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# Volumes and areas of Early Weichselian ice dammed lakes in Northern Russia

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## Abstract

The early Weichselian Ice Sheet on the continental shelves of the Barents and Kara seas advanced onto the Northern Russian mainland and blocked the paths of the north-flowing rivers to the Arctic Ocean. As a consequence huge proglacial lakes were dammed between the ice margin in the north and the continental drainage divides in the south. The lake in the Pechora lowland, named Lake Komi, is the best mapped (Astakhov et al. 1999; Mangerud et al. in press). The damming of the rivers Yenisei and Ob caused an overflow to the Aral Sea with further drainage to the Caspian and Black seas. Volumes and areas of these Early Weichselian ice dammed lakes were estimated using modern topography, elevations of the former lake surfaces and the geographic position of the damming ice margin. In addition, estimations have been made of the volumes of additional water in the Aral and Caspian Seas respectively; if they were to be filled from today's levels up to their overflow passes. Calculated volumes and areas are summarized in Table 1.

The use of modern topography for the volume and area estimation does not consider sediment deposition or erosion in the lake's basins that took place since the time of the paleo-lake's phases considered. The topography was derived from the Global Land One-Kilometer Base Elevation (GLOBE) Digital Elevation Model (GLOBE Task Team et al., 1999) and the bathymetry from the International Bathymetric Chart of the Arctic Ocean (IBCAO) grid model (Jakobsson et al. 2000), with a horizontal resolution of 2500 m. The GLOBE and IBCAO grids were projected to Lamberts Equal Area projection, resampled to a grid spacing of 1000 m, and combined using Intergraph's Modular GIS Environment (MGE) software modules were the calculations were performed.

The Northern Russian and Western Siberian Early Weichselian ice dammed lakes were comparable in size to the largest stage, Upper Campbell beach level, of the North American ice dammed lake Agassiz that formed ca 9400 <sup>14</sup>C yr B.P (Leverington et al., 2000).

The lakes changed the hydrology of much of the continent, the fresh water supply to the Arctic Ocean, and even to the Caspian and Black seas, possibly also the Mediterranean. A catastrophic tapping of the ice dammed lakes into the Arctic Ocean probably took place during the final stage of the Early Weichselian when the ice sheet retreated.

Table 1. Estimates of volumes and areas of Early Weichselian ice dammed lakes in Northern Russia and Western Siberia and additional water that would fill the Caspian and Aral seas respectively, if they were filled up to their overflow passes shown on the main map.

Ice dammed lakes and additional water in the Caspian and Aral Seas	Topographic level of watersurface (m)	Area (1000 km <sup>2</sup> )	Volume (1000 km <sup>3</sup> )	Average Depth (m)
Lake west of the Timan Ridge	100	218	15.1	69
Lake Komi between Timan Ridge and Urals	100	78.1	2.35	30
Lake between the Urals and the Central Siberian Highland	70	760	21.4	28
Caspian Sea between 28 m b.s.l. and 26 m a.s.l. (area in brackets is the total area at 26 m a.s.l.)	-28 to 26	424 [830]	34.3	
Aral Sea between 40 m a.s.l. and 57 m a.s.l. (area in brackets is the total area at 57 m a.s.l.)	40 to 57	[121]	1.48	
Lake Agassiz, Upper Campbell beach level formed 9.4 <sup>14</sup> C ka B.P. [Leverington et al., 2000]		263	22.7	86

