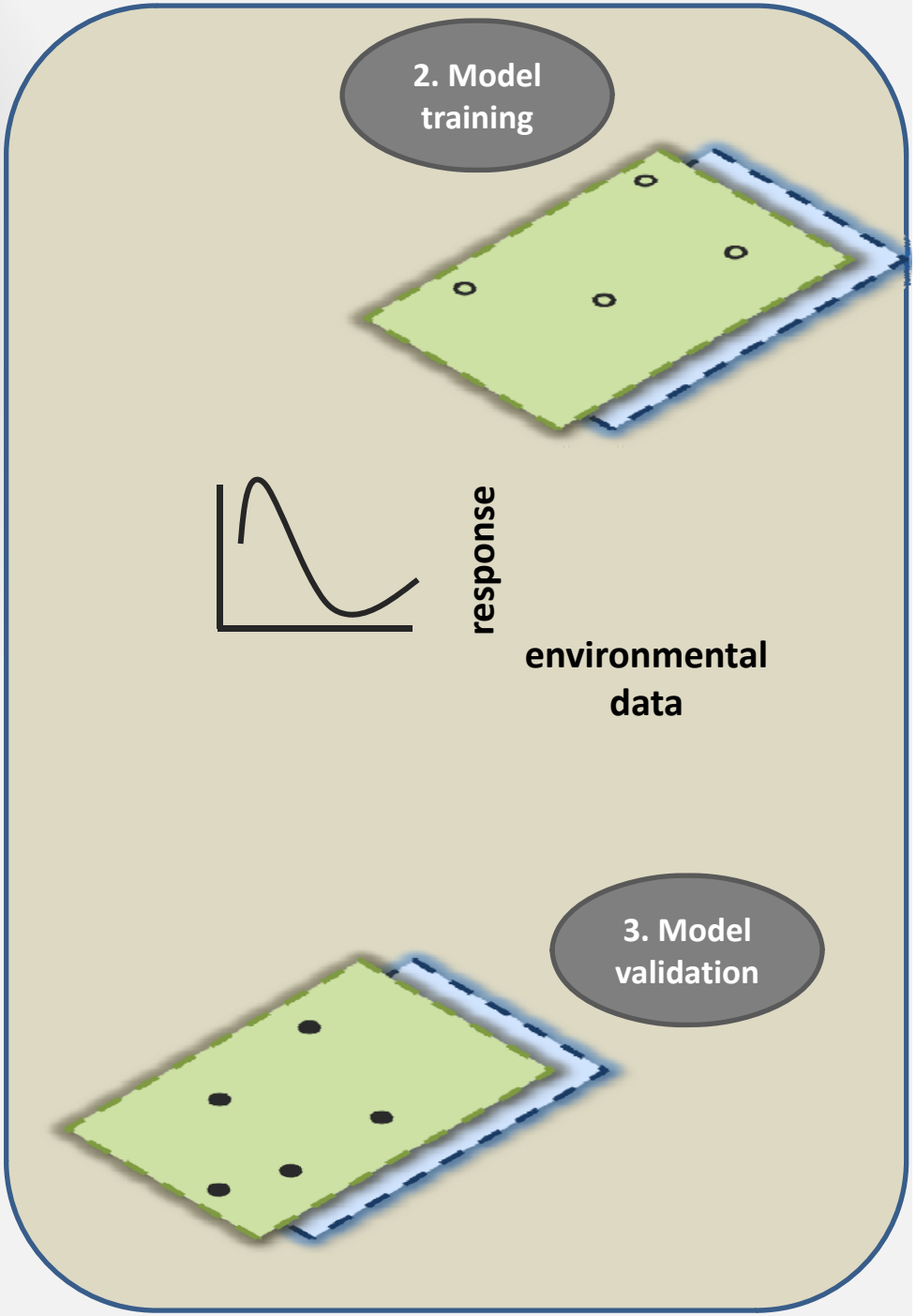
Worldclim

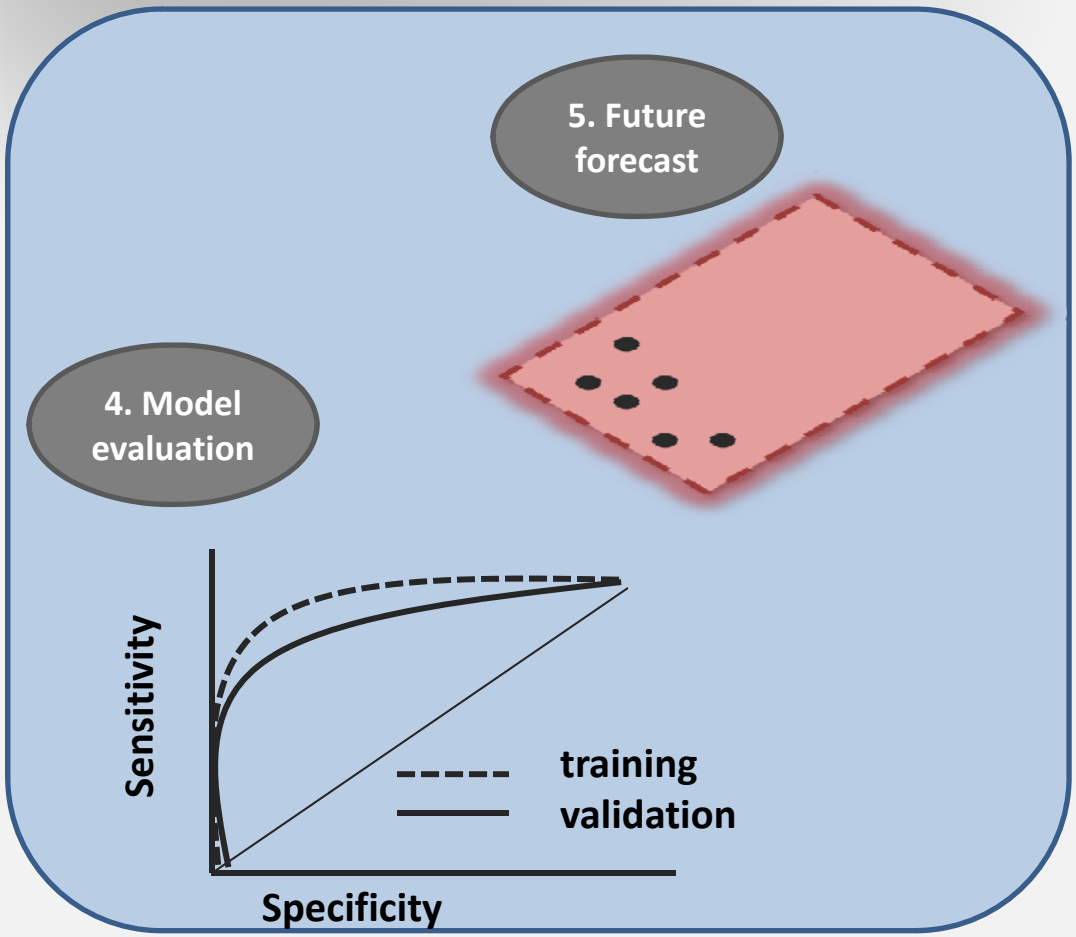
I Logistic regression

II Maximum entropy

III Random forest

IV Support vector machines

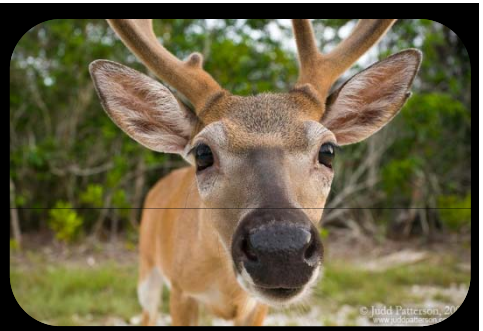




Area Under the Curve (AUC)

