FORESTLAND DECAY IN MARESME USING SENTINEL-2 IMAGERY

Recent available SENTINEL 2 data represents a new key to providing a feasible monitoring of decay of forest mass on a regional scale.

The challenge

A significant portion of the forests of the Maresme region (Catalunya, Spain) is affected by a severe decaying of the trees, in particular, the stone pine (Pinus pinea), due to different factors like drought, the infestation by a wood boring insect (Thomicus destruens) and by several fungi.

In order to be able to delimit the areas with affected trees, Institut Cartogràfic i Geològic de Catalunya (ICGC), at the request of Diputació de Barcelona (DIBA), has carried out a complete detection based on the study of Sentinel-2A imagery of Copernicus (The European Earth Observation Programme). The study focused on the detection of affected forestland in summer between 2015 and 2016, based on vegetation indices, especially from the Improved Vegetation Index (EVI) and the subsequent analysis of the changes and tendencies toward decay.


Partial affected Pinus pinea forestland in Maresme

This article describes the methodology used in the study and the first results obtained. DIBA technical services are charged with the task of validating the results in situ.

The space based solution

The images captured by the MSI sensor of the Sentinel-2A satellite, with public and free access, were used as a basic material to detect the decline of the forest masses for one year, between the summers of 2015 and 2016.

In total, 11 images were obtained along the different weather stations. The first image was taken on 2 August 2015 and the last one on 24 November 2016. With this set of images, the phonological cycle of trees could be interpreted from summer to winter of 2015 and in the same seasonal period for 2016.

One of the techniques most used in Earth Observation to detect vegetation and assess its state is the use of vegetation indices, which are based on the arithmetic combination of two or more spectral bands sensitive to characteristic behaviours of vegetation.
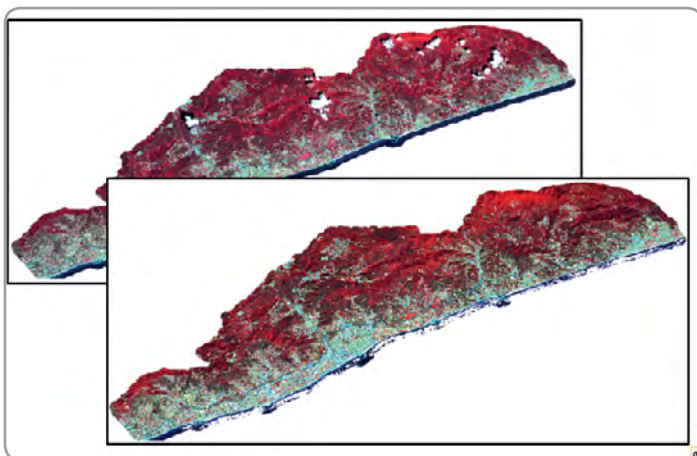
SENTINEL-2 imagery over the study area taken at 02/08/2015 and 26/08/2016

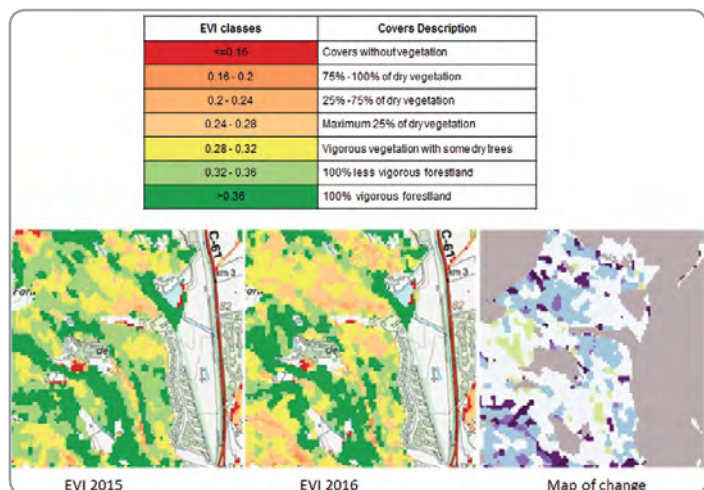| Thematic Area	Region of Application	Sentinel mission used	Copernicus Service used	Usage Maturity Level
AGRICULTURE, FOOD, FORESTRY AND FISHERIES	CATALONIA	S2	–	4

The vegetation index chosen was the Enhanced Vegetation Index (EVI), since it incorporates the radiation of the blue spectral zone (B2) that helps to correct the signal associated with the soil and the atmospheric effects.

Indices calculation was carried out without previous fieldwork, so the images of infrared photogrammetric flights from 2015 and 2016 of the ICGC ortoXpres free service (25 cm of spatial resolution) were consulted, to relate the results of the index to the different degrees of decay of the forest masses.

The changes show the areas of expansion of decay according to EVI resulting maps from 2015 and 2016.

EVI classes	Covers Description
<=0.16	Covers without vegetation
0.16 - 0.2	75% - 100% of dry vegetation
0.2 - 0.24	25% - 75% of dry vegetation
0.24 - 0.28	Maximum 25% of dry vegetation
0.28 - 0.32	Vigorous vegetation with some dry trees
0.32 - 0.36	100% less vigorous forestland
>0.36	100% vigorous forestland

EVI 2015   EVI 2016   Map of change

Legend and decay map from EVI between 2015 and 2016 on local scale and changes by using SENTINEL-2 imagery

Benefits to Citizens

EVI enables the clear detection of the affected areas in the summer images with good spectral signatures thanks to well illuminated areas. Mountainous areas with shadow effects were not as well detected.

"This application of Copernicus Sentinel-2 has transformed Earth Observation Data into a decision support information."

Ramon Riera,
Diputació de Barcelona

The results, published as official maps by the DIBA, are used by the Department of Agriculture of Catalonia (DARP) as a decision support tool for the forest management of affected areas during the 2017 campaign.

Outlook to the future

The resulting maps show some areas of maximum affectation and expansion that will be consolidated (corroborated) by a new study of the EVI including the 2017 data.

DIBA and ICGC work together in a coordinated way to enlarge and improve the analysis moving towards 2017. The new areas aimed at for the project will be to increase the area of study, to foster whole fieldwork measurements and validation in the forestland during the summer of 2017 (closer to data acquisition of Sentinel-2 images) and to improve the distinction between forest and shrub cover introducing Lidar dataset.

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