

Using species distribution models for predicting climate change impacts on protected areas

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Objective

Protected areas (PA)

- Assessment of parks at global level
- 130,000 and increasing
- What are the consequences of climate change?
- Will there be other areas that can protect the same animals?
- Will PAs protect the animals or act as prisons?



Context: Web Services

- Results to be used in updated version of APAAT
- DOPA – Digital Observatory of Protected Areas



JOINT RESEARCH CENTRE
Land Resource Management Unit

European Commission > JRC > IES > LRM > Data & Products > African protected areas

All countries Select a protected area

Assessing protected areas in Africa

This EXPERIMENTAL information system is part of a first attempt at a large scale assessment of protected areas using objective continent-wide data sets and methodologies as opposed to case studies on individual parks or global assessments (e.g. Chape et al. 2005 et al.). The website contain information on 741 protected areas, across 50 countries, and includes information on 280 mammals, 381 bird species and 930 amphibian species, and a wide range of climatic, environmental and socioeconomic information. The purpose of the work is to provide to decision makers a regularly updated tool to assess the state of Africa PAs and to prioritize them according to biodiversity values and threats so as to support decision-making and fund allocation processes.

We are continually looking to improve and update this website. We would be happy to receive any comments and suggestions as to how this website can be improved - more or better data or how to best present the data for example.

The 741 African protected areas covered in this website:



Press "Shift" and draw the new map extent

5 October 2012



DIGITAL OBSERVATORY FOR PROTECTED AREAS (DOPA)
Institute for Environment and Sustainability

European Commission > JRC > IES > DOPA

DOPA

Digital Observatory for Protected Areas

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The Digital Observatory for Protected Areas

"Providing the right information to the right people with the right tools"

The Digital Observatory for Protected Areas (DOPA) has been created as a component of the GEO-BON observation network by the Joint Research Centre in collaboration with other international organizations including the Global Biodiversity Information Facility (GBIF), the UNEP-World Conservation Monitoring Centre (WCMC), BirdLife International and the Royal Society for the Protection of Birds (RSPB). DOPA is conceived as a set of distributed databases combined with open, interoperable web services (Figure 1) to provide a large variety of end-users including park managers, decision-makers and researchers with means to assess, monitor and forecast the state and pressure of protected areas at the global scale.

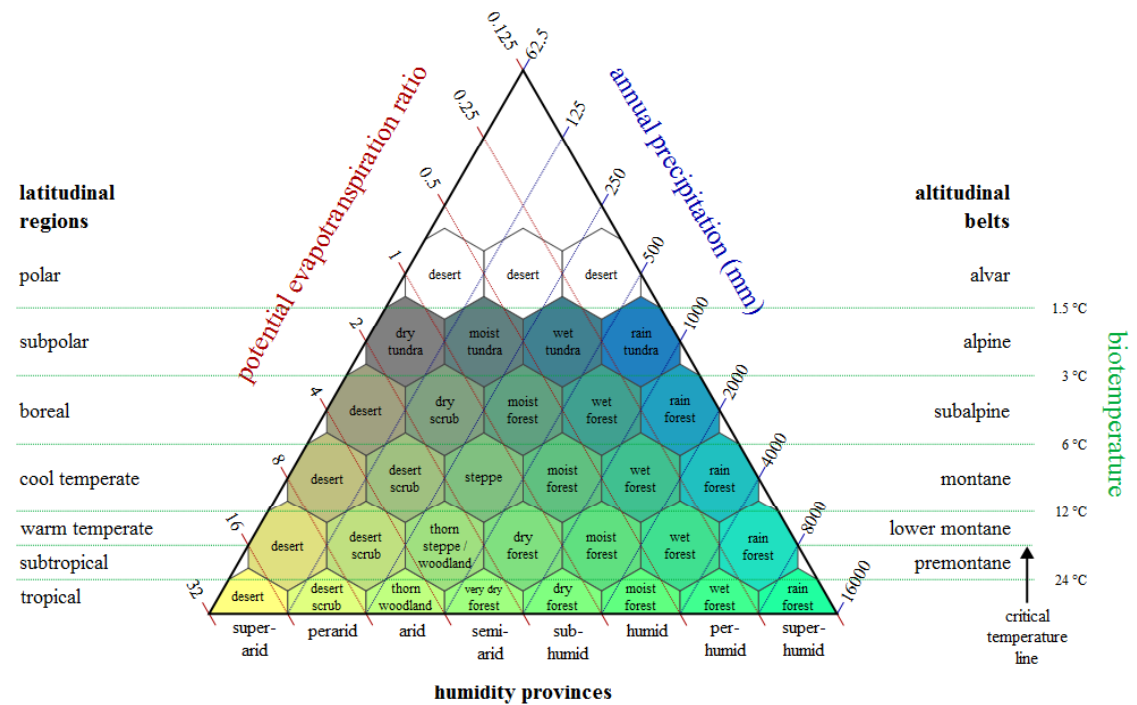
DOPA is also a contribution to the Group on Earth Observations Biodiversity Observation Network (GEO-BON), the biodiversity arm of the Global Earth Observation System of Systems (GEOSS).



