Quantifying Weather and Climate Impacts on Health in Developing Countries (QWeCI)

Science Talk

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Seasonal-to-decadal prediction of the West African monsoon

Javier García-Serrano
IC3 (Barcelona), LOCEAN-IPSL (Paris)

jgarcia@ic3.cat

Seasonal-to-annual prediction skill of the dominant West African Monsoon rainfall regimes

Luis R. L. Rodrigues et al. "*Seasonal prediction of the intraseasonal variability of the West African monsoon precipitation*"

WEST AFRICAN MONSOON

Hovmöller of precipitation averaged over 10W-10E

1982-2008

GPCP (land+ocean observational dataset)

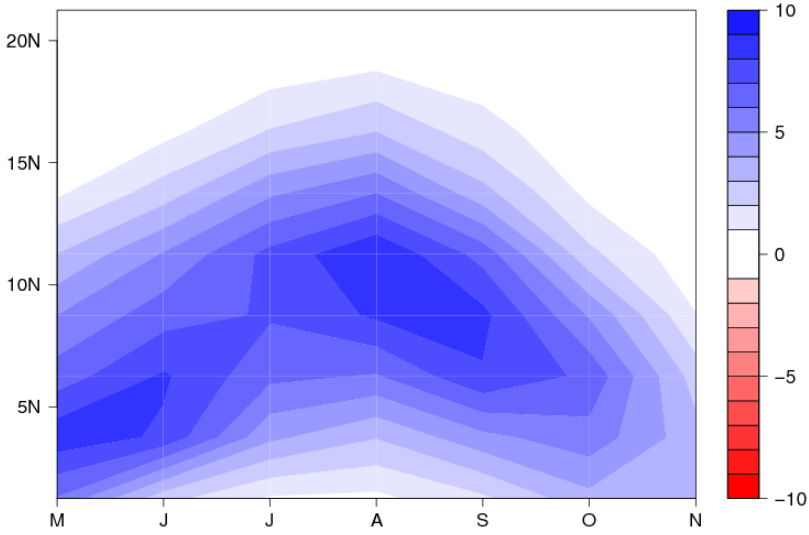
ECMWF.Syst4 (three start dates):

MAY / lead time 0

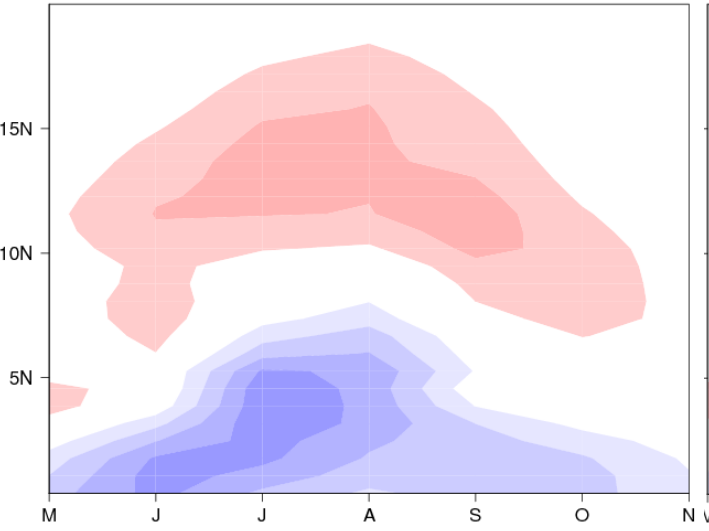
FEB / lead time 3

NOV / lead time 6

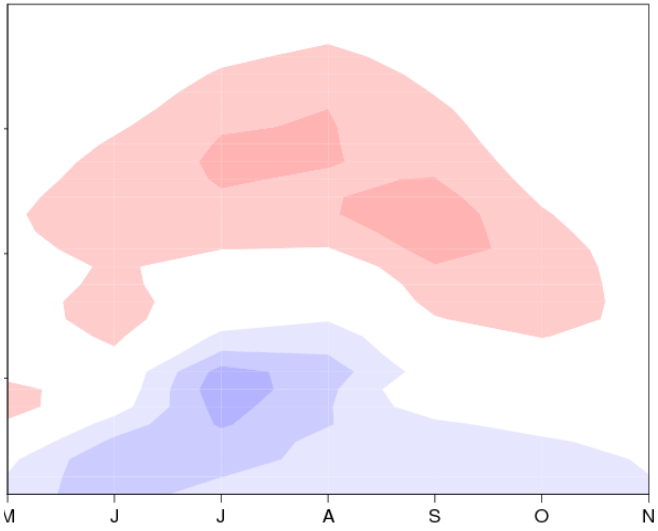
GPCP climatology



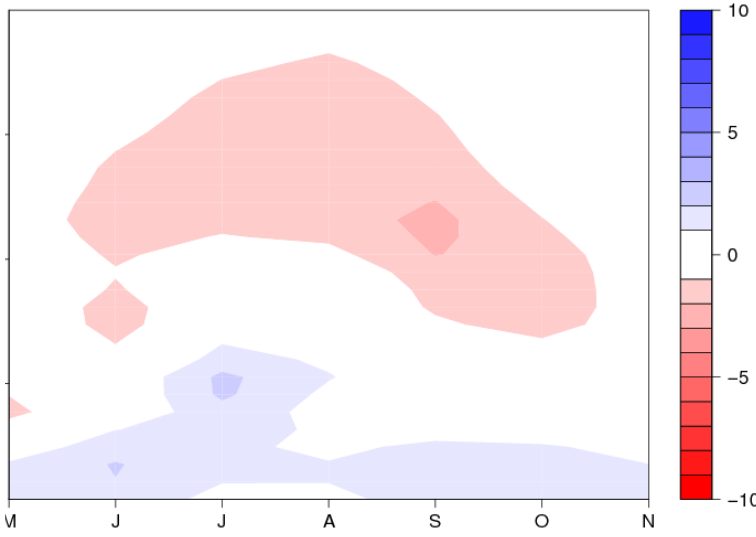
ECMWF.Syst4 (NOV) – GPCP



ECMWF.Syst4 (FEB) – GPCP

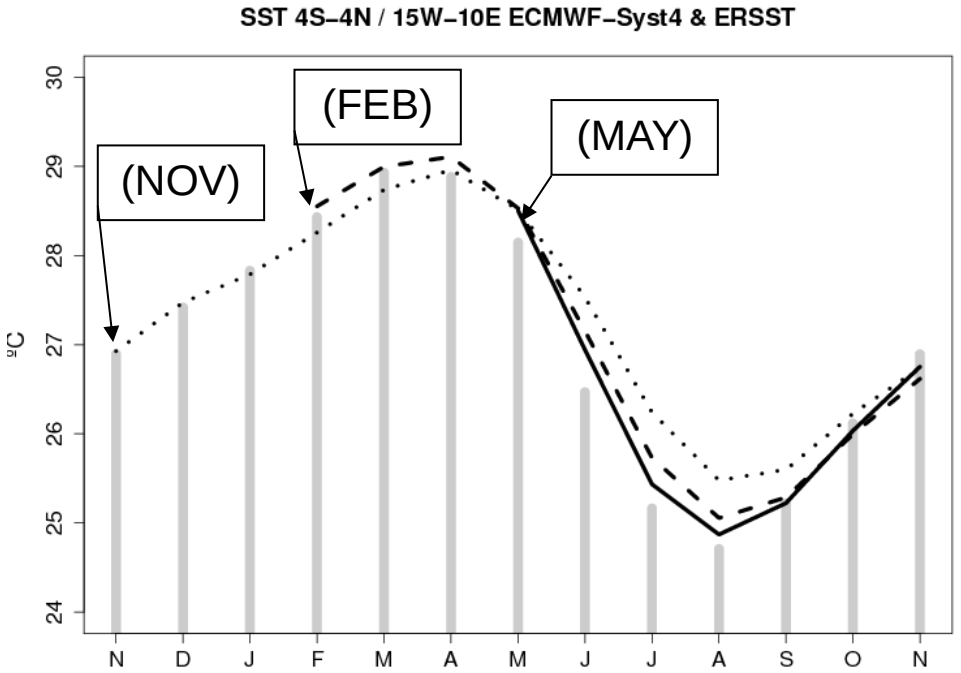


ECMWF.Syst4 (MAY) – GPCP

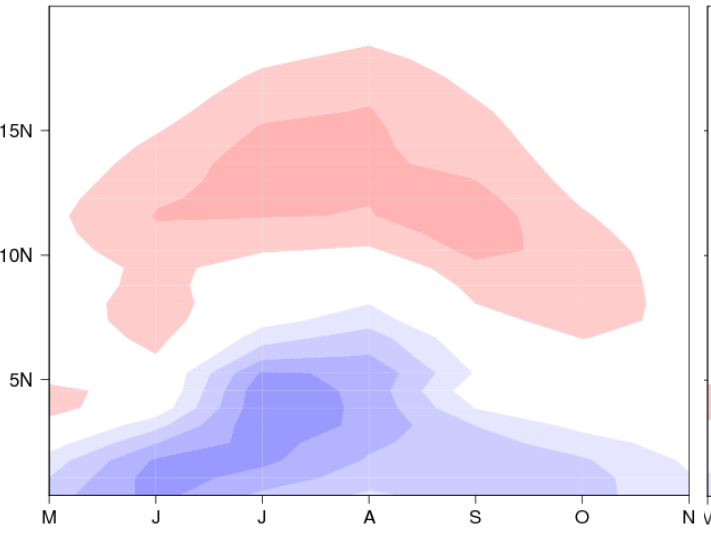


Doblas-Reyes et al. (2013, WIREs Clim Change)

