

Forecasting Seasonal African Rainfall: Capabilities and Opportunities

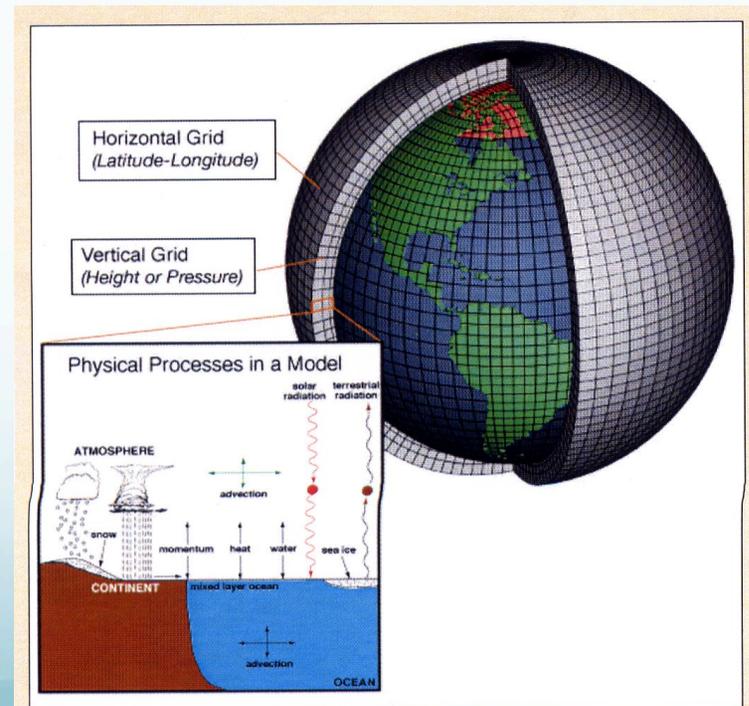
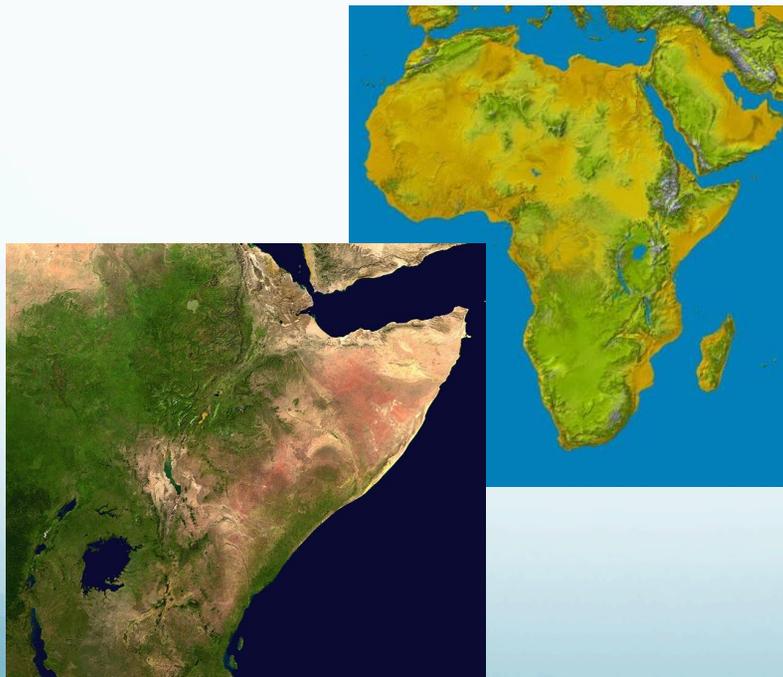
- ° How Well do Tools Simulate the Climatological Seasonal Cycle?
- ° How Much of Seasonal African Rainfall Originates from Ocean Variability?
- ° What are the Oceanic Patterns Driving African Rainfall Variability?

Martin Hoerling, Quan XiaoWei, Jon Eischeid, Brant Liebmann

NOAA and University of Colorado-CIRES

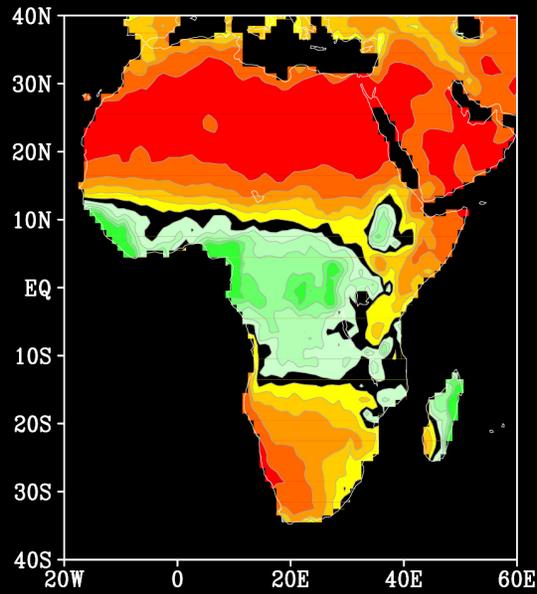
Modeling Tools for Assessing African Rainfall Variability & Predictability

- Global, high resolution models (~100km horizontal scales)
- Multiple models, coupled and uncoupled (ECHAM5, CAM4, GFS, CFS)
- Ensemble methods (key for understanding predictability; NMME/IMME)
- Simulations spanning 1979-present (AMIP)
- Hindcast predictions spanning 1982-present (CFS forecast system)

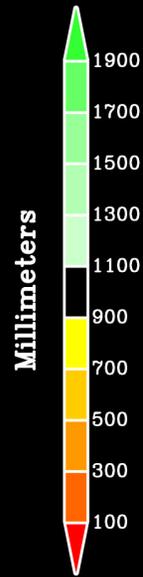


Annual Precipitation

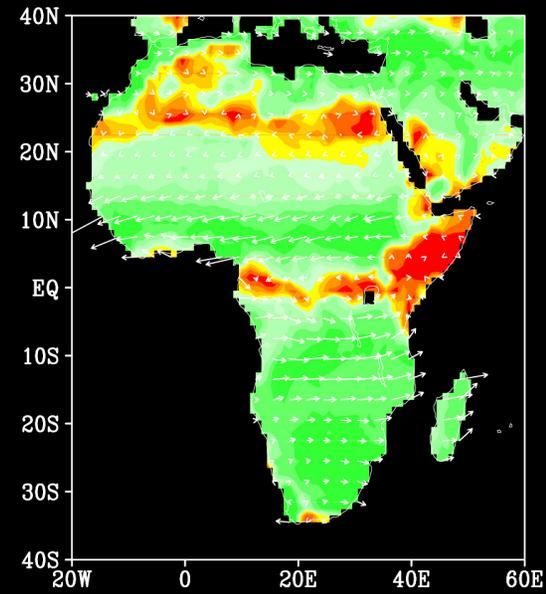
Observed



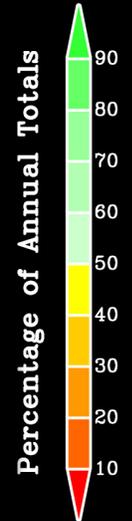
Millimeters



First Harmonic



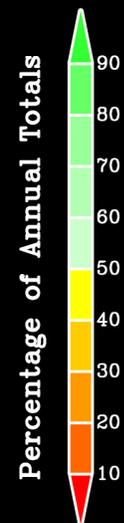
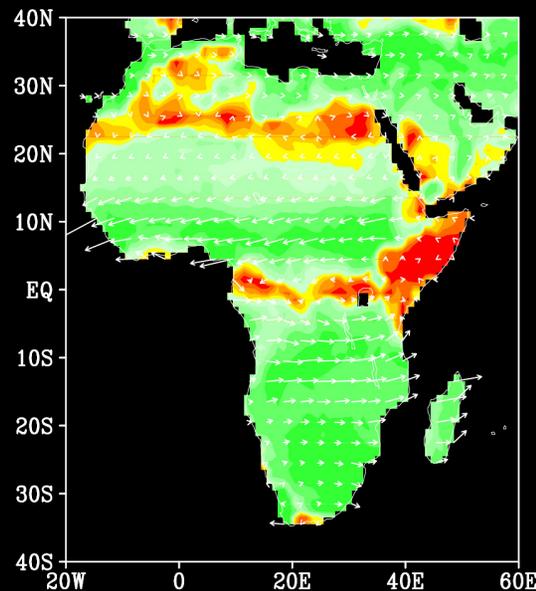
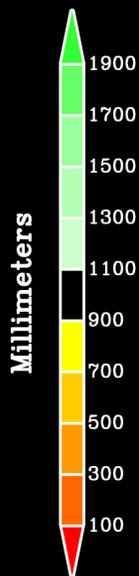
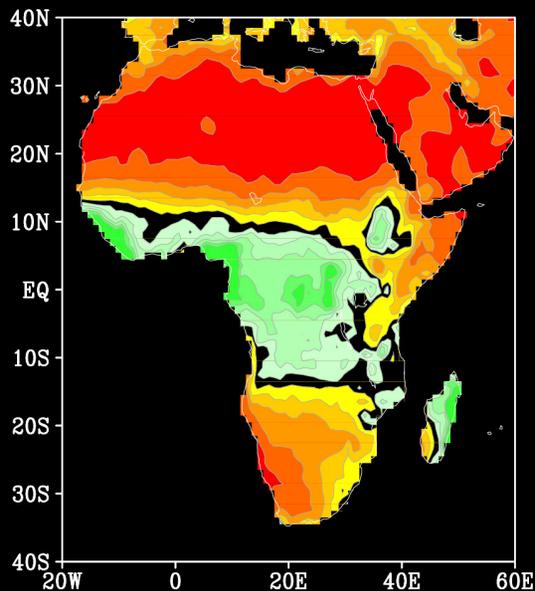
Percentage of Annual Totals



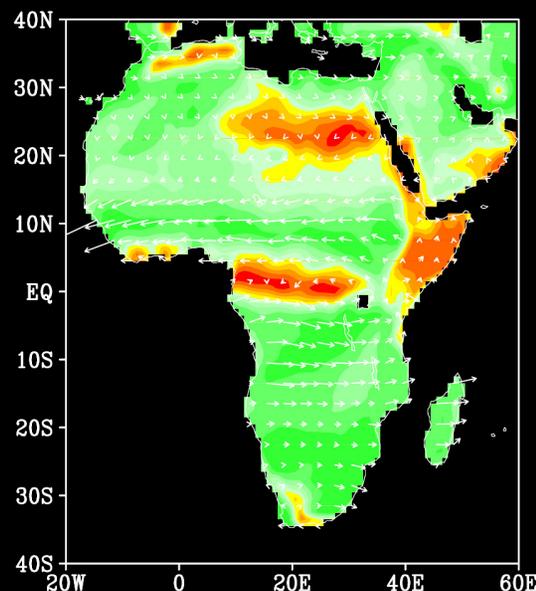
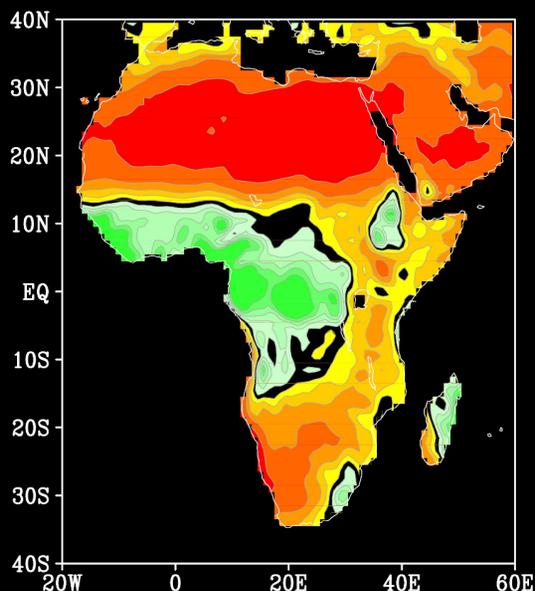
Annual Precipitation

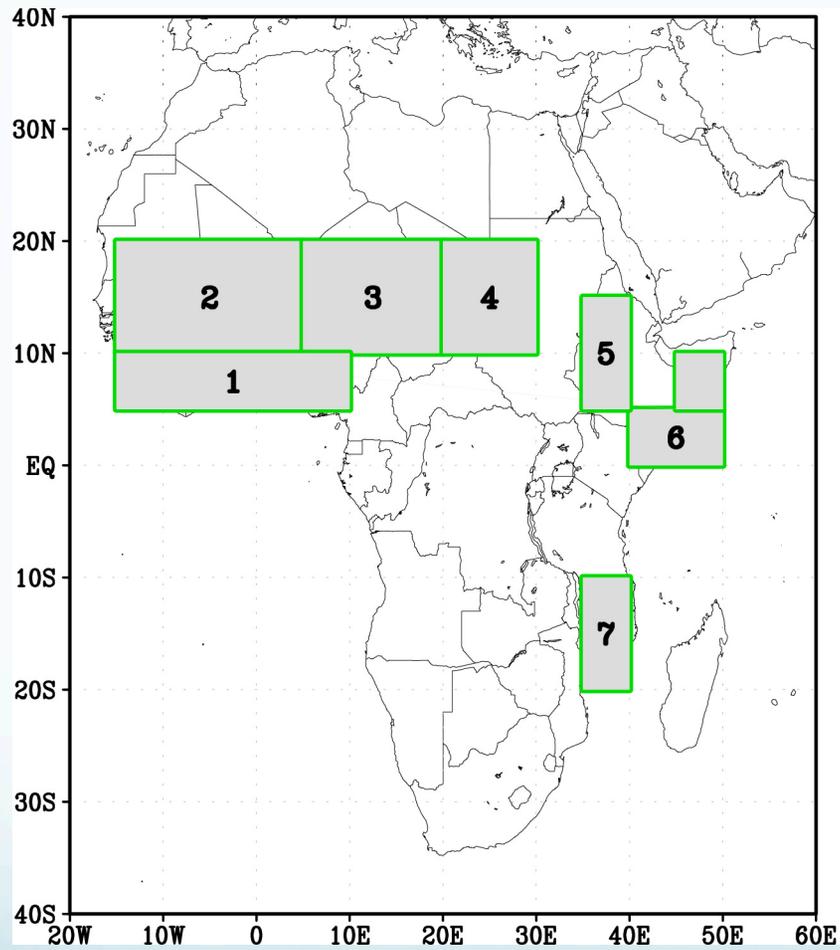
First Harmonic

Observed



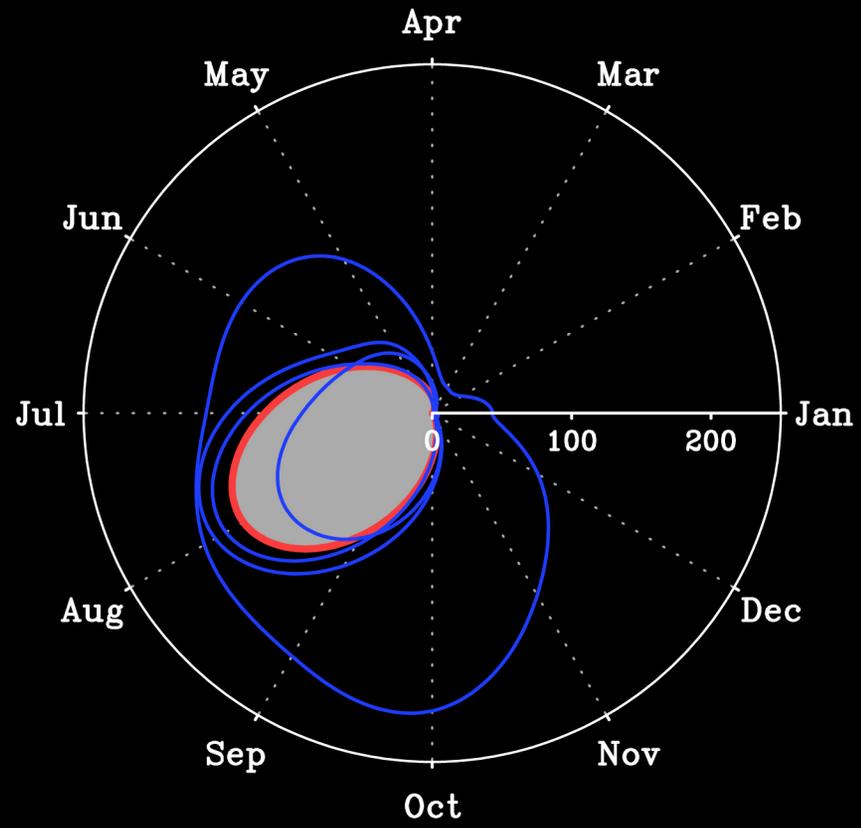
Simulated - GFSv2



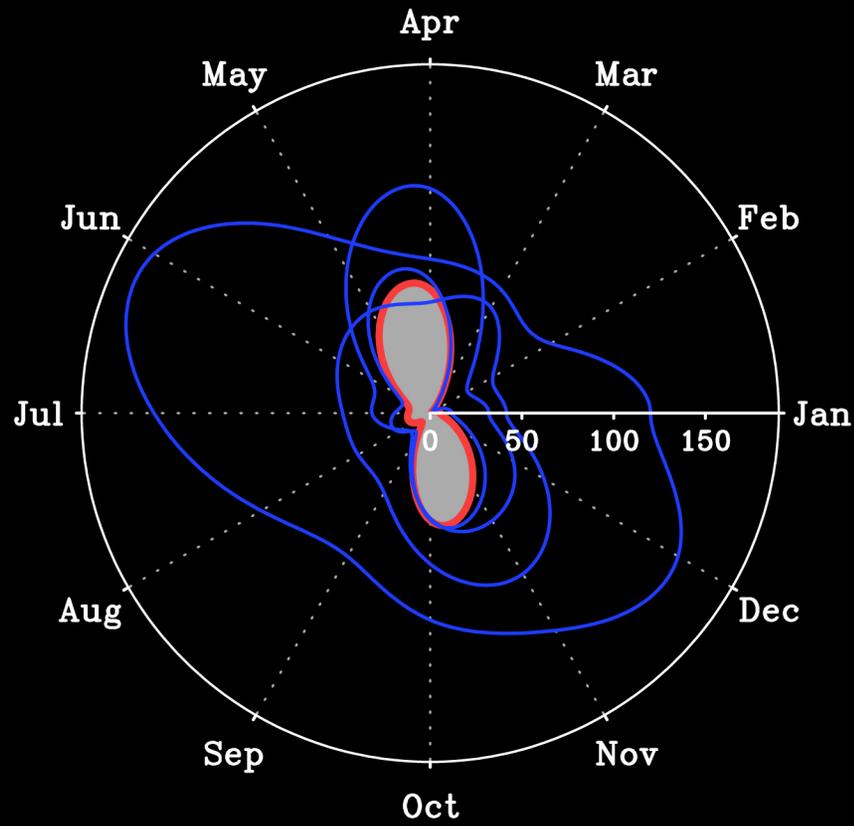


- 1 Guinea**
- 2 West Sahel**
- 3 Central Sahel**
- 4 East Sahel**
- 5 Ethiopia**
- 6 Eastern Horn**
- 7 Southeast**