Kappa

Spatial correlation



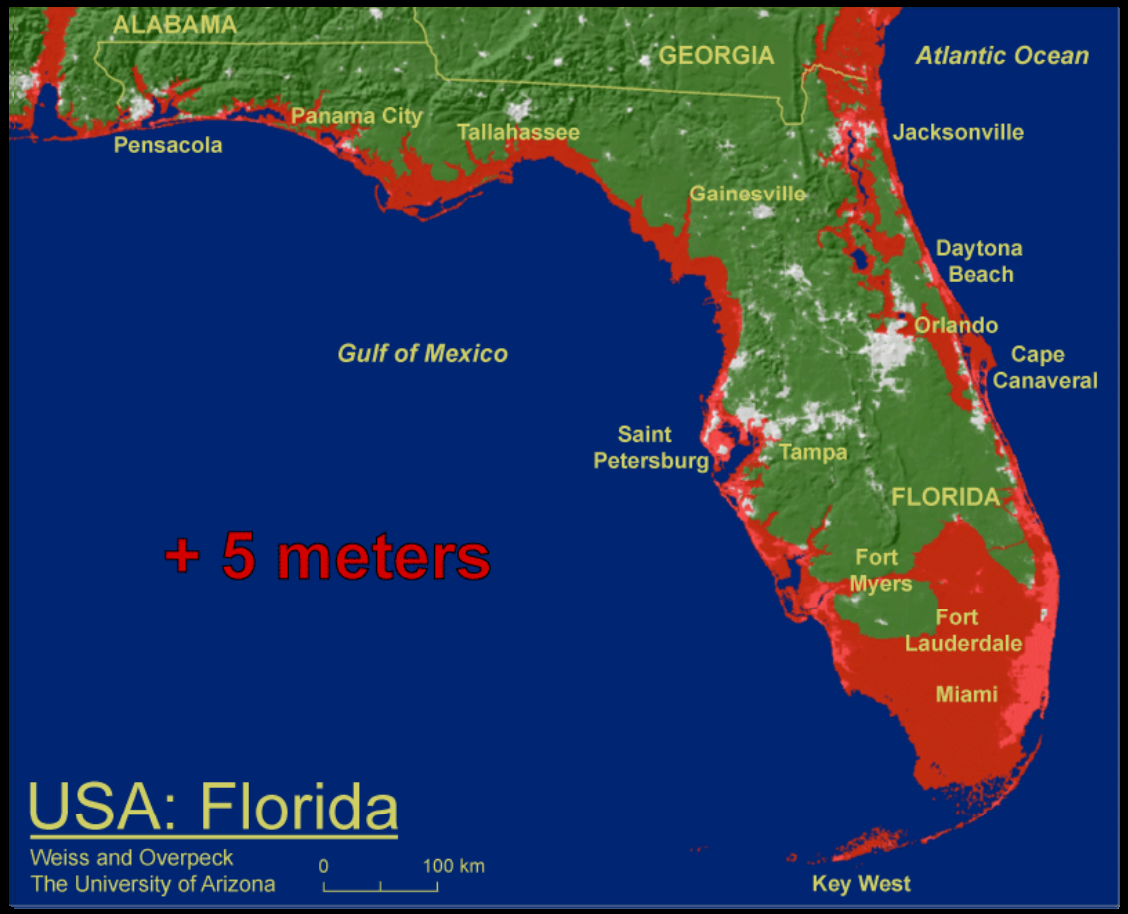
