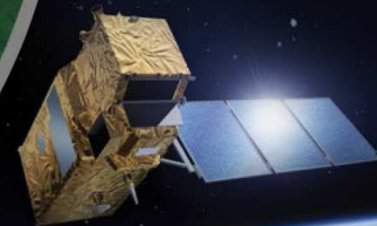


## → SENTINEL-2 FOR AGRICULTURE

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



Newsletter 4 - July 2015

### Successful Sentinel-2 launch

The eagerly awaited Sentinel-2A spacecraft just launched will be a game changer for agricultural monitoring due to its frequent and consistent observation over the globe. Sentinel-2 will now complement observations of the SPOT 5 Take 5 experiment running since early spring for a full seasonal 2015 coverage over the Sen2Agri test sites in the Northern hemisphere.

This newsletter focuses on these new data sources, their exploitation and on the basic principles of the Sen2Agri processing system itself.

### Sentinel-2: here it is!

Developed for Europe's Copernicus environmental monitoring programme and widely anticipated by the whole Earth observation community, the Sentinel-2 A satellite was launched successfully on June 23<sup>rd</sup> from Kourou, French Guiana, by a Vega rocket.

With its innovative high-resolution multispectral imager including 13 spectral bands, Sentinel-2 will provide unprecedented views of Earth. In combination with a swath width of 290 km and frequent revisit times, it offers a new perspective of our land and vegetation, particularly relevant for large scale agriculture monitoring.

During the commissioning phase, which is planned to last 3 months, data will be collected mainly for calibration purposes but also for reference data sets for different application domains. The latter ones our project will make full use of to show early results of Sentinel-2 for agricultural monitoring.

The whole Sentinel-2 mission, based on two identical satellites operating as a constellation in the same orbit and phased 180° apart, will cover all Earth's land surfaces and offer a 5-day revisit capability to any point on the globe. The second sensor, Sentinel-2B, is scheduled for launch after mid 2016.

Additional information about the mission can be retrieved from the [Sentinel-2 User Handbook](#),

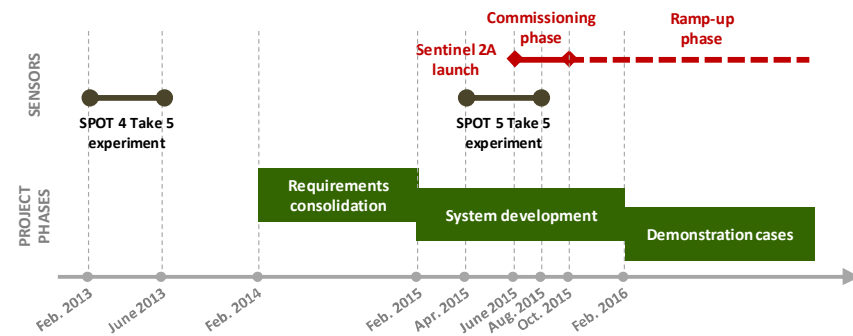


A close-up of an area in the Po Valley, showing the city of Pavia (left) and the confluence of the Ticino and Po rivers - Subset from the first Sentinel-2A image acquired on 27 June 2015  
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## Consolidating our achievements with the SPOT 5 Take 5 experiment

The current project phase focuses on prototyping the specified Sen2Agri EO products which will be followed by a last demonstration phase running the developed system with actual Sentinel-2 time series in 2016. However, due to the 3-month commissioning phase, Sentinel-2 routine acquisitions will not start for us before the end of summer, even if some of our project sites will be specifically targeted by ESA. It will therefore be too late to monitor the main part of the 2015 growing season in the Northern hemisphere.



