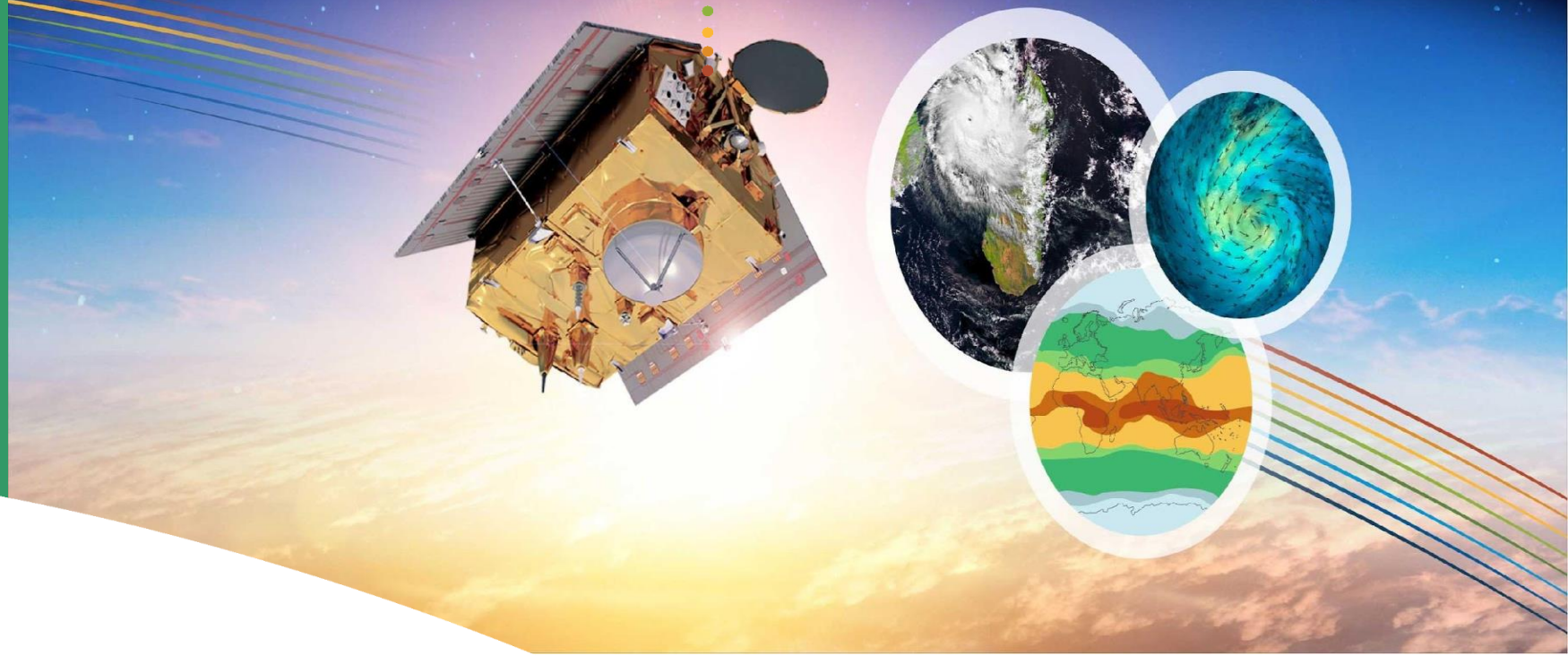
Seasonal Forecasting Workshop on agro-hydro-climatic characteristics of the main rainfall season in the Gulf of Guinea countries / PRESAGG -11

Accra, GHANA

February 26 to March 01, 2024



Technical Note for: MAM & AMJ 2024
Issued: Feb 2024

ClimSA
INTRA-ACP CLIMATE SERVICES AND RELATED APPLICATIONS PROGRAMME

An initiative of the Organisation of African, Caribbean and Pacific States funded by the European Union

Prepared By: ACMAD Team

Outline

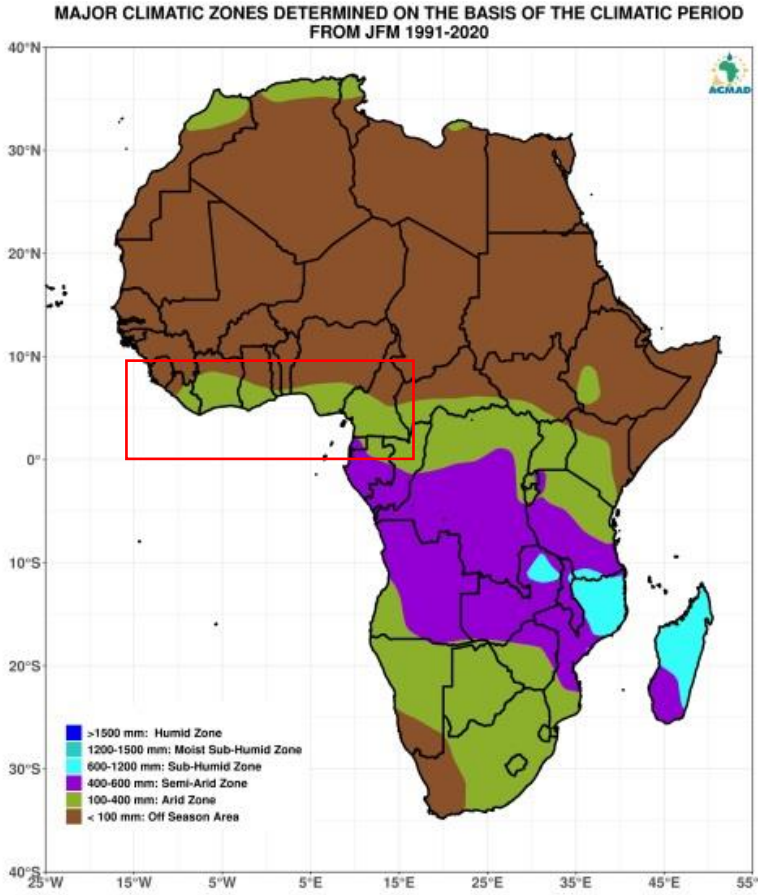
1. *Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends*
2. *Composite analysis*
3. *Analogue Analysis*
4. *Teleconnections analysis (i,e ENSO, AMO, IOD, SIOD, Atlantic Dipole, NAO, AO, SAM, Benguela Nino, Mediterranean SSTAs)*
5. *Linear regression, principal component, canonical correlation analysis*
6. *Teleconnections analysis (i,e ENSO, AMO, IOD, SIOD, Atlantic Dipole, NAO, AO, SAM, Benguela Nino, Mediterranean SSTAs)*
7. *Interactions analysis between seasons (summer and following winter) and regions for the same target season (i.e summer African monsoon and Atlantic cyclone activity)*
8. *Single Model Ensemble Analysis (i,e ECMWF, NCEP, UKMET)*
9. *Multi-model Ensemble Analysis (ie MME, Copernicus, IRI)*
10. *Consolidation and consensus Analysis*

Step 1:

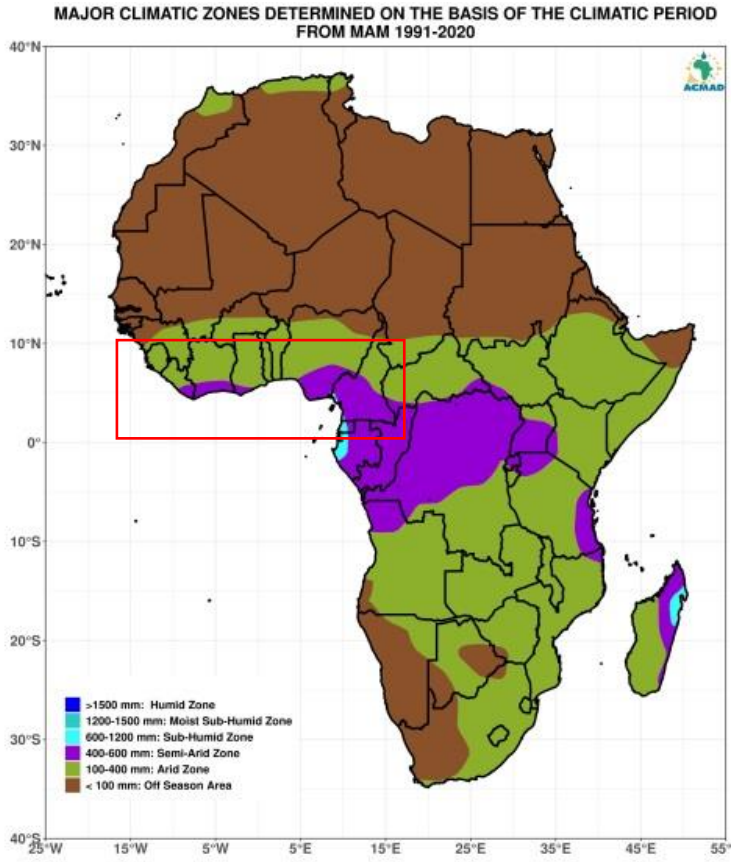
Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends

Time series analysis of Climate variability and trends (Climatic zones)

Season 1 = MARCH-APRIL-MAY

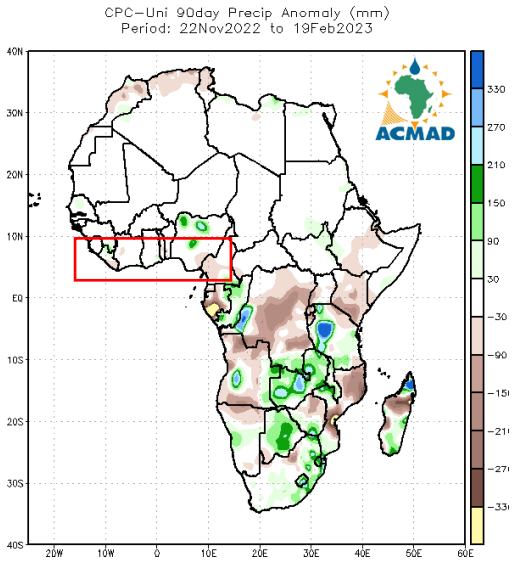


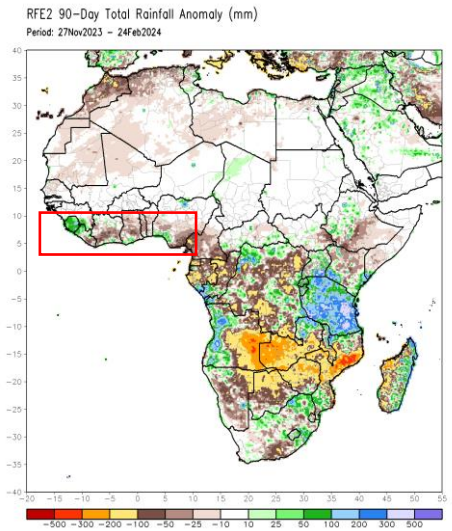
Season 2 = APRIL-MAY-JUNE



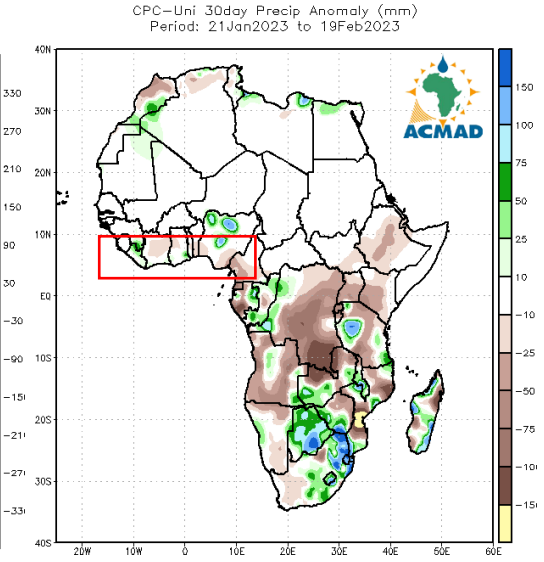
Time series analysis of Climate variability and trends(Persistence forecast)

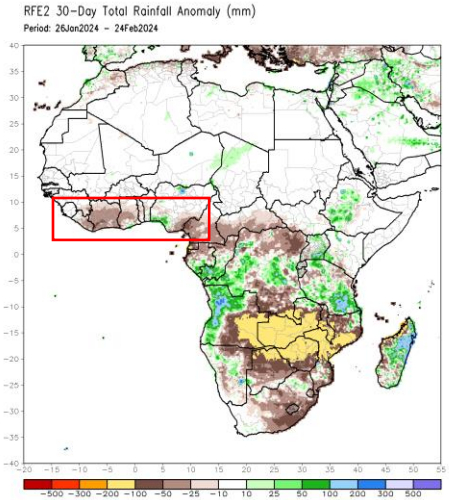
Latest 90-days



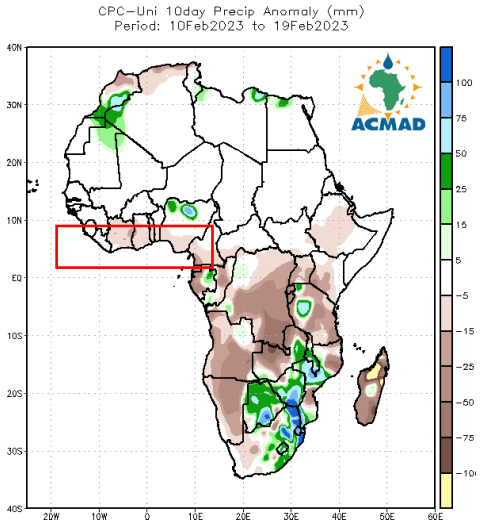


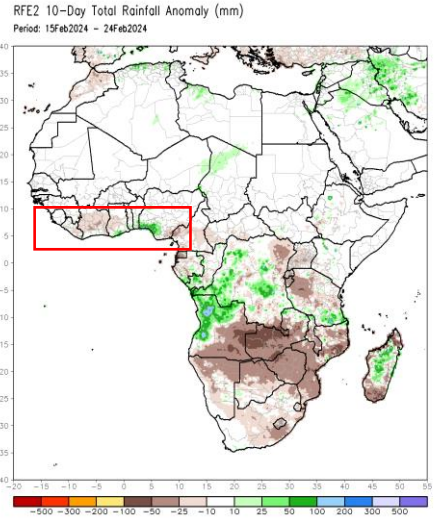
Last 30-days



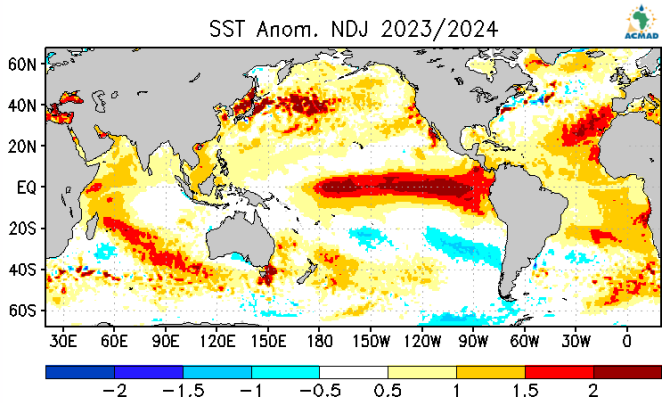


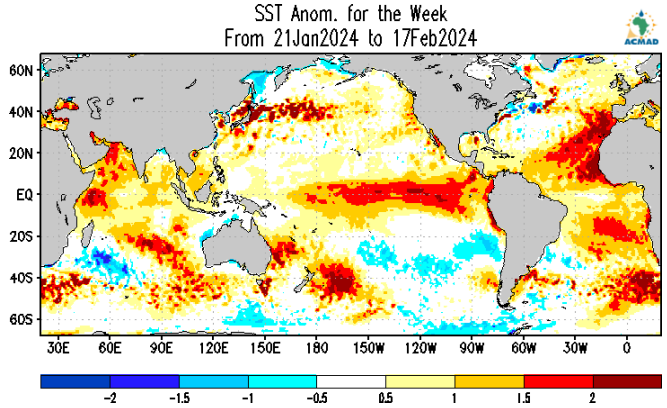
Last 10-days

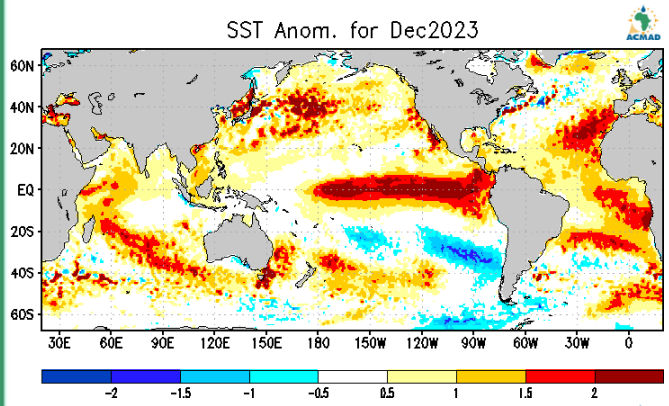


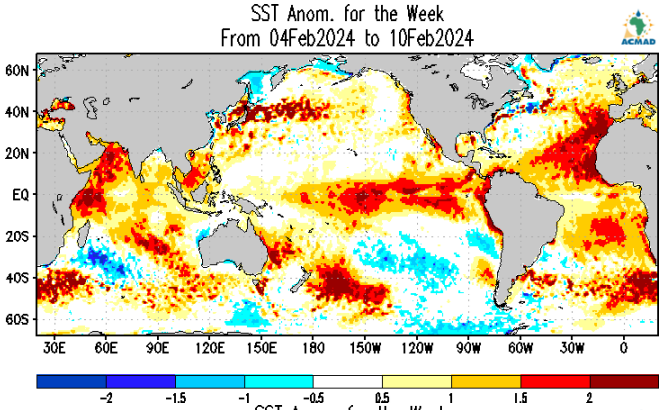


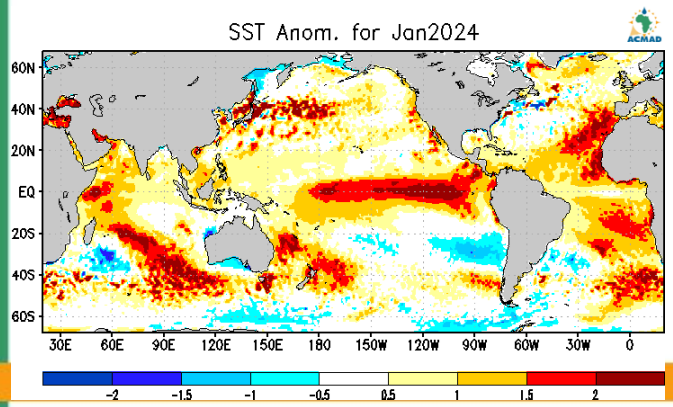
State of the Global Ocean –
Current Status

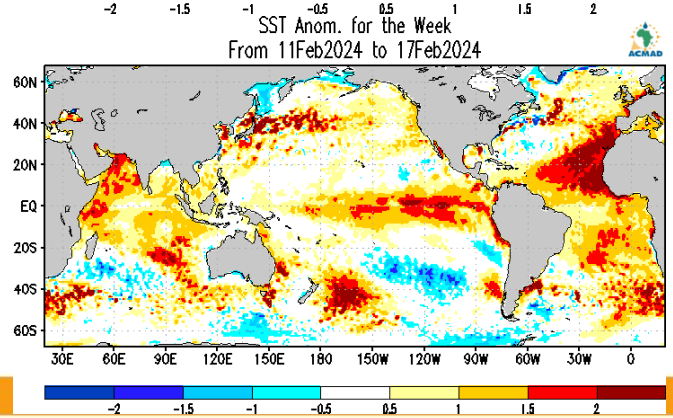








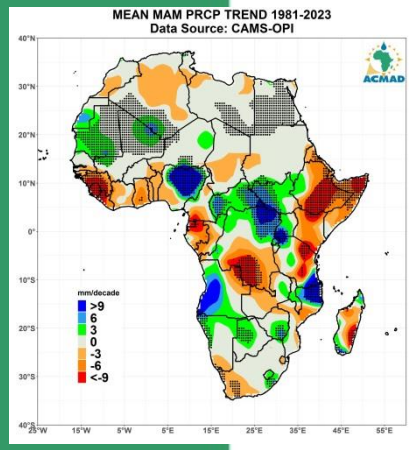




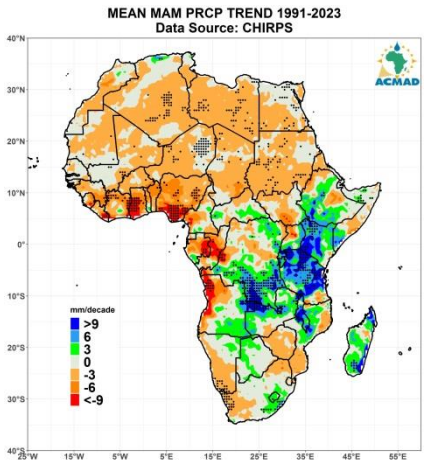
Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends (1/4)