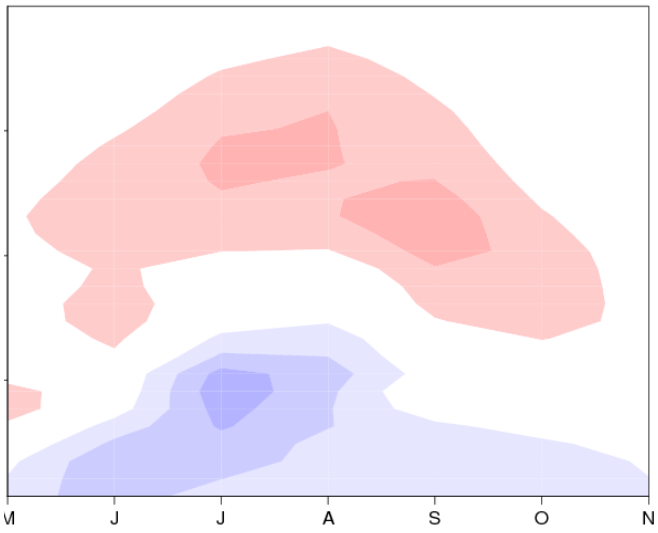
The systematic error of ECMWF.Syst4 in tropical convection is tightly associated with the warming drift in the tropical Atlantic SSTs



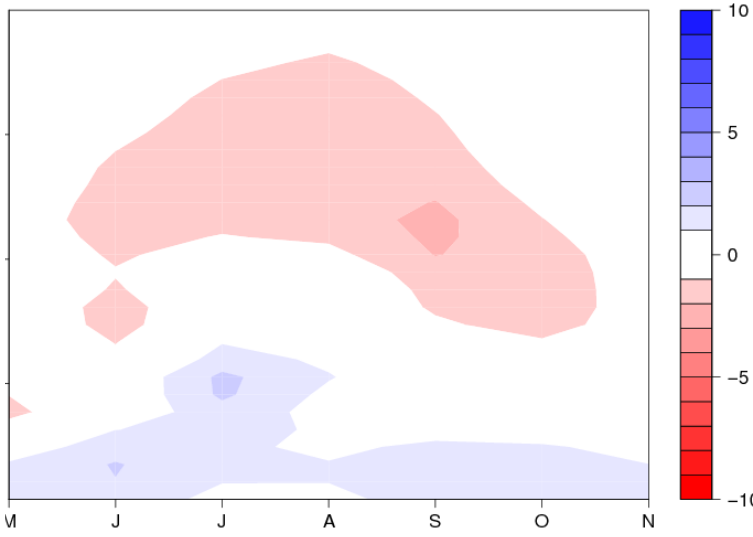
ECMWF.Syst4 (NOV) – GPCP



ECMWF.Syst4 (FEB) – GPCP

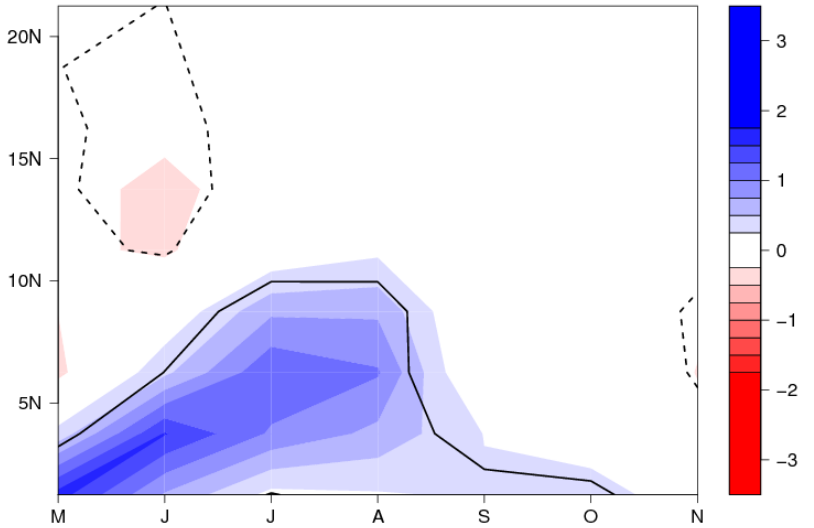


ECMWF.Syst4 (MAY) – GPCP



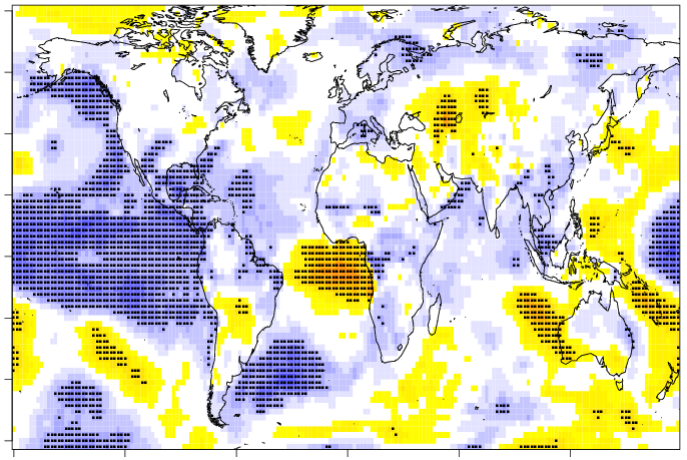
Doblas-Reyes et al. (2013, WIREs Clim Change)

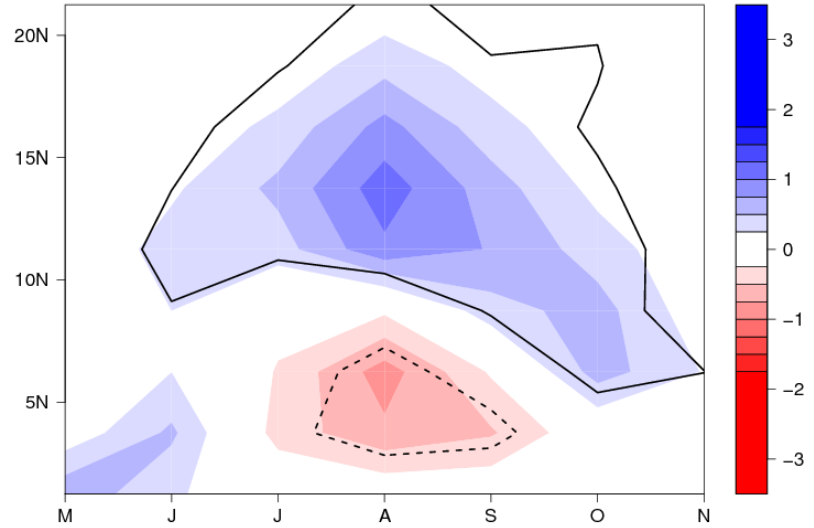
The observed interannual variability of the Hovmöller of precipitation (GPCP) is dominated by the Guinean (EOF#1) and Sahelian (EOF#2) rainfall regimes, associated with the recent Atlantic-Pacific inter-tropical connection and the inter-hemispheric gradient (AMO, IPO) respectively.



EOF#1 27%

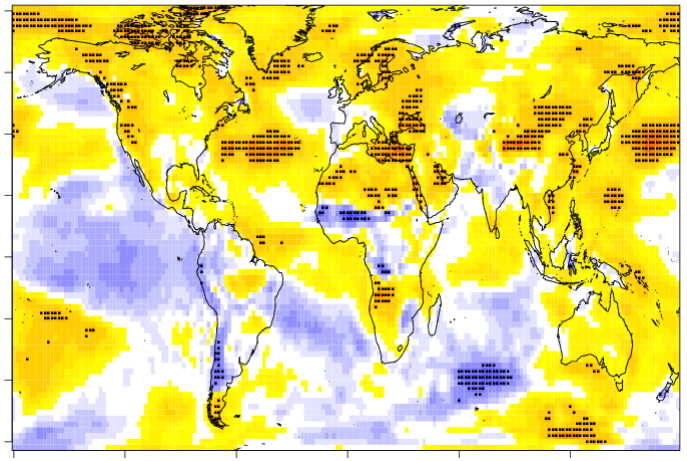
PC1 x NCEP/NCAR surface temperature (JAS)





EOF#2 20%

PC2 x NCEP/NCAR surface temperature (JAS)

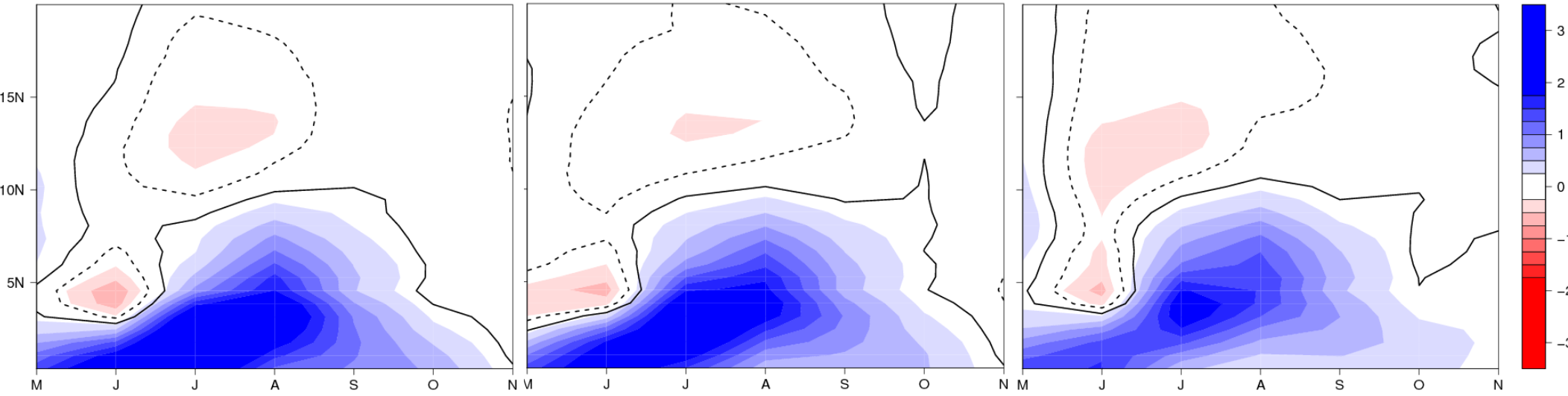


The leading EOF mode of the Hovmöller of precipitation in ECMWF.Syst4 is the Guinean rainfall regime. EOF#1 pattern in each start date reflects the model systematic error in tropical convection. ECMWF.Syst4 captures the recent Atlantic-Pacific relationship.

