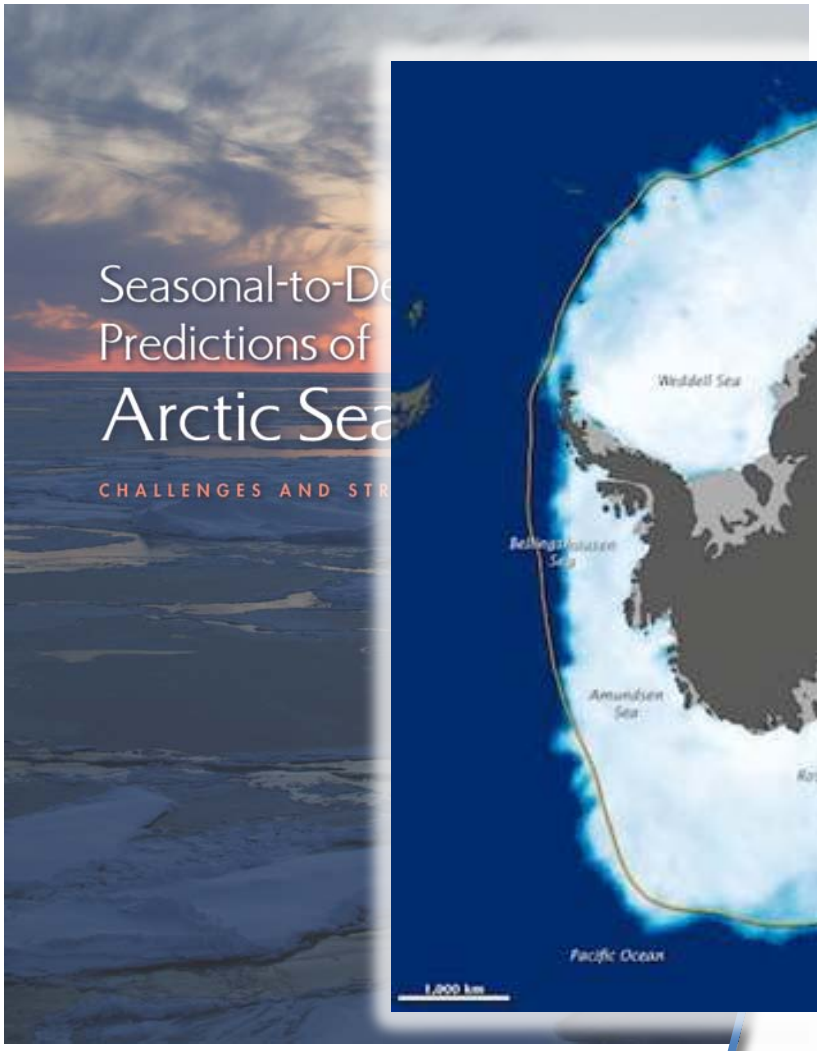
Initial Value Predictability of Antarctic Sea Ice

Marika Holland

National Center for Atmospheric Research

Collaborators: Ed Blanchard-Wrigglesworth (U. WA), Jennifer Kay (NCAR), Steve Vavrus (U.WI)

NCAR is sponsored by the National Science Foundation



?

