

## BURNT AREA MAPPING AT PROVINCIAL LEVEL USING SENTINEL IMAGERY

*Sentinel-2 imagery was analysed to map the extent of burnt areas in the affected municipalities of "Città Metropolitana di Torino".*

### The challenge

The Piemonte region in northwest Italy was affected by a series of large fires in October 2017, caused by a combination of long lasting drought conditions, high temperatures, strong winds and arsonists. Once the immediate emergency response phase ended, the main challenge was to create a comprehensive inventory of the burnt areas, as explicitly required by national regulations, in a short timeframe. Field mapping of the burnt areas is a demanding task in terms of resources and time. Satellite imagery is indeed an effective and efficient approach to speed up such a task with a sufficient degree of accuracy.

### The space based solution

The efficiency and effectiveness of a space-based solution for burnt areas mapping for this specific event was already demonstrated by the Copernicus Emergency Management Service (© European Union, 2012-2018), which mapped 6 of the most affected areas in the framework of [EMSR253] forest fire in Piemonte, Italy. The Public Authority "Città metropolitana di Torino" (NUTS3 level), covering 316 municipalities grouped into 11 homogeneous areas, decided therefore to integrate an operational satellite based solution to map the burnt areas in the 60 affected municipalities of Torino [Turin], integrating and updating the 6 areas already analysed by the Copernicus EMS service. For this purpose, it collaborated with the ITHACA research centre, which has long-standing experience in emergency mapping, and with Politecnico di Torino. Multi-temporal Copernicus Sentinel-2 optical images acquired before, during and after the forest fire event (thanks to the ~3 days revisit time of the constellation at mid-latitudes) were processed. The availability of multispectral information in the Short Wave and Near infrared

bands allowed burnt areas to be delineated with an adequate accuracy even in the presence of fire smoke, that would have jeopardised the analysis based only on visible data. Burnt areas have been exported in GIS-ready formats to allow further value-added analyses.

### Benefits to Citizens

The main benefits of the EO space-based solution is mainly in terms of safety of citizens and infrastructures. Intersecting the burnt areas with the in-situ data of provincial authorities (e.g. urban areas strategic infrastructures, risk zones) enables to carry out timely risk analyses in the affected areas, e.g. debris flow risk, safe mobility planning, allowing preventive measures to be assessed (also in terms of costs), prioritised and planned. Furthermore, the availability of a comprehensive burnt areas database (a strict user's requirement) derived by satellite imagery efficiently supports administrative processes foreseen by national regulations in case of fires events (e.g., prohibitions



Burnt areas in Val di Susa, Città metropolitana di Torino after the forest fires in October 2017.

(Source: Città Metropolitana di Torino)

Thematic Area



CIVIL PROTECTION

Region of Application



CITTÀ METROPOLITANA DI TORINO

Sentinel mission used



S1  
S2

Copernicus Service used



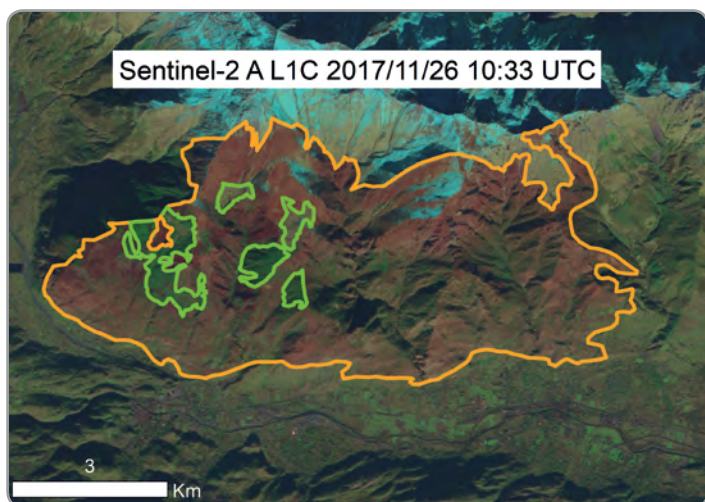
CEMS

Usage Maturity Level



3/4

prescriptions, penalties). Satellite-based analysis are indeed faster than traditional time-consuming field surveys and cheaper than aerial flights, allowing large areas (including possible inaccessible areas) to be mapped with homogeneous interpretation guidelines. Long lasting events can also be monitored thanks to the short revisiting time. For this specific event, the estimation of the impact of forest fires on ecosystem services has been also experimented by "Città metropolitana di Torino", to estimate the social costs of reactivating lost ecosystems services or to maintain their baseline conditions.



Burnt area extent (Susa, Torino) and severity (orange, completely burnt – green, partially burnt) overlaid on a post-event Sentinel-2 imagery. (Source: ITHACA)

## Outlook to the future

In order to consolidate the support of the Sentinel derivative products to public authorities, dedicated ad-hoc services tailored to regional and/or provincial requirements could be further developed. In particular, the exploitation of data acquired by the Sentinel-1 radar SAR constellation would allow the limitations of optical data to be overcome. Sentinel-1 imagery can indeed also provide information in the event of cloud coverage. Furthermore, considering the increased availability of services and products

“A comprehensive mapping of the burnt areas over the provincial territory in a short timeframe enables a more efficient response, especially in terms of protection of citizens.”

**Massimo Vettoretti**  
Città metropolitana di Torino

based on Sentinel imagery, ad-hoc operational workflows can be developed at provincial authority level to ingest space-based data (possibly including the outputs of the European Forest Fire Information System, EFFIS) and to extract the required value-added information.

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