LIMITATIONS IN PREDICTION, PROJECTION AND DOWNSCALING OF PRECIPITATION OVER WEST AFRICA

Mojisola Adeniyi, PhD
Department of Physics, University of Ibadan,
Nigeria.

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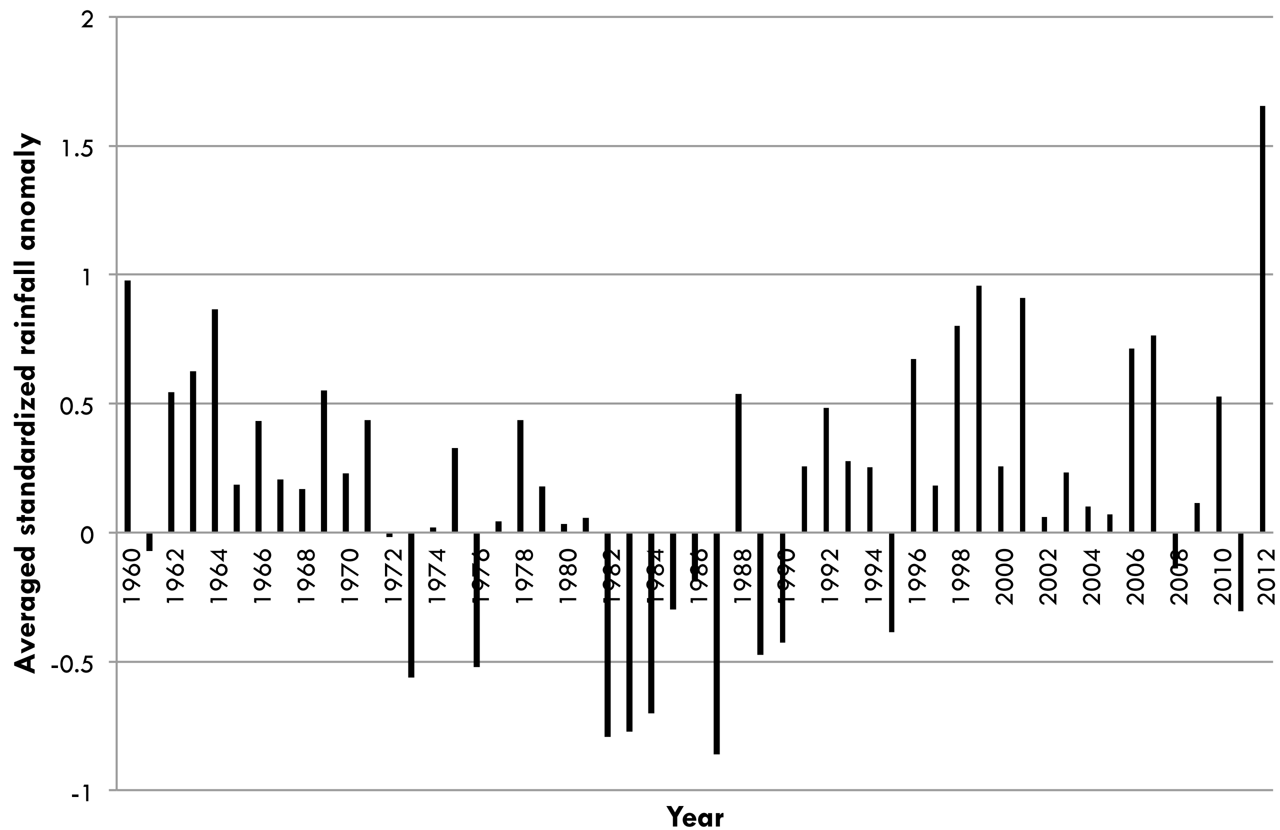
PREAMBLE

West Africa population is vulnerable to climate change impacts



Rainfall variability over Northern Nigeria

Preamble (contd.) Flood of 2007 over West Africa.

Climate change is inevitable
-impacts not desirable.

25 Sept. 2012 flood at Lokoja in Nigeria (vanguardngr.com)

Worst flood in 50 yrs, total flooded area 820 sq km (International charter (http://www.disasterscharter.org/web/charter/home)

Preamble(contd.)

