FOCUS-AFRICA
Full-value chain Optimised Climate User-centric Services for Southern Africa

Estimating Agronomic Calendar of a Wet-season using AquaBEHER Tool

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PLAN INTERNATIONAL

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Overview: *what is AquaBEHER?*

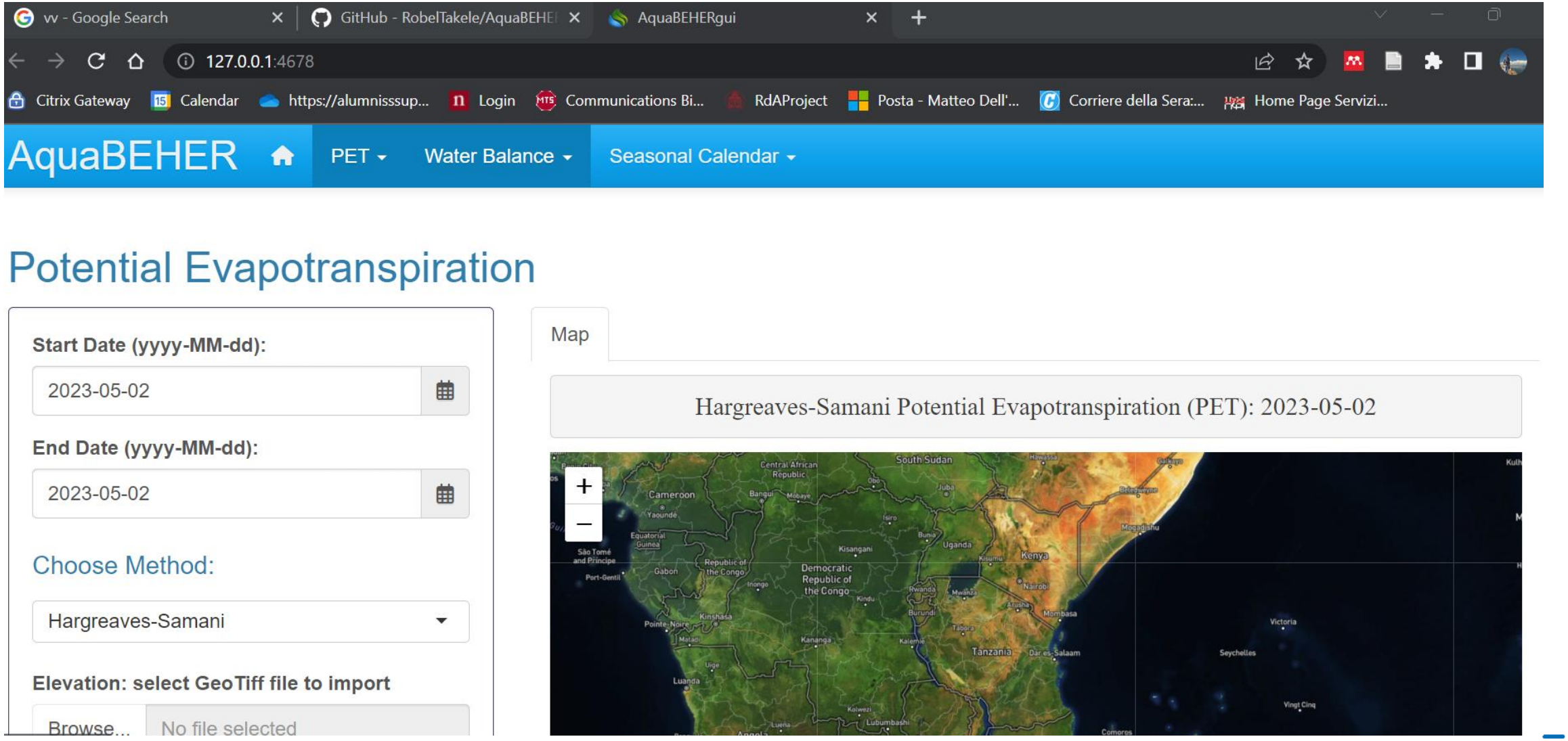
- AquaBEHER is an R package that computes and integrates daily reference evapotranspiration (Eto) into a daily soil-water balance model to estimate the agronomic calendar of a wet-season.

- The tool can be used to estimate and plot/map characteristics (onset, cessation and duration) of the wet-season calandar using climate data obtained from weather stations/farm locations and from spatial objects/over regions.

Overview: *What does it do ?*

- ✓Estimates daily reference evapotranspiration.
- ✓Estimates parameters of daily soil-water balance.
- ✓Estimates agronomic calendar (onset, cessation and duration) of the wet season.
- ✓Visualize the estimsted outputs in the form of table, graphs or maps and export the figures to file.
- ✓Export the estimated output data in the form of tables (Excel) and spatial object (NetCDF) to file.

Overview: *How does it look?*



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Methods: *characteristics of the wet-season calendar*

- A normal cropping period is one when there is an excess of precipitation over potential evapotranspiration (PET).
- Such a period meets the evapotransiration demands of crops and recharge the moisture of the soil profile.
- Thus, the onset of the wet-season will start on the first day, when the actual-to-potential evapotranspiration ratio is greater than 0.5 for 7 consecutive days, followed by a 20-day period in which plant available water remains above wilting over the root zone of the soil.
- The wet-season will end, cessation, on the first day when the actual-to-potential evapotranspiration ratio is less than 0.5 for 7 consecutive days, followed by 12 consecutive non-growing days in which plant available water remains below wilting over the root zone of the soil.

Methods: *characteristics of the wet-season calendar*

Climatic Onset

The first wet day after 01-Sep of a 3-day wet-spell receiving at least ***Rw3day***, without grater than 7 dry days in the following 10 days.

Climatic Cessation

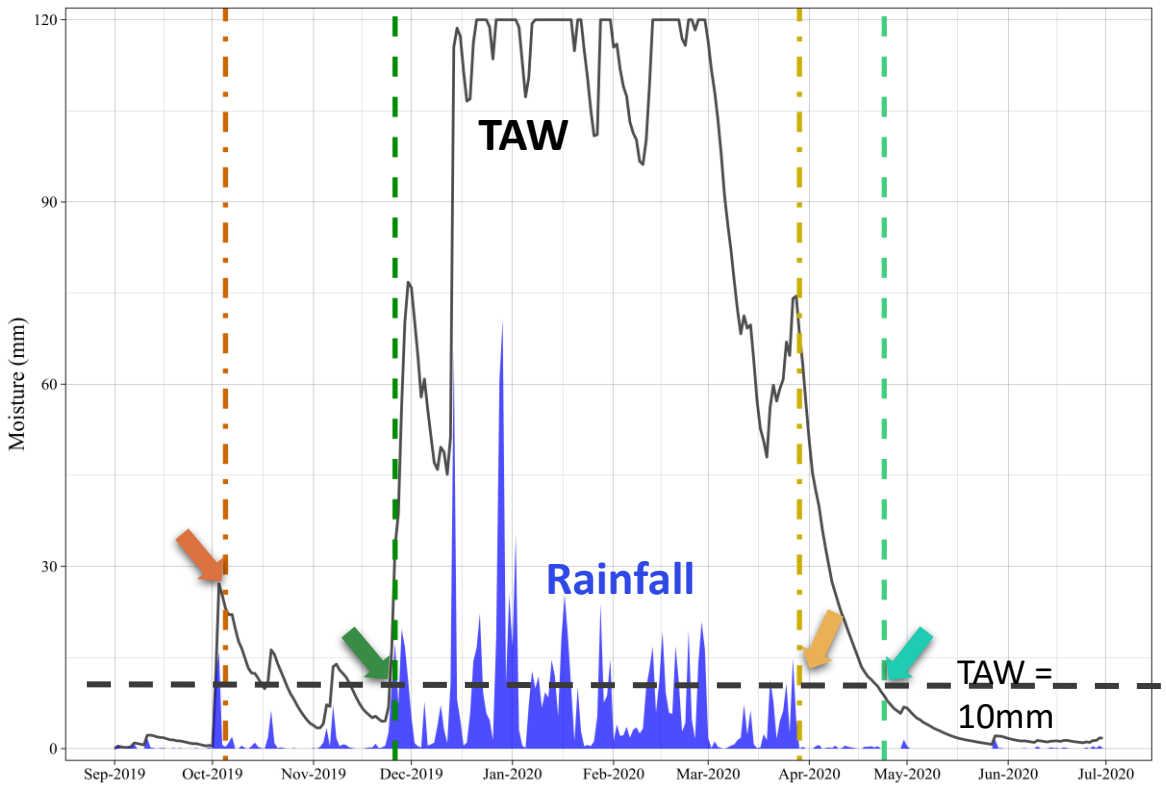
A day after 01-March which, 20-day rainfall amount is less than ***Rx20day***.