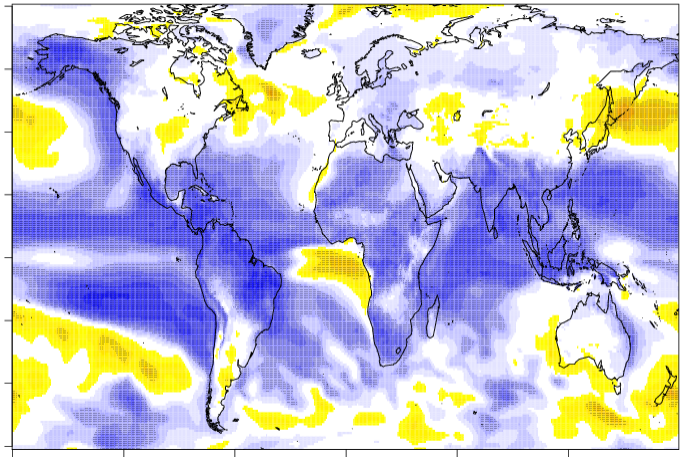
EOF#1-NOV 39%

EOF#1-FEB 38%

EOF#1-MAY 30%

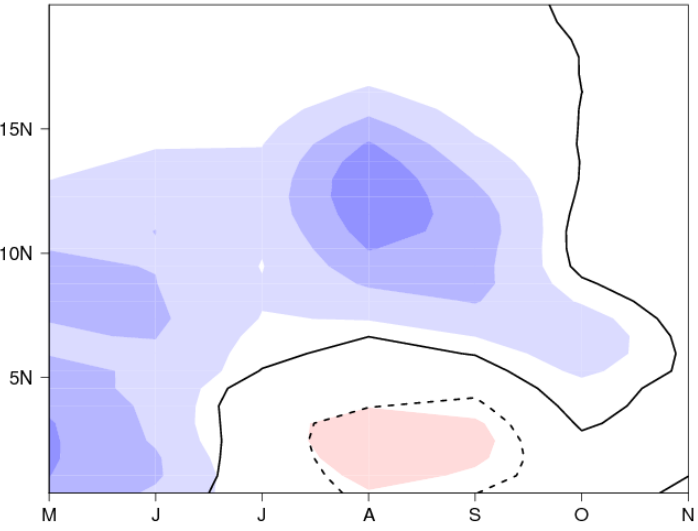


PC1-MAY x surface temperature (JAS)

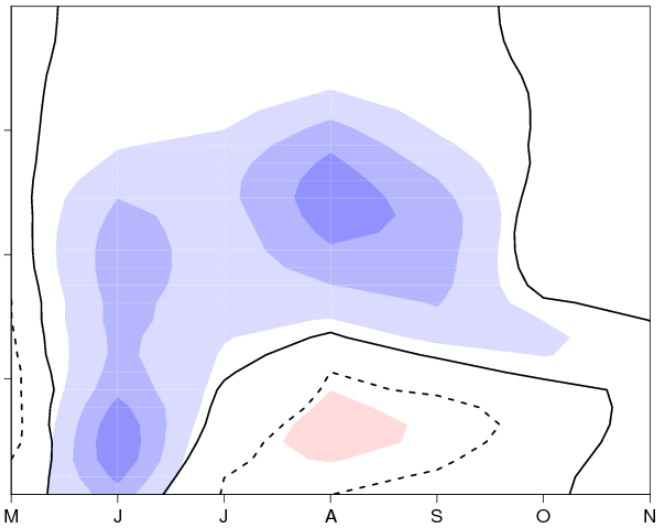


The second EOF mode of the Hovmöller of precipitation in ECMWF.Syst4 is the Sahelian rainfall regime. ECMWF.Syst4 captures the related inter-hemispheric gradient, including the projection onto both the AMO and the IPO.

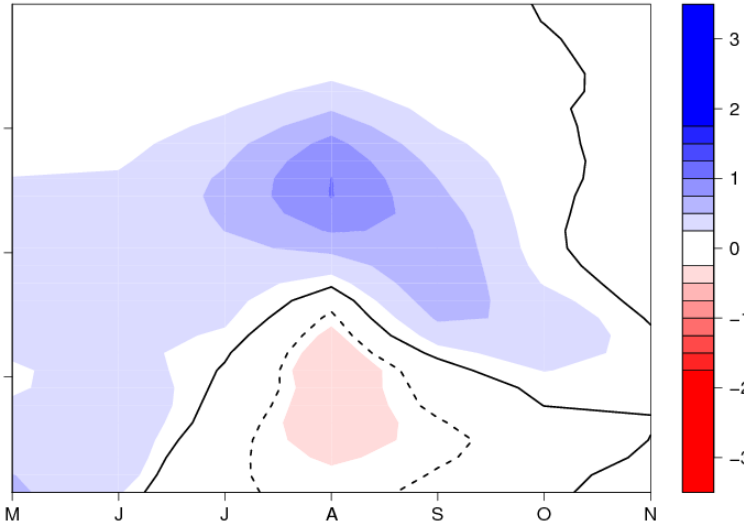
EOF#2-NOV 10%



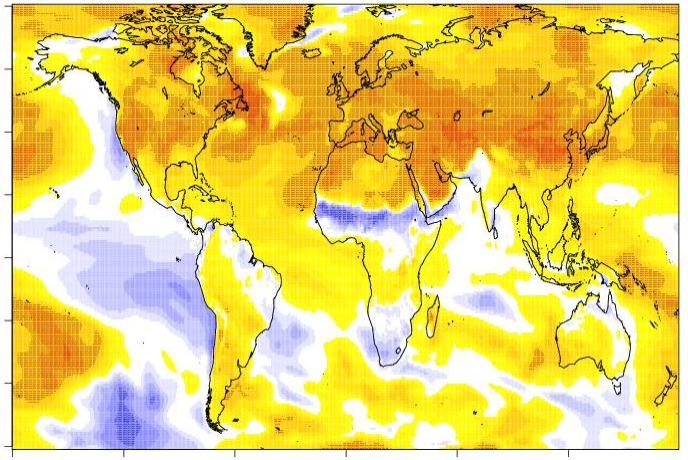
EOF#2-FEB 10%



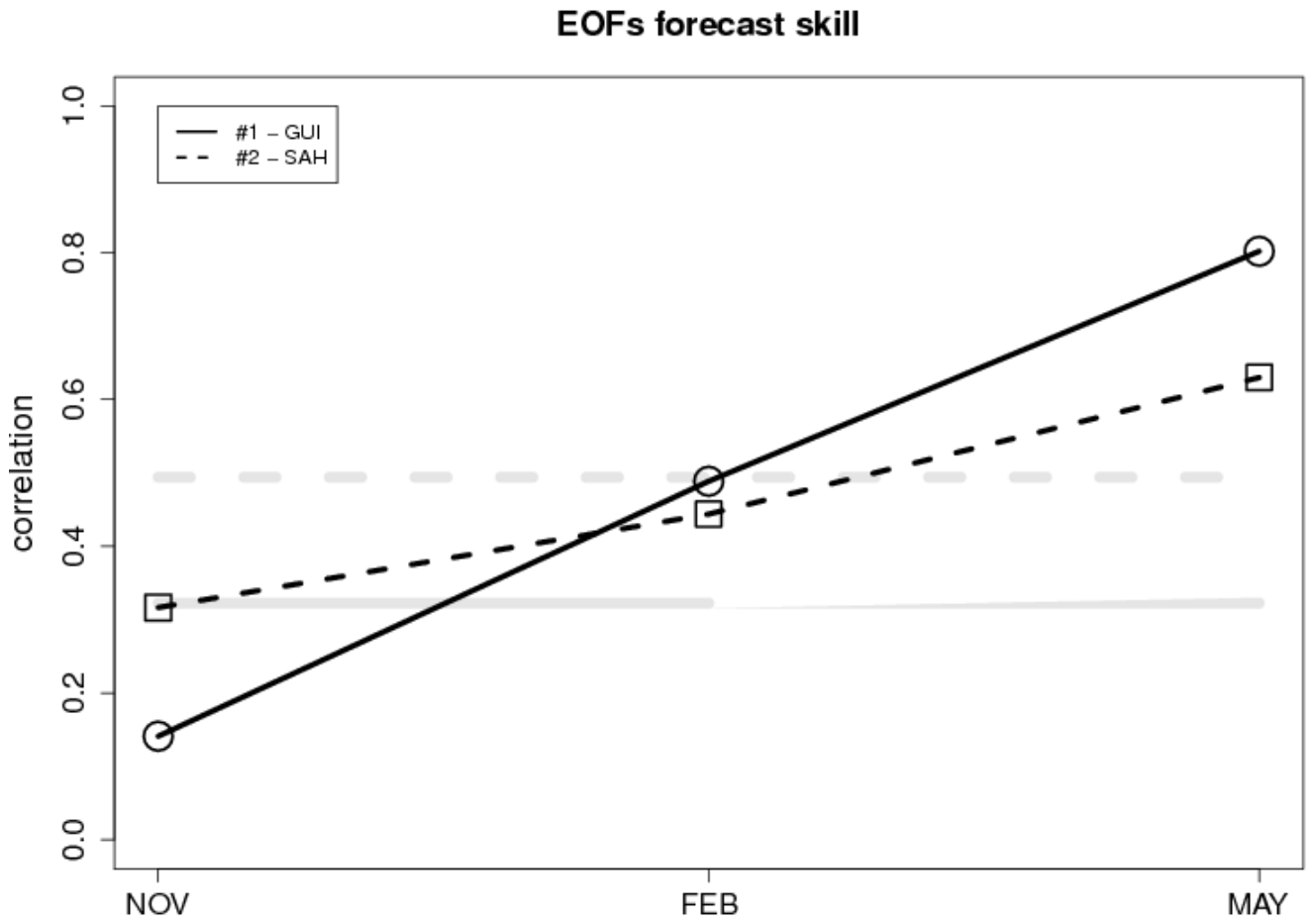
EOF#2-MAY 11%



PC2-MAY x surface temperature (JAS)



Ensemble-mean anomaly correlation coefficient between GPCP and ECMWF.Syst4 Hovmöller-EOF modes. The Guinean rainfall (EOF#1, solid) skill is statistically significant up to FEB (lead time = 3 months); the Sahelian rainfall (EOF#2, dashed) has statistically significant skill only in MAY (lead time = 0 months).



