Met Office
Hadley Centre

Forecast of July-August-September 2022 season rainfall in the Sahel and other regions of tropical North Africa: Updated forecast

FORECAST OF JULY-AUGUST-SEPTEMBER 2022 SEASON RAINFALL IN THE SAHEL AND OTHER REGIONS OF TROPICAL NORTH AFRICA: UPDATED FORECAST

Andrew Colman
Met Office Hadley Centre, Exeter, UK

Part 1: Forecast

The July-August-September (JAS) 2022 rainfall forecast in Figure 1.1 for three climatologically defined regions, the Sahel, Soudan and Guinea Coast, is based on output from the ECMWF SEAS5 dynamical seasonal prediction system. Information on the dynamical prediction system, the methodology used to generate the forecast, and a map of the regions, is provided in Part 2.

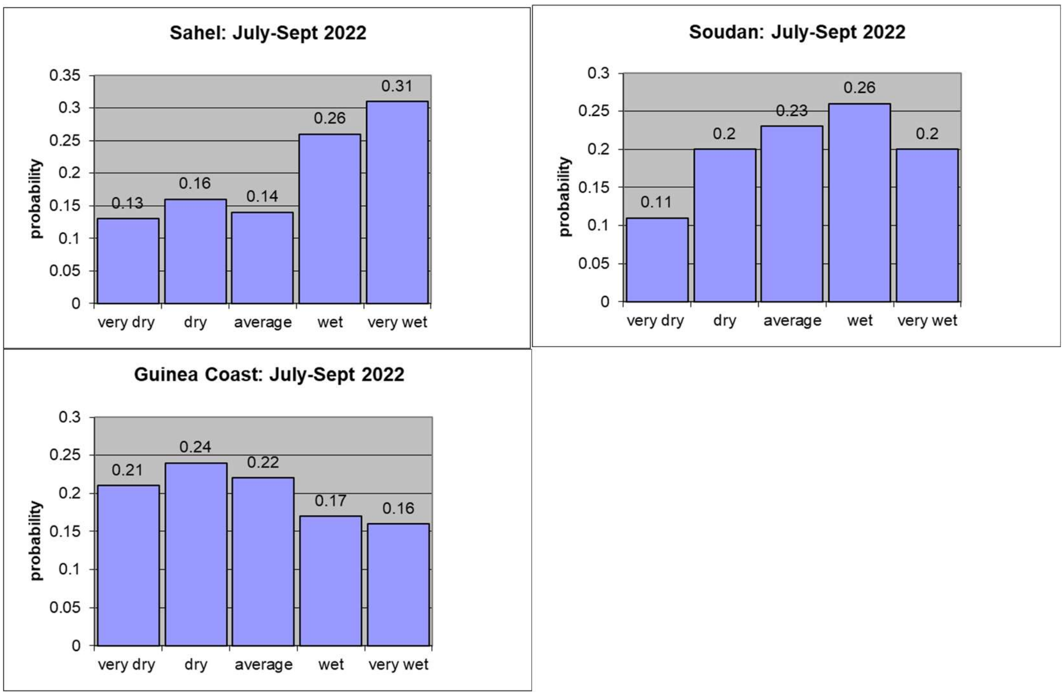

Figure 1.1: Predicted probabilities for July-August-September 2022 rainfall for the Sahel (15°W to 37.5°E,12.5°N to 17.5°N); Soudan (7.5°W to 33.75°E, 10°N to 12.5°N) and Guinea Coast (7.5°W to 7.5°E, 5°N to 10°N) regions. Probabilities are for 5 categories referred to as: very dry, dry, average, wet and very wet. The category boundaries are defined from 1961-1990 observations, such that the climatological probability for each category in that period is by definition 0.2 (20%).

To generate the forecast, ensemble predictions for JAS 2022 from a start date in early June have been combined to create an ensemble of 51 members. Probabilities for the 5 quintile categories presented in Fig. 1.1 were calculated using the ensemble and a scaling procedure, as described in Part 2.

To complement Fig. 1.1, the scaled JAS hindcast values for 1981-2016 and the forecast for 2022 are shown in Fig. 1.2, along with the observed JAS rainfall, for each region. All values are scaled as described in Part 2. The box and whisker format indicates the range of all the members (whiskers) and the range of the inner half of the ensemble (box).

Correlations between observed and retrospective ensemble mean values of precipitation are 0.55 for the Sahel, 0.6 for the Soudan and 0.52 for the Guinea coast.

Due to a data availability issue, this time, the regional forecasts displayed in Figure 1.1 and 1.2 have been produced using the ECMWF SEAS5 system instead of GloSea. The same methodology is used as described in Section 2 except the hindcast period has been extended from 1993-2016 to 1981-2016. ECMWF forecast maps can also be seen on the Copernicus website https://climate.copernicus.eu/charts/c3s_seasonal/.

