

Oceanography Seminar

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“Deep Breaths of the Southern Ocean”

Satellite microwave observations of Antarctic sea ice started in 1973, just in time to capture a massive open water area enclosed in winter sea ice, known as a polynya, within the Weddell Sea. This polynya was roughly the size of the United Kingdom and it lasted thru the winters of 1974-1976 with mixed layer depths >3000m observed in its vicinity. A similar Weddell Sea polynya hasn't been seen since. However, September 2017 satellite observations indicate that a new Weddell Sea polynya may be starting to form. This first aim of this research is to determine the impact (magnitude and duration) of the 1970s polynya on ocean carbon, biology, temperature, and volume transports. Secondly, how will the formation of a new large polynya in 2018 impact 21st century climate projections? We address these questions with a coupled ocean (MOM5), sea-ice (SIS), biogeochemistry (WOMBAT) model at $\frac{1}{4}^\circ$ resolution with 50 vertical levels. In the model, we create a polynyas of similar size and duration as observed in the 1970s with a small wind perturbation localised over Maude Rise in 1973 and 2017. We find that most of the observed warming trend of AABW and the slowdown of the lower cell of the Southern Ocean overturning since the 1980s can be attributed to the multi-decadal recovery from the 1970s Weddell Sea polynya event. The polynya also increases oxygen concentrations by 50% and the ocean-to-atmosphere carbon flux by >200% in the Atlantic sector of the Southern Ocean. In essence, the Southern Ocean breathed deeply from 1974-1976, and has been holding its breath since. If the Southern Ocean starts breathing deeply again in the winter of 2018, the climate impacts will be pronounced and last for decades to come.

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