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Investigating the drivers of abrupt Antarctic sea ice decline

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Antarctic sea ice cover experienced an abrupt decline in 2016, transitioning from a record maximum state to a record minimum state. However, the drivers of this rapid retreat are currently not well understood. Therefore, it is difficult to determine whether this signals the start of a long term melting trend, as has been long anticipated by climate models, or is an isolated episode of internal climate variability. In this study, we utilise the CMIP6 archive to understand if internal climate variability could be responsible for this Antarctic sea ice anomaly, and if so what the primary atmospheric and oceanic drivers are. This involves examining composites of the tropical teleconnections, subsurface ocean heat content, and high latitude atmospheric variability preceding extreme Antarctic sea ice anomalies in CMIP6 simulations. The primary objective is to elucidate the multifaceted factors influencing these extreme events, specifically addressing the 2016-2017 sea ice retreat, with lessons for 2023's extreme Antarctic sea ice state. Initial results indicate that such events are possible in the absence of anthropogenic emissions in some climate models, although the occurrences are considered rare. We also show that that using the limited observed record alone will underestimate the interannual variability of the Antarctic sea ice cover and therefore overestimate how rare such an anomaly would be. In fact, if we extend the observed record further back using statistical reconstructions, rapid declines of sea ice extent occurred in the early and mid 20th century. Our results highlight the importance of internal climate variability in the Southern high latitudes and advance our understanding of the drivers and predictability of Antarctic sea ice changes. We discuss the implications of this work for 2023's record Antarctic sea ice anomaly.