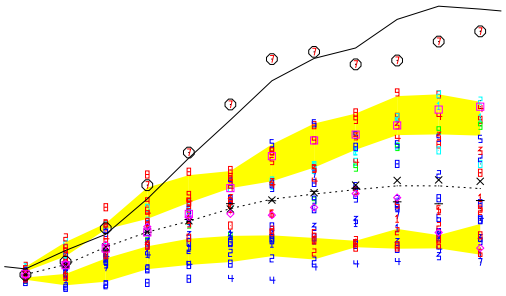
Assessing the Impact of Stochastic Forcing on ENSO Events



Andrew Wittenberg
GFDL/NOAA

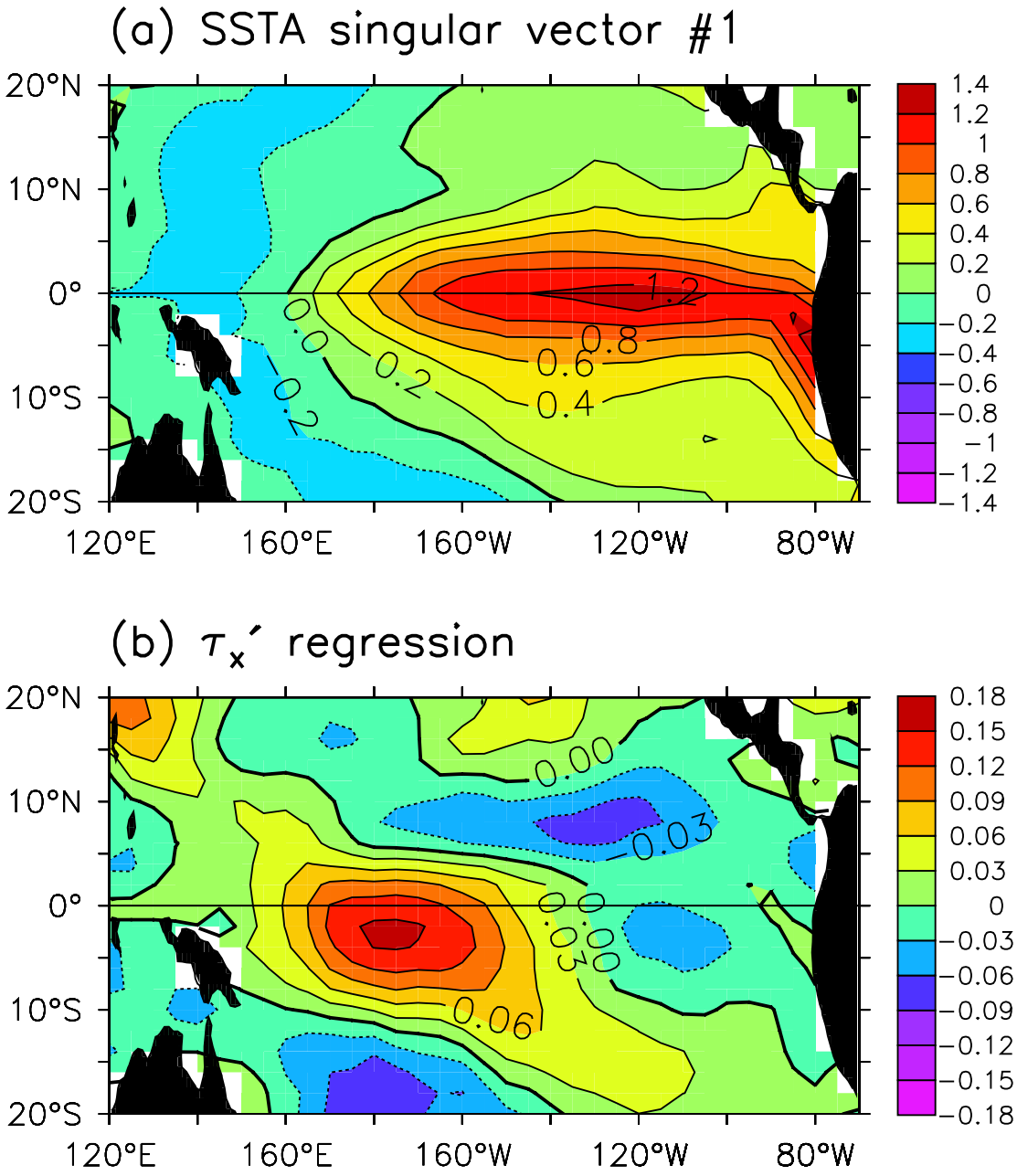
Eli Galanti
IRI/Columbia University

Thanks to:
Gabriel Vecchi

Email: Andrew.Wittenberg@noaa.gov

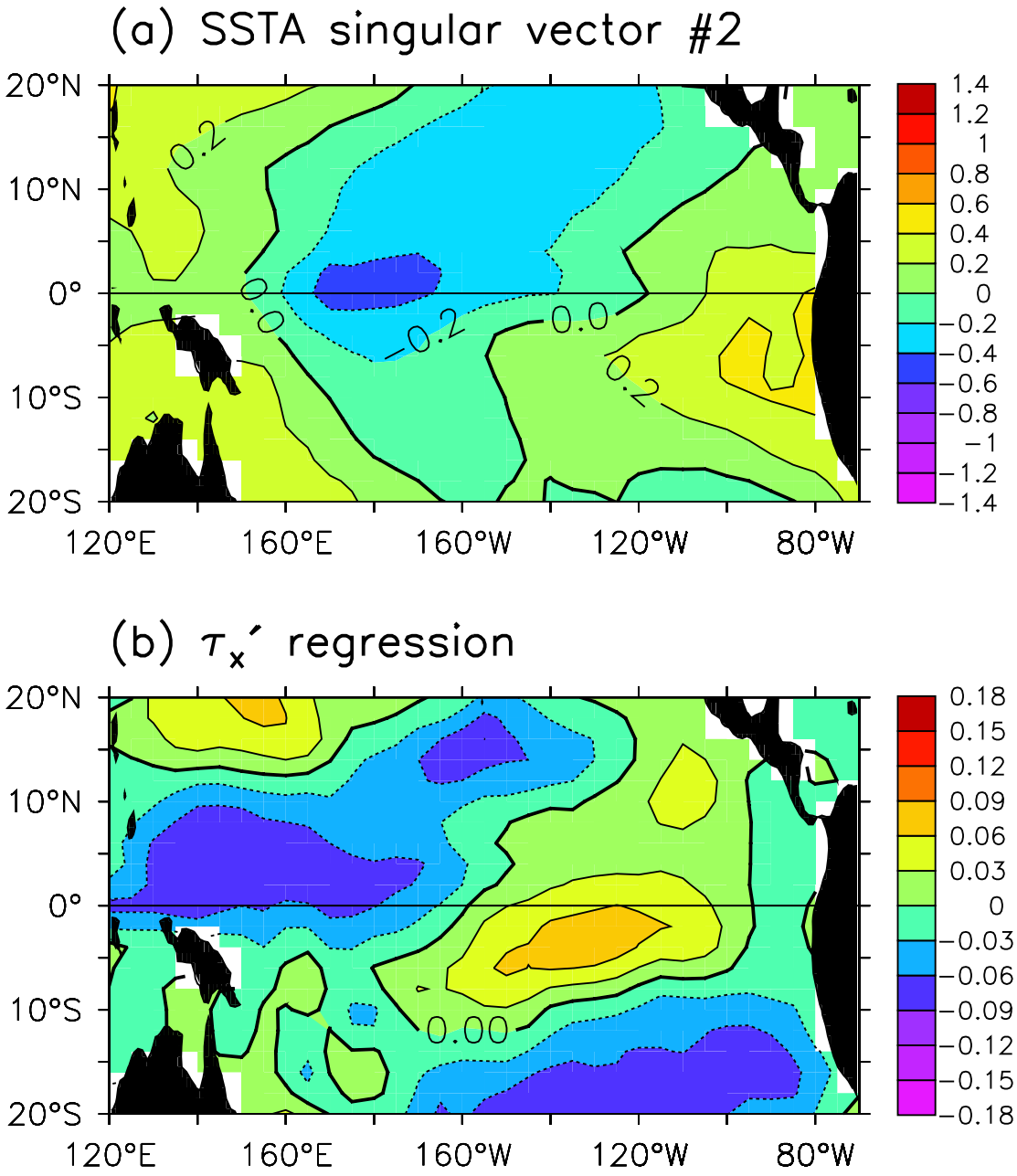
Statistical Atmosphere (Mode 1)

SST and wind stress from NCEP2 (1979–2002)

