



Robust evaluation of seasonal forecast quality using teleconnections

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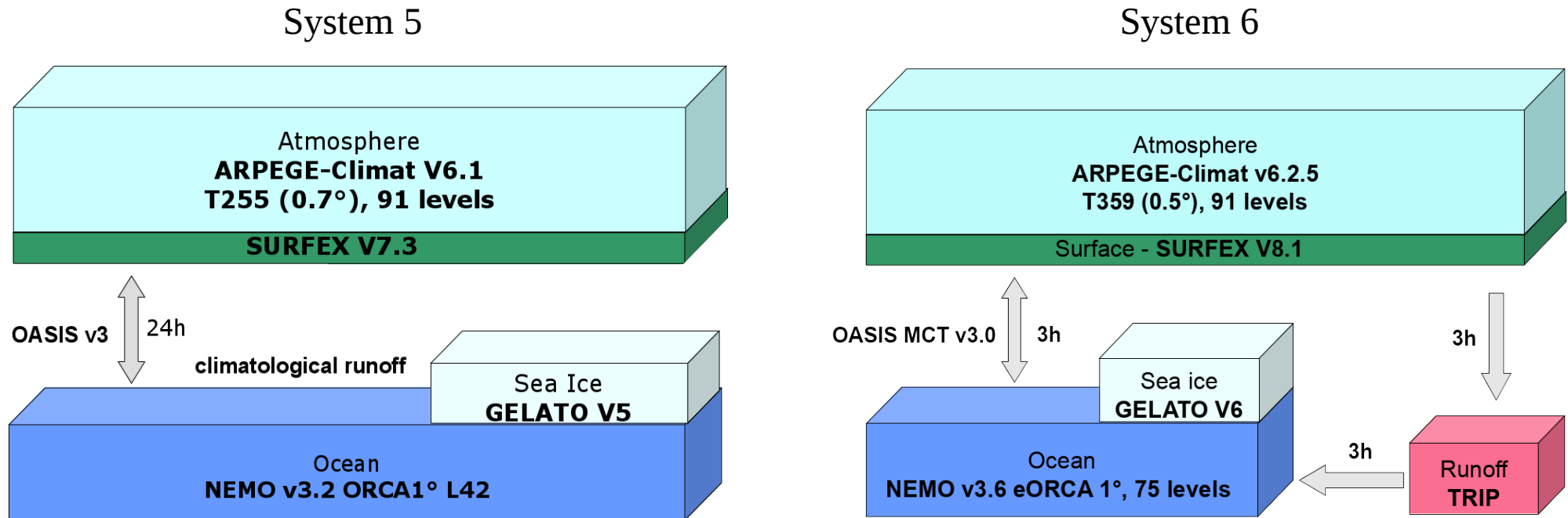
Boulder, 19th September 2018

Motivation of the work

Forecast System N → Forecast System N+1

- Does forecast skill scores improve after model developments?
- Is the model able to reproduce the responses (in terms of teleconnections) to the main variability modes at seasonal time scales?
- Is the information given by the comparison of teleconnections more robust than traditional skill scores?

CNRM-CM System 5 and System 6

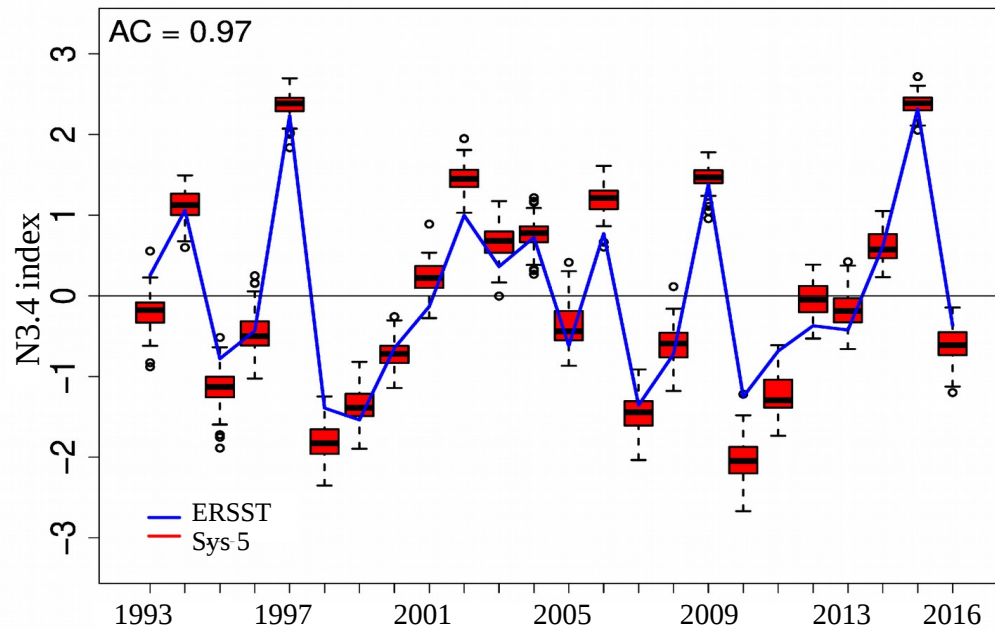


For this study:

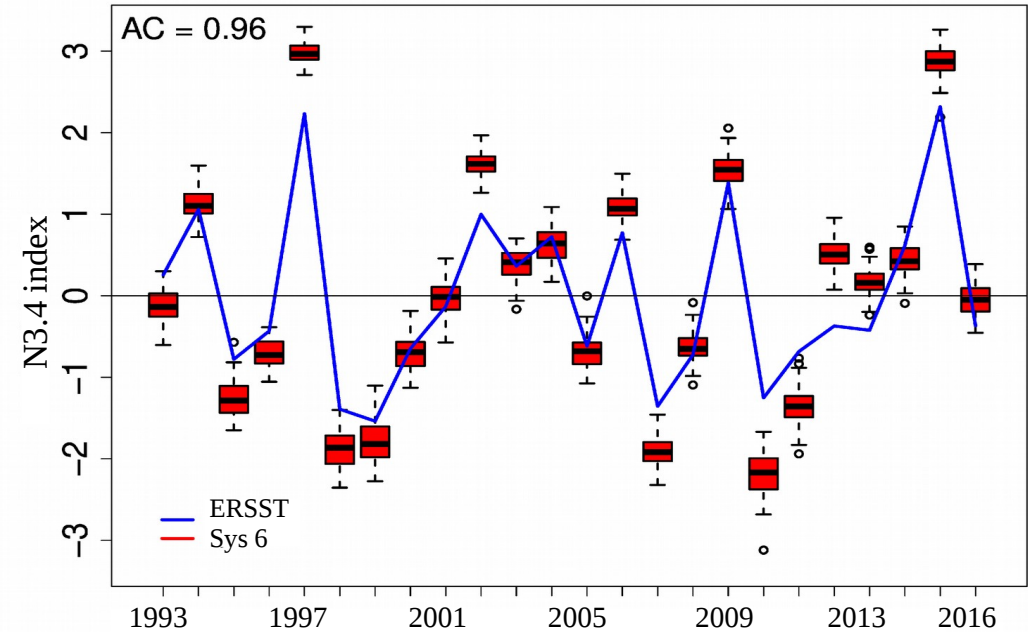
- Atmospheric component initialised with ERA-Interim, ocean and sea-ice components initialised with an upscaled analysis of GLORYS.
- 24 start dates starting the 1st of November 1993-2016 (run for 7 months).
- **80 ensemble members** generated with stochastic dynamic perturbations.

