

First continuous profiler observation of wintertime Antarctic coastal polynya

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Antarctic coastal polynyas are the regions where sea ice forms vigorously, leading to supply of dense abyssal water for the global ocean. Monitoring the sea state of coastal polynyas especially in winter hence has global implications. To fully understand the development of water characteristics, capturing of the whole water column is required. However, the wintertime observations of seasonal ice zone such as polynya is not abundant so far, due to the severe and variable conditions of polar oceans.

To realize a near-realtime observation of water column in coastal polynya, we deployed a tethered profiling float over the whole winter in Cape Darnley polynya, East Antarctica (bottom depth of 230 m). The tethered float was manufactured by IHI Corporation, with a temperature and salinity sensor (SBE37 of Seabird Scientific) attached.

The float observation was successful in operation for more than eight months from Feb. 26 to Nov. 13, 2017. This float was designed to park at 150 dbar depth and to surface (upto 20 dbar when sea ice is supposed to exist) at 10-day interval. During this period, 26 profiles for the water column from 180 dbar to 20 dbar were obtained. The whole 160-dbar depth range was covered by nearly half of the 26 profiles, and the total ratio of depth coverage was 81%. Comparison with a current meter record nearby (one mile distance) revealed that the minimum depth achieved did not correlate with the current speed.

The obtained record clearly revealed a seasonal development of the whole water column. While relatively warm water initially remained in the water column, significant freshening occurred and temperature decreased to the freezing point throughout the column from March to April. Then salinity gradually increased to about 35 (150 dbar) in October, successfully covering the whole cycle of sea ice production. The layer near the parking depth (between 120 dbar and 180 dbar) was covered with much higher temporal resolution, showing variations of higher frequencies.

Although the satellite data transmission was not successful due to the battery shortage, signal transmission was successful at the preparation stage. A revision of this platform will enable the monitoring of seasonal ice zone in the polar oceans, to help filling the remaining gap of the global ocean monitoring array.

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