Impact of SST bias on equatorial Atlantic interannual variability in partially coupled model experiments

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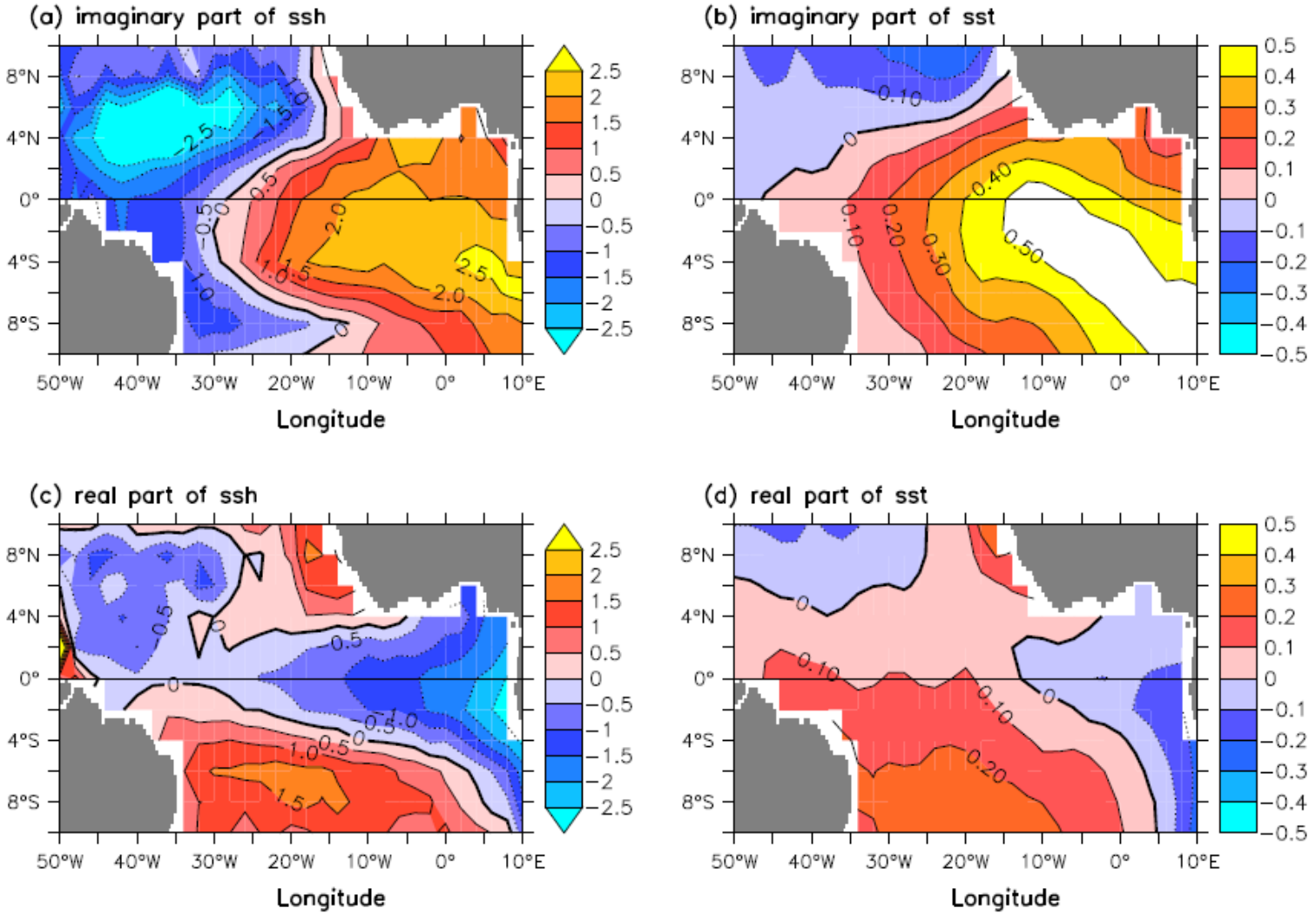
1. Statistical (POP) analysis of observed equatorial Atlantic interannual variability and predictability
2. Impact of SST biases on tropical Atlantic interannual variability in the Kiel Climate Model (KCM)
3. Atlantic zonal mode influence on ENSO, the aborted 2014 El Niño event

1. Statistical (POP) analysis of observed equatorial Atlantic interannual variability and predictability

- POP analysis: fit a multivariate AR1-process to the data (compute eigenvectors and eigenvalues from the system matrix)
- used equatorial Atlantic SST and altimeter SSH anomalies 1992-2013 in the POP analysis, low-pass filter (cutoff: 8months)
- 6 EOFs were retained in the POP analysis, which explain 77% of the joint variance in the SST and SSH data
- Statistical forecasts of equatorial Atlantic SST were made with the leading POP mode representing the Atlantic zonal mode