Multi-annual-to-decadal prediction skill of the dominant West African Monsoon rainfall regimes

J. García-Serrano, F.J. Doblas-Reyes, R.J. Haarsma, I. Polo (2013): "*Decadal prediction of the dominant West African rainfall modes*", J. Geophys. Res. (in press)

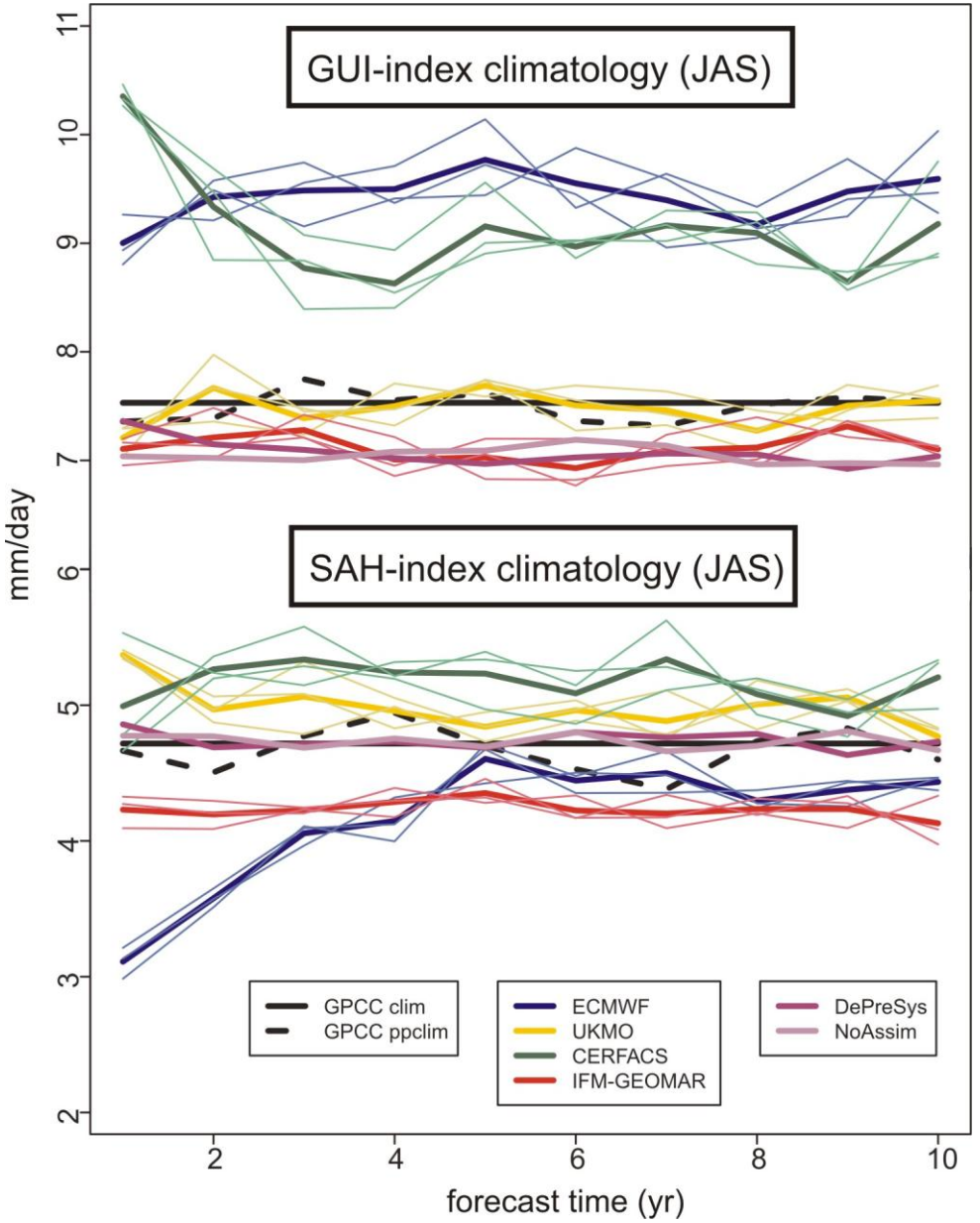
Observational climatology and model drift in the ENSEMBLES multi-model and perturbed-parameter decadal hindcasts of the West African monsoon (WAM) precipitation;
5-yr intervals between start dates:

Guinean rainfall

5N-10N / 10W-10E

Sahelian rainfall

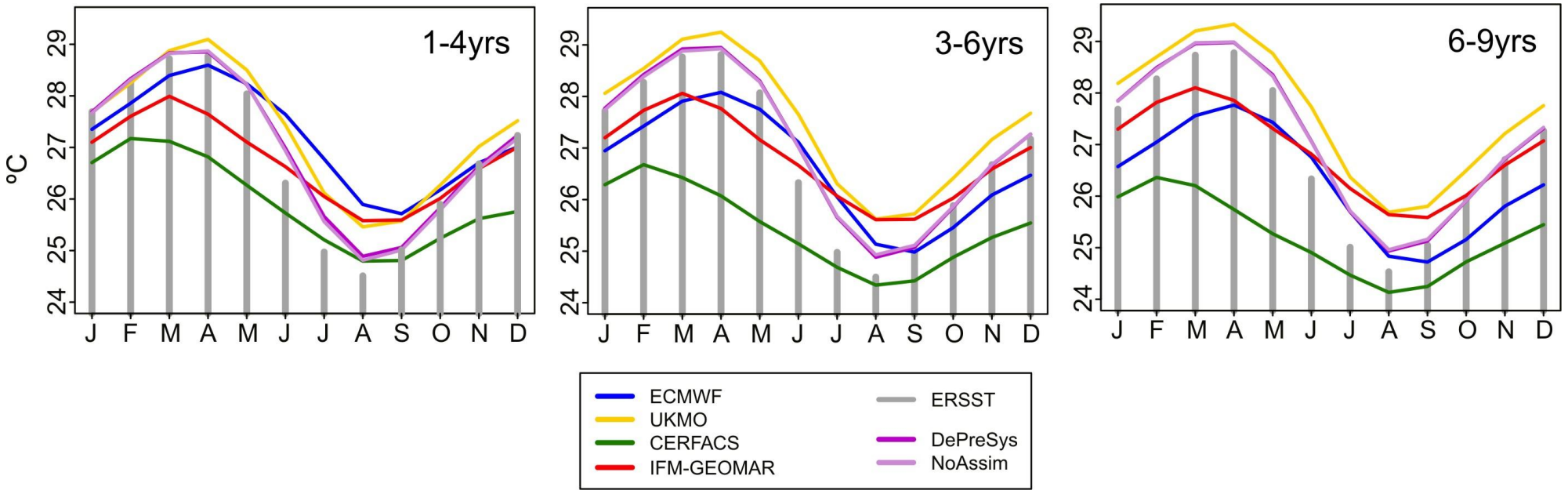
10N-17.5N / 15W-15E



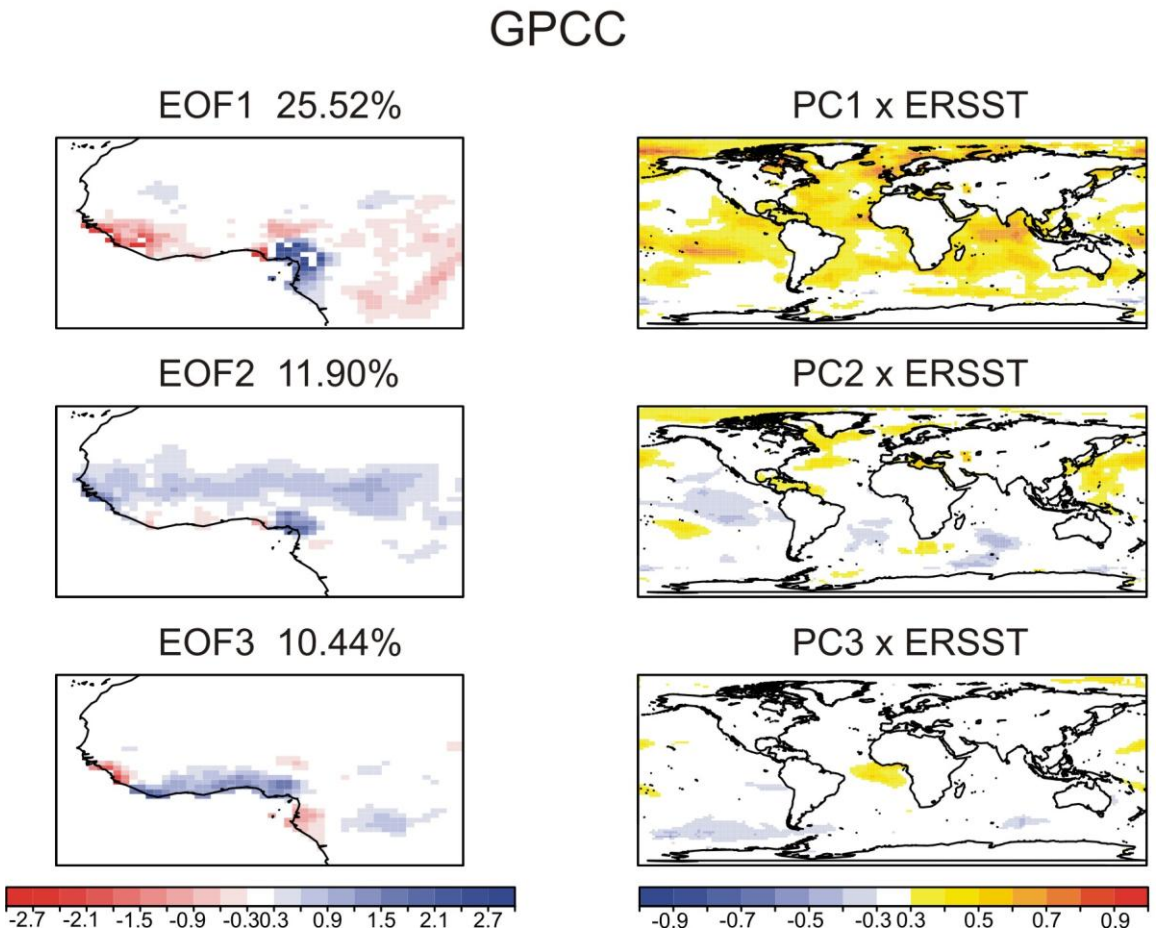
Observational climatology (bars) and model climate (lines) in the ENSEMBLES multi-model and perturbed-parameter decadal hindcasts of tropical SST;
5-yr intervals between start dates:

Gulf of Guinean SST

5S-5N / 15W-10E



Observational leading EOFs of July-September (JAS) WAM precipitation in 1961-2009, neither filter nor detrending is applied: EOF1 shows negative anomalies in the western part of the WAM region, and its associated with global-warming; EOF2 corresponds to the Sahelian rainfall and projects onto the inter-hemispheric gradient that involves the AMO and IPO signals; EOF3 is the Guinean rainfall and relates to the Atlantic Niño.



