

First land cover maps using SPOT4 (Take5) images

C. Marais-Sicre, J. Inglada, O. Hagolle, M. Kadiri, J. Cros, J-F. Dejoux



Land cover map production

A precise knowledge of land use and land cover is crucial for many scientific studies and for many operational applications. This accurate knowledge needs **frequent information updates**, but may also need to be able to go back in time in order to perform trend analysis and to suggest evolution scenarios.

Satellite remote sensing offers the possibility to have a global point of view over large regions with frequent updates, and therefore it is a very valuable tool for land cover map production.

The kind of data provided by **Sentinel-2** allows to foresee the development of land cover map production systems which should be able to **update the information monthly at a global scale**.

However, for those maps to be available in a timely manner and with a good quality, **robust, reliable and automatic methods are needed** for the exploitation of the available data.

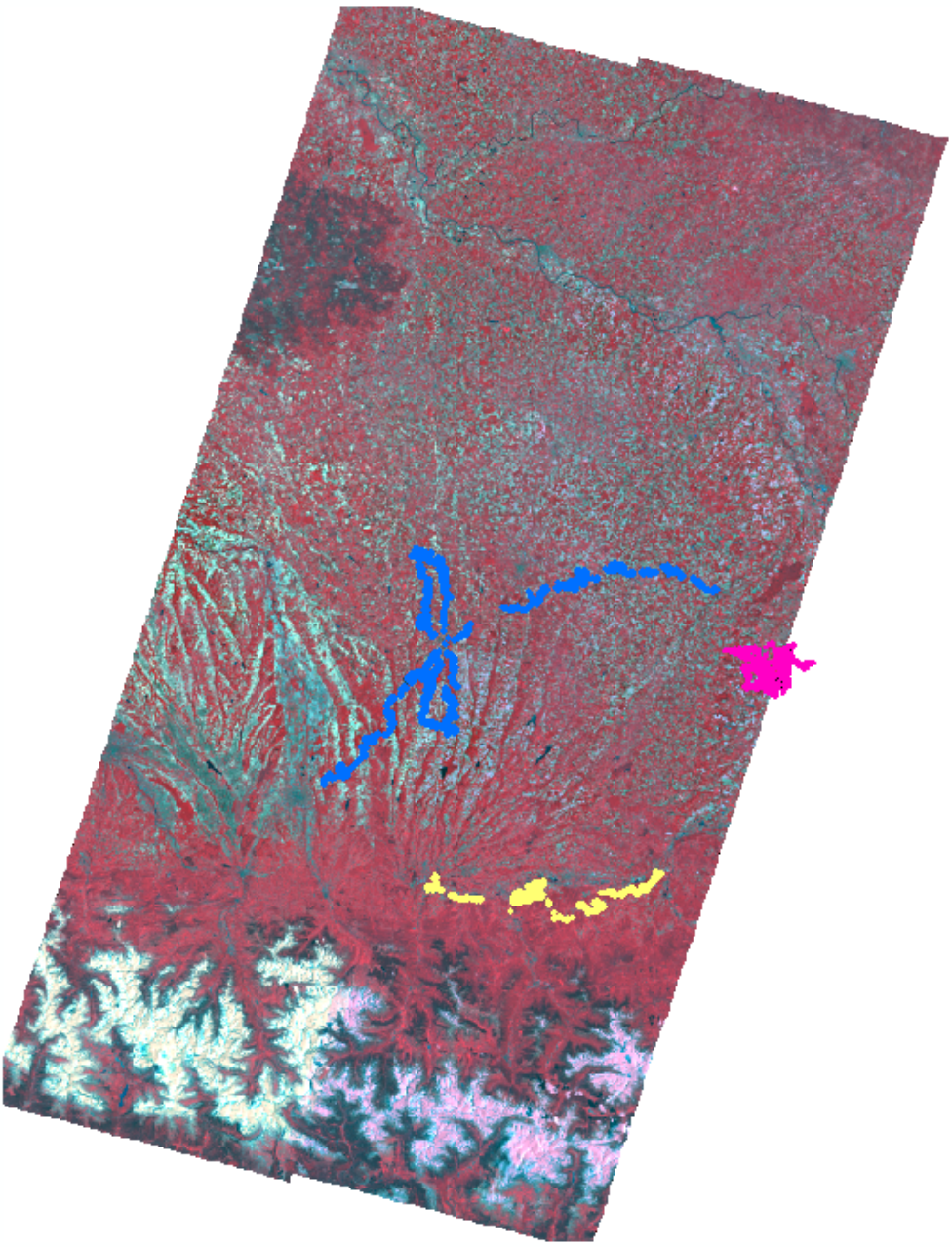
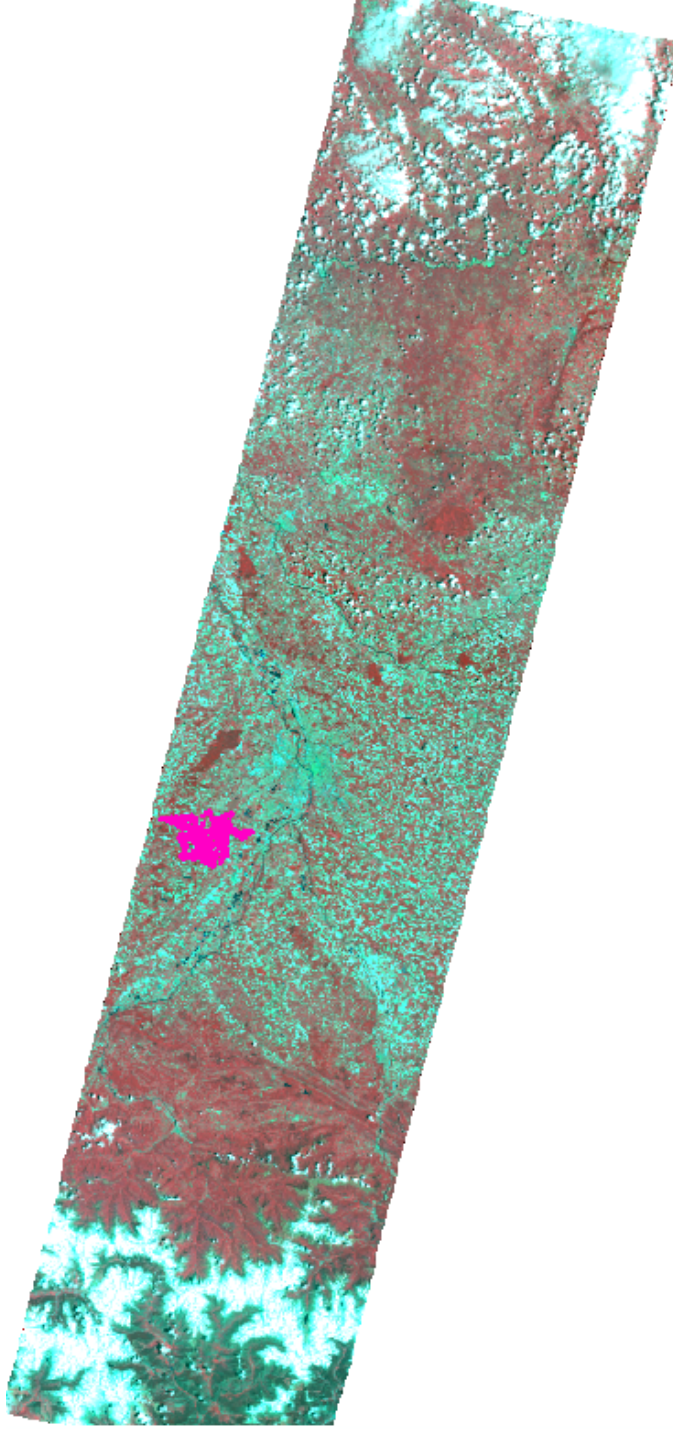
SPOT4 (Take5): a Sentinel-2 simulator

