

Simulating the variability of Eastern Boundary Upwelling over the past millennium

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Thank you



clisap^o

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Motivation

- influence of external forcing on upwelling
 - Eastern Boundary Upwelling Systems
 - Arabian Sea
- Bakun hypothesis:
 - intensified upwelling due to increasing greenhouse gas concentrations
- analysis of the past millennium and the 20th century

Outline

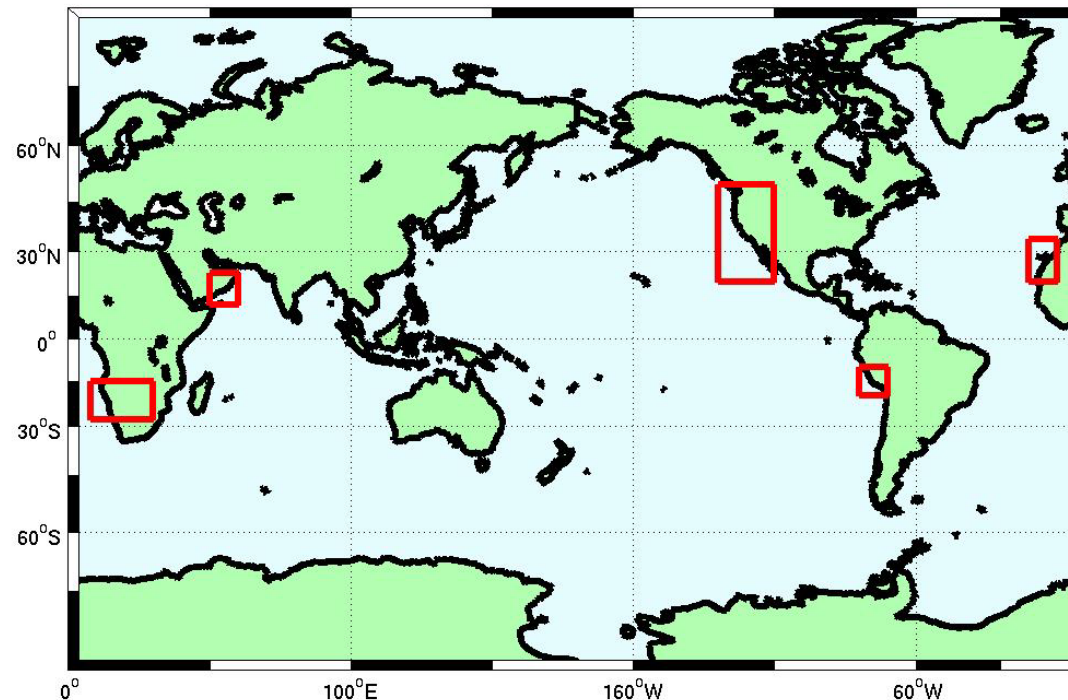
- annual cycle
- drivers of upwelling
- timeseries and trends of upwelling
- influence of the Asian Monsoon
- connection of upwelling regions



