

REGIONAL POLYNYA-BIOGEOCHEMICAL CONNECTIONS IN COASTAL ANTARCTICA

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Motivation

The Southern Ocean is experiencing rapid change at the same time as it is becoming a frontier for fisheries. Marine Protected Areas (MPA; Fig. 1) have been adopted or proposed around Antarctica to protect vulnerable ecosystems. Coastal polynyas are areas of high ice production and also serve as a location where biology may thrive. **We seek to better understand the ecological importance of coastal polynyas and how the physical and biological systems may change in the future.**

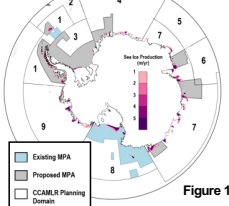


Figure 1

Methods

- Satellite observations of sea ice concentration from SSM/I CDR product (1979-2021).
- Coupled ocean-sea ice-ecosystem hindcast forced with JRA55 reanalysis (1958-2021).
 - The MARBL ecosystem model (Fig.2) simulates four phytoplankton and two zooplankton types. Higher trophic level connections are not simulated directly.

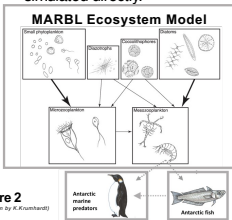


Figure 2 (Illustration by M. Frankfort)

- Developed polynya identification algorithm (Fig. 3) that is reproducible, verifiable, and applicable to gridded data

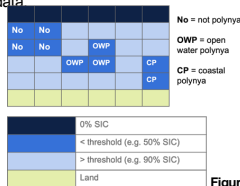
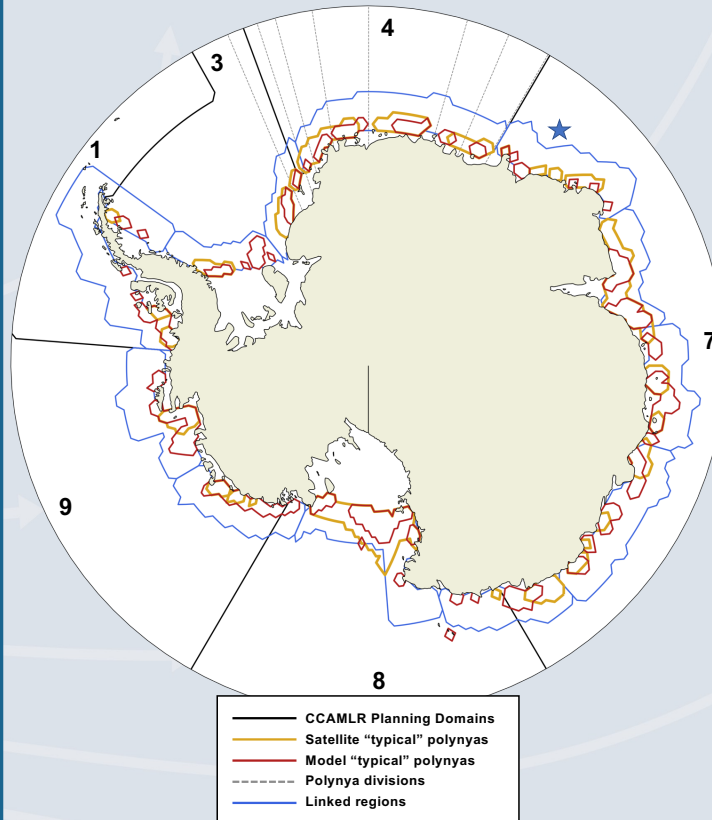


Figure 3 (Diagram by L. Landrum)

Can we group coastal polynyas based on linkages in physical or biological conditions over time?



"Typical" polynyas

- Identified regions that were identified as a polynya more than 10% of the year on average.
- In satellite data, used 85% concentration threshold. In model hindcast, used 0.4m thickness threshold.

Are polynya regions linked?

- Goal: to identify which polynyas may be linked physically and/or biologically.
- Separated 32 individual polynyas based on "typical" satellite identification and calculated covariance of polynya area and coastal net primary productivity in those regions to guide grouping (Fig.4).

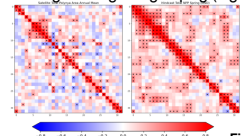


Figure 4

How are polynyas and biology changing over time in different regions?

- Look at how the polynyas and net primary productivity evolve in different regions over time (Fig.5)

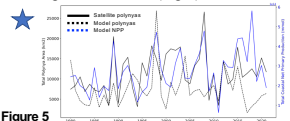
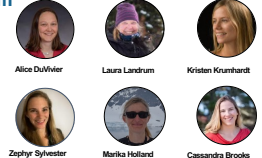


Figure 5

- Future work: expand to future climate projections of biological and physical system using the Community Earth System Model Version 2 Large Ensemble (CESM2-LE).

Team



Talk to me to learn more about the biogeophysical connections and what the implications may be!

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