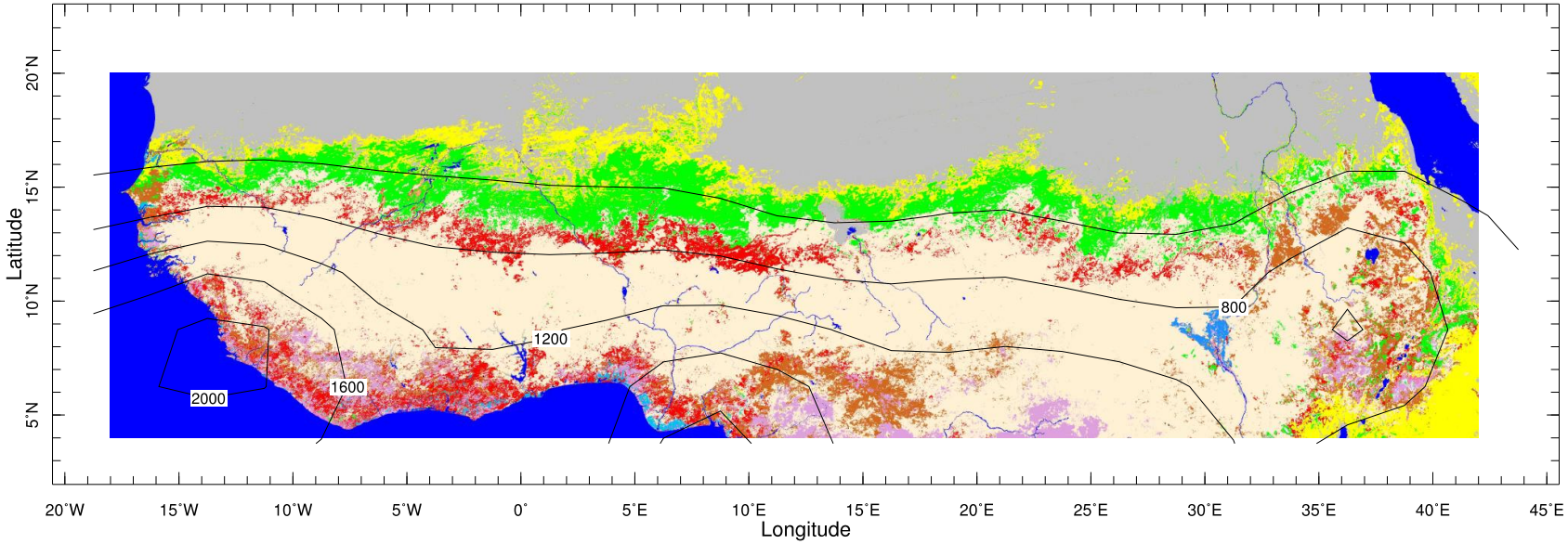
The skill of the North American Multi-Model Ensemble in predicting Sahel rainfall

Alessandra Giannini with A. Ali, C. P. Kelley,
B. L. Lamptey, B. Minoungou, O. Ndiaye

NOAA/CPC Climate Diagnostics and
Prediction Workshop 2020

International Research Institute
for Climate and Society
EARTH INSTITUTE | COLUMBIA UNIVERSITY