Western Sahel Climatological Pcpn

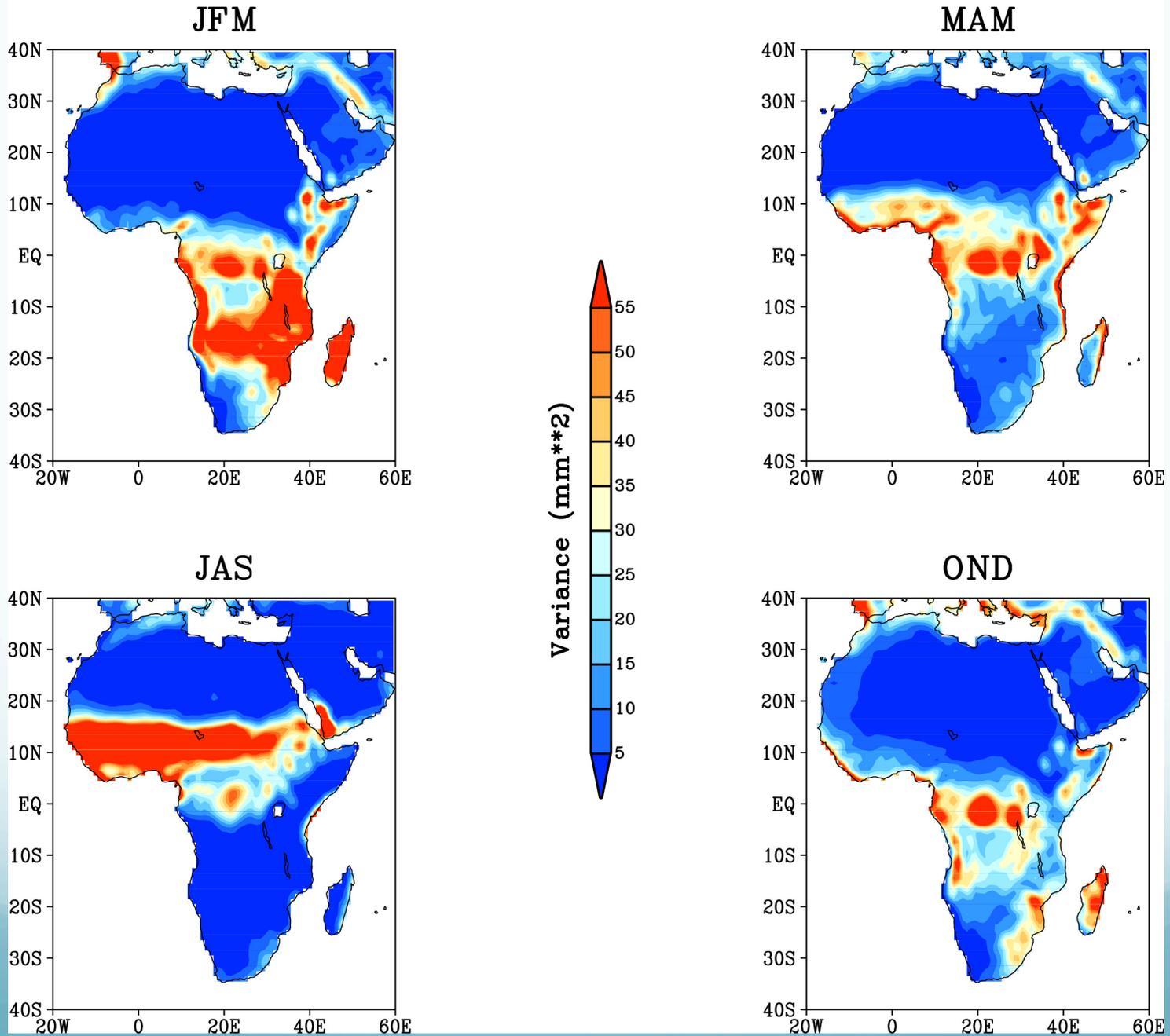


Eastern Horn Climatological Pcpn



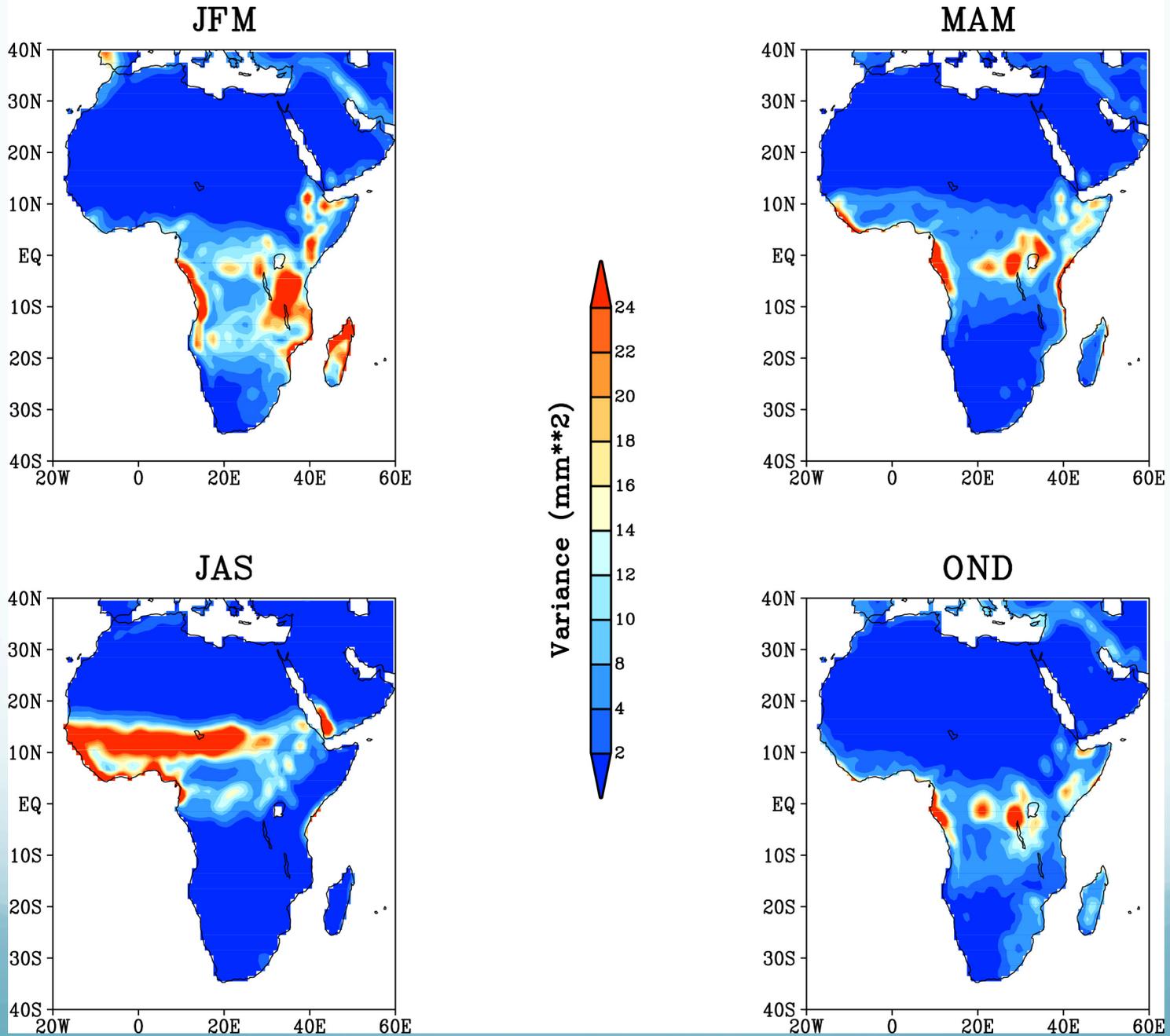
Total Pcpn Variance (GFSv2)

12 simulations 1979-2010



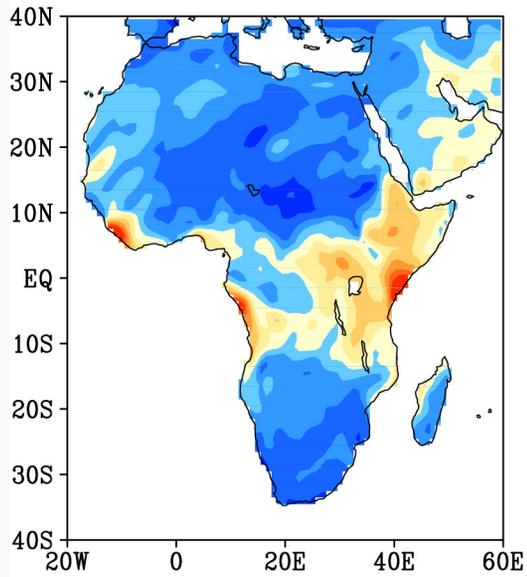
SST Forced Pcpn Variance (GFSv2)

12 simulations 1979-2010

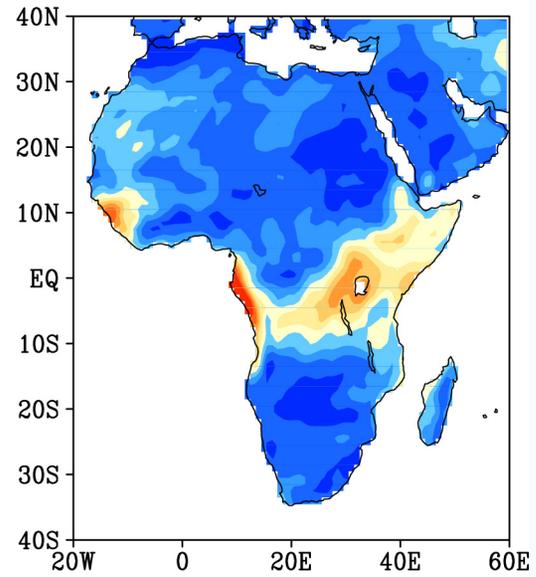


Ratio of Pcpn Variance (GFSv2)

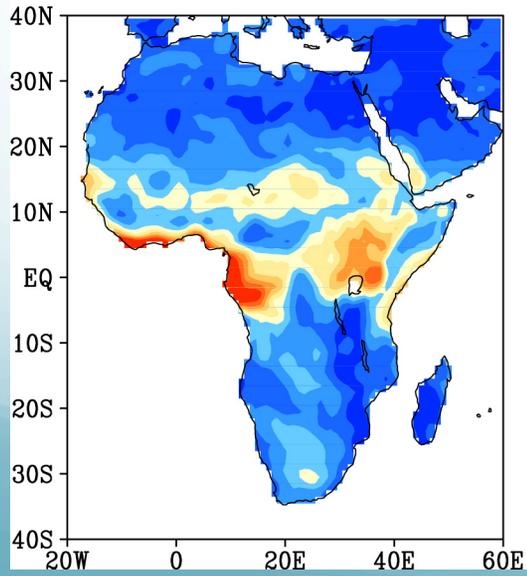
JFM



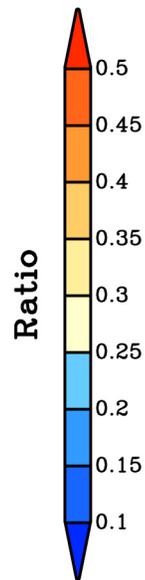
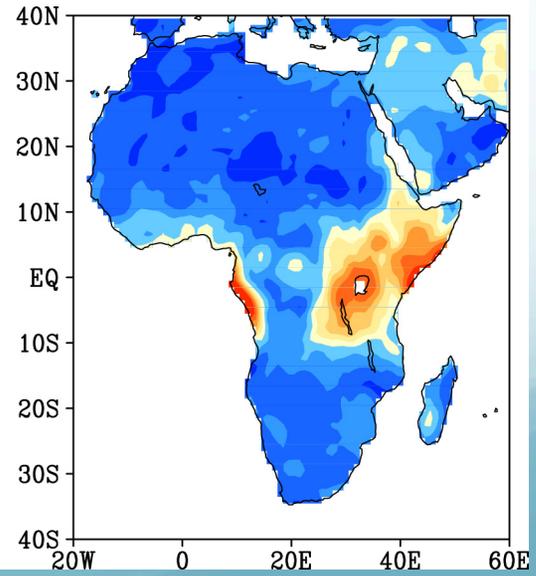
MAM



