CLIMTAG

Climate Information Tool for Agriculture

General overview

9–11 oktober 2023

Flanders State of the Art

ACMAD

KENTER

KPMG

entrepreneurs for entrepreneurs
Sustainable cooperation with the South

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vito.be

Climate Information portal for Agriculture

The CLimate InforMation porTal for

to accelerate a climate-resilient agricultural sector in Africa

IDENTIFY

threats and opportunities

EXPLORE

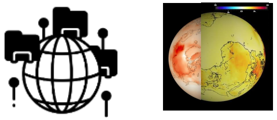
long-term trends by climate projections
short-term prognoses by seasonal forecasts

REACT

crop planning
strategic climate adaptation
climate funding

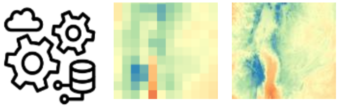
A web portal that gives immediate access to a wealth of tailored agro-climate information at high resolution

1. *Agro-climate indicators*
2. *Seasonal forecasts*
3. *Crop suitability*
4. *Timeseries for crop modelling*



High-quality climate input data

Co-creation with stakeholders



Data processing in the cloud

Intuitive web portal

vito

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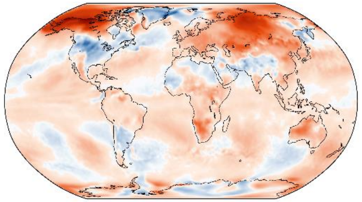
Climate and seasonal weather information for agriculture

from the past to the future

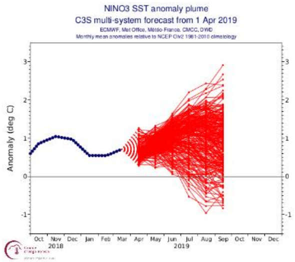
now

1961 — 2100

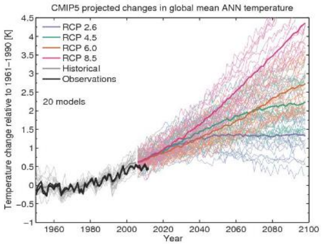
REFLECT
with **agro-climate indicators (1)** from historical data



RESPOND
with **agro-seasonal weather indicators (2)** for the next 6 months



ADAPT
with future **agro-climate indicators (1)** and **crop suitability parameters (3)** throughout the 21st century



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Agro-climate indicators

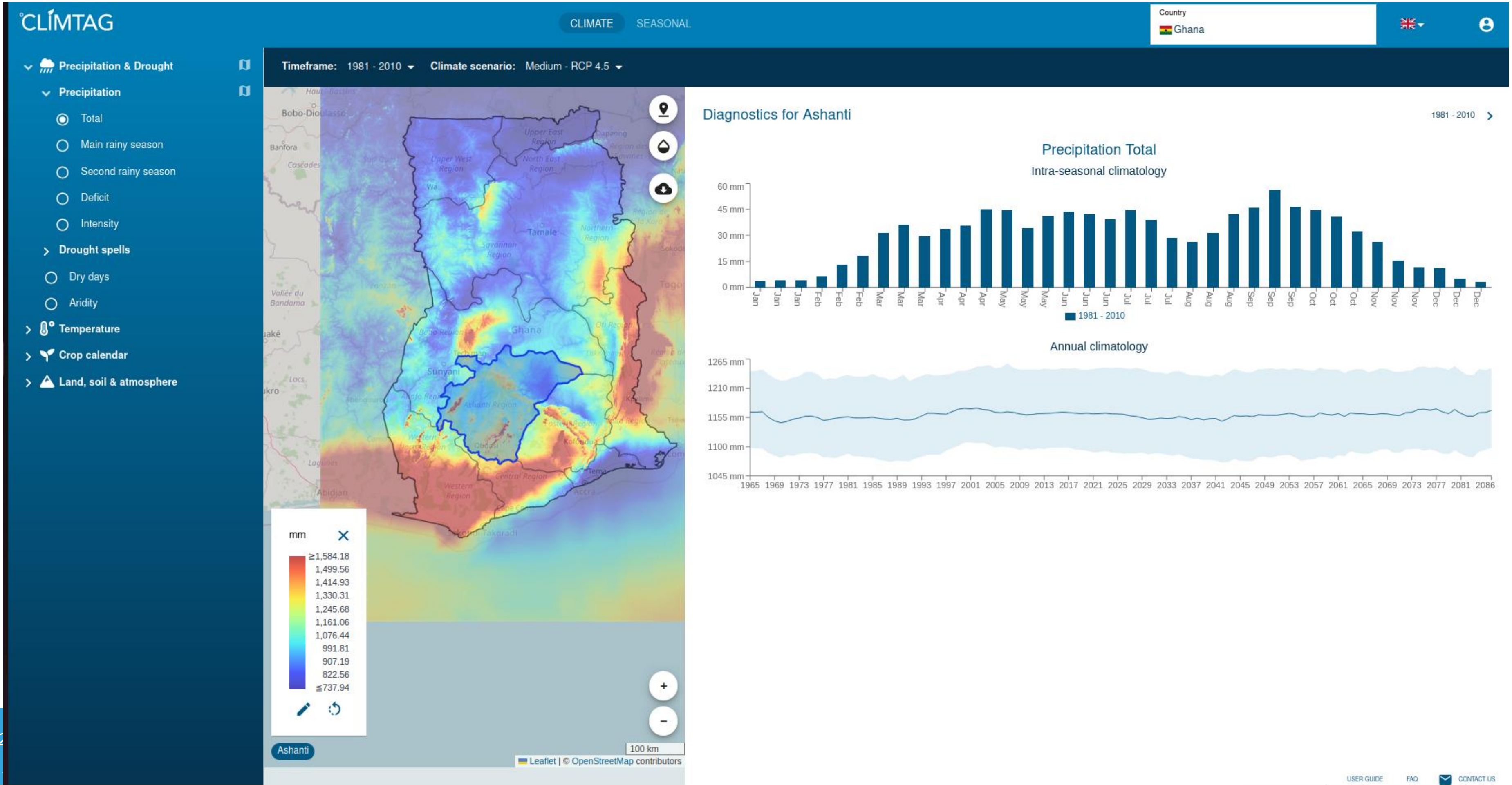
For past and future

- 56 x agro-climate indicators
- 3 x climate scenarios
- 15 x climate models
- 4 x time horizons
- 24 x countries

