



Improving age-depth models using sediment accumulation rates

Wim Hoek*, Philip Minderhoud & Kim Cohen

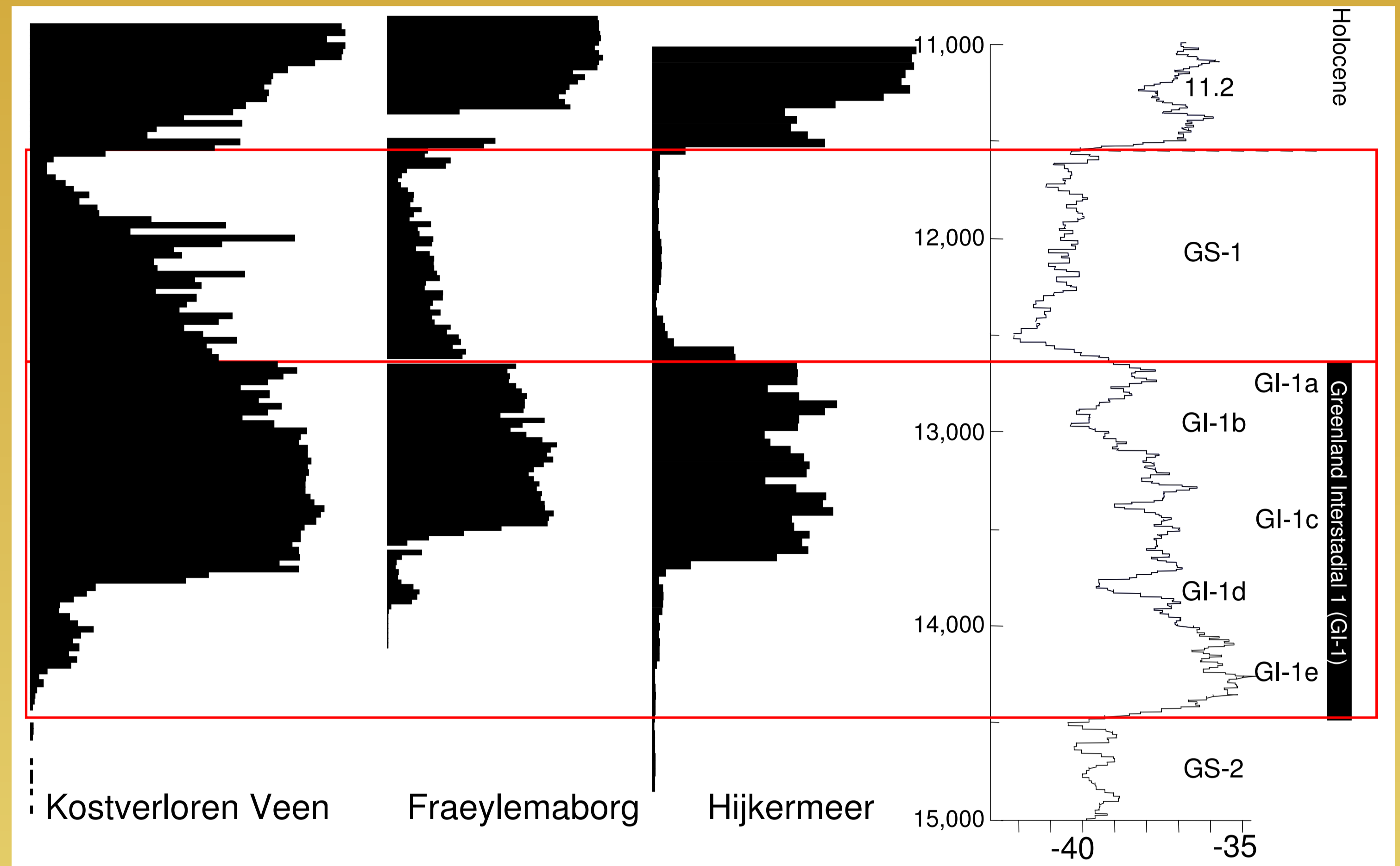
Faculty of Geosciences, Utrecht University, the Netherlands * w.z.hoek@uu.nl



