Methodology for the detection of observable phenomena in time series of daily satellite images: application to burned areas

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Abstract: The design of an algorithm for the detection of a phenomenon employing satellite images, not only requires an accurate knowledge of its spectral features but also of how they vary over time. Moreover, the designed algorithm to be widely applied has to take into account all the disturbing factors of the radiometric measurements of the study area: the direct ones as the consequence of the emergence of the phenomenon to research and the non-direct due to the data uncertainty. The detection of the phenomenon implies knowing its spectral behaviour patterns. For that task, multiple variables should be analyzed (both the original radiometric measures and index derived from them) and select those that allow describing in the best possible way, both the phenomenon itself and its behaviour's temporal evolution.

In this work, a methodology for the detection, at pixel level, of observable phenomena in time series of daily satellite images has been developed. It consists of various steps: a) pre-processing of daily images in order to obtain ten-days composites; b) construction of the statistical variables space to consider in a Bayesian classifier; c) designing the algorithm by selecting the training cases; d) obtaining probability maps linked to the presence/absence of the phenomenon to be observed, and e) post-processing to improve the results obtained by applying multiple techniques. The results are analyzed using accuracy metrics. Likewise, a software tool has been designed to apply this methodology to detect burned areas in North American boreal forests using AVHRR images of 0.05 ° (~ 5 km) spatial resolution. The quality of the results is comparable to recently published work using images with 1 km spatial resolution.

Keywords: Boreal Forest, Burned Area Algorithm, Time Series, AVHRR.