

# Castile and León crops and natural land map

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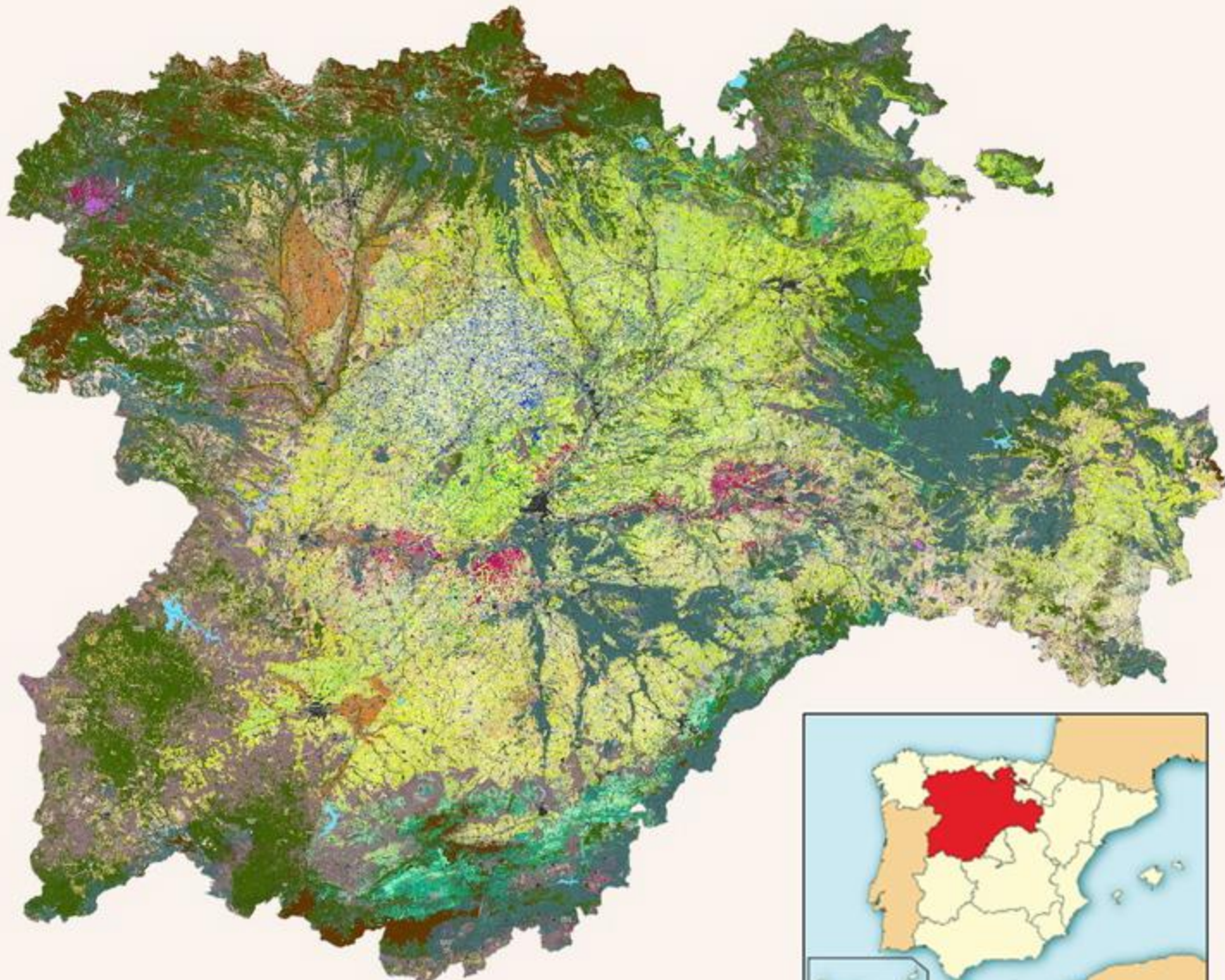
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# Objectives

- Create a raster dataset with annual crops and land identification (Linked to LPIS) at 20 m GSD.
- Include pastures and natural vegetation. It improves crop classification quality and add users to the product.
- Use the classification as a general purpose layer in multiple projects:
  - Water use planning and water balances in aquifers.
    - Discrimination between irrigated and non irrigated land.
    - Estimation of water volumes due to crop and water needs knowledge.
  - CAP Subsidies controls.
    - On the spot controls, greening (rotations).
    - LPIS land use update.
  - Agricultural Statistics (cropped area, common crop rotations,...).
  - Environment monitoring (NATURA 2000).
  - Agribusiness information (supply, monitoring, etc.)
  - Other remote sensing and crop modeling projects that require crop specific information.

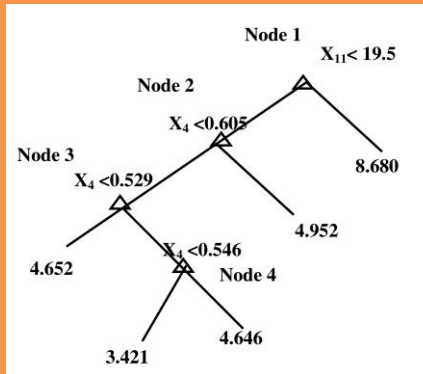


# Methodology

Creation of the decision trees using machine learning techniques with **training cases**



Decision tree classifier



**-Independent variables-**

- Satellite imagery
- Height , aspect
- Slope
- Climate data
- LPIS class

**Classified cases:**

*Pixels with assigned class*



# Legend

Includes irrigation and non-irrigation discrimination for crops that could be grown under both conditions.

