Oceanic exchanges at the Dotson Ice Shelf calving front, West Antarctica

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ABSTRACT

Recently, the rapid retreat of the ice shelves in the West Antarctica due to climate change has been established from remotely satellite observation. Especially, widespread thinning of ice shelves in the coast around the Amundsen Sea has been recorded in recent decades due to intrusions of relatively warm Circumpolar Deep Water (CDW) onto the continental shelf. Such an intrusion of CDW supplies heat to the Ice shelves and leads to ice shelves basal melting and spreading of meltwater from the glacier. Dotson Ice Shelf (DIS) is an ice shelf south of Amundsen Sea polynya (ASP), which has been found to have a high basal melting rate due to oceanic heat transport steered towards it in the Dotson-Getz Trough (DGT). In order to estimate the oceanic heat transport into the cavity, three long-term moorings were deployed in front of DIS in January 2014 and measured vertical profiles of current velocities, temperature, and salinity for two years. During the measurement period, modified CDW (mCDW) was observed to intrude along the bottom of the eastern slope of DGT. This warm salty water melts glacial ice, mixes with the meltwater and spreads to the north along the western slopes of DGT. A strong seasonal variation was observed, with maximum southward flow during austral summer and minimum in austral autumn and winter. The seasonal variation correlated with the local Ocean Surface Stress Curl (OSSC) by sea ice and wind distribution in ocean surface, in similarity with previous studies form nearby regions. Meltwater outflows showed maximum during autumn and minimum during spring. The outflow velocities were influenced by zonal density gradients induced by the seasonal variation of meltwater fraction. Also, the meltwater fraction at western slope lags heat transport at eastern slope by 145 days. The thickness of mCDW on the eastern slope of the DIS showed a strong inter-annual variation affected by Ekman upwelling along DGT. During austral summer, southeasterly wind on the eastern boundary of ASP shows the strong inter-annual variability associated with the longitudinal location of Amundsen Sea Low (ASL).