Data

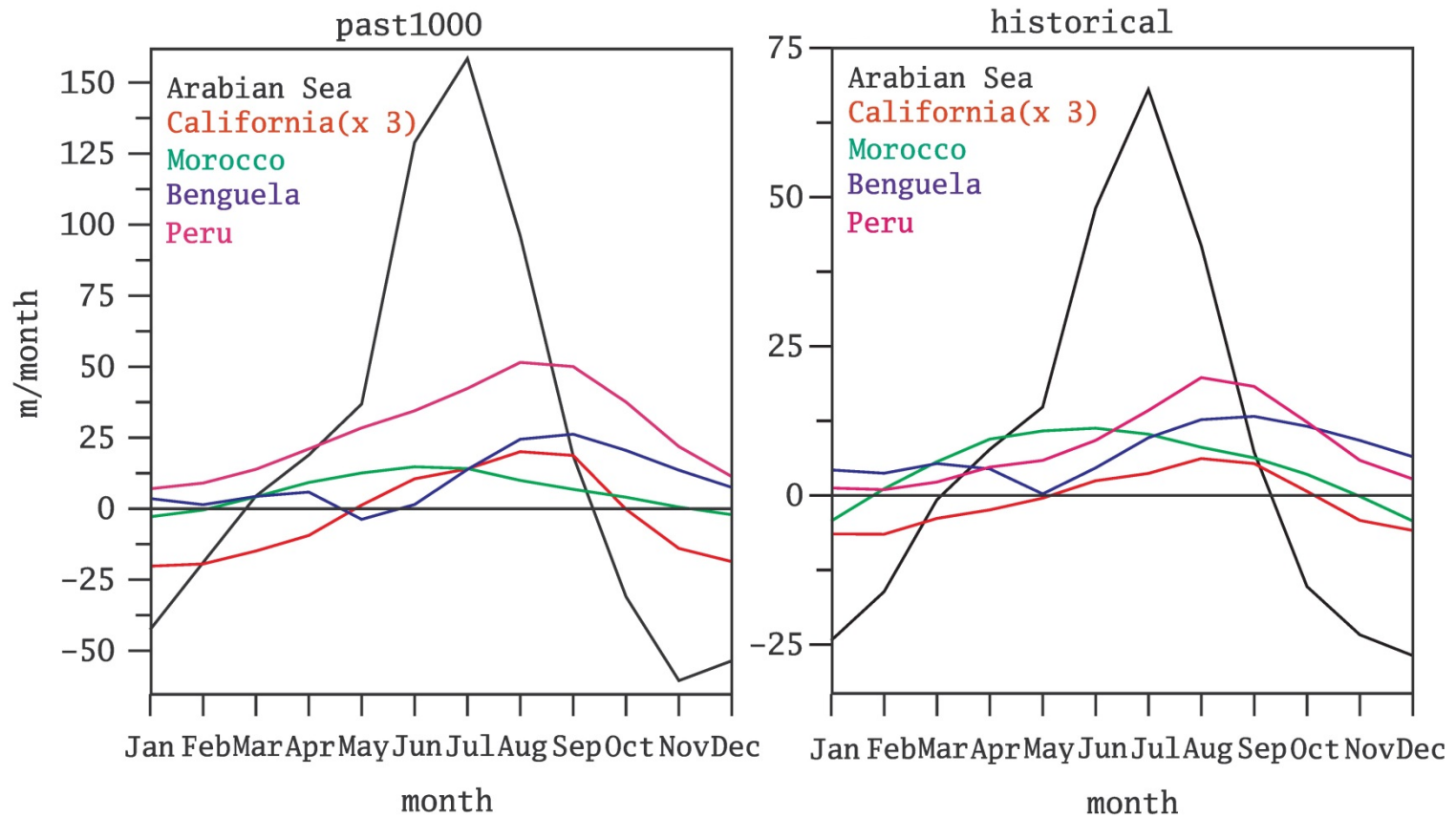
MPI-ESM CMIP5

- coupled: MPIOM, ECHAM6, HAMOCC - global
- historical MR: 1850 – 2005, T63/L90,0.4/L40
- past1000 P: 850 – 1850, T63/L49,1.5/L40
- 3 realizations: same model, same forcing, different initial conditions
- upwelling in Benguela, Peru, California, Morocco, Arabian Sea