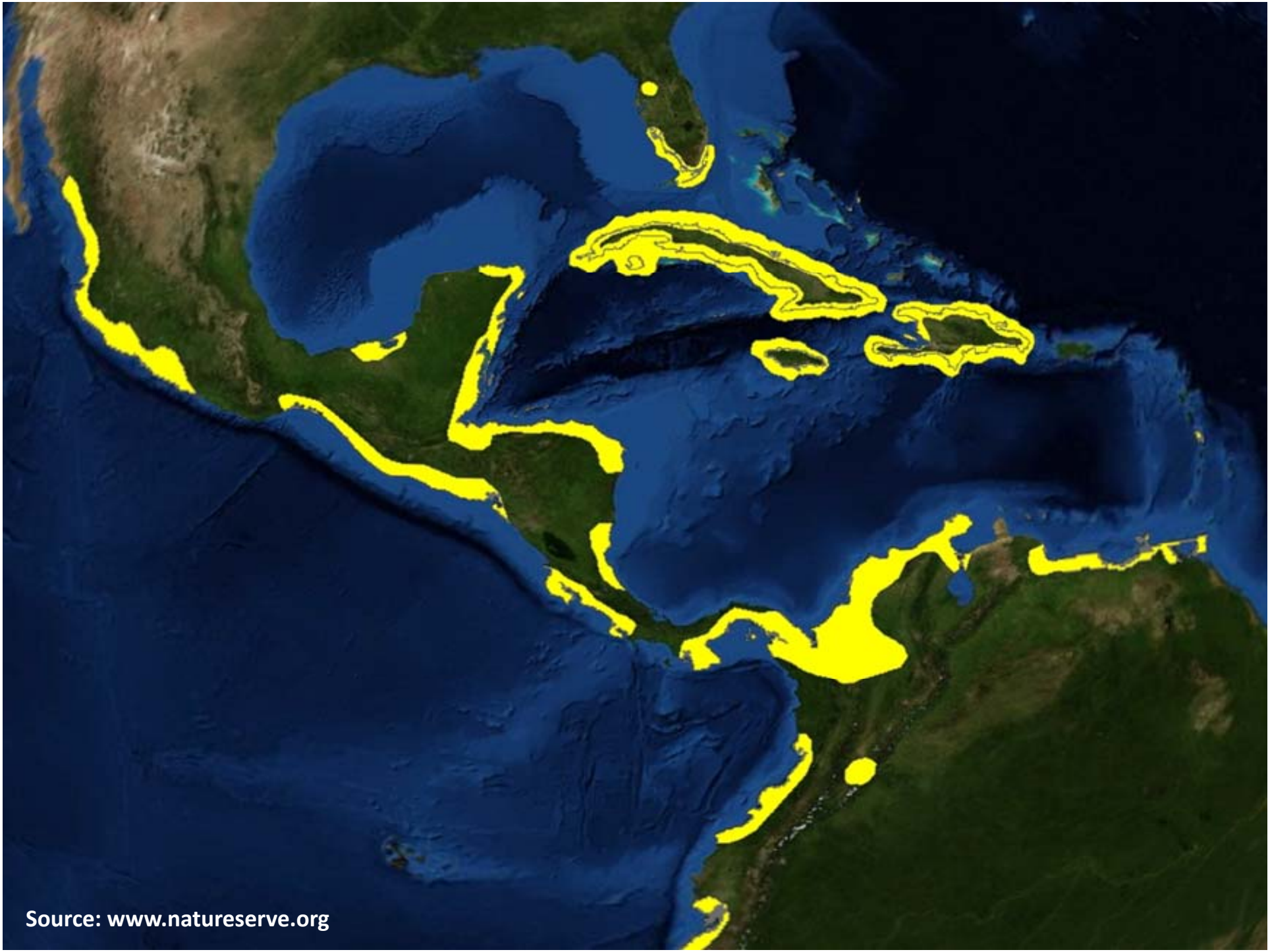
