On North American Decadal Climate for 2011-2020

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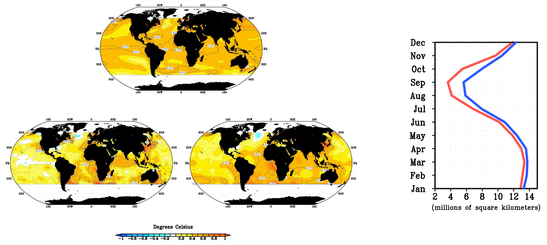
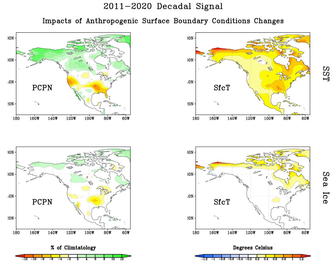
2011-2020 Scenarios for Anthropogentic Change in Ocean Boundary Conditions



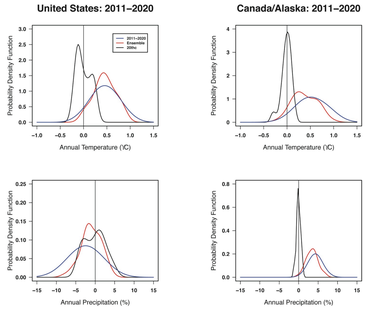
Left: Three scenarios for the 2011-2020 change in SSTs (relative to 1971-2000). Top: Derived from CMIP3 simulations. Bottom: Derived from observations using the method of Temporal Optimal Detection (Ribes et al. 2010) applied to two different SST data sets. Right: Sea ice scenario based on persisting 2007-09 concentrations (red curve), as compared to 1971-2000 climate (blue curve).

2011-2020 Anthropogenic Boundary Forced Decadal Signal



North American precipitation (left) and surface air temperature (right) anomalies based on specifying our scenarios for anthropogenic changes in SSTs (top) and sea ice (bottom) in three different atmospheric GCMs. Shown are 15-member, 3-model ensemble average decadal anomalies computed with respect to each AGCM's 1971-2000 climatology. The SST-forced responses are the average of AGCM runs subjected to each of the 3 separate SST scenarios.

2011-2020 Decadal Signal and Decadal Noise



Probability distributions for contiguous US (left) and Canada/Alaska (right) surface air temperature (top) and precipitation (bottom) anomalies. Red PDF is 10-yr averaged anomalies generated by AGCMs forced by scenarios of 2011-2020 anthropogenic SST changes. Black PDFs are 10-yr averaged anomalies forced by internal decadal SST variability. This is derived from the analysis of detrended AMIP simulations of the 20th Century. Blue PDFs are the probability forecasts for 2011-2020 that combine decadal signals due to impacts of anthropogenic SST and sea ice changes with the internally generated decadal variability.

PREDICTANDS	2011-2020 DECADAL SIGNAL	2011-2020 FORECAST STD DEV	5% - 95% CONFIDENCE	INTERNAL DECADAL SST STD DEV	ATM NOISE STD DEV
US TMP	+0.48°C	0.27°C	-0.02/+0.93°C	0.15°C	0.15°C
CANADA TMP	+0.49°C	0.28°C	+0.09/+0.98°C	0.11°C	0.13°C
US PPT	-2.1%	3.6%	-8.3/+3.4%	2.7%	2.4%
CANADA PPT	+4.1%	1.6%	+1.8/+7.1%	0.5%	0.7%

Quantification of Decadal Signal and Noise: Our diagnosis of decadal signal and noise for U.S.and Canadian climate indicates a high predictability for 2011-2020 surface air temperature and for Canadian precipitation---the anthropogenic boundary forced signals are found to be appreciably greater than the internal variability. By contrast, we find internal decadal variability of precipitation to be greater than the amplitude of the anthropogenic precipitation signal over the US. Our results suggest that initialized decadal predictions, which seek to forecast both externally-forced signals and the internal variability, would be important for rendering skillful forecasts where the external signal is small compared to internal variability, such as for US decadal precipitation.

Purpose: We apply a signal-to-noise approach to North American decadal variability to understand decadal predictability. The "decadal signal" denotes the surface boundary constrained forced response resulting from impacts of anthropogenic changes in SST/sea ice conditions. The "decadal noise" denotes the internally generated decadal variability of the natural coupled system. As a particular illustration of this component analysis of decadal variability, we construct a 2011-2020 North American T and P probabilistic forecast that quantifies signal, the internal variability, and overall uncertainty.