Niño 3.4 skill comparison for lead time 2 to 4 (DJF)

System 5



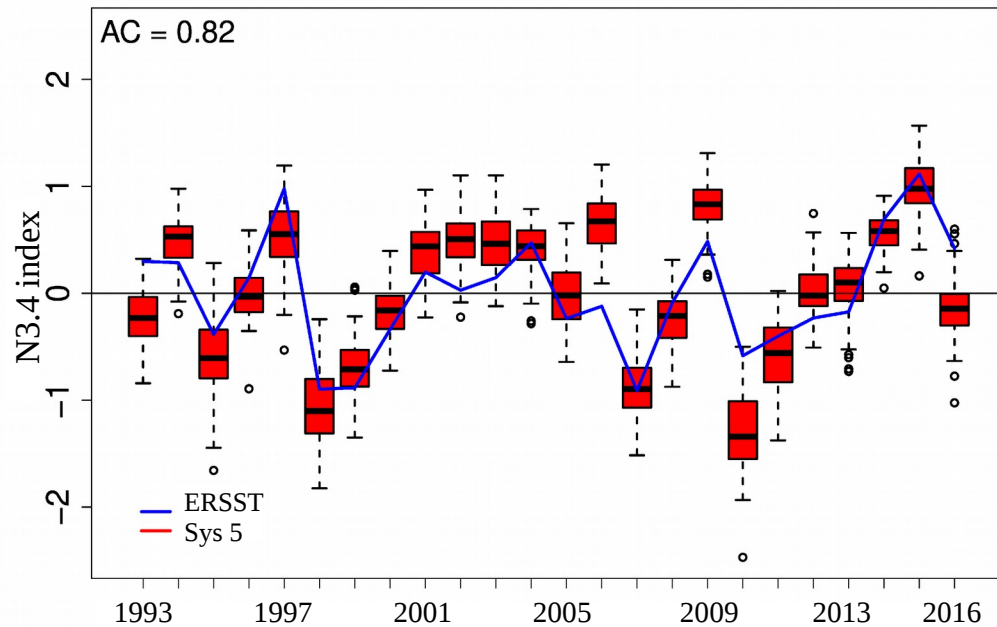
System 6



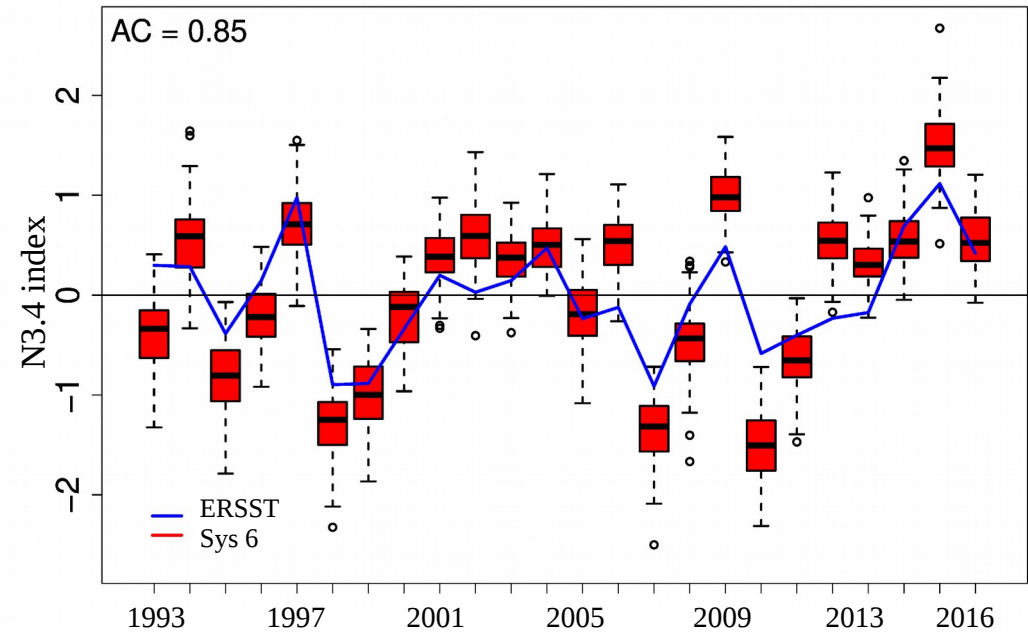
Niño 3.4 index is calculated as the area average over the region 120°W-170°W, 5°S-5°N.

Niño 3.4 skill comparison for lead time 5 to 7 (MAM)

System 5



System 6

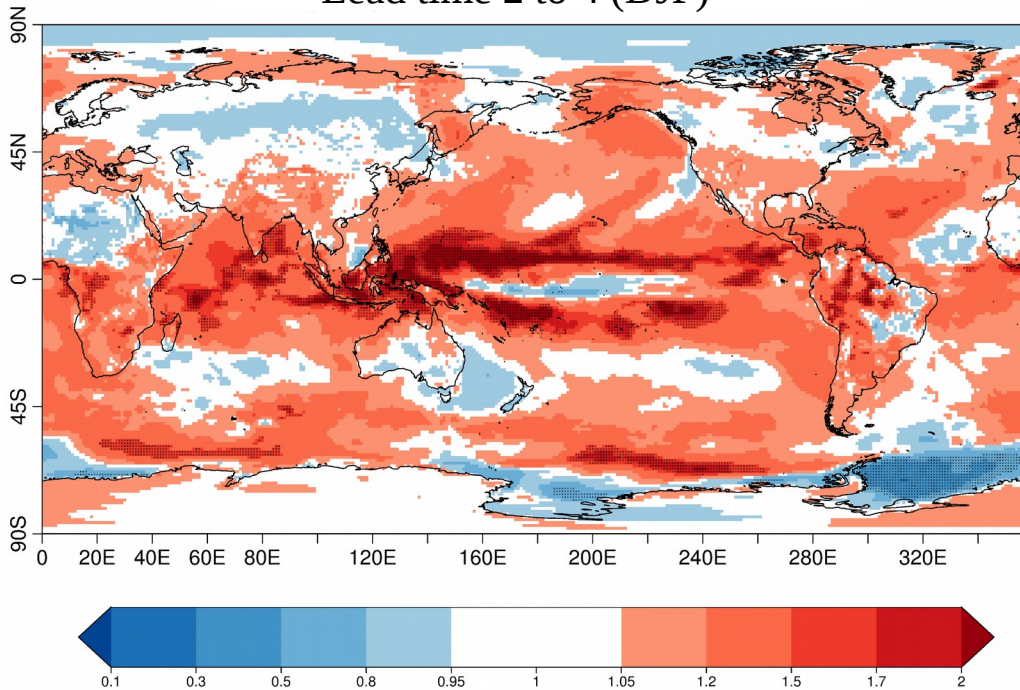


Niño 3.4 index is calculated as the area average over the region 120°W-170°W, 5°S-5°N.

Near surface temperature skill comparison

RMSE ratio sys5/sys6 calculated with ERA-Interim

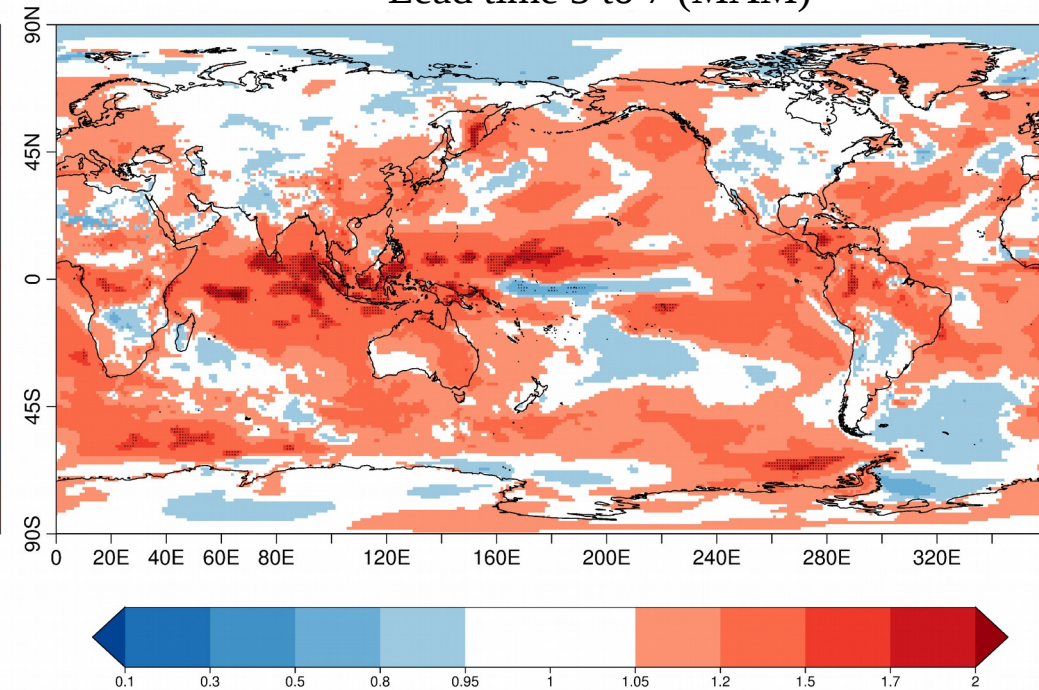
Lead time 2 to 4 (DJF)