Species distribution
Ecosystem Services
Habitat modeling
Land cover mapping
Monitoring of Marine Ecosystems
Monitoring of Terrestrial Ecosystems & Fire ecology
Environmental Management

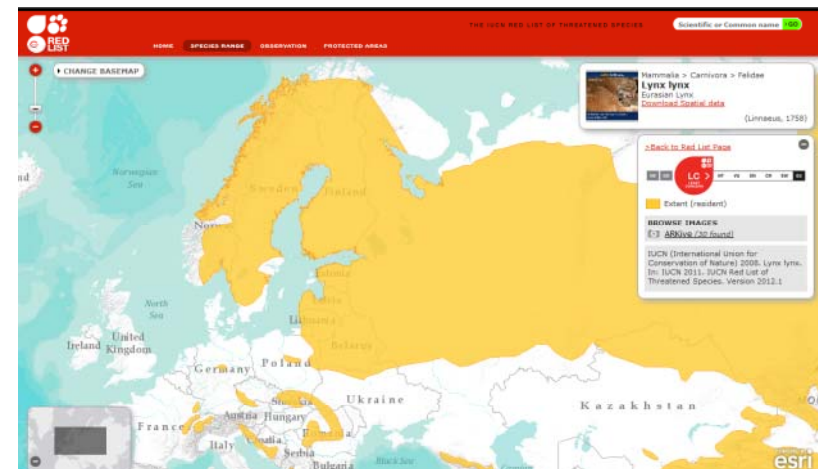
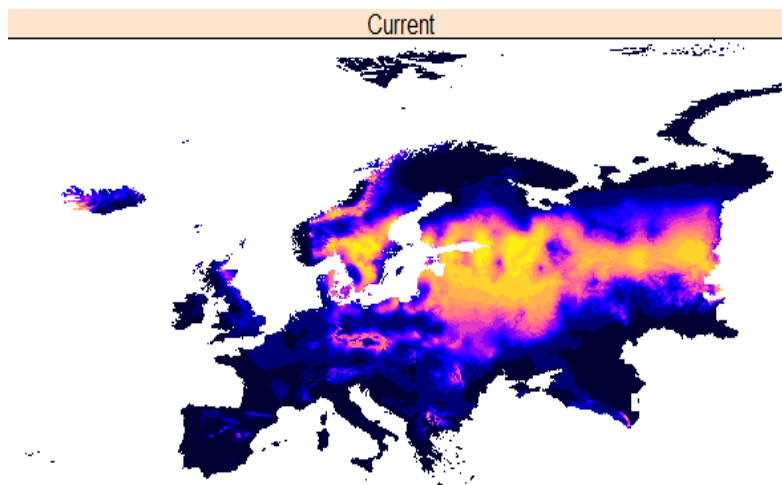
Climate data

- Using Holdridge variables – current and forecast
- Climate data from WorldClim – 10min
- Examples with HADCM3 A2a scenario – relatively large changes