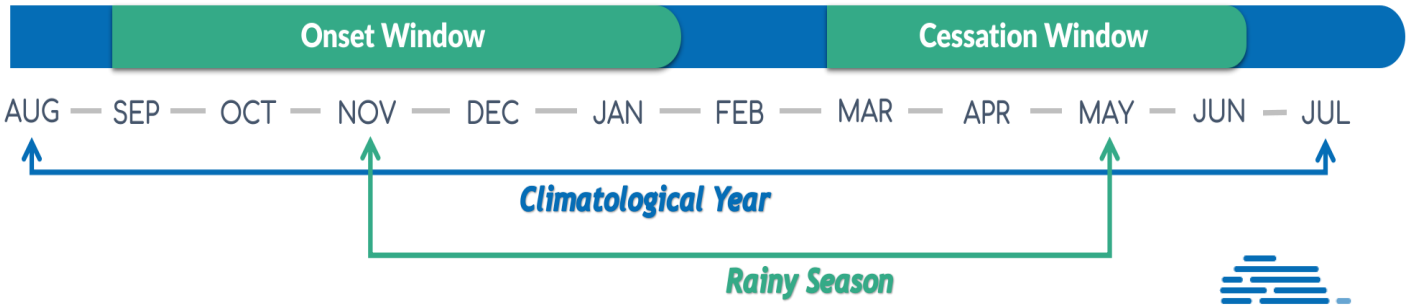
AgroClimatic Onset

The first day after 01-Sep, when the Eratio (Ea/Ep) > 0.5, followed by a 20-day period in which TAW remains > 10mm.

AgroClimatic Cessation

Season has ended at the first day (Eratio<=0.5) after 01-Mar following 12 consecutive non-growing days (TAW<10mm).





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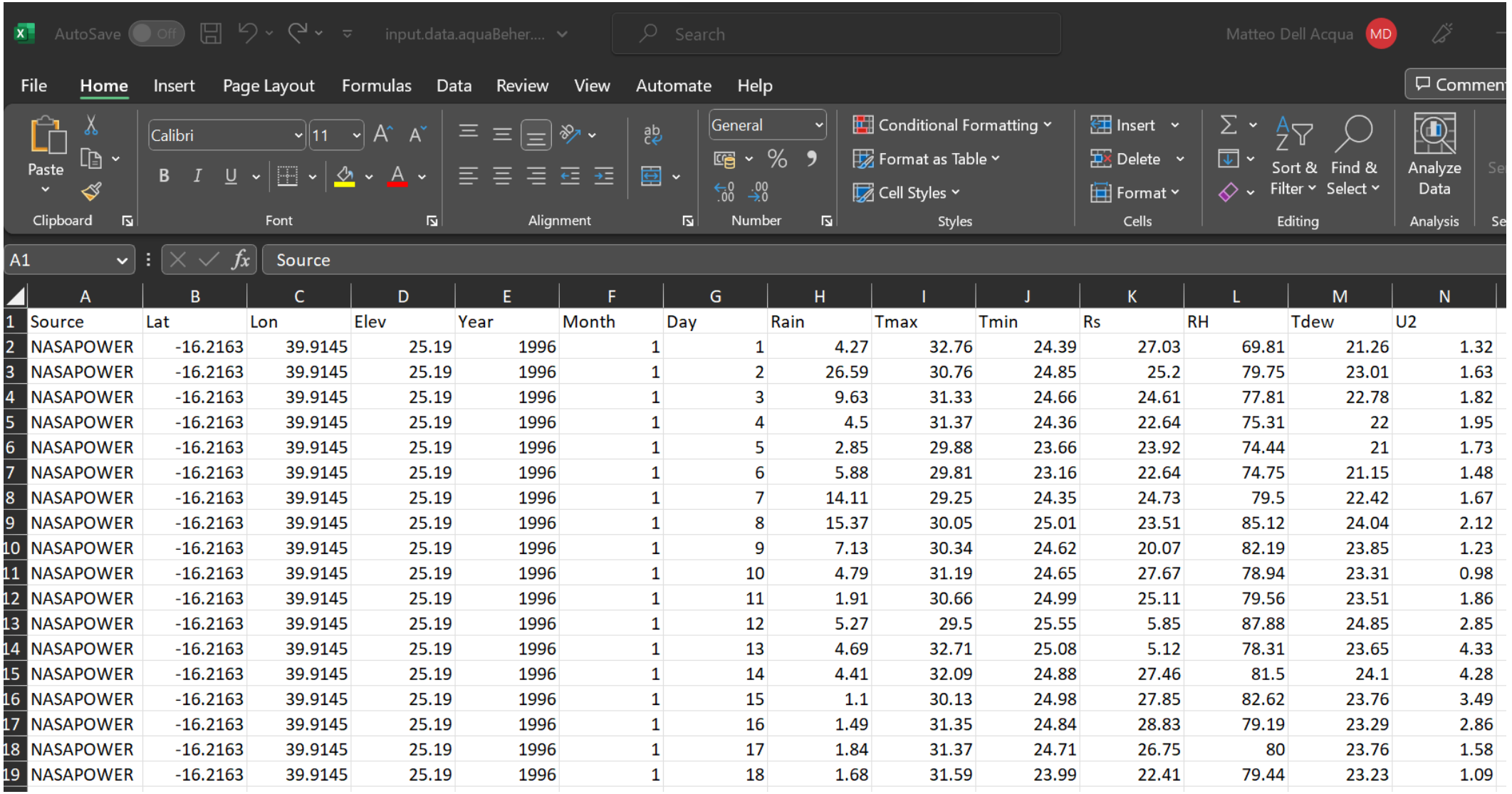
Methods: *How does it work?*

- AquaBEHER requires daily climate data to estimate PET.
- Using Rainfall, PET and soil properties, it computes daily soil water balance for the root zone to acount for suply and demand of soil moisture.
- Then, the tool estimates the agronomic calendar of the wet-season using soil-water balance parameters.

