INSTITUTIONEN FÖR MARINA VETENSKAPER

Ocean Circulation in the Amundsen Sea, West Antarctica

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Abstract

The increase of mass loss from the Antarctic Ice Sheet is a significant contribution to global sea level rise. The most rapid changes are occurring in the Amundsen Sea area, where the thinning of the floating glaciers is assumed to be driven by the ocean. Relatively warm and salty deep water is forced upon the continental shelf and then flows southward in deep glacially scoured channels crossing the shelf. The warm waters contain enough heat to melt the glacial ice as they reach the base of the glaciers. The circulation of water masses on the Amundsen Sea shelf is sensitive to atmospheric forcing, while the regional atmospheric conditions are highly variable. A better understanding of this ice-ocean-atmosphere system is central to our ability to assess global sea level rise, which is occurring today and is projected to increase in the future.

The temporal variability, heat content, pathways and vertical structure of the ocean currents in primarily the Dotson-Getz trough, the main western pathway for warm deep waters on the Amundsen Sea continental shelf, were investigated in this study. The major data source for these analyses was in-situ subsurface moorings giving time series of temperature, salinity and current velocity. Other material includes shipborne measurements, numerical model output and a variety of satellite and reanalysis data. The main findings from this work are the following. In the bottom layer on the eastern side of the trough, there is a continuous inflow of warm deep water with a temperature of several degrees C above the local freezing point. The currents transporting the heat have a strong a depth independent part. Flow variability is substantial on daily and sub-daily timescales and inflows are correlated with regional eastward winds. The warm inflows interact with the base of the ice shelves and a part of this flow leaves the channel on the western side as cooled and freshened water mass. The assessed melt rates induced by this clockwise circulation agree with satellite based estimates. The bathymetry databases for this region contain large errors, which has implications for model studies and transport calculations.

Keywords: Antarctica, Amundsen Sea, West Antarctic Ice Sheet, Circumpolar Deep Water, shelf circulation, ocean model, icebergs, remote sensing