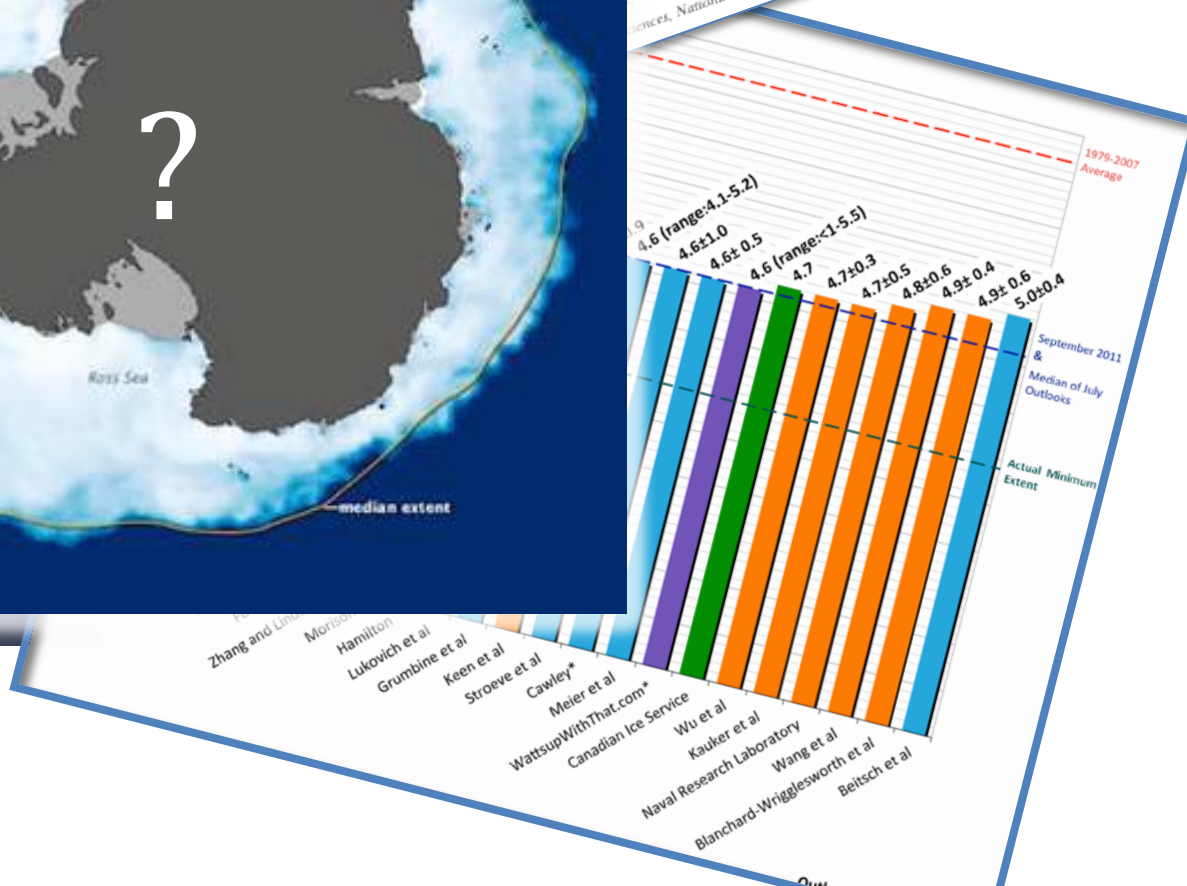
231

RTH ET AL.

f Arctic Sea Ice in a GCM Ensemble
vations

KYLE C. ARMOUR, AND CECILIA M. BITZ
iversity of Washington, Seattle, Washington

DEWEAVER
nces, National Science Foundation, Arlington, Virginia



THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

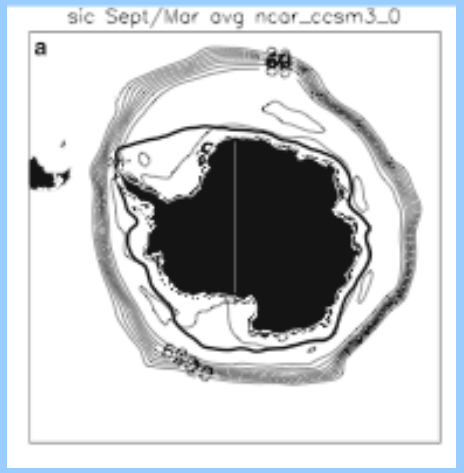
Seasonal-Interannual Sea Ice Predictability

