

Development of forecasting system for interannual time scales on the basis of INM RAS climate model

*Evgeny Volodin, Andrey Gritsoun
Institute of Numerical Mathematics RAS*

volodinev@gmail.com

INM climate models for CMIP6

INM-CM4-8: Atmosphere 2x1.5L21, top=10hPa; Ocean
1x0.5L40

For PMIP, ISMIP6

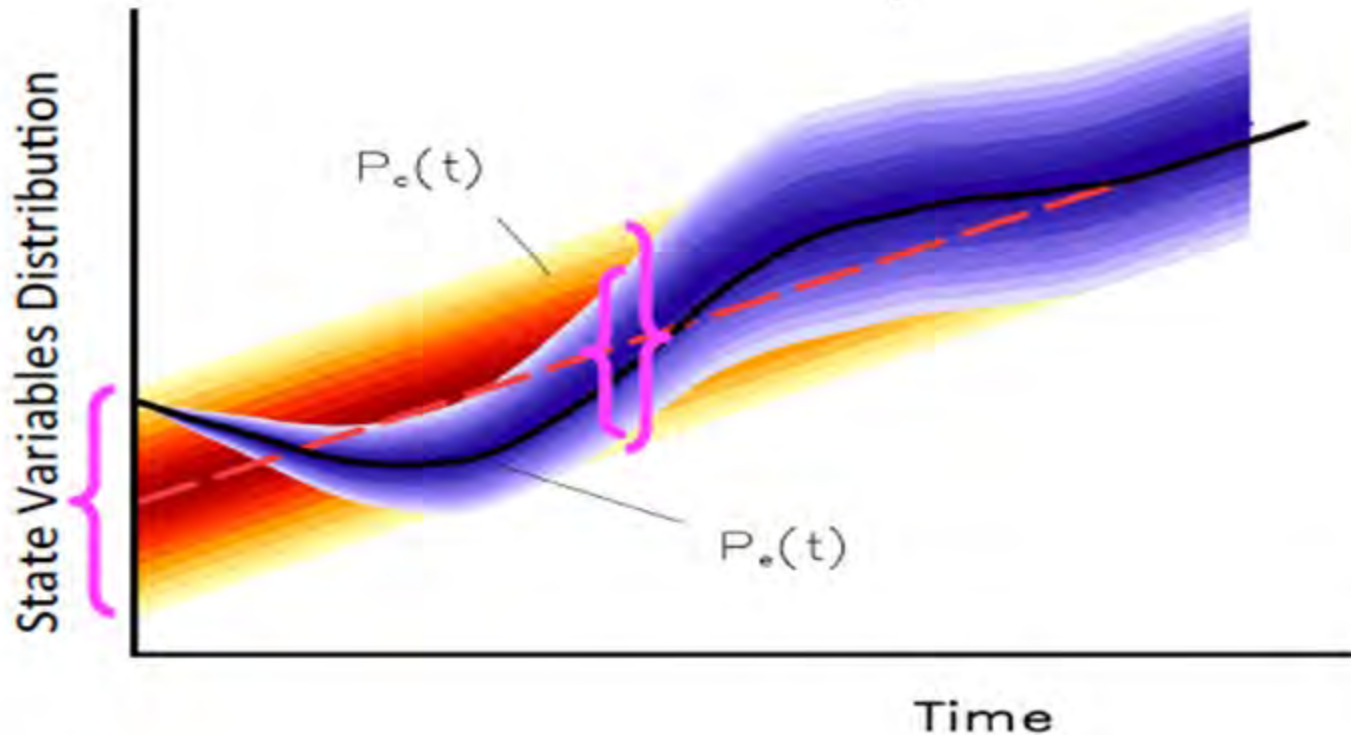
INM-CM5-0: Atmosphere 2x1.5L73, top=0.2hPa, Ocean
0.5x0.25L40

For Decadal Prediction Project

INM-CM5-H: Atmosphere 0.67x0.5L73, top=0.2hPa,
Ocean 0.167x0.125L40

For HiResMIP

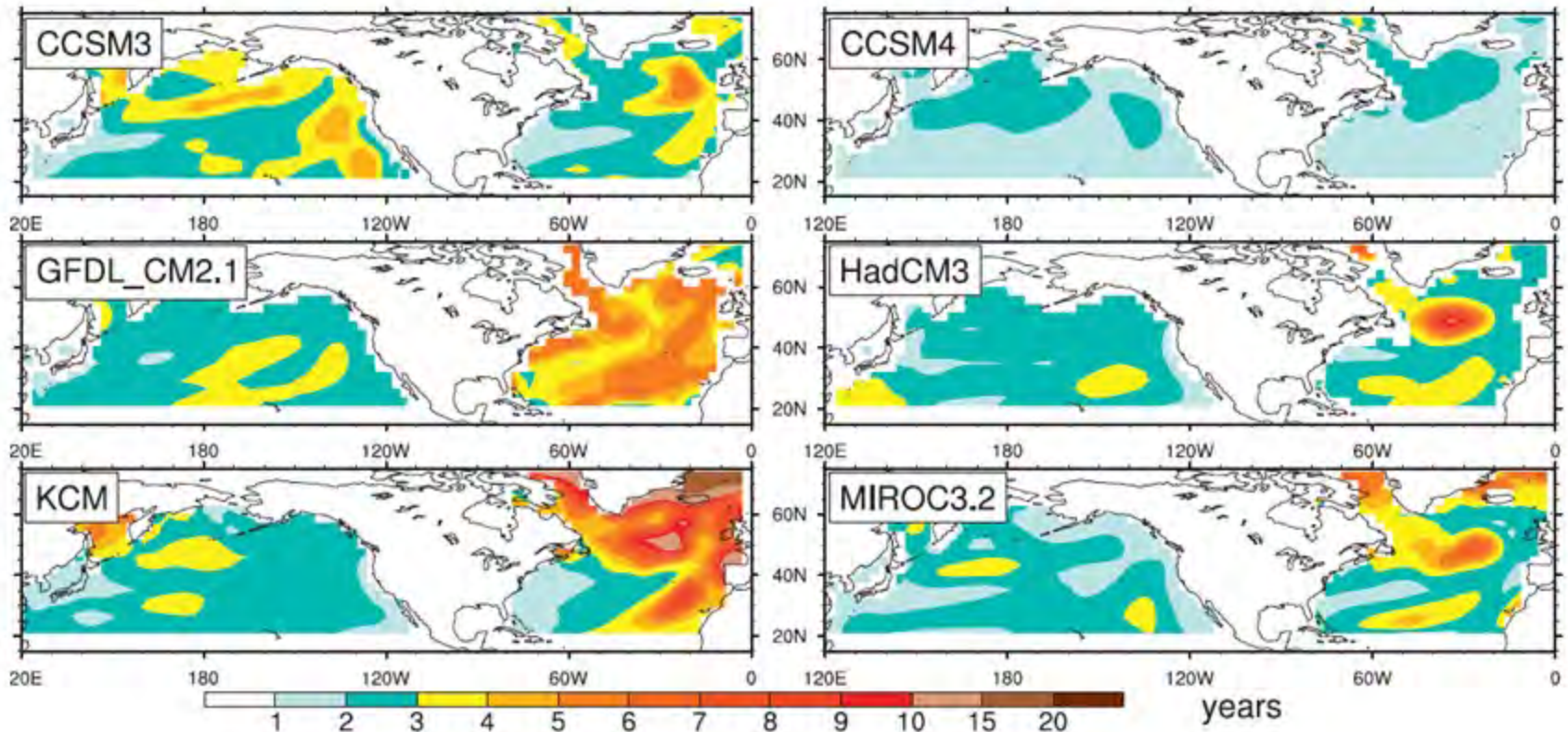
Predictability of the first kind (influence of initial conditions) and the second kind (influence of forcing)



Red – ensemble that utilizes forcing only. Blue – ensemble that utilizes forcing and initial conditions.