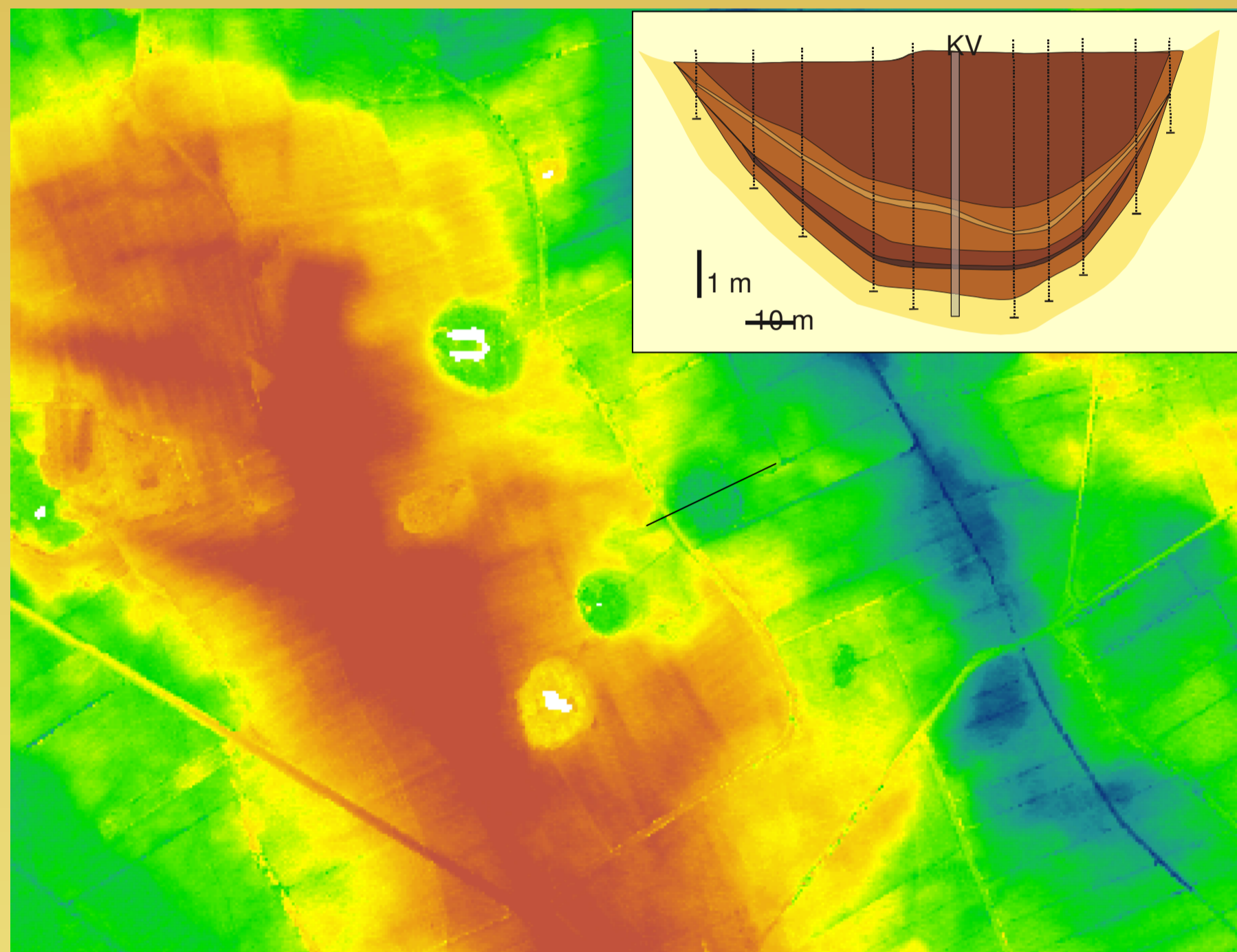
In the Netherlands, the remains of hundreds of pingos have been recognised over the last decades, especially after the development of high-resolution digital elevation models (see poster Astrid Ruiters). These pingos presumably originated as a result of hydrostatic pressure, under conditions of discontinuous permafrost during the cold Weichselian Pleniglacial. As temperature rose at the onset of the Lateglacial interstadial (GI-1, round ca. 12,500 ¹⁴C BP or 14,700 cal BP), permafrost most likely started to disappear from that time onward resulting in the development of pingo remnants – isolated depressions with or without a rampart. Because pingo remnants in the Netherlands act as closed systems without inflow, contamination is regarded negligible and therefore their fills form a unique record of climatic and environmental change since the last deglaciation (see poster Renée de Bruijn).

