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Climate-sensitive Carbon Cycling Adjacent to a Melting Ice Shelf in West Antarctica

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Abstract Text:

The Amundsen Sea hosts one of the most productive polynyas in all of Antarctica, with a peak atmospheric carbon dioxide (CO2) flux density previously estimated to be 10x higher than the Southern Ocean average (Mu et al., 2014). The region is vulnerable to climate change, experiencing rapid losses in sea ice, a changing icescape, and some of the fastest melting glaciers flowing from the West Antarctic Ice Sheet, a process being studied by the International Thwaites Glacier Collaboration (ITGC). Although the Amundsen Sea Polynya has been explored by multiple international expeditions and shown to be a significant carbon sink, the biogeochemical composition of the outflow from the glaciers surrounding the Amundsen Sea and the potentially important role of the coastal current have been largely unstudied beyond models. In collaboration with a UK-based physical oceanographic program (ITGC TARSAN), the ARTEMIS project (NBP22-02) collected shipboard seawater samples for the carbonate system, macro- and micronutrients, organic matter, and microorganisms to gather data needed to understand the impact of the melting ice sheet on both the coastal ecosystem and the regional carbon cycle. ARTEMIS sampled later season conditions (January to March) for the first time, yet depletion of inorganic nitrogen was not observed. The open waters of the polynya were rich in algal biomass and highly undersaturated (< 200 μatm) with CO2. The coastal current nearer to the ice shelf exhibited a greater range of conditions, with low fluorescence and supersaturated CO2 observed at the surface in some but not all areas. Observations of heavy phytodetritus on the seafloor beneath both the central polynya and the coastal current confirm organic carbon export to as deep as 1000 m. Here, we report estimates of net community production within the polynya and along the coastal current and compare these data to estimates made during earlier-season expeditions (e.g., NPB 10-05; ASPIRE; December-January).