Sentinel 2 products for wildfires monitoring in Bolivia

The project requested a cloud resource to run eo-applications to monitor wildefires in Bolivia. On the cloud resources have been installed the WASDI Platform to process the EO Images.
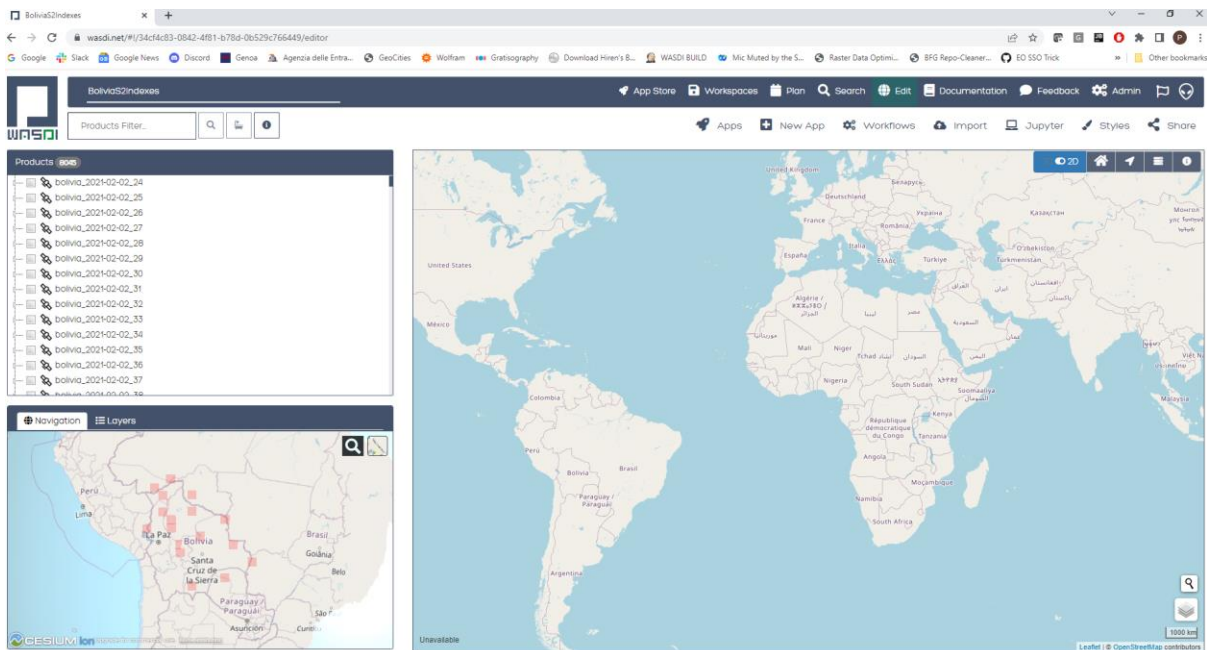

Figure 1 - Workspace on WASDI Platform

Wildfires are one of the most affecting hazards in Bolivia. In the last decades, very impactful events occurred in 2010, 2019 and 2020, affecting ecosystems and areas of incredible biodiversity, such as the Amazonian forest, the Chiquitano forest and the wetlands called "Pantanal".

Typically in Bolivia dry season corresponds also to the period of time dedicated to traditional practices for preparing agricultural fields for sowing (called "chaqueo"), which involve burning brush piles for soil fertilization. This increases the potential risk of wildfires, especially when these brush piles' fires go out of control, evolve and start spreading as major wildfires, also due to meteorological conditions.

National institutions involved in Disaster Risk reduction and Management and Emergency Response for wildfires are:

- The National Hydrological and Meteorological Service (SENAMHI), in charge of monitoring and forecasting of hydrometeorological conditions
- The General Directorate for forestry management and development (DGGDF), in charge of monitoring forestry conditions and ensuring sustainable use of this natural resources
- The Deputy Ministry for Civil Defense (VIDECI), in charge of defining guideline for disaster risk reduction at national level, providing emergency and humanitarian response face to natural disasters.

CIMA Research Foundation has provided in the last decade a continuous support for strengthening early warning and emergency response capacities of these national institutions. Particularly, a common platform for multi-risk forecasting, monitoring and early warning has been implemented, called myDewetra. This platform has been conceived to:

- enhance monitoring and forecasting capabilities of hydro-meteorological variables, supplying a unique and fast access point to information from different sources (satellite data, local observation network, regional and local forecast models, etc…);
- Use IT technologies aiming at reducing time of non-expert actions (e.g. less time wasted in data gathering, more time for data analysis and decision-making);
- foster data sharing and communication among authorities and agencies involved in Disaster Risk Reduction and Management (myDewetra as a "round table").

Within this framework, throughout several projects the platform was further developed and strengthened with the integration of new products and tools.

