Geophysical Research Abstracts
Vol. 15, EGU2013-7652, 2013
EGU General Assembly 2013

Controls on the Southern Ocean mixed layer salinity budget in CMIP5 models

Sally Close and Hugues Goosse

Université catholique de Louvain, Centre de recherches sur la terre et le climat Georges Lemaître, Earth and Life Institute, Belgium (sally.close@uclouvain.be)

Global-scale changes in upper ocean salinity, driven by changes in freshwater forcing, are both predicted by climate models as a feature of the climatic response to anthropogenic climate change and reported by a number of recent observation-based studies. In the extrapolar regions, such change has been predominantly attributed to changes in the hydrological cycle. However, in the high latitudes, changes in sea ice coverage may also provide a significant source of freshwater forcing. Variations in mixed layer properties have wide-reaching influence, affecting, for example, oceanic heat storage and the rates of exchange between the atmosphere and deeper ocean. It has further been suggested that heat supplied by the deep ocean may have a significant influence on the cryosphere, indicating that a good understanding of the behaviour of the Southern Ocean mixed layer is crucial to describing the climate of this region. Our aims in this work are to assess the dominant mechanisms that drive salinity variability in the Southern Ocean mixed layer using model data and to further examine the relationship between mixed layer and sea ice variability.

In this study, the evolution of the upper Southern Ocean hydrographic structure in response to the RCP4.5 forcing scenario is analyzed using model data drawn from the Coupled Model Intercomparison Project Phase 5 archive. A robust freshening trend is evident, associated with an increase in stratification and decoupling of the upper ocean as the mixed layer gains buoyancy at a faster rate than the underlying ocean. The magnitudes of the individual terms of the salinity budget are evaluated, and significant discrepancy noted amongst the models analysed here. Motivated by the important role of entrainment suggested by this analysis, we examine the relationship between the weakening entrainment rate, decreasing sea ice coverage and increases in heat storage at depth that are evident in the model data. Our analysis suggests that the balance between oceanic and atmospheric heat fluxes may play a significant role in modulating sea ice coverage, and hence that fundamental oceanic processes that are, at present, inconsistently represented amongst models may be important in explaining recent and future Antarctic sea ice variability.