JAS

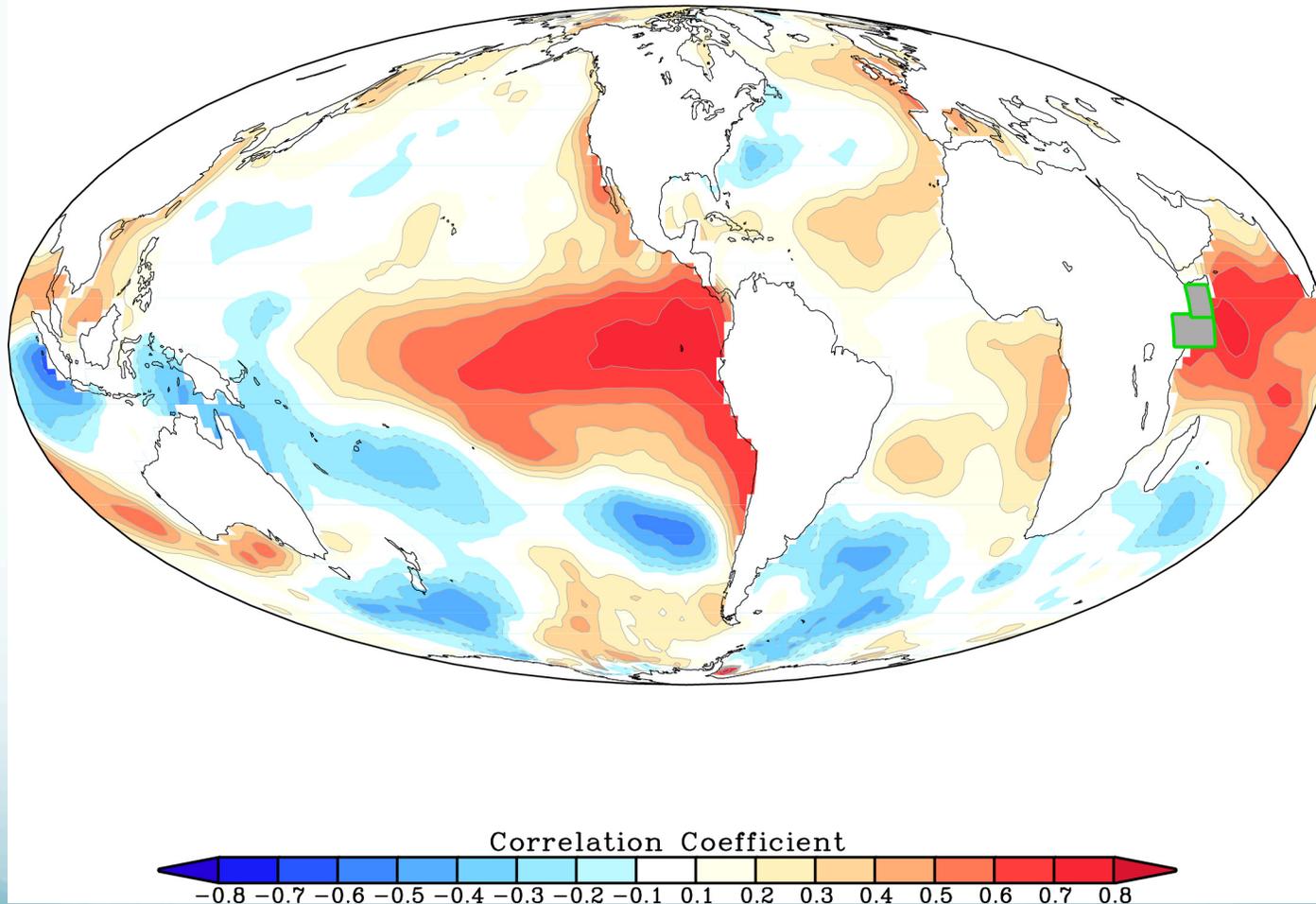


OND



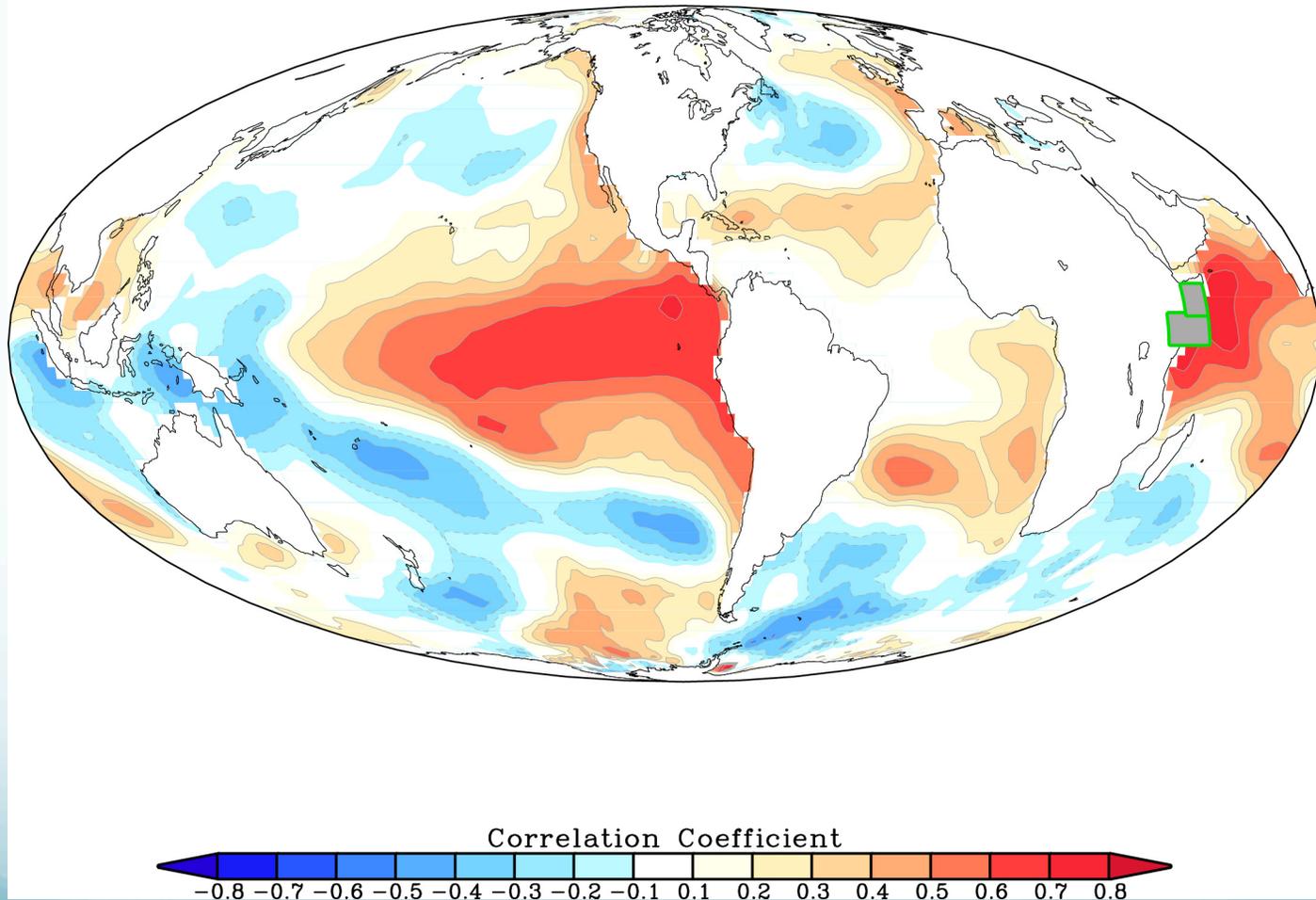
Observed “Short Rain” Variability vs Global SSTs

Correlation of Observed SST and
Eastern Horn Rainfall: October–December



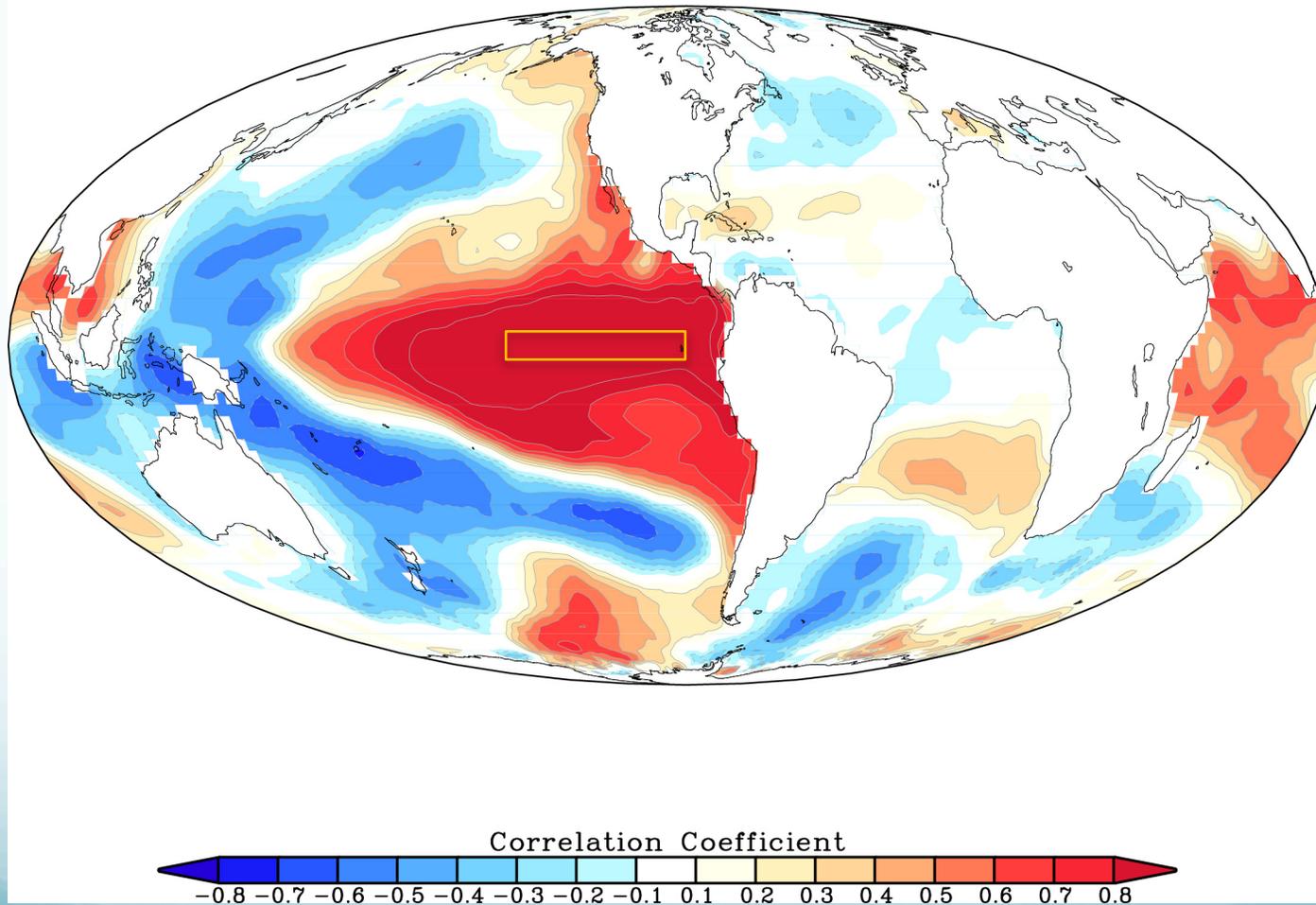
GFS “Short Rain” Variability vs Global SSTs

Correlation of Observed SST and
East Horn GFSv2 Rainfall: October–December



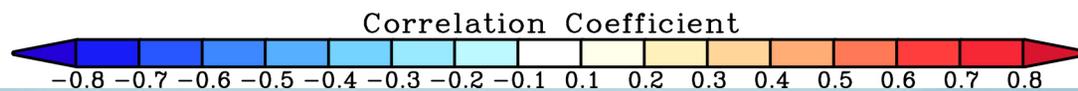
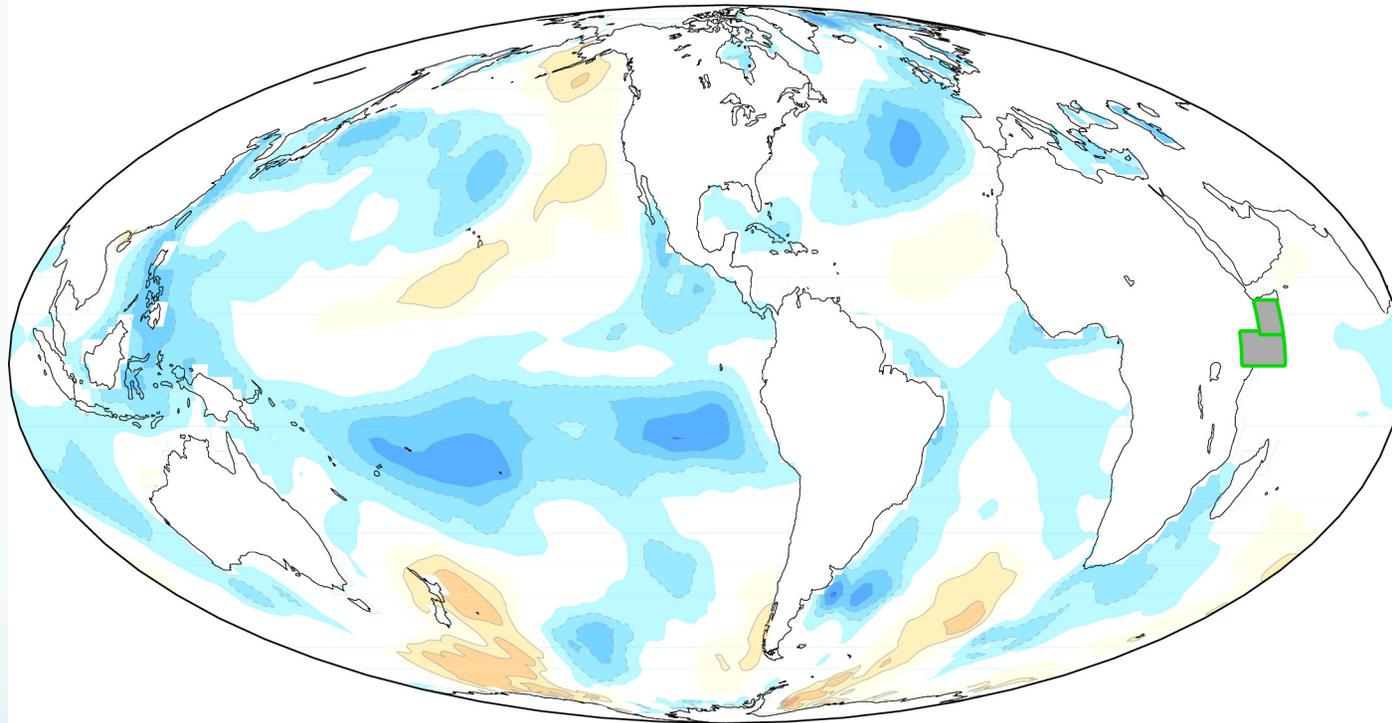
Global SST Pattern Linked to ENSO : Oct-Dec

Nino 3 SST vs. SST: OND, 1979-2010



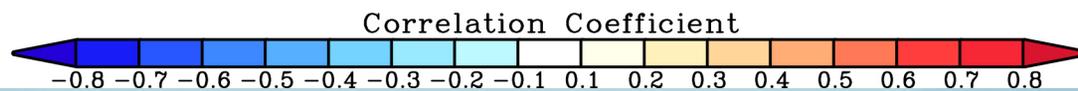
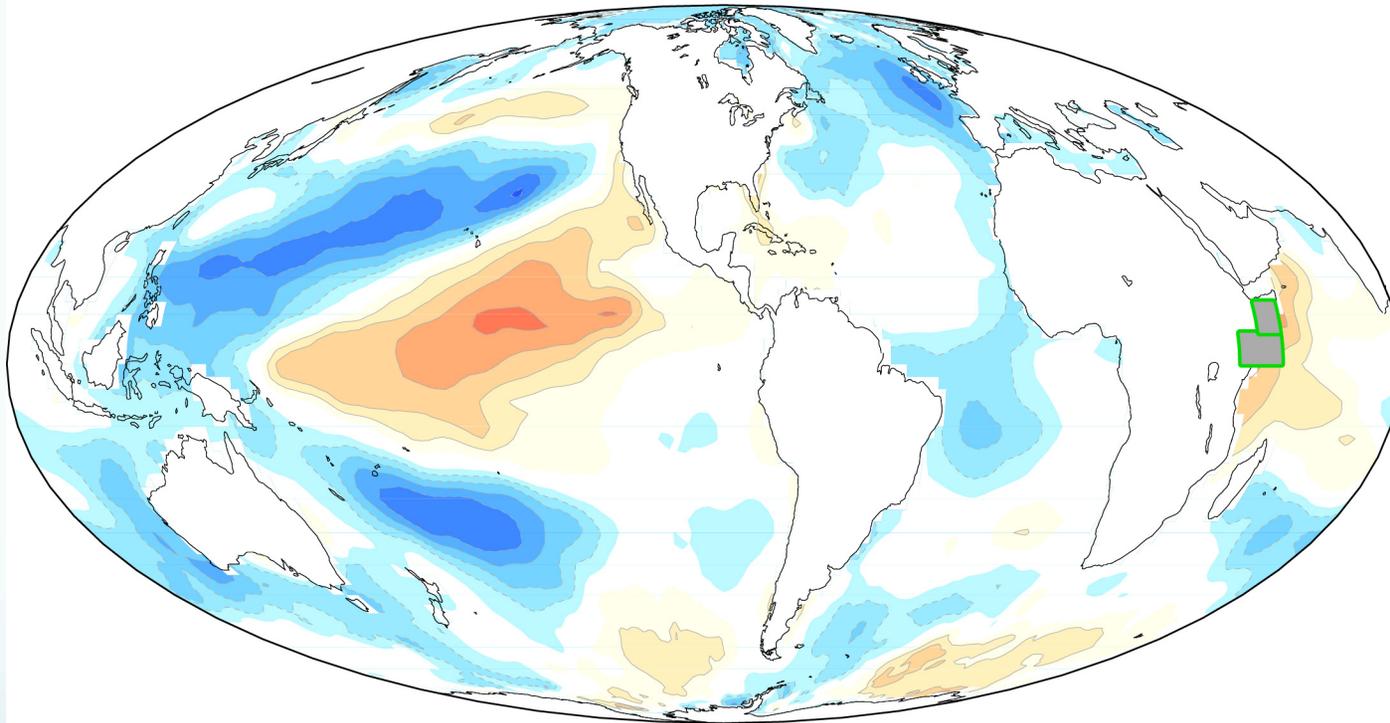
Observed “Long Rain” Variability vs Global SSTs

Correlation of Observed SST and
Eastern Horn Rainfall: March–May



GFS “Long Rain” Variability vs Global SSTs

Correlation of Observed SST and
East Horn GFSv2 Rainfall: March–May



Opportunities for African Rainfall Forecasting

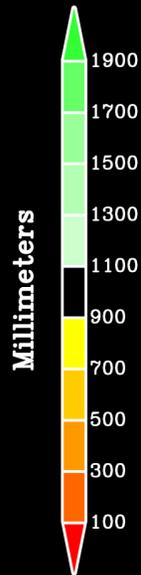
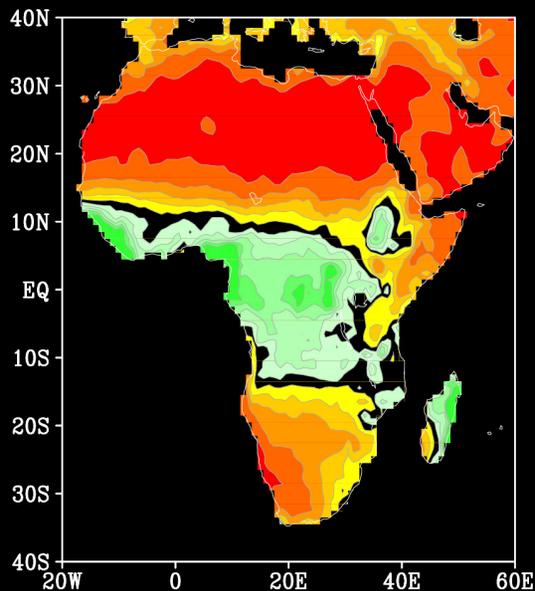
- *Learn How SSTs Condition Rainy Season Precipitation*
- *Evaluate “Potential Predictability” of the Rainy Seasons*
- *Assess Prospects to Realize/Exceed Potential Predictability thru Initialization*
- *Improve Upon Rainy Season Forecasts via Monthly Updates*
- *Generate Probabilistic Rainy Season Forecasts via Multi-Model Ensembles*

