EXPANSION OF ALIEN INVASIVE PLANTS ALONG THE ROADS: A REMOTE SENSING APPROACH

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Introduction

Invasions by alien species are among the most important threats to ecosystems and human well-being. Many of the plants that surround us in our daily lives are exotic, brought by man from its native habitat, a process deeply enhanced by the intensification of world trading. The magnitude of the negative impacts associated to such threat demand an effort dedicated to monitor the invasion status and territorial susceptibility, information which is essential to identify measures to mitigate the impacts. The issue of invasive species is relatively recent for scientific research, and supports the need for further studies based on inter and multidisciplinary cooperation in different scientific domains. In this study, the main target alien species are *Acacia dealbata, Acacia melanoxylon, Robinia pseudoacacia and Ailanthus altissima*. These invasive species form dense stands preventing the development of native vegetation. In order to detect the distribution of alien species and to monitor the expansion of this invasion the use of Earth Observation data proved to be a very promising approach. The study of large areas became easier and affordable with the emergence of free and open source geographic information system (GIS), such as QGIS. QGIS revealed to be not only a desktop GIS but also to provide a spatial file browser, a server application, and web applications.

In this study, we aim to characterise the spatial distribution of invasive species identified along the roads, in one of the main transport/energy corridors linking Portugal to Spain (Évora, Montemor-o-Novo and Arraiolos regions), to better equate the conservation measures to be adopted in those infrastructures. To identify the invasive species along the roads, we used multi-temporal aerial images and orthophotomaps between 1956 and 2016. Then, we built a model to analyse the expansion of the invasive species along the roads. Finally, we identified areas that are more susceptible to invasion in order to assist prevention, detection and early intervention directed to control/elimination, as well as to produce updated distribution of these invasive species.

Data

This study generated a land cover map series of invasive species distributed along the roads between 1956 and 2016. A data set per date of aerial images and orthophotomaps was used for 1956, 1985, 1995 and 2016. Aerial images were acquired in the framework of the project Life LINES - “Linear Infrastructure Networks with Ecological Solutions”.

Classification

The invasive species were identified along the roads from field surveys, aerial images and orthophotomaps between 1950 and 2016, and GoogleEarth. We used QGIS 2.14.1 to compile the main roads of the study area and to create waypoints of the target invasive species. A multi-temporal classification maps were built with the aid of the Semi-Automatic classification plugin of QGIS. First, we applied a semi-automatic classification to check the different objects of the study area. A legend with 6 classes was established for image classification: Alien plants, Montado, Crops, Roads, Urban area, and Water. Training of the classifier was done using data from expert knowledge and pre-existing maps at different scales. The Jeffries-Matusita index (JM) was applied to quantify the pair-wise classes’ spectral separability and to allow the improvement of data quality. A land cover mapping

algorithm was developed using Maximum Likelihood. Five land cover maps were obtained for 1956, 1985, 1995 and 2016.

Accuracy assessment

The classification accuracy was assessed using a confusion matrix, obtained with the data collected in the field. The Kappa coefficient and overall accuracy were calculated.

Change detection

The detection of changes in land cover maps was obtained by map differencing between date-pairs: 1956-1985, 1985-1995, 1995-2006 and 2006-2016.

Modelling process

The expansion of the invasive species along the roads was analysed by a modelling technique based on the maximum entropy approach (MAXENT). Such modelling technique presents a forecast based on the probability distribution of maximum entropy, supported on a correlation between the presence of the organism (occurrences) and a set of predictor or explanatory variables. The selection of a modelling method grounded on the maximum entropy principle is based on the good results in terms of performance comparing to other predictive modelling methods of correlative nature, namely its robustness facing changes on parametrizations.

Preliminary Results and Discussion

We were able to identify areas that are more susceptible to invasion in order to assist prevention, detection and early intervention directed to control/elimination, as well as to produce updated distribution of these invasive species. Based on the preliminary results, we observed a slight pattern of how invasive species expanded along the roads.

Conclusions

The use of Semi-Automatic classification plugin of QGIS showed to be a good tool to generated a land cover map series.

The use of species distribution modelling helped to assess the susceptibility of a territory to invasion.

The results of this study should be applied, in the light of conservation effectiveness, to develop a well-planned management control of invasive species demands.