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Multiproxy analysis of a relict charcoal hearth field in Brandenburg (Germany)

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The increasing availability of high resolution digital elevation models (DEM) from LIDAR during the last decades made the remote sensing of relict charcoal hearths (RCHs) possible, even under dense vegetation. This led to an increased interest in the study of the legacy effect of this historic craft on the landscape. Relict charcoal hearths are visible on DEM derived shaded relief maps as button-shaped circular elevations with diameters of 4 – 30 m. In the field RCH sites are mainly detectable by their high content of charcoal which remained in the soil for the last centuries. Current studies resulted in several thousand of remotely mapped and archaeologically excavated RCH sites in the forested areas around the former iron work in Peitz near Cottbus, Germany. The factory´s main production period in the 18^{th} century led to a high demand in charcoal which was produced in the forest in upright standing hearths. So far, 170 RCHs are analysed dendrochronologically, dating their operation into a timeframe between the mid-16^{th} to mid-19^{th} centuries. The impact of historical charcoal production on the landscape scale is still unclear, which is of particular interest regarding ongoing discussions about the potential C-sequestration of black carbon in soils.

In this study, we used a multimethodological approach combining laboratory soil analysis and field methods, GIS-based analysis of remote sensing data and dendrochronological dating of charcoals in a 0,25 km^2 large study plot in the forest district Tauer, about 20 km (linear distance) of the historical ironwork in Peitz. This forested area was intensively used for charcoal production. The scopes of the study are 1) the assessment of the detection quality of GIS-based RCH mapping by comparison with detailed field mapping; 2) the determination and balancing of soil organic matter (SOM) stocks on RCHs; 3) the determination of the CO_2-flux rate of the charcoal-containing soils.

Comparing the results of field- and GIS-based RCH mapping revealed a high missing rate of the latter method, as about 40 % of RCHs mapped in the field are not visible on DEM-derived shaded relief maps. Preliminary results of soil analyses suggest an at least twice as high SOM content in soils influenced by charcoal production, even without considering larger charcoal fragments ($>$ 2mm). Soil CO_2-flux rates are significantly higher on RCHs than on the surrounding forest soils. The results suggest a significant impact of historical charcoal production on soils in regards to its SOM and therefore carbon content, a legacy which has the potential to be greatly underestimated if RCH sites are only mapped digitally.