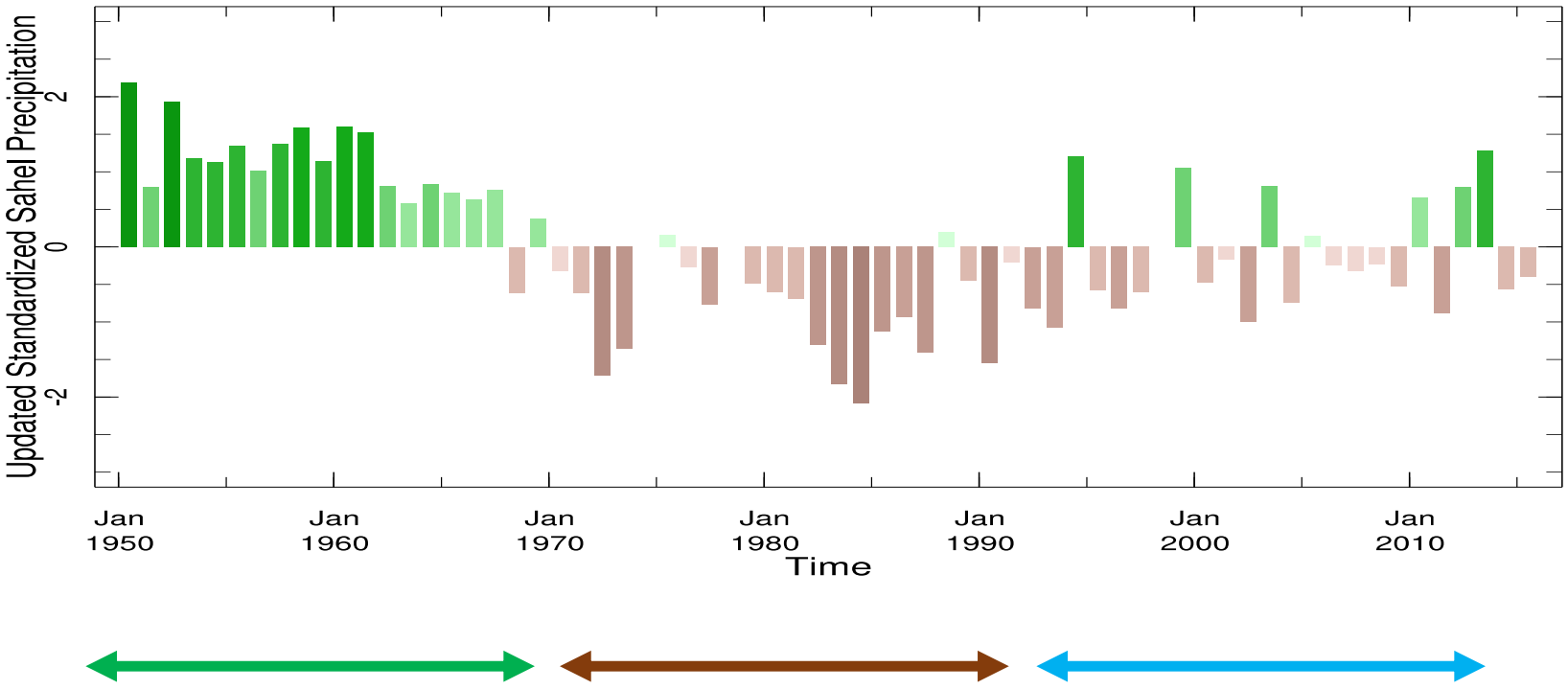
The Sahel: the southern edge of the Sahara, 400-600 mm/year



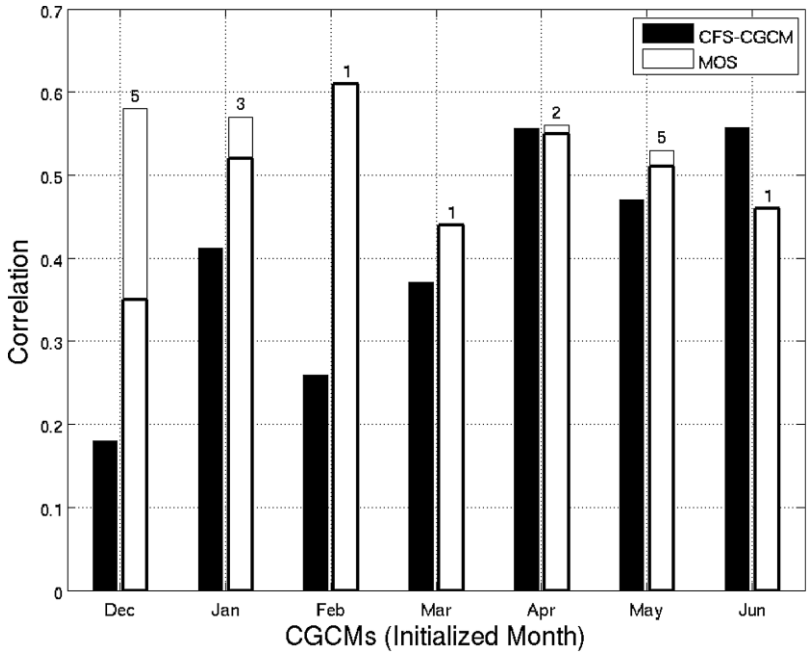
land cover: shrubland, grassland, cropland

Sahelian epochs: wet, dry, variable

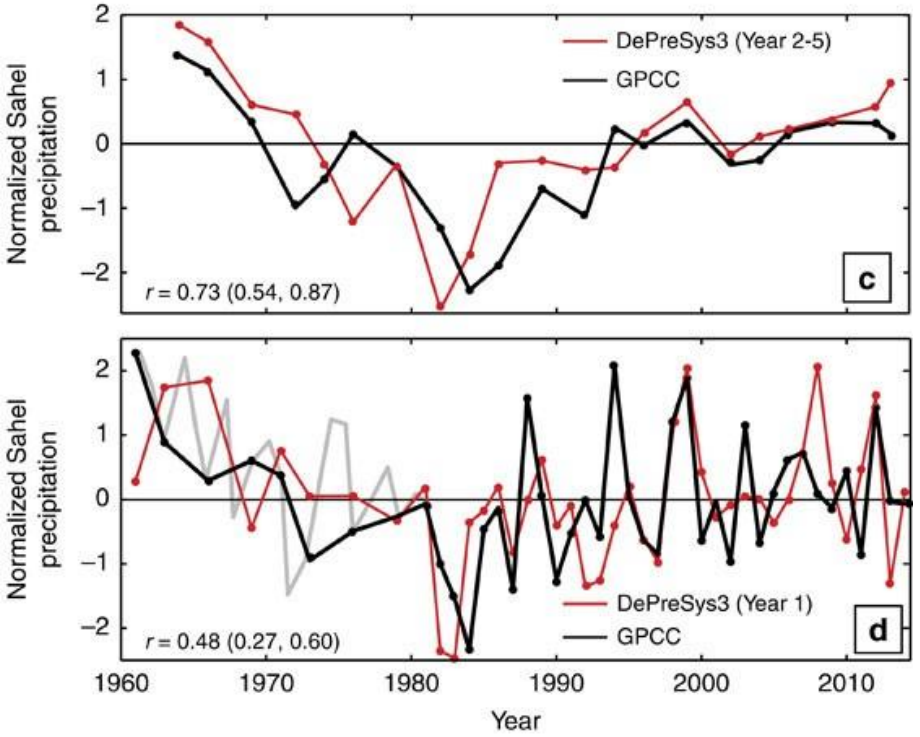
variable: prediction gains in practical relevance



