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Variability of the Amundsen Sea Low and the Associated Regional Sea Ice Trends in the AO-UMUKCA Model

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Significant Sea ice loss in the Amundsen and Bellingshausen Seas, and regional warming in West Antarctica and the Antarctica Peninsula have been observed over the past few decades. These changes are affected by the presence of the Amundsen Sea Low (ASL), a quasi-stationary area of climatological low pressure that exists over the South Pacific sector of the Southern Ocean between the Antarctic Peninsula and the Ross Sea.
Previous studies have shown that the circulation in the ASL sector region is strongly influenced by large-scale patterns of atmospheric variability, such as the southern annular mode (SAM) and El Nino Southern Oscillation (ENSO). Studies have also demonstrated a deepening of the ASL, particularly in austral spring and to a lesser extent autumn, the former related to decreases in the underlying cyclone central pressures and the latter previously suggested as due to stratospheric ozone depletion. However, two recent studies have demonstrated that surface warming related to the Atlantic Multidecadal Oscillation (AMO) reduces the surface pressure in the Amundsen Sea and contributes to the observed dipole-like sea-ice redistribution between the Ross and Amundsen–Bellingshausen seas and to the Antarctic Peninsula warming.
We use the recently developed atmosphere-ocean chemistry-climate model AO-UMUKCA to investigate factors affecting the variability of the ASL and subsequently sea ice trends in the Amundsen-Bellingshausen seas. We use output from two simulations, a pre-industrial control integration forced with 1850s climate, and a time slice integration forced with 2000s climate.
The control integration is used to estimate the internal variability of ASL, and in calculating the modeled sea ice trends in absence of external forcing. We investigate whether changes in the ASL, and subsequently sea ice trends are linked to variability in tropical sea surface temperatures. The different combinations of SAM-ENSO phase are also studied and linked to changes in the ASL.