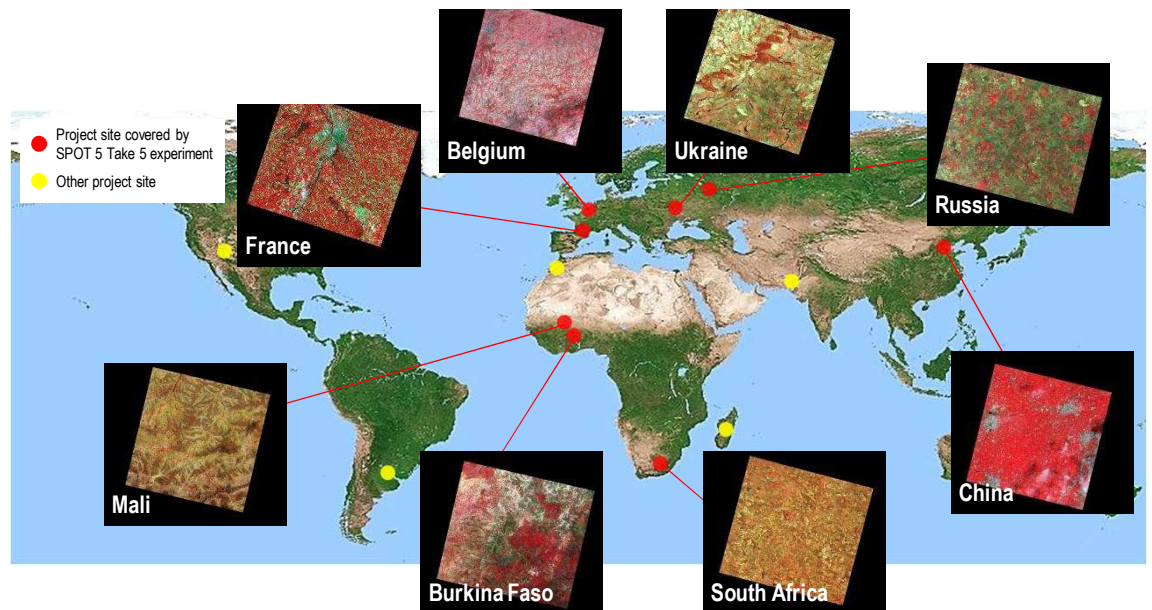
Fortunately, the SPOT 5 Take 5 experiment offers our consortium a unique opportunity to cover all this growing season and thus smooth the transition with Sentinel-2 data without waiting for another year. Thanks to an ESA-CNES cooperation, SPOT 5 has been placed in a 5-day cycle orbit early April, allowing to acquire a new Sentinel-2 like dataset until next August. Using these data, we will therefore be able to deliver a continuous suite of products from July 2015 as and when Sentinel-2 images are received.

The first images of the SPOT 5 Take 5 experiment, already acquired, are currently under processing (<http://www.cesbio.u-ps-tlse.fr/multitemp/?p=5353>). The corresponding L1C products, as well as the L2A ones, are already available for downloading (<https://spot-take5.org>).

A set of **8 sites** has been chosen for SPOT 5 Take 5 acquisitions, most of them already used during the project benchmarking activities.

A new one was added in **Mali**, a critical place in terms of food security, as reliable local partners have been identified in this country.

All these sites belong to the **JECAM** network, with a fair distribution in both hemispheres.



On each of the selected sites, the 4 Sen2-Agri EO products will be generated: **cloud-free composites, dynamic cropland masks, crop type maps** and **vegetation status indicators**. In order to gain a maximum of experience from the experiment, two production schemes are foreseen:

- ❖ A **Near-Real Time production** concerning France and Mali, using the prototyped Sen2-Agri system validated during to the benchmarking process to deliver products during late spring and summer 2015;
- ❖ A **production at the end of the season** for the remaining 6 sites (Belgium, Burkina Faso, China, Russia, South Africa and Ukraine) once the Sen2-Agri system is fully developed. This second stage may include a few Sentinel-2 images to complete image time series once the SPOT 5 Take 5 experiment is over.

All the products will be validated on the basis of independent in-situ data to derive quantitative accuracy figures using the same criteria as those applied during the benchmarking. Besides, a user-oriented assessment will be set up as it is a key component of the user dialogue. The primary objective will be to iterate with our champion users to confirm the products meet their needs and to receive their feedback.



## The Sen2-Agri system: a multipurpose framework

The Sentinel-2 for Agriculture project aims not only at delivering information products, but also at developing an open source system allowing any user to generate -at his own premises and in an operational way- the products tailored to his needs.

