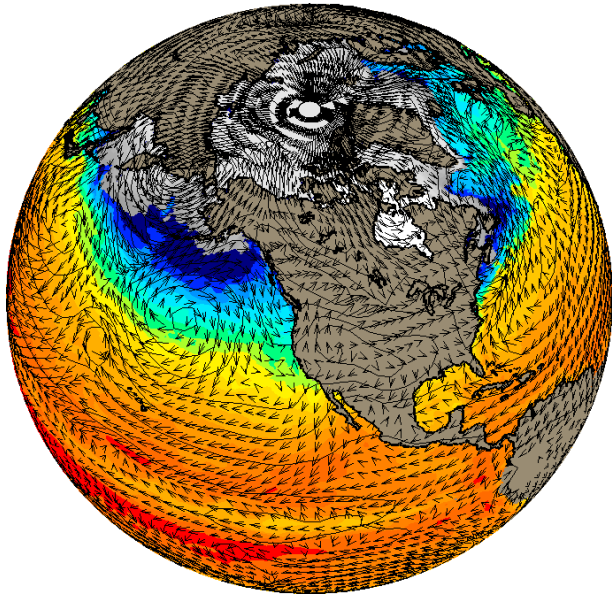


Decadal prediction in the Pacific

Gerald A. Meehl and Aixue Hu

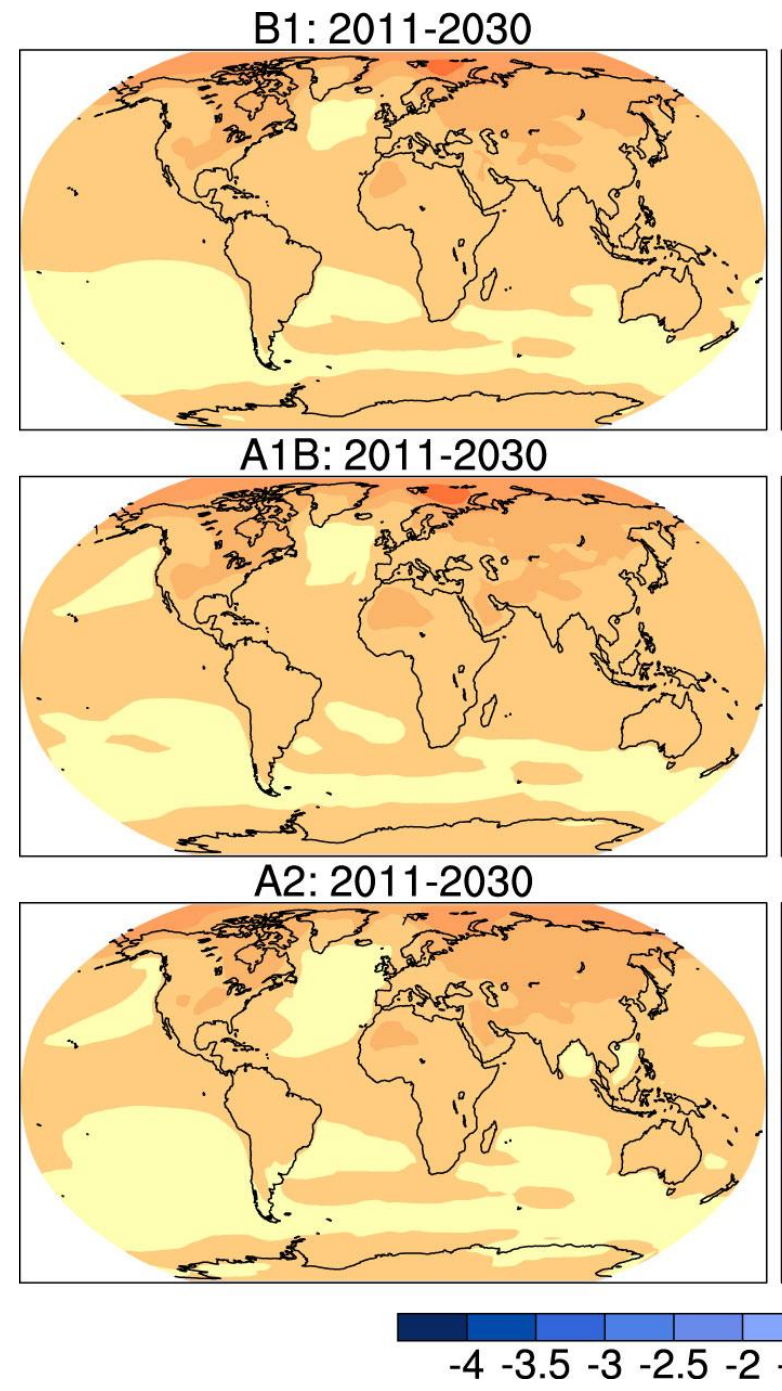


NCAR

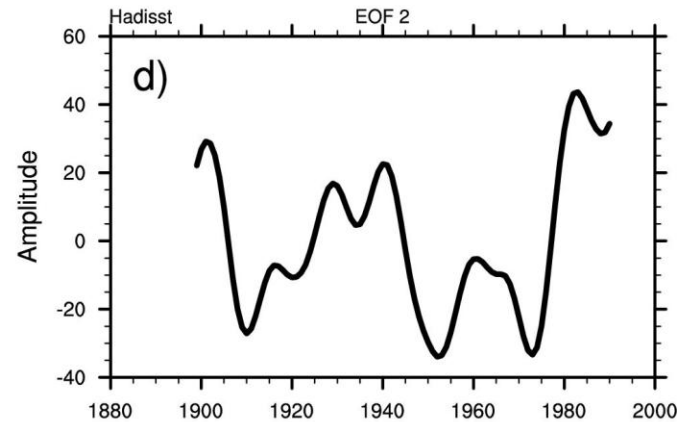
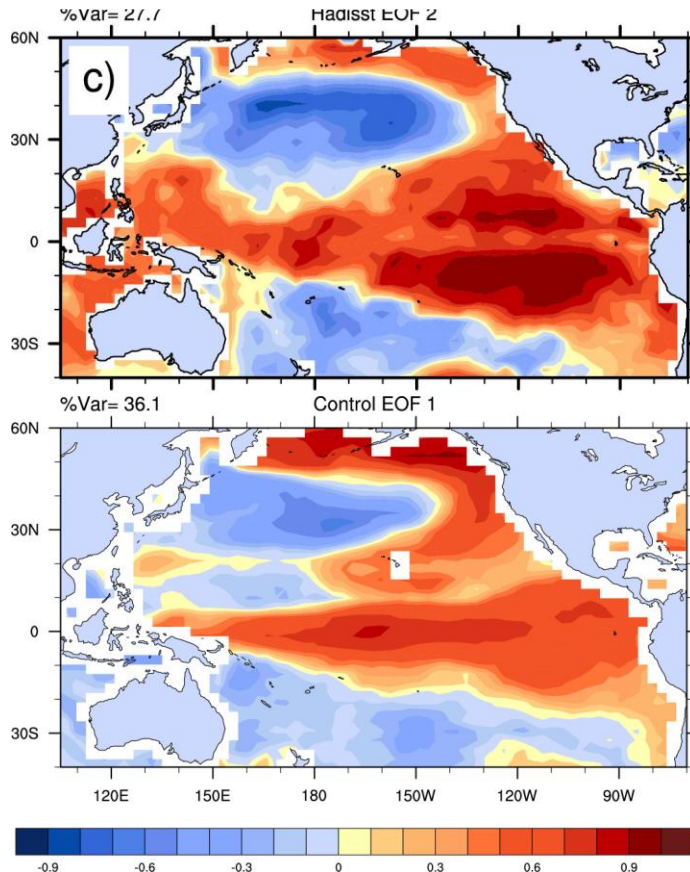
Decadal prediction from a multi-model ensemble (IPCC AR4, Ch. 10 Fig. 10.8)

By averaging over a multi-model ensemble, the decadal signal is, at minimum, 1) the forced response to increasing GHGs (doesn't depend much on which scenario is used) and 2) climate change commitment

