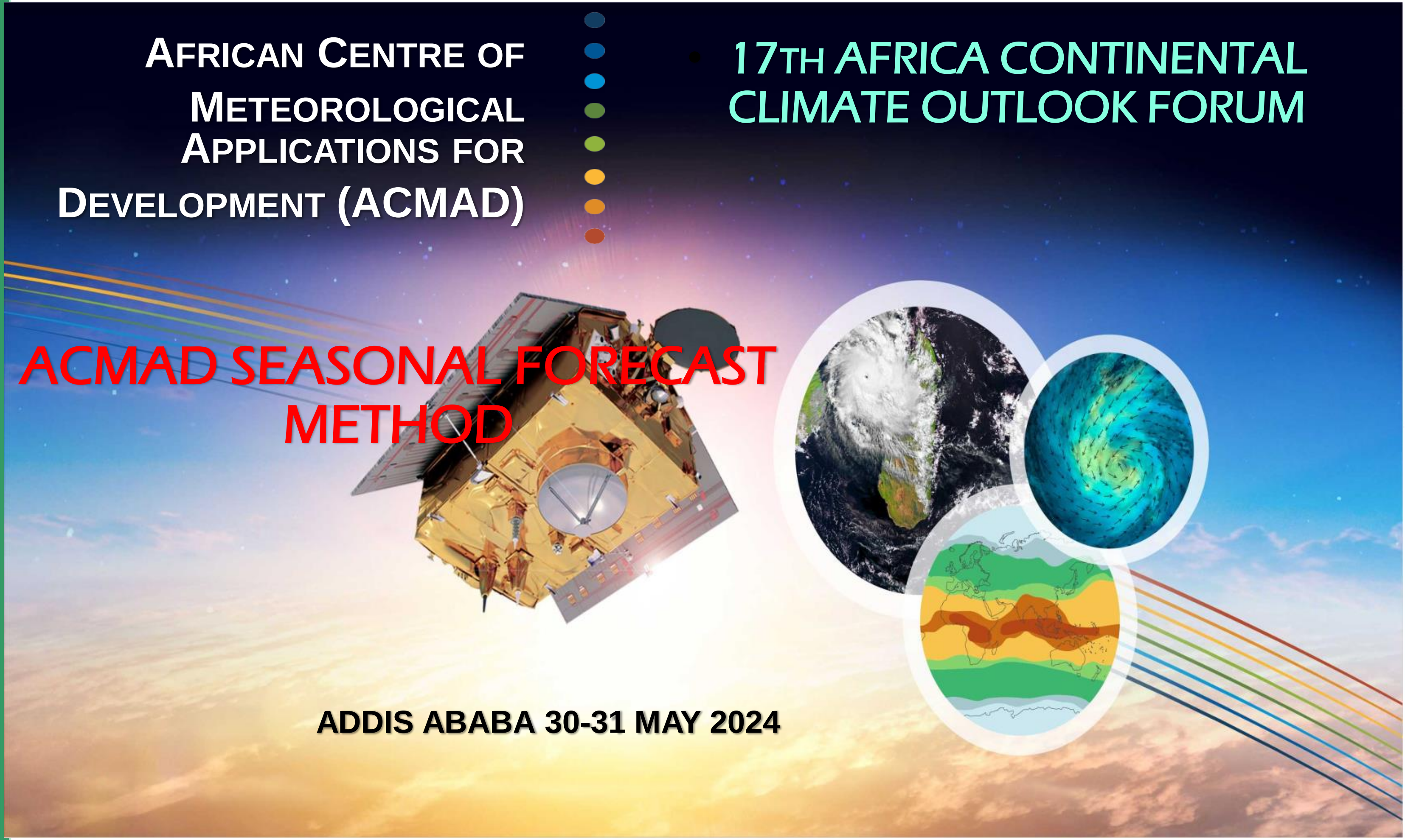
WORLD
METEOROLOGICAL
ORGANIZATION



AFRICAN CENTRE OF
METEOROLOGICAL
APPLICATIONS FOR
DEVELOPMENT (ACMAD)

17TH AFRICA CONTINENTAL
CLIMATE OUTLOOK FORUM

ACMAD SEASONAL FORECAST METHOD

ADDIS ABABA 30-31 MAY 2024

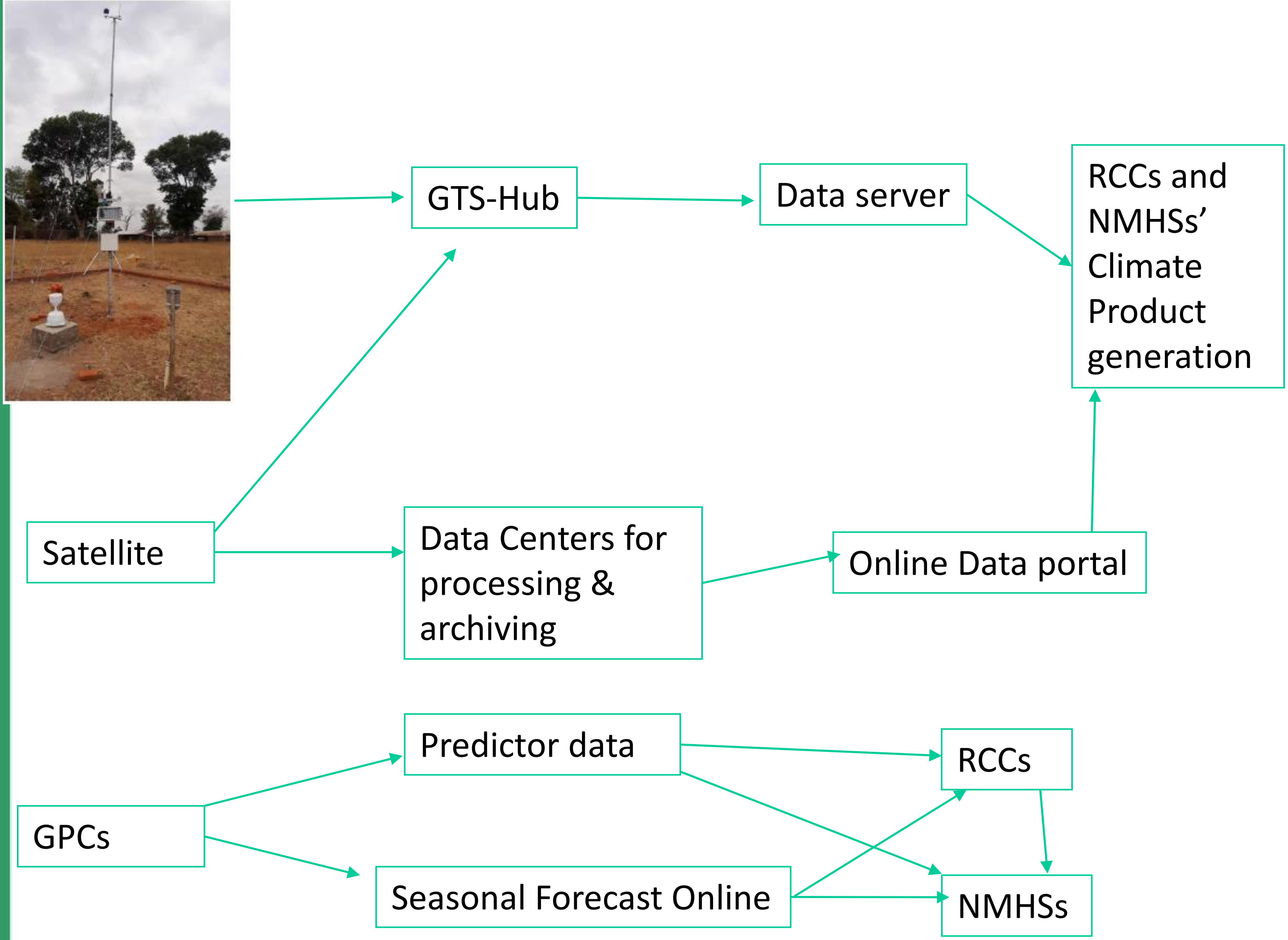
ClimSA
INTRA-ACP CLIMATE SERVICES AND RELATED APPLICATIONS PROGRAMME

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

CONTENT

1. ***DATA PRECESSING***
2. ***TOOLS***
3. ***PRODUCTS***
4. ***SEASONAL FORECAST’9 STEPs***

DATA PROCESSING



GTS-Hub

Data server

RCCs and NMHSs’ Climate Product generation

Satellite

Data Centers for processing & archiving

Online Data portal

Predictor data

RCCs

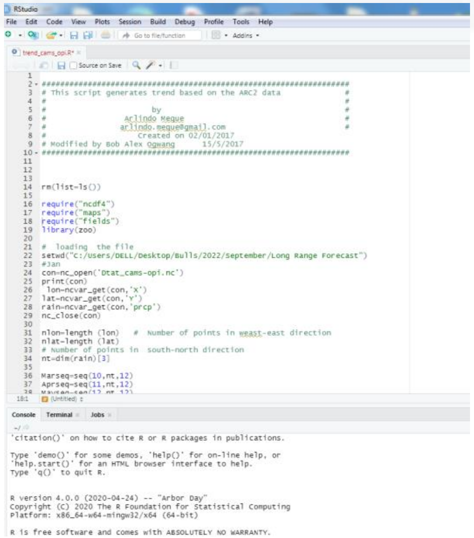
GPCs

Seasonal Forecast Online

NMHSs

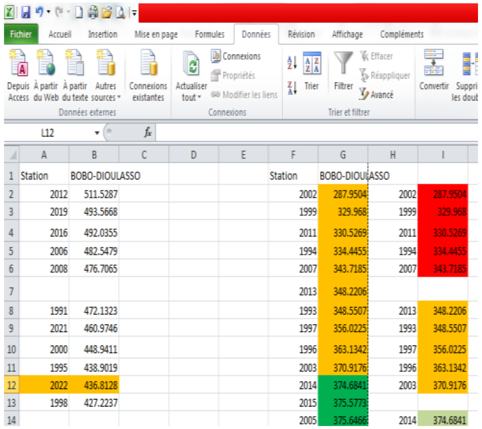
TOOLS

R & RStudio


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
trend_cams_opi.R*
Source on Save
18:1
(Untitled)
Console
Terminal
Jobs
~/

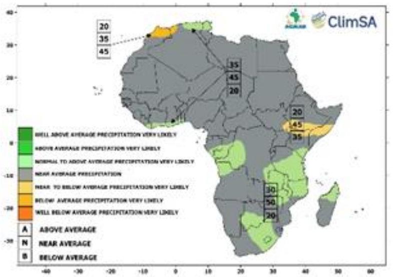
```
##################################################################
# This script generates trend based on the ARC2 data            #
#                                                                #
#                         by                                     #
#                   Arlindo Meque                                #
#                 arlindo.meque@gmail.com                        #
#                     Created on 02/01/2017
# Modified by Bob Alex Ogwang      15/5/2017
##################################################################



rm(list=ls())

require("ncdf4")
require("maps")
require("fields")
library(zoo)

#  loading  the file
setwd("C:/Users/DELL/Desktop/Bulls/2022/September/Long Range Forecast")
#Jan
con=nc_open('Dtat_cams-opi.nc')
print(con)
 lon=ncvar_get(con,'X')
lat=ncvar_get(con,'Y')
rain=ncvar_get(con,'prcp')
nc_close(con)

nlon=length (lon)   #  Number of points in weast-east direction
nlat=length (lat)
# Number of points in  south-north direction
nt=dim(rain)[3]

Marseq=seq(10,nt,12)
Aprseq=seq(11,nt,12)
```

```
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.


R version 4.0.0 (2020-04-24) -- "Arbor Day"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
```


Fichier
Accueil
Insertion
Mise en page
Formules
Données
Révision
Affichage
Compléments
Depuis Access
À partir du Web
À partir du texte
Autres sources
Connexions existantes
Actualiser tout
Connexions
Propriétés
Modifier les liens
Trier
Filtrer
Effacer
Réappliquer
Avancé
Convertir
Suppri les doub
Données externes
Connexions
Trier et filtrer
L12

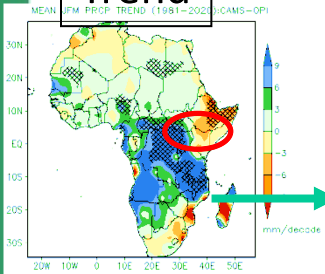
	A	B	C	D	E	F	G	H	I
1	Station	BOBO-DIOULASSO				Station	BOBO-DIOULASSO		
2	2012	511.5287				2002	287.9504	2002	287.9504
3	2019	493.5668				1999	329.968	1999	329.968
4	2016	492.0355				2011	330.5269	2011	330.5269
5	2006	482.5479				1994	334.4455	1994	334.4455
6	2008	476.7065				2007	343.7185	2007	343.7185
7						2013	348.2206		
8	1991	472.1323				1993	348.5507	2013	348.2206
9	2021	460.9746				1997	356.0225	1993	348.5507
10	2000	448.9411				1996	363.1342	1997	356.0225
11	1995	438.9019				2003	370.9176	1996	363.1342
12	2022	436.8128				2014	374.6841	2003	370.9176
13	1998	427.2237				2015	375.5773		
14						2005	375.6466	2014	374.6841

QGIS

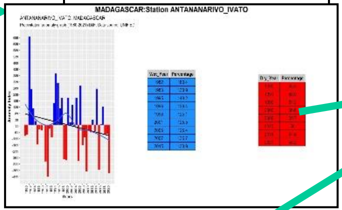

ClimSA
20
35
45
35
45
20
20
45
35
30
50
20
WELL ABOVE AVERAGE PRECIPITATION VERY LIKELY
ABOVE AVERAGE PRECIPITATION VERY LIKELY
NORMAL TO ABOVE AVERAGE PRECIPITATION VERY LIKELY
NEAR AVERAGE PRECIPITATION
NEAR TO BELOW AVERAGE PRECIPITATION VERY LIKELY
BELOW AVERAGE PRECIPITATION VERY LIKELY
WELL BELOW AVERAGE PRECIPITATION VERY LIKELY
A ABOVE AVERAGE
N NEAR AVERAGE
B BELOW AVERAGE
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30
40
50
60

PRODUCTS

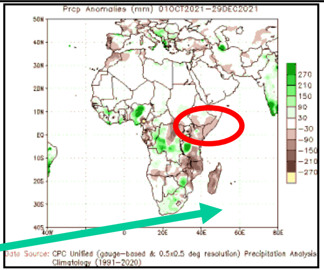
Trend


MEAN JFM PRCP TREND (1981–2020):CAMS–OPI
30N
20N
10N
EQ
10S
20S
30S
20W 10W 0 10E 20E 30E 40E 50E
mm/decade

Time series

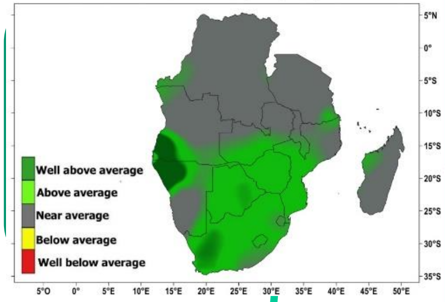


Climate variability: Persistence

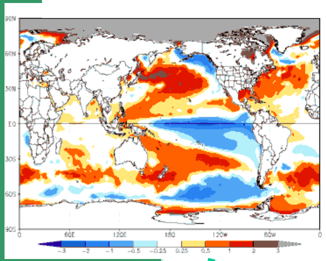

Prcp Anomalies (mm) 01OCT2021–29DEC2021
270
210
150
90
30
−30
−90
−150
−210
−270
Data Source: CPC Unified (gauge–based & 0.5x0.5 deg resolution) Precipitation Analysis
Climatology (1991–2020)

Composite

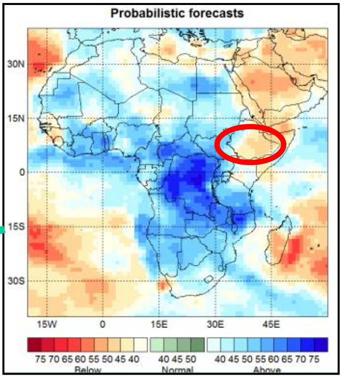
COMPOSITE WET OND: 1995, 1998, 2007,2020


Well above average
Above average
Near average
Below average
Well below average
5°N
0°
5°S
10°S
15°S
20°S
25°S
30°S
35°S
5°O 0° 5°E 10°E 15°E 20°E 25°E 30°E 35°E 40°E 45°E 50°E

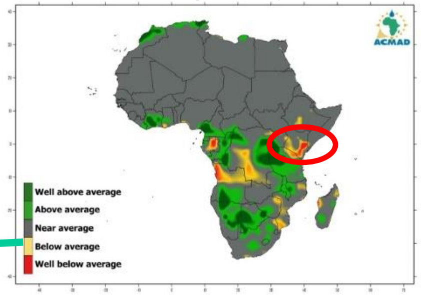
Ocean State: SSTs


60E 120E 180 120W 60W
−3 −2 −1 −0.5 −0.25 0.25 0.5 1 2 3

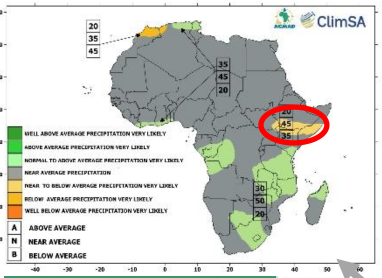
Canonical


Probabilistic forecasts
30N
15N
0
15S
30S
15W 0 15E 30E 45E
75 70 65 60 55 50 45 40
Below
40 45 50
Normal
40 45 50 55 60 65 70 75
Above

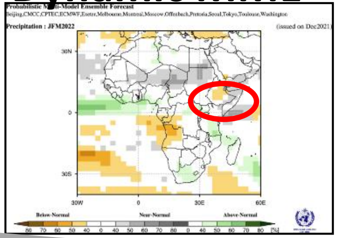
Analogue years


ACMAD
Well above average
Above average
Near average
Below average
Well below average