Particularly, regarding wildfires' monitoring and forecast, high-resolution multispectral satellite images can be such an important tool. Therefore, during last year, in order to support national DRM institutions, Sentinel S2 images has been integrated into myDewetra platform for wildfire monitoring purposes in near real-time.

Standard band combination algorithms were implemented in the WASDI platform, which enables fast and continued processing of diverse source of Earth Observation (Sentinel in particular). Outputs were then integrated into the Bolivian myDewetra platform. The algorithms also consider cloud cover and exclude from processing and integrating all images which have cloud cover major than 30%. Every part of the Bolivian territory is covered by a Sentinel S2 image every 5-10 days and throughout the implemented algorithm images are made available to national DRM institutions with a latency period of about 30 hours.

Particularly, three specific products have been integrated:

- a combination of bands B04, B03 and B02, the so-called "True color"
- a combination of bands B12, B11 and B04, the so-called "False urban color"
- a combination of bands B12, B08 and B04, the so-called "Shortwave infrared (SWIR)".

Each one of these three products are used from Bolivian national institutions for different operational use:

- True color → this specific combination of bands allows to clearly identify fires' smoke identification and also to follow-up the evolution of fire spreading (front and direction)
- False urban color → this specific combination of bands allows the identification of active flames and also the follow-up of the evolution of fire spreading (front direction)
- Shortwave infrared (SWIR) → this specific combination of bands is well-known for enabling the identification of actives flames, which implies the possibility of monitoring the fire front, and particularly the estimation of burnt areas.

Some examples of operational use of Sentinel S2 images, as an integrated product within myDewetra platform, for wildfire monitoring in 2020 in Bolivia is thus showed.

Late September 2020 wildfires spreading started in the northern areas of the municipality of Concepción (Santa Cruz region). Meteorological conditions were favorable for a quick evolution of wildfires sizes and beginning of October 2020 VIDECI moved its experts in monitoring, early warning and emergency response from national headquarters in the capital city, La Paz, directly on the field.

Sentinel S2 images have been quite useful for monitoring wildfires conditions and leading in an effective way all the emergency response operations of firefighting.

By using the True Color product, national DRM institutions were able to monitor smokes from several wildfires ongoing (three are clearly visible in Figure 1), as the possible evolution of the fire spreading. This helped a lot in correctly and efficiently allocate and move firefighting resources.

Figure 2: Image with band combination called "True color" from Sentinel S2 (4th October 2020) covering the northern area of the municipality of Concepción (Santa Cruz region). Smoke from at least 3 ongoing wildfires is clearly identified, as also the possible direction of the fire spreading.

By using the False Urban Color product, national DRM institutions were able to clearly identify active flames from ongoing wildfires, evaluate the extent of the fire front and the possible direction of fire spreading. In Figure 2 a detailed of a huge wildfire in the northern area of Concepción is presented.
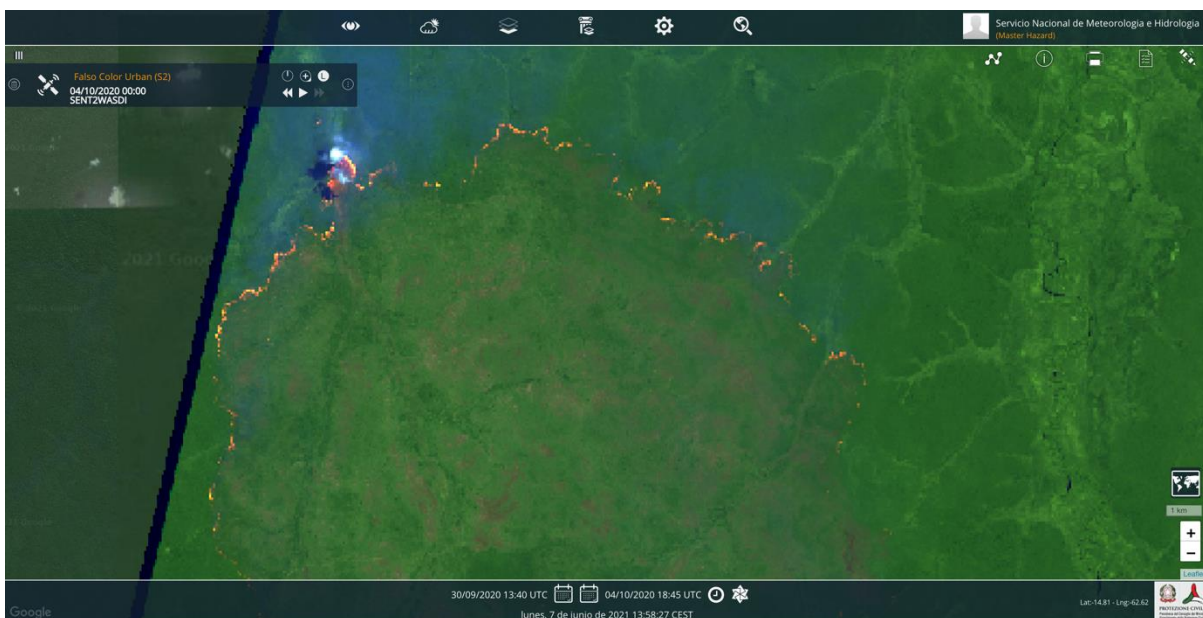