- Arable Crops**
- Wheat
  - Barley
  - Maize
  - Other cereals
  - Sunflower
  - Rape seeds
  - Green peas
  - Other grain legumes
  - Sugar Beet
  - Other industrial crops
  - Potato
  - Horticulture
  - Aromatic plants
  - Alfalfa
  - Forage crops

- Permanent Crops**
- Vineyard
  - Fruit trees
  - Nuts trees
  - Olive grove

- Forest and Seminatural Area**
- Grassland
  - Scrub
  - Coniferous forest
  - Broad-leaved deciduous forest
  - Broad-leaved evergreen forest
  - Sheet of water
  - Artificial surfaces
  - Bare rocks
  - Bare soil



# Training cases

## CROPS

Cooperation with the Regional CAP department

- Data mining on Integrated Administration and Control System (IACS) database

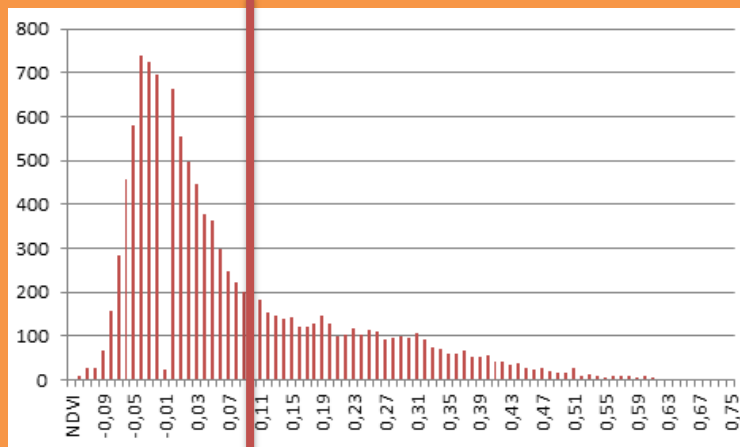
## NATURAL LAND

Cooperation with the Environment department

- Land Cover and Use Information System of Spain (SIOSE)
- National forest inventory
- Habitats maps (Natura 2000)
- In house digitalization

## Training preprocessing example

### NDVI Fallow land

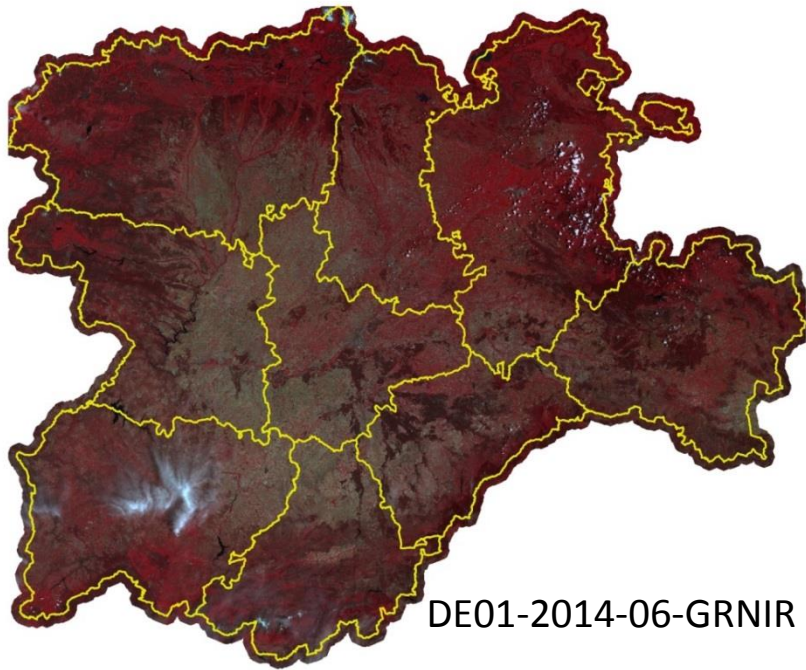


Bare soil ←

→ Vegetated (non-plough)



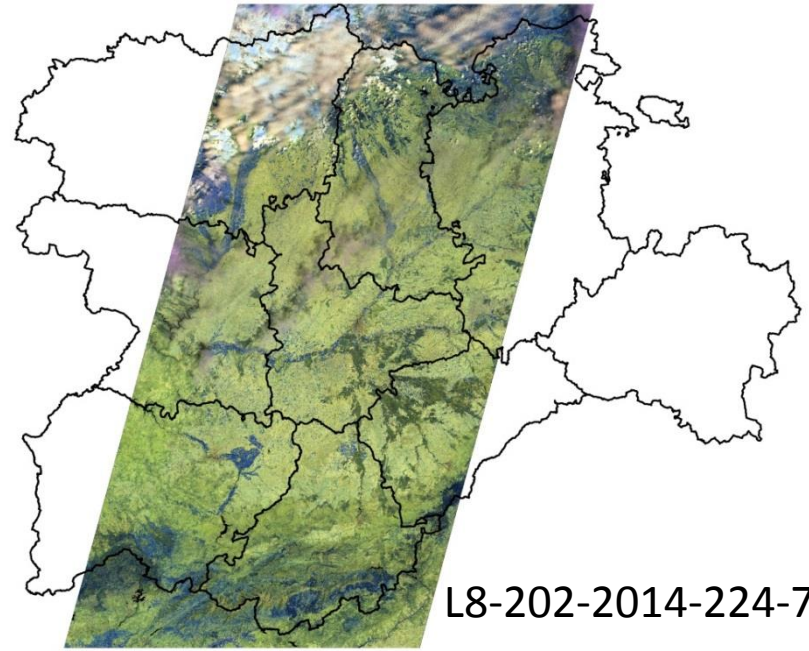
# Satellite imagery



DE01-2014-06-GRNIR

## Deimos-1 (2011-2015)

- Between 8-10 coverages per season.
- Resampled to 20 m GSD define project's frame.
- Acquisition dates accurately selected to achieve irrigation discrimination on winter crops.