Predictability using forcing dominates at large time scales

Time of potential predictability (years) of 1 year mean heat content at 0-300m for CMIP5 models



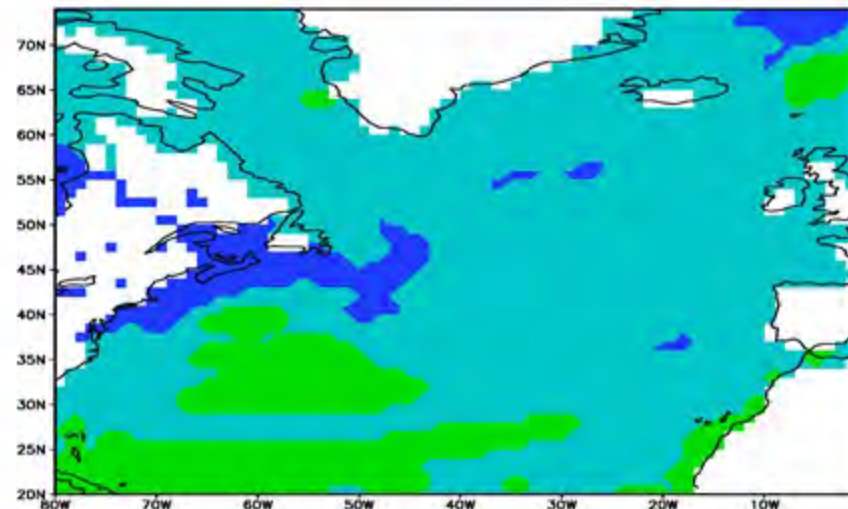
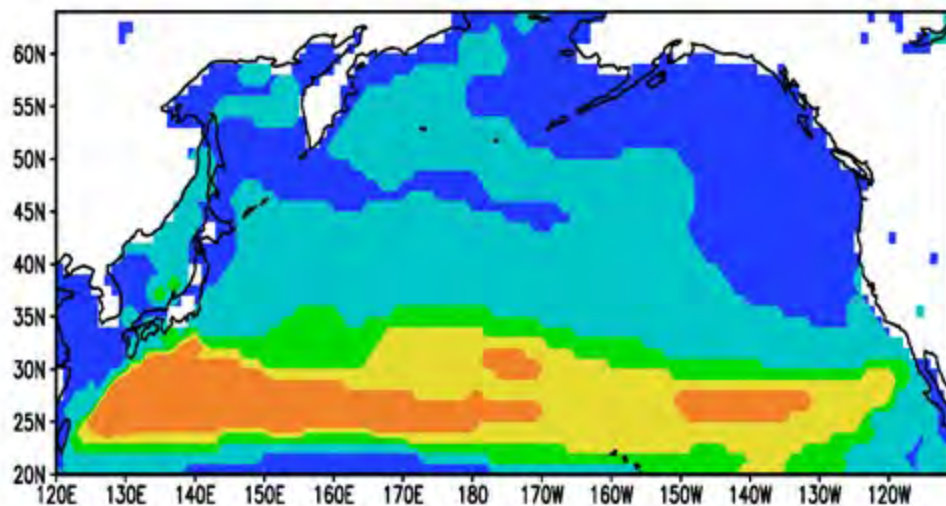
We produce ensemble of model runs from some initial states.

Signal=norm of average over all ensemble members from chosen initial state

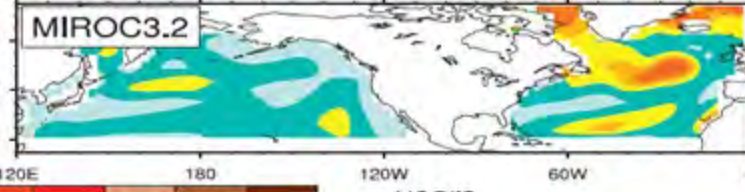
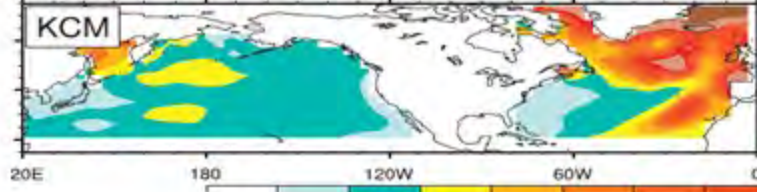
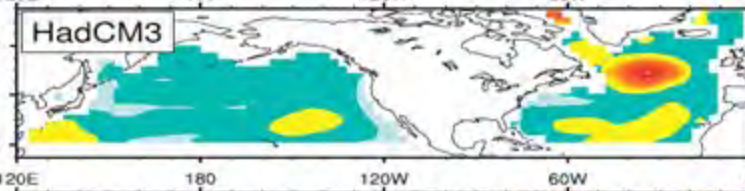
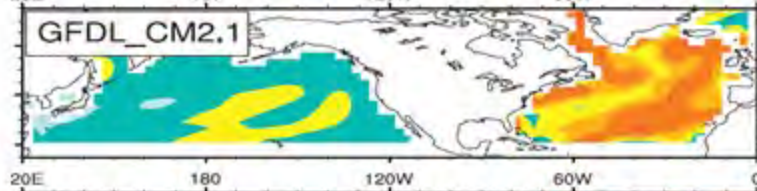
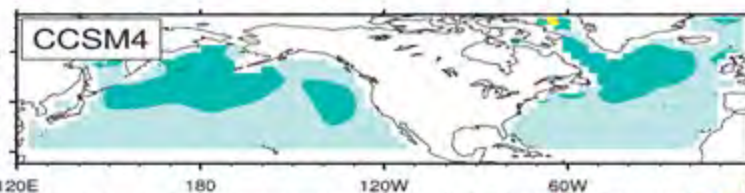
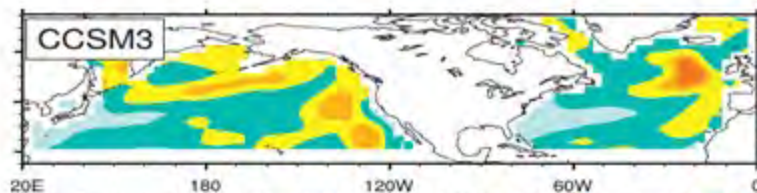
Noise=mean distance between individual ensemble members

We have predictability of $\text{signal}/\text{noise} > \text{some chosen value (0.6)}$

