Predictability of seasonal Sahel rainfall beyond the spring barrier using GCM MOS correction

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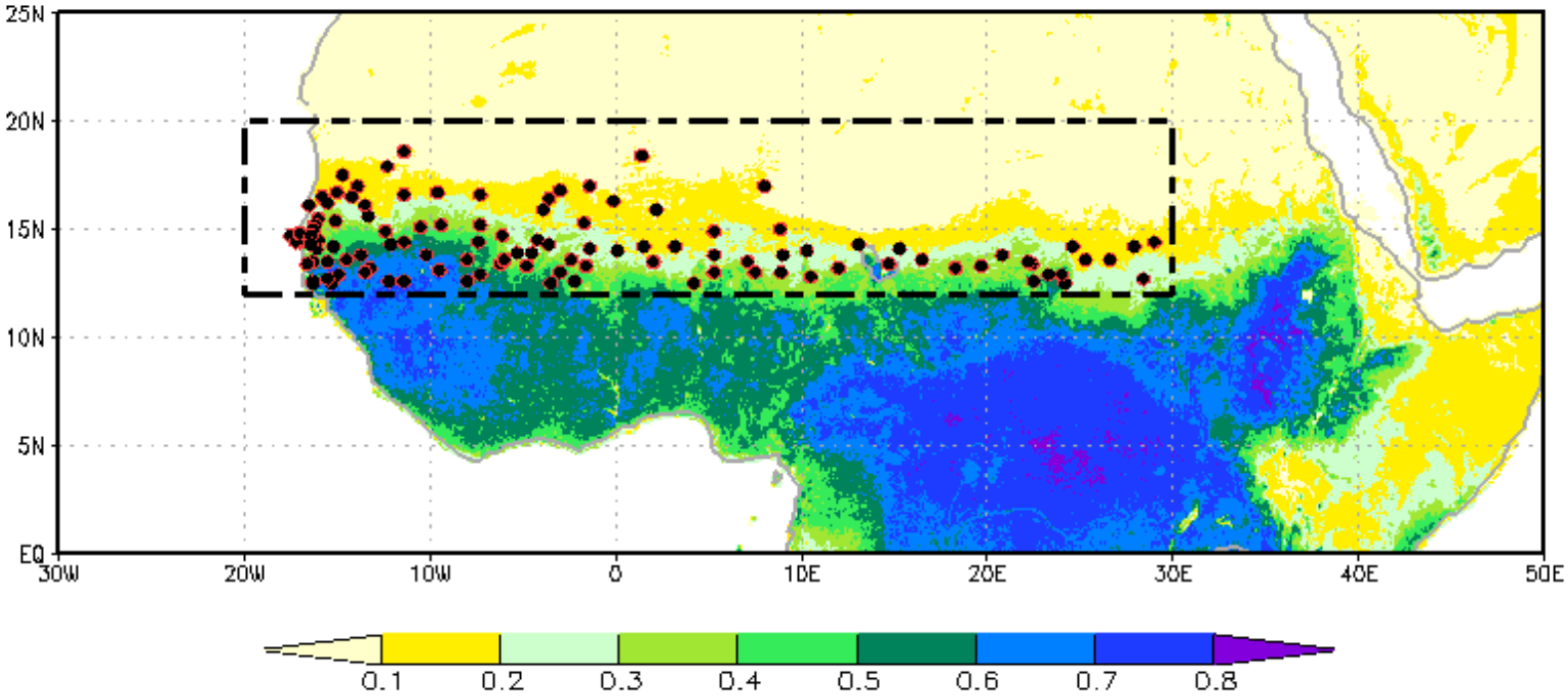
Motivation for this study

- ✓ Short rainy season : 4 months
- ✓ Strong climate variability
- ✓ Huge socio-economical impacts :
  - ✓ Health : malaria, meningitis
  - ✓ Agriculture : rain fed and shepherd
  - ✓ limited economic resources

Sahel



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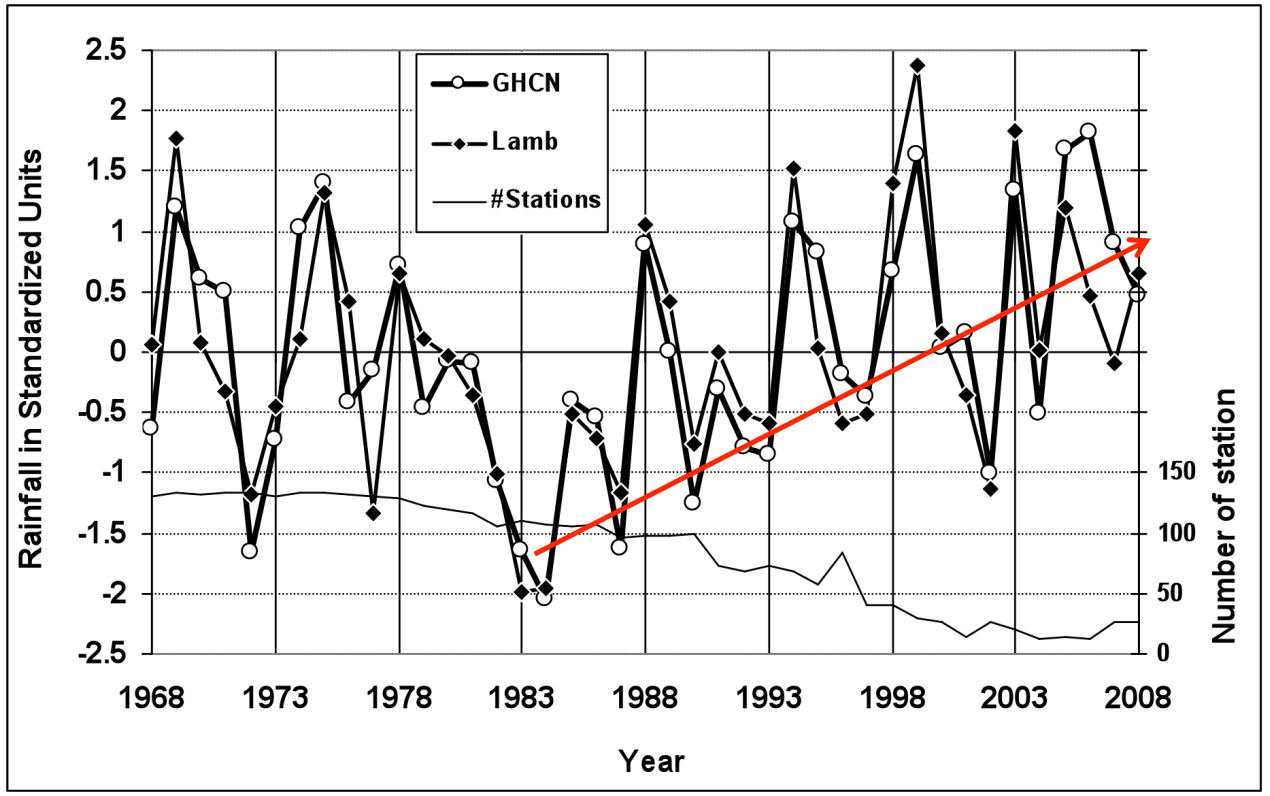


