Sea Ice as a Source of Predictability for Ecological Forecasting Applications

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A New Arctic and an Emerging Need for Sea Ice Predictions



- Decline in Arctic sea ice extent over the satellite era has motivated a need for seasonal sea ice predictions.
- Sea ice predictions are needed by: northern communities, shipping industries, fisheries, ecotourism, oil and gas industries, scientific logistics, wildlife management.
- Sea ice predictability research suggests that sea ice is potentially predictable on the seasonal-to-interannual timescale.

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Fisheries Management

- Bering Sea Pollock and Cod stocks tend to follow the position of the winter sea ice edge.
- Predicting the sea ice edge position months to years in advance would provide useful information for fisheries management.

Spring and Summer Phytoplankton Blooms

- Sea ice limits sunlight entering the upper ocean in spring/summer; limits phytoplankton blooms under ice, and modulates the timing of blooms in seasonal ice zones.
- Recent thinning and increased melt pond coverage on ice has led to more frequent favorable conditions for sub-ice blooms.
- Predicting the timing of ice retreat may provide predictability for the timing of the spring bloom; predicting ice thickness and albedo would provide predictability for sub-ice summer blooms.

• Sea Ice as a Habitat

- Many species depend on sea ice as a habitat (e.g. bowhead whales, seals, walruses, polar bears).
- Predicting sea ice conditions could allow for more effective conservation and wildlife management.



Wyllie-Echeverria and Wooster (1998), Fish. Oceanog.





George et al. (2020), Arctic Report Card

Potential to Leverage Sea Ice Based Predictability along U.S. Coastlines

- Leveraging sea ice predictability relevant for predictions in the Bering Sea (8), Chukchi Sea (7), and Beaufort Sea (10).
- Different mechanisms of sea ice predictability in different regions and seasons.
- Sea ice predictability is a function of spatial scale – smaller scales are more susceptible to atmospheric forcing, and therefore less predictable.
- Most sea ice prediction systems are based on coarse resolution global models. These may not be 'fit-forpurpose' for many coastal applications.
- Sea ice data assimilation is a maturing field. Assimilating sea ice and ocean observations may allow for skillful initialization of biogeochemical variables (e.g. Park et al. (2019), Science).



Mechanisms of Arctic Sea Ice Predictability

- Recorded talk from Ocean Sciences Meeting (apologies for not being able to present today 😕).
- Idea: use dynamical prediction systems to understand the mechanisms of sea ice predictability.
- Notes
 - This talk focuses on summer predictions in the Laptev and East Siberian Seas. The same mechanisms are relevant for summer sea ice predictions in the Beaufort Sea.
 - This talk focuses on winter predictions in the Labrador and Barents Seas. The same mechanisms are relevant for winter sea ice predictions in the Bering Sea.
 - Other relevant mechanisms, not mentioned in the talk, are teleconnections associated with large-scale modes of climate variability (ENSO, NPGO, PDO).
- This talk focuses on physical variables. I look forward to learning more about potential synergies with the biogeochemical forecasting, modeling, and data assimilation communities.
- Talk link: <u>https://www.youtube.com/watch?v=M3ypY9vPRpQ</u>