Decadal Variability & Predictability in Six AOGCMs

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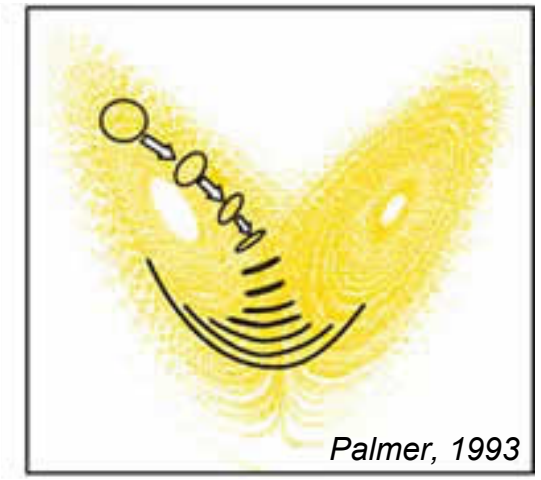

NCAR

Office of Science
U.S. Department of Energy

✓ Control Runs from

- CCSM3, NCAR ……700yr
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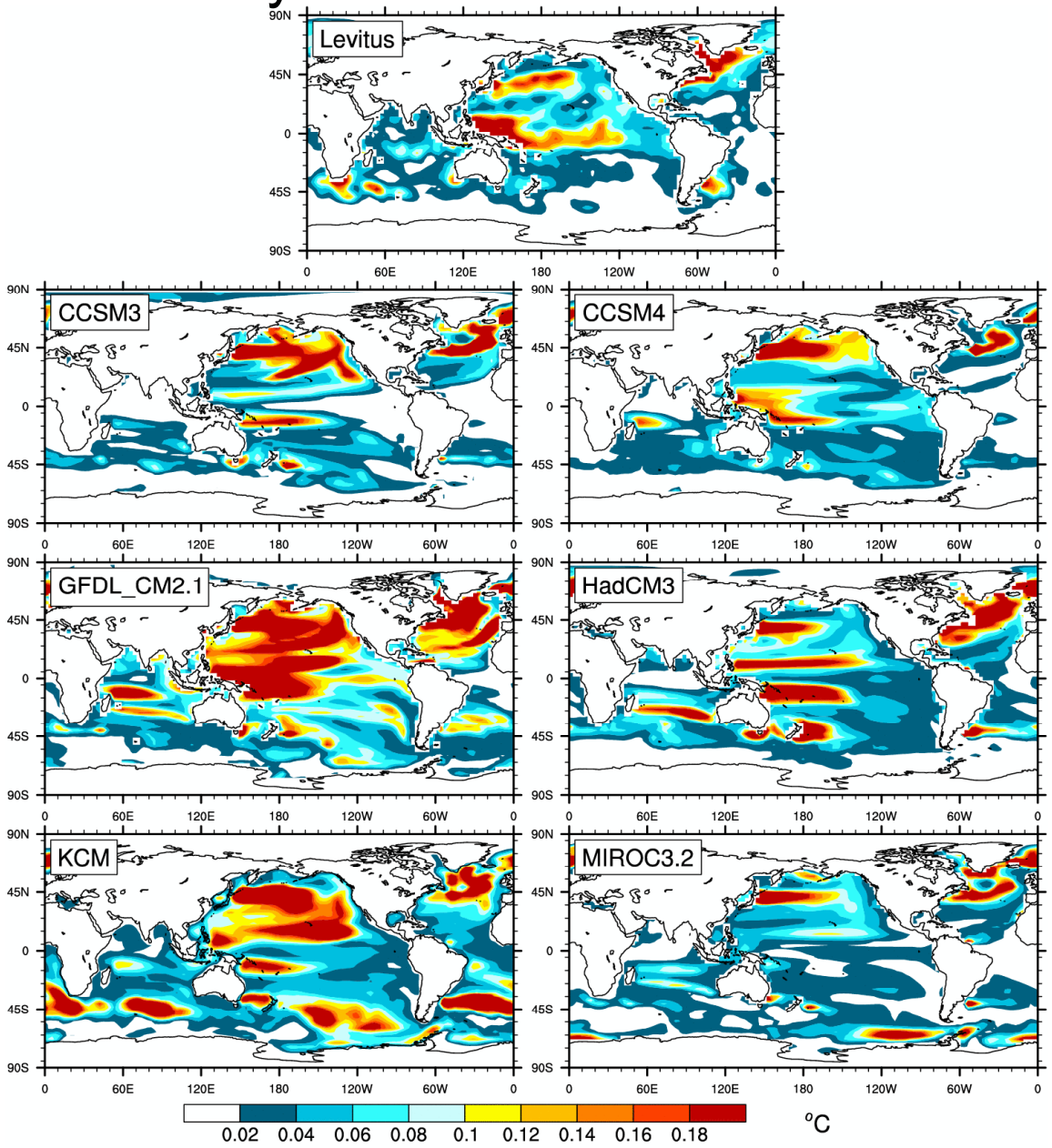
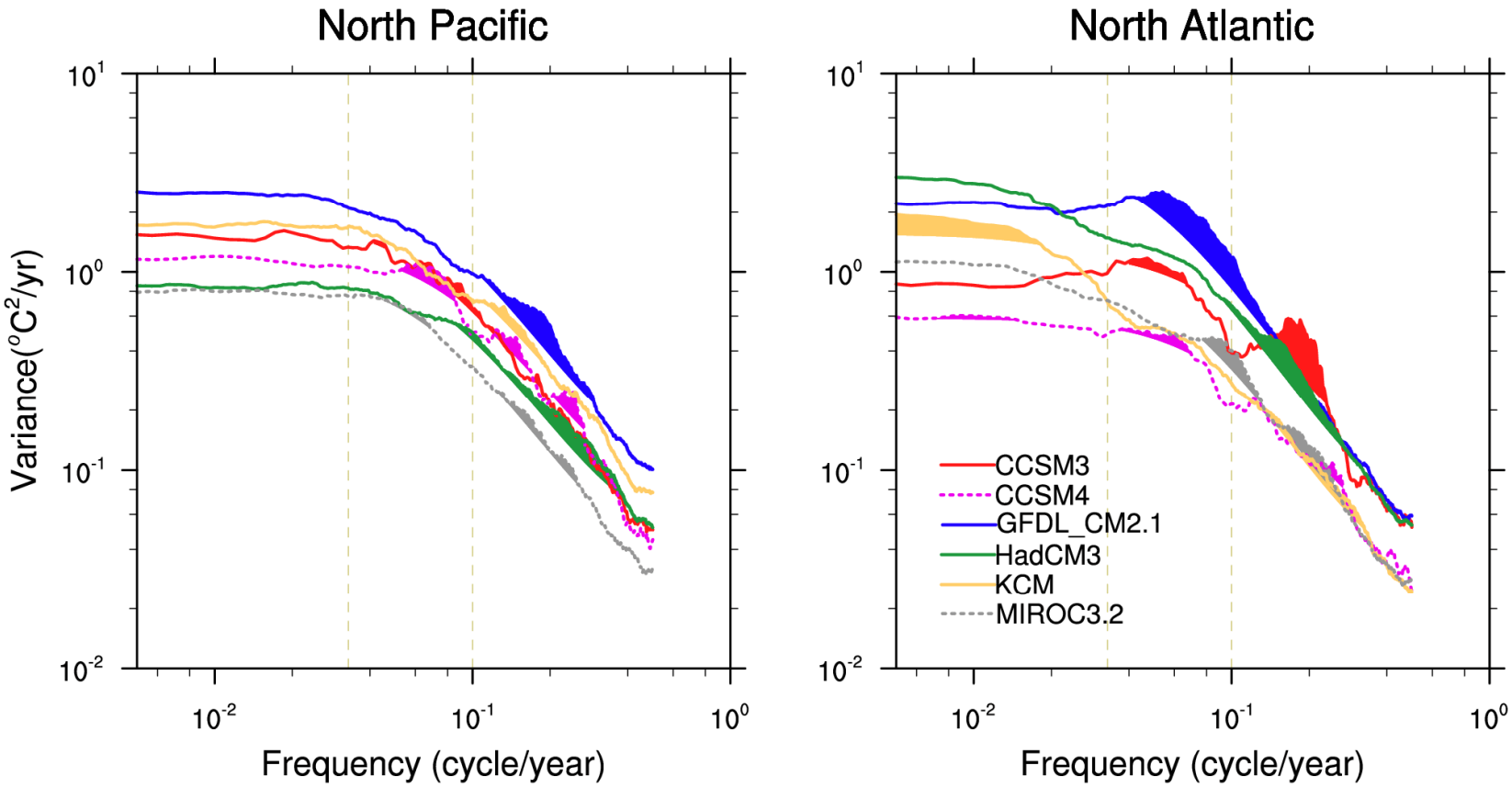
- KCM, University of Kiel ……..4200yr
- CM2.1, GFDL……...2500yr
- MIROC3.2, CCSR & JAMSTEC ……3600yr
- HadCM3, Hadley Centre ……...5400yr