GHCN Series: 12-20N, 18W-30E

WIND CLIMATOLOGY JAS

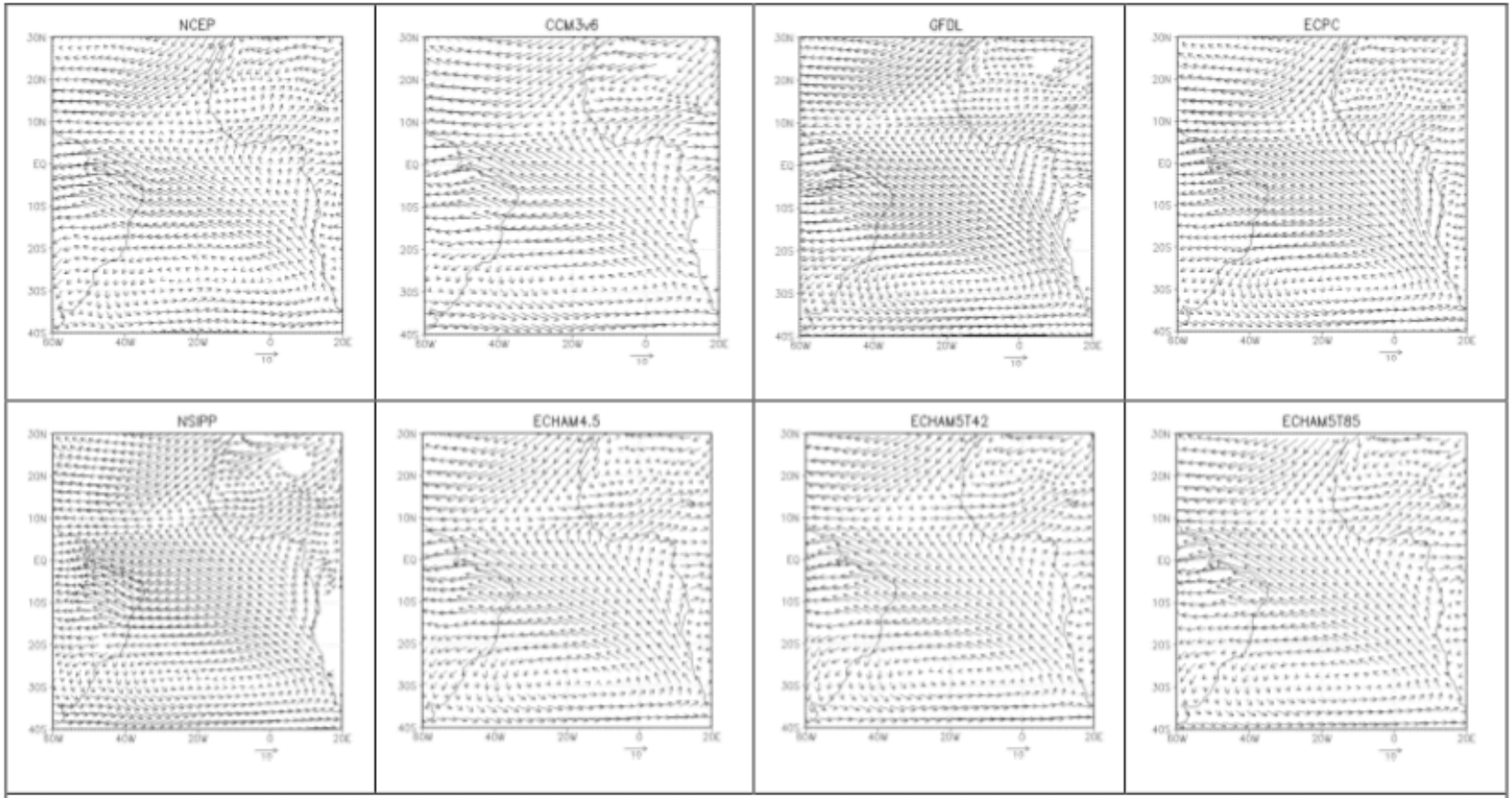
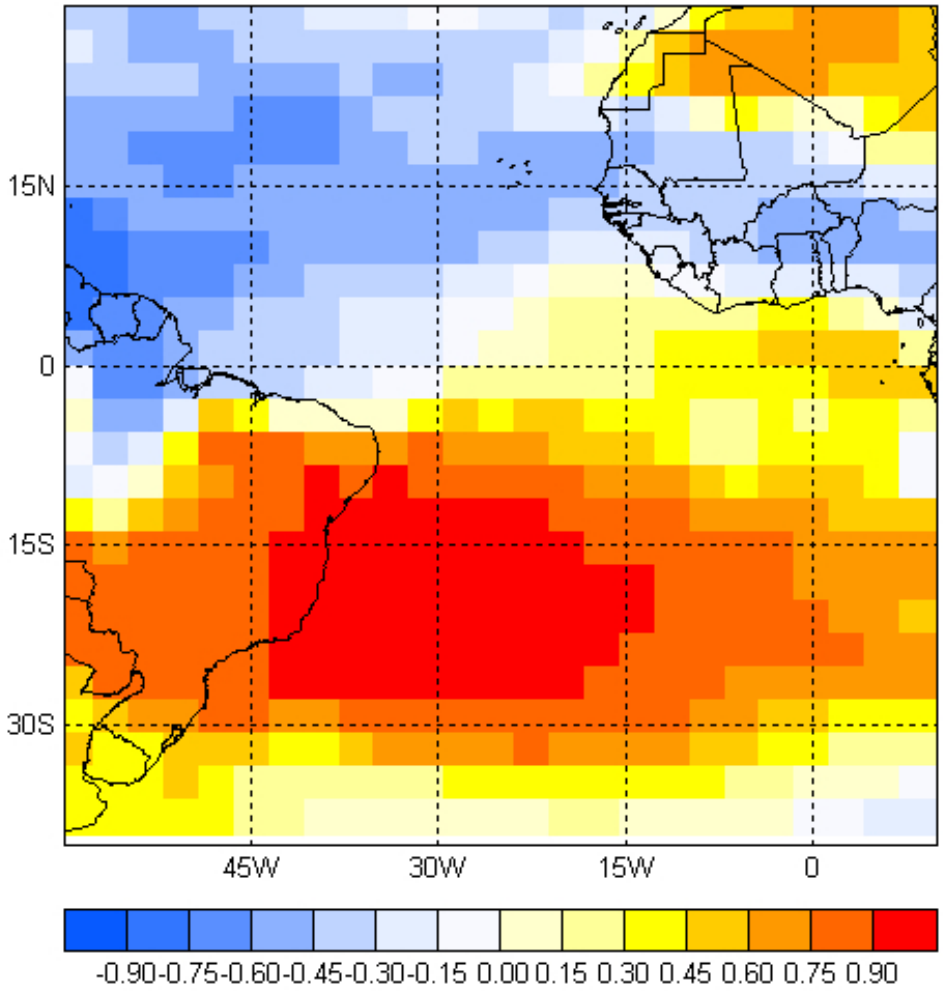


Fig. III.7b : The 925 hPa climatological wind simulated by AGCMs depicting the low level monsoon flow during JAS 1968-2001.

APPROACH FOR CORRECTING GCM SIMULATION

Ndiaye et al., 2009, Int Jour. of Climatol.



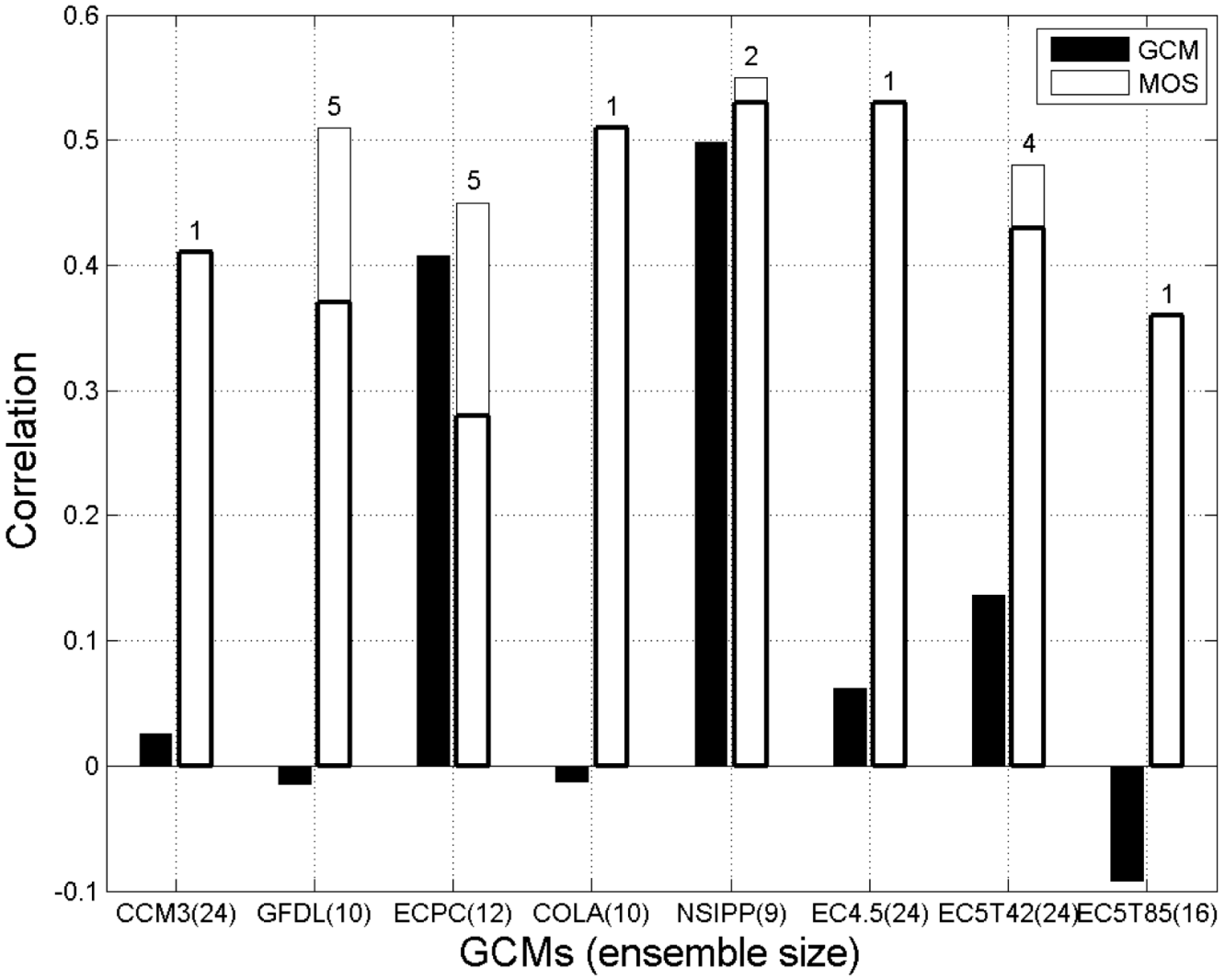
First EOF of model's low level (925mb) zonal wind over tropical Atlantic

