



## **Capturing total chronological and spatial uncertainties in palaeo-ice sheet reconstructions: the DATED example**

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Glacial geologists generate empirical reconstructions of former ice-sheet dynamics by combining evidence from the preserved record of glacial landforms (e.g. end moraines, lineations) and sediments with chronological evidence (mainly numerical dates derived predominantly from radiocarbon, exposure and luminescence techniques). However the geomorphological and sedimentological footprints and chronological data are both incomplete records in both space and time, and all have multiple types of uncertainty associated with them. To understand ice sheets' response to climate we need numerical models of ice-sheet dynamics based on physical principles. To test and/or constrain such models, empirical reconstructions of past ice sheets that capture and acknowledge all uncertainties are required. In 2005 we started a project (Database of the Eurasian Deglaciation, DATED) to produce an empirical reconstruction of the evolution of the last Eurasian ice sheets, (including the British-Irish, Scandinavian and Svalbard-Barents-Kara Seas ice sheets) that is fully documented, specified in time, and includes uncertainty estimates. Over 5000 dates relevant to constraining ice build-up and retreat were assessed for reliability and used together with published ice-sheet margin positions based on glacial geomorphology to reconstruct time-slice maps of the ice sheets' extent. The DATED maps show synchronous ice margins with maximum-minimum uncertainty bounds for every 1000 years between 25-10 kyr ago.

In the first version of results (DATED-1; Hughes et al. 2016) all uncertainties (both quantitative and qualitative, e.g. precision and accuracy of numerical dates, correlation of moraines, stratigraphic interpretations) were combined based on our best glaciological-geological assessment and expressed in terms of distance as a 'fuzzy' margin. Large uncertainties (>100 km) exist; predominantly across marine sectors and other locations where there are spatial gaps in the dating record (e.g. the timing of coalescence and separation of the Scandinavian and Svalbard-Barents-Kara ice sheets) but also in well-studied areas due to conflicting yet apparently equally robust data. In the four years since the DATED-1 census (1 January 2013), the volume of new information (from both dates and mapped glacial geomorphology) has grown significantly (~1000 new dates). Here, we present work towards the updated version of results, DATED-2, that attempts to further reduce and explicitly report all uncertainties inherent in ice sheet reconstructions.

Hughes, A. L. C., Gyllencreutz, R., Lohne, Ø. S., Mangerud, J., Svendsen, J. I. 2016: The last Eurasian ice sheets – a chronological database and time-slice reconstruction, DATED-1. *Boreas*, 45, 1–45. 10.1111/bor.12142