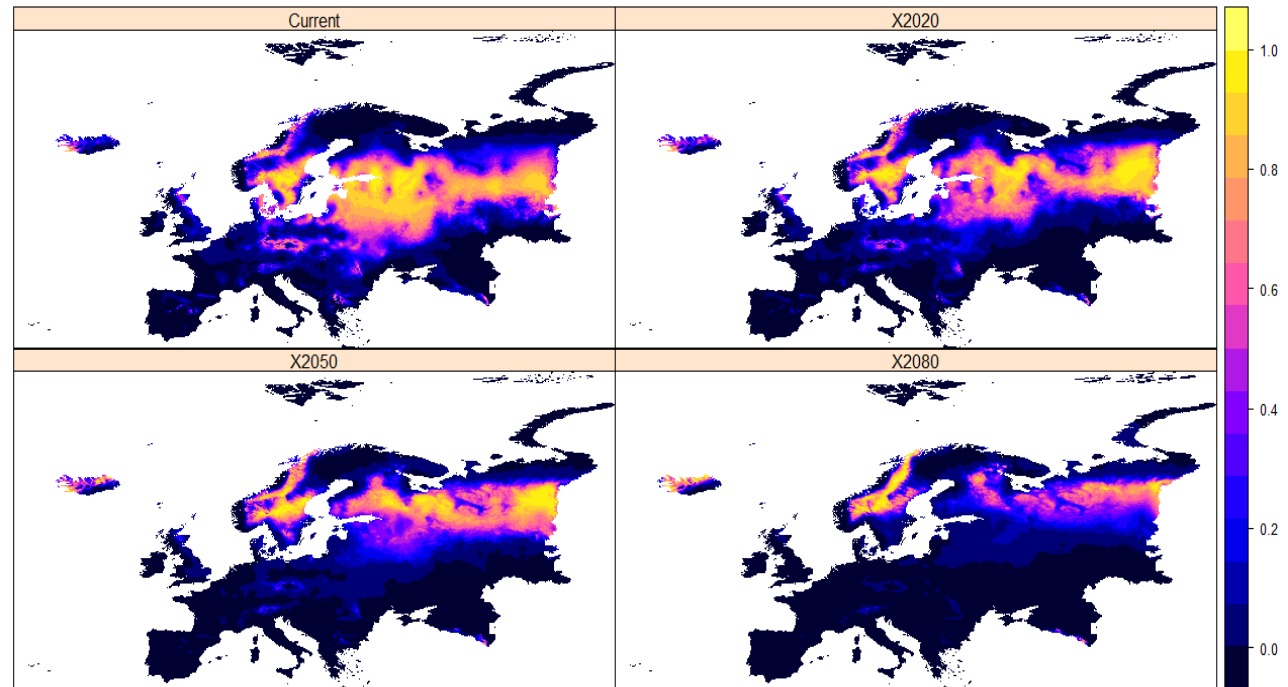


Species distribution models

- Predicts the similarity to a training data set of environmental indicators
- Several methods such as Maxent, Bioclim, Domain, Mahalanobis
- Frequently used for forecasting impacts of climate change on species habitats



Forecast



- Some limitations
 - Can be challenging to find the right combination of environmental indicators
 - Is current climate the limiting factor?
 - Will some species be well adapted for new climates?

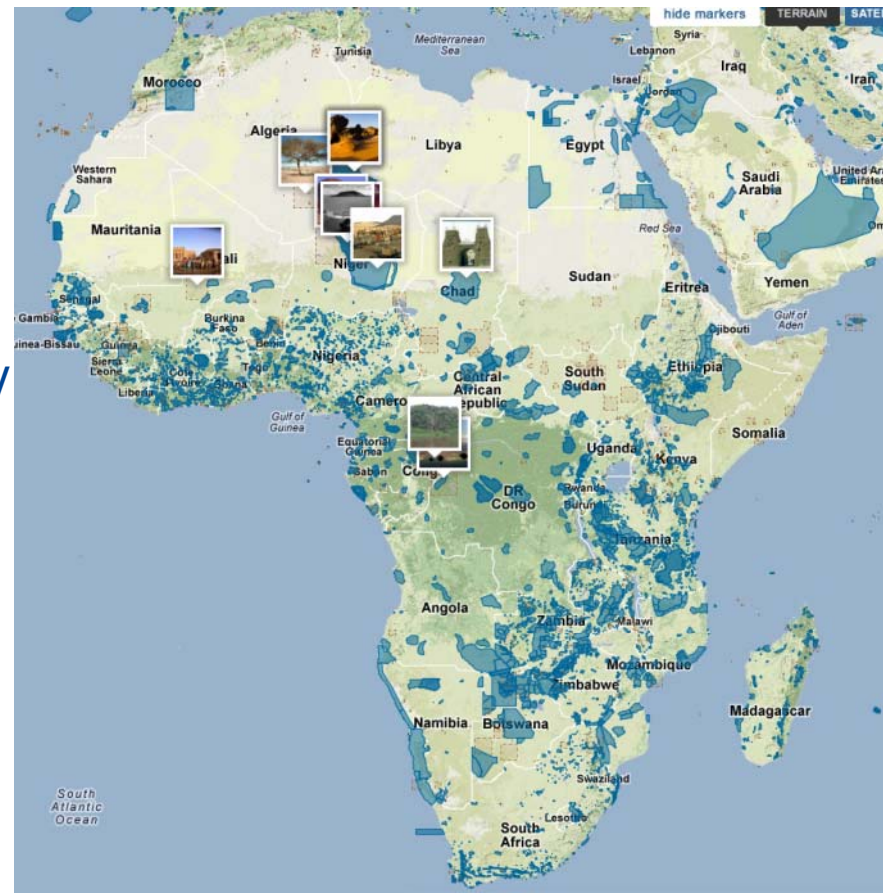
Predicting impact of climate change for protected areas

We want

- Method giving PA tolerance for changes, not looking at individual species
- Consistent method easy to apply for large number of parks
- Method finding which parks are more threatened by climate change