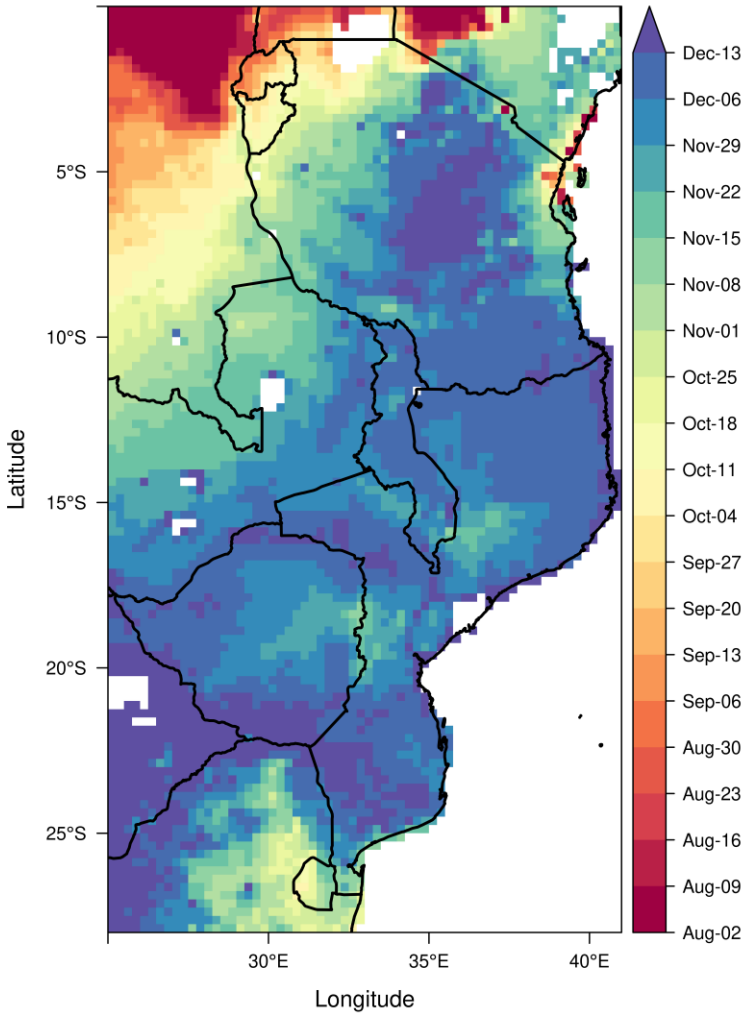
Output



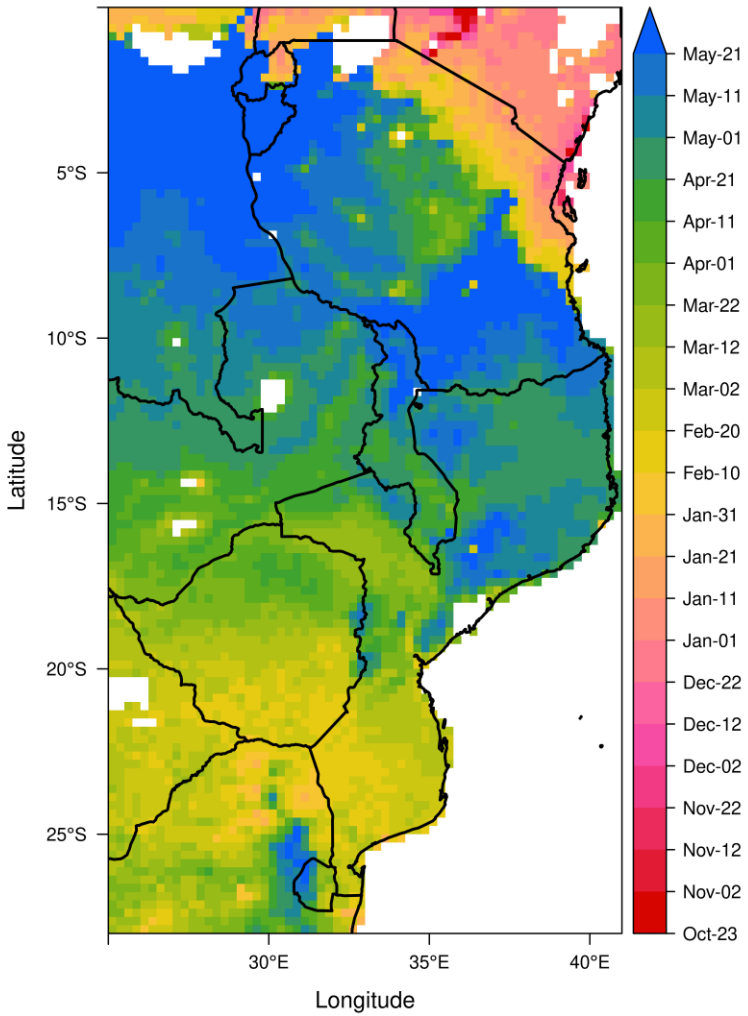
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Source	Lat	Lon	Elev	Year	Month	Day	Rain	Tmax	Tmin	Rs	RH	Tdew	U2
2	NASAPOWER	-16.2163	39.9145	25.19	1996	1	1	4.27	32.76	24.39	27.03	69.81	21.26	1.32
3	NASAPOWER	-16.2163	39.9145	25.19	1996	1	2	26.59	30.76	24.85	25.2	79.75	23.01	1.63
4	NASAPOWER	-16.2163	39.9145	25.19	1996	1	3	9.63	31.33	24.66	24.61	77.81	22.78	1.82
5	NASAPOWER	-16.2163	39.9145	25.19	1996	1	4	4.5	31.37	24.36	22.64	75.31	22	1.95
6	NASAPOWER	-16.2163	39.9145	25.19	1996	1	5	2.85	29.88	23.66	23.92	74.44	21	1.73
7	NASAPOWER	-16.2163	39.9145	25.19	1996	1	6	5.88	29.81	23.16	22.64	74.75	21.15	1.48
8	NASAPOWER	-16.2163	39.9145	25.19	1996	1	7	14.11	29.25	24.35	24.73	79.5	22.42	1.67
9	NASAPOWER	-16.2163	39.9145	25.19	1996	1	8	15.37	30.05	25.01	23.51	85.12	24.04	2.12
10	NASAPOWER	-16.2163	39.9145	25.19	1996	1	9	7.13	30.34	24.62	20.07	82.19	23.85	1.23
11	NASAPOWER	-16.2163	39.9145	25.19	1996	1	10	4.79	31.19	24.65	27.67	78.94	23.31	0.98
12	NASAPOWER	-16.2163	39.9145	25.19	1996	1	11	1.91	30.66	24.99	25.11	79.56	23.51	1.86
13	NASAPOWER	-16.2163	39.9145	25.19	1996	1	12	5.27	29.5	25.55	5.85	87.88	24.85	2.85
14	NASAPOWER	-16.2163	39.9145	25.19	1996	1	13	4.69	32.71	25.08	5.12	78.31	23.65	4.33
15	NASAPOWER	-16.2163	39.9145	25.19	1996	1	14	4.41	32.09	24.88	27.46	81.5	24.1	4.28
16	NASAPOWER	-16.2163	39.9145	25.19	1996	1	15	1.1	30.13	24.98	27.85	82.62	23.76	3.49
17	NASAPOWER	-16.2163	39.9145	25.19	1996	1	16	1.49	31.35	24.84	28.83	79.19	23.29	2.86
18	NASAPOWER	-16.2163	39.9145	25.19	1996	1	17	1.84	31.37	24.71	26.75	80	23.76	1.58
19	NASAPOWER	-16.2163	39.9145	25.19	1996	1	18	1.68	31.59	23.99	22.41	79.44	23.23	1.09

Output

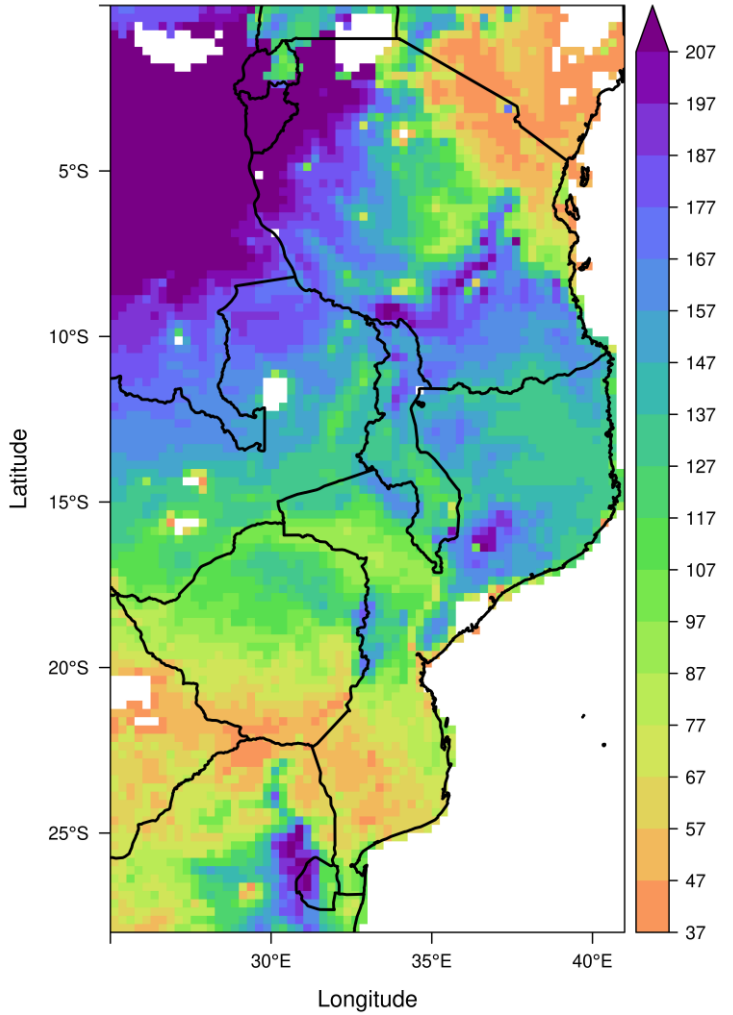
Normal (50th %) agronomic onset of the wet-season [1982:2022]



Normal (50th %) agronomic cessation of the wet-season [1982:2022]



Normal (50th %) agronomic duration (days) of the wet-season [1982:2022]



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Methods: *Platform*

- The tool can be installed and run on R environment on any basic laptop and tested across different platforms (Windws, Linux, MacOS).
- For spatial estimations over larger domains/regions, a high-spec computer might be required, depending on the size and resolution of the data.
- The package can be integrated to other aplication platforms as a background process to adopt the functionalities of the tool.
- For flexible usage an online alternative with graphical user interface (*AquaBEHERgui)* is available.