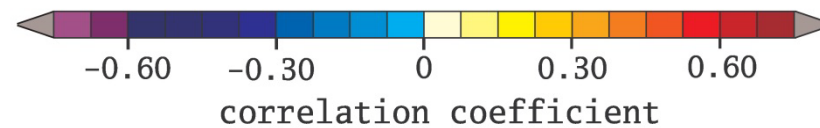
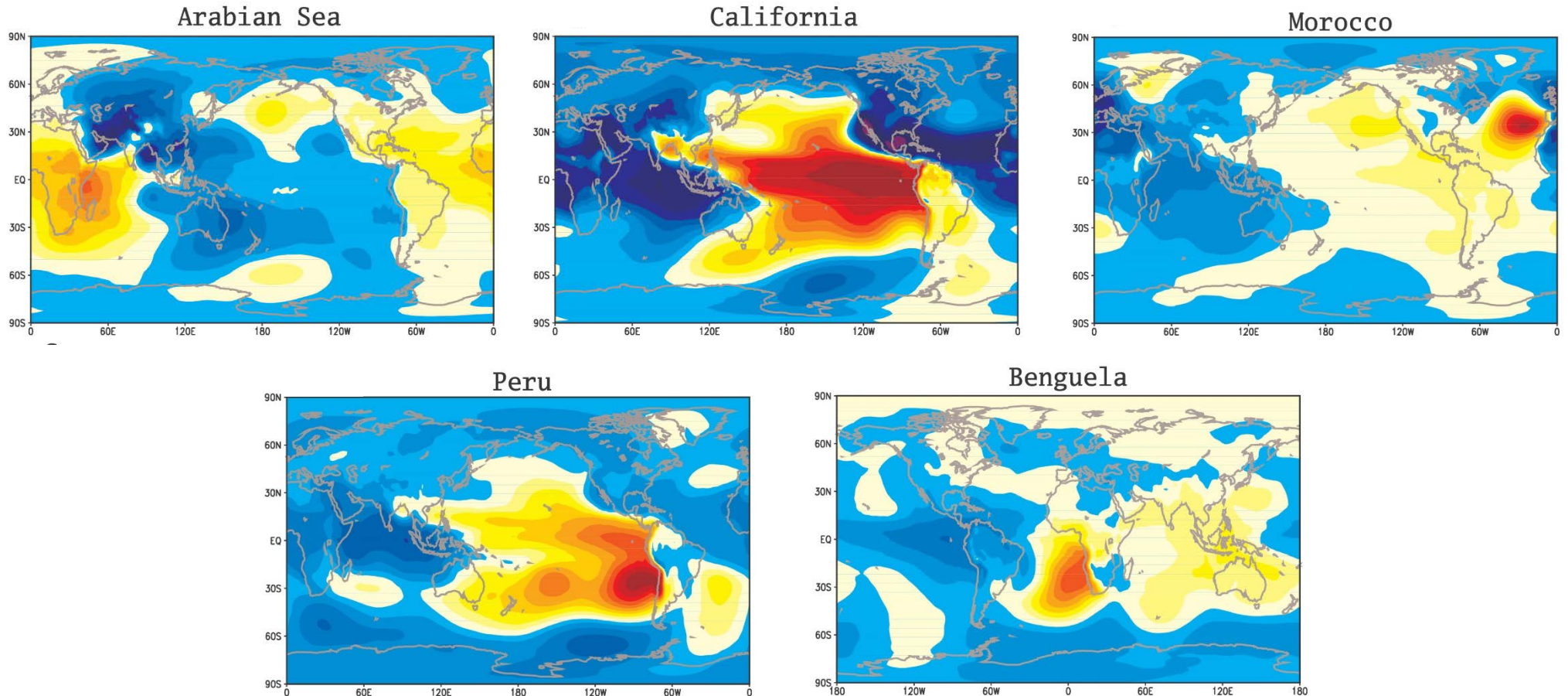


Annual cycle