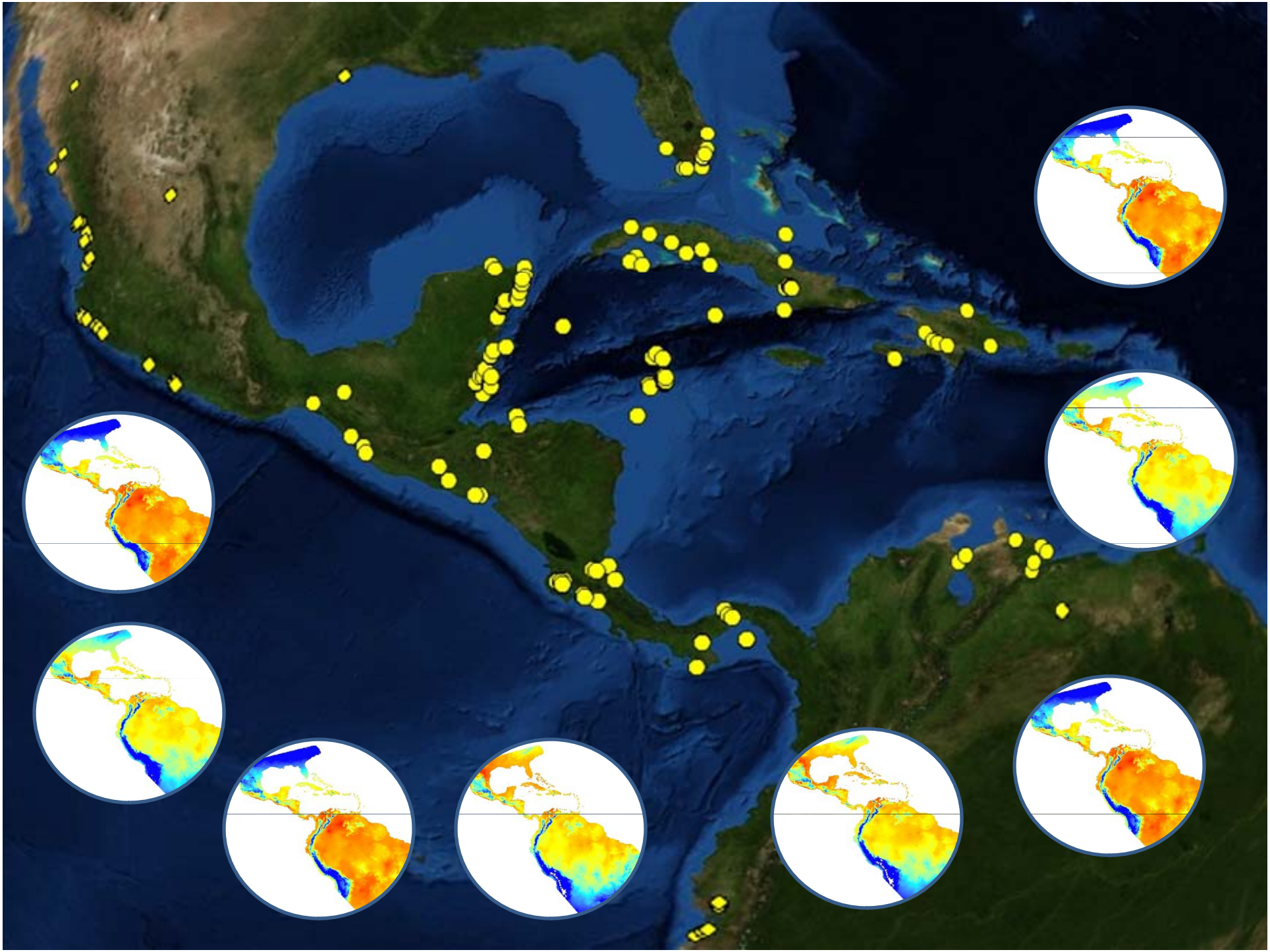
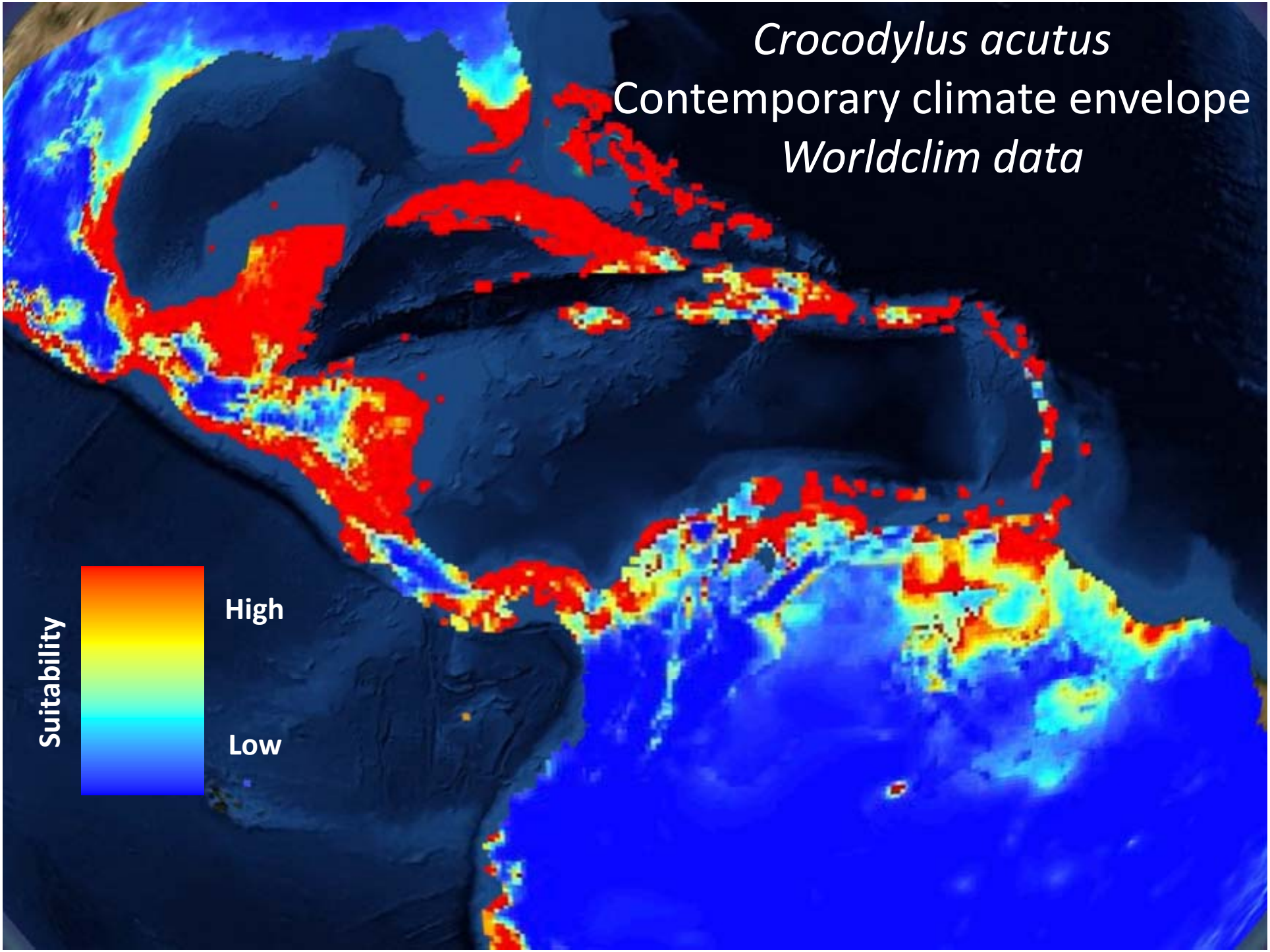