Significant area of Sys 6 improvements : 7.84 %

Significant area of Sys 5 improvements : 0.67 %

Lead time 5 to 7 (MAM)



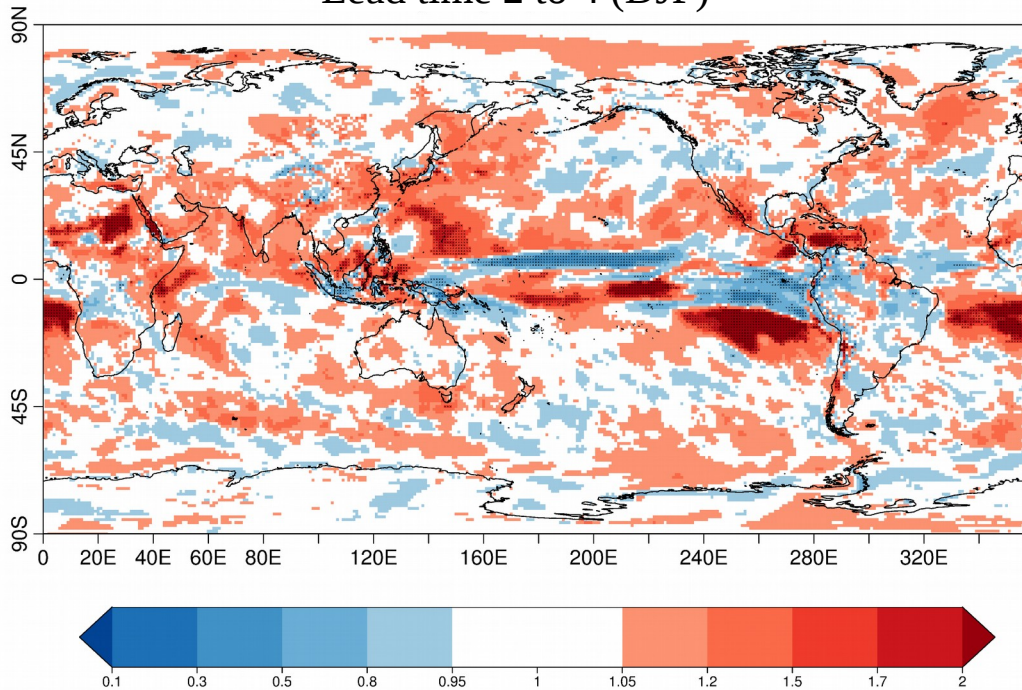
Significant area of Sys 6 improvements : 2.53 %

Significant area of Sys 5 improvements : 0.06 %

Precipitation skill comparison

RMSE ratio sys5/sys6 calculated with GPCP

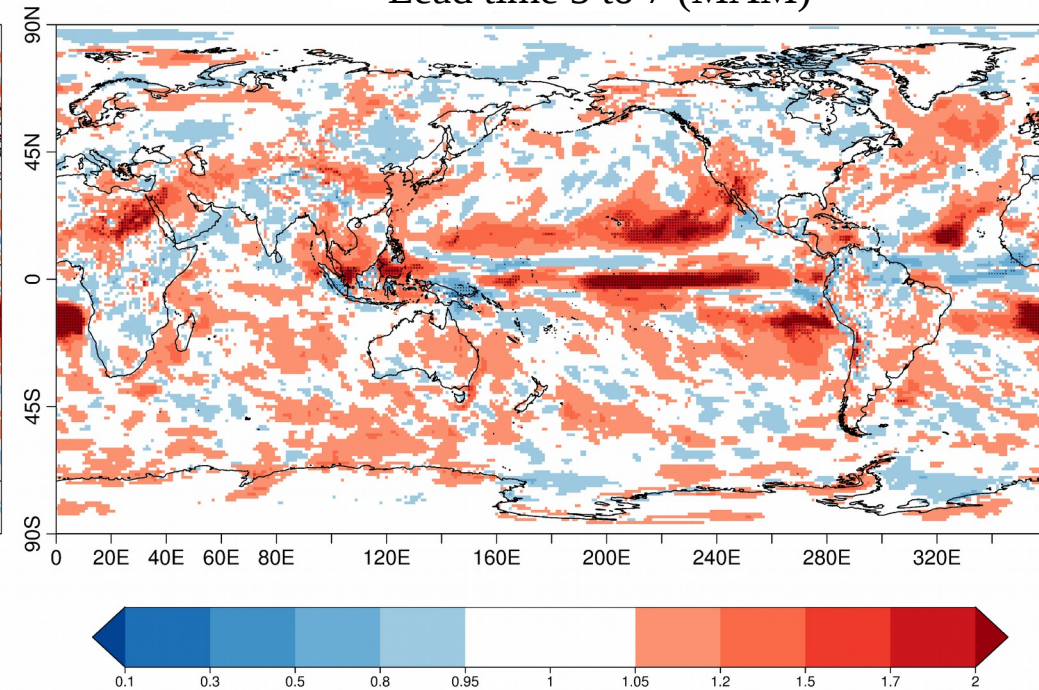
Lead time 2 to 4 (DJF)



Significant area of Sys 6 improvements : 4.50 %

Significant area of Sys 5 improvements : 1.71 %

Lead time 5 to 7 (MAM)

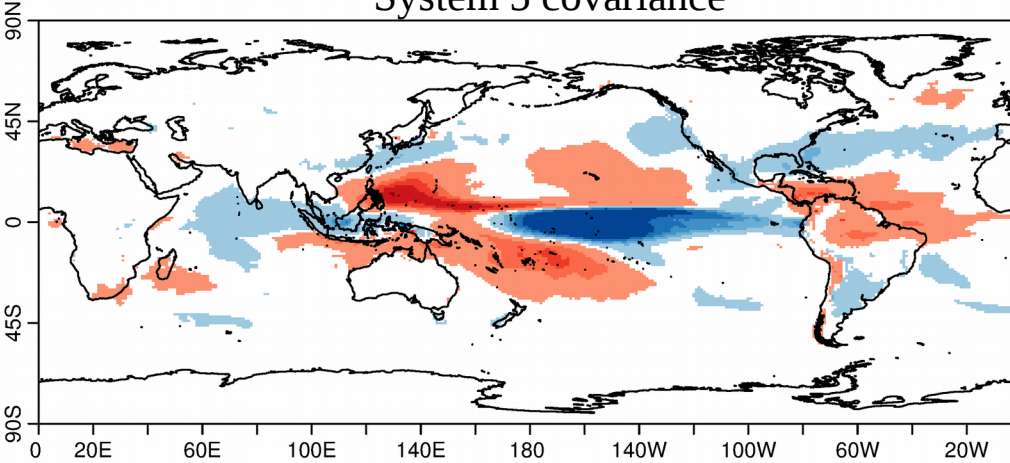


Significant area of Sys 6 improvements : 3.38 %

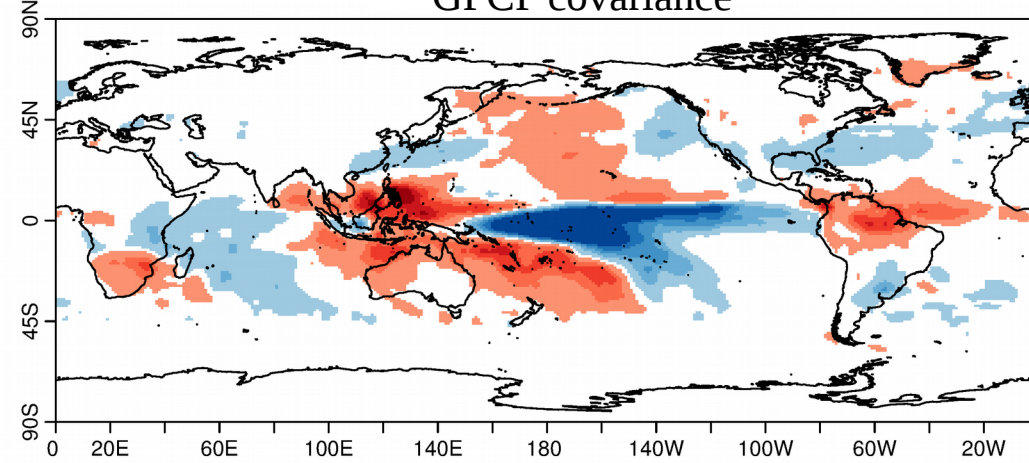
Significant area of Sys 5 improvements : 0.31 %