prior research (coupled models)

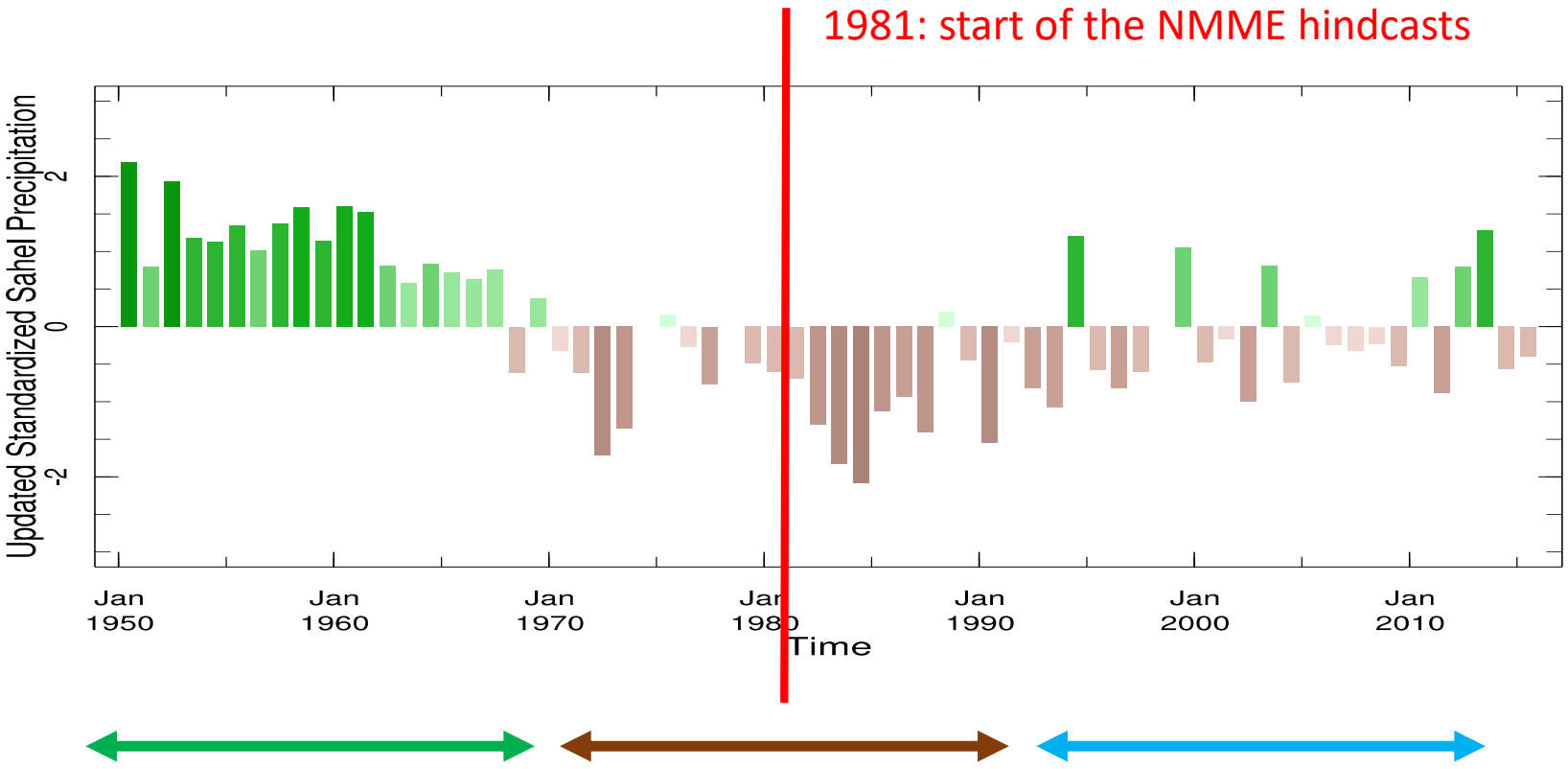


Ndiaye *et al.* 2011, in J. Climate
predictor is CFS precipitation [filled bars]
predictor is MOS-corrected CFS wind pattern



