Reconstructing deep ocean carbonate ion during the LGM and deglaciation using foraminiferal Mg/Ca

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We are developing a proxy for deep ocean carbonate ion concentration based on the Mg/Ca ratio of planktonic foraminifera. We exploit the 'dissolution effect', the decrease in the ratio with increased water depth, to reconstruct the paleo-carbonate ion gradient using samples obtained from multiple cores along a depth transect. Mg/Ca measurements were made on *G. ruber*, *G. sacculifer*, and *N. dutertrei*, species commonly used in paleo-temperature reconstructions. The species have different sensitivities to both temperature and carbonate ion concentration. Data from the shallow core is used to estimate the temporal change in the Mg/Ca ratio due to temperature. We attribute the residual decrease in the ratio with increased water depth to changes in CO_3^{2-}. We present results for depth transects in the western tropical Atlantic (LGM) and western tropical Pacific (LGM and deglaciation). The Atlantic results suggest a steeper carbonate ion gradient during the LGM in comparison to the modern in agreement with the inferred changes in water mass geometry during the LGM (implied by $\delta^{13}C$ reconstructions). Our Pacific reconstructions suggest a more corrosive deep-water mass in the deep Pacific during the LGM and similar or slightly better preservation during the deglaciation in comparison to today. The Pacific results are at odds with the long-held view of better preservation in the Pacific during the LGM, however, they are in agreement with other proxy data. We have also generated electron microprobe Mg/Ca image maps from the same samples used in the carbonate ion reconstructions to characterize how dissolution alters shell chemistry.

Do aerosols influence climate extremes?

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Changes in climate extremes may have severe implications for food supply and human security. Type, frequency and intensity of extreme events are expected to change as climate changes. In a warmer future climate, there will be an increased risk of more intense, more frequent and longer-lasting heat waves. (IPCC, 2007). Summer drying and more intense precipitation in winter is expected as well. This trend might be enhanced by future reduction in aerosol emissions. Aerosols reduce solar insolation and thus cool the surface during daytime and exert a warming effect during nighttime, damping temperature extremes and the diurnal amplitude. Aerosols decrease evaporation rate and increase the stability in the boundary layer. This affects precipitation amount and distribution. In addition, aerosol particles influence cloud microphysics and precipitation formation.

Equilibrium simulations are performed using the global atmospheric GCM aerosol model ECHAM5-HAM coupled to a mixed layer ocean model to assess possible impacts of future aerosol and aerosol precursor emissions and greenhouse gas concentrations on climate [1]. Results of these simulations are analyzed in respect to extreme values of temperature and precipitation. Indicators for moderate weather extremes have been introduced which take place on larger temporal and spatial scales and are, therefore, suitable for analyses of global model results. We conducted simulations in which only GHG concentrations are changed or only aerosol emissions are changed to disentangle the importance of both individual forcing agents.

[1] Kloster *et al.* (2008) *Atmos. Chem. Phys.* **8**, 6405-6437.