Season 1 MAM

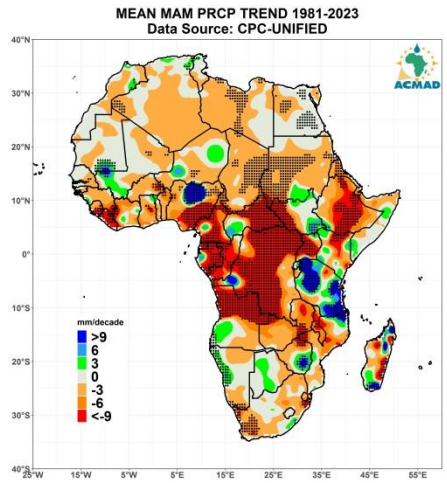
CAMS-OPI



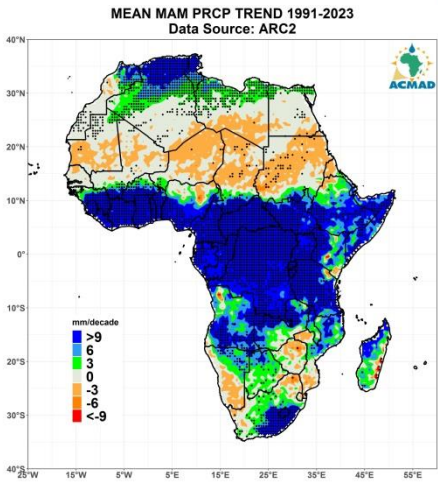
CHIRPS



CPC-UNI

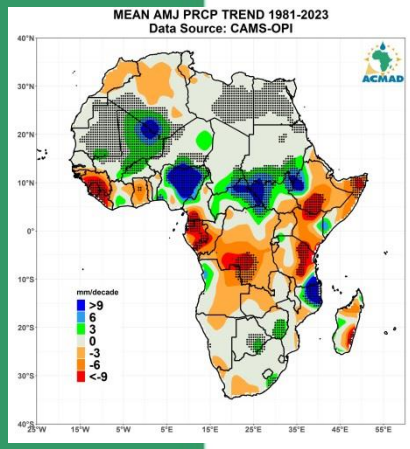


ARC2



Season 2 AMJ

CAMS-OPI



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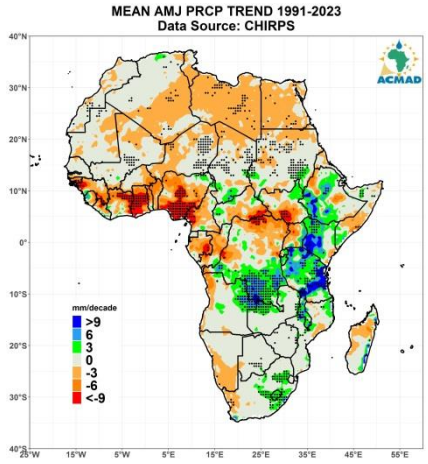
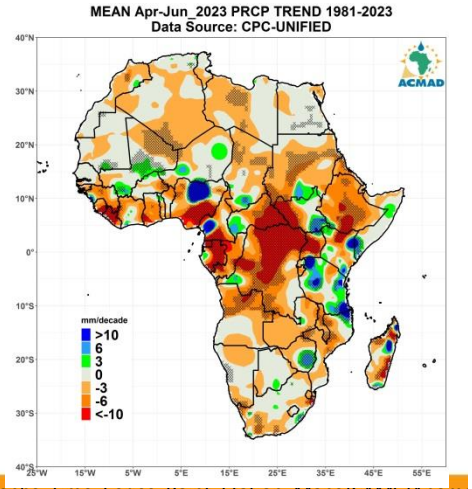
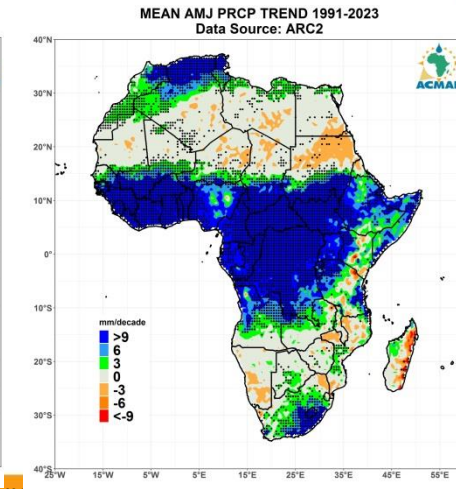


CPC-UNI

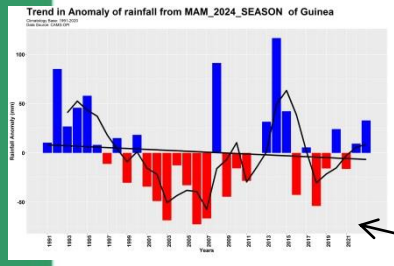


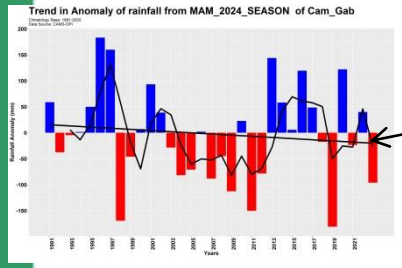
ARC2

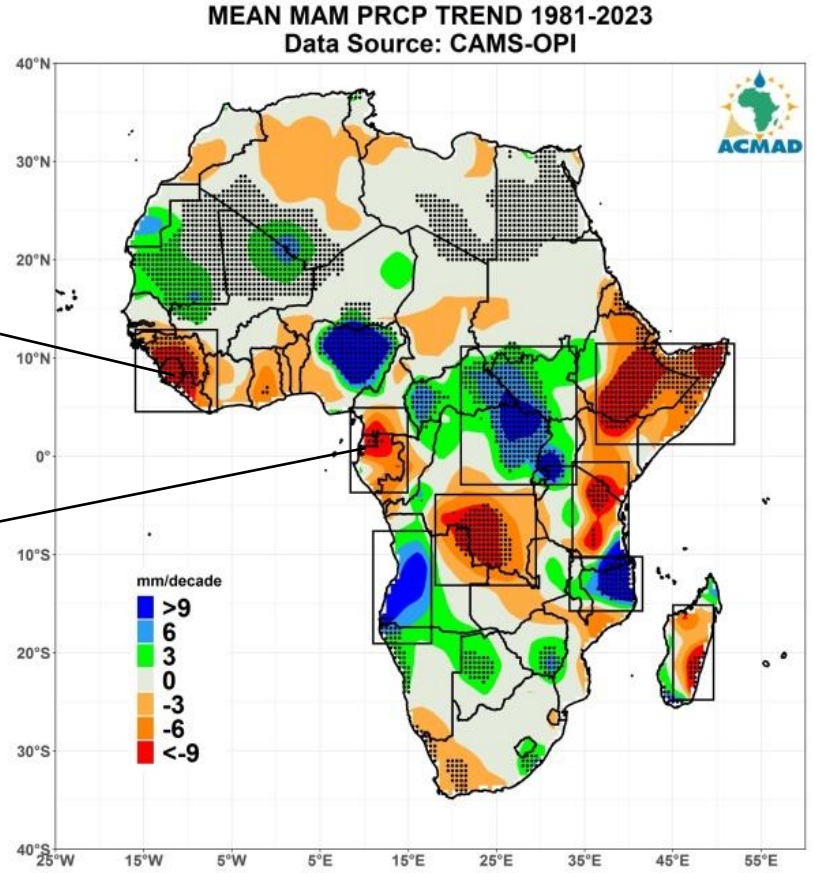


Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends (1/5)

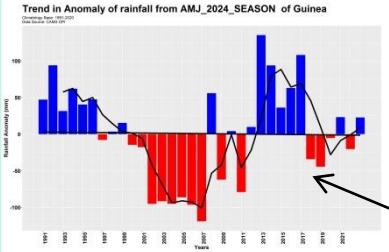
MAM Season 1

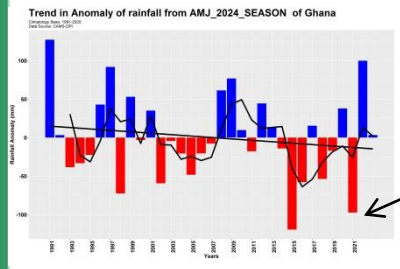


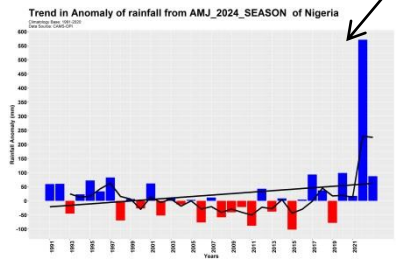


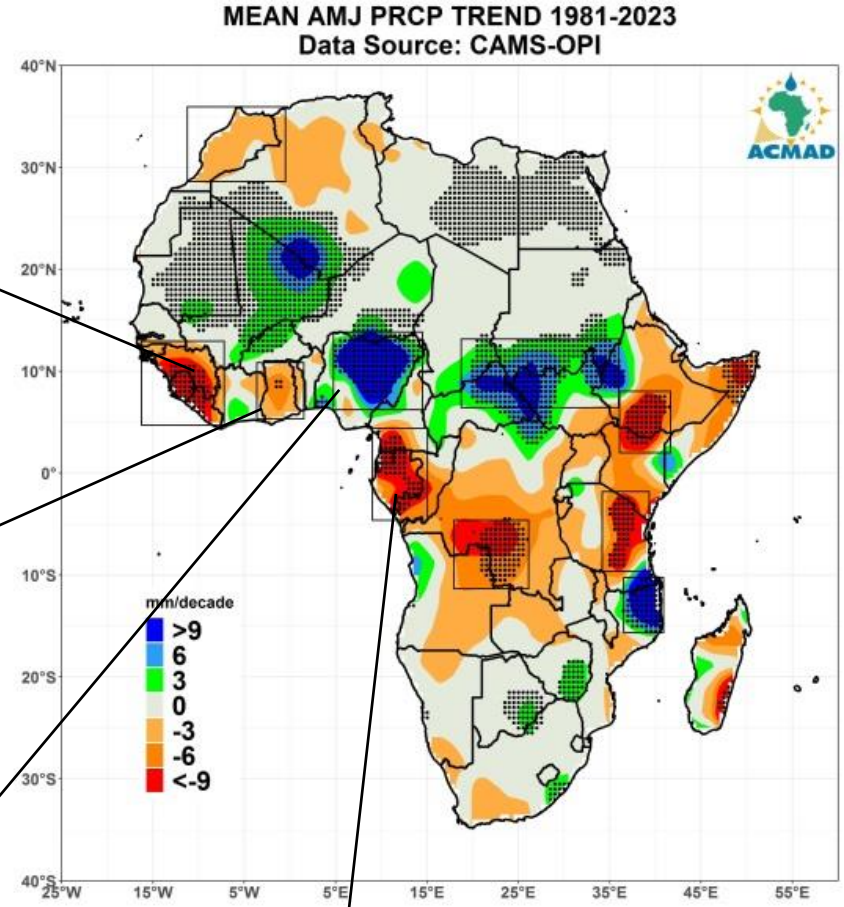


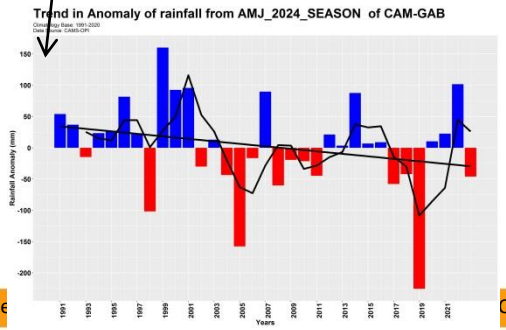
Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends (1/6)











Step 2:

Identification of Drivers Patterns for Dry and Wet years

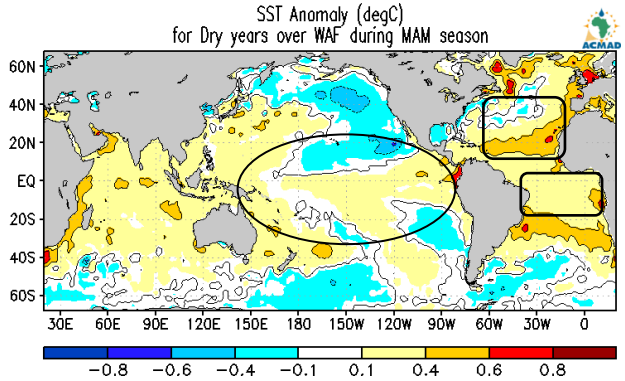
Comparative Analysis with the drivers projected status

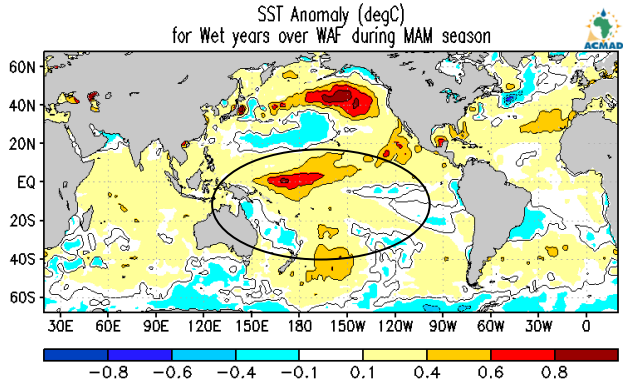
Composite analysis (Dry Years) – SSTs & Rainfall (MAM)

DRY

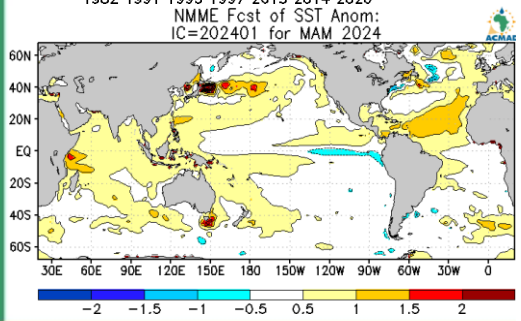
WET

SST Composite

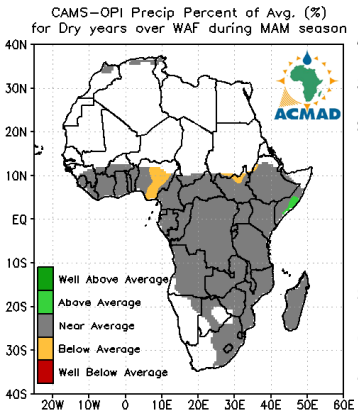




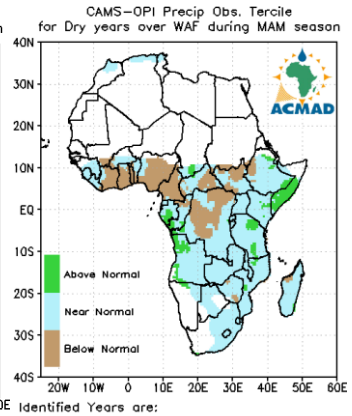
Identified Years are:
1982 1991 1995 1997 2013 2014 2020



Rainfall Composite

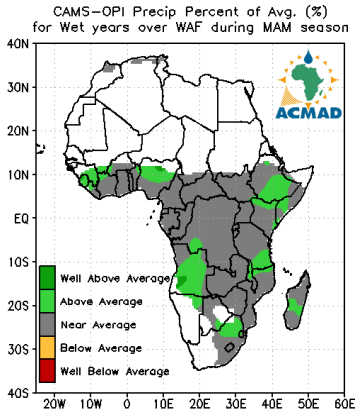


Identified Years are:
1987 1990 1998 1999 2003 2007 2010 2011

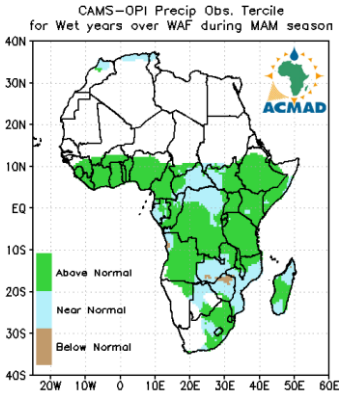


Identified Years are:
1987 1990 1998 1999 2003 2007 2010 2011

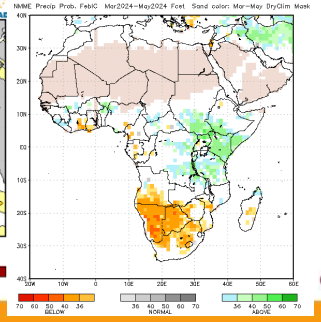
CAF
1981
1988
1993
1998
2004
2005
2011
2019

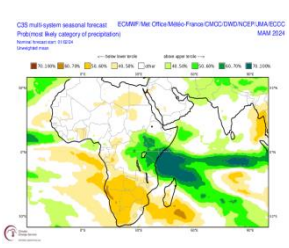


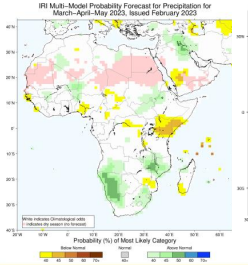
Identified Years are:
1982 1991 1995 1997 2013 2014 2020

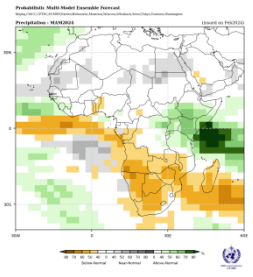


Identified Years are:
1982 1991 1995 1997 2013 2014 2020







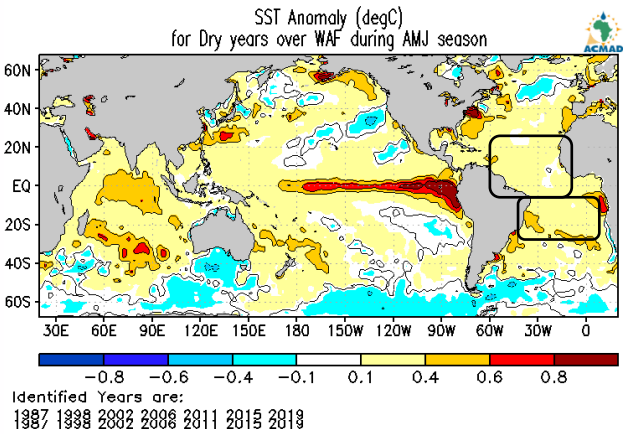


Composite analysis (Dry Years) – SSTs & Rainfall (AMJ)

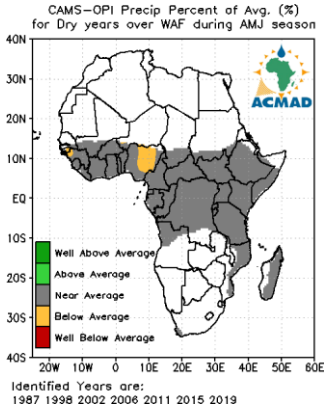
DRY

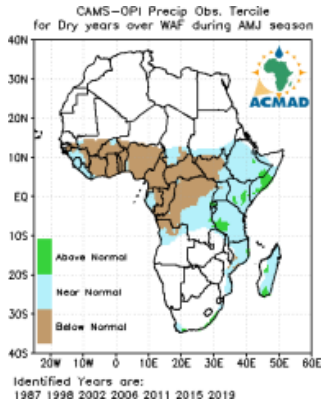
WET

SST Composite

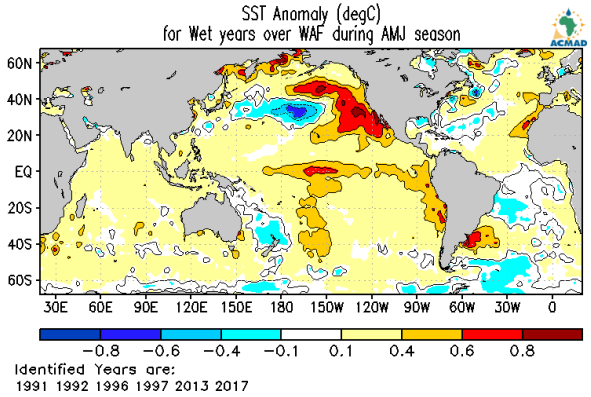


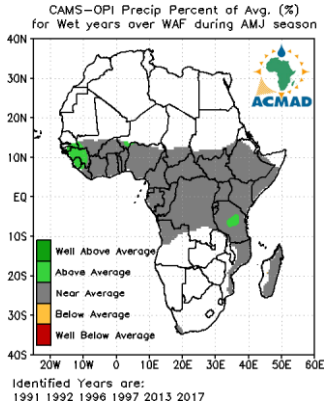
Rainfall Composite

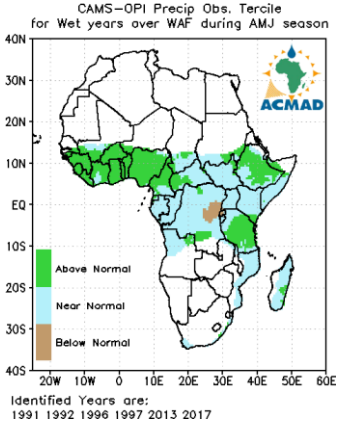




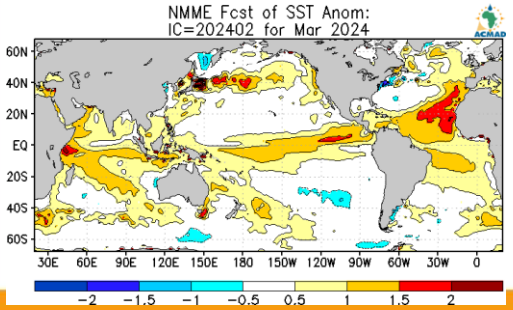
WAF
1987
1998
2002
2006
2011
2015
2019

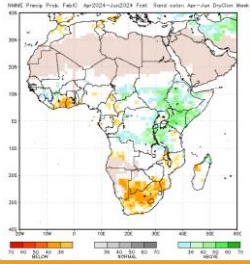


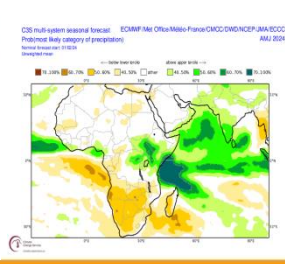


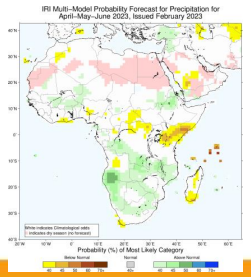


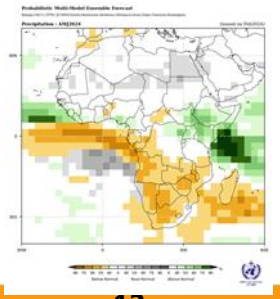
WAF
1991
1992
1996
1997
2013
2017











Step 3:
Analogue Years Analysis

Identification of Analogue Years (2)

