→ SENTINEL-2 FOR AGRICULTURE

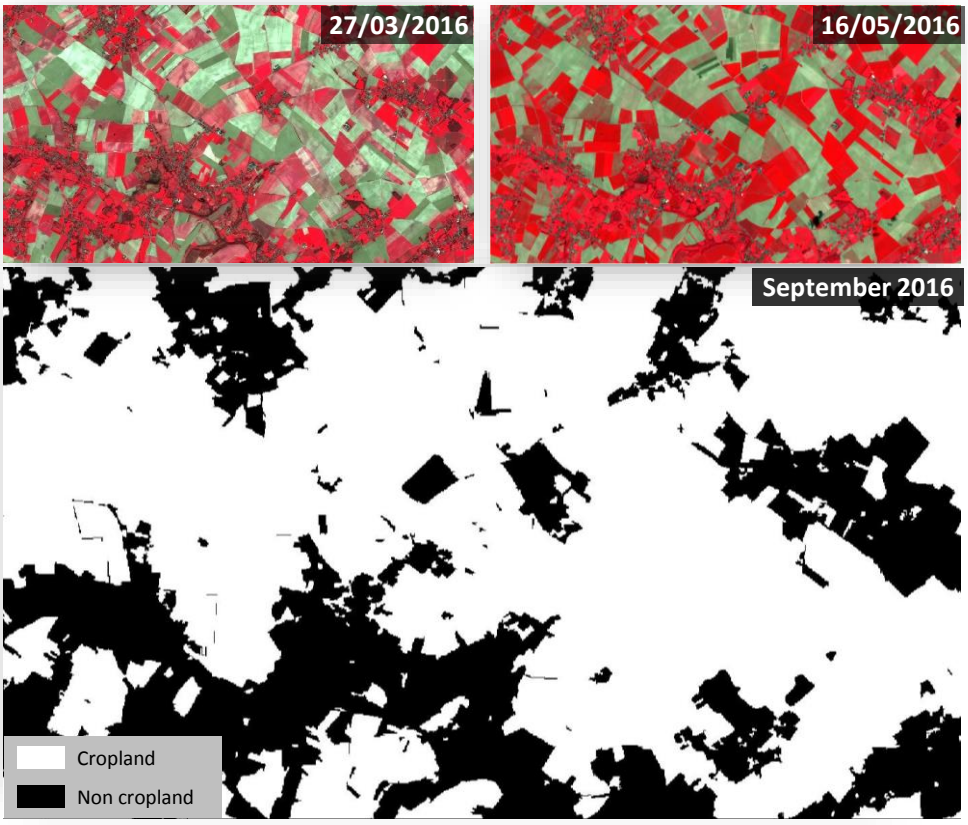
Towards the exploitation of Sentinel-2 for local to global operational agriculture monitoring

Dynamic Cropland Mask: delineating crop areas in the most efficient way

The Dynamic Cropland Mask consists in a **binary map** separating annual cropland areas and other areas, thus corresponding to a mask over annually cultivated areas.

The **annual cropland** is defined as a piece of land with a minimum area of 0.25 ha, actually sowed/planted and harvestable at least once within the year following the sowing date.

Starting from the mid of the growing season, this binary map is produced on a **monthly basis**, to serve for instance as a mask for monitoring crop growing conditions, as basis for sampling stratification and for agricultural extension. Its accuracy is expected to increase as long as additional images are integrated into the development process.



Images from the Sentinel-2 time series over Belgium (top)
and Dynamic Cropland Mask obtained in September 2016, using 7 months of data (bottom)

Product specifications

- Local to national coverage
- 10-meter spatial resolution
- First mask delivered at the middle of the season, then updated on a monthly basis
- Available 5 days after the acquisition period
- Binary legend Crop/Non-Crop
- Thematic accuracy progressively increasing between successive product versions: F1-score of 50% at the middle of the growing season and 80% at the end.
- Geometric accuracy inherited from L1C products accuracy
- DIMAP format including GeoTIFF raster images
- UTM-UPS/WGS84 projection, inherited from the L1C S2 tiles
- XML file metadata

Input data

- A **Sentinel-2 L1C image time series**, optionally completed by an additional **Landsat 8 L1T image time series**, automatically downloaded from ESA and USGS facilities. These data are first turned into **L2A products** (i.e. bottom of atmosphere reflectance products, with snow, water, cloud and cloud shadow masks) through a specific processor of the Sen2-Agri system based on the Multi-sensor Atmospheric Correction and Cloud Screening (MACCS) algorithm (Hagolle et al., 2015, 2010, 2008).
- Depending on the selected processing approach, **user supplied field information** or a **reference crop mask** showing crop and non crop areas over the considered site (in any case, a default version of the reference crop mask is available)