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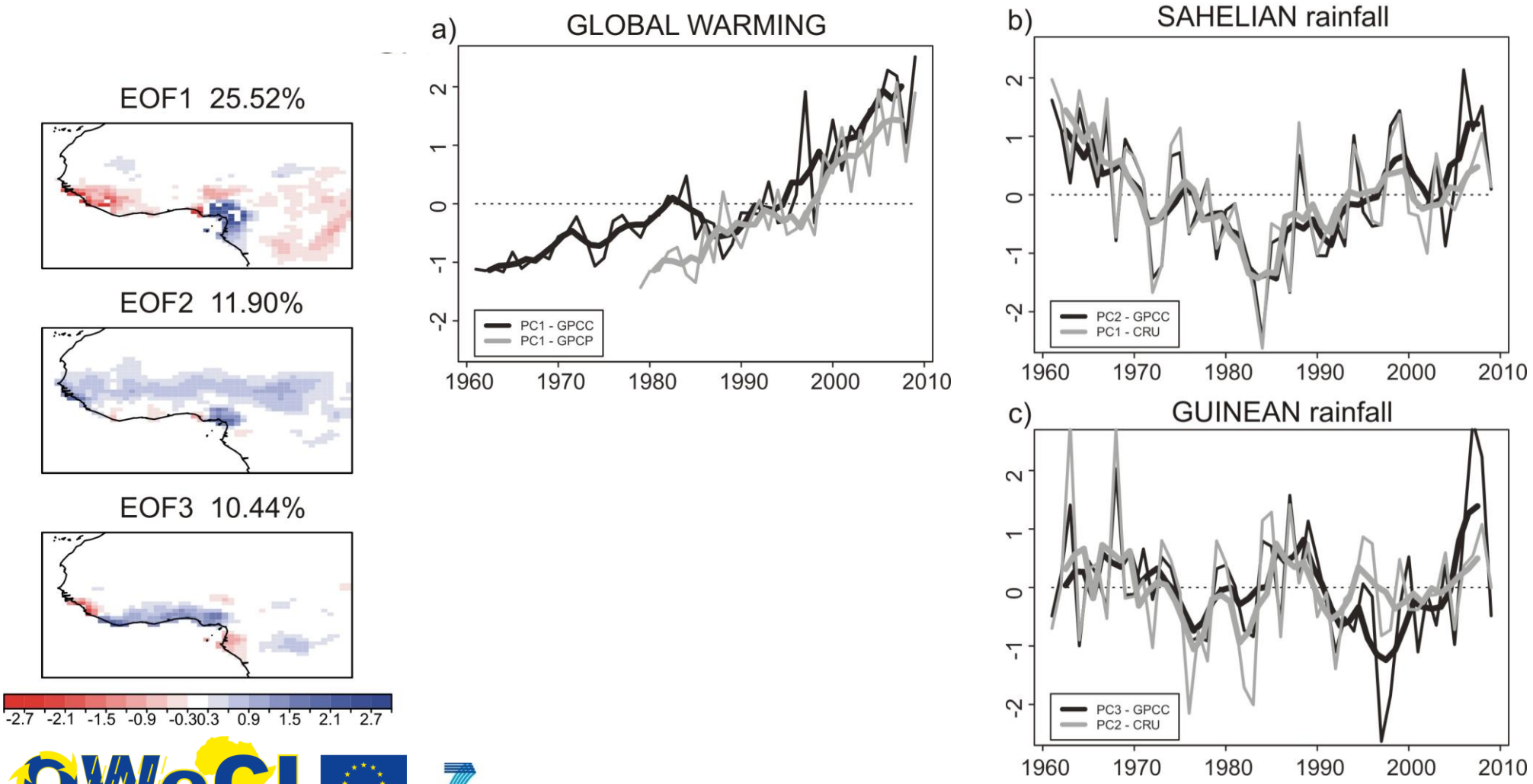
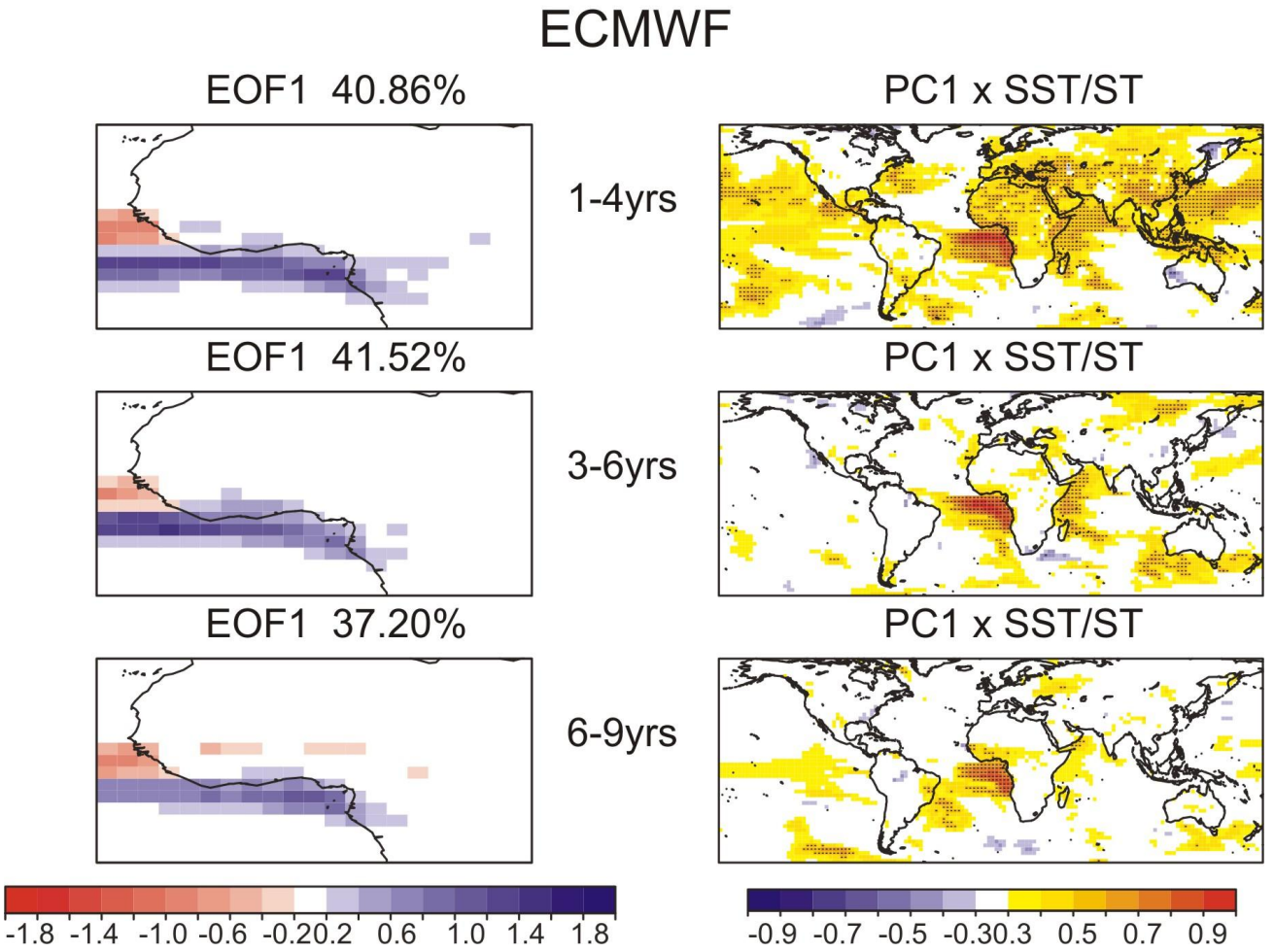


(Example) ECMWF leading EOFs of July-September (JAS) WAM precipitation in three different forecast averages: EOF1 corresponds to the Guinean rainfall, and its mainly associated with the Atlantic Niño; EOF2 corresponds to the Sahelian rainfall and projects onto the inter-hemispheric gradient. The AMO signature, particularly the subtropical branch, shows consistency across all the forecast systems.