33.8% of variance

(used as predictor for Sahel rainfall)

USING REGIONAL WIND TO CORRECT POOR GCM

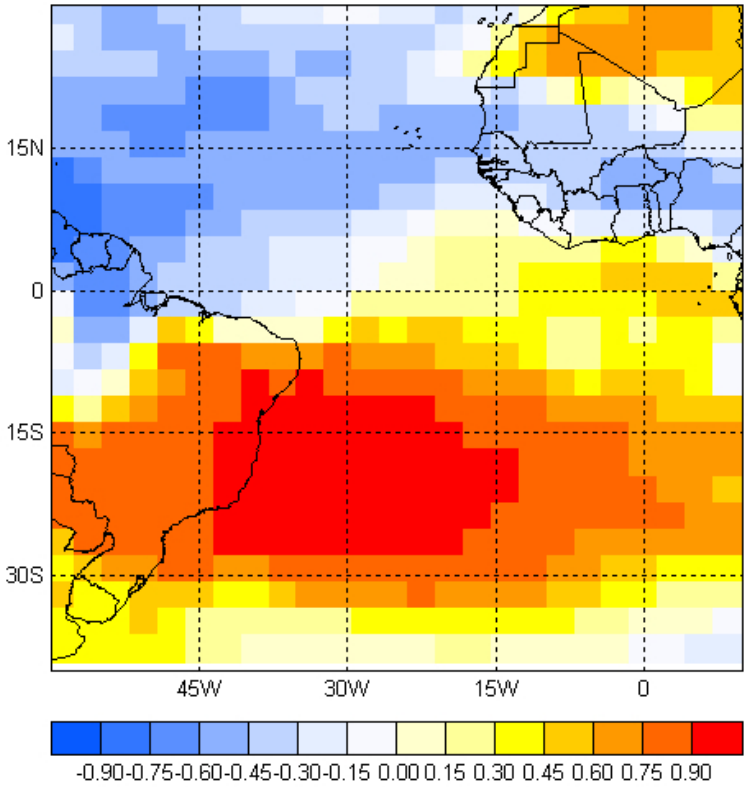
rainfall simulation over 1968-2001

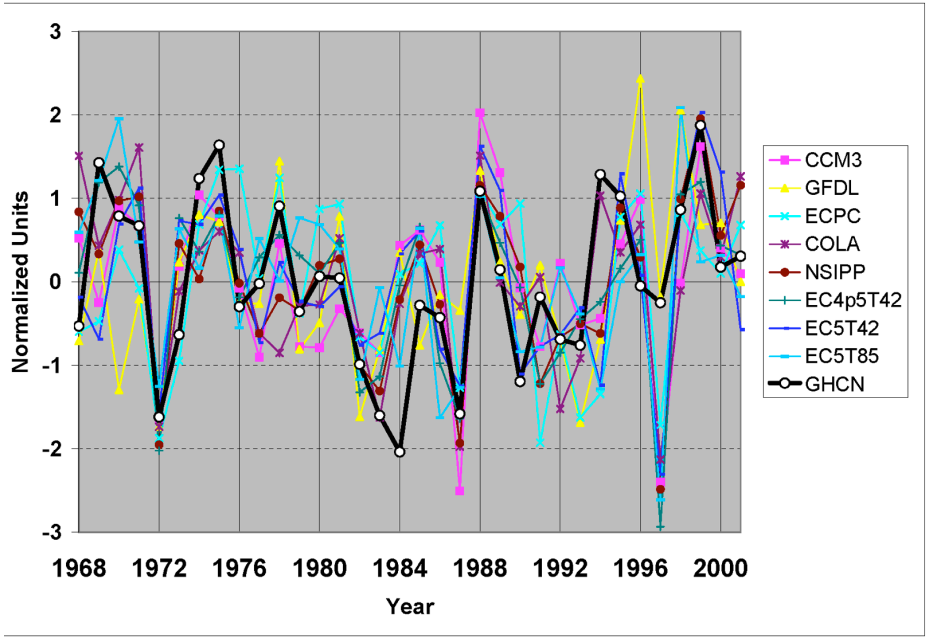


Raw GCM skill (shaded bar) MOS skill with MOS (open)

Consistency and robustness of GCM's EOF approach

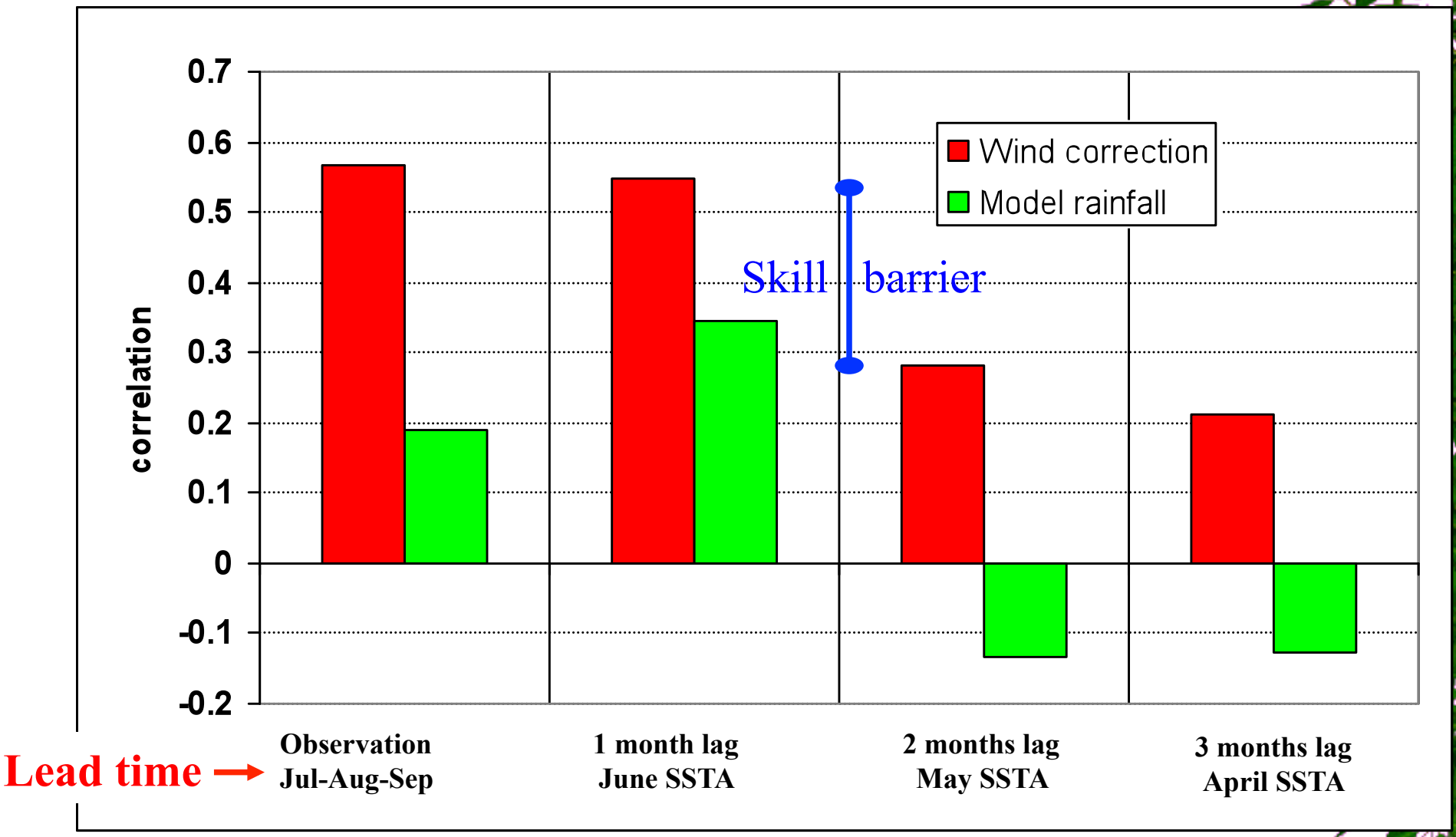
Time-series of each of the GCM EOFs used in the MOS (colored lines), along with GHCN Sahel rainfall index (black line).