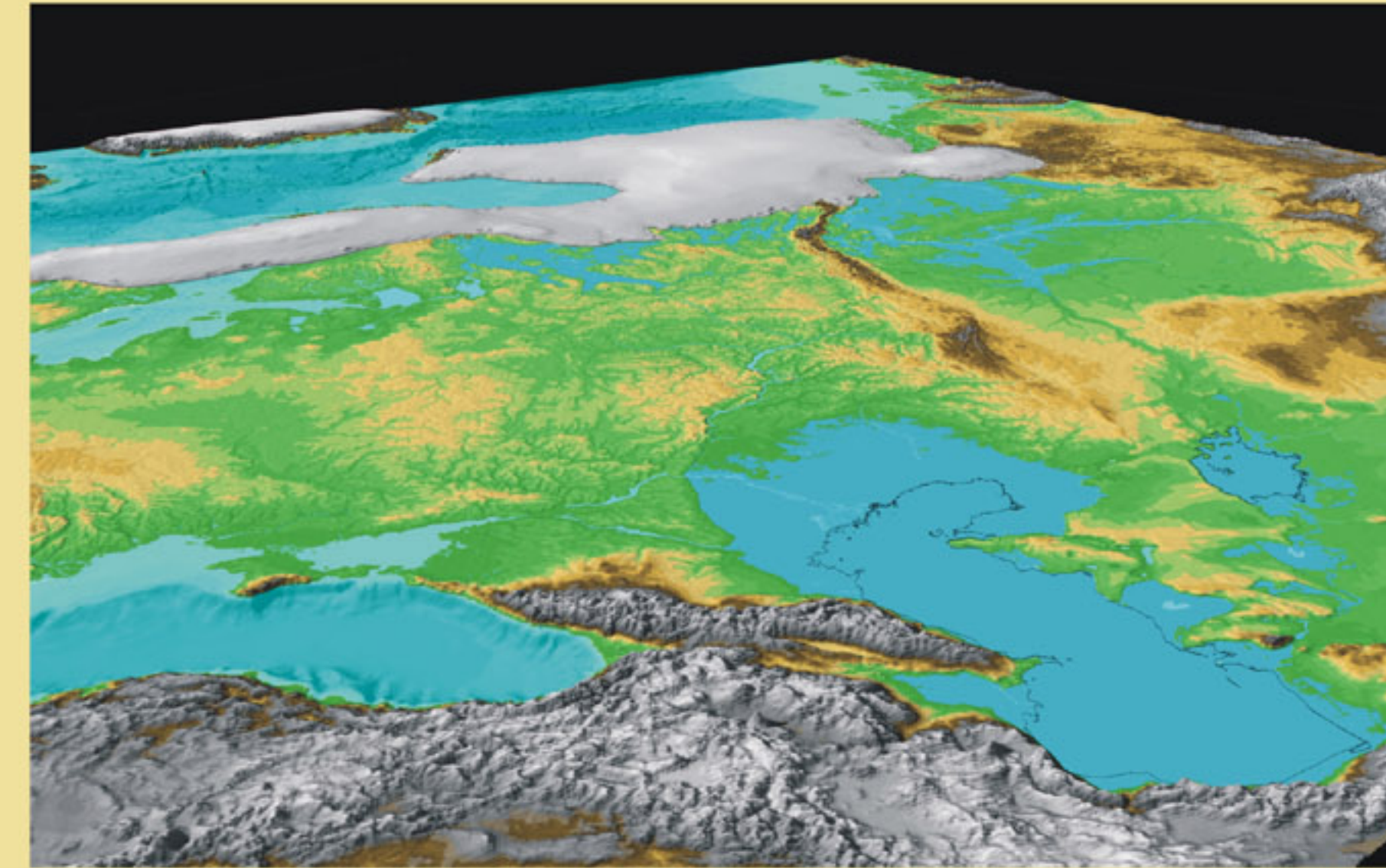


## Early Weichselian ice dammed lakes in Northern Russia

- Legend**
- Early Weichselian Ice sheet limit (90-100 ka). Modified from Eurasian Ice Sheet project (Svendsen et al., 2001)
  - Ice sheet limit used to dam the proglacial lakes
  - Ice dammed lakes
  - Hydrology from the Digital Chart of the World. Only water bodies larger than 20km<sup>2</sup> are shown.

### Map sources

The maps are compiled by Martin Jakobsson using the Intergraph GIS softwares Geocada Professional and MGE.  
 Projection: Lamberts Equal Area  
 Datum: WGS 84  
 Bathymetry: International Bathymetric Chart of the Arctic Ocean [Jakobsson et al., 2000] and Predicted topography [Smith & Sandwell, 1992]  
 Coastline: World Vector Shoreline  
 Land topo.: US Geological Survey GTOPO30 and GLOBE



3D-visualization of the Early Weichselian ice dammed lakes and the higher levels of the Caspian and Aral Seas as shown in the main 2D-map and Table 1. Shorelines of the Caspian and Aral Seas are plotted in black for comparison using the World Vector Shoreline Plus database. The visualization was made using the software Fledermaus from IVS ([www.ivs.unb.ca](http://www.ivs.unb.ca)).

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