Applicability: *where can be used?*

- The tool can be used across regions where crop production is cultured.
- Daily data on climate parameters and data on soil properties is a requirement to utilize the functionalities of the tool; a collection of those datasets are publicly available at global level this days.
- The tool is tested at varies locations and cropping systems over sub-sharan africa.

Applicability: *who can use it ?*

- Primary target users are:-
  - National/sub-national and regional meteorological service providers (NMHS).
  - Agricultural Research Centers and Universities.
  - Development organizations (such as CGIAR centers, UN agencies, NGO's) engaged in research and provision of climate service and agriculture sector.
  - Private companies engaged in the provision of climate service,
  - Private crop producers.

Upcoming versions >>>

- Include additional functionalities:
  - Include additional functionalities for downscaled multi-modal ensemble seasonal prediction of calendar of the wet-season.
  - Include estimation of additional relevant parameters such as dry-spells, number of rain days ...
  - Include functionality of input data preprocessing

Project Partners

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LGi sustainable innovation

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BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

Amigo

University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad

CSIR our future through science

Met Office

WEMC World Energy & Meteorology Council

UNITY AND FREEDOM

IIAM Instituto de Investigação Agrária de Moçambique

THANK YOU

Get in touch for more information!

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Project coordinator – Roberta Boscolo, WMO

All project reports will be available for download on the Focus-Africa website **www.focus-africaproject.eu**

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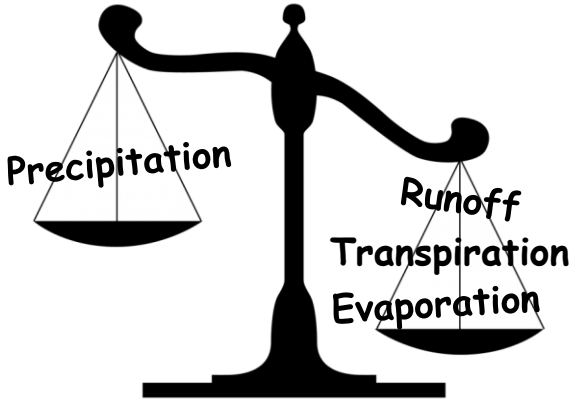
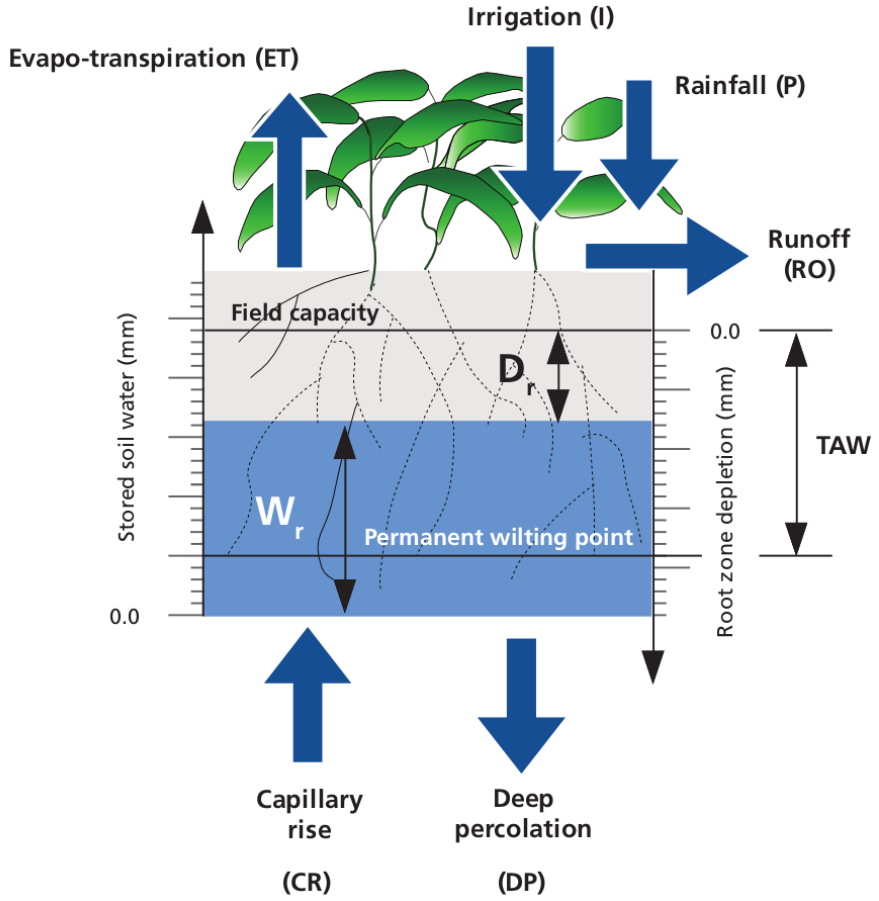
Methods: *Dynamic Soil-water Model; processes and mechanisms*

$$\Delta SW_i = SW_{i-1} + P_i + I_i + CR_i - RO_i - ET_i - DP_i$$

A simple daily computation for the root zone to account for supply and demand of soil moisture.





The method consists of assessing the incoming and outgoing water flux into the crop root zone ***(Allen et al. 1998; Ritchie, 1998; Woli et al., 2012).***

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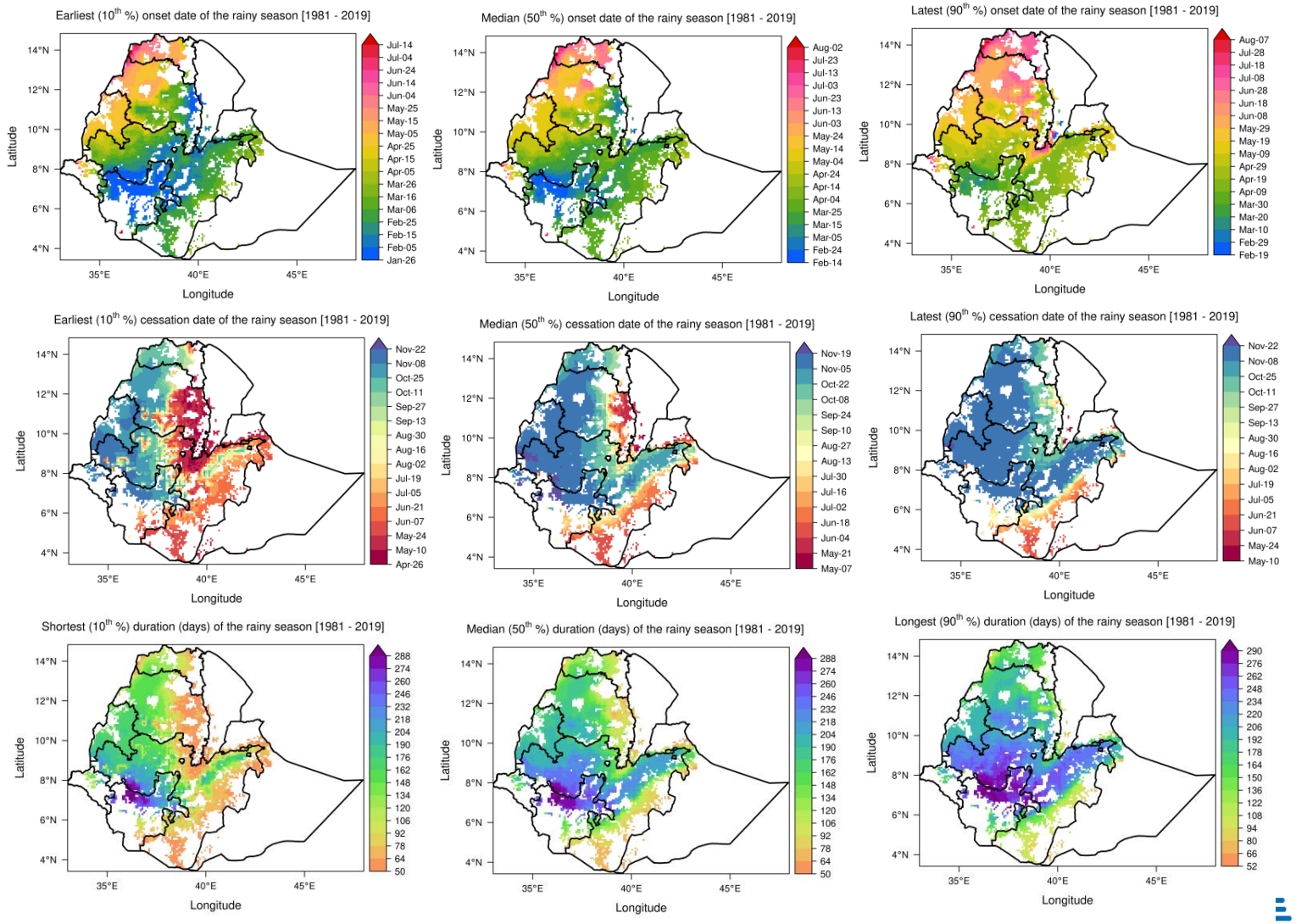
Annex: *use-case over Ethiopia*