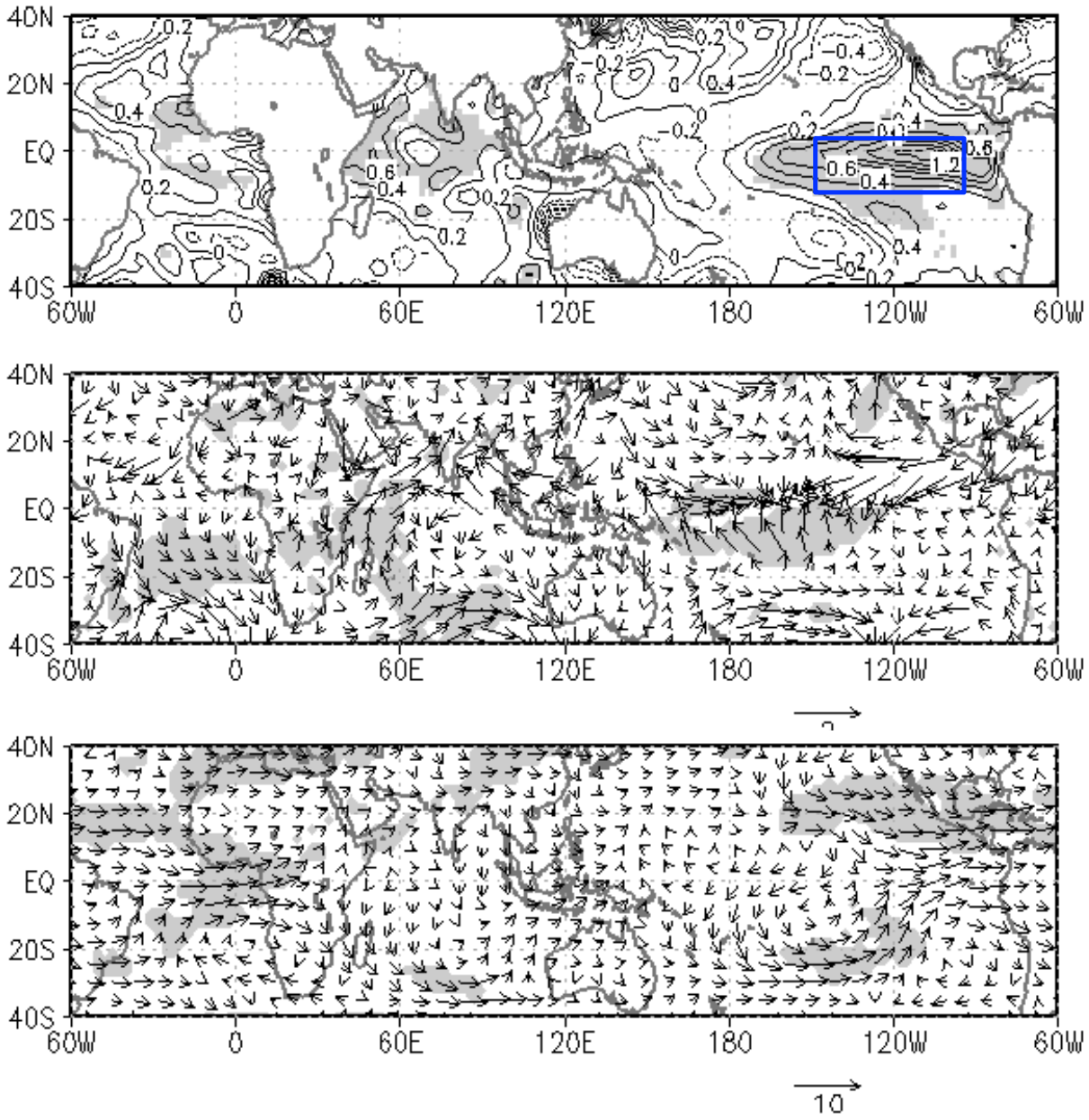


GCM rainfall vs regional wind MOS correction

Forecast for JAS season over Sahel (10-20N and 20W-30E) 1968-03

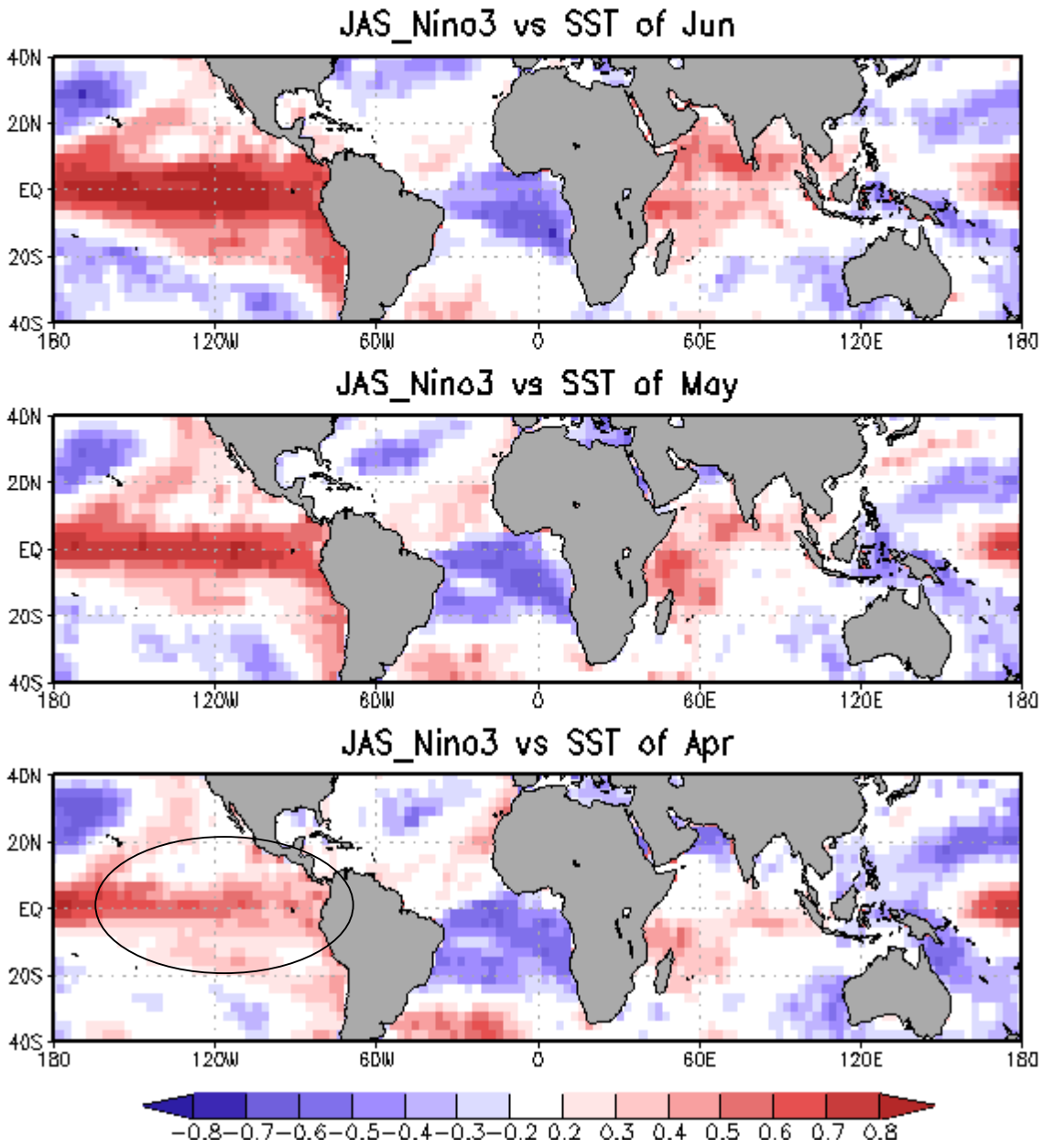


Systematic tendency of SSTA, Surface wind and 200hPa wind between good forecast in June and failed forecast in May

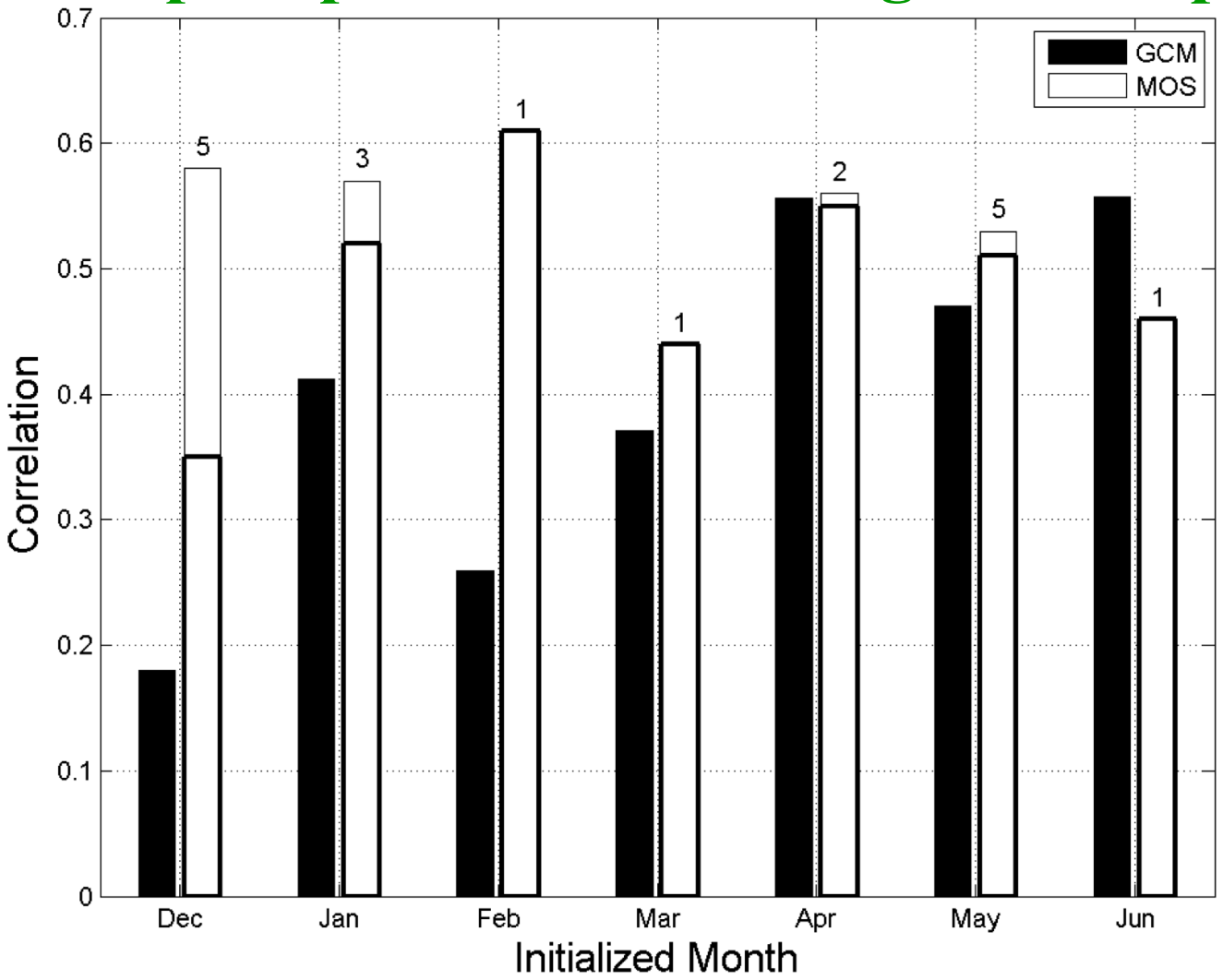


Obs JAS Nino 3 versus Obs SST fields

