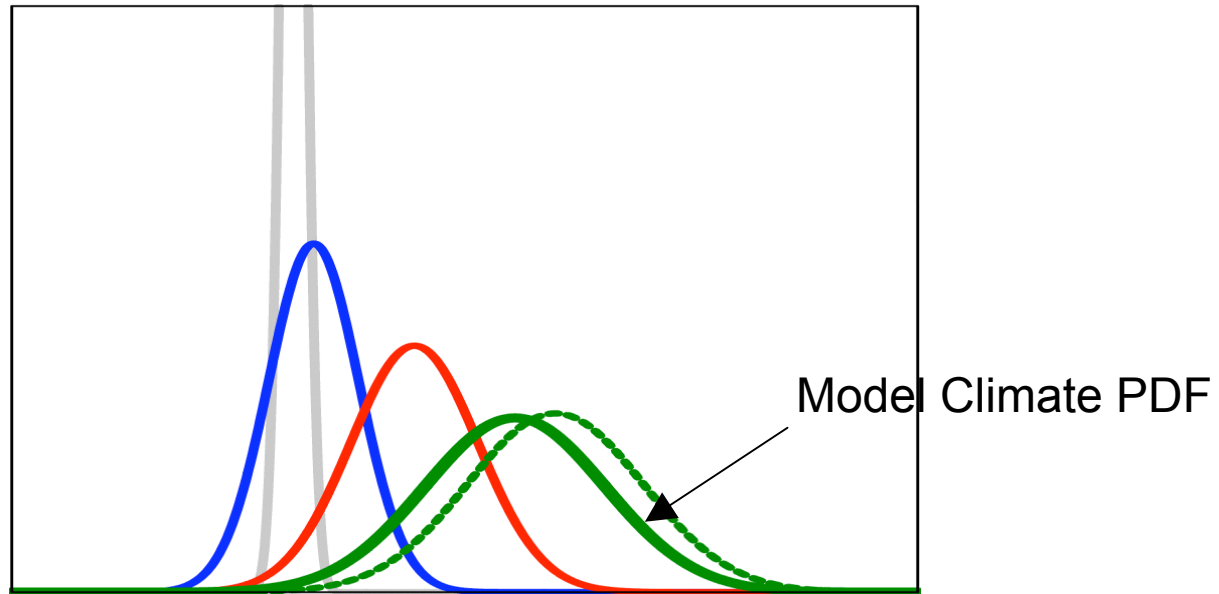
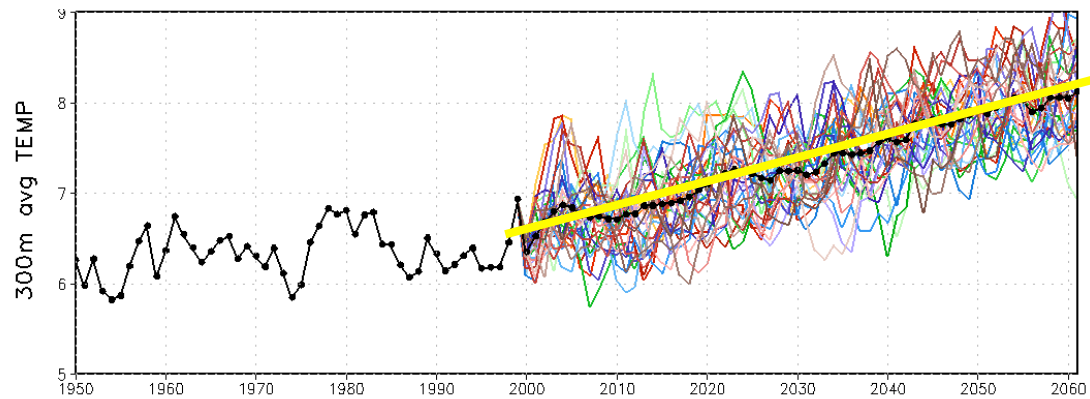