The anomaly pattern over west Africa is similar to Met Office GloSea6 gridded probability forecasts which are accessible here:

http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks/glob-seas-prob

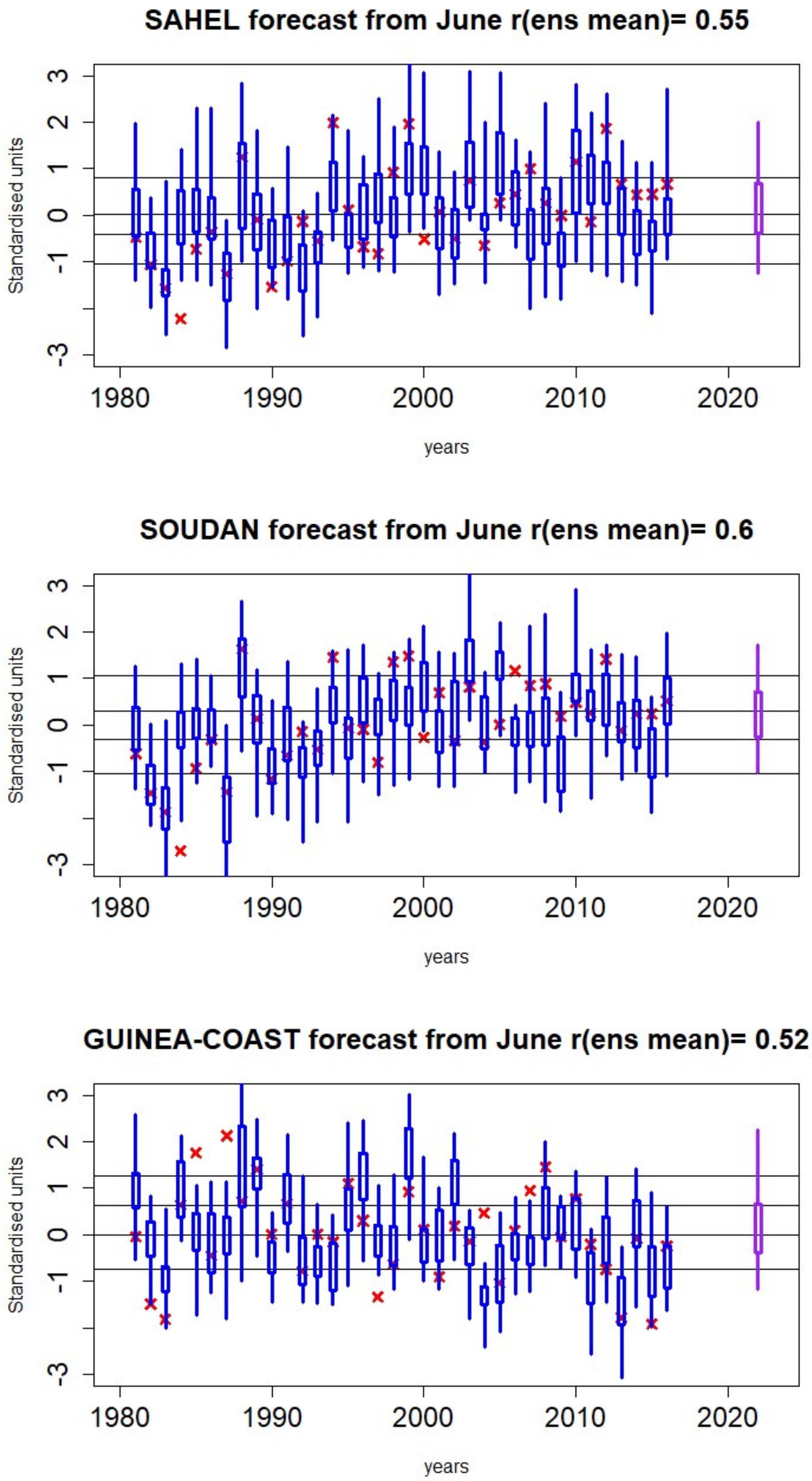

Figure 1.2: ECMWF SEAS5 ensemble predictions for July-August-September 2022 (purple box-and-whisker far right) and corresponding retrospective forecasts (blue box-and-whisker) and observed rainfall (red crosses) for each year 1981-2016 and for the three North African regions. Solid horizontal lines are the quintile boundaries scaled as in Part 2.

Part 2: Further information

Note: For JAS 2022, ECMWF SEAS5 has been in used in place of Met Office GloSea6. With the exception of the change to the hindcast period as described in Part 1, all other details here remain the same.

The Met Office has been making forecasts of July-August-September seasonal rainfall for the Sahel and other climatologically defined regions in North Africa since 1986 using a combination of statistical and dynamical methods. Following a review of the forecast methods in 2007 these North Africa forecasts are now based purely on dynamical model forecasts of rainfall, produced using the Met Office seasonal forecast system. See http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal .

The forecast is presented as a prediction for the three climatologically defined regions shown in Figure 2.1. For consistency with previous forecasts, the three regions are referred to as the Sahel (15°W to 37.5°E, 12.5°N to 17.5°N), the Soudan (7.5°W to 33.75°E, 10°N to 12.5°N) and the Guinea coast: (approximately 7.5°W to 7.5°E, 5°N to 10°N).

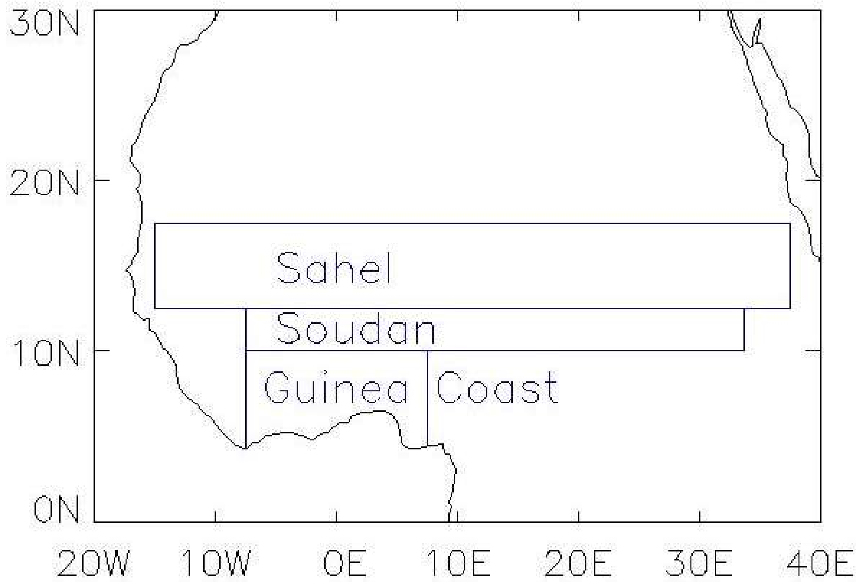

Figure 2.1 Geographical location of the three regions.

Methodology

Data from the GloSea6 system are used to calculate outlooks for each of the three regions as follows, using regionally averaged precipitation for July-August-September (JAS) from forecasts initialised in April .
The forecasts in Figure 1.1 are presented as probabilities of quintile categories of total JAS rainfall for each of the three regions. The quintiles are evaluated using observed JAS rainfall data for 1961-1990. This climatology period is chosen as it is the WMO standard and widely used in regional climate outlook forums including PRESASS. The five quintile categories are equiprobable over the 1961-1990 climatology period and are referred to as 'very dry', 'dry', 'average', 'wet' and 'very wet'. Thus, for example, a predicted value of 0.4 for the 'dry' category indicates a probability of 0.4 (40%) that the JAS regionally-averaged precipitation will be within the dry category with boundaries defined by the equiprobable 1961-1990 categories.

The expression of the forecast probabilities relative to a 1961-1990 climatology is done to conform to this widely used standard and thus to aid forecast interpretation. For various reasons the conversion will not be exact and thus the probability values should be interpreted as indicating the general shift in the distribution rather than as being numerically precise.

Use of ensemble members to produce probability forecasts

Forecast probabilities are all evaluated using standardised data. For each region the hindcast standard error is calculated from the observed seasonal precipitation and hindcast ensemble data available for 1993-2016. For each ensemble member of the real-time forecast, a Gaussian distribution with standard deviation equal to the hindcast standard error and mean equal to the forecast JAS precipitation for that member is obtained. This Gaussian distribution is used to calculate probabilities for the 5 quintile categories from each ensemble member. The probabilities from each member are then simply averaged to calculate the probabilities presented in the forecast, Figure 1.1.

Bias correction and standardisation

In order to correct for model bias, the observed JAS time series for the three regions, and the GloSea6 model hindcast time series for the three regions, are standardised using the common period 1993-2016.
Thus the standardised observed precipitation is

$$SPo = \frac{Po - APo}{SDPo} ,$$

where P_o = observed precipitation, AP_o = average observed precipitation over 1993-2016 and SDP_o = standard deviation of observed precipitation over 1993-2016 .

Similarly for model data, the standardised model precipitation is

$$SPm = \frac{Pm - APm}{SDPm} \ ,$$

where P_m = model precipitation, AP_m = average model precipitation over 1993-2016 and SDP_m = standard deviation of model precipitation over 1993-2016.

Quintiles (quintile category boundaries) are evaluated using observed data for 1961-1990. These quintile category boundaries are then scaled using 1993-2016 scales as above, so a standardised boundary is

$$SQBPo = \frac{QBPo - APo}{SDPo} \ ,$$

where QBP_o = an observed quintile category boundary for 1961-1990 (in the same units as observed precipitation P_o) , and AP_o and SDP_o are as defined above.

Met Office:
FitzRoy Road, Exeter
Devon, EX1 3PB
UK

Tel: +44(0)1392 885680
Fax: +44(0)1392 885681
enquiries@metoffice.gov.uk
www.metoffice.gov.uk