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Assessing recent climatic change across north-west China using lake sediments from the Badain Jaran Desert

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The East Asian summer monsoon,which is an important component of the climate of China, influences the lives of over a billion people. It is important to predict how the monsoon system will alter in response to future changes in the climate system, but for this to be achievable, more knowledge of palaeoclimatic fluctuations of the monsoon, on a variety of timescales, is required. Furthermore, spatial variability of the monsoon needs to be considered, requiring palaeoclimatic records from across China. The Badain Jaran Desert in north-west China is located at the modern day landward boundary of the East Asian summer monsoon. The climate of the desert is mainly controlled by changes in precipitation and / or evaporation rates, probably in relation to changes in the intensity of the East Asian summer monsoon. Palaeoclimatic reconstructions from this region therefore record changes in the strength of the summer monsoon. The desert is composed of stationary sand dunes of up to 500 m high, between which are over 100 groundwater fed lakes. In 2005 and 2006, modern hydrological sampling of the lakes, springs and precipitation events took place using geochemical and isotopic techniques to provide baseline information on modern limnology, which was previously unavailable. The results of this study show that the groundwater feeding the various lakes is of a relatively homogeneous composition. Despite this, there is a large salinity and isotopic gradient across the suite of lakes and the water balance of an individual lake is controlled by evaporation, mediated by basin morphology.

Short sediment cores (all $<$ 1 meter in length) have been collected from some of the lakes that are at the lower end of the salinity gradient. The palaeolimnology of these lakes have been reconstructed using biological (diatom floras and ostracod abundances), isotopic (authigentic carbonate and organic carbon) and geochemical (trace metal ratios of ostracod valves) techniques. The chronology of the sediment cores, which is based on 137-Cs and 210-Pb techniques, shows that the sediment cores cover the past $\sim$300 years. Due to the complex interaction of basin morphology, groundwater inputs and evaporation, each lake responses differently to climatic perturbation, although comparisons of multiple basins allows regional climate signals to be separated from basin specific change. Despite the short length of the sediment records there are extremely large variations in the proxies measured. These changes are caused by rapid fluctuations in lake levels, which are in turn caused by variations in the amount of evaporation from the lake. However, sudden jumps in the surface area to volume ratio can also occur when the lake overflows its basin sill and spreads across a large area without a corresponding increase in the lake volume. This work has significance for north-west China where domestic and agricultural demands for water are increasing due to the migration of people into the region.