Correlation is over the 1981-2001 period



CFS skill correlation over 1981-2008 from raw precipitation and through MOS approach

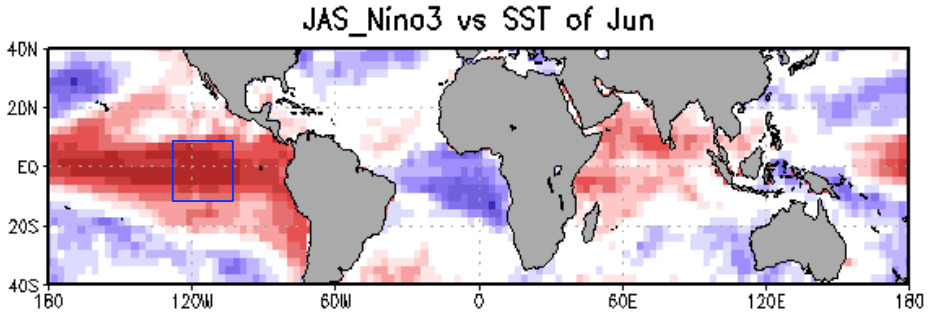


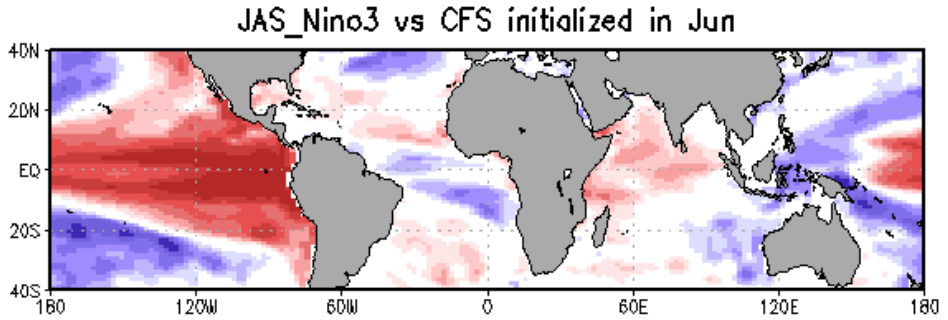
Raw CFS skill (shaded bar) MOS skill with Low level Zonal wind EOF

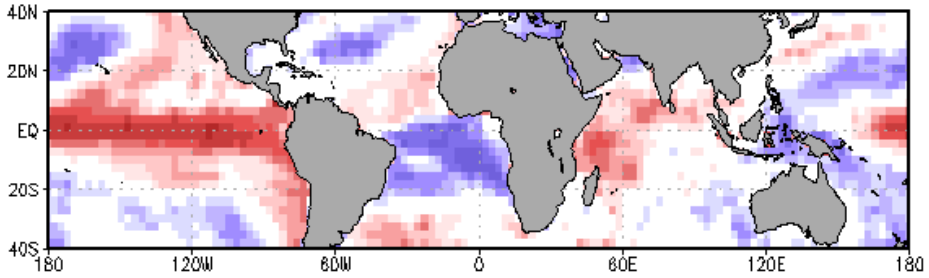
Ndiaye et al. 2011, Journal of Climate.