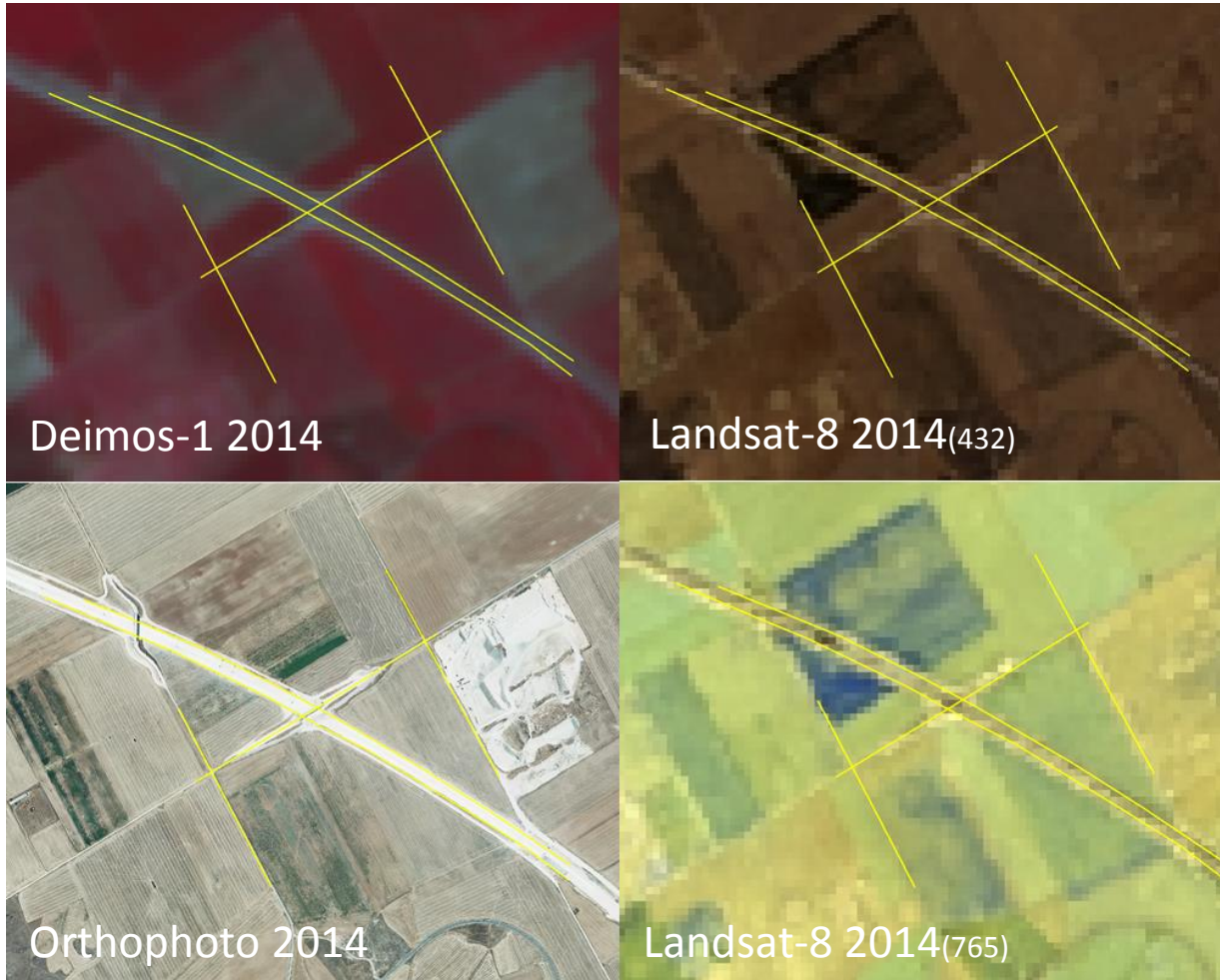
L8-202-2014-224-765

## Landsat-8 (2013-2015)

- Intensively processed in order to be adapted to project frame (including pan-sharpening)
- Complements Deimos-1 data with more spectral bands (helps crops identification)



# DEIMOS-Landsat overlay







# Layers for classification

Satellite scenes per year:

	2011	2012	2013	2014	2015
Deimos-1	28	17	16	21	31
LandSat-8	0	0	75	80	102

Independent variables per year:

2011	2012	2013	2014	2015
29	26	203	225	341

# Internal accuracy vs training database

*Tabla 3. Grado de coincidencia entre los pixeles de la capa de entrenamiento y el Mapa*

Clase	Acierto %	Clase	Acierto %
Frutales	99	Girasol	91
Urbano-viales	99	Otros cereales regadío	90
Olivar	99	Alfalfa regadío	90
Aromáticas	99	Colza	90
Hortícolas	99	Cebada	87
Frutales cascara	99	Trigo	85
Viñedo	98	Girasol regadío	85
Lamina agua	98	Roquedos	80
Remolacha	96	Frondosas siempre verdes	76
Maíz	95	Alfalfa	73
Patatas	94	Guisantes	72
Otras leguminosas grano	93	Suelo desnudo	68
Pastizal	92	Trigo regadío	68
Matorral	91	Cebada regadío	62
Coníferas	91	Forrajeras	61
Frondosas caducifolias	91	Otros cereales	44



