Geophysical Research Abstracts
Vol. 12, EGU2010-5916, 2010
EGU General Assembly 2010

July temperature of the last 1000 years. A low frequency record from northern Finland reconstructed from pine pollen abundance

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A Shpagnum fuscum peat profile from a small mire close to the northern forest limit of Pinus sylvestris in eastern Finnish Lapland has been analysed for its pollen content. The profile is sampled as a continuous time series at a temporal resolution that it close to annual for the last 100 years but decreases to around 30 years per sample for the period AD1000 – AD 500. It is known from an adjacent monitored pollen deposition series for the past 25 years that the pollen accumulation rate (PAR, grains cm-2 year-1) of Pinus is a proxy for July temperature, so it is hypothesized that the same is true for the Pinus PAR extracted from the peat. The calculation of such a PAR is highly dependent on the age depth model, so a swarm of age-depth chronologies were generated to show the error range on the PAR calculations. The July temperature instrumental record of the nearest meteorological station was smoothed to match the temporal resolution of the PAR and then used to calibrate the record to allow a reconstruction back over the 1000 years. July temperature influences annual pollen production but, in the long term, it also influences tree volume so, as the temporal resolution decreases, this aspect begins to dominate the PAR signal. Although the precise source area of the pine pollen contained in the peat is unknown it can be calculated from models of pollen dispersal that 90 % of it comes from with c. 20 km and it is assumed that this source area has remained constant during the last 1000 years although during that period tree volume has certainly changed. Because of this dual signal, in warmer periods, the temperature reconstruction maybe amplified. In contrast, in periods where temperatures fall below 12°C pollen production ceases, so reconstructions to lower temperatures on the basis of the pine PAR are not possible. The coldest period was during the Maunder minimum and the warmest between AD1250 and AD1350.