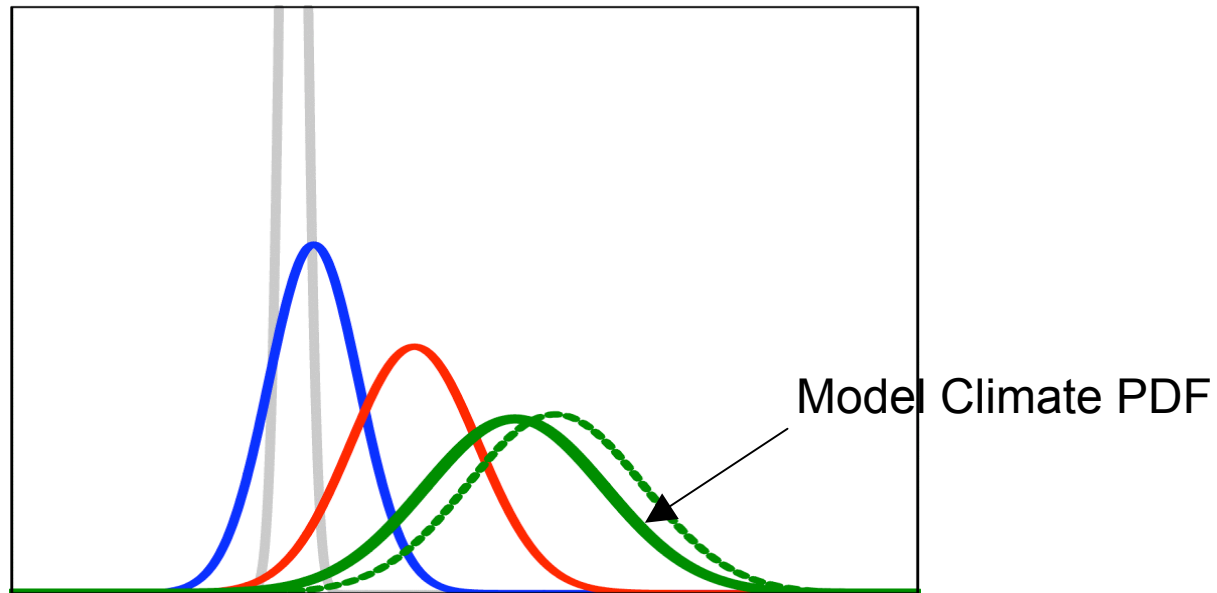
Information & Predictability



0-300m annual mean ocean temperature
at 140°E-200°E, 40°N-50°N



Information & Predictability



0-300m annual mean ocean temperature
at 140°E-200°E, 40°N-50°N

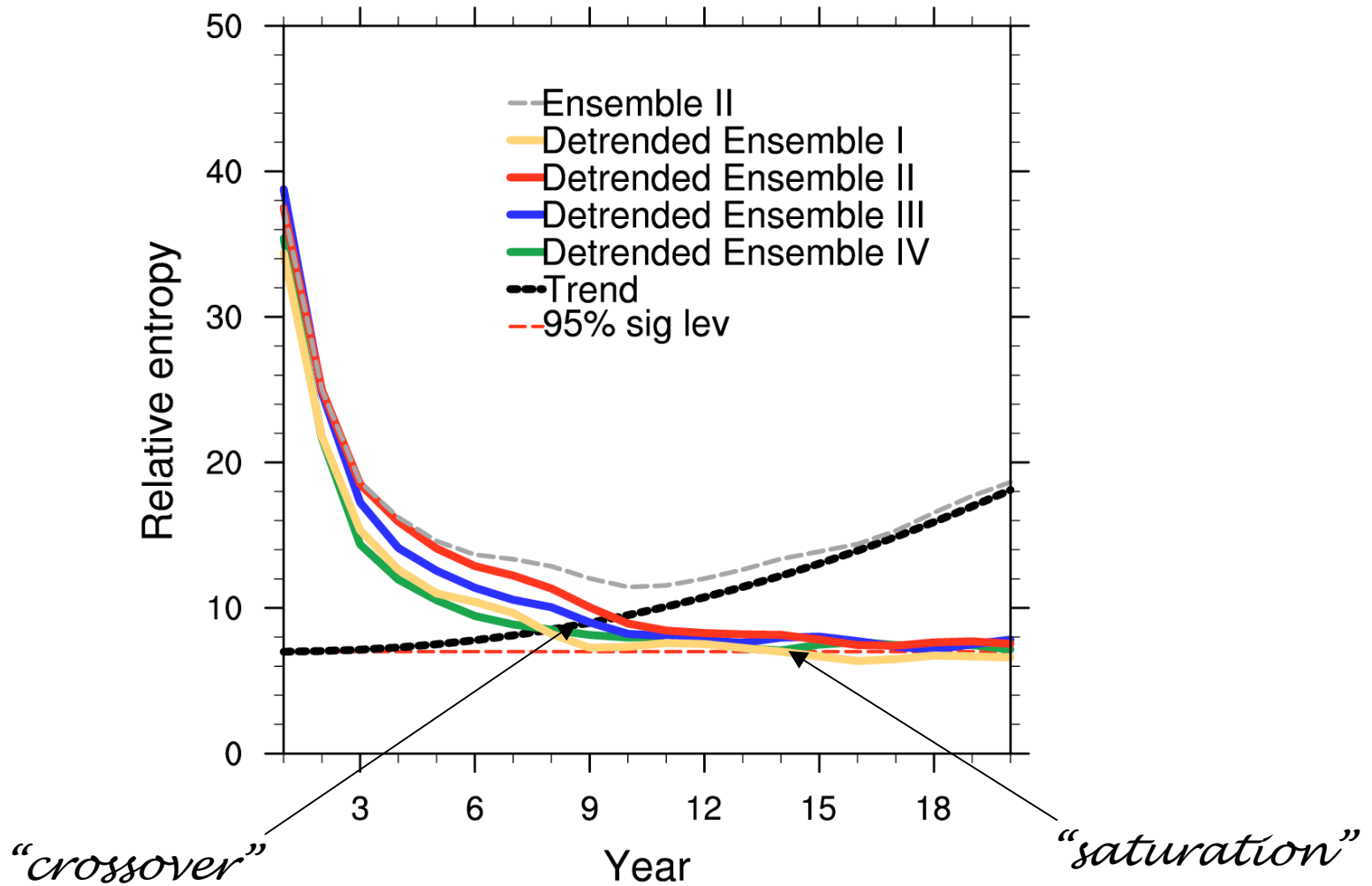
Relative Entropy