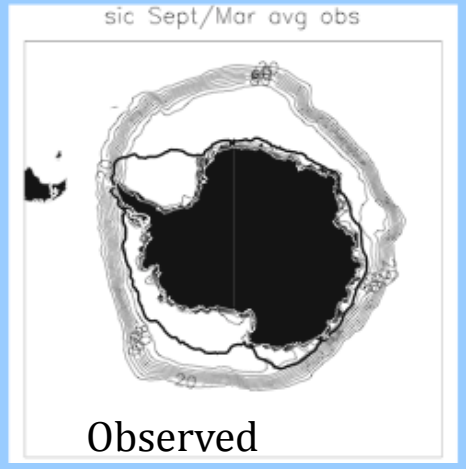
- What is the inherent predictability sea ice?
- What factors contribute to predictability/influence loss of predictability?

- Model experiments:
  - 20 member ensembles of CCSM3 with same initial ice-ocean-land state/slight change in initial atmospheric state
  - Run for 2 years
  - Initialized with 1970 conditions from a standard CCSM3 20th century simulation

Same simulations were assessed for Arctic predictability

(Holland et al., submitted)

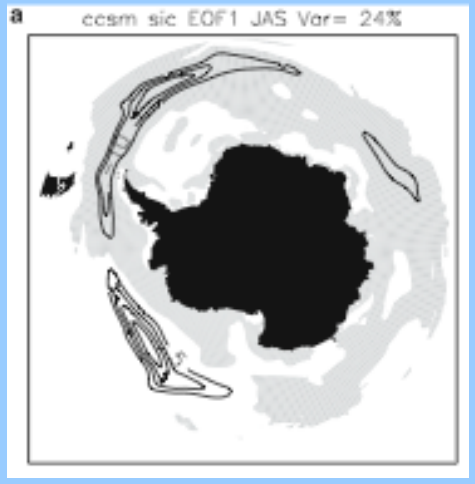


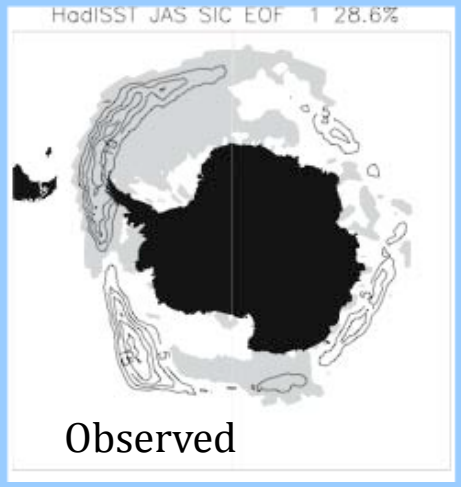


Observed

Mean State: Ice too extensive

1st EOF of Ice Concentration



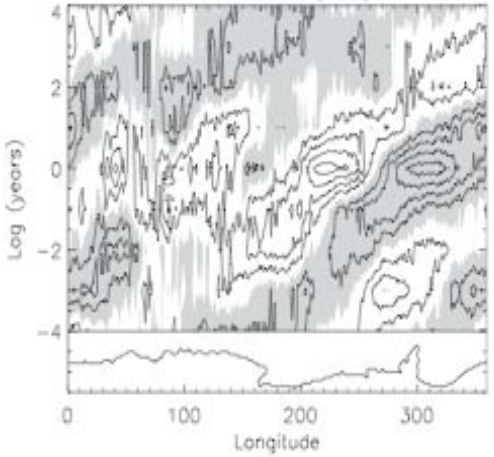


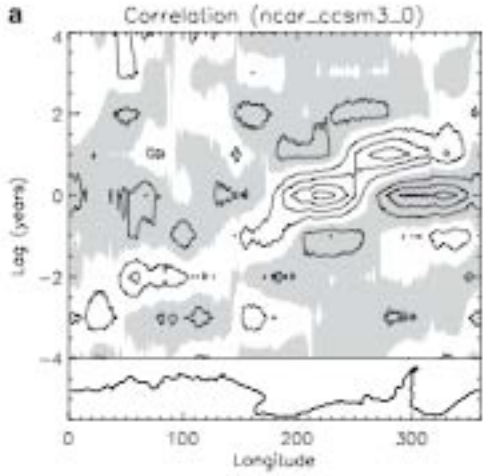
Observed

Variability: Reasonable

CCSM3 Results

Observed





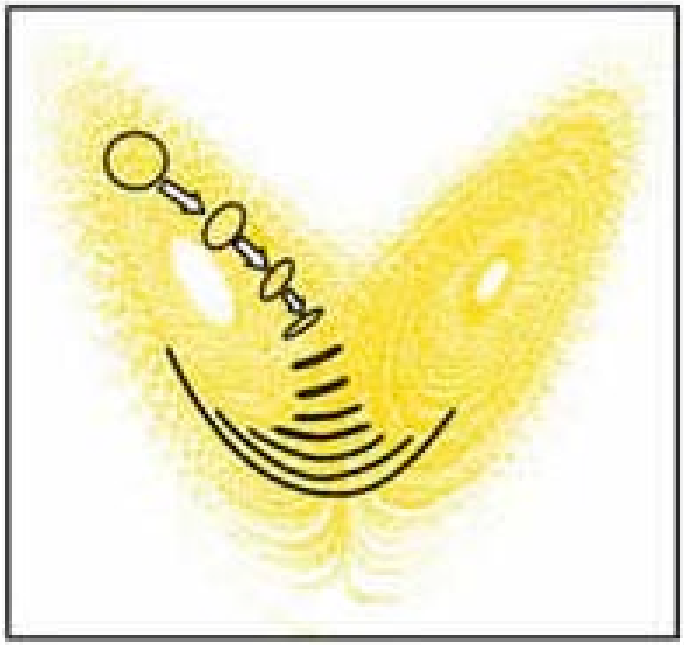
Eastward propagation of ice anomalies

Marika M. Holland · Marilyn N. Raphael

Twentieth century simulation of the southern hemisphere climate in coupled models. Part II: sea ice conditions and variability