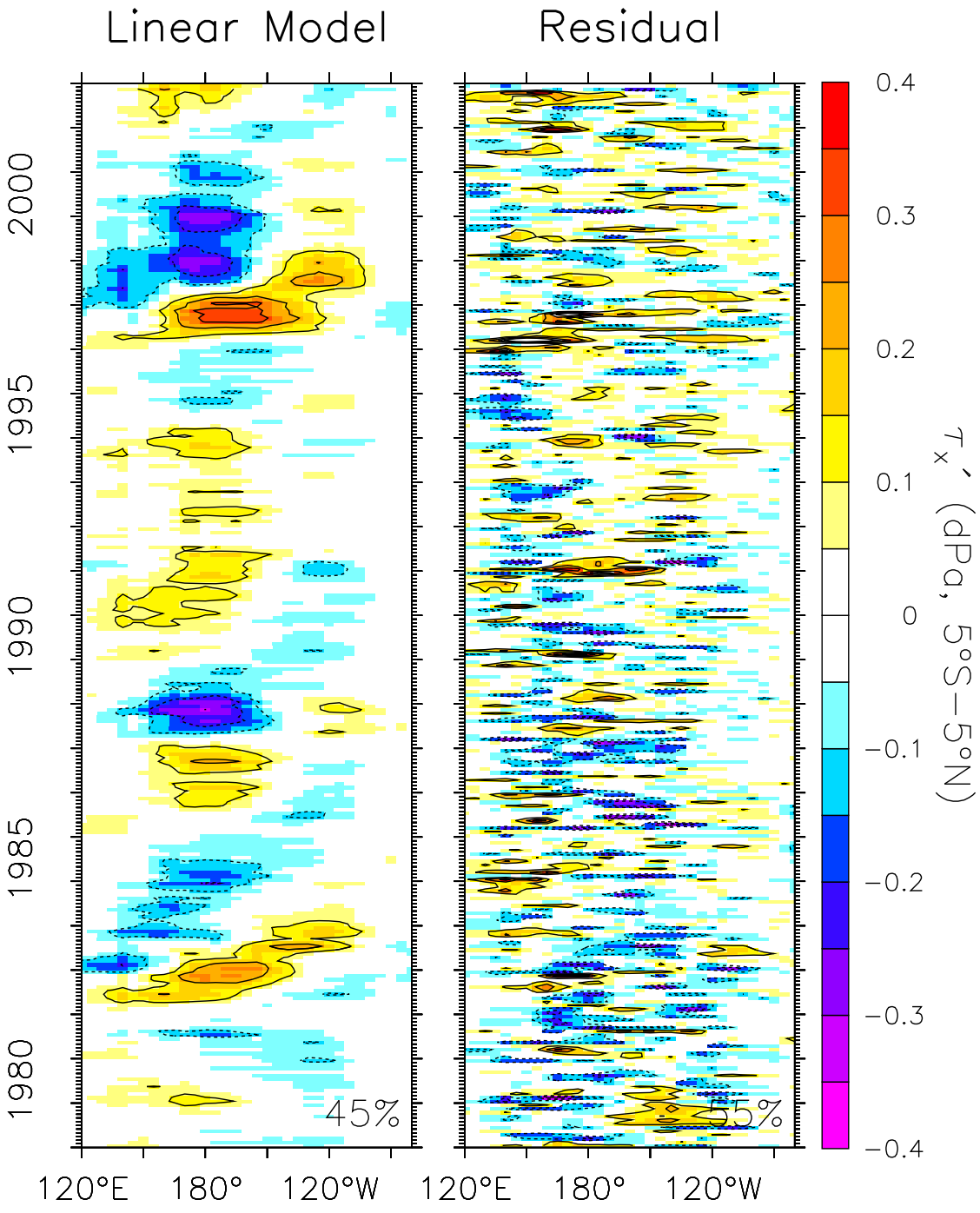


Statistical Atmosphere (Mode 2)

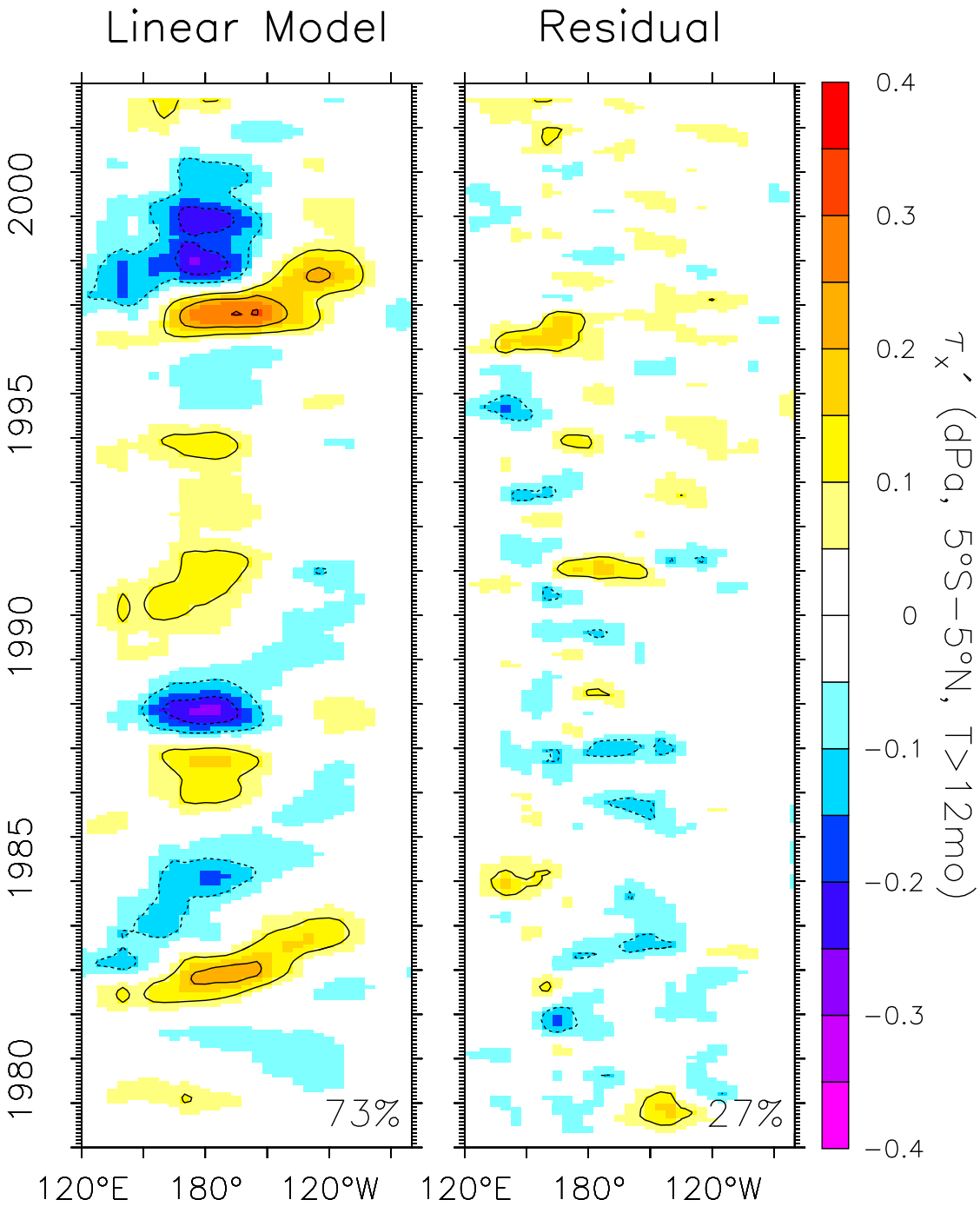
SST and wind stress from NCEP2 (1979–2002)