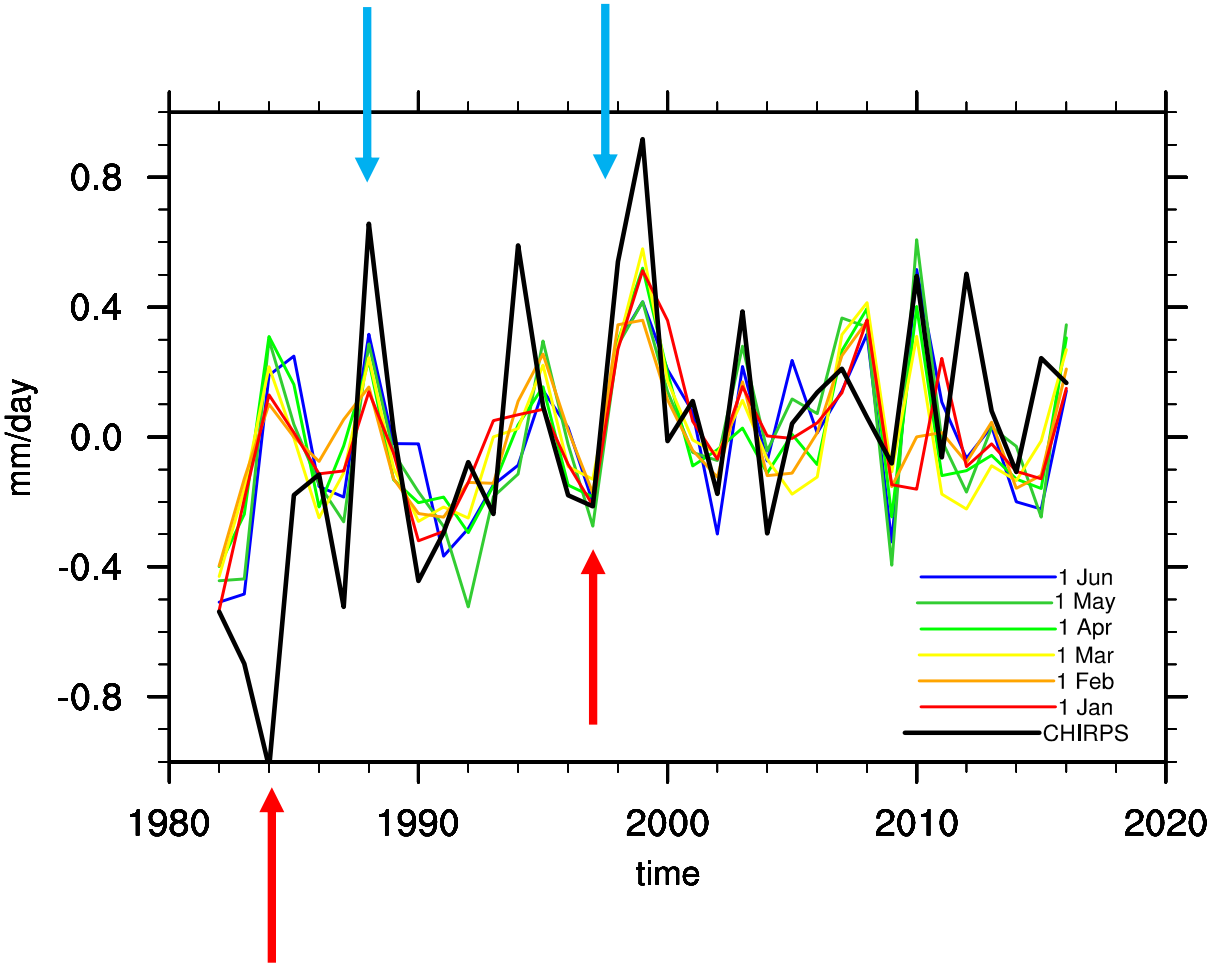
Sheen *et al.* 2017, in Nature Comms.
decadal predictions, in years 2-5 [top], and in year 1 [bottom]