✓ Annual mean upper 300m mean temperature

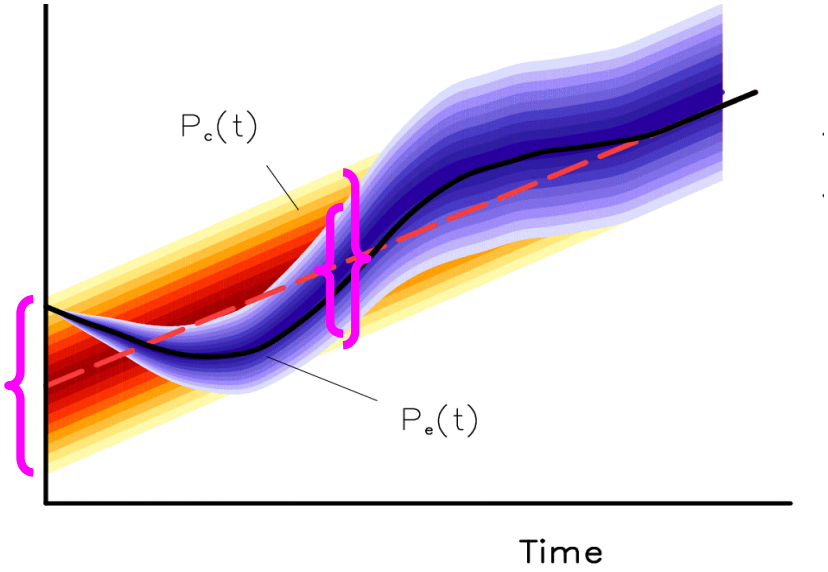
T0-300 5yr Low-Pass Standard Deviation



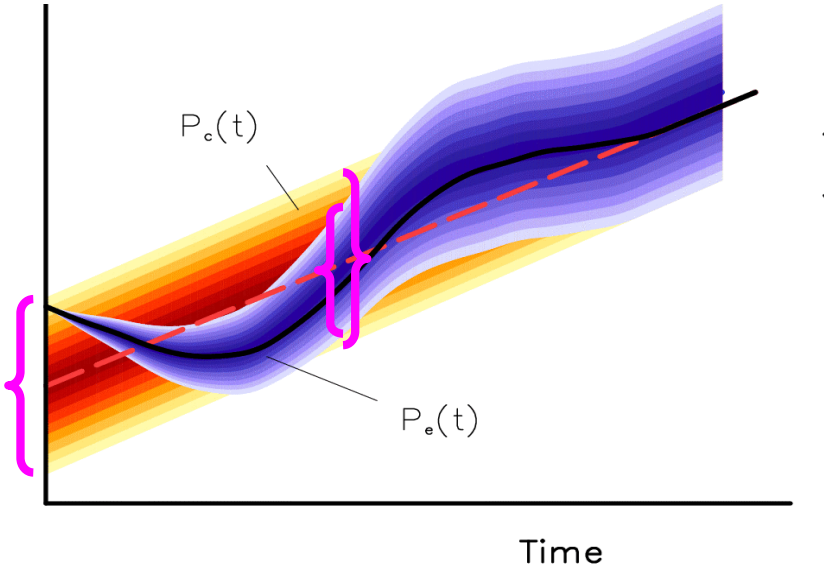
Average Spectrum



Initial Value Predictability



Initial Value Predictability

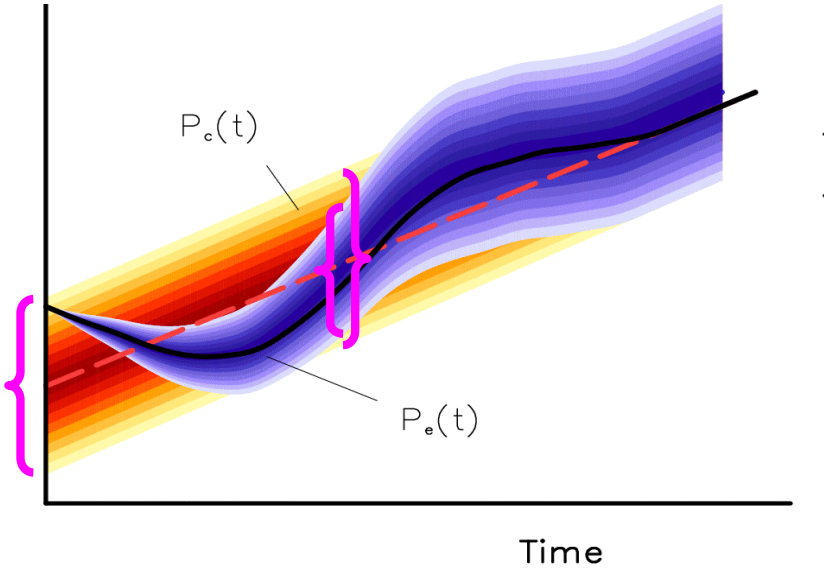


Relative Entropy

$$R = \int_S P_e(s) \ln\left[\frac{P_e(s)}{P_c(s)}\right] ds = \frac{1}{2}\left[\ln\left(\frac{\sigma_c^2}{\sigma_e^2}\right) + tr\,\frac{\sigma_e^2}{\sigma_c^2} + (\mu^e - \mu^c)^T \sigma_c^{-2} (\mu^e - \mu^c) - n\right]$$

dispersion *signal*

Initial Value Predictability



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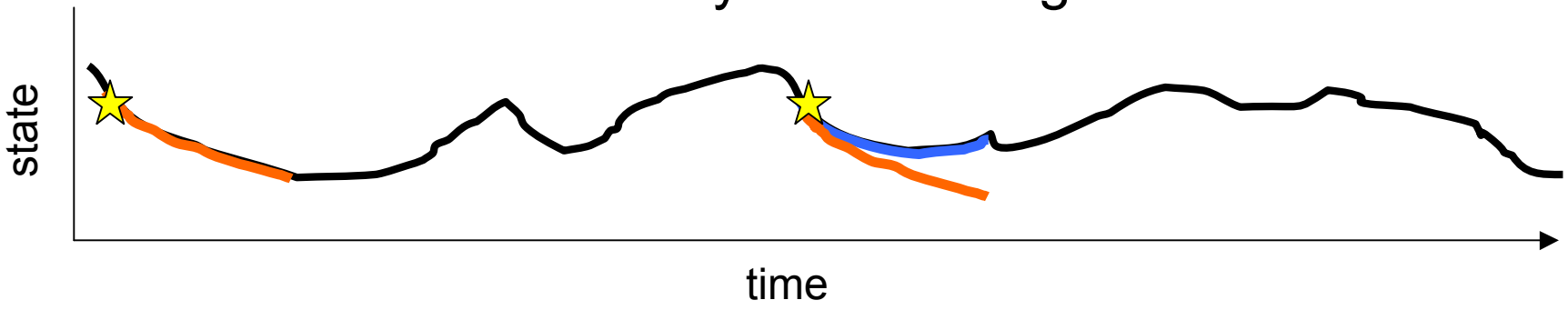
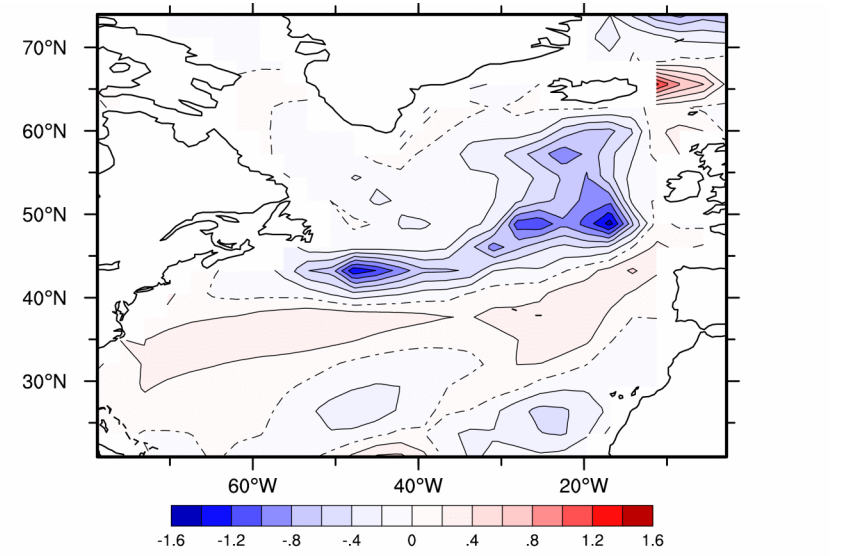
dispersion *signal*