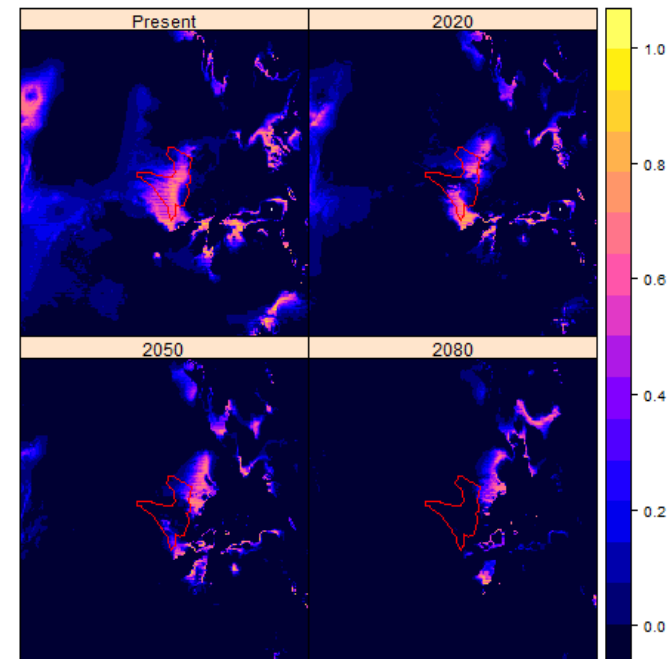
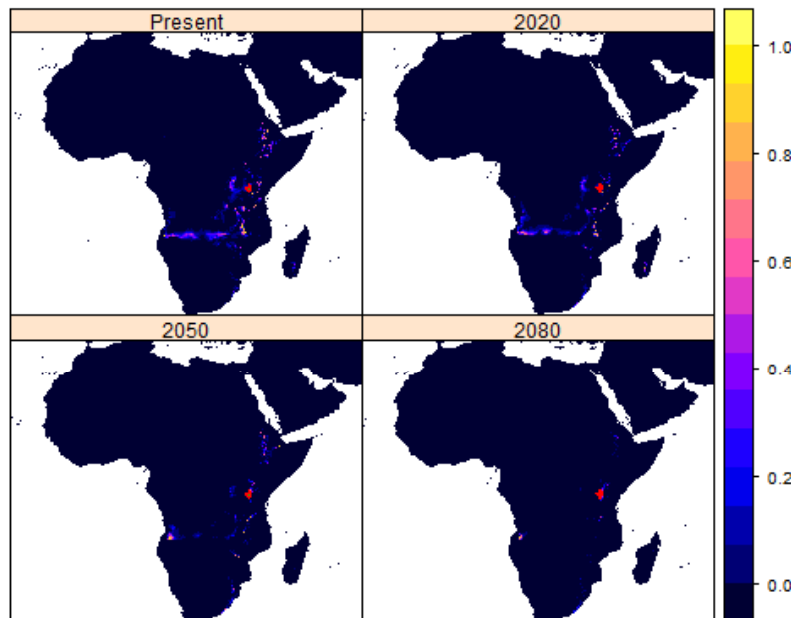
SDMs: Robustness to change depends on variability of training data

