Geophysical Research Abstracts
Vol. 20, EGU2018-7677, 2018
EGU General Assembly 2018

Comparative assessment of various charcoal records on a same site: a way to better tackle past fire regime?

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Information about past fire regime might provide valuable insights for the investigation of past landscape dynamics. However, a significant lock limits the assessment of the past fire regime.
Standard methods of fire history assessment, based on the quantification of charred particles into sedimentary sequence, permit only to assess few components of the past fire regime, such as frequency or return interval. Others important components remain hardly documentable. This is especially damageable when aiming to assess the determinism of the fire disturbance and the possible interactions of it with other components of the past landscape dynamics, such as vegetation type, human action, and climate. This assessment is a key issue for the understanding of the dynamics of past ecosystems, especially in Europe where human activities is a key determinism of ecosystems dynamics since at least six millennia, instead or coupled with climate influences.
Only the combination of complementary proxies may provide significant amount of data to relevantly assess past fire regime. This complementary is even more powerful when combining proxies with different spatial resolution. Indeed, it is assume that wildfire, which have got climate-controlled ignition, are more significantly occurring at large spatial scale, while man-made fire are related to local human activities and therefore are more significantly occurring into a mosaic patterns at local scale (i.e. forest stand scale). Therefore, to disentangle the source of fire in a same study area it appears relevant to assess charcoal records with different, and independent, spatial resolution. This is what we illustrate here with study cases in Northern Germany.
We realized comparative assessment of various charcoal records from large spatial scale (i.e. micro-charcoal signals from peat-bogs) to high spatial resolution (i.e. soil charcoal signals). This latter proxy also permitted us to assess the type of fuel of the local fires. This is a key information to assess the source of fire ignition. Indeed, it is well establish that it exist ‘easily flammable’ and ‘hardly flammable’ vegetation, which burn only with man-made fire as it seems to be the case on our investigated areas. Such information was complemented by pollen data which provided insights about human presence, climate constraint, and vegetation responses to fire disturbances.
Overall, we illustrate that our comparative assessment of various charcoal records allow one to detect the spatial patterns of fire occurrences (depending however on the sampling strategy). Also, soil charcoal data combine with pollen data provide valuable information about the fuel type of the detected fire events. Thus, through our study case we point out a relevant, innovative, approach to more fully define the past fire regime. This is a key contribution to the assessment of the interactions between fire, vegetation, climate and humans.