annual cycle is modelled realistically

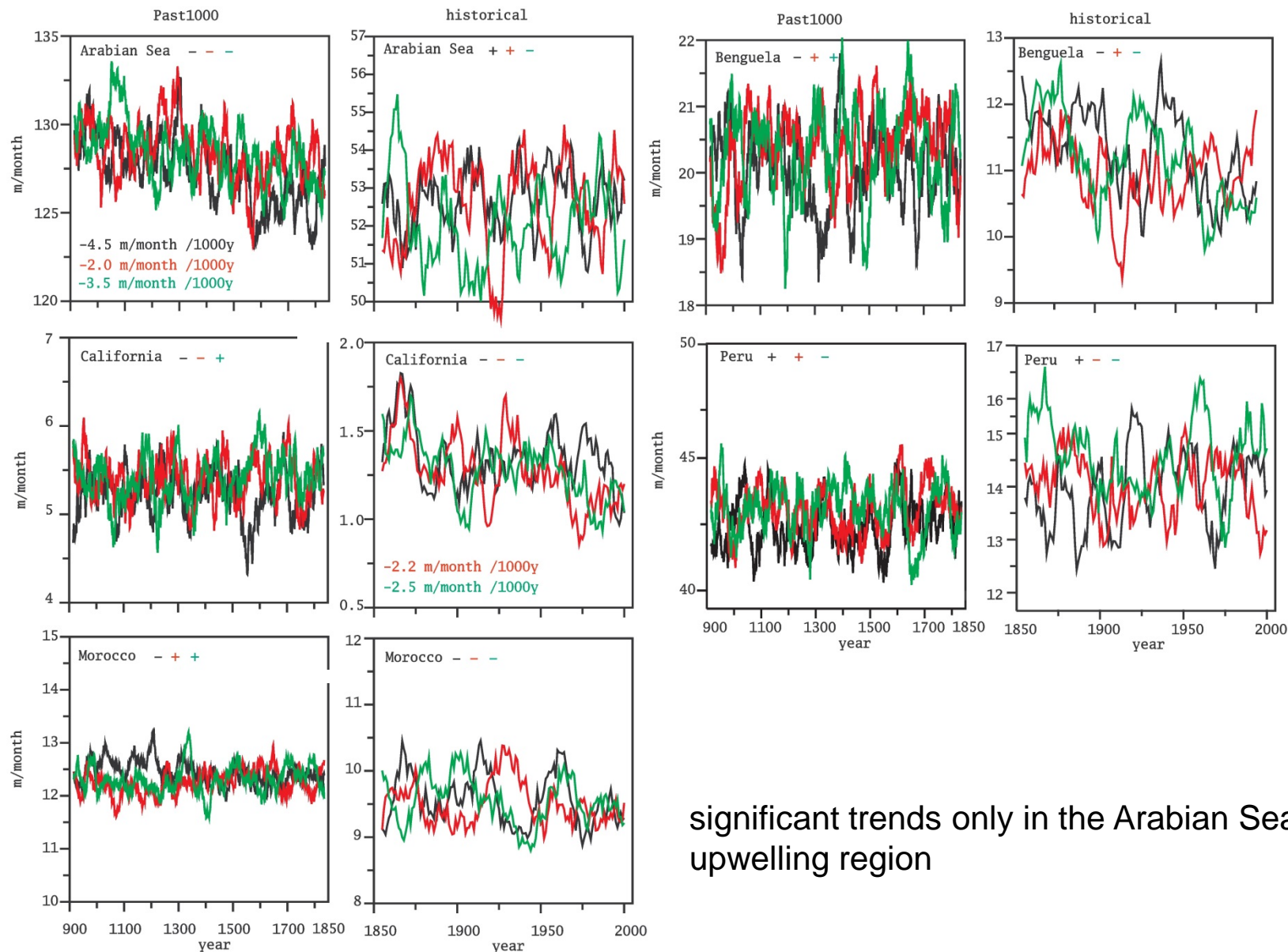
Correlation of upwelling and sea level pressure



