Grassland mapping using SPOT5Take5 and Sentinel data in south Italy

In brief

AIM:

To investigate the benefits from using multi-temporal dataset of EO images to produce maps of grassland areas with a (semi) automatic procedure.

WHY:

The grassland areas are very important from the environmental point of view and their conservation is crucial to protect the biodiversity.

HOW:

A multi-sensor dataset is used in two ways: first the biophysical parameters derived from the dataset is used to create a potential grassland map. Then, from the analysis of the temporal behavior of the NDVI potentially cultivated (ploughed) areas are excluded for obtaining the final grassland mask.

What is a grassland?

According to the FAO definition, Grassland is a *"land covered with grasses and other herbaceous species. Woody plants may be present, but if so, they do not cover more than 10% of the ground. There are many different types of grassland designated by ecozone, topography, climate, soil conditions, and so on. Derived grassland is maintained in that condition by regular burning; edaphic grassland arises on particular soil types, for example, those found in or around permanent or seasonal swamps"*.

Grassland monitoring

Grasslands host a fraction of Europe's biodiversity that is much larger than for other habitat types with similar or bigger spatial extent[1]. However several studies prove that the changes in agricultural practices and land use pressures threaten grasslands which are disappearing at an alarming rate[2].

EU legislation

Grasslands mapping is relevant for the application of some EU directives such as:

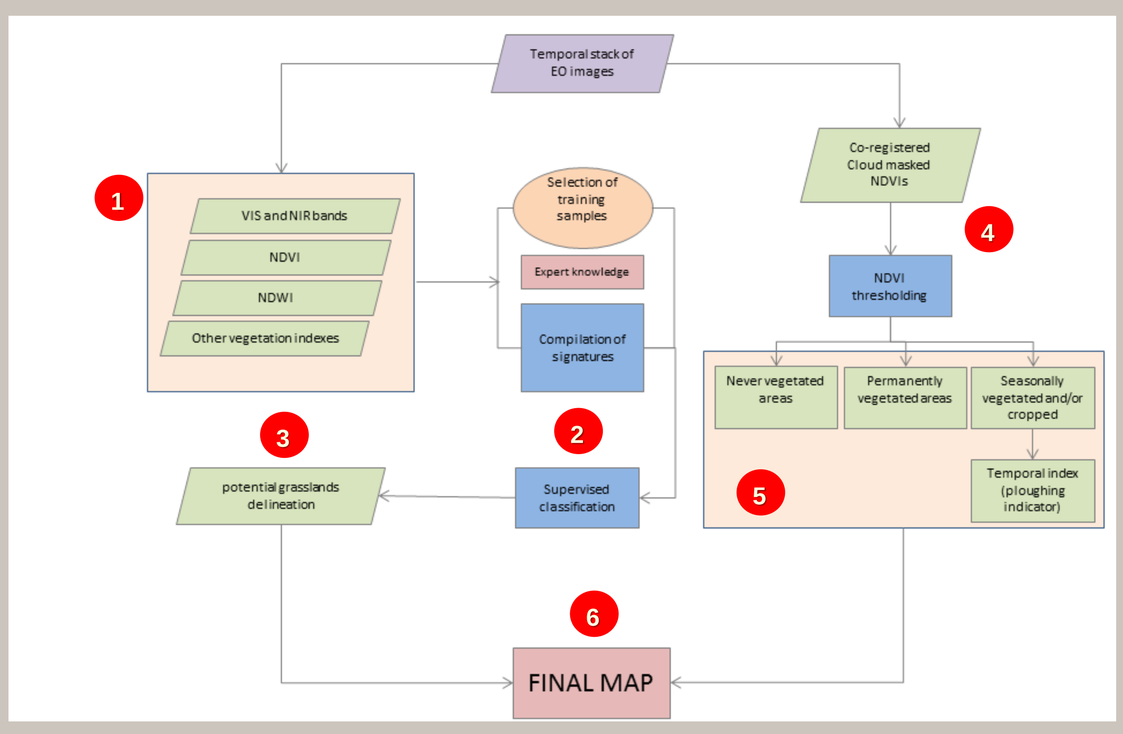
Habitats Directive

The Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species.

EIA Directive

Directive 2011/92/EU contains a legal requirement to carry out an environmental impact assessment (EIA) of public or private projects likely to have significant effects on the environment, prior to their authorization.

APPLIED METHODOLOGY



1. *A set of biophysical parameters is derived from the multi sensors input EO images stack.*
2. *A supervised land cover classification is performed after the selection of a training dataset*
3. *The result of the classification is a mask of the potential grassland areas*
4. *In parallel, from the NDVI time series a common threshold is statistically derived in order to separate (permanently) vegetated from non-vegetated areas*
5. *From the analysis of the temporal behavior of vegetated pixels three different classes are derived, as well as a ploughing indicator*
6. *Combining the 3 and 5 the final grassland mask is derived.*

KEY POINTS

Images selection

In the classification process (1 to 3) only the vegetated images are considered, in particular taking into account the seasonality of the grassland. This is done automatically considering the European bioclimatic zones.