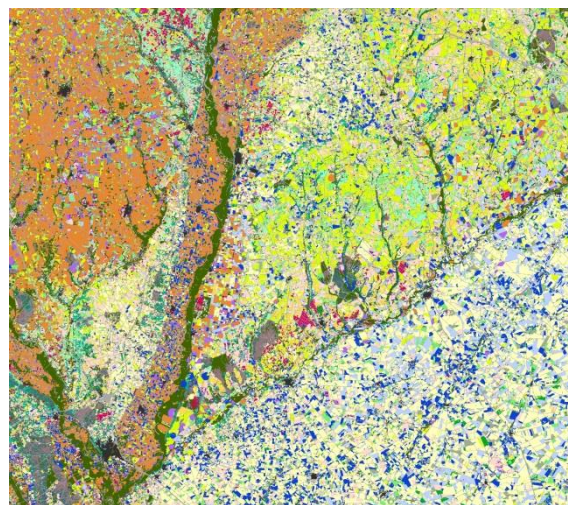
# External accuracy vs frame area survey (2014)

*Tabla 4. Grado de coincidencia entre los píxeles clasificados en las zonas de control ESYRCE y el Mapa*

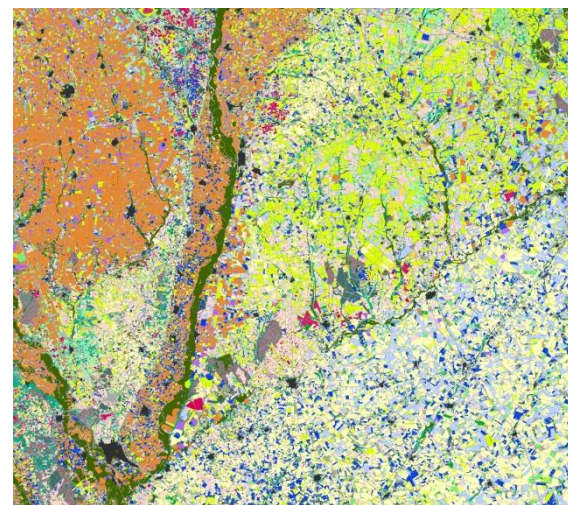
<b>Clase</b>	<b>Acierto %</b>	<b>Clase</b>	<b>Acierto %</b>
Frutales	100	Trigo	84
Viñedo	98	Alfalfa	82
Olivar	94	Otros cultivos industriales	78
Maíz	93	Coníferas	67
Remolacha	92	Guisantes	66
Aromáticas	92	Hortícolas	51
Girasol	91	Otras leguminosas grano	40
Cebada	87	Otros cereales	35
Colza	85	Frutales cascara	34
Patatas	85	Forrajeras	28