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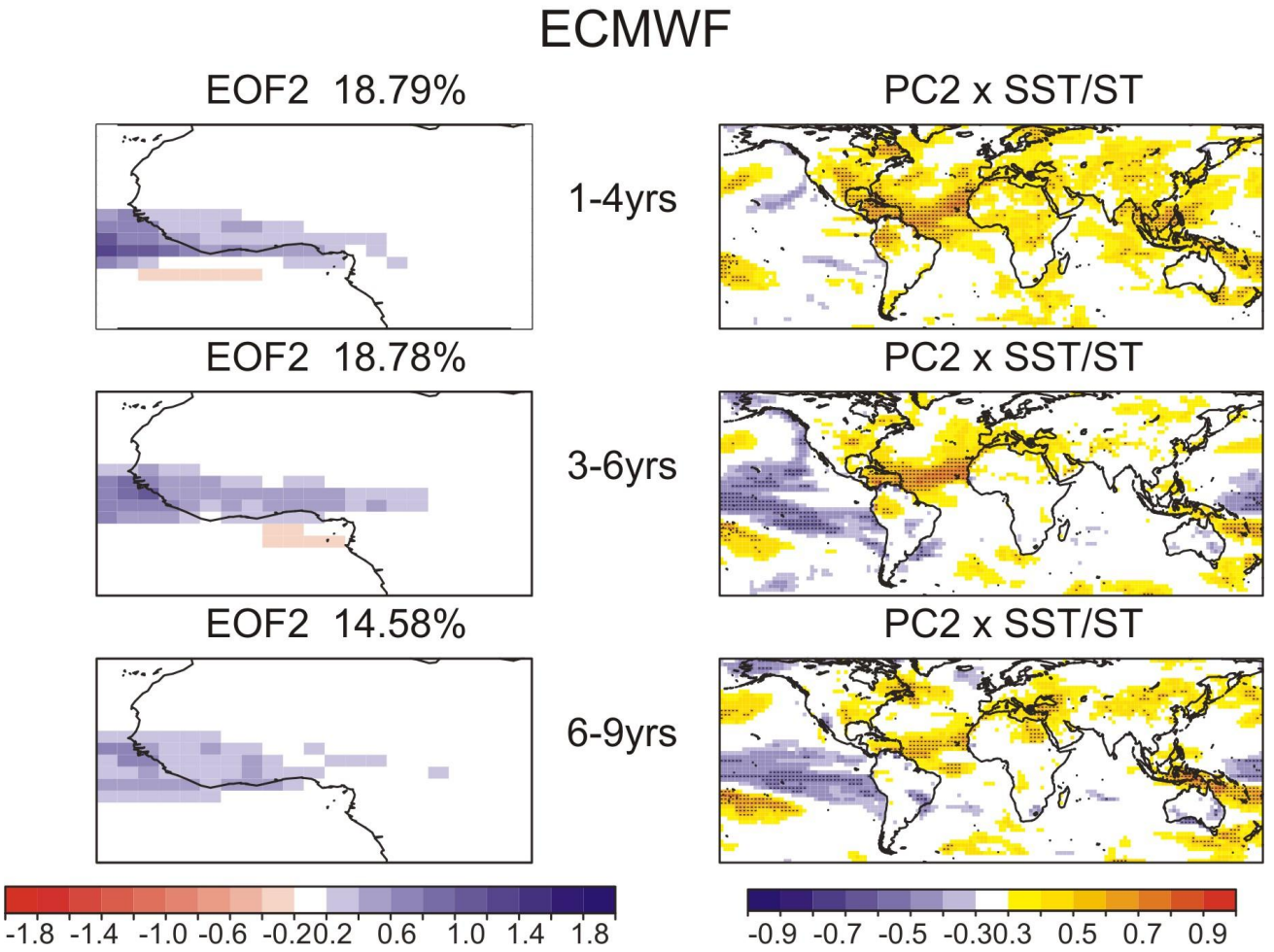
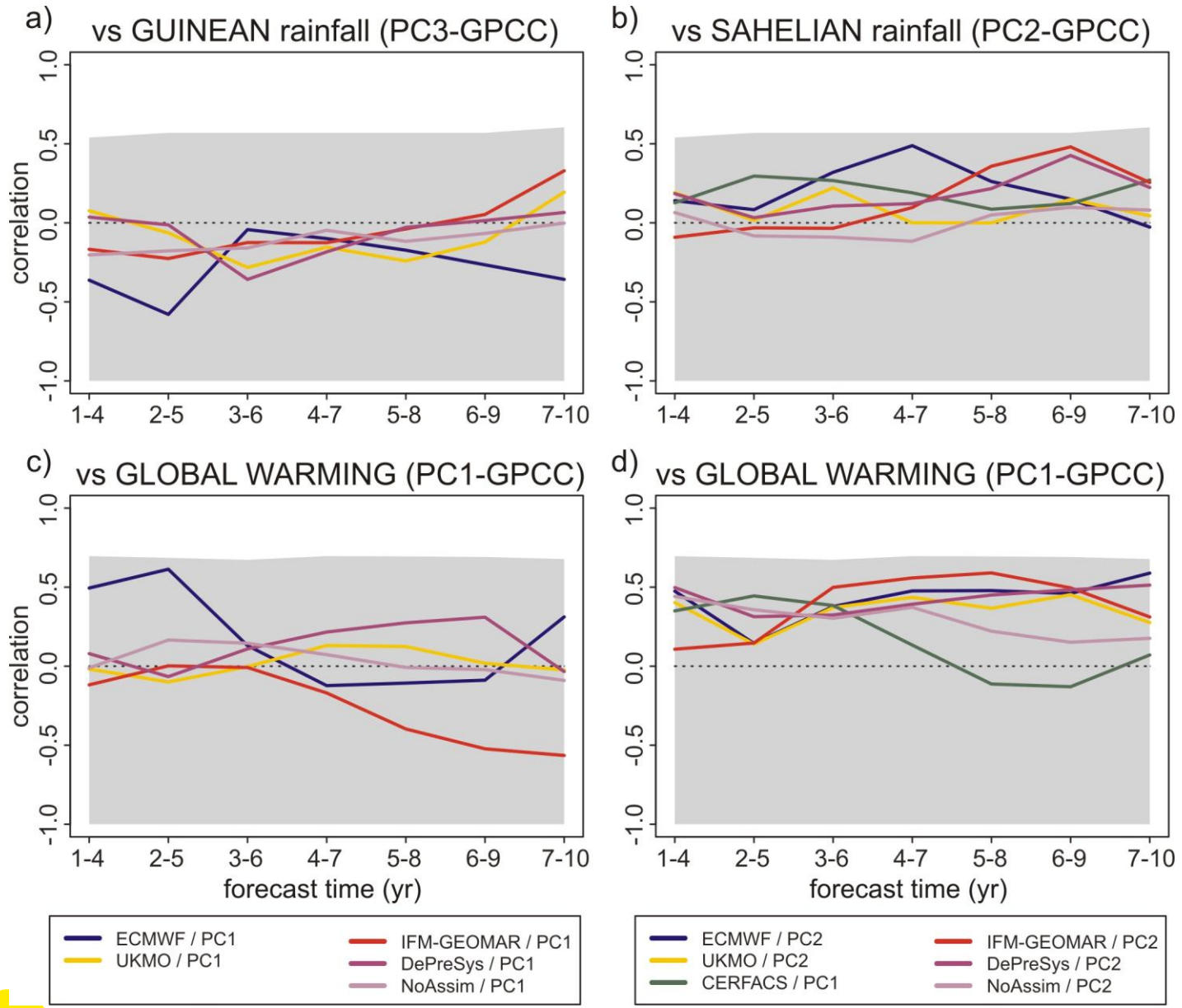


Ensemble-mean correlation coefficient of the model Guinean rainfall mode (left; a,c) and the model Sahelian rainfall mode (right; b,d) against the observational leading EOFs.