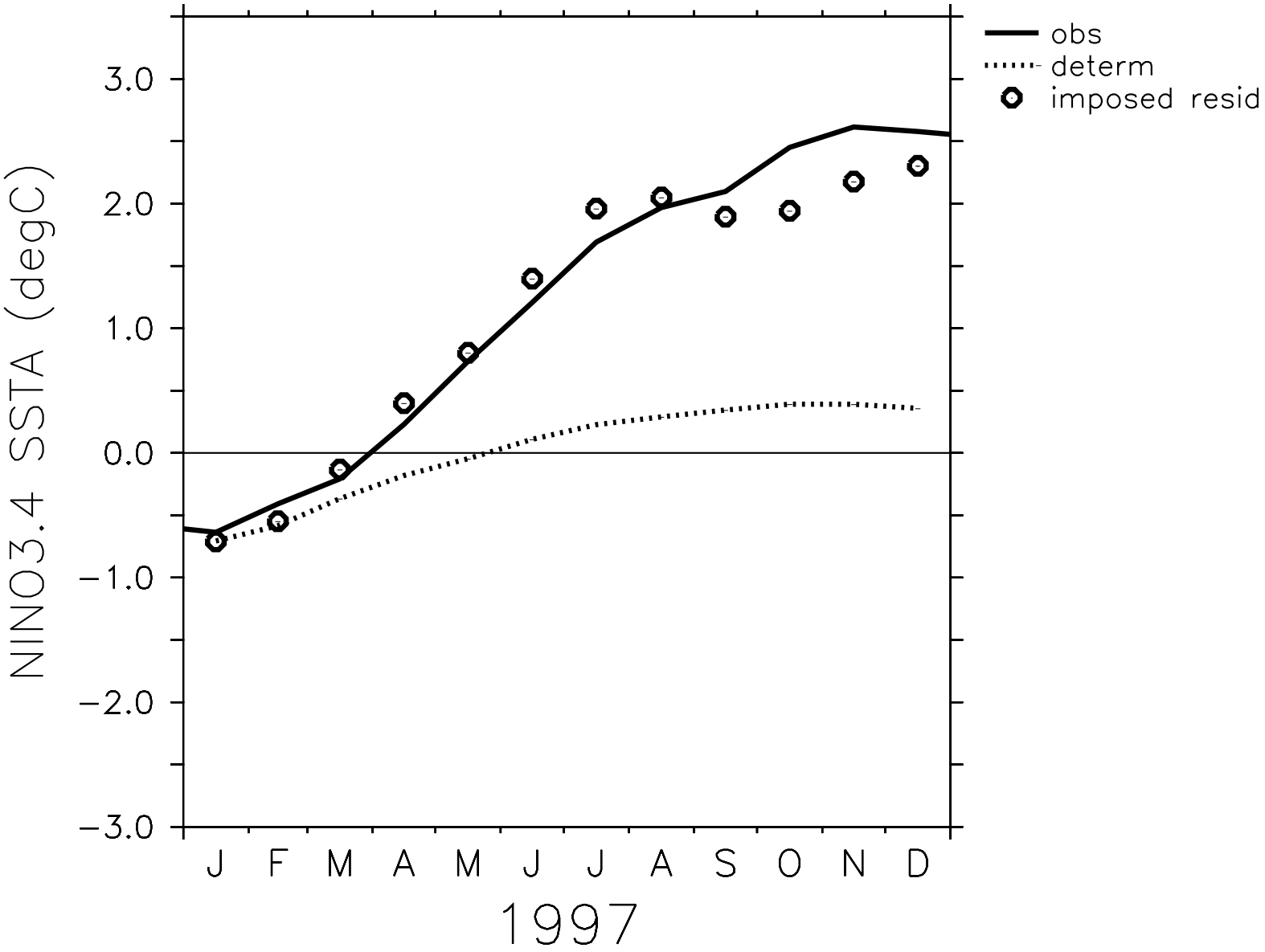
Wind Stress Decomposition: monthly NCEP2 obs



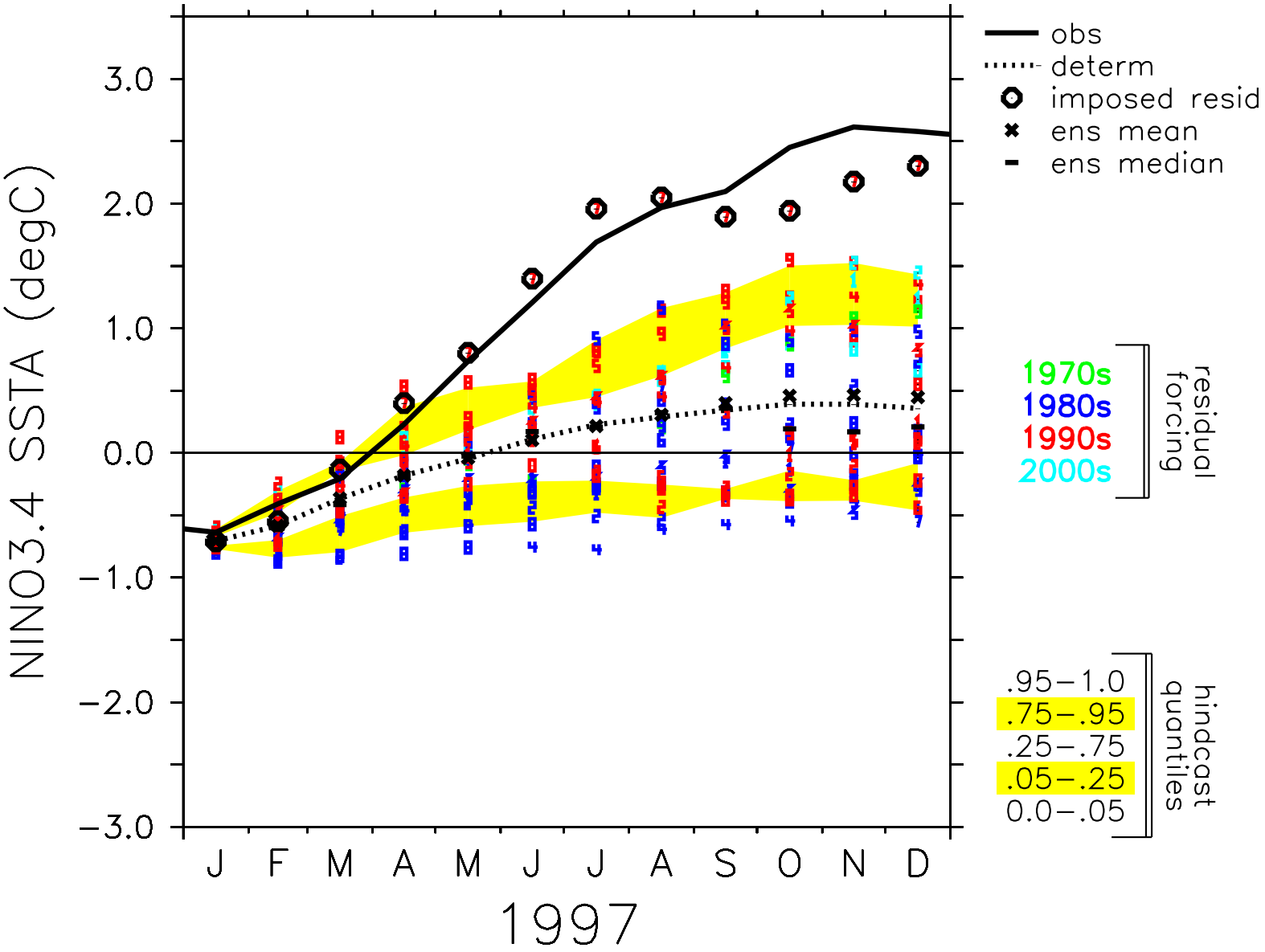
Wind Stress Decomposition: low-pass NCEP2 obs



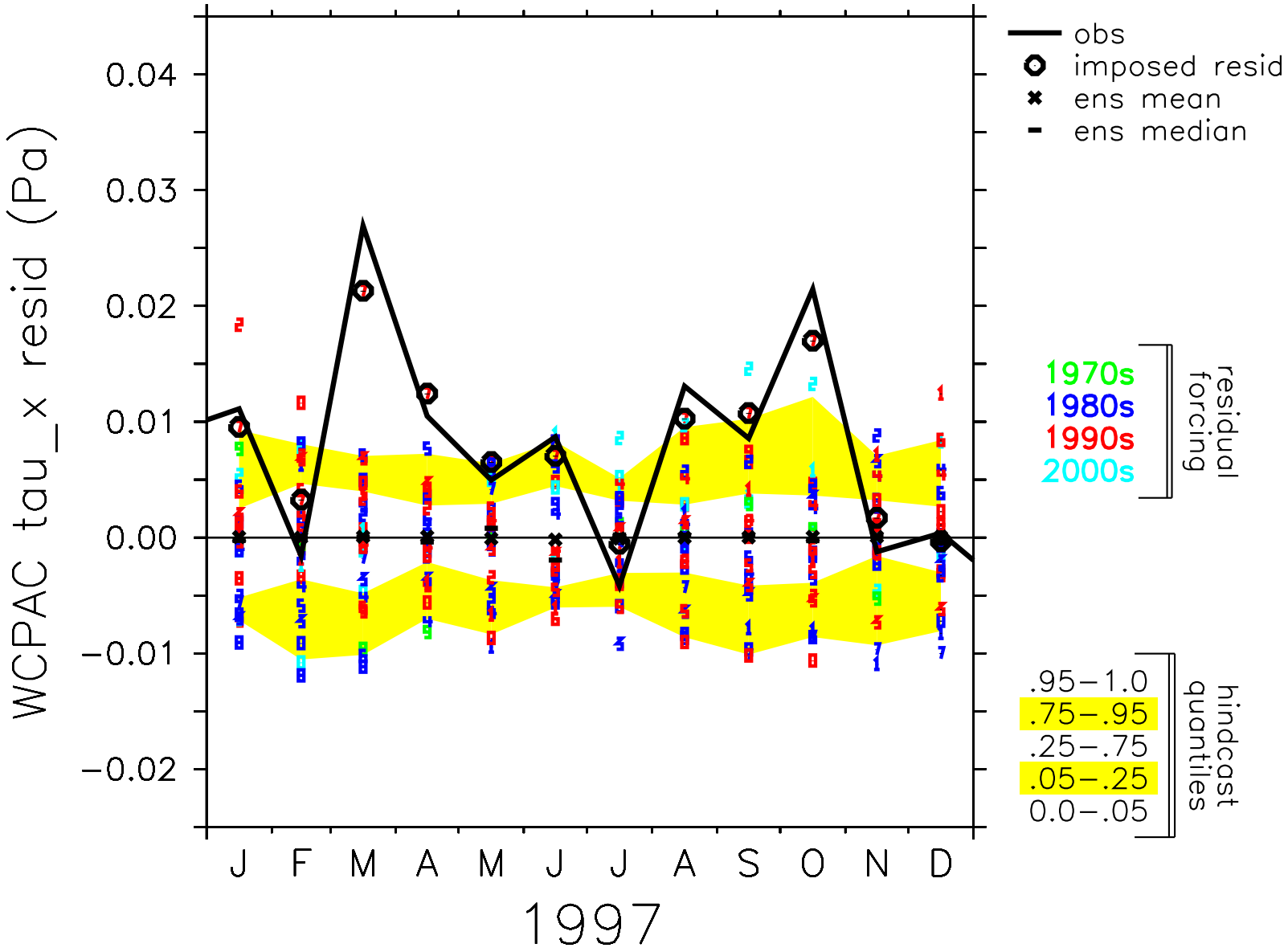
Deterministic Forecasts of East Pacific SST Anomalies