Additional Slides for Discussion



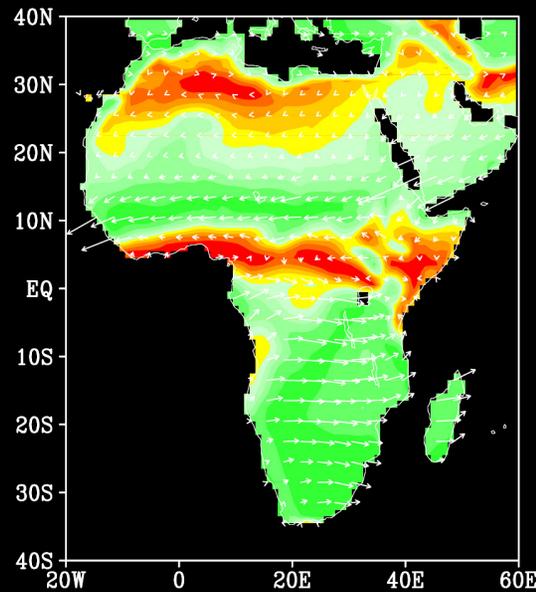
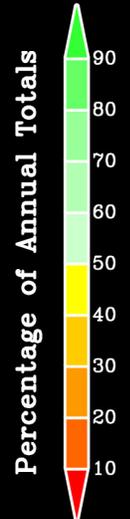
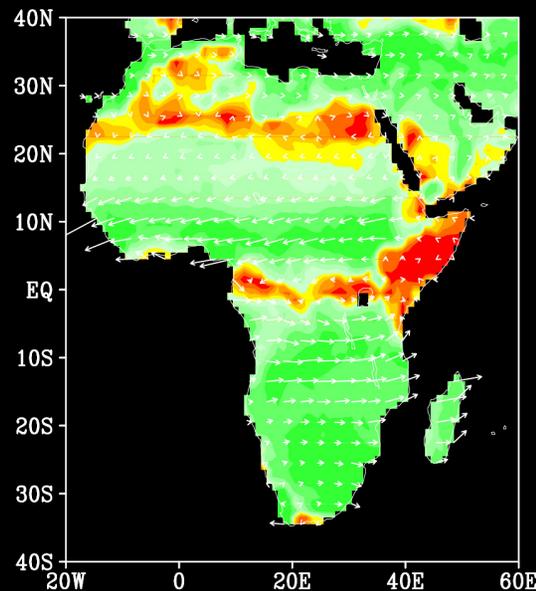
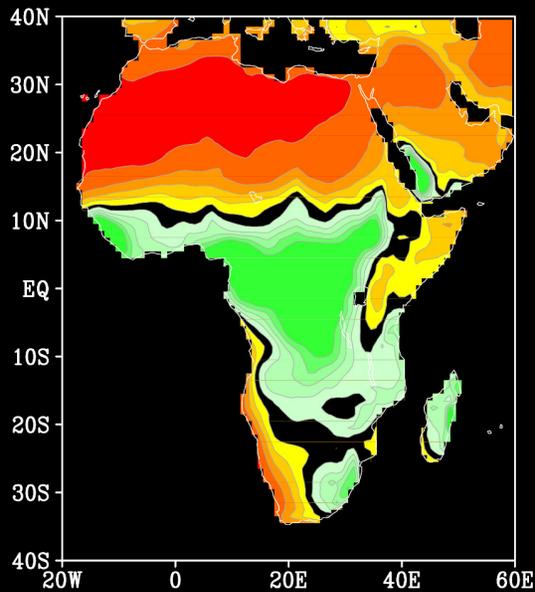
Annual Precipitation

Observed



First Harmonic

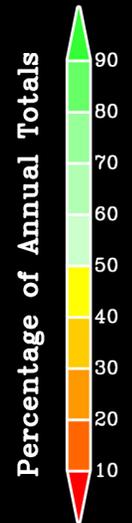
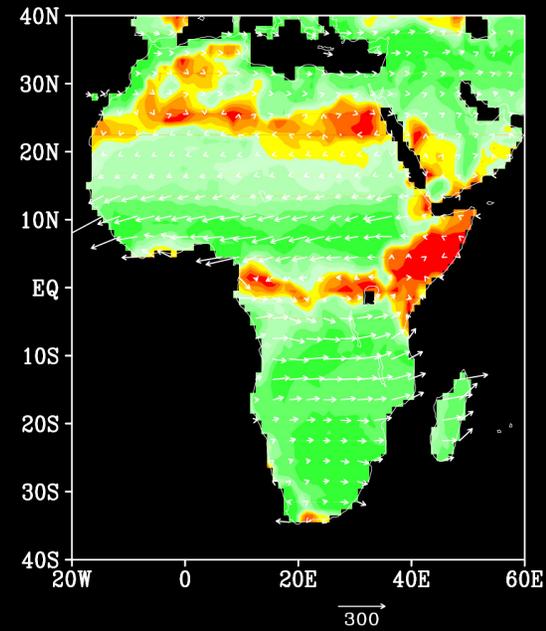
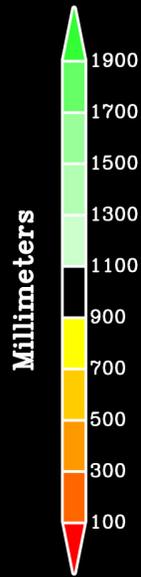
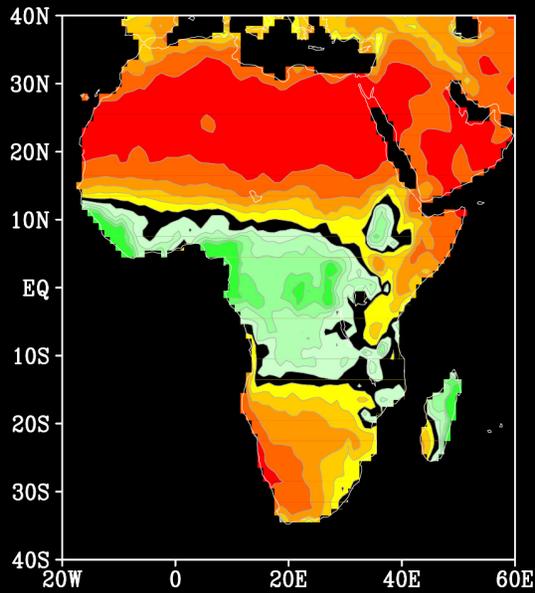
Simulated - CAM4



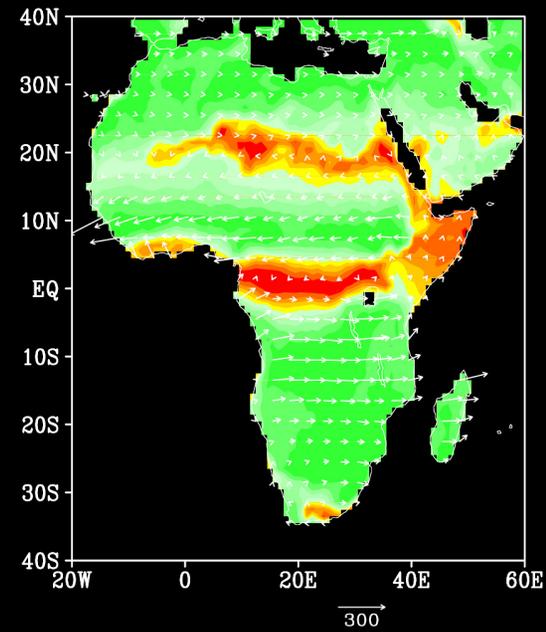
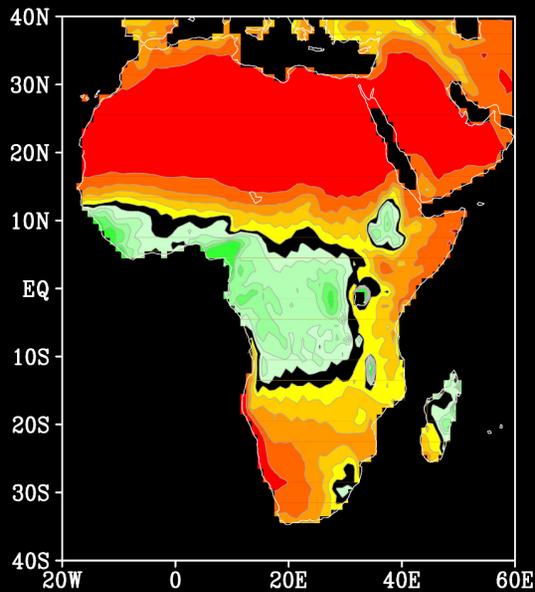
Annual Precipitation

First Harmonic

Observed



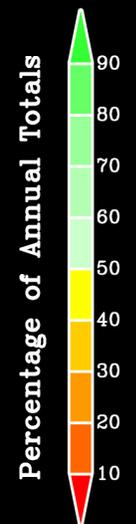
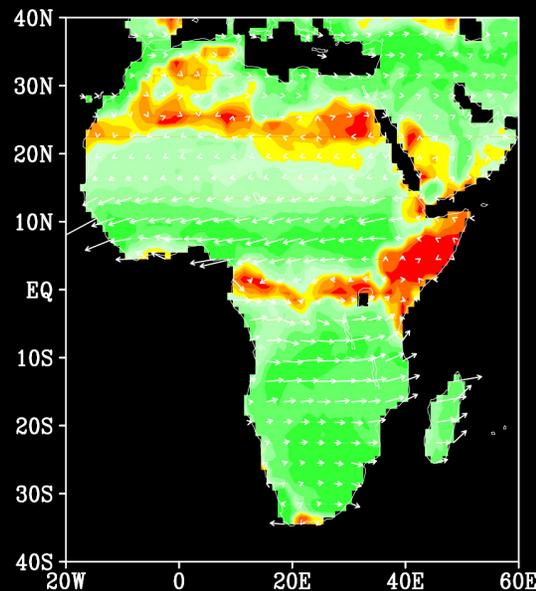
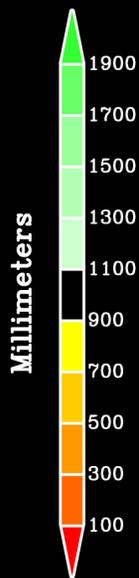
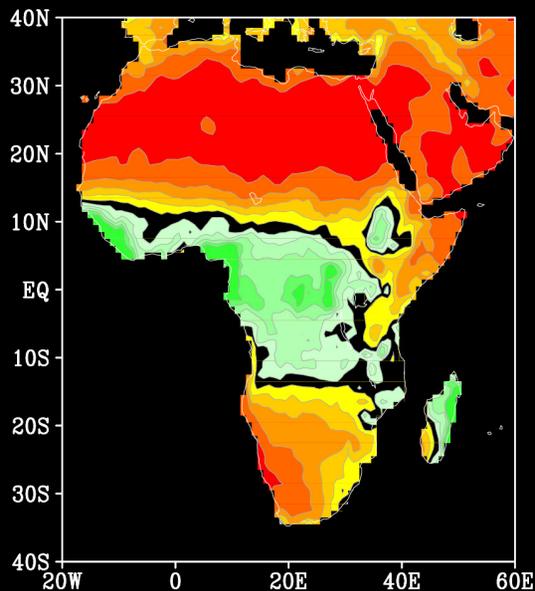
Simulated - ECHAM5



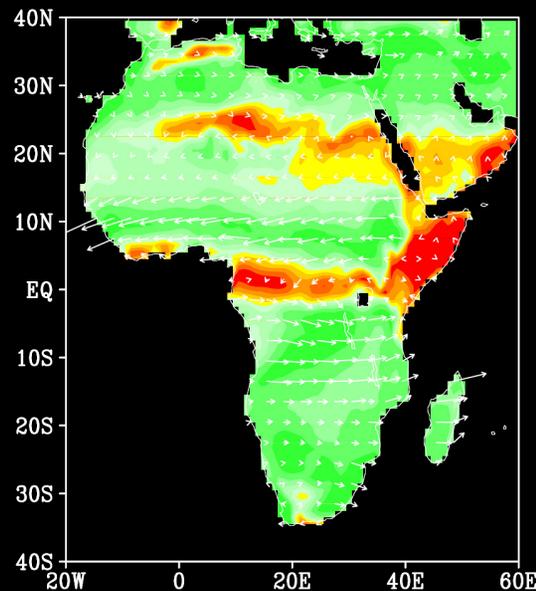
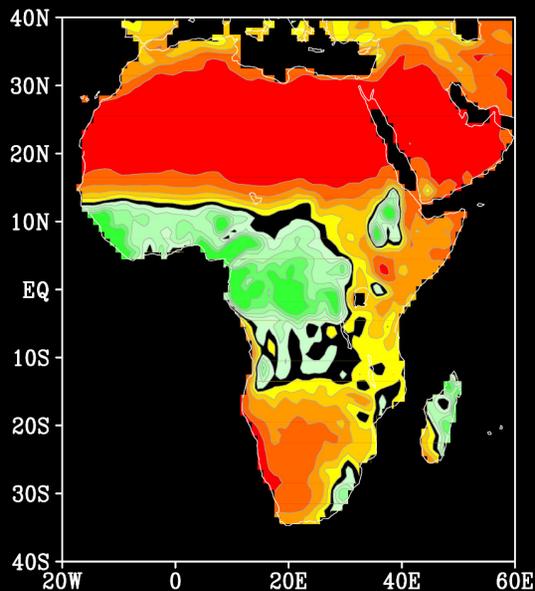
Annual Precipitation

First Harmonic

Observed



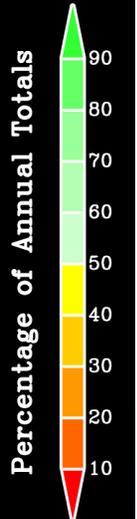
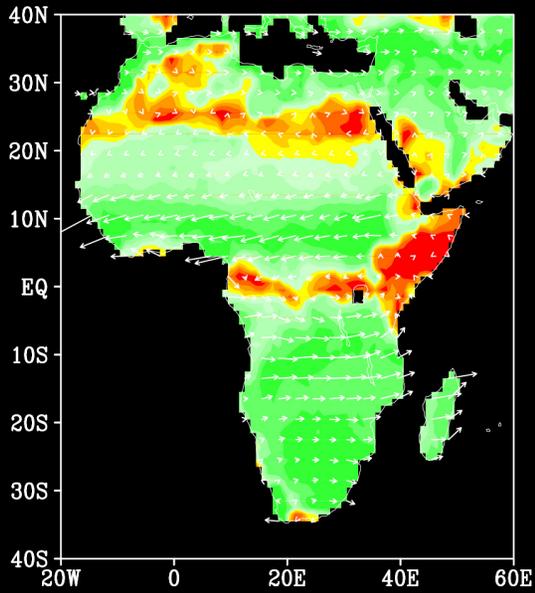
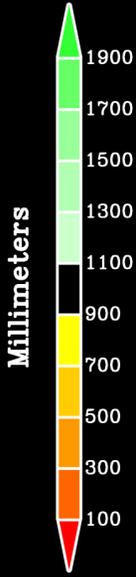
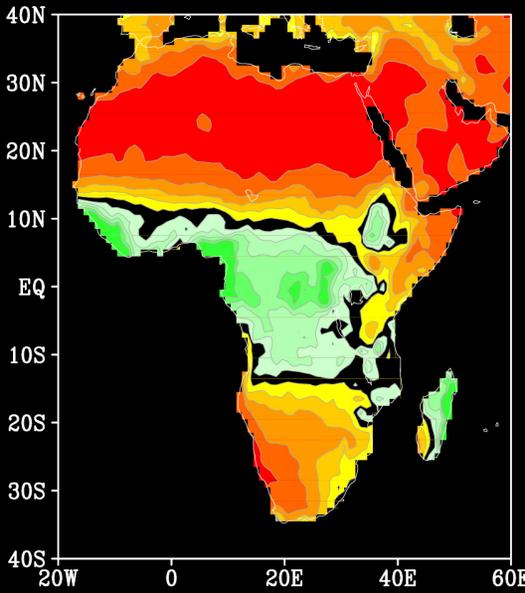
Simulated - CFSv2



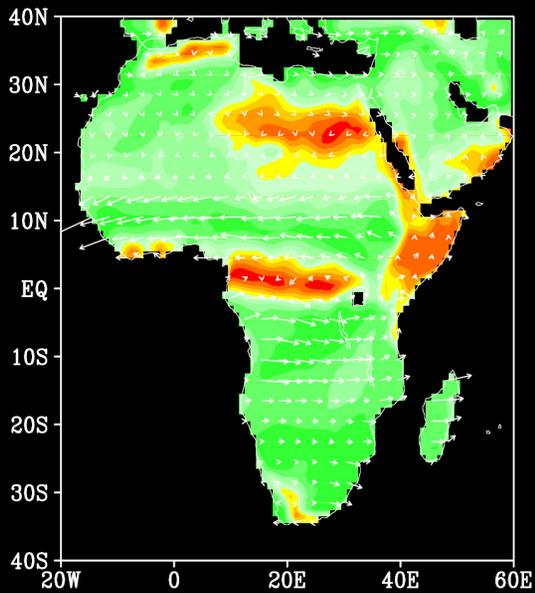
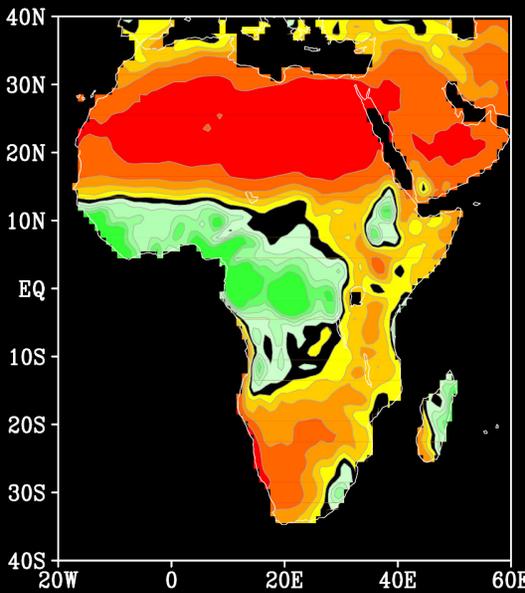
Annual Precipitation