But if there are modes of decadal variability that could be predicted, the regional skill of decadal predictions could be increased



The Pacific Decadal Oscillation (PDO) or Interdecadal Pacific Oscillation (IPO)

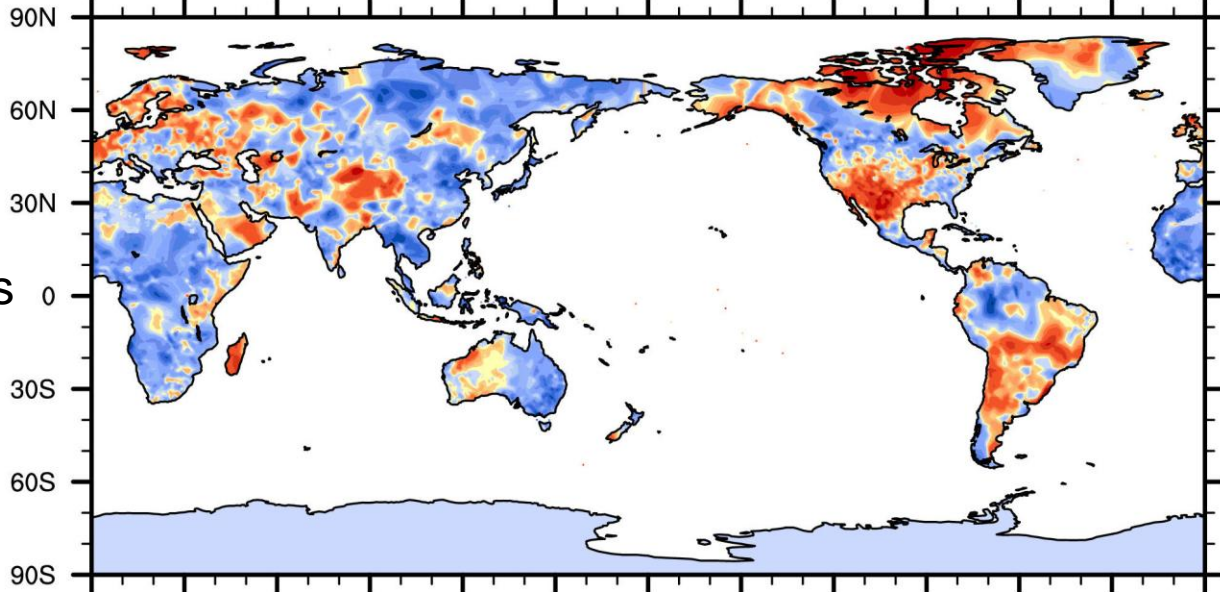


The observed IPO pattern resembles “inherent” decadal pattern from unforced model control run (pattern correlation= +0.63)