← Present day pingo near Tuktoyaktuk, Mackenzie Delta, Canada (above), and the Mekelermeer pingo remnant in the N-Netherlands (below).

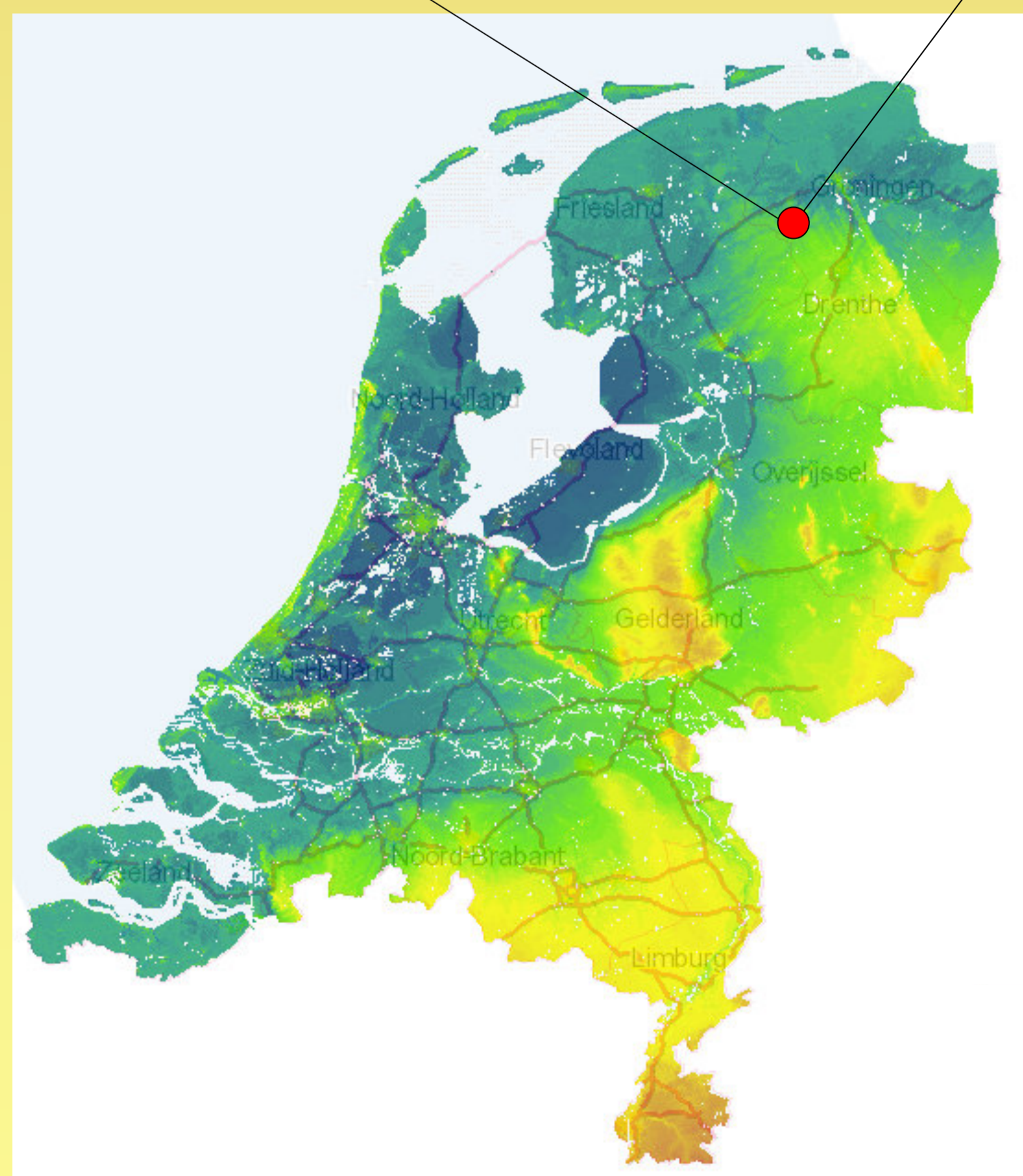
→ Loss on Ignition results from 3 Pingo sites in the northern Netherlands and comparison with Greenland NGRIP ice core oxygen isotope record.