First Harmonic

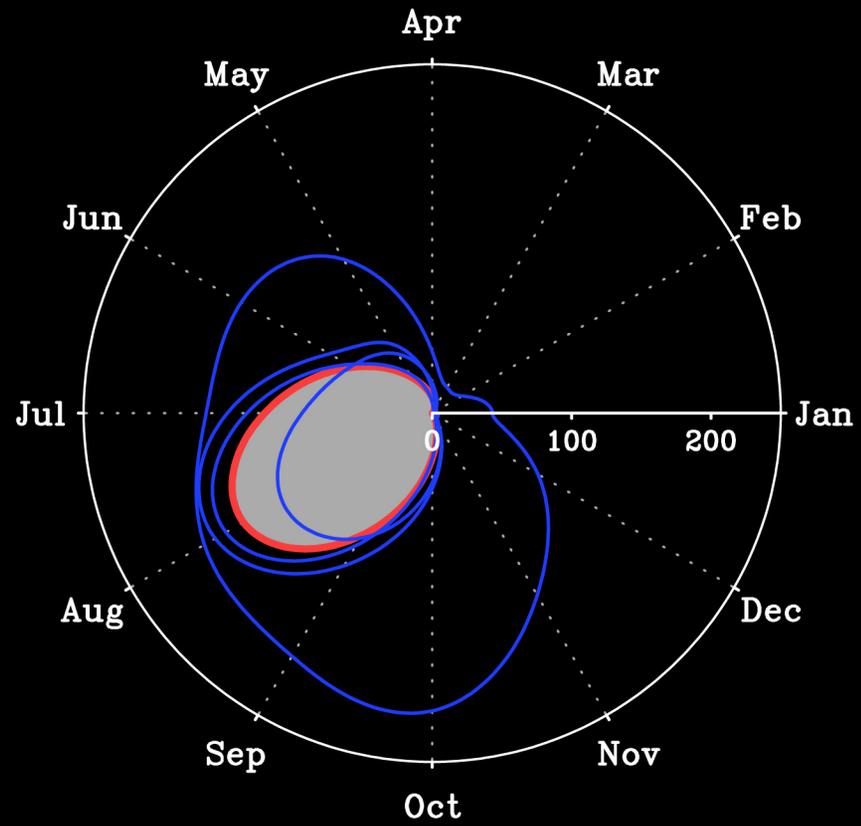
Observed



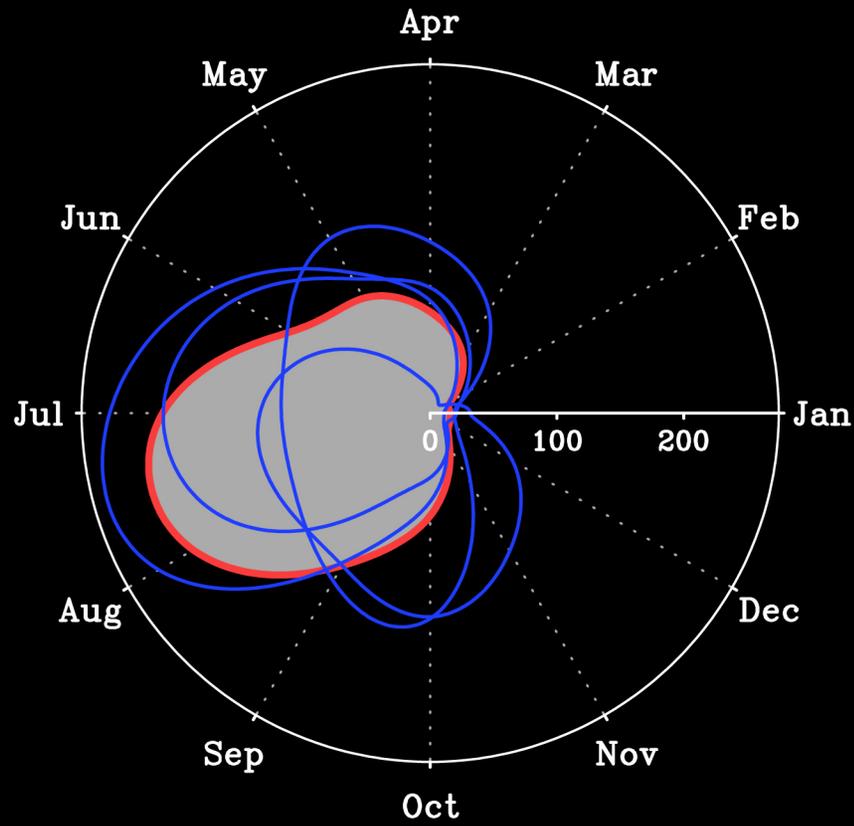
Simulated - GFSv2



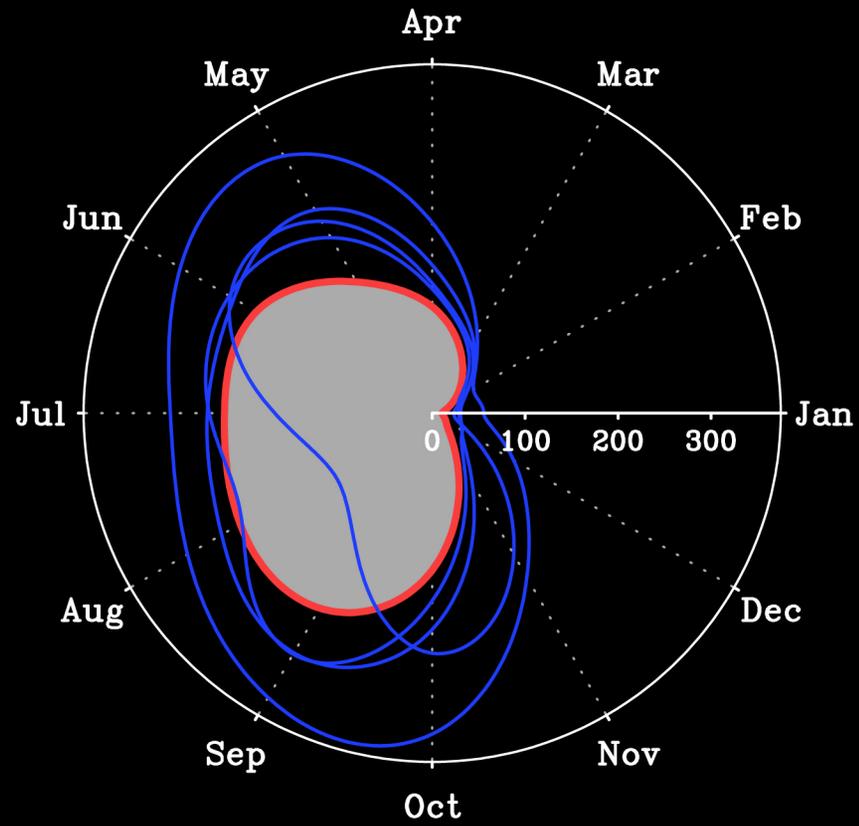
Western Sahel Climatological Pcpn



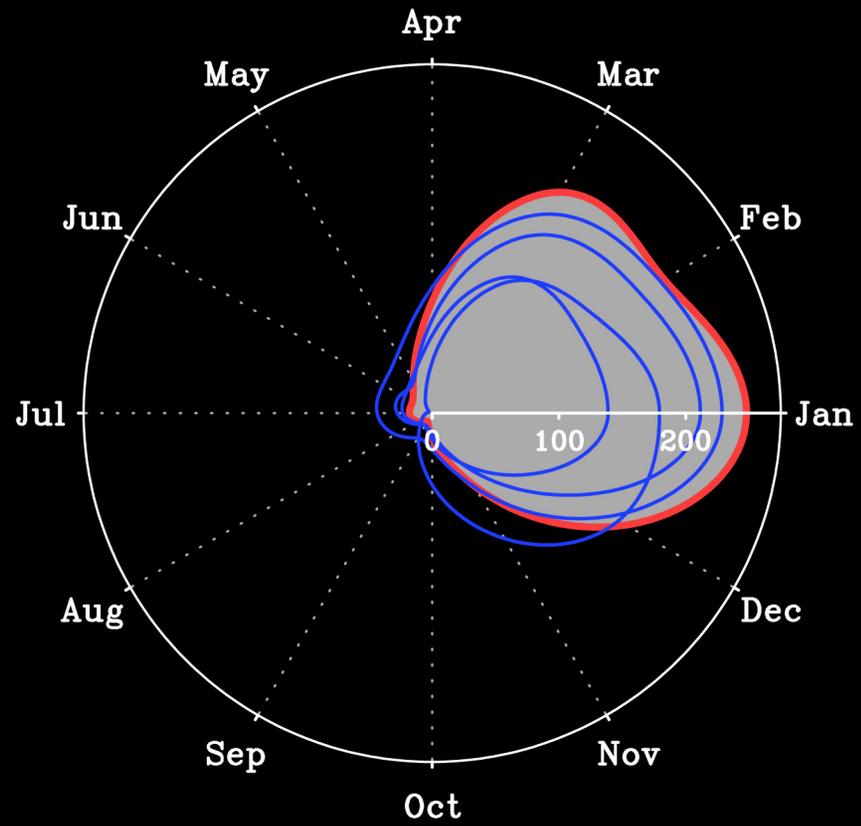
Ethiopia Highland Climatological Pcpn



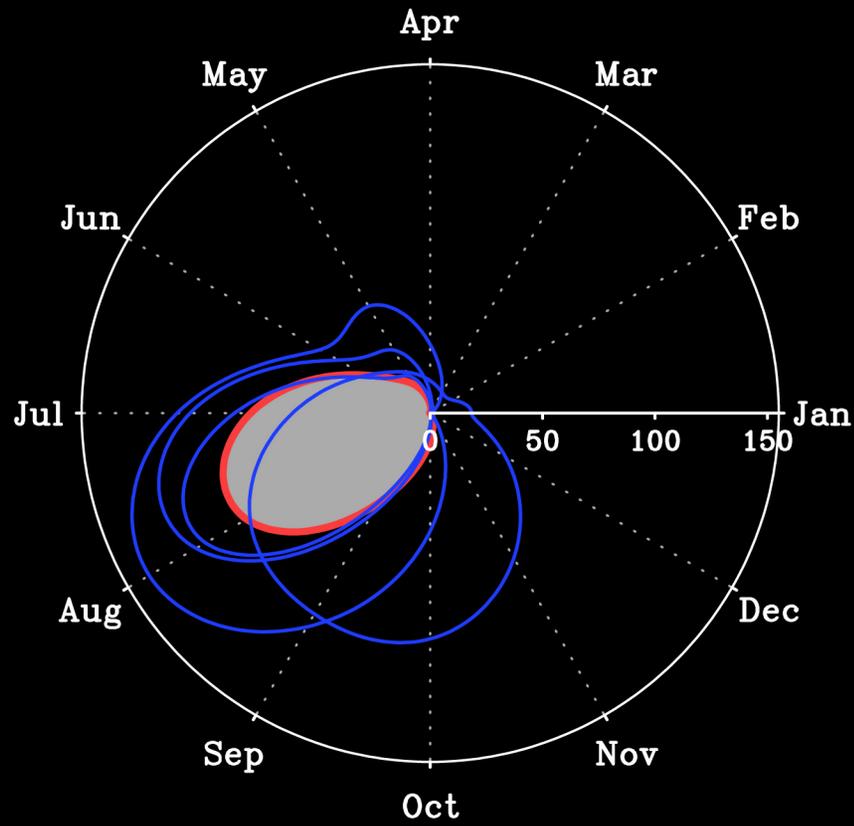
Guinea Coast Climatological Pcpn



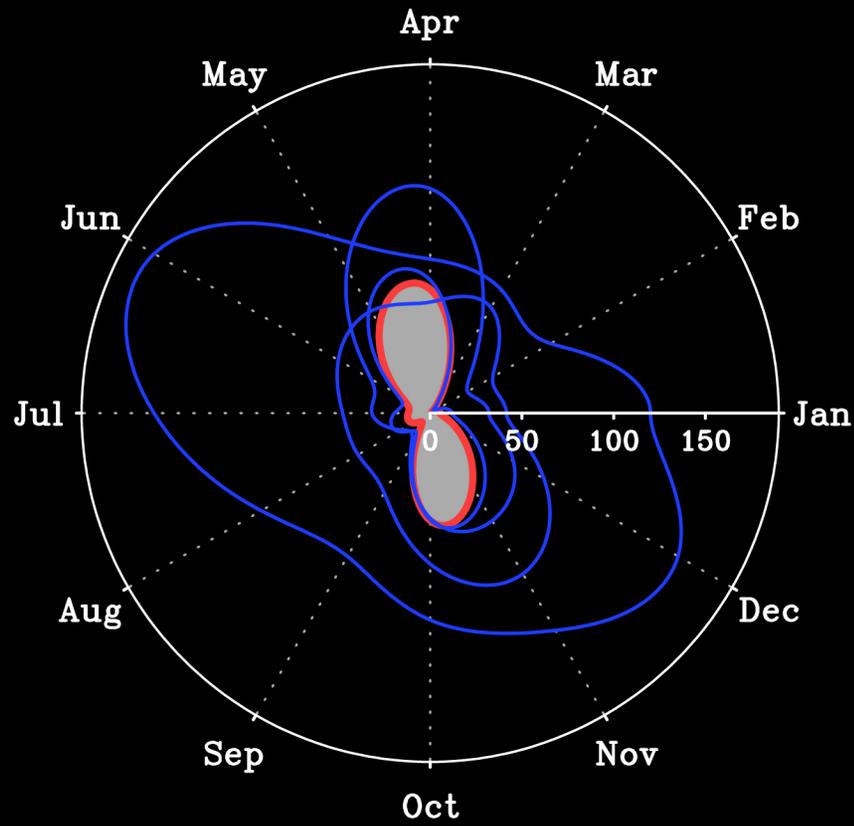
Southeast Africa Climatological Pcpn



East Sahel Climatological Pcpn

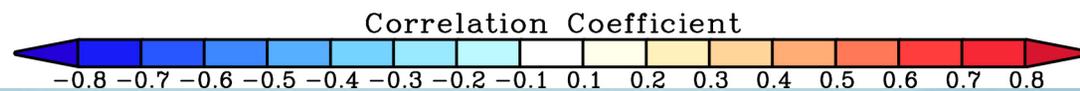
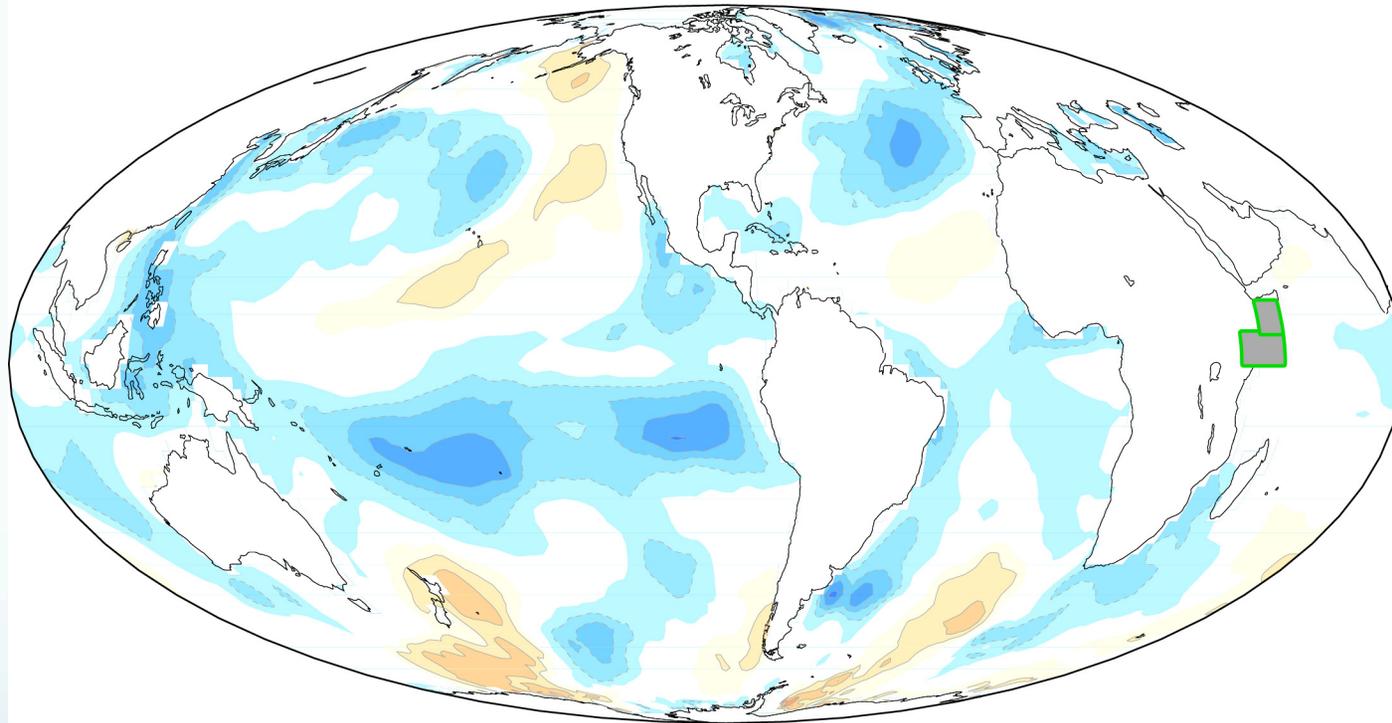