SEASONAL OUTLOOK

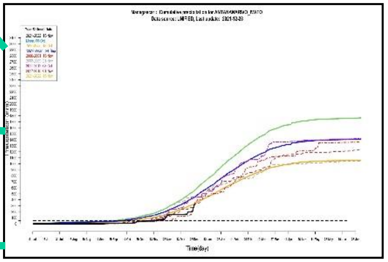

ACMAD
ClimSA
20
35
45
35
45
20
20
45
35
30
50
20
WELL ABOVE AVERAGE PRECIPITATION VERY LIKELY
ABOVE AVERAGE PRECIPITATION VERY LIKELY
NORMAL TO ABOVE AVERAGE PRECIPITATION VERY LIKELY
NEAR AVERAGE PRECIPITATION
NEAR TO BELOW AVERAGE PRECIPITATION VERY LIKELY
BELOW AVERAGE PRECIPITATION VERY LIKELY
WELL BELOW AVERAGE PRECIPITATION VERY LIKELY
A ABOVE AVERAGE
N NEAR AVERAGE
B BELOW AVERAGE
-40 -30 -20 -10 0 10 20 30 40 50 60

Dynamic MME


Probabilistic Multi-Model Ensemble Forecast
Beijing,CMCC,CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Pretoria,Seoul,Tokyo,Toulouse,Washington
Precipitation : JFM2022
(issued on Dec2021)
30N
0
30S
30W 0 30E 60E
Below-Normal
Near-Normal
Above-Normal

AI: Neural Networks

Daily cumulative profile



Cluster Analysis

SEASONAL FORECAST APPROACHS

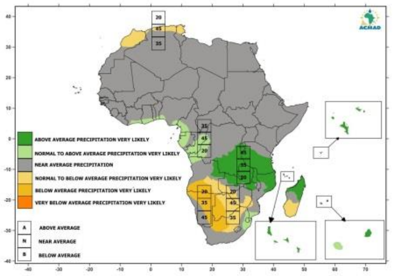
1. ***Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends***
2. ***Composite analysis***
3. ***Analogue Analysis***
4. ***Linear regression, principal component, canonical correlation analysis***
5. ***Teleconnections analysis (i,e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

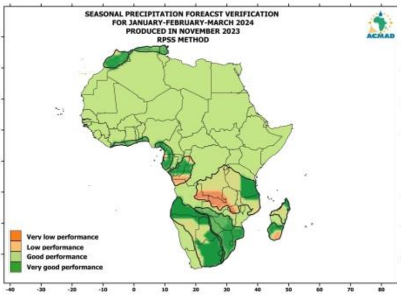
Step 1:

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

VERIFICATION

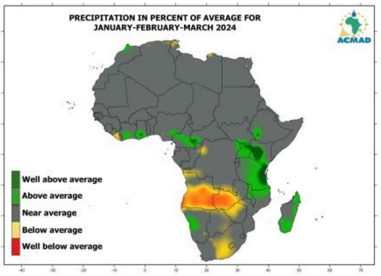
SEASONAL PRECIPITATION FORECAST
FOR JANUARY-FEBRUARY-MARCH 2024
ISSUED ON NOVEMBER 24, 2023


ACMAD
ABOVE AVERAGE PRECIPITATION VERY LIKELY
NORMAL TO ABOVE AVERAGE PRECIPITATION VERY LIKELY
NEAR AVERAGE PRECIPITATION
NORMAL TO BELOW AVERAGE PRECIPITATION VERY LIKELY
BELOW AVERAGE PRECIPITATION VERY LIKELY
VERY BELOW AVERAGE PRECIPITATION VERY LIKELY
A ABOVE AVERAGE
N NEAR AVERAGE
B BELOW AVERAGE



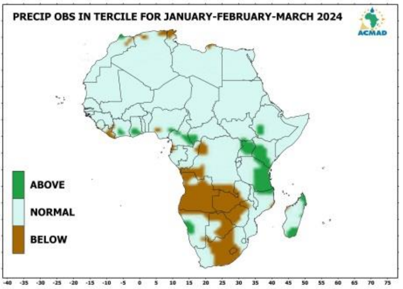
SEASONAL PRECIPITATION FOREACST VERIFICATION
FOR JANUARY-FEBRUARY-MARCH 2024
PRODUCED IN NOVEMBER 2023
RPSS METHOD

ACMAD
Very low performance
Low performance
Good performance
Very good performance



PRECIPITATION IN PERCENT OF AVERAGE FOR
JANUARY-FEBRUARY-MARCH 2024

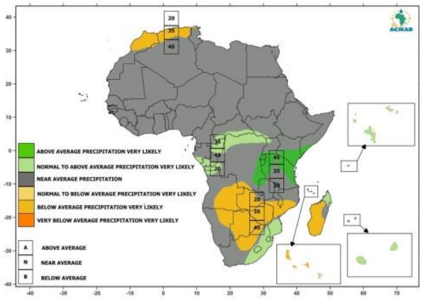
ACMAD
Well above average
Above average
Near average
Below average
Well below average

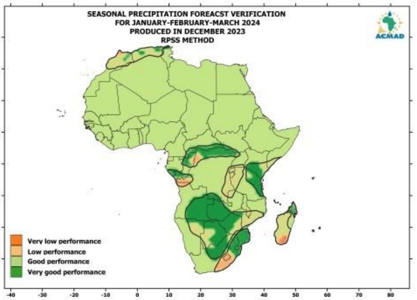


PRECIP OBS IN TERCILE FOR JANUARY-FEBRUARY-MARCH 2024

ACMAD
ABOVE
NORMAL
BELOW

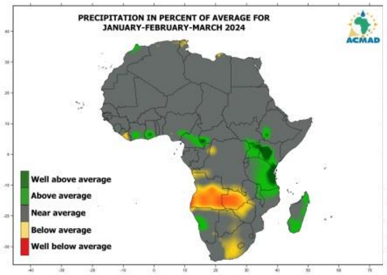
SEASONAL PRECIPITATION FORECAST
FOR JANUARY-FEBRUARY-MARCH 2024
ISSUED ON DECEMBER 29, 2023


ACMAD
ABOVE AVERAGE PRECIPITATION VERY LIKELY
NORMAL TO ABOVE AVERAGE PRECIPITATION VERY LIKELY
NEAR AVERAGE PRECIPITATION
NORMAL TO BELOW AVERAGE PRECIPITATION VERY LIKELY
BELOW AVERAGE PRECIPITATION VERY LIKELY
VERY BELOW AVERAGE PRECIPITATION VERY LIKELY
A ABOVE AVERAGE
N NEAR AVERAGE
B BELOW AVERAGE



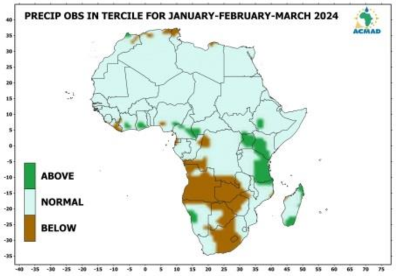
SEASONAL PRECIPITATION FOREACST VERIFICATION
FOR JANUARY-FEBRUARY-MARCH 2024
PRODUCED IN DECEMBER 2023
RPSS METHOD

ACMAD
Very low performance
Low performance
Good performance
Very good performance



PRECIPITATION IN PERCENT OF AVERAGE FOR
JANUARY-FEBRUARY-MARCH 2024

ACMAD
Well above average
Above average
Near average
Below average
Well below average



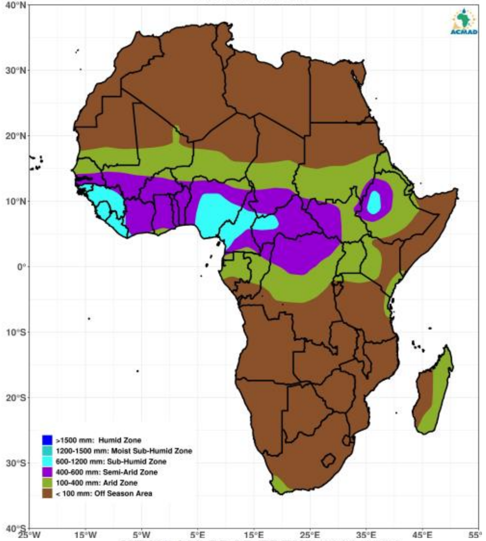
PRECIP OBS IN TERCILE FOR JANUARY-FEBRUARY-MARCH 2024

ACMAD
ABOVE
NORMAL
BELOW

Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends (1/3)

Season 1

MAJOR CLIMATIC ZONES DETERMINED ON THE BASIS OF THE CLIMATIC PERIOD FROM JJA 1981-2010

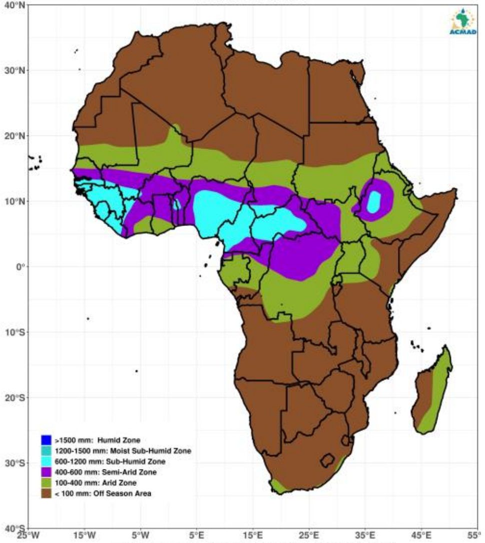

ACMAD
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
25°W
15°W
5°W
5°E
15°E
25°E
35°E
45°E
55°
>1500 mm: Humid Zone
1200-1500 mm: Moist Sub-Humid Zone
600-1200 mm: Sub-Humid Zone
400-600 mm: Semi-Arid Zone
100-400 mm: Arid Zone
< 100 mm: Off Season Area

CLIMATIC ZONE

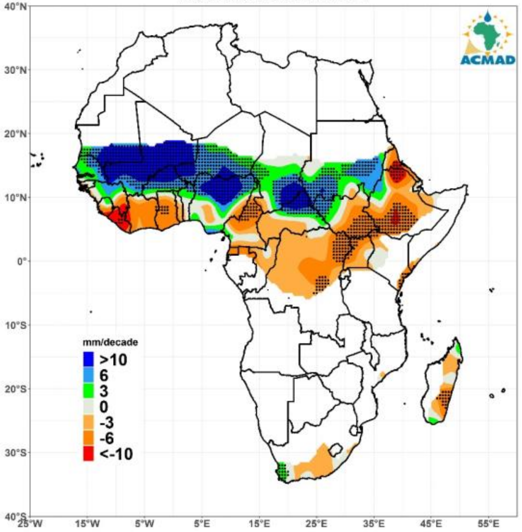
- 🟦 >1500 mm: Humid Zone
- 🟦 1200-1500 mm: Moist Sub-Humid Zone
- 🟦 600-1200 mm: Sub-Humid Zone
- 🟪 400-600 mm: Semi-Arid Zone
- 🟩 100-400 mm: Arid Zone
- 🟫 < 100 mm: Off Season Area

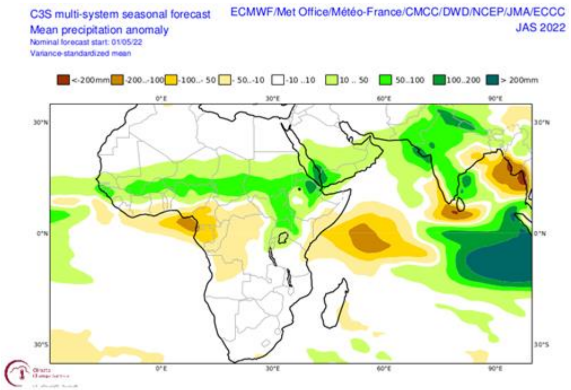
Season 2

MAJOR CLIMATIC ZONES DETERMINED ON THE BASIS OF THE CLIMATIC PERIOD FROM JAS 1981-2010


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°
>1500 mm: Humid Zone
1200-1500 mm: Moist Sub-Humid Zone
600-1200 mm: Sub-Humid Zone
400-600 mm: Semi-Arid Zone
100-400 mm: Arid Zone
< 100 mm: Off Season Area

MEAN JJA PRCP TREND 1980-2021
Data Source: CAMS-OPI


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
mm/decade
>10
6
3
0
-3
-6
<-10

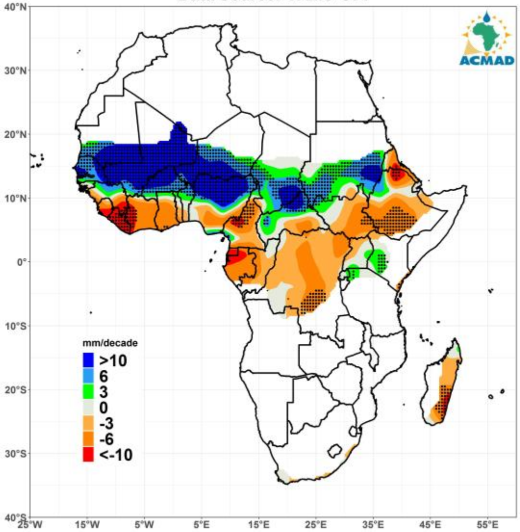


C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JAS 2022

<-200mm
-200..-100
-100..-50
-50..-10
-10..10
10..50
50..100
100..200
> 200mm
0°E
30°E
60°E
90°E
30°N
0°N
30°S

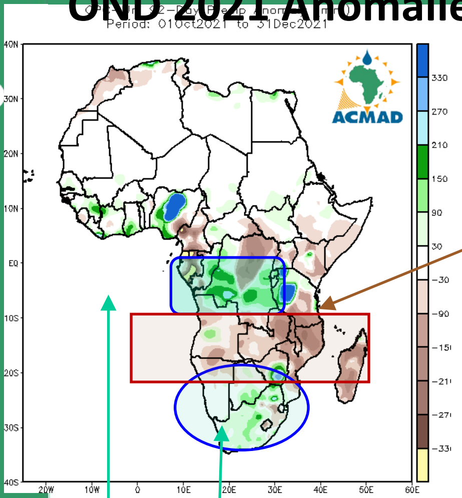
MEAN JAS PRCP TREND 1980-2021
Data Source: CAMS-OPI


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
mm/decade
>10
6
3
0
-3
-6
<-10

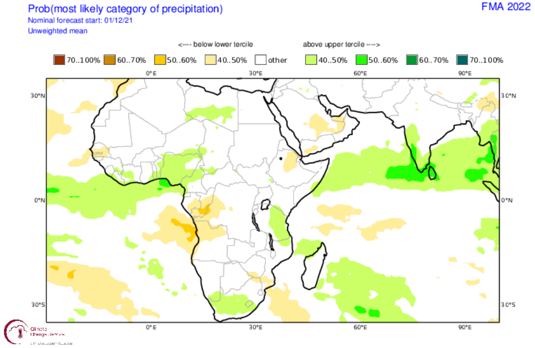
http://sgbd.acmad.org:8080/thredds/fileServer/ACMAD/CDD/climatemonitoringservice/Anomaly_Graphs_Time_Series_Point_Station_Maps/CAMS/Anomaly_Graphs_JAS_CAMS.html

FORECAST PERSISTENCE (WET AND DRY CONDITIONS)

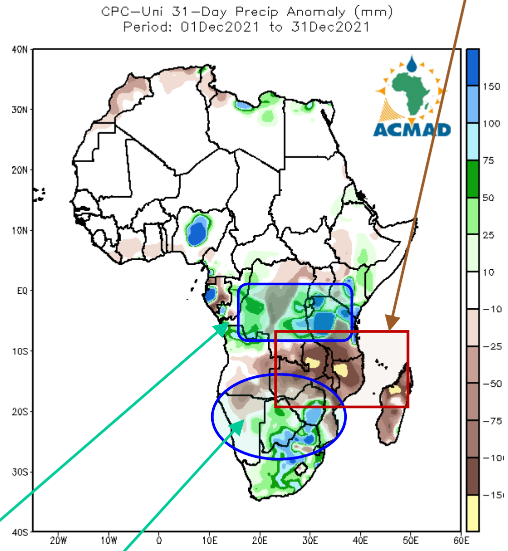
OND 2021 Anomalies


Period: 01Oct2021 to 31Dec2021
ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
330
270
210
150
90
30
−30
−90
−150
−210
−270
−330

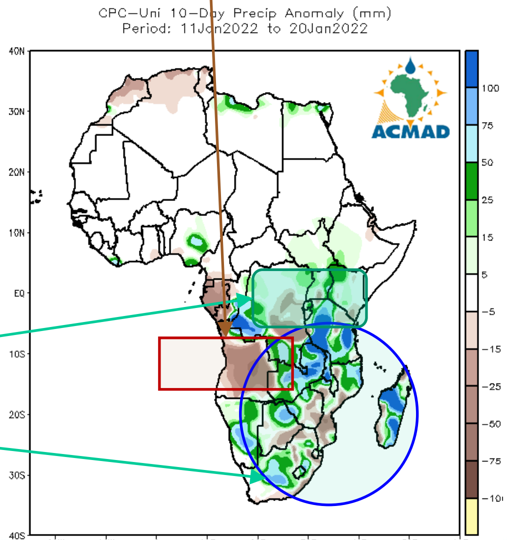
Persistent Dry conditions

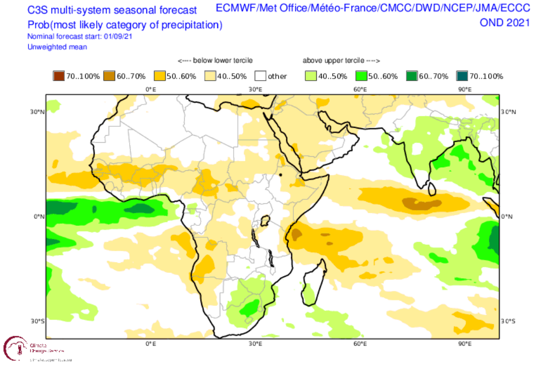

C3S multi-system seasonal forecast
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
Prob(most likely category of precipitation)
FMA 2022
Nominal forecast start: 01/12/21
Unweighted mean
<---- below lower tercile
above upper tercile ---->
70..100%
60..70%
50..60%
40..50%
other
40..50%
50..60%
60..70%
70..100%
0°E
30°E
60°E
90°E
30°N
0°N
30°S