Attractor averages

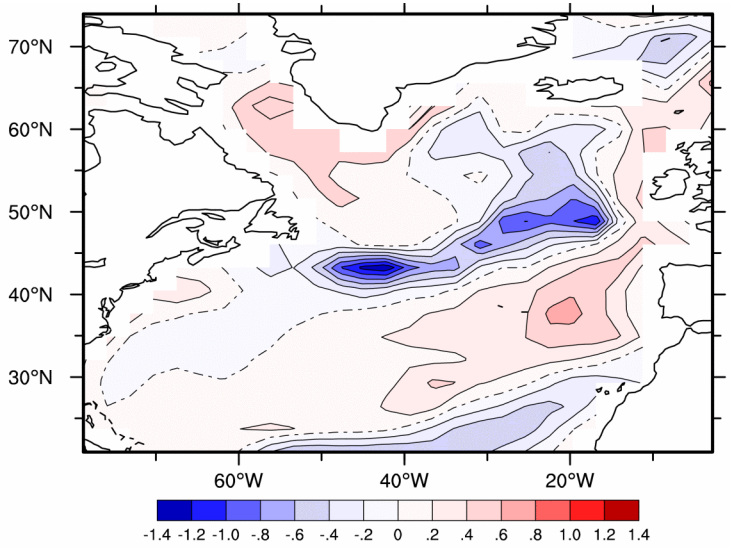
Predictability from Analogs



CCSM3 yr 236



CCSM3 yr 337

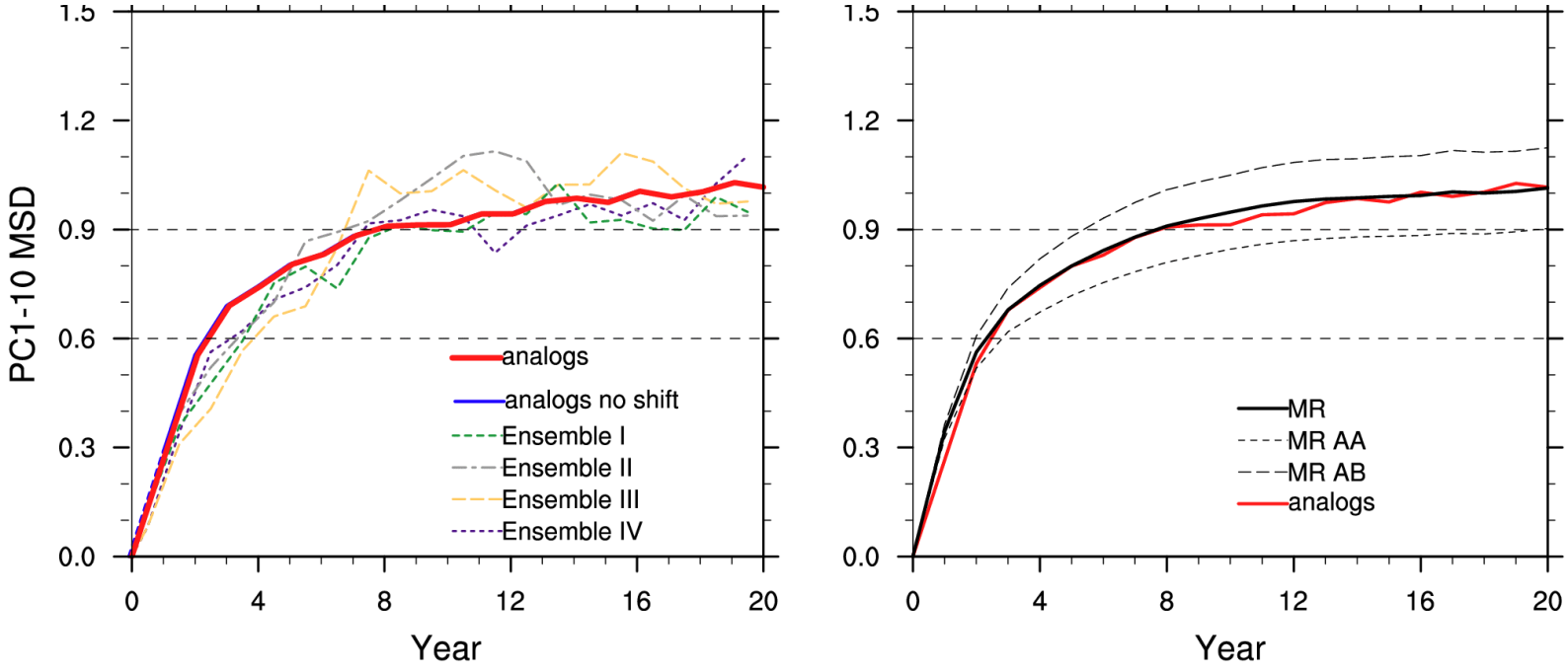


X

Predictability from Ensembles, Analogs & Regression

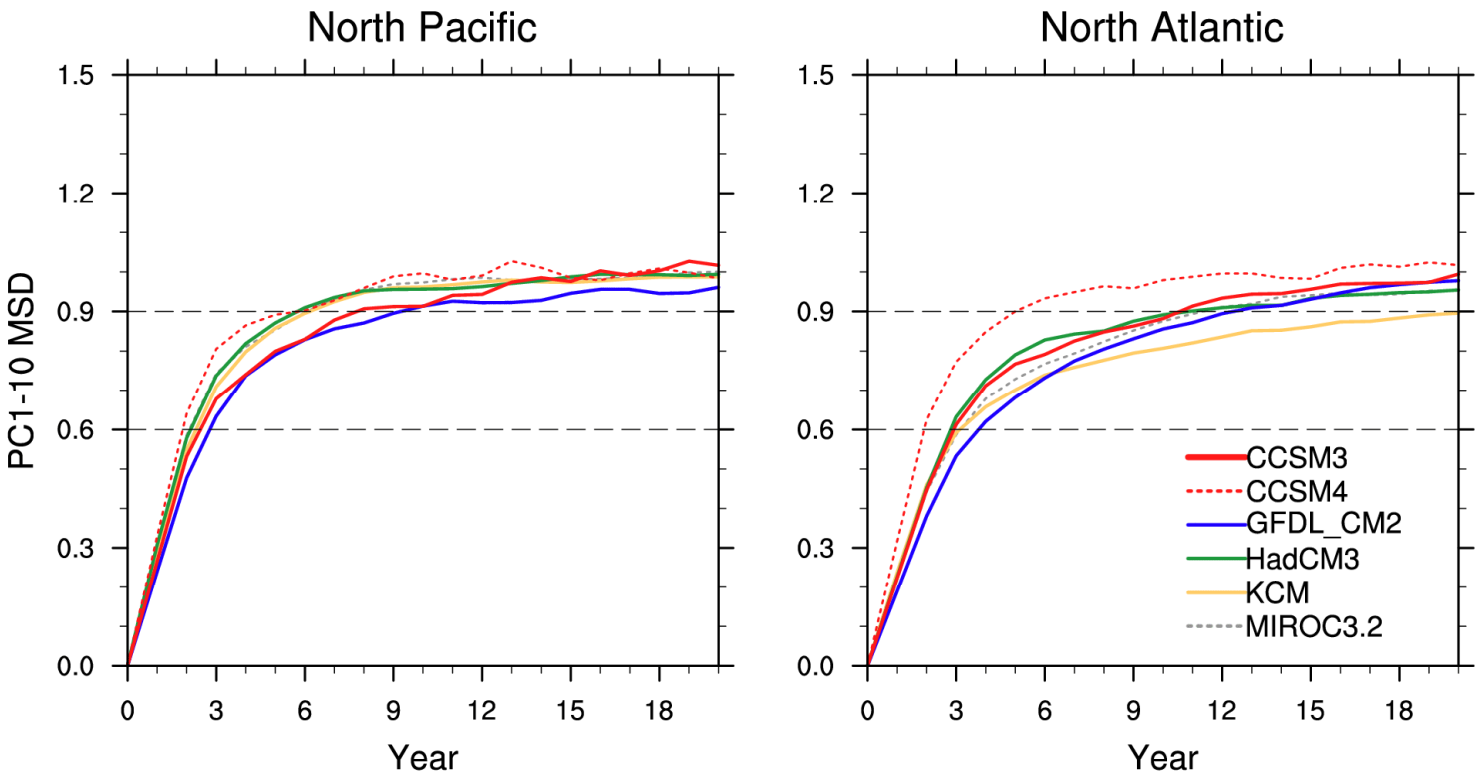
