Geophysical Research Abstracts, Vol. 7, 04618, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04618

Long-term partially coupled ocean-atmosphere experiments: The role of the tropical oceans for northern hemisphere climate variability

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A number of atmospheric model simulations has demonstrated an impact of global sea surface temperatures (SST) on the observed changes in the northern extratropical atmospheric circulation, in particular, on the recent positive trend of the NAO. Some first experiments with coupled atmosphere-ocean models have been performed in order to evaluate the role the tropical SST changes for decadal climate trends (e.g. Bader and Latif, 2004). Here we investigate the role of the tropical SST for interannual to interdecadal variability in the northern extratropical atmosphere and ocean, in particular, for the variability of the north Atlantic thermohaline circulation.

Several long-term (more than 500 years) experiments with the coupled atmosphere-ocean general circulation model ECHAM5/MPI-OM1 (spatial resolution resolution appr. 3x3 degrees) using a "partial coupling" technique have been performed. In these experiments, temperatures of the upper oceanic layer in certain regions were prescribed to climatological values obtained from a control experiment of 1000 years duration. In three simulations, temperatures have been set to the climatology (thus excluding interannual variability) in the tropical Pacific, Atlantic and Indian Ocean, respectively. Changes in the mean state and variability have been compared to the control experiment. First results of the analysis are presented in this study. In particular, a significant increase of extratropical decadal SST variability have been found in the North Pacific in the experiment with no interannual variability in the Indian Ocean. Decadal variability in the North Atlantic is slightly intensified in the sensitivity experiments. A strong cooling of the tropical Indian and Atlantic Ocean SSTs has resulted from prescribing climatological SSTs in the tropical Pacific.