- Adaptation is the only way out.
- Requires reliable prior climate information which remains a challenge.

AIM

- To improve the reliability of the available climate information.
- Objectives are to:
  - identify the limitations in projection, prediction and downscaling of precipitation over West Africa.
  - enumerate the factors responsible for the limitations
  - suggest a number of actions that can reduce the limitations with a view to improving the reliability, of projected, predicted and downscaled precipitation over West Africa.

SRA1B CONSENSUS

Low consensus at the north

Low consensus at western Sahel

High consensus at the central Sahel

High consensus at the south

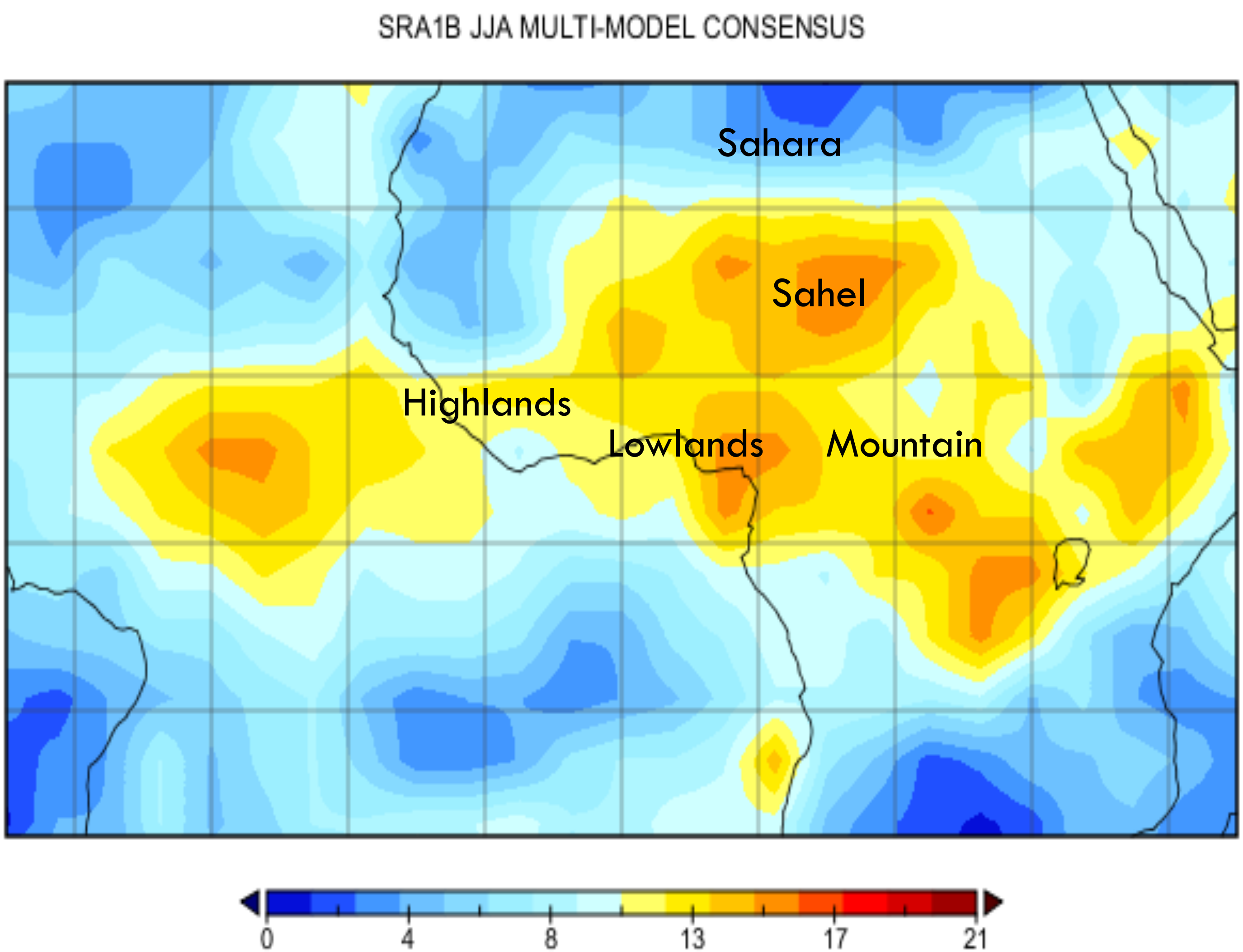


Table 1 Consensus (%) of AR4 scenarios A1B, A2 and B1 projections over West Africa

