ANIS

Accuracy of Niches Improved by Satellite

Institut de Recherche pour le Développement FRANCE

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INTEGRATE FIELD AND REMOTE SENSING DATA USING HABITAT DESCRIPTORS, A KEY FOR EFFICIENT POLICIES IN CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY

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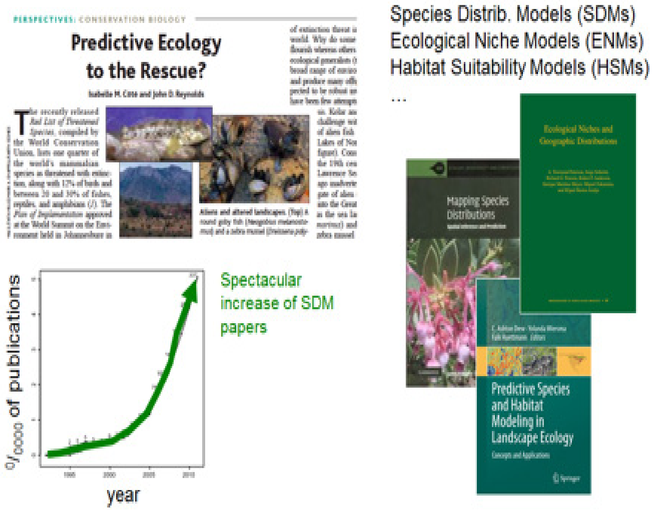
20 Partners: IRD, Bondy, France; IRD, New Caledonia, France; INRIA, Saclay, France; MNHN/GBIF-France, Paris, France; FRB/CESAB, Aix en Provence, France; Botanical Garden and Botanical Museum, Berlin, Germany; Museo Nacional de Ciencias Naturales, Madrid, Spain; Aston University, Birmingham, United Kingdom; Royal Botanic Garden, Kew, United Kingdom; Botanic Garden, Meise, Belgium; Lausanne University, Switzerland; Botanic Garden, Geneva, Switzerland; Kansas University, Lawrence, USA; Qatar University, Qatar; Khalifa University, United Arab Emirates; Google Earth, Mountain View, USA; GBIF, Copenhagen, Denmark; Mahalanga University, Madagascar; IRAD, Yaounde, Cameroon; Yaounde University, Cameroon.

In recent years, models of ecological niches and species distributions have developed tremendously, especially when applied to conservation and global change, but also to address more fundamental issues. However, if ENMs have the potential to provide key support to conservation decisions, accurate predictions are required to limit the risk of false decisions. These models thus not only need appropriate species distribution data but also require accurate and informative environmental data to quantify ecological niches and predict species distributions. However, obtaining meaningful and reliable environmental descriptors has remained so far a major limitation of these predictive modeling approaches. One promising source of new or improved data for ENMs is remote sensing. Remote sensing products are not new, and remotely-derived environmental predictors have already been used in ENMs at various scales, e.g. to derive alternative climatic maps as predictors, to map single tree species or genus (Fig. 1), to support monitoring programs or as improved environmental descriptors, e.g. from hyperspectral images in ENMs. However, as the 'big data' revolution goes on, ENMs have lagged behind taking full advantage of the full potential provided by the new generation of remote sensing data becoming available as large international Earth monitoring project develop.



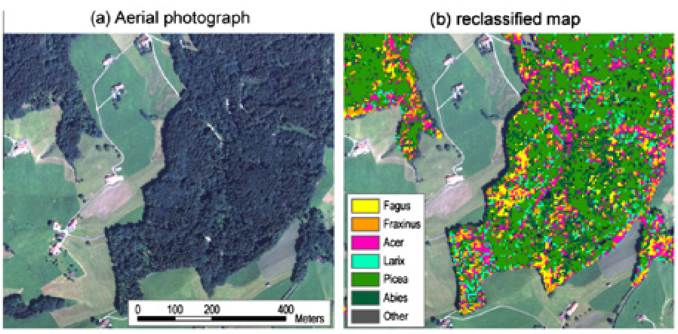


Fig. 1: Multi-species vegetation maps derived from hyperspectral imagery (source: Engler et al. 2013).

APPROACH

The objective is to refine species distribution model predictions by including remote-sensed habitat descriptors in niche models. The idea is to:

1. bring together image analysis / remote sensing and niche modeling specialists,
2. adapt the most recent image analysis techniques, for extracting habitat related descriptors,
3. integrate these descriptors into niche and distribution modelling

This approach should bring a substantial refinement of methods for describing and predicting species distributions, a fundamental tool for addressing most biodiversity's scientific and operational issues.

The literature, confirmed by experts in image processing and in niche modeling, shows that with the recent progress in image analysis techniques, as well as in the spatiotemporal resolution, coverage, and availability of satellite and aerial images, the context is most favorable and timely.