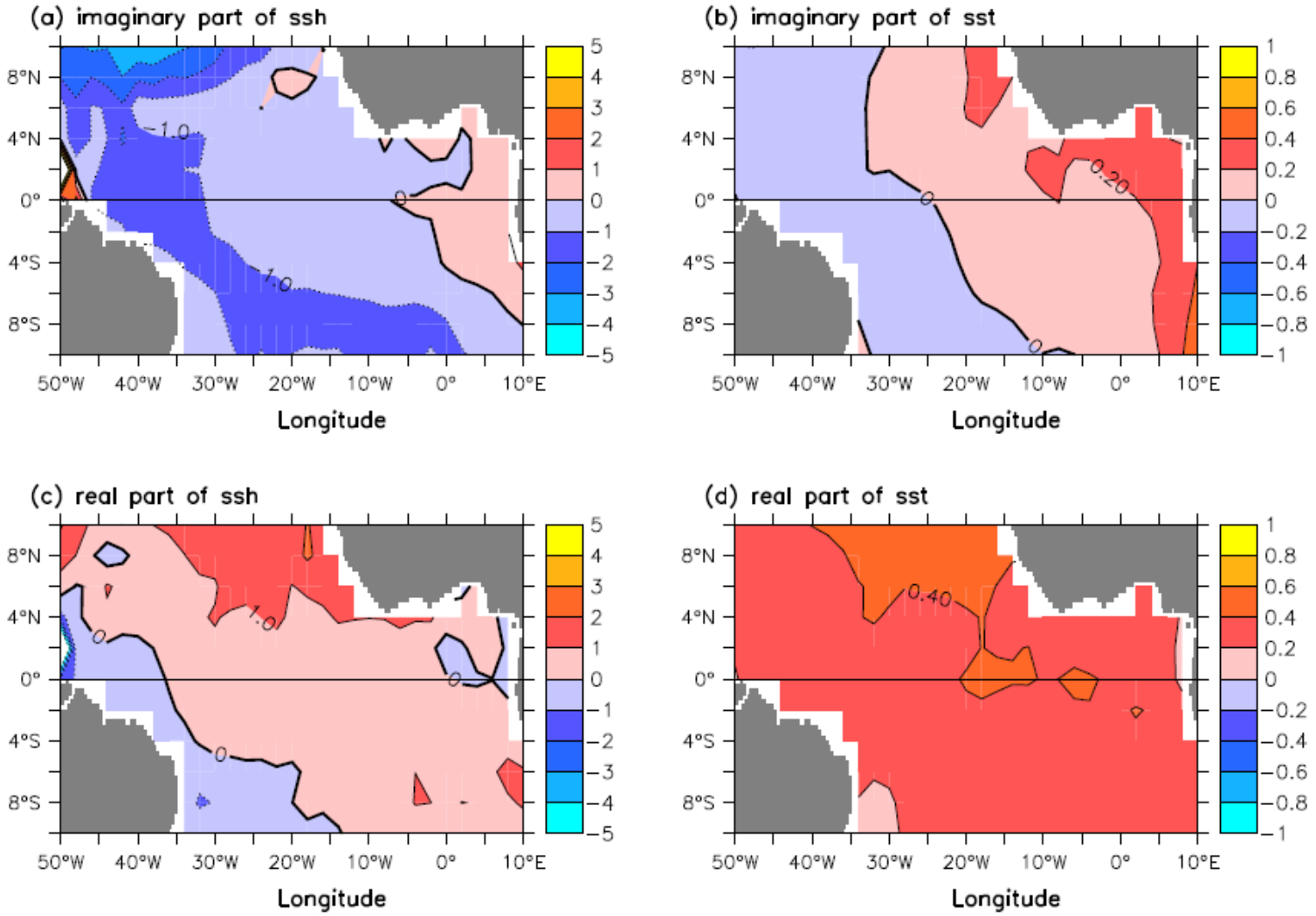
Leading POP mode from observed SST and SSH: the Atlantic zonal mode

P=25 months, δ=22 months, 33% explained variance.