Climate Dynamics (2006) 26: 229–245
DOI 10.1007/s00382-005-0087-3

Assessing Predictability

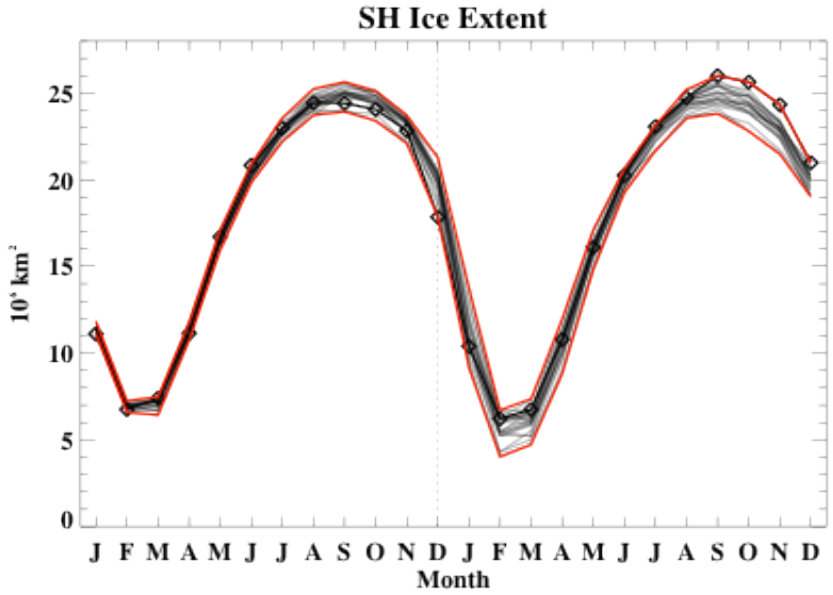


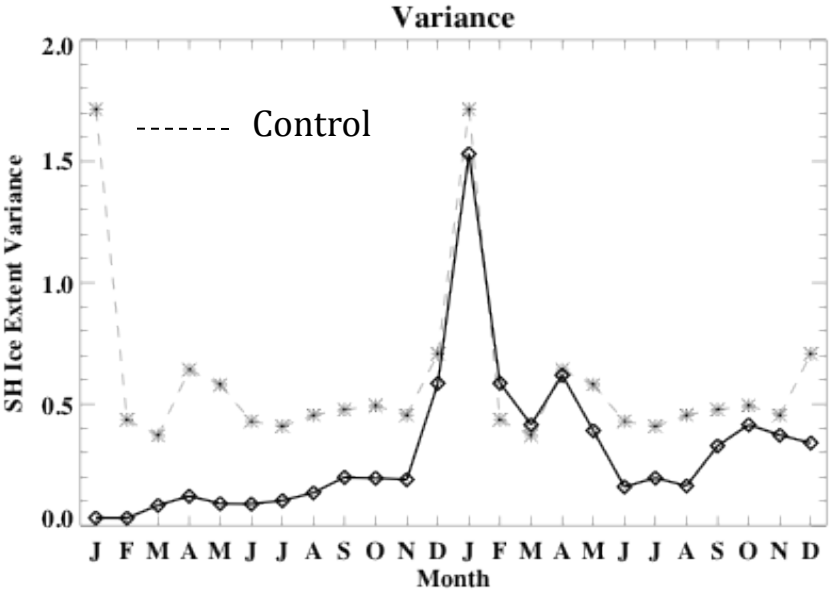
- Examine how ensemble members diverge over time
- Compare to the natural variability of the system
- When these are indistinguishable, predictability is lost