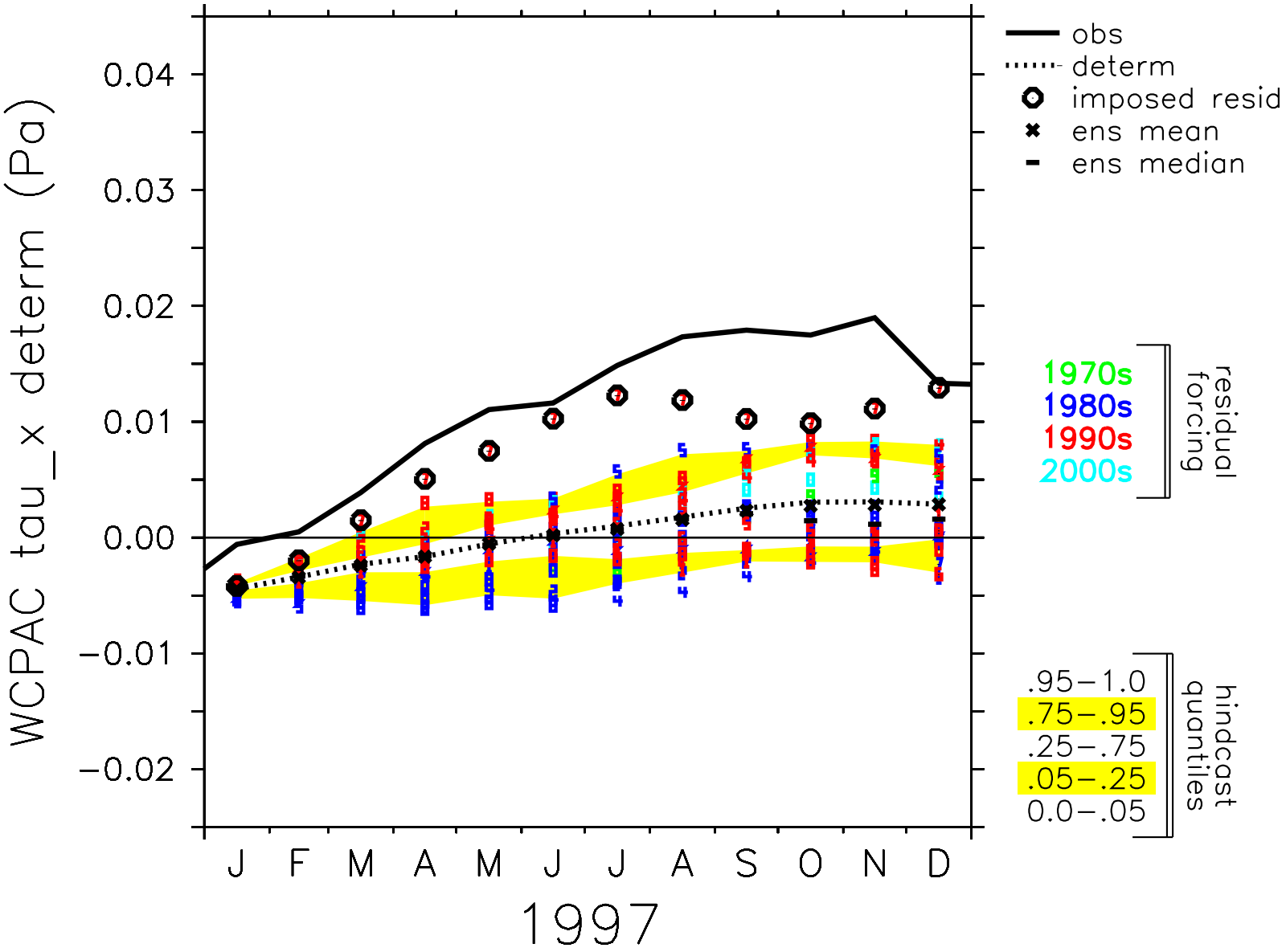
Stochastic Forecasts of East Pacific SST Anomalies