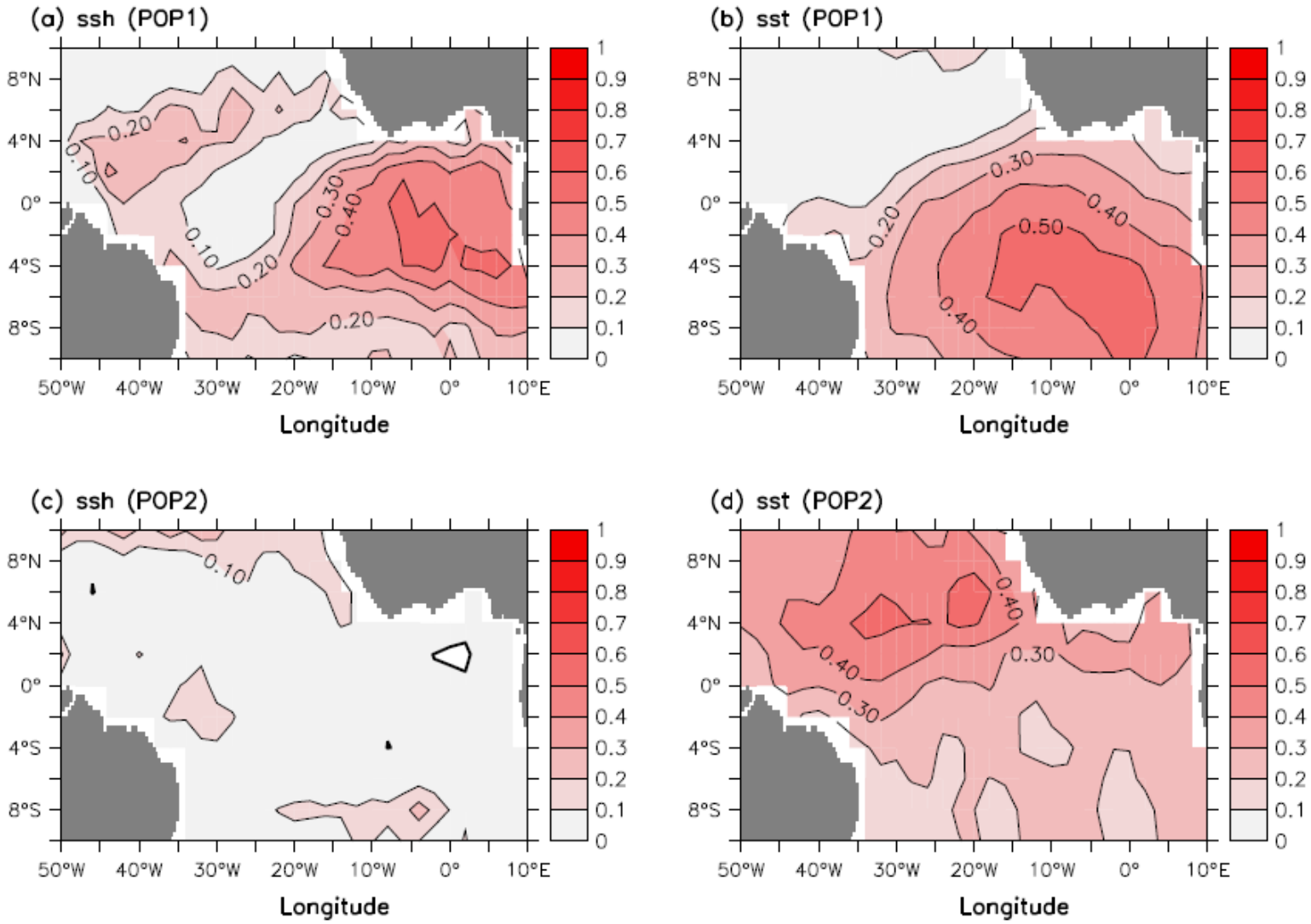


Second POP mode from observed SST and SSH: ENSO response of tropical North Atlantic

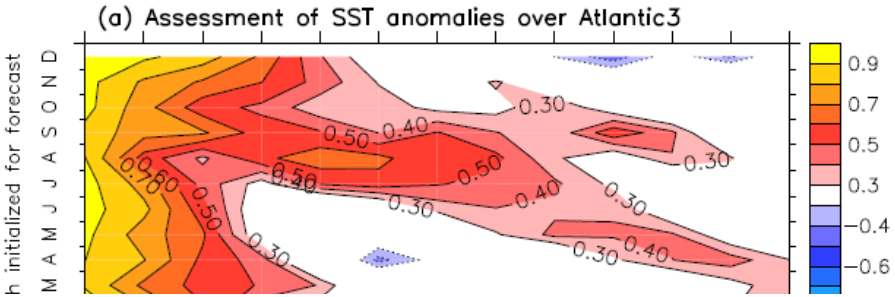
P=54 months, δ=24 months, 25% explained variance.



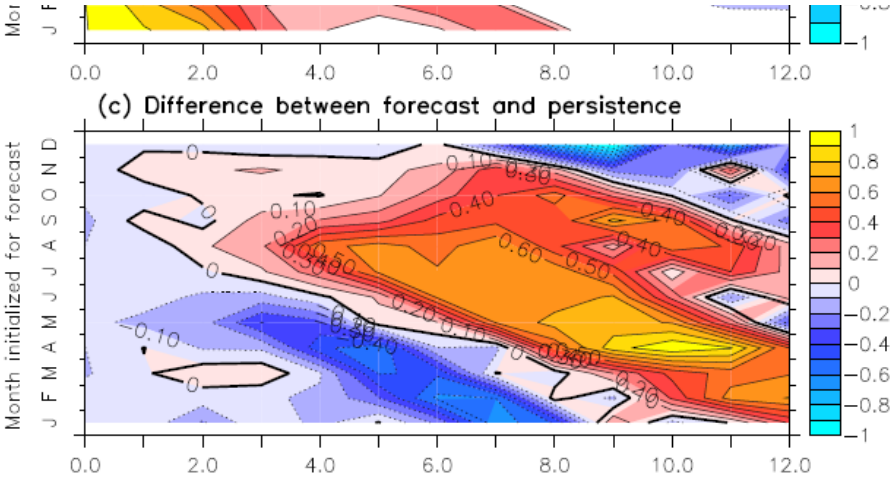
Variances explained locally by the two POP modes (with respect to the raw monthly data)



Monthly stratified skill in forecasting ATL3 SST anomalies using only the zonal mode calculated from observations



Some artificial skill is inherent to the POP forecasts, as no independent training period was used (too short records)



