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The role of polynyas on the atmospheric budget of methane

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Coastal polynyas are areas of anomalous open water and thin ice in regions that are otherwise covered by sea ice. They frequently occur around the Antarctic continent in response to strong offshore katabatic wind stresses. The loss of heat from the open ocean to the cold atmosphere can enormously enhance rates of ice production. In polynya areas, the coupling between the atmosphere, sea ice and ocean is complex, and the role of ice formation on the budget of the main climate forcing carbon gases remains unknown. During the PIPERS expedition on the N.B. Palmer from April to June 2017, we performed continuous measurements of methane concentrations in the atmosphere and in the surface water from New Zealand to the polynyas of the Ross Sea. Discrete sampling was carried out in parallel to calibrate the continuous systems and to later measure the stable isotope ratios of both gases in the water, in the ice and in the air. The stable isotope data enable unravelling the pathways involved in gas formation and removal. While the concentrations of both gases were relatively low in the surface waters of polynyas, the preliminary atmospheric data show higher methane levels in the atmosphere at locations where sea ice formation was most intense. These data together with the isotopic ratios of both gases, with biogeochemical proxies and with meteorological data allow unravelling the role of sea ice formation on the exchange of methane between the polar ocean and the atmosphere.