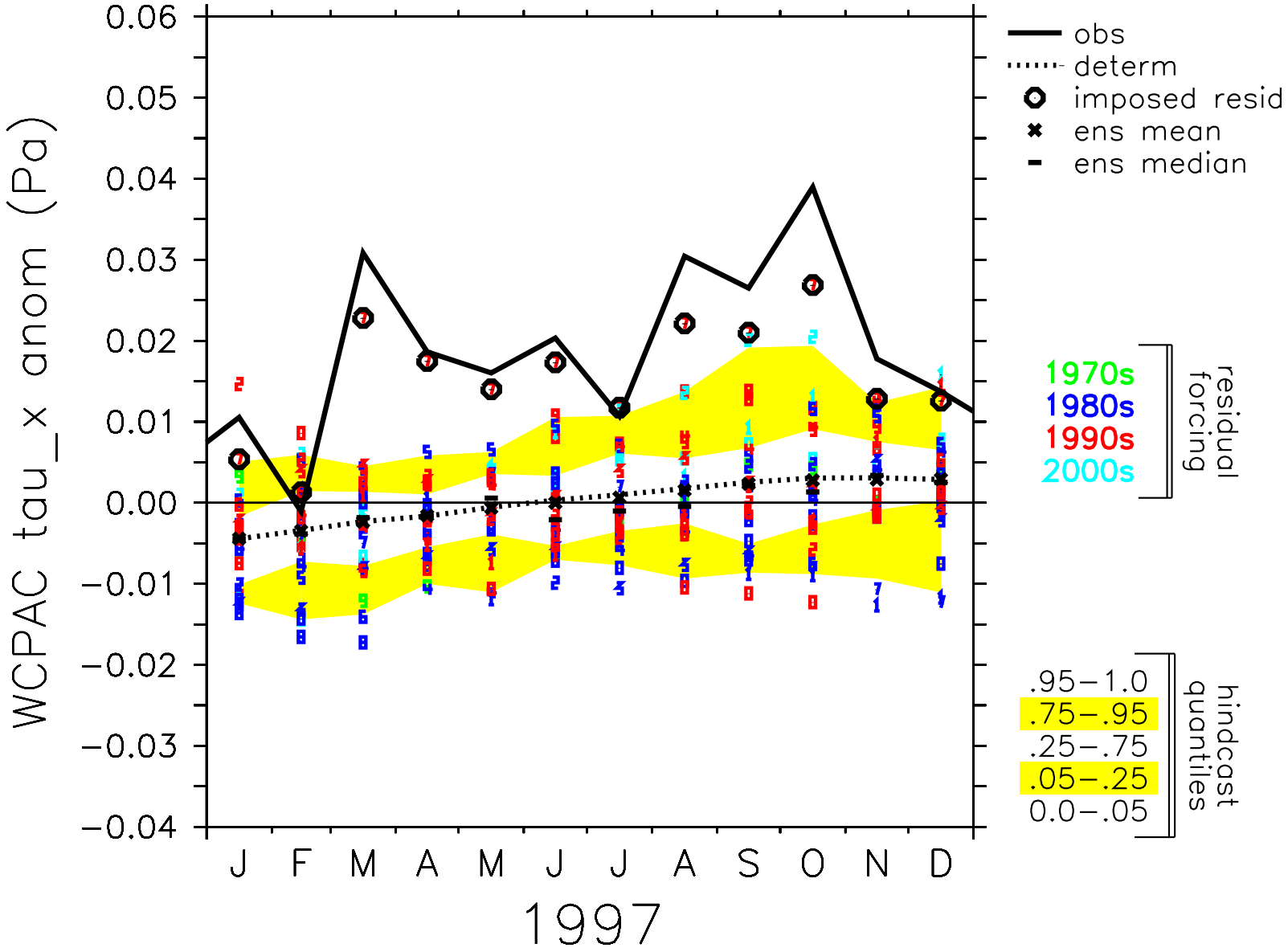
NCEP2 Residual Zonal Wind Stress



NCEP2 Deterministic Zonal Stress Anomaly

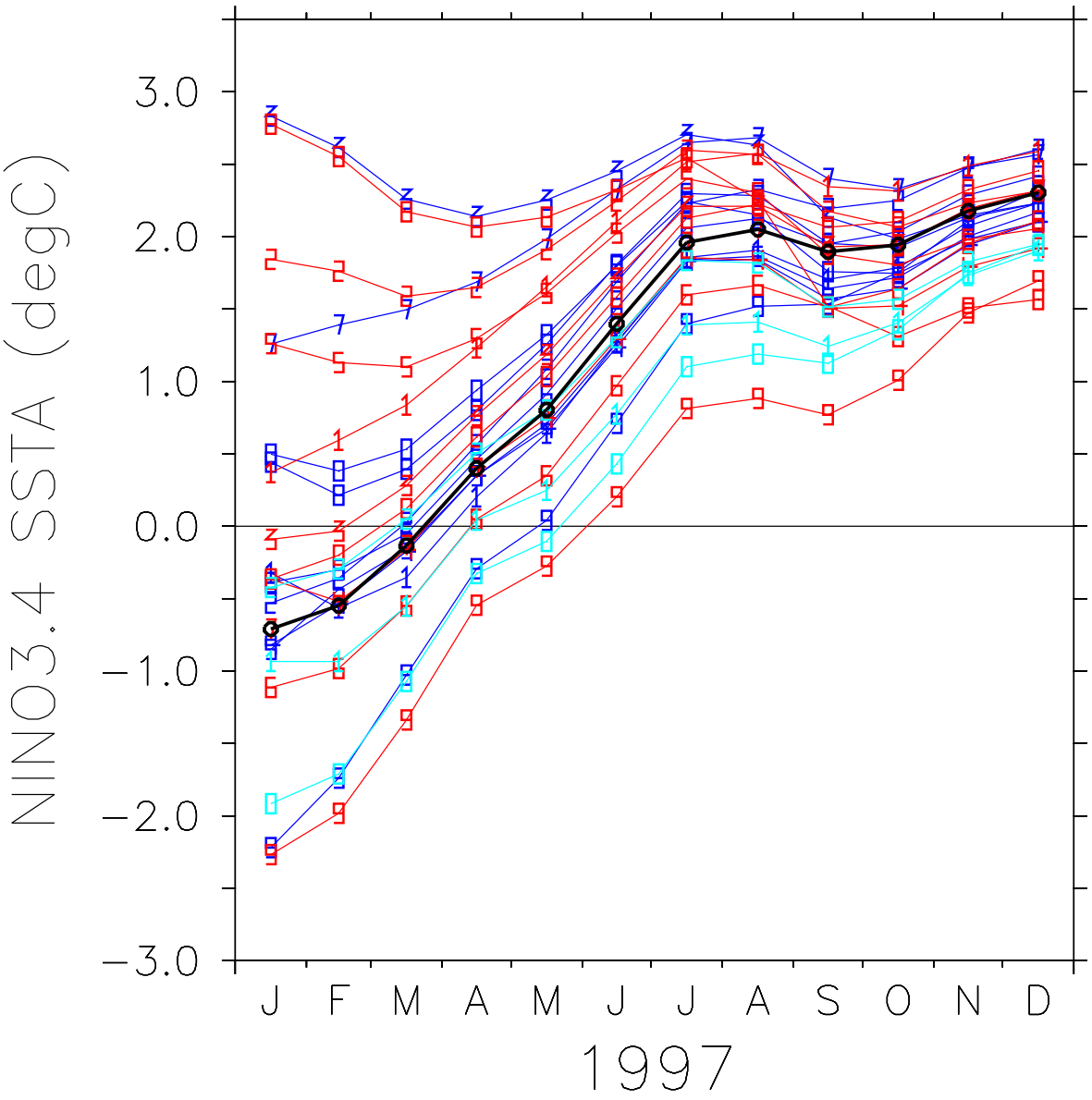


NCEP2 Full Zonal Stress Anomaly



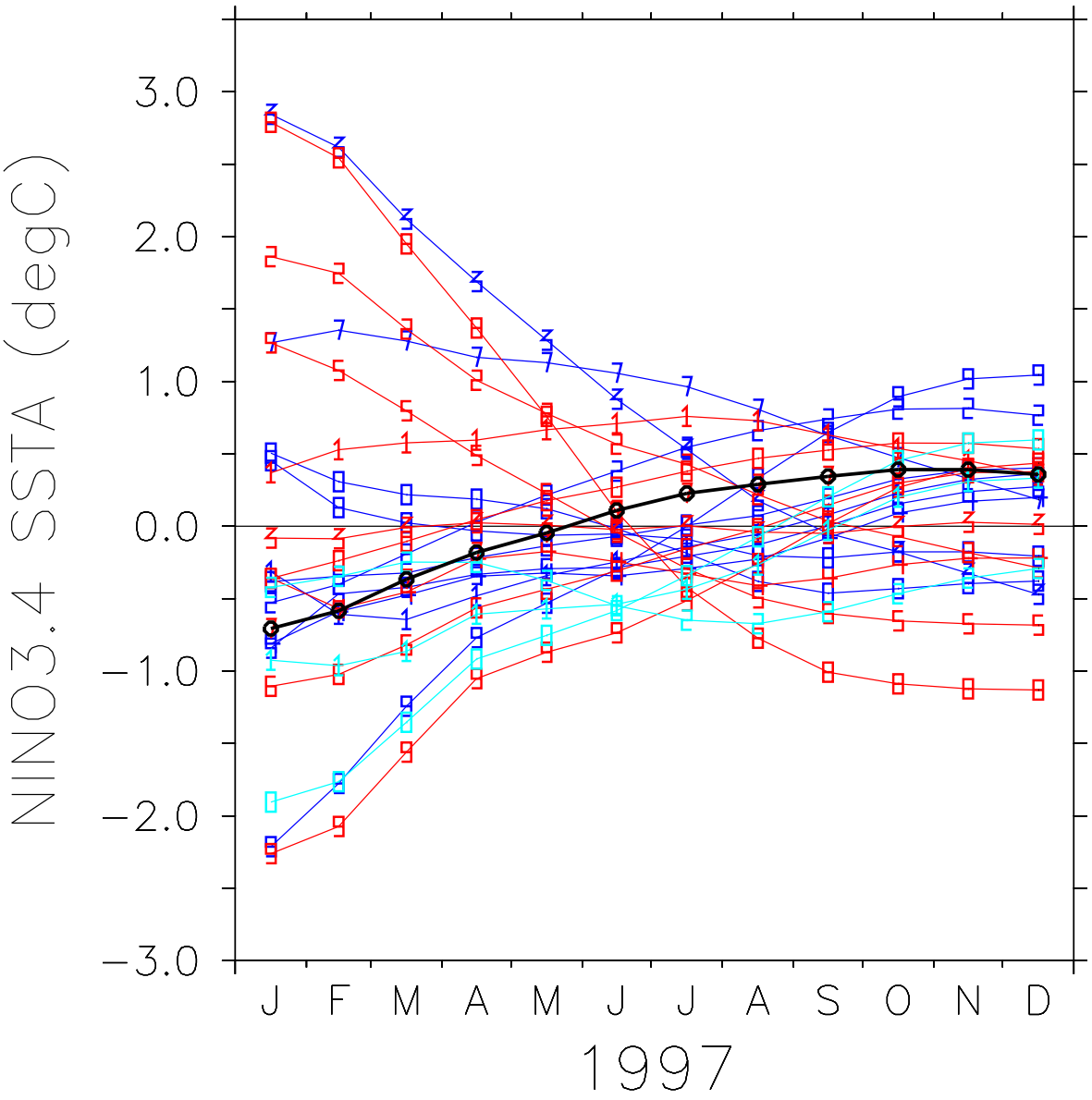
