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An algorithm for satellite-based burned area mapping using change point detection and Markov random fields

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Area burned in tropical savannas of Brazil and Australia was mapped using SPOT-VGT daily 1km resolution imagery and a new algorithm based on change point detection techniques. Each study area covers about 250,000 km2 and the mapping exercise spans a 11-yr period (1999-2009). Our algorithm addresses each pixel as a time series and detects changes in the statistical properties (mean and variance) of NIR and SWIR reflectance values, to identify potential burning dates. We compare the performance of binary segmentation (BinSeg) and Pruned Exact Linear Time (PELT) change point detection techniques. Mean reflectance values observed at a pixel over the week after a change point has been detected are compared with a biome-specific statistical distribution of burned area reflectance values, to assess the probability that the change point detected does correspond to a burn event. Change points corresponding to an increase in reflectance are dismissed as potential burn events, as are those occurring outside of a pre-defined fire season. In the last step of the algorithm, monthly burned area probability maps are converted to dichotomous (burned-unburned maps), using Markov Random Fields. A preliminary assessment of our results is performed by comparing them with those from the MODIS active fires and burned area products, taking into account differences in spatial resolution between the two sensors.