Sahelian epochs: wet, dry, variable

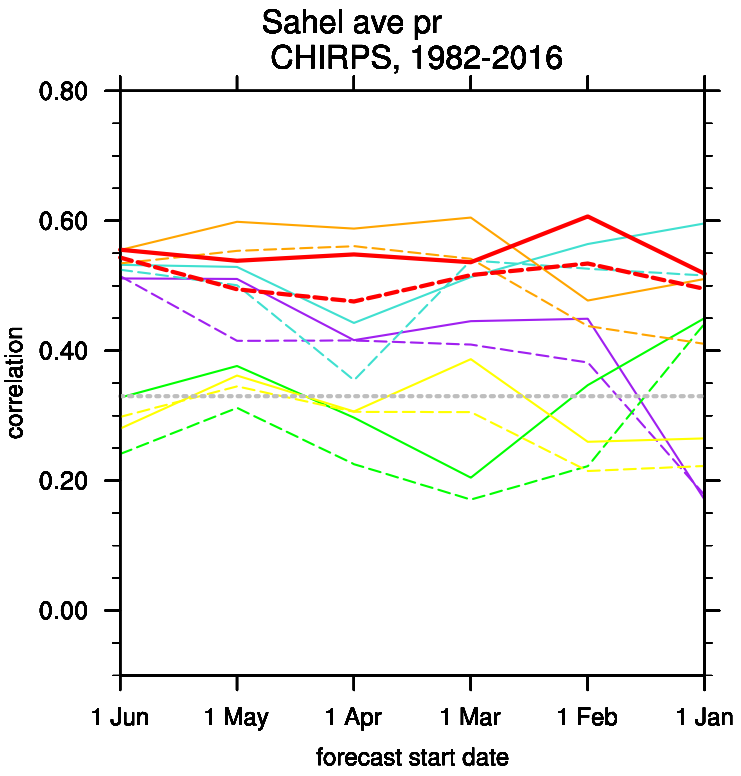


NMME Jul-Sep Sahel precipitation predictions at lead times from Jan to Jun (1982-2016)

Sahel = 10-20N, 20W-40E



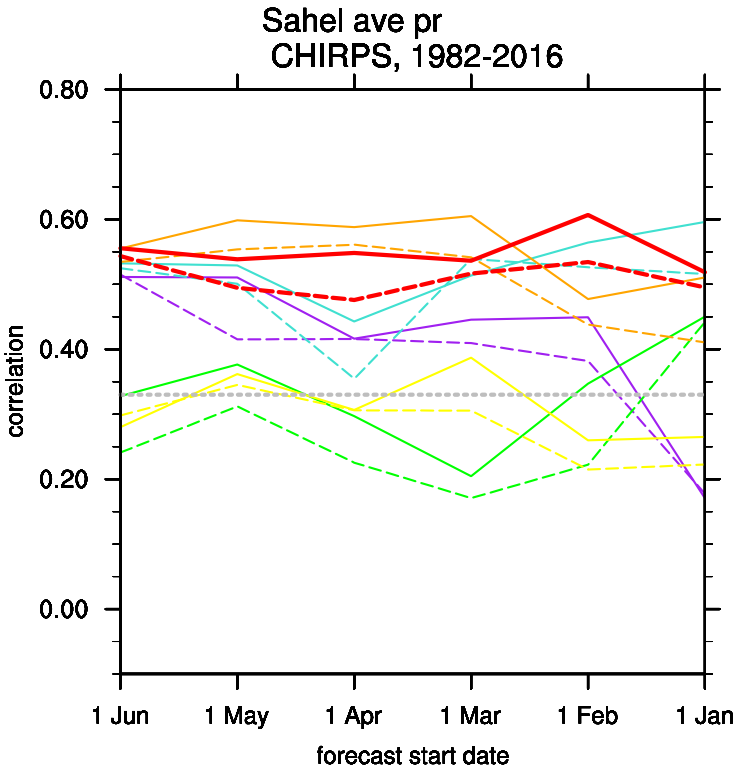
deterministic skill: Spearman (solid) and Pearson (dashed) correlations

