ECOPOTENTIAL: Integration of Earth Observation in ecological modelling

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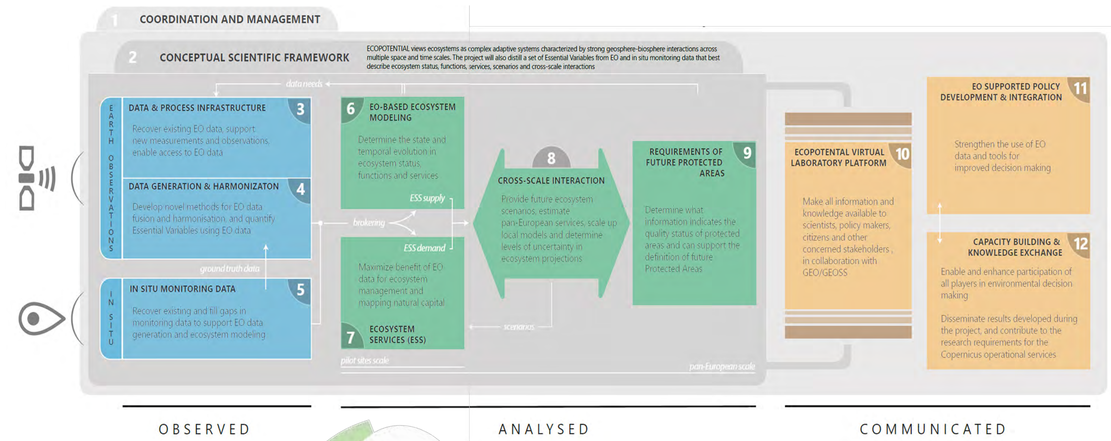
Sustainable development demands for an enhanced-evidence-and science-based policy and management of the environment. The ECOPOTENTIAL way to address the issue is to improve the capability of monitoring and modelling the ecosystems and ecosystem services by starting from Protected Areas. The PAs thus act as open labs for building the necessary knowledge base to face the challenge of global change.

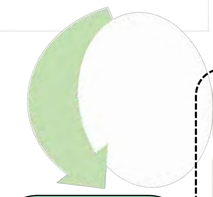
A major asset of the ECOPOTENTIAL's approach to enhance predictive capacity of the state and temporal evolution of ecosystems is to focus on the integration of modelling techniques with EO data, both remote and in-field. The goal is to improve our knowledge on ecosystem nonlinearity, complexity and uncertainties and to predict ecosystem changes in key PAs.

ECOPOTENTIAL develops and applies a range of EO-data based conceptual, correlative and process-based models on mountains, arid and coastal/ marine ecosystems and prototypes online data services for ecosystem indicators and potential supply of ecosystem services using data-assimilation. The poster showcases a few examples.

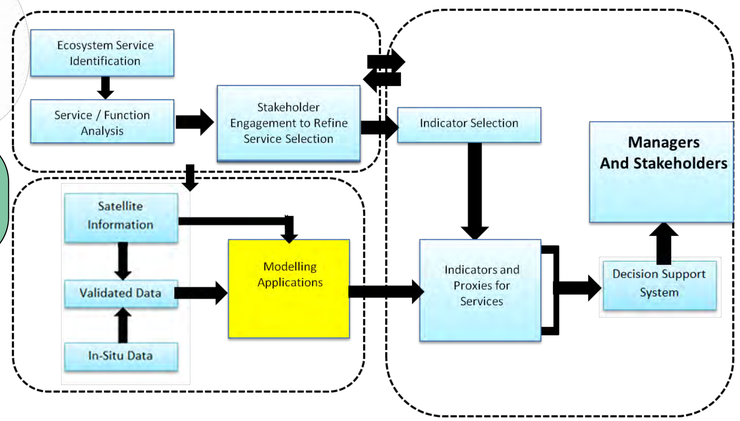
PROJECT STRCTURE



CASE STUDIES



INTEGRATION OF EO DATA IN THE CONSERVATION OF ECOSYSTEMS



Acknowledgements

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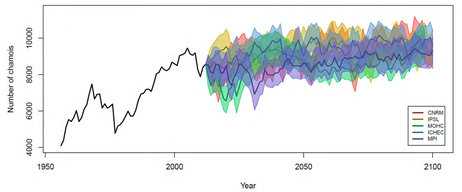
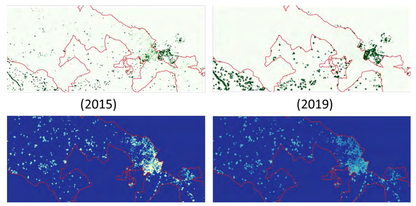
Climatic effects on population dynamics



- To estimate future population trends, the best-performing models have been forced with the time series of meteorological variables generated by 5 CMIP5 climate models in the framework of the CORDEX program for the RCP4.5 and RCP8.5 scenarios in the period 2013-2100. Applied to the chamois population in Gran Paradiso National Park.
- The analysis includes both ground count data and variables extracted by remote sensing data (e.g. presence of standing water in rice fields, MODIS time series).

Figure: Projection of chamois population in the Gran Paradiso National Park , according to the output of 5 CMIP5 climate models

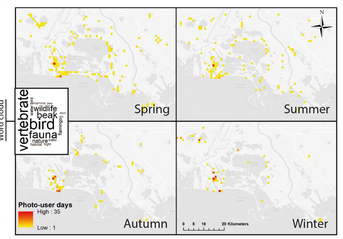
Optimal control of invasive species



- Based on process based models injesting remote sensing data and products as well as in-situ data.
- Allows to simulate the spread of an invasive species with and without control actions
- Optimizes in space and time the allocation of the resources to be used for the eradication of the species in a Protected Area.
- Applied to the spiecies Ailanthus Altissima species in the Murgia Alta National Park.

Figure: Species distribution (top) and optimal resource allocation (bottom) at two different times

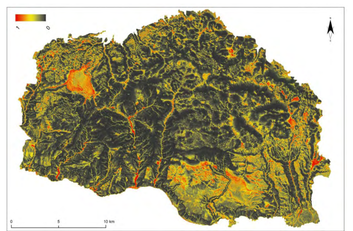
Cultural ecosystem services



- Combining techniques from machine learning (image analysis), natural language processing (Latent Semantic Analysis (LSA)) and self-organising maps (SOM).
- Over >20,000 photos from the Camargue region in Southern France analysed.
- Clustering algorithms revealed six distinct user groups, which including ornithology, religious pilgrimage, general use and aviation.
- Users mapped both temporally and spatially.

Figure: Photo-User Days (PUD) for "bird lovers" seasonally in the Carmague, France.

Habitat suitability



- Based on topographic variables and in-situ data.
- MaxEnt approach used to correlate the presence of a species (lizard Podarcis cretensis, Samaria National Park) to 2nd order parameters or secondary topographic attributes (geodiversity).
- The results are important for targeted conservation management of the endemic lizard.

Figure: Suitability map of the endemic lizard related to topographic variables

Serious games

- Integration of modeling, remote sensing, expert knowledge, and monitoring data
- Takes advantage of Bayesian Belief Networks to highlight uncertainty in policy and mitigation measures.
- Allows players to explore the trade-offs in optimizing ecosystem services for specific goals.
- Facilitates discussion between stakeholders on the implementation of possible measures and the effects.

Figure: screenshot with an example of game options