Potential Prognostic Predictability

- PPP = $1-\sigma^2_t(\text{ens})/\sigma^2(\text{cont})$

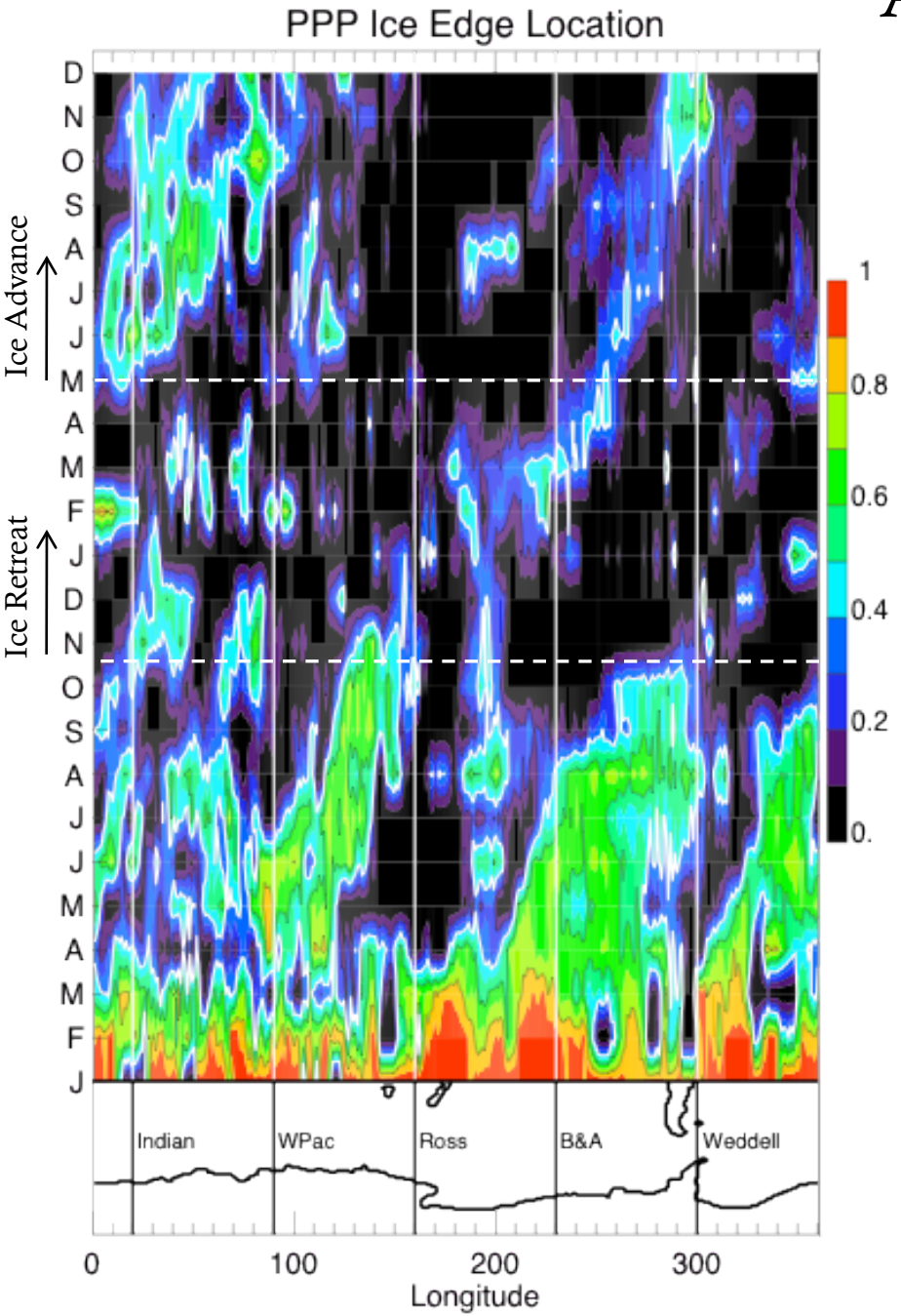
Assessing Predictability