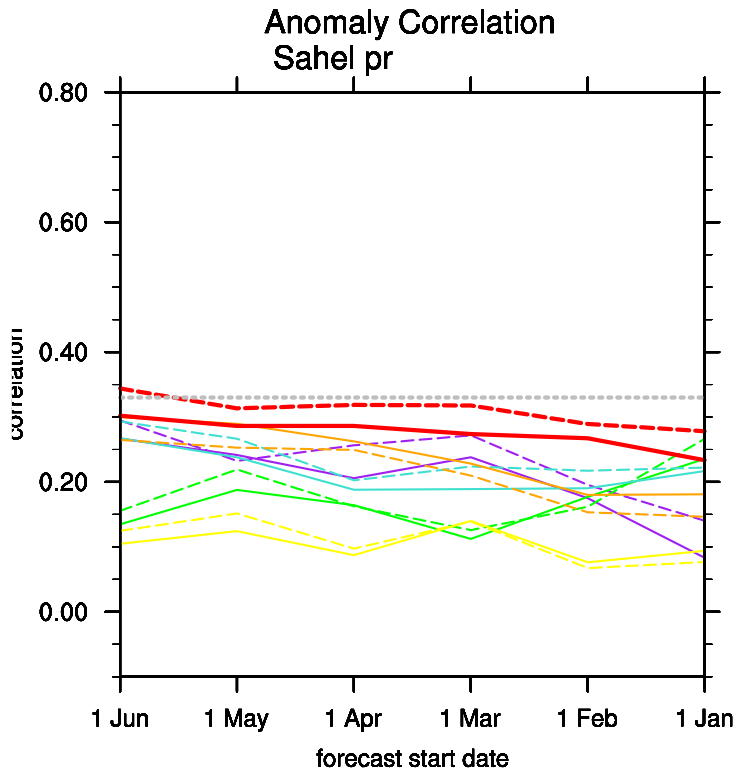


correlations of the ensemble mean with CHIRPS observations

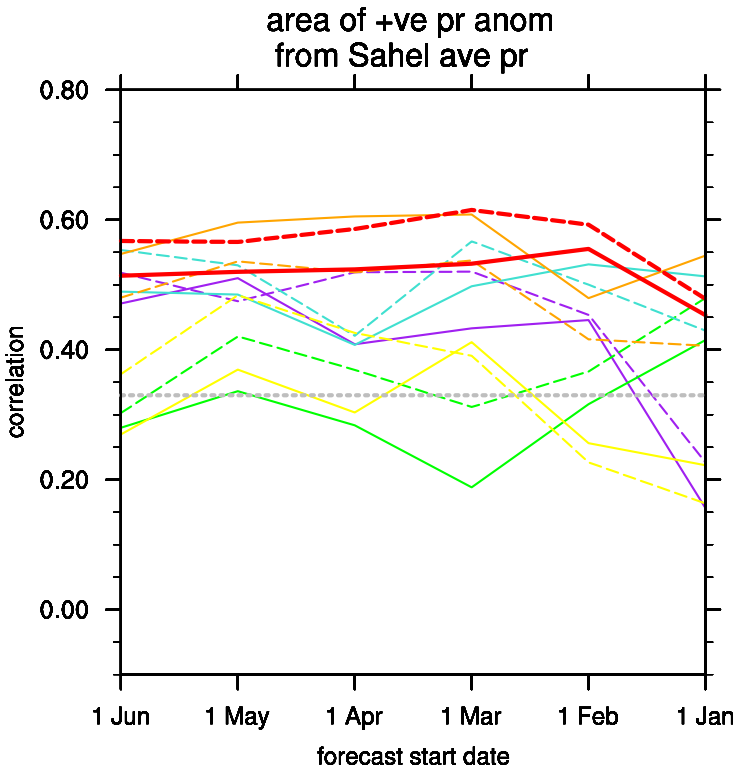
- multi-model mean in thick red
- single models in thin color

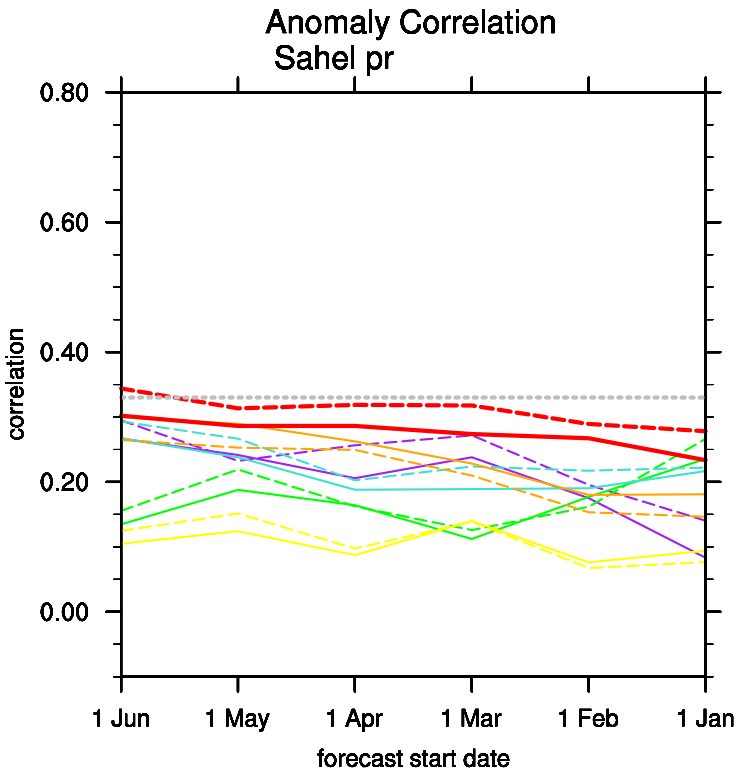
1. the forecast of the (spatial) average is better than the average of forecasts