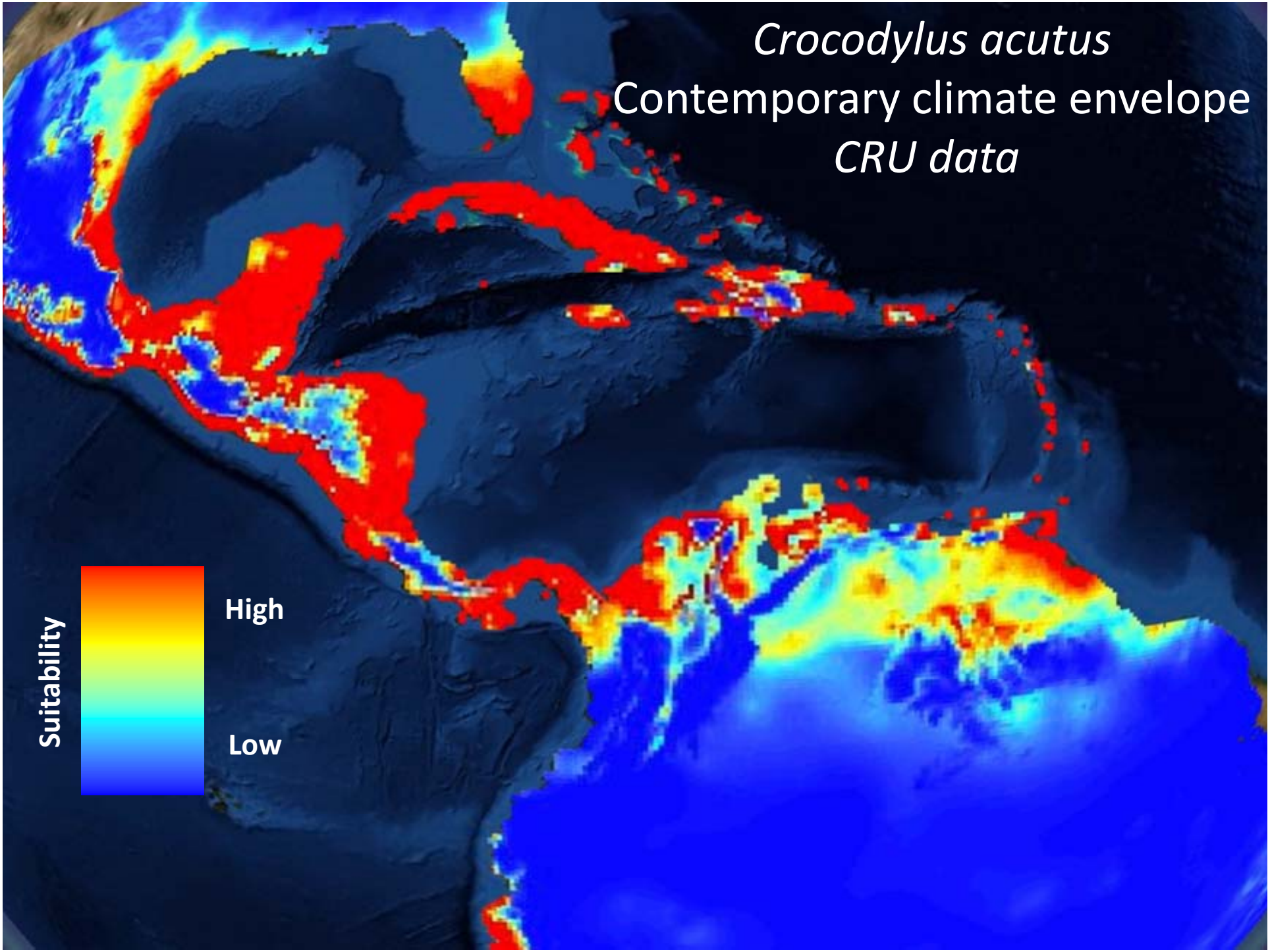