$$R = \frac{1}{2} \left[\ln \left(\frac{\sigma_c^2}{\sigma_e^2} \right) + \frac{\sigma_e^2}{\sigma_c^2} + \frac{(u^e - \mu^c)^2}{\sigma_c^2} + 1 \right]$$

“dispersion” *“signal”*

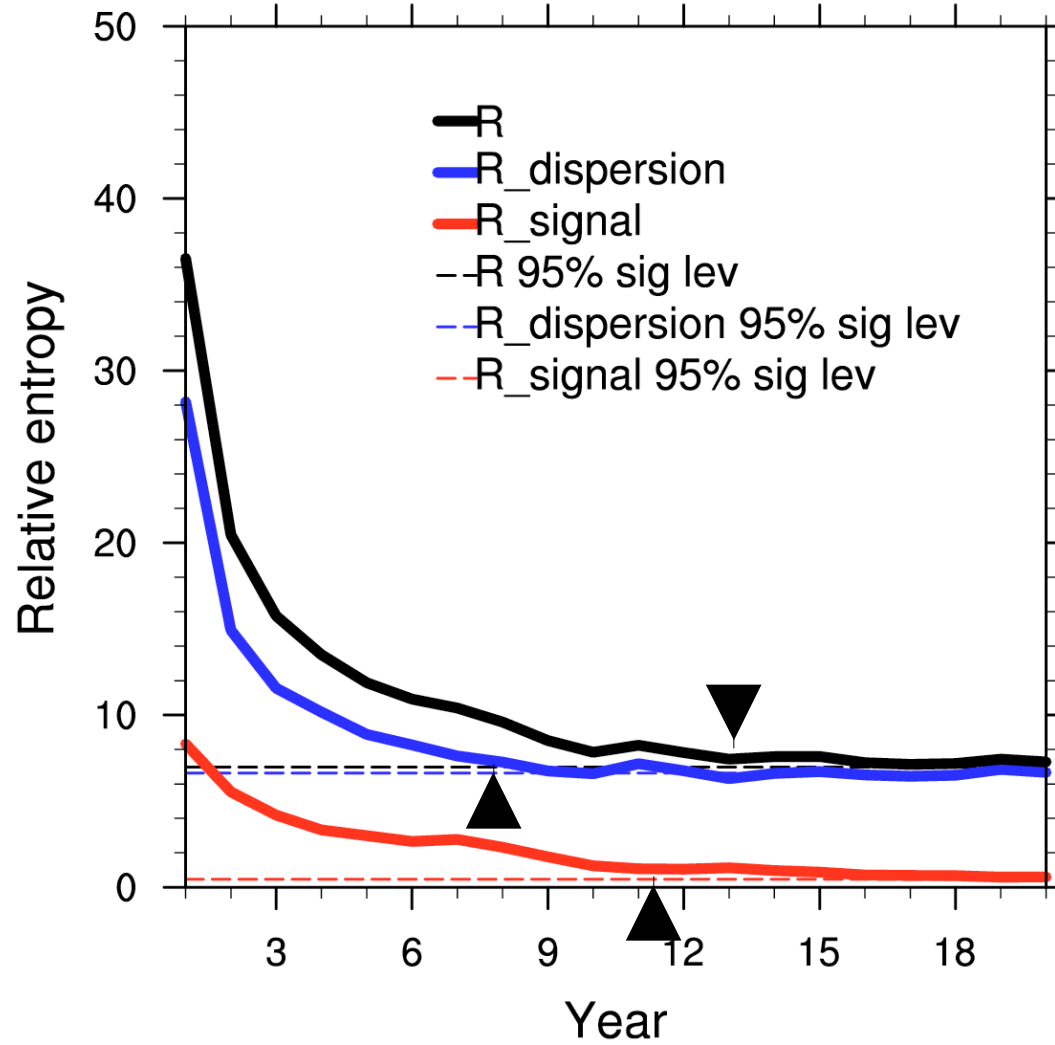
Information in 0-300m temperature CCSM3 A1b ensembles