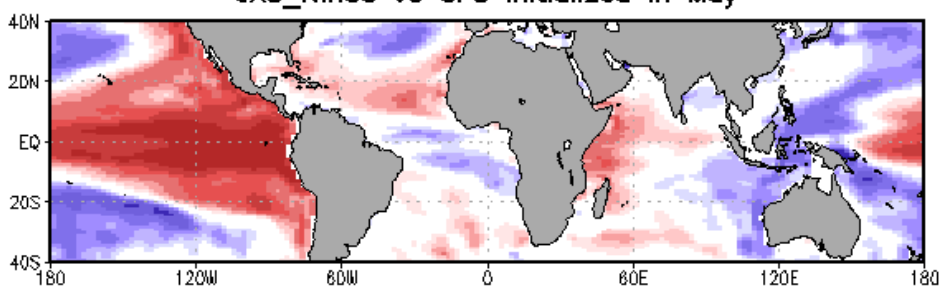
Obs JAS Nino 3 versus Obs SST fields (left panels) and CFS SST JAS forecast fields (right panels)

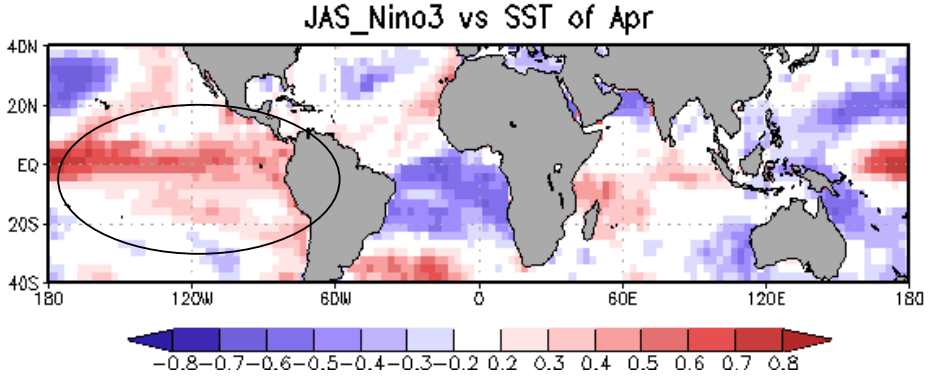
Correlation is over the 1981-2001 period

