A NEW DETAILED CROP AND NATURAL LAND MAP

Crop and forest species identification with unprecedented resolution as a tool for land monitoring in Castile and León (Spain).

The challenge

Castile and León is a very large region (94,224 km2) dominated by vast areas of cropland (mainly grain crops on arable land) surrounded by natural landscapes. Existing land cover projects at European and National level consider arable land as a single class that groups all crops in an individual legend item without giving information about the heterogeneity of the agricultural landscapes in such a big area nor their annual evolution. Moreover, forest and semi natural areas are not characterised well enough for land planning and assessment.

The challenge was to create a very detailed land cover map, updated annually with crop and forest identification at species level by means of remote sensing and ancillary data available within the regional government.

The project is conceived as a concerted and coordinated effort by the Agricultural and Livestock Department, and the Environmental Department, with the common objective of monitoring agricultural and natural land simultaneously.

The space based solution

Sentinel-2 and Sentinel-1 satellites provide an incredible tool for assessing land cover due its spatial accuracy, frequency of acquisition and ease of access.

Land cover classification is performed using machine learning techniques based on year long time series of images together with ancillary data such as elevation, slope, average precipitation, vegetation height taken from LIDAR flights, etc.

In order to implement the machine-learning algorithm, high-quality training cases are required, which are selected from different sources of information available in the Regional Government such as the Integrated Administration and Control System (IACS) from Common Agricultural Policy and Forest Inventories.

Following this methodology, detailed crop and natural land maps have been produced every year since 2011. Before the appearance of Sentinel-2, the product was based on Landsat-8 and mainly on Deimos-1 images at a considerable cost.

Since 2017, the product has been based solely on Copernicus images, providing an increase in the spatial resolution up to 10m as well as a significant cost reduction.
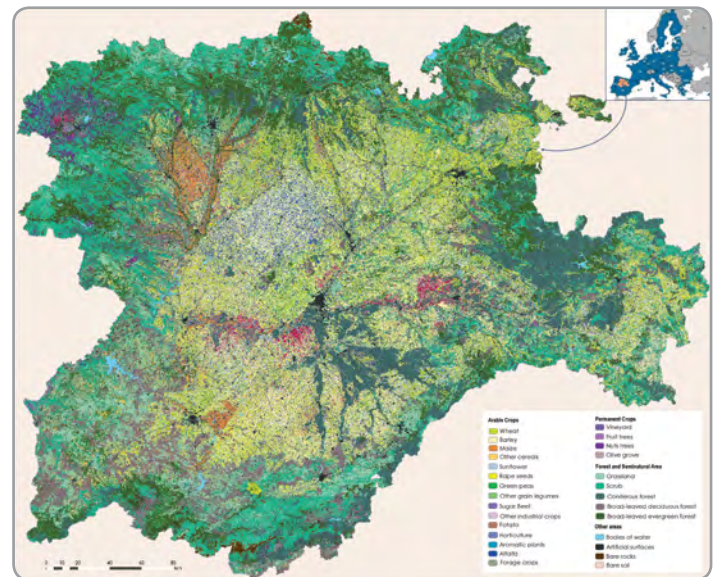
Crop and natural land classification map over the region of Castile and León for 2017.
Credit: Contains modified Copernicus Sentinel data [2016]

Thematic Area	Region of Application	Sentinel mission used	Copernicus Service used	Usage Maturity Level
AGRICULTURE, FOOD, FORESTRY AND FISHERIES	CASTILLA Y LEON	S1 S2	–	4

Benefits to Citizens

The land cover maps are easily accessible through the Internet http://www.mcsncyl.itacyl.es]. Users with a technical background can download the entire product in order to develop their own projects and analysis; meanwhile basic users can access the information through a web interface that includes the cadastral information. The availability of yearly layers allows users to check crop rotations and land cover changes.

From a government perspective, the land cover map also enables the monitoring of land changes and the assessment of the fulfilment of different requirements of land owners in a very efficient and cost effective way. The map allows for the control of protected areas included in the Habitats Directive and for the monitoring of the use of water in agricultural land by the River Basin Authority. Moreover, the land cover map is an invaluable tool for monitoring the agricultural activities for CAP subsidies, in particular, to control crop diversity and coupled aids (crop specific payments).
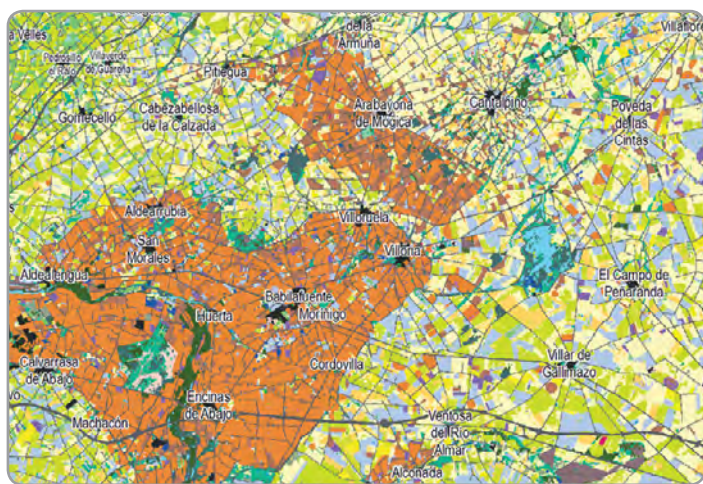
Example of crop and natural land classification map over a mixed area with irrigated and rainfed crops in Salamanca province.
Credit: Contains modified Copernicus Sentinel data [2017]

"This crop map will allow us to monitor agricultural activities as well as improve the effectiveness of the CAP controls and reduce the farmer's paperwork."

Juan Pedro Medina Rebollo,
D. G. Regional Paying Agency

Outlook to the future

The production of such a detailed land cover map requires the availability of one to three (cloud free) satellite images per month of the whole territory with adequate spatial resolution. Sentinel-1 and Sentinel-2 satellites represent the only available operational constellation that can guarantee the production of the map on an annual basis with reliability.

The use of data science techniques based on the integration of earth observation datasets, with other sources of data will produce a change in the way land is monitored all over Europe with important implications for the citizens.

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