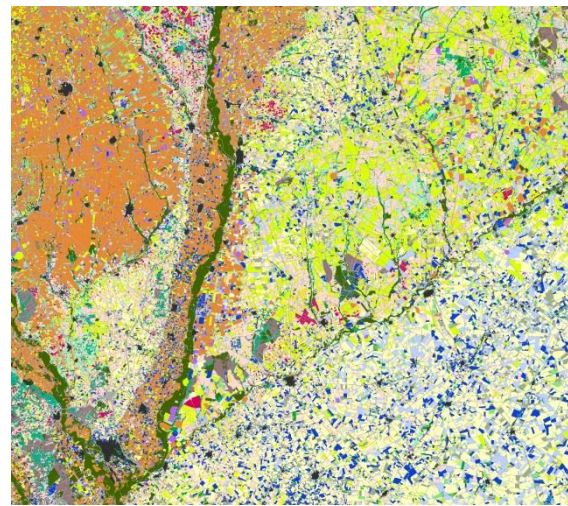
# Results 2011-2014



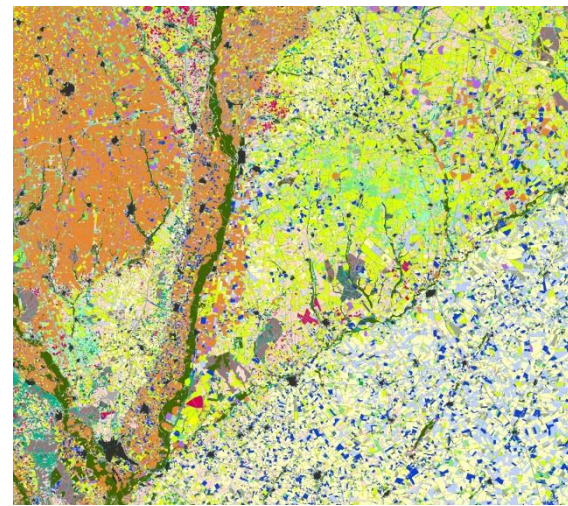
2011



2012



2013

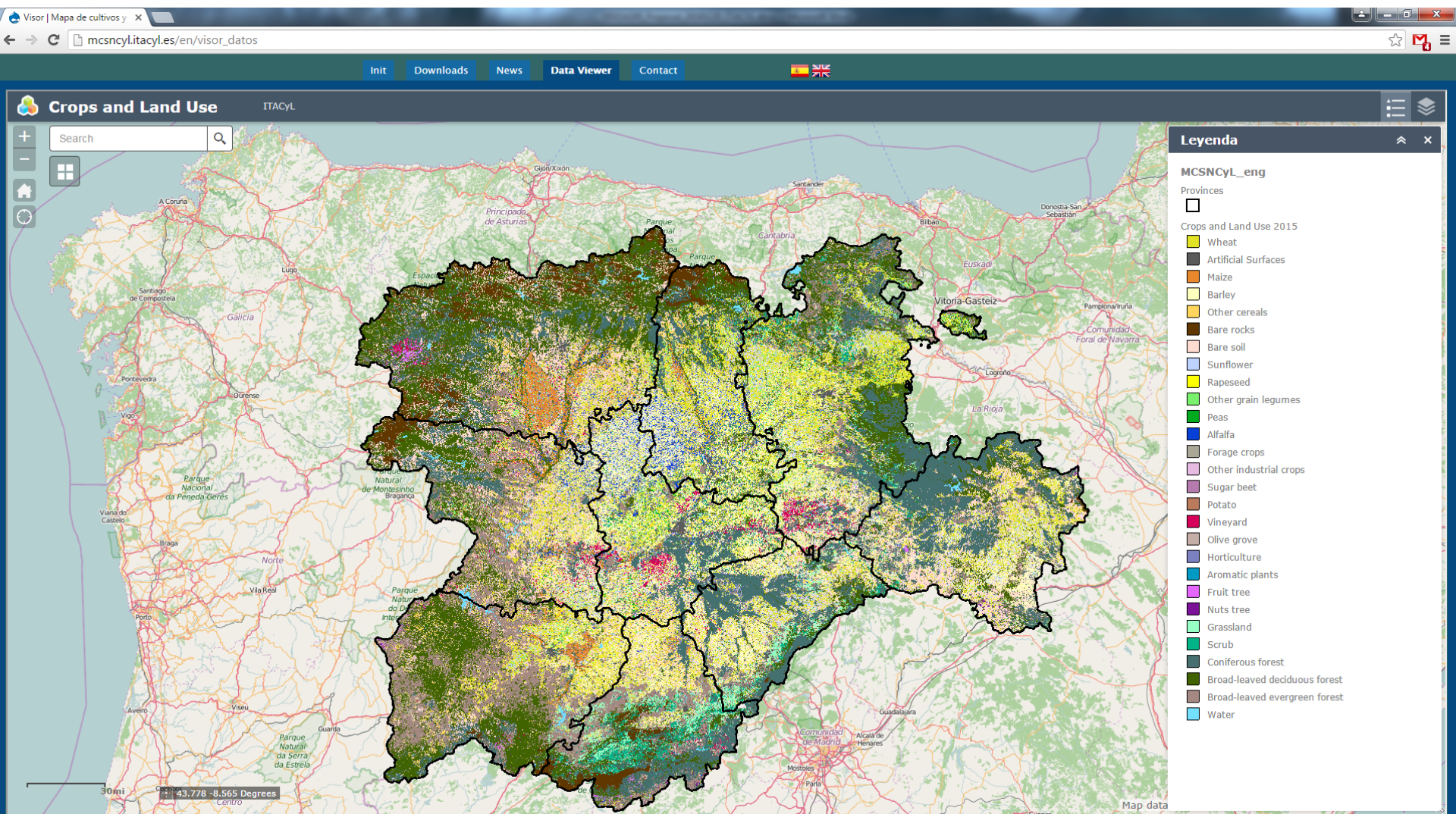


2014



# Data access and download at

<http://mcsncyl.itacyl.es>



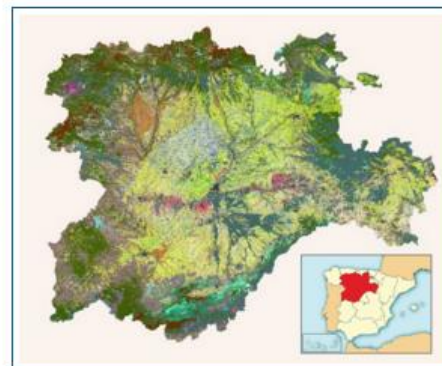
[View](#)[Edit](#)

Castile and Leon crops and natural land map (MCSNCyL, Spanish acronym) is a land use layer, updated annually, obtained through satellite imagery. The goal of the project is to produce a map of land use that represents the changes in annual arable crops as well as permanent crops and the areas of natural vegetation. The project began in 2013, and since then layers for the years 2011, 2012, 2013, 2014 and 2015 have been generated.

The procedure imply the use of images from [Deimos-1](#) (2011–2015) and [Landsat 8](#) (2013–2015) satellites. From 2016 onwards it is expected to use only [Sentinel-2A](#) images, improving the spatial resolution from 20 to 10 m. The classification is performed using a machine learning algorithm trained with data retrieved from several sources, specially Integrated Administration and Control System for Common Agricultural Policy subsidies database and some other Land use databases available in Spain (Land Parcel Identification System, SIOSE, Mapa Forestal, etc.). There is not specific field work.

The project is led by the Agricultural Technological Institute of Castile and Leon (ITACyL) and has the support of the Duero River Basin District Authority and the National Geographical Institute of Spain for the image acquisition. The Regional Ministry of Public Works and Environment and the Regional Ministry of Agriculture cooperate in the supply of training cases. The project is an adaptation of the US Crop Data Layer from US Department of Agriculture.

The overall classification accuracy is 80% (kappa) on average, being generally much higher in crop classes than in natural land. You can find more information about the project and accuracies obtained for each crop [in this article published](#) in the XVI Congress of the Spanish Association of Remote Sensing, 2015 (in Spanish language).





# Conclusions

- High accuracy classification in wide areas without specific field work. Approximately **80%** kappa. (Higher accuracy in main crops).
- Traditional remote sensing application reliable due to the availability of high frequency high resolution imagery time series and data mining tools.
- Operational product (service) available for multiple purposes. Early version in June (less accurate but usable) and definitive version in December.