Blue – La Nina

Red– El Nino

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.7	-1.4	-1.1	-0.8	-0.7	-0.6	-0.6	-0.5	-0.5	-0.6	-0.7	-0.7
2001	-0.7	-0.5	-0.4	-0.3	-0.3	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3
2002	-0.1	0.0	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.2	1.3	1.1
2003	0.9	0.6	0.4	0.0	-0.3	-0.2	0.1	0.2	0.3	0.3	0.4	0.4
2004	0.4	0.3	0.2	0.2	0.2	0.3	0.5	0.6	0.7	0.7	0.7	0.7
2005	0.6	0.6	0.4	0.4	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.6	-0.8
2006	-0.9	-0.8	-0.6	-0.4	-0.1	0.0	0.1	0.3	0.5	0.8	0.9	0.9
2007	0.7	0.2	-0.1	-0.3	-0.4	-0.5	-0.6	-0.8	-1.1	-1.3	-1.5	-1.6
2008	-1.6	-1.5	-1.3	-1.0	-0.8	-0.6	-0.4	-0.2	-0.2	-0.4	-0.6	-0.7
2009	-0.8	-0.8	-0.6	-0.3	0.0	0.3	0.5	0.6	0.7	1.0	1.4	1.6
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2010	1.5	1.2	0.8	0.4	-0.2	-0.7	-1.0	-1.3	-1.6	-1.6	-1.6	-1.6
2011	-1.4	-1.2	-0.9	-0.7	-0.6	-0.4	-0.5	-0.6	-0.8	-1.0	-1.1	-1.0
2012	-0.9	-0.7	-0.6	-0.5	-0.3	0.0	0.2	0.4	0.4	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.5	-0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.5	0.6	0.7
2015	0.5	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.2	2.4	2.6	2.6
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4	-0.5	-0.6	-0.7	-0.7	-0.6
2017	-0.3	-0.2	0.1	0.2	0.3	0.3	0.1	-0.1	-0.4	-0.7	-0.8	-1.0
2018	-0.9	-0.9	-0.7	-0.5	-0.2	0.0	0.1	0.2	0.5	0.8	0.9	0.8
2019	0.7	0.7	0.7	0.7	0.5	0.5	0.3	0.1	0.2	0.3	0.5	0.5
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
2022	-1.0	-0.9	-1.0	-1.1	-1.0	-0.9	-0.8	-0.9	-1.0	-1.0	-0.9	-0.8
2023	-0.7	-0.4	-0.1	0.2	0.5	0.8	1.1	1.3	1.6	1.8	1.9	2.0

Analog Years
2003
2010
2016
2019

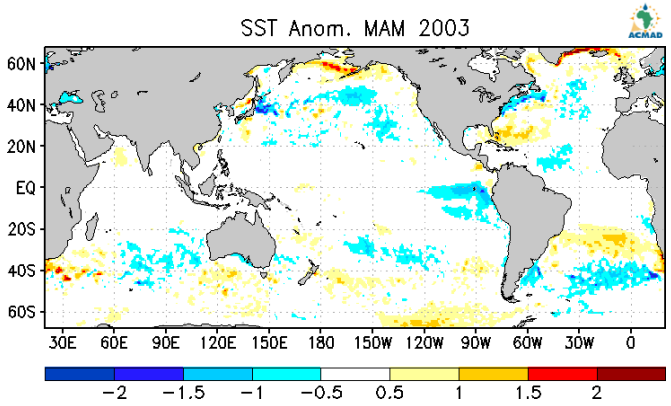
Forecasted SST evolution

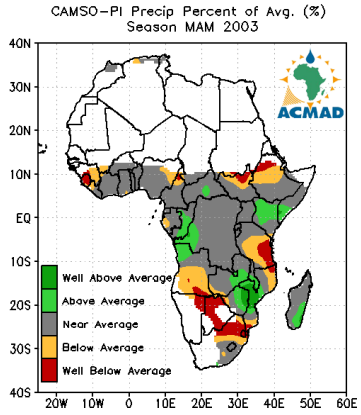
Seasons (2024 – 2024)

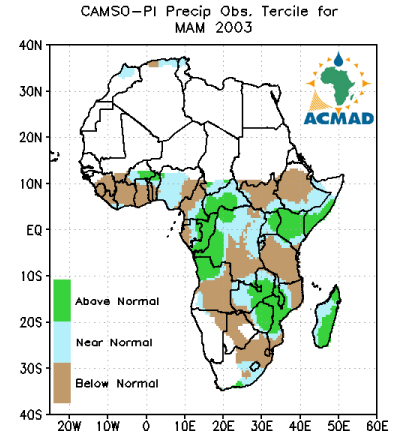
Model	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON
Average, Dynamical models	**1.576**	**1.178**	**0.720**	**0.285**	**-0.194**	**-0.617**	**-0.813**	**-0.762**	**-0.827**
Average, Statistical models	**1.432**	**1.094**	**0.728**	**0.392**	**0.074**	**-0.223**	**-0.465**	**-0.627**	**-0.750**
Average, All models	**1.526**	**1.149**	**0.722**	**0.322**	**-0.085**	**-0.430**	**-0.639**	**-0.686**	**-0.783**

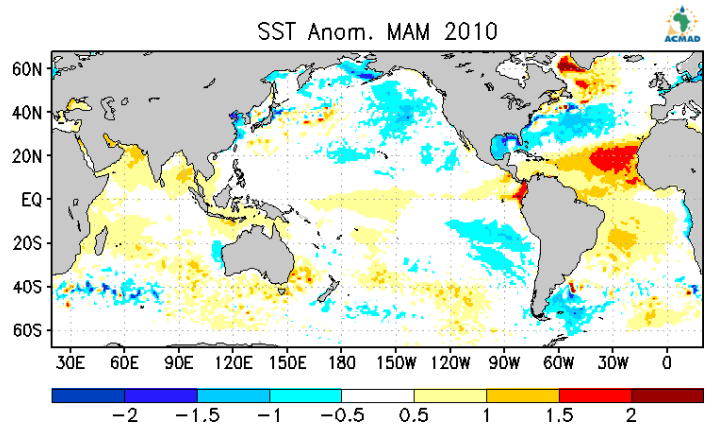
Forecasted evolution of SSTs during the coming target seasons indicate a transition from an ENSO positive (El Nino) phase to an ENSO Neutral phase during the coming target seasons

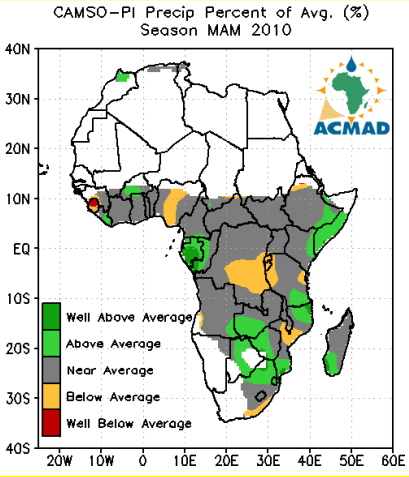
Analogue Analysis (3) – Identical Years– MAM

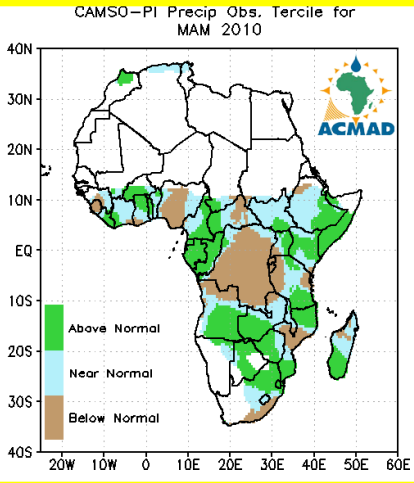


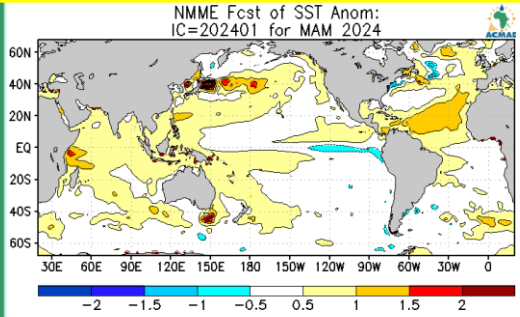


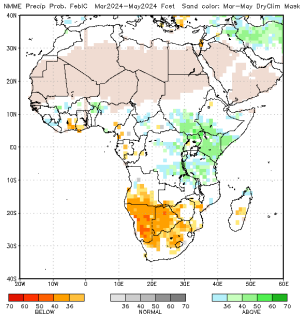


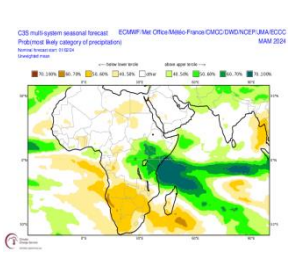


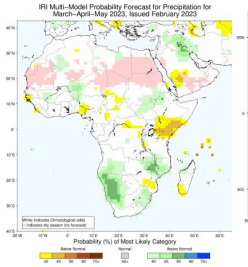


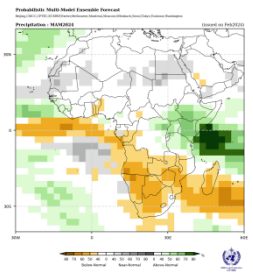




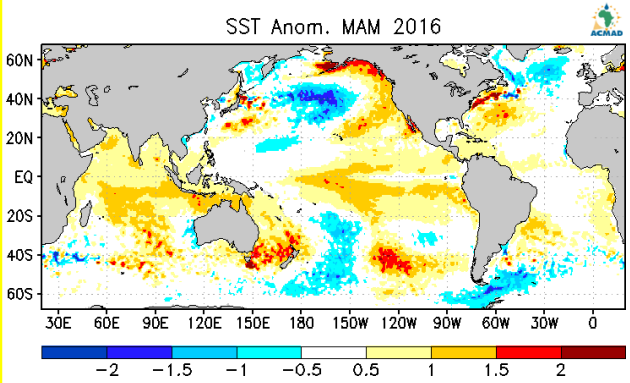


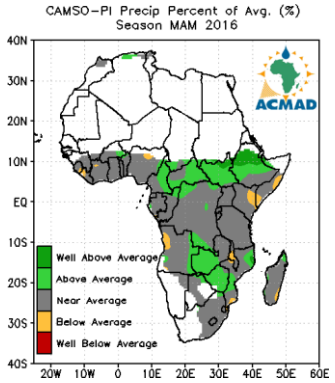


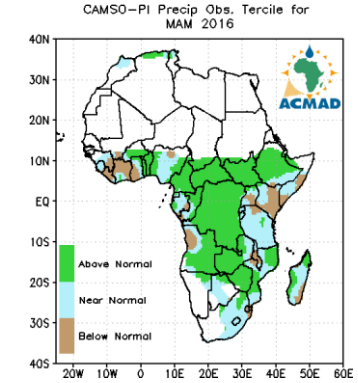


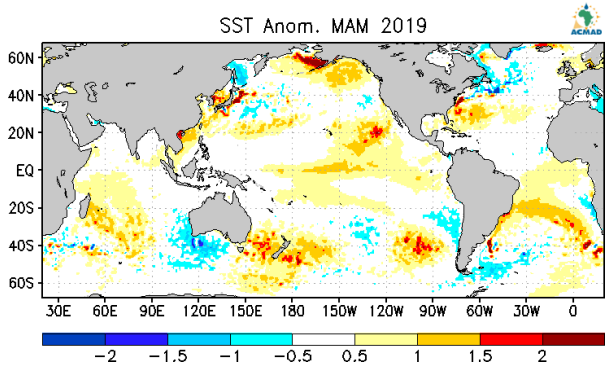


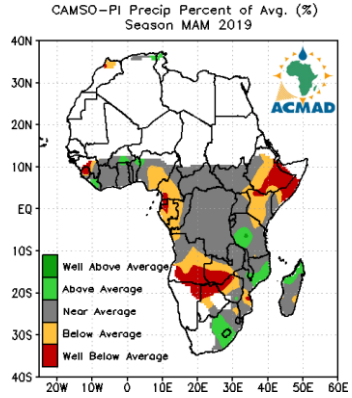
Analogue Analysis (3) – Identical Years– MAM

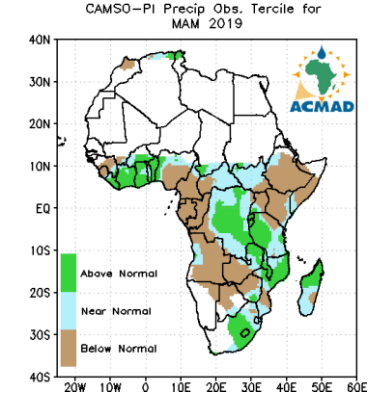


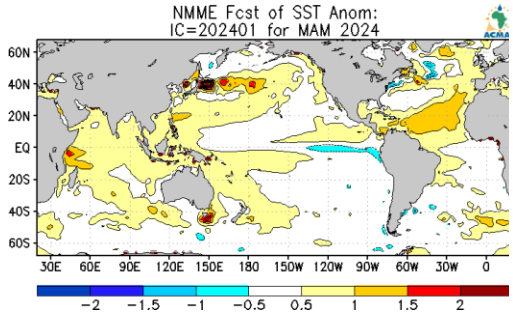


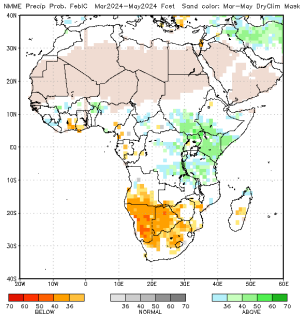


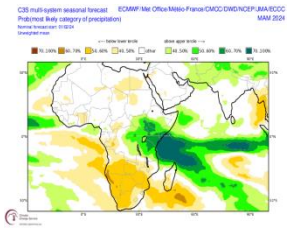


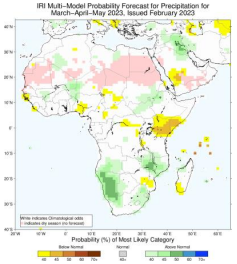


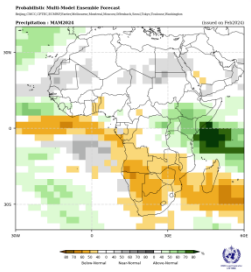




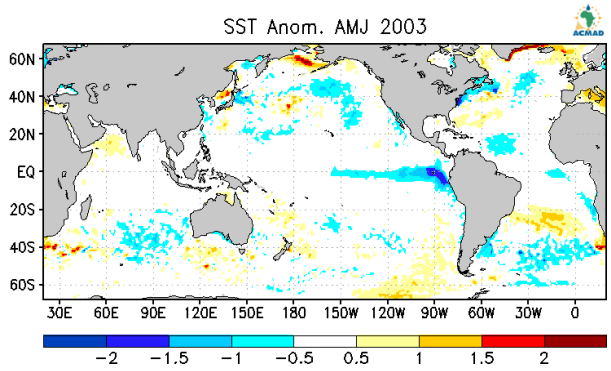


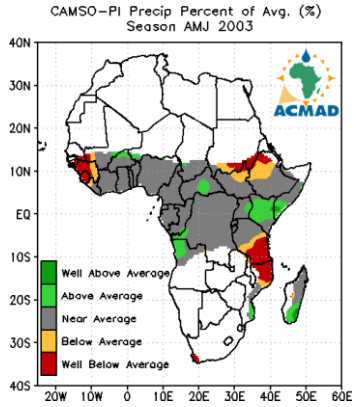


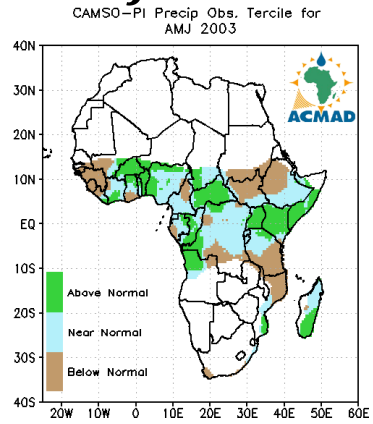


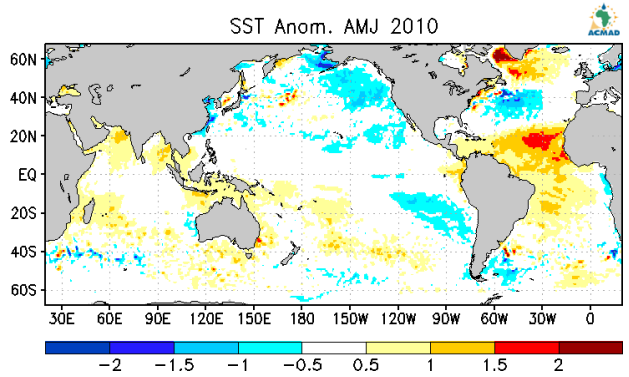


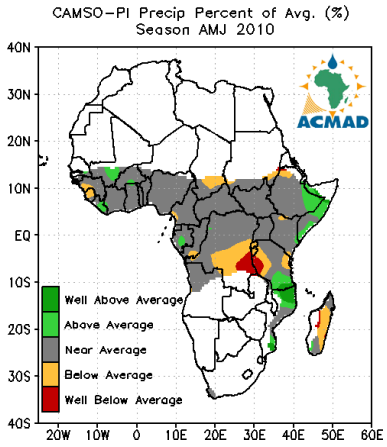
Analogue Analysis (3) – Identical Years– AMJ

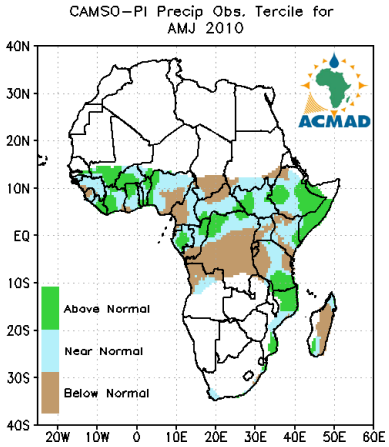


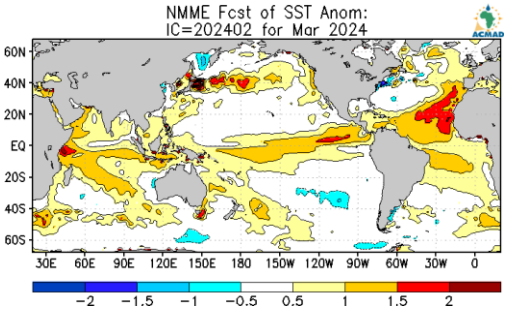


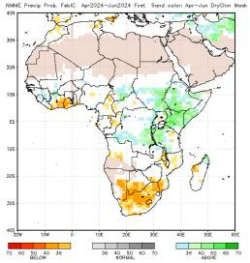


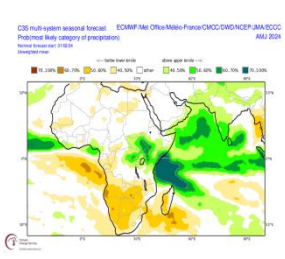


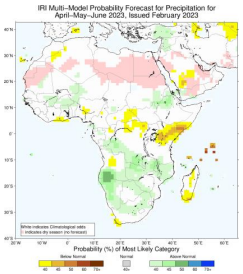


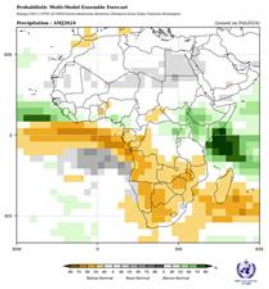




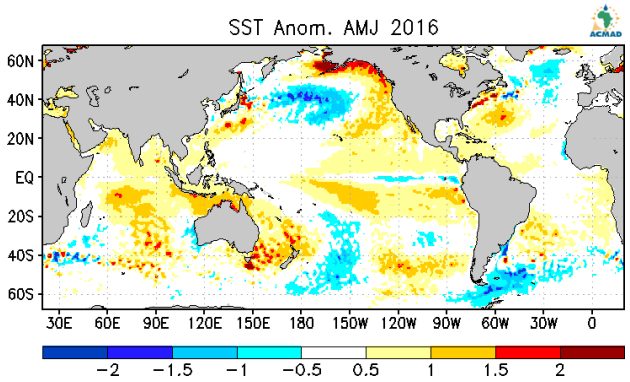


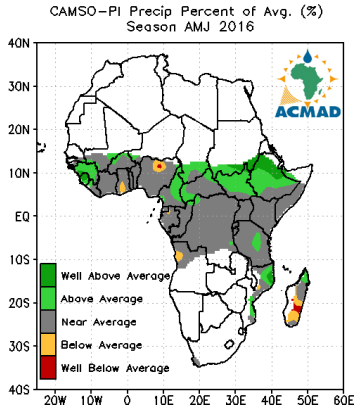


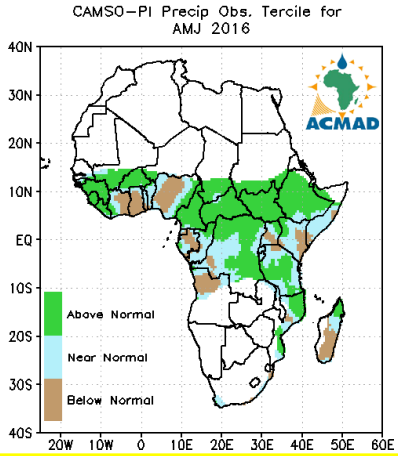


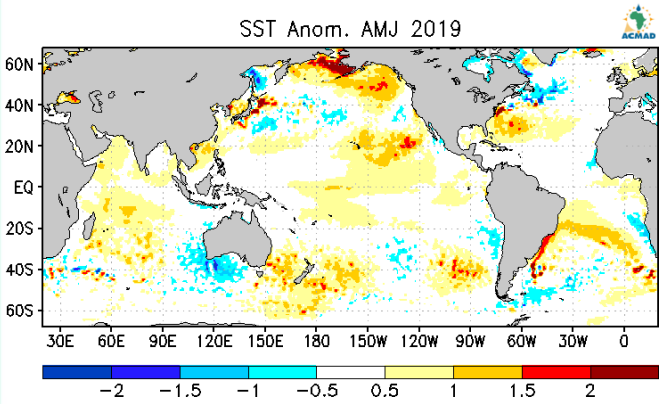


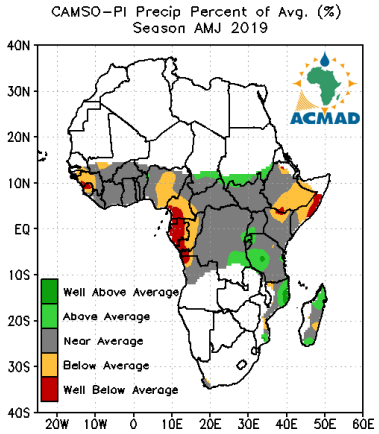
Analogue Analysis (3) – Identical Years– AMJ