IPO correlated with low pass filtered precipitation

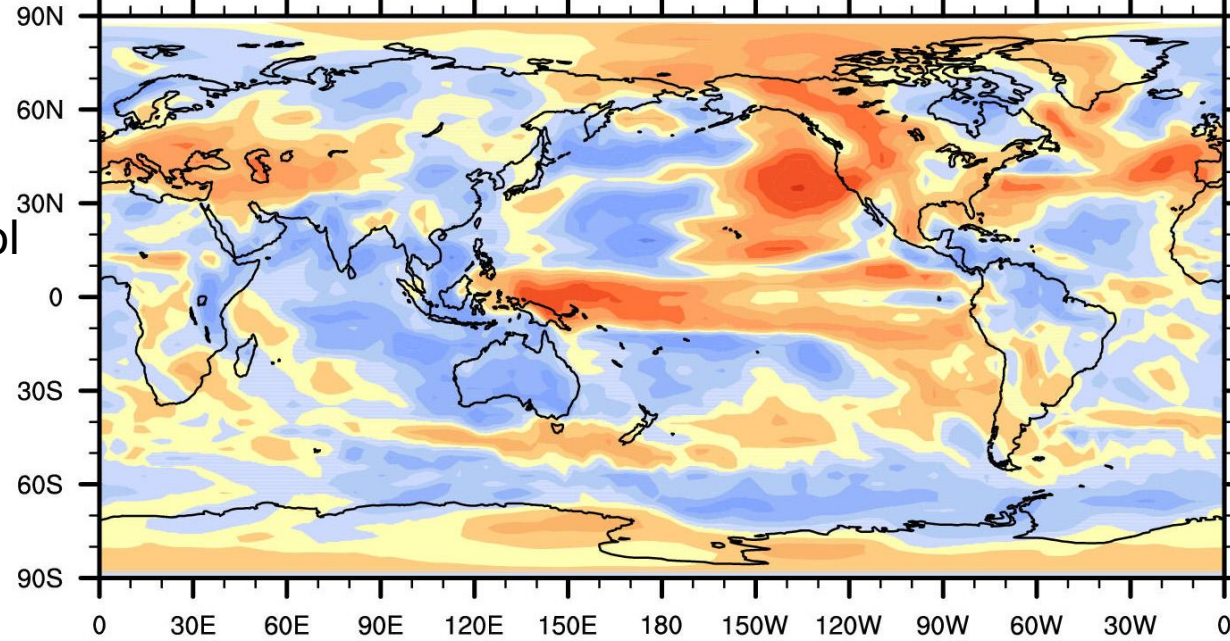
Cross correlation EOF 1 %Var=32.0

Observations



Cross correlation EOF 1 %Var=23.7

Model control

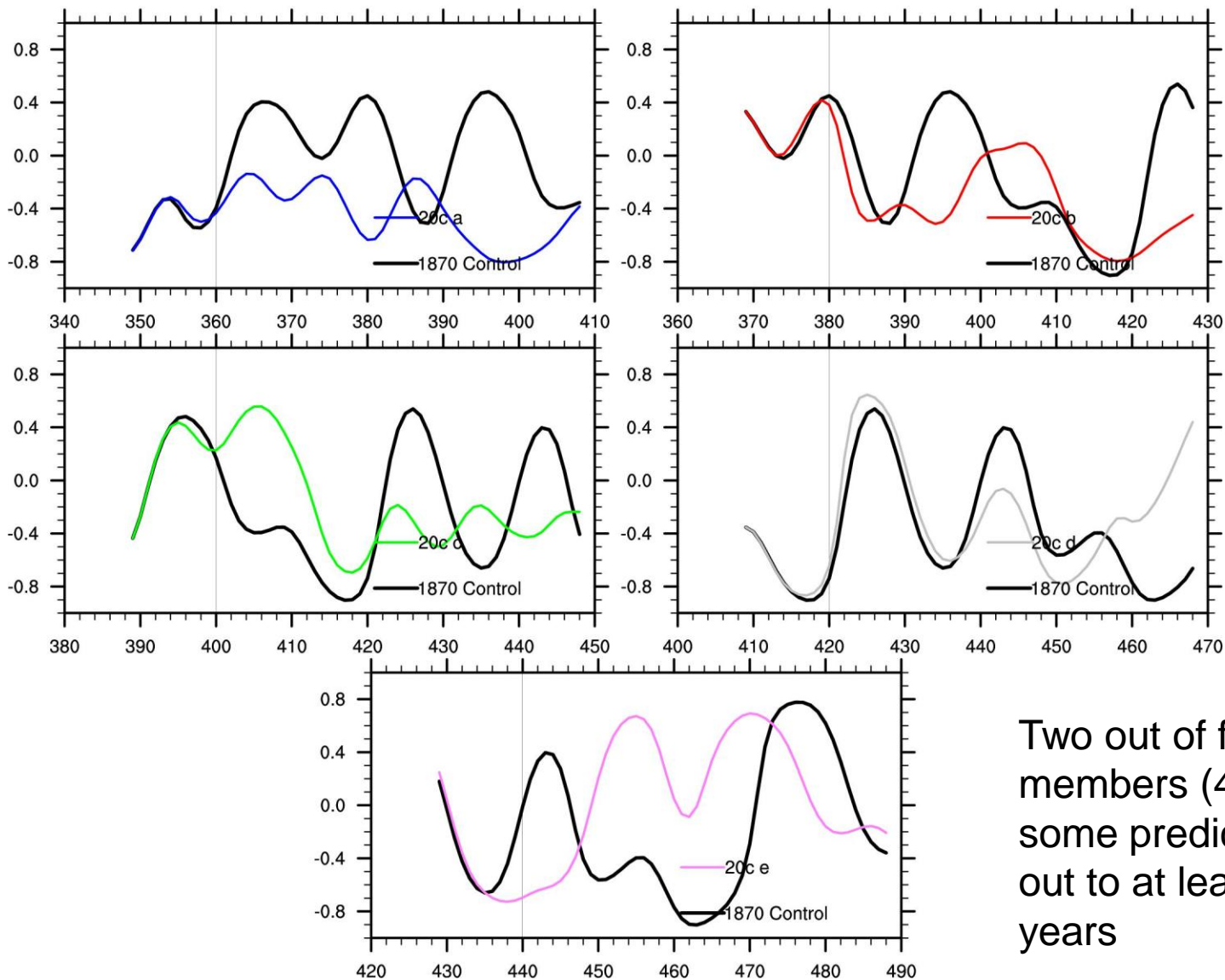


Can the IPO pattern be “predicted” in five 20th century runs?

CCSM3 (T85, ~140km resolution) 20th century simulations branched from different times in the pre-industrial control run (Different initial states of the coupled climate system)

Track the IPO index (EOF1 pattern from the control run) in the initial stages of each 20th century run, and compare to the same period in the control run (all low pass filtered)

Pattern correlation EOF1



Two out of five members (40%) show some predictive skill out to at least 10 years