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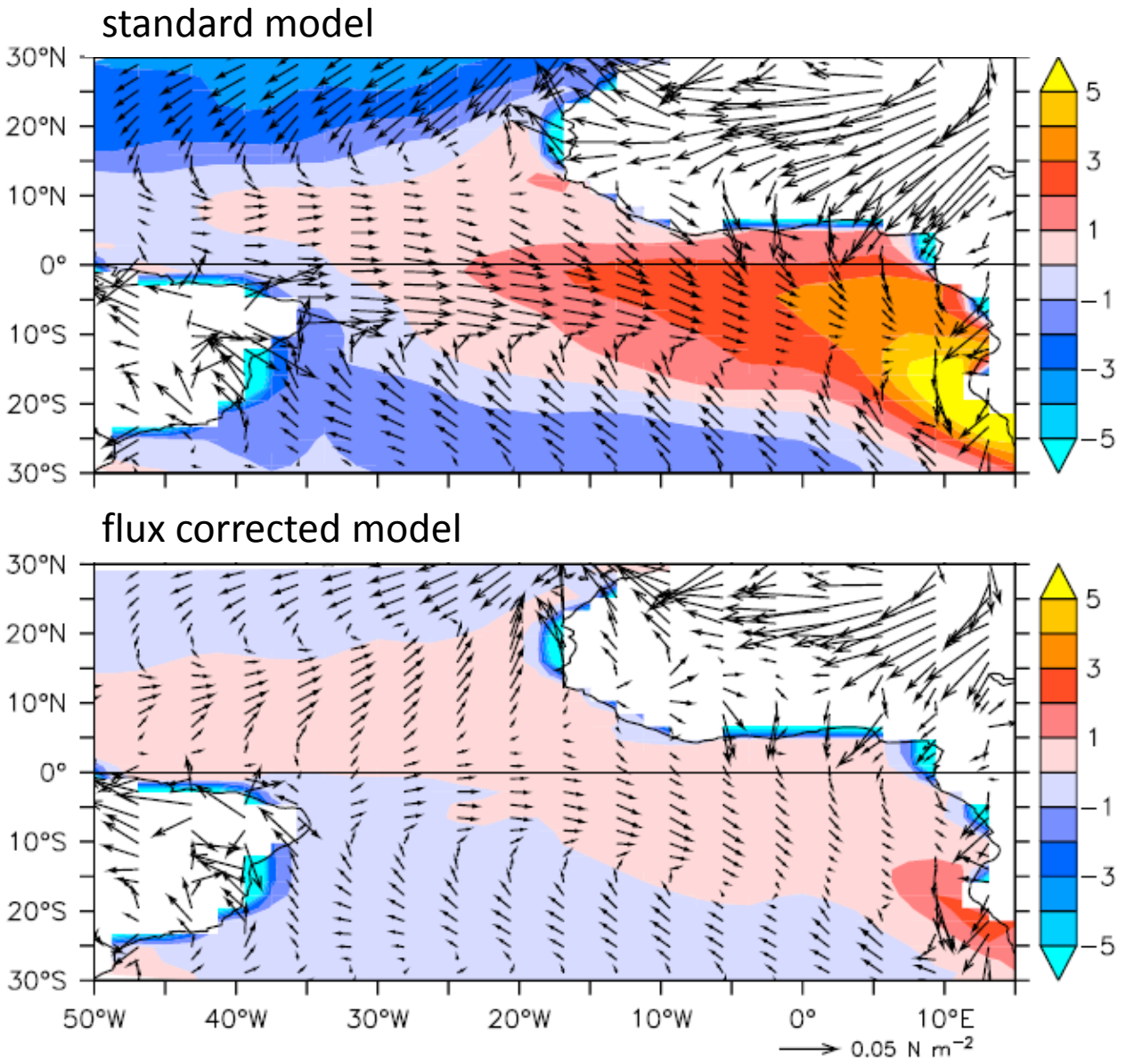
2. Impact of SST bias on interannual SST variability

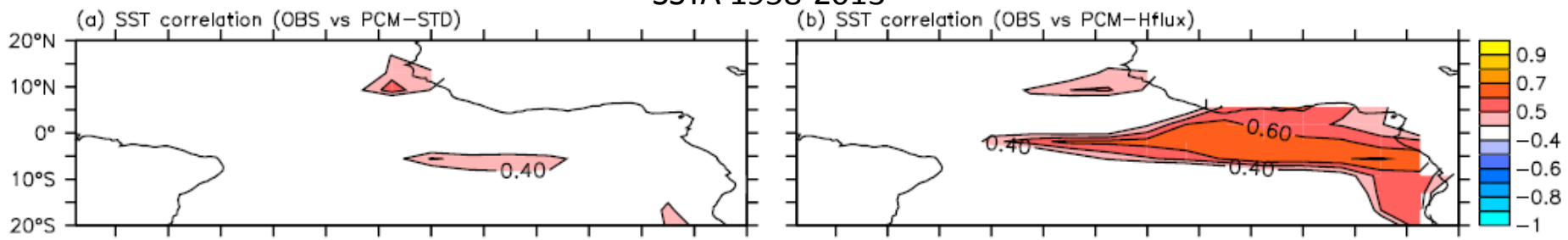
- heat flux correction applied to the Kiel Climate Model (KCM)
- atmosphere resolution T31 horizontally (3.75° × 3.75°) and low-top, ocean resolution 2° with latitudinal refinement to 0.5° within ±10° latitude
- KCM is forced by observed wind stress anomalies calculated from ERA-40 (1958-2001) and ERA-Interim (2002-2013)
- 6 realizations, only the ensemble mean is shown

Annual mean SST and wind stress biases

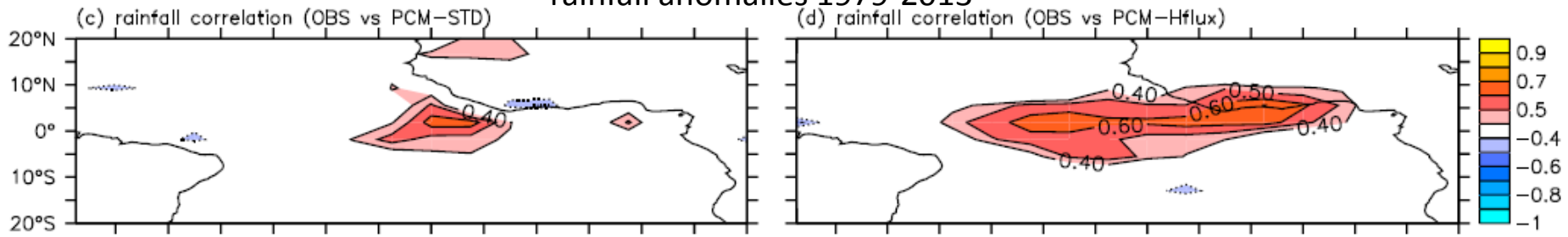


Correlations in hindcasting observed SST (top), rainfall (middle) and SSH (bottom) anomalies in JJA