Sub-region Scenarios	B1	A1B	A2
Sahara	10.5- 47.4	4.7- 38	13.3- 46.6
Sahel	15.8- 63.2	14.3- 81	20- 73.3
Highlands	36.8- 52.6	38- 62	13- 60
Lowlands	42.1- 63.2	52.4- 81	20- 60
Mountain	47.4- 78.9	42.9- 81	46.7- 86.7

Table 2a Cross validated correlation for PP statistical downscaling models for precipitation over West Africa

PREDICTOR	MAY	JUNE	JULY	AUG	SEPT
PV850 MAX	0.33(3)	0.56(8)	0.51(2)	0.57(1)	0.36(1)
PV850 MIN	-0.66	-0.54	-0.61	-0.59	-0.55
RH500 MAX	0.47(5)	0.59(2)	0.32(1)	0.73(7)	0.31(1)
RH500 MIN	-0.50	-0.60	-0.71	-0.43	-0.48
T1000 MAX	0.45(1)	0.5(7)	0.57(3)	0.49(2)	0.32(1)
T1000 MIN	-0.52	-0.62	-0.64	-0.58	-0.52
q500 MAX	0.43(4)	0.66(1)	0.33(2)	0.71(6)	0.22(0)
q500 MIN	-0.53	-0.73	-0.79	-0.50	-0.52

Table 2b Cross validated correlation for MOS downscaling models for west Africa precipitation

PREDICTOR	MAY	JUNE	JULY	AUG	SEPT
ERA 40 MAX	0.34(2)	0.61(7)	0.38(2)	0.47(7)	0.42(1)
ERA 40 MIN	-0.56	-0.53	-0.57	-0.57	-0.66
ERAIN MAX	0.9(16)	0.59(9)	0.42(3)	0.57(5)	0.42(5)
ERAIN MIN	-0.43	-0.56	-0.82	-0.66	-0.60
CONV MAX	0.62(14)	0.55(5)	0.52(4)	0.34(3)	0.42(4)
CONV MIN	-0.87	-0.60	-0.72	-0.62	-0.54
LARGES MAX	0.78(9)	0.49(13)	0.45(9)	0.54(12)	0.52(2)
LARGES MIN	-0.60	-0.50	-0.55	-0.55	-0.68

Factors responsible for the limitations

- Insufficient no of predictors
- Lack of good quality data (reanalysis, observed)
- 3 types of error in GCM
- Poor nudging result over the tropics

Suggested actions/Conclusion

- Increase the number of predictors(new predictors should be tested).
- Improve the quality of reanalysis and observed data
- Improve nudging over the tropics
- Downscale nudged GCM output.
- The impacts of climate change over West Africa could be adequately catered for if the suggested actions are taken.

References

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THANK YOU FOR YOUR ATTENTION

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Some selected AR4 models

CODE	CENTRE	A1B	A2	B1
BCM2	Bjerknes Centre for Climate Research, Norway	Yes		Yes
CGMR	Canadian Centre for Climate modeling and Analysis, Canada	Yes	Yes	Yes
FGOALS	Institute of Atmospheric Physics, China	Yes		Yes
GFCM20	Geophysical Fluid Dynamics Laboratory, USA	Yes	Yes	Yes
HADCM3	UK Met. Office, UK	Yes	Yes	Yes
INCM3	Institute for Numerical Mathematics, Russia	Yes	Yes	Yes
INGSXG	National Institute of Geophysics and Volcanology, Italy			
IPCM4	Institut Pierre Simon Laplace, France	Yes	Yes	Yes
MIHR	National Institute for Environmental Studies	Yes		Yes
MIMR	National Institute for Environmental Studies	Yes	Yes	Yes
MPEH5	Max-Planck-Institut for Meteorology, Germany	Yes	Yes	Yes
MRCGCM	Meteorological Research Institute, Japan	Yes	Yes	Yes

