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The triggers for Conger Ice Shelf demise: long-term weakening vs. short-term collapse

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Ice shelf instability is a key uncertainty in future sea level rise projections, as several small-scale processes leading to ice shelf collapse remain poorly quantified. Historical large scale ice shelf collapses, like the Conger Ice Shelf collapse in March 2022, therefore, provide unique insights in the processes leading to ice shelf instability.

In this study, we assess the long- and short-term changes on Conger Ice Shelf in historical satellite records (Landsat, Sentinel, MODIS, ICESat) and model output of ocean and climate conditions (HYCOM, RACMO, IMAU-FDM and ERA-5). Based on both observations and model output we determine the role of known ice shelf instability processes like hydrofracturing, basal melting and damage changes. Moreover, we evaluate the role of extreme weather and ocean conditions in the sudden Conger Ice Shelf collapse.

The longer satellite record shows that Conger Ice Shelf has been weakening for years and then collapsed in two abrupt events (2 and 15 of March 2022). The long-term weakening is the result of damage processes and calving events due to extreme ocean/weather conditions that gradually abate the ice shelf. The abrupt Conger Ice Shelf collapse, however, coincides with extreme atmospheric and ocean conditions (e.g., ocean slope and wave conditions) that trigger the weakened ice shelf into a sudden collapse. Our results show that the known ice shelf instability processes like hydrofracturing and basal melting do not play a key role in the abrupt Conger Ice Shelf collapse, but that gradual weakening followed by extreme weather and ocean conditions triggered the ice shelf collapse.

Our results stress the importance of separating ice shelf weakening from ice shelf collapse in studies of ice shelf stability. Moreover, they imply that extreme weather and oceanic conditions need to be to considered when assessing the future vulnerability of Antarctic ice shelves to collapse.