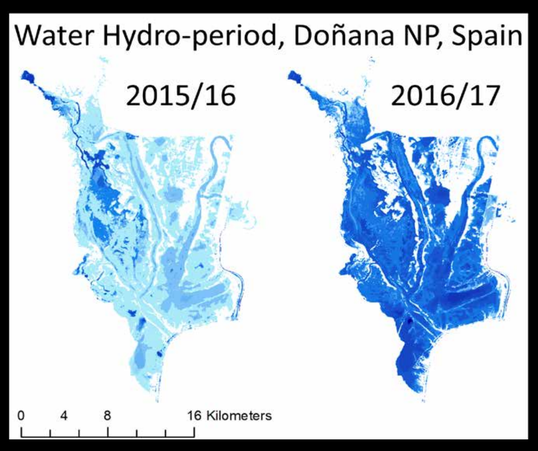
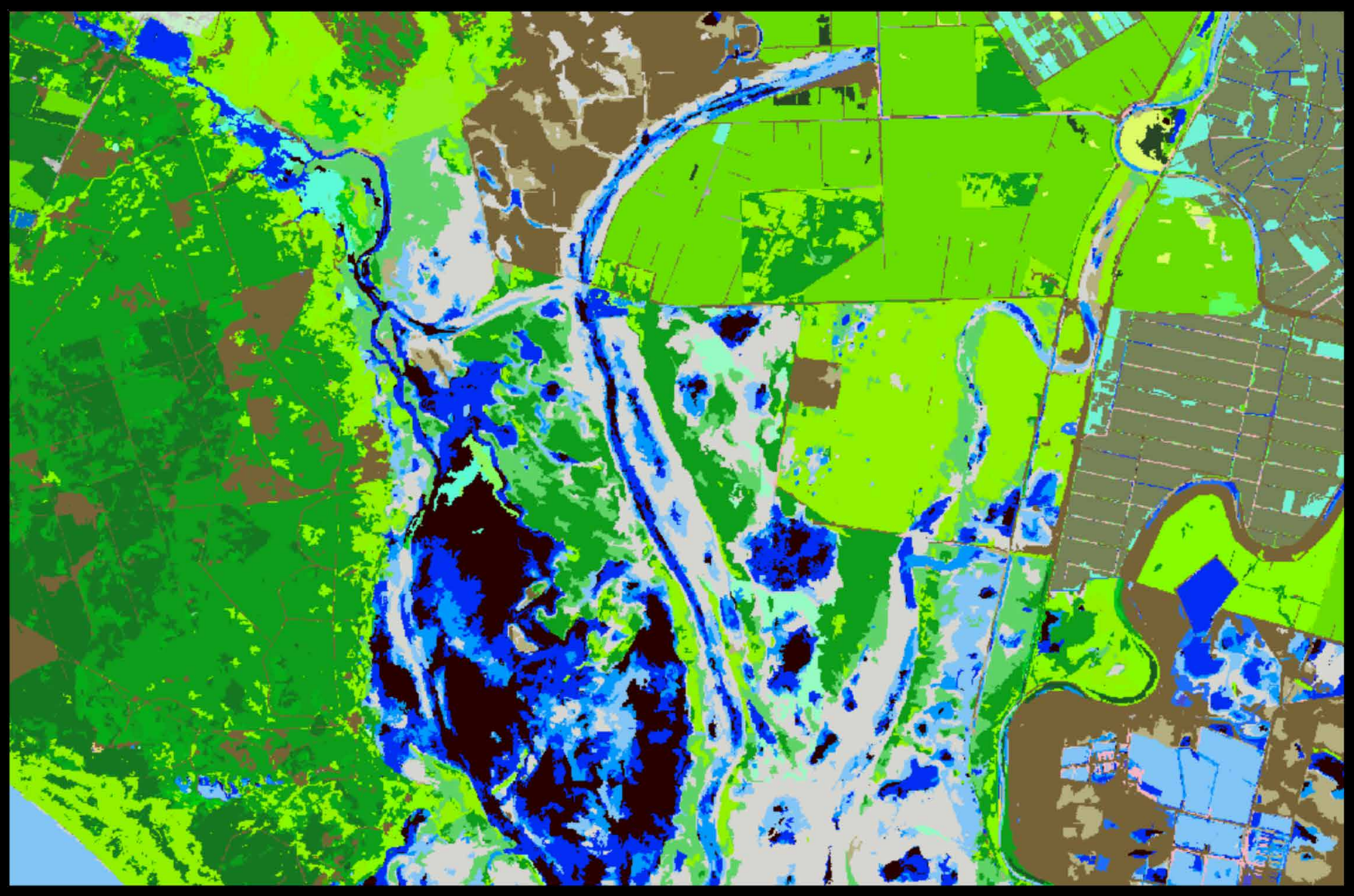
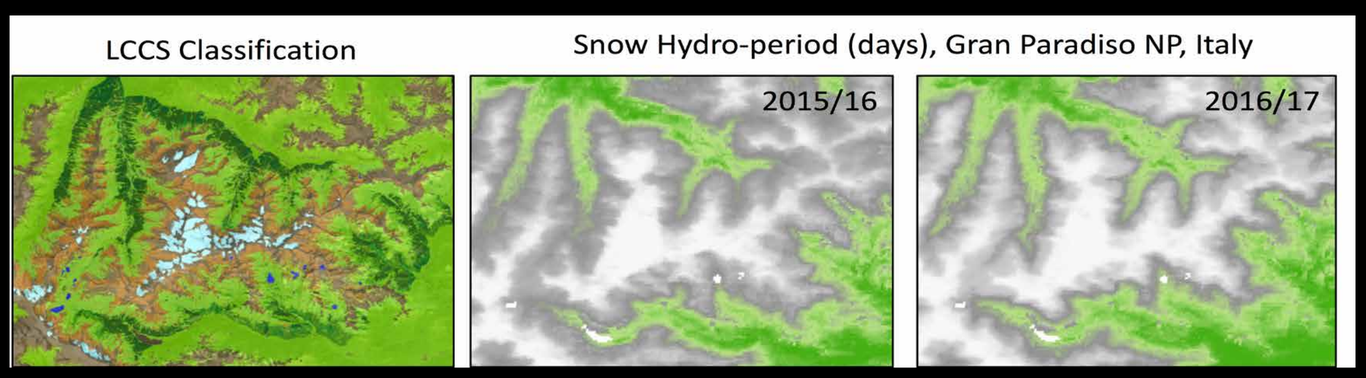


