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A novel procedure to map burned areas exploiting Sentinel-2 dense multitemporal series

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Remote Sensing data play a major role in supporting knowledge about wildfires by delivering rapid information to map fire damaged areas in a precise and prompt way. Recently, the large availability of dense multitemporal series of satellite data, freely provided by Copernicus Programme, opened the way for the development of new methodologies to produce more detailed wildfires maps and to support the management of fire-related environmental emergencies. In particular, the high revisit frequency and improved spatial and spectral resolution of the MSI optical sensor onboard Sentinel-2 satellites provide an unprecedent perspective for delivering rapid and updated information to support vegetation fires monitoring. Despite the large availability of freely available satellite data, there are still few examples of operational services for high resolution wildfire mapping at national level based on new satellite sensors. Key prerequisites to map areas disturbed by wildfires in an accurate and prompt way include the development of automated and transferable procedures, possibly without any a priori information, and the exploitation of the entire satellite time series.
This research study presents a novel procedure to identify burned areas from dense multitemporal series of Sentinel-2 data. The procedure allows to effectively produce high spatial resolution burned area maps with no a priori knowledge about wildfire occurrence or burned areas spatial distribution. The proposed methodology uses the entire dense Sentinel-2 time series and is founded on a threshold-based classification based on empirical observations, that discovers wildfire fingerprints on vegetation cover by means of an abrupt changes detection procedure. Various spectral indices, describing wildfire disturbance, were used to identify burned areas and were compared in order to identify their performances in terms of spectral separability. Additionally, the radiometric signal in the SWIR spectral domain is exploited to detect active fires within the identified burned areas.
Effectiveness of the procedure in mapping high spatial resolution burned area at national level was demonstrated for the Italy 2017 wildfires case study. Results were compared to the thematic maps generated under the Copernicus Emergency Management Service to test the effectiveness of the methodology.
Results demonstrate how the proposed procedure allows an extremely unprecedented perspective with high resolution mapping of burned areas, offering a benchmark for the development of new operational downstreaming services at national level based on Copernicus data for the systematic monitoring of wildfires from dense Remote Sensing optical time series.