



The atmospheric chemistry in the Last Glacial Maximum : A model study

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The oxidation capacity of the atmosphere is ultimately controlling the lifetime and therefore the burden of many trace gases including the greenhouse gas methane. Studying the atmospheric chemistry during the Last Glacial Maximum (LGM) combined with trace gas measurements in ice cores will help to validate our understanding of the earth system, to understand the interglacial changes in methane concentrations, and to interpret the trace gas concentration data found in ice cores.

We modeled the tropospheric chemistry with a state-of-the-art three-dimensional chemical transport model (CTM), MOZART, driven by the meteorology output from an atmospheric circulation model, ECHAM. Using a dynamical vegetation model, including a fire module, we estimated the vegetation as well as the resulting biogenic and biomass burning emissions such as hydrocarbons, carbon monoxide (CO), and nitrogen oxides (NO_x), all of which are known to affect atmospheric chemistry. We also took into account the effects of changed vegetation on chemistry due to deposition fluxes, surface reflectivity (albedo), and dust source regions. Model runs using present day conditions, preindustrial conditions as well as LGM conditions were performed. Among other differences in the chemical composition, the results indicate a slight enhancement of the oxidation capacity which is mainly driven by the reduced biogenic VOC emissions and the reduced methane emissions. In general the tropospheric chemistry is relatively stable due to counteracting effects of different emission source changes and climate changes. Further we used our model simulations to calculate the nitrate deposition flux and estimated the NO_x source contributions to nitrate concentrations measured in icecores. In contrast to literature our results suggest that lightning is the most important NO_x source controlling the nitrate concentration in tropical ice cores.