Sentinel 2 Multi-Spectral Instrument (MSI) (S-2) images have been used for mapping burned areas within the borders of the Vesuvio National park, Italy, severity affected by fires during summer 2017. A fuzzy algorithm, previously developed for Mediterranean ecosystems and Landsat data, have been adapted and applied to S-2 images. Major improvements with respect to the previous algorithm characteristics are i) the use of S-2 band reflectance in post-fire images and as temporal difference (delta pre- and post-fire) and ii) the definition of fuzzy membership function based on statistics (percentiles) of reflectance as derived from training areas.

The following input bands were selected based on their ability to discriminate burned vs. unburned areas: post-fire NIR (Near Infrared, S-2 band 8), post-fire RE (Red Edge, S-2 bands 6 and 7) and temporal difference (delta post-pre fire) of the same bands and additionally of SWIR2 (ShortWave Infrared, S-2 band 12).

For each input, a sigmoid function has been defined based on percentiles of the unburned and burned histogram distributions, respectively, derived from training data. In this way, and with respect to previous formulation of the algorithm, membership function can be defined in an automated way when ancillary layer are provided for extracting statistics of burned and unburned surfaces.

Input membership degrees for the selected bands have been integrated to derived pixel-based synthetic scores of burned likelihood with Ordered Weighted Averaging (OWA) operators. Different operators were tested to represent different attitudes/needs of the stakeholders between pessimistic (the maximum extent of the phenomenon to minimise the chance of underestimating) and optimistic (minimise the chance of overestimating).

Output score maps provided as continuous values in the [0,1] domain have been segmented to extract burned/unburned areas; the performance of the combined threshold and OWA operator has been evaluated by comparison with Copernicus fire damage layers from the Emergency Management Service (EMS) (https://emergency.copernicus.eu/). Error matrix, F-score and omission and commission error metrics have been analysed.

Finally, the correlation between fuzzy score derived by applying OWA operators has been analysed by comparison with Copernicus EMS fire damage layers as well as fire severity computed as temporal difference of the NBR index. Results show satisfactory accuracy is achieved for the identification of the most severely affected areas while lower performance is observed for those
areas identified as slightly damage and probably affected by fires of lower intensity. Moreover, some discrepancies have been observed between different layers of fire severity due to the non-unique definition of the criteria used for assessing the impact of fires on the vegetation layer.