Geophysical Research Abstracts
Vol. 20, EGU2018-13404, 2018
EGU General Assembly 2018

Quantitative appraisal of the spatial and temporal distribution of pyrogenic biomarkers in modern Iberian sediments and soils

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We have evaluated the drivers of the modern spatial distribution of pyrogenic biomarkers throughout the Iberian Peninsula, and analysed the dominant transport pathways to aquatic settings. The goal of the study is to determine the spatial and temporal scales of the wildfires that the sedimentary accumulation of the pyrogenic biomarkers represent. For this purpose, we have compiled an extensive collection of soils and lacustrine sediments throughout Spain. The sample suite is representative of a wide range of climates and ecosystems. We have quantified the abundance of monosaccharide anhydrides (MAs) biomarkers, namely levoglucosan (1,6-anhydro-β-D-glucopyranose), and polyaromatic hydrocarbons (PAHs). The data obtained has been mapped and compared to the documented occurrence of wildfires in Spain over the last 50 years. The end goal of the study is also to develop a pyrogenic biomarker approach to reconstruct quantitatively the palaeo-occurrence of biomass wildfires from lake sediments.

The regional distribution of fires in Spain is the primary driver of the spatial distribution of pyrogenic biomarkers in soils and sediments. Thus, the sedimentary concentration of pyrogenic biomarkers correlates with the percentage of burned forest land on a scale equivalent to the area of the municipality where the lake is located (i.e. tens to hundreds of hectares). We conclude that wind is the dominant mode of transport of pyrogenic biomarkers to Spanish lake sediments from regional wildfires (i.e. beyond the lake catchment). Organic matter diagenesis is also a significant factor, albeit as a secondary control, in the accumulation of the biomarkers in soils and sediments. Our study also shows that pyrogenic biomarkers can be used as palaeoproxies to quantify the area of forest burnt in the region surrounding the lake, beyond its catchment, in addition to the frequency of fires. This conclusion is supported by a high resolution historical reconstruction that we have undertaken in lake Montcortés (NE Spain) spanning the last century. The biomarker proxy data yields an estimate of burned area that is within the same range as the documented information for the same period for the county where the lake is located. This finding further illustrates the potential of pyrogenic biomarker proxies to yield quantitative information on regional wildfire variables (e.g. burnt area) in the past on decadal time-scales.