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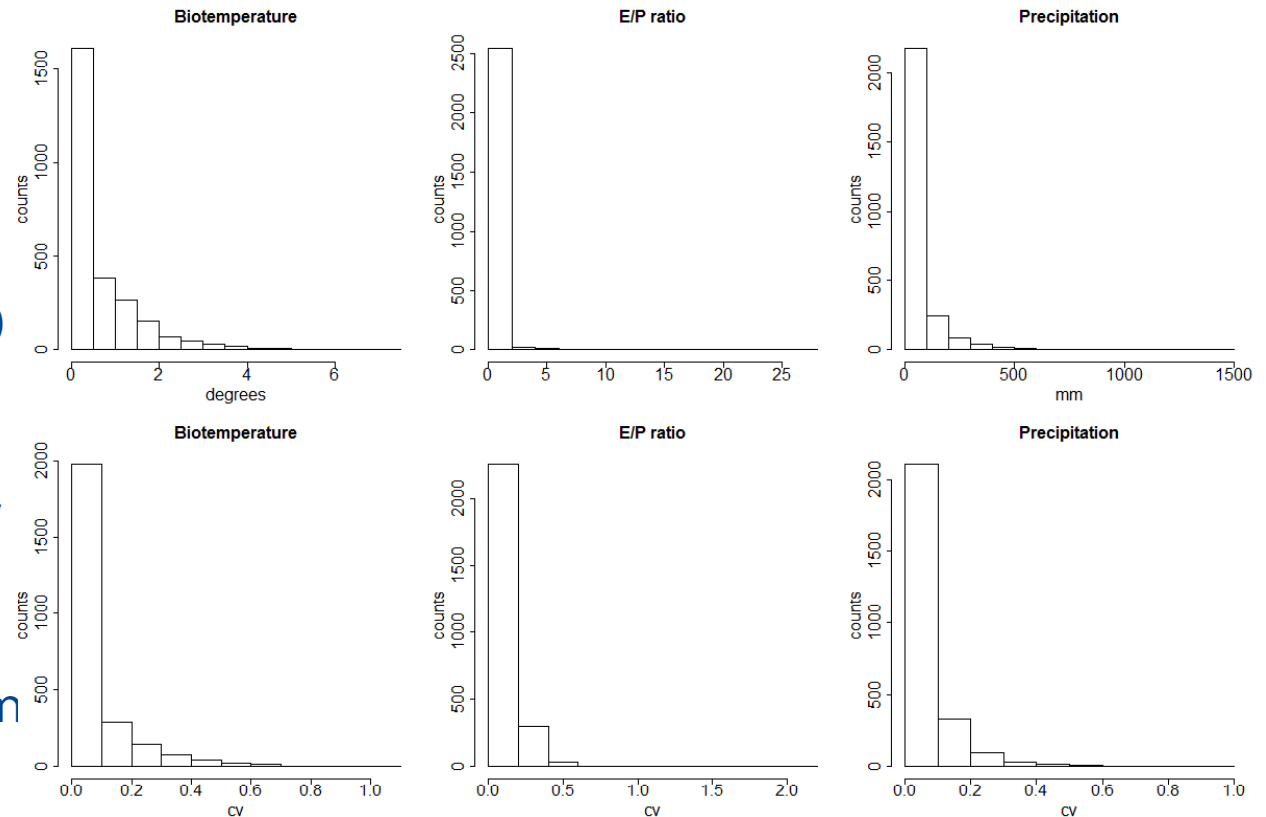
Naïve method: Use climate variables from PA

- Large PAs have larger tolerance to changes than small PAs
- Hilly PAs have larger tolerance to changes than homogeneous PAs



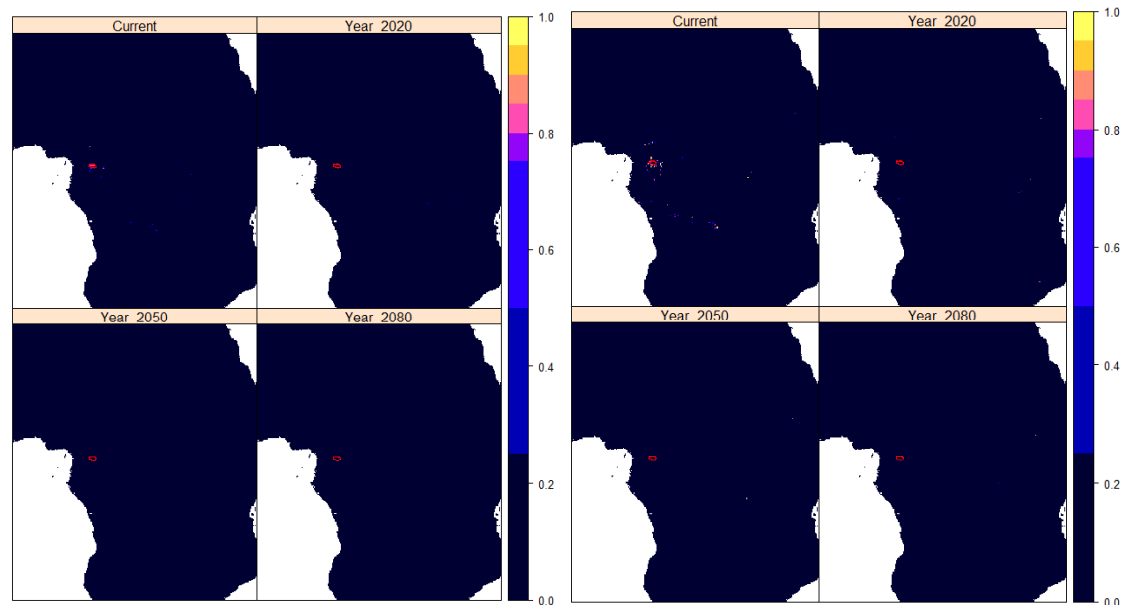
Observed variability within PAs

- Small variability within parks
- Variability based on interpolated maps (smoothing)
- Around 3,000 of the largest parks
- Smaller variability in smaller parks
- Serengeti: 1.2C, 0.14, 85mm