Random Initial Conditions

forced by 1997 stress residual

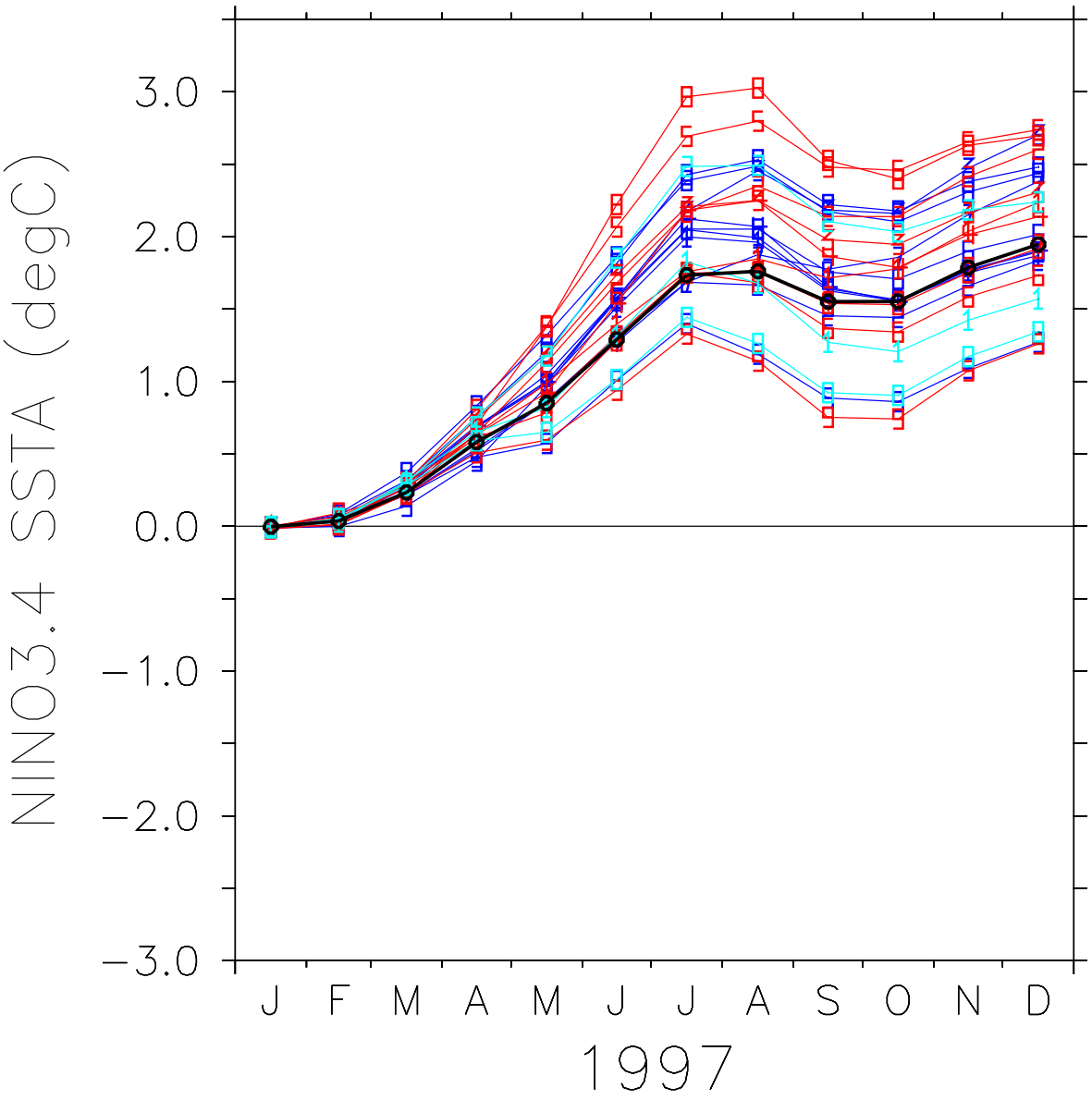


Random Initial Conditions

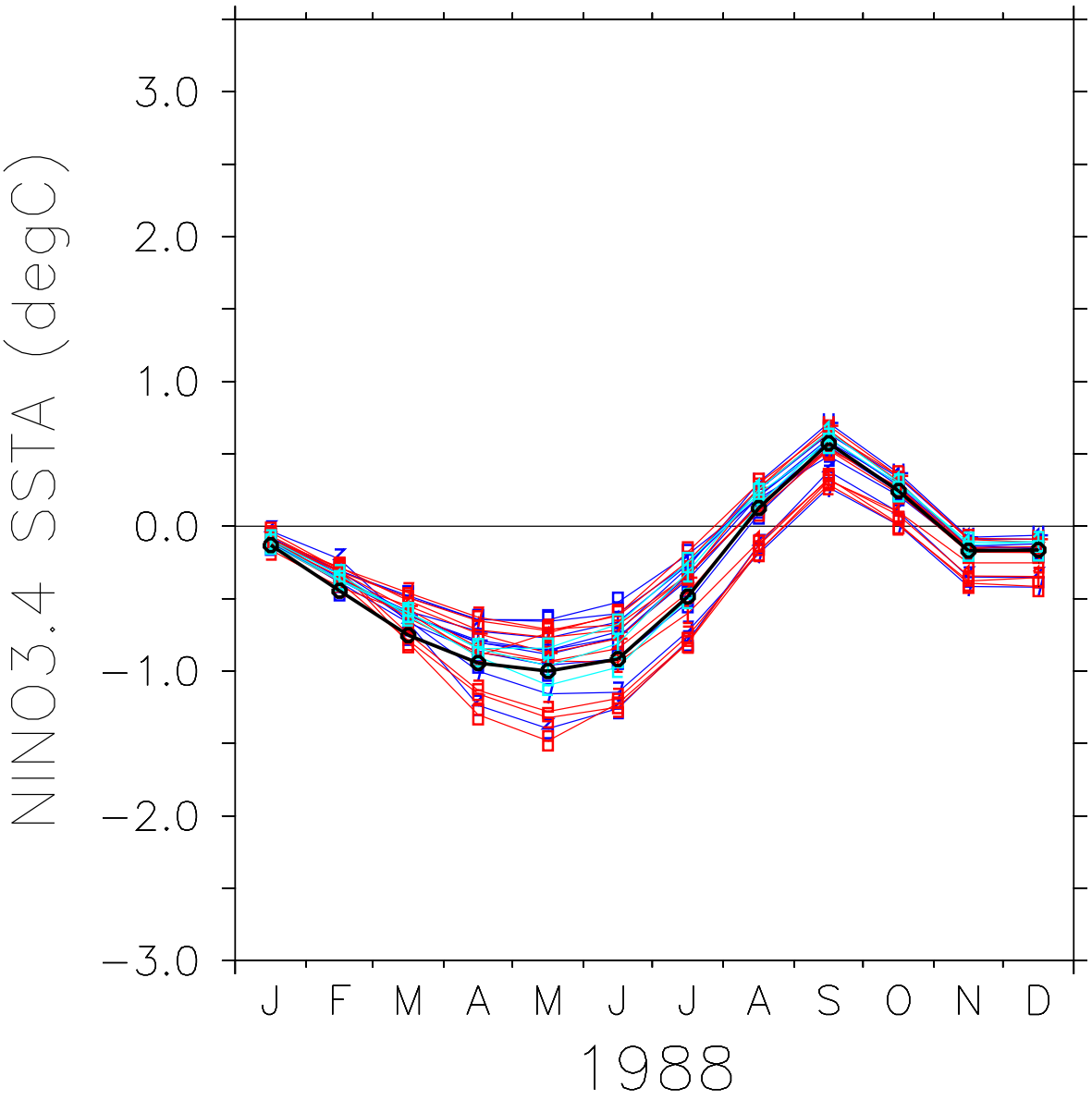
deterministic evolution



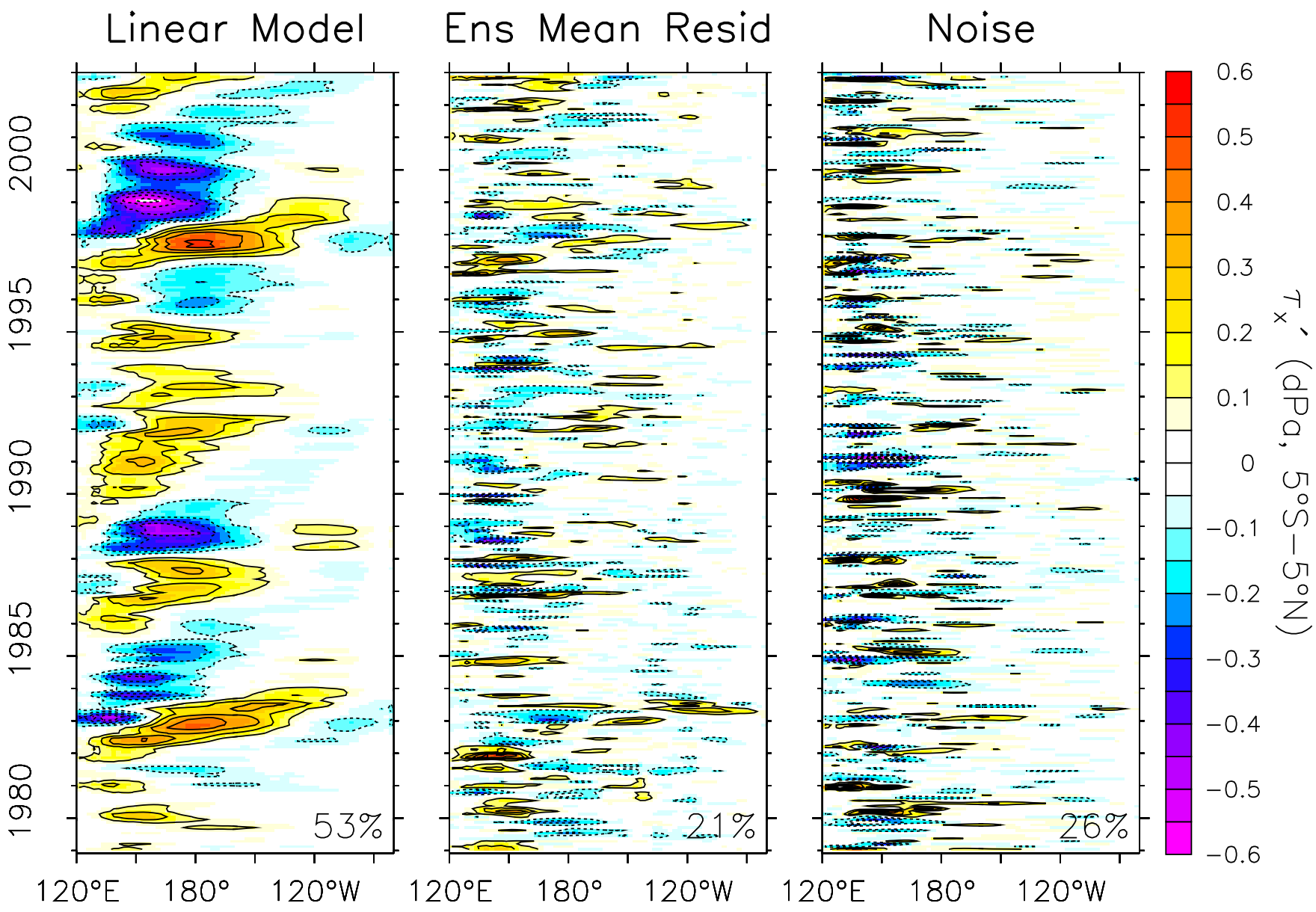
