Geophysical Research Abstracts
Vol. 14, EGU2012-5343, 2012
EGU General Assembly 2012

Spatial variation in the charcoal pool

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It is well known that the soil charcoal pool varies significantly in size across different types of forest landscapes and regional climates. However, the level of variation on fine spatial scales within a given forest landscape remains poorly known. Here we use a geostatistical approach to describe the spatial structure and variability of the soil charcoal pool in a boreal forest landscape. Our study landscape is a watershed including a small lake and two distinct types of forests, viz. Norway spruce (Picea abies) and Scots pine (Pinus sylvestris) forests. The study is based on 200 forest soil cores and one lake sediment core in which the amount of macroscopic charcoal was measured.

The amount of charcoal in the forest soil cores was very variable and ranged from 0 to 3600 g per square meter. The variation was profound also on fine spatial scales, i.e. 0.05 - 0.2 m, and geostatistical analysis revealed only weak spatial structuring on scales from 0.05 up to 200 m. Although weak spatial structuring, there were three significant and general patterns in the soil charcoal pool. First, there was a positive relationship between the amount of charcoal in the soil and the density of the contemporary forest. Second, there was more charcoal in the spruce forest than in the pine forest. Third, the amount of charcoal in the soil increased with increasing distance from the lake.

The lake sediment core, which had a depth of 3 m and an age of 11 000 years, recorded a continuous influx of macroscopic charcoal throughout the Holocene. Interestingly, the amount of charcoal in the lake sediment exceeded that in the majority of the forest soil cores, indicating a relatively high degradation rate of charcoal in the forest soil and that charcoal is well preserved in the lake sediment.