In order to avoid wasting time when Sentinel-2 is launched, it is necessary to prepare today for the use of these data. Since there were no suitable data to perfectly simulate the features of Sentinel-2, **CNES** decided to launch the **SPOT4 (Take 5) experiment** to simulate the repetitivity of Sentinel-2 satellite, using SPOT4, from February to mid June 2013. The data characteristics are:

- **Resolution:** 20m
- **Coverage:** 45 sites are observed with a field of view of 60 to 120 km using both SPOT4 HRVIR instruments. Combining observations from adjacent orbits, it was possible to obtain 200 km wide sites.
- **Revisit:** 5 days with constant viewing angles.
- **Spectral:** 4 bands

The data has been processed by the **THEIA Land Data Centre** and is **freely available** for download at <http://spirit.cnes.fr/take5/>.

Data available for the Midi-Pyrénées South-West site

West track	East track	Ground truth
		A field data collection campaign synchronous to the satellite acquisitions was organised. The field work was conducted in 3 study areas (blue, pink and yellow in the images to the left) which were visited 6 times between February and September 2013, and corresponded to a total of 2000 agricultural plots . This allowed to monitor the cultural cycle of Winter crops, Summer crops and their irrigation attribute, grasslands, forests and built-up areas. The final nomenclature consists in 16 land cover classes .
Acquisition dates 2013-02-16 2013-02-21 2013-03-03 2013-04-17 2013-06-06	Acquisition dates 2013-02-17 2013-02-22 2013-03-04 2013-04-13 2013-06-07	

