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"From Weichselian Ice-Sheet Dynamics to Holocene Land Use Development in Western Pomerania and Mecklenburg"

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New insights on ice dynamics from analysis of terrain of Latvia

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During deglaciation ice bed topography is playing an increasingly important role in ice dynamics. Rises in the ice bed are becoming obstacles causing splitting of ice flow into separate lobes. Bed topography constrained ice flow can be quite fast, sometimes even surge like, thus leading to formation of new landforms that are specific to ice flow properties of their formation time. If new ice flow direction persists for long enough time, all morphological evidence of previous ice regime can be erased. Availability of new LiDAR based high-resolution digital terrain models allows to start to search for landforms that preserves information on ice flow properties before its separation into lobate structure – characteristic for glacial retreat time. The bed of Last Weichselian glaciation in territory of Latvia mainly consisted of soft sediments accumulated during previous glaciations and in the front of advancing ice (Zelčs et al., 2011). Such sediments are prone to glacial erosion and thus fast erasure of any pre-existing landforms. Thus small linear landforms characteristic of fast ice flow could be preserved only in areas afterwards covered with stagnant ice, or in cases when ice flow direction did not change with the onset of deglaciation.

Preliminary analysis of new high-resolution terrain model of Latvia has revealed presence of linear landforms underlying landforms of deglaciation time. In the basal elevation of Northern and – more prominently – Eastern Kursa Upland large number of narrow linear landforms are present. Their width is from 20 to 300 m, height – 0.5 to 10 m, with less than 5 m being most common. Length of such lineaments can exceed 10 km, although tracing for more than 5 – 8 km is complicated due to erosion by or cover of younger landforms (fig. 1C). In some places on the eastern side of the upland they are traceable as negative landforms, although most likely it is more related to mode of preservation than being indicative of their genesis. Morphological properties of those landforms match description of Mega-scale glacial lineations (MSGLs) as given by Stokes et al. (2013).

The age of these MSGLs can be determined only tentatively – they are (barely) traceable below landforms of Gulbene Ice Marginal Zone (IMZ) – the first step of deglaciation of Eastern Kursa Upland (Zelčs et al., 2011) –, and thus predate it. Orientation of MSGLs indicates on a fast flow from the direction of Baltic Ice Stream (fig. 1B), but there is no large moraine present that one could expect in case of its collision with the fast flowing Zemgale Ice Lobe (Lamsters and Zelčs, 2015) of Rīga Ice Stream (B_5 after Boulton et al., 2001). This indicates complete reorientation of major ice flow direction in the region during the Late Weichelian glaciation with Baltic Ice Stream being the dominant one before onset of deglaciation.

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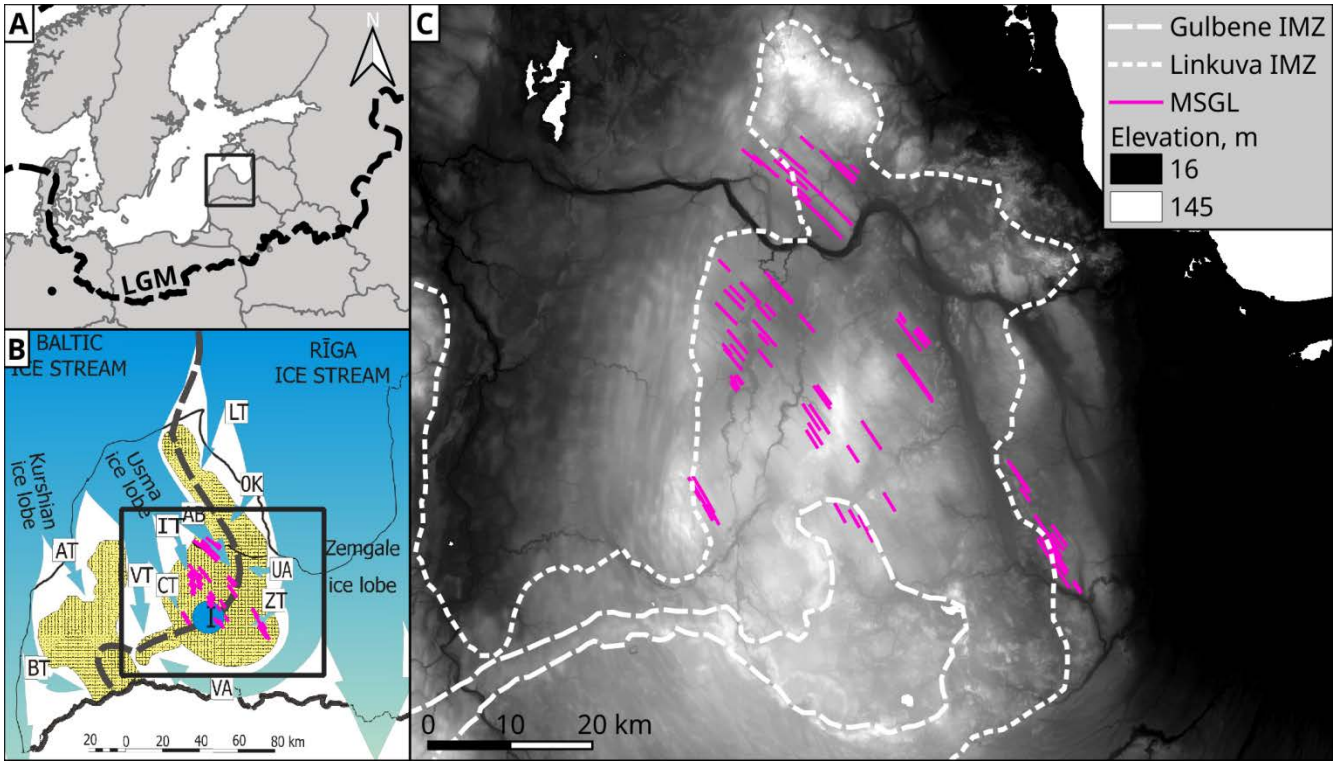

Figure 1: A – location of study area. Area of B shown with a square; B – major ice flow directions after Zelčs and Markots (2004). Area of C shown with a square; C – location of selected MSGLs from Northern and Eastern Kursa Uplands. IMZs after Zelčs et al. (2011). Elevation data – Latvian Geospatial Information Agency (2018).

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