December 2021 Anomalies


CPC–Uni 31–Day Precip Anomaly (mm)
Period: 01Dec2021 to 31Dec2021
ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
150
100
75
50
25
10
−10
−25
−50
−75
−100
−150

Last week of Jan 2022 anom

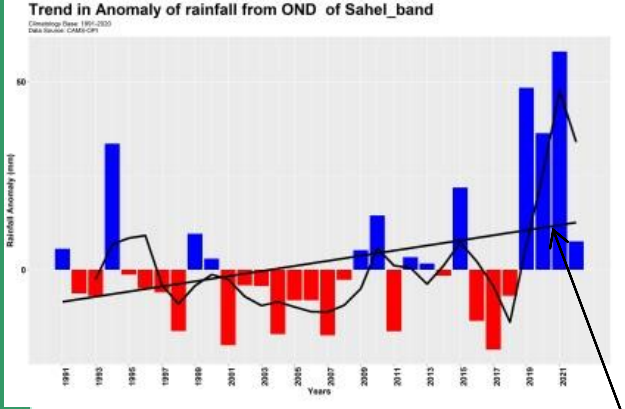

CPC–Uni 10–Day Precip Anomaly (mm)
Period: 11Jan2022 to 20Jan2022
ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
100
75
50
25
15
5
−5
−15
−25
−50
−75
−100


C3S multi-system seasonal forecast
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
Prob(most likely category of precipitation)
OND 2021
Nominal forecast start: 01/09/21
Unweighted mean
<---- below lower tercile
above upper tercile ---->
70..100%
60..70%
50..60%
40..50%
other
40..50%
50..60%
60..70%
70..100%
0°E
30°E
60°E
90°E
30°N
0°N
30°S

Persistent wet conditions

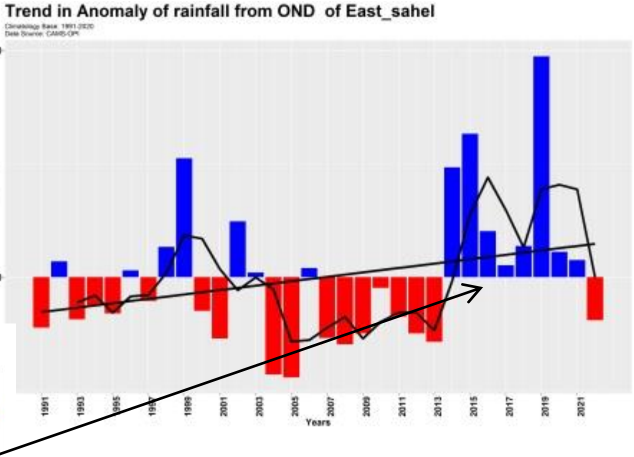
Time series analysis of Climate variability (seasonal and annual cycles, interannual/interdecadal variability) and trends (6/6)

Season 3



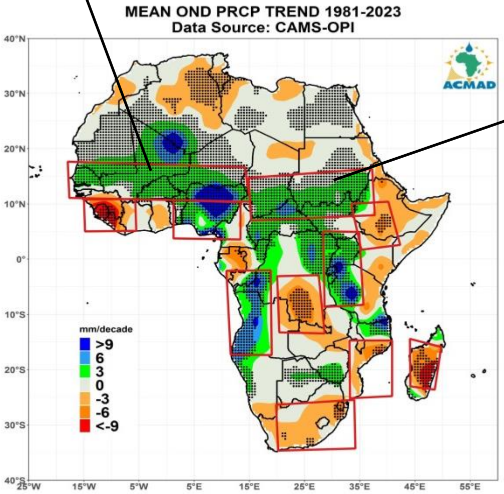
Trend in Anomaly of rainfall from OND of Sahel_band

Climatology Base: 1991-2020
Data Source: CAMS-OPI



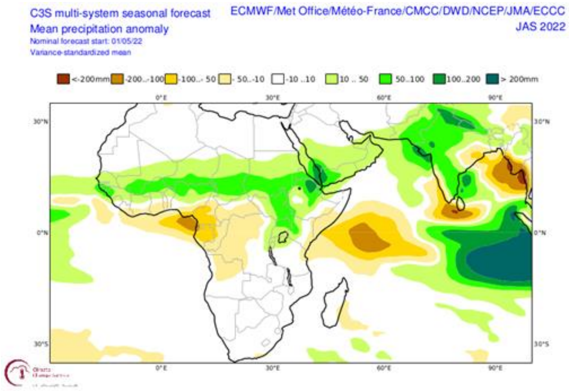
Trend in Anomaly of rainfall from OND of East_sahel

Climatology Base: 1991-2020
Data Source: CAMS-OPI



MEAN OND PRCP TREND 1981-2023
Data Source: CAMS-OPI

ACMAD
mm/decade
>9
6
3
0
-3
-6
<-9
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



C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

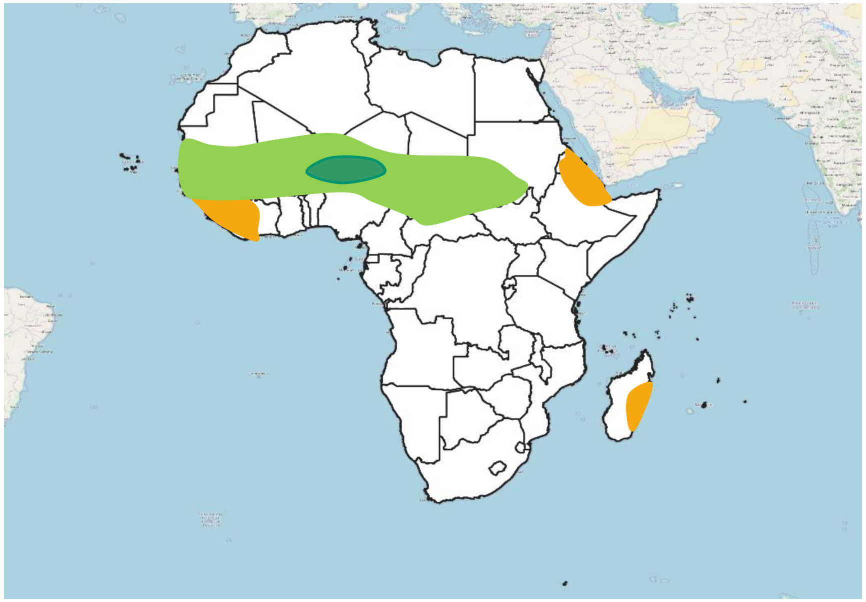
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JAS 2022

<-200mm
-200..-100
-100..-50
-50..-10
-10..10
10..50
50..100
100..200
> 200mm
0°E
30°E
60°E
90°E
30°N
0°N
30°S

http://sgbd.acmad.org:8080/thredds/fileServer/ACMAD/CDD/climatemonitoringservice/Anomaly_Graphs_Time_Series_Point_Station_Maps/CAMS/Anomaly_Graphs_JAS_CAMS.html

Preliminary indicative outlook based on ***Step 1***

FCST SCENARIO



Step 2:

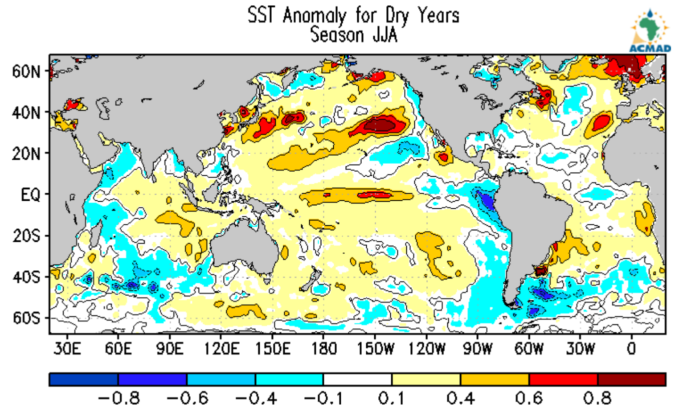
SSTs and Rainfall Composite analysis for Dry and Wet Years

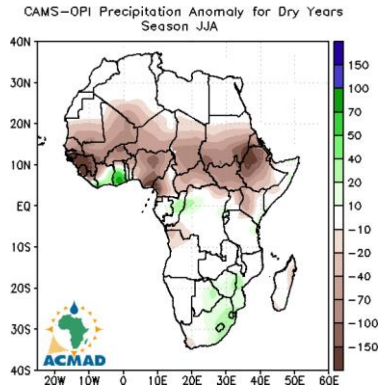
Composite analysis (Dry and Wet Years) – SSTs & Rainfall

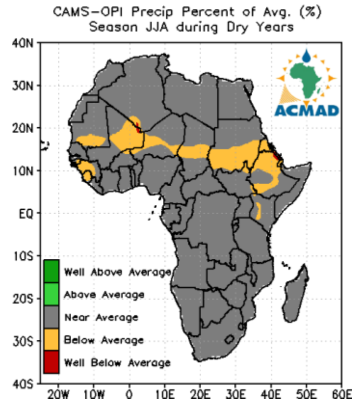
SST Composite

Rainfall Composite

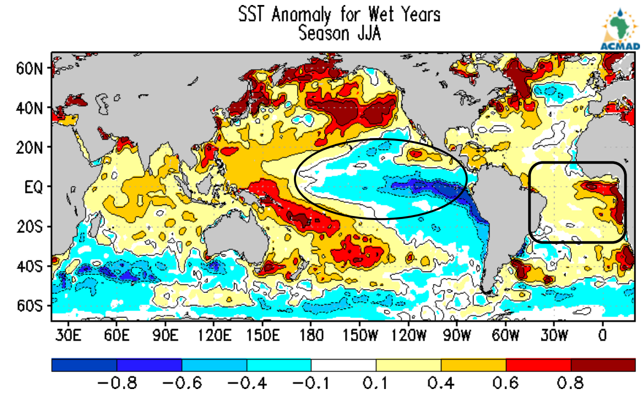
DRY

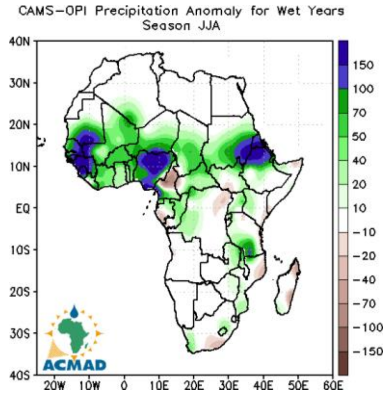

SST Anomaly for Dry Years
Season JJA
ACMAD
60N
40N
20N
EQ
20S
40S
60S
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W 0
−0.8 −0.6 −0.4 −0.1 0.1 0.4 0.6 0.8

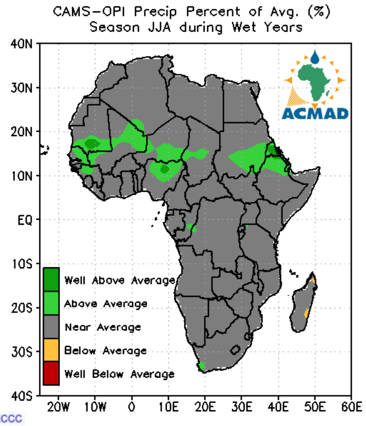

CAMS−OPI Precipitation Anomaly for Dry Years
Season JJA
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W 10W 0 10E 20E 30E 40E 50E 60E
150
100
70
50
40
20
10
−10
−20
−40
−70
−100
−150
ACMAD


CAMS−OPI Precip Percent of Avg. (%)
Season JJA during Dry Years
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W 10W 0 10E 20E 30E 40E 50E 60E
ACMAD
Well Above Average
Above Average
Near Average
Below Average
Well Below Average

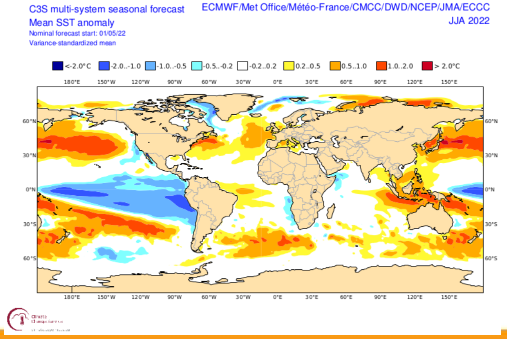
WET

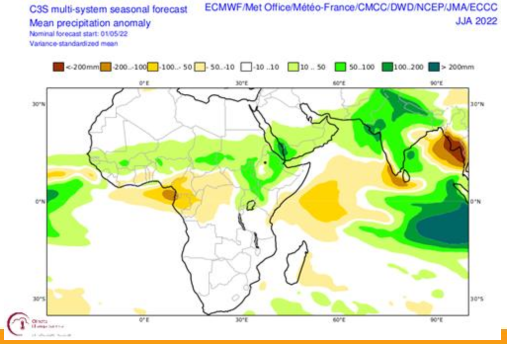

SST Anomaly for Wet Years
Season JJA
ACMAD
60N
40N
20N
EQ
20S
40S
60S
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W 0
−0.8 −0.6 −0.4 −0.1 0.1 0.4 0.6 0.8


CAMS−OPI Precipitation Anomaly for Wet Years
Season JJA
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W 10W 0 10E 20E 30E 40E 50E 60E
150
100
70
50
40
20
10
−10
−20
−40
−70
−100
−150
ACMAD


CAMS−OPI Precip Percent of Avg. (%)
Season JJA during Wet Years
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W 10W 0 10E 20E 30E 40E 50E 60E
ACMAD
Well Above Average
Above Average
Near Average
Below Average
Well Below Average

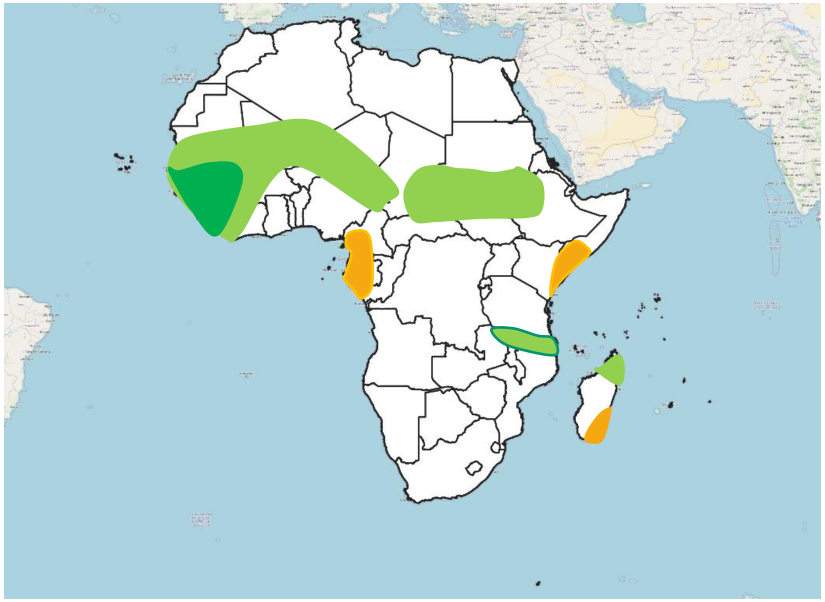
FCST


C3S multi-system seasonal forecast
Mean SST anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E 150°W 120°W 90°W 60°W 30°W 0°E 30°E 60°E 90°E 120°E 150°E
60°N
30°N
0°N
30°S
60°S


C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-200mm
-200..-100
-100..- 50
- 50..-10
-10 ..10
10 .. 50
50..100
100..200
> 200mm
0°E 30°E 60°E 90°E
30°N
0°N
30°S

Preliminary indicative outlook based on Step 2

FCST SCENARIO



Step 3:

Analogue Years Analysis

Identification of Analogue Years (1)

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**									

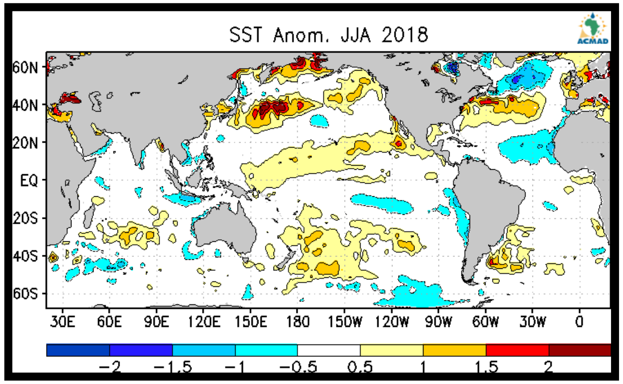
	Saisons (2022 – 2023)								
Modèle	AMJ	MJJ	JJA	JAS	ASS	FILS	OND	NDJ	DJF
Modèles moyens et dynamiques	-0,699	-0,603	-0,486	-0,432	-0,460	-0,586	-0,638	-0,436	-0,314
Moyenne, modèles statistiques	-0,718	-0,599	-0,509	-0,489	-0,511	-0,542	-0,510	-0,473	-0,392
Moyenne, Tous les modèles	-0,705	-0,601	-0,493	-0,449	-0,476	-0,569	-0,588	-0,453	-0,351

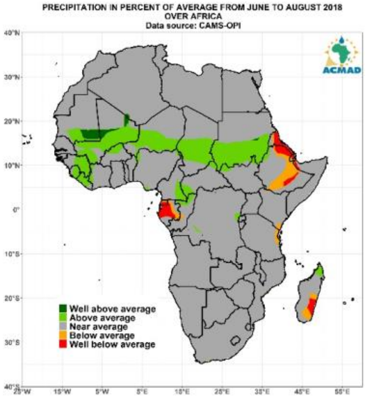
- **Identified analogue years – 2001, 2009, 2012, 2018, 2021**