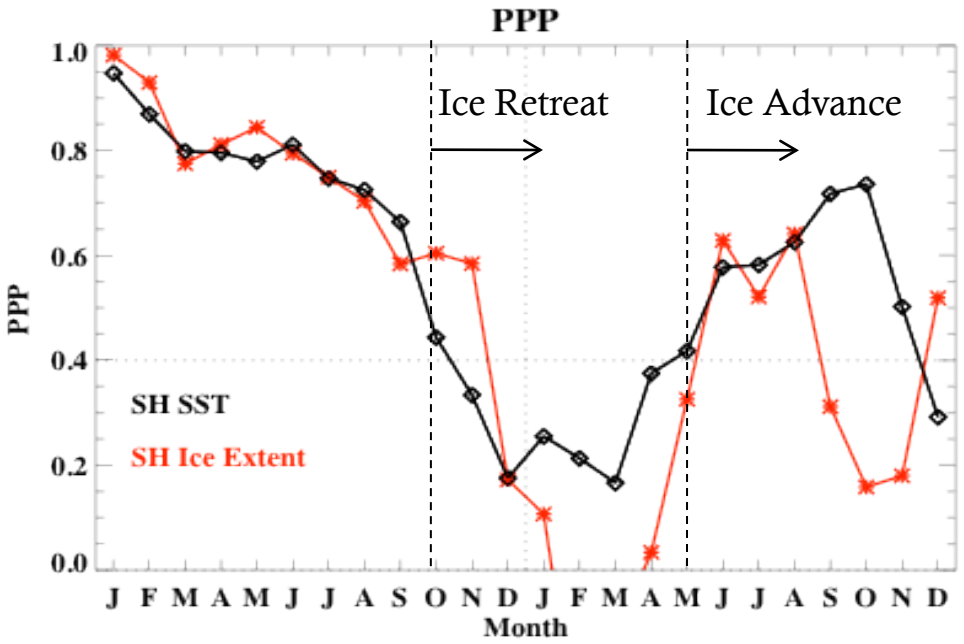




- Examine how ensemble members diverge over time
- Compare to the natural variability of the system
- When these are indistinguishable, predictability is lost

