Sen2-Agri system demonstration over 5 local sites spread over the world

The demonstration aims at validating and qualifying the Sen2-Agri system and products and assessing their suitability for regional to national agricultural monitoring purposes. It has been done through national (covering at least 500,000 km²) and local (corresponding each one to a 300 x 300 km² area) sites, to show the usefulness of the Sen2-Agri information products for governmental, scientific and international agricultural entities.

Mali, Ukraine and South Africa were selected for the national demonstration. The results are presented in separate newsletters. This issue focuses on the 5 local sites for which the system running and the products generation was in charge of the consortium: China, France, Madagascar, Morocco and Sudan.

Each local site organized a field campaign to provide in-situ data representative of their main land cover classes and crop types. The system was operated by the consortium to deliver the full suite of Sen2-Agri products to the sites who was then in charge of analyzing them and giving feedback. When possible, use cases are being identified and discussed with relevant and interested end-users from public and private sectors, NGOs, international bodies and/or scientific institutions.

Map of Sen2-Agri system demonstration over 3 national and 9 local sites
Morocco

Moroccan region of Tensift and Oum Er-rabia watersheds includes the city of Casablanca. Alfalfa is cultivated during summer, wheat and sugar beet are the main winter crops and maize is grown throughout the season.

The Tadla plain (Oum Er-rabia watersheds) includes the city of Beni Mellal. The main crops are wheat, sugar beet, alfalfa, orange tree and olive tree, with a growing season all over the year (from September to August).

In both regions, the fields size ranges between 0.5-10 ha, with mainly irrigated crops. The climate is arid to semi-arid, with a dry season from April to October and a wet season from November to March. The annual rainfall is 300mm.

Time series of Leaf Area Index at 10 meters, derived from Sentinel-2 and Landsat 8 over the irrigated perimeter of Tadla during the 2016 growing season

Crop mask and crop type map over 3 areas, associated with a cloud-free composite in true and false color

- Cropland
- Non cropland
- Winter wheat
- Maize
- Beans
- Sugar beet
- Alfalfa
- Other crops

14 Apr 16
24 Apr 16
14 May 16
24 May 16
6 Jun 16
26 Jun 16
France

The French site is located in the Midi-Pyrénées region, half-way between the Mediterranean and Atlantic coast. It counts 2 instrumented sites, regular field campaigns for land cover and biomass.

The field size is around 10 ha and the main crop types are winter wheat, rapeseed, maize, sunflower but also tree crops, vegetables and flowers.

The climate is Temperate to Mediterranean. Winter crops are cultivated from October to July while summer crops (e.g. rapeseed) are planted in September to be harvested in June.

Cloud-free Composite product corresponding to August 2016, obtained from Sentinel-2 and Landsat 8 data collected during a 50-day period from 5 July to 25 August, 2016.

Crop Type map obtained at the end of the season (November 2016).

With a pair of high-detail illustrations for Crop Mask and Crop Type.

- Cropland
- Non cropland

Zooms of the crop mask and crop type over the French local site.
China

The Chinese site is located in the Shandong region, to the South of Beijing.

Fields are rather small (0.2-0.8 ha). Main crops are **winter wheat**, **corn**, **cotton** and **vegetables**. The typical crop rotation is winter wheat from mid-October to early June and corn from mid-June to end of September.

The climate is temperate, semi-arid, monsoon climate, with an annual mean precipitation about 582 mm, concentrated from late June to September.
Madagascar

The local site in Madagascar is Antsirabe, with Antananarivo being the closest major city. This site includes the JECAM site, over which field data are collected every year for gathering information about land use practices and crop types.

The climate is subtropical, characterized by a wet cloudy and rainy season from October to April.

Fields are very small, with an average of 0.03 ha. The main crop is the rice, both rainfed and irrigated. A specific is that there are a lot of mixed crops within the rainfed cultivated domain. Other important crops are maize, sweet potatoes, potatoes, cassava and fruit crops.

Zooms of the cloud-free composite, crop mask and crop type map over the Itasy region (central highlands) on the left, associated with more detailed maps over the valley on the right.

Time series of Leaf Area Index at 10 meters, derived from Sentinel-2 and Landsat 8 over the 2016-2017 growing season.
Sudan

Despite the importance of the agricultural sector to Sudan’s economy, the country lacked a reliable and up-to-date agricultural land cover database. The importance to start building an operational agriculture monitoring system convinced us to test the Sen2-Agri system in this context, in close collaboration with the Ministry of Agriculture.

The demonstration site stretches over both Sudan and South Sudan and is made up of:

- The **White Nile State**, which belongs to Sudan, in the north;
- The northern part of the **Upper Nile State**, which belongs to South Sudan, in the south.

The climate is continental.

The main crops are **sorghum**, **wheat**, **millet** and **sesame**. These crops can be either rainfed or for some of them irrigated. Depending of the crop type, the field size widely varies from 1 to 50 ha.

Agriculture is partly mechanized and a sugarcane agroindustry also exists.

The growing season ranges from April to November, with a land preparation period in April/May followed by planting in July or early August. Harvest occurs in November at the latest.
Local demonstrations to tackle agricultural systems diversity
Sentinel-2 for Agriculture at a glance

Achieving sustainable food security for all people is a priority highlighted during the Millennium Summit of the United Nations in 2000, which defined the eradication of extreme poverty and hunger as one of the eight Millennium Development Goals. In response to such growing pressure, the development of agriculture applications is becoming a strategic target for the remote sensing community.

In this context, ESA has launched the Sentinel-2 for Agriculture project, as a major contribution to the R&D component of the GEOGLAM initiative and to the JECAM network activities. This 3-year project 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 open source algorithms and software to process Sentinel-2 data in an operational manner and derive Earth Observation products relevant for crop monitoring in the major worldwide representative agriculture systems.

The project is carried out in close collaboration with 20 organizations, centers, universities or companies belonging to the agriculture monitoring communities. They are our Champion Users, involved in the project since its very beginning.

The activities are split into several steps for coming to national and local demonstration:

- During Phase 1, user requirements have been collected and consolidated to set up relevant products and system specifications. Simulated test datasets representative of Sentinel-2 imagery were acquired over 12 test sites to benchmark algorithms and design the system.
- Phase 2, now closed, was devoted to the development of an open source processing system and the generation of prototype products based on the Phase 1 outcomes.
- Started after the Sentinel-2 commissioning phase, Phase 3 aimed at demonstrating and validating the developed system with actual Sentinel-2 time series, with the additional objective to transfer the system to the Champion Users at operational level.

The Sentinel-2 for Agriculture project is carried out by a consortium led by the Université Catholique de Louvain (BE) and involving the Centre d’Études Spatiales de la Biosphère (FR) and the companies CS - Systèmes d’Information (FR), CS Romania (ROU) and GISAT (CZ).