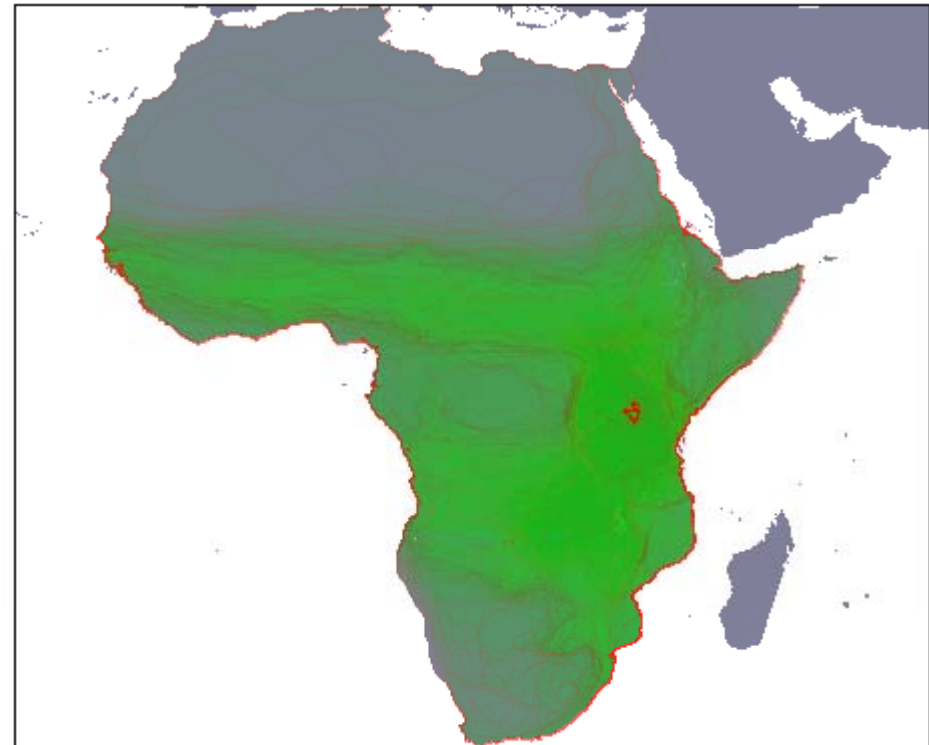
Simple improvement – use minimum variability

- Compare the estimated variability with a minimum variability
- Modify covariance function if necessary
- Based on guessing
- Computationally fast
- More consistent result
- Not always better result



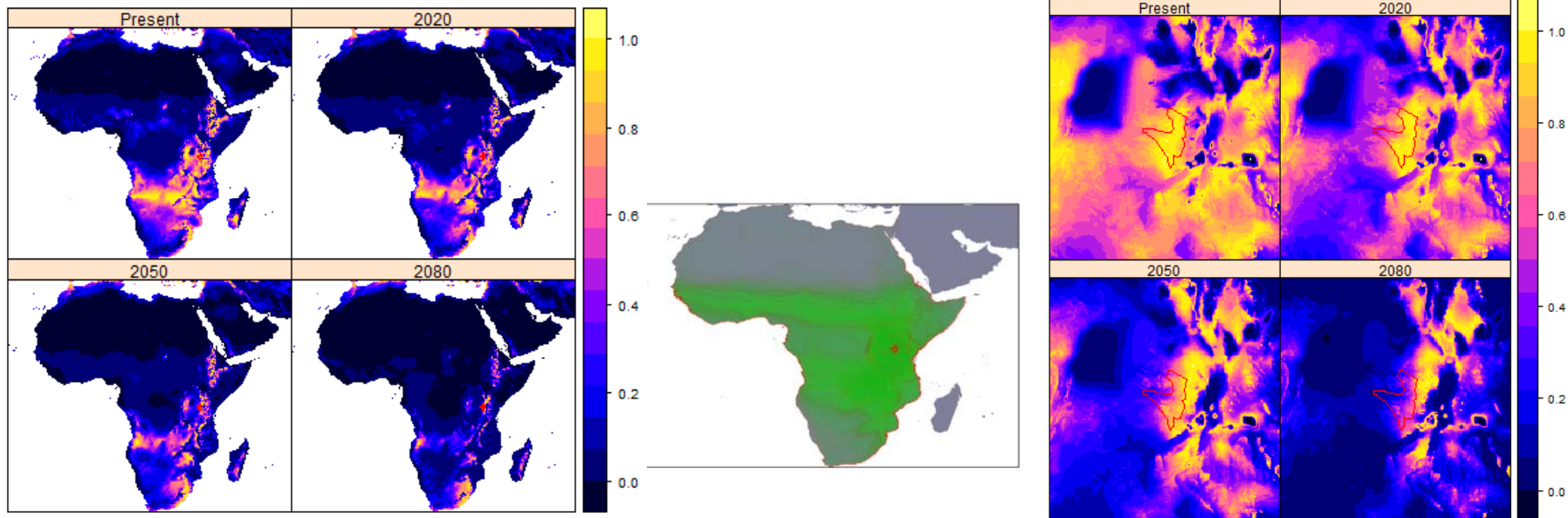
Where do the species in a park live?