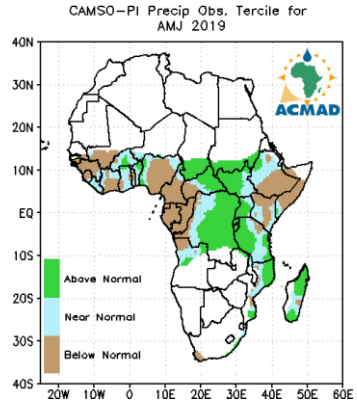


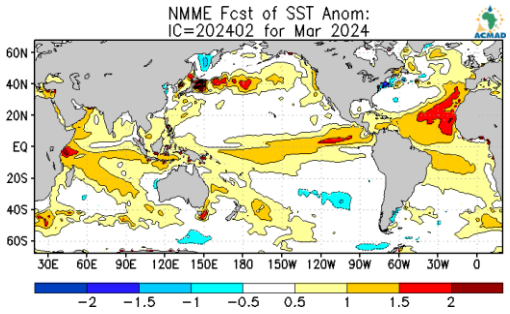


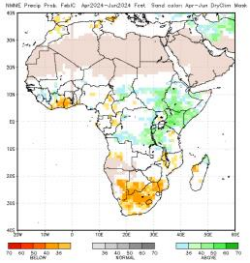


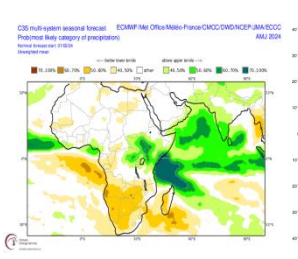


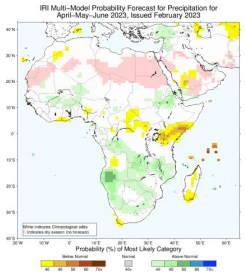


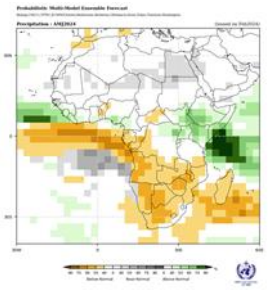




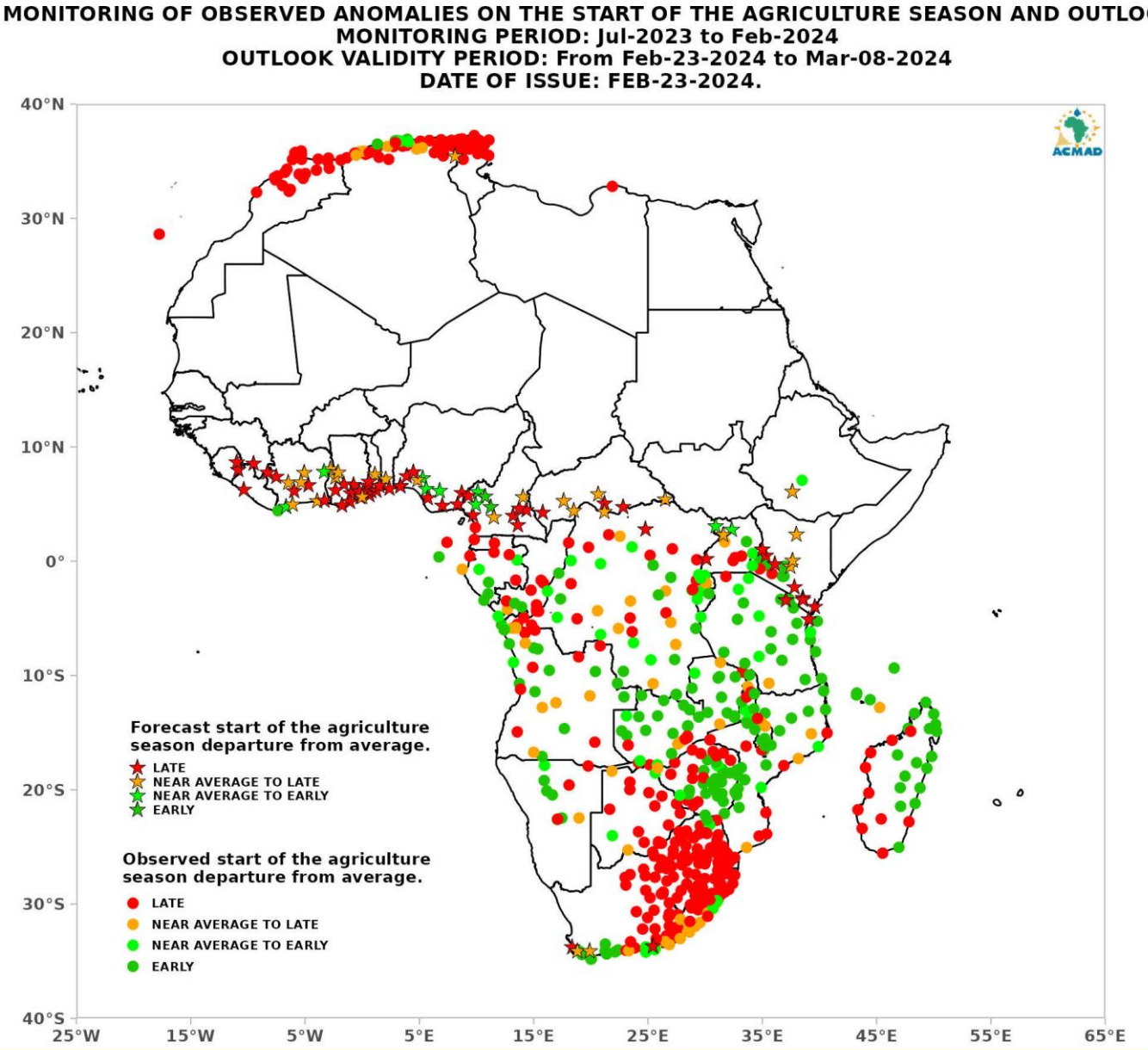






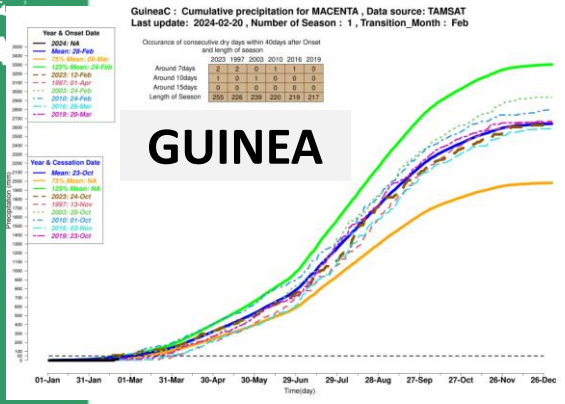


ONSET

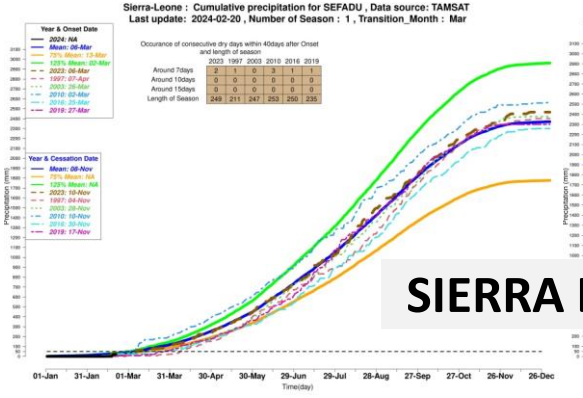

MONITORING OF OBSERVED ANOMALIES ON THE START OF THE AGRICULTURE SEASON AND OUTLOOK
MONITORING PERIOD: Jul-2023 to Feb-2024
OUTLOOK VALIDITY PERIOD: From Feb-23-2024 to Mar-08-2024
DATE OF ISSUE: FEB-23-2024.
ACMAD
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
25°W
15°W
5°W
5°E
15°E
25°E
35°E
45°E
55°E
65°E
Forecast start of the agriculture season departure from average.
LATE
NEAR AVERAGE TO LATE
NEAR AVERAGE TO EARLY
EARLY
Observed start of the agriculture season departure from average.
LATE
NEAR AVERAGE TO LATE
NEAR AVERAGE TO EARLY
EARLY

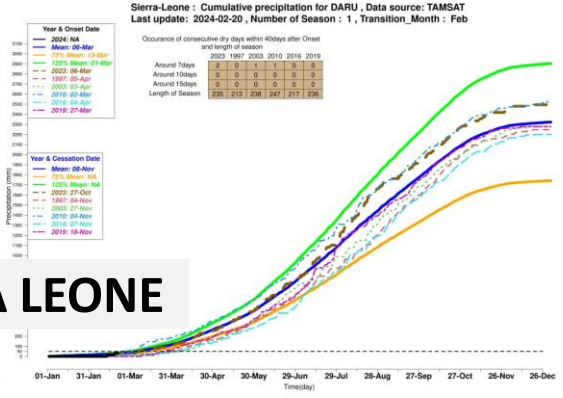
Analog years Analysis

- Analysis of stations profiles for the Analog years (1/3)

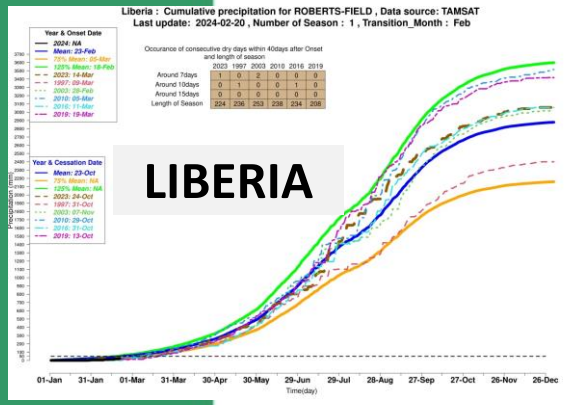


GUINEA

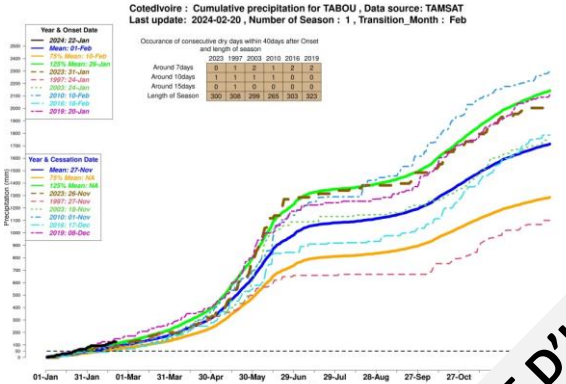


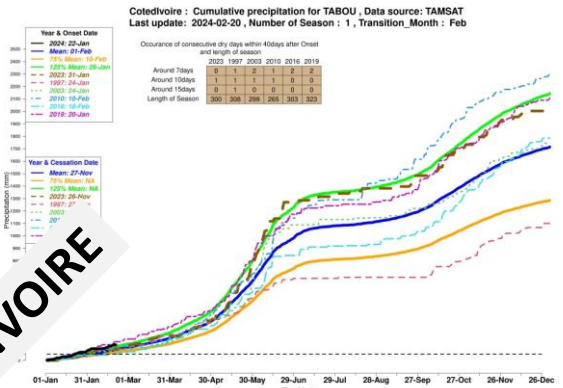


SIERRA LEONE

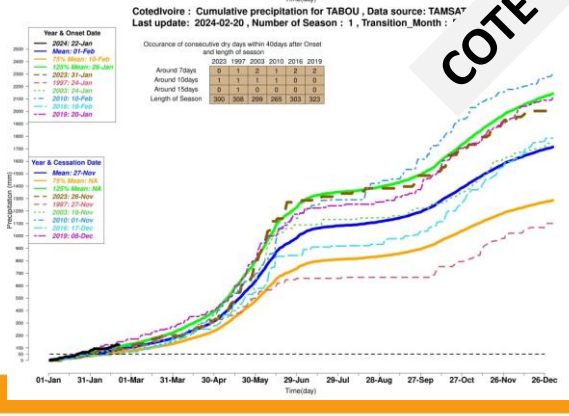


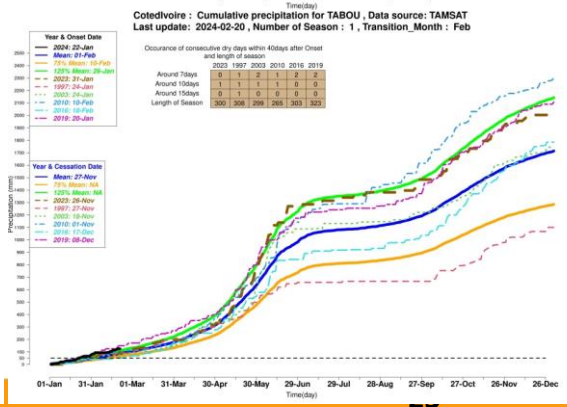
LIBERIA





COTE D'IVOIRE

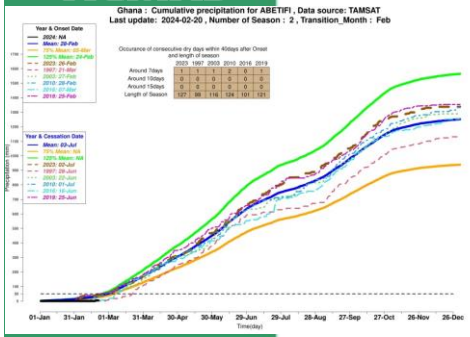


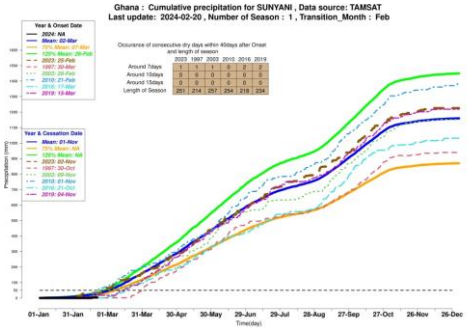


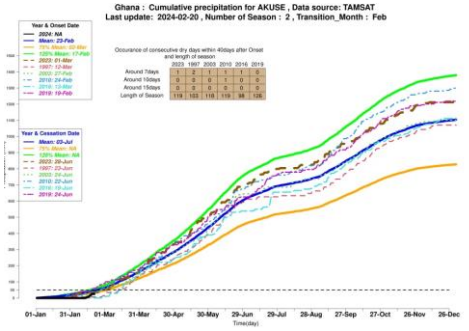
Analog years Analysis

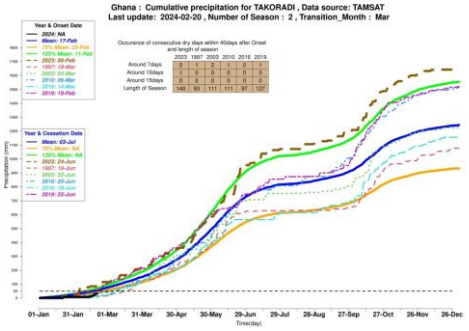
- Analysis of stations profiles for the Analog years (2/3)

GHANA









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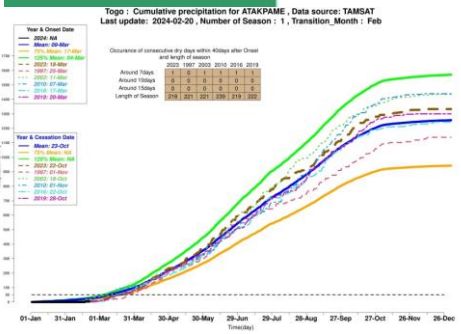
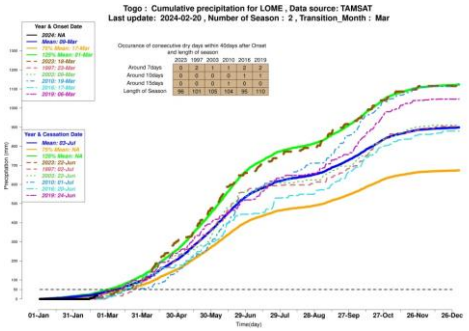
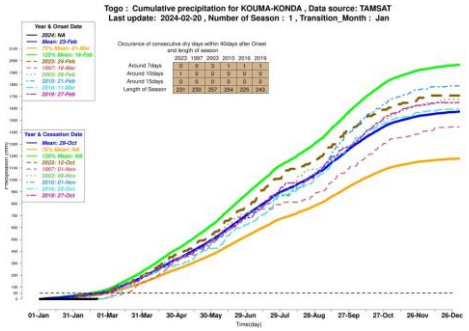
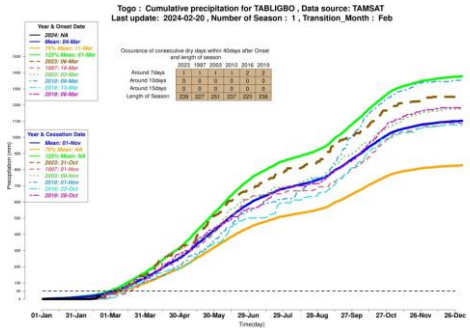
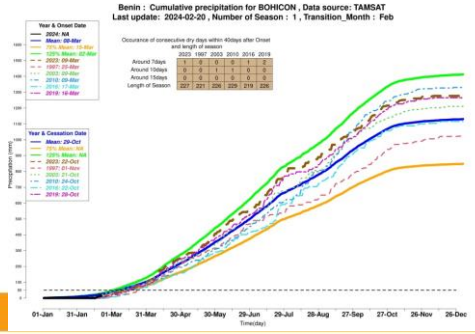


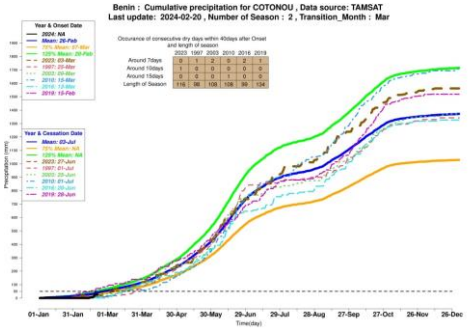






BENIN

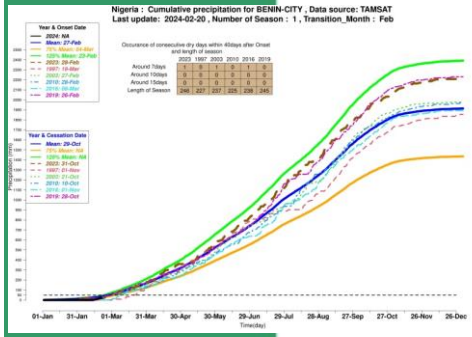


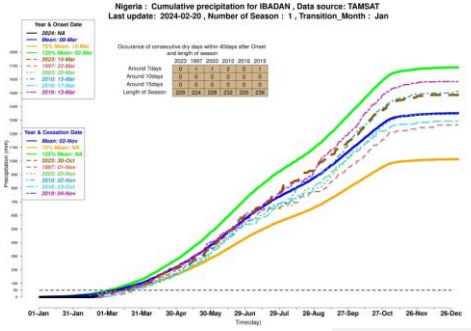


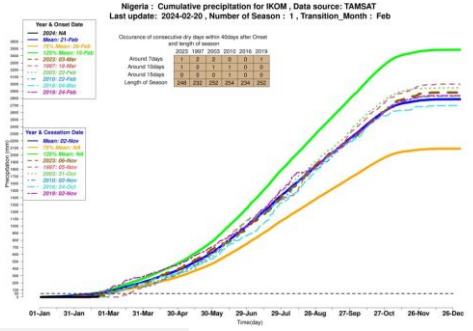
Analog years Analysis

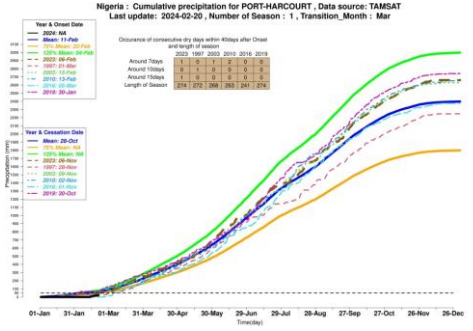
- Analysis of stations profiles for the Analog years (3/3)

