Geophysical Research Abstracts
Vol. 17, EGU2015-6074, 2015
EGU General Assembly 2015

Elephant overflows: Multi-annual variability in Weddell Sea Deep Water driven by surface forcing

Andrew Meijers (1), Michael Meredith (1), Povl Abrahamsen (1), Alberto Naviera-Garabato (2), Miguel Ángel Morales Maqueda (3), and Kurt Polzin (4)

(1) British Antarctic Survey, Cambridge, United Kingdom, (2) University of Southampton, Southampton, United Kingdom, (3) National Oceanographic Centre, Liverpool, United Kingdom, (4) Woods Hole Oceanographic Institute, Woods Hole, United States

The volume of the deepest and densest water mass in Drake Passage, Lower Weddell Sea Deep Water (LWSDW), is shown to have been decreasing over the last 20 years of observations, with an associated reduction in density driven by freshening. Superimposed on this long term trend is a multi-annual oscillation with a period of 3-5 years. This variability only appears in Drake Passage; observations in the east of the Scotia Sea show a similar long term trend, but with no apparent multi-annual variability. Clues as to the source of this variability may be found on the continental slope at approximately 1000 m immediately north of Elephant Island on the northern tip of the Antarctic Peninsula. Here there is an intermittent westward flowing cold/fresh slope current whose volume and properties are strongly correlated with the LWSDW multi-annual variability, although leading the LWSDW by around one year. As the slope current and LWSDW are separated from each other both geographically and in water mass characteristics, their co-variability implies that they are responding to a common forcing, while the lag between deep LWSDW and shallow slope current provides information on the timescale of this response.

A newly available high resolution temperature and salinity multi-year time series from the Elephant Island slope at 1000 m is compared with reanalysis and model derived surface fluxes, sea ice extent and wind stress. We find that there are strong positive relationships between the surface wind stress and heat flux over the shelf at the tip of the Antarctic Peninsula and the properties of the slope current at 1000 m on seasonal to annual timescales. We use tracer release experiments in the Southern Ocean State Estimate (SOSE) model to investigate the lag between the slope current and LWSDW timeseries and hypothesise that the observed multi-annual variability in both water masses is driven by surface forcing over the shelf and the overflow of modified water from the slope in the north-west Weddell Sea. The lag observed between the two time series is due to the difference in water mass paths to the observation points in Drake Passage. We discuss the role of atmospheric modes of variability such as ENSO and SAM, as well as climate trends, on this relationship and their potential impact on future LWSDW export.