WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: MN3421

Title: Paleohydrologic response of the Mississippi Headwaters watershed to Holocene climate change

Focus Categories: Hydrology, None

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Abstract

The Mississippi Headwaters watershed, an 7000 km2 area of north-central Minnesota is occupied in part by three large lakes: Cass, Leech, and Winnibigoshish. The hydrology of these lakes are integrated with the surrounding watershed, in particular the Mississippi River, the course of which has changed several times during the late-Holocene. The southeast margin of Lake Winnibigoshish is composed of a dunefield which formed during the mid-Holocene, under warmer, drier climatic conditions. The desiccated bed of Winnibigoshish was presumably the source of the aeolian sediment. Geomorphic relationships and hydrologic modeling suggest that the formation of the dunes was due in large part to the particular hydrologic budget of Winnibigoshish during the early- and mid-Holocene. In contrast, little or no mid-Holocene aeolian sediment is associated with Cass and Leech Lakes, despite the fact that all three lakes lie in the same watershed, and have synchronously had essentially the same climate, vegetation, geology, and topography throughout the Holocene.

The association of aeolian sediments with Winnibigoshish and not Cass and Leech Lakes suggests several insights into the behavior of the Headwaters Lakes: 1) The response of each lake to similar climactic inputs can vary widely, 2) The hydrologic budget of each lake is dominantly a function of the basin:lake area ratio, and 3) Synchronous differences in the sediment records of each of the lakes record differences in the hydrologic budget and residence time of each lake, which in turn are a function of climate. These insights suggest that documentation and interpretation of synchronous differences in the sediment records of each of the Headwaters Lakes promises to be a sensitive record of climate change in north-central Minnesota. In addition, in contrast to previous studies that have focused on interpretation of sediment records of small lakes in small watersheds, the large lakes will dominantly record regional-scale changes.