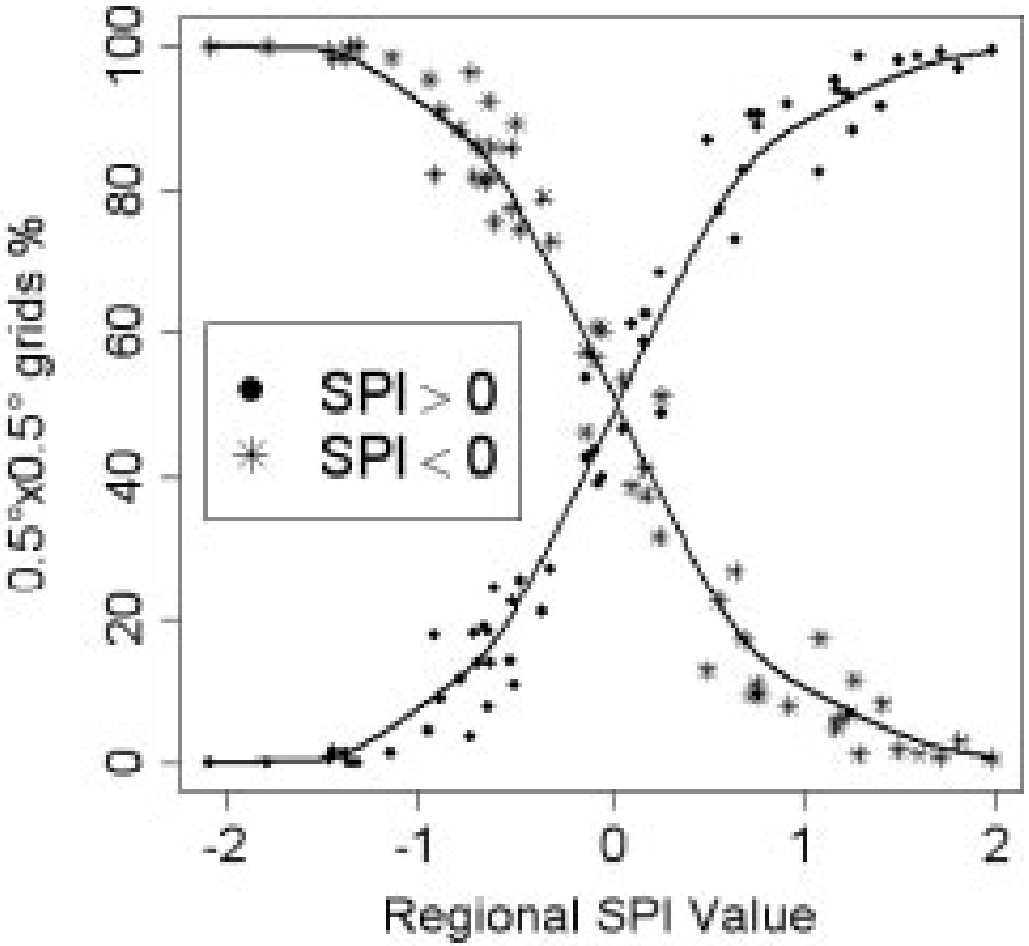
2. cannot predict what will happen at a specific location, but can predict overall tendency – spatial coherence