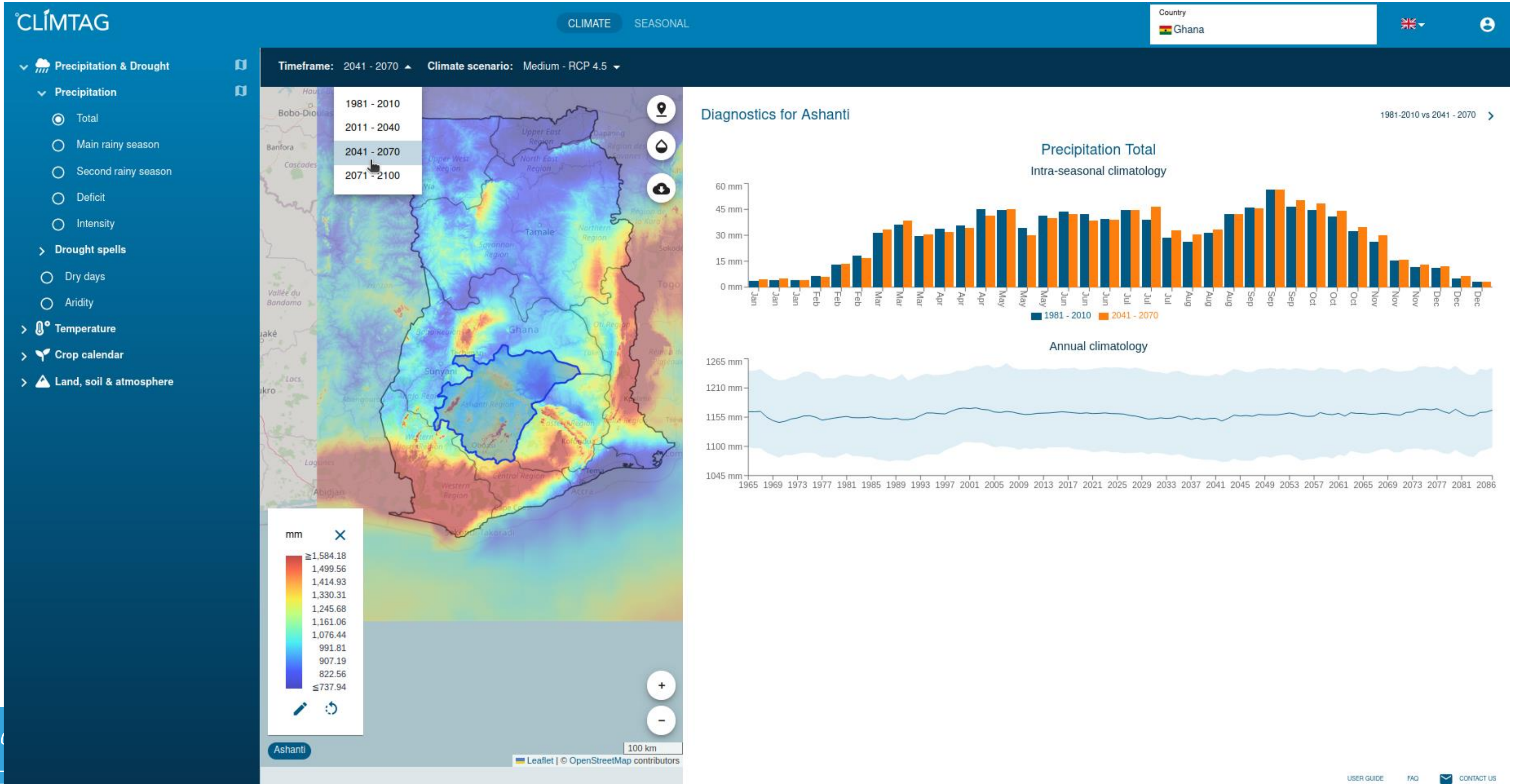
INTUITIVE DASHBOARD

Empowered by Flanders State of the Art

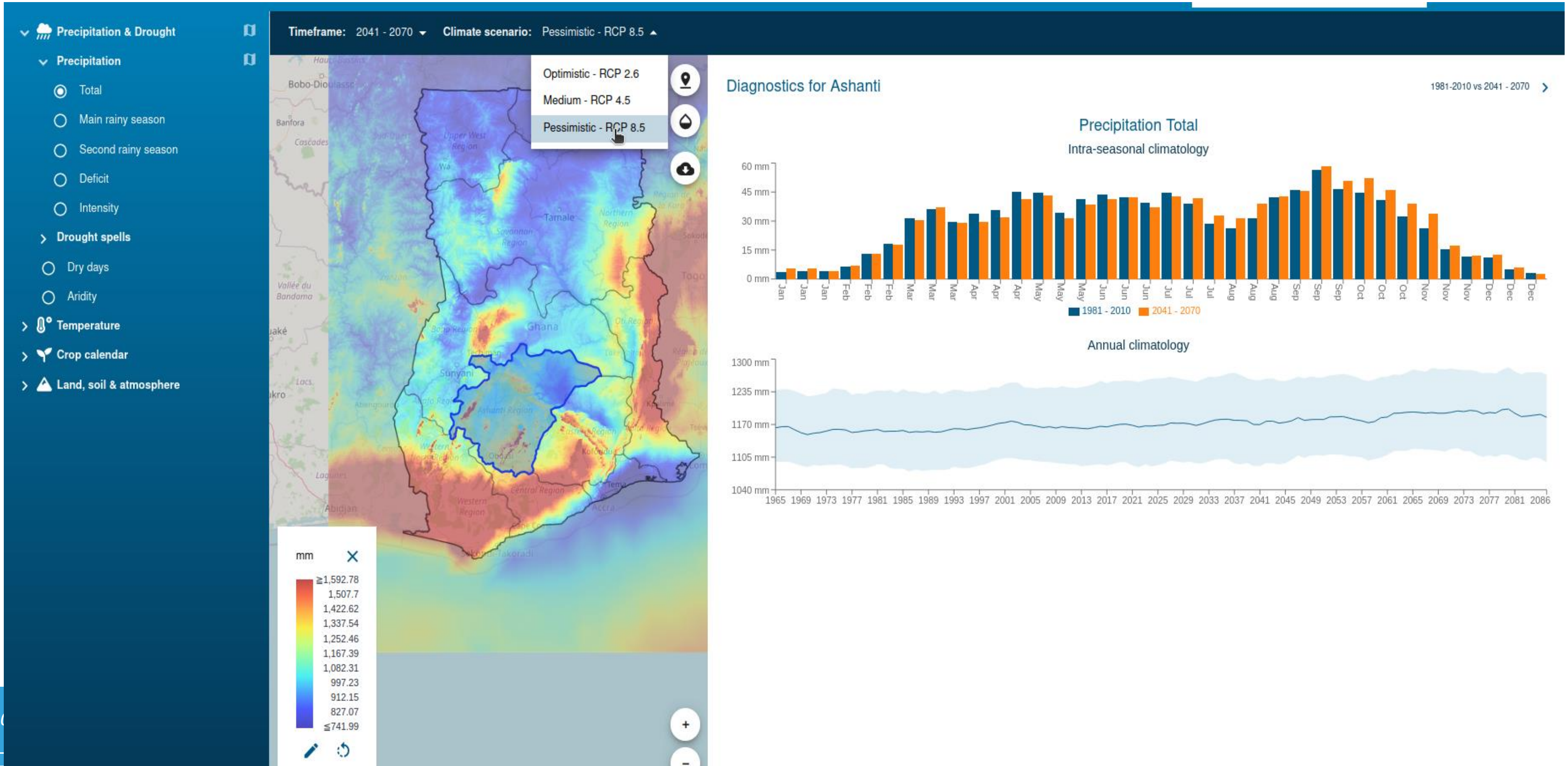
MAPS, SEASONAL CYCLES, TRENDS, DETAILED DATA FOR DISTRICTS



FOUR TIME HORIZONS



THREE CLIMATE SCENARIOS



56 AGRO-CLIMATE INDICATORS IN 4 CATEGORIES

- Precipitation & Drought
  - Precipitation
    - Total
    - Main rainy season
    - Second rainy season
    - Deficit
    - Intensity
  - Drought spells
    - Main rainy season
      - Onset of first drought
      - Maximum duration
      - Mean duration
      - Number
    - Second rainy season
  - Dry days
  - Aridity

- Temperature
  - Mean
  - Daily maximum
    - Mean
    - Minimum
    - Maximum
  - Daily minimum
  - Warm spell duration
    - Main rainy season
    - Second rainy season
  - Crop-specific growing degree days
    - Main rainy season
      - Dry beans
      - Soja
      - Groundnut
      - Maize, sorghum and rice
      - Sugarcane
      - Potato
      - Tef
      - Wheat
    - Second rainy season

- Crop calendar
  - Main rainy season
    - Onset
    - Cessation
    - Length
  - Second rainy season

- Land, soil & atmosphere
  - Solar radiation
    - Minimum
    - Mean
    - Maximum
  - Humidity
  - Wind speed
    - Minimum
    - Mean
    - Maximum
  - Soil moisture upper layer
  - Land cover - Copernicus
  - Reference evapotranspiration

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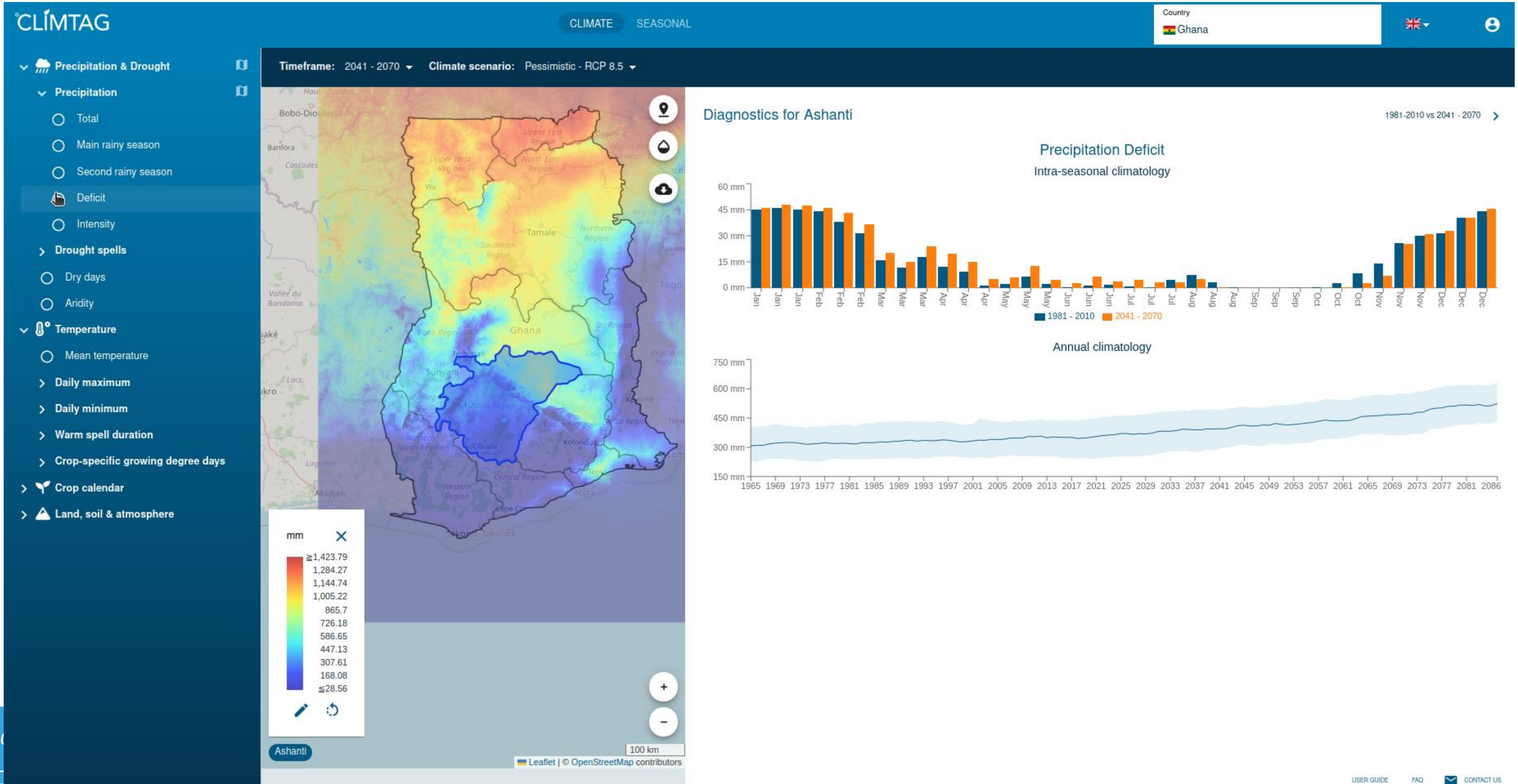
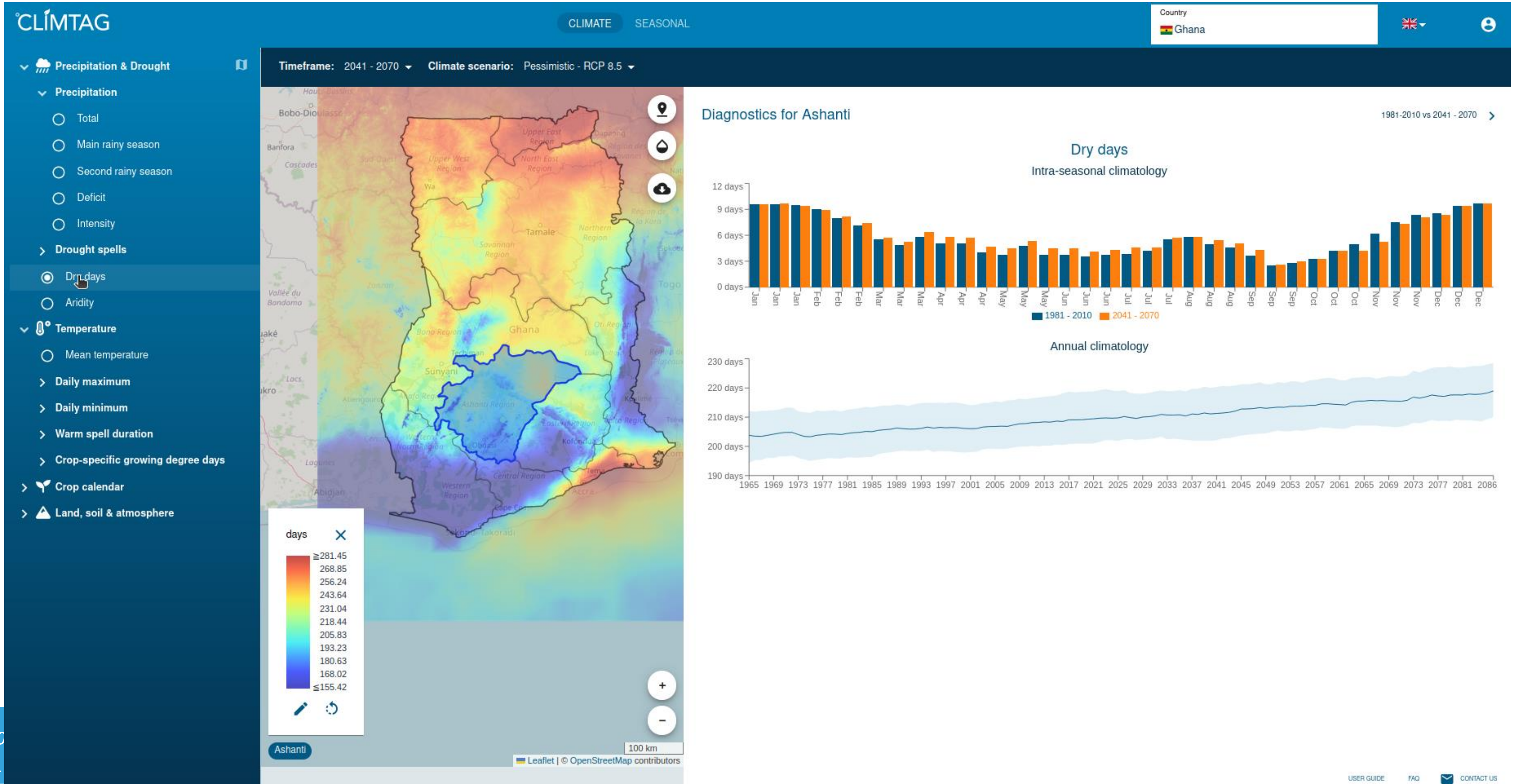
EG., TEMPERATURE