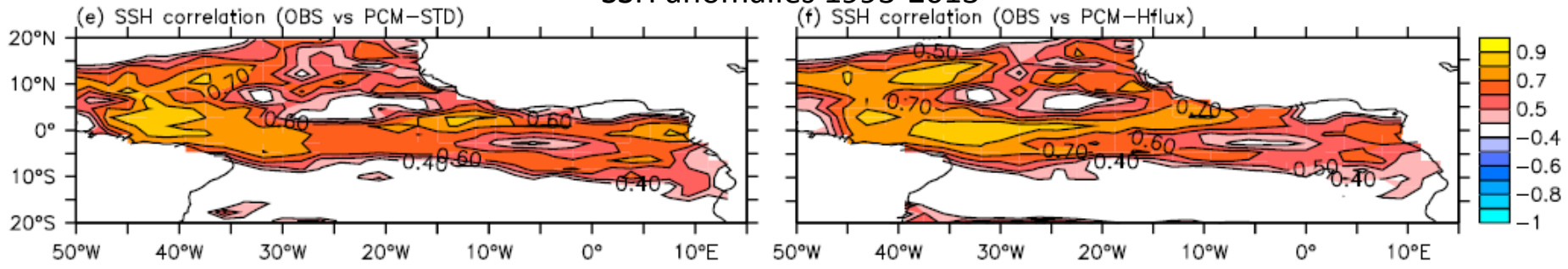
SSTA 1958-2013



rainfall anomalies 1979-2013



SSH anomalies 1993-2013



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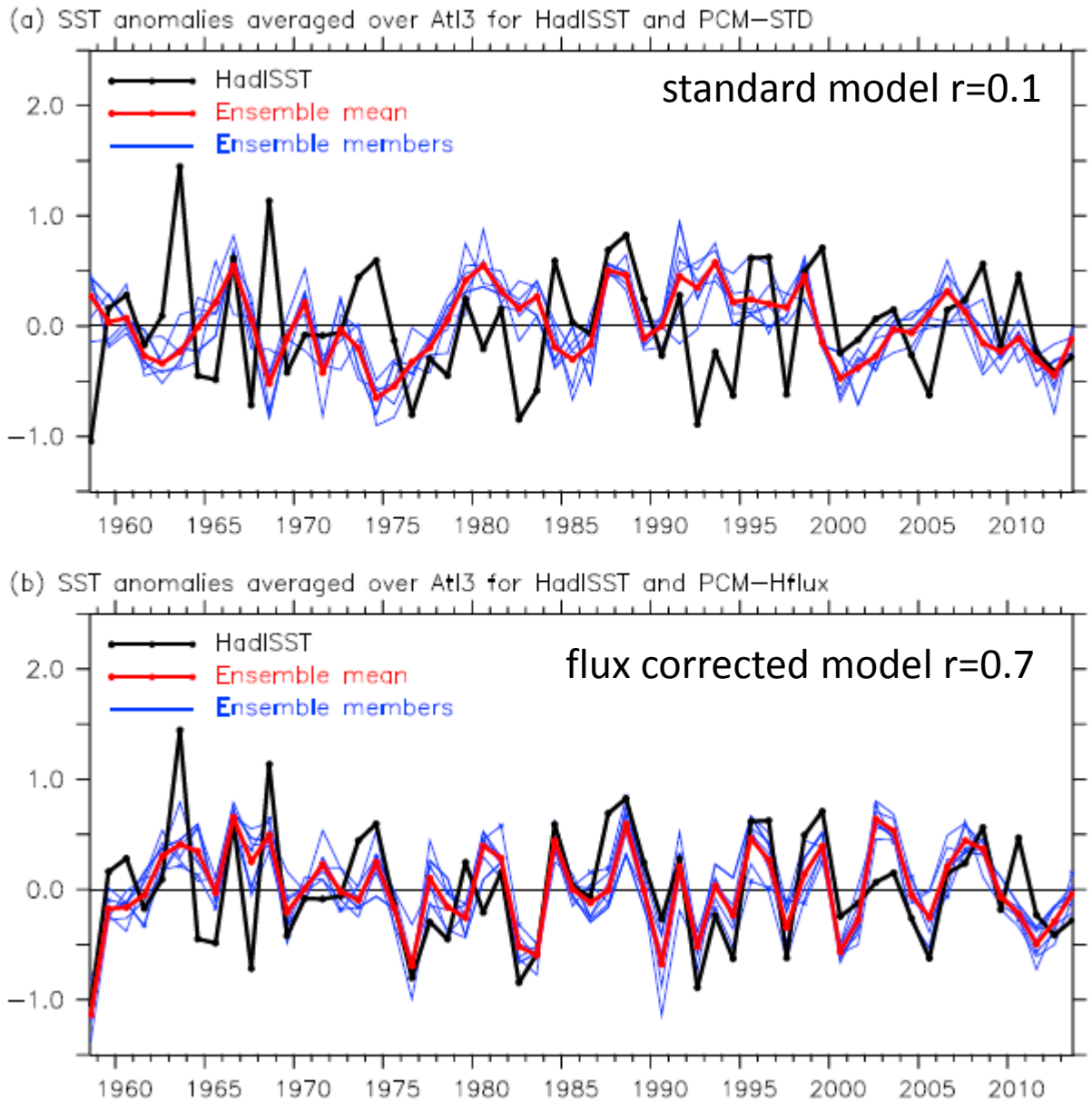