pressure gradient drives upwelling



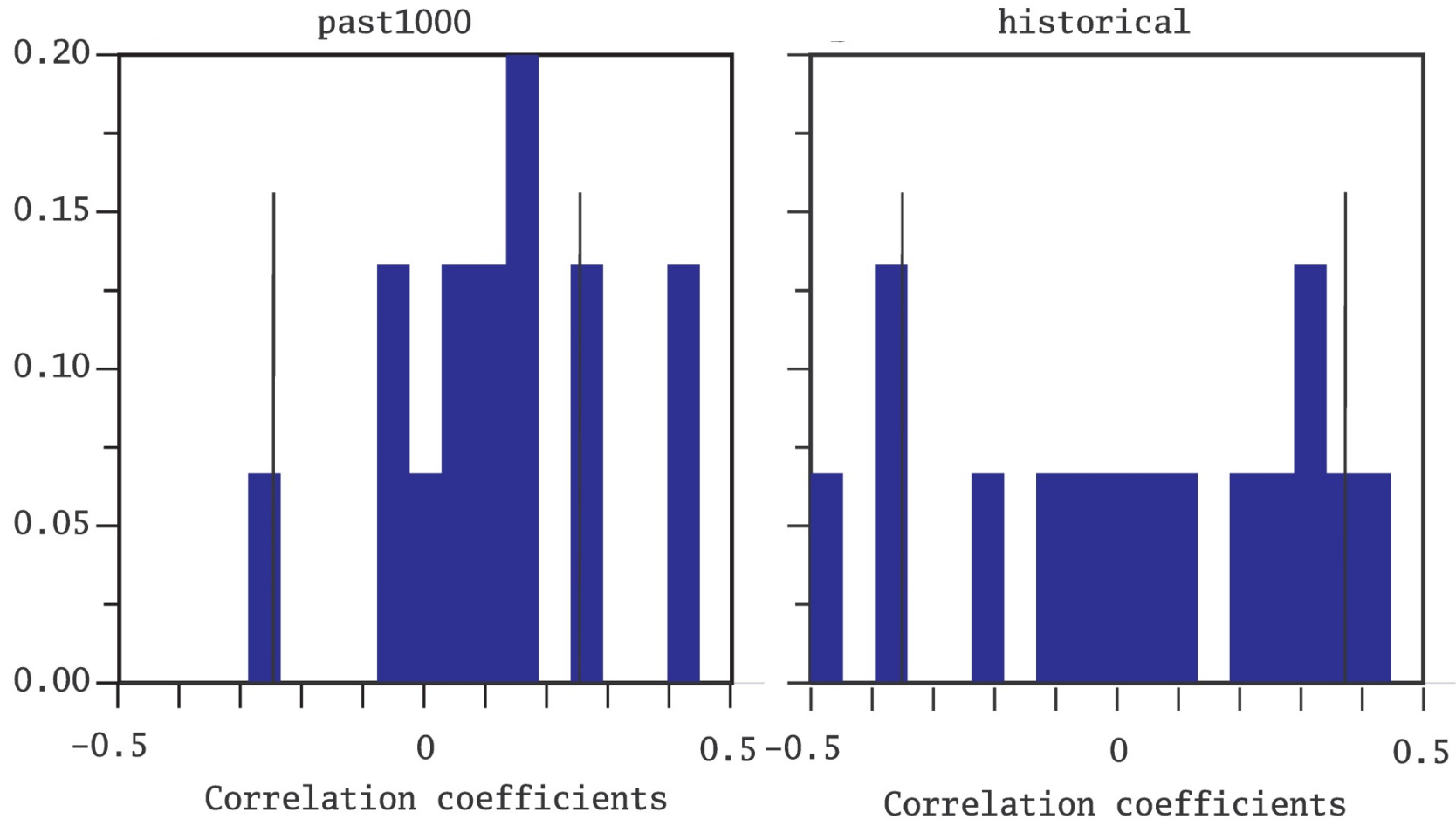
Time series of upwelling



significant trends only in the