Fennoscandian GGD_5 gradient mirrored in leaf epidermal properties

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The strong latitudinal climate gradient from nemoral to arctic over Fennoscandia provides a unique opportunity to track GGD_5 changes and its imprint on leaf morphology.
Quantifying seasonal GDD_5 as Undulation Index (Fig.1a) shows a significant correlation (Fig.1b). Thermal growing season properties can thus be deduced from fossil leaves preserved in sediments (Fig.1c).

The analysis of UI (Fig. 2a) under known GDD_5 (Fig. 2b) demonstrates that this relation is largely independent of regional habitat conditions such as day light length and e.g. precipitation.

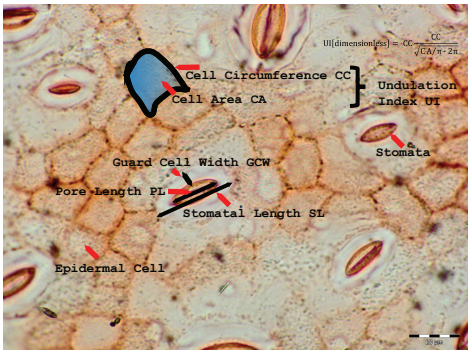

Figure 1a

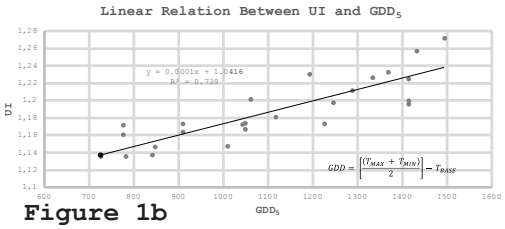

Figure 1b

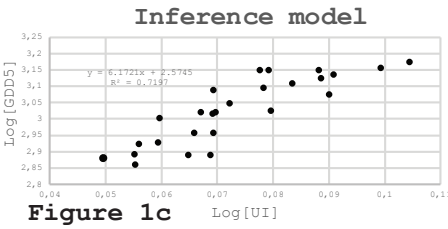

Figure 1c

Figure 1: (a) *Betula pubescens* epidermal properties including Undulation Index. (b) Linear relation between Growing Degree Days at T_5 (GDD_5) and Undulation Index (UI). GDD_5 range: 725 - 1493, UI range: 1.12 - 1,27. (c) Log-Log transformed Inference model predicting Growing Degree Days at T_5 (Log[GDD_5]) from Undulation Index (Log[UI]) values. Log[GDD_5] range: 2.86 – 3.17, Log[UI] range: 0.055 – 0.104.

Figure 2a

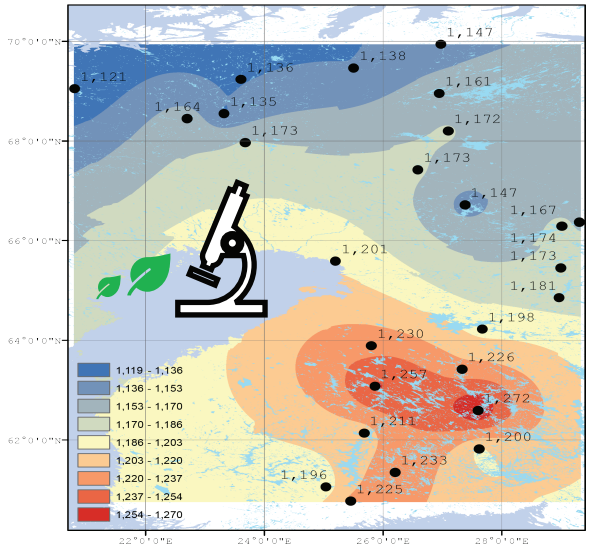

Figure 2b

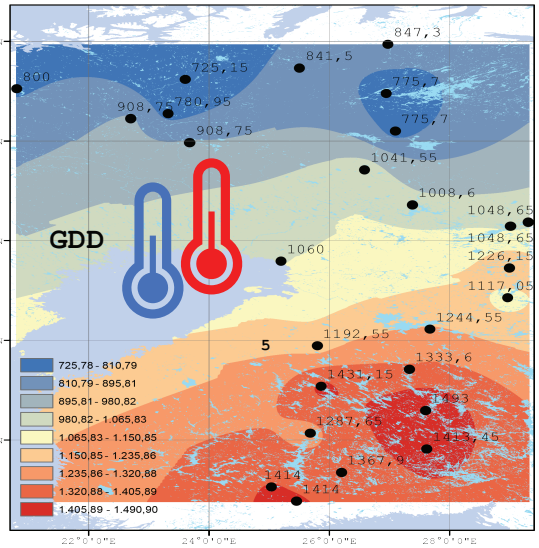

Figure 2: UI(a) and GDD5 (b) data collected in fall 2016 projected on their sample locations in Fennoscandia, with Kriging interpolations. *B.pubescens* ssp *czerapanovii* leaf samples have been collected in fall 2016 in approximately 100km distance intervalls between 60° and 70° latitude to represent a relevant temperature gradient from the nemoral to arctic climate zones. Mean daily temperatures were taken from nearby meteorological stations.

Conclusions:
This study proves that the UI can be applied in GDD_5 reconstructing over a wide geographical range and further provides a new calibration set for *Betula pubescens*. Combining *B.pubescens* with *B.nana* we are now able to reconstruct growing season dynamics over past phases of rapid climate change independent of vegetation succession, local light regimes and migrational species shifts.

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NWO Netherlands Organisation for Scientific Research