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Development of an operational tool for early detection of fire with new Indian Ocean Data Coverage Meteosat-8

Christophe Révillion (1), Sébastien Peillet (2), Sylvain Cros(3), Nicolas Sébastien(3), Télesphore Brou(1)

(1) Université de La Réunion, UMR 228 Espace-Dev (IRD, UA, UG, UM, UR), SEAS-OI, 40 Avenue de Soweto 97410 Saint-Pierre, La Réunion, France
(2) Office National des Forêts en Guyane, Réserve de Montabo, 97300 Cayenne, Guyane, France
(3) Reuniwatt, 14 rue de la Guadeloupe, 97490 Sainte-Clotilde, La Réunion, France

Introduction

The longer the reaction time on a fire, the more likely it is to become uncontrollable and the greater the impact on people and the environment. The UMR Espace-Dev in Reunion Island at the SEAS-OI station (http://www.seas-oi.org/) and the Reuniwatt compagny have therefore initiated the implementation of an early fire detection system due to their frequency in the South West of the Indian Ocean. This system is based on the use of satellite Earth Observation data to monitor large regions.

Meteosat Second Generation (MSG) data were selected for the fifteen minute time interval between each acquisition and their large spatial extent. A Bash shell and Python 2.7 processing chain has been created for real-time fire detection, from the acquisition of MSG data to the online publication of alerts.

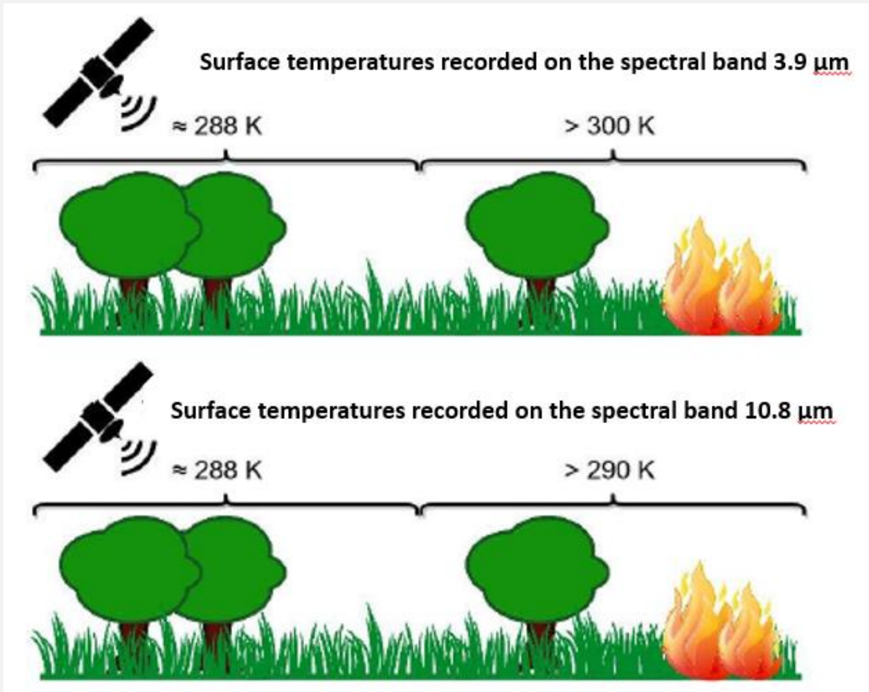
Material and methods

From the MSG data, the 3.9 µm and 10.8 µm wavelength bands required for fire detection are selected. These raw data are then reconstituted in raster to extract the radiance values in a first time and finally the surface temperatures. Initially, the tests were made using the Low Rate Image Transmission (5 channels available, three hours interval between acquisitions) data on sub-Saharan Africa, in preparation of the operational service of the recently reorbited MSG-1 satellite for Indian Ocean Data Coverage.

Two filters are then applied to detect thermal anomalies.

The absolute filter is applied with the following expression : $T_{3,9}>300K$ AND $T_{10,8}>290$ K AND $\Delta T>15$ with $\Delta T=T_{3,9}-T_{10,8}$ who represent the limit value from which we know there is a thermal anomaly.

