Geophysical Research Abstracts, Vol. 8, 01369, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01369

An analysis of the atmospheric processes driving the large-scale winter sea ice variability in the Southern Ocean

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We have investigated the influence of different atmospheric processes on the winter sea ice cover in the Southern Ocean using both model and observational results. The model used is the global sea ice-ocean model ORCA2-LIM driven by the NCEP-NCAR (National Centers for Environmental Prediction-National Center for Atmospheric Research) reanalysis daily surface air temperatures and winds. The observations consist out of both the HadISST1 sea ice concentrations and the NCEP-NCAR reanalysis data. Our results point to different processes that influence the winter sea ice concentration and thickness in the Southern Ocean. First of all, northward (southward) wind anomalies induce divergence (convergence) anomalies of the sea ice close to the continent and a northward (southward) anomalous sea ice drift, leading to a larger (smaller) sea ice extent and thinner (thicker) ice close to the continent. Furthermore, these anomalous winds induce lower (higher) temperature above the sea ice, which is followed by a larger (smaller) sea ice production. Finally, zonal wind changes modify the sea ice exchanges between the different basins. A significant negative correlation has also been seen, both in the model and in the observations, between the winter sea ice extent in the Amundsen-Bellingshausen Seas and the Weddell Sector, which could be linked to the influence of the Southern Annular Mode (SAM) and the El Niño Southern Oscillation (ENSO). However, none of the known atmospheric patterns is capable of explaining the large scale variability of the winter sea ice extent integrated over the whole Southern Ocean.