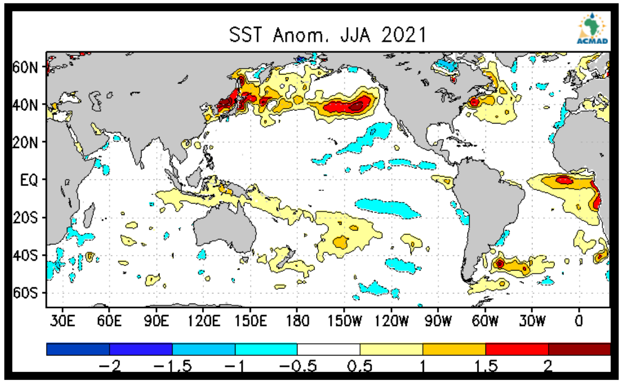
Analogue Years Analysis

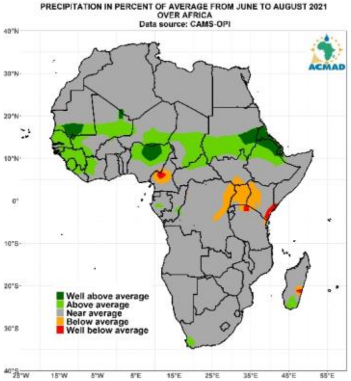
Seasonal SSTs maps for Target Season(s)

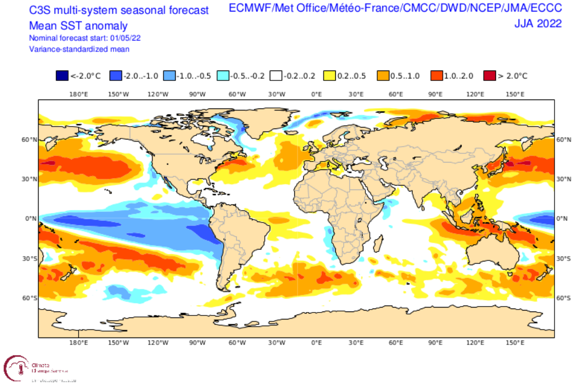
Analogue Analysis (3) – Rainfall Spatial Distribution


SST Anom. JJA 2018
60N
40N
20N
EQ
20S
40S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
−2
−1.5
−1
−0.5
0.5
1
1.5
2
ACMAD

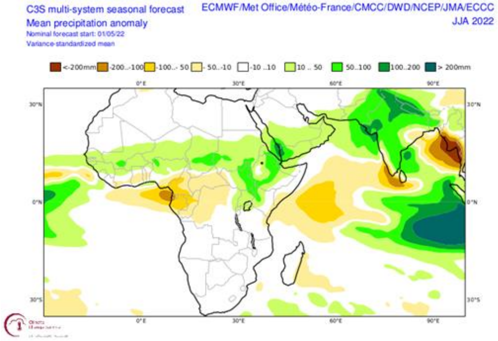

PRECIPITATION IN PERCENT OF AVERAGE FROM JUNE TO AUGUST 2018
OVER AFRICA
Data source: CAMS-OPI
Well above average
Above average
Near average
Below average
Well below average
ACMAD


SST Anom. JJA 2021
60N
40N
20N
EQ
20S
40S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
−2
−1.5
−1
−0.5
0.5
1
1.5
2
ACMAD


PRECIPITATION IN PERCENT OF AVERAGE FROM JUNE TO AUGUST 2021
OVER AFRICA
Data source: CAMS-OPI
Well above average
Above average
Near average
Below average
Well below average
ACMAD


C3S multi-system seasonal forecast
Mean SST anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S

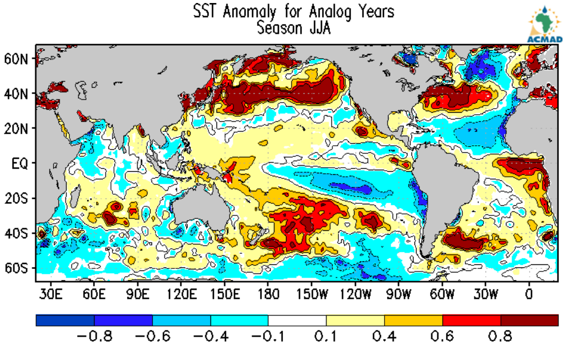

C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-200mm
-200..-100
-100..- 50
- 50..-10
-10 ..10
10 .. 50
50..100
100..200
> 200mm
0°E
30°E
60°E
90°E
30°N
0°N
30°S

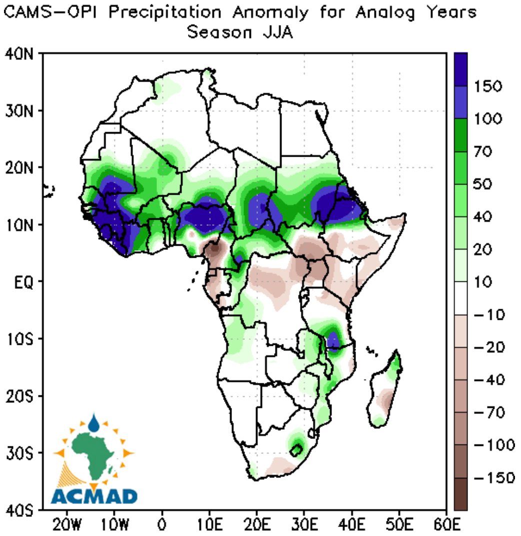
Identical Analogue Year Composite (6)

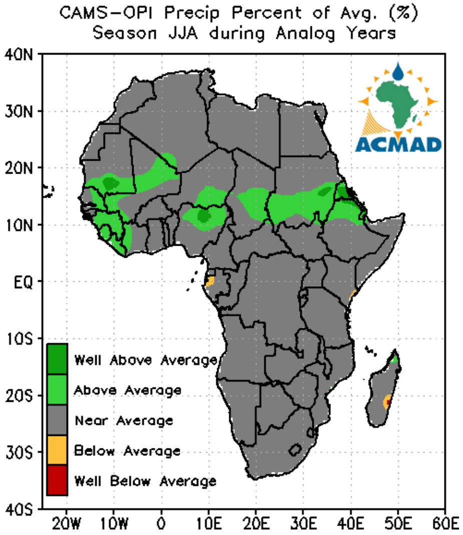
Composite

SSTs

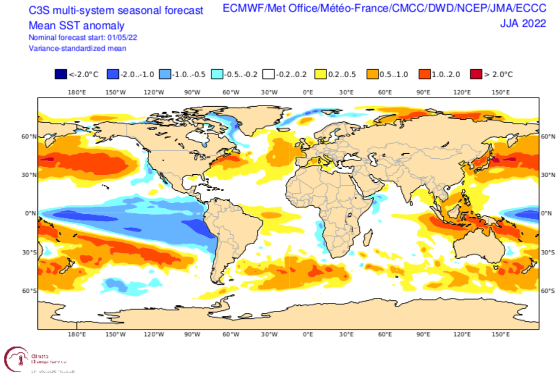

SST Anomaly for Analog Years
Season JJA
ACMAD
60N
40N
20N
EQ
20S
40S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
−0.8
−0.6
−0.4
−0.1
0.1
0.4
0.6
0.8

Rainfall

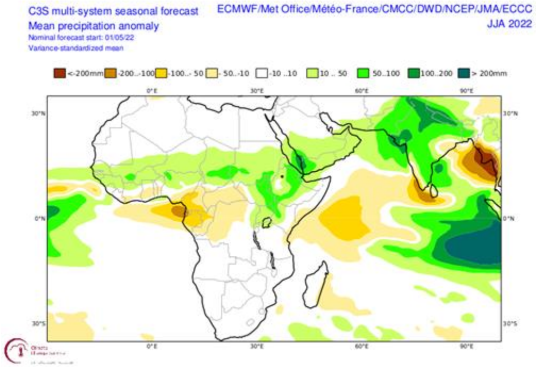

CAMS−OPI Precipitation Anomaly for Analog Years
Season JJA
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
150
100
70
50
40
20
10
−10
−20
−40
−70
−100
−150
ACMAD


CAMS−OPI Precip Percent of Avg. (%)
Season JJA during Analog Years
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
ACMAD
Well Above Average
Above Average
Near Average
Below Average
Well Below Average

FCST


C3S multi-system seasonal forecast
Mean SST anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

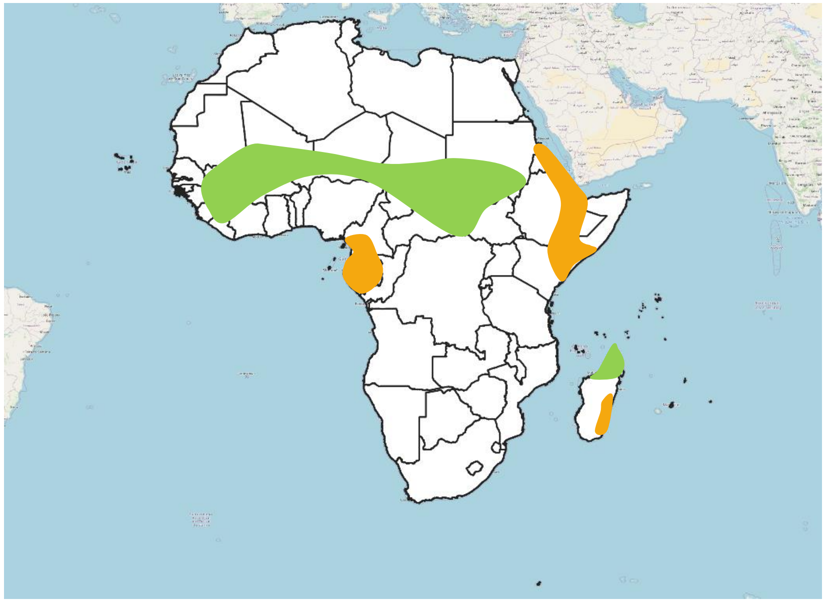
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S


C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean

ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-200mm
-200..-100
-100..- 50
- 50..-10
-10 ..10
10 .. 50
50..100
100..200
> 200mm
0°E
30°E
60°E
90°E
30°N
0°N
30°S

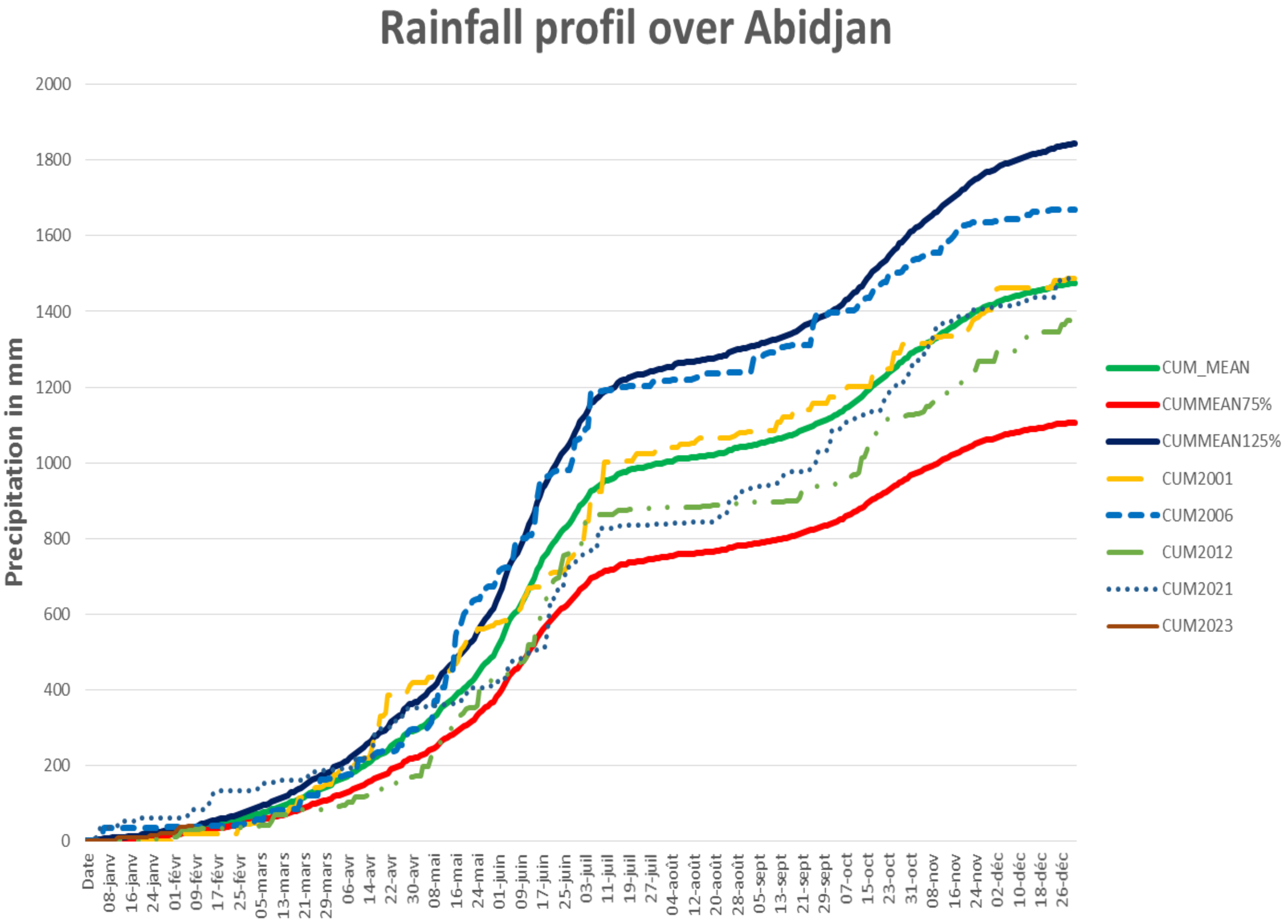
Preliminary indicative outlook based on Step 3

