START OF THE AGRICULTURE SEASON DEFINITION AT ACMAD

Date: September 16, 2021

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1. Introduction

Seasonal Climate outlooks issued by most Regional Climate Outlooks in Africa present probabilistic forecasts of total seasonal precipitation. Agriculture stakeholders have repeatedly requested information on the start of the agriculture season and timing of transition from wet to dry conditions during the season.

Many parts of Africa are often described as having monsoon climate (i.e West and east African monsoon). The start of the agriculture season is of greater application value among the elements of the agriculture calendar. Many start of agriculture season definitions have been proposed and are being used over Africa. On simple definition by Lo et al. (2007) provides an overview and is considered as on of the simplest definition based on the date of accumulation of 50 mm of rainfall. This was considered as the amount of rainfall that is required to generate new plant growth after the usually dry season (Cook anf Heerdegen 2001).

Adaptation of this definition for Application in Africa has been considered by ACMAD. The climatological accumulation of rainfall for each location is first generated and the average date corresponding to 50 mmm accumulation is identified as climatological start of the agriculture season. The determination of each year's strat of the season date is then the date of rainfall accumulation reaching 50 mm starting 30 days before the climatological start of the season date. Early or late start of the season is determined by the date of rainfall accumulation reaching 50 mm on the 125% and 75% of the climatological rainfall accumulation graphs. If for a given year 21 dry days is observed between the last two rain events contributing to the 50 mm accumulation, the start of the season should be the date of next rain event.

2. Data and Methods

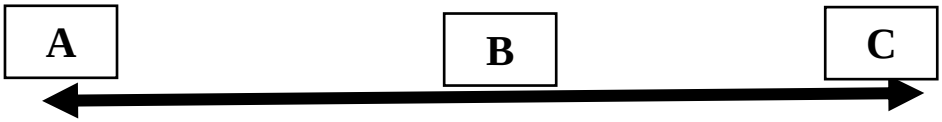
a. Rainfall data

The data used is the African Rainfall Climatology version 2 (ARC2) data series and/or Unified Precipitation Data from the US /NOAA.

b. *Start of the season generation methodology and procedure*

For a given station data (estimated and/or Observed) time series:

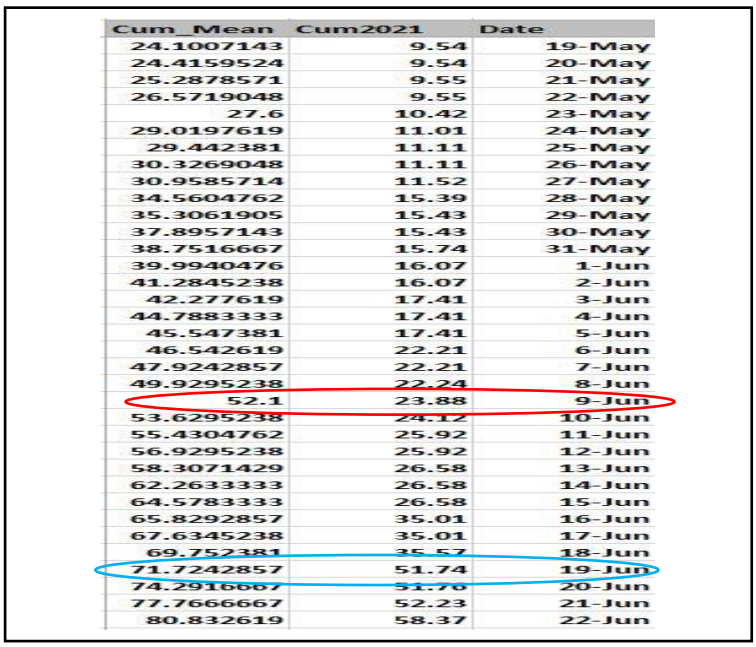
- Calculate the daily mean of the long time series
- Calculate the cumulative of the daily mean and 75%/125% of it.
- Identify the dates on the threshold 50 mm for the mean 75% and 125% of the mean
- We create an interval using the mean onset date and its two boundaries. Set B=Mean Onset (Normal), A=125% Mean Onset (Early), C=75% Mean Onset (Late). The interval is



- Calculate the cumulative of the current year started **30 days before** the mean onset:
    - If the cumulative reach 50mm (Season Started) then the date D where this threshold is reach is determined.
- The date D is compared within the created interval
    - If D < A then the current year has early start.
    - If A <= D <= B then the current year has normal to early start.
    - If B <= D <= C then the current year has normal to late start.
    - If D > C then the current year has late start.