ALABAMA
GEORGIA
Atlantic Ocean
Panama City
Tallahassee
Pensacola
Jacksonville
Gainesville
Daytona Beach
Orlando
Gulf of Mexico
Cape Canaveral
Saint Petersburg
Tampa
FLORIDA
+ 5 meters
Fort Myers
Fort Lauderdale
Miami
USA: Florida
Weiss and Overpeck
The University of Arizona
0
100 km
Key West

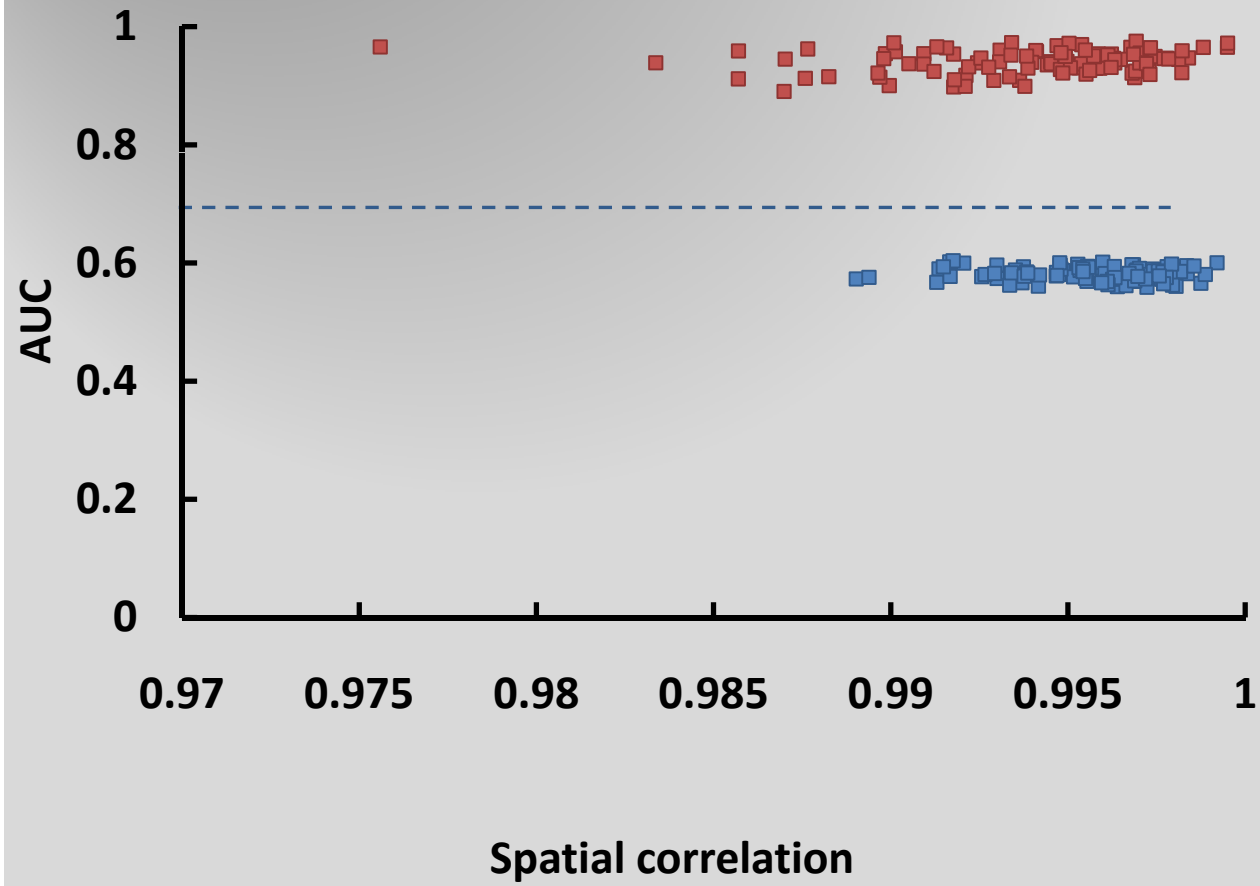
Photo: Jemeema Carrigan

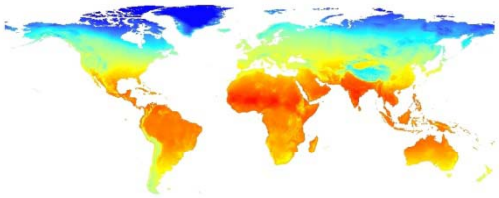

Source: www.natureserve.org



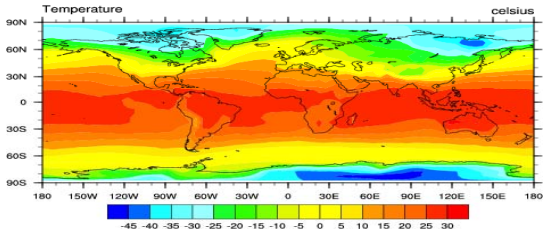

Crocodylus acutus
Contemporary climate envelope
Worldclim data
Suitability
High
Low


