The Marine Icescape as Modulator of Ocean-Ice Shelf Interactions

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The Amundsen Sea Embayment (ASE), known for its thinning ice shelves and accelerated glacial losses, is also distinguished by the seasonally active Pine Island and Amundsen Sea polynyas. These two polynyas are separated and heavily influenced by the Thwaites Glacier Tongue and its northward extension of icebergs cemented together by fast ice. This partially grounded northward ice obstruction is a physical barrier to both surface air-sea interactions and to ocean and sea ice circulation. While it has been shown that the marine icescape (inclusive of seasonal and multiyear sea ice, fast ice, and grounded and drifting icebergs) plays an important buttressing role in the stability of Antarctic ice shelves, here we investigate how the marine icescape in the ASE might also modulate ocean circulation and ocean heat delivery to ice shelf cavities. In this presentation, we combine satellite observations of sea ice, ocean observations (including oxygen isotopes) from the ASE, and output from a regional 3D sea ice-ice shelves-ocean model to investigate the role of icebergs, ice tongues, fast ice, and seasonal sea ice in modulating ocean-ice shelf interactions. Our results reveal that future changes in the coastal icescape are unlikely to reverse the high ice shelf melting rates of the Amundsen Sea, but instead – and at least for the icescape changes observed between 2011-2022 -- melt rates were slightly enhanced. Our results also reveal that variability in sea ice production in the ASE can contribute to onshelf variability in ocean heat content (and thus ice shelf melting rates), where years of high (low) sea ice production are associated with low (high) onshelf ocean heat content. How these local onshelf processes associated with changes in the marine icescape compare to non-local drivers of ocean heat supply will be addressed in a future study.