The hydroperiod is the number of days in a year when the soil is covered with water, and depends on the duration, frequency, depth and seasonality of the floods. It is used to assess water availability in wetlands, which support bird populations, fish farming or specific agricultural production. The hydroperiod can be estimated with satellite data in the visible and near infrared. Here above you see two hydroperiod maps for a wetland (Doñana, Spain) generated by the analysis of time series of images from the satellites Sentinel-2A and Landsat for the years 2015-2016 and 2016-2017 (map elaborared from data and products by ECOPOTENTIAL partners).

This map on the right shows the area of the Doñana National Park in Spain and reports a summary of the analysis of changes in land cover, in the extent of areas flooded by water and in the hydroperiod, derived from the analysis of time series of Sentinel-2 satellite data (map elaborared from data and products by ECOPOTENTIAL partners).



Detecting changes by satellites



From left to right: Figure a) Land cover map obtained from automatic classification of Sentinel-2A images. Figure b-c: Annual snow cover duration maps (expressed in number of days per year) obtained from the analysis of time series of Sentinel-2A images for the periods 2015-2016 and 2016-2017 for Gran Paradiso National Park (IT). Maps elaborared from data and products by ECOPOTENTIAL partners.

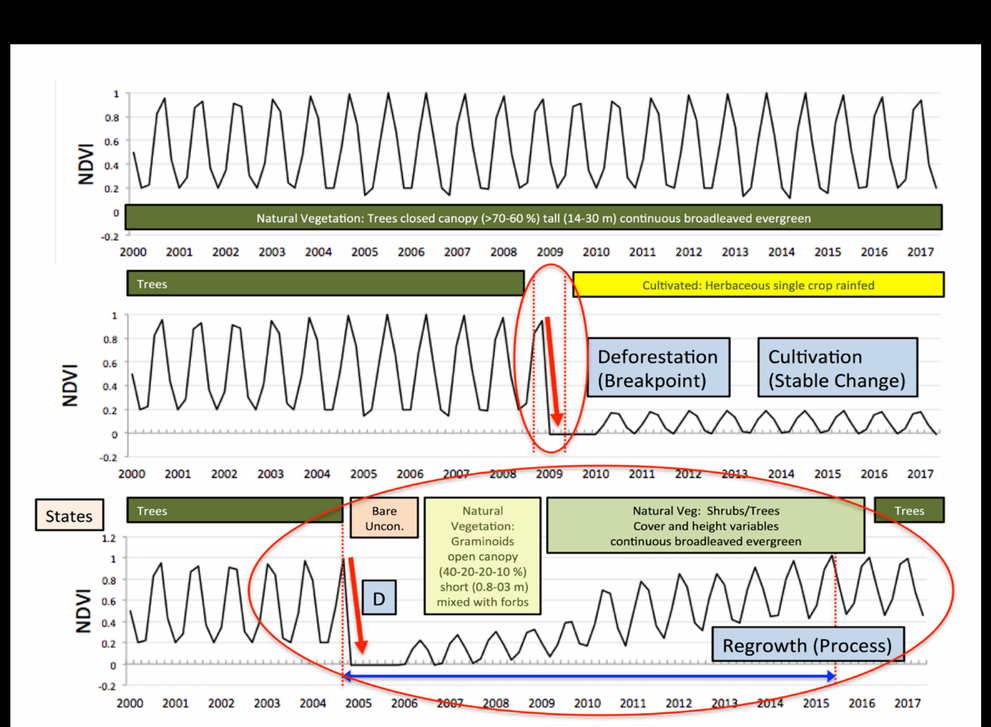
Earth observation satellites acquire images of the Earth's surface in various wavelength ranges (bands) of the electromagnetic spectrum, depending on the sensors they house on board. Satellites in "heliosynchronous polar" orbit, i.e. long trajectories passing through the poles, always fly over the Earth's surface at "the same solar time": having identical light conditions is essential to compare the same area over the long term.

