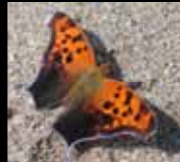


# GBIF & GEOSS Strengthening predictions of global change impacts on biodiversity

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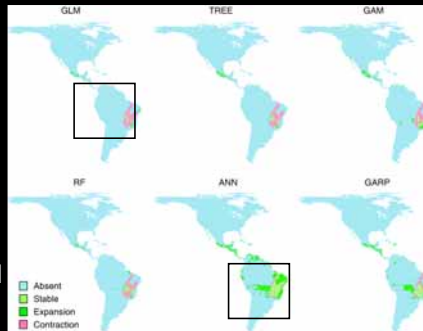
## Overall objectives

- Provide a relevant scientific application that may imply future architectural needs.
- Demonstrate potential to generate policy-relevant science by linking data from GEOSS and GBIF.
- Improve our predictions for species distributions to future global changes.
- Accurately predicting and then mitigating the impacts of future climate change is critical.



## Predicting climate change impacts: Current approach

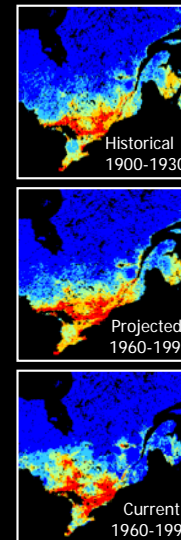
- Based on contemporary patterns
- Highly variable predictions from different niche models.
  - Same region
  - Same species (marmoset)
  - Different methods
- Models can only be tested *weakly* because they are forecasts.
  - No evidence at all that spatial models work temporally.



**Expansion**  
**Contraction**

Lawler et al. 2006.  
*Global Change Biology.*

## Calibrating predictions of future climate change impacts



Use historical data to model historical range

Use historical model to project current range

Use current data to model current range

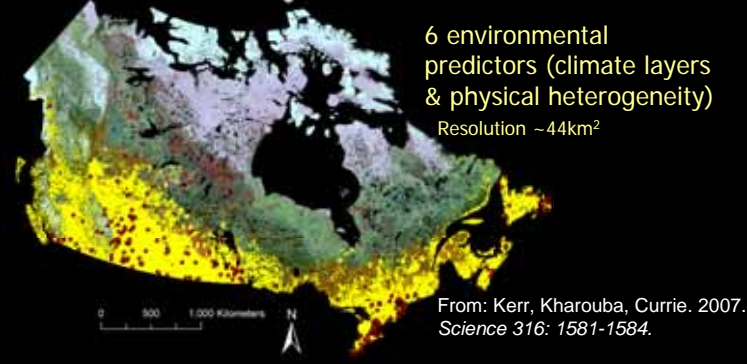
Compare projected range to modeled current range

Use current range to project range in the future

## Models



- Maximum entropy (Maxent)
- Canadian National Collection of Butterflies  
- Accessible through CBIF/ GBIF

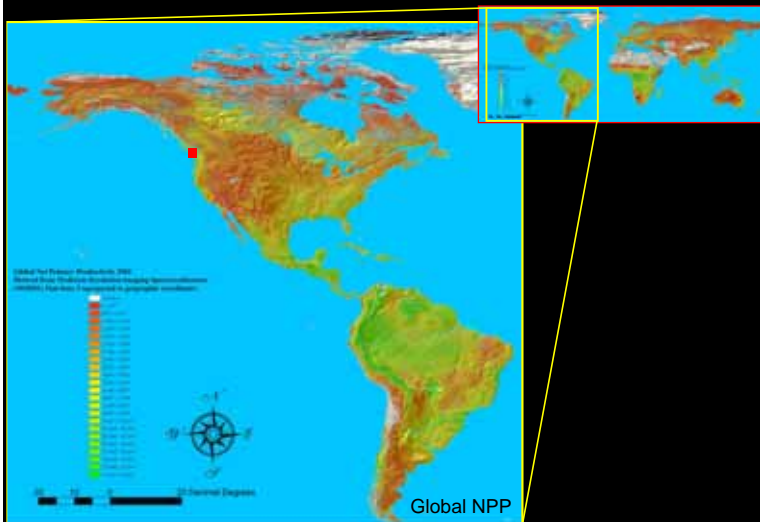


## Data requirements for modelling

- Use of high quality remote sensing datasets is vital to capture real-world variability. GEOSS architecture promises to vastly improve access to such data.
- One important limitation when linking GEOSS to GBIF is that RS data extend back no farther than the 1970's.