NIGERIA

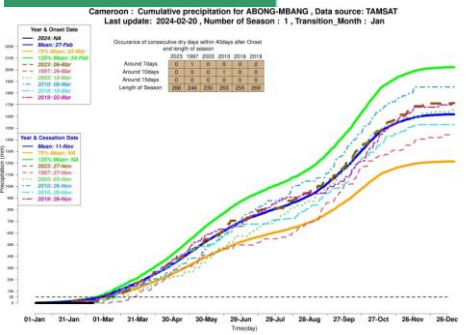


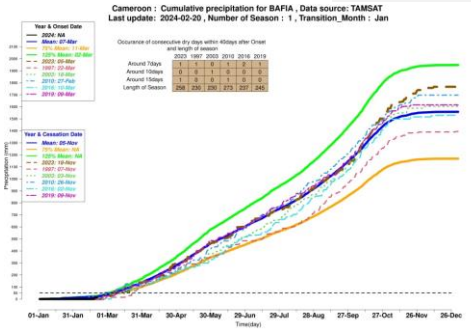


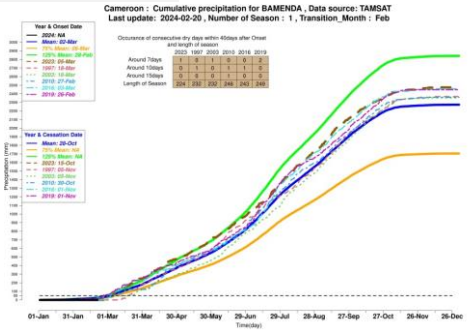


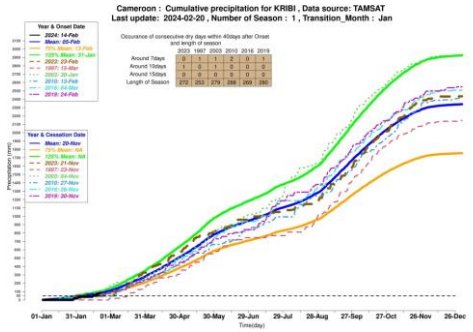


CAMEROON

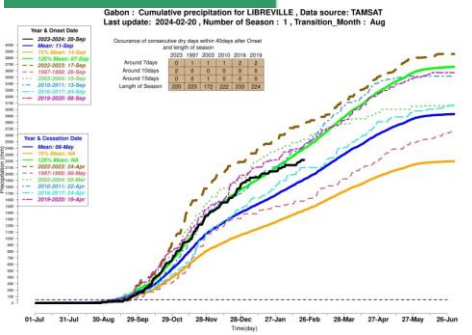


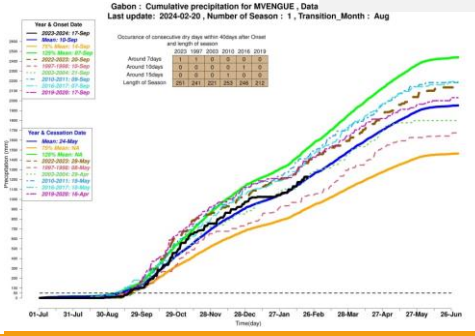


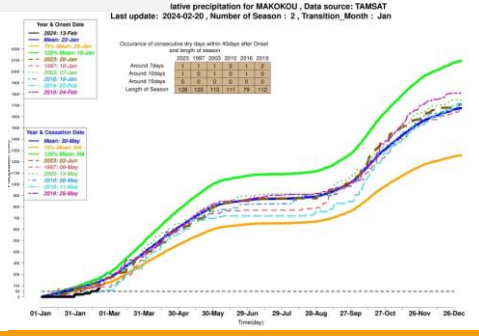


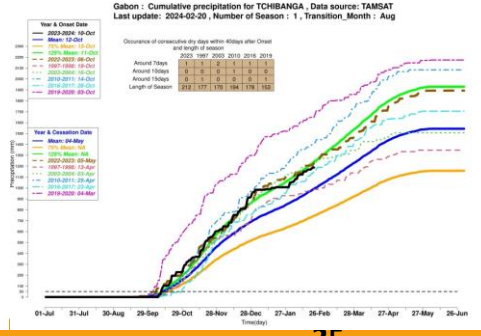


GABON









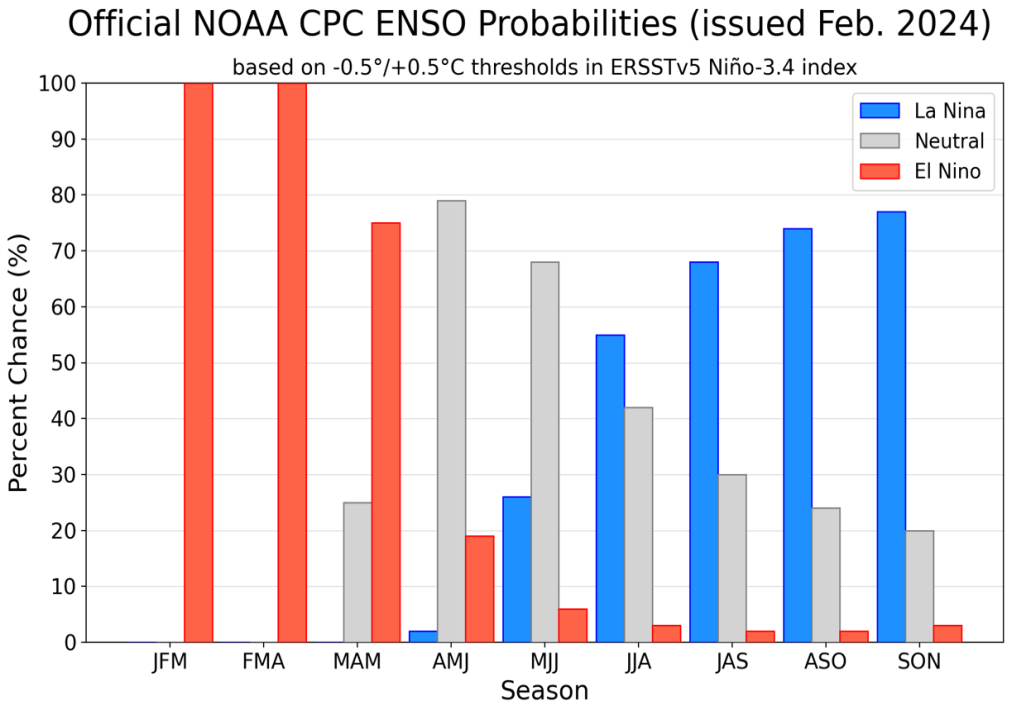
Step 4:

Teleconnections analysis (i,e ENSO, AMO, IOD, SIOD, Atlantic Dipole, NAO, AO, SAM, Benguela Nino, Mediterranean SSTAs)

CPC Probabilistic ENSO Outlook

Updated: 8 February 2024

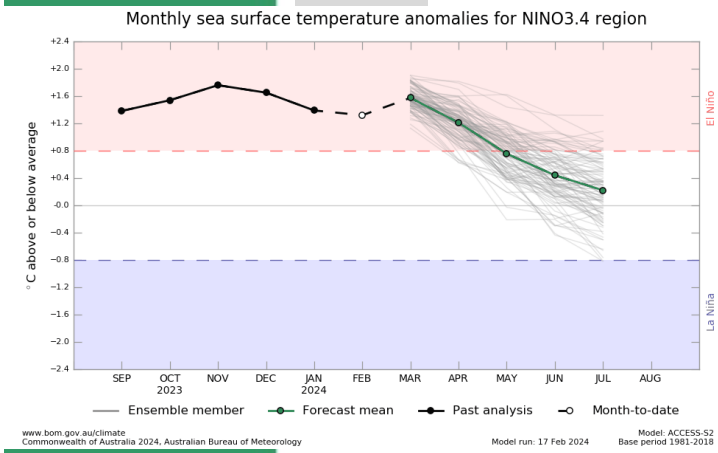
A transition from El Niño to ENSO-neutral is expected by April-June season 2024, with ENSO-neutral persisting through May-July 2024. Thereafter, La Niña is favored in June-August, and chances increase through the September-November season.



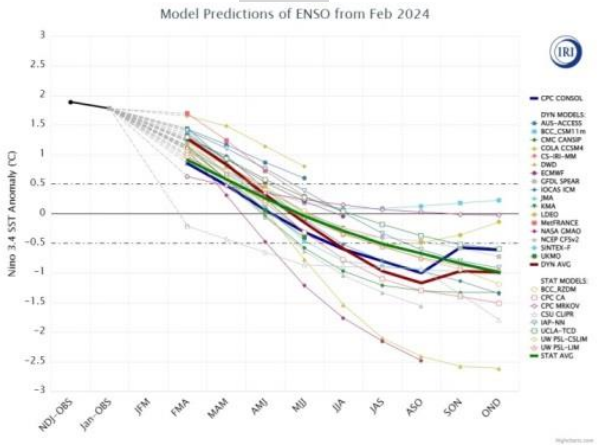
Teleconnections analysis (i,e ENSO TNA and TSA) - Index plumes

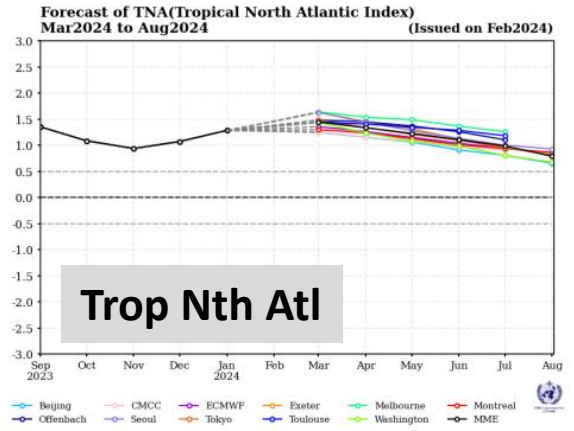
ENSO Plumes

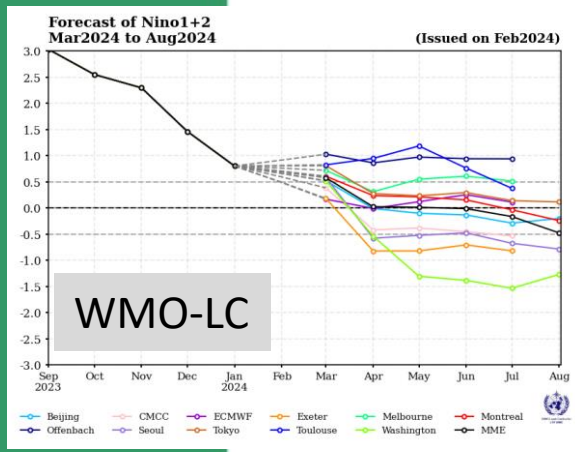
BoM

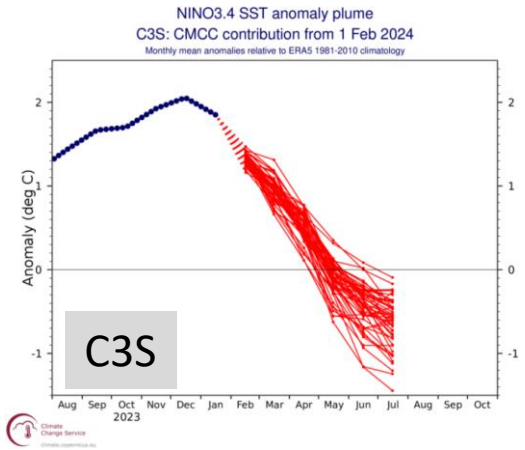


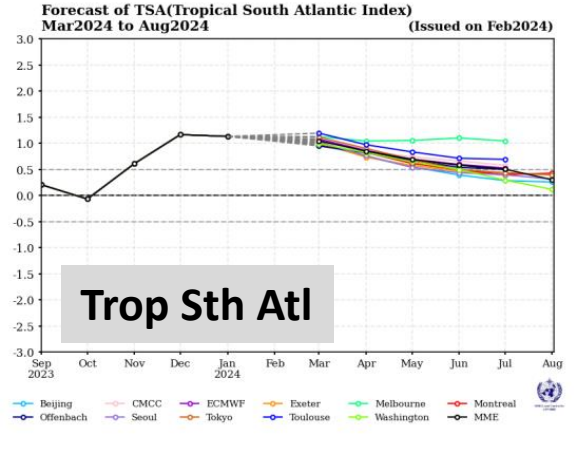
IRI











Moderate to neutral El Nino

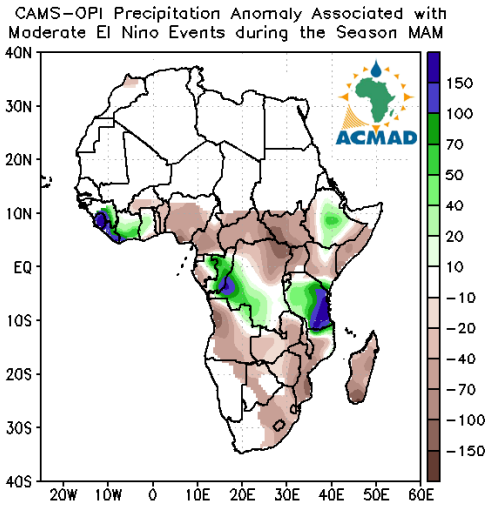
Positive TNA and TSA

Teleconnections analysis – Likely impacts on the within the region

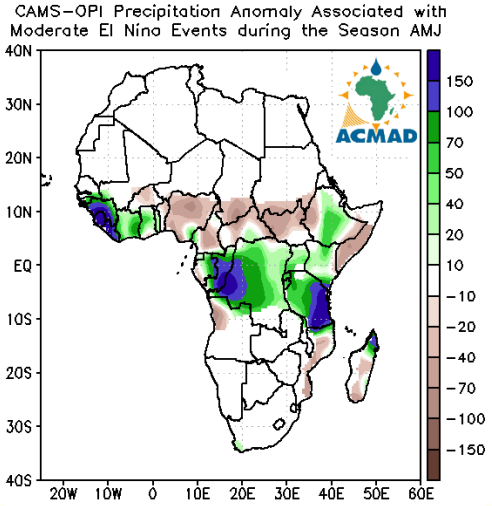
MAM

AMJ

Mod El Nino

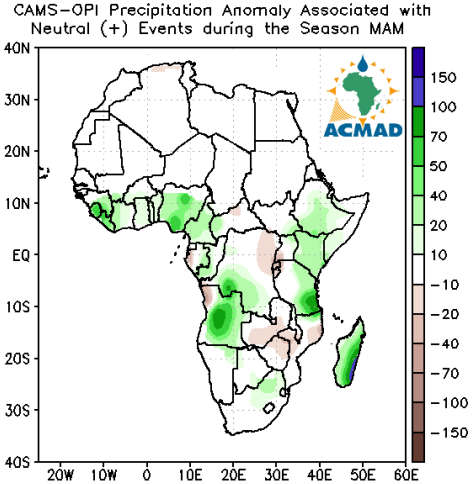


Identified Years are:
1983 1992

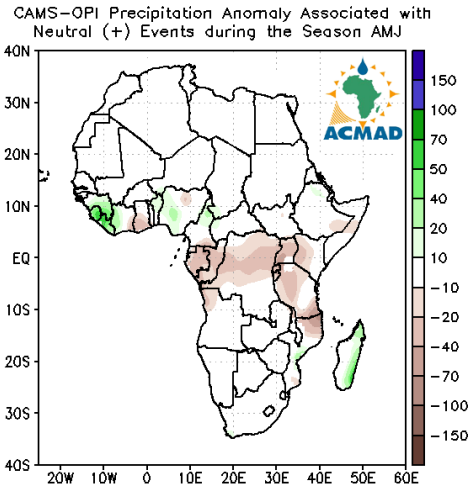


Identified Years are:
1983 1992

Weak El Nino to Neutral pos



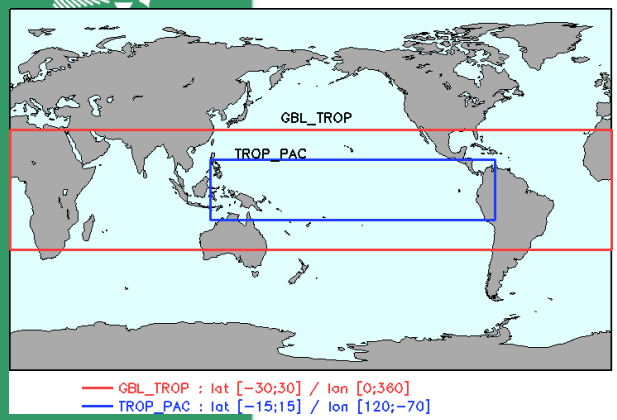
Identified Years are:
1982 1990 1991 1994 1995 1997 2002 2004 2005
2010 2014 2017 2020

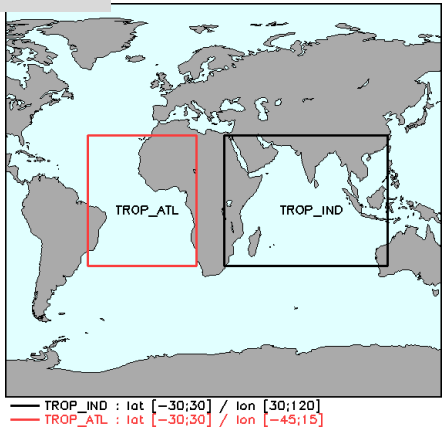


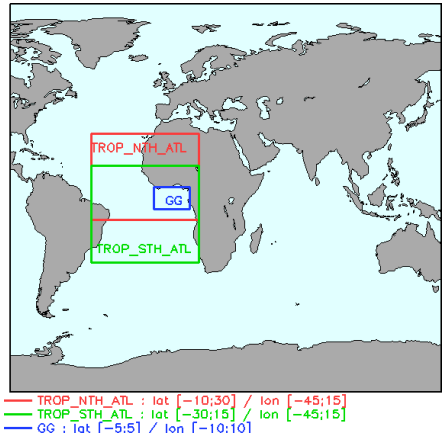
Identified Years are:
1990 1991 1994 1995 1998 2002 2004 2005 2009
2014 2016 2017

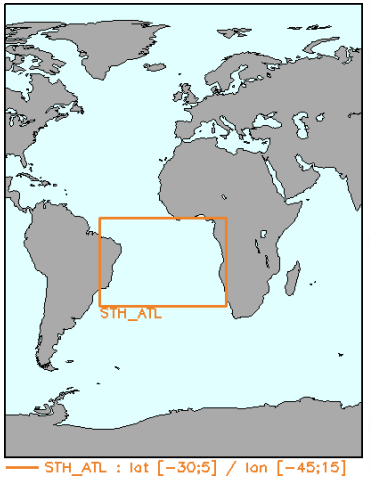
Step 5:
Statistical Forecast –
Using CPT in CCA Method

Predictor Domain
(with SST as X)

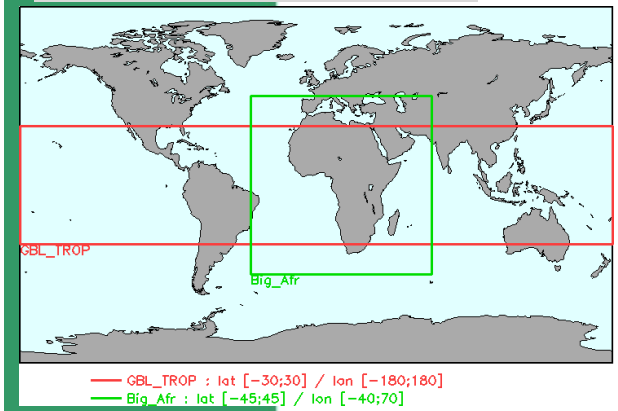






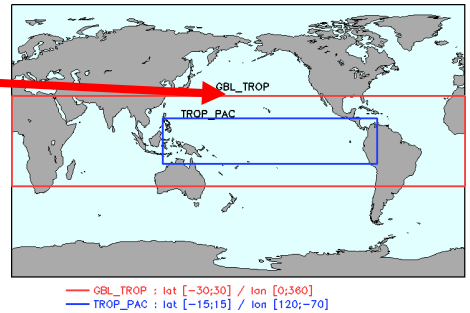


Predictor Domain
(with Precip as X)

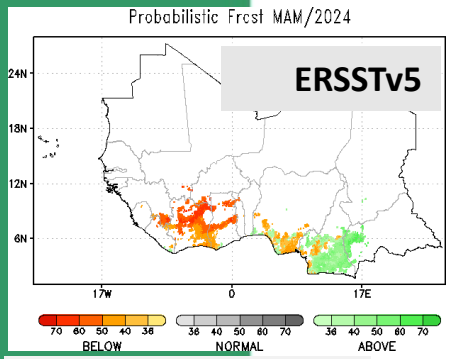


DATA SOURCES FOR EXPERIMENTS	
PREDICTAND	Gridded Observed Precipitations from CAMSOPI, TAMSAT
PREDICTOR	Observed Sea Surface Temperature from ERSSTv5
	Predicted Sea Surface Temperature from NMME (cfsv2, cmc1, cmc2, gfdl, ncar_ccsm4, nmme)
	Predicted Rainfall from NMME (cfsv2, cmc1, cmc2, gfdl, nasa, ncar_ccsm4, nmme)