CCSM3

North Pacific



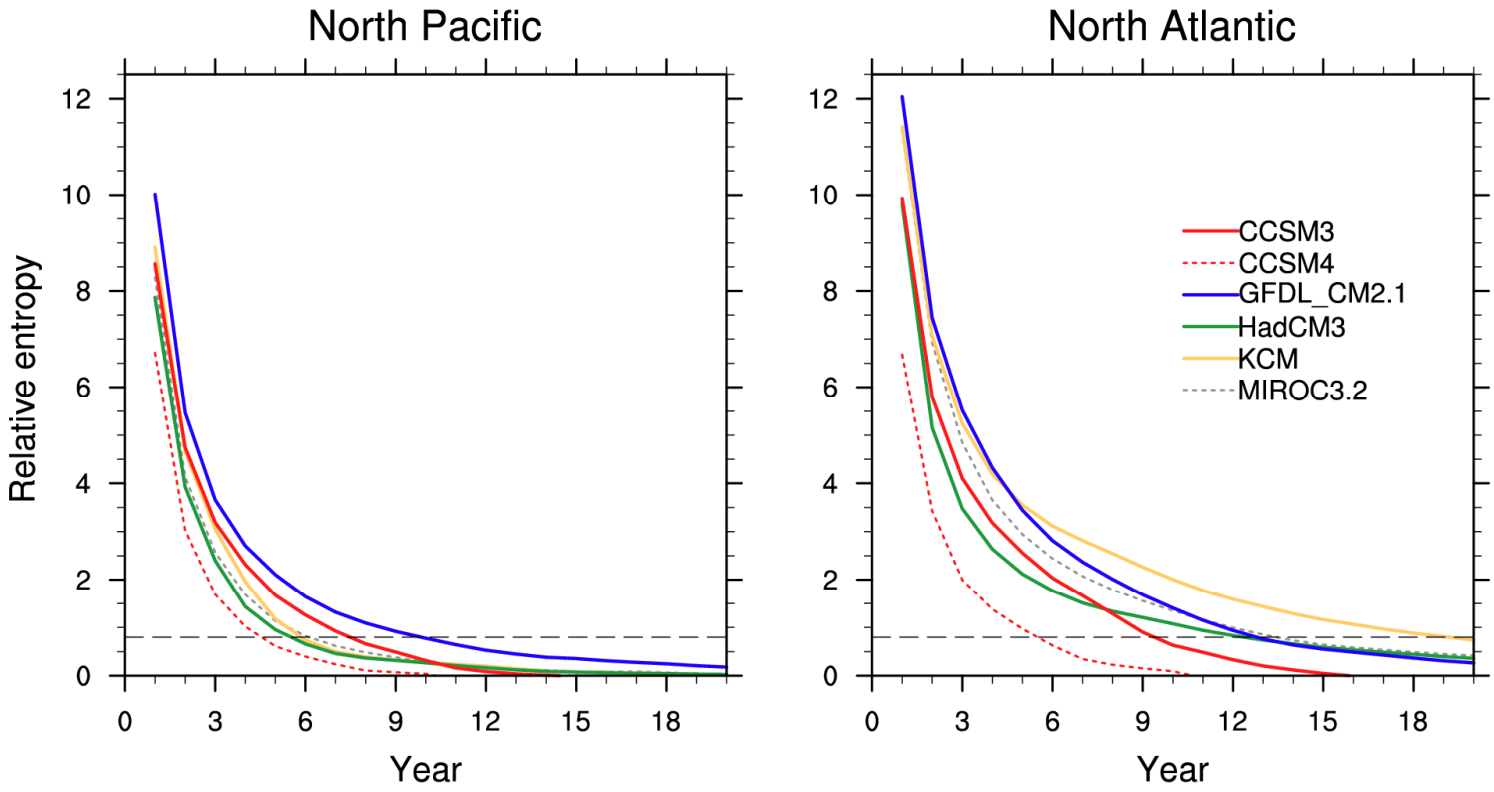
Mean Square Difference

analog method



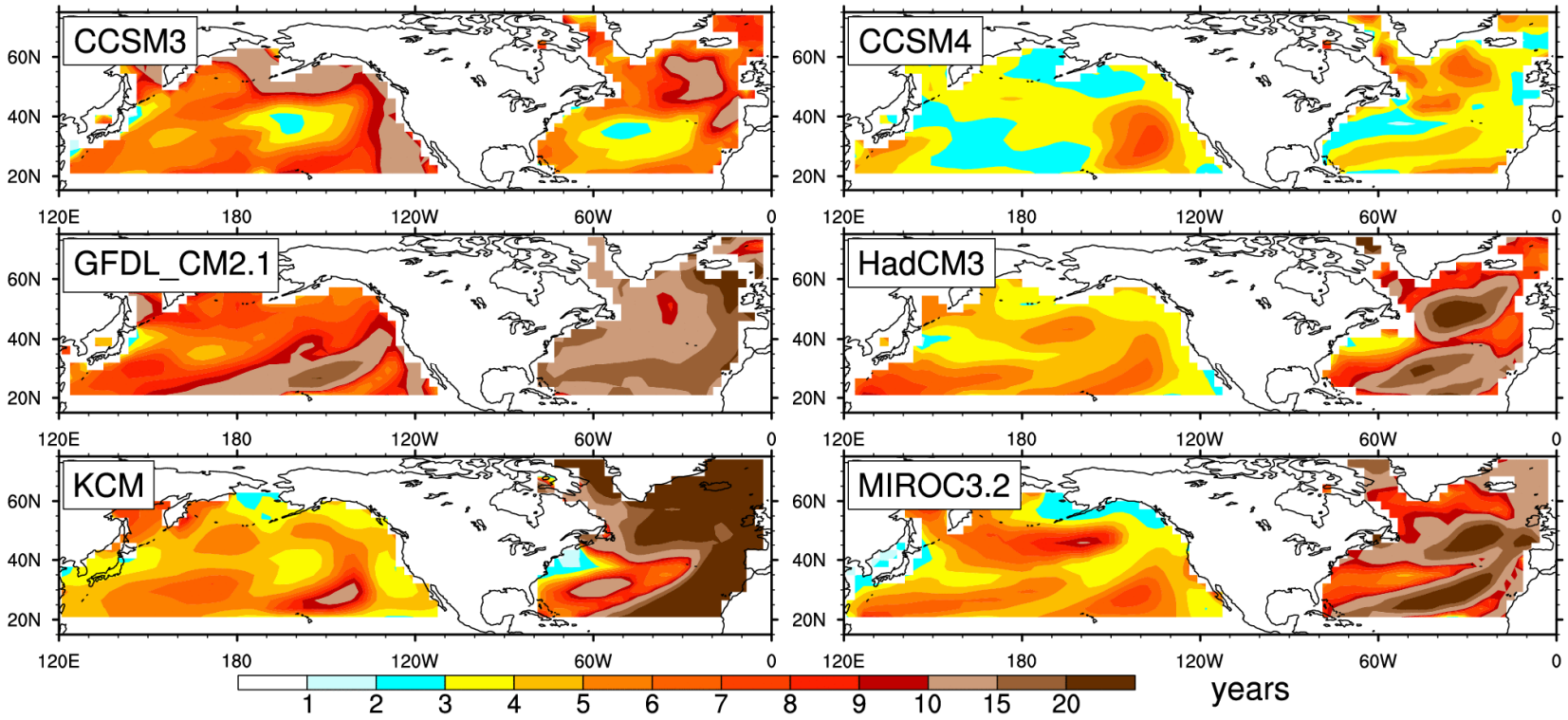
Basin Total Relative Entropy

multivariate regression method

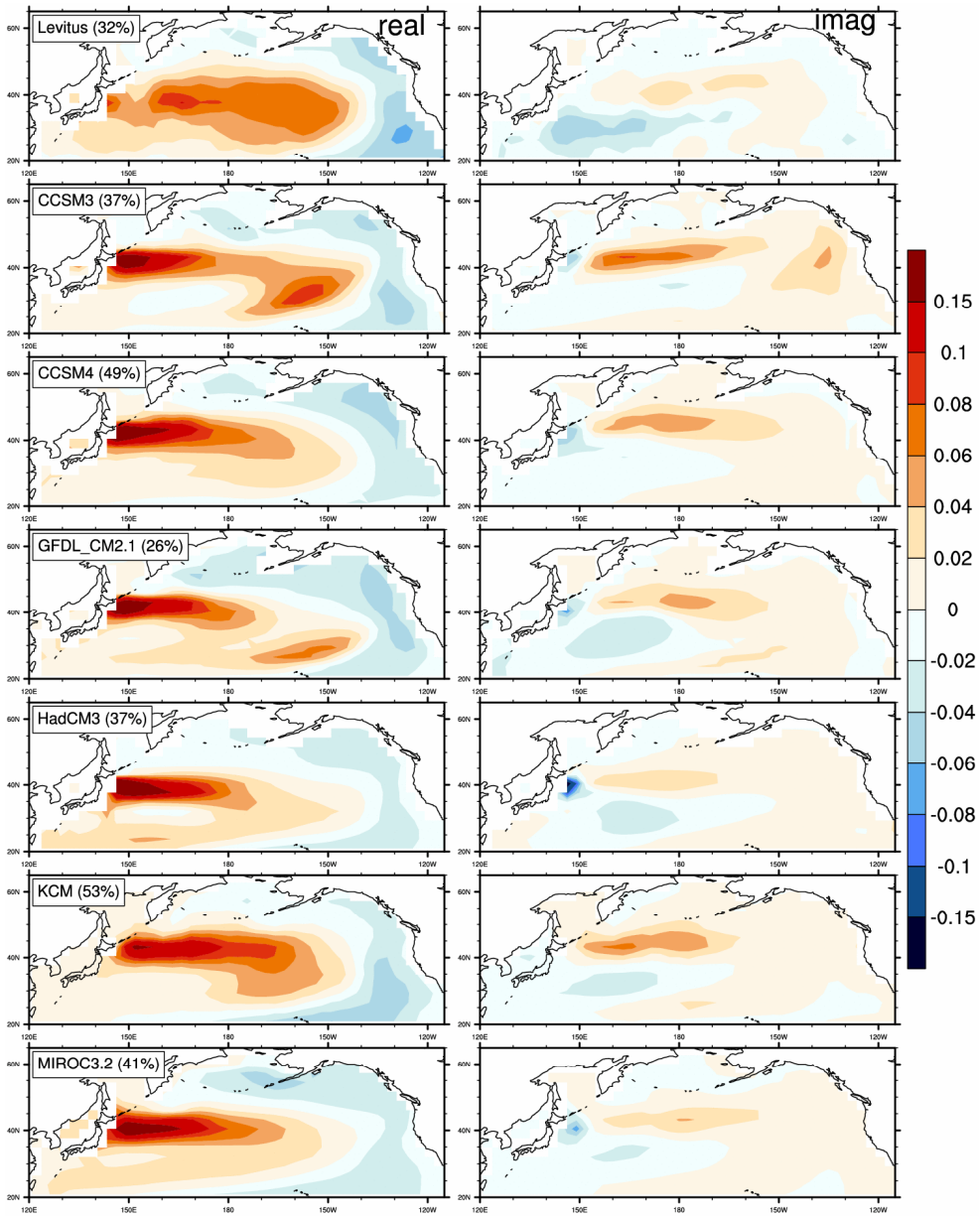