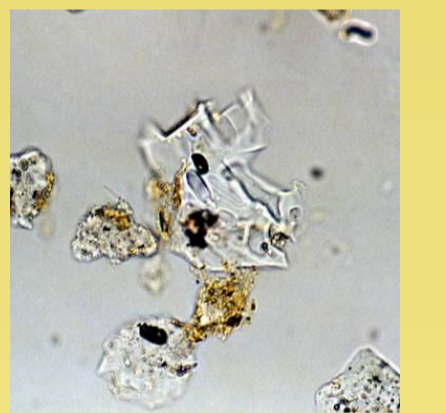
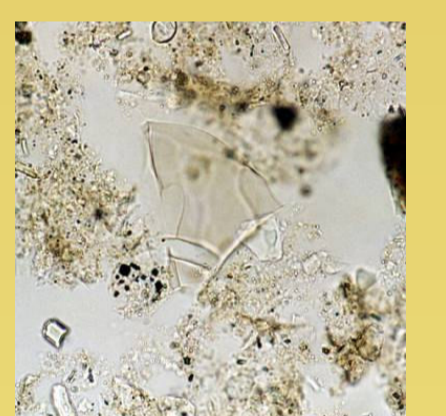
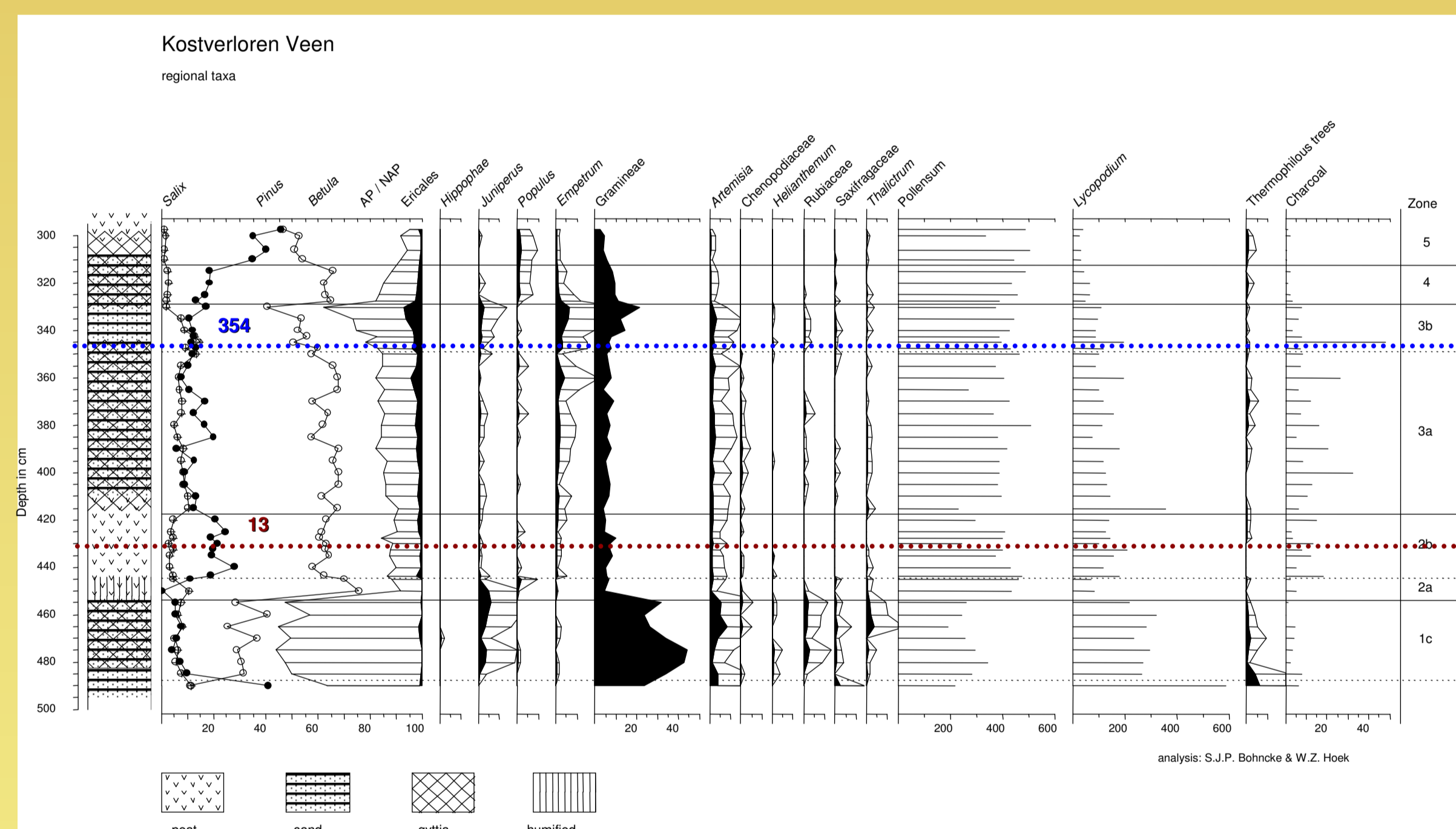
Kostverloren Veen