Arabian Sea and California upwelling region



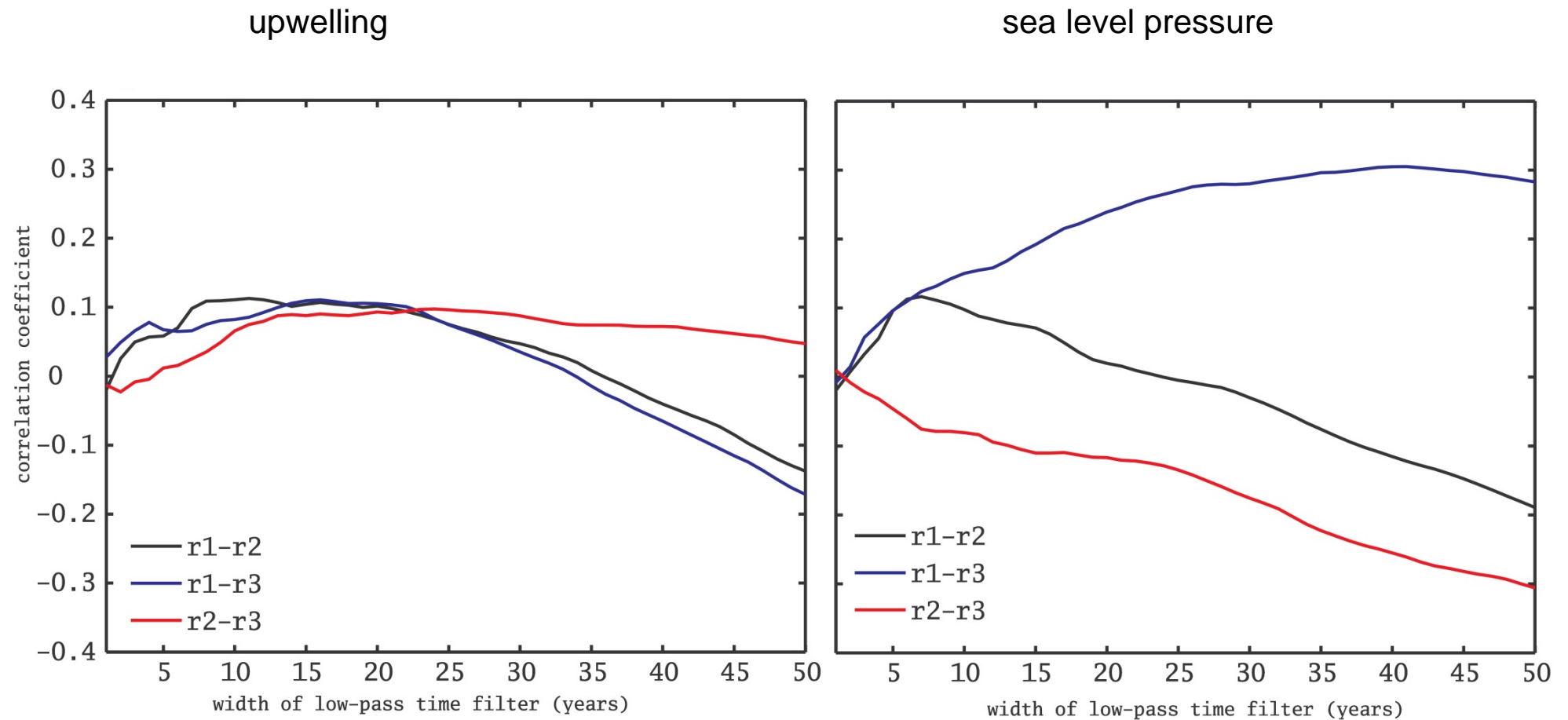
Histogram of correlations between realizations