Agronomic calendar of the wet-season over Maize growing areas of Ethiopia.



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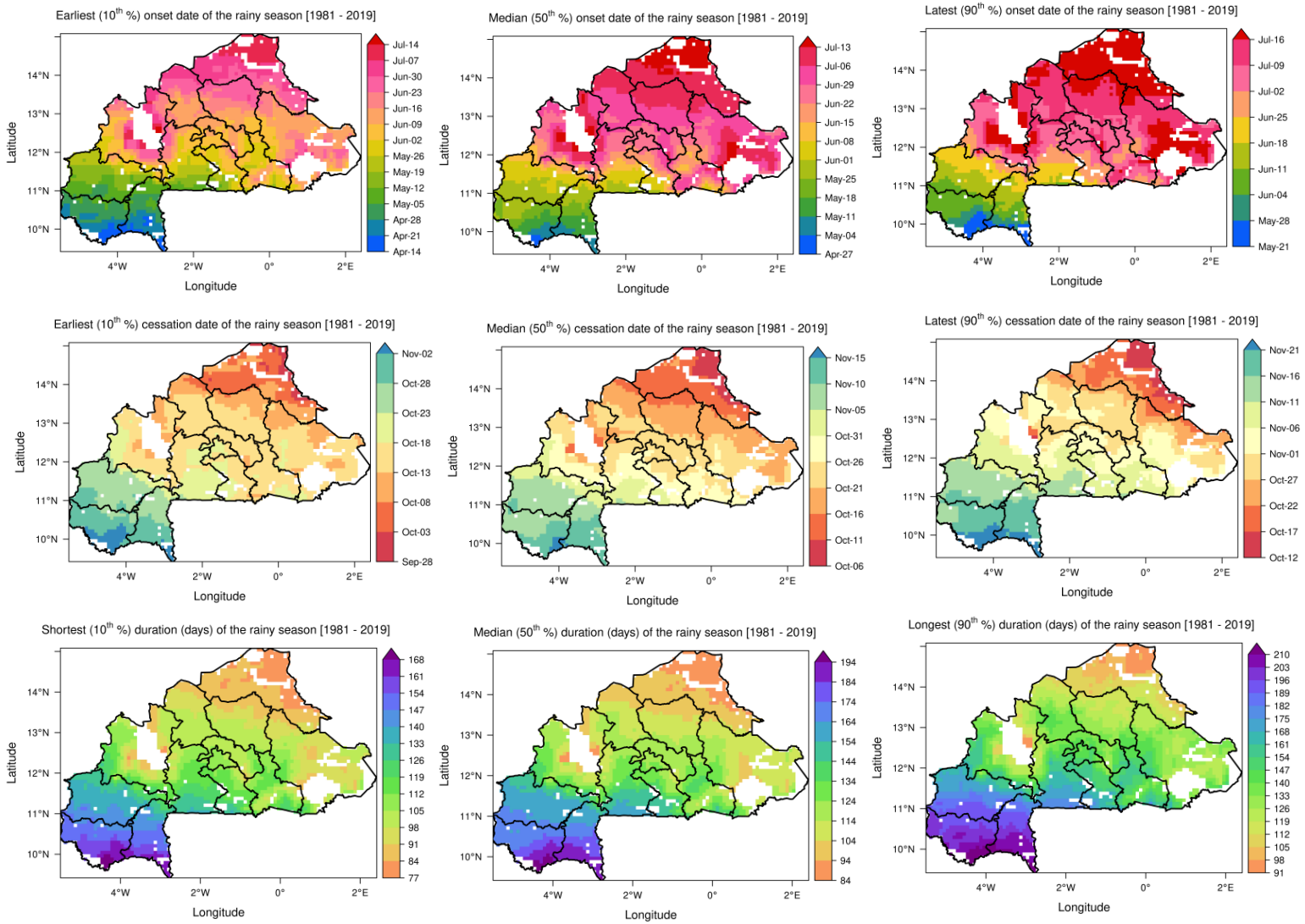
Annex: *use-case over Burkina Faso*

Agronomic calendar of the wet-season over sorghum growing areas of Burkina Faso.



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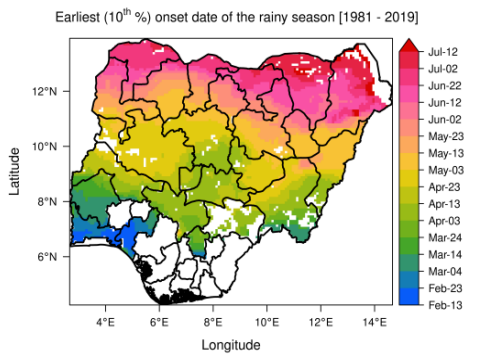
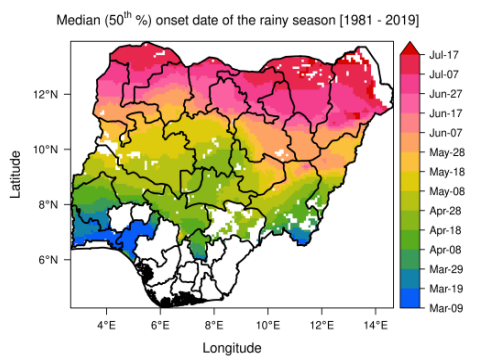
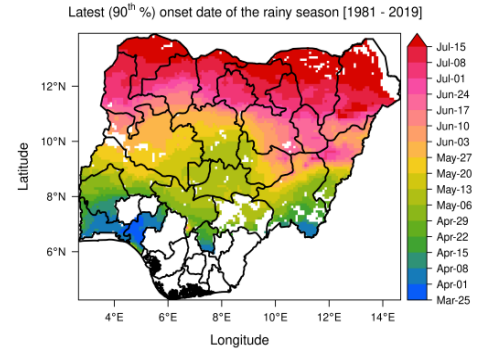
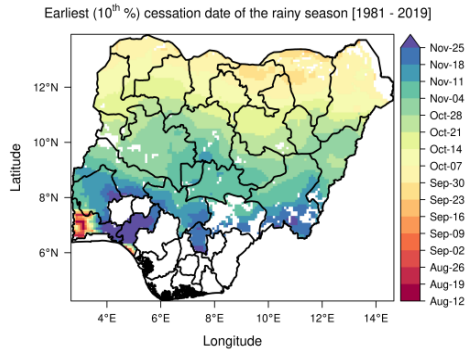
Annex: *use-case over Nigeria*

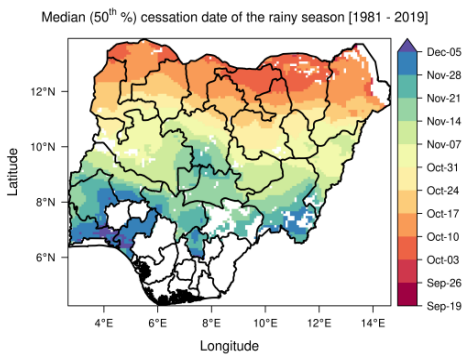
Agronomic calendar of the wet-season over sorghum growing areas of Nigeria.