Global Domain EOF1-25

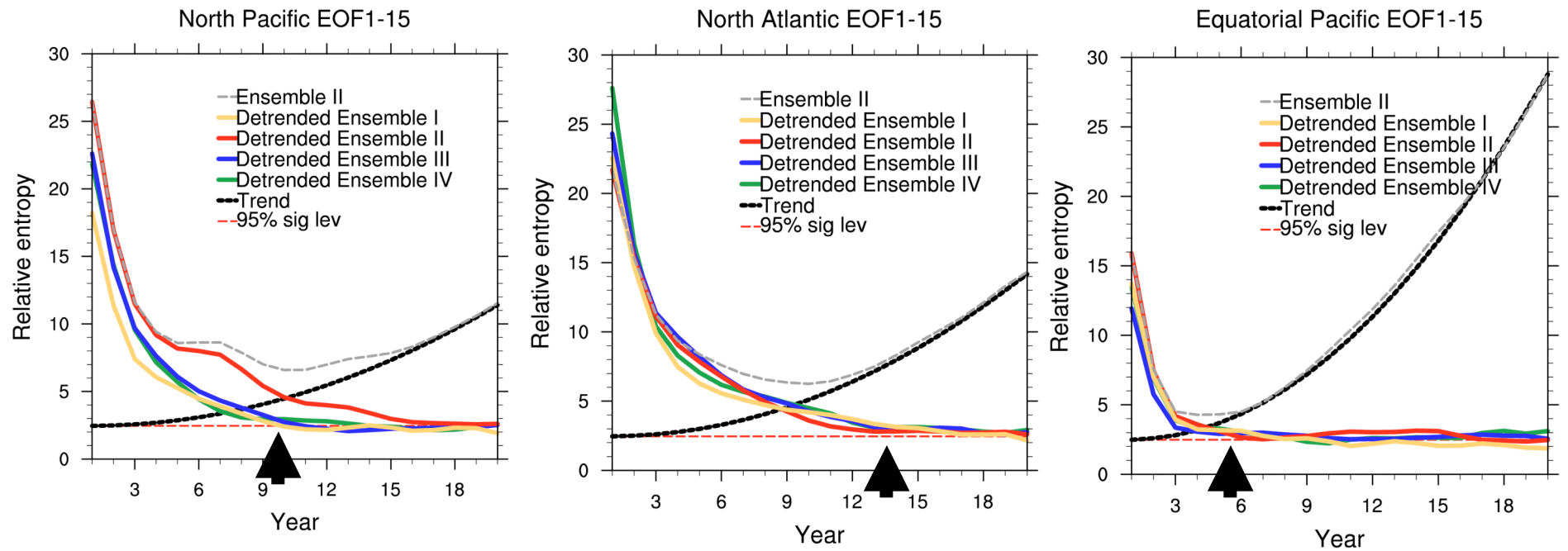


Decomposition of 0-300m Temperature Predictability

