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Understanding fire, weather and land cover interactions from long-term terrestrial observations and satellite data on a transect from Europe to North Africa

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Long-term historical time series records of fire activity (number of fires and total area burned) extending back to the late 1800s, that are very rare worldwide, were found and used within the GRADIENT project that correspond to (i) Switzerland, central Europe (1900-2014), (ii) Greece, south Europe (1897-2014), (iii) Algeria, north Africa (1870-2014) and (iv) Tunisia (1902-2015), north Africa which together with the spatial-explicit reconstruction of recent fire history from Landsat satellite images (1984-2016), gave a unique and excellent opportunity to understand fire, weather and land use/land cover (LULC) interactions in a north to south transect. Differences in bio-geographical characteristics provided by the four selected study areas, located on a large geographical gradient covering two continents gave the opportunity to document the role of fire in different biomes, to explore cross-scale issues and assess how fire-weather-LULC interactions vary across different scales, especially under a climate change context. GRADIENT project consisted of three topics that correspond mainly to three different scales. The specific objectives were: (i) the identification of trends, patterns and relationships between forest fires, weather, land cover and socio-economic variables from long-term observations, (ii) the reconstruction of recent fire history and the assessment of burning patterns and fire selectivity on an annual basis from satellite images, and (iii) the exploration of post-fire vegetation dynamics and recovery for selected large fire events using time series satellite images.

Specifically, for each one of the three objectives the main overall conclusions are (i) in principle there is a characteristic fire activity in all four study areas defined by the general pyro-environment with certain peaks occurred at specific years associated to physical and social factors. The role of precipitation is different in the gradient from the wet to dry areas. Moisture is more evident as an underlying explanation mechanism in the wet study area while temperature is more evident in the dry study areas, (ii) remote sensing can be used with semi-automatic methods to reconstruct the recent fire history though certain difficulties exist especially in the North study area where cloudiness is a potential problem. For all study areas selective burning is evident that also depends on the available to burn landscape. Frequent fires were also observed that burn mainly grasslands and shrublands. and (iii) remote sensing either by using low resolution or medium-high resolution satellite data provides critical information of the phenology of the fire affected areas that can be used efficiently to post-fire studies. The consideration of the full phenological cycle of landscape enhances the interpretation power of the spectral signal. Within the GRADIENT project vegetation phenology and time series statistics proved very useful not only to study vegetation recovery in fire affected areas but also to identify the time period where the fire or fires occurred and define also the vegetation phenology before the fire. This is very useful first for integrating this concept into a burned land mapping approach and second for identifying what type of vegetation is burned.