low correlations between realizations



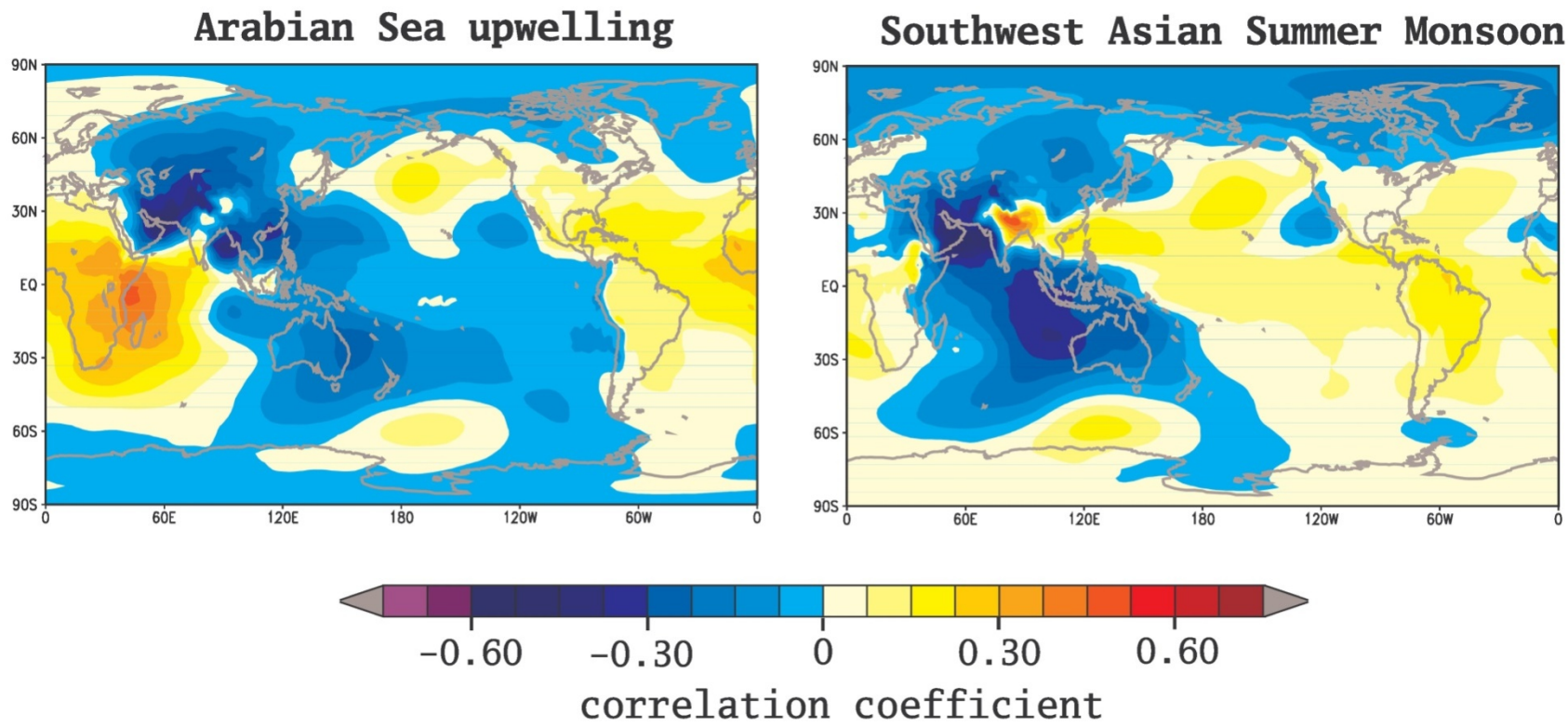
Correlations with low-pass time filter



correlations stay low even with low-pass time filter

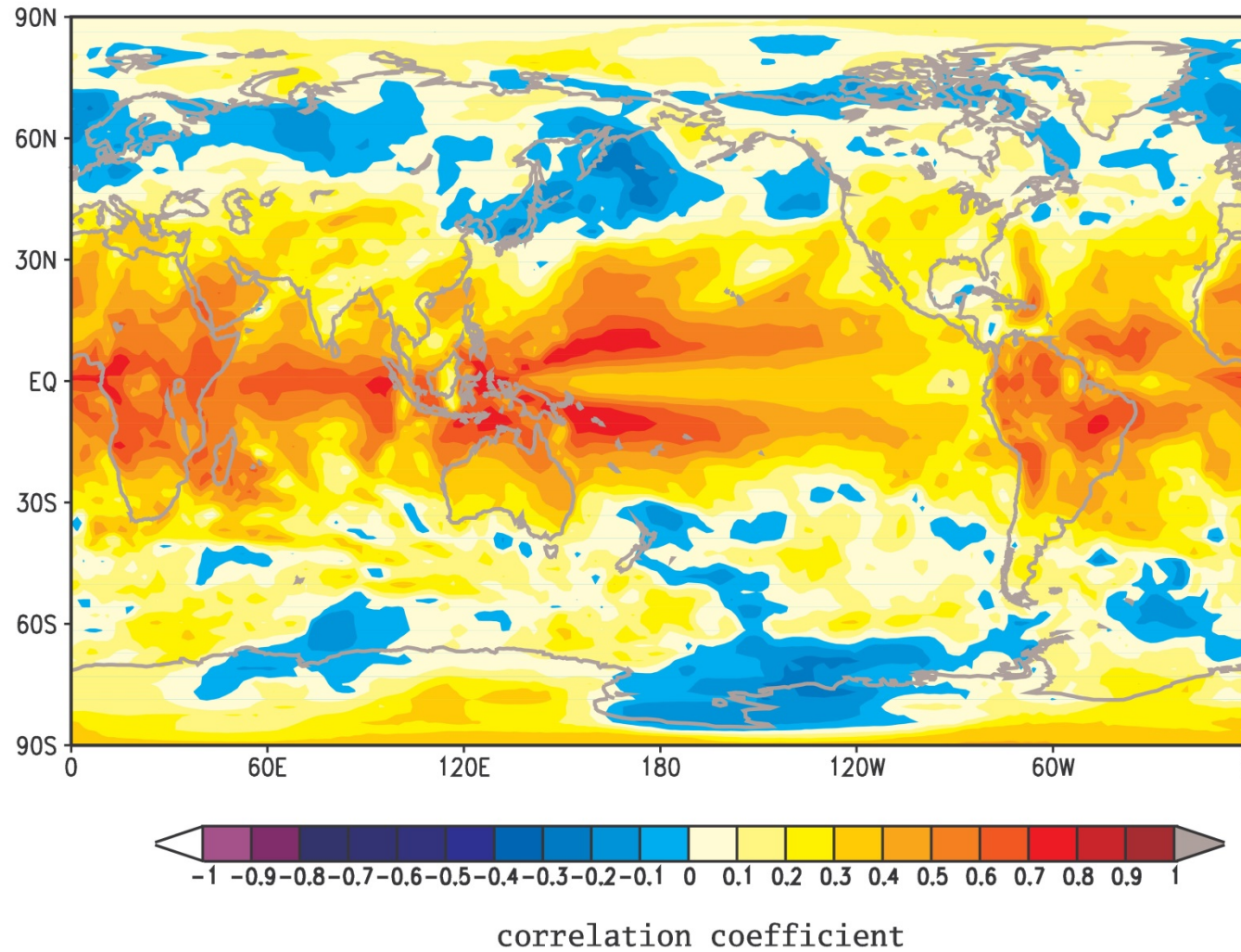


Arabian upwelling and Monsoon



correlation of sea level pressure with upwelling and the Asian Summer Monsoon show differences

