

Quantifying Wedge-Ice Volumes in Yedoma and Thermokarst Basin Deposits

Mathias Ulrich, Guido Grosse, Jens Strauss and Lutz Schirrmeister

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ABSTRACT

Wedge-ice volume (WIV) is a key factor in assessing the response of ice-rich permafrost landscapes to thaw and in quantifying deep permafrost soil carbon inventories. Here, we present a method for calculating WIV in late Pleistocene Yedoma deposits and Holocene thermokarst basin deposits at four study areas in Siberia and Alaska. Ice-wedge polygons and thermokarst mound (baydzherakh) patterns were mapped on different landscape units using very high-resolution (0.5 m/pixel) satellite imagery (WorldView-1 and GeoEye-1). In a geographic information system (GIS) environment, Thiessen polygons were automatically created to reconstruct relict ice-wedge polygonal networks, and field and published data on ice-wedge dimensions were used to generate three-dimensional subsurface models that distinguish between epi- and syngenetic ice-wedge geometry. The results reveal significant variations in WIV between the study sites and within certain terrain units. Calculated maximum WIV ranges from 31.4 to 63.2 vol% for Yedoma deposits and from 6.6 to 13.2 vol% for thermokarst basin deposits.

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