SST change induced by 1997 residual



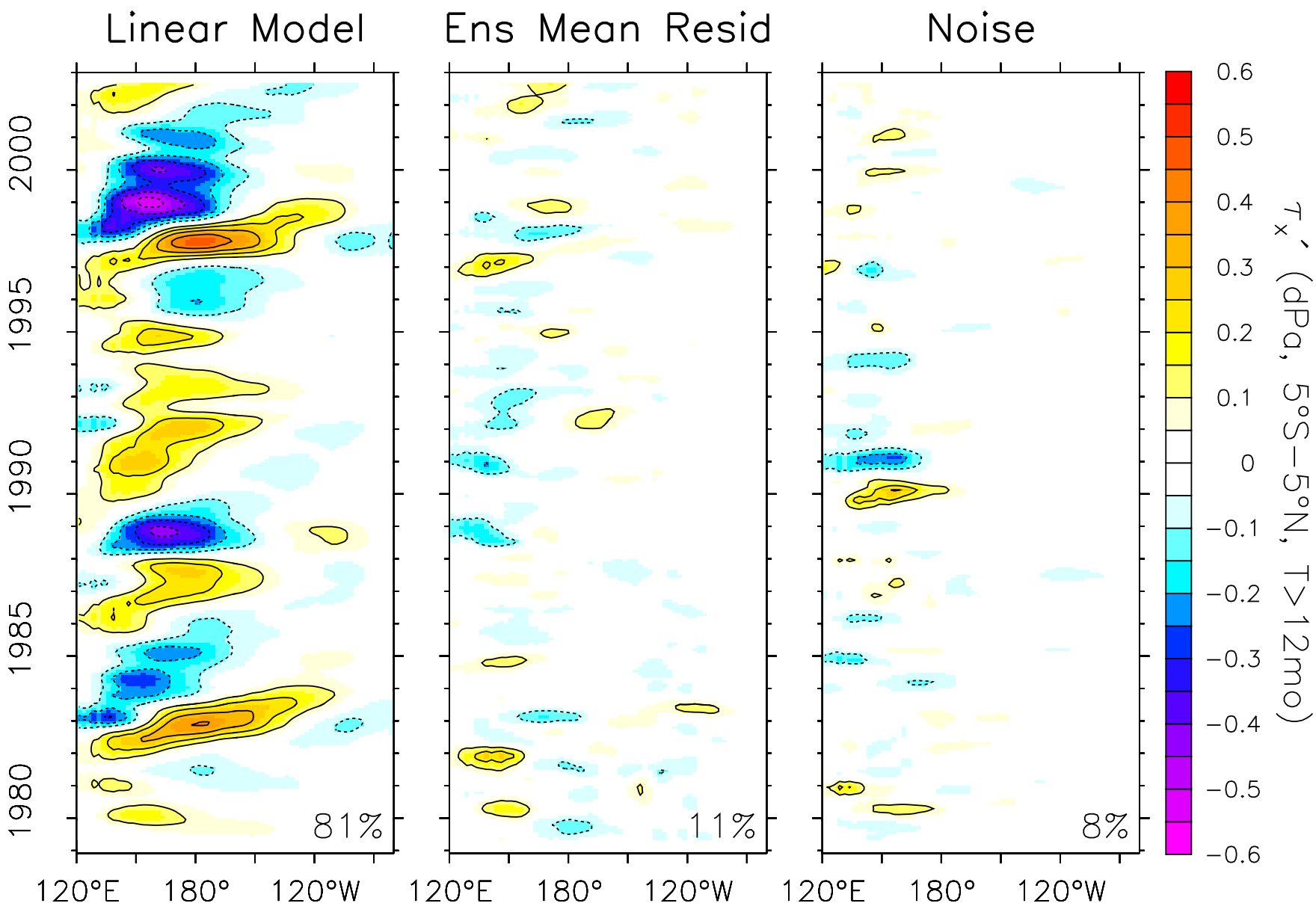
SST change induced by 1988 residual



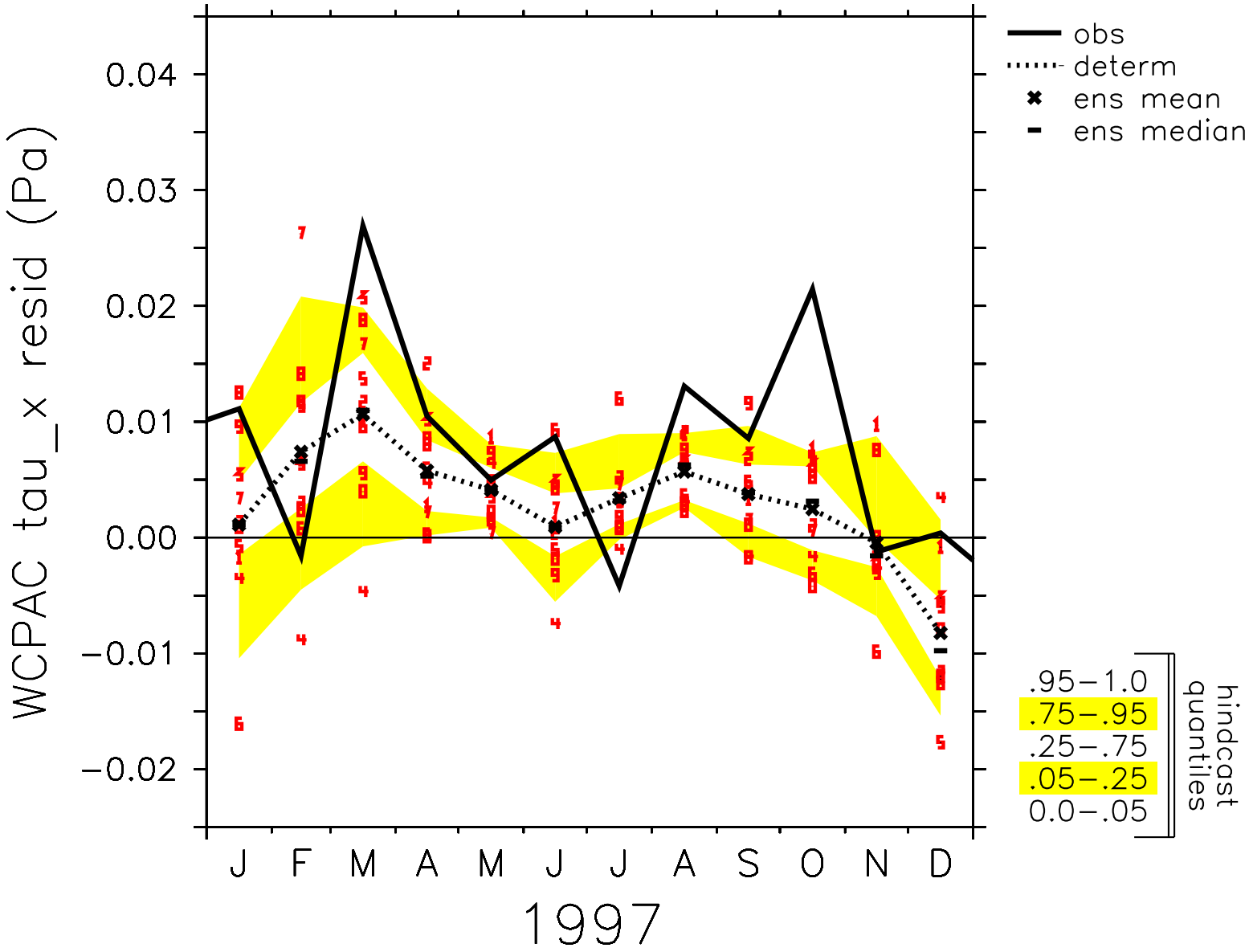
AGCM Wind Stress Decomposition: Monthly Mean



