On North American Decadal Climate for 2011-2020

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Factors Relevant for North American Decadal Climate Predictability

1. Sensitivity to external radiative forcing

2. Sensitivity to sea surface temperature/sea ice variation that are internal to the system

3. Contribution from atmospheric internal variability to decadal means
Methods for Predicting Decadal Climate

- **Uninitialized CGCM methods** → *driven by specified evolving, or current committed, external forcing (CMIP3/CMIP5)*

- **Initialized CGCM methods** → *various initialization procedures (CMIP5)*

- **Empirical methods** → *persistence; extrapolation of observed trends and/or decadal modes*

- **Hybrid Empirical/AGCM methods** → *GCMs driven by specified surface boundary forcing using scenario-based predictions of SST/sea ice.*
Deriving the SST Scenarios for 2011-2020

• Method of temporal optimal detection (Ribes et al. 2010) applied to observational data → temporal patterns of sfcT are derived from CMIP3 simulations for 1900-2020, and the observed SSTs are regressed upon the ensemble temporal pattern to derive the 2011-2020 SST anomaly.

• Observationally-driven scenarios → NOAA ERSST and Hurrell SST for 1900-2009

• CMIP3 SST projections for 2011-2020 → ensemble average SST anomaly from A1B scenario runs of 22 different CMIP3 models
Sea Surface Temperature Anomaly Scenarios
2011–2020
Experimental Design for our 2011-2020 Outlooks

° Atmospheric GCMs forced by specified 2011-2020 decadal mean SST/sea ice anomaly scenarios → 3 different SST & one sea ice scenario.
° Multi-model approach using 3 different AGCMs → same models for which 20th Century AMIP simulations are also available.
° 50-yr integrations → time slice experiments for the impact of 2011-2020 surface boundary condition forcings

For the atmosphere it is only the SST that matters!!
Multi-Model Response to SST/Sea Ice Scenario

2011-2020

PCPN

% of Climatology

TEMP

Degrees Celsius
Factors Relevant for North American Decadal Climate Predictability

1. Sensitivity to external radiative forcing (e.g., what might be different SST scenarios for next decade)

2. Sensitivity to sea surface temperature/sea ice variation (i.e., different SST trajectories due to internal variability, and their atmospheric response)

3. Contribution from atmospheric internal variability to decadal means
Factors Relevant for North American Decadal Climate Predictability

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Conclusions

° A hybrid empirical/AGCM method for predicting 2011-2020 North American decadal climate has a merit given that:
  
  I. Much of the external radiative forcing of NA decadal climate is physically linked to the SST/sea ice response to that forcing.
  
  II. Removes the potentially negative impact of the substantial biases in SST climatologies occurring in coupled model (Shin and Sardeshmukh 2010).
  
  III. Facilitates diagnosis of the factors affecting predictability.

° Outlook for 2011-2020 North American climate, constrained by scenarios of the changes in SST/sea ice resulting from AG forcing, show:

  I. Widespread warming of the continent (+0.5 C relative to 1971-00)
  
  II. Increased precipitation over Canada/Alaska (+4% of climo)
  
  III. Decreased precipitation over the contiguous US (-2% of climo)

° A probabilistic outlook was generated by convolving the impact of the scenarios of SST/sea ice change with the statistical impact of natural decadal SST/sea ice variability during the 20th Century.