Antarctic Sea Ice Predictability

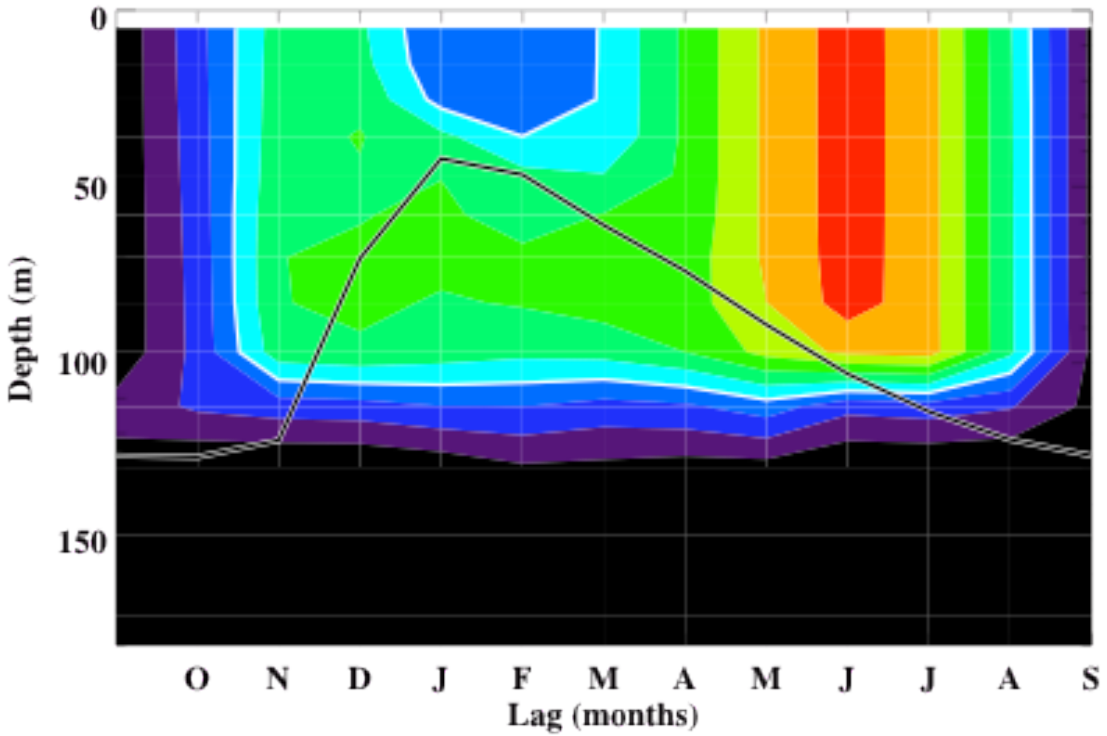




- Ice extent predictability negligible during the ice retreat season
- Predictability returns during ice advance
- Predictability of ice edge location has an eastward propagating signal

Holland et al., submitted

Antarctic Predictability



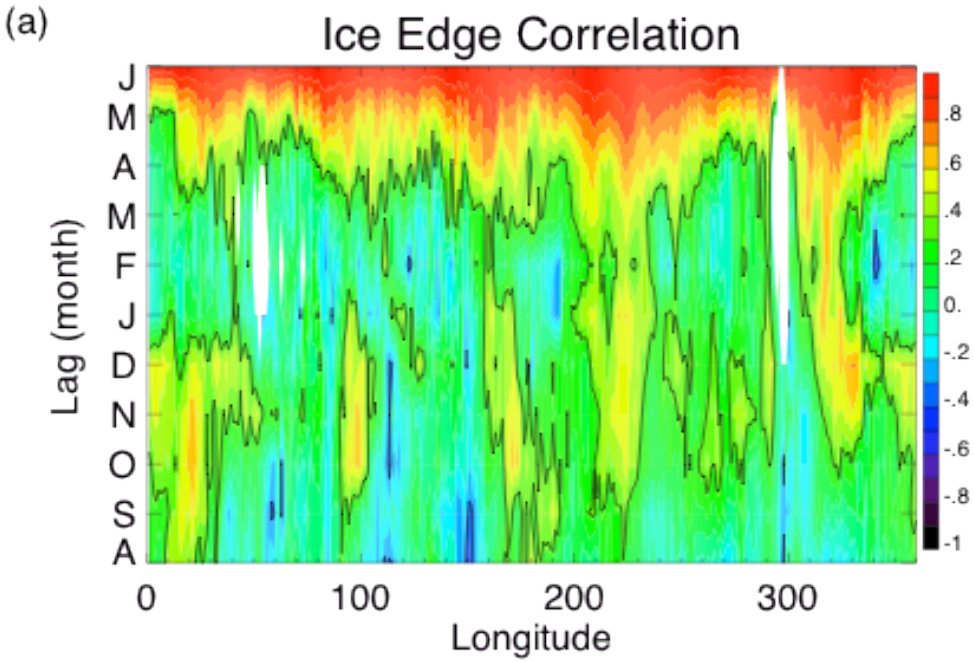
Correlation of June SST with temperature at different months/depths