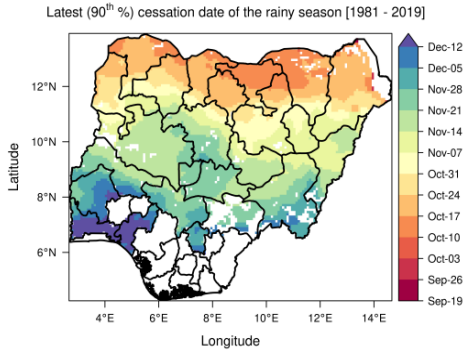


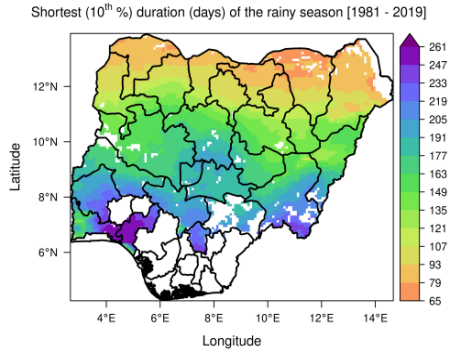


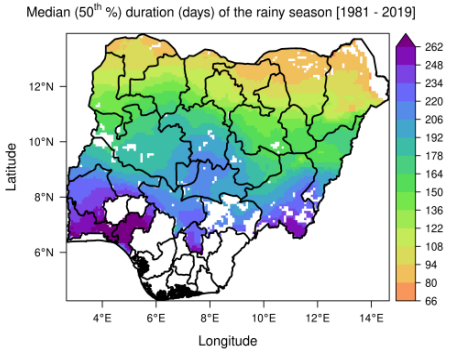


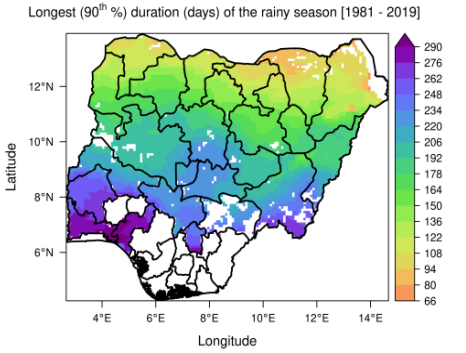












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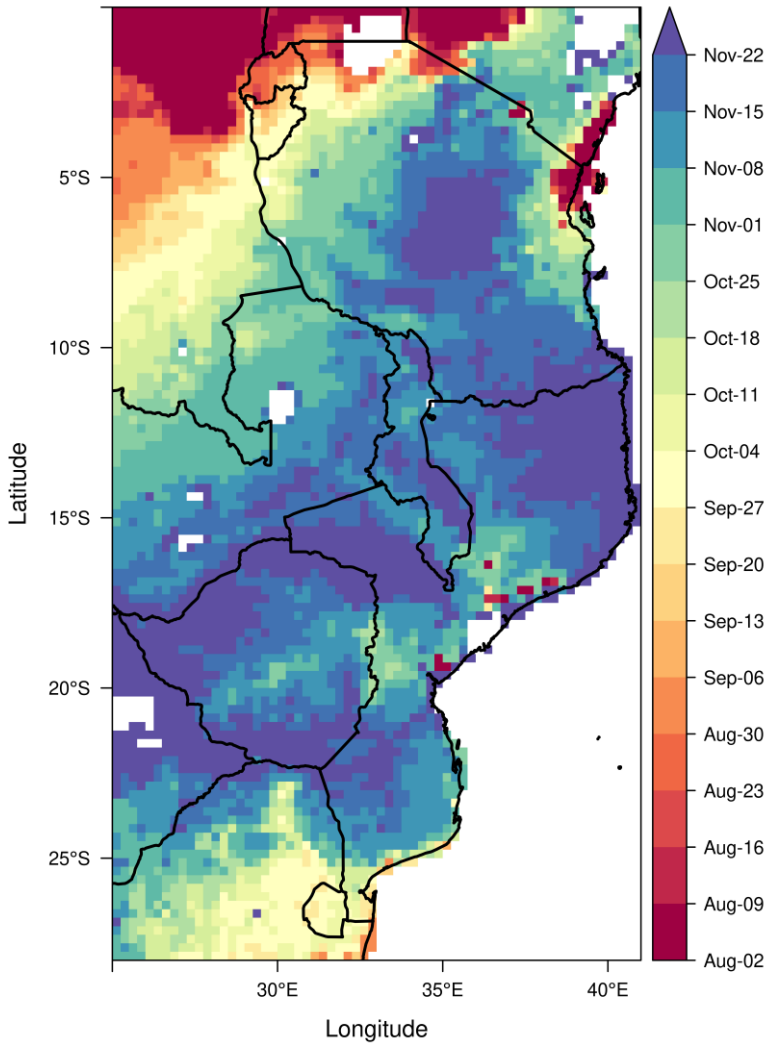
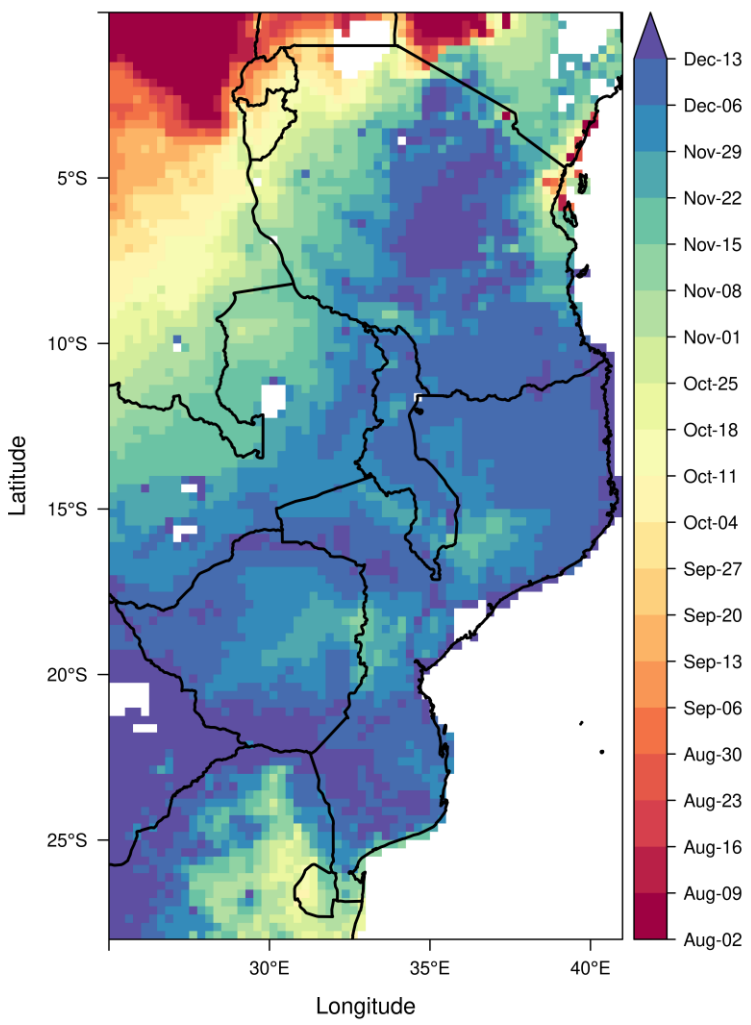
Onset