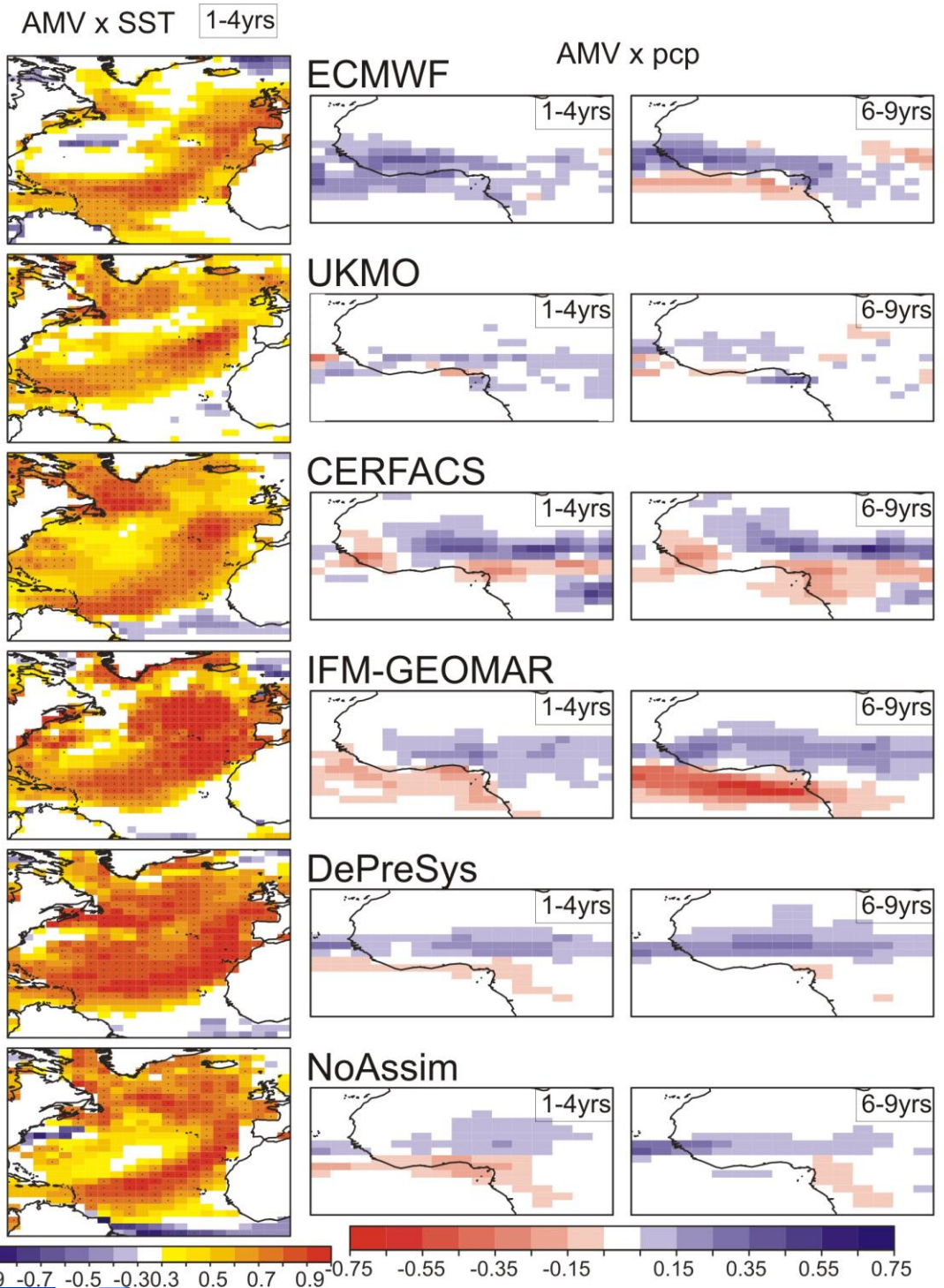


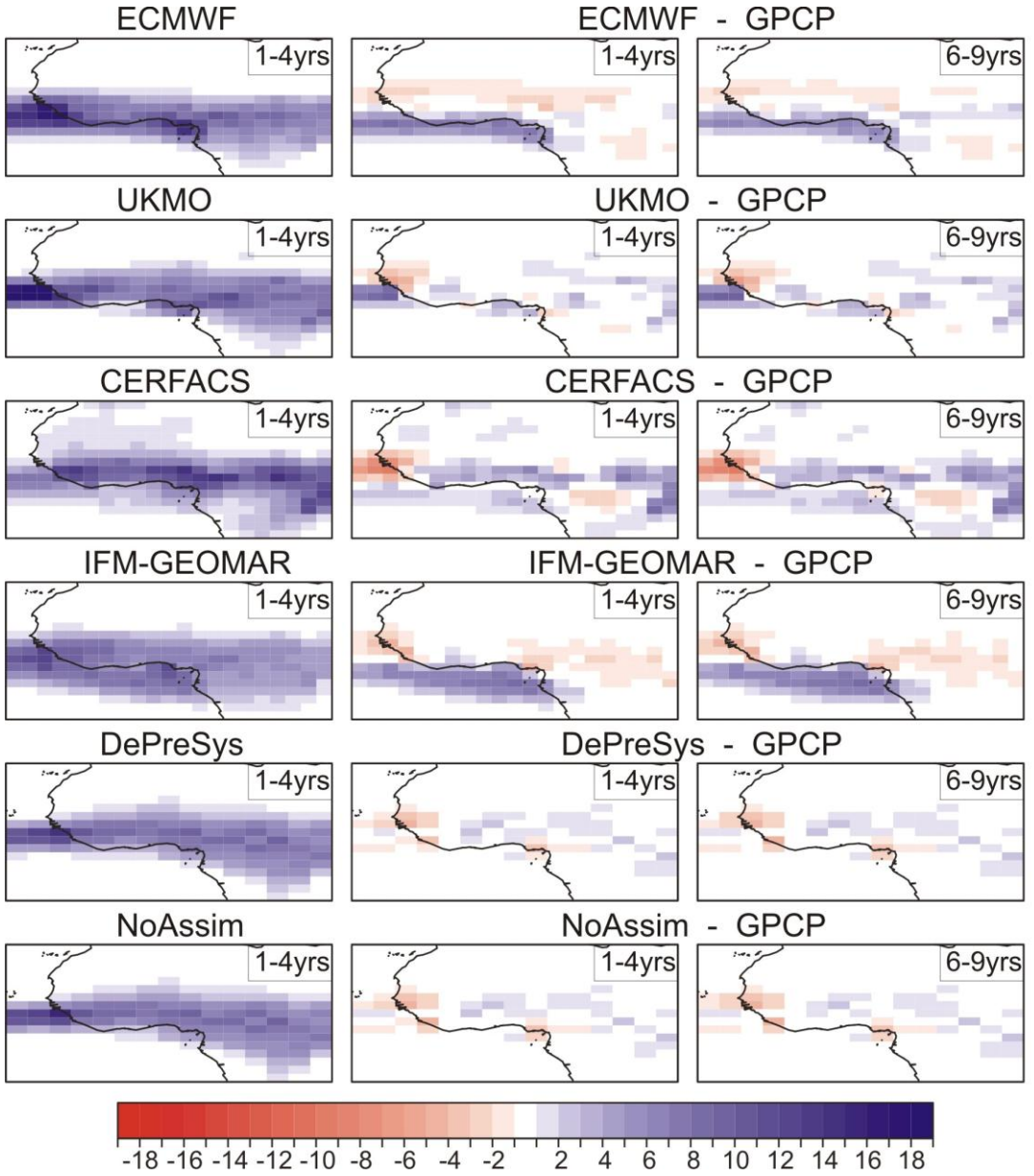
SUMMARY

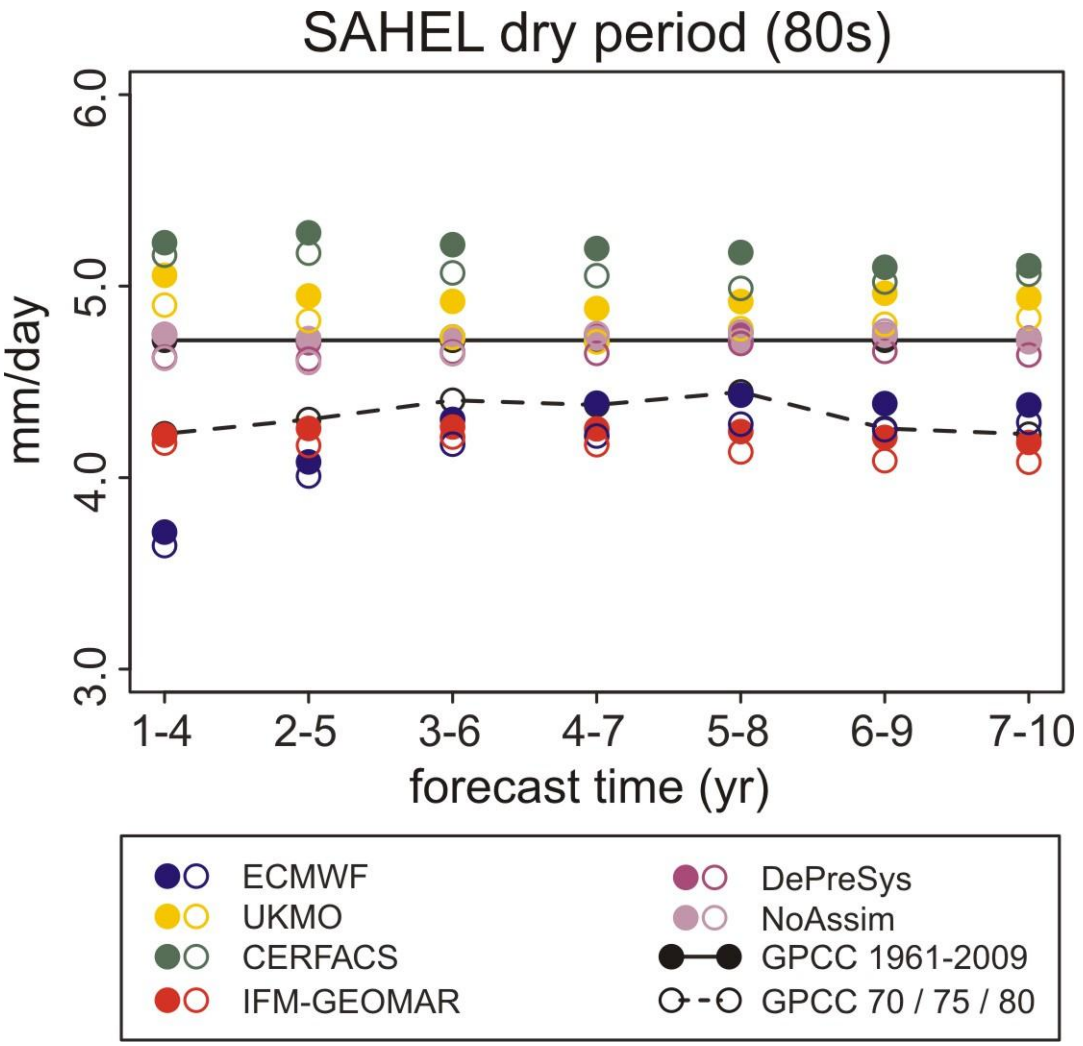
- The skill assessment of the longitudinally-averaged precipitation over West Africa (Hovmöller, 10ºW-10ºE) has revealed levels of skill not achieved so far by using direct model output of rainfall. The Guinean precipitation regime reached correlations of about 0.8 at the start date of May (zero lead time) and 0.5 at the start date of February (3-month lead time). The Sahelian precipitation regime reached correlations of about 0.6 at the start date of May, 0.45 in February, and 0.3 at the start date of (the previous) November (6-month lead time) .

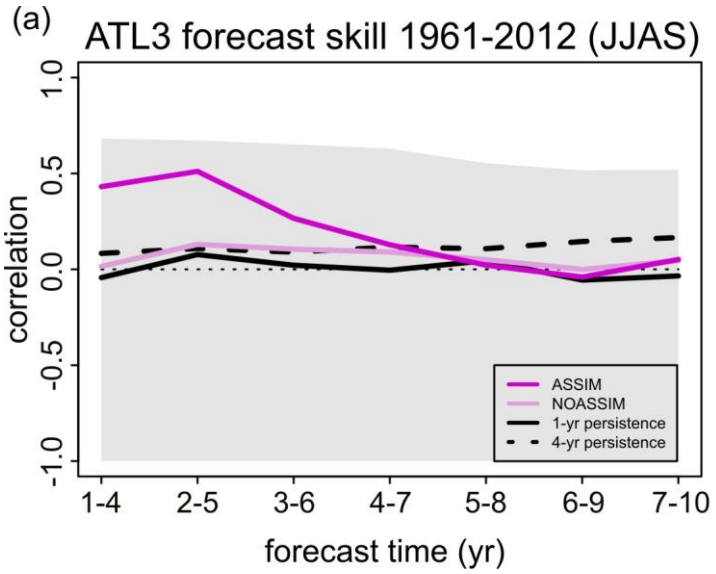
- No significant multi-year skill has been found to predict the dominant WAM rainfall regimes (Guinean, Sahelian) at interannual-to-decadal timescales. However, the good performance across the models in simulating the relationship between these rainfall modes and surrounding SST forcings (ATL3, AMO) points out encouraging prospects for decadal forecasting.