EG., PRECIPITATION DEFICIT



EG., DRY DAYS



CLIMTAG
CLIMATE
SEASONAL
Country
Ghana
Precipitation & Drought
Precipitation
Total
Main rainy season
Second rainy season
Deficit
Intensity
Drought spells
Dry days
Aridity
Temperature
Mean temperature
Daily maximum
Daily minimum
Warm spell duration
Crop-specific growing degree days
Crop calendar
Land, soil & atmosphere
Timeframe: 2041 - 2070
Climate scenario: Pessimistic - RCP 8.5
days
≥281.45
268.85
256.24
243.64
231.04
218.44
205.83
193.23
180.63
168.02
≤155.42
Ashanti
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Ashanti
1981-2010 vs 2041 - 2070
Dry days
Intra-seasonal climatology
12 days
9 days
6 days
3 days
0 days
1981 - 2010
2041 - 2070
Annual climatology
230 days
220 days
210 days
200 days
190 days
1965
2086
USER GUIDE
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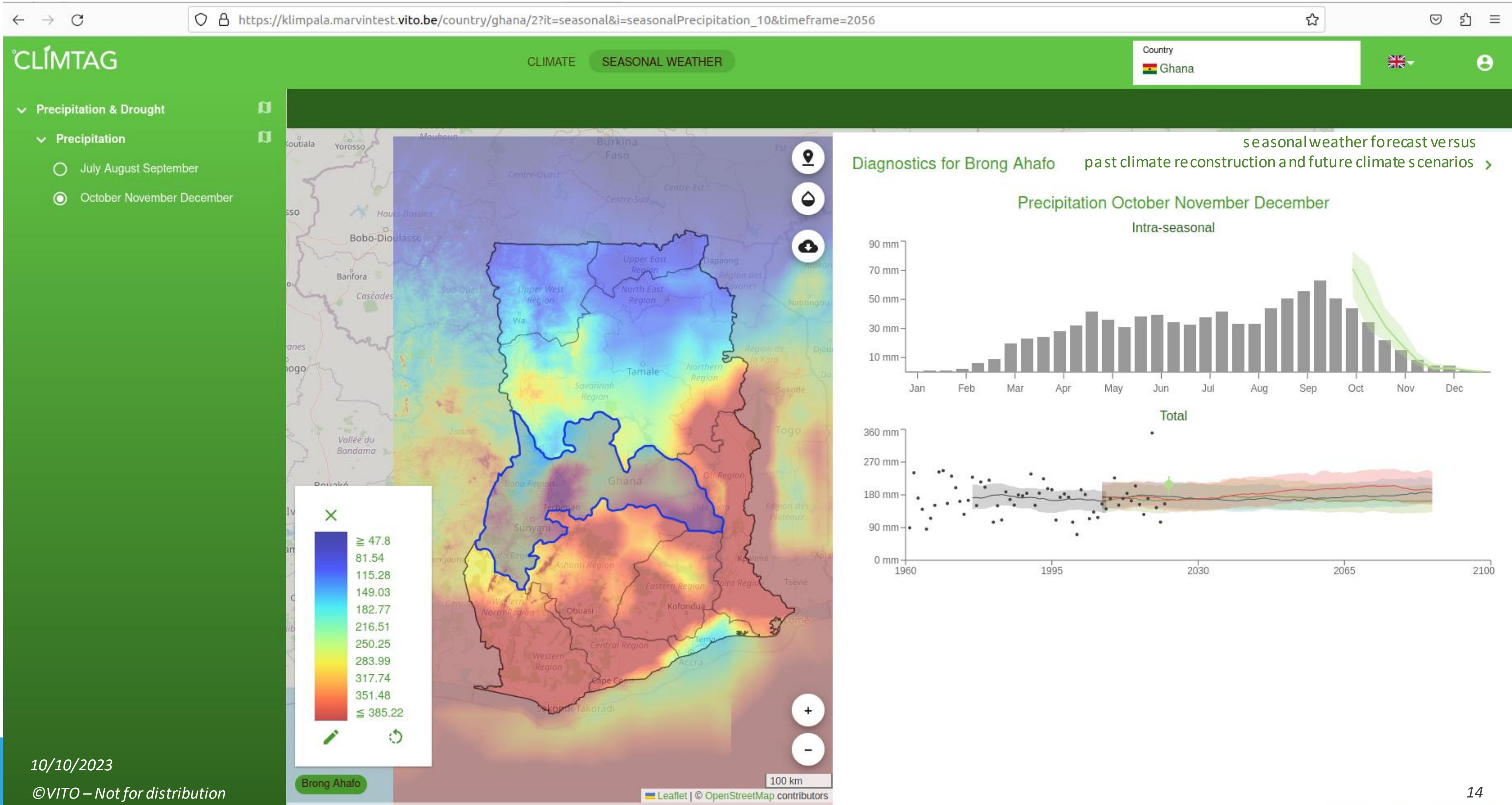
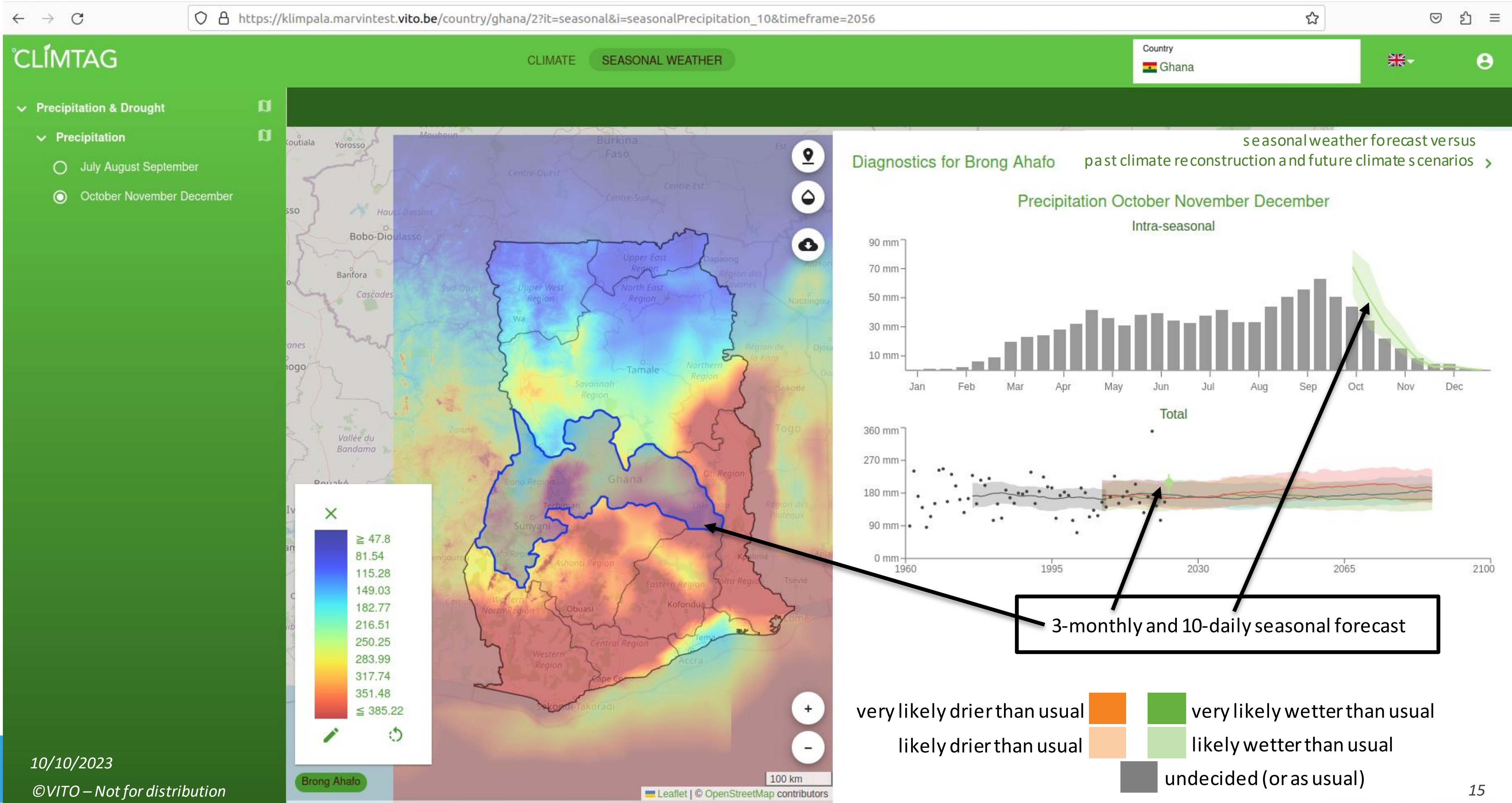
Seasonal forecasts for the next 6 months