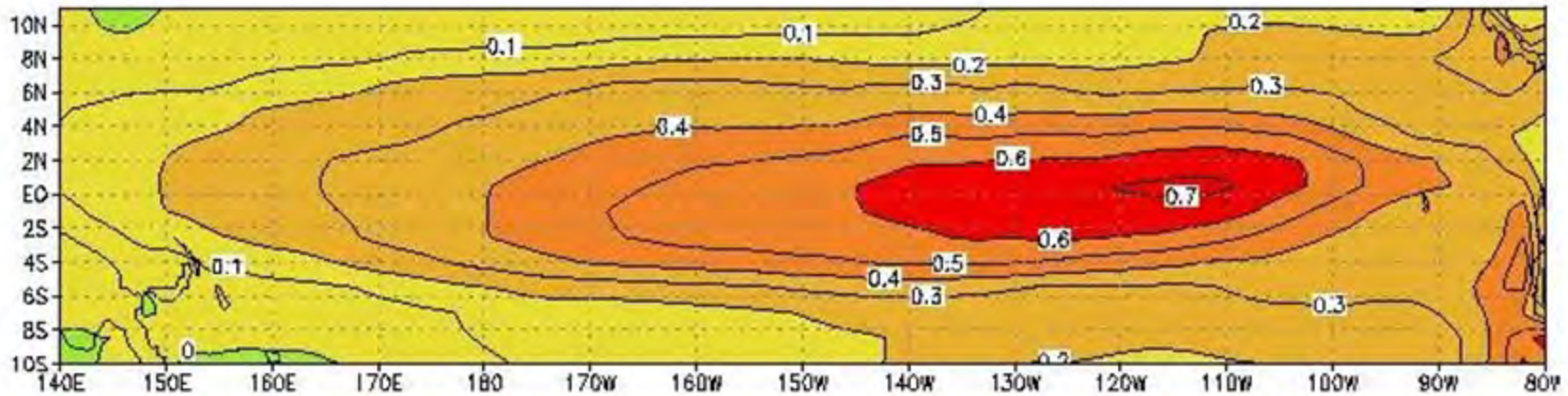
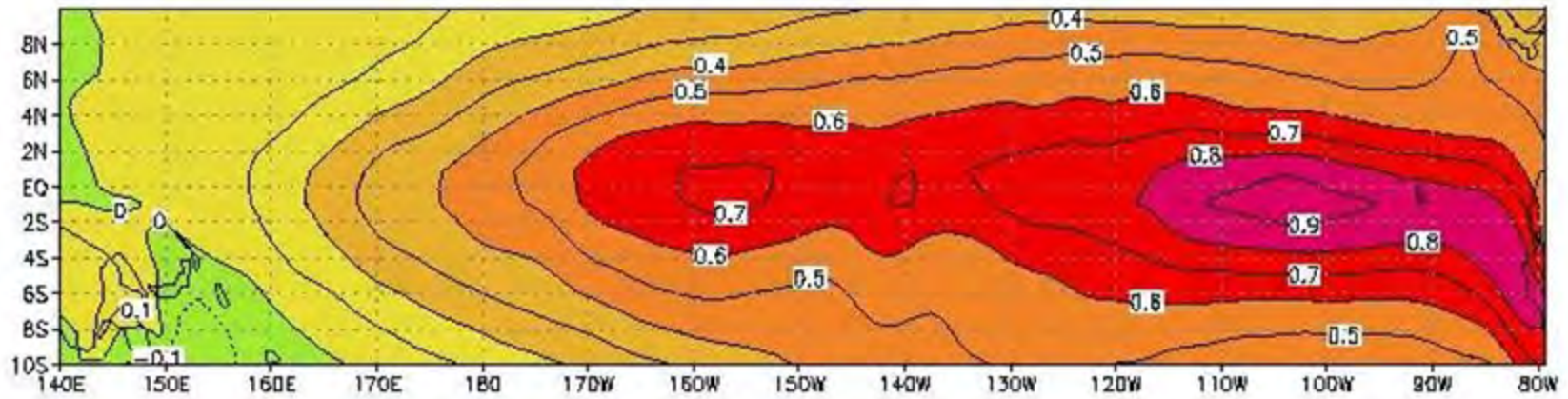
Time of potential predictability for INMCM5



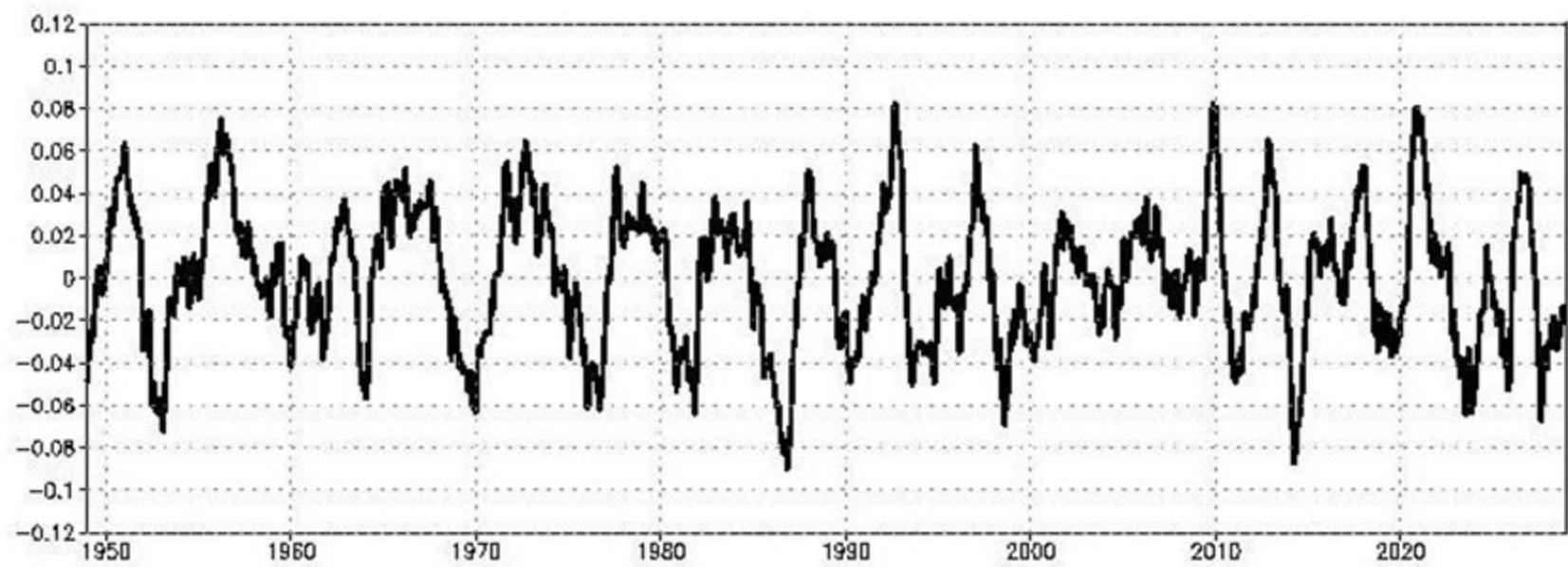
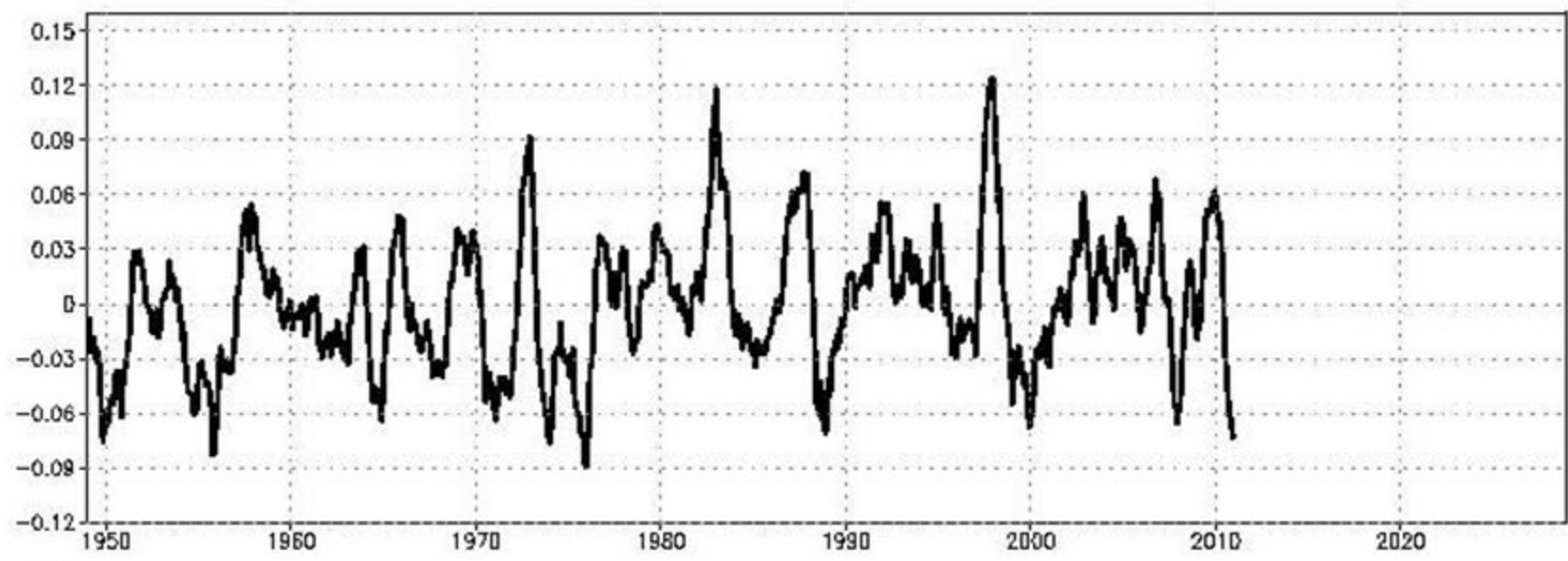
Different predictability!