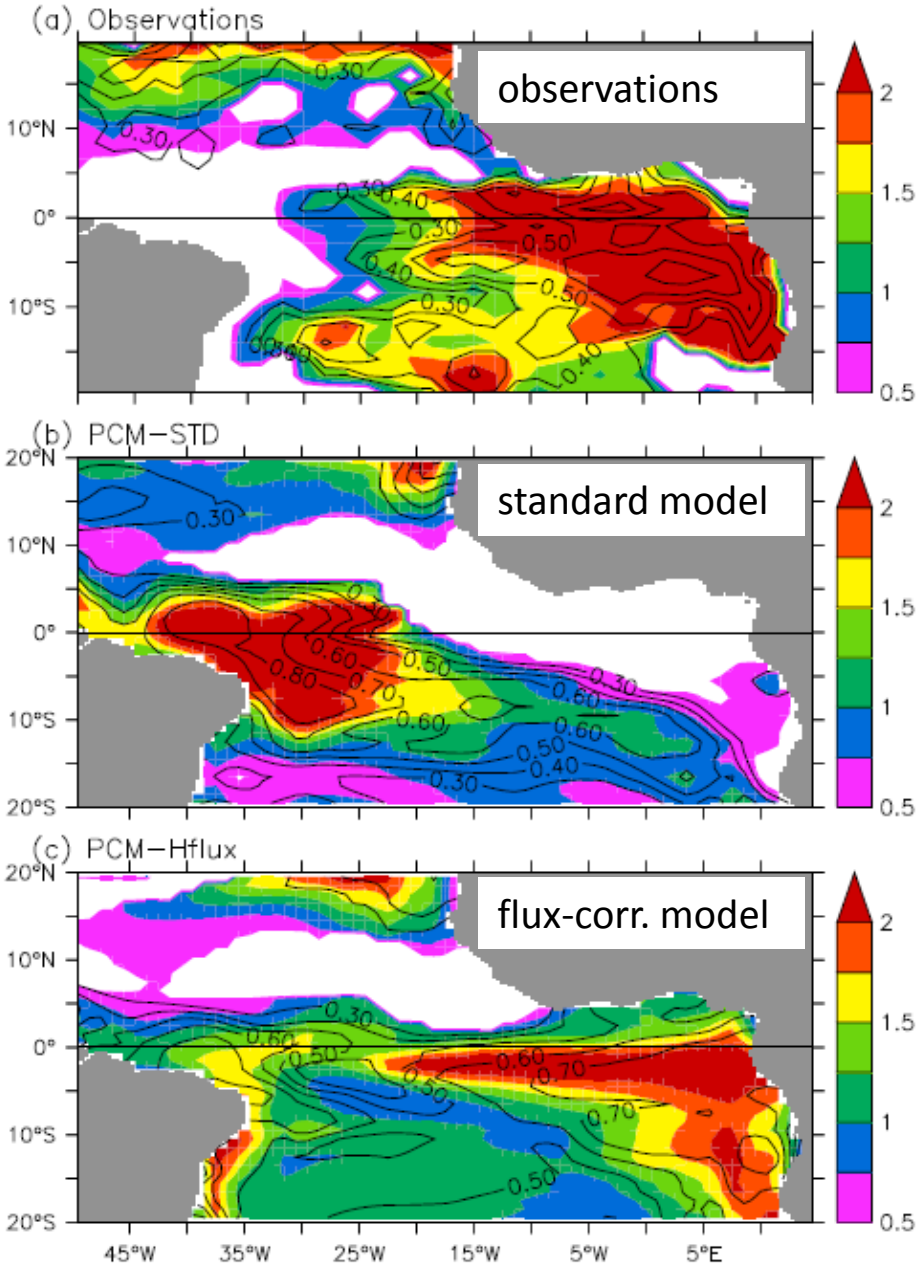
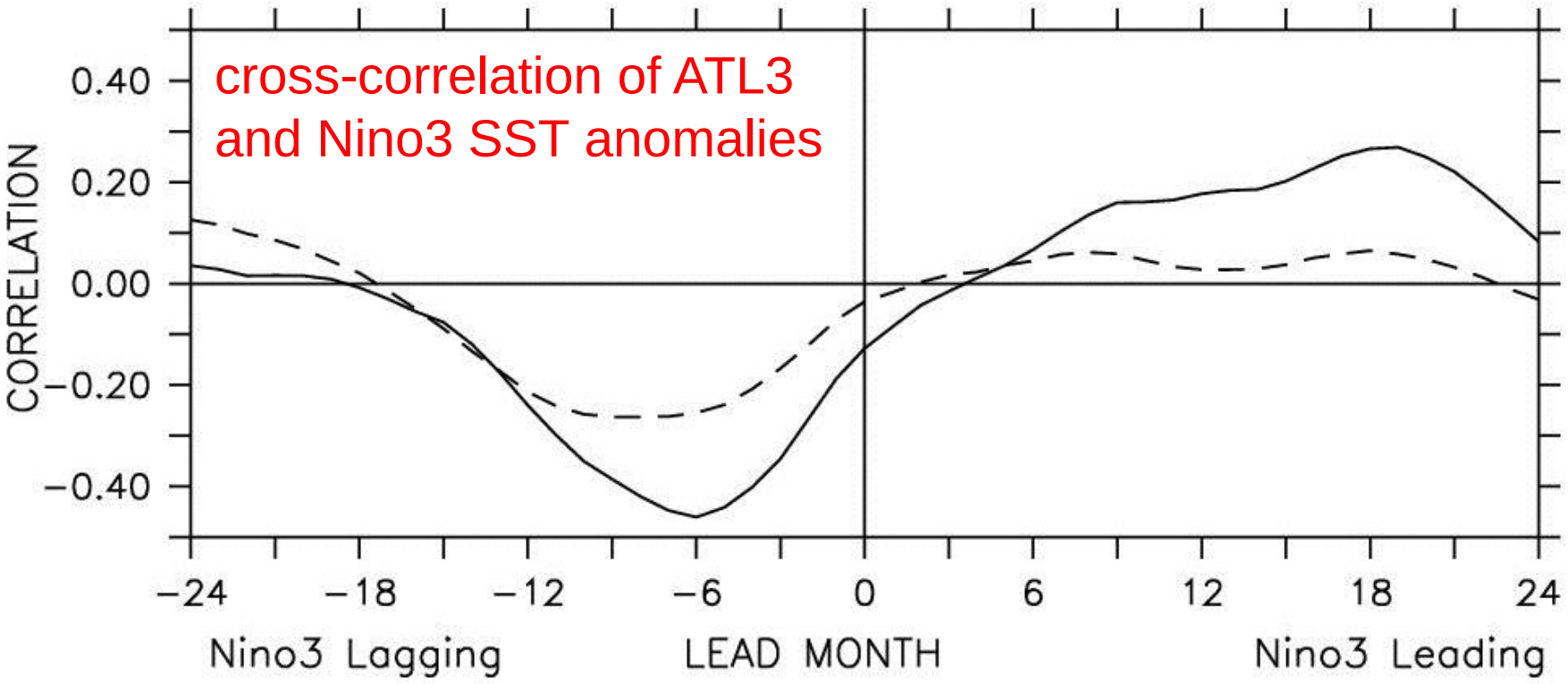
SST anomalies averaged over the ATL3 region (JJA)



regression of SST onto local SSH anomalies (JJA)