Example (Niamey Data)

Let's consider Niamey Data (Unified precipitation source: https://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP/.CPC/.UNIFIED_PRCP/.GAUGE_BASED/.GLOBAL/.v1p0/.extREALTIME/.rain/)



Cum_Mean	Cum2021	Date
24.1007143	9.54	19-May
24.4159524	9.54	20-May
25.2878571	9.55	21-May
26.5719048	9.55	22-May
27.6	10.42	23-May
29.0197619	11.01	24-May
29.442381	11.11	25-May
30.3269048	11.11	26-May
30.9585714	11.52	27-May
34.5604762	15.39	28-May
35.3061905	15.43	29-May
37.8957143	15.43	30-May
38.7516667	15.74	31-May
39.9940476	16.07	1-Jun
41.2845238	16.07	2-Jun
42.277619	17.41	3-Jun
44.7883333	17.41	4-Jun
45.547381	17.41	5-Jun
46.542619	22.21	6-Jun
47.9242857	22.21	7-Jun
49.9295238	22.24	8-Jun
52.1	23.88	9-Jun
53.6295238	24.12	10-Jun
55.4304762	25.92	11-Jun
56.9295238	25.92	12-Jun
58.3071429	26.58	13-Jun
62.2633333	26.58	14-Jun
64.5783333	26.58	15-Jun
65.8292857	35.01	16-Jun
67.6345238	35.01	17-Jun
69.752381	35.57	18-Jun
71.7242857	51.74	19-Jun
74.2916667	51.76	20-Jun
77.7666667	52.23	21-Jun
80.832619	58.37	22-Jun

We can see in red circle where the cumulative mean reach 50mm correspond to 9th of Jun and in the blue circle the cumulative of 2021 reach 50mm at 19th of Jun. This shown the late start.

3. **Algorithm**

Input: Historical Station Data, Analogue Years, Season

Output: Onset Date by Year Data Frame

Begin:

-Compute the daily mean (Using long time series)

-Compute the cumulative sum of the daily mean

-Compute 125% and 75% cumulative sum of the daily mean

If (Maximum cumulative sum of the daily mean for a target season >100mm)

- **Determine the mean onset date using the cumulative sum of the daily mean (Where it reach 50 mm).**
- **Determine the late onset and earlier onset using 75% and 125% cumulative sum.**
- **Using Analogue years and current years**
    1. **Start the cumulative sum 30 days before the mean onset date for all the analogue and current year.**
    2. **Determine the mean onset for the analogue years where cumulative reach 50mm:**
        - **If there is no more than 21 days between two rains that give the 50mm keep the date as the onset.**
        - **Else the date of the next rain after the cumulative of 50mm is considered as the onset.**
    3. **Check if cumulative sum of the current year is greater than 50mm**
        - **The season started then determine the onset date**
    4. **If the cumulative sum of the current year is less than 50mm**
        - **The onset date is unknown (N/A) then the station is on onset forecast state.**

End.

3.References

Cook, G. D., and R. G. Heerdegen, 2001: Spatial variations in the duration of the rainy season in monsoonal Australia. Int. J. Climatol., 21, 1723–1732

Lo, F., M. C. Wheeler, H. Meinke, and A. Donald, 2007: Probabilistic forecasts of the onset of the north Australian wet season. Mon. Wea. Rev., 135, 3506–3520..

Ati, O.F.; Stigter, C.J.; Oladipo, E.O., ***2002*** *A comparison of methods to determine the onset of the growing season in northern Nigeria.Int. J. Clim., vol. 22, 731–742.*

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