Geophysical Research Abstracts
Vol. 12, EGU2010-3747, 2010
EGU General Assembly 2010

Multi-proxy evidence for climate-driven changes in arctic lakes from northern Russia over the Holocene.

Angela Self (1,2), Stephen Brooks (1), Vivienne Jones (2), Nadia Solovieva (2), Suzanne McGowan (3), Peter Rosén (4), Emily Parrott (2), Heikki Seppä (5), and Sakari Salonen (5)

(1) Department of Entomology, Natural History Museum, Cromwell Road, London SW7 5BD, UK (A.Self@nhm.ac.uk), (2) Environmental Change Research Centre, Department of Geography, University College London, Gower Street, London WC1E 6BT, UK , (3) Department of Geography, University of Nottingham, University Park, NG7 2RD, UK, (4) Climate Impacts Research Centre, SE-981 07 Abisko, Sweden, (5) Department of Geology, University of Helsinki, P.O. Box 64, 00014, Finland

Average arctic temperatures have increased at almost twice the rate of the rest of the world over the last 100 years and climate projections suggest this trend is likely to continue resulting in an additional warming of 2 – 3°C in annual mean air temperatures by 2050. Freshwater ecosystems occupy a substantial area of the terrestrial environment in the Arctic and are particularly sensitive to temperature increases which may lead to profound changes in catchment characteristics, permafrost, hydrology and nutrient availability. Therefore it is important to understand how past changes in climate have affected these ecosystems. In this paper we present one of the first quantitative multi-proxy climate records from arctic Siberia.

The affect of early – mid Holocene and recent climate change on arctic lakes in northern Russia were investigated in multi-proxy studies. The past climate was reconstructed using chironomid inference models to estimate mean July air temperatures and trends in continentality. Stable isotopes and LOI were analysed to infer past changes in sediment organic matter. Near-infrared spectroscopy (NIRS) and/or diatoms were used to infer changes in lake water total organic carbon and algal pigments and/or diatoms were used to infer changes in productivity and light penetration in the lake.

Analyses of a sediment core from a tundra lake (Lake Kharinei) in north-eastern European Russia show significant assemblage changes in diatoms, chironomids and pigments, which coincide with climate-driven vegetation shifts from open birch forest to spruce forest and then to tundra over the Holocene. During the open birch phase of the late Glacial - early Holocene, chironomid-inferred reconstructions suggest that the climate was approximately 1 - 3°C warmer and more continental than present. Isotopic analyses indicate a productive environment receiving a significant input of organic material from terrestrial plants into the lake. Both diatoms and NIRS-TOC also suggest that the lake water was relatively high in TOC. Spruce forest became established within the catchment during the early – mid Holocene, which appears to have stimulated algal production. Throughout this period July air temperatures are inferred to have gradually declined to present-day values and the climate became more maritime. From ca. 4000 cal yrs BP July air temperatures remained stable but continentality increased leading to a shorter ice-free period. The pollen and macrofossil record indicates a transition to tundra vegetation ca 3000 cal yr BP which coincides with major changes in pigments, chironomids and diatoms.

High resolution reconstruction of climate variability over the last 200 years from two tundra lakes on the Putoran Plateau, western Siberia, suggest that mean July air temperatures warmed by approximately 0.5°C between ca 1820 - 1980 and have remained relatively stable over the last 30 years. However major compositional changes in the chironomid and diatom assemblages have occurred within the last 125 - 50 years. Since the 1970s increases in the instrumental June temperature record and a chironomid-inferred shift to a more maritime climate have been accompanied by increases in diatom accumulation rates together with an increase in within-lake productivity and a trend towards increased algal productivity (as highlighted by stable isotope analysis). The synchronicity of the changes suggests the biota may be responding to lengthening of the ice-free period and related limnological changes.

The changes in these Russian lakes corroborate results from Europe and Arctic Canada and indicate a circumpolar pattern of climate-driven regime change in arctic lakes in the last 100 years.