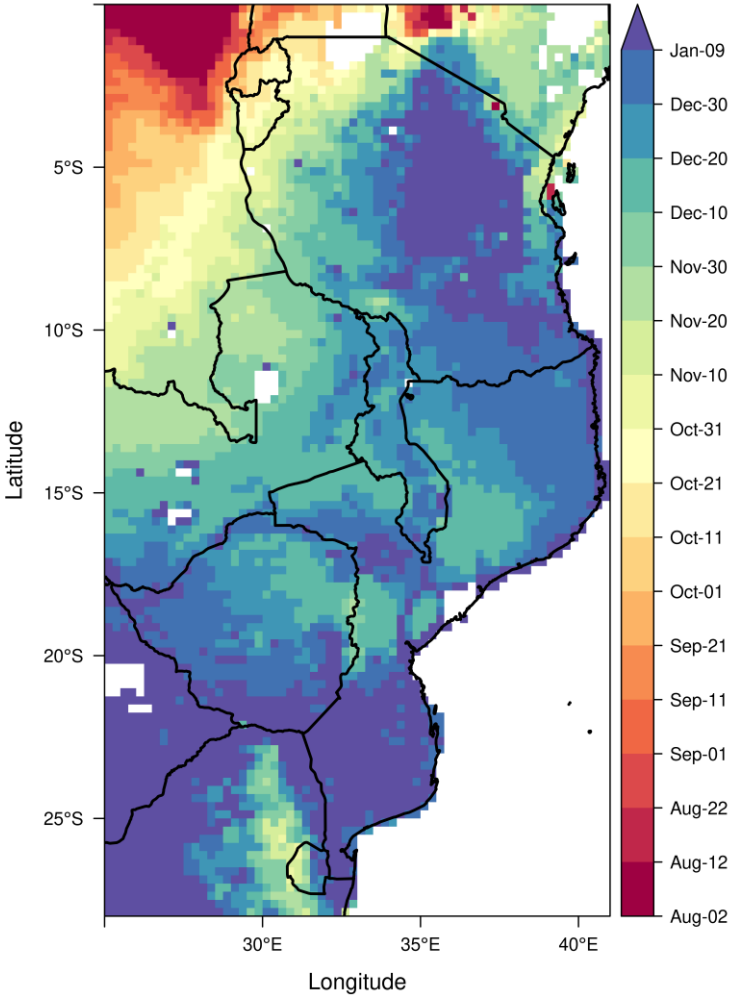
Earliest (10th %) agronomic onset of the wet-season [1982:2022]



Normal (50th %) agronomic onset of the wet-season [1982:2022]



Late (90th %) agronomic onset of the wet-season [1982:2022]



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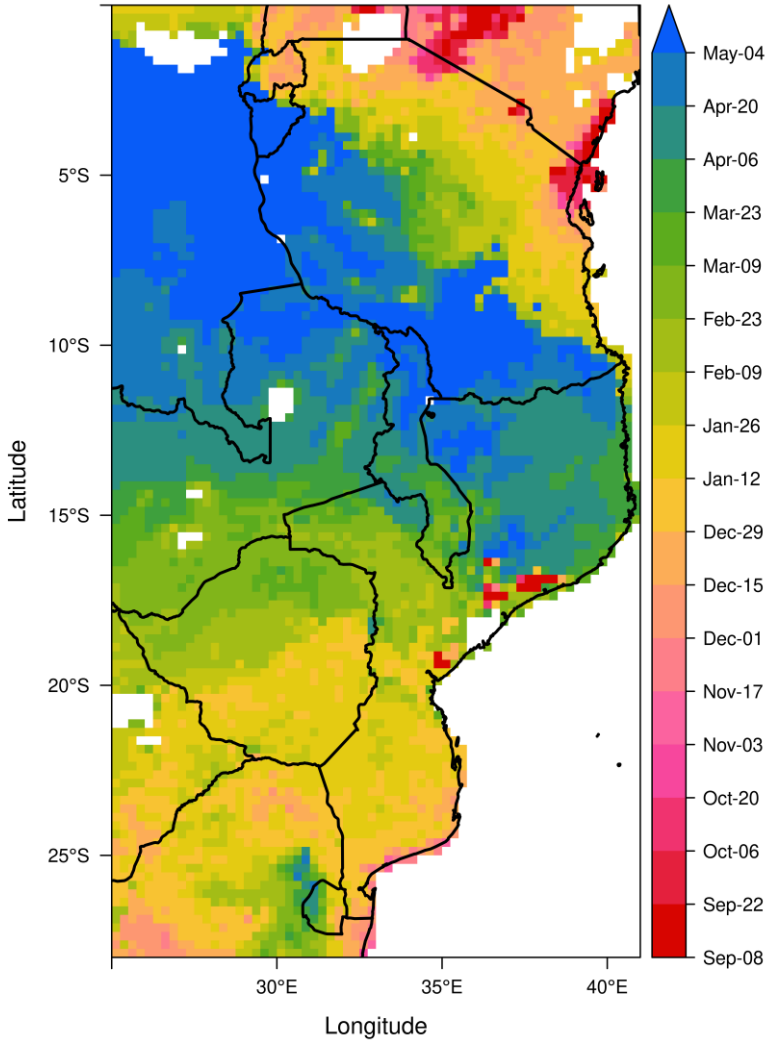
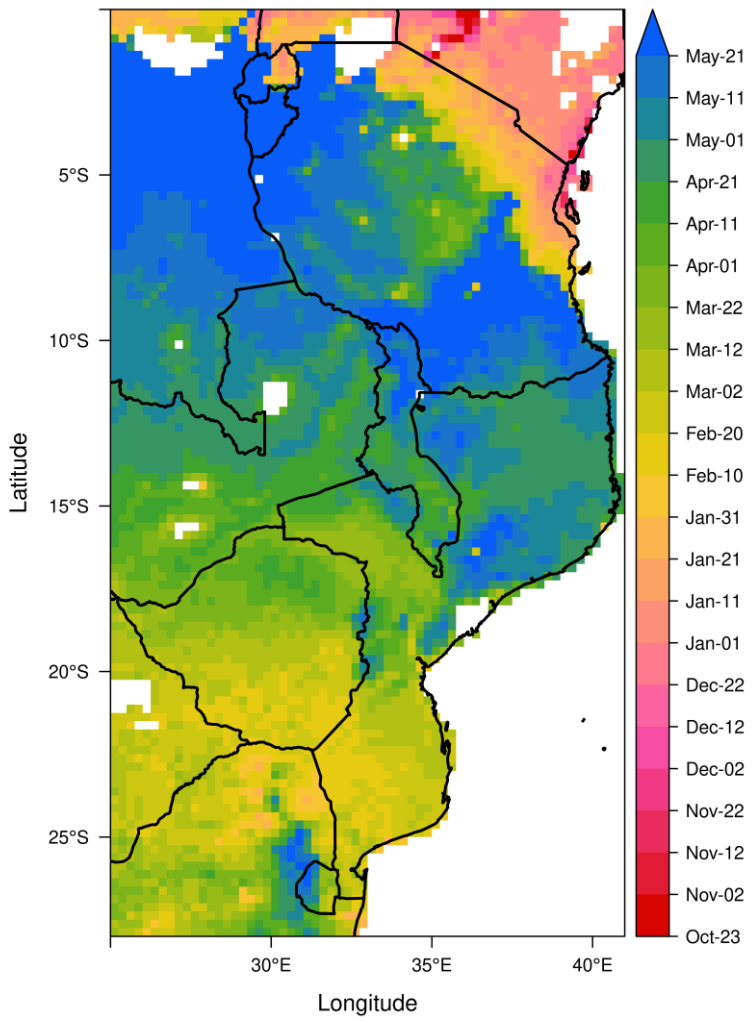
Cessation

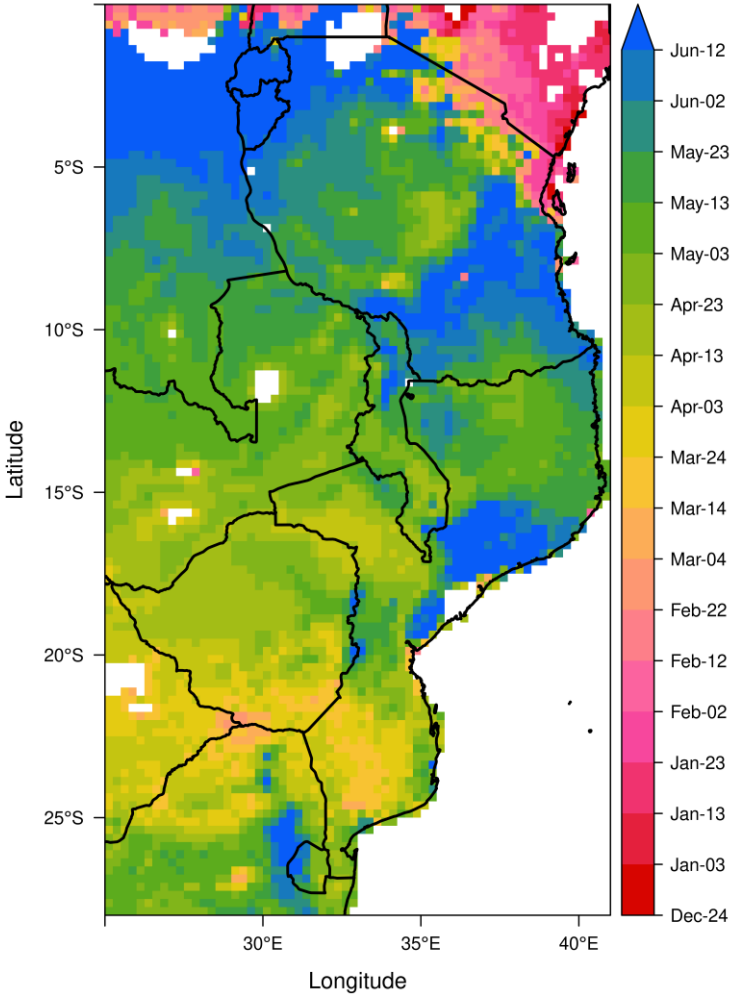
Earliest (10th %) agronomic cessation of the wet-season [1982:2022]