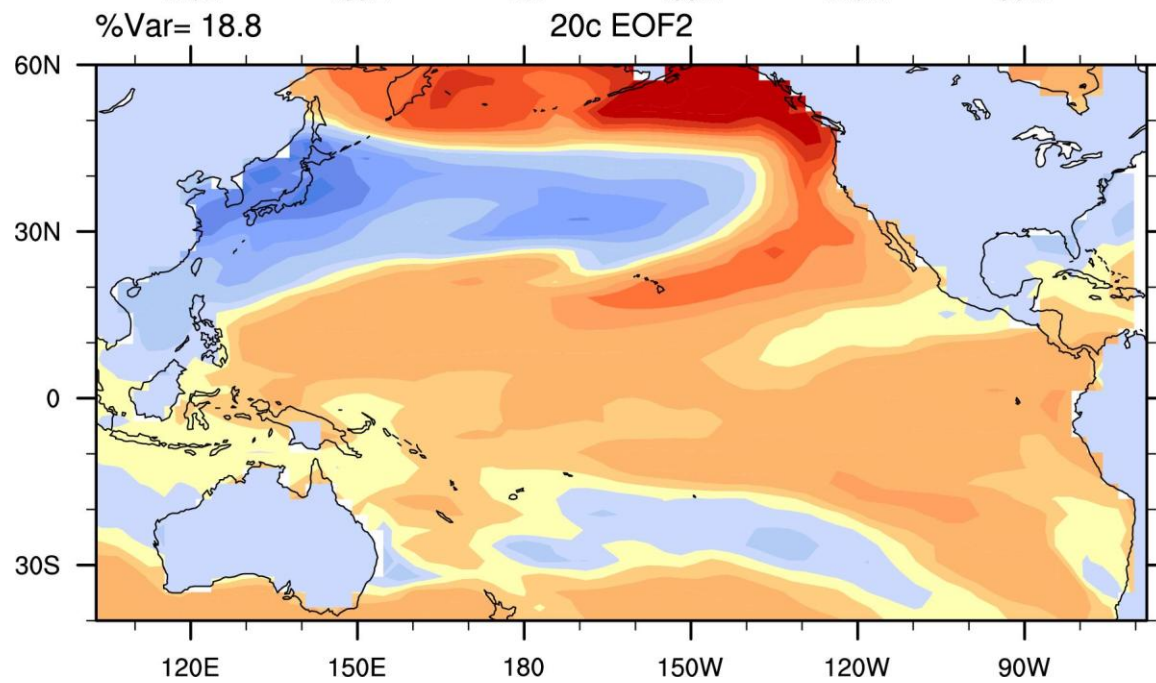
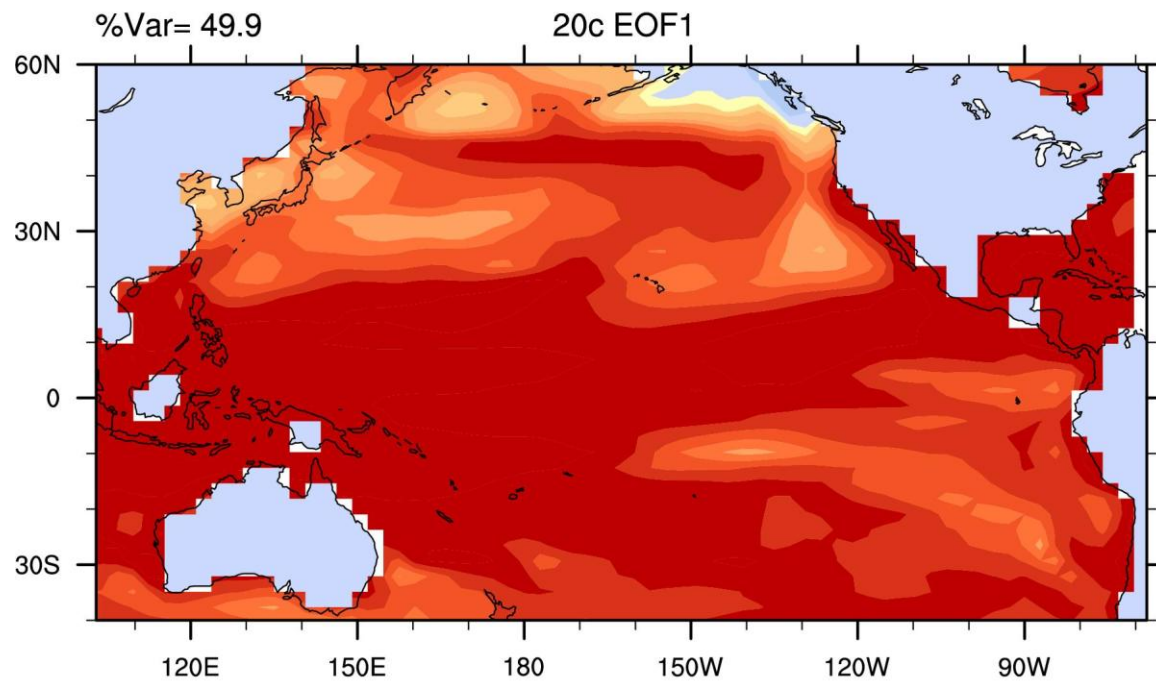
Can the IPO pattern be “predicted” in a large ensemble of early 21st century simulations?

CCSM3 (T42, ~280 km resolution) 21st century simulations branched from the end of a single 20th century run; one member is the reference (continuous simulation from 20th to 21st century with A1B scenario)