SPECIFIC CHALLENGE

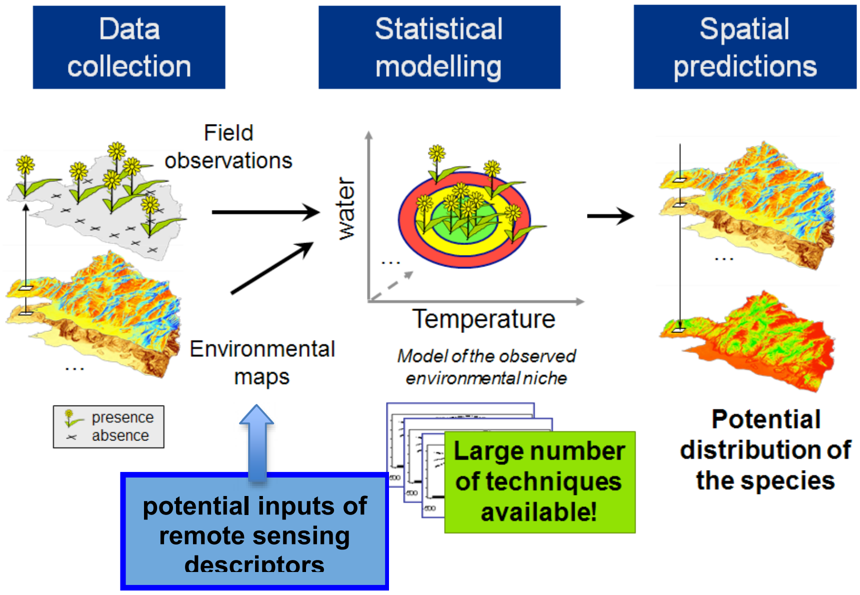
The main challenge is to identify relevant habitat descriptors, which will (1) reliably characterize habitats, (2) be reliably associated to visual characteristics, and (3) be easy to incorporate into SDMs.

PRINCIPLE OF SPECIES DISTRIBUTION MODEL PREDICTIONS

Predictions based on species distribution models are realized in 3 steps:

1. Look where the species is actually observed (GBIF mediated occurrences: www.gbif.org) ; then look at the environmental conditions where the species has been observed, using the world environmental databases (e.g. www.worldclim.org), and add habitat descriptors extracted from remote sensing; and produce a vector of the statistical distributions of environment parameters - including habitat descriptors - for the species;
2. Conversely, deduce the probability distribution of the species presence in the space of environment parameters; if relevant, add hypotheses: e.g. to take into account the ways the species may disseminate;
3. Then, for a zone of interest, look at the environmental conditions, and deduce the probability of the species presence at all points in the zone.

Finally, apply a threshold to this probability, and deduce the potential area of distribution of the species in the zone of interest.



SCOPE

ANIS scope is global:

• Geographically, ANIS' scope is global: field data and environmental data are now available from global portal, like GBIF and Worldclim; and remote sensed data also have quasi global coverage, including high resolution data provided by Google Earth Engine for research projects where they are involved, as is the case of ANIS.

• Thematically, the scope of application of ANIS's expected results is as global as can be, from phylogeny and evolution research, to climate change impact assessment, through mining impact mitigation or cosmetics industry sourcing.

• Taxonomically, ANIS's scope is also perfectly global, applicable to all forms of life.

RELATION WITH EU FACILITIES, PROGRAMS AND GOALS

Facilities

JRC Ispra (Lucy Bastin) is interested by ANIS approach: JRC have generated products relating to forest intactness and global surface water in collaboration with Google, and LB has also carried out preliminary explorations with deep learning and other novel analysis techniques to generate habitat descriptors from volunteered images. JRC's work on biodiversity monitoring and protected area connectivity mapping will be continued in the BIOPAMA 2 project and will make use of GBIF data as appropriate; they are interested by ANIS's partnership and use cases.

Programs

EU-BON: ANIS has a potential for contributing to EU-BON goals, if a new phase starts after March 2017.

Capacity4Dev: with several use cases in Cameroon, Madagascar and New Caledonia, involving several local academic partners, ANIS will contribute to capacity development in Sub-Saharan Africa and the Pacific, in relation with concrete issues in various domains: threatened species conservation, climate change adaptation, anthropic pressure mitigation, invasive species monitoring, and health environment interface.

Goals

HORIZON 2020 WORK PROGRAMME 2018-2020, Societal Challenge 5 "Climate action, environment, resource efficiency and raw materials"

SC5.2.1 *Climate action in support of the Paris Agreement*

Species Distribution Models (SDMs) are key to a both in-depth and robust assessment of the impacts, vulnerabilities and risks imposed by climate change on biodiversity. Sound assessments need the best possible models, and ANIS approach should greatly enhance SDMs accuracy (with an expected average reduction of predicted distribution areas by 5 to 50), and realism, since habitat fragmentation, which seriously impedes species conservation and adaptation to climate change, will thus be taken into account.

SC5.2.5 *Raw materials*

Accurate SDM based predictions are key in mitigating the impact of extractive activities - impact assessment, low impact operation scheme design, ecosystems restoration, compensation - and thus strongly contribute to securing resources and funding.

SC5.2.6 *Earth observation*

ANIS approach will allow making the most of both field observations and remote sensed data, by combining them into accurate SDMs and predicted distributions, will thus greatly enhance the quality of EO services for the benefit of all stakeholders, from scientists to the private sector (e.g. mining, forestry, or pharmacy), including NGOs and inter-governmental entities, like IPBES.