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The potential of satellite data to study individual wildfire events

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Large wildfires have important social, economic and environmental impacts. In order to minimize their impacts, understand their main drivers and study their dynamics, different approaches have been used. The reconstruction of individual wildfire events is usually done by collection of field data, interviews and by implementing fire spread simulations. All these methods have clear limitations in terms of spatial and temporal coverage, accuracy, subjectivity of the collected information and lack of objective independent validation information. In this sense, remote sensing is a promising tool with the potential to provide relevant information for stakeholders and the research community, by complementing or filling gaps in existing information and providing independent accurate quantitative information.

In this work we show the potential of satellite data to provide relevant information regarding the dynamics of individual large wildfire events, filling an important gap in wildfire research. We show how MODIS active-fire data, acquired up to four times per day, and satellite-derived burnt perimeters can be combined to extract relevant information wildfire events by describing the methods involved and presenting results for four regions of the world: Portugal, Greece, SE Australia and California. The information that can be retrieved encompasses the start and end date of a wildfire event and its ignition area. We perform an evaluation of the information retrieved by comparing the satellite-derived parameters with national databases, highlighting the strengths and weaknesses of both and showing how the former can complement the latter leading to more complete and accurate datasets.

We also show how the spatio-temporal distribution of wildfire spread dynamics can be reconstructed using satellite-derived active-fires and how relevant descriptors can be extracted. Applying graph theory to satellite active-fire data, we define the major fire spread paths that yield information about the major spatial corridors through which fires spread, and their relative importance in the full fire event. These major fire paths are then used to extract relevant descriptors, such as the distribution of fire spread direction, rate of spread and fire intensity (i.e. energy emitted). The reconstruction of the fire spread is shown for some case studies for Portugal and is also compared with fire progressions obtained by air-borne sensors for SE Australia.

The approach shows solid results, providing a valuable tool for the reconstruction of individual fire events, understand their complex spread patterns and their main drivers of fire propagation. The major fire pathsand the spatio-temporal distribution of active fires are being currently combined with fire spread simulations within the scope oftheFIRE-MODSATproject, to provideuseful information to support and improve fire suppression strategies.