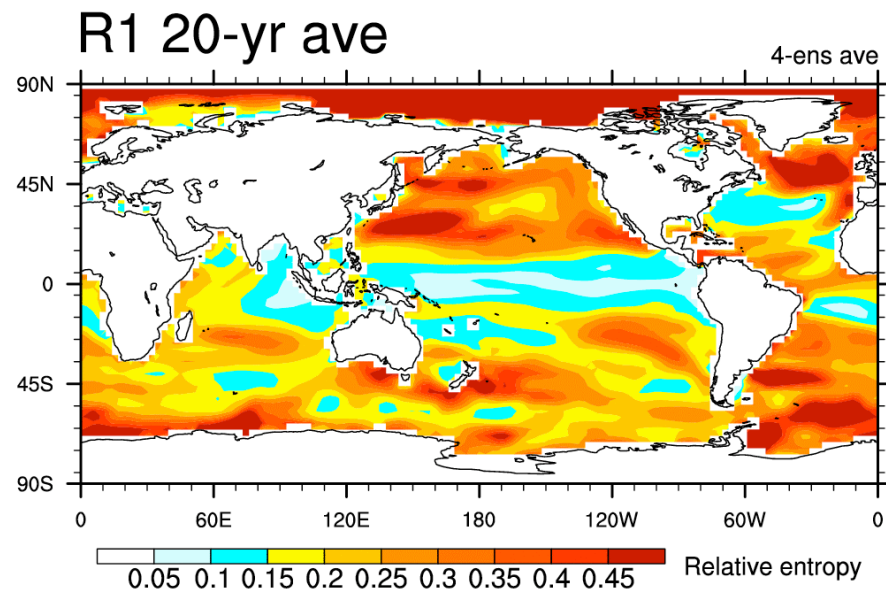
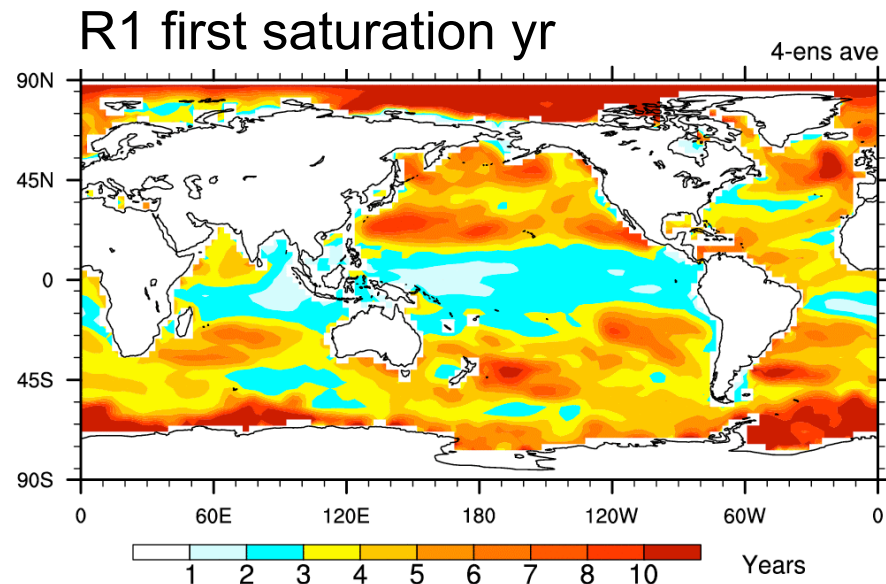
Global Domain EOF1-25, 4 Ensemble Avg