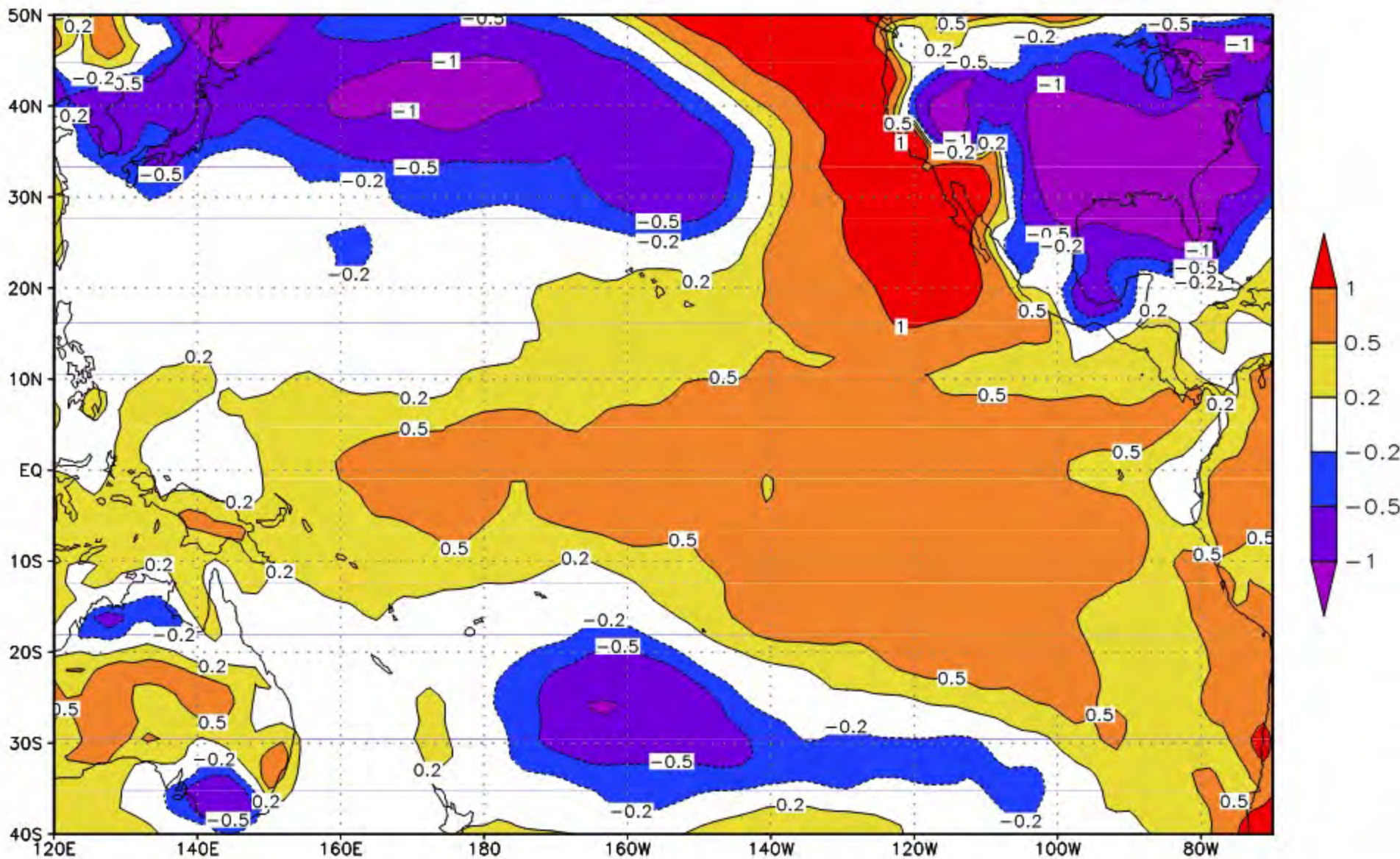
EOF-1 of monthly mean tropical Pacific SST. ERSSTv4 (top), model (bottom)



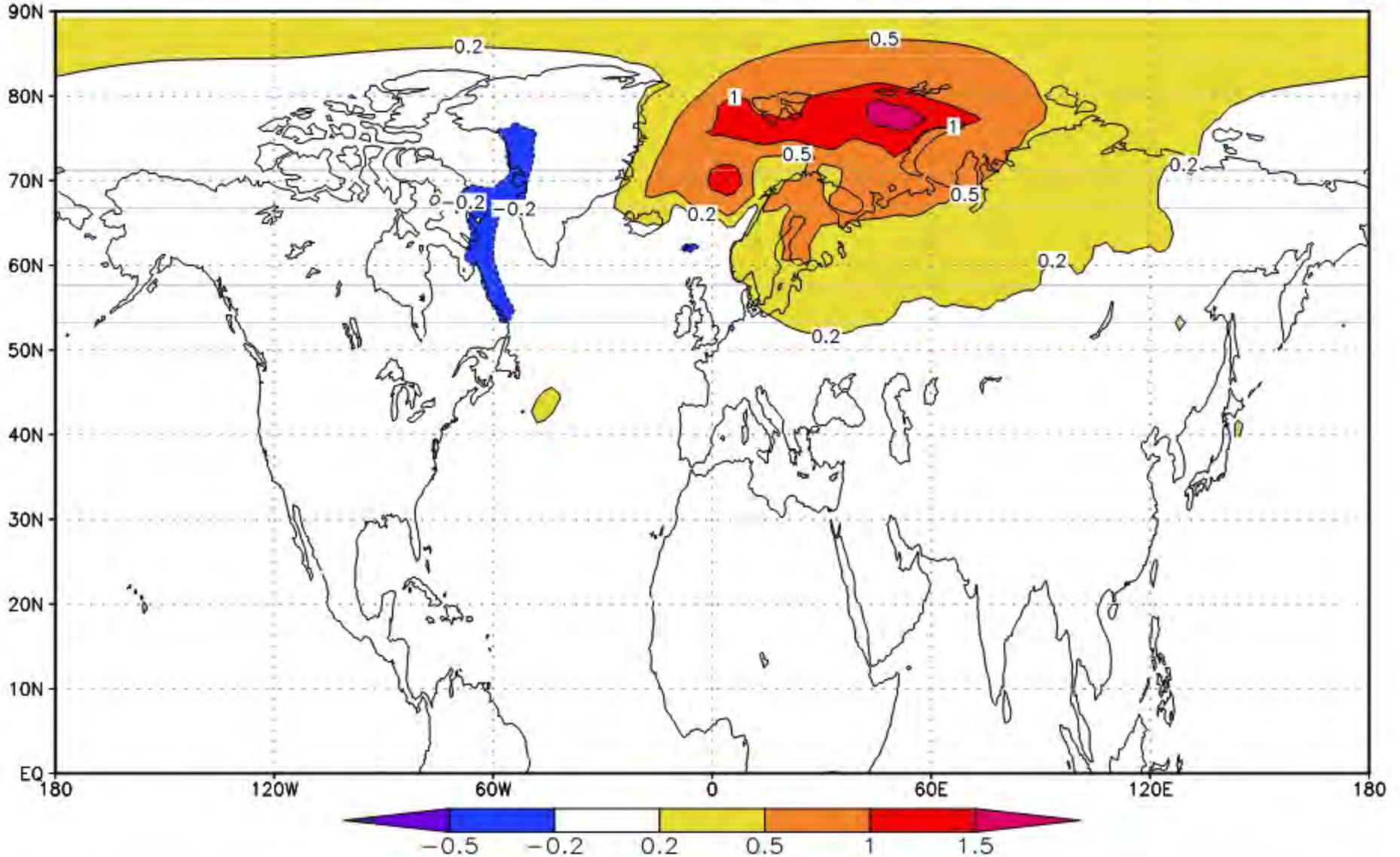
Time series of expansion coefficient in OBS (top) and MODEL (bottom)



