Inflows of offshore-origin warm water toward Totten Ice Shelf region, East Antarctica

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The Antarctic ice sheet is the largest freshwater reservoir on the Earth surface. Mass loss from the Antarctic ice sheet results directly in global sea-level rise and Southern Ocean freshening. Recent observational and modeling studies have demonstrated that ice shelf basal melting, resulting from the inflow of warm water onto the Antarctic continental shelf, plays a key role in the ice sheet’s mass balance. In recent decades, warm ocean-cryosphere interaction in the Amundsen and Bellingshausen Seas (ABS) has received a great deal of attention. In contrast, East Antarctic continental shelves are primarily occupied by “cold waters” (Schmidtko et al., 2014), with ice shelves typically having cold ice cavities. An exception is Totten Ice Shelf (TIS) which experiences the highest basal melt rates in East Antarctica (>10 m/yr) comparable with those for the ABS ice shelves. Although comprehensive hydrographic observations from ice front to continental shelf and slope regions are indispensable for understanding ice-ocean interaction beneath the TIS, so far, the observations in these regions are quite sparse. The only one observation has been done by Australia in January 2015 and has revealed relatively warm, modified CDW inflows into TIS cavity (Rintoul et al., 2016; Silvano et al., 2017).

In this presentation, we show the characteristics of offshore-origin warm water distribution at the TIS ice front and continental slope regions, using the hydrographic data obtained by Icebreaker *Shirase* in March 2018 (59th Japanese Antarctic Research Expedition) and R/V *Kaiyo-maru* in February 2019 (multidisciplinary ecosystem survey in the eastern Indian sector of the Antarctic with a focus on Antarctic krill, Fisheries Agency). The offshore-origin modified Circumpolar Deep Water (mCDW, up to 0.3^{o}C) is found in deep glacial troughs near the TIS ice front, which is ~0.7^{o}C warmer than that observed at the almost same position in January 2015 (Rintoul et al., 2016). This suggests a seasonal or interannual variation in inflowing ocean heat flux into TIS cavity. Along the continental slope, warmer mCDW (>1^{o}C) lies at subsurface layer (~300-500 dbar), and particularly warm cores (1.2-1.4^{o}C) is found around the eastern limb of cyclonic eddies, indicating a possible role of cyclonic eddies on a poleward transport of offshore warm water. Various processes from offshore to ice front regions would consequently result in the variations in the ocean heat flux into TIS cavity (i.e., the magnitude of basal melting) with various time scales.

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