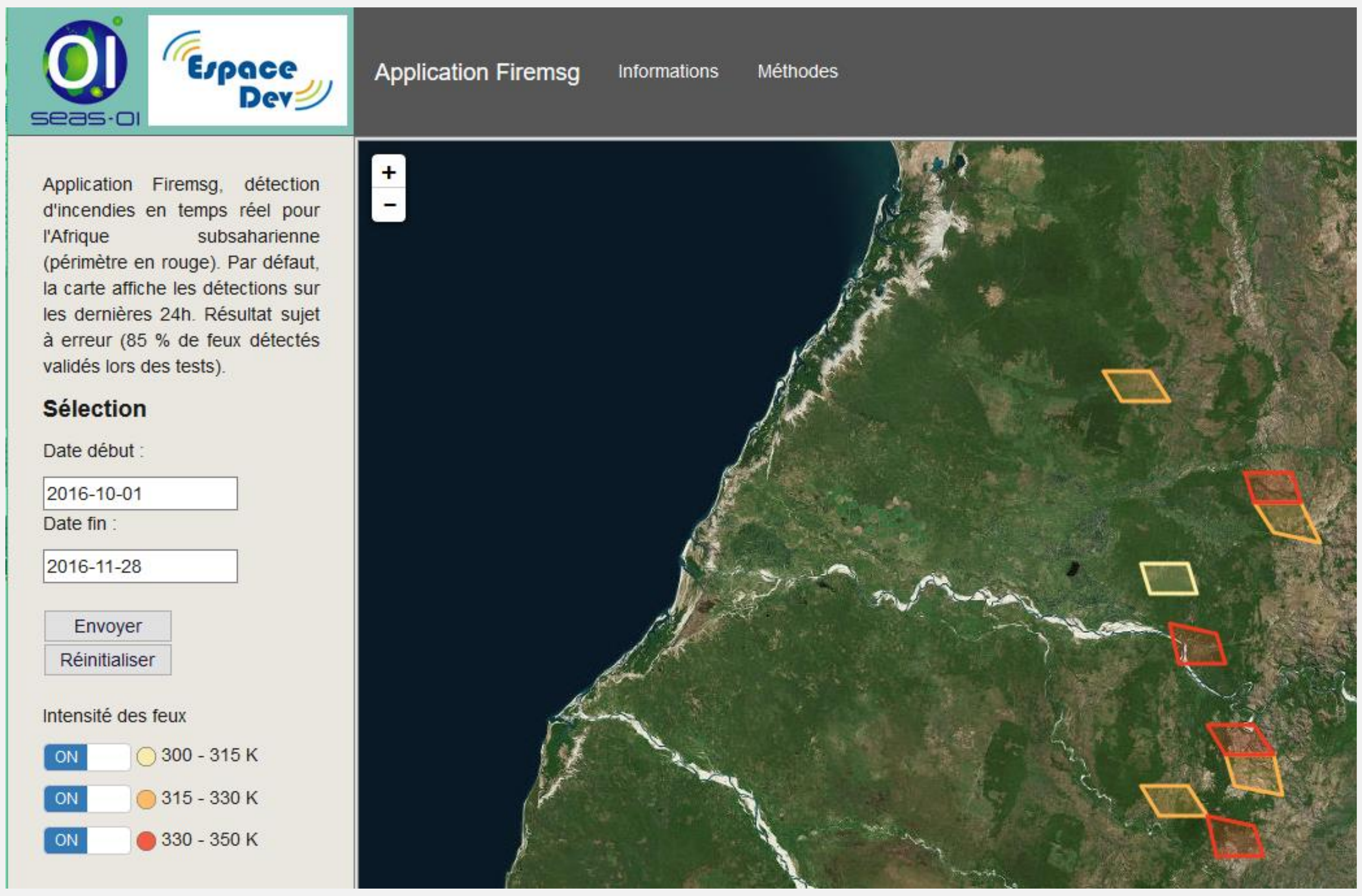
Then, the contextual model that allows to correct the errors due to the clouds. This model uses a mobile window to evaluate whether a potential fire pixel is effectively a thermal anomaly with regard to its close environment.