Dedicated viewer

- 3-monthly aggregated precipitation forecasts, but also 10-daily values
- probabilities for having (non-)anomalous precipitation by means of a 'tercile summary'
- Seasonal forecasts are available from the start of each month, for the next 6 months
- Overlay with historical data and climate projections for comparison

seasonal weather forecast versus
past climate reconstruction and future climate scenarios





3-monthly and 10-daily seasonal forecast

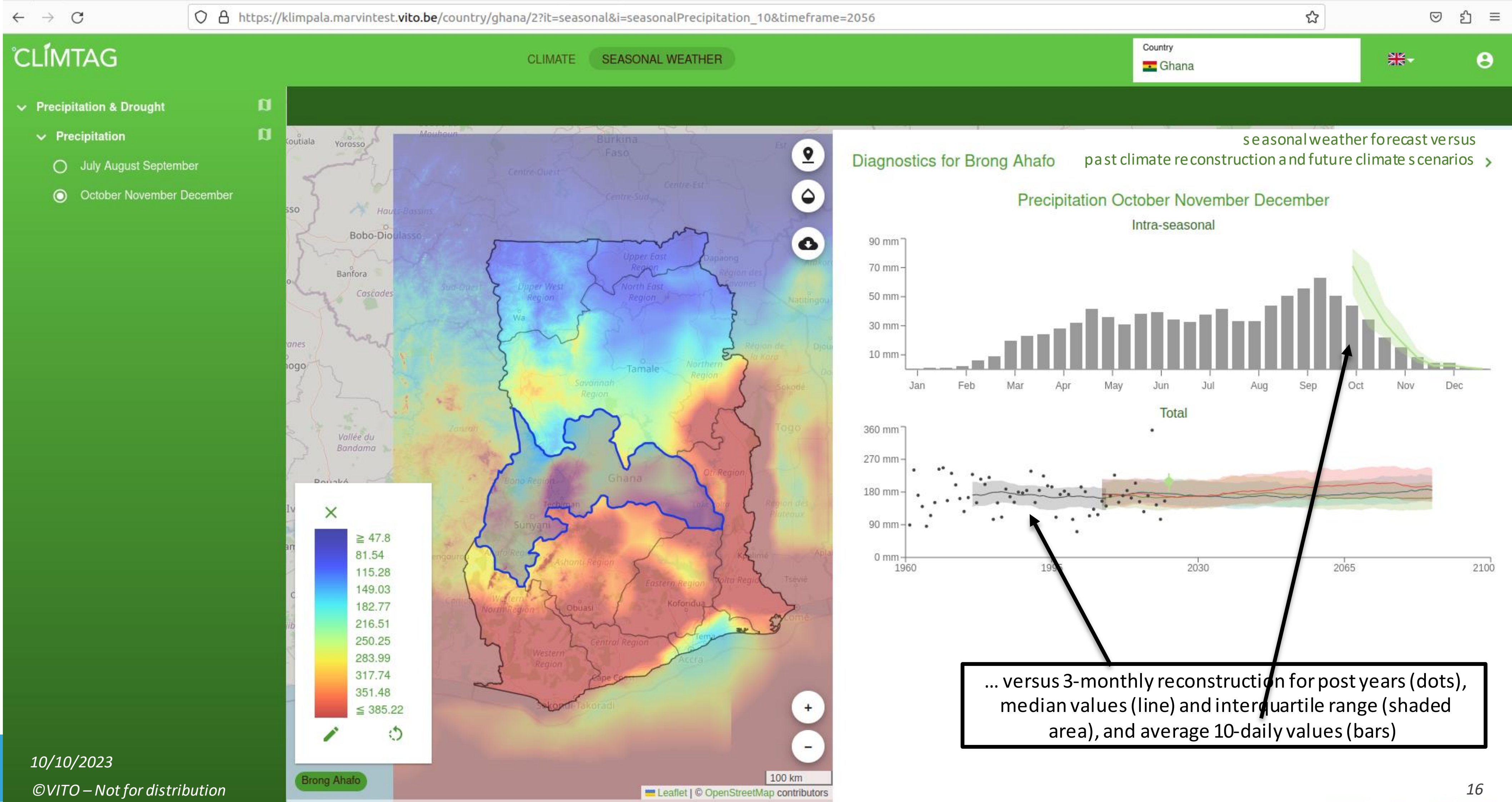
very likely drier than usual

likely drier than usual

very likely wetter than usual

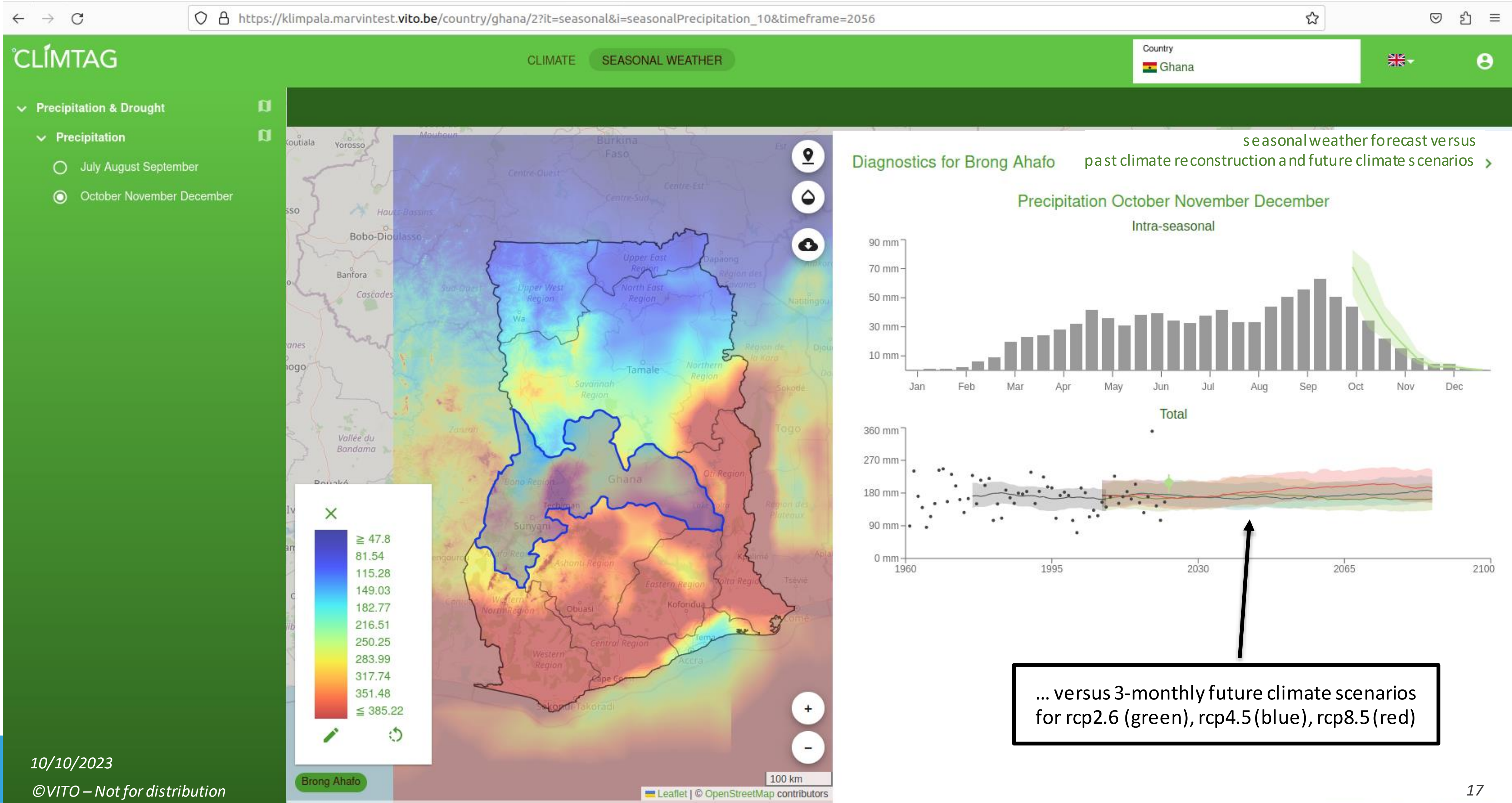
likely wetter than usual

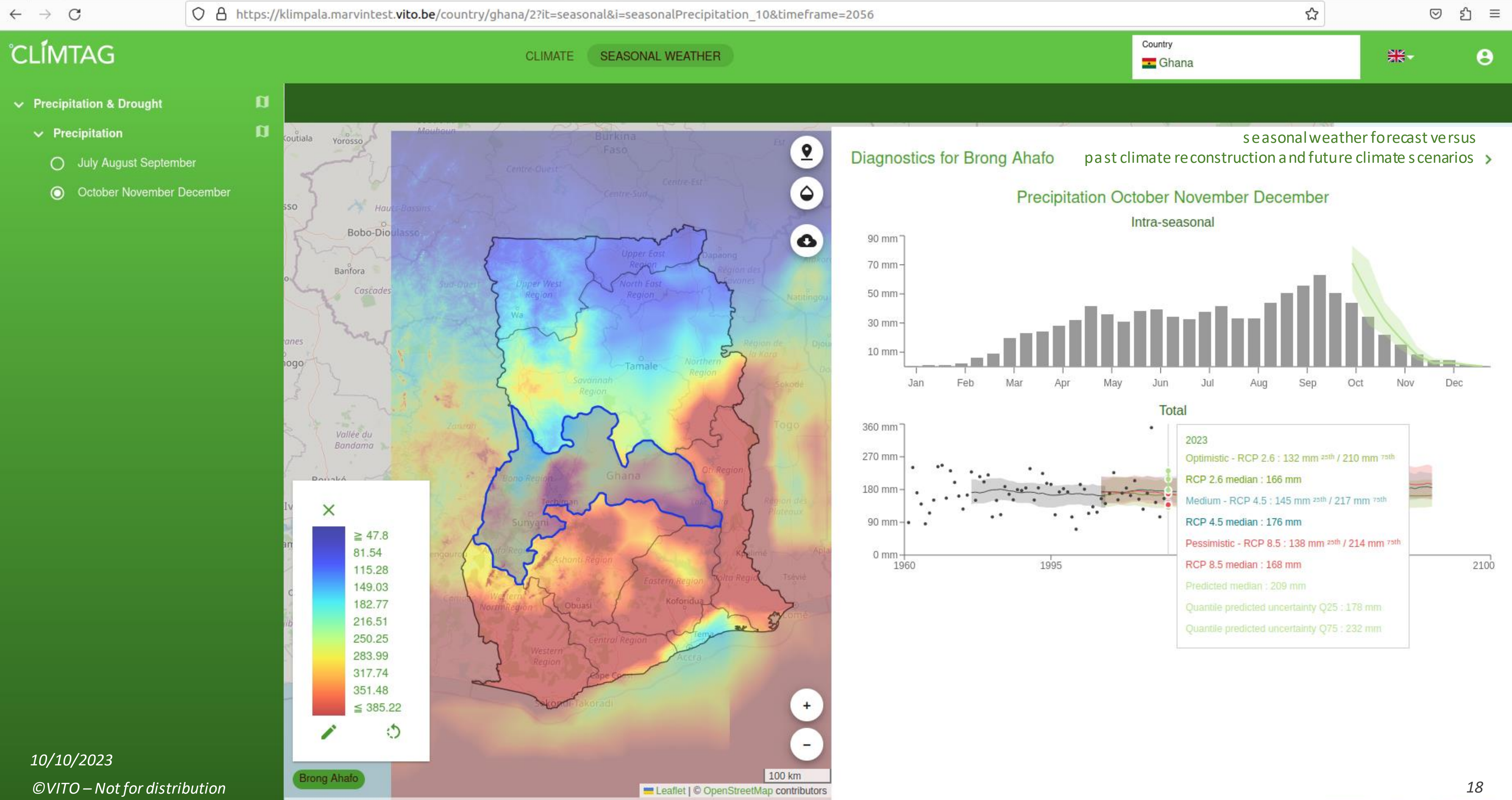
undecided (or as usual)



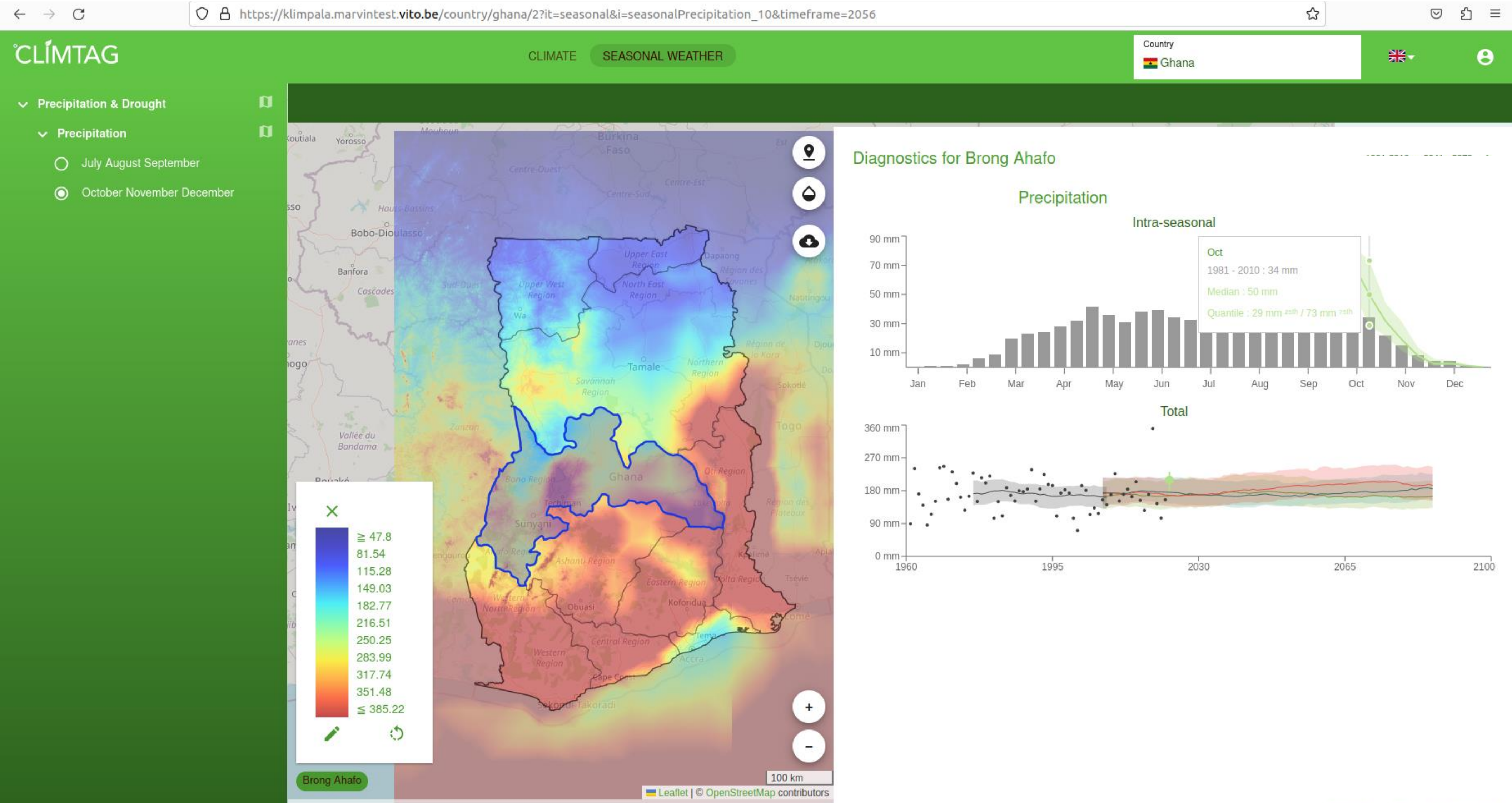
seasonal weather forecast versus past climate reconstruction and future climate scenarios

… versus 3-monthly reconstruction for post years (dots), median values (line) and interquartile range (shaded area), and average 10-daily values (bars)


https://klimpala.marvintest.vito.be/country/ghana/2?it=seasonal&i=seasonalPrecipitation_10&timeframe=2056
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Precipitation & Drought
Precipitation
July August September
October November December
≧ 47.8
81.54
115.28
149.03
182.77
216.51
250.25
283.99
317.74
351.48
≦ 385.22
Brong Ahafo
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Brong Ahafo
seasonal weather forecast versus
past climate reconstruction and future climate scenarios
Precipitation October November December
Intra-seasonal
90 mm
70 mm
50 mm
30 mm
10 mm
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
360 mm
270 mm
180 mm
90 mm
0 mm
1960
1995
2030
2065
2100
... versus 3-monthly future climate scenarios for rcp2.6 (green), rcp4.5 (blue), rcp8.5 (red)



https://klimpala.marvintest.vito.be/country/ghana/2?it=seasonal&i=seasonalPrecipitation_10&timeframe=2056