FCST SCENARIO

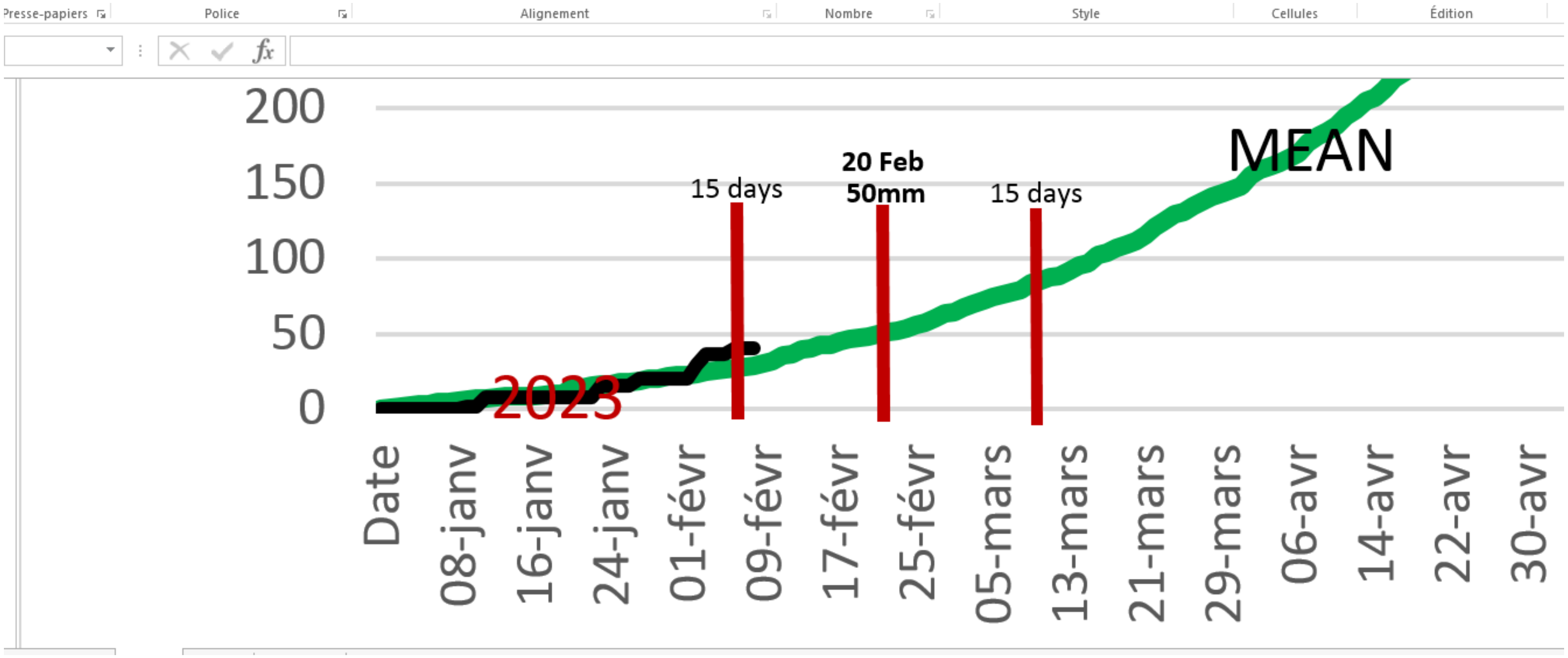


Step 4: Daily Rainfall Profil

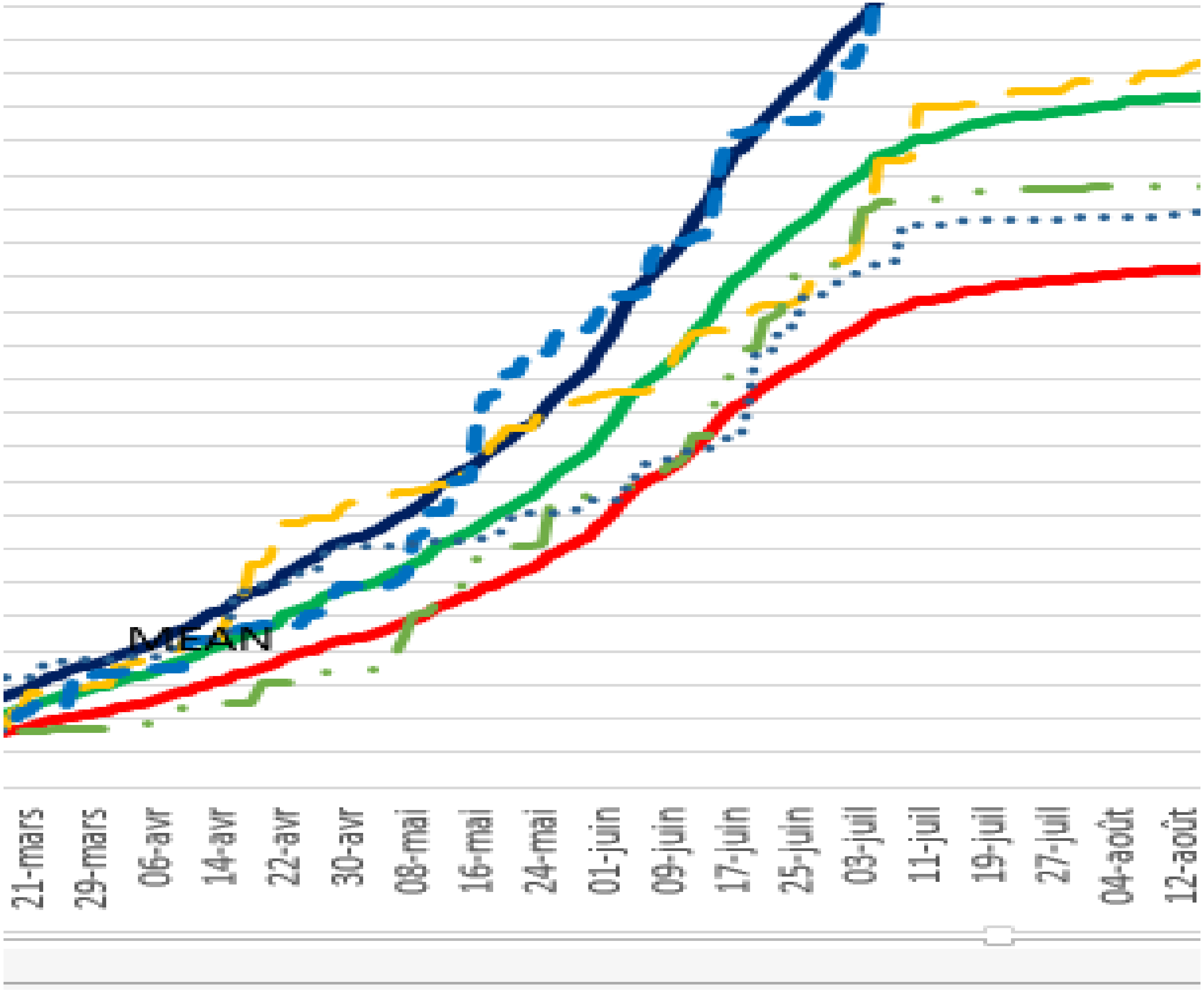
Daily rainfall profil



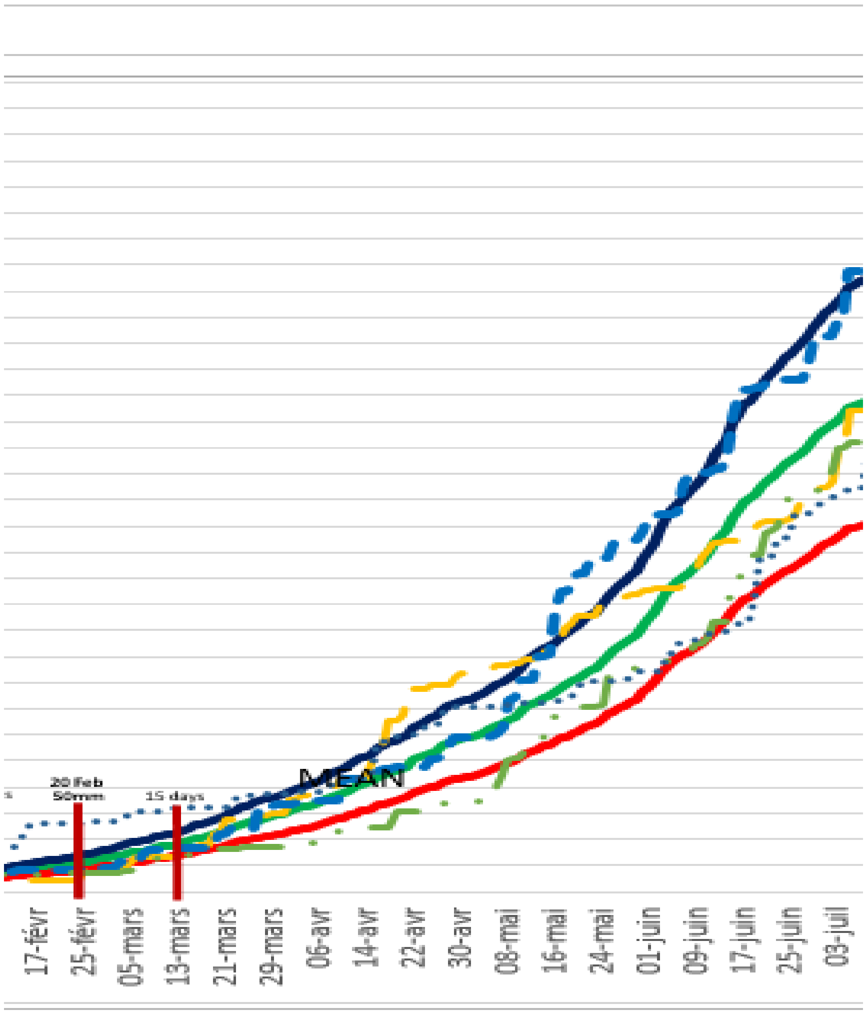
ONSET SEASON


Presse-papiers
Police
Alignement
Nombre
Style
Cellules
Édition
fx
200
150
100
50
0
15 days
20 Feb
50mm
15 days
MEAN
2023
Date
08-janv
16-janv
24-janv
01-févr
09-févr
17-févr
25-févr
05-mars
13-mars
21-mars
29-mars
06-avr
14-avr
22-avr
30-avr

Rainfall distribution



Quality of the season



Step 5: Statistical Forecast

Canonical correlation analysis

Outlook based on Obs. SSTs, Fcst SSTs & Precip – Season 1

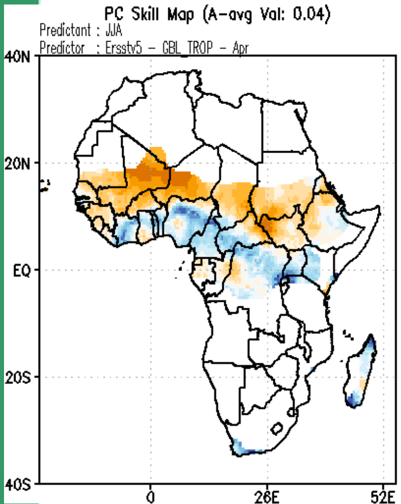
nmme fcst Precip

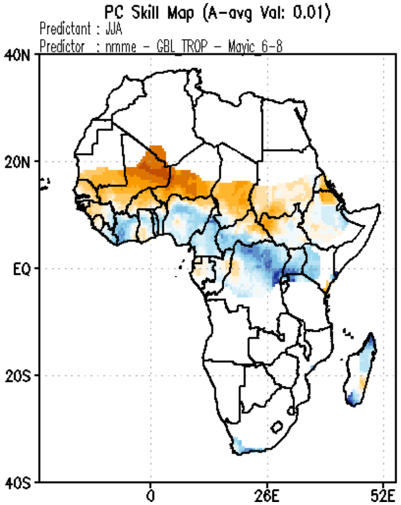
OBS. SSTs

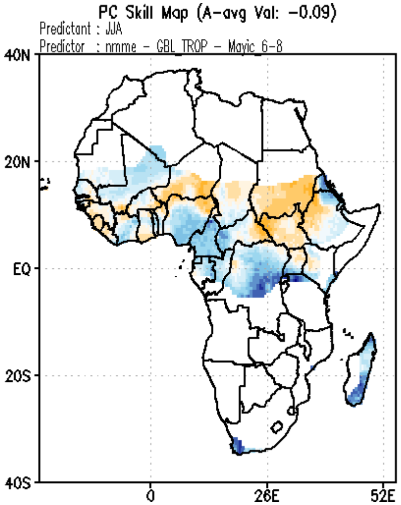
nmme fcst SSTs

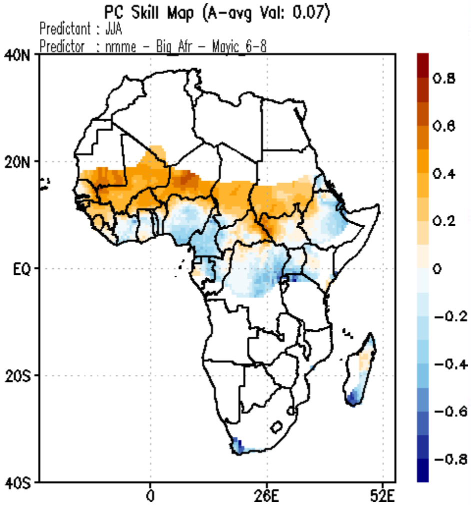
Global predictor

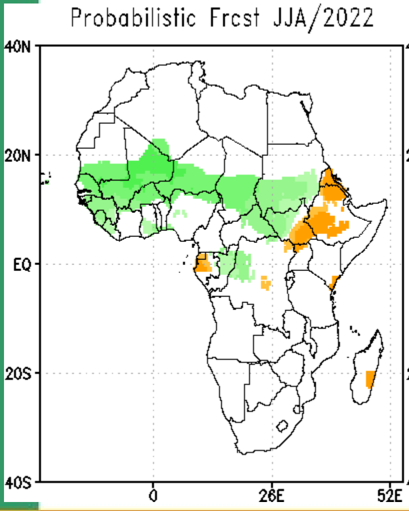
Regional predictor

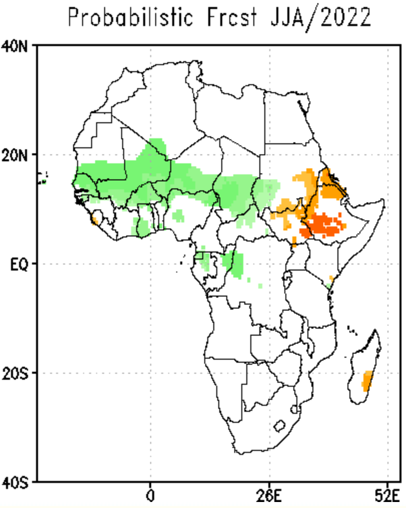

PC Skill Map (A-avg Val: 0.04)
Predictant : JJA
Predictor : Ersstv5 – GBL_TROP – Apr
40N
20N
EQ
20S
40S
0
26E
52E

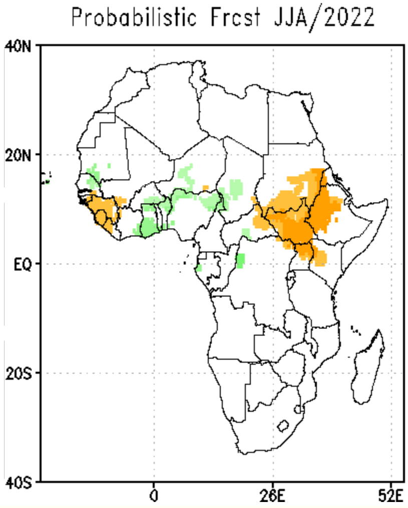

PC Skill Map (A-avg Val: 0.01)
Predictant : JJA
Predictor : nmme – GBL_TROP – Mayic_6-8
40N
20N
EQ
20S
40S
0
26E
52E

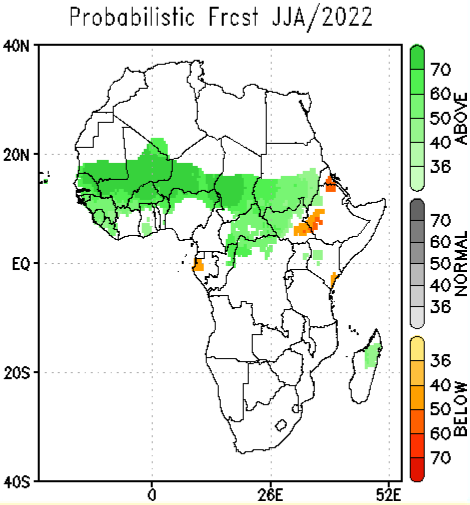

PC Skill Map (A-avg Val: −0.09)
Predictant : JJA
Predictor : nmme – GBL_TROP – Mayic_6-8
40N
20N
EQ
20S
40S
0
26E
52E


PC Skill Map (A-avg Val: 0.07)
Predictant : JJA
Predictor : nmme – Big_Afr – Mayic_6-8
40N
20N
EQ
20S
40S
0
26E
52E
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8

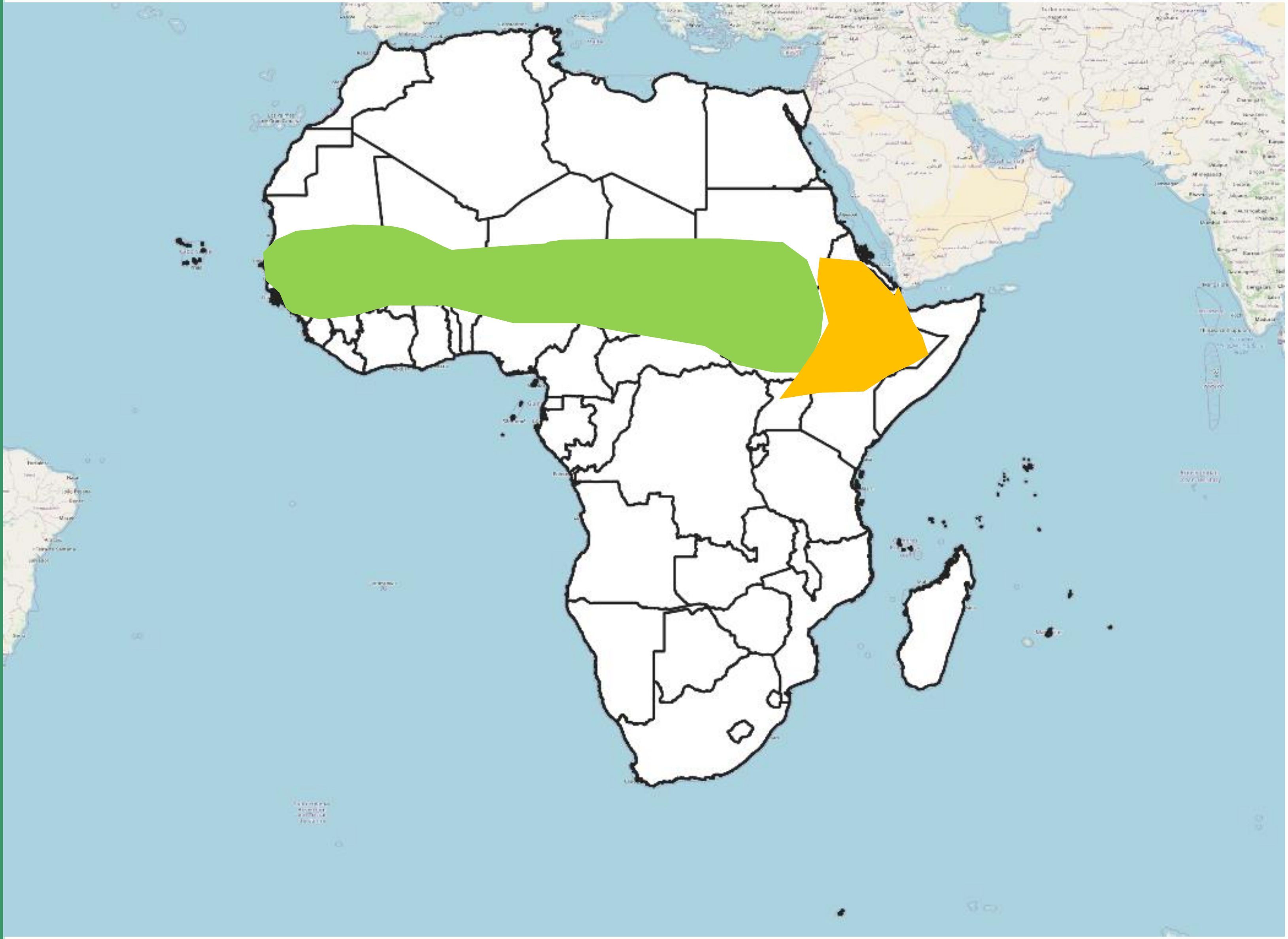

Probabilistic Frcst JJA/2022
40N
20N
EQ
20S
40S
0
26E
52E


Probabilistic Frcst JJA/2022
40N
20N
EQ
20S
40S
0
26E
52E


Probabilistic Frcst JJA/2022
40N
20N
EQ
20S
40S
0
26E
52E


Probabilistic Frcst JJA/2022
40N
20N
EQ
20S
40S
0
26E
52E
70
60
50
40
36
ABOVE
70
60
50
40
36
NORMAL
36
40
50
60
70
BELOW

Preliminary indicative outlook based on Step 4

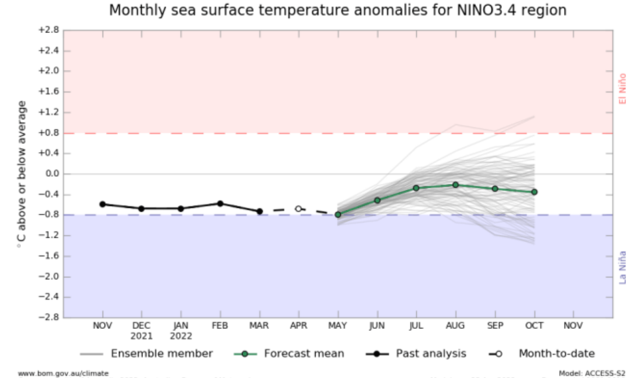


Step 6:

