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Open-Ocean Polynyas in the Cooperation Sea, Antarctica

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Extensive studies have addressed the characteristics and mechanisms of open-ocean polynyas in the Weddell and Cosmonaut Seas. Here, we show that more persistent open-ocean polynyas occur in the Cooperation Sea (CS) (60°E-90°E), a sector of the Southern Ocean off the Prydz Bay continental shelf, between 2002 and 2019. Polynyas are formed annually mainly within the 62°S-65°S band, as identified by sea ice concentrations less than 0.7. The polynyas usually began to emerge in April and expanded to large sizes during July-October, with sizes often larger than those of the Maud Rise polynya in 2017. The annual maximum size of polynyas ranged from $115.3 \times 10^3 \text{ km}^2$ in 2013 to $312.4 \times 10^3 \text{ km}^2$ in 2010, with an average value of $188.9 \times 10^3 \text{ km}^2$. The Antarctic Circumpolar Current (ACC) travels closer to the continental shelf and brings the upper circumpolar deep water to much higher latitudes in the CS than in most other sectors; cyclonic ocean circulations often develop between the ACC and the Antarctic Slope Current, with many of them being associated with local topographic features and dense water cascading. These oceanic preconditions, along with cyclonic wind forcing in the Antarctic Divergence zone, generated polynyas in the CS. These findings offer a more complete circumpolar view of open-ocean polynyas in the Southern Ocean and have implications for physical, biological, and biogeochemical studies of the Southern Ocean. Future efforts should be particularly devoted to more extensively observing the ocean circulation to understand the variability of open-ocean polynyas in the CS.