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Using MODIS imagery to assign dates to maps of burn scars in Portugal

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In the European context, Portugal presents the highest number of fire occurrences and has the largest area affected by wildfires. Like other southern regions of Europe, Portugal has experienced a dramatic increase in fire incidence during the last few decades that has been attributed to modifications in land-use as well as to climatic changes and associated occurrence of weather extremes. Wildfire activity also presents a large inter-annual variability that has been related to changes in the frequency of occurrence of atmospheric conditions favorable to the onset and spreading of large-fires.
Since 1990, the Portuguese Authority for Forests (AFN) has been producing yearly maps of fire perimeters under a protocol with the Department of Forest Engineering of the Institute of Agronomy (DEF/ISA). The AFN fire atlas uses end of fire season Landsat TM/ETM imagery to map all fire perimeters with area larger than 5ha. Because it relies on end-of-season imagery, the atlas provides a spatial snapshot of the yearly area burned, and dates of burn for individual events cannot be estimated. Such information is nevertheless crucial to understand the fire regime and fire seasonality and to disentangle the complex interactions among fire, land cover and meteorology.
The aim of the present work is to develop an automated procedure that allows using time series of moderate resolution imagery, such as the one provided by the MODIS instrument on-board TERRA and AQUA, to assign dates of burning to scars larger than 500 ha in the Landsat based fire atlas.
The procedure relies on the so-called (V,W) burned index that uses daily reflectance obtained from the 1km MODIS Level 1B calibrated radiance from bands 2 (NIR) and 20 (MIR). The algorithm detects persistent changes in the (V,W) burned index time series, within each Landsat burned scar. The day of maximum change is then identified by means of a discrimination index, together with thresholds from the (V,W) time series. A spatial filter is finally applied to remove the outliers.
An assessment of the temporal accuracy of the algorithm was conducted for the year 2005. For this year, Landsat based fire scars larger than 500ha have an associated detection date, based on field information provided by the AFN. The detection date is here assumed as ignition date of each scar. It is also assumed that each scar corresponds to a single fire event. Using 78 fire scars, we computed the time difference, in days, between the detection date and the date of burn, estimated by the algorithm. Our results show that 70% of all scars were correctly dated by the algorithm with differences to the AFN detection date up to three days. These correspond to 83% of the overall burned area used in the accuracy assessment.