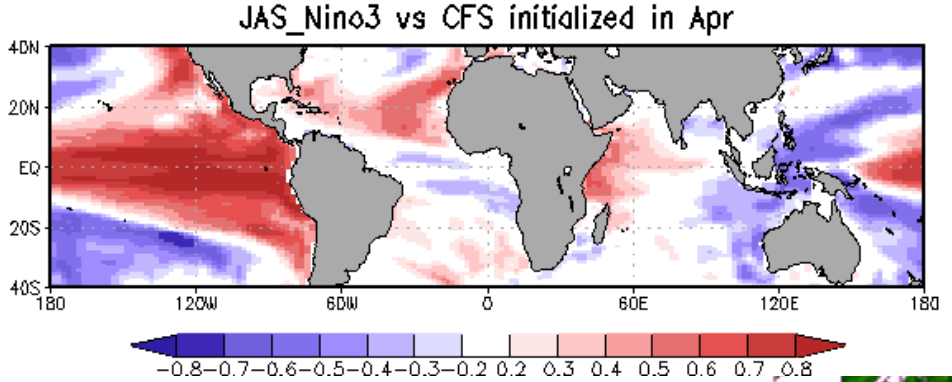




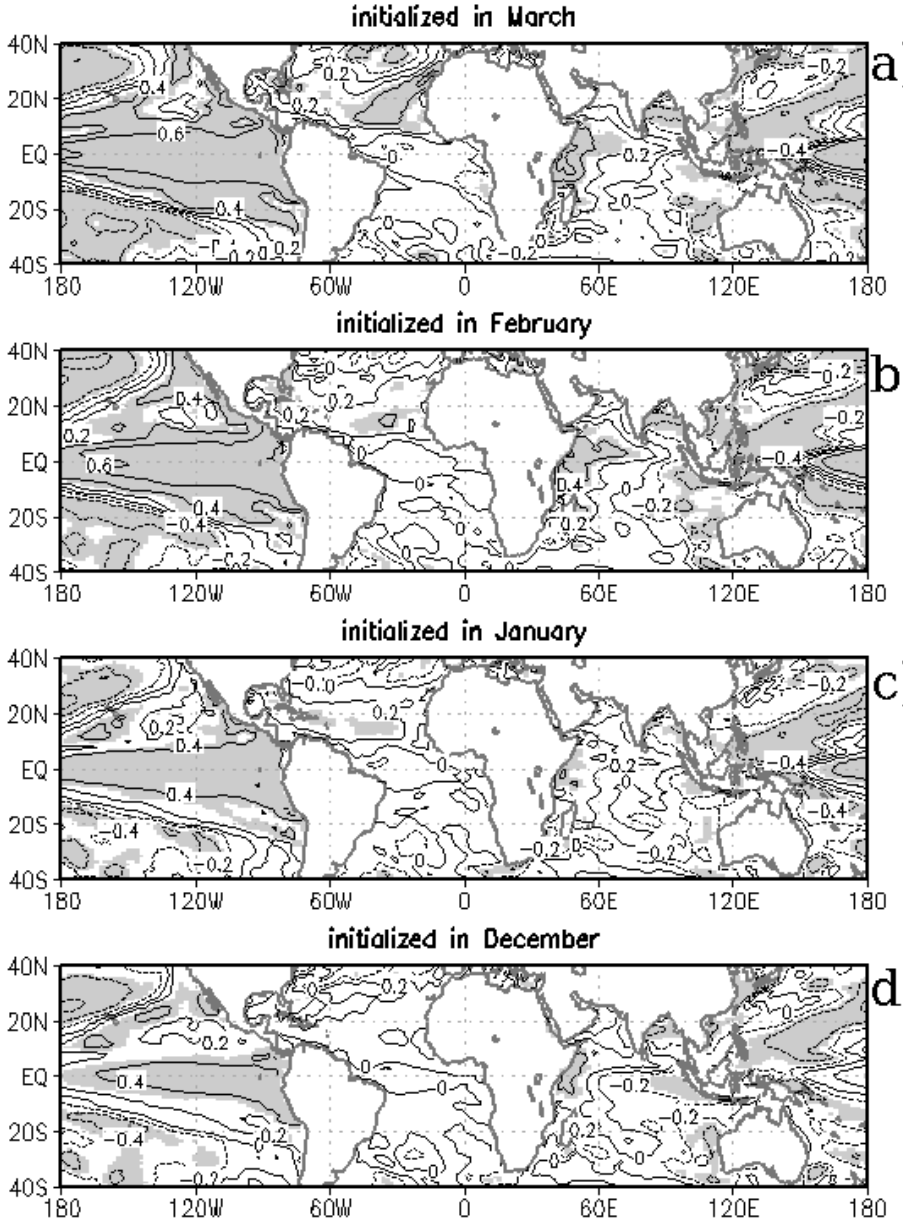


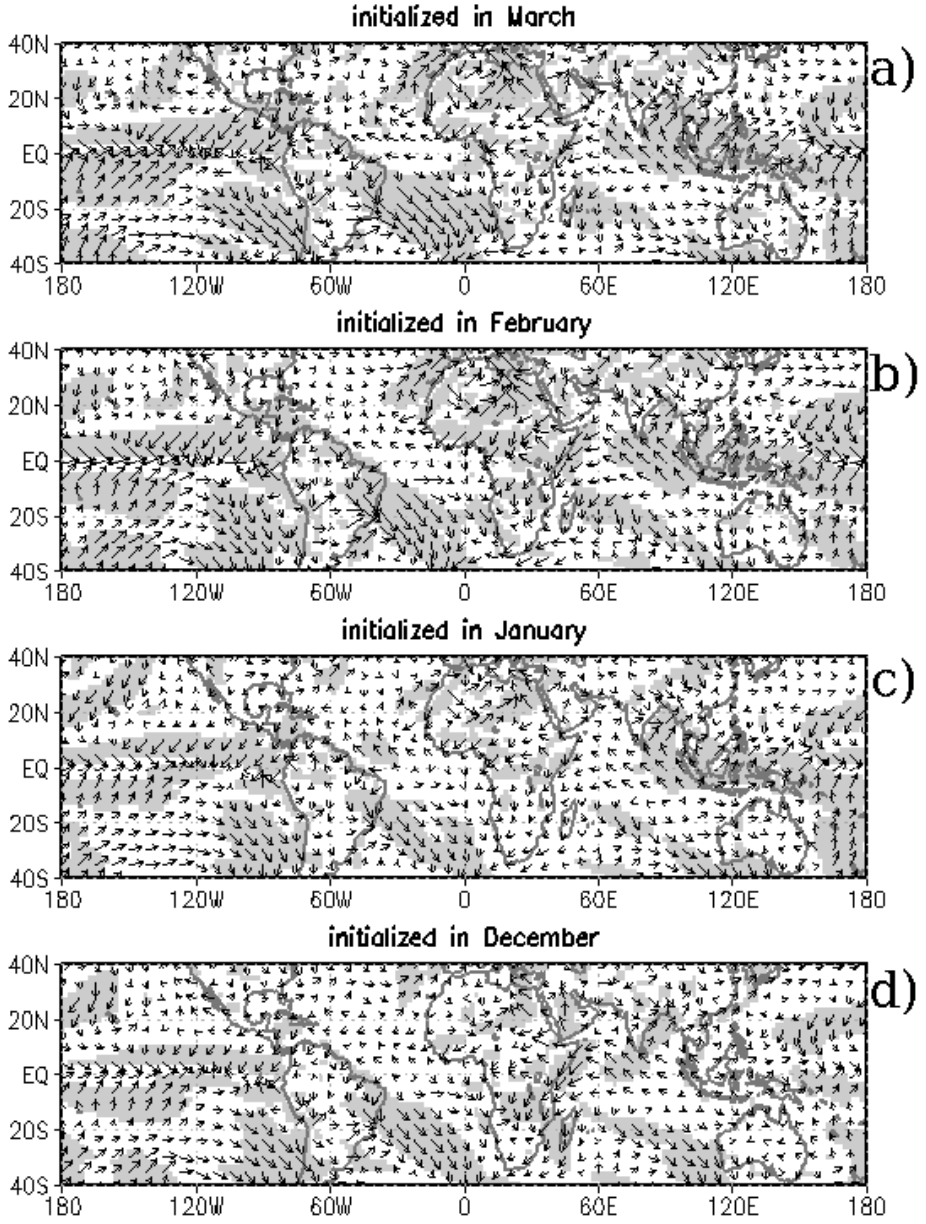






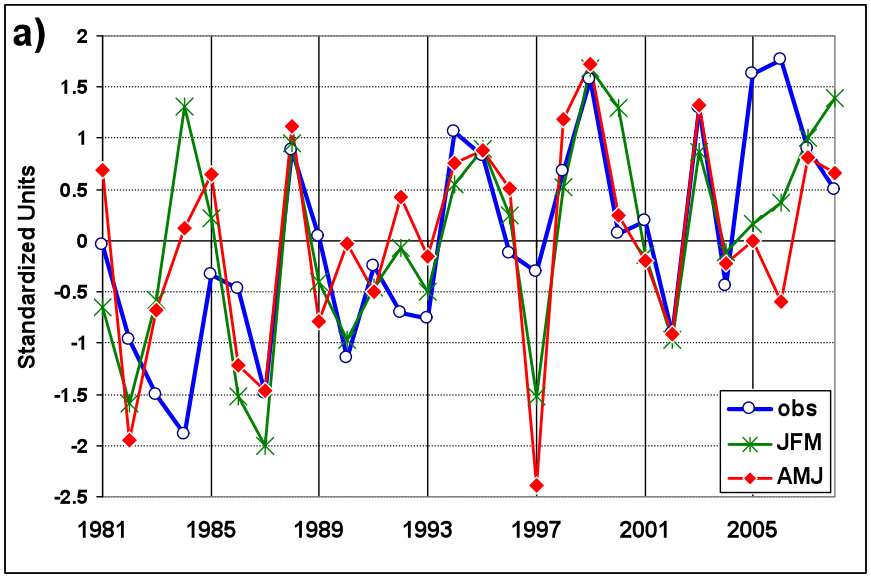
lead-time improvements in the coupled CFS model