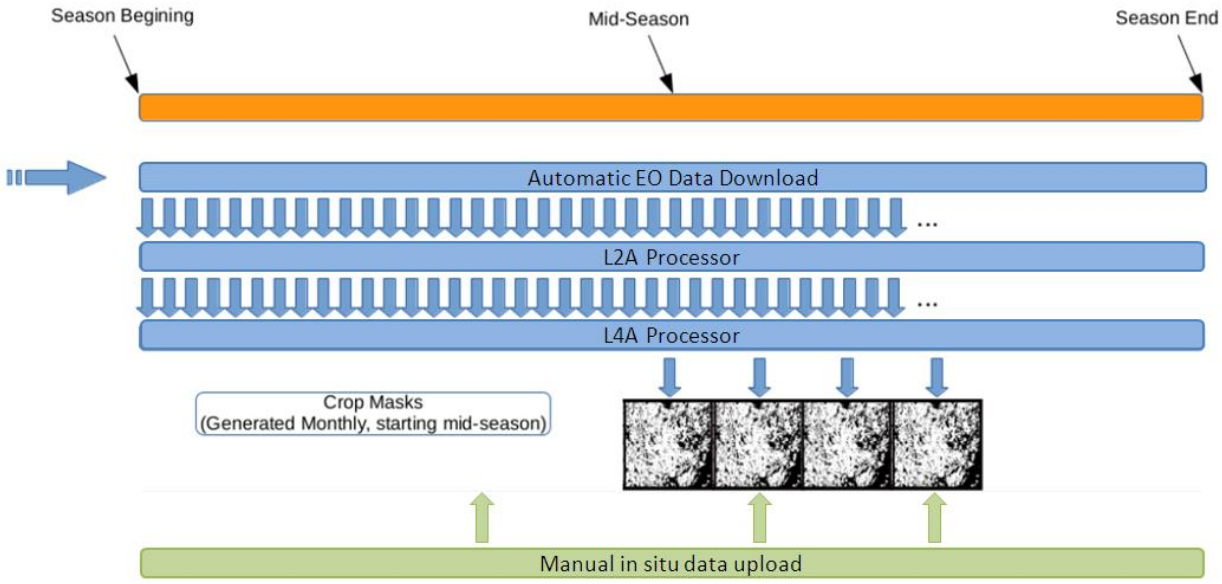
Data volume

- **500 Mb** for the whole season for a local coverage, i.e. an area corresponding to ~9 Sentinel-2 tiles (300 x 300 km²)
- **5 Gb** for a national coverage, i.e. an area of 500 000 km²

Processing methodology

The Dynamic Cropland Mask can be produced either using an **automatic operating mode** as the input images become available or in an **offline way** at the end of the growing season. The mask is provided along with a quality flag indicating for each 10-meter pixel the number of cloud free image available during the acquisition period.

Two alternative approaches are available for the development : the first one requires actual **in situ samples**, whereas the second builds its own sample collection from a **reference crop mask**. In both cases, the product is generated using the well-known Random Forest classifier, completed on demand by an **a posteriori filtering**, based on a per-object approach, to smooth out the resulting Cropland Mask. The detailed methodology is described in Matton N. et al., *An Automated Method for Annual Cropland Mapping along the Season for Various Globally-Distributed Agrosystems Using High Spatial and Temporal Resolution Time Series*, Remote Sens. 2015, 7, 13208-13232 and in Valero S. et al., *Production of a Dynamic Cropland Mask by Processing Remote Sensing Image Series at High Temporal and Spatial Resolutions*. Remote Sens. 2016, *8*, 55.



Delivery schedule of the Dynamic Cropland Mask product with regard to the user-defined growing season

Sentinel-2 for Agriculture is a 3 year project which aims at demonstrating the benefit of the Sentinel-2 mission for agriculture across a range of crops and agricultural practices. The intention is to provide the international user community with validated algorithms and an open source processing system to derive in an operational way Earth Observation products relevant for crop monitoring using Sentinel-2 data.

The project, funded by ESA, is carried out by a consortium involving the **Université Catholique de Louvain** (BE), the **Centre d'Études Spatiales de la Biosphère** (FR) and the companies **CS - Systèmes d'Information** (FR) and **CS Romania** (ROU), working in close collaboration with 18 organizations, centers, universities or companies belonging to the agriculture monitoring communities.