Eastern Horn Climatological Pcpn

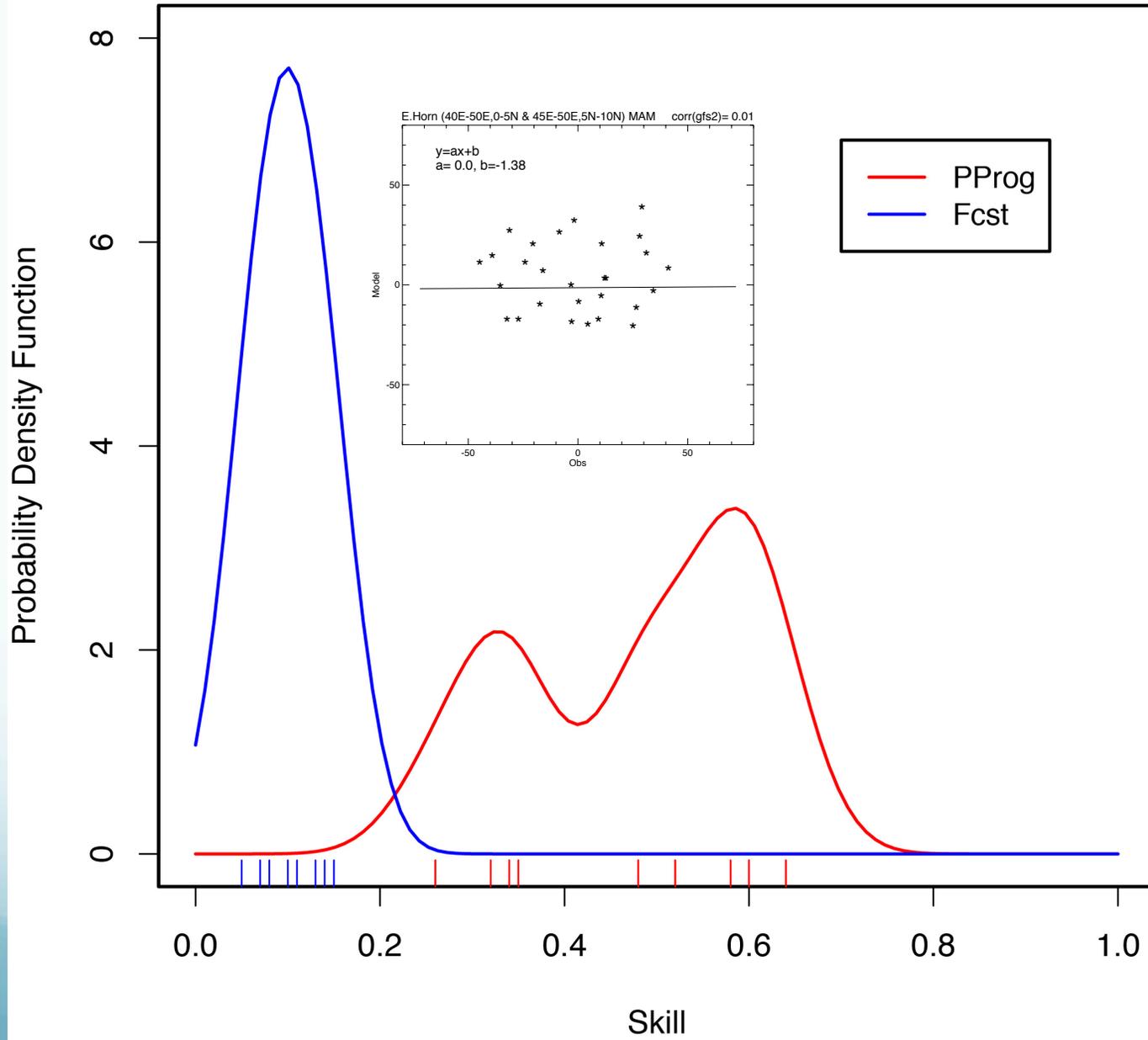


Observed “Long Rain” Variability vs Global SSTs

Correlation of Observed SST and
Eastern Horn Rainfall: March–May

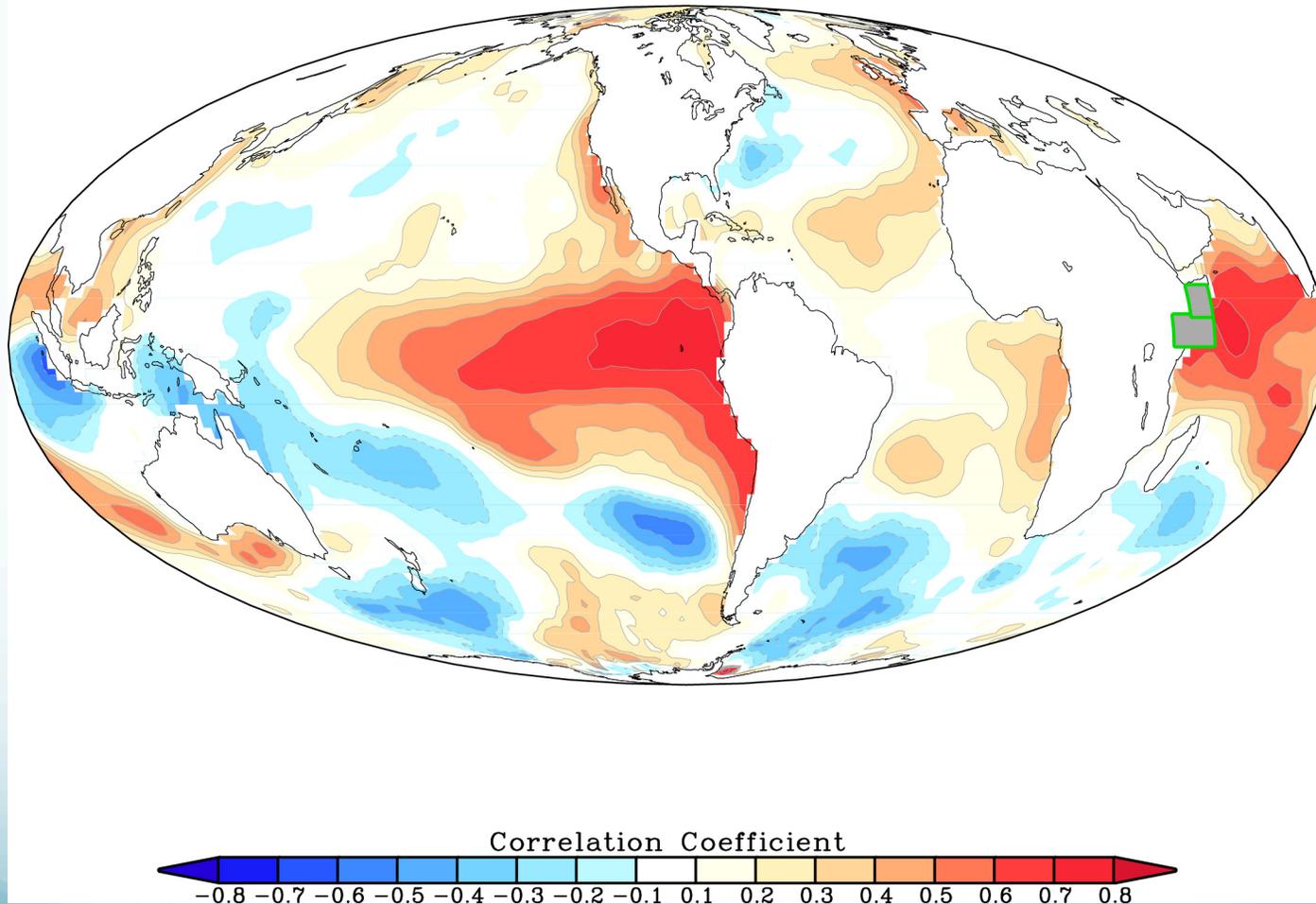


Horn of Africa–Long Rains (MAM)

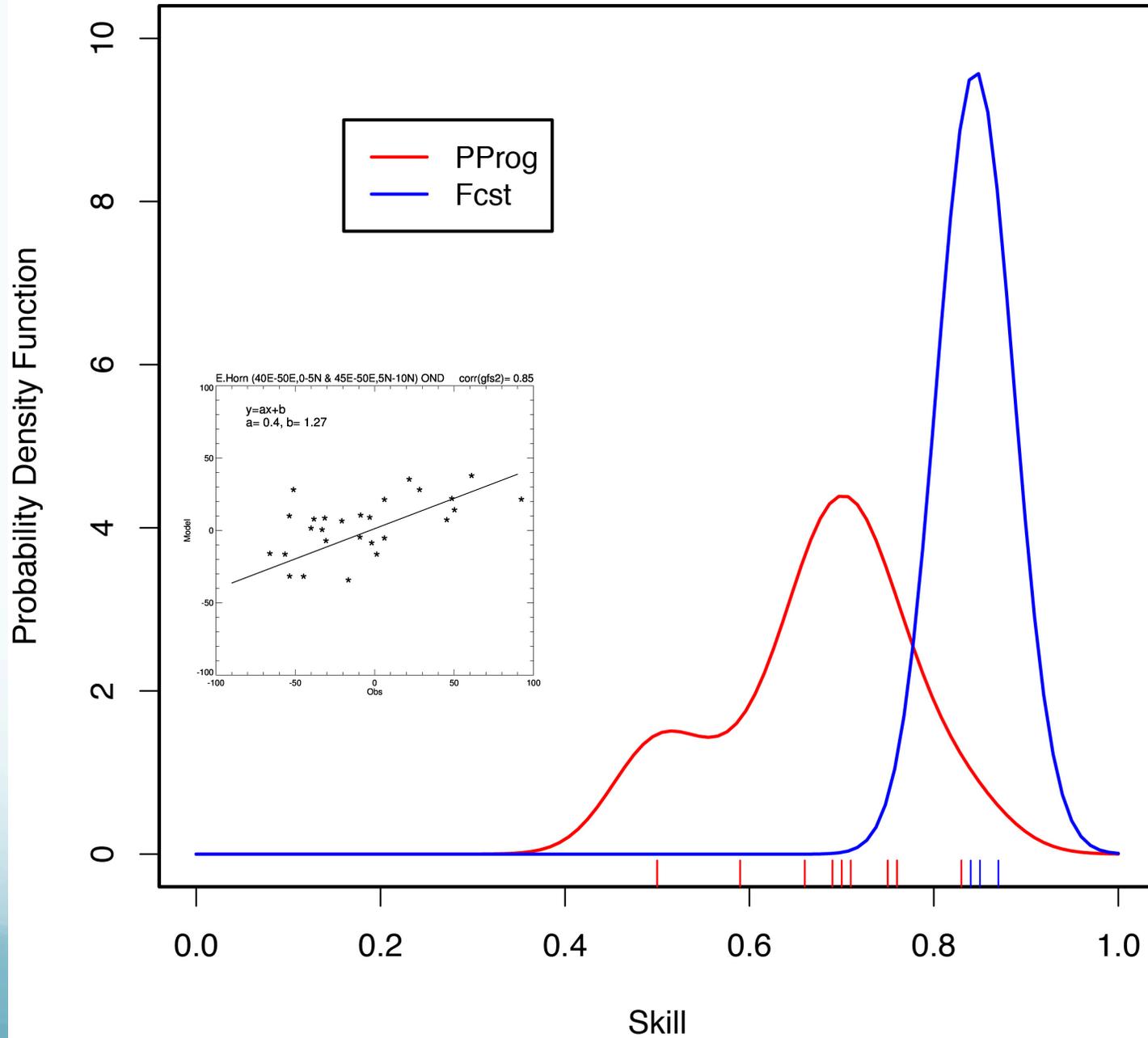


Observed “Short Rain” Variability vs Global SSTs

Correlation of Observed SST and
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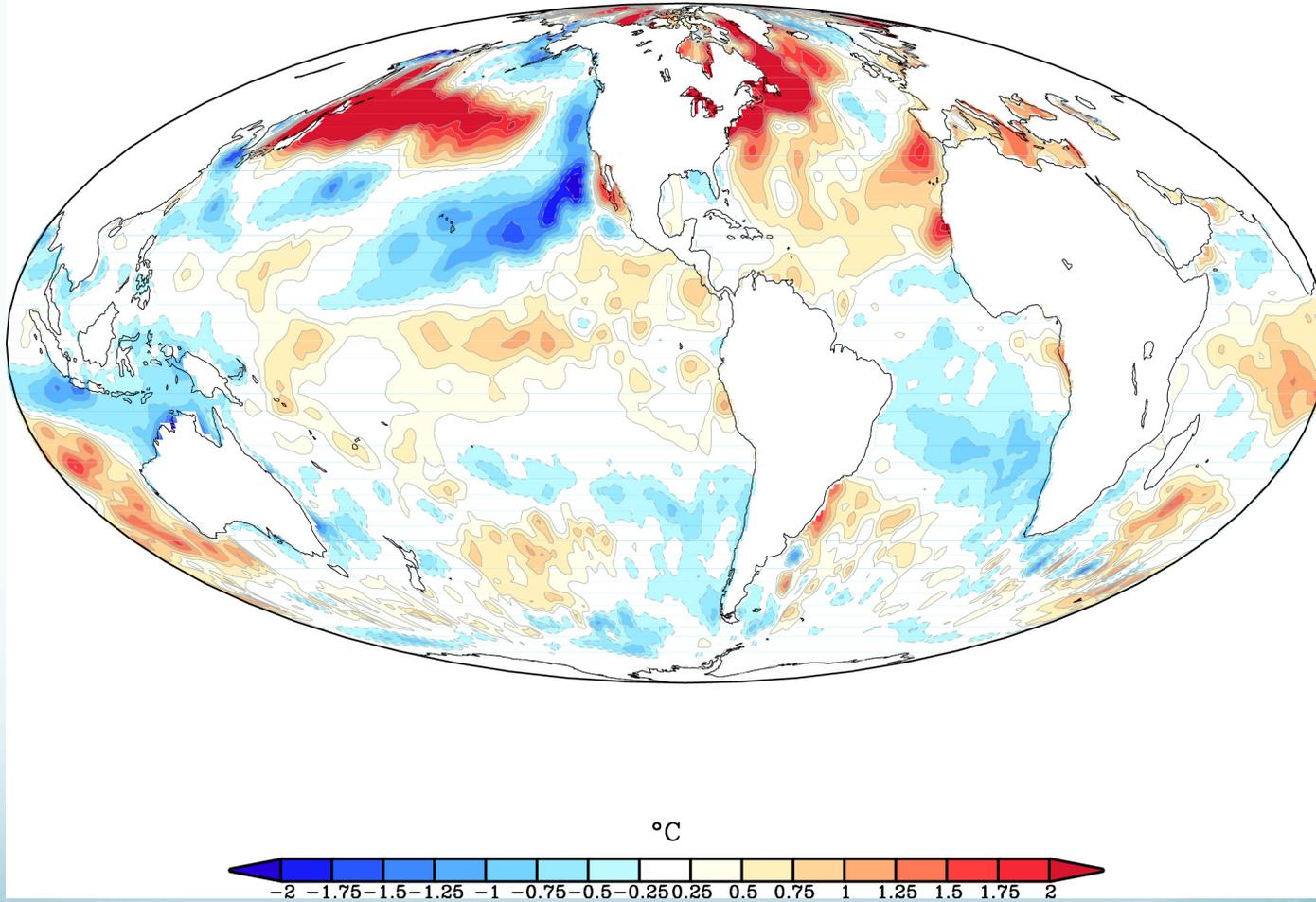


Horn of Africa–Short Rains (OND)

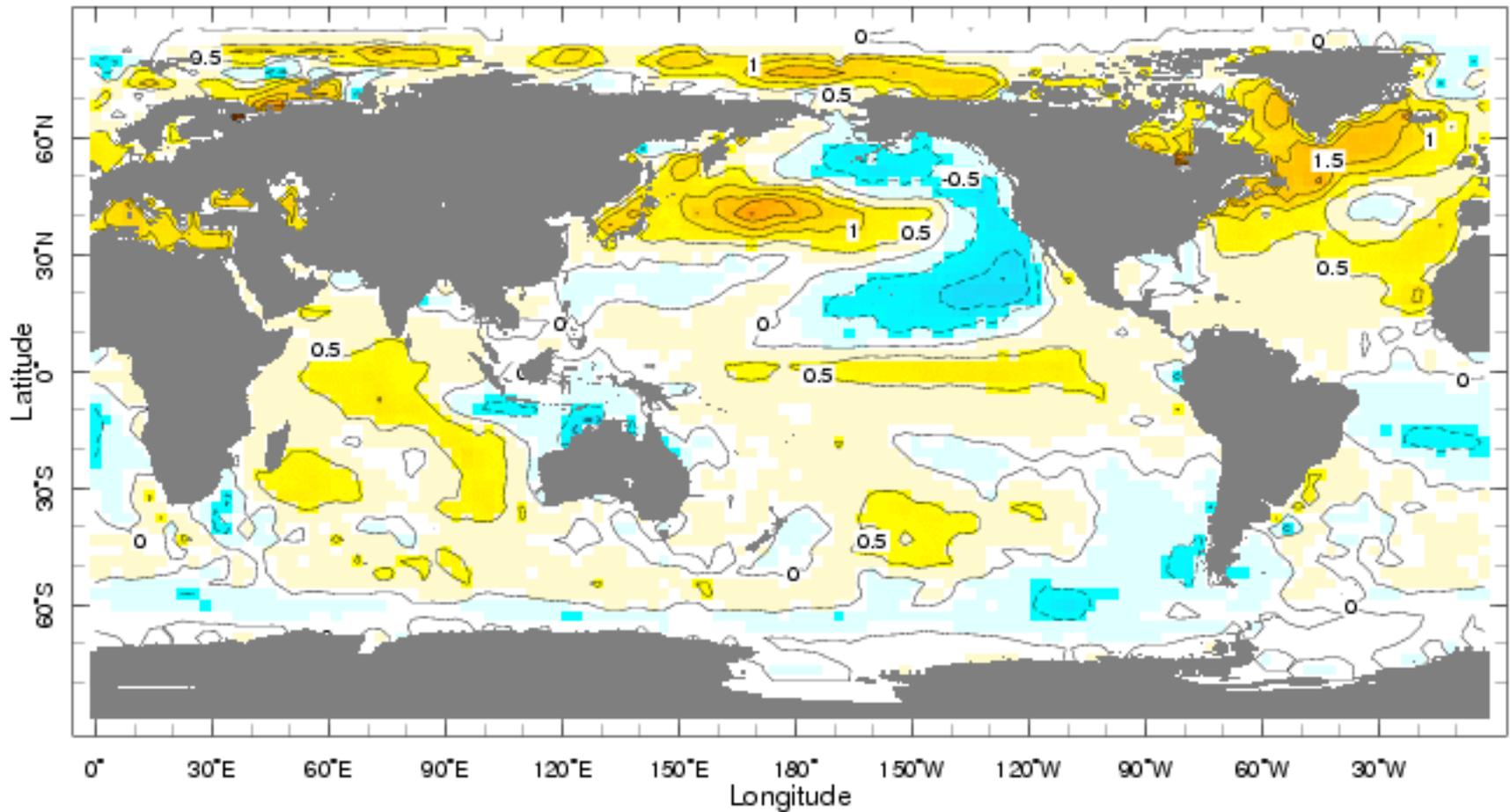


How Will the Short-Rains of East Africa Fare in 2012?