Predictor
SST over Global Tropical Ocean

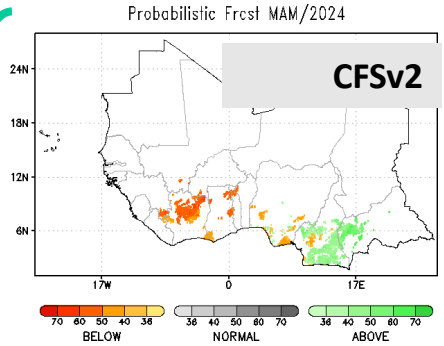


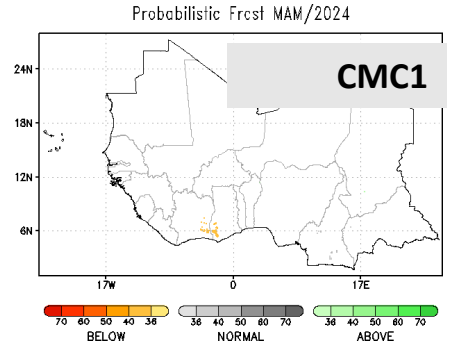
Predictand: MAM Rainfall from TAMSAT

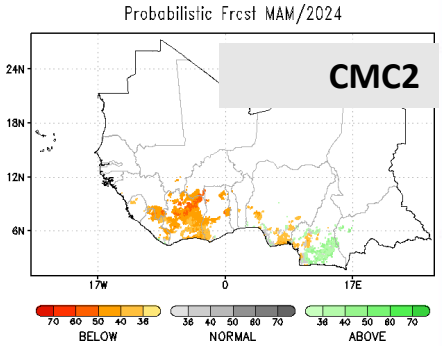


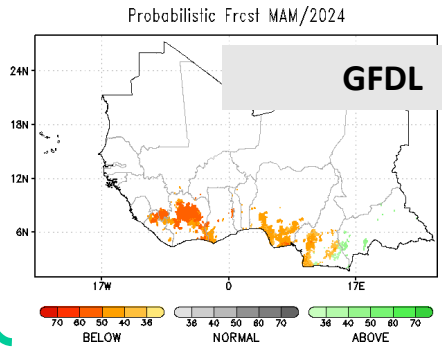
Jan Obs. SST as Predictor

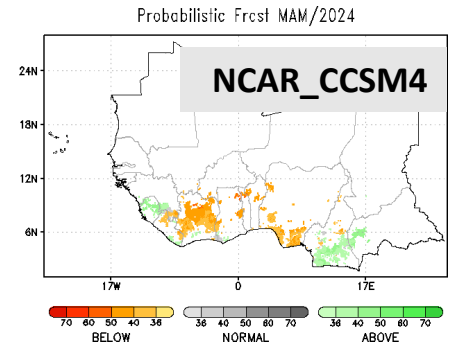
MAM Frcst (FebIC) SST as Predictor

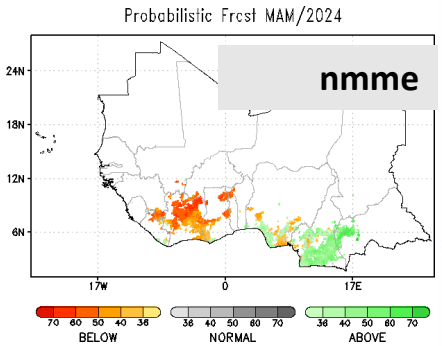






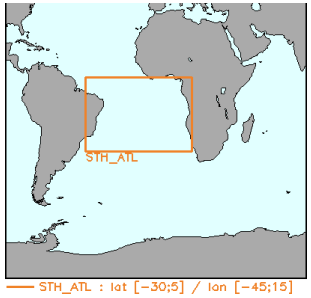




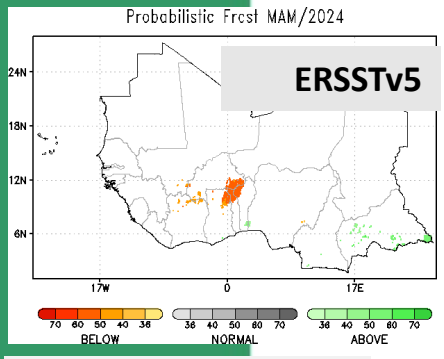


Using a Skill Mask of 0.3

Predictor
SST over South Atlantic Ocean

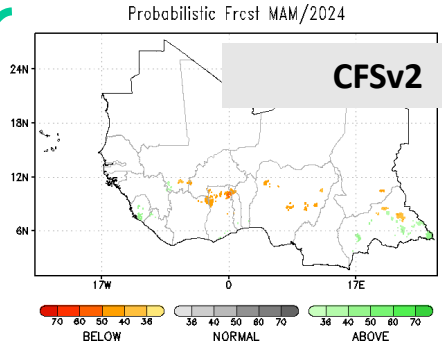


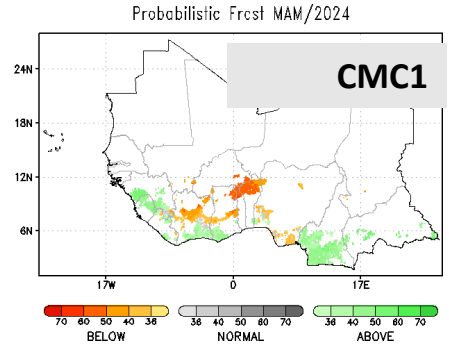
Predictand: MAM Rainfall from TAMSAT

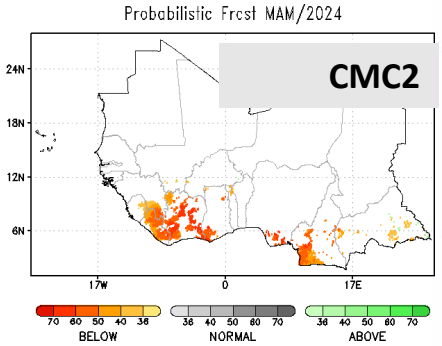


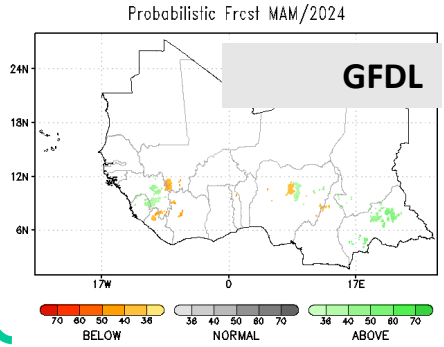
Jan Obs. SST as Predictor

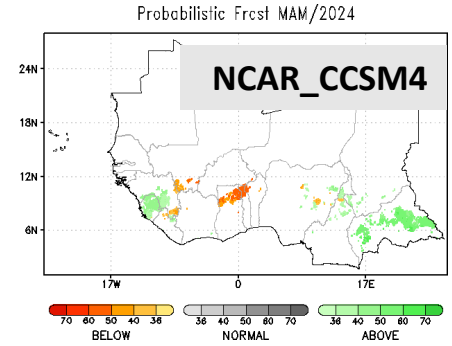
MAM Frcst (FebIC) SST as Predictor

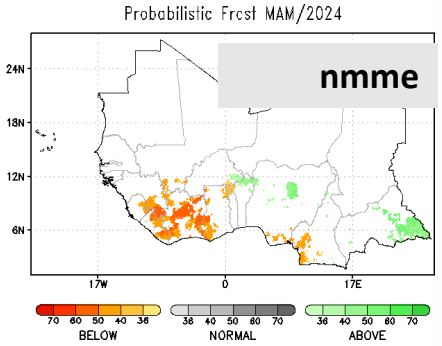










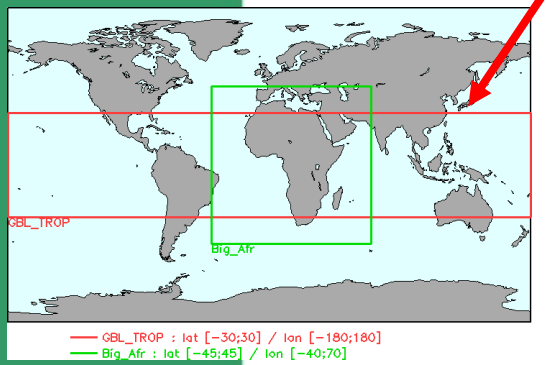


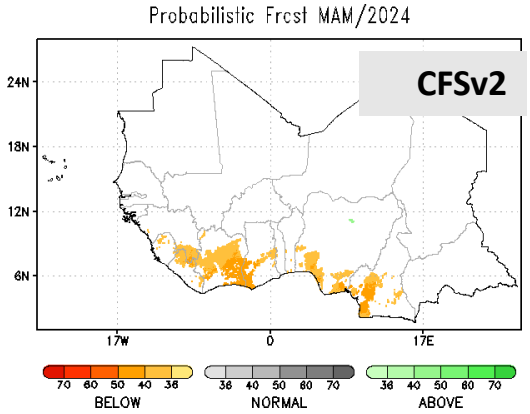
Using a Skill Mask of 0.3

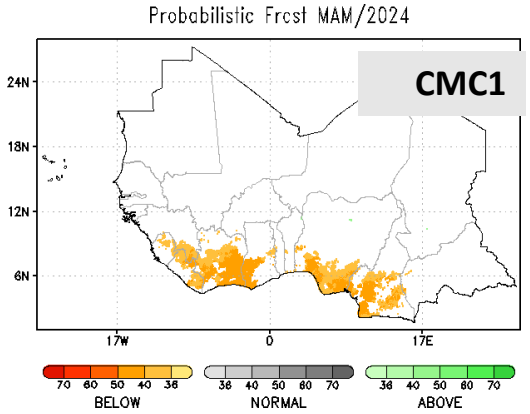
Predictor
Precip over Global Tropical

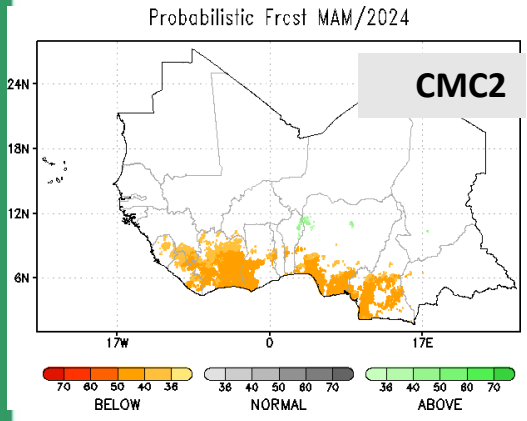
Predictor (X): MAM Frcst (FebIC) Rainfall

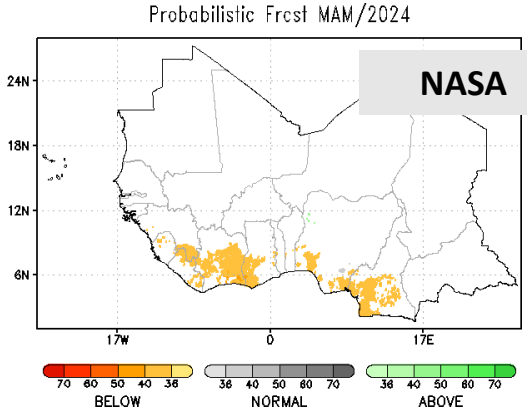
Predictand (Y): MAM Rainfall from TAMSAT

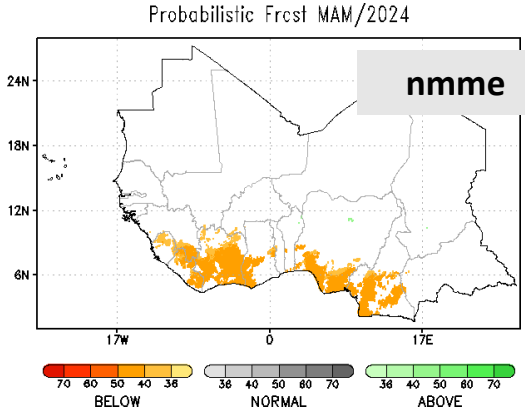






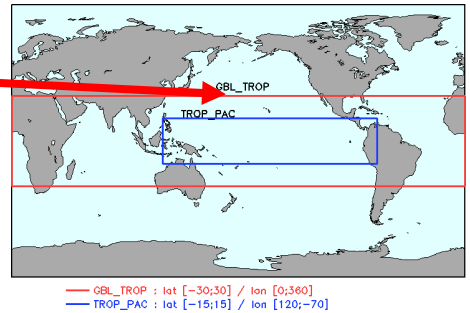




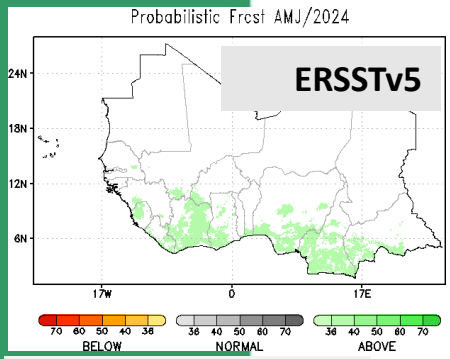


Using a Skill Mask of 0.3

Predictor
SST over Global Tropical Ocean

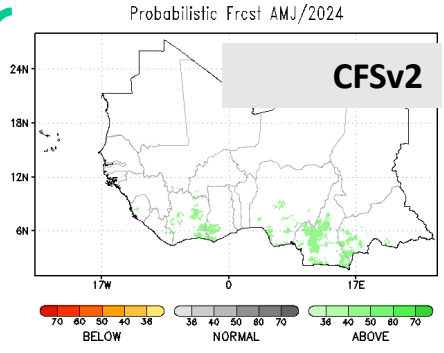


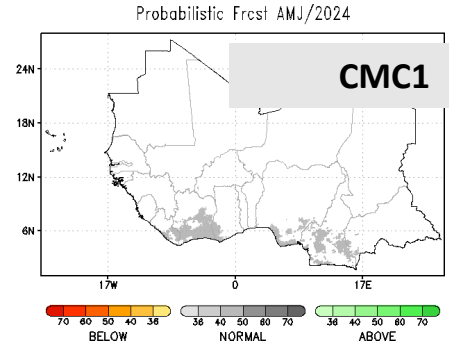
Predictand: AMJ Rainfall from TAMSAT

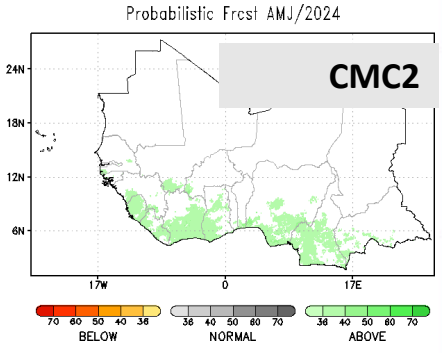


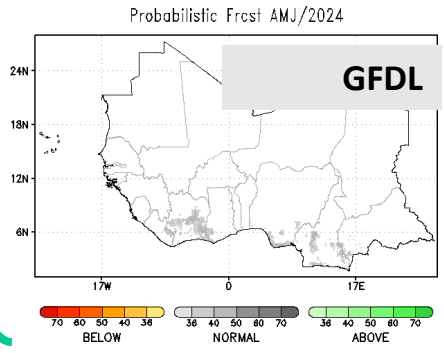
Jan Obs. SST as Predictor

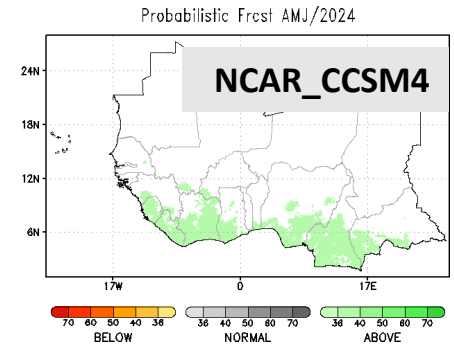
AMJ Frcst (FebIC) SST as Predictor

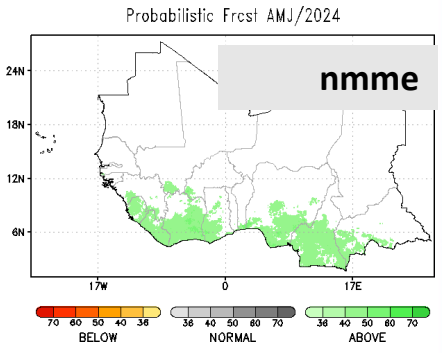






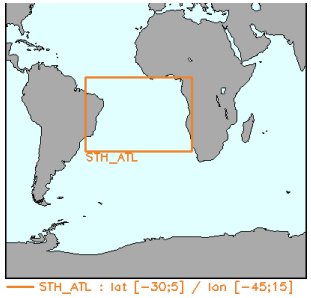






Using a Skill Mask of 0.3

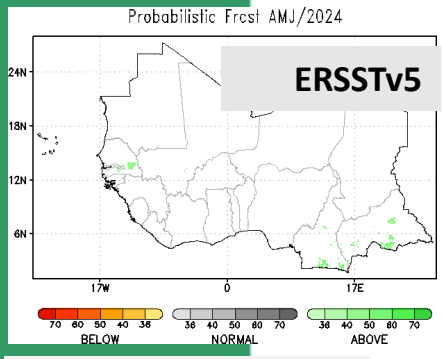
Predictor
SST over South Atlantic Ocean

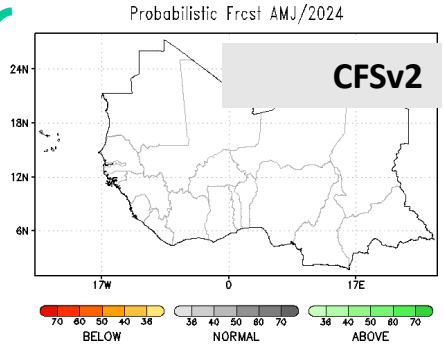


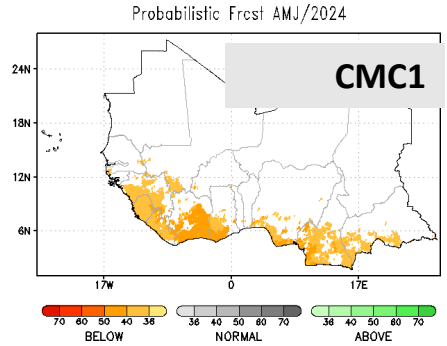
Predictand: AMJ Rainfall from TAMSAT

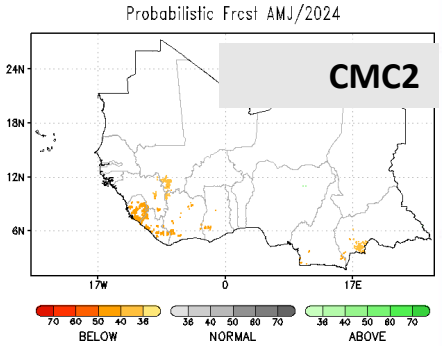
Jan Obs. SST as Predictor

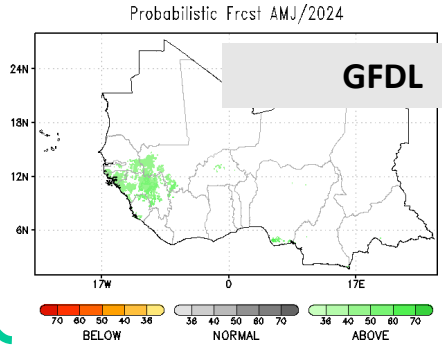
AMJ Frcst (FebIC) SST as Predictor

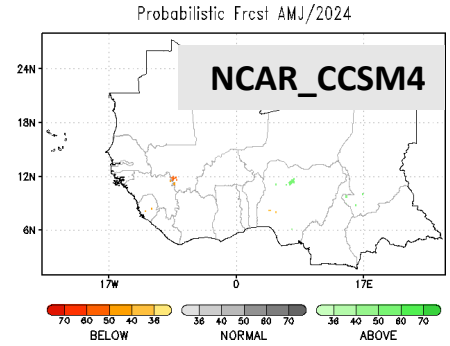


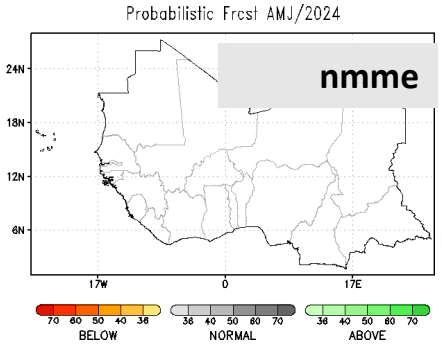










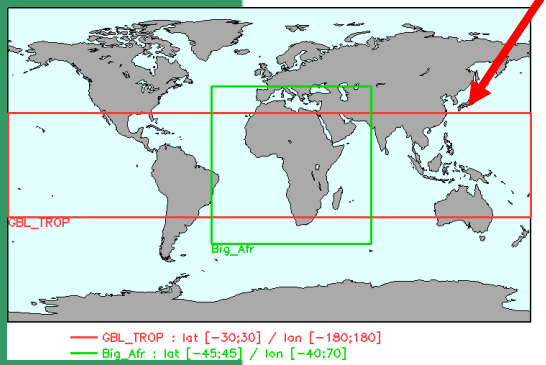


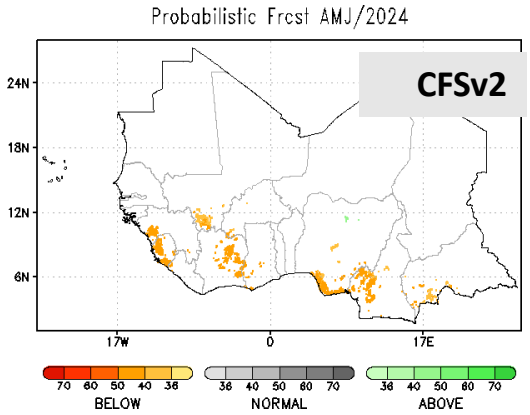
Using a Skill Mask of 0.3

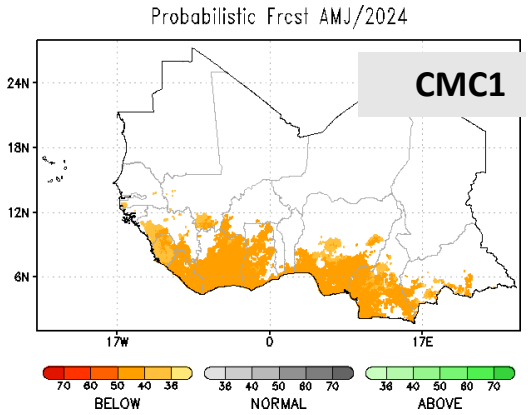
Predictor
Precip over Global Tropical

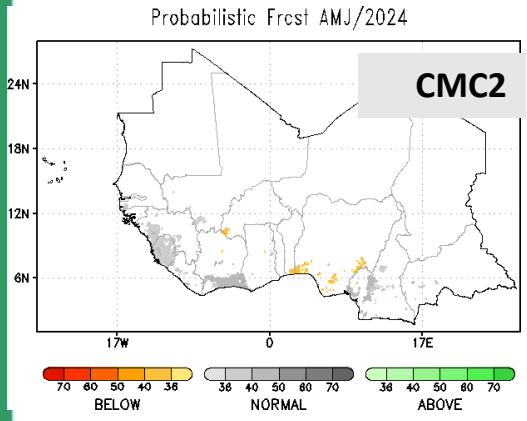
Predictor (X): AMJ Frcst (FebIC) Rainfall

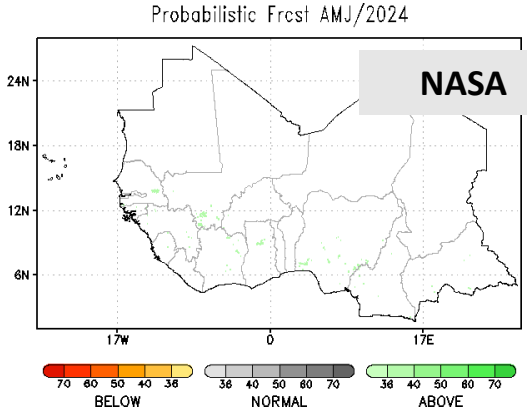
Predictand (Y): MAM Rainfall from TAMSAT