SRESA1B DIFF

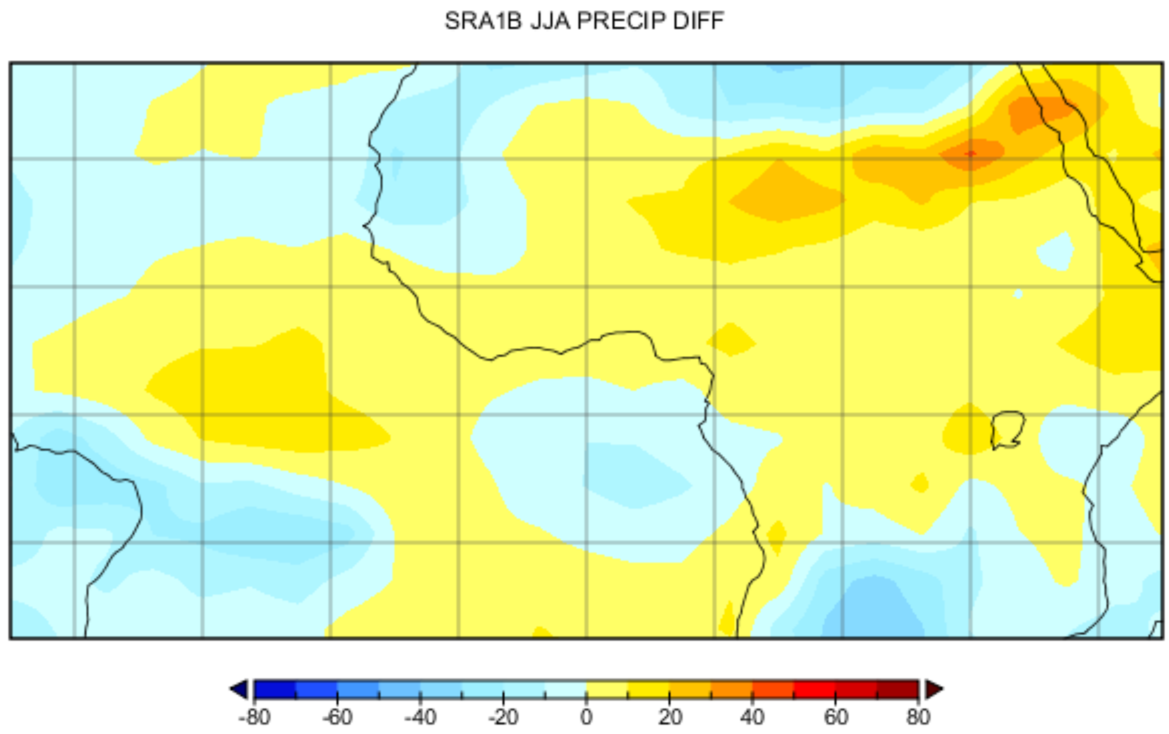
SRESA1B

Sahara dryness 20%

Wetness central Sahel (30 %).

Dryness western Sahel part (-20 %)