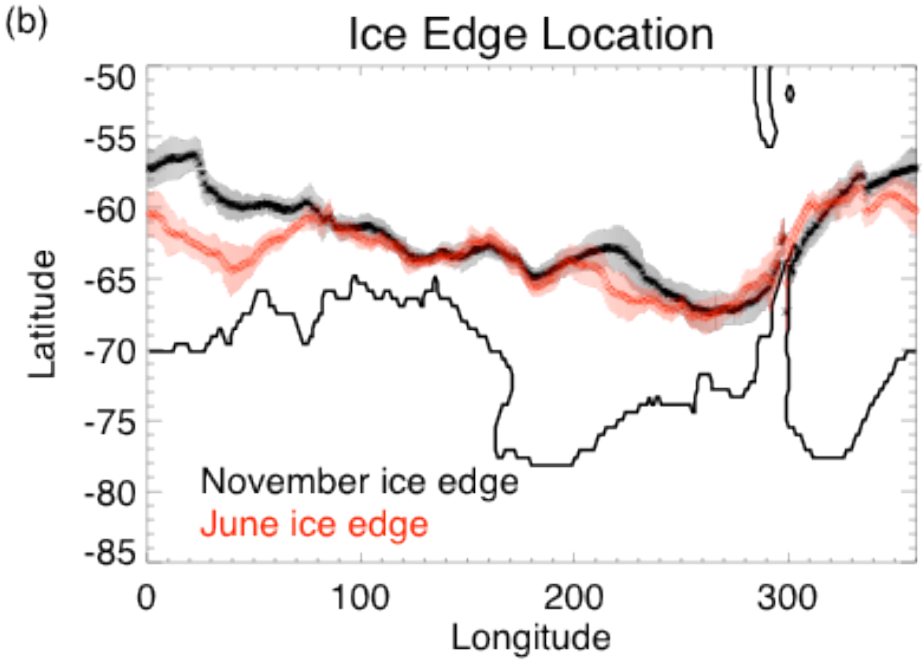
Correlations from control integrations suggest ocean temperature reemergence plays a role in ice predictability

Mechanism does not occur consistently around Antarctica

Holland et al., submitted

Antarctic Predictability





Observational analysis: Supports the presence of "re-emergence" of predictability

Ice edge location anomalies in June correlated to previous November

Holland et al., submitted

Summary/Conclusions

- From simulations initialized on January 1: Antarctic sea ice exhibits
  - Initial predictability (for ~9 months) with an eastward propagating component
  - A loss of predictability over the ice retreat season
  - A re-emergence of predictability in winter – associated with ocean heat content "memory"
  - Lagged correlations from observations seem to support this
- Compared to Arctic predictability characteristics
  - Similar winter predictability re-emergence
  - But Arctic sea ice exhibits predictability in summer associated with ice thickness "memory"

Future Work

- Are predictability characteristics modified in high-resolution simulations?
- Are they robust across different CESM model versions?
- How are they influenced by biases in the mean ice conditions?