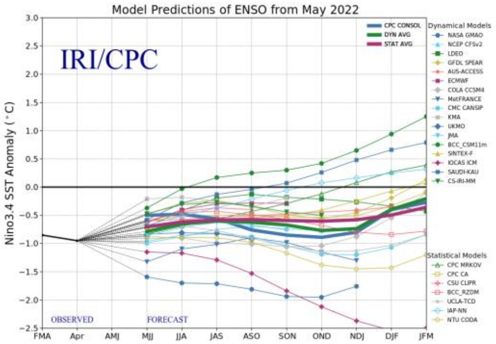
Teleconnections analysis (i,e ENSO, AMO, IOD, SIOD, Atlantic Dipole, NAO, AO, SAM, Benguela Nino, Mediterranean SSTAs)

Teleconnections analysis (i,e ENSO) - Index plumes

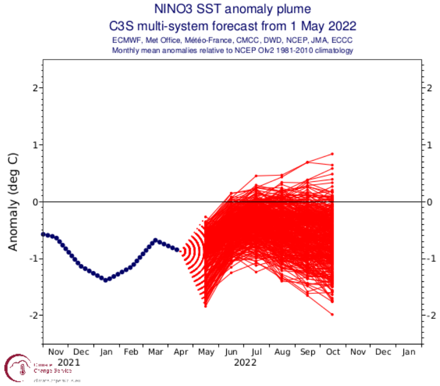
BoM



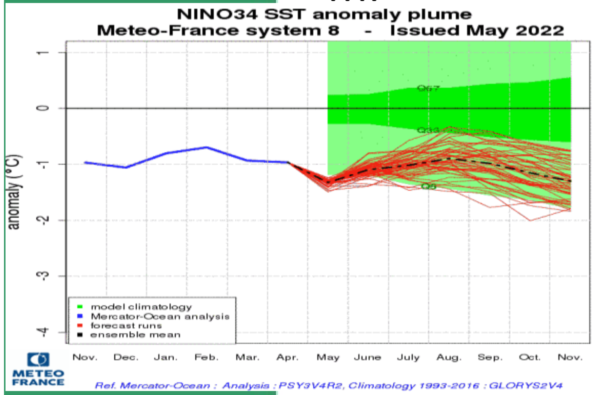
IRI



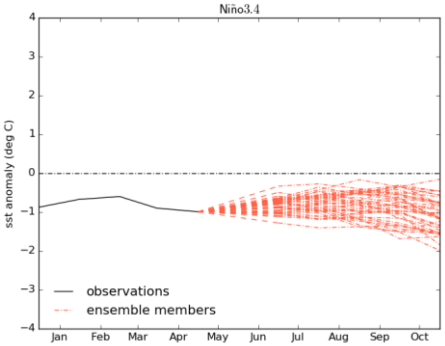
C3S



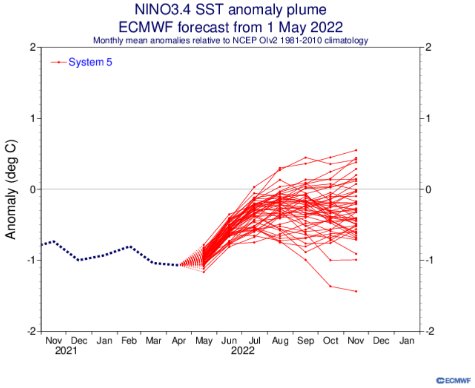
MF



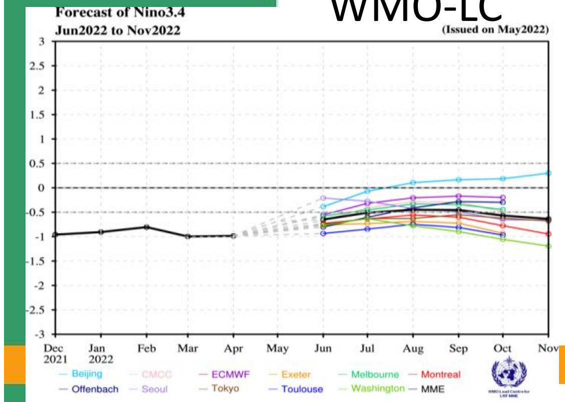
UKMO



ECMWF

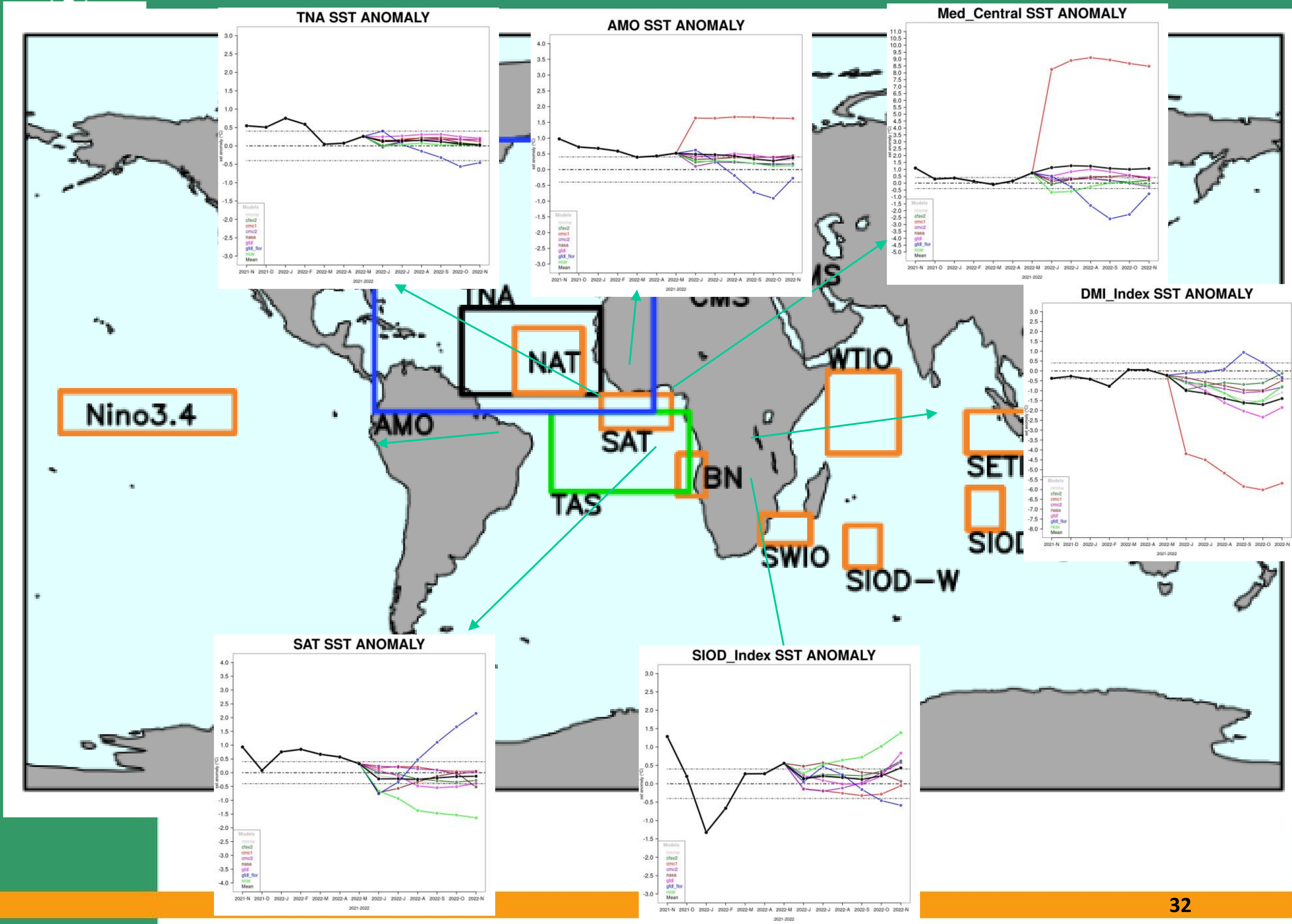


WMO-LC



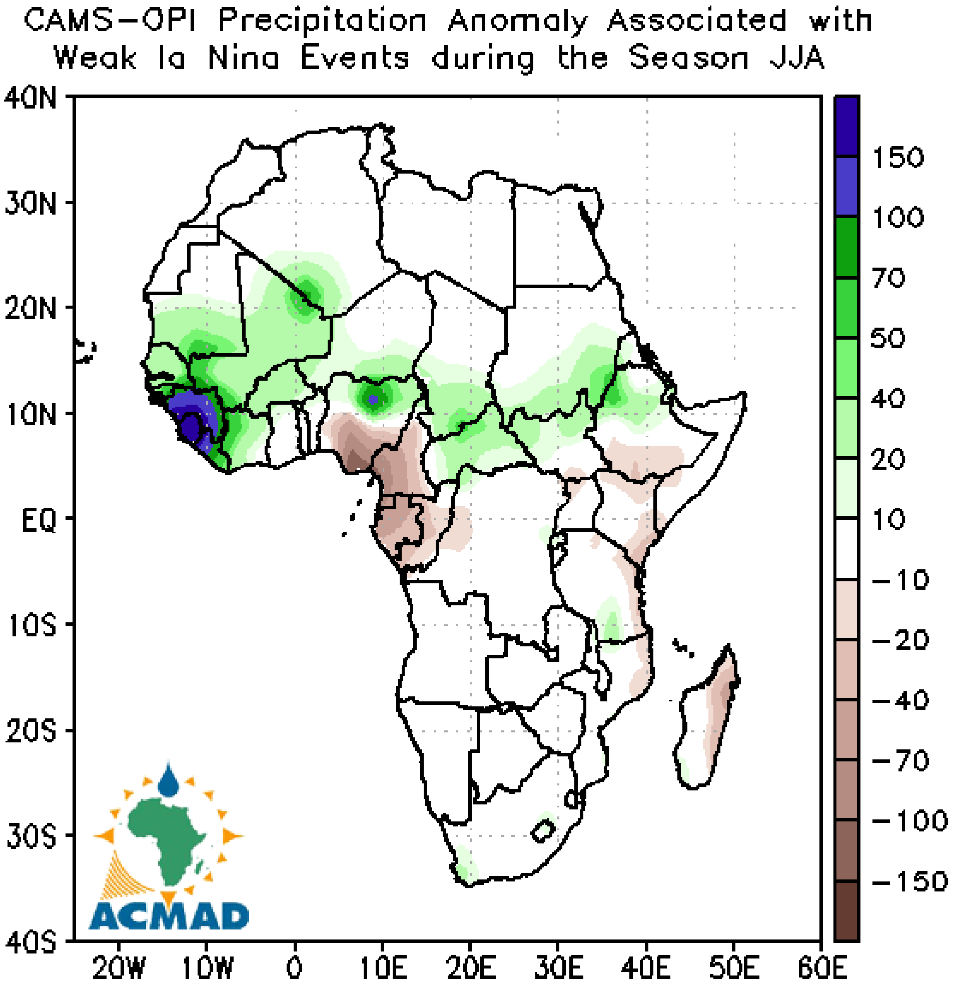
Weak La Nina

Evolutions of SST over specific ocean basins



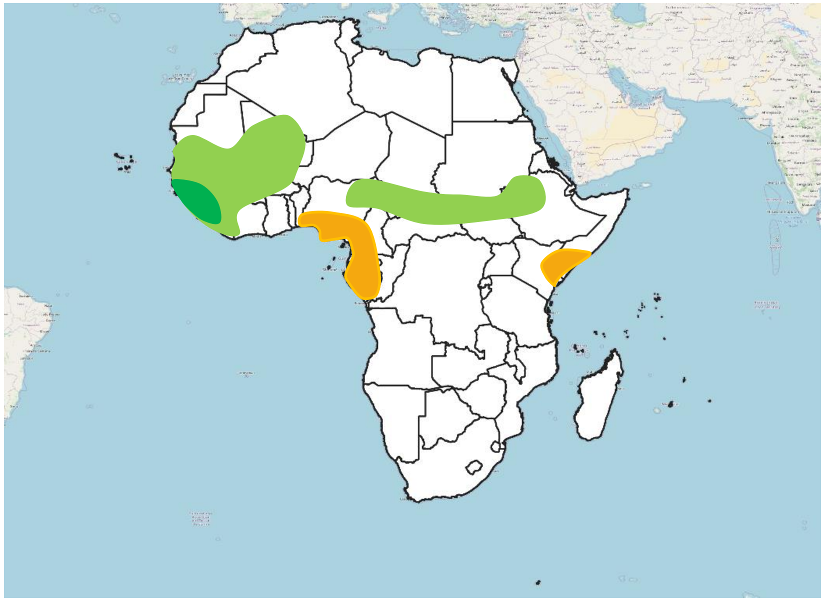
Teleconnections analysis – Rainfall Composites – Season 1

Weak to Moderate La Nina


CAMS–OPI Precipitation Anomaly Associated with
Weak la Nina Events during the Season JJA
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
150
100
70
50
40
20
10
−10
−20
−40
−70
−100
−150

Indicative Preliminary outlook based on ***Step 5***

FCST SCENARIO



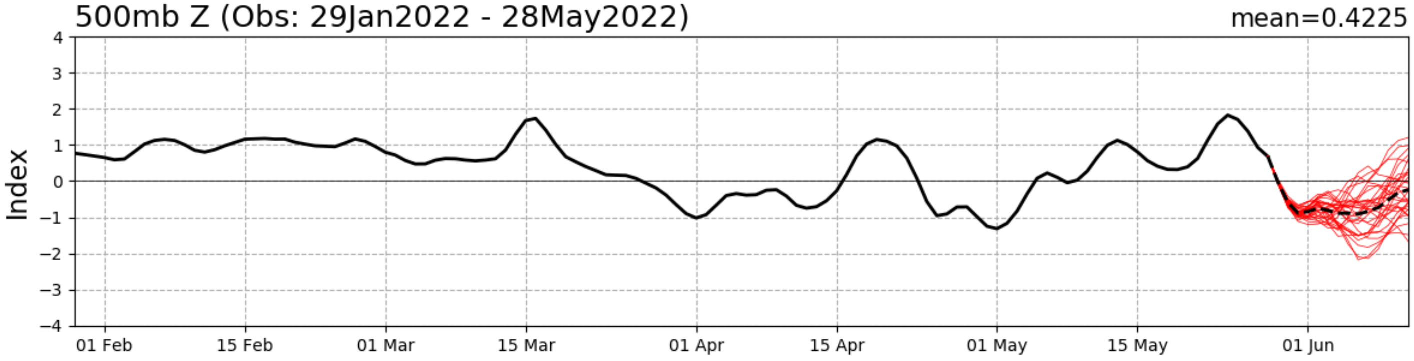
Step 7:

Interactions analysis between seasons (summer and following winter) and regions for the same target season (i.e summer African monsoon and Atlantic cyclone activity)

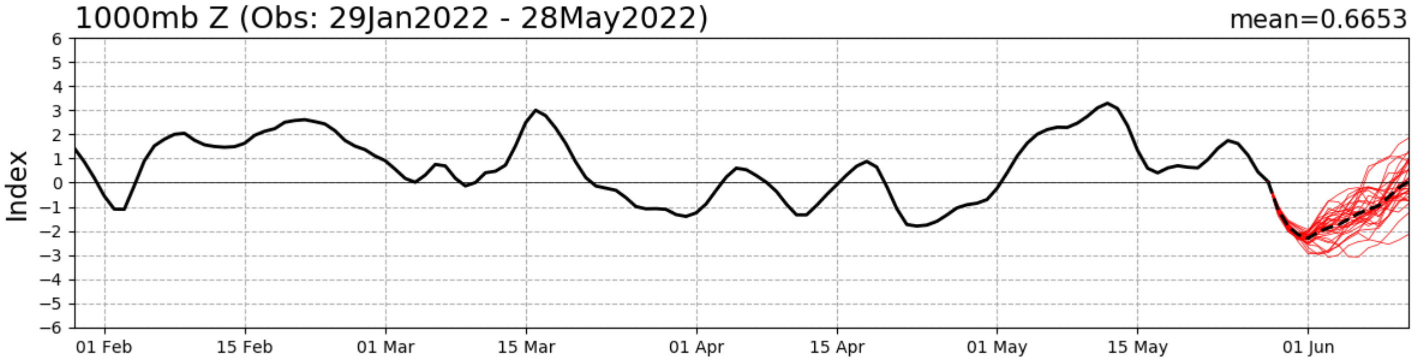
Interactions analysis between regions for the same target season (i.e summer African monsoon and Atlantic cyclone activity)

NAO and AO

NAO Index: Observed & GEFS Forecasts

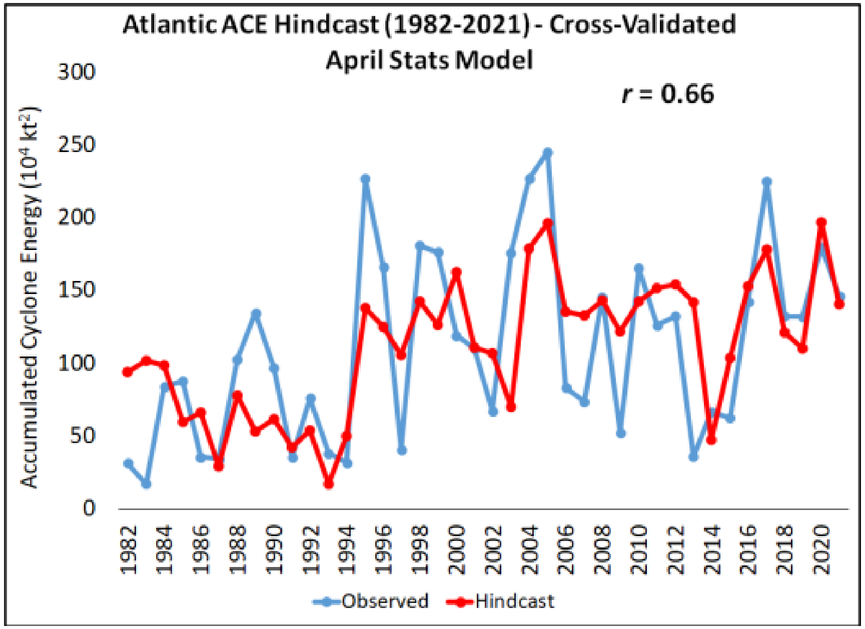


AO Index: Observed & GEFS Forecasts



Interactions analysis between regions for the same target season (i.e summer African monsoon and Atlantic cyclone activity)