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Precipitation & Drought
Precipitation
July August September
October November December
seasonal weather forecast versus
past climate reconstruction and future climate scenarios
Diagnostics for Brong Ahafo
Precipitation October November December
Intra-seasonal
90 mm
70 mm
50 mm
30 mm
10 mm
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
360 mm
270 mm
180 mm
90 mm
0 mm
1960
1995
2100
2023
Optimistic - RCP 2.6 : 132 mm 25th / 210 mm 75th
RCP 2.6 median : 166 mm
Medium - RCP 4.5 : 145 mm 25th / 217 mm 75th
RCP 4.5 median : 176 mm
Pessimistic - RCP 8.5 : 138 mm 25th / 214 mm 75th
RCP 8.5 median : 168 mm
Predicted median : 209 mm
Quantile predicted uncertainty Q25 : 178 mm
Quantile predicted uncertainty Q75 : 232 mm
≧ 47.8
81.54
115.28
149.03
182.77
216.51
250.25
283.99
317.74
351.48
≦ 385.22
Burkina Faso
Upper East Region
Upper West Region
North East Region
Northern Region
Savannah Region
Tamale
Bono Region
Ghana
Sunyani
Ashanti Region
Eastern Region
Obuasi
Koforidua
Western North Region
Western Region
Central Region
Accra
Sekondi-Takoradi
Togo
Bobo-Dioulasso
Banfora
Brong Ahafo
100 km
Leaflet | © OpenStreetMap contributors


https://klimpala.marvintest.vito.be/country/ghana/2?it=seasonal&i=seasonalPrecipitation_10&timeframe=2056
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Precipitation & Drought
Precipitation
July August September
October November December
≧ 47.8
81.54
115.28
149.03
182.77
216.51
250.25
283.99
317.74
351.48
≦ 385.22
Brong Ahafo
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Brong Ahafo
Precipitation
Intra-seasonal
90 mm
70 mm
50 mm
30 mm
10 mm
Oct
1981 - 2010 : 34 mm
Median : 50 mm
Quantile : 29 mm / 73 mm
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
360 mm
270 mm
180 mm
90 mm
0 mm
1960
1995
2030
2065
2100