Basin Dependence of Predictability of 0-300m Temperature



Local, univariate relative entropy



Predictability of Intrinsic Modes

Haiyan Teng
tomorrow

Generalizations from the Control

Linear Inverse Modeling

If a system is approximately linear with Gaussian white noise driving

$$\frac{d\mathbf{x}}{dt} = \mathbf{B}\mathbf{x} + \xi,$$

then

$$\exp(\mathbf{B}\tau_0) = \mathbf{C}(\tau_0)\mathbf{C}^{-1}(0) .$$

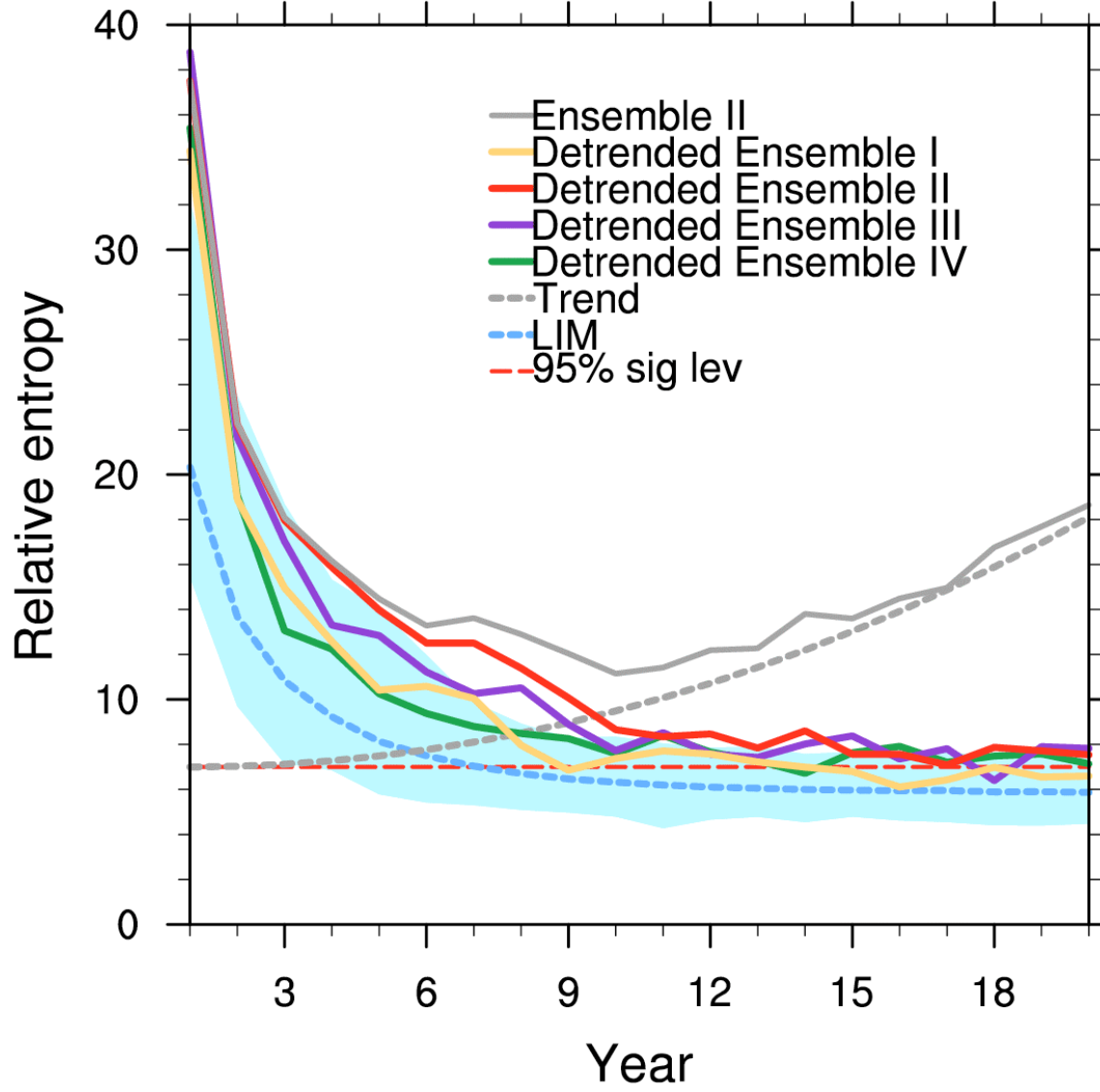
And using propagator

$$\mathbf{G}(\tau) = \exp(\mathbf{B}\tau) = [\mathbf{G}(\tau_0)]^{\tau/\tau_0},$$

the future mean and covariance of an initial state can be found

$$\left\{ \begin{array}{l} \bar{\mathbf{x}}(t + \tau) = \mathbf{G}(\tau)\hat{\mathbf{x}}(t) \\ \langle \mathbf{x}(t + \tau)\mathbf{x}^T(t + \tau) \rangle = \mathbf{C}(0) - \mathbf{G}(\tau)\mathbf{C}(0)\mathbf{G}^T(\tau) . \end{array} \right.$$