- Include estimated species ranges
- Mean and variance weighted with the presence in the park
- Data sets with high uncertainty
- Likely to overestimate similarity
- Possible to give higher weights to particular animals (red list, endemic species, etc.)



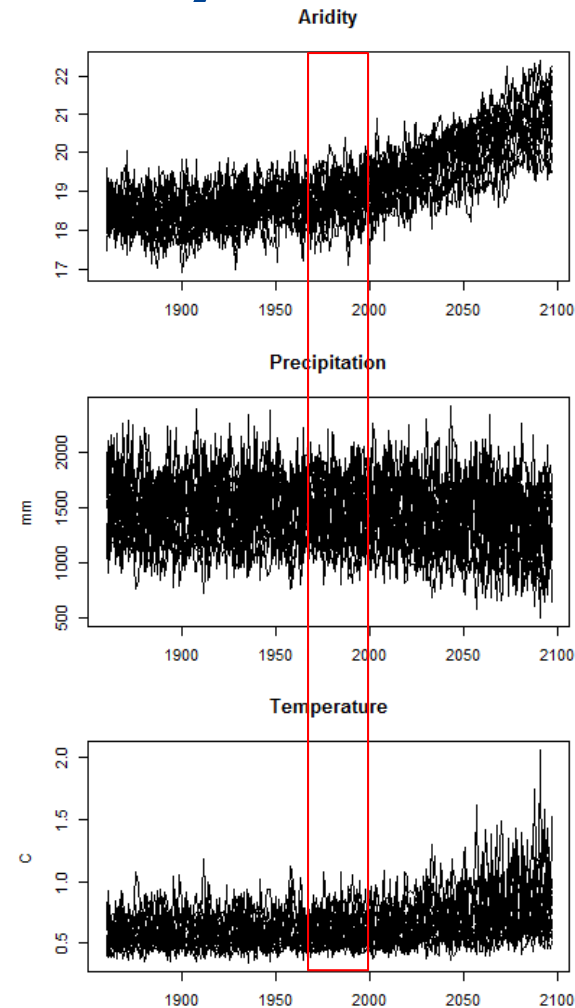
Weighted with species ranges

- Most likely overestimating similarity
- Still rather extreme decrease for this park



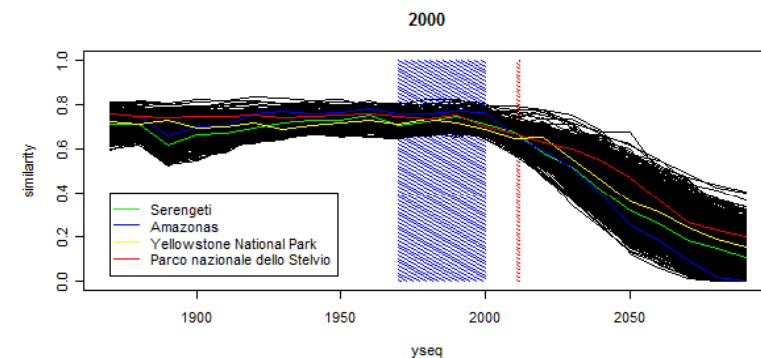
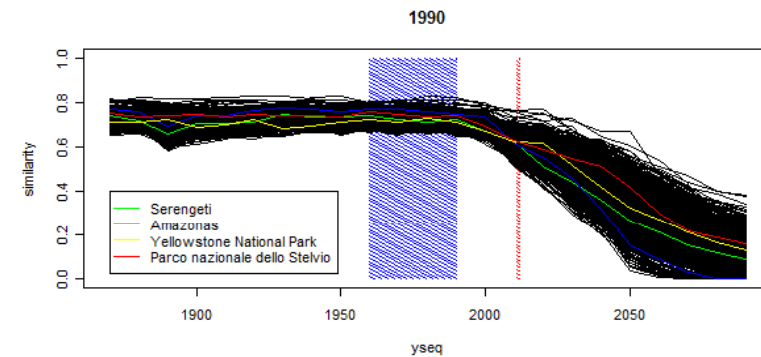
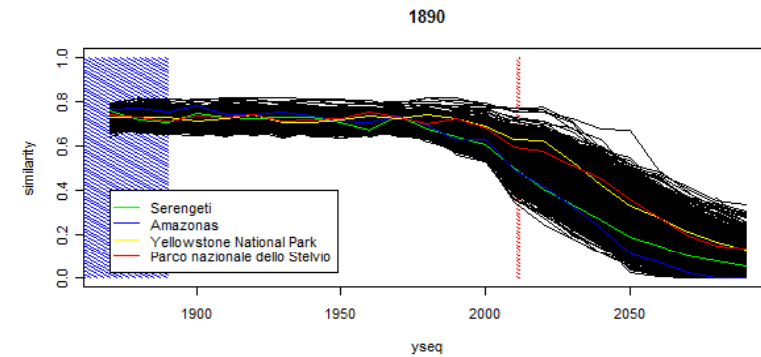
What is the variability today?

- Use temporal variability as substitute for tolerance
- Time series from HADCM3 model (1859-2098)
- QUMP runs with uncertainty
- Use 30-year period as reference
- Variance represents hindcast climatic variability for a location

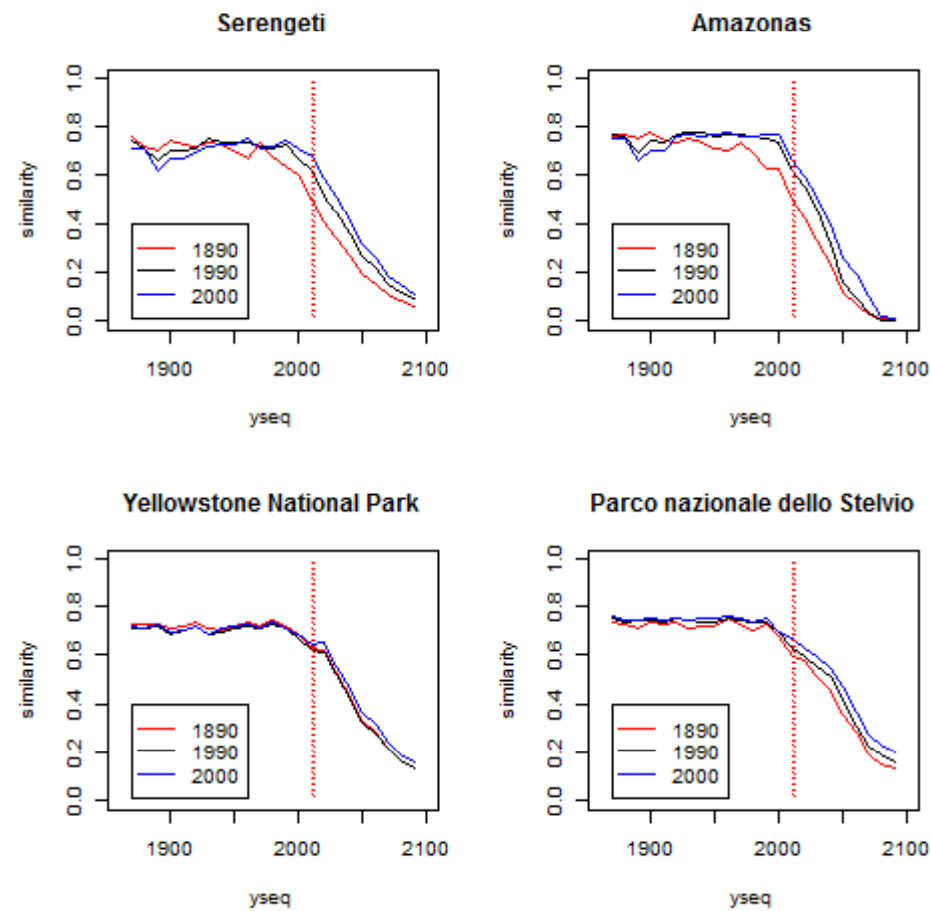


Similarity with the future

- Similarity between reference period and future climate
- Figure shows median of QUMP runs
- All scenarios show strong decrease, strongest for tropical areas
- Method not yet used for computing similarity maps



Effect of reference period



Conclusions

- Necessary to assess climate change impacts on PAs globally – available through web service
- SDMs are useful – variability of training data defines tolerance for changes
- Four methods – not ranked
- Validity of result for a park depends on reliability of GCMs and downscaling method (Hartley)
- Methods do not take possible thresholds into account - difficult to assess for all parks
- Who will live in new climates?



Thanks!

This work is partly funded by the European Commission, under the 7th Framework Programme, by the EuroGEOSS project funded by DG RTD and by the UncertWeb project funded by DG INFSO. The views expressed herein are those of the authors and are not necessarily those of the European Commission. More information on eHabitat & DOPA can be found at <http://dopa.jrc.ec.europa.eu/>