Monthly SST Departure: 2012/08/26–2012/09/22

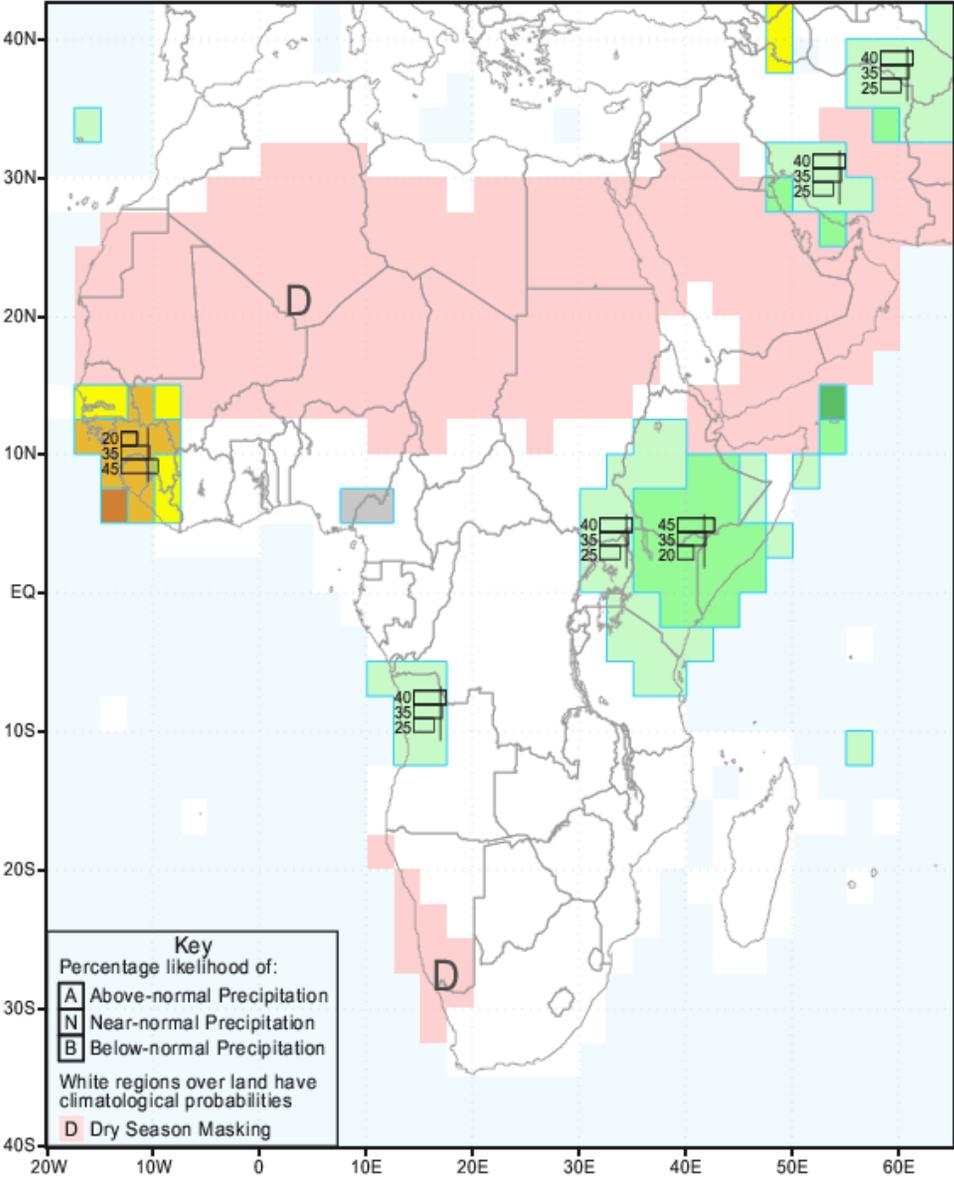


IRI SST Forecast for October-December 2012

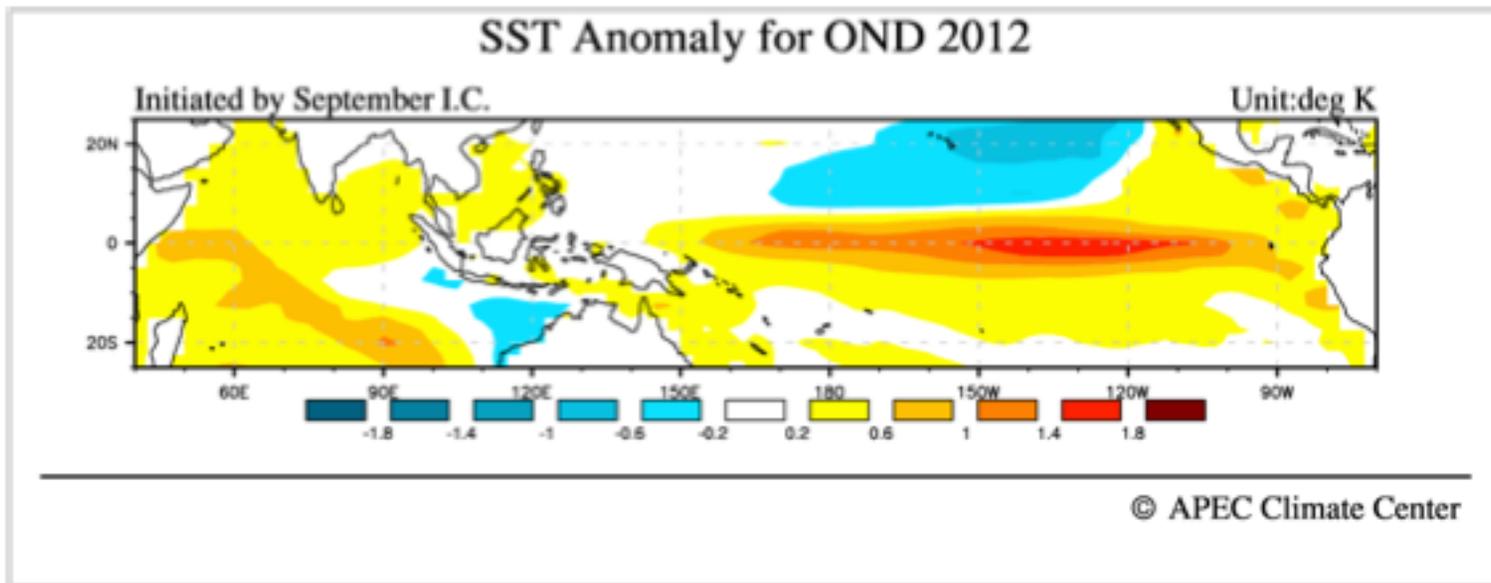


Oct-Dec 2012 IRI seasonal Forecast SSTA issued 0000 1 Sep 2012

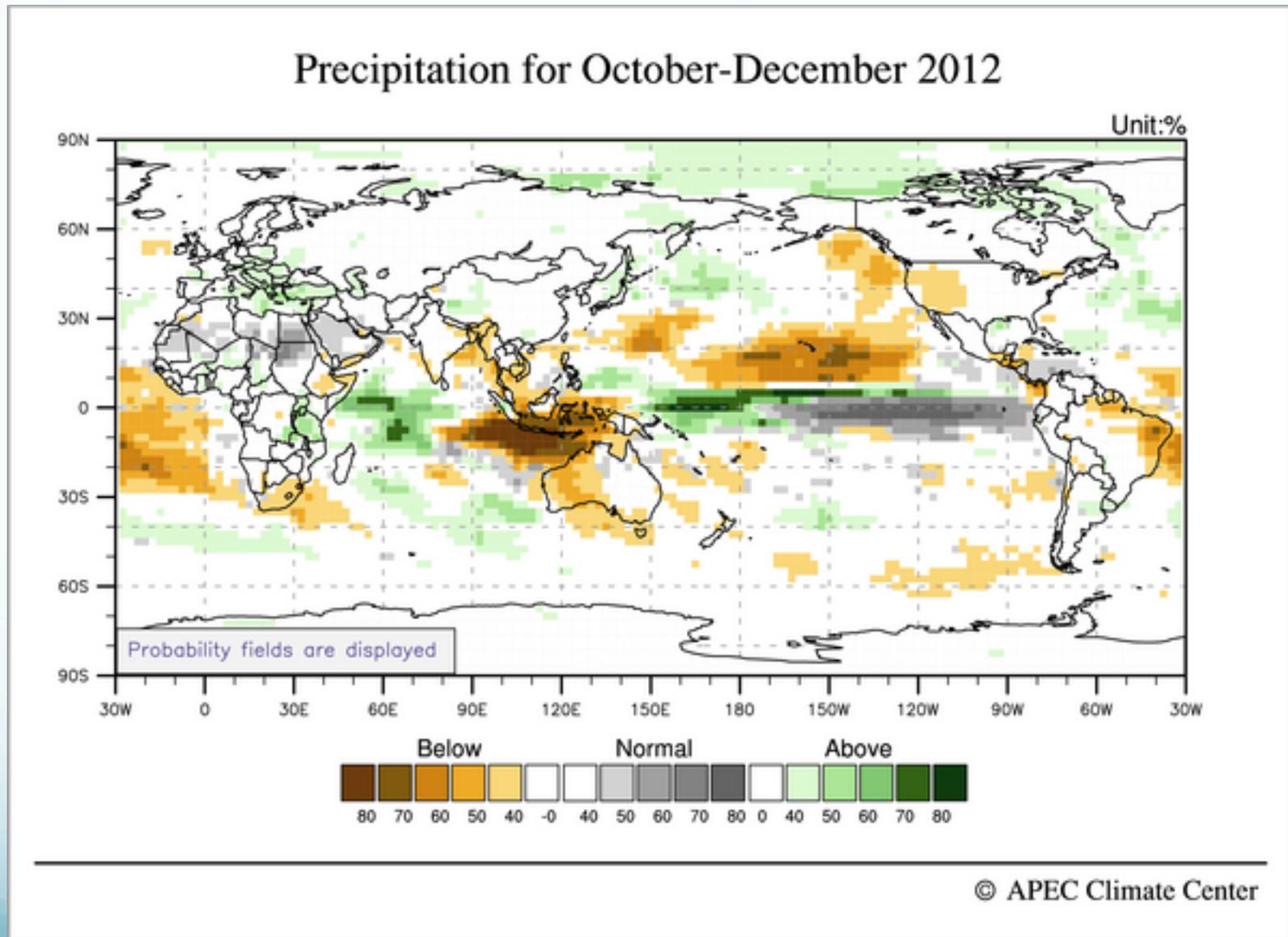
IRI Multi-Model Probability Forecast for Precipitation
for October-November-December 2012, Issued September 2012



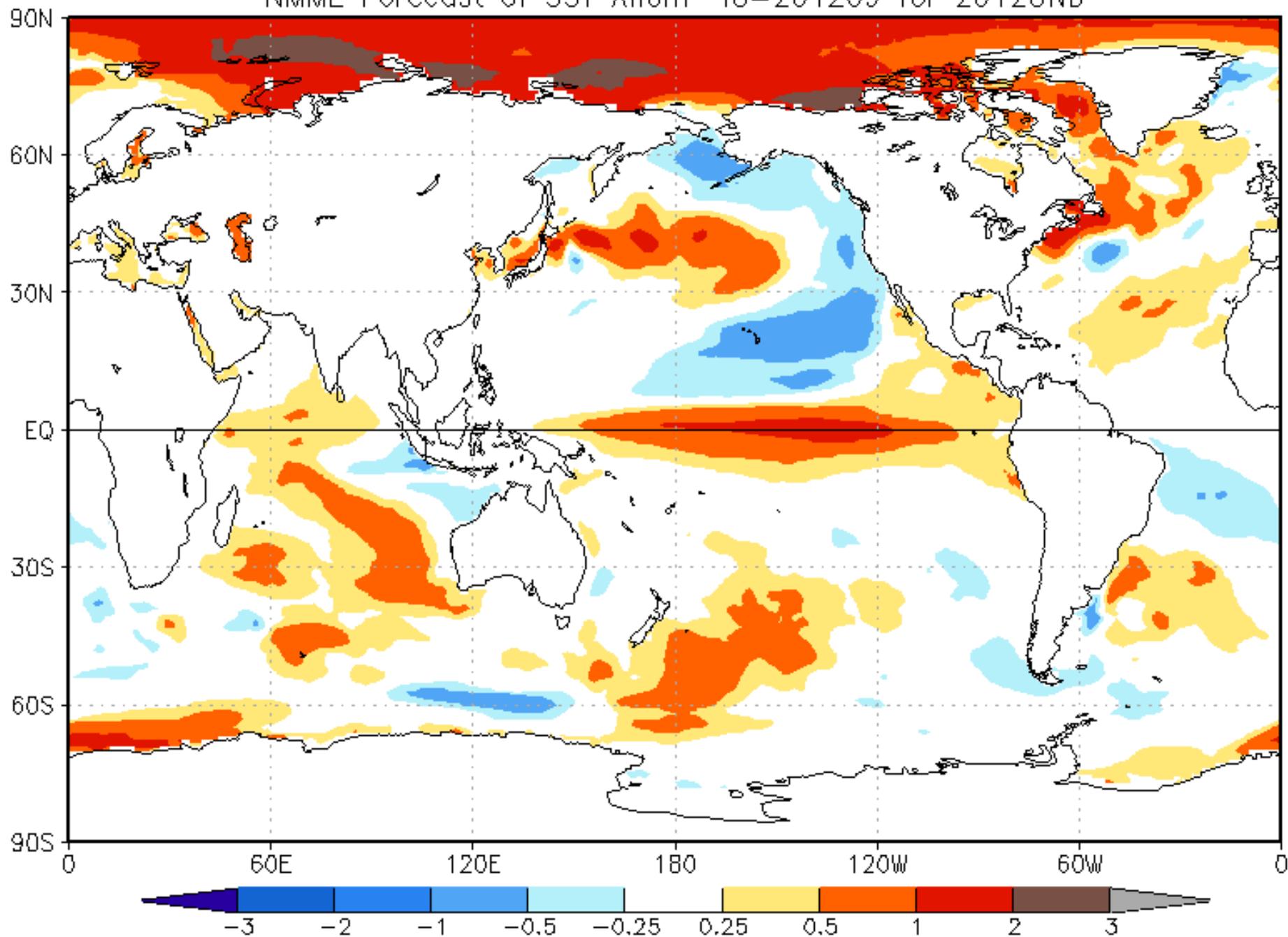
APEC SST Forecast for October-December 2012



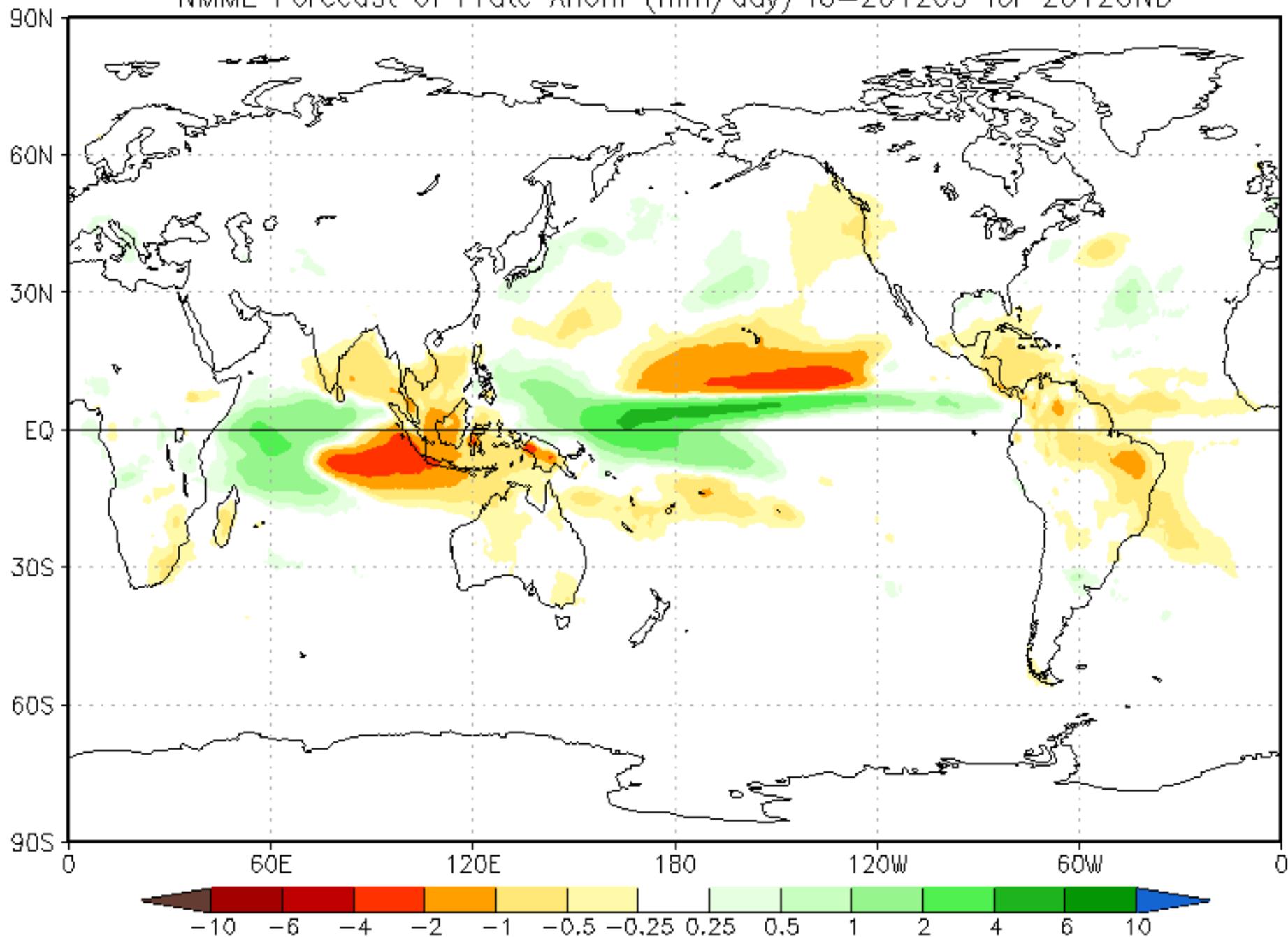
APEC Pcpn Forecast for October-December 2012