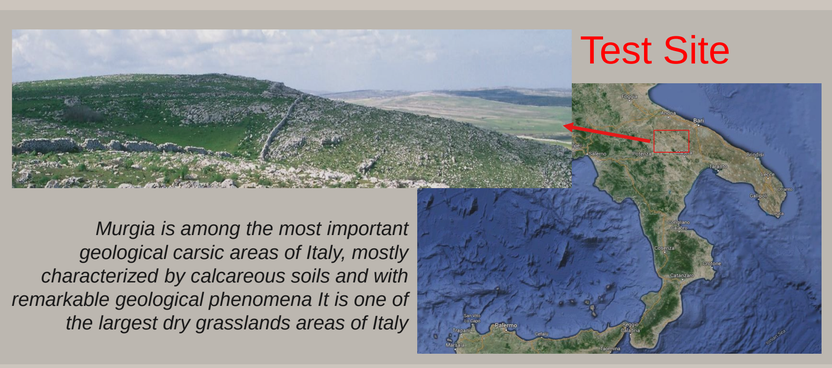
Multi-sensors dataset

The procedure has been developed in order to be used with EO images acquired by different satellite sensors in order to have a dense temporal distribution of the images.

Applicability

The procedure is very general and can be smoothly applied in different climatic zones.
Expertise is required in the selection of the training dataset, in order to identify different grassland types depending on the bioclimatic zone considered.

THE CASE STUDY



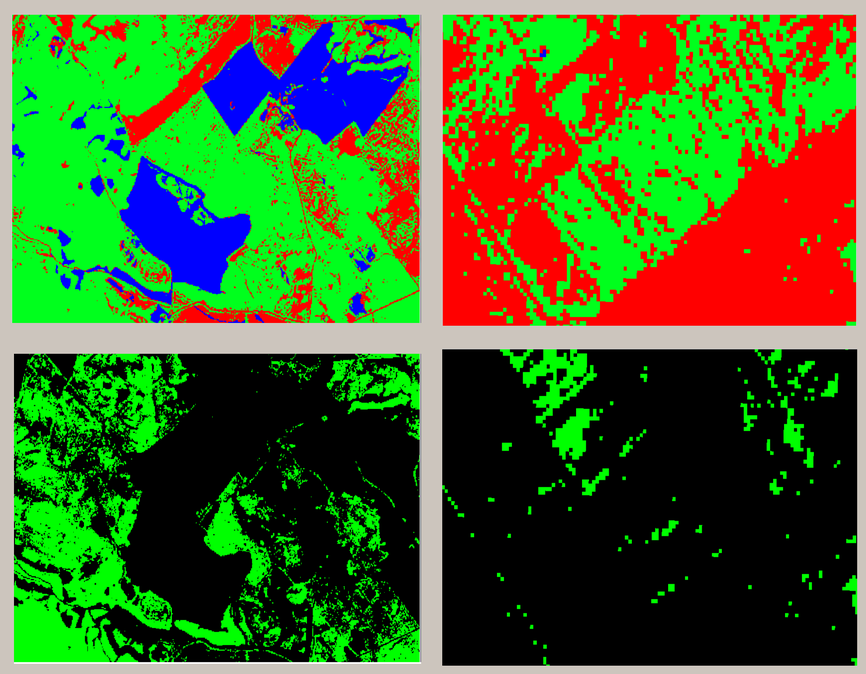
Murgia is among the most important geological carsic areas of Italy, mostly characterized by calcareous soils and with remarkable geological phenomena It is one of the largest dry grasslands areas of Italy

A single image classification has been performed using a Spot5Take5 image acquired on 13th April 2015, to produce a grassland/no grassland map. By comparing this map with a reference data set an OA=74% has been obtained.

The methodology described above has been applied to the whole dataset composed by 18 Spot5Take5, images acquired from 13/04/2015 to 31/08/2015 and 7 Sentinel-2 images acquired from 14/08/2015 to 01/01/2016. The final map has been obtained, showing an OA=91%.

The final map

The reference dataset (red on the left) and the two classifications on the right. The yellow map has been obtained using a single image classification while the blue one using the multi-temporal dataset.



Examples of false alarms reduction

References

[1] Bruchmann,I.& Hobohm, C. "Halting the loss of biodiversity: Endemic vascular plants in grassland of Europe". Grassland Science in Europe 15: 776-778

[2] LIFE and Europe's grasslands: Restoring a forgotten habitat" João Pedro Silva (Technical expert), Justin Toland, Wendy Jones, Jon Eldridge, Edward Thorpe, Eamon O'Hara http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/grassland.pdf

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