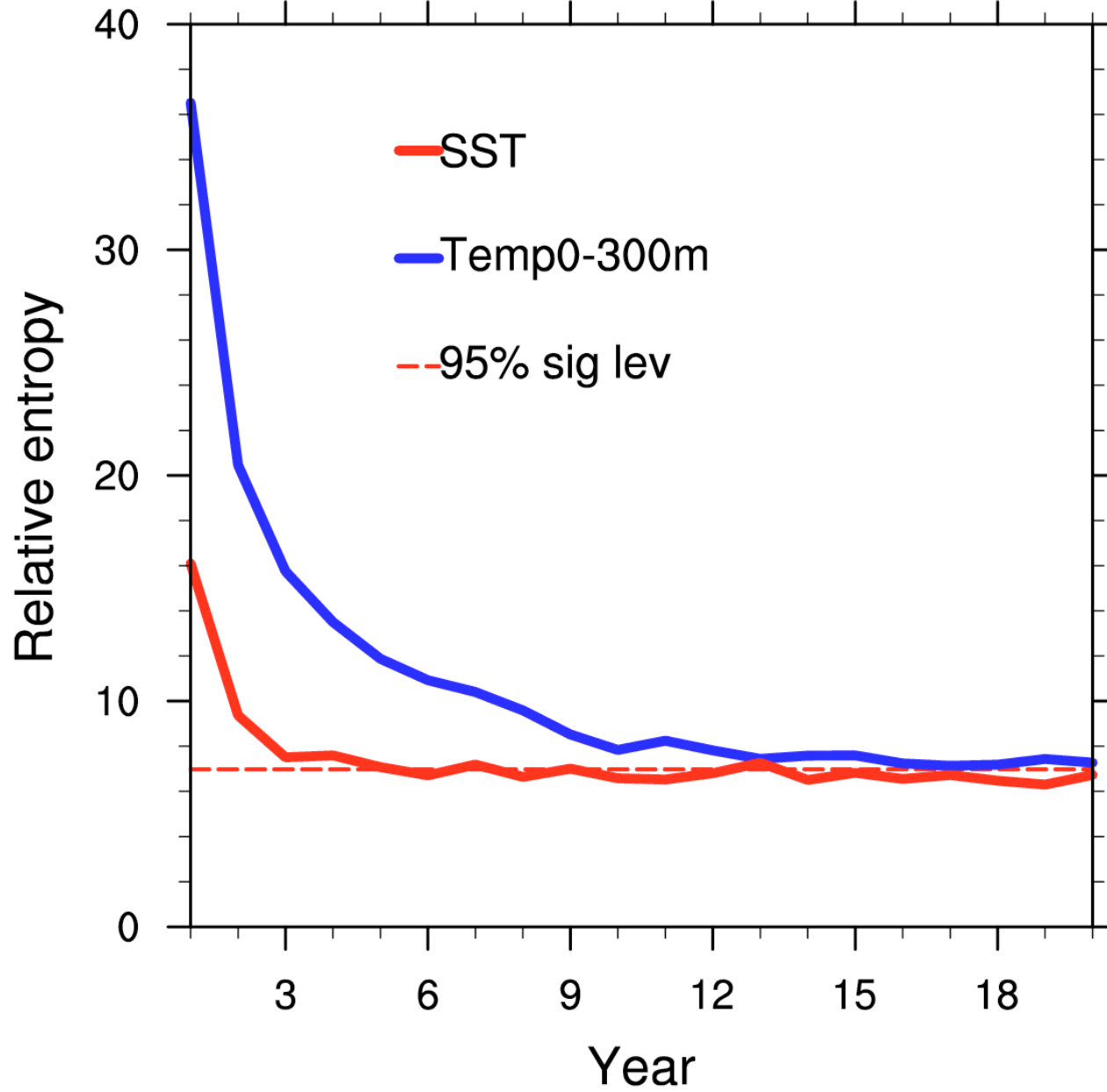
Global Domain EOF1-25



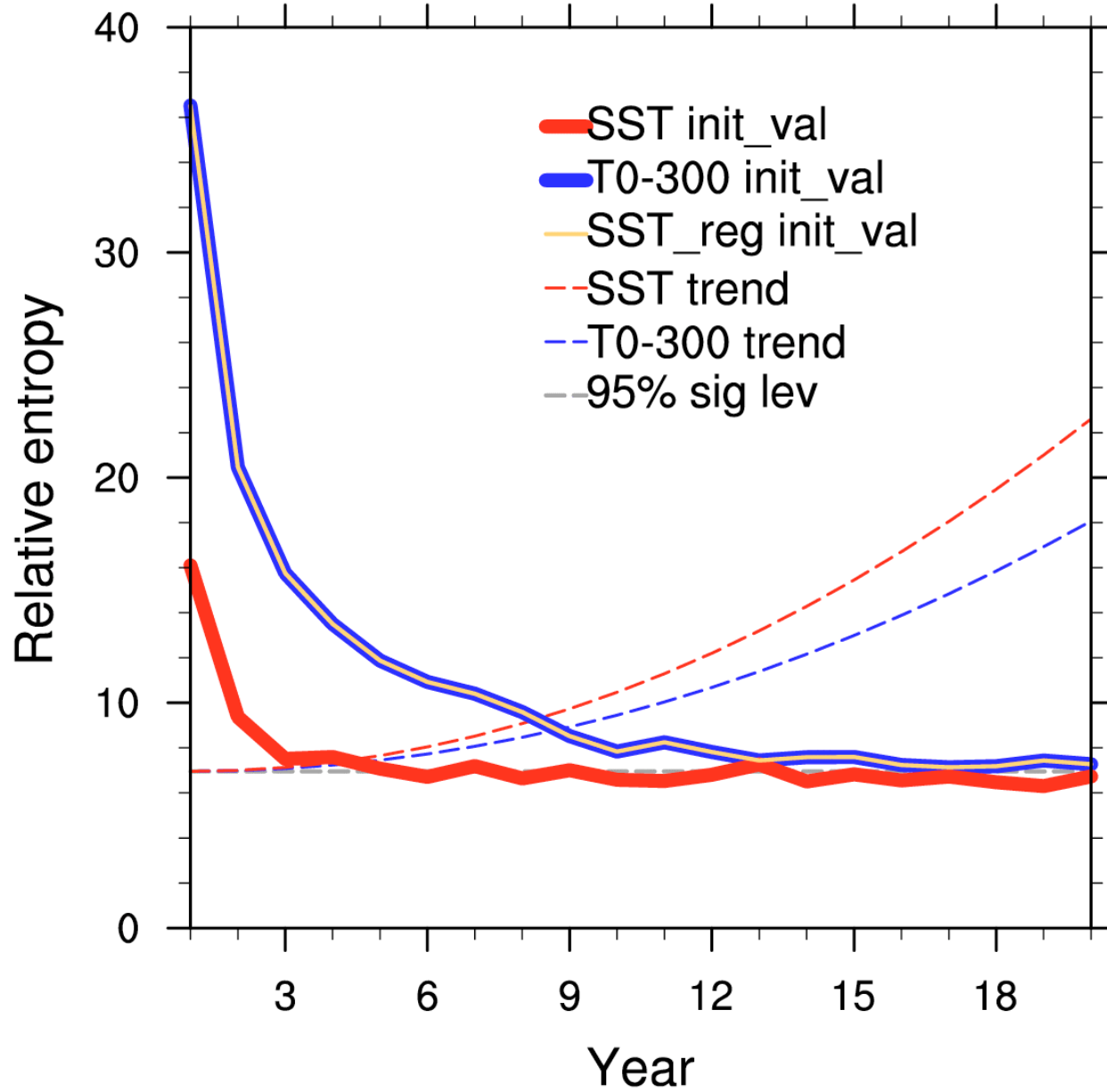
Other variables:

SST

Global Domain EOF1-25



Global Domain EOF1-25



Summary

- Globally, initial information is lost at **~yr12** and the forced response dominates after **~yr8**
- The **mean signal** last longer than covariance information
- Predictability **varies by a factor of 4** between basins and by 3 within basins
- **Intrinsic variability** in controls can be used to estimate predictability, but simple diagnosis of timescale is not sufficient
- **Subsurface temperature** is more predictable than SST and can be used to identify the predictable component of SST