Hurricane FCST 2022



August-October Correlations w/ Predictor 1 (1982-2019)

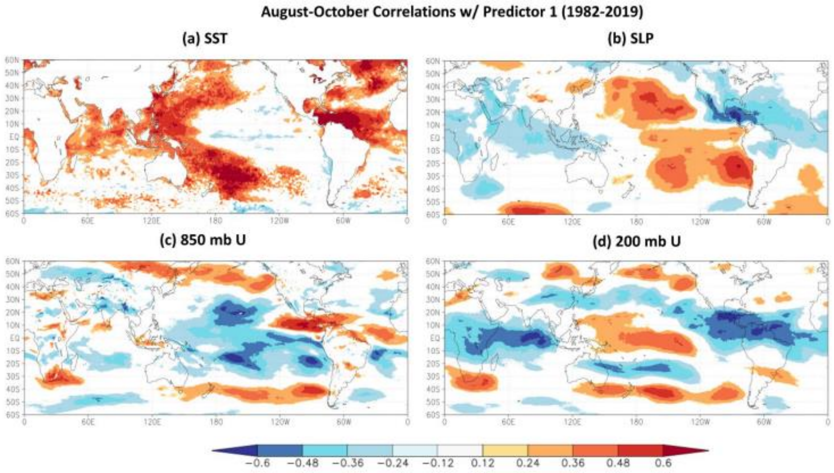
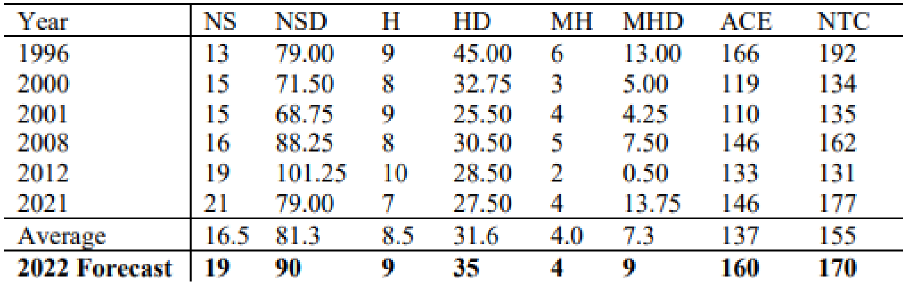


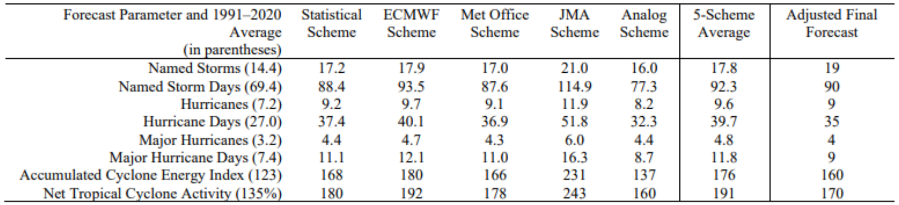
Figure 4: Rank correlations between January–March SST in the tropical and subtropical Atlantic (Predictor 1) and (panel a) August–October sea surface temperature, (panel b) August–October sea level pressure, (panel c) August–October 850 hPa zonal wind and (panel d) August–October 200 hPa zonal wind. All four of these parameter deviations in the tropical Atlantic are known to be favorable for enhanced hurricane activity.

Table 10: Analog years for 2022 with the associated hurricane activity listed for each year.



Year	NS	NSD	H	HD	MH	MHD	ACE	NTC
1996	13	79.00	9	45.00	6	13.00	166	192
2000	15	71.50	8	32.75	3	5.00	119	134
2001	15	68.75	9	25.50	4	4.25	110	135
2008	16	88.25	8	30.50	5	7.50	146	162
2012	19	101.25	10	28.50	2	0.50	133	131
2021	21	79.00	7	27.50	4	13.75	146	177
Average	16.5	81.3	8.5	31.6	4.0	7.3	137	155
2022 Forecast	**19**	**90**	**9**	**35**	**4**	**9**	**160**	**170**

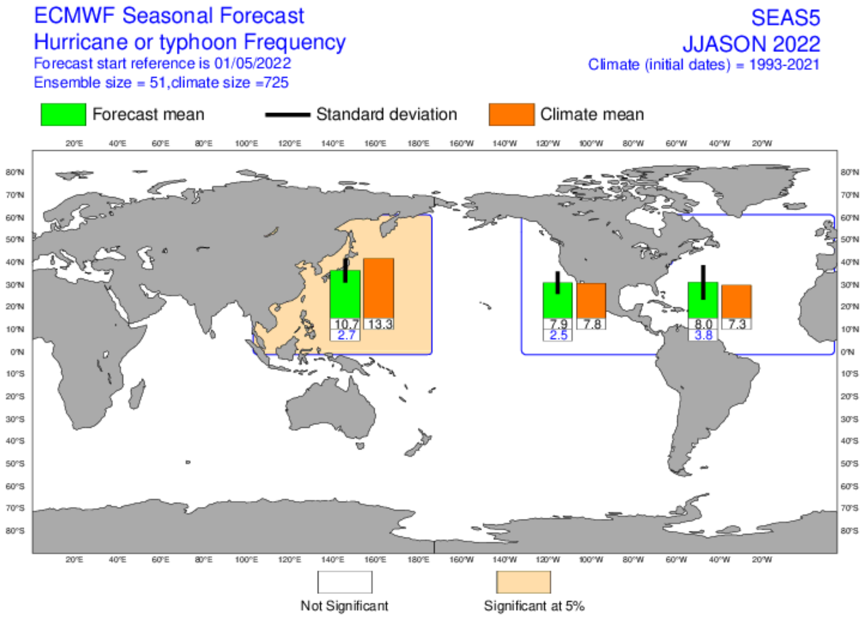
Table 11: Summary of our early April statistical forecast, our statistical/dynamical forecasts, our analog forecast, the average of these five schemes and our adjusted final forecast for the 2022 hurricane season.

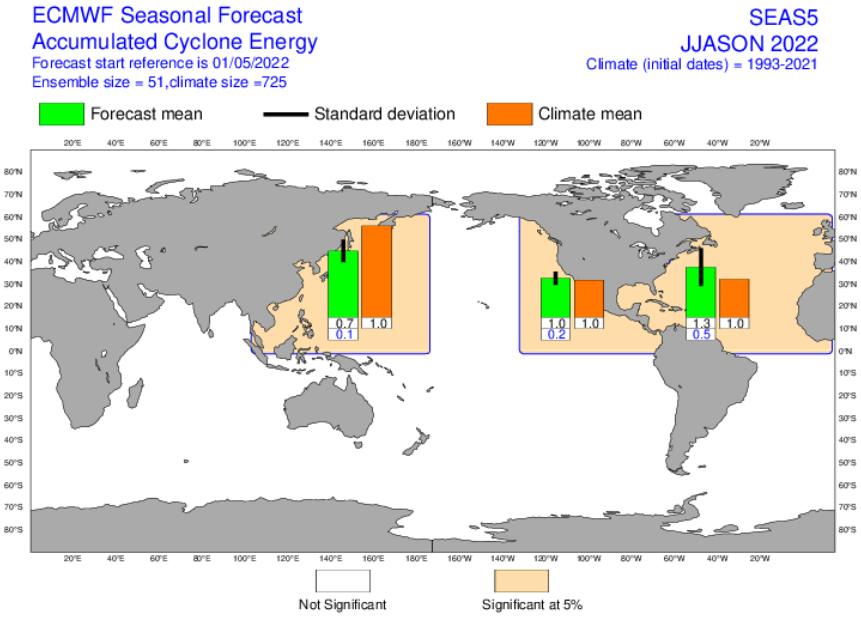


Forecast Parameter and 1991–2020 Average (in parentheses)	Statistical Scheme	ECMWF Scheme	Met Office Scheme	JMA Scheme	Analog Scheme	5-Scheme Average	Adjusted Final Forecast
Named Storms (14.4)	17.2	17.9	17.0	21.0	16.0	17.8	19
Named Storm Days (69.4)	88.4	93.5	87.6	114.9	77.3	92.3	90
Hurricanes (7.2)	9.2	9.7	9.1	11.9	8.2	9.6	9
Hurricane Days (27.0)	37.4	40.1	36.9	51.8	32.3	39.7	35
Major Hurricanes (3.2)	4.4	4.7	4.3	6.0	4.4	4.8	4
Major Hurricane Days (7.4)	11.1	12.1	11.0	16.3	8.7	11.8	9
Accumulated Cyclone Energy Index (123)	168	180	166	231	137	176	160
Net Tropical Cyclone Activity (135%)	180	192	178	243	160	191	170

Interactions analysis between regions for the same target season (i.e summer African monsoon and Atlantic cyclone activity)

Tropical Hurricane FCST 2022


ECMWF Seasonal Forecast
Hurricane or typhoon Frequency
Forecast start reference is 01/05/2022
Ensemble size = 51,climate size =725
SEAS5
JJASON 2022
Climate (initial dates) = 1993-2021
Forecast mean
Standard deviation
Climate mean
10.7
2.7
13.3
7.9
2.5
7.8
8.0
3.8
7.3
Not Significant
Significant at 5%


ECMWF Seasonal Forecast
Accumulated Cyclone Energy
Forecast start reference is 01/05/2022
Ensemble size = 51,climate size =725
SEAS5
JJASON 2022
Climate (initial dates) = 1993-2021
Forecast mean
Standard deviation
Climate mean
0.7
0.1
1.0
1.0
0.2
1.0
1.3
0.5
1.0
Not Significant
Significant at 5%

Step 8:

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

SSTs and Rainfall Forecasts

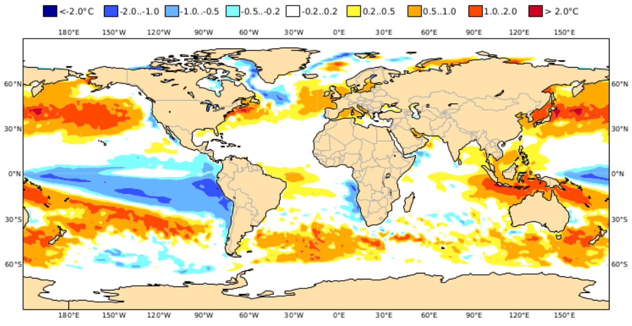
Single Model Ensemble Analysis (SSTs)

Season 1

ECMWF

C3S: ECMWF contribution
Mean SST anomaly
Nominal forecast start: 01/05/22
Ensemble size = 51, climate size = 600

JJA 2022

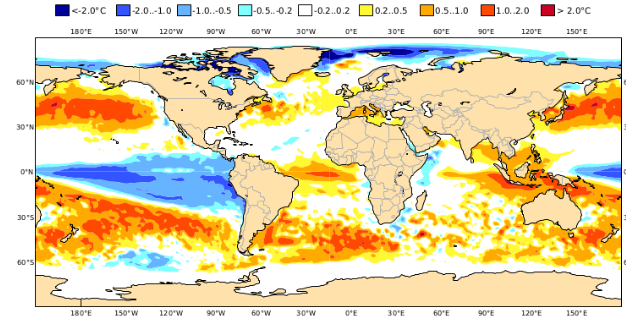


<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S

MF

C3S: Météo-France contribution
Mean SST anomaly
Nominal forecast start: 01/05/22
Ensemble size = 51, climate size = 600

JJA 2022

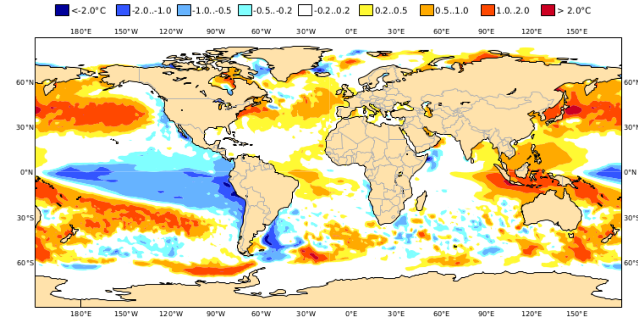


<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S

UKMO

C3S: Met Office contribution
Mean SST anomaly
Nominal forecast start: 01/05/22
Ensemble size = 50, climate size = 672

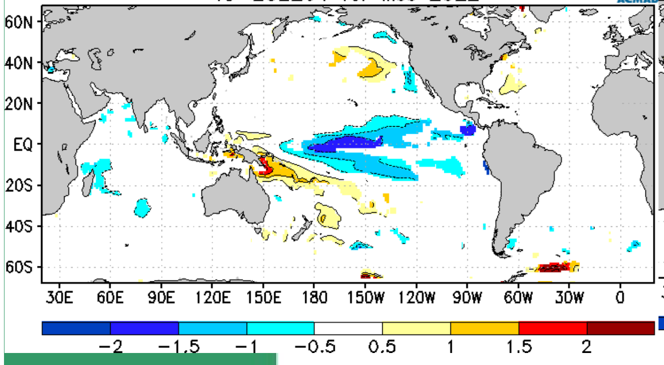
JJA 2022



<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S

CFSv2

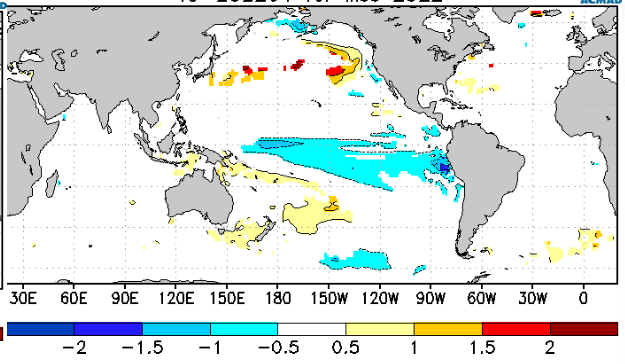
CFSv2 Fcst of SST Anom:
IC=202204 for MJJ 2022



ACMAD
60N
40N
20N
EQ
20S
40S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
-2
-1.5
-1
-0.5
0.5
1
1.5
2

CanCM4i

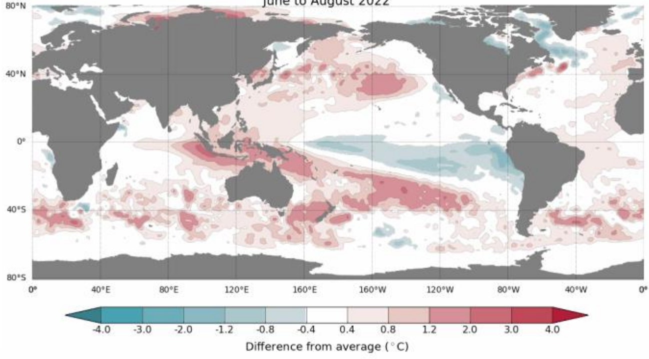
CMC1 Fcst of SST Anom:
IC=202204 for MJJ 2022



ACMAD
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
-2
-1.5
-1
-0.5
0.5
1
1.5
2

BoM

Difference from average sea surface temperature forecast for June to August 2022



80°N
40°N
0°
40°S
80°S
0°
40°E
80°E
120°E
160°E
160°W
120°W
80°W
40°W
0°
-4.0
-3.0
-2.0
-1.2
-0.8
-0.4
0.4
0.8
1.2
2.0
3.0
4.0
Difference from average (°C)

www.bom.gov.au/climate
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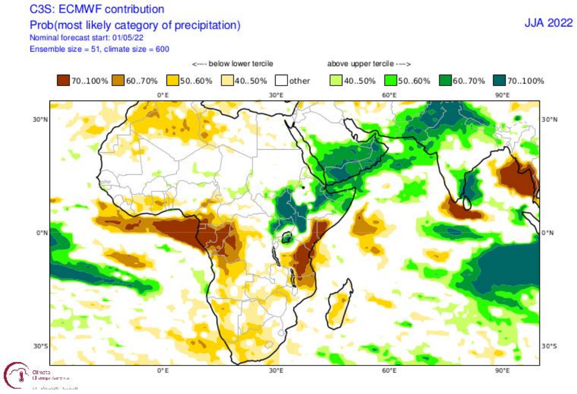
Model: ACCESS-S2
Base period: 1981-2018

Model run: 21/05/2022
Issued: 23/05/2022

Single model Ensemble Analysis (Rainfall)

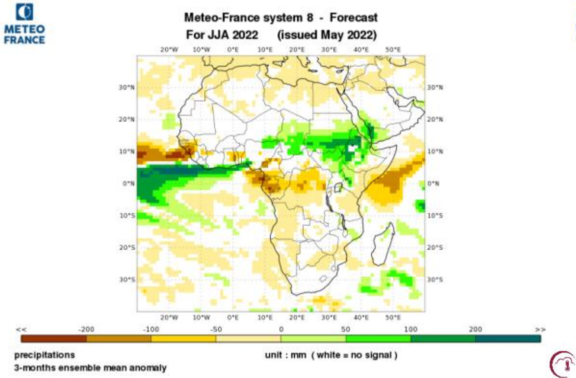
Season 1

ECMWF


C3S: ECMWF contribution
Prob(most likely category of precipitation)
Nominal forecast start: 01/05/22
Ensemble size = 51, climate size = 600
JJA 2022

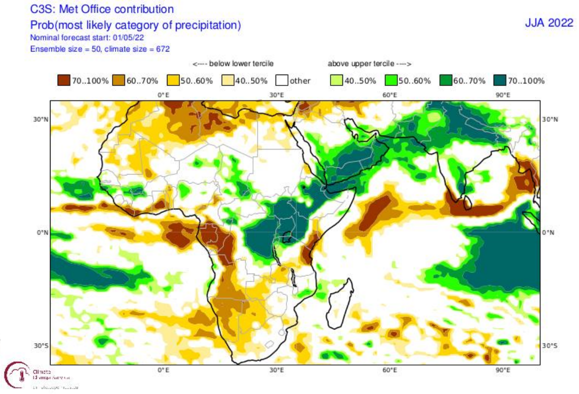
<---- below lower tercile
above upper tercile ---->
70..100%
60..70%
50..60%
40..50%
other
40..50%
50..60%
60..70%
70..100%
0°E
30°E
60°E
90°E
30°N
0°N
30°S