# 2016 Prospects

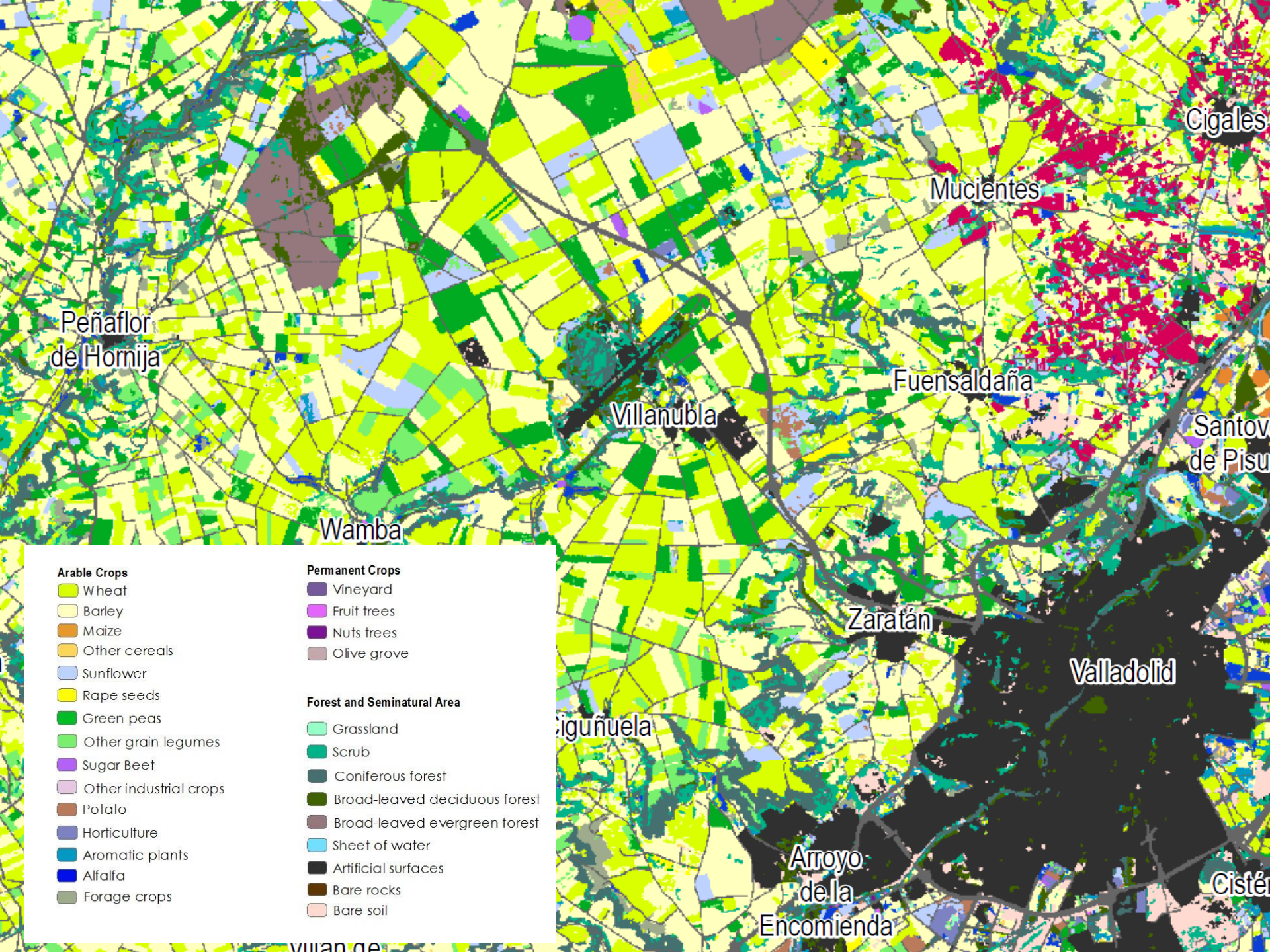
- Incorporation of Sentinel 2-A imagery in 2016 layer. Spatial resolution increase to **10m**. **If problems related to S-2 acquisitions are solved.**
- Incorporation of vegetation heights as independent variable from LIDAR dataset will improve dramatically accuracy in natural land.
- Environment department will provide specific training cases tailor made for this project.
- Study of integration of Sentinel-1 speckle filtered images that would improve classification in natural land.





# Collaborating entities

- Agricultural Technological Institute of Castilla y León –ITACyL- (Regional Ministry of Agriculture) is the organization in charge of image acquisition, image processing and classification using machine learning algorithms.
- Regional Ministry of Public works and Environment cooperates intensively within the project with the supply of training cases and the processing of LIDAR data.
- Common Agriculture Department (Regional Ministry of Agriculture) provides Applications databases.
- Duero River Basin District Authority and the National Geographical Institute of Spain collaborate with the image acquisition expenses within Spanish National Remote Sensing Plan.