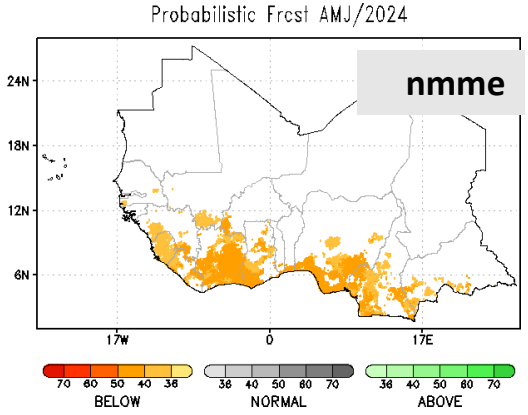








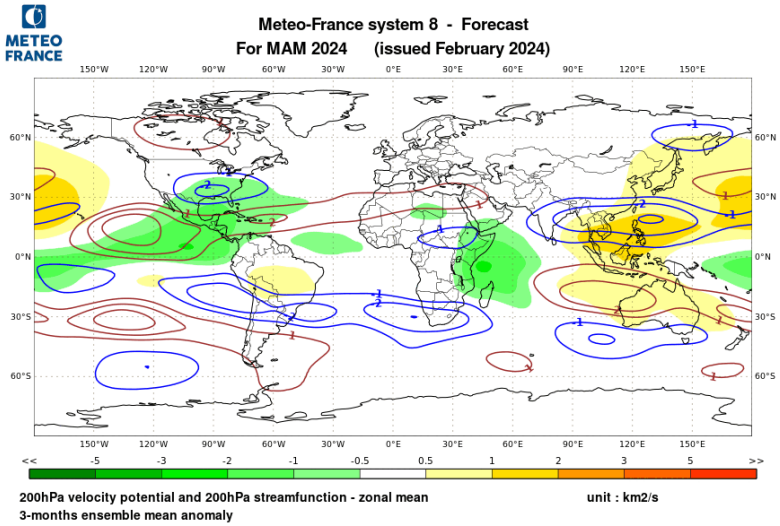


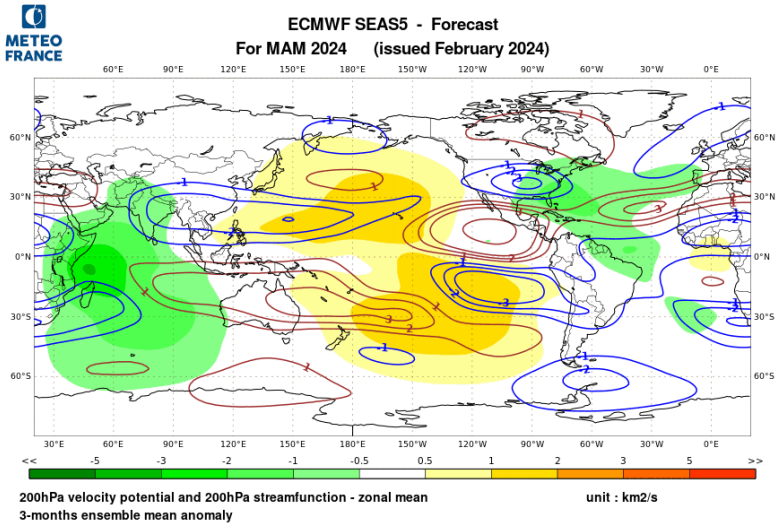


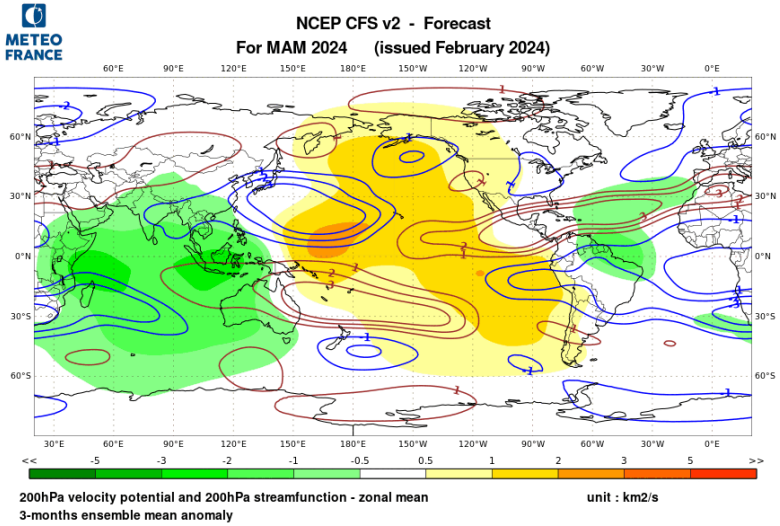
Using a Skill Mask of 0.3

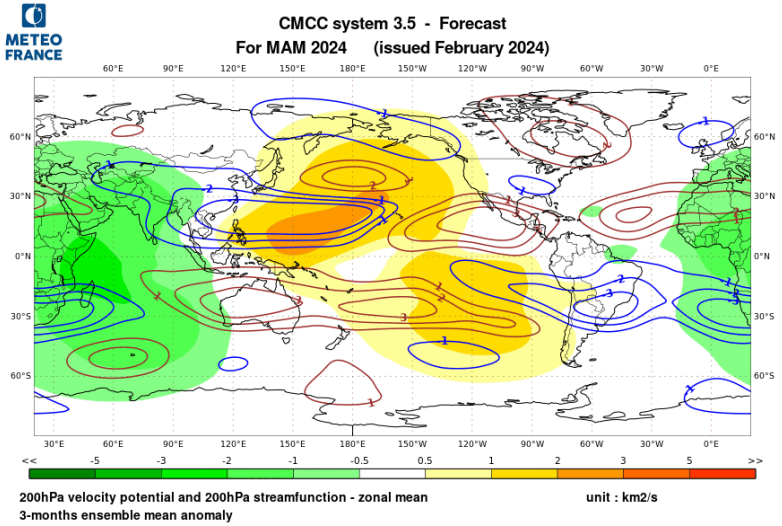
Step 6:
Interactions analysis between seasons and regions for the same target season – Impact of Tropical Activity

Interaction with Tropical Activity – Season 1

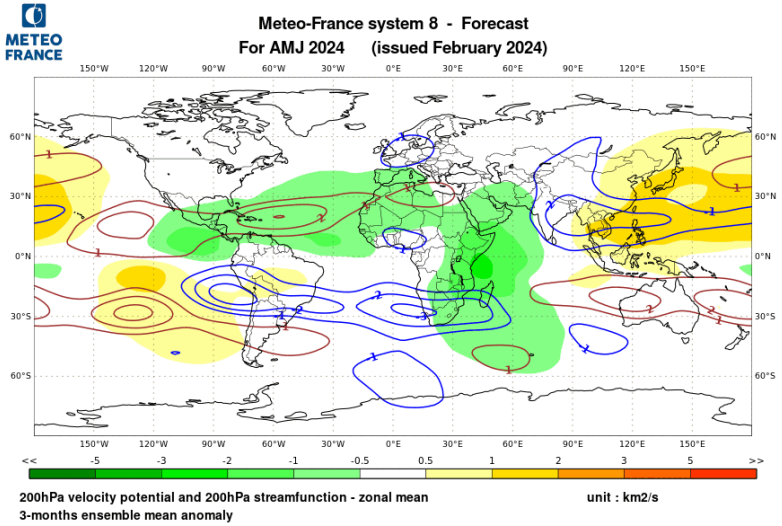


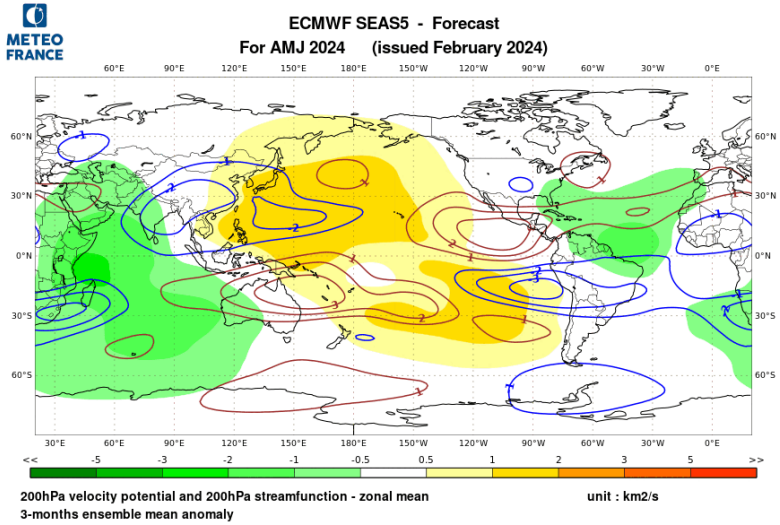


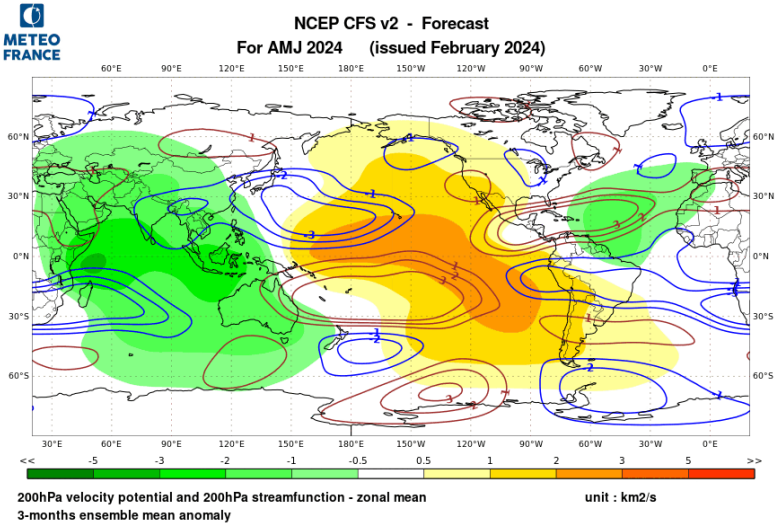


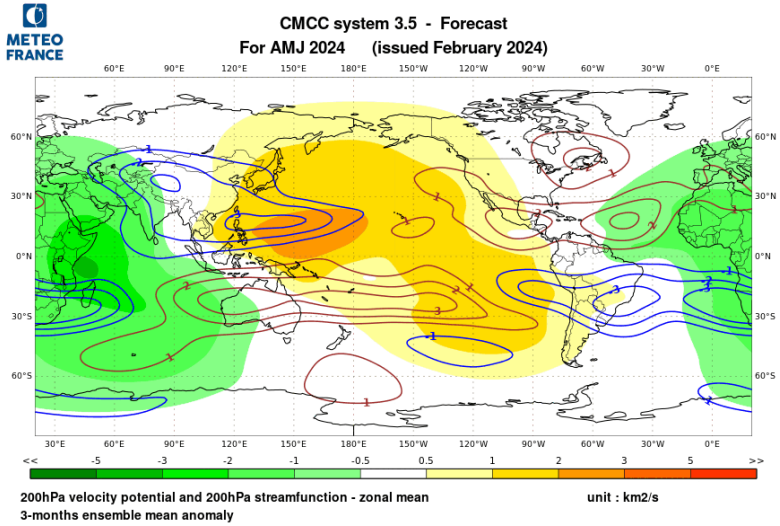


Interaction with Tropical Activity – Season 2







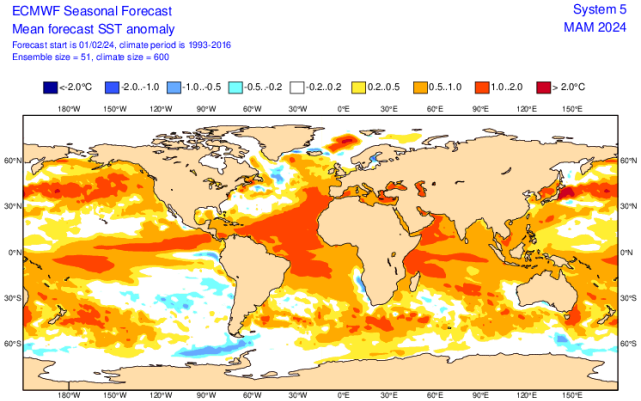
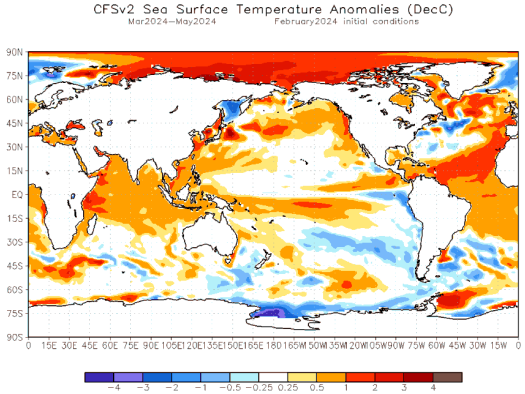
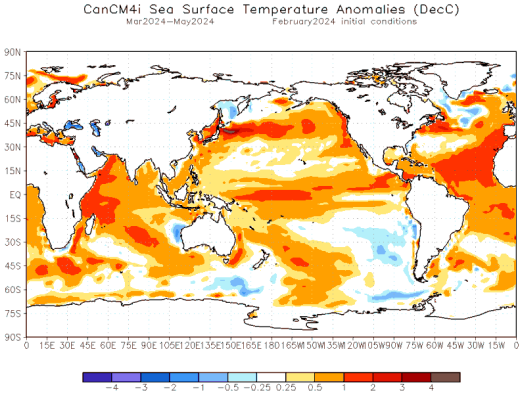
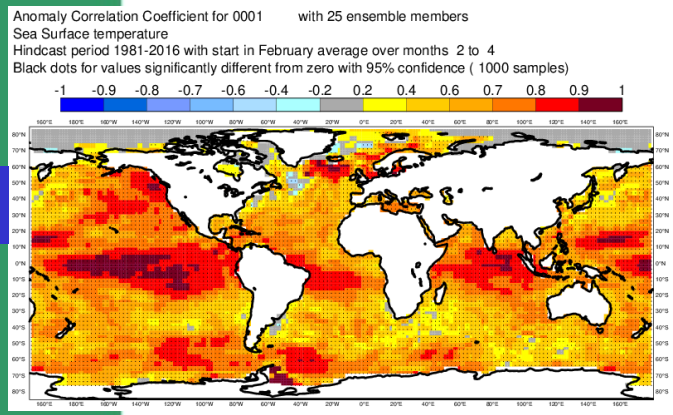
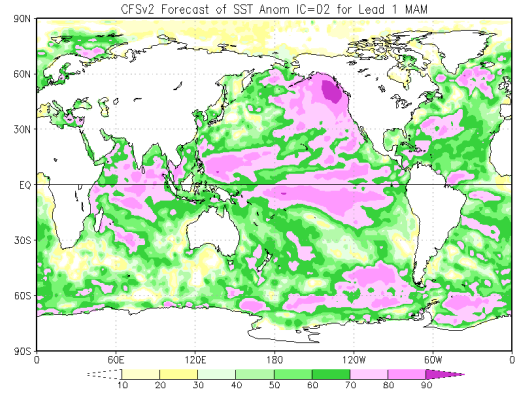
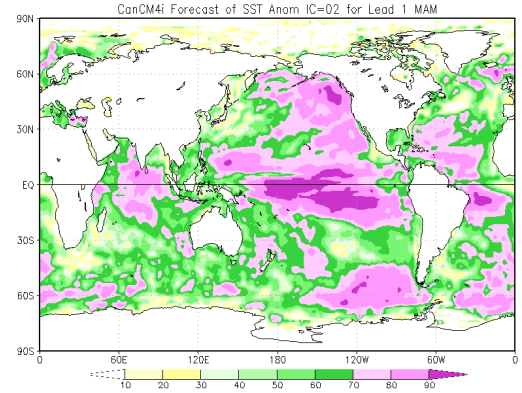


Step 7:
Single Model Ensemble Analysis (i,e ECMWF, MF, NCEP, UKMET)

SSTs and Precip Forecast

Single Model Ensemble Analysis (SSTs)

MAM Season

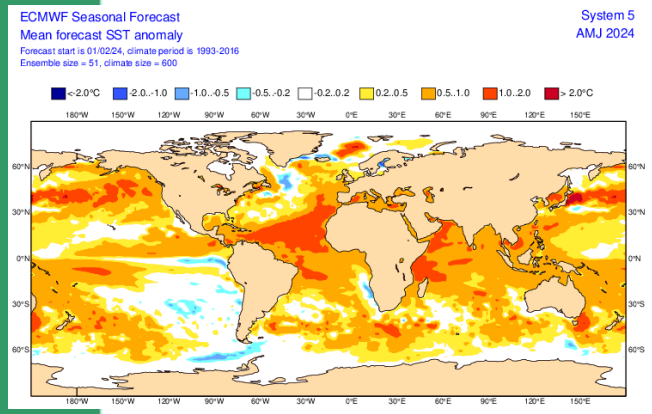
	ECMWF	CFSv2	CanCM4i
FCST			
SKILL			

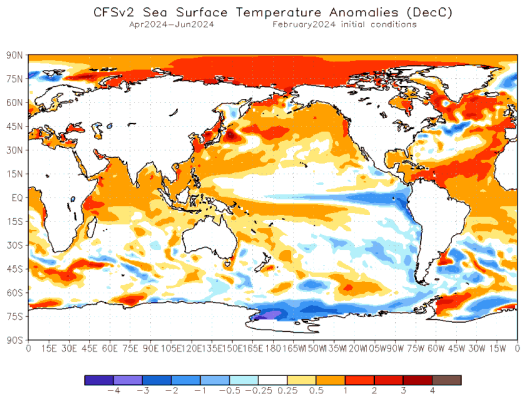
Single Model Ensemble Analysis (SSTs)

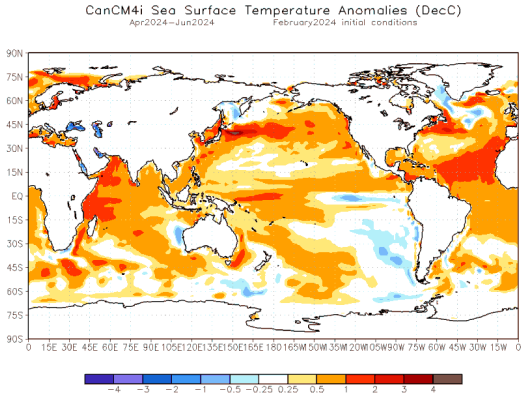
AMJ Season

ECMWF | **CFSv2** | **CanCM4i**

FCST







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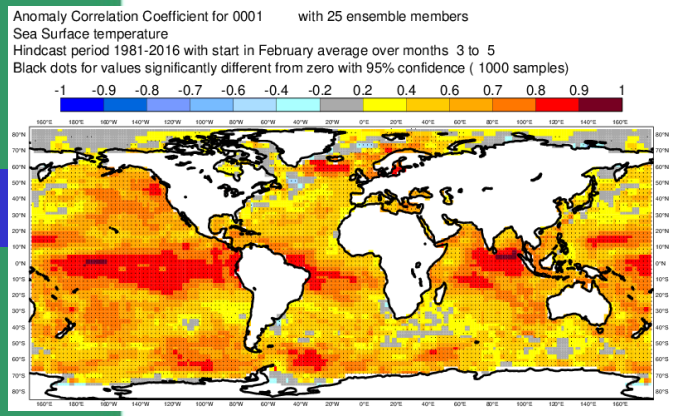
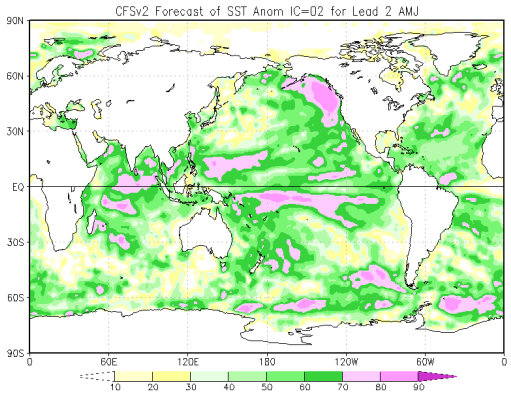
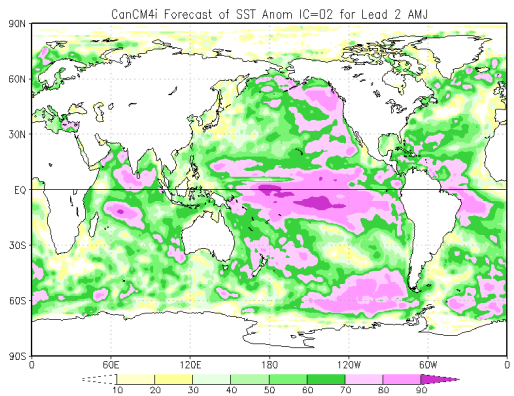




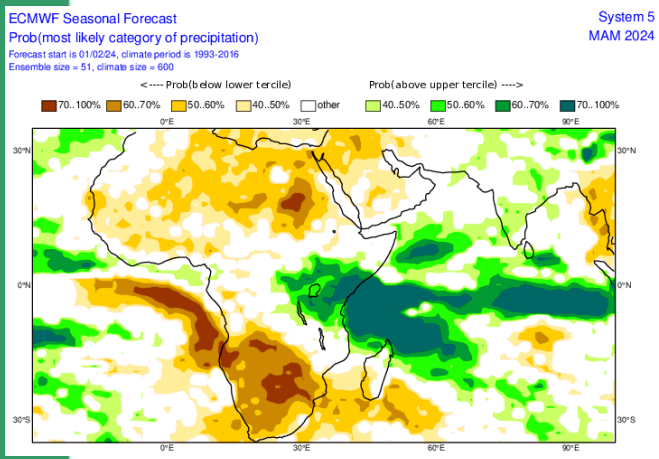


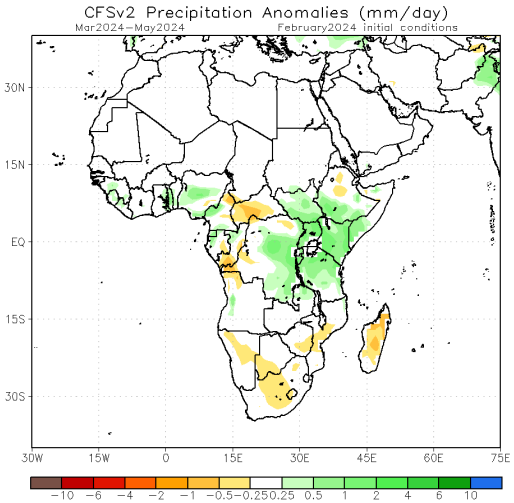
Single model Ensemble Analysis (Rainfall)