Laser altimetry DEM (www.ahn.nl) and cross-section. DEM colour interval span 5 meters.



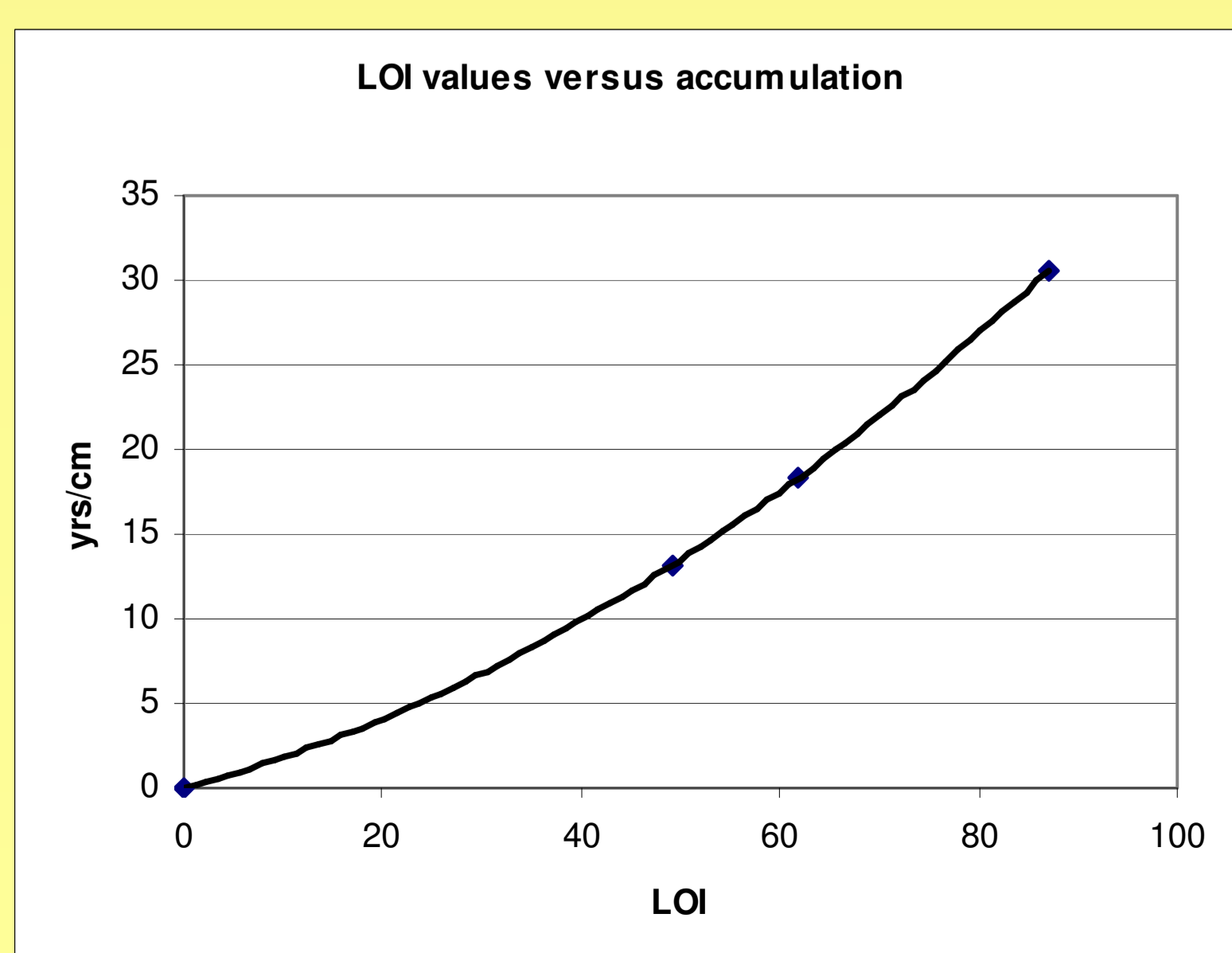