Crop suitability indicators

- Based on the agro-climate indicators of CLIMTAG

Crop Suitability Index

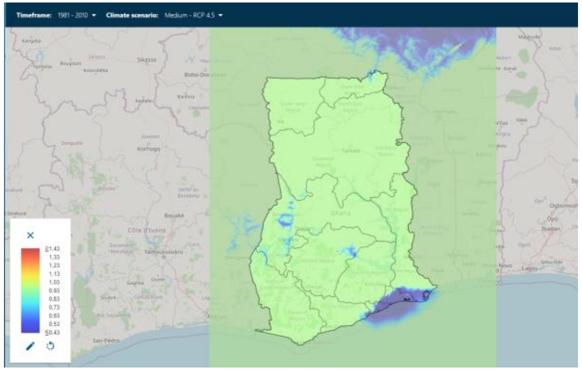
Preview in CLIMTAG

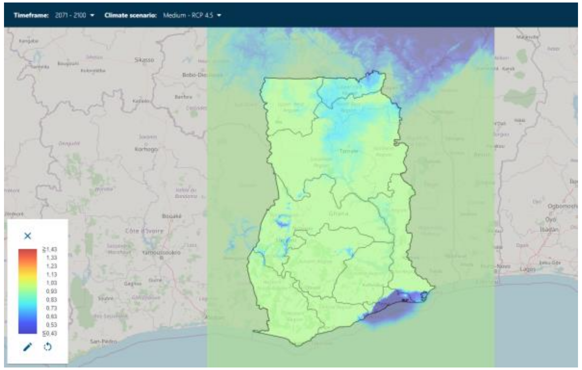
Maize suitability in Ghana

1981 - 2010

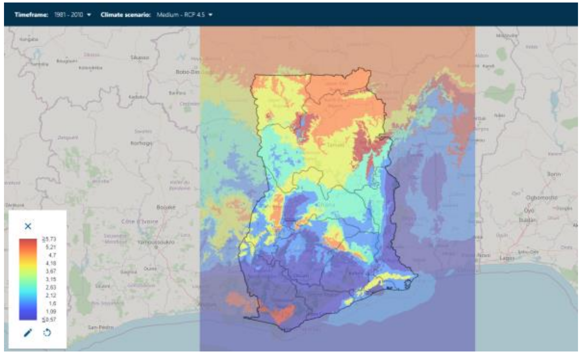
2071 - 2100

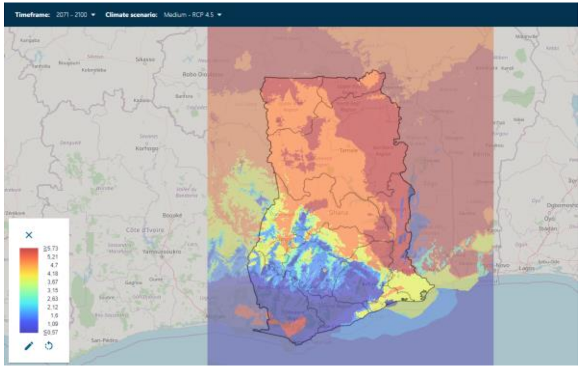
Crop Suitability index

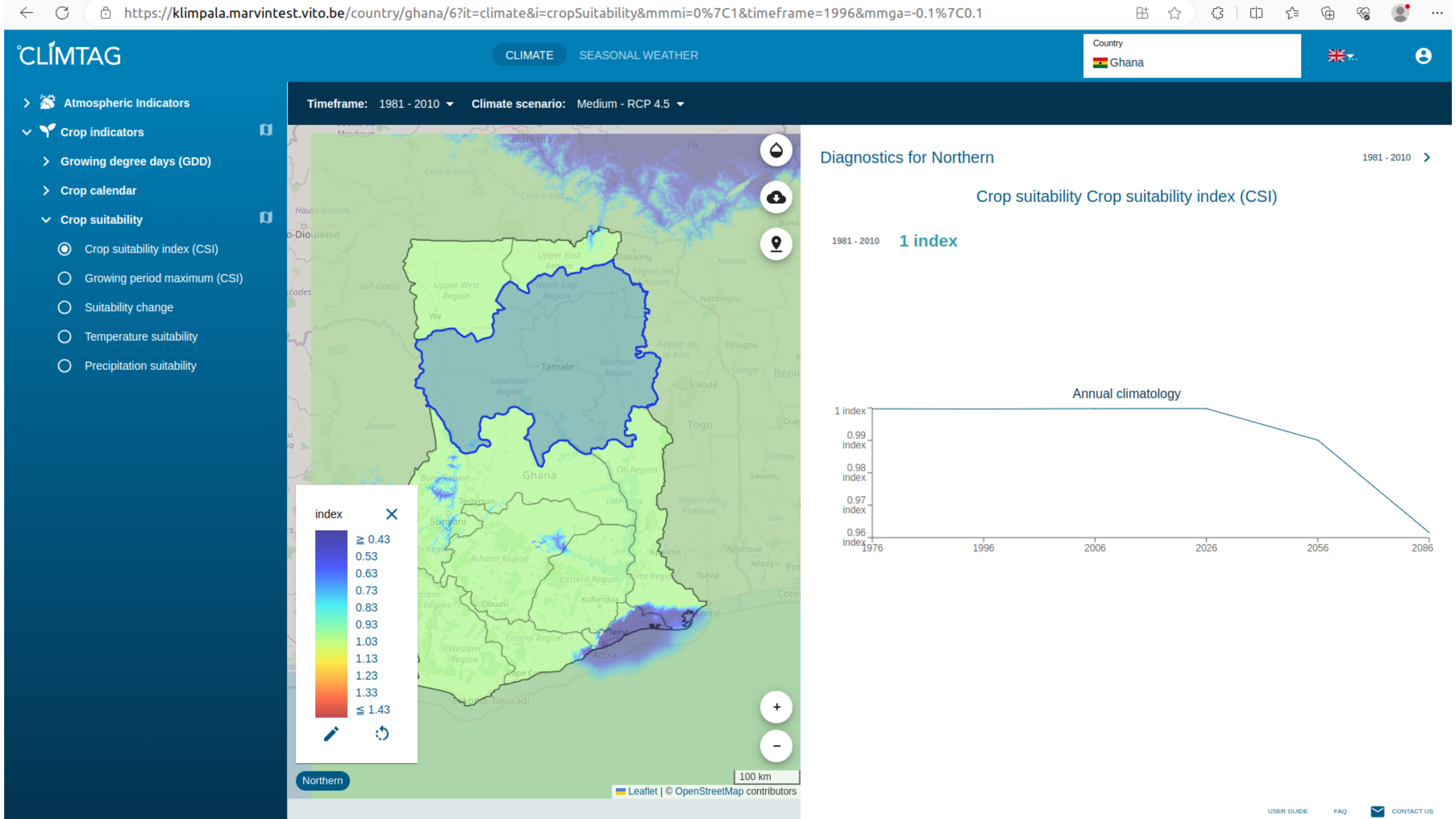




Best starting month of cropping season






https://klimpala.marvintest.vito.be/country/ghana/6?it=climate&i=cropSuitability&mmmi=0%7C1&timeframe=1996&mmga=-0.1%7C0.1
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Atmospheric Indicators
Crop indicators
Growing degree days (GDD)
Crop calendar
Crop suitability
Crop suitability index (CSI)
Growing period maximum (CSI)
Suitability change
Temperature suitability
Precipitation suitability
Timeframe: 1981 - 2010
Climate scenario: Medium - RCP 4.5
index
≧ 0.43
0.53
0.63
0.73
0.83
0.93
1.03
1.13
1.23
1.33
≦ 1.43
Northern
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Northern
1981 - 2010
Crop suitability Crop suitability index (CSI)
1981 - 2010
1 index
Annual climatology
1 index
0.99 index
0.98 index
0.97 index
0.96 index
1976
1996
2006
2026
2056
2086
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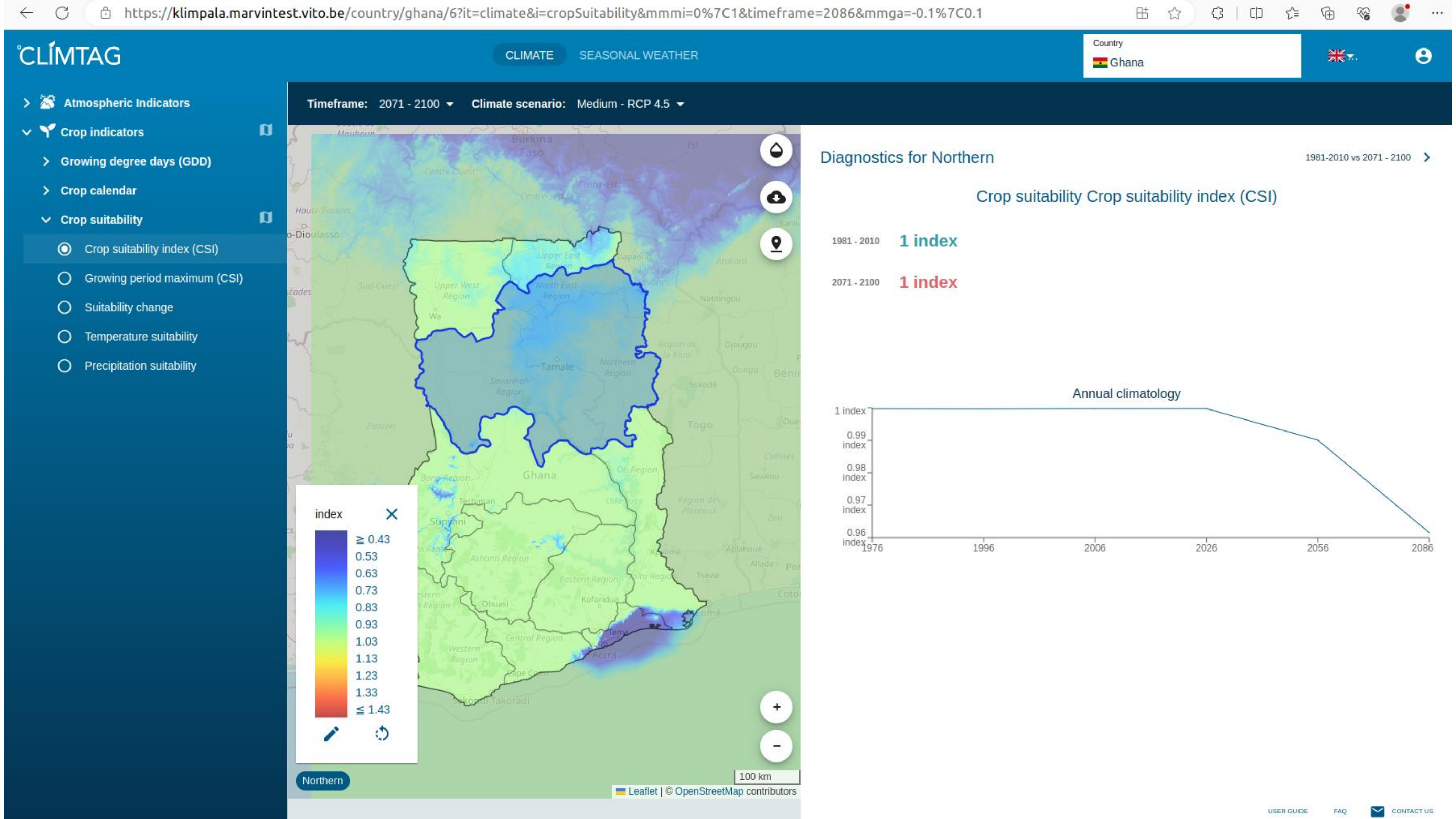
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CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Atmospheric Indicators
Crop indicators
Growing degree days (GDD)
Crop calendar
Crop suitability
Crop suitability index (CSI)
Growing period maximum (CSI)
Suitability change
Temperature suitability
Precipitation suitability
Timeframe: 2071 - 2100
Climate scenario: Medium - RCP 4.5
Burkina Faso
Upper East Region
Upper West Region
North East Region
Northern Region
Savannah Region
Tamale
Wa
Bono Region
Techiman
Sunyani
Ashanti Region
Eastern Region
Oti Region
Volta Region
Koforidua
Obuasi
Central Region
Western Region
Cape Coast
Sekondi-Takoradi
Tema
Accra
Ghana
Togo
Lomé
index
≧ 0.43
0.53
0.63
0.73
0.83
0.93
1.03
1.13
1.23
1.33
≦ 1.43
Northern
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Northern