Crocodylus acutus
Contemporary climate envelope
CRU data
Suitability
High
Low



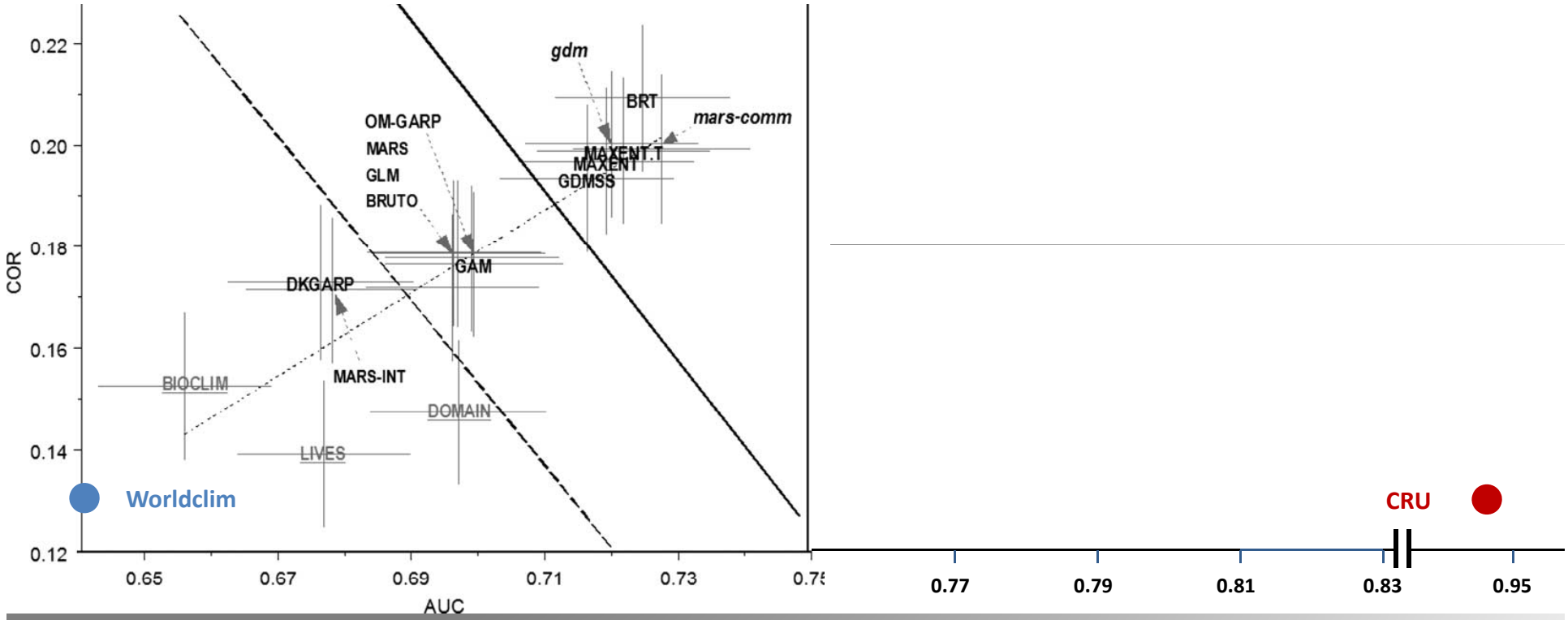


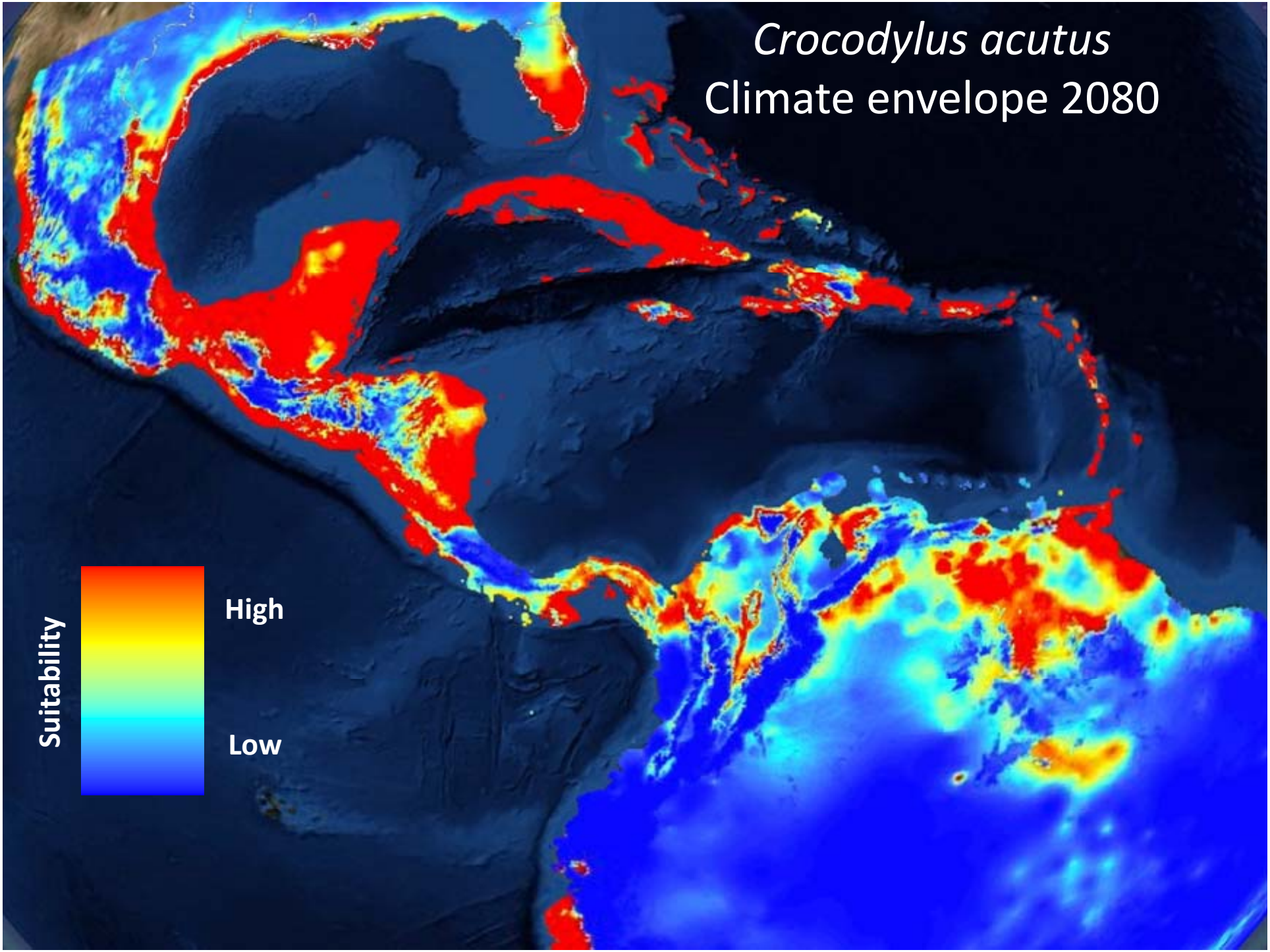
Climate Research Unit

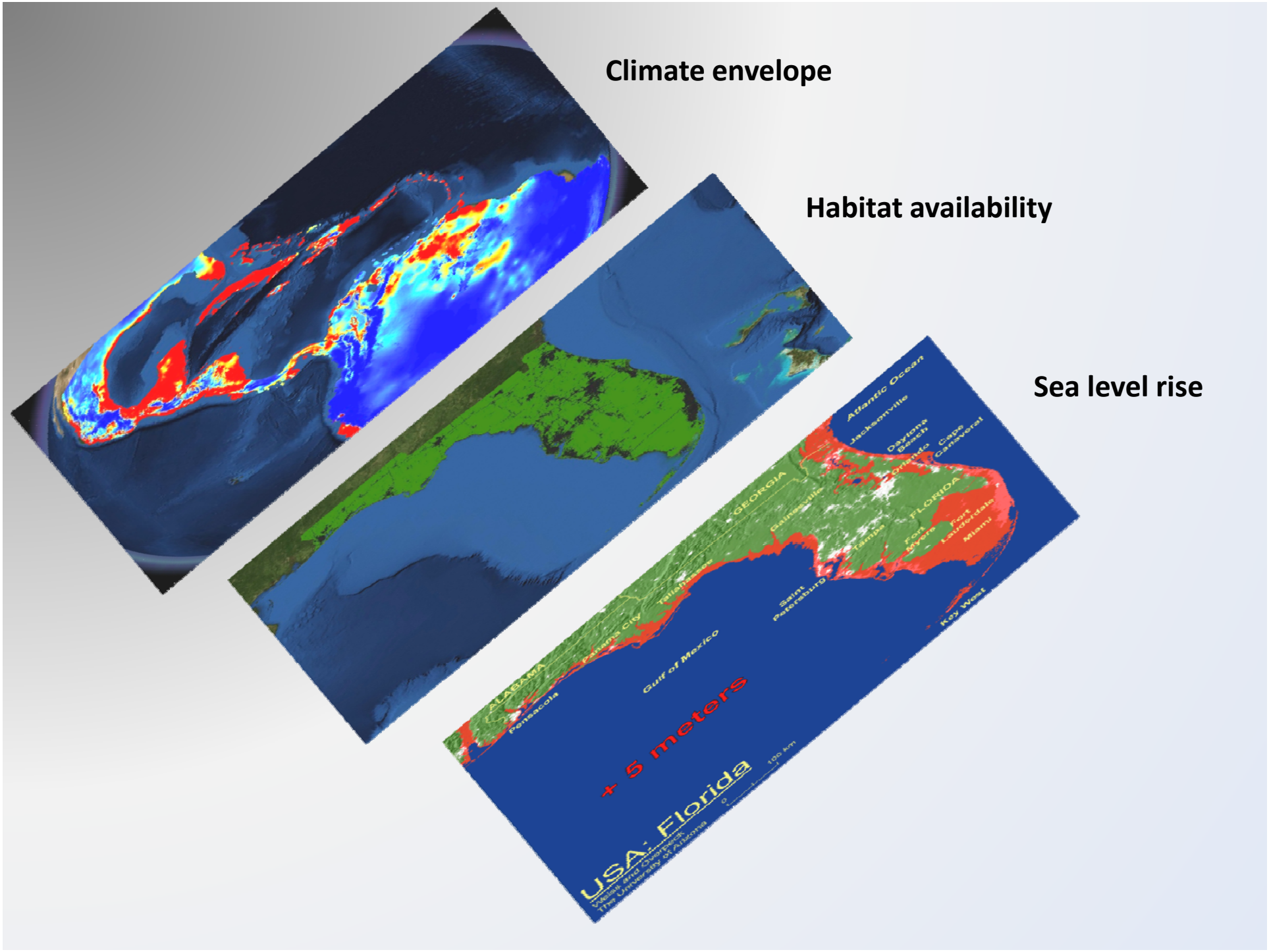


Worldclim

From Elith et al. 2006 *Ecography* 29: 129—151




Crocodylus acutus
Climate envelope 2080
Suitability
High
Low


Climate envelope
Habitat availability
Sea level rise
Atlantic Ocean
Jacksonville
Daytona Beach
Orlando
Cape Canaveral
GEORGIA
Gainesville
FLORIDA
Tampa
Fort Myers
Fort Lauderdale
Miami
Key West
Saint Petersburg
Tallahassee
Panama City
Pensacola
ALABAMA
Gulf of Mexico
+ 5 meters
USA: Florida
100 km

Funding for the first year of this project was provided by USGS Greater Everglades Priority Ecosystems Science, FWS South Florida Ecological Services Office, and NPS Critical Ecosystems Science Initiative.

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USGS science for a changing world

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U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR