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Uncertainty propagation in assessing ecosystems similarities – an example application using eHabitat

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eHabitat is a Web Processing Service (WPS) designed to compute the likelihood of finding ecosystems with equal properties. The original underlying idea of the service is to allow end-users to characterize ecosystems within defined boundaries, typically an area protected for conservation purposes, and to assess the probabilities to find similar ecosystems outside of these boundaries. Examples of applications are the modeling of habitats when linking eHabitat to species data, the assessment of the irreplaceability of selected habitats or the analysis of connectivity between protected areas.

Inputs to the eHabitat WPS are typically thematic maps in a raster format that can be selected using standardised catalogues. Typical input layers are derived from land cover and climatic maps. By using forecasted climatic data, eHabitat can be used to contrast forecasted ecosystems with the current situation. Hence, the main potential of eHabitat resides in its possibility to be chained with other modeling web services, a concept that has already been encouraged by Geller and Turner (2007) with their concept of a network of interacting modeling services, the Model Web.

Because the input layers used to feed eHabitat can range from geophysical data captured through remote sensing to socio-economical indicators, the service is exposed to a broad range of different types and levels of uncertainties. Chained to other services from the Model Web to perform ecological forecasting for example, eHabitat would be an additional component further propagating uncertainties from a potentially long chain of model services. This integration of complex resources increases the challenges in dealing with uncertainty.
UncertWeb will create the Uncertainty enabled Model Web by promoting interoperability between data and models with quantified uncertainty, building on existing open, international standards. UncertWeb will thus develop open source implementations of encoding standards, service interface profiles, discovery and chaining mechanisms, and generic tools to realize a "Model Web" taking uncertainty in data and models into account.

In the case study described here, we use climate data for predicting the ecological similarity between protected areas in Africa today and in the future. The data are the climatic variables used in Holdridge's lifezones, i.e. biotemperature, annual precipitation and the ratio between annual potential evapotranspiration and precipitation. Biotemperature is the average temperature after replacing all monthly below freezing point with zero-values. The original data sets of monthly temperatures and precipitation from today and the future are found from the WorldClim data base (www.worldclim.org). The main aim is to assess the vulnerabilities of the different protected areas to climate change. With changing climate, the conditions inside the park will be less similar to the current conditions, but there are some cases where areas outside the park could offer higher similarities. As the future climate predictions are uncertain, and more uncertain than the current estimates, the possible conclusions to be drawn from the analysis will be affected. This paper discusses how the results are influenced by the propagation of uncertainties in eHabitat and will present the benefits and limitations of the use of the UncertWeb framework through the example application.