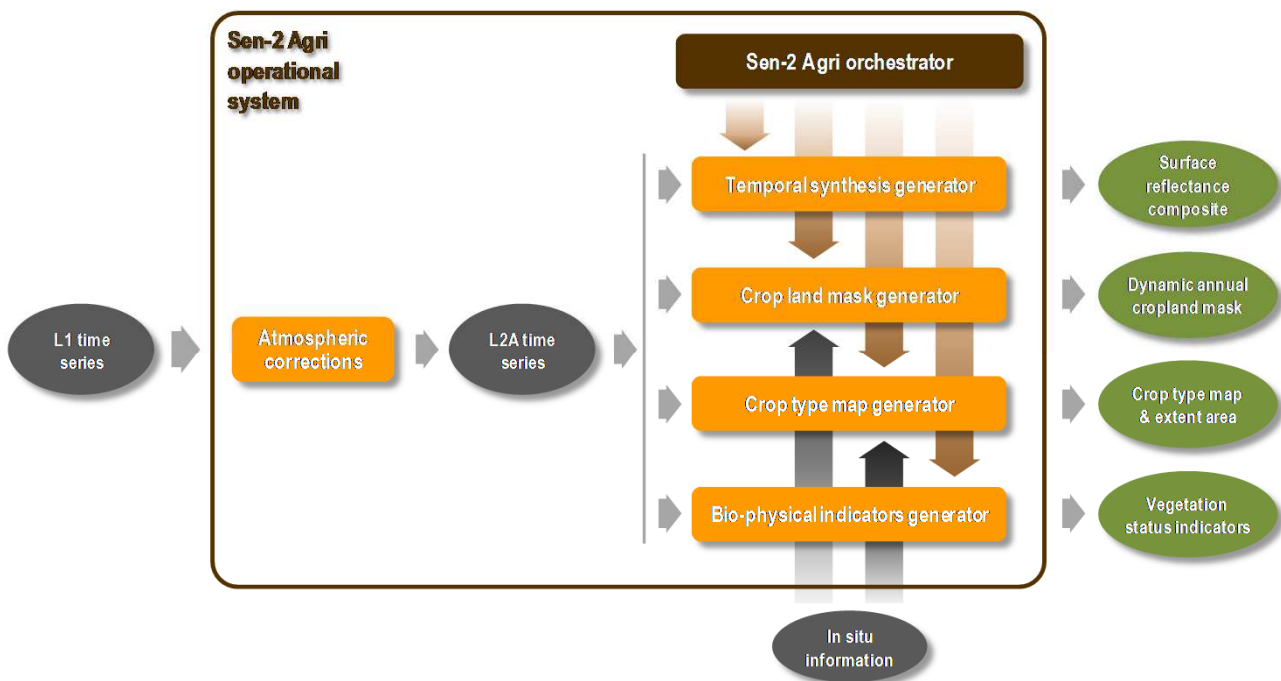
In order to ensure cost-effectiveness, as well as to make implementation and maintenance easier, the Sen-2 Agri system will be designed from the beginning as modular and interactive. In practical terms, it will be based on open source software and include two main parts:

- ❖ A set of **Software Components** which will form the Sen2-Agri ToolBox, each one being an independent executable corresponding to a single or a set of algorithms to support the development of a given product type;
- ❖ An **Orchestrator**, used to manage these Software Components to monitor the whole Sen-2 Agri system and execute processing jobs.

The modular design and the standardization of interfaces considered during the development make the Sen-2 Agri architecture targeted at various user profiles:

- ❖ **High-level analysts**, who want to integrate the products into their estimations related to agriculture and food production status and are interested in a direct delivery of the products by the Sen-2 Agri system ;
- ❖ **Operator level users**, who aim at running the system and generating the Sen2-Agri products in their own facilities to control and validate the results, then disseminate them to their own high-level users;
- ❖ **Research users**, who would rather access and tune the components available within the Sen2-Agri ToolBox, to define new products and validate them in order to optionally produce them into their own production system or into the Sen2-Agri one.

Designed to work not only with **Sentinel-2** but also **Landsat 8** imagery, the Sen-2 Agri system will be able to ingest **in situ information**, more particularly to customise the development of dynamic cropland masks and of crop type maps.



### Let's talk about it

- After one year of project, the organization of the **2<sup>nd</sup> User Workshop** is now on track. Joint to the next JECAM Science Meeting, this event, to be held in **Brussels** between **November 16 and 20, 2015**, will give the opportunity to present the results of the benchmarking as well as of the SPOT 5 Take 5 experiment and to discuss them in detail with the sites managers.

Besides, this workshop will mark the beginning of the project training and capacity building activities, giving to the attending users an overview of the Sen2-Agri system and a first concrete appraisal of its features, as well as a demonstration of its first prototype.



### 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 18 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**, now over, user requirements have been collected and consolidated to set up relevant products and system specifications. Simulated test datasets representative of future Sentinel-2 imagery were acquired over 12 test sites to benchmark algorithms and design the system.
- ▶ **Phase 2**, currently under progress, is devoted to the development of an open source processing system and the generation of prototype products based on the Phase 1 outcomes.
- ▶ Starting right after the Sentinel-2 commissioning phase, **Phase 3** will demonstrate and validate 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) and **CS Romania** (ROU).



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