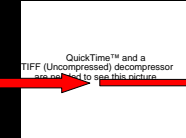
## RS data can also include climate surrogates



- Precision and accuracy of biodiversity observations is difficult to match with readily accessible RS data.
  - Google Earth sometimes has better data than main science agencies!



*Polygonia* spp



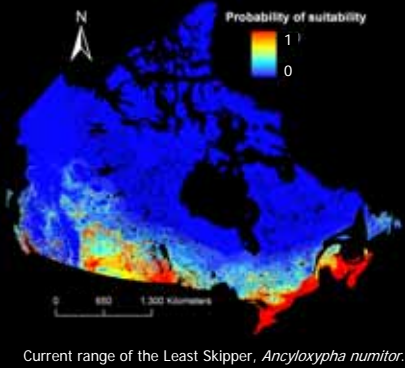
Expected from a particular location on Vancouver Island



That exact location probably did NOT support a *Polygonia* population. Furthermore, environmental changes can be **fast** but biodiversity data updates are **slow**.

## Maximum entropy (Maxent)

- One of many possible niche modeling techniques.
- Assigns a relative index of environmental suitability to each pixel



Current range of the Least Skipper, *Ancyloxypha numitor*.

## Model evaluation

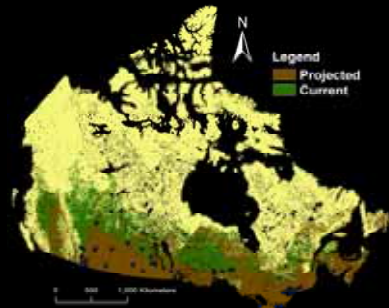
- Correlation across
  - Pixels
  - Ecodistricts
- Model accuracy for projection model (I.e. do the models work when run through time?)



Black Swallowtail, *Papilio polyxenes*. Photo: J Kerr

## Model accuracy

- Calculated % of occurrence pts for 1960-1990 correctly classified as suitable by the projected model.
- Converted MAXENT outputs to binary (estimating presence-absence)

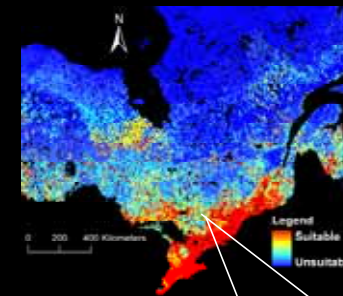


Projected and current range of Meadow Fritillary, *Boloria bellona*.

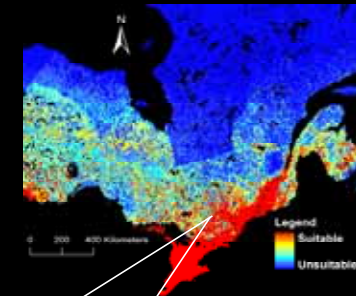


## Correlation across pixels

Projected range

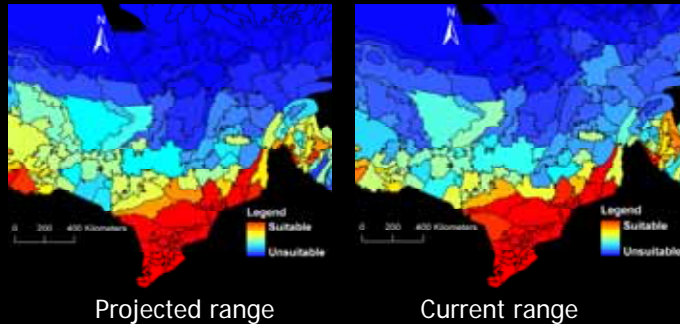


Current range



## Correlation across ecodistricts

- Average predicted suitability per ecodistrict (n=1025)



## Results

How accurate are predictions of distribution change?

