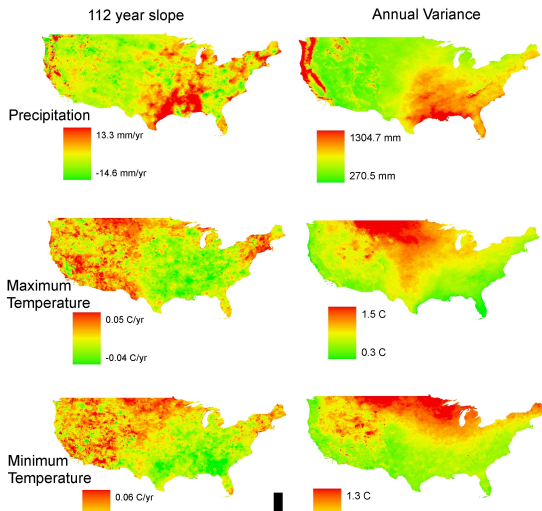


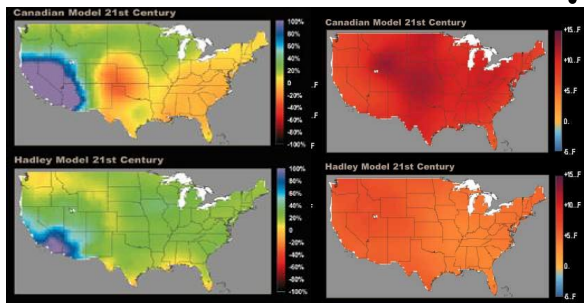


Invasive Species and Climate Change

1. Quantifying past climate trends



2. Bracketing future climate change scenarios from existing or new models

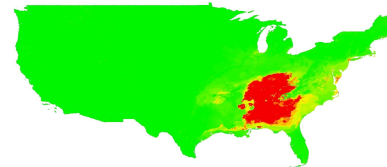


3. Forecasting species range shifts based on current distributions and interdisciplinary datasets from Biology, Water, Mapping, and Geology.

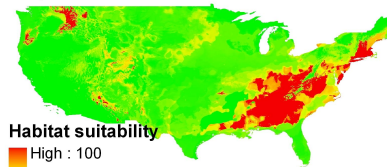
Japanese Honeysuckle



Current Climate



Projected 2100 (NCAR CCM3 Model)



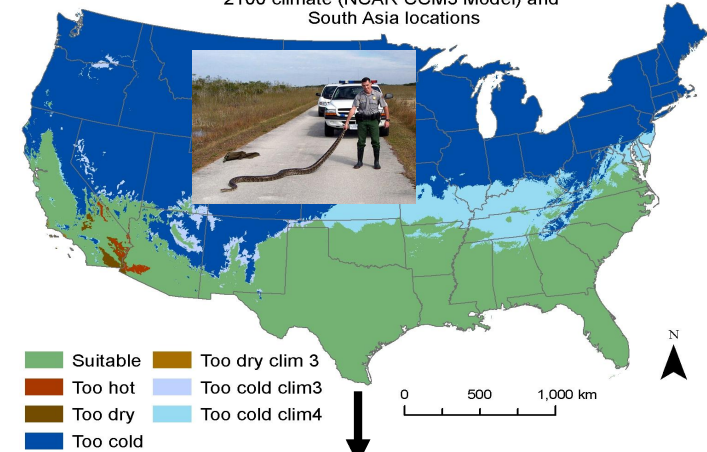
Habitat suitability
High : 100
Low : 0

6. Getting the information to on-the-ground managers for prevention, "watch lists," risk assessments, early detection, rapid response, control, and restoration.



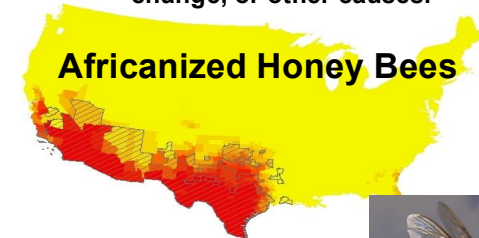
4. Testing various models on many species at multiple spatial scales

Potential *Python molurus* range in the US based on projected 2100 climate (NCAR CCM3 Model) and South Asia locations

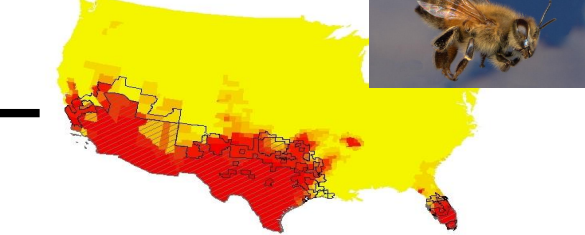


5. Isolating background rates of spread from those caused by climate change, land use change, or other causes.

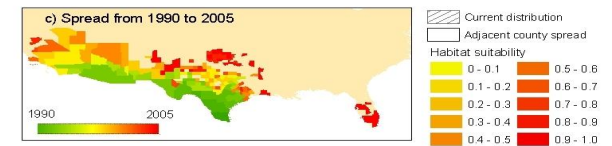
a) Current climate



b) Projected 2100 climate (NCAR CCM3 model)



c) Spread from 1990 to 2005



Modeling Diverse Taxa at Diverse Resolutions Using Various Techniques

- Models for plants, animals, and diseases
- Models at varying spatial extents and resolutions
- Comparison of modeling techniques; different scales, resolution, and extents (local to global); native and non-native species; generalists vs. specialists; rare or common species

Model Technique	Description	Reference
Logistic Regression	Presence/absence data prediction of habitat suitability	McCullagh and Nedler, 1989
Multiple Linear Regression	Continuous data predictions (e.g., percent cover) using regression principles	Most statistical packages
Maxent	Inferences from available data, avoiding unfounded constraints from the unknown (principles of maximum entropy)	Phillips et al., 2006
GARP	Successive iterations of a rule-set, modified each time, to convergence	Stockwell and Peters, 1999
CART	Repetitively partitions the dependent data into two homogenous groups at a node using regression principles	Breiman et al., 1984
Environmental Envelope	Environmental range where present applied to other locations	Jarnevich et al., In review
Manually derived	Species-specific model generated by experts, implemented spatially in ArcGIS	For example, see Rodda et al., In review

References:

Breiman, L., J.H. Friedman, R.A. Olshen, and C.G. Stone. 1984. Classification and regression trees. Wadsworth International Group, Belmont, Calif., USA.

Jarnevich, C.S., D.T. Barnett, T.J. Stohlgren, and J. Kartez. (In review). A simple framework for an invasive species early-warning system for counties. *Frontiers in Ecology and the Environment*.

McCullagh, P., and Nelder, J.A. 1989. Generalized linear models, 2nd ed. Chapman & Hall, London, UK.

Phillips, S. J., R. P. Anderson, and R.E. Schapire. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling* 190:231–259.

Rodda, G.H., C.S. Jarnevich, and R.N. Reed. (In review). What parts of the U.S. mainland are climatically suitable for invasive alien pythons spreading from Everglades National Park? *Frontiers in Ecology and the Environment*.

Stockwell, D., and Peters, D. 1999. The GARP modelling system: problems and solutions to automated spatial prediction. *International Journal of Geographical Information Science* 13 (2):143–158.

Contact:

Tom Stohlgren (stohlgren@usgs.gov) or Catherine Jarnevich (jarnevich@usgs.gov) or Tracy Davern (davern@usgs.gov)