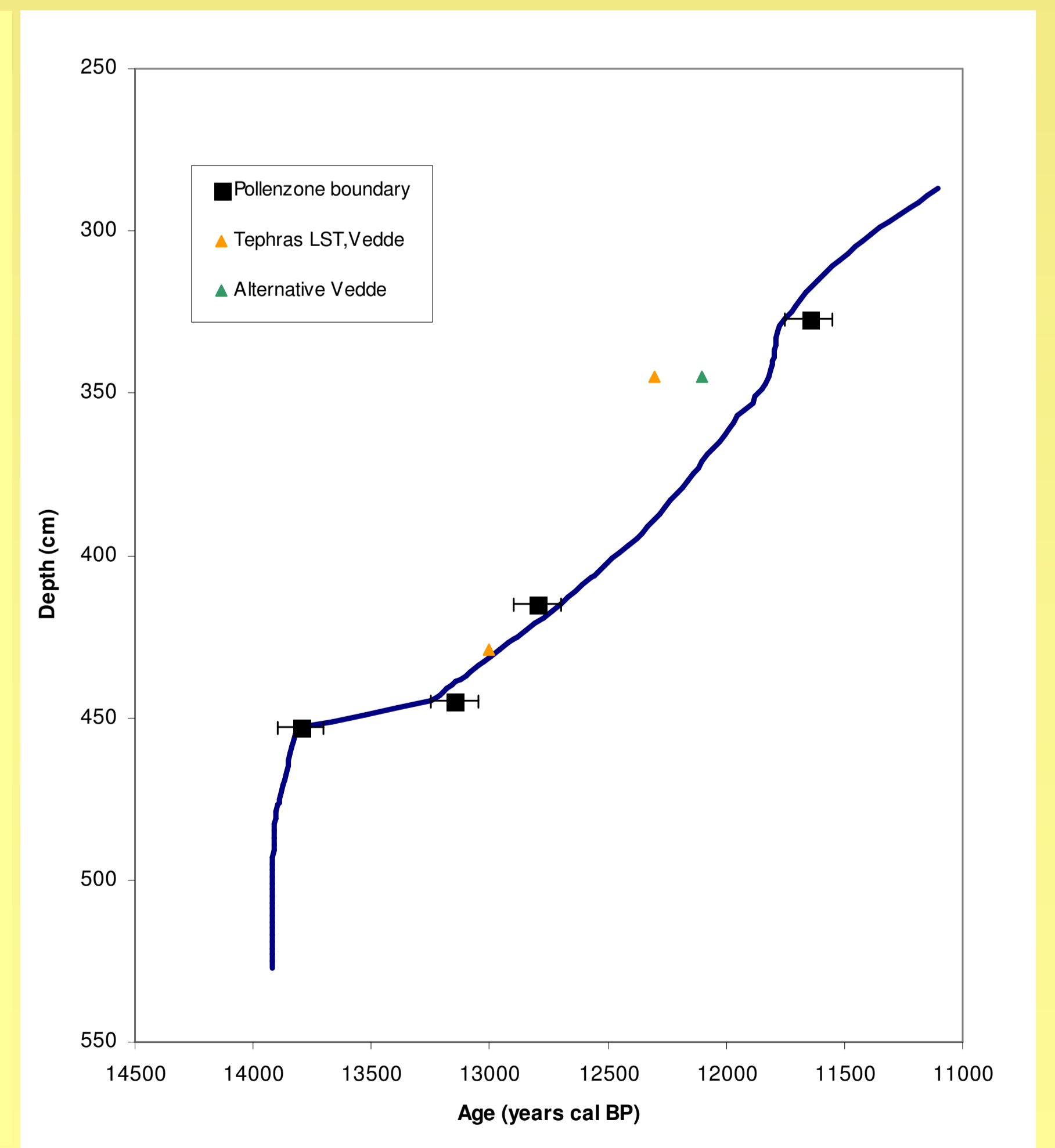
→ Pollen diagram and presence of microtephra in Kostverloren Veen. (after Davies et al., 2005)