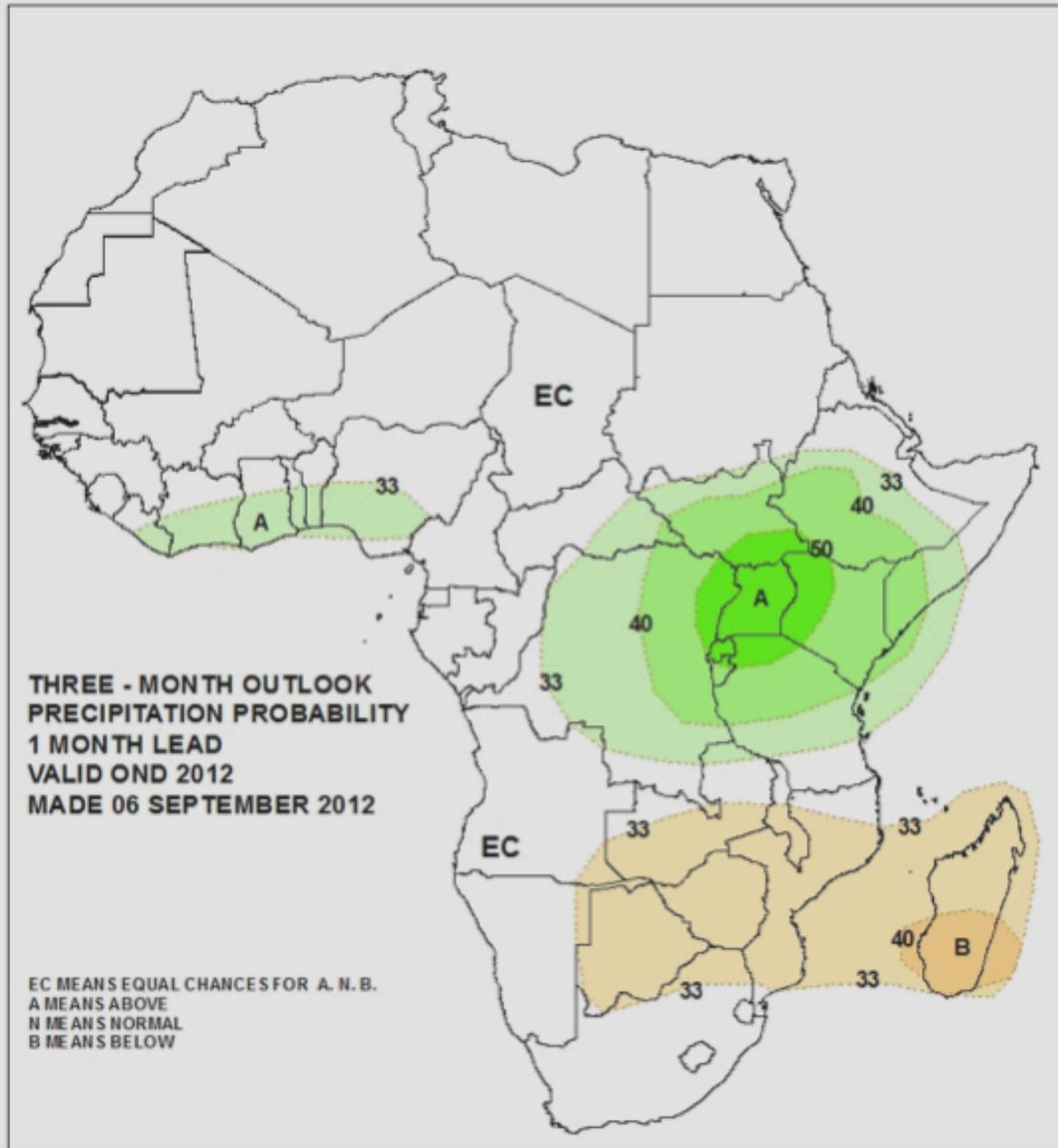
NMME Forecast of SST Anom IC=201209 for 2012OND



NMME Forecast of Prate Anom (mm/day) IC=201209 for 2012OND



CPC Africa Desk October-December 2012



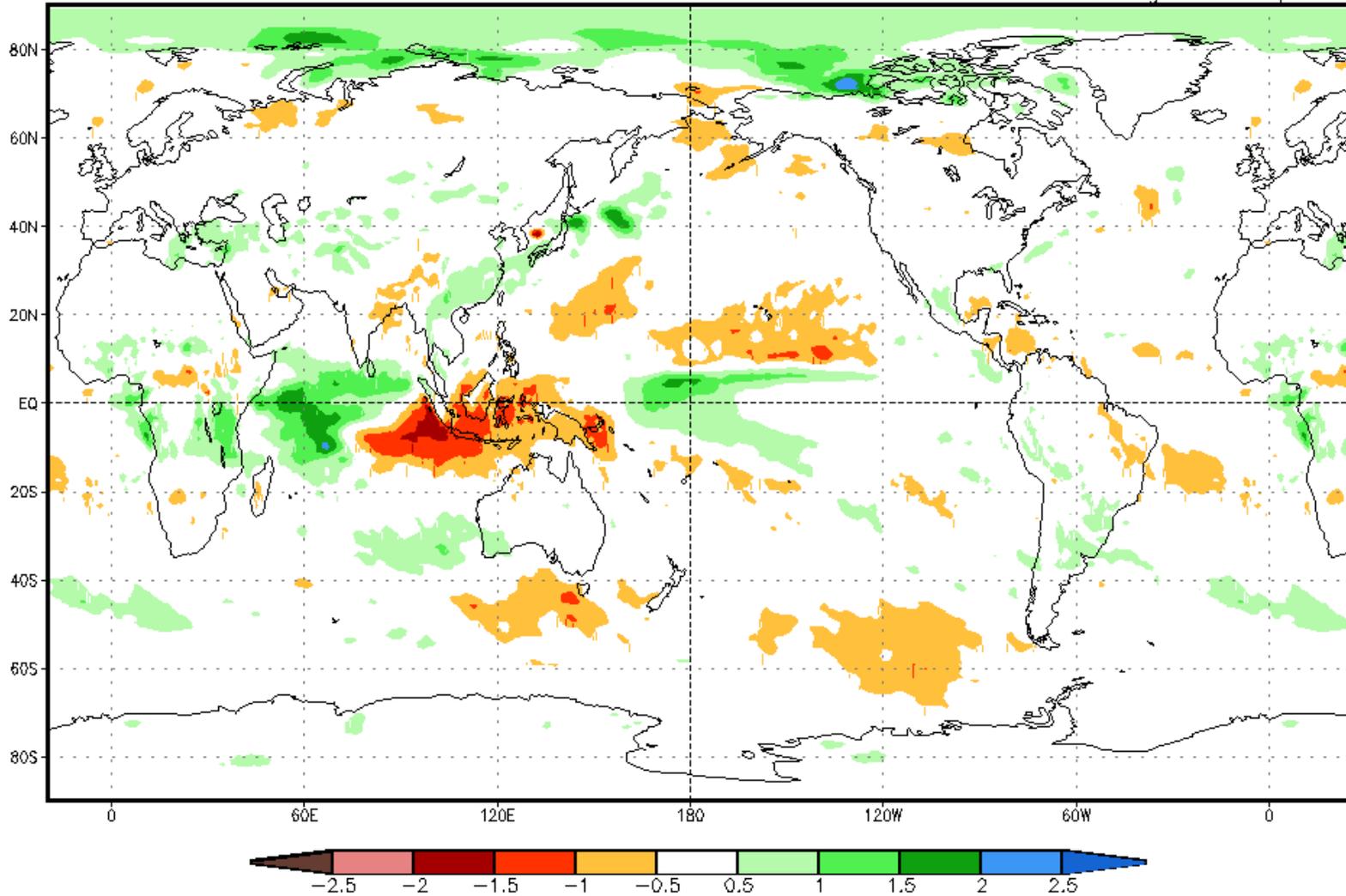


CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Oct–Nov–Dec 2012

Initial conditions: 28Aug2012–6Sep2012



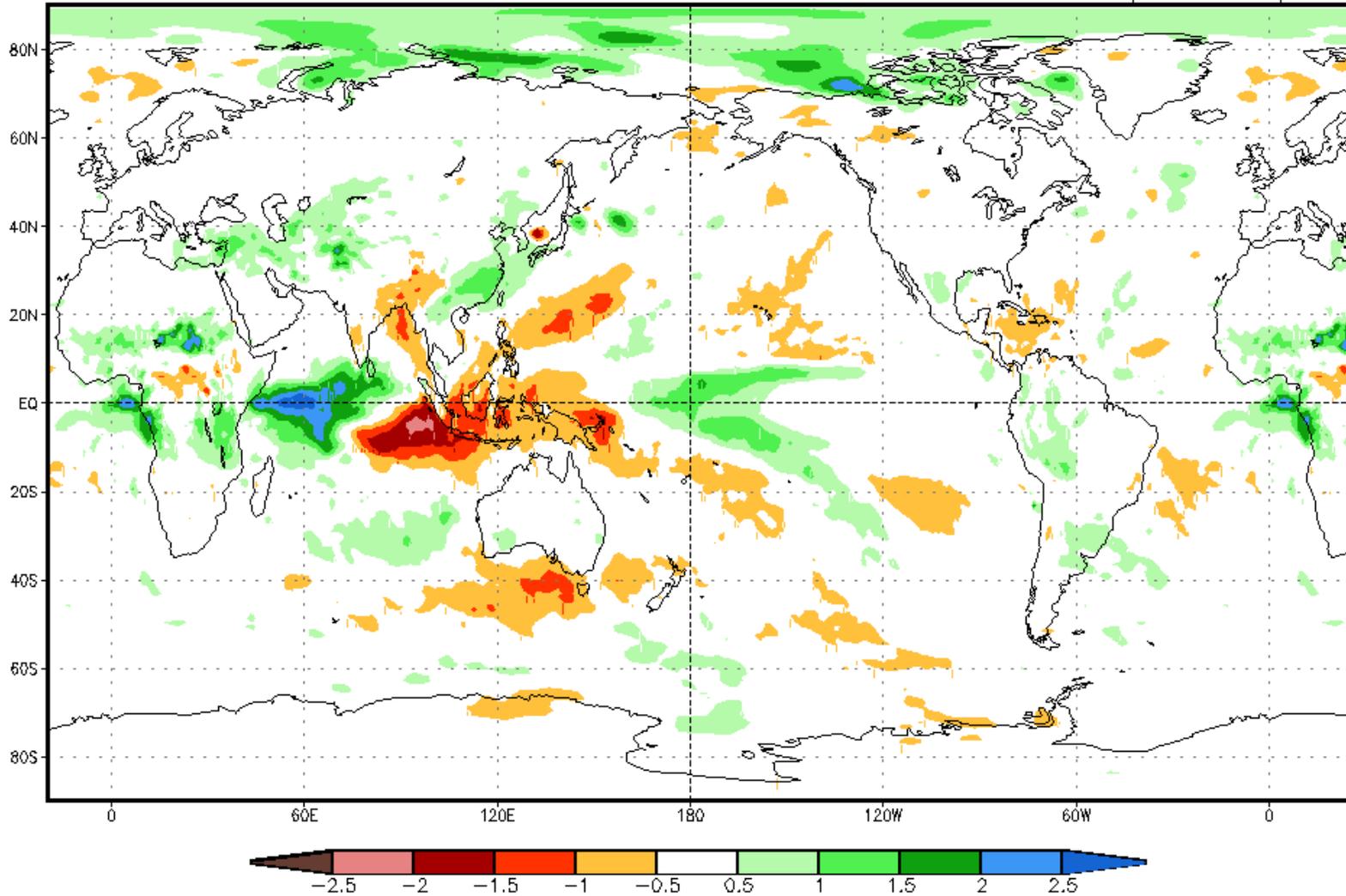


CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Oct–Nov–Dec 2012

Initial conditions: 7Sep2012–16Sep2012



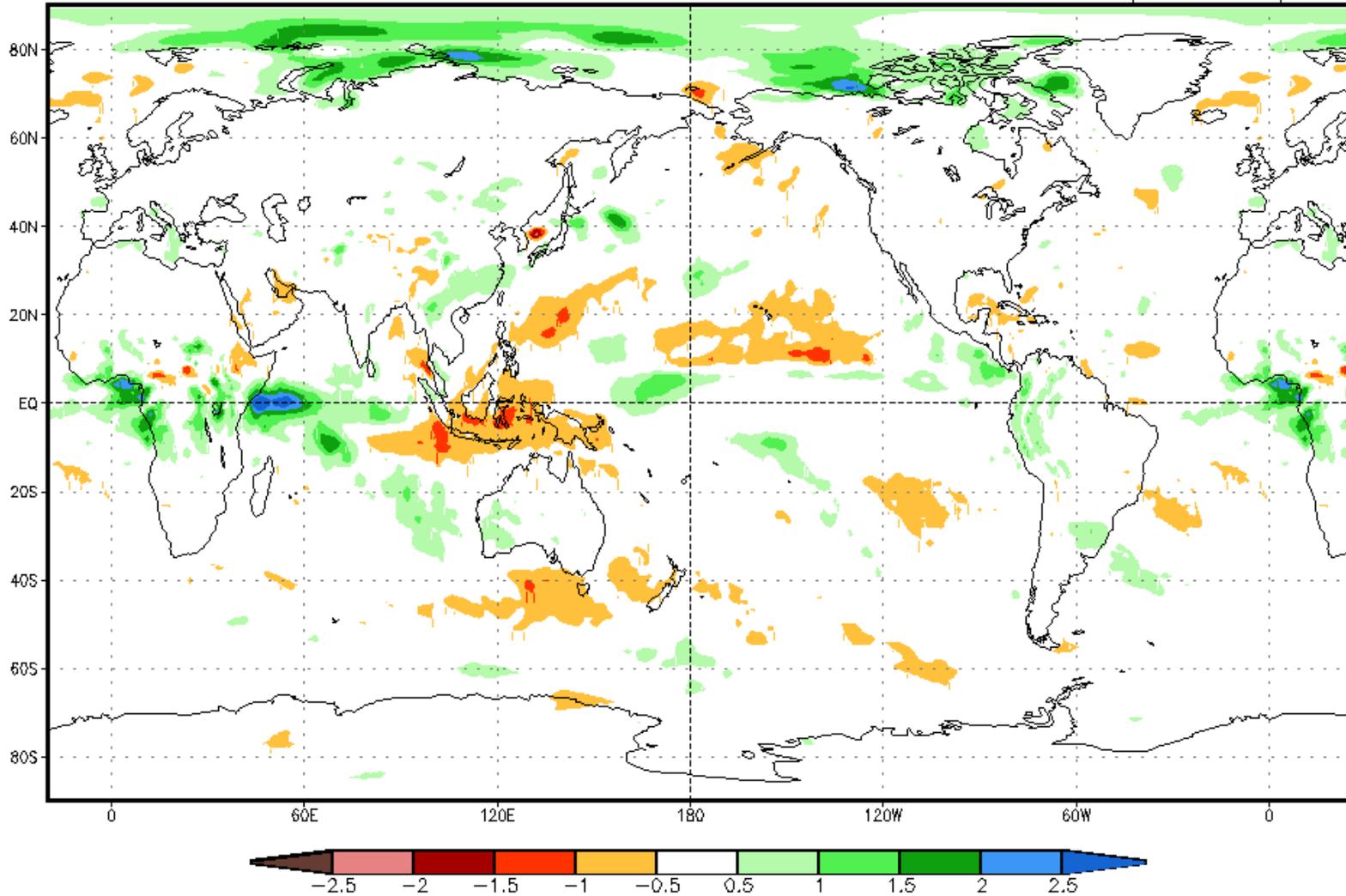


CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Oct–Nov–Dec 2012

Initial conditions: 17Sep2012–26Sep2012





And, the FEWS-NET Forecast Is?

Or

And the FEWS-NET Synthesis of Forecasts Is?

Preliminary Hindcast and Simulation Skill Assessment

		CFS2							GFS2
		0-lead 1m-fcst	20d-lead 1m-fcst	0-lead 1m-fcst	5d-lead 3m-fcst	10d-lead 3m-fcst	15d-lead 3m-fcst	20d-lead 3m-fcst	AMIP
W. Sahel	JAS	0.796	0.534	0.448	0.270	0.242	0.038	-0.201	0.438
C. Sahel	JAS	0.742	0.456	0.330	0.332	0.075	0.167	0.053	0.382
E. Sahel	JAS	0.528	0.401	0.352	0.210	0.074	0.167	0.184	0.435
E. Horn	OND	0.885	0.907	0.444	0.614	0.798	0.573	0.641	0.849
E. Horn	MAM	0.192	0.197	0.097	0.279	0.114	0.381	-0.168	0.010
<u>Ethio.H.Land</u>	ASO	0.649	0.503	0.476	0.517	0.519	0.471	0.551	0.586
S.E. Africa	JFM	0.680	0.022	0.263	-0.017	-0.109	0.146	-0.099	0.177
Guinea Coast	JAS	0.562	0.292	0.595	0.417	0.387	0.212	0.400	0.564