MF


Meteo-France system 8 - Forecast
For JJA 2022 (issued May 2022)
precipitations
3-months ensemble mean anomaly
unit : mm (white = no signal)

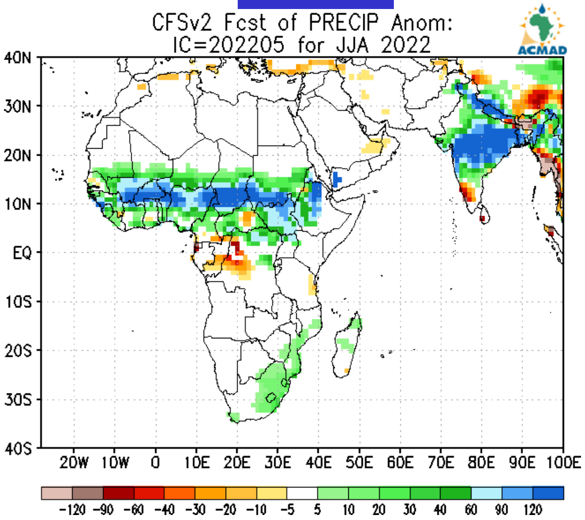
METEO FRANCE
20°W
10°W
0°E
10°E
20°E
30°E
40°E
50°E
30°N
20°N
10°N
0°N
10°S
20°S
30°S
<<
-200
-100
-50
0
50
100
200
>>

UKMO


C3S: Met Office contribution
Prob(most likely category of precipitation)
Nominal forecast start: 01/05/22
Ensemble size = 50, climate size = 672
JJA 2022

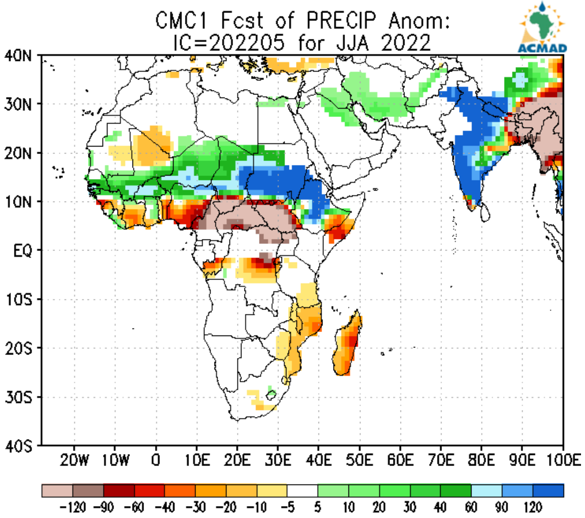
<---- below lower tercile
above upper tercile ---->
70..100%
60..70%
50..60%
40..50%
other
40..50%
50..60%
60..70%
70..100%
0°E
30°E
60°E
90°E
30°N
0°N
30°S

CFSv2


CFSv2 Fcst of PRECIP Anom:
IC=202205 for JJA 2022

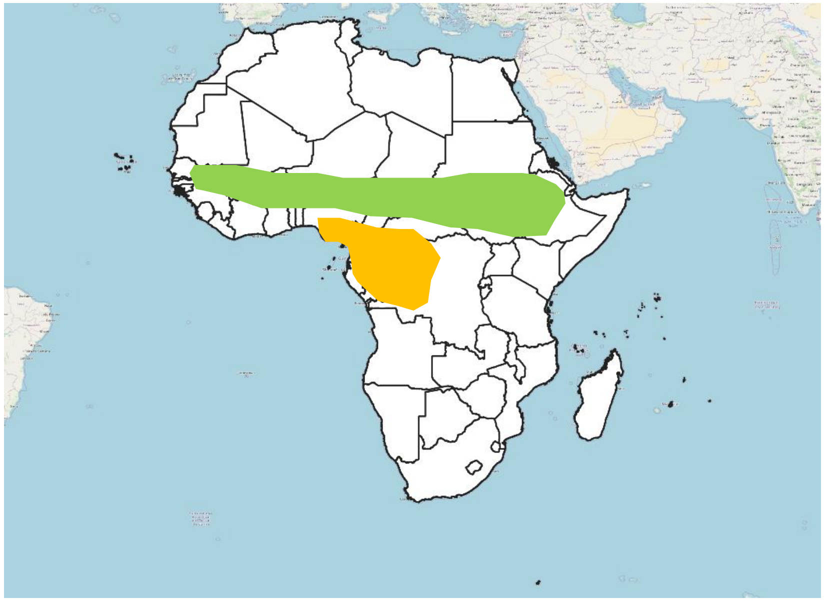
ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
70E
80E
90E
100E
-120
-90
-60
-40
-30
-20
-10
-5
5
10
20
30
40
60
90
120

CanCM4i


CMC1 Fcst of PRECIP Anom:
IC=202205 for JJA 2022

ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
70E
80E
90E
100E
-120
-90
-60
-40
-30
-20
-10
-5
5
10
20
30
40
60
90
120

Preliminary outlook based on Step 8



Step 8a:

Multi - Model Ensemble Analysis (i,e WMO-LC, MME, Copernicus, IRI)

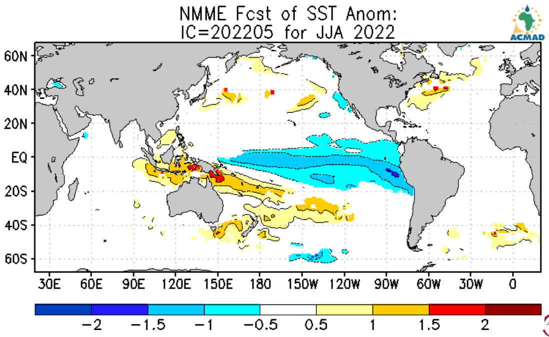
SSTs Forecasts

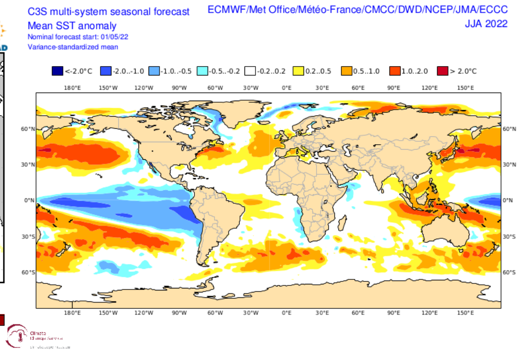
Multimodel Ensemble Analysis (SSTs)

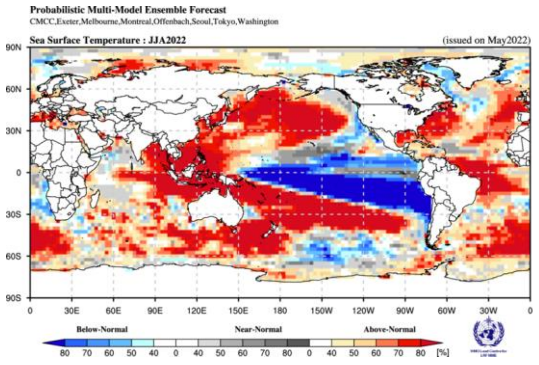
NMME

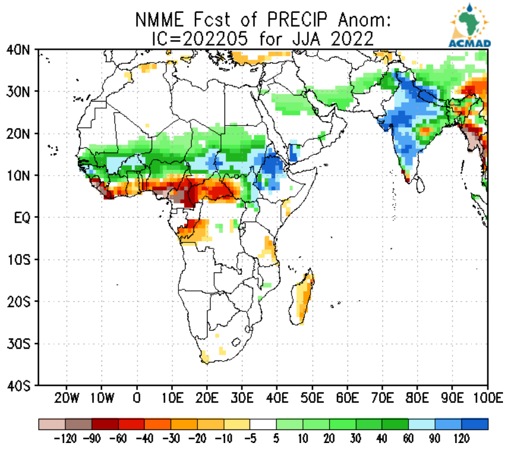
C3S

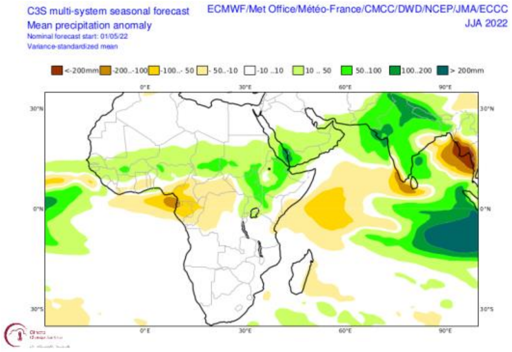
WMO

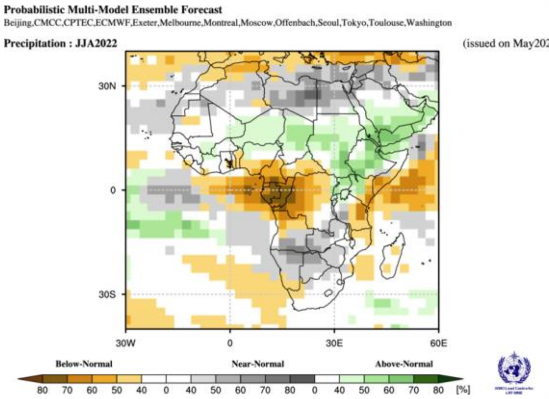

NMME Fcst of SST Anom:
IC=202205 for JJA 2022
ACMAD
60N
40N
20N
EQ
20S
40S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
−2
−1.5
−1
−0.5
0.5
1
1.5
2


C3S multi-system seasonal forecast
Mean SST anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-2.0°C
-2.0..-1.0
-1.0..-0.5
-0.5..-0.2
-0.2..0.2
0.2..0.5
0.5..1.0
1.0..2.0
> 2.0°C
180°E
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
120°E
150°E
60°N
30°N
0°N
30°S
60°S


Probabilistic Multi-Model Ensemble Forecast
CMCC,Exeter,Melbourne,Montreal,Offenbach,Seoul,Tokyo,Washington
Sea Surface Temperature : JJA2022
(issued on May2022)
90N
60N
30N
0
30S
60S
90S
0
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
Below-Normal
Near-Normal
Above-Normal
80
70
60
50
40
0
40
50
60
70
80
0
40
50
60
70
80
[%]

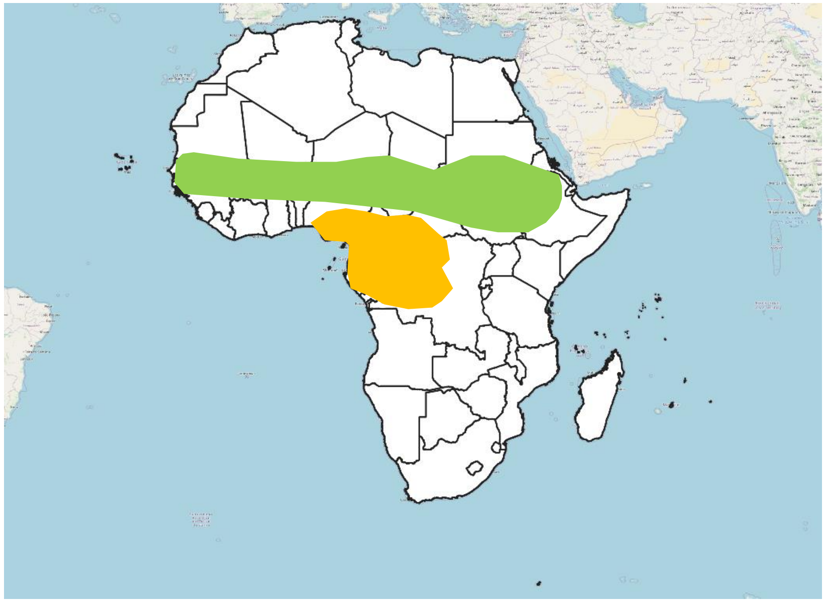

NMME Fcst of PRECIP Anom:
IC=202205 for JJA 2022
ACMAD
40N
30N
20N
10N
EQ
10S
20S
30S
40S
20W
10W
0
10E
20E
30E
40E
50E
60E
70E
80E
90E
100E
−120
−90
−60
−40
−30
−20
−10
−5
5
10
20
30
40
60
90
120


C3S multi-system seasonal forecast
Mean precipitation anomaly
Nominal forecast start: 01/05/22
Variance-standardized mean
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
JJA 2022
<-200mm
-200..-100
-100..- 50
- 50..-10
-10 ..10
10 .. 50
50..100
100..200
> 200mm
0°E
30°E
60°E
90°E
30°N
0°N
30°S


Probabilistic Multi-Model Ensemble Forecast
Beijing,CMCC,CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington
Precipitation : JJA2022
(issued on May202
30N
0
30S
30W
0
30E
60E
Below-Normal
Near-Normal
Above-Normal
80
70
60
50
40
0
40
50
60
70
80
0
40
50
60
70
80
[%]

Preliminary outlook based on Step 8

FCST SCENARIO

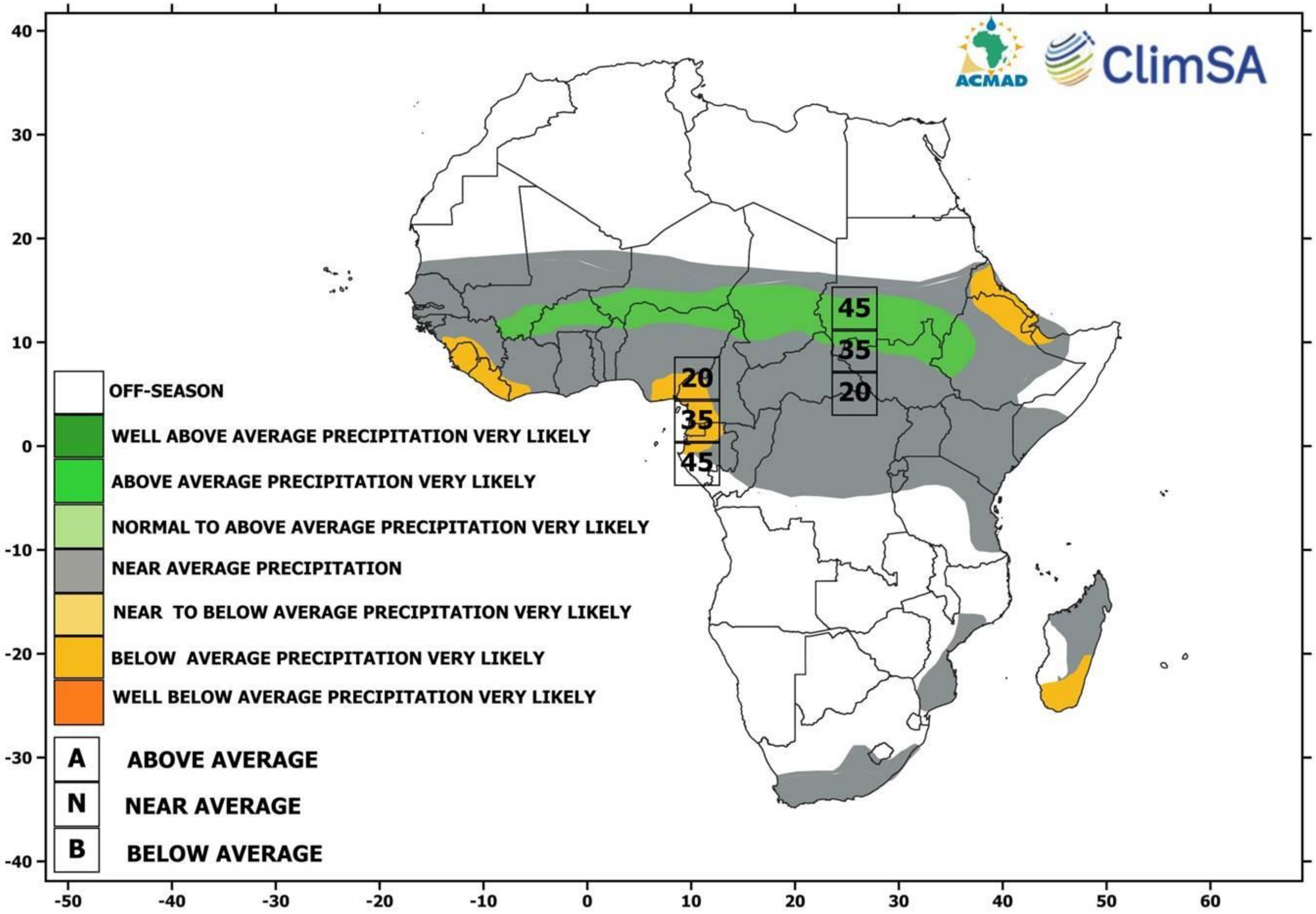


Step 9:

Consolidation Analysis of institutional outlook

SEASONAL PRECIPITATION OUTLOOK FOR JJA 2022

SEASONAL PRECIPITATION FORECAST
FOR JUNE-JULY-AUGUST 2022
ISSUED ON APRIL 29, 2022


40
30
20
10
0
-10
-20
-30
-40
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
ACMAD
ClimSA
45
35
20
20
35
45
OFF-SEASON
WELL ABOVE AVERAGE PRECIPITATION VERY LIKELY
ABOVE AVERAGE PRECIPITATION VERY LIKELY
NORMAL TO ABOVE AVERAGE PRECIPITATION VERY LIKELY
NEAR AVERAGE PRECIPITATION
NEAR TO BELOW AVERAGE PRECIPITATION VERY LIKELY
BELOW AVERAGE PRECIPITATION VERY LIKELY
WELL BELOW AVERAGE PRECIPITATION VERY LIKELY
A ABOVE AVERAGE
N NEAR AVERAGE
B BELOW AVERAGE

ACMAD

THANK YOU