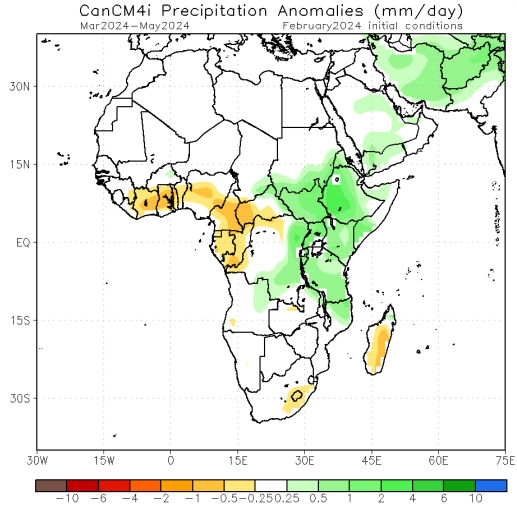
MAM Season

ECMWF | **CFSv2** | **CanCM4i**

FCST







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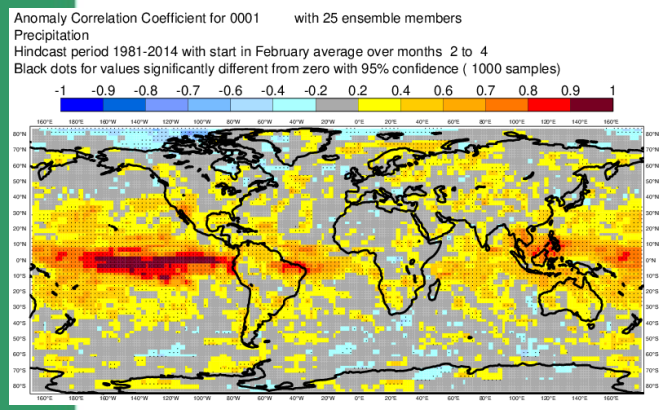
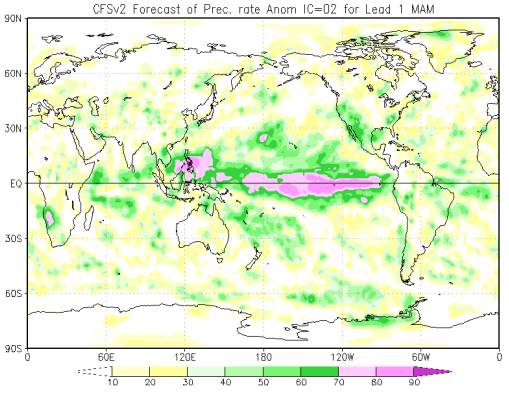
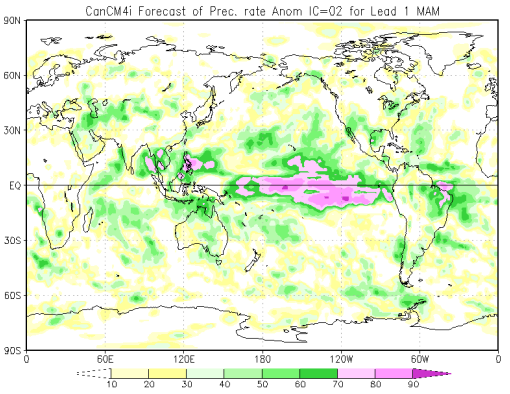




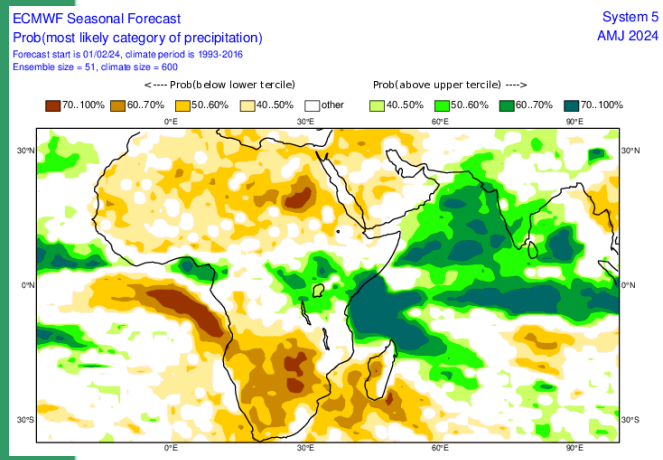


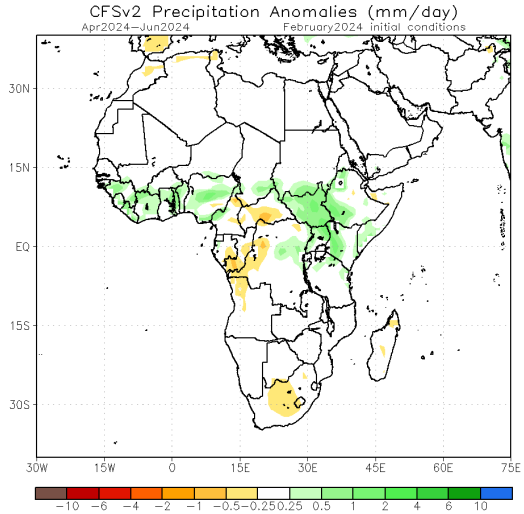
Single model Ensemble Analysis (Rainfall)

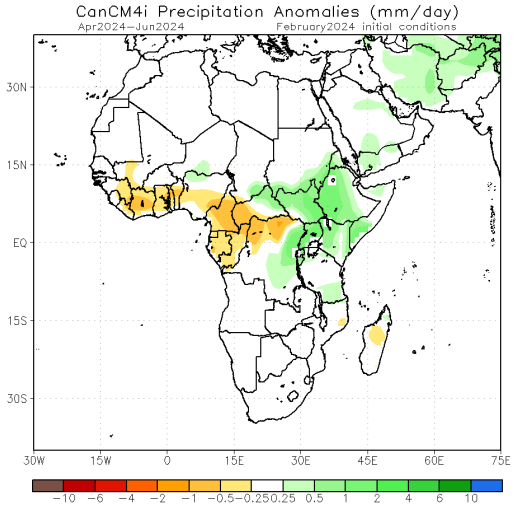
AMJ Season

ECMWF | **CFSv2** | **CanCM4i**

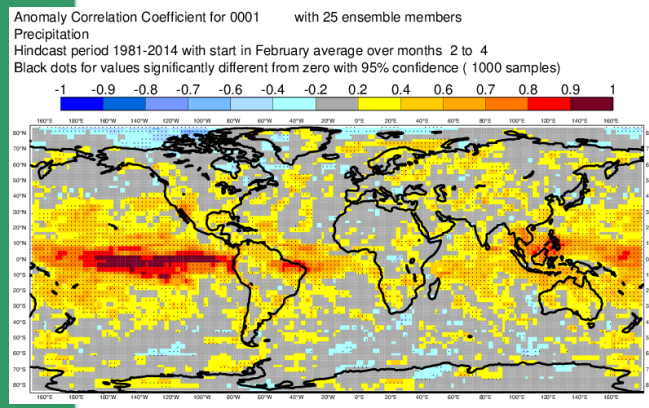
FCST

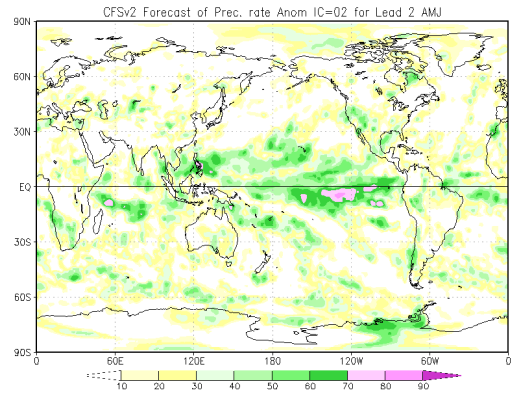


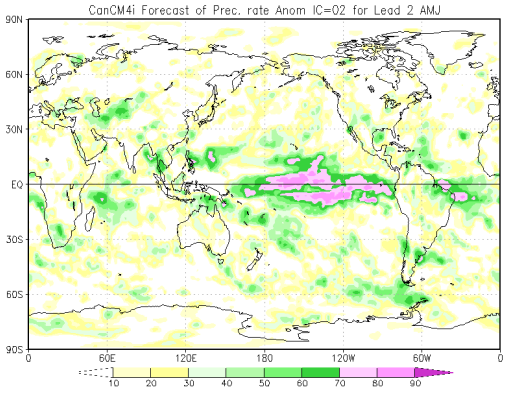




SKILL







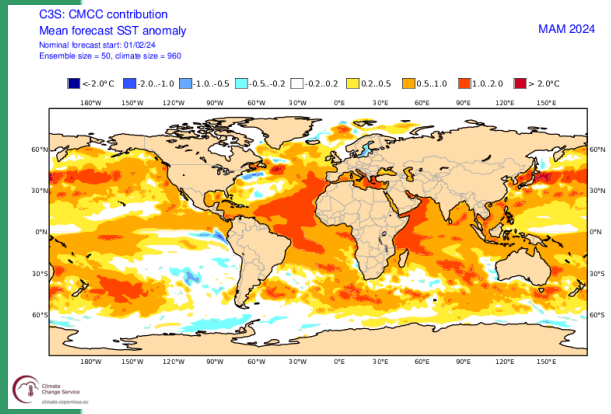
Step 8:
Multi Model Ensemble Analysis (i,e C3S, NMME, WMO-LC)

SSTs and Precip Forecast

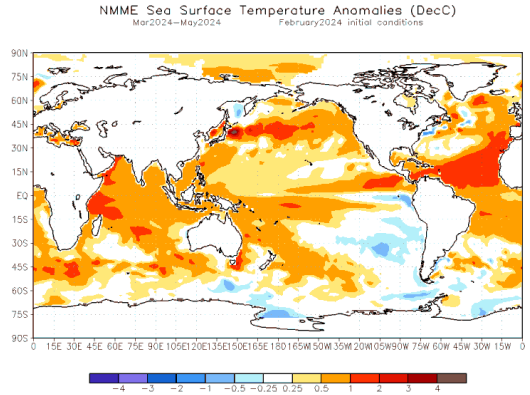
Multimodel Ensemble Analysis (SSTs)

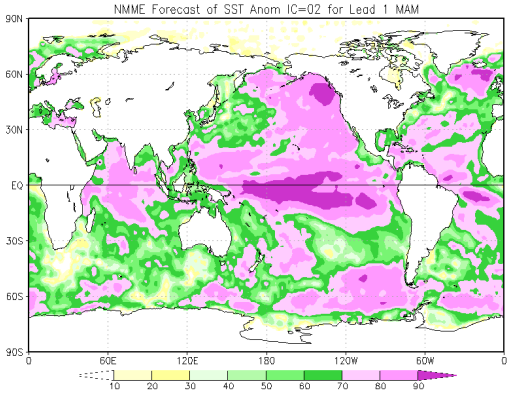
MAM Season

C3S



NMME





WMO-LC

FCST

SKILL

Multimodel Ensemble Analysis (SSTs)

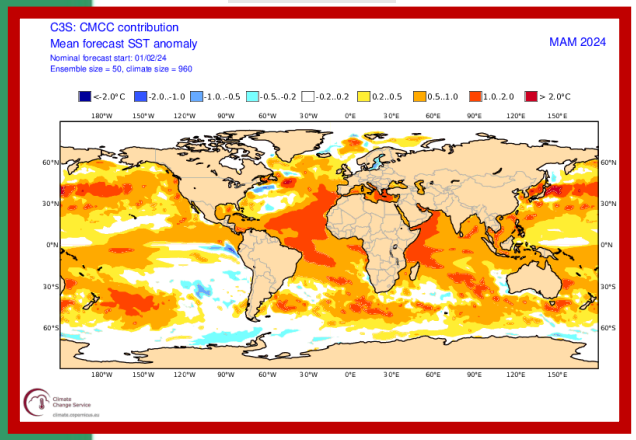
AMJ Season

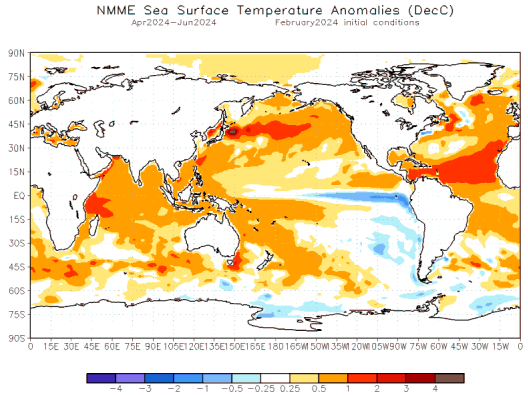
C3S

NMME

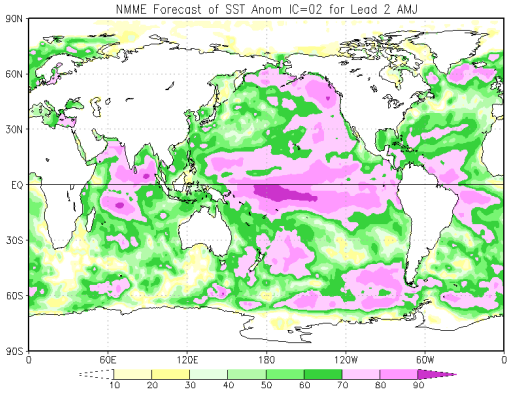
WMO-LC

FCST





SKILL



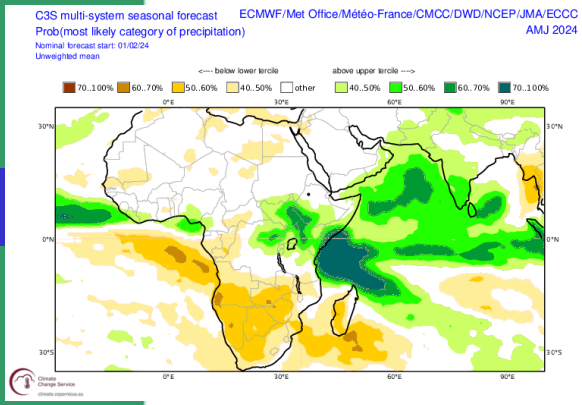
Multimodel Ensemble Analysis(Rainfall)

MAM Season

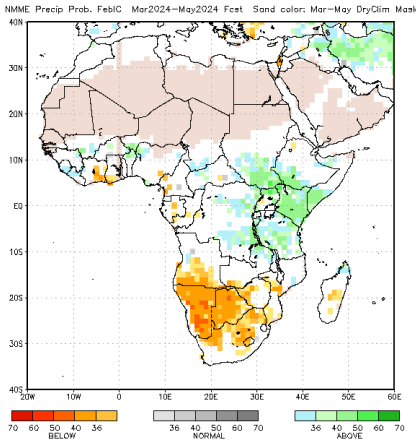
FCST

SKILL

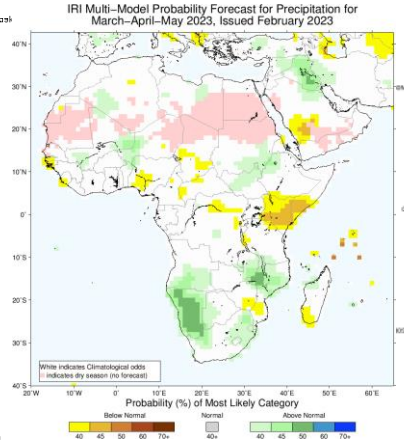
C3S



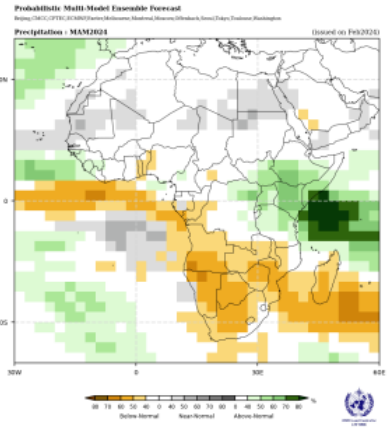
NMME

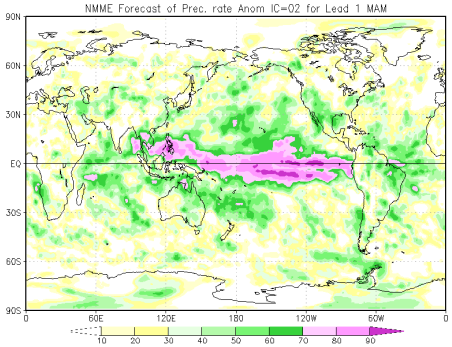


IRI



WMO-LC





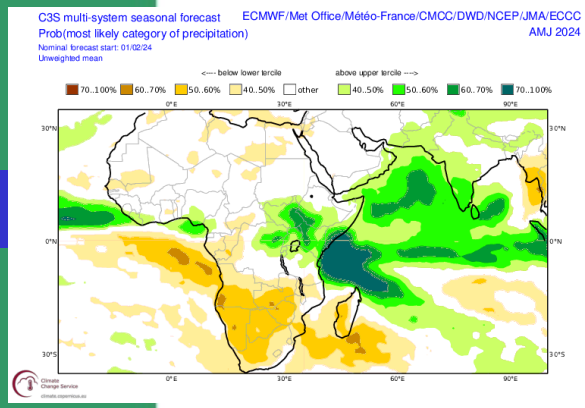
Multimodel Ensemble Analysis(Rainfall)

AMJ Season

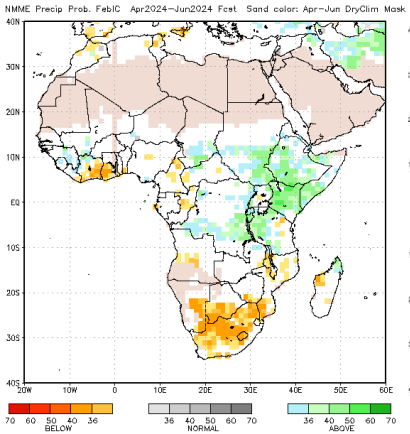
FCST

SKILL

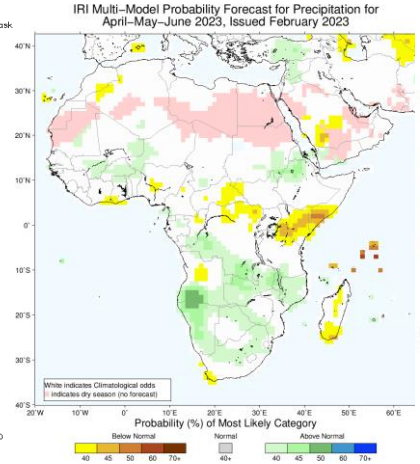
C3S



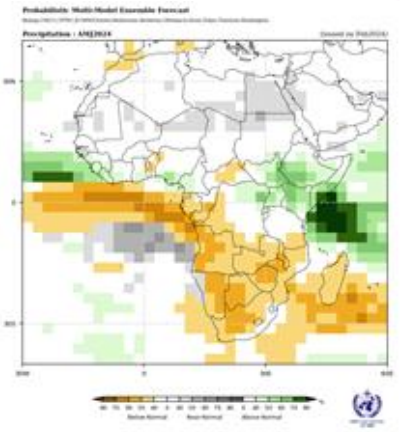
NMME

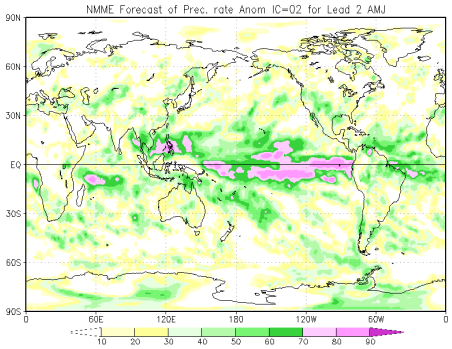


IRI



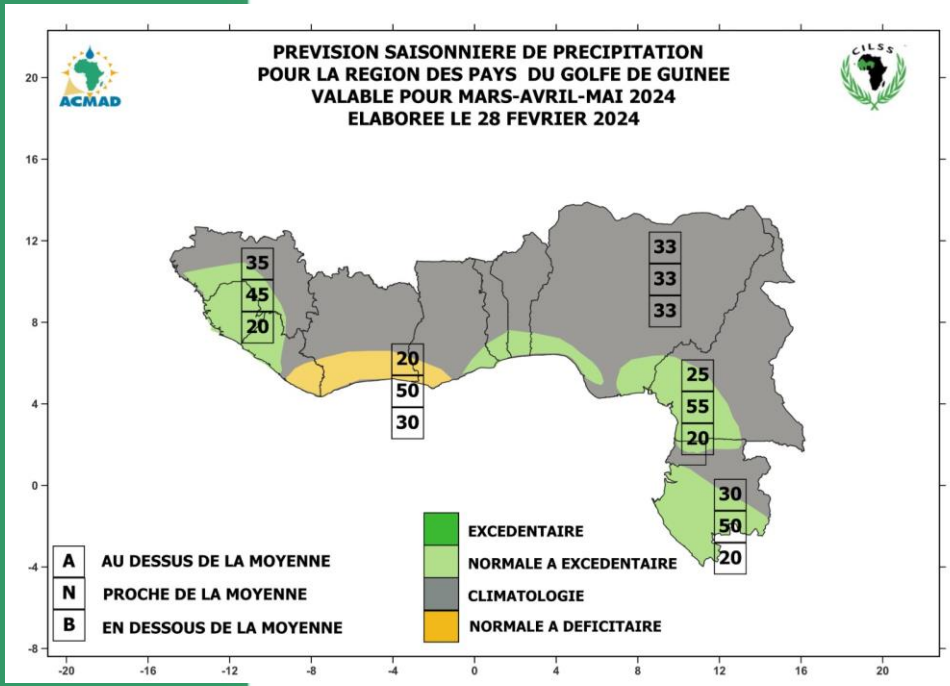
WMO-LC

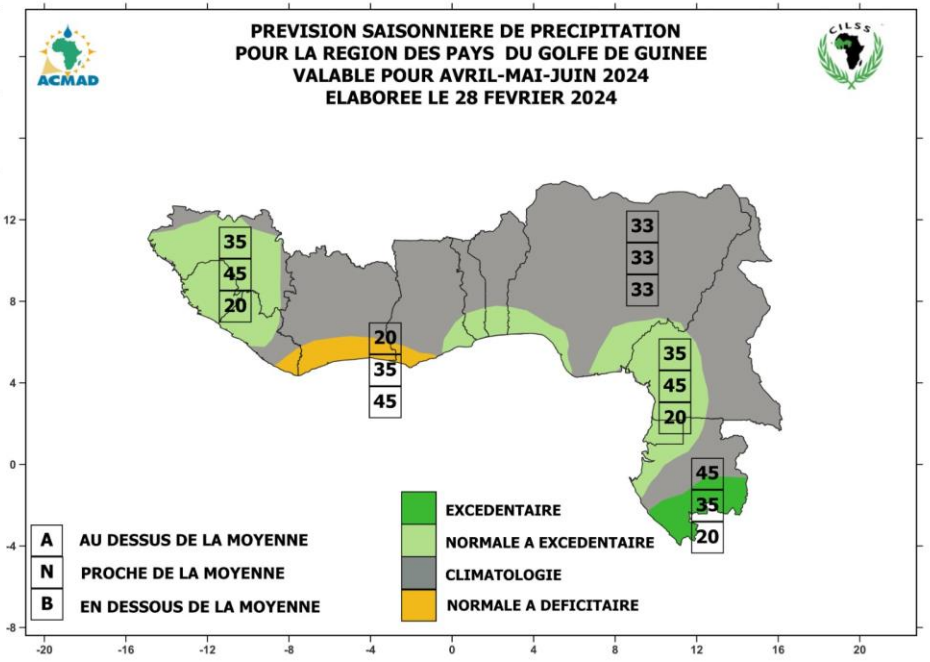




Step 9:
Consolidation Analysis of institutional outlook

SEASONAL PRECIPITATION OUTLOOK FOR MAM & AMJ 2024





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