Wetness southern part 10-20 %

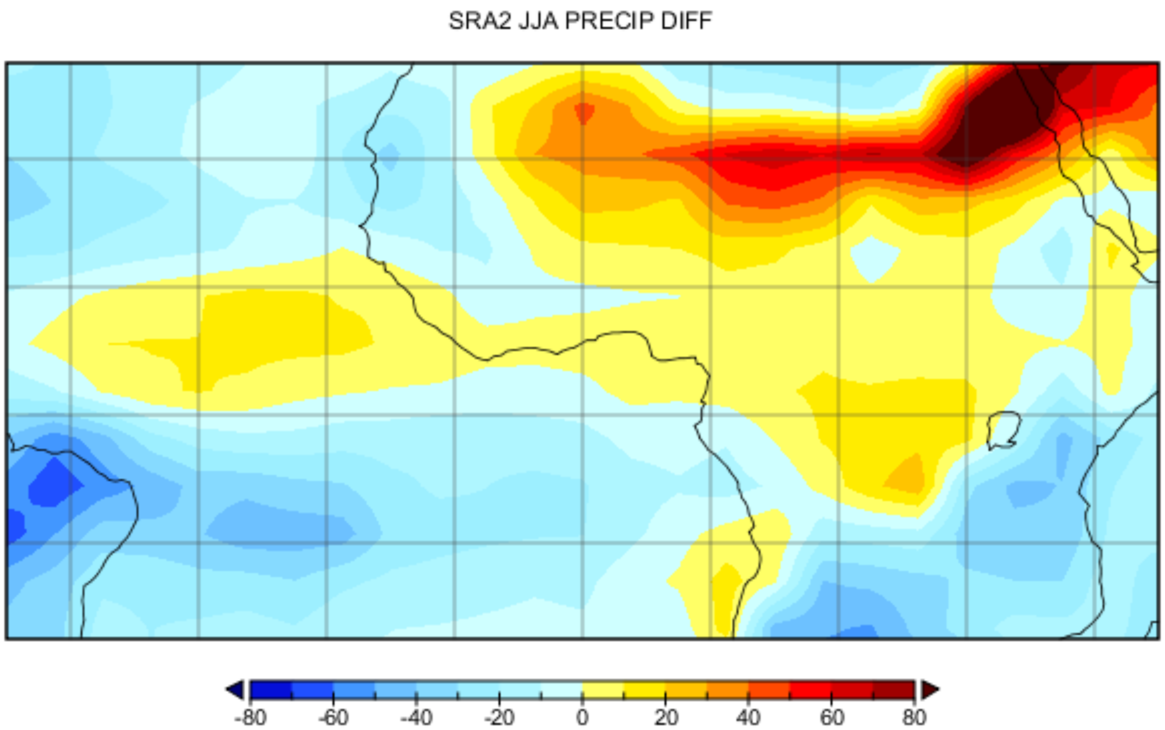


SRESA2 DIFF

SRESA2 DIFF

Reduced precipitation Western Sahel 10-30 % . 10 % reduction at northern Ghana, Togo and West central Nigeria. 30-70% increase at the remaining part of Sahel

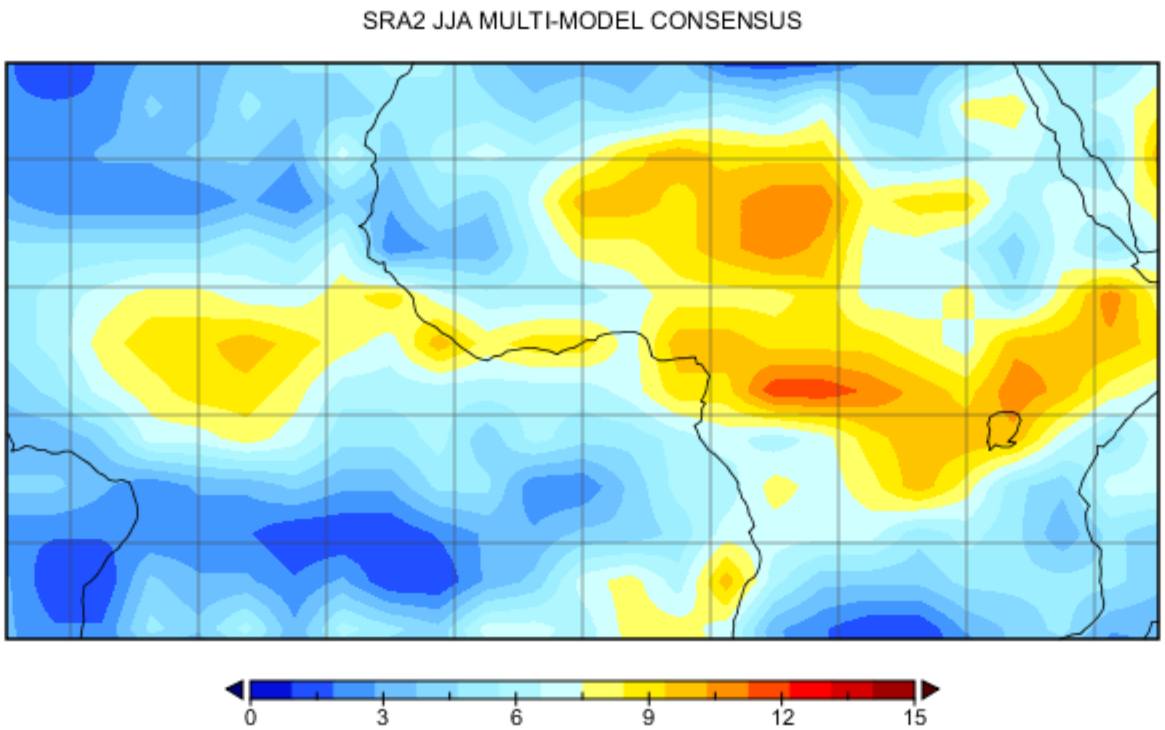
Up to 10% increase over Nigeria, Liberia Southern Togo and Ghana