Example of surface temperature products with fire detection results when the two filters are applied

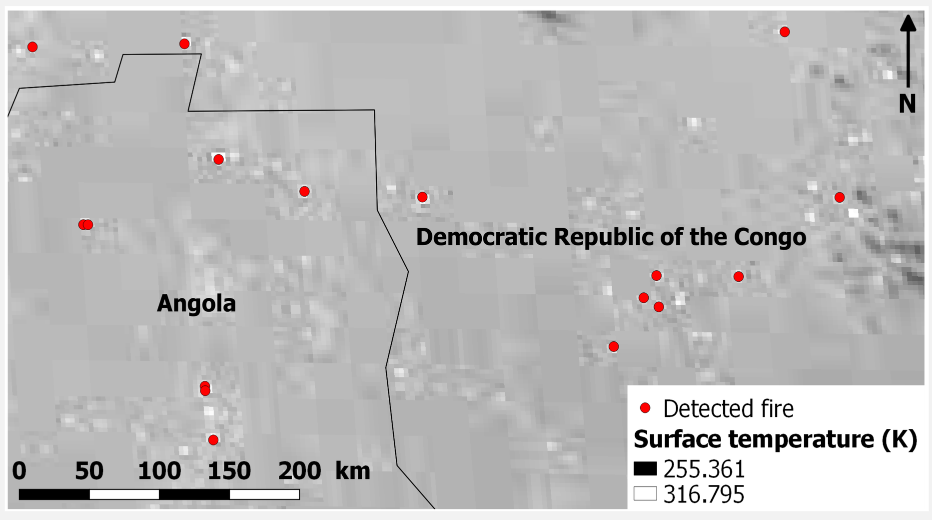
Detection results : webmapping interface and detection accuracy

The processing chain for the fire detection is executed in five minutes which allows an important reactivity of the system. When the processing is complete the results are directly available online on an mapping interface (**www.seas-oi.org/detection_incendie**). This allows the entire database to be queried, depending on the intensity of the anomalies and the date since July 2016.