Figure 3: Detail of an Image with band combination called "False urban color" from Sentinel S2 (4th October 2020) covering a specific huge wildfire in the northern area of the municipality of Concepción (Santa Cruz region). Active flames and the extent of the fire front are clearly identified.

Late September 2020, some important wildfires occurred also in the Chiquitania area, that was the most affected area in the previous year, 2019. Among the municipalities impacted there was San Matias (Santa Cruz region).

By using the Shortwave infrared product, national DRM institutions were able to clearly identify in San Matias the extent of the areas already burnt by fires as also active flames indicating that the wildfire was still ongoing. Considering the information provided also from Sentinel S2 images, a better better distribution of the efforts for emergency response was possible, as also a first evaluation in terms of losses and impact to forestry and natural resources. In Figure 3 a detailed of burnt areas from an important wildfire in San Matias is presented.
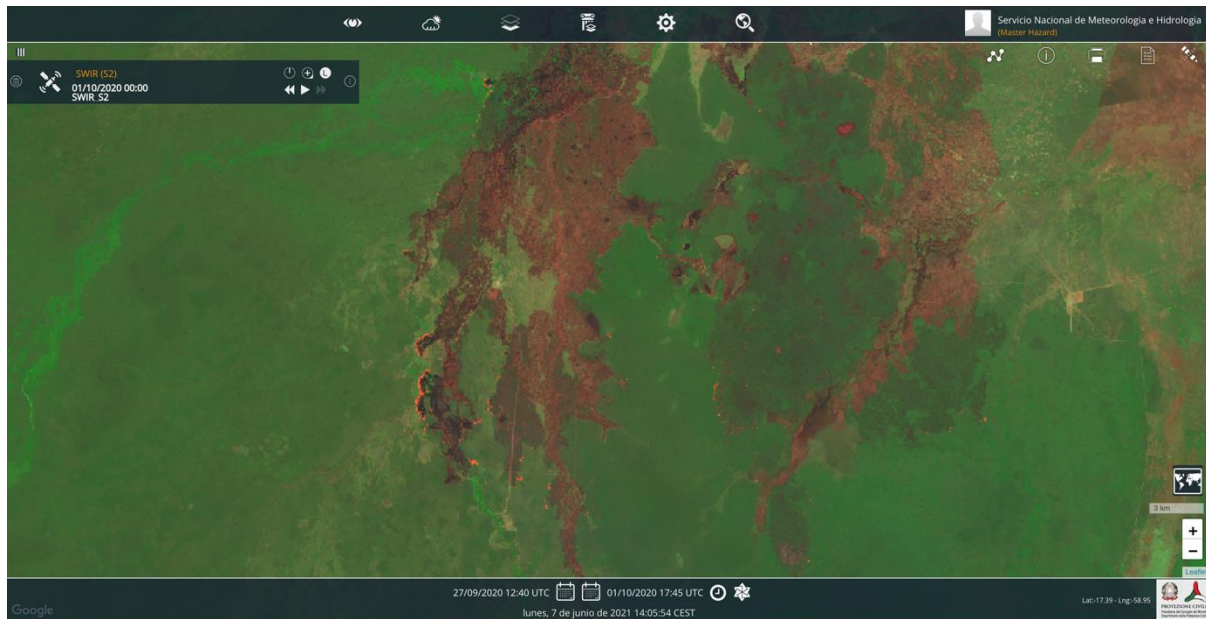

Figure 4: Detail of an Image with band combination called "Shortwave infrared" from Sentinel S2 (1st October 2020) covering a specific huge wildfire in the municipality of San Matias (Santa Cruz region). The extent of the already burnt areas is clearly identified, as also active flames along the fire front.

According to national DRM institutions in Bolivia, having Sentinel S2 images available and integrated in their own platform for multi-risk monitoring and early warning provided an important contribution during 2020 wildfire season. It helped to improve the efficiency in terms of time and better allocation of all the resources engaged in firefighting.

Besides the real-time run, a retrospective analysis covering the entire 2019 and 2020 was performed to understand the behaviour specific wildfire events and calibrate wildfire forecast models and Propagator, the fire propagation algorithm (the latter not operational yet.