SRA2 CONSENSUS

SRA2 CONSENSUS

Lower consensus at the North and west coastal areas, Higher consensus at the central part and over Nigeria and Cameroon

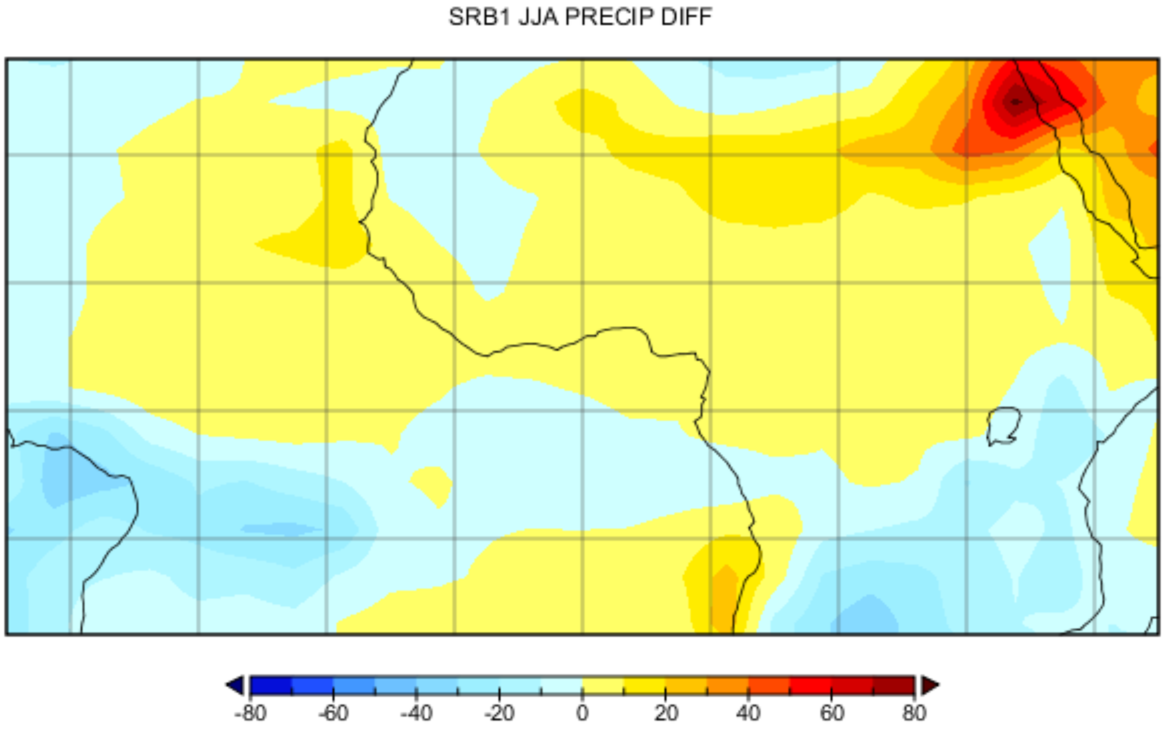


SRB1 DIFF

SRB1 DIFF

10 % increase at the southern countries and up to 20 % increase at the Sahel.