Year of Nominal Predictability Limit

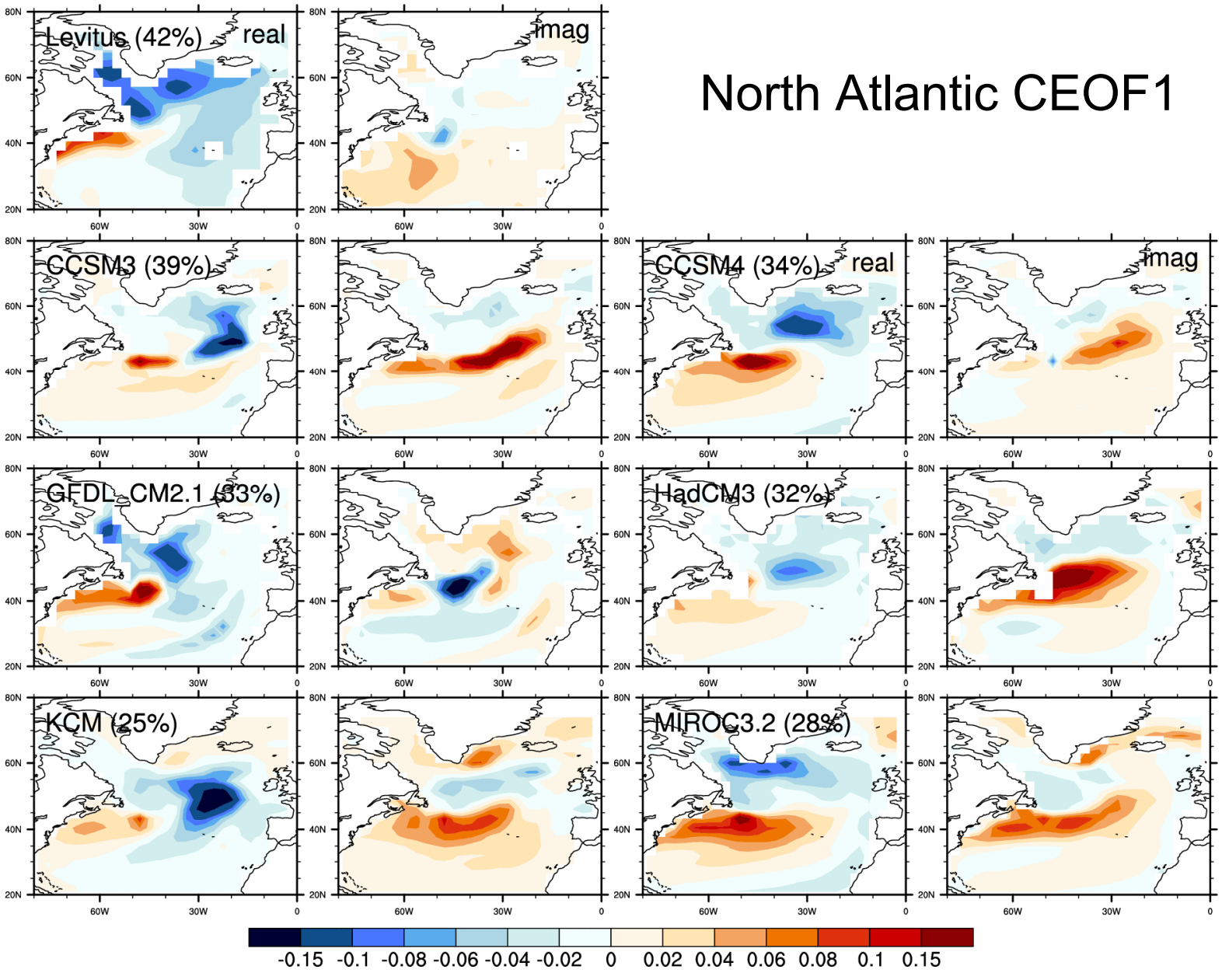
multivariate regression method



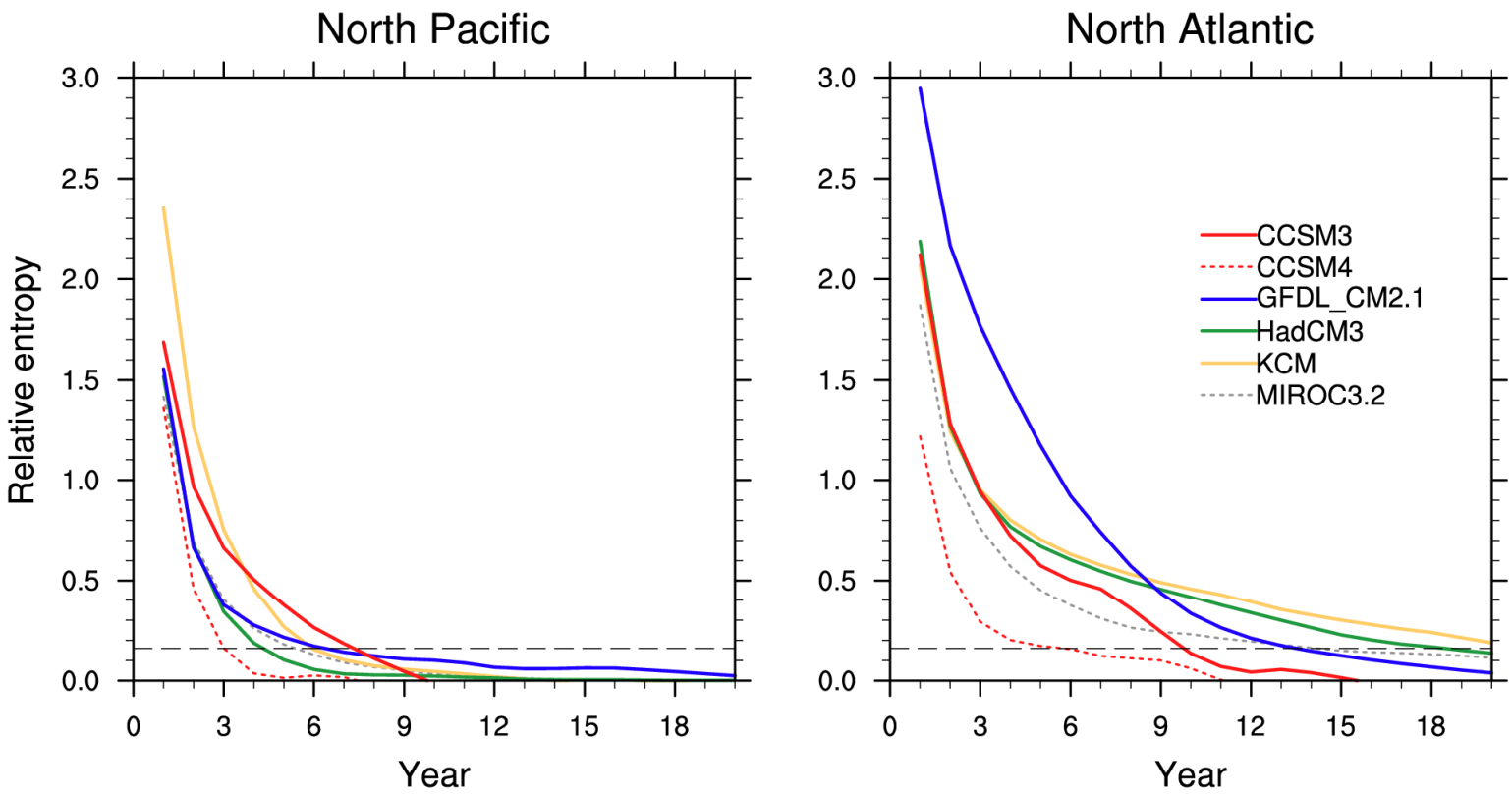
North Pacific CEOF1



North Atlantic CEOF1



Relative Entropy for CEOF1



Summary

1. *For basins and modes, T0-300 initial value predictability limit is roughly a **decade***
2. *Basin predictability limits vary by a factor of **two** and modal limits by a factor of **three** from model to model*
3. *For a given model, predictability varies by a factor of **four** from region to region*

Ergo

*** An essential component of any decadal prediction effort is quantification of the predictability of the forecast model**

*** Current numerical models cannot be used to assessment decadal predictability**

e-damping time