2. amplitude of regional anomaly and spatial coherence are related

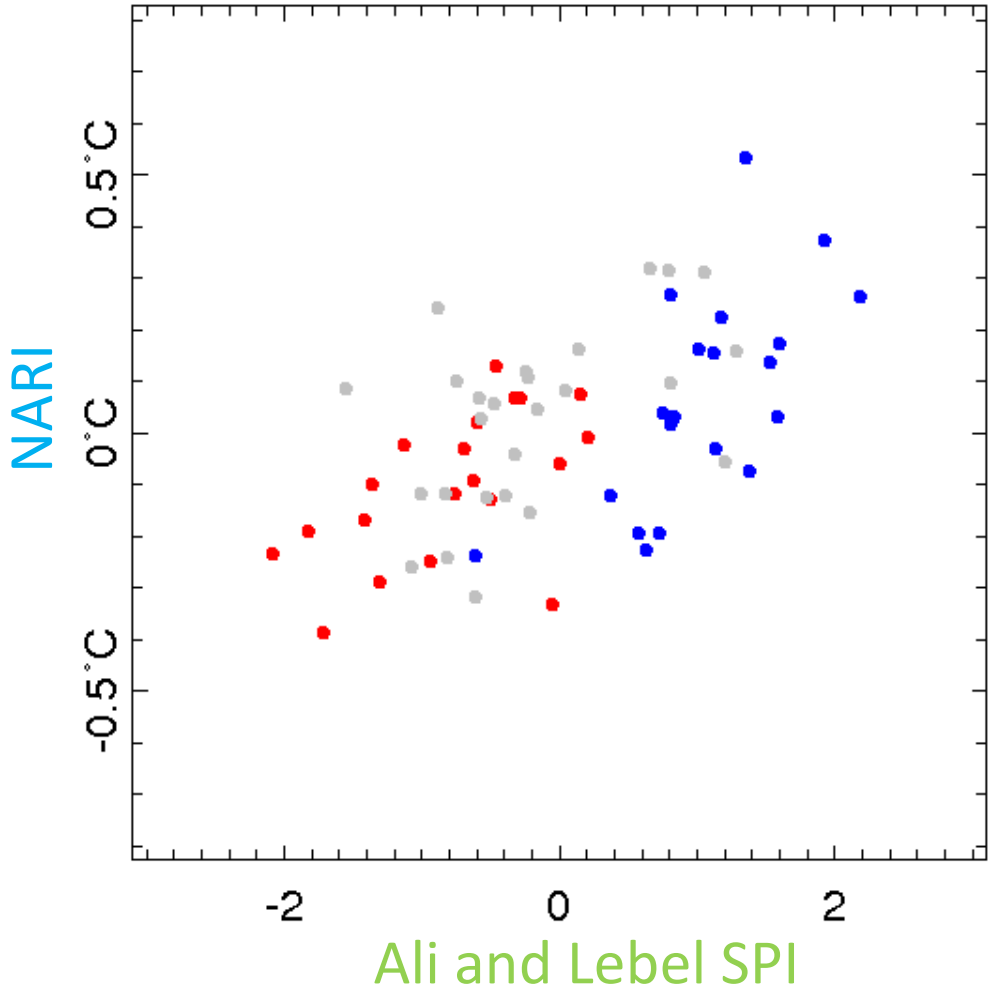
Ali and Lebel 2009, in Int J Climatol



3. source of predictability: NARI

North Atlantic Relative Index

10-40N, 75-15W minus 20S-20N



1950-1969 – wet

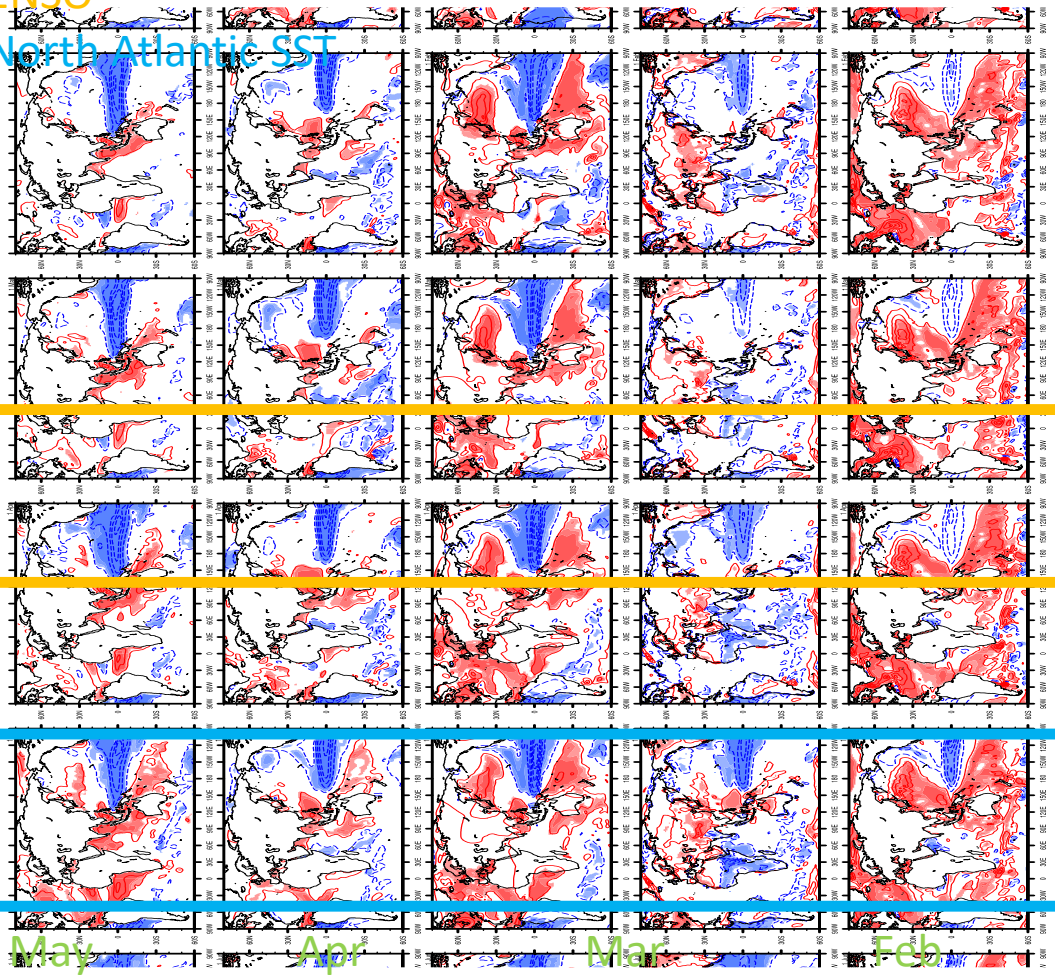
1970-1989 – dry

1990-2015 – variable

3. source of predictability: NARI
[North Atlantic Relative Index]

model predicts ENSO

model predicts North Atlantic SST



Jun May Apr Mar Feb Jan

forecast start date

Conclusions

- The North American Multi-model Ensemble predicts July–September Sahel-wide precipitation as skillfully in February/March as in June
- Skill comes from the ability to predict tropical Pacific and North Atlantic surface temperatures, attributable to two models in particular
- Skill in predicting the spatial average is significantly higher than the spatial average of local skill
- Spatial coherence is as predictable as the regional average

Acknowledgements:
NASA/AST-2/SERVIR: 15-SERVIR15_2-0027
ANR-17-MPGA-0015 [project title: PRODUCT]
Columbia University/ACToday/Senegal