Comparison of covariances of precipitation with N3.4 for DJF

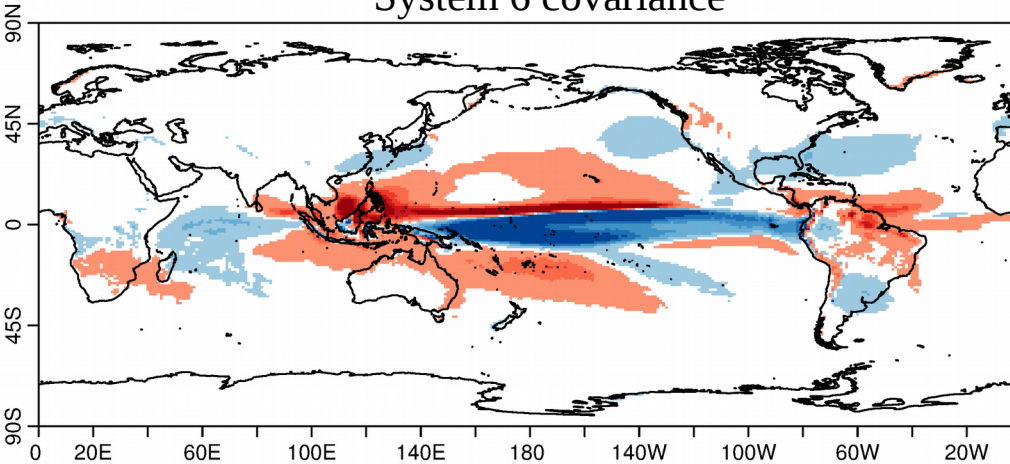
System 5 covariance



GPCP covariance

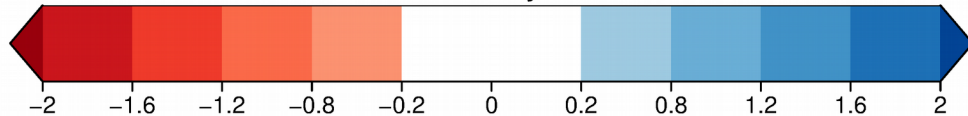


System 6 covariance



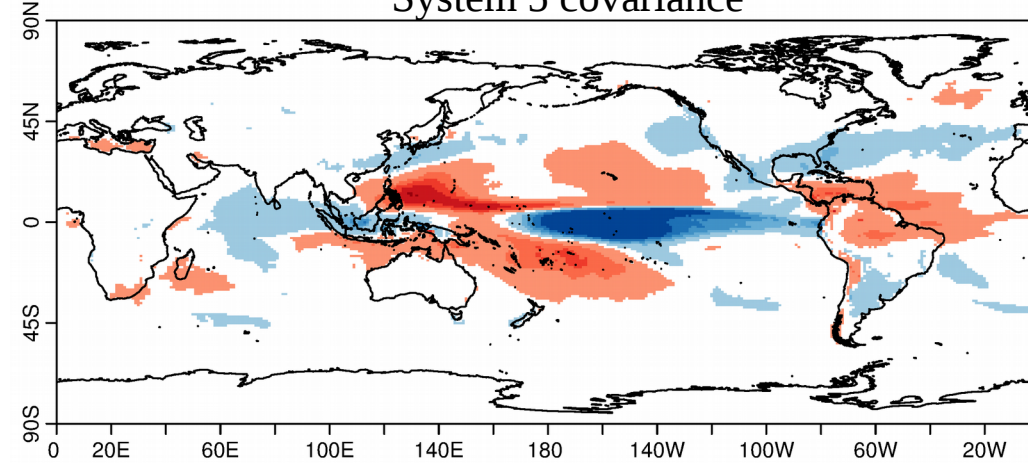
$$C(x) = \frac{\sum_{y=1}^{24} N3.4_y \cdot Prec_y(x)}{24}$$