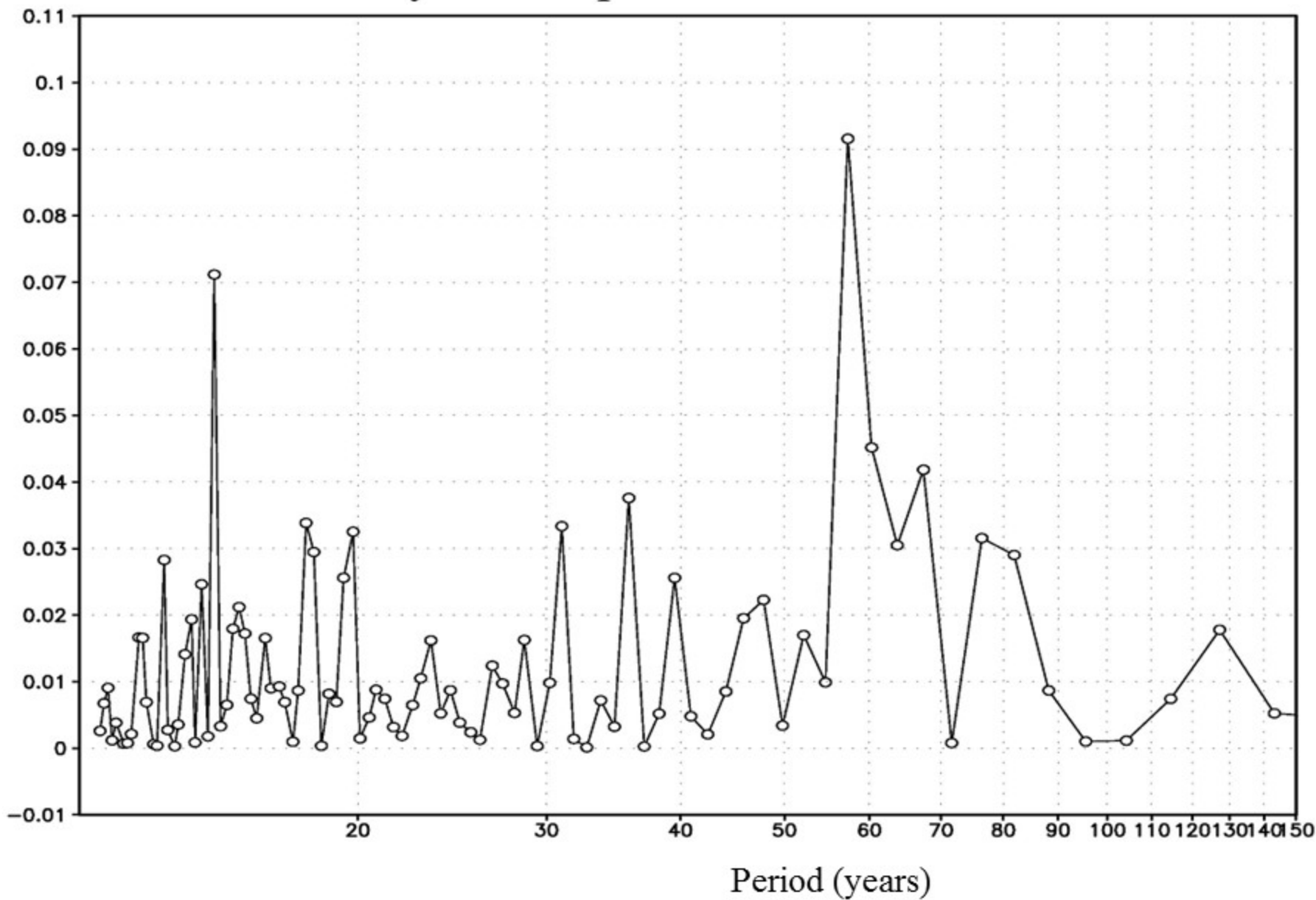
OBS SST pattern for positive PDO index



EOF-1 of 5-year mean surface temperature in the model



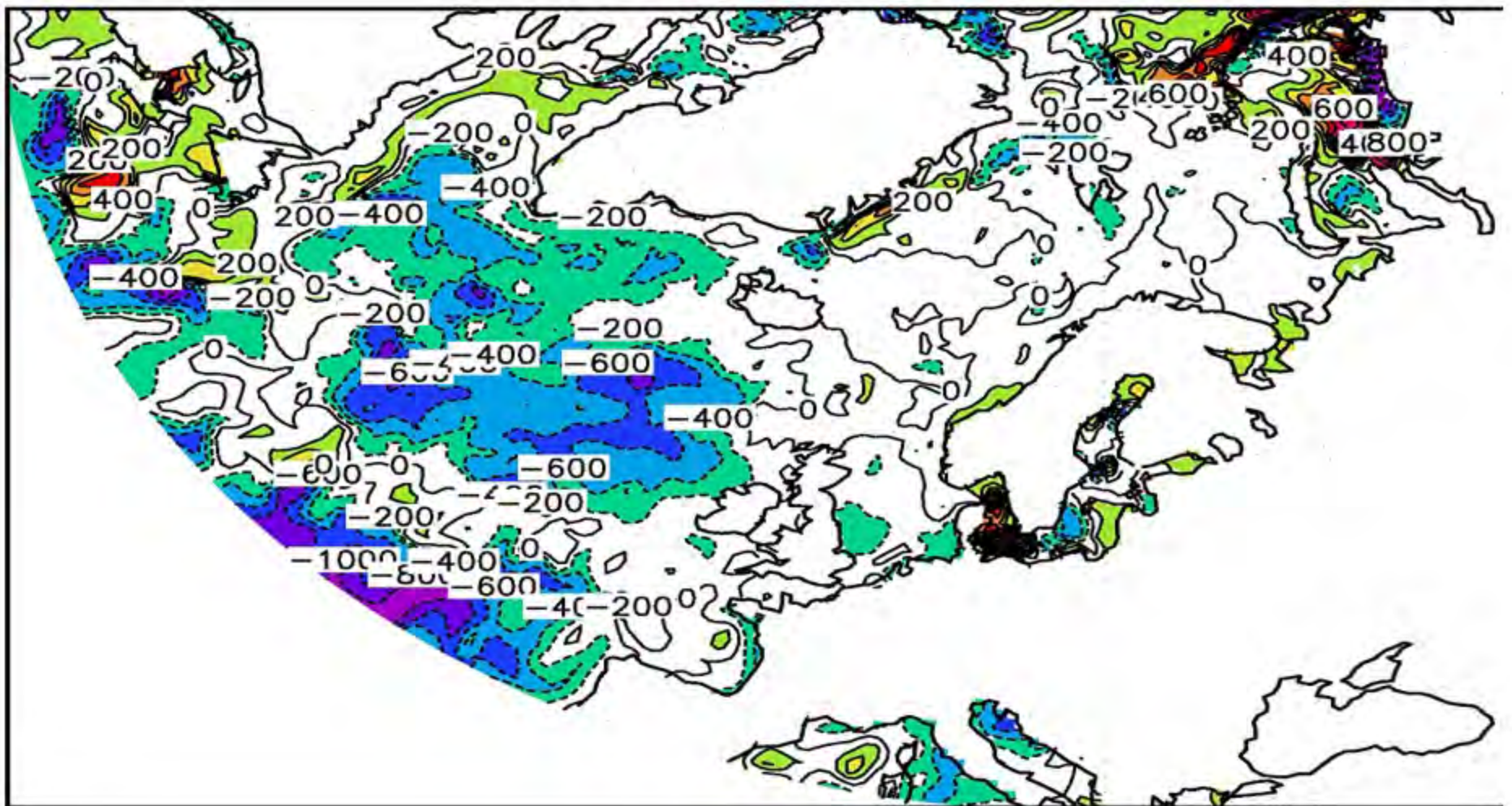
Time spectrum of Arctic temperature on the basis of 1200 years of preindustrial run



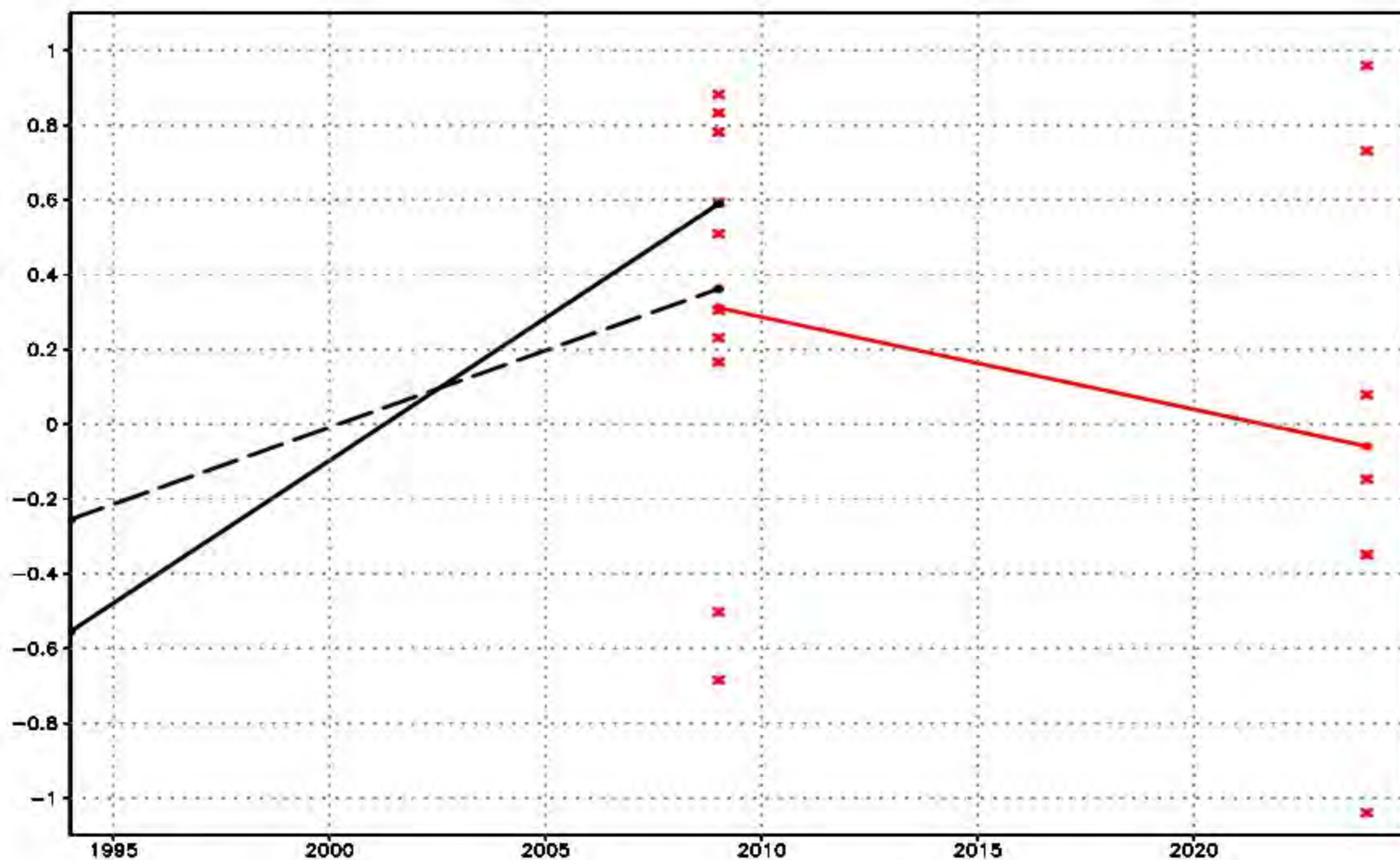
Scheme for case study decadal forecast:

1. Anomalies of oceanic temperature and salinity were calculated from SODA reanalysis (1979-2011) for Jan 1995
2. Anomalies were added to oceanic climatology of climate model for preindustrial run.
3. Atmospheric state was taken from model run
4. 10 members of ensemble were generated using small disturbance of initial state
5. Duration of each run was 30 years. No change of external forcing

