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A one million year record of atmospheric temperature, ice sheet volume and global sea level

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Many deep sea sediment cores have been drilled over the past decades. The oxygen isotope (δ^{18}O) record from these cores, extracted from skeletal remains of benthic foraminifera, depends on the mean isotopic value of the world oceans and on local deep sea temperature at the time of deposition. The first is a strong function of land ice volume and of the average isotopic composition of the ice sheets. We use a detailed model of the North American and Eurasian ice sheets to relate variations in continental ice volume and ocean isotopic composition to temperature and sea level. More specifically, we apply an inverse methodology in which the forcing is a 1 million year (Myr) record of δ^{18}O. The model is set to find values of surface air temperature, deep sea temperature, ice volume and global sea level that are consistent with the prescribed variations in oceanic δ^{18}O. This procedure results in 1 Myr time series of these quantities, in which several glacial cycles can clearly be identified. Reconstructed temperature and sea level will be compared to other, independent records. The dominant periodicity of the various variables and the importance of leads and lags between different variables will be discussed. We will show details of the temporal and spatial behaviour of the extent, volume and mass balance of the Fennoscandian, Laurentide and Corderillan ice sheets. Finally, we will quantify the individual contributions of land ice volume and deep ocean temperature to the observed isotope record.