mm/day

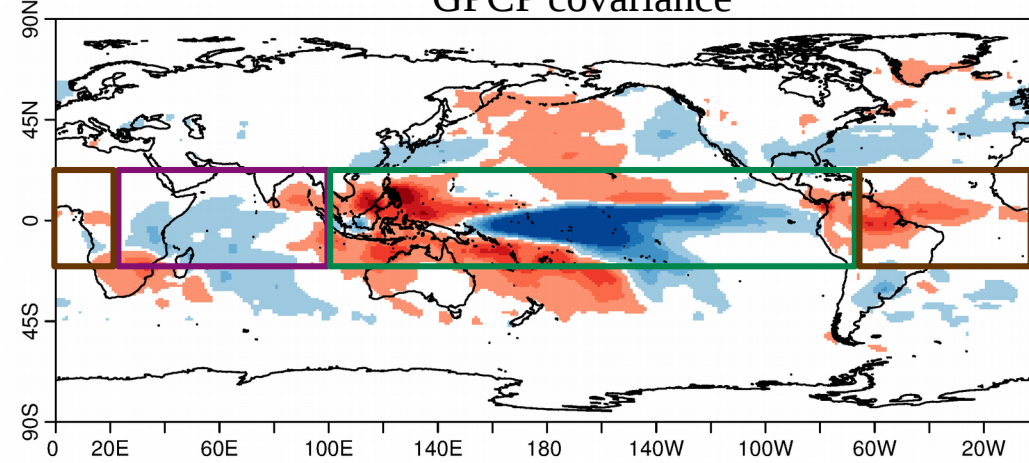


Comparison of covariances of precipitation with N3.4 for DJF

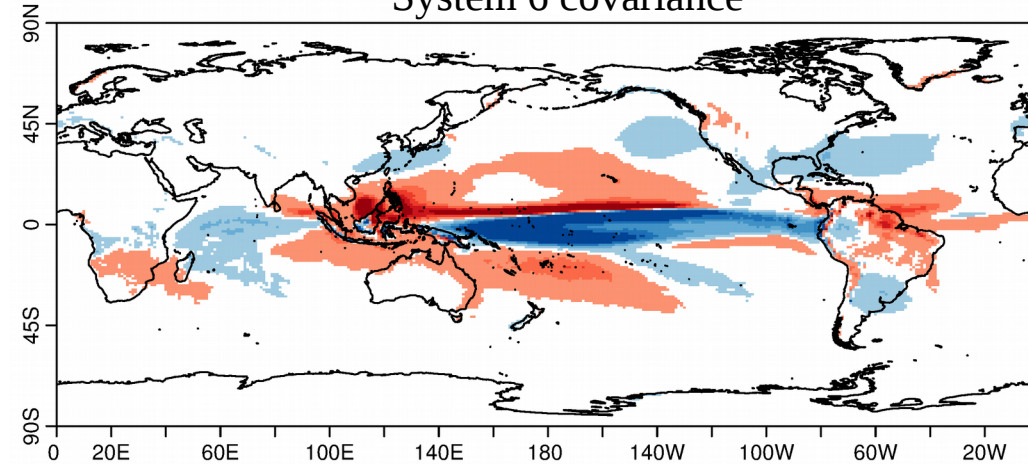
System 5 covariance



GPCP covariance



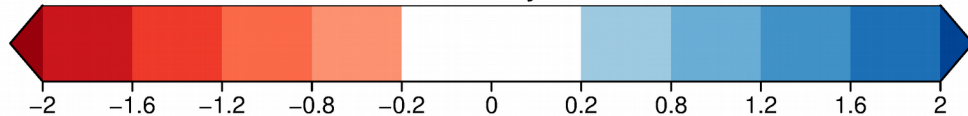
System 6 covariance



Pattern correlation

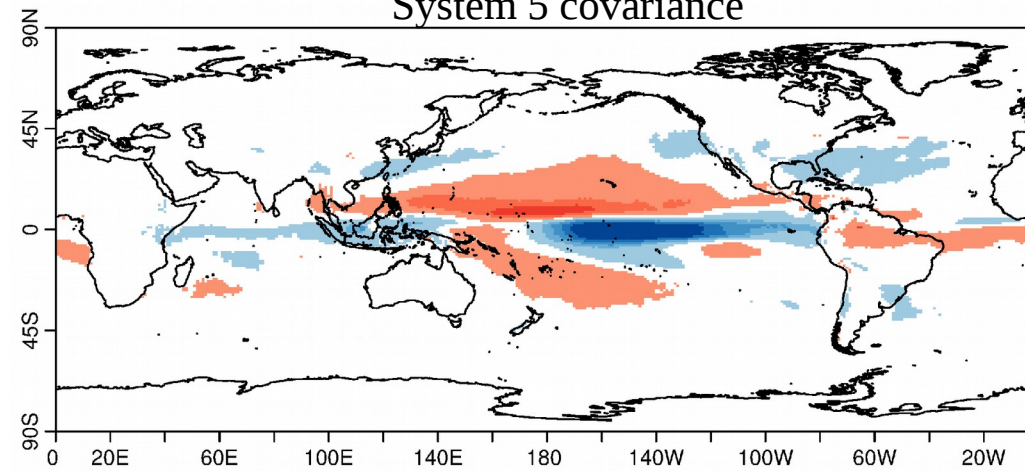
Region 30°N-30°S	System 5	System 6
Atlantic (60°W-20°E)	0.71	0.76
Indian (21°E-100°E)	0.21	0.70
Pacific (101°E-59°W)	0.74	0.80

mm/day

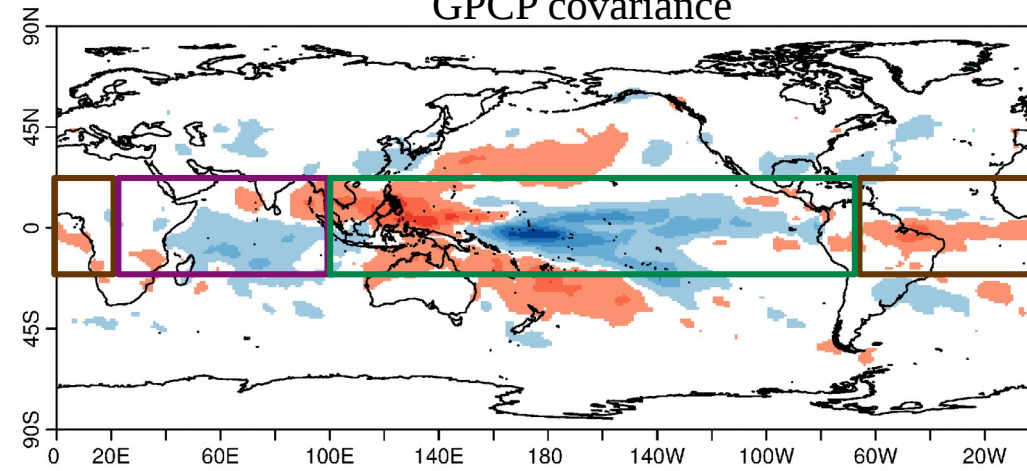


Comparison of covariances of precipitation with N3.4 for MAM

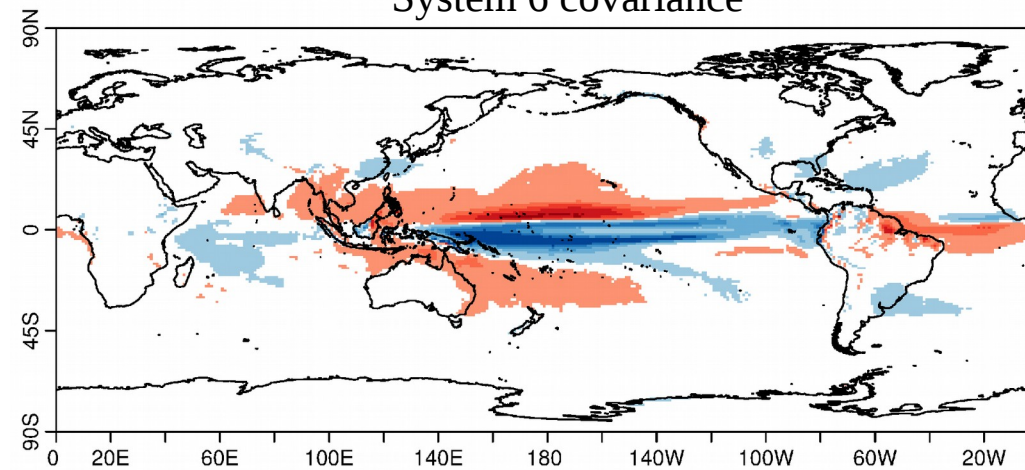
System 5 covariance



GPCP covariance



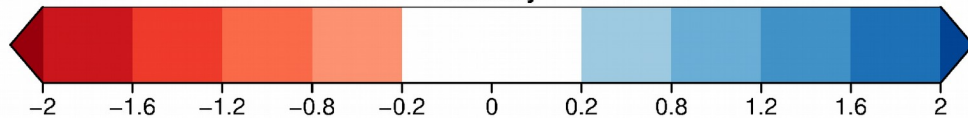
System 6 covariance



Pattern correlation

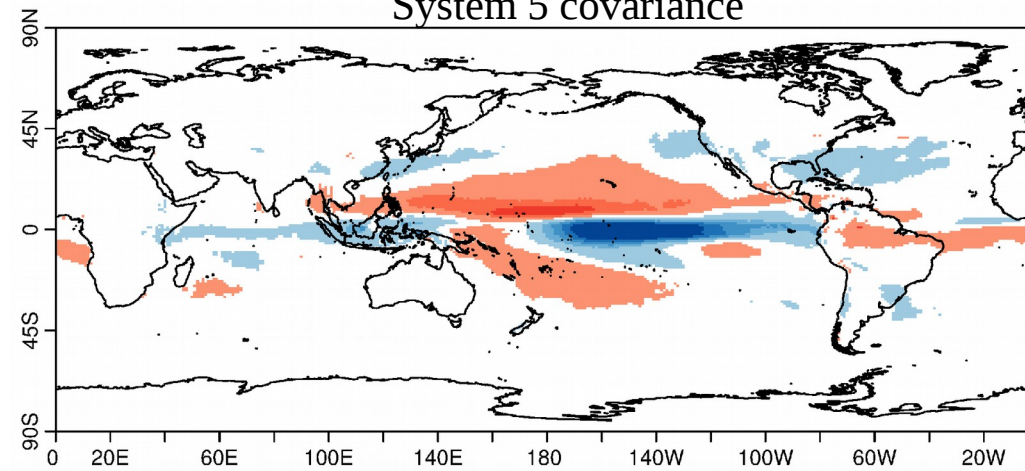
Region 30°N-30°S	System 5	System 6
Atlantic (60°W-20°E)	0.55	0.63
Indian (21°E-100°E)	0.60	0.76
Pacific (101°E-59°W)	0.42	0.59