1981-2010 vs 2071 - 2100
Crop suitability Crop suitability index (CSI)
1981 - 2010 1 index
2071 - 2100 1 index
Annual climatology
1 index
0.99 index
0.98 index
0.97 index
0.96 index
1976
1996
2006
2026
2056
2086
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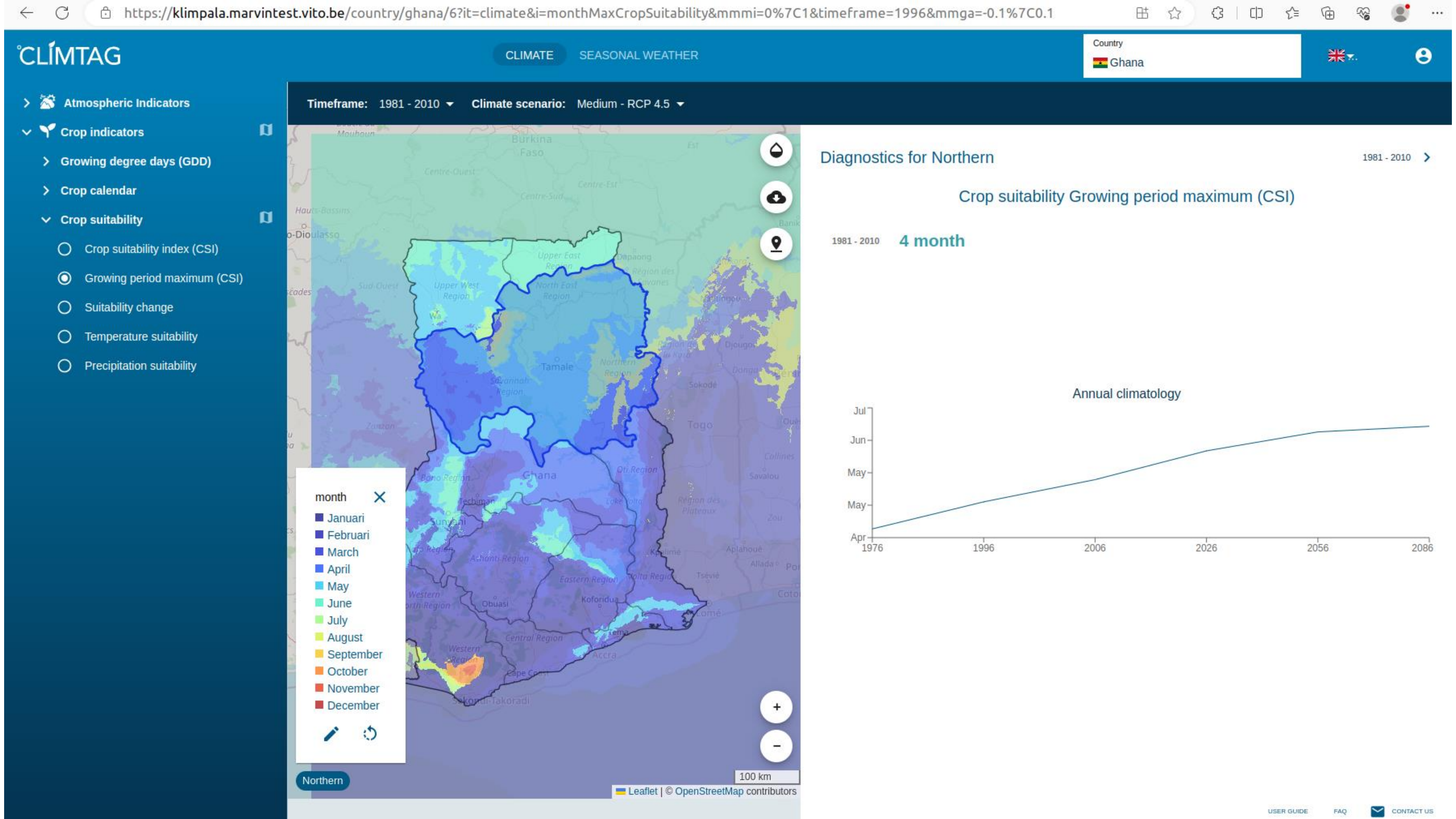
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CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Atmospheric Indicators
Crop indicators
Growing degree days (GDD)
Crop calendar
Crop suitability
Crop suitability index (CSI)
Growing period maximum (CSI)
Suitability change
Temperature suitability
Precipitation suitability
Timeframe: 1981 - 2010
Climate scenario: Medium - RCP 4.5
Burkina Faso
Tamale
Ghana
Togo
month
Januari
Februari
March
April
May
June
July
August
September
October
November
December
Northern
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Northern
1981 - 2010
Crop suitability Growing period maximum (CSI)
1981 - 2010
4 month
Annual climatology
Jul
Jun
May
May
Apr
1976
1996
2006
2026
2056
2086
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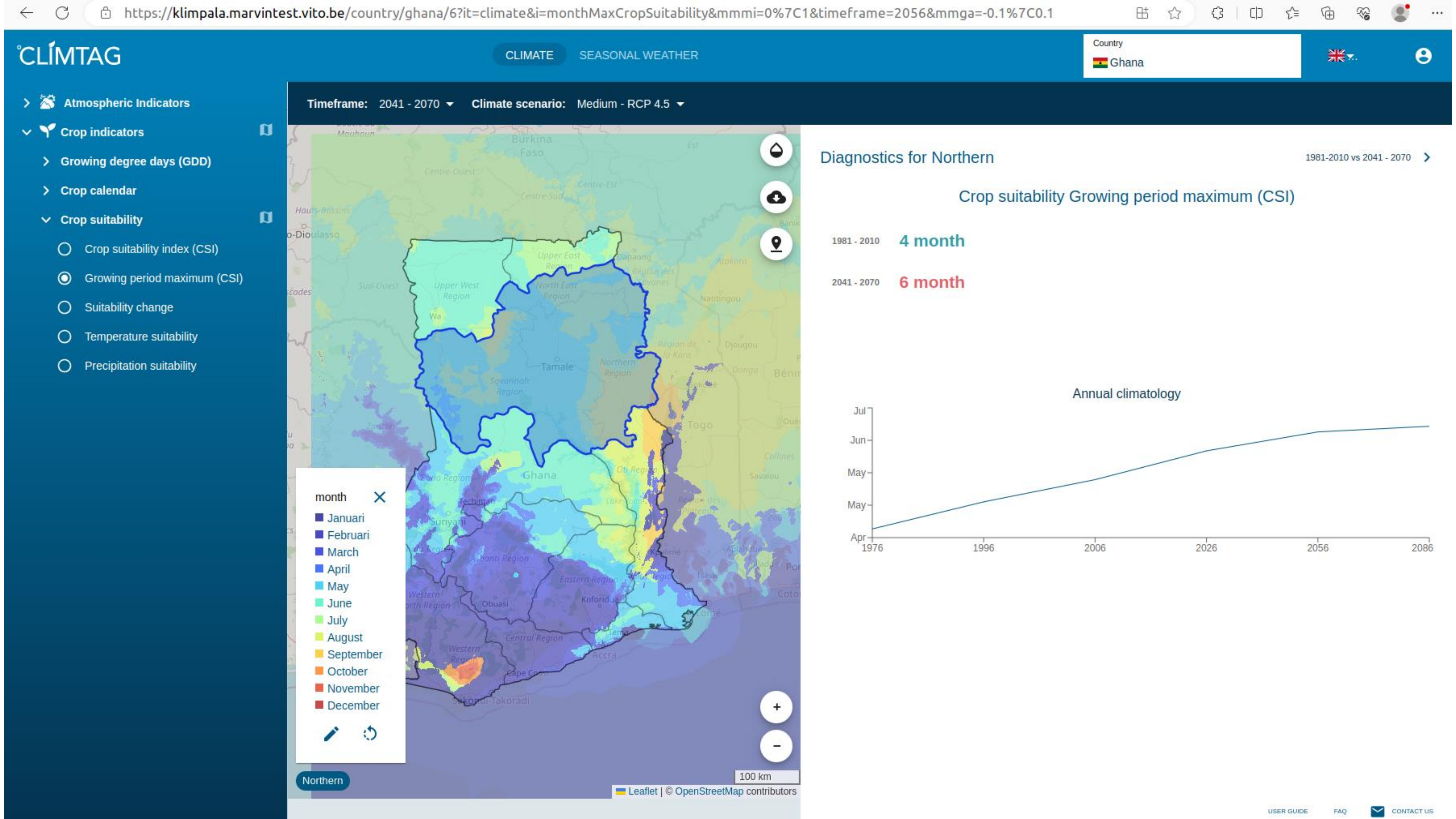
https://klimpala.marvintest.vito.be/country/ghana/6?it=climate&i=monthMaxCropSuitability&mmmi=0%7C1&timeframe=2056&mmga=-0.1%7C0.1
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Atmospheric Indicators
Crop indicators
Growing degree days (GDD)
Crop calendar
Crop suitability
Crop suitability index (CSI)
Growing period maximum (CSI)
Suitability change
Temperature suitability
Precipitation suitability
Timeframe: 2041 - 2070
Climate scenario: Medium - RCP 4.5
Burkina Faso
Tamale
Ghana
Togo
month
Januari
Februari
March
April
May
June
July
August
September
October
November
December
Northern
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Northern
1981-2010 vs 2041 - 2070
Crop suitability Growing period maximum (CSI)
1981 - 2010
4 month
2041 - 2070
6 month
Annual climatology
Jul
Jun
May
May
Apr
1976
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2056
2086
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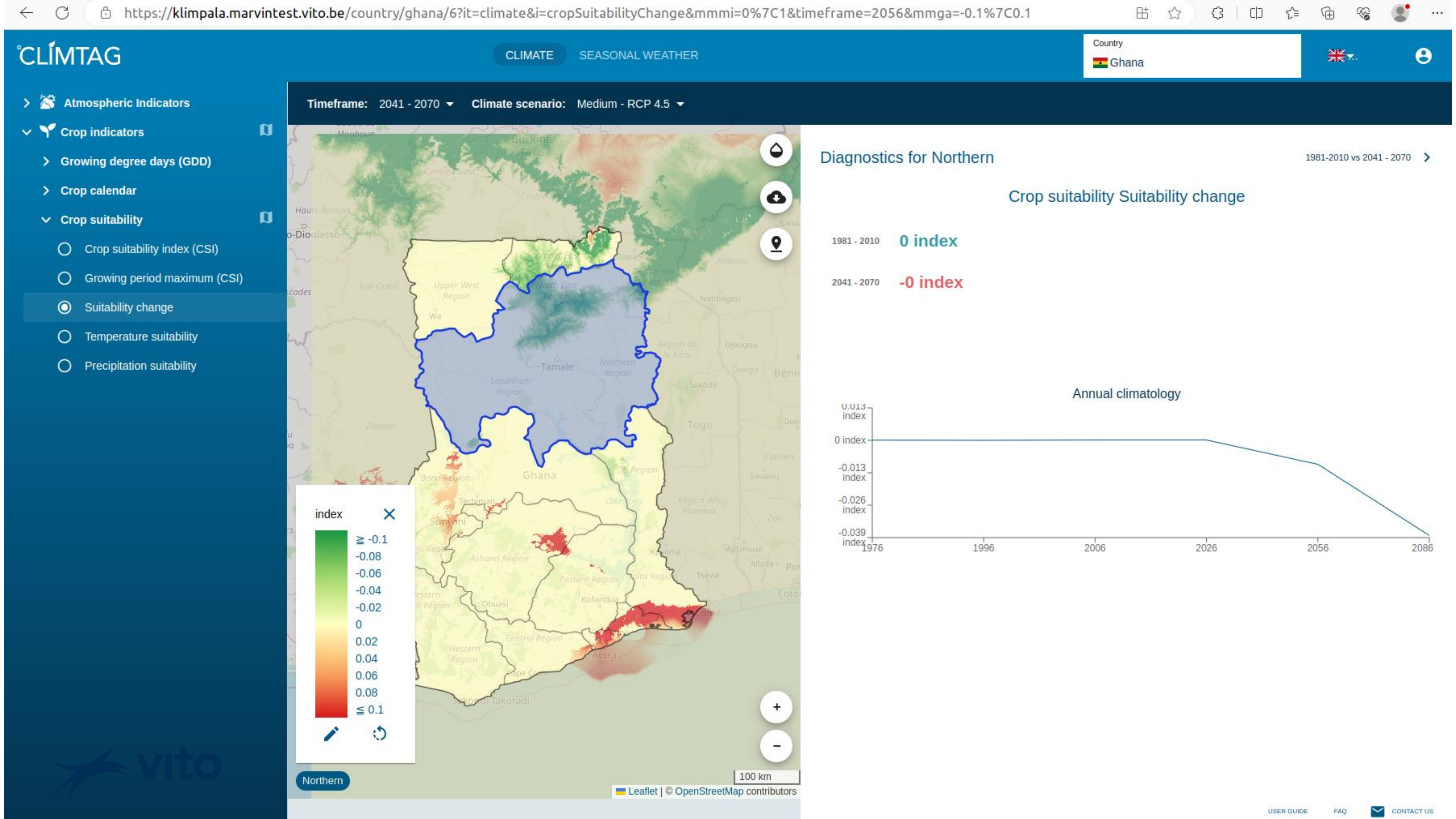