**Arable Crops**

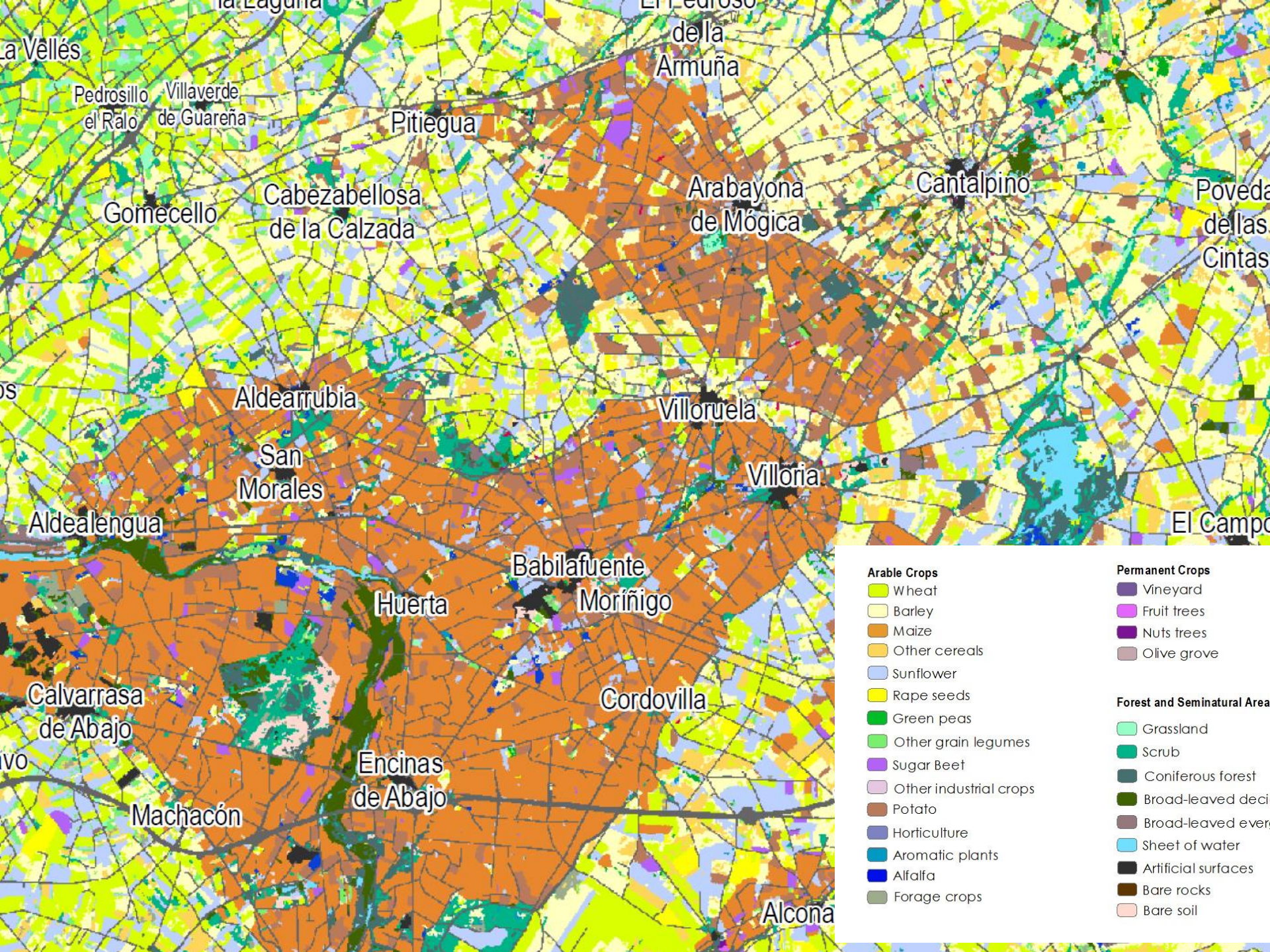
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- Vineyard
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**Forest and Seminatural Area**

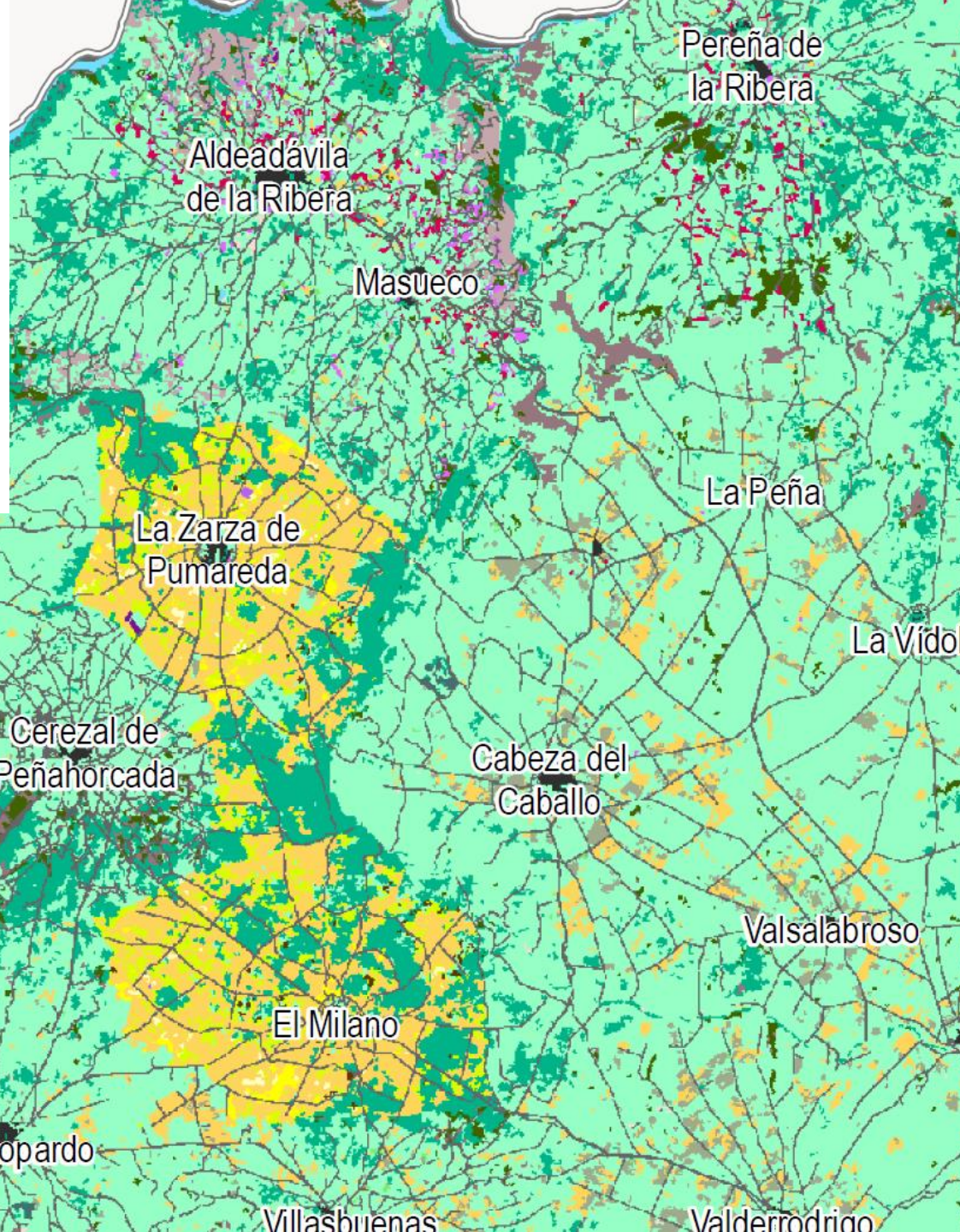
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- Scrub
- Coniferous forest
- Broad-leaved deciduous forest
- Broad-leaved evergreen forest
- Sheet of water
- Artificial surfaces
- Bare rocks
- Bare soil