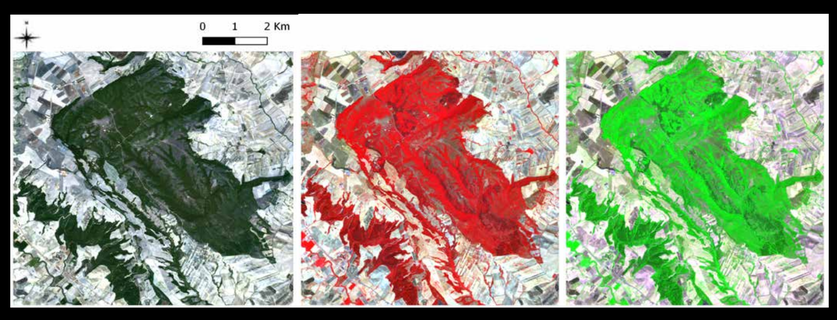
By analysing the satellite remote sensing images, it is possible to extract the changes that have taken place in a given time interval in a certain area (scene). Very complex algorithms are used, which also allow to correct some unwanted effects, such as the effect of the atmosphere, the presence of orographic reliefs, the cloud cover, which creates shadow on the ground, and the spatial alignment between adjacent "scenes".

The choice of the change detection method and the type of satellite data to be considered depend on the purpose of the analysis:
- The analysis of phenomena whose effects propagate over long periods of time (e.g., changes in the extent or state of vegetation, in the concentration of marine chlorophyll, in the temperature of the marine or terrestrial surface; effects due to fires, etc.) is carried out using time series of images within one year or in several years;
- To analyze changes between two precise moments (e.g., pre- and post-event) it is possible to adopt different methodologies for the comparison between two scenes related to two precise time moments T1 and T2, with T2 > T1.

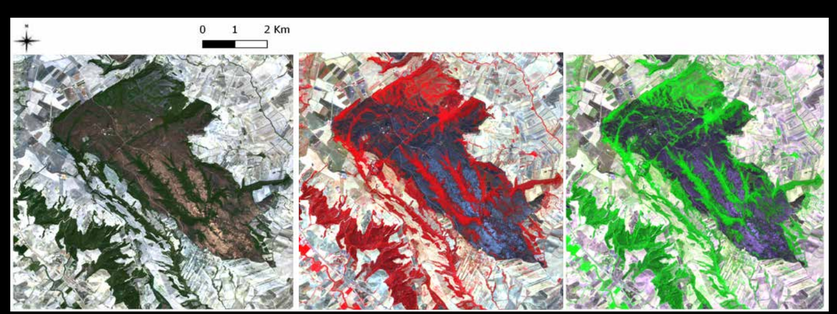
When analyzing a time series of images, we detect in a series of scenes how the signal (or a set of signals) recorded at a given point changes over time, highlighting points of discontinuity due to the occurrence of a change. In the comparison between two scenes related to two precise temporal moments, depending on the available data, it is possible to compare two maps (e.g. "land cover" or bio-geographic-physical variables estimated from satellite data). The validation of change maps using ground measurements is fundamental, as it is necessary to define their accuracy and correlate the change detected by the processing of satellite data with the event to be monitored with a given reliability.

These charts represent three cases of temporal trend of the NDVI index (Normalized Vegetation Differential Index), which is an indicator of the state and coverage of vegetation measurable by satellite sensors in the visible and near-infrared, for a forest of evergreen broadleaf trees. Upper chart: the typical trend of a time series of the NDVI Index in the absence of changes. Central and lower chart: the trends of the NDVI in the case of stable change (e.g. where the area is intended for agricultural use after deforestation) or in the case of regrowth, as, for example, happens if, as a result of deforestation, spontaneous natural regeneration occur (lower graph).





06/08/2017. Murgia Alta, "Bosco Difesa Grande". Sentinel 2-A image before the fire happened on 12/08/2017



06/08/2017. Murgia Alta, "Bosco Difesa Grande". Sentinel 2-A image after the fire happened on 12/08/2017

In the example above (forest fire in the Alta Murgia National Park, in Puglia) it is possible to catch land cover changes from the comparison between two images acquired by the satellite Sentinel-2A before and after the fire. The integration of the information contained in the signal received in the visible and near and medium infrared bands allows to better grasp details and properties (images developed by the Institute for Atmospheric Pollution of CNR for ECOPOTENTIAL).

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