mm/day

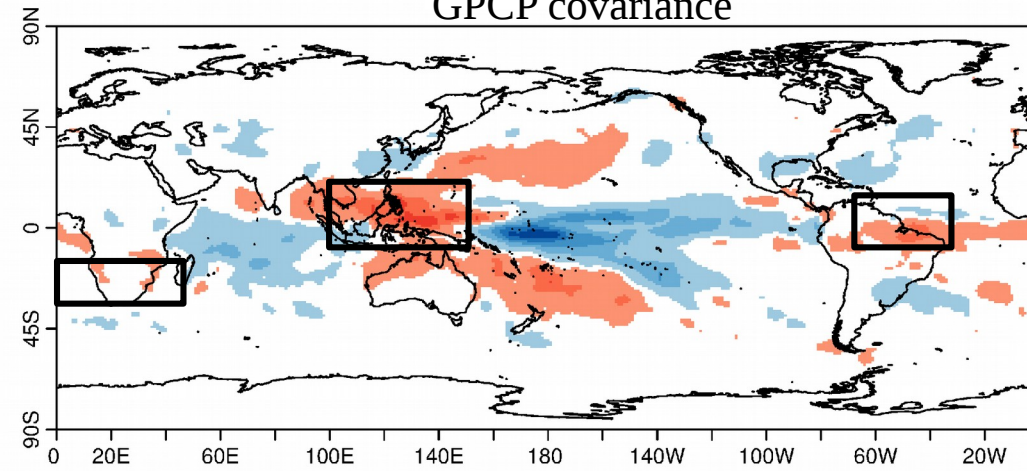


Comparison of covariances of precipitation with N3.4 for MAM

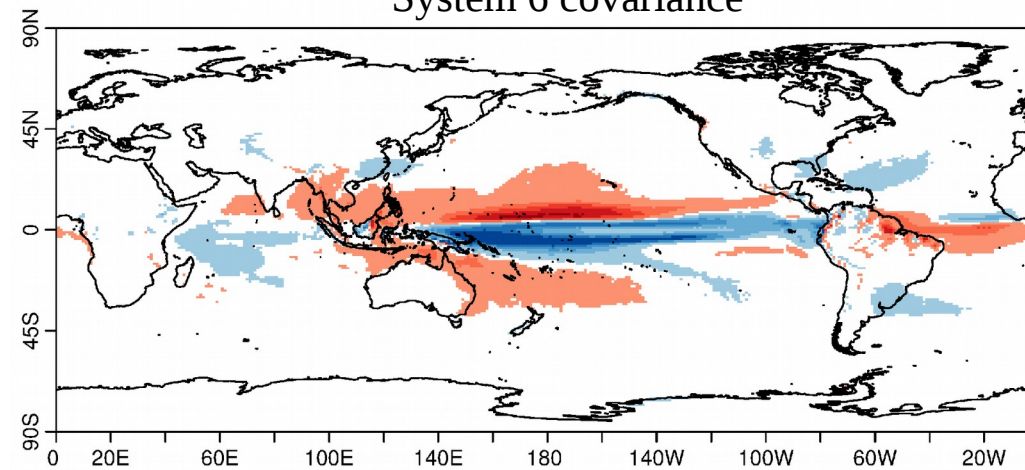
System 5 covariance



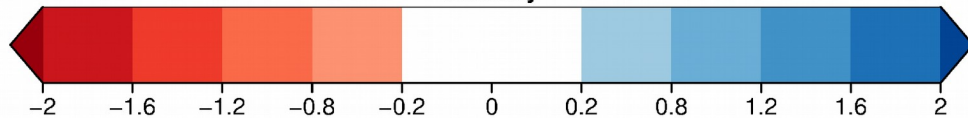
GPCP covariance



System 6 covariance



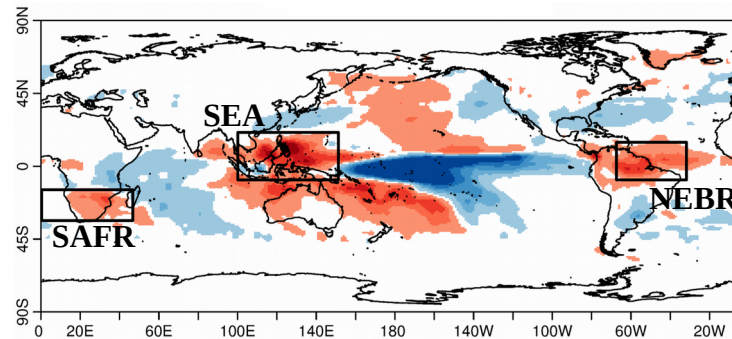
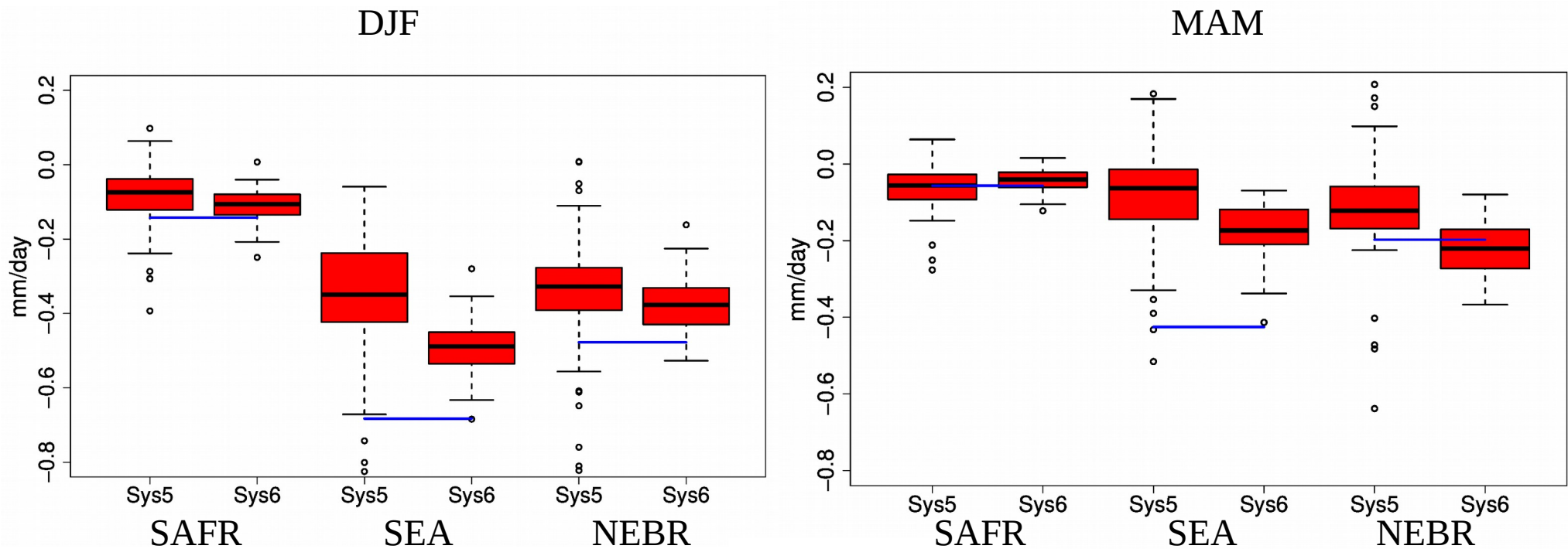
mm/day



Region	Latitude	Longitude
SAFR	35°S-12°S	10°W-52°E
SEA	11°S-20°N	95°E-155°E
NEBR	10°S-10°N	70°W-30°W

