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Optimizing Fire Severity Mapping using the Image Compositing Technique: An Assessment of the Effects of the Compositing Period and the Reducing Statistical Method on Fire Severity Signal.

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Abstract

Fire severity is an important component of the fire regime as it accounts for the immediate and long-term effects of fire on the ecosystems. Remote sensing data and the image compositing technique allow the assessment of fire effects over large regions through time by generating spectral fire severity composites. However, the accuracy of these composites is influenced by different parameters including the compositing period used to filter pre-and post-fire images such as the lag timing (time elapsed since the fire) and seasonal timing (season of the year) as well as the reducing statistical method used to combine all pixels into a single image. In this study, we have evaluated the effect of these parameters on the severity signal measured by the Relativized Burnt Ratio (RBR), derived from Landsat using the Google Earth Engine (GEE) platform. Specifically, we focused on determining the optimal combination of these parameters to generate severity composites that accurately differentiate between burned and unburned areas, better correlate with field measures of severity (Composite Burned Index – CBI), and cover the entire study region. We generated different severity composites using various compositing periods and statistical methods in several fires (n = 1,466 from 1985-2017) within a large Mediterranean area of Central-Spain, as well as in their surrounding unburned areas. The compositing period included the lag timing (initial assessment: year of fire; and extended assessment: year after the fire) and the seasonal timing (with or without seasonal changes between pre-and post-fire images). The statistical methods used were Mean, Median, Medoid and Quality-mosaic (Min-Max). The effect of these parameters on RBR values was determined by ANOVA and post-hoc tests, and the intra-annual variability of RBR values was assessed using the Mann-Kendall test. Finally, the correlation between each severity composite and CBI was estimated for two large fires in Eastern-Spain (Guadalajara [n = 73] and Yeste [n = 32]) using second-order polynomial regression models. The initial assessment during the same seasonal timing of the pre-and post-fire composites (pre: summer; post: summer), in combination with the Quality mosaic better-detected fire severity signal and differentiated between burned and unburned areas in this Mediterranean area. These severity composites also showed the strongest fit with CBI (R^2 = 0.80; 0.61 for Yeste and Guadalajara, respectively) and the highest spatiotemporal coverage. This study provides valuable insights for optimizing fire severity mapping across large areas through time, using the image compositing technique in a semi-automatic manner.

Keywords: Fire severity mapping; image compositing; RBR; initial and extended assessment; central tendency and range statistics; seasonality; Google Earth Engine