→ Age model for Kostverloren Veen based on Loss-on-Ignition characteristics.

Clastic sediments have a higher accumulation rate than organic sediments, which ratio is given in the LOI record. Applying a linear interpolation between the given pollen zone boundaries would inevitably ignore the different sedimentation rates of the sediments in the pingo basin fill, given by the large fluctuations of the LOI record. The LOI record is used to tune the interpolation between the pollen zone boundaries, producing a non-linear age model that incorporates the differences in sedimentation rate between clastic and organic sediment. This age model approaches the reality better than linear interpolation.

The tephra markers Vedde and LST are not incorporated into the tuning process and used afterward for validation. In the interval of 445-455 cm, a period of hiatus is expected, based on both the pollen zonation and lithology, indicating dry conditions. For this interval the age is linear interpolated between the two boundaries.



← Relation between Loss on Ignition values and accumulation based on biozone boundaries

Final considerations

- In the given environment of a pingo basin fill, the accumulation rate is not only influenced by variations in clastic influx. Changes in primary production due to temperature fluctuations during the Lateglacial, will have influenced the accumulation of organic sediment over time. These two changing variables make it difficult to quantify the net accumulation rate of the pingo infill.
- However, changes in accumulation rate, captured in the sedimentary record, and measurable using e.g. LOI, should be incorporated in age models for continuous sedimentary records.