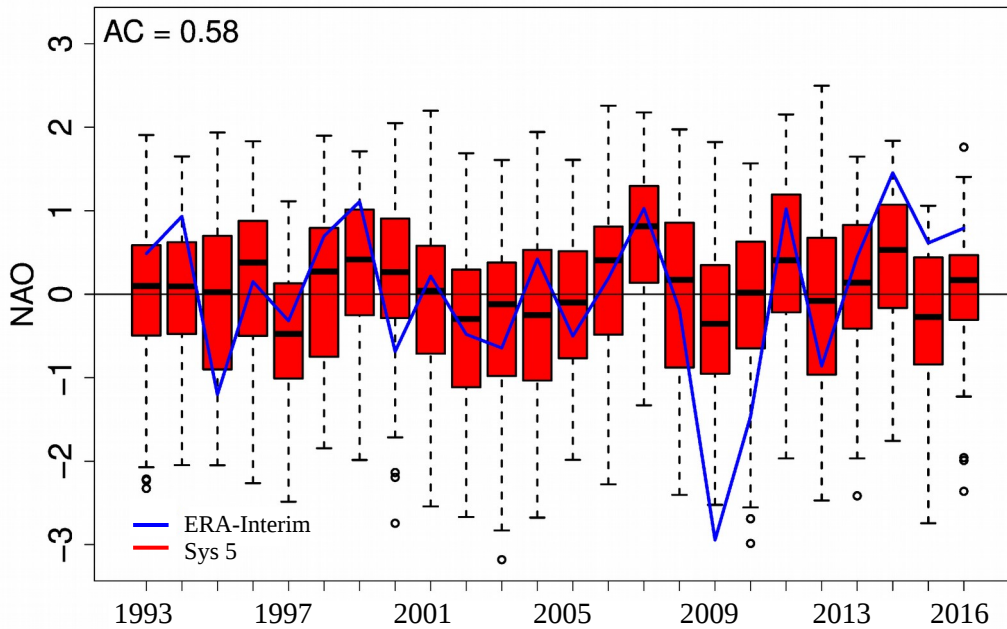
Definition of the regions from Giorgi and Francisco 2000
(*Clim. Dyn.* 16 : 169-182)

Distribution of the covariances of individual members for precipitation and N3.4

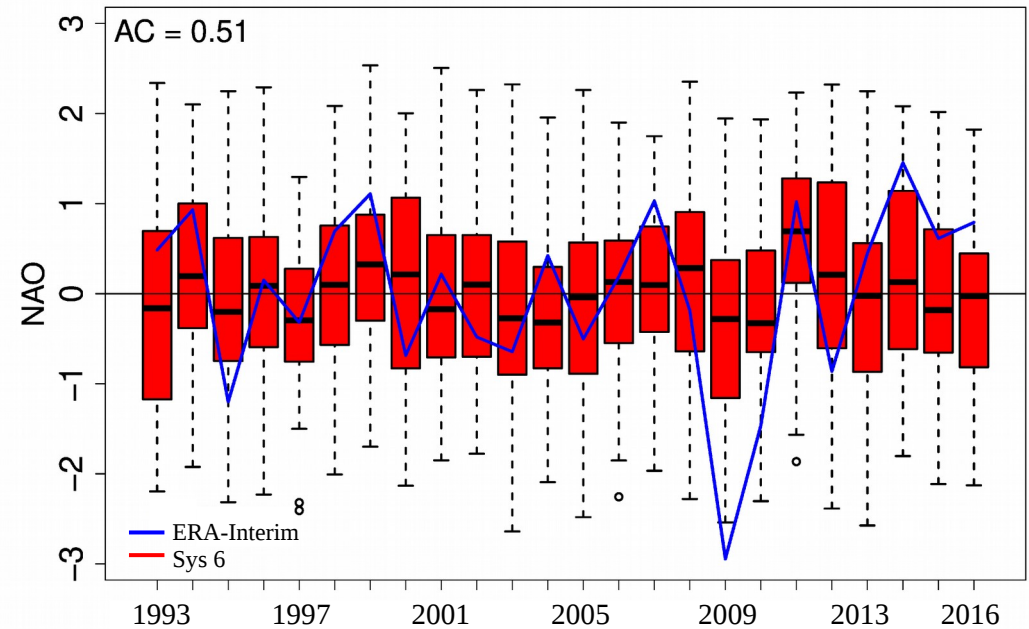


NAO skill comparison

System 5

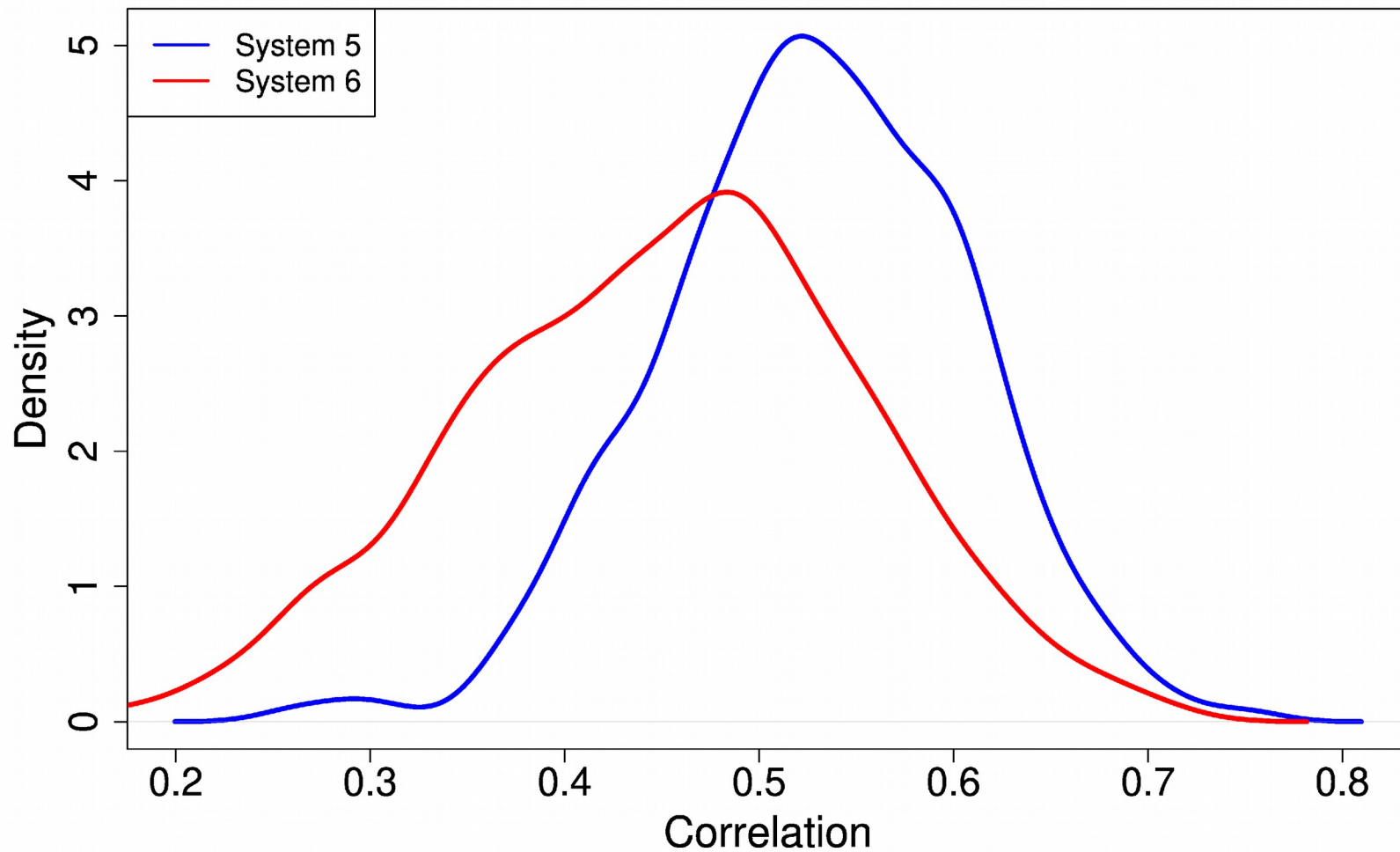


System 6



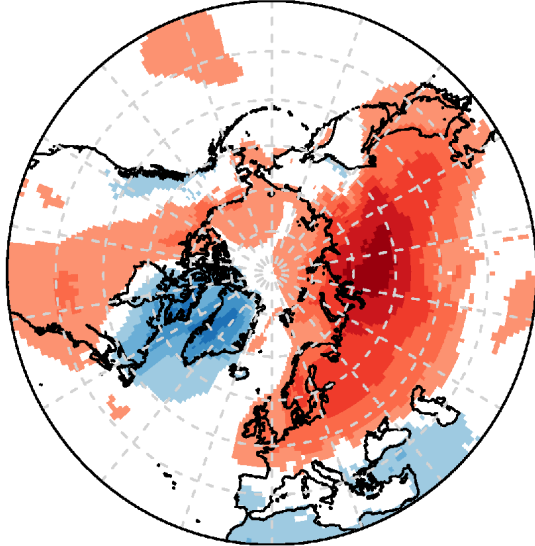
NAO index is calculated as the leading EOF of geopotential height anomalies at 500 hPa over the region 20°N-80°N, 80°W-40°E.