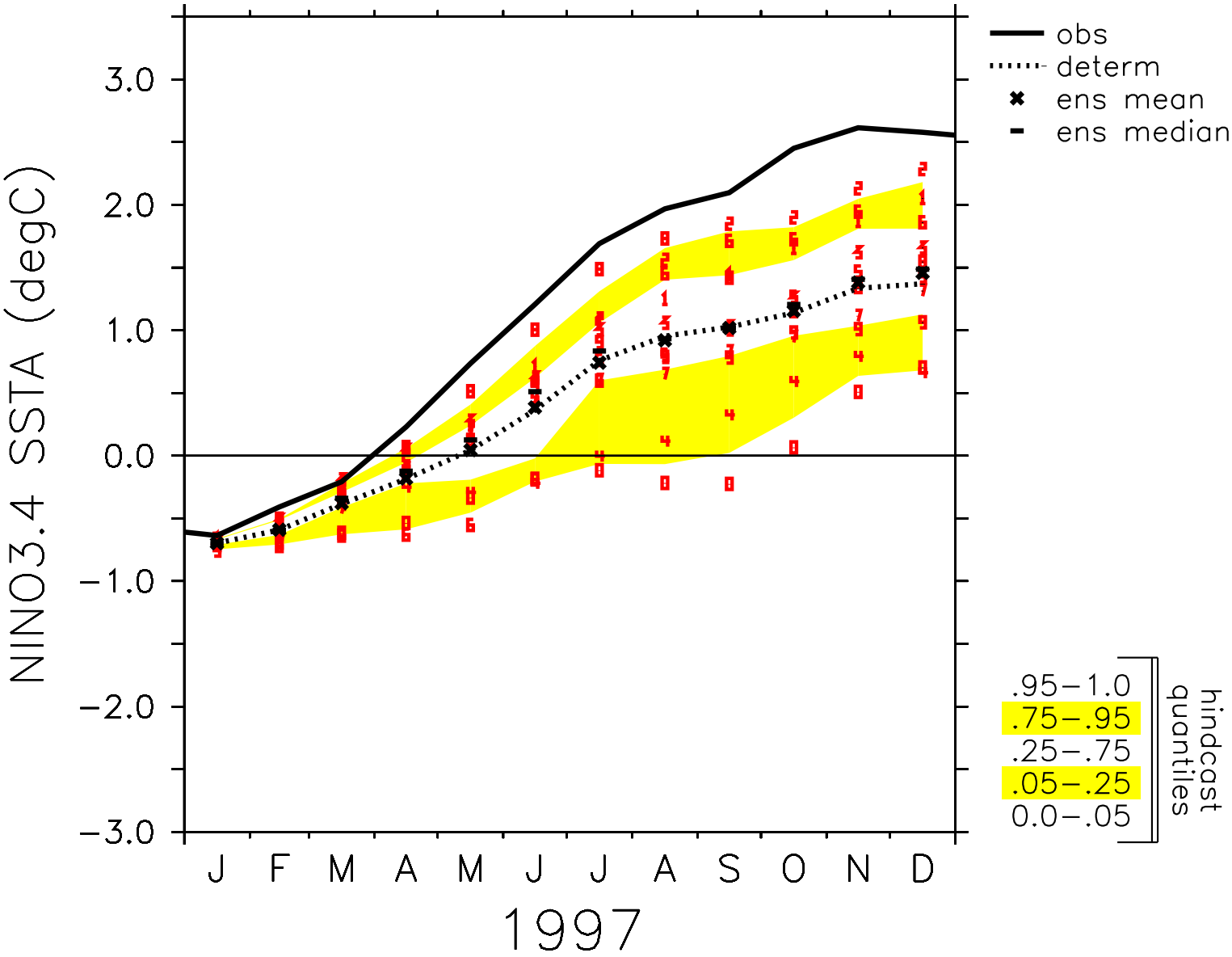
AGCM Wind Stress Decomposition: Low-Pass



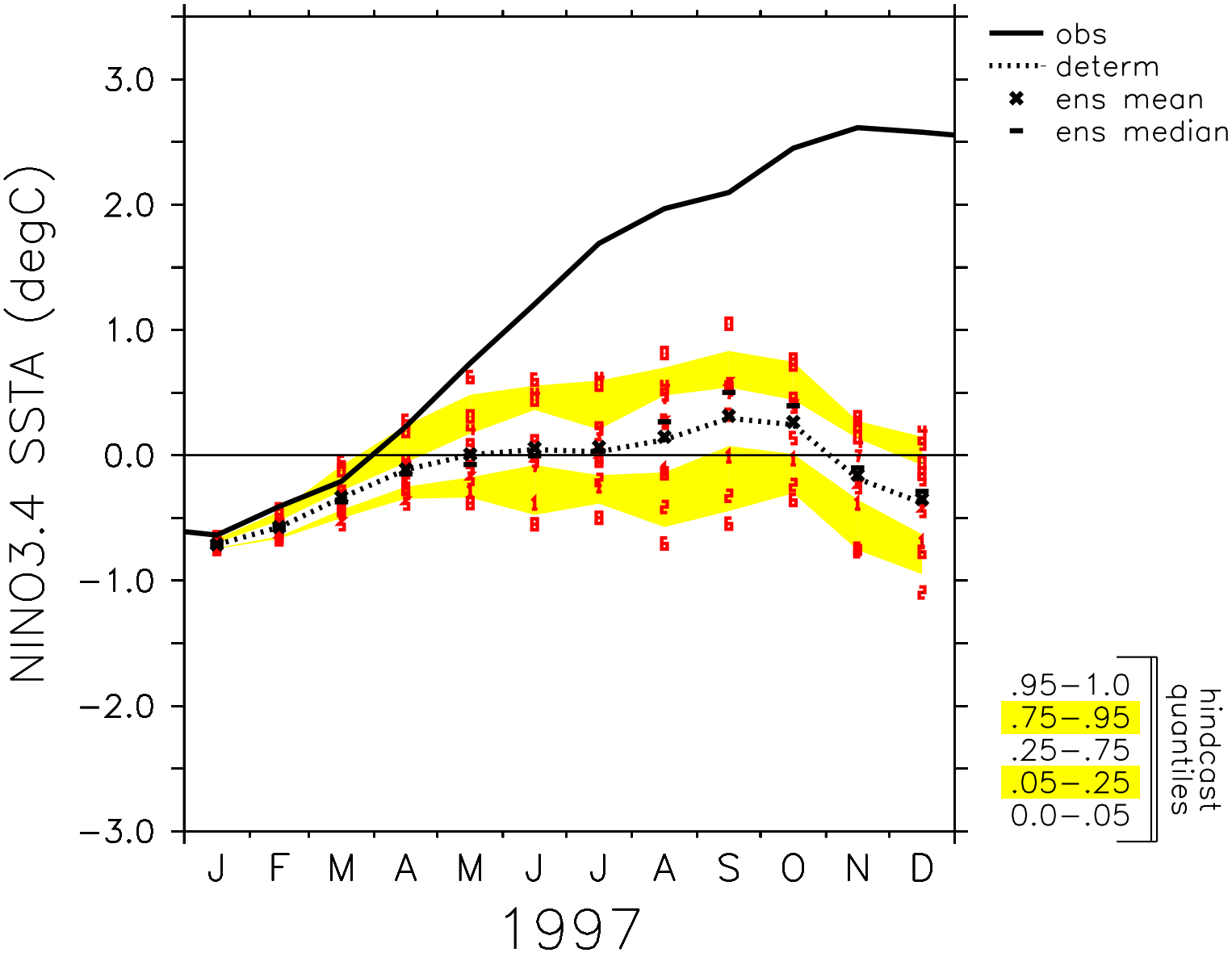
AGCM Residual Zonal Wind Stress



“Cheatcasts” forced by AGCM stress residuals



“Cheatcasts” Forced By Negative AGCM Stress Residuals



Summary

1. Regression onto tropical Pacific SST captures most interannual variance of equatorial Pacific τ_x'.

2. But the residual stress matters. It induces strong dispersion of ENSO forecasts.

3. Pacific was preconditioned for warming in 1997. But unusually intense residual westerlies greatly amplified the warming.

4. The residual stress is not entirely random. Even the “noise part” has structure.