Normal (50th %) agronomic cessation of the wet-season [1982:2022]



Late (90th %) agronomic cessationt of the wet-season [1982:2022]



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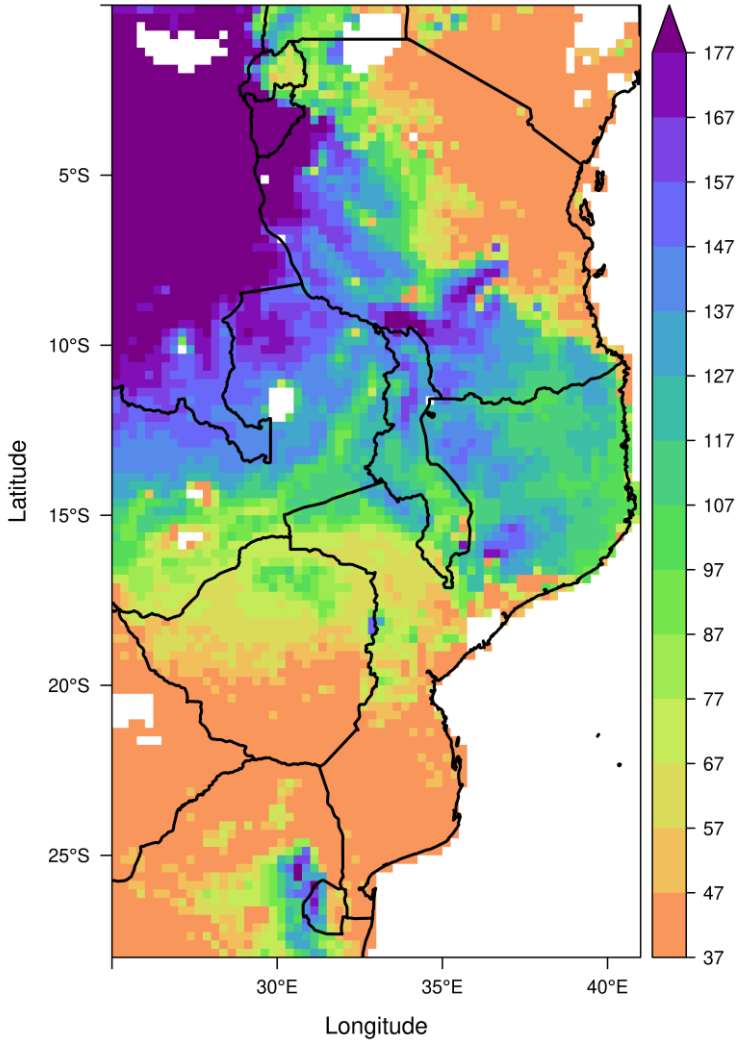
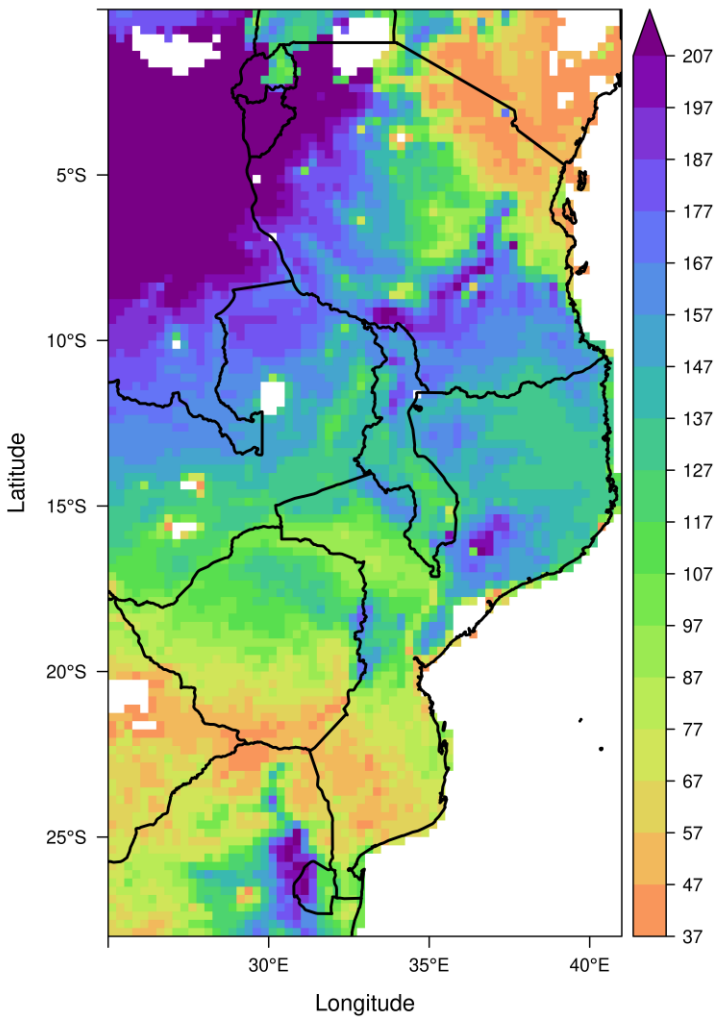
Duration

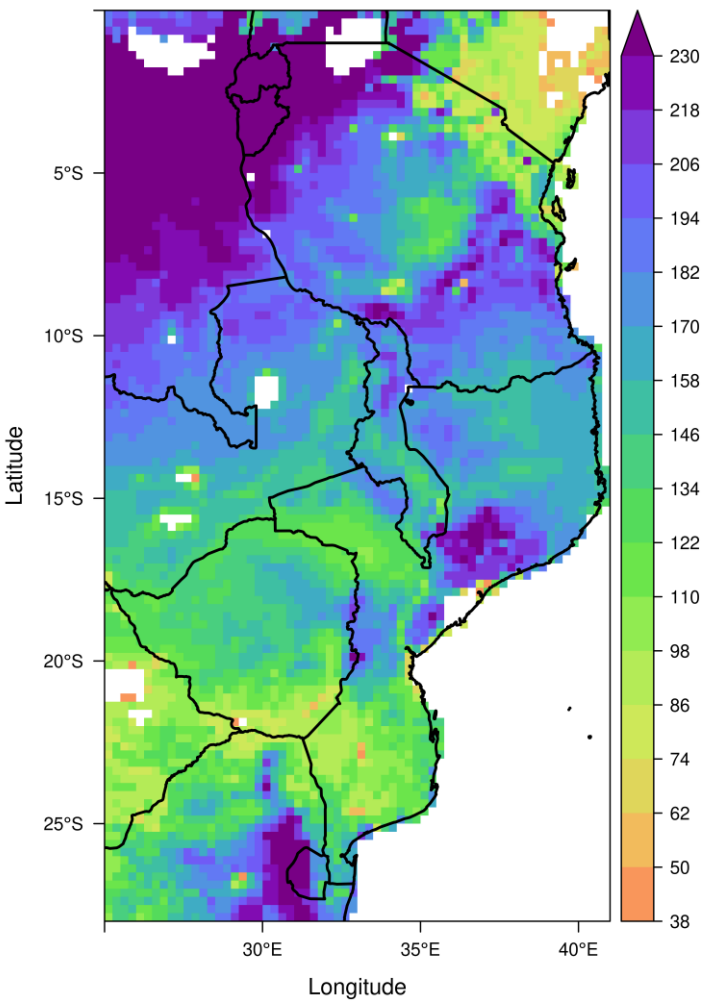
Shortest (10th %) agronomic duration (days) of the wet-season [1982:2022]



Normal (50th %) agronomic duration (days) of the wet-season [1982:2022]



Longest (90th %) agronomic duration (days) of the wet-season [1982:2022]



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