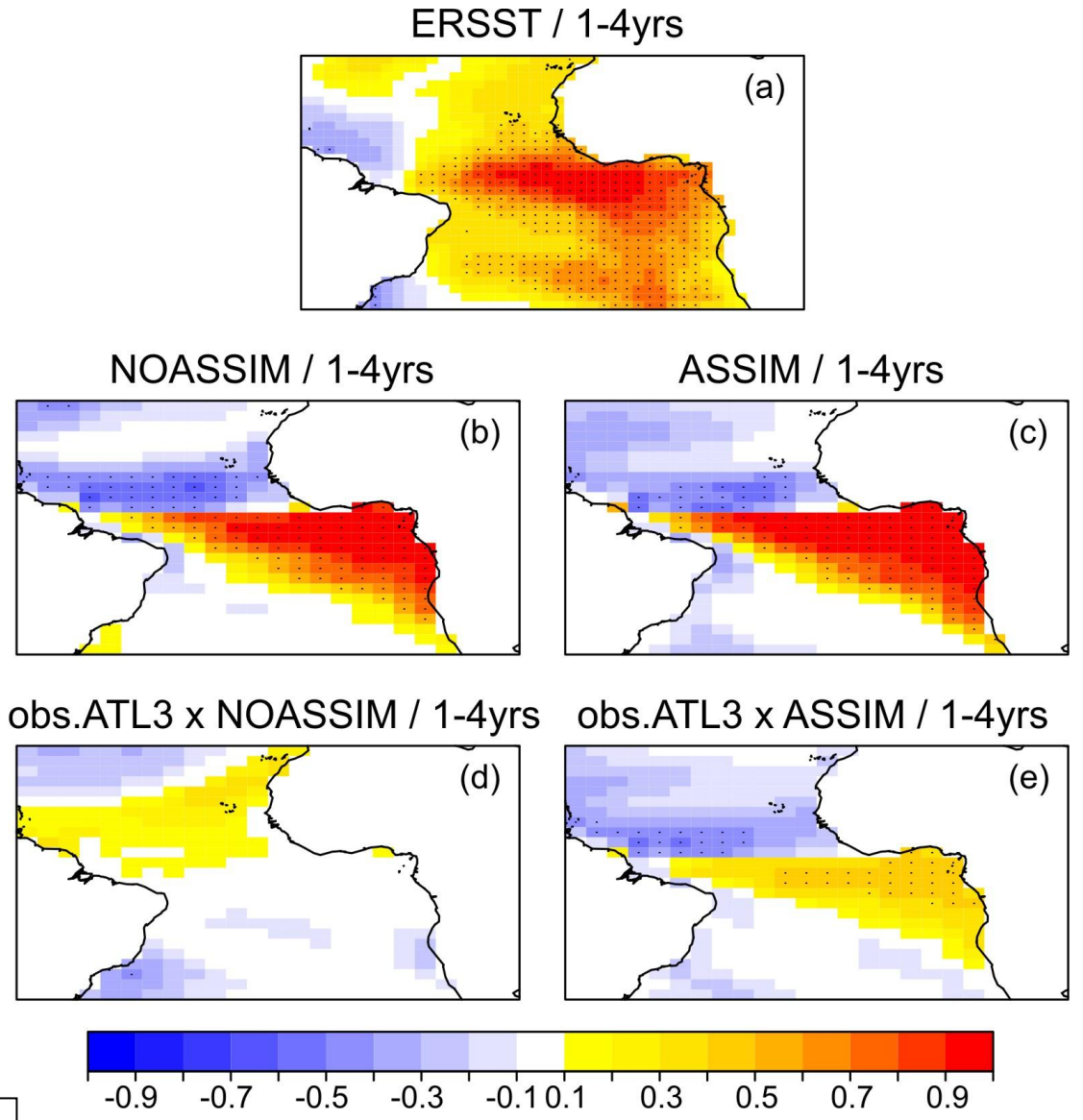
EXTRA SLIDES


AMV x SST
1-4yrs
AMV x pcp
ECMWF
1-4yrs
6-9yrs
UKMO
1-4yrs
6-9yrs
CERFACS
1-4yrs
6-9yrs
IFM-GEOMAR
1-4yrs
6-9yrs
DePreSys
1-4yrs
6-9yrs
NoAssim
1-4yrs
6-9yrs
-0.9 -0.7 -0.5 -0.3 0.3 0.5 0.7 0.9
-0.75 -0.55 -0.35 -0.15 0.15 0.35 0.55 0.75

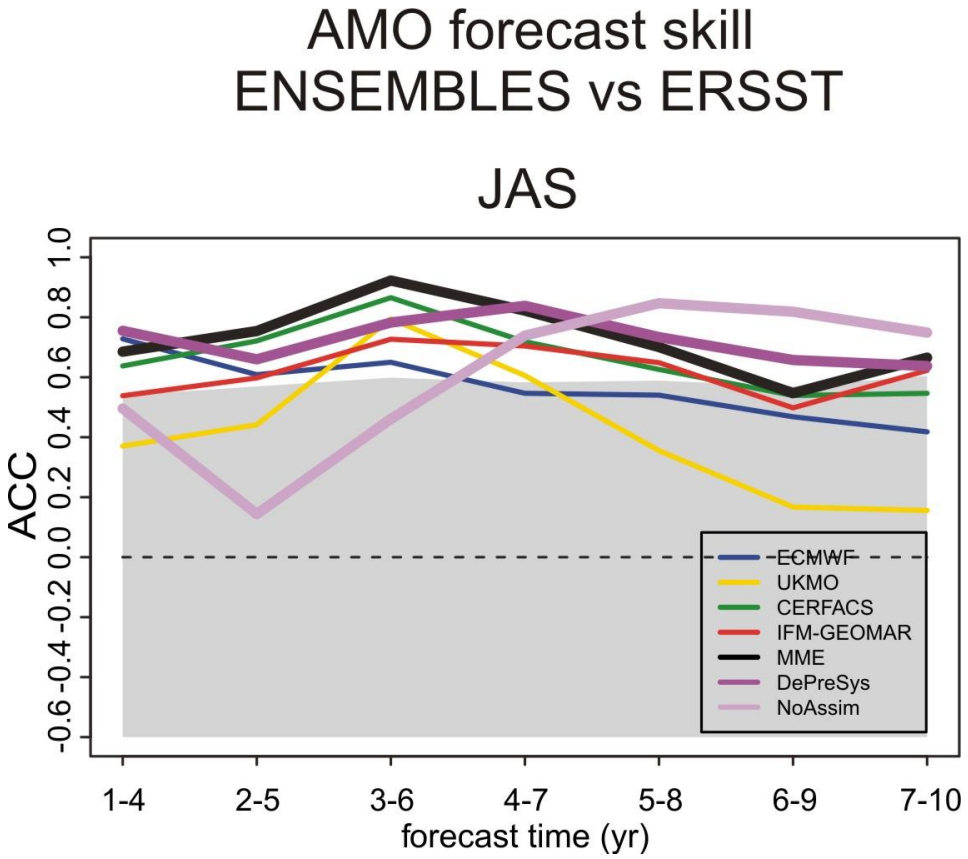

ECMWF
1-4yrs
ECMWF - GPCP
1-4yrs
6-9yrs
UKMO
1-4yrs
UKMO - GPCP
1-4yrs
6-9yrs
CERFACS
1-4yrs
CERFACS - GPCP
1-4yrs
6-9yrs
IFM-GEOMAR
1-4yrs
IFM-GEOMAR - GPCP
1-4yrs
6-9yrs
DePreSys
1-4yrs
DePreSys - GPCP
1-4yrs
6-9yrs
NoAssim
1-4yrs
NoAssim - GPCP
1-4yrs
6-9yrs
-18 -16 -14 -12 -10 -8 -6 -4 -2 2 4 6 8 10 12 14 16 18


SAHEL dry period (80s)
mm/day
6.0
5.0
4.0
3.0
1-4
2-5
3-6
4-7
5-8
6-9
7-10
forecast time (yr)
ECMWF
UKMO
CERFACS
IFM-GEOMAR
DePreSys
NoAssim
GPCC 1961-2009
GPCC 70 / 75 / 80

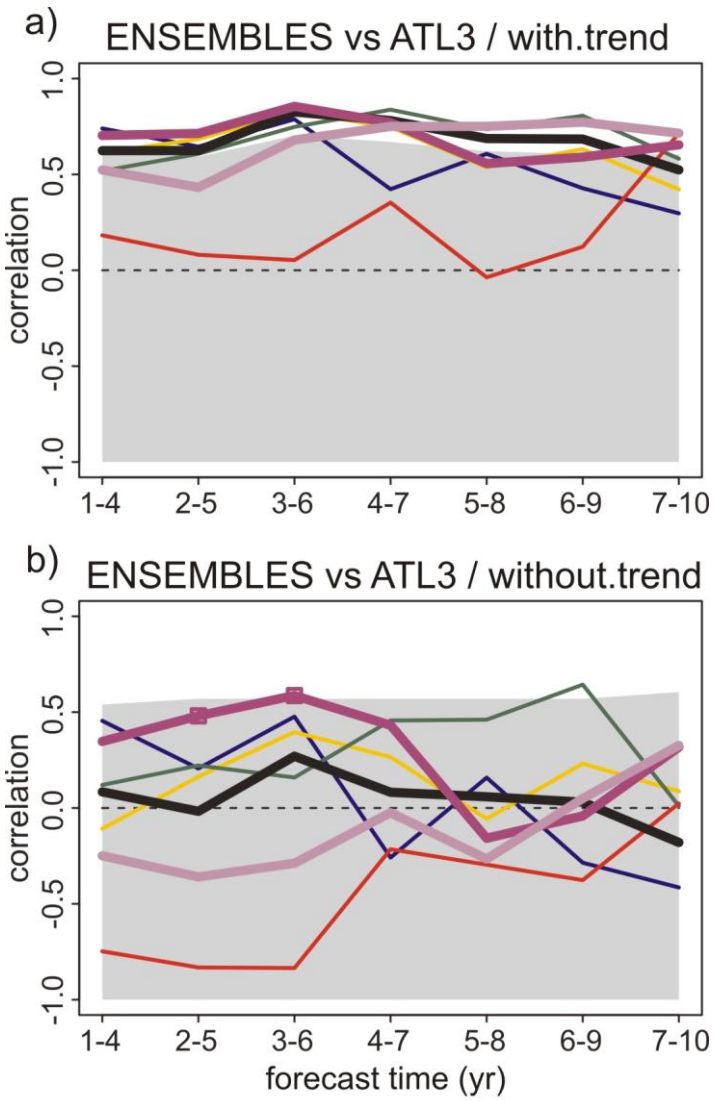




García-Serrano et al. (2013, submitted to FDLT)



J. García-Serrano, F. J. Doblas-Reyes (2012), *Clim. Dyn.*, 39, 2025-2040



J. García-Serrano, F. J. Doblas-Reyes, R. J. Haarsma, I. Polo (2013), *J Geophys. Res.* (in press)