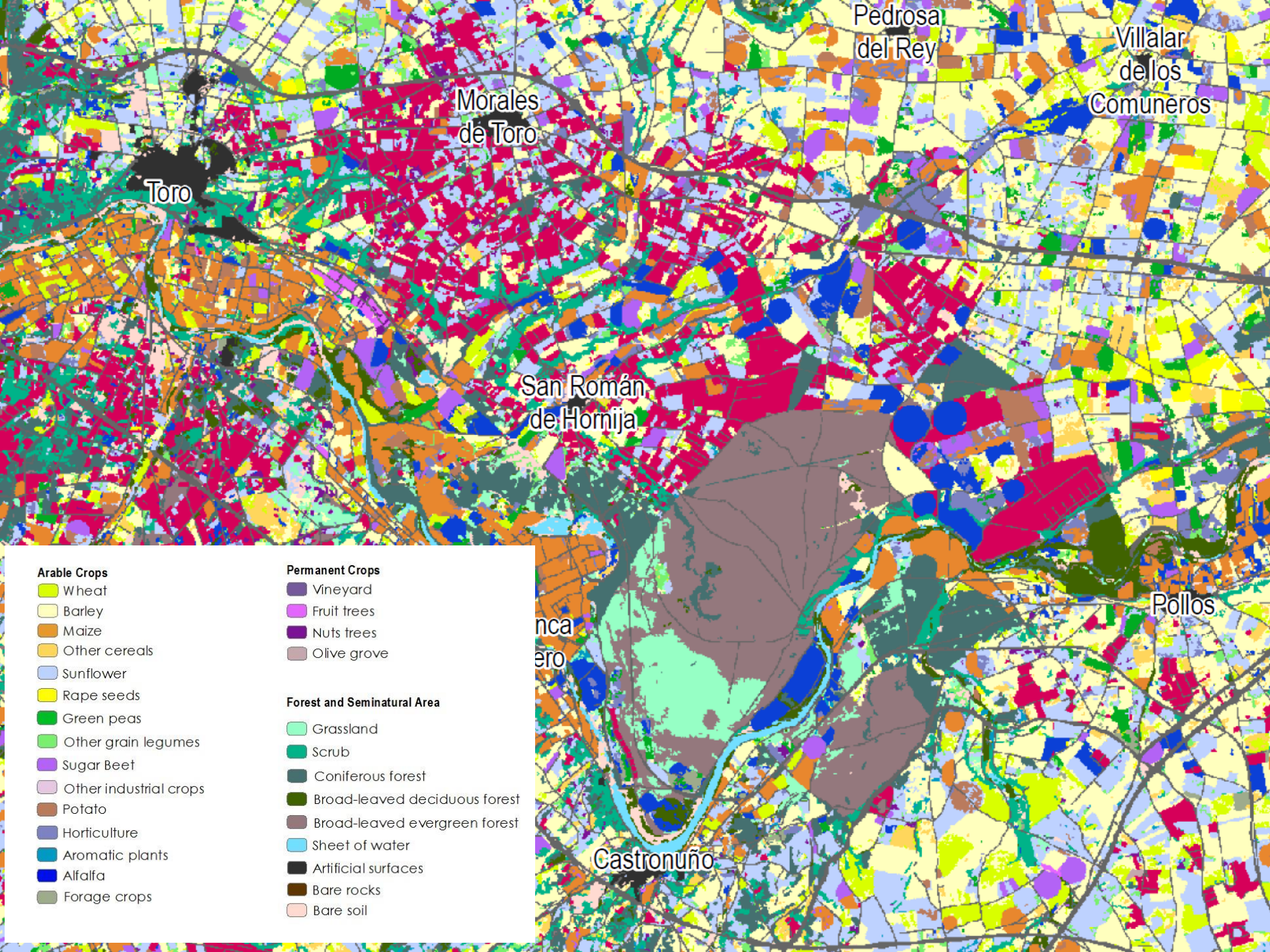


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