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Assessing fire severity through the integration of remote sensing and field burn indices: the big forest fires in North-Western Italy during autumn 2017

Donato Morresi, Raffaella Marzano, Renzo Motta, and Matteo Garbarino
University of Turin, Department of Agricultural, Forest and Food Sciences, Grugliasco, Italy

The assessment of fire severity is a fundamental step required in the definition of post-disturbance management activities and priorities. Detecting and mapping the spatial heterogeneity of different severity classes within the fire perimeter allows to better distributing in time and space eventual post-fire restoration interventions. The present study describes the assessment of fire severity realized following the nine big fire events that burned almost 10000 ha in the Piedmont region during autumn 2017 (burned area per each fire ranging from 164 to 3974 ha). Two distinct methodologies, Burn Remote Sensing involving remote sensing data and a complementary field sampling approach, were integrated to characterize first and second order fire effects on the different components of the burned forest stands. Two timeframes of acquisition were applied to identify effects soon after fire and during the next growing season for Initial and Extended Assessments, respectively. The latter includes vegetative recovery potential and delayed mortality. Change detection techniques able to catch the difference of spectral signals from forests after the fire were applied. The applied methodology utilizes multispectral images acquired before and after the fire by the MSI sensor (MultiSpectral Instrument) on the Sentinel-2 satellites (European spatial programme Copernicus). The Normalized Burn Ratio (NBR), the standard index currently used for the detection of the fire perimeter and the assessment of fire severity, was computed. This index uses the Near infrared (NIR) and the Shortwave infrared (SWIR) spectral bands. The B8a (NIR) and the B12 (SWIR2) bands with a 20 m spatial resolution were used to compute the NBR values for the pre and post-fire scenarios. We then derived the delta Normalized Burn Ratio (dNBR) by subtracting the NBR post-fire from the NBR pre-fire values for each pixel. In order to reduce the noise produced by the phenological differences between the pre and post-fire periods, dNBR values have been calibrated with a value obtained from unburned stands. Burn indices based on field data were tested (e.g. CBI – Composite Burn Index e GeoCBI – Geometrically Structured Composite Burn Index), applying a stratified sampling design according to forest categories and severity classes (as defined with the dNBR). These indices were used to calibrate and validate remote sensing results, relating detected radiometric change to actual fire effects on the ground.