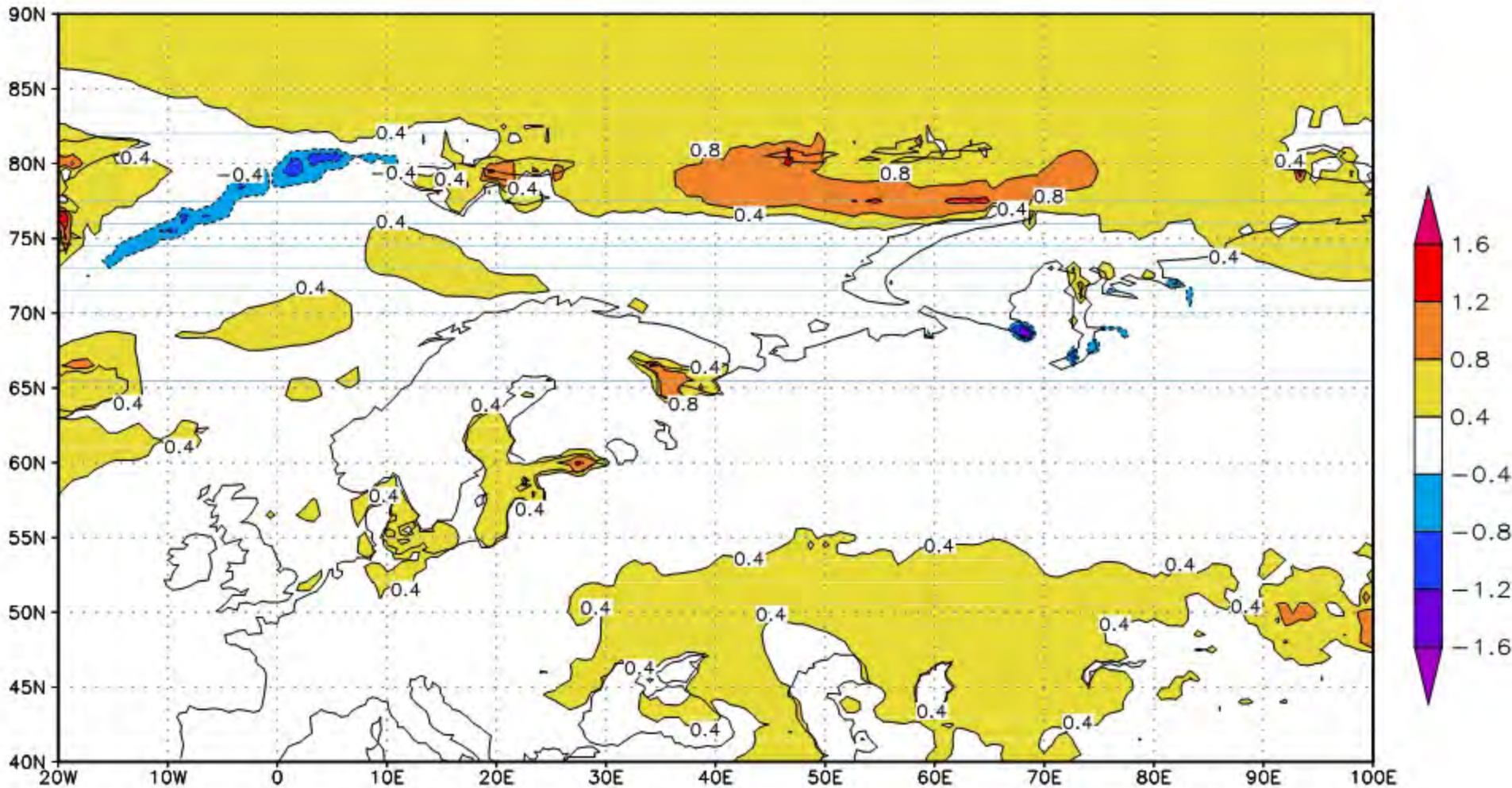
Initial anomaly of surface density



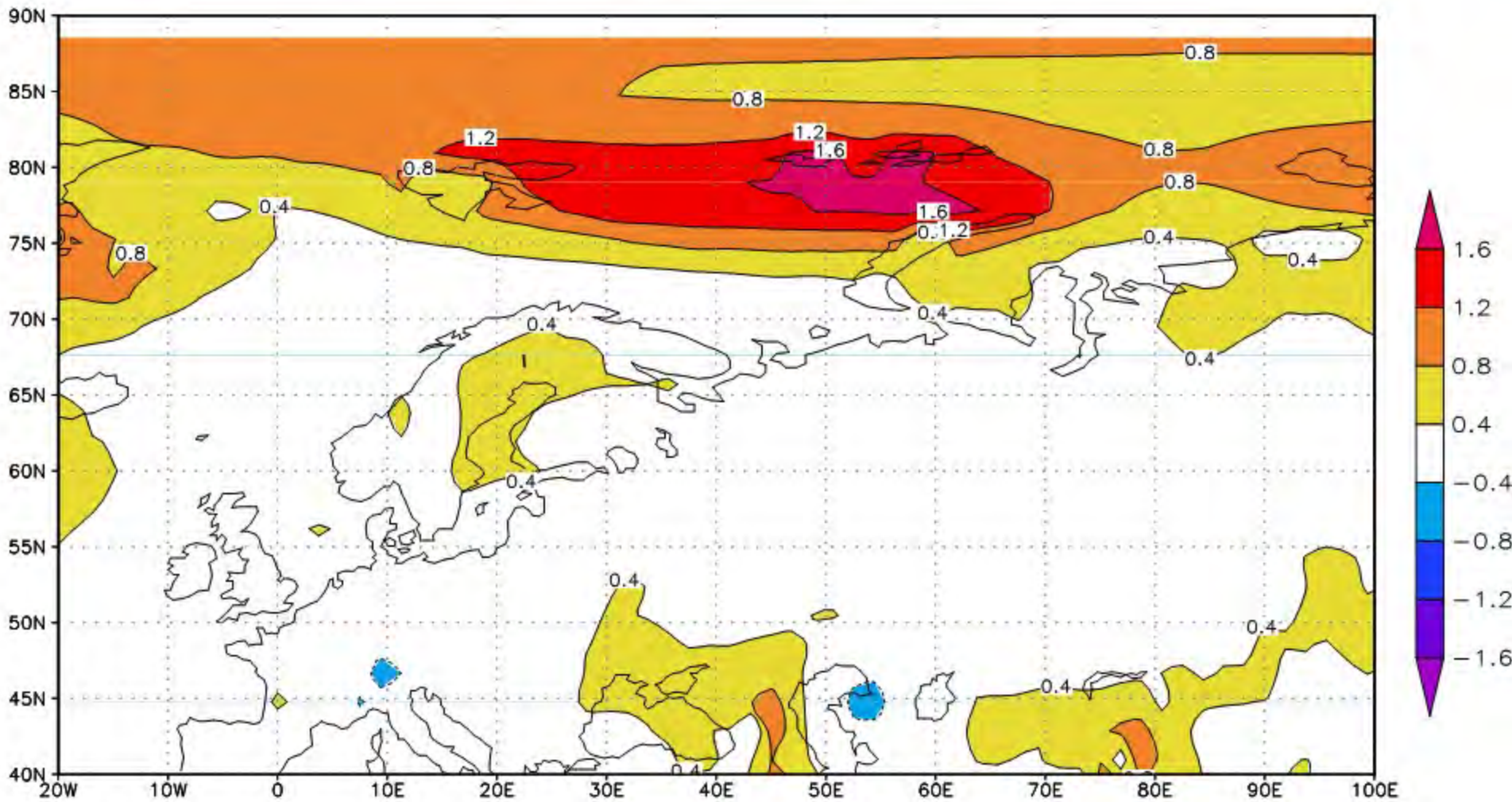
15 year mean surface temperature anomaly in region 70N-88N, 20W-80E in MERRA (dashed black), NCEP (solid black), individual forecasts (red crosses) and ensemble mean (red solid line)