10 % reduction at the Western Sahel.

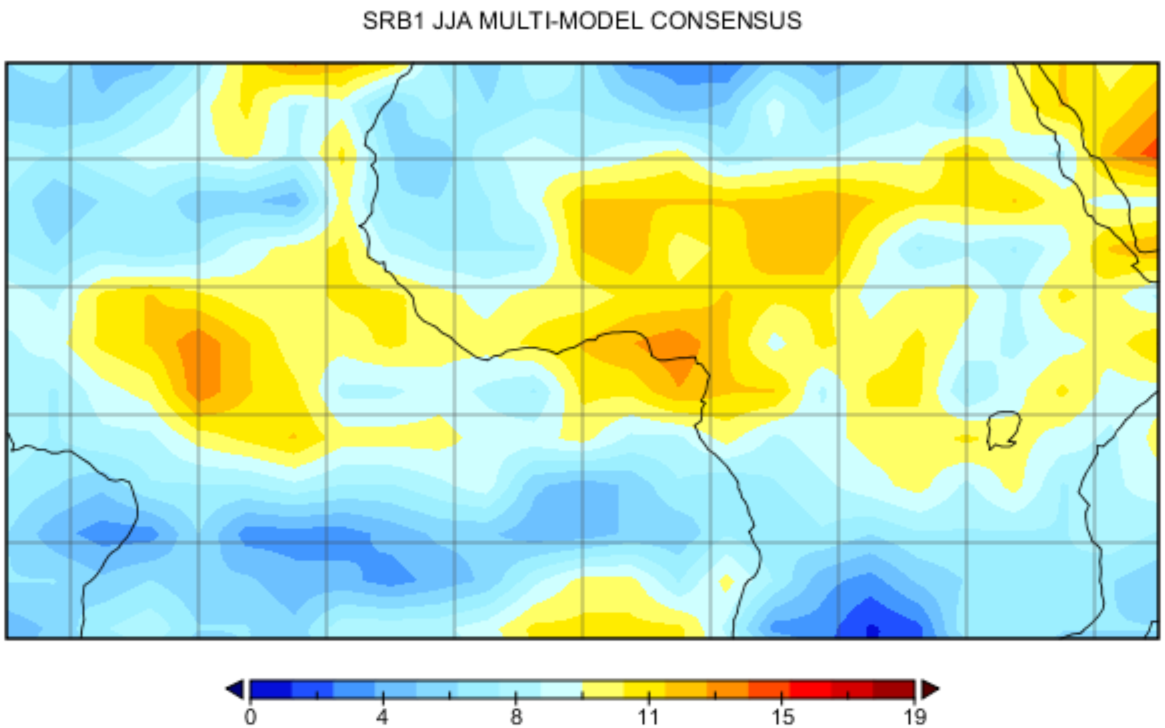


SRB1 CONSENSUS

SRA1B CONSENSUS

Lower consensus at the Western Sahel.

Higher consensus at the central WA to the coast and southern West Africa



Validated and cross-validated correlations between observed and predicted JJAS precipitation

Station	Lat	Lon	Tr_corr	Val_corr	CVal_corr
1	6.59	3.34	0.50	0.33	**0.5**
2	7.39	3.90	0.58	0.45	**0.53**
3	7.77	4.57	0.89	0.27	**0.8**
4	10.31	9.85	0.49	0.20	**0.49**
5	10.52	7.43	0.54	0.24	**0.53**
6	13.48	2.17	0.61	0.36	**0.6**
7	13.78	8.98	0.49	0.35	**0.48**
8	13.80	5.25	0.75	0.39	**0.73**
9	16.97	7.98	0.57	0.33	**0.37**

- Statistical prediction models generally have low to medium skill (Udomboso & Amalia ,2011; Colman & Davey, 2003).

Dynamical downscaling of West Africa precipitation

- RCMs, have high bias in amount and inter-annual variability of precipitation (Paeth et al., 2005)
- RegCM4 convection schemes could not mimic the observed inverse precip. distribution of Septembers 1989 &1998 (Adeniyi, 2013).