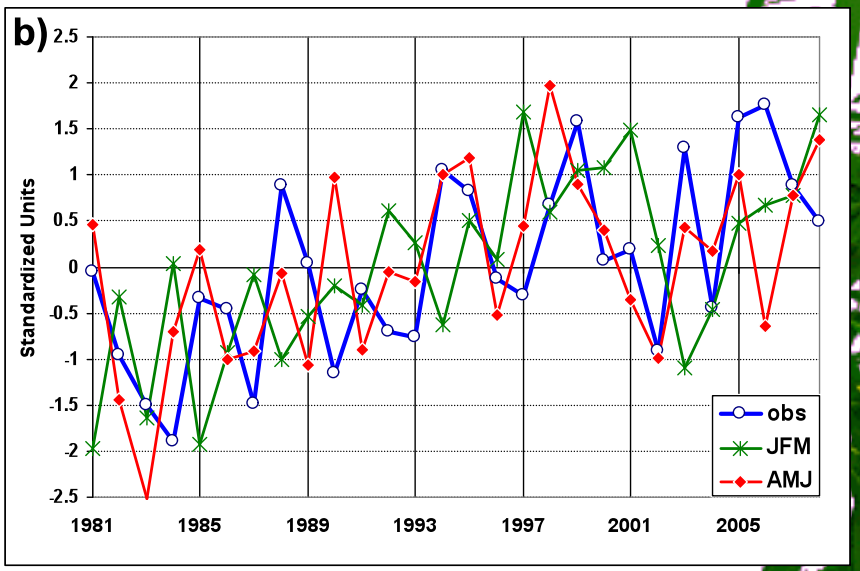


Sahel rainfall LF predictions by CFS 1981-2008

Using the MOS



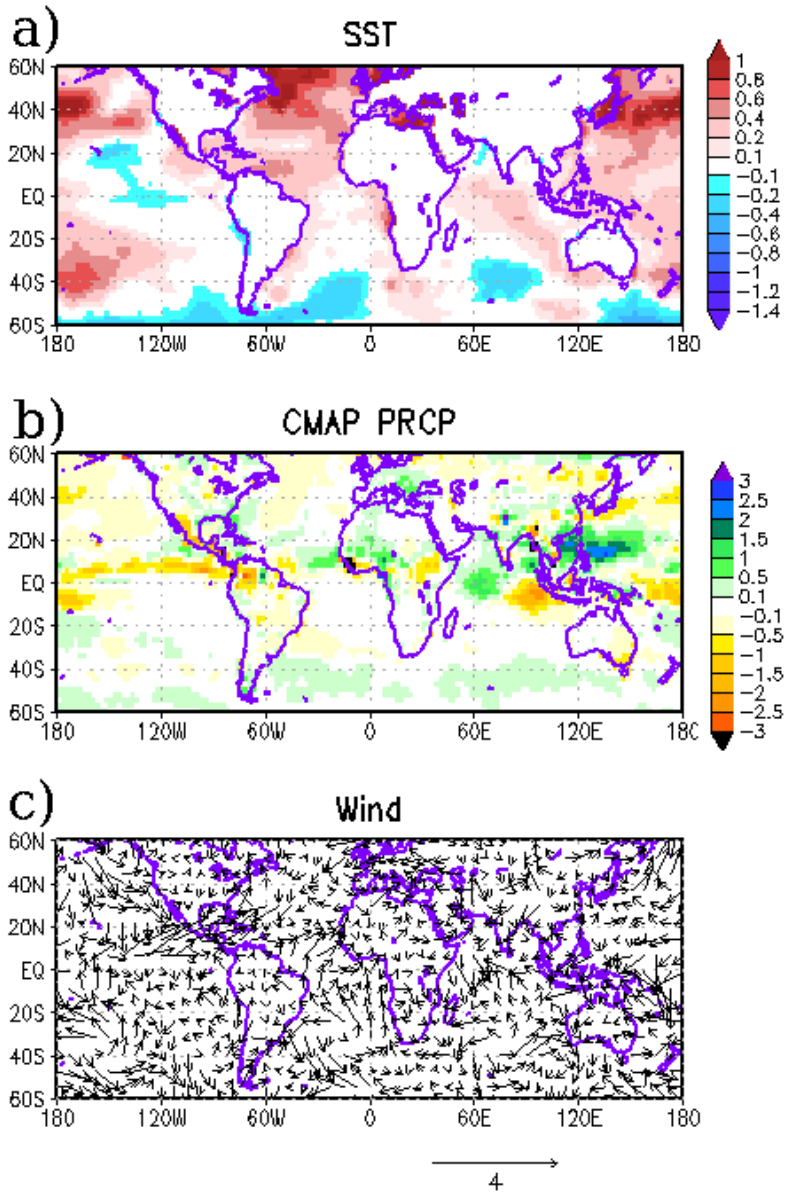
Raw rainfall



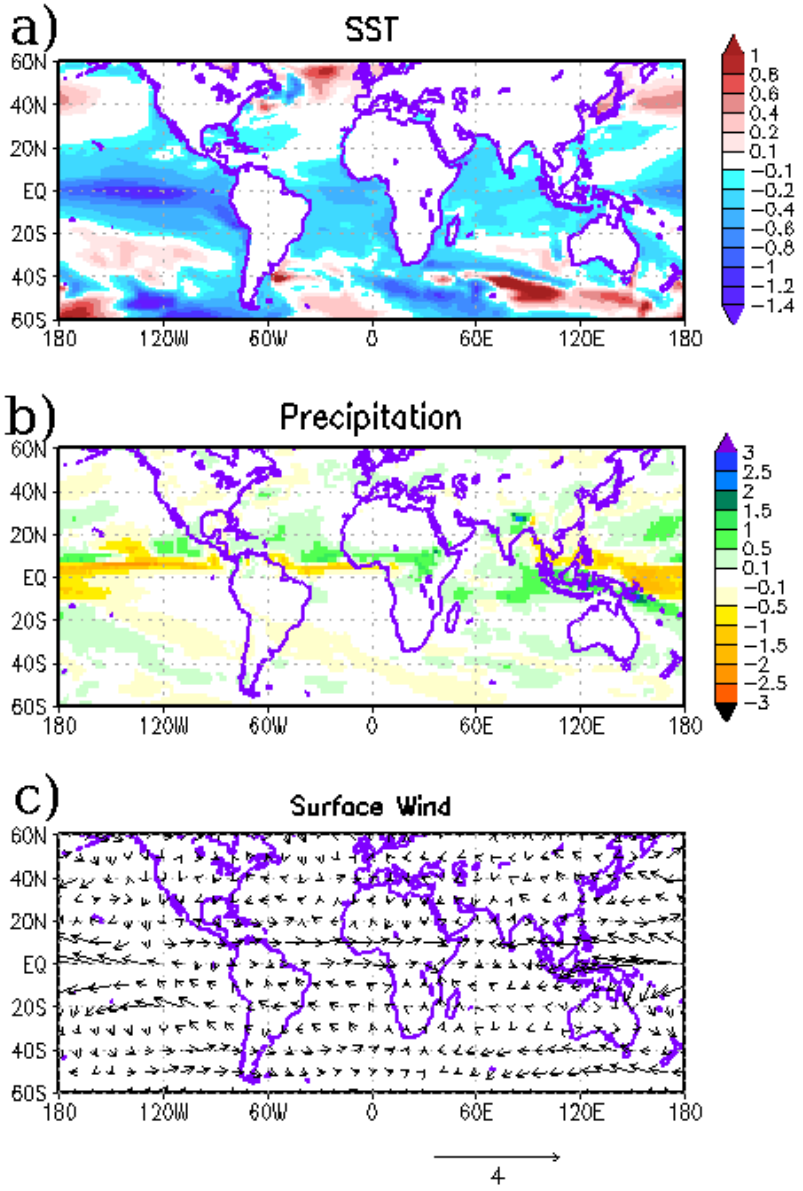
	JFM	AMJ
Raw Precipitation Predictions	0.24	0.57
MOS EOF1 Predictions	0.57	0.54

AMJ=average of all initializations across April-June
JFM=average of all initializations across Jan-Mar

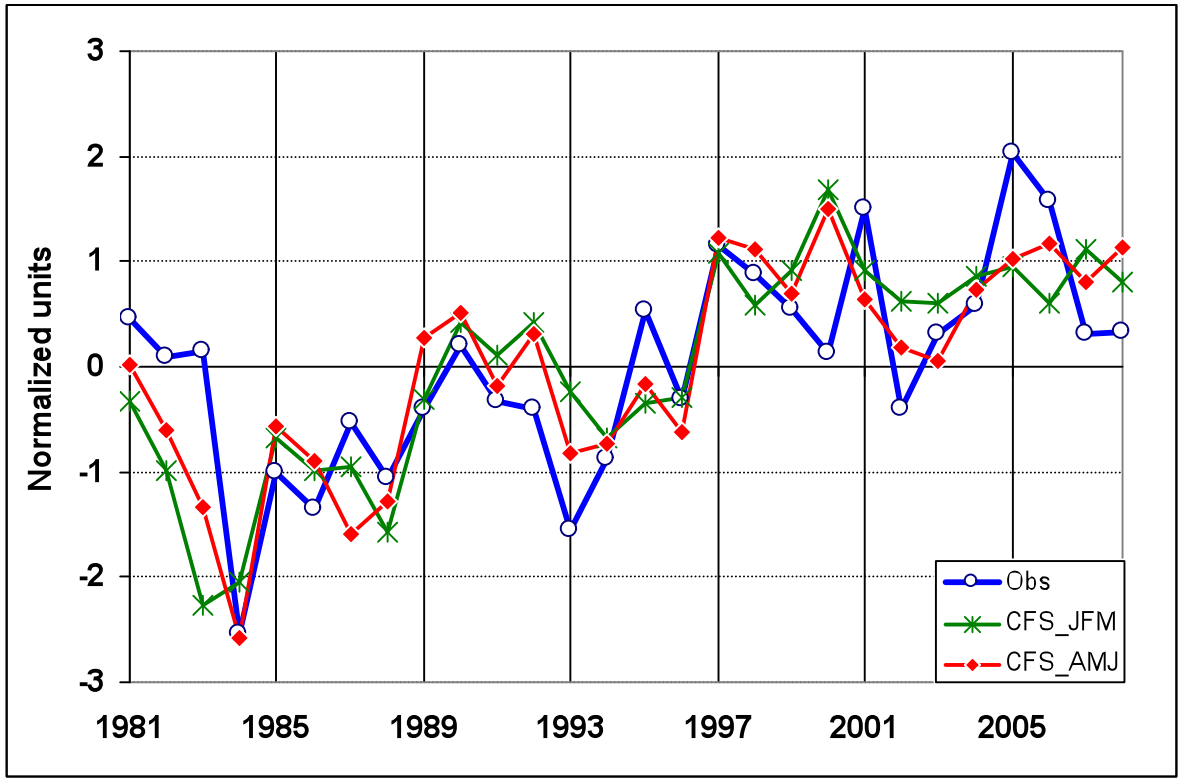
Composite difference 1994-2008 MINUS 1981-1993 for observed JAS fields.
(a) SST (ºC), (b) rainfall (mm/day) and (c) reanalysis near-surface wind (m/s).



Composite difference 1994-2008 MINUS 1981-1993 for CFS JAS fields, from runs initialized in Jan-Mar each year



Time-series of JAS North Atlantic MINUS South Atlantic (AtlN-S) SST.
Observed (blue curve),
Predicted by the CFS-GCM from initializations in
Jan-Feb-Mar (green line, r=0.64 with observed)
and initializations in Apr-May-Jun (red line, r=0.78 with observed).



CONCLUSION

- Tropical Atlantic winds are a good proxy for Sahel rainfall in GCMs at seasonal to multidecadal timescales
- Previous attempts at prediction limited by SST development during boreal spring (true for GCMs and empirical methods)
- CFS contains skill r~0.6 at lead times up to six months, with clear skill on the interannual timescale when the MOS is applied
- Accurate tracking the recent increase in precip in the Sahel

THANK YOU

	JFM	AMJ
Raw Precipitation Predictions	0.24	0.57
Raw Precipitation Predictions after Detrending	-0.22	0.31
MOS EOF1 Predictions	0.57	0.54
MOS EOF1 Predictions after Detrending	0.33	0.39

Teleconnection between observed Nino3 and global wind and SST field