Geophysical Research Abstracts
Vol. 15, EGU2013-10905, 2013
EGU General Assembly 2013

Increasing presence of Arctic Ocean deep waters in the Greenland Sea

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Deep convection has been known to provide the coldest and freshest waters to the deep Greenland Sea, whose properties are balanced with the advection of warmer and saltier waters from the deep Arctic Ocean. However, during the last three decades, deep convection has come to a halt in the Greenland Sea.

As previously reported and updated in this work through the analysis of the free available hydrographic data in the central Greenland Sea and in the Arctic Ocean from 1950 to 2010 (Pangaea and ICES data bases), as a consequence of this, two major hydrographic changes are observed: (1) the appearance and deepening of an intermediate temperature maximum and (2) a continuous warming and saltening of the deep Greenland Sea. The origin of both findings is found in the advection of Arctic Ocean deep waters from the Amerasian and Eurasian basins, respectively, into the central Greenland Sea. Associated to the first, a temperature increase of 0.35˚C from 1993 to 2009 is observed at 1700 m. Below 2000 m, the temperature and salinity have increased at a mean rate of 0.136˚C/decade and 0.01decade^{-1} in the last three decades. Overall, the stop of deep convection and the advection of Arctic Ocean deep waters result among the highest deep warming and saltening trends of the World Ocean in the Greenland Sea.

In addition to the described update of the state of these changes, two new accomplishments are fulfilled in this study. First, in absence of deep convection, the continuous changing of the thermohaline properties of the deep Greenland Sea requires exchanges with adjacent ocean basins. This scenario enables us the estimation of the necessary transports from the deep Arctic to explain the observed changes. A transport of Eurasian Basin Deep Water of 0.31$\pm$0.04 Sv is obtained. Secondly, the warming and saltening of the deep Greenland Sea contributes, as any other ocean basin, to the World Ocean heat content and sea level rise. The estimation of these contributions shows larger numbers than traditionally expected for Polar Regions: 1% for its contribution to the World Ocean heat content -100 times larger than the contribution per unit area of the deep Pacific Ocean-; and 0.12% for the global sea level rise.

The results presented here are relevant not only for future assessments of the state of the Greenland Sea but also for the entire Arctic Mediterranean, and global energy budget studies.