Probability distribution of NAO correlation (subsamples of 50 members)

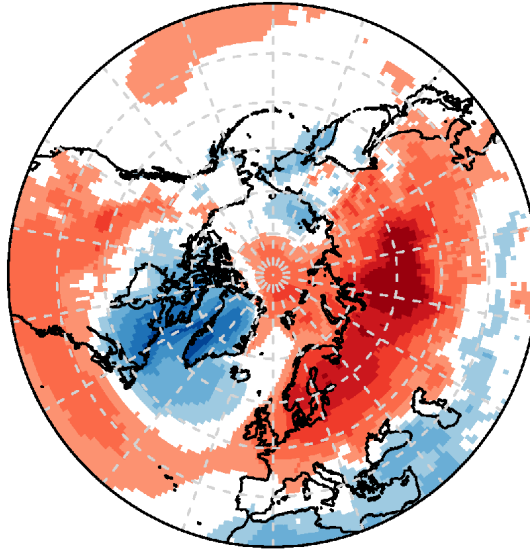


Comparison of covariances of temperature with NAO

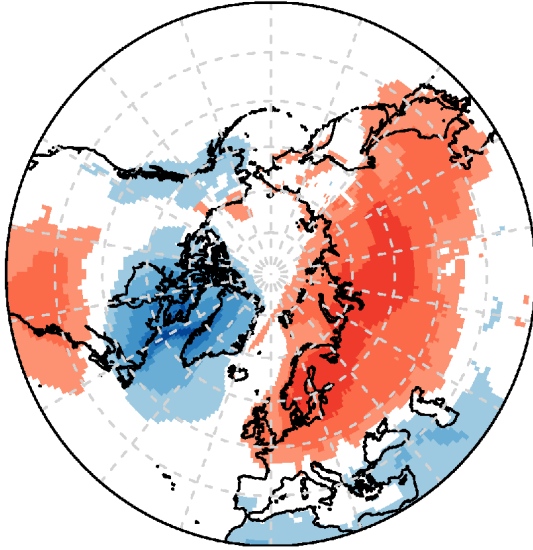
System 5 covariance



ERA-Interim covariance



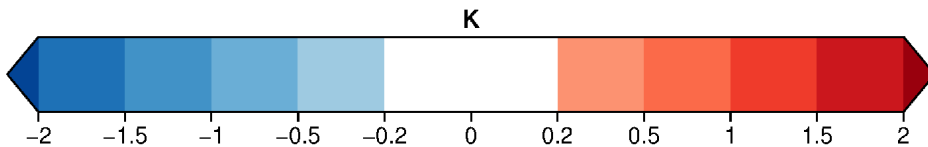
System 6 covariance



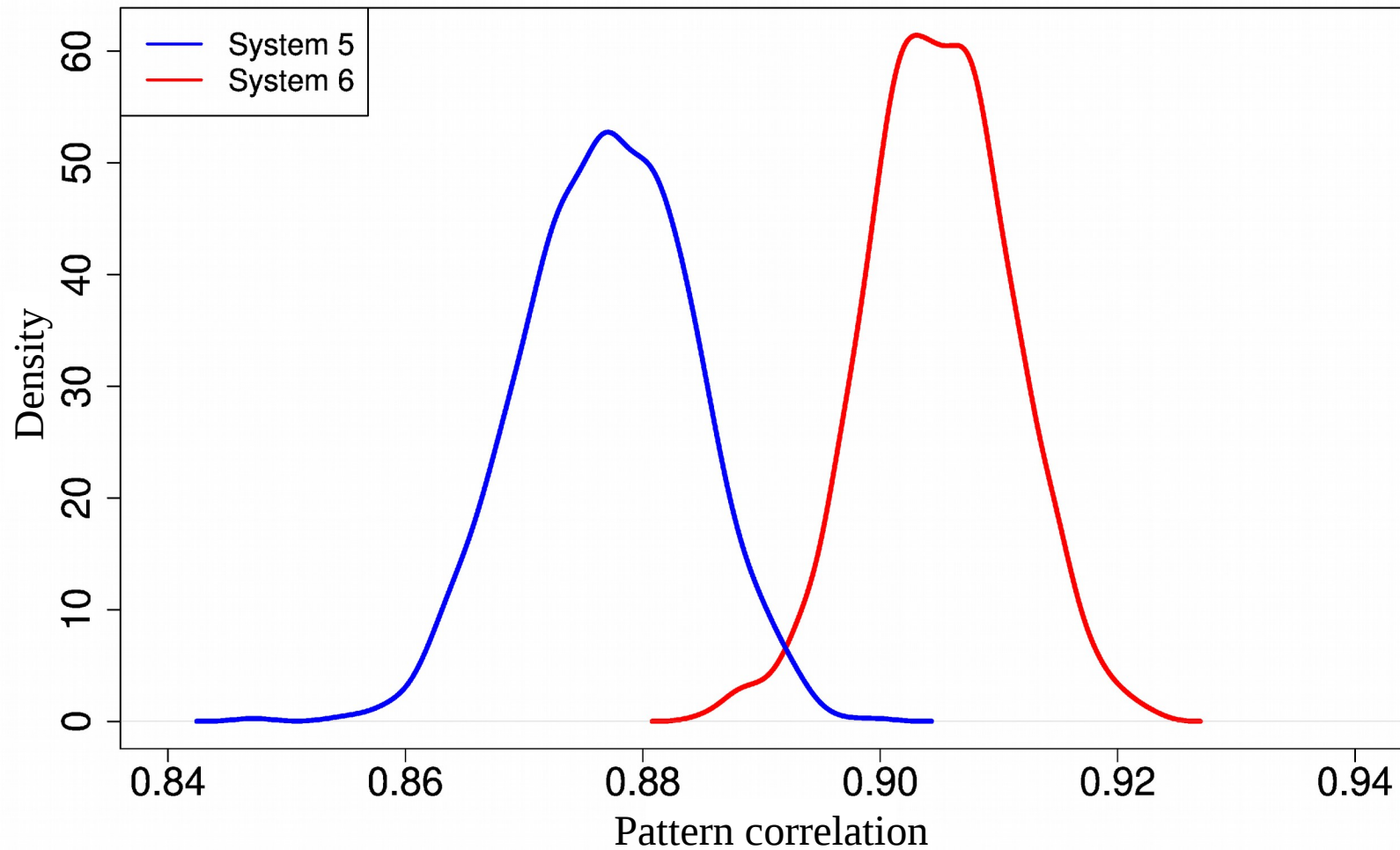
Pattern correlation in the region 30N-90N

System 5	System 6
0.88	0.91

$$C(x) = \frac{\sum_{y=1}^{24} NAO_y \cdot Temp_y(x)}{24}$$



Probability distribution of pattern correlation for temperature with NAO (subsamples of 50 members)



Summary: Is System 6 better than System 5?

- It is difficult to draw a robust conclusion with the usual scores.
 - System 6 improves the near surface temperature prediction in the tropical Pacific.
 - However it shows a degradation of skill for the NAO index, although there is some uncertainty about the score.
- System 6 improves the quality of teleconnections.
 - Higher pattern correlation is shown both in the covariances between precipitation and N3.4 and between temperature and NAO.
- Having a better representation of teleconnections ensures an improved consistency of System 6 with physical mechanisms.



Thank you !

Volpi et al.: Robust evaluation of seasonal forecast quality using teleconnections, *under revision to Q. J. R. Meteorol. Soc.*