Abstract

Seasonal forecasting requires a thorough dynamical understanding of the atmospheric response to boundary forcing such as sea surface temperature anomalies.
This thesis focusses on atmospheric teleconnections related to the El Niño/Southern Oscillation (ENSO) phenomenon and on the dynamics contributing to the signal communication to remote regions. Both of these are investigated by conducting ensemble experiments with an atmospheric general circulation model (ECHAM4).

Some of these experiments have been performed at high horizontal resolution (T106) to examine the role of resolution in simulating the observed atmospheric anomalies during ENSO extremes. A clear resolution dependence of the ENSO response is found over the North Atlantic/European sector.

Furthermore, the atmospheric response is analyzed with respect to its antisymmetry (El Niño and La Niña-type forcing) and is shown to considerably deviate from a simple sign reversal, both in the mean flow and subseasonal fluctuations.

The extratropical transient eddy activity is modified by ENSO through a meridional shift of the midlatitudinal cyclone tracks. In order to gain more insight into the role of transient eddies in determining the atmospheric response to ENSO, the feedback of the transient eddies onto the mean flow is analyzed in terms of the eddy forcing onto the mean streamfunction. Evidence is presented that ENSO related changes in the upper-tropospheric transient eddy vorticity fluxes help to reinforce the mean streamfunction response. However, at lower levels, transient eddy temperature fluxes tend to destroy the mean temperature response and thus to reduce baroclinicity.

Considering anthropogenic climate change, it may be asked whether the atmospheric response to ENSO is changed under future climate conditions. From experiments analogous to those conducted under present climate conditions, it can be concluded that the atmospheric response to the tropical Pacific forcing remains rather robust.

Finally, the influence of ENSO on tropical storms (e.g. hurricanes) is analyzed from a multi-year ECHAM4/T106 integration. In this context, also the large-scale circulation providing the background for tropical storm development is considered. It is shown that the vertical wind shear is clearly affected by ENSO.