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Pollen-inferred quantitative reconstructions of Holocene land-cover in NW Europe for the evaluation of past climate-vegetation feedbacks - The Swedish LANDCLIM project and the NordForsk LANDCLIM network

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Reliable predictive models are needed to describe potential future climate changes and their impacts. Land surface-atmosphere feedbacks and their impacts on climate are a current priority in the climate modelling community, but reliable records of long-term land use and vegetation change required for model evaluation are limited. Palaeoecological and palaeo-climatic data provide a unique record of the past changes in vegetation, land use and climate on time scales relevant to vegetation processes and global change projections. The application of a new technique (the REVEALS model (Sugita 2007) to landscape reconstruction using fossil pollen data makes robust comparisons with vegetation model output possible . The model corrects for biases caused by e.g. inter-taxonomic differences in pollen productivity and dispersal. Our results show that pollen percentages, a traditional indicator of land cover changes, generally underestimate the unforested areas and certain broad-leaved trees such as Corylus and Tilia, while they often overestimate Betula and Pinus (see Cui et al. BG 6.2). Climate models use simplified land-surface classifications (plant functional types (PFTs)), such as grass (i.e. open land), deciduous trees, and conifers. Therefore, the observed large discrepancies in past land cover between the REVEALS estimates and pollen percentages are expected to influence model outcomes of the Holocene regional climate in NW Europe.

The LANDCLIM project and research network (sponsored by the Swedish [VR] and Nordic [NordForsk] Research Councils) aim to quantify human-induced changes in regional vegetation/land-cover in NW Europe during the Holocene, and to evaluate the effects of these changes on the regional climate through altered feedbacks. We use the REVEALS model, theoretically derived and empirically tested, to estimate the percentage cover of taxa and groups of taxa (PFTs) from fossil pollen data for selected time windows of the Holocene, at a spatial resolution of ca. 1o x 1o. The REVEALS estimates of the past cover of PFTs will be 1) compared with the outputs of the LPJ-GUESS (10 PFTs), a widely-used dynamic vegetation model and 2) used as an alternative to the LPJ-GUESS-simulated vegetation (3 PFTs) to run for the past the regional climate model RCA3 developed at the Rossby Centre, Norrköping, Sweden. The study will evaluate and further refine these models (RCA3 and LPJ-GUESS) using a data-model comparison approach that incorporates new syntheses of palaeoclimatic data as well. It will lead to new assessments of the possible effect of various factors on climate, such as deforestations and afforestations, and changes in vegetation composition and spatial patterns of land cover/land use. Refined climate models and empirical land-cover reconstructions will shed new light on controversial hypotheses of past climate change and human impacts, such as the “Ruddiman hypothesis”.

First maps of REVEALS estimates of plant functional types (PFTs) are now available for Sweden, Norway, Finland, Denmark, Estonia, Poland, Germany, The Czech Republic, Switzerland and Britain (see Mazier et

al. C1.21 and Trondman et al. C1.22). Correlation tests show that the REVEALS estimates are robust in terms of ranking of the PFTs' abundance (see Mazier et al, C1.21). The LANDCLIM project and network are a contribution to the IGBP-PAGES-Focus 4 PHAROS programme on human impact on environmental changes in the past.

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