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Temporal and spatial analysis for post-fire vegetation recovery in a Mediterranean site. An approach using optical Sentinel-2 and SAR Sentinel-1 imagery.

Giandomenico De Luca[1], João M. N. Silva[2], and Giuseppe Modica[1]
[1]Deaprtment of Agriculture, University "Mediterranea" of Reggio Calabria, Italy (giandomenico.deluca@unirc.it; giuseppe.modica@unirc.it)
[2]Forest Research Centre, School of Agriculture, University of Lisbon, Portugal (joaomsilva1@edu.ulisboa.pt)

In this work, a multi-sensors temporal and spatial approach was carried out to monitor the vegetation post-fire recovery rate in a Mediterranean site (in part falling within the Nature2000 network) through the use of the optical Sentinel-2 and SAR C-band Sentinel-1 imagery temporal-series. The study area was observed for one year before and three years after the fire event. Several vegetation indices (VIs) were calculated for both optical (normalized difference vegetation index, NDVI; green NDVI, GNDVI; normalized red-edge vegetation index, NDRE, normal burn index, NBR; normalized difference water index, NDWI) and SAR (radar vegetation index, RVI; dual-polarized SAR vegetation index, DPSVI; radar forest degradation index, RFDI) data from which the temporal spectral profiles were extracted in the function of one of the three vegetation types (natural/semi-natural native forest, eucalyptus plantation and grasslands), of the burn-severity gradient, and of the orbit path of SAR satellite. What emerged is that the recovery spectral dynamics are highly influenced in terms of time and magnitude by both vegetation type and, mainly, burn severity. Optical Sentinel-2 observations showed that native woody and non-woody vegetation presented higher efficiency in restoring the ecological and physiological equilibrium by the observed time, whereas C-band SAR Sentinel-1 information seems to point out that the structural characteristics cannot be recovered in such a short time, although both the data appeared impacted by saturation. Climate variables, in particular monthly rainfall, compared and correlated with the temporal spectral profiles, demonstrated to be very influential on the SAR signal, especially for a higher degree of burn severity. The spatial distribution of the post-fire recovery rate was estimated by calculating the burn recovery ratio (BRR), optimized using the random forest (RF) machine learning regressor model to account the natural phenological changes which affect unburned vegetation during the time. The BRR results validated what had been recorded in the temporal profiles. The effectiveness of open-source data, software, and models interoperability for post-risk monitoring purposes of vulnerable habitats was also emphasized in this study.