

Interannual variability of sea ice production in the Dalton Polynya and its possible effects on melting of the Totten Glacier

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It was thought that ice shelves in East Antarctica are relatively stable because of colder water on continental shelf than in West Antarctica. However, recent satellite studies suggest that melting of the Totten Glacier in East Antarctica is accelerating. Considering that this glacier area has a potential to raise the global sea level by four meters, evaluation of the change in this glacier area is an urgent issue. By now the cause of acceleration of melting of the Totten Glacier has not been well understood. Sea ice production in the Dalton Polynya upstream of the Totten Glacier can be a factor for the change of the melting, because cold and saline Dense Shelf Water (DSW) formed by the polynya ice production tends to prevent the intrusion of warm water originating from Circumpolar Deep Water. In this study, we examined interannual variabilities of sea ice production in the Dalton Polynya and its relation to those of atmospheric condition and landfast ice. We used daily sea ice production data derived from the satellite microwave radiometers, AMSR-E and AMSR2, using the improved version of thin ice thickness algorithm (Nakata et al., 2019) that can discriminate ice type (active frazil and thin solid ice). As atmospheric data, we used hourly reanalysis data from the ERA5. It is found that sea ice production in the Dalton Polynya significantly decreased after 2011. The average of annual ice production during 2012-2018 is only 65% of the average during 2003-2011. Although this difference is partly due to the bias caused by the difference in the sensor AMSR-E (2003-2011) and AMSR2 (2012-2018), this decrease is likely significant because the decrease rate is largest among all the major Antarctic polynyas except the Mertz Polynya that was directly affected by the glacier calving. If the decreased ice production in the Dalton Polynya is related to the acceleration of melting of the Totten Glacier, the following scenario is proposed: the decrease of cold and saline DSW caused by the decreased ice production facilitate warm water intrusion to the ice shelf cavity, enhancing the melting of the glacier. We also discuss the relationship among the variations of sea ice production, atmospheric condition, and landfast ice.

Keywords: Costal polynya, Fastice, Sea ice production, Totten Glacier