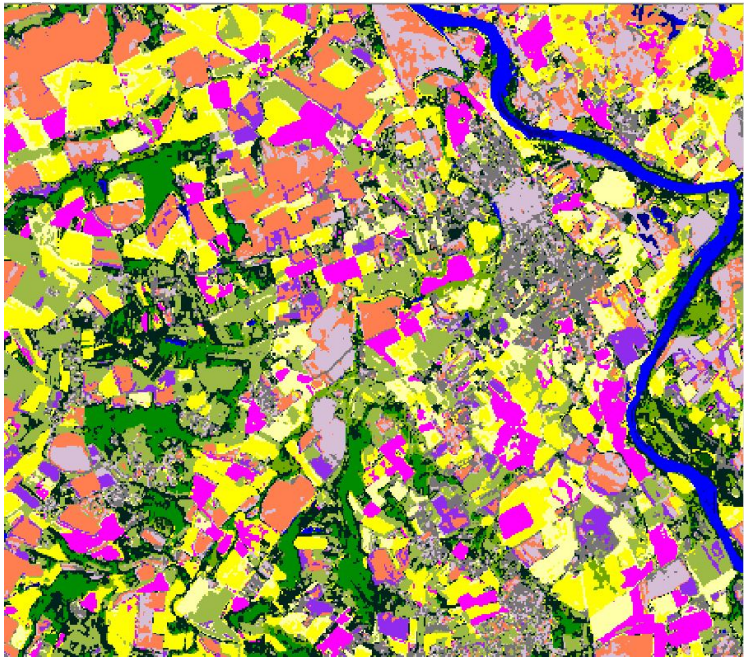
Results

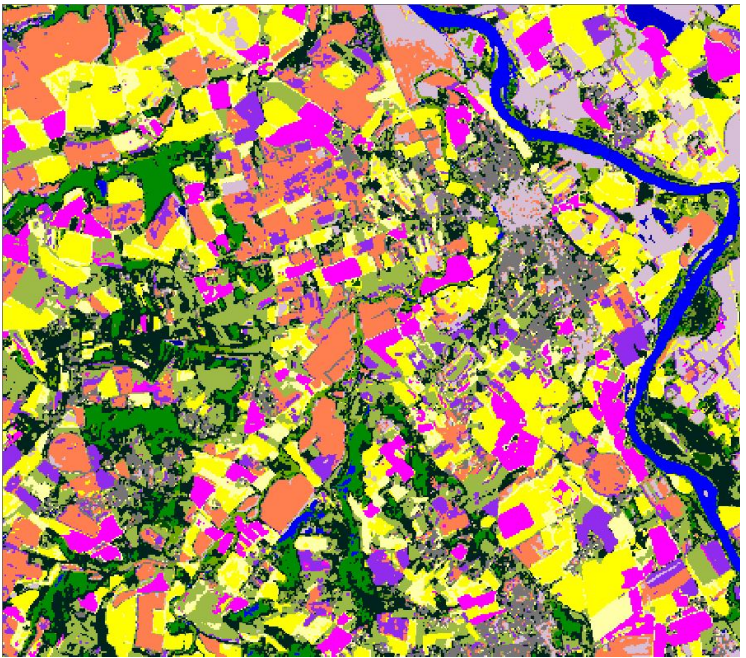


The first results of **supervised SVM classification (using the ORFEO Tool-box)** can be considered as very promising, since they allow to obtain more than **90% of correctly classified pixels** for both the East and the West tracks and since the continuity between the two swaths is excellent.

Some confusions can be observed between **bare soils or mineral surfaces and Summer crops**, but these errors should be reduced by using LANDSAT 8 images acquired during the Summer, when Summer crops will develop. Merging of the land cover maps obtained on the East and West Sudmipy tracks (the cloudy areas were cropped out). The comparison against the ground truth (the black dots on the map to the South-West of Toulouse) results in a **kappa index of 0.89 for the West and 0.92 on the East**.

Analysis





F-Score	West	East
wheat	86.32	85.96
rapeseed	97.63	97.44
barley	88.00	86.92
grass	78.79	85.71
maize	85.86	93.21
sunflower	94.29	90.21

This zoom compares the results obtained on the common area of the two tracks (West to the left and East to the right). **The two classifications were obtained independently**, using the same method and the same training data, but with images acquired at different dates and with different viewing angles. **The main errors are maize plots labeled as bare soil**, which is not surprising, since this crop was just emerging when the last image was acquired. There are also **confusions between wheat and barley**, but even on the field, one has to be a specialist to tell them apart.

Conclusions

After performing these experiments, we were very satisfied with the **operationnality of our tools**, both in terms of computation times and classification accuracy.

Given the data volume to be processed (about **10 GB of images**) we could have expected very long computation times or a limitation in terms of memory limits of the software used. Computation times are very interesting: several minutes for the training and **several tens of minutes for the classification**.

The **classification error rates** are also **satisfactory** for a **detailed crop nomenclature**.

The Sentinel-2 Agriculture project



The **Sentinel-2 Agriculture** project, aims at showing on a **large scale** project, the capabilities of Sentinel-2 mission for **agriculture monitoring**, by providing an **open source processing software** to generate, among other products, **crop type maps**.