3. Zonal mode influence on ENSO

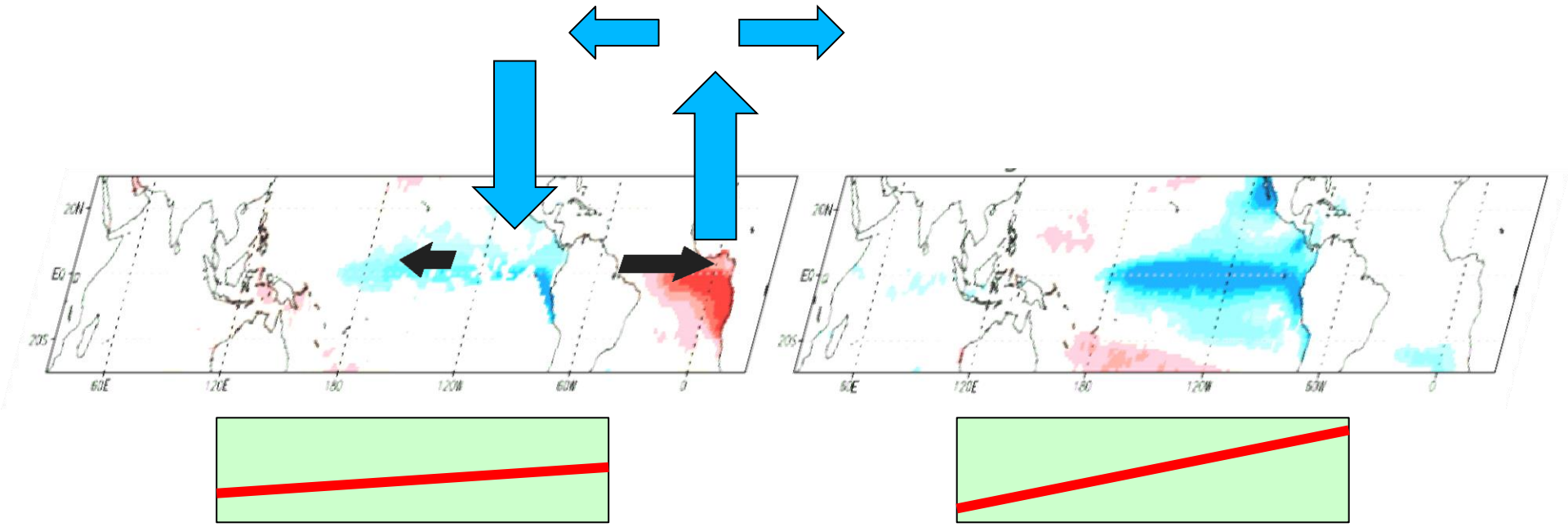


Keenlyside and Latif, 2007

Observations and climate models show that Atlantic zonal mode events can influence ENSO through changes in the Walker Circulation