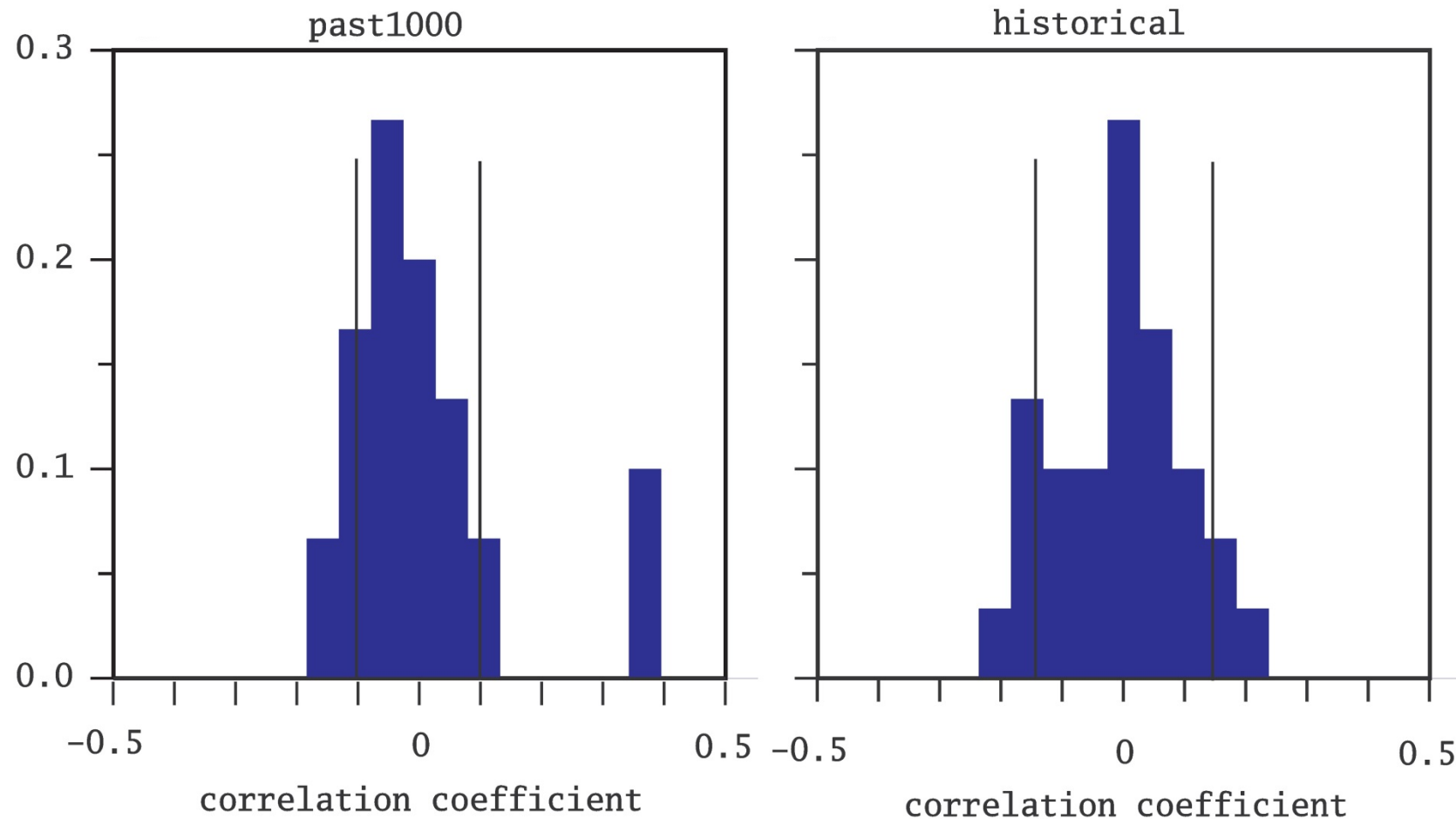
Global skin temperature



SST variability is more strongly externally driven in the tropical belt but low in upwelling regions



Correlations between upwelling regions



correlations between upwelling of the different regions are low, except for Peru-California

Summary

- MPI-ESM CMIP5 simulation realistically represents the upwelling and its drivers
- upwelling in all regions is driven by the sea level pressure gradient between land and ocean
- upwelling is not driven externally in the past millennium in this simulation
- upwelling do not show a clear trend in the past millennium except for the Arabian sea in the past1000 simulation
- the Asian Summer Monsoon impacts the Arabian upwelling but the relation is not direct in this simulation
- the SST is driven more strongly externally in the tropical belt
- correlations are low between the upwelling regions except for Peru and California

Thank you for your attention

Tim, N., Zorita, E., Hünicke, B., Yi, X. and Emeis, K.-C. (2015): Imprint of external climate forcing on coastal upwelling systems over the past millennium. Submitted to Nature Geoscience, under review.