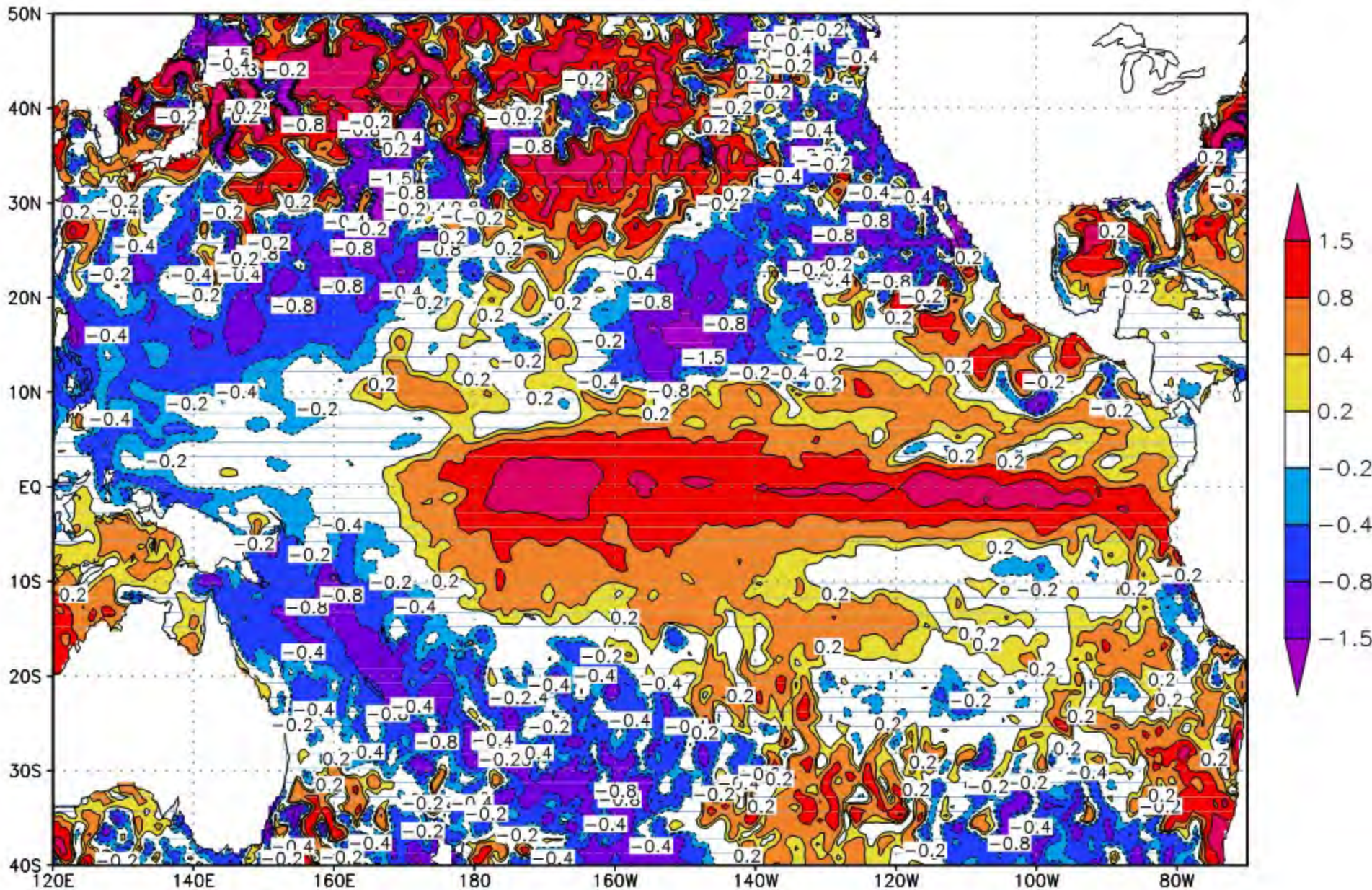
Anomaly of surface temperature in 1996-2010 with respect to 1980-1995 according to MERRA



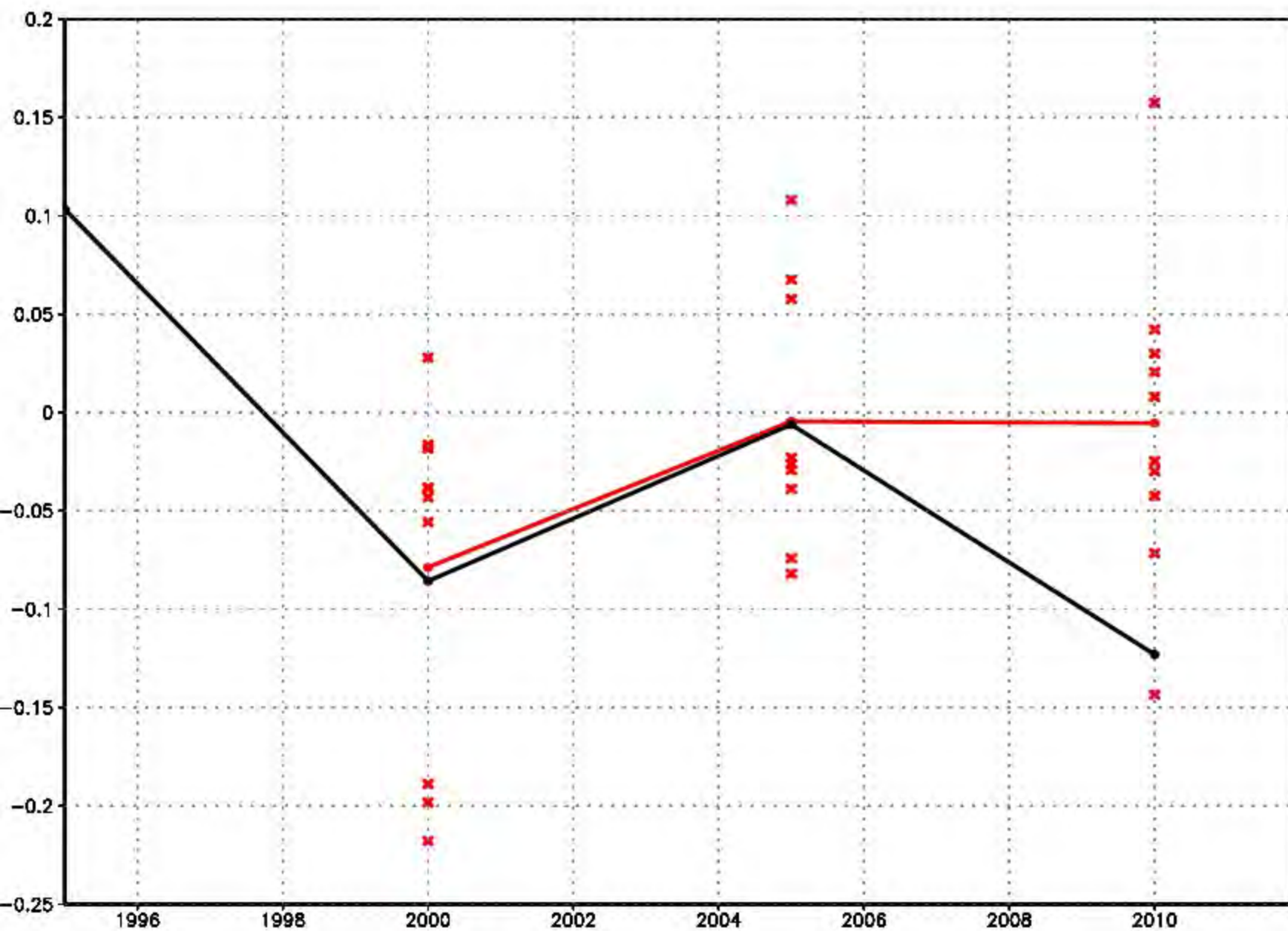
Anomaly of surface temperature in 1996-2010 with respect to 1980-1995 according to NCEP



Initial SST anomaly in Jan 1995



5 year mean PDO index for NCEP (black) and model (red)



Future plans: participation in Decadal Prediction subproject of CMIP6

1. Case studies. Ensemble of runs for some interesting data: climate regime shift in 1977 and 1996. Different initialization (assimilation of atmospheric reanalysis, or SST and SLP only, or oceanic reanalysis)
2. Ensemble of 5-year or 10-year forecasts from each second year from 1979 to present if only enough computer resources will be available.