Initial Value Predictability of Antarctic Sea Ice

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Seasonal-Interannual Sea Ice Predictability

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

Model experiments:
- 20 member ensembles of CCSM3 with the 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)
Mean State: Ice too extensive

1st EOF of Ice Concentration

Variability: Reasonable

CCSM3 Results

Eastward propagation of ice anomalies
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
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?