	Average R <sup>2</sup> (±SE)	Average Slope (±SE)
Pixels	0.46 (0.016)	0.78 (0.022)
Ecodistricts	0.60 (0.020)	0.88 (0.026)

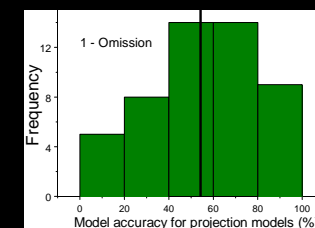
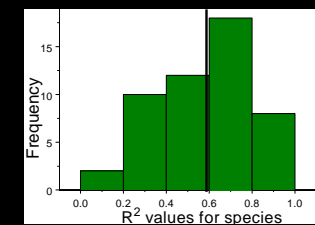
Predictions are biased and have variable precision.

## Results

- Projected ranges included 58% of species observations in the present-day.
- Current modeled ranges included 93% of species observations in the present-day.
- For 65% of the species, projected ranges were smaller than species' current ranges.
  - Perhaps an effect of variable sampling intensity?

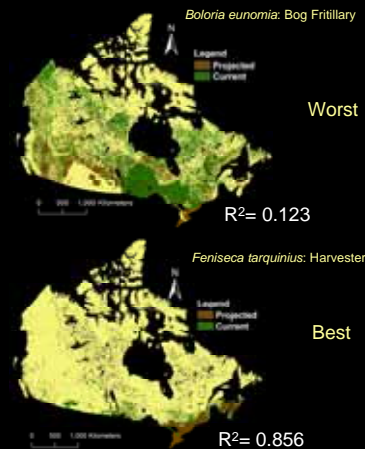
## Discussion

- Predictive ability of projections are good but variable.
- Predictions improve at regional scales.
- These species may respond quickly to climate change.



## Moving Forward:

- Is predictive ability based on biological characteristics of species?
  - lower for northern species with larger distributions
- What do these models predict for the future?
- How do models relate to field observations of species presences?
  - Canada Global Change Transect (CGCT)



## Canada Global Change Transect



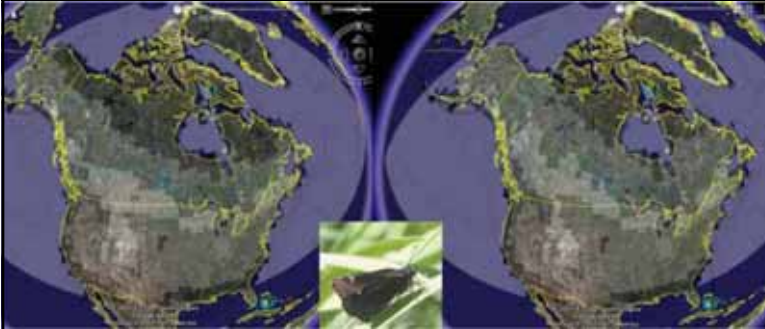
## Implications for predicting the future

- Sometimes the assumption that spatial models can predict trends through time is simply wrong.
  - Some species do not respond as expected and there is no apparent way to tell which ones.
  - Predicting climate change impacts is better done using species assemblages (not individual species) and at a regional scale.
  - Calibration against known responses is helpful!

## GEOSS-GBIF

- Generating historical models is possible within the data/modelling framework constructed for GEOSS and GBIF.
- Once appropriate data and historical calibration are assembled, the GEOSS framework can be used to predict outcomes:

## GEOSS-GBIF partnerships for climate change forecasts



Nativi, S., P. Mazzetti, H. Saarenmaa, J. T. Kerr, H. Kharouba, E. O Tuama, & S.J.S. Khalsa. In press. Predicting the impact of climate change on biodiversity - a GEOSS schenario. The Full Picture.

## Conclusions

- Predicting future climate/land use change impacts accurately is possible.
  - BUT, individual species can behave idiosyncratically.
  - Use many species and calibrate future predictions on observed, past responses.
- GEOSS - GBIF partnerships expand the reach of the science and improve policy relevance.

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