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Unprecedented Strong Modified Warm Deep Water Flow towards Filchner Ronne Ice Shelf in 2017

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Abstract

The Filchner-Ronne Ice Shelf (FRIS), fringing the southern Weddell Sea, plays a key role in the formation of Weddell Sea Deep and Bottom Water, which are precursors of world ocean's AABW. At present, a large continental shelf covered with cold and dense water protects FRIS from intense basal melting. Model studies, however, have suggested the potential for enhanced flow of Modified Warm Deep Water (MWDW) toward and under FRIS via the Filchner Trough, causing a substantial increase in basal melt rates by the end of this century. Mooring time series spanning 2014 to 2016 at 76°S revealed a distinct seasonal cycle in hydrography along the eastern flank of the Filchner Trough with warm inflow occurring only during summer, while winter is dominated by a weakly stratified water column at the surface freezing point. The seasonality is driven by seasonal evolution of the shelf break thermocline in combination with local buoyancy forcing. The mooring time series was extended to 2018 and while the general pattern of the described seasonal cycle is reaffirmed, an unprecedented strong warm inflow with temperatures being about 0.5°C above the previously observed inflow, was observed in 2017. Additionally, bottom temperatures above -1.5°C persisted throughout the whole winter together with a fresh anomaly in salinity. A warm signal was also measured by a LoTUS buoy deployed at 77°C during 2017. Weaker than average along-coast wind stress was present in the upstream region from summer through winter 2017 and likely lead to a stronger shoaling of the shelf break thermocline upstream of Brunt Shelf Ice causing the observed inflow. Likely, MWDW also entered the Brunt Ice Shelf cavity, which lead to enhanced basal melting that, in turn, could explain the observed fresh water anomaly. The inflow event affected the continental shelf hydrography in a favourable way for an earlier onset of warm inflow in the following summer.