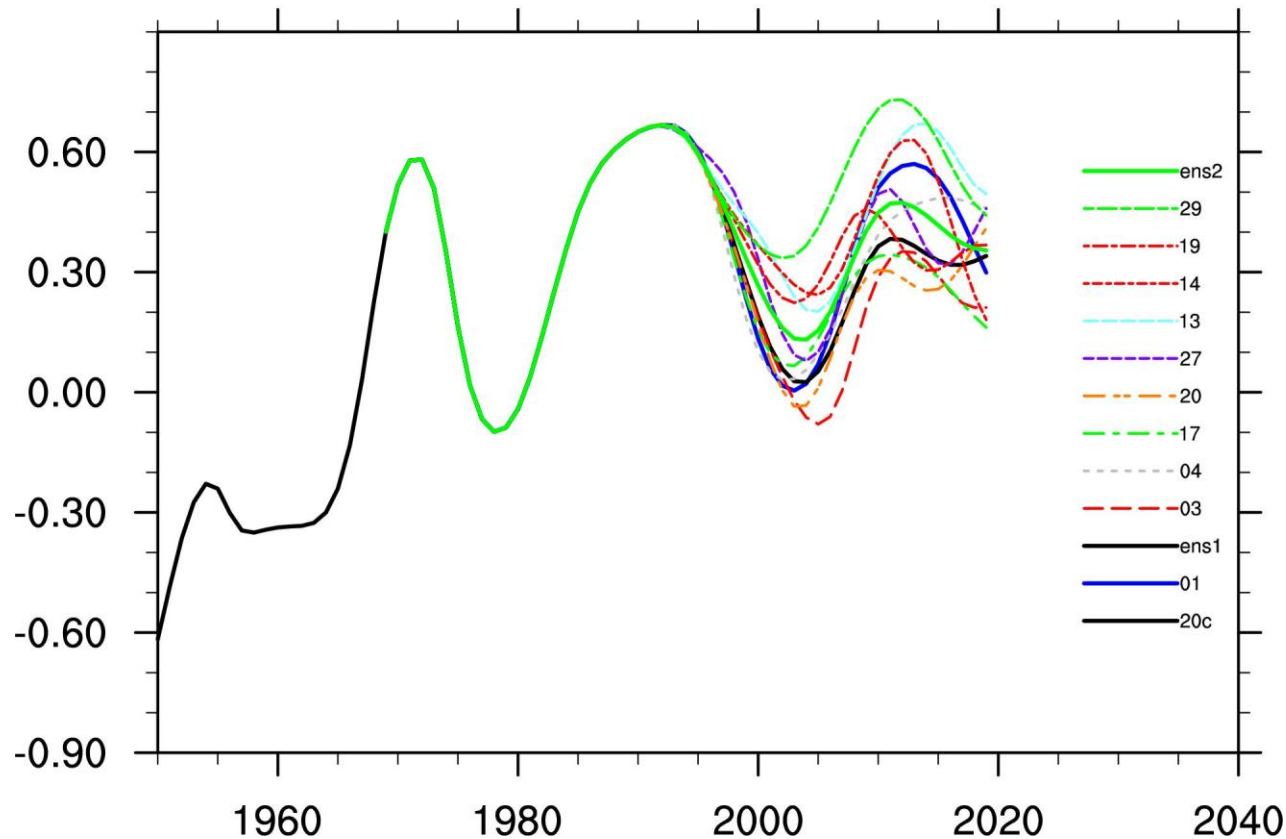
29 ensemble members using end of 20th century ocean initial state but perturb the atmospheric initial state (using atmospheric state from different days around the initial ocean state)

Track the IPO index (IPO pattern in transient simulations is EOF2; EOF1 is forced warming trend) in the initial stages of each 21st century run, and compare to the reference 21st century simulation

CCSM3 T42 20c EOF patterns



Decadal predictions of IPO index for the Pacific EOF2 pattern correlation (9 members)



9 out of 29 members (31%) show some predictive skill out to 20 years

(CCSM3.0, T42, atmospheric initial state perturbed with same ocean initial state at year 2000; one reference, 29 ensemble members)

Conclusions

1. “Decadal” (PDO or IPO) pattern in observations is dominant low frequency mode of SST variability in the Pacific; connected with regional rainfall anomalies in south and east Asian region and southwest North America
2. Predicting the decadal evolution of this pattern would add regional skill to forced response and climate change commitment
3. Five 20th century simulations branched from different initial states in the pre-industrial control run show some skill in a subset (2 out of 5, 40%) of the ensemble members for predicting the IPO pattern 10-15 years in advance
4. A reference simulation and a 29 member ensemble of predictions for the first half of the 21st century show 9 out of 29 members (~30%) with predictive skill for the IPO
5. Science question: Why do some ensemble members (30-40% from two different experimental configurations) show decadal predictive skill for the IPO and others do not? (similar results have been shown for decadal predictions for the ocean meridional overturning circulation in the Atlantic)