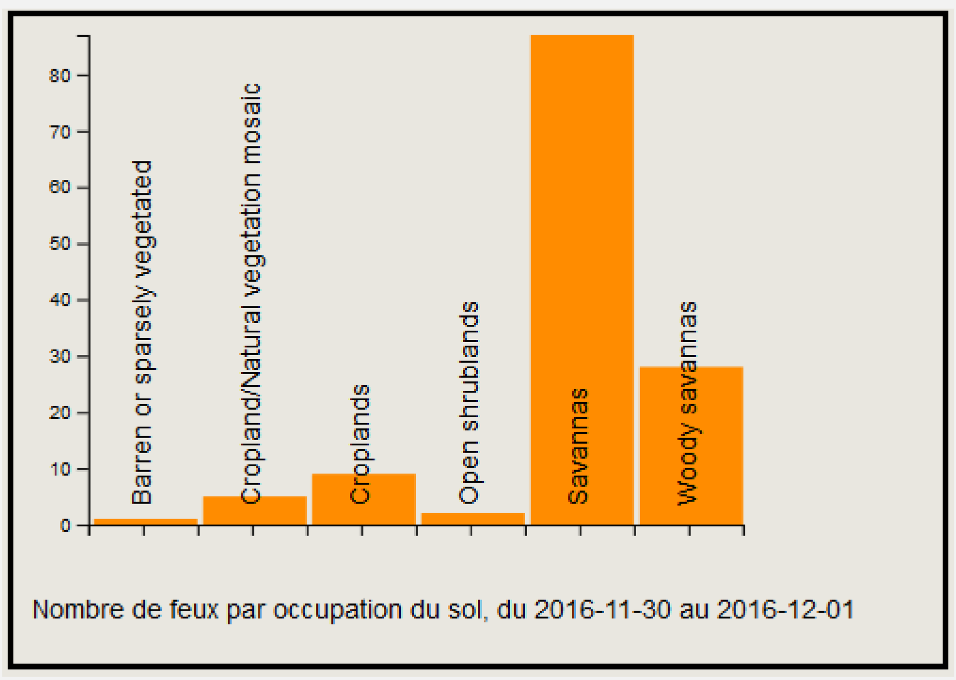


In addition, a statistical calculation tool has been integrated into the web mapping platform. This allows, through a database that integrates the borders of countries and the MODIS Global Land Cover to calculate the number of fires detected per country and per land use class. This simple tool can be used to extract valuable indicators for fire managers on the seasonality of fires and the ecosystems that are the most affected.

Concerning the quality of the detection algorithm**, statistical tests yield 85% of good detections,** the remaining 15% being either false alerts or alerts that can not be confirmed or confirmed. This confirms the effectiveness of the detection algorithm.



First results : fire detection temperature on the pixels of the MSG images from the two spectral bands used



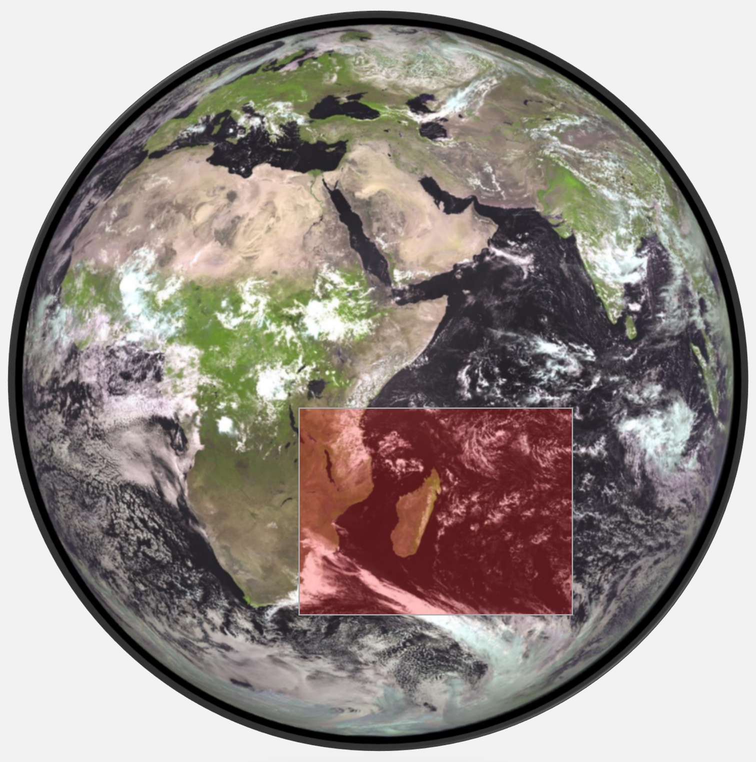
Statistics on land-use patterns affected by fires between 30 November and 01 December 2016. According to the Global Land Cover 2012 classification. Example of statistics extracted automatically from the online interface.

Conclusion

With the new Indian Ocean Data Coverage service, the results are now relevant for Madagascar and countries from East Africa (Mozambique, Tanzania). But the resolution of the images proved to be inadequate for the small island territories of the area (Seychelles, Mascarene Islands). To improve the tool on these small territories, the processing and integration of other types of data, with better spatial resolution, is envisaged (VIIRS, MODIS).

The improvement of the current tool thanks to these data will be facilitated by the recent direct reception of MODIS images by the SEAS-OI station. In the medium term, this evolution will make it possible to offer early detection products with greater reactivity and greater precision.

Finally, the integration of high-resolution data was tested. The first tests showed that this could lead the system to achieve 91% of good detection.



New orbit of the Meteosat 8 satellite and the future spatial extent of the operational application

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Corresponding authors : christophe.revillion@univ-reunion.fr, telesphore.brou@univ-reunion.fr