boreal summer SST

boreal winter SST

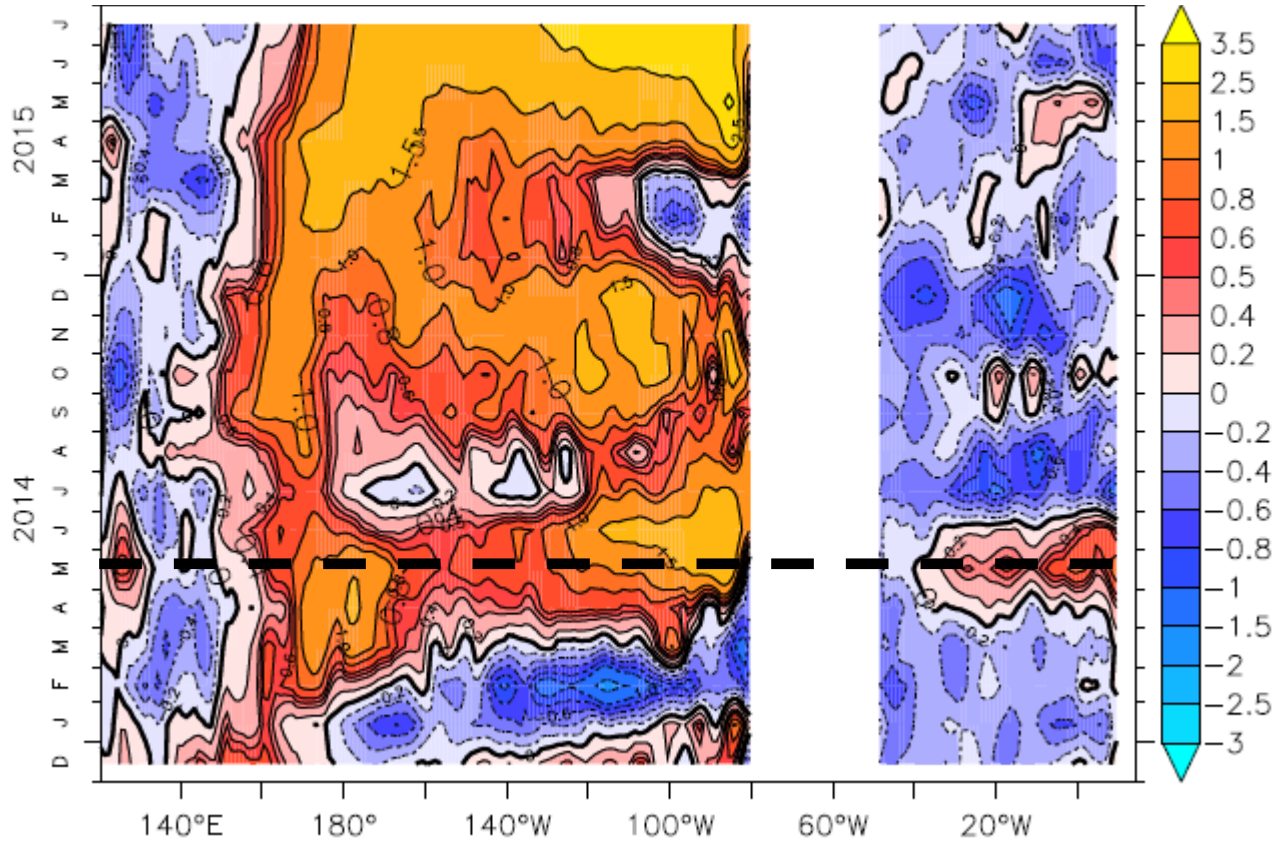


equatorial Pacific thermocline

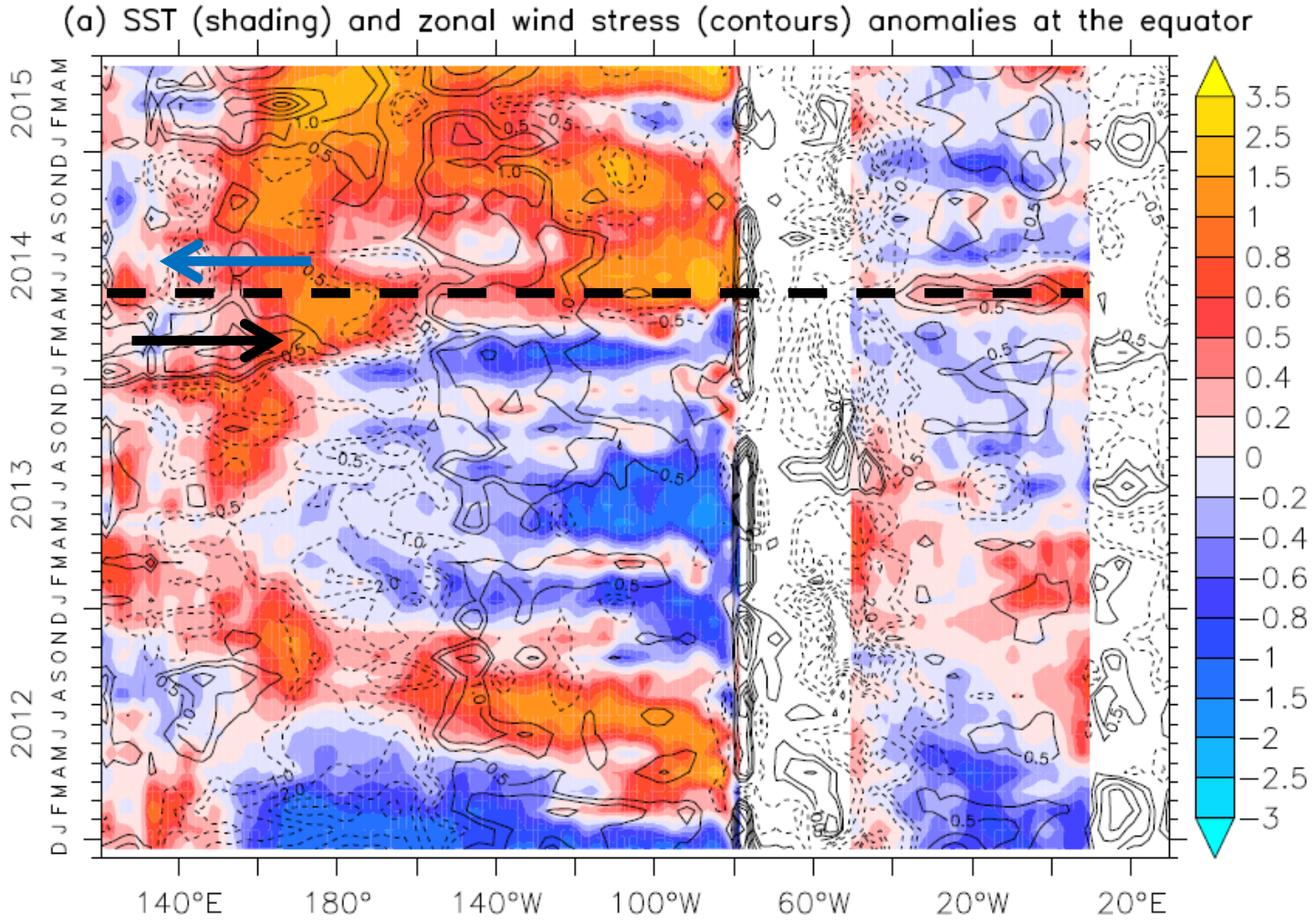
Rodriguez-Fonseca et al. (2009), Ding et al. (2012) and Ding et al. (2013)

The aborted 2014 El Niño event – was the warm phase of the Atlantic zonal mode responsible?

SST anomalies along the equator



SST and zonal wind stress anomalies along the equator: anomalous easterlies developed over the western Pacific just after the warming the equatorial Atlantic



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Is the Atlantic zonal mode the mosquito….?

Thank you for your attention!

to be continued….

Ding, H., R. J. Greatbatch, M. Latif, and W. Park (2015), The impact of sea surface temperature bias on equatorial Atlantic interannual variability in partially coupled model experiments, Geophys. Res. Lett., 42, 5540–5546, doi:10.1002/2015GL064799.

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