https://klimpala.marvintest.vito.be/country/ghana/6?it=climate&i=cropSuitabilityChange&mmmi=0%7C1&timeframe=2056&mmga=-0.1%7C0.1
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Atmospheric Indicators
Crop indicators
Growing degree days (GDD)
Crop calendar
Crop suitability
Crop suitability index (CSI)
Growing period maximum (CSI)
Suitability change
Temperature suitability
Precipitation suitability
Timeframe: 2041 - 2070
Climate scenario: Medium - RCP 4.5
Upper West Region
North East Region
Upper East Region
Tamale
Northern Region
Savannah Region
Ghana
Bono Region
Ashanti Region
Eastern Region
Western Region
Central Region
Obuasi
Koforidua
Accra
Sekondi-Takoradi
Togo
index
≧ -0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
≦ 0.1
Northern
100 km
Leaflet | © OpenStreetMap contributors
Diagnostics for Northern
1981-2010 vs 2041 - 2070
Crop suitability Suitability change
1981 - 2010
0 index
2041 - 2070
-0 index
Annual climatology
0.013 index
0 index
-0.013 index
-0.026 index
-0.039 index
1976
1996
2006
2026
2056
2086
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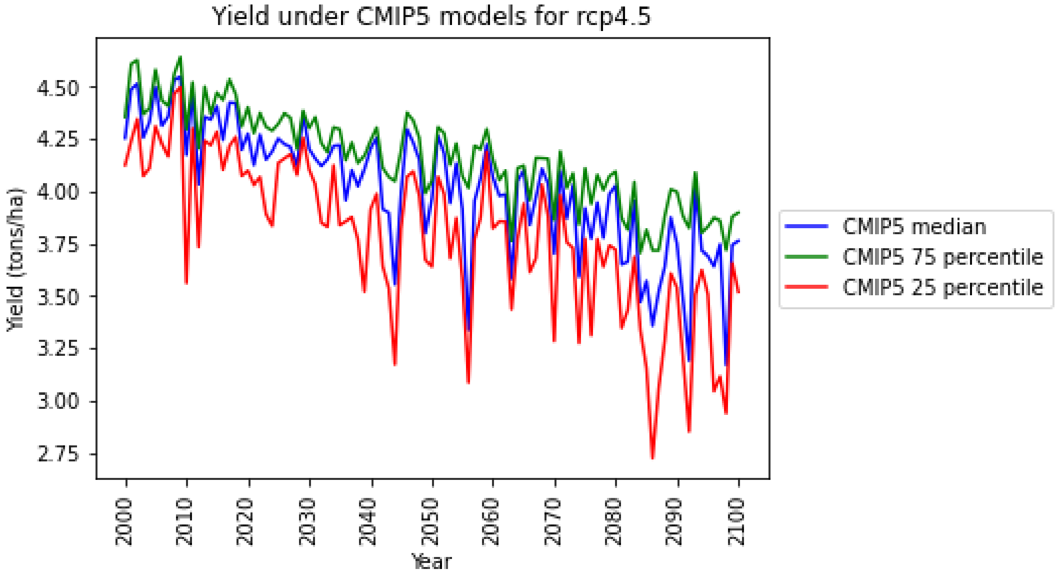
Crop yield modelling

- Crop yield module with AquaCrop



Jinja Uganda (0°27'05.2"N 33°11'33.5"E)

Figure from Master thesis Hajar Serrhini Naji

Examples

G-STIC StratAdapt Mali

- Capacity and expertise in crop modelling in Mali
- Access to climate information data and tools for the agri sector – CLIMTAG in Mali
- Modeling sorghum yields in current and future climate scenarios – link CLIMTAG to AquaCrop model (FAO)
- Identification of most promising climate adaptation practices and their socio-economic factors

Perspectives

- Upscale CLIMTAG with more countries and their agricultural calendars for smallholder farmers
- Validation and integration of more local meteo data
- Integration of ACMAD products
  - seasonal outlook, weather outlook of precipitation and onset of the rainy season
- Redesign of dashboard showing the whole of Africa with ability to zoom to the specific countries

CLIMTAG

Climate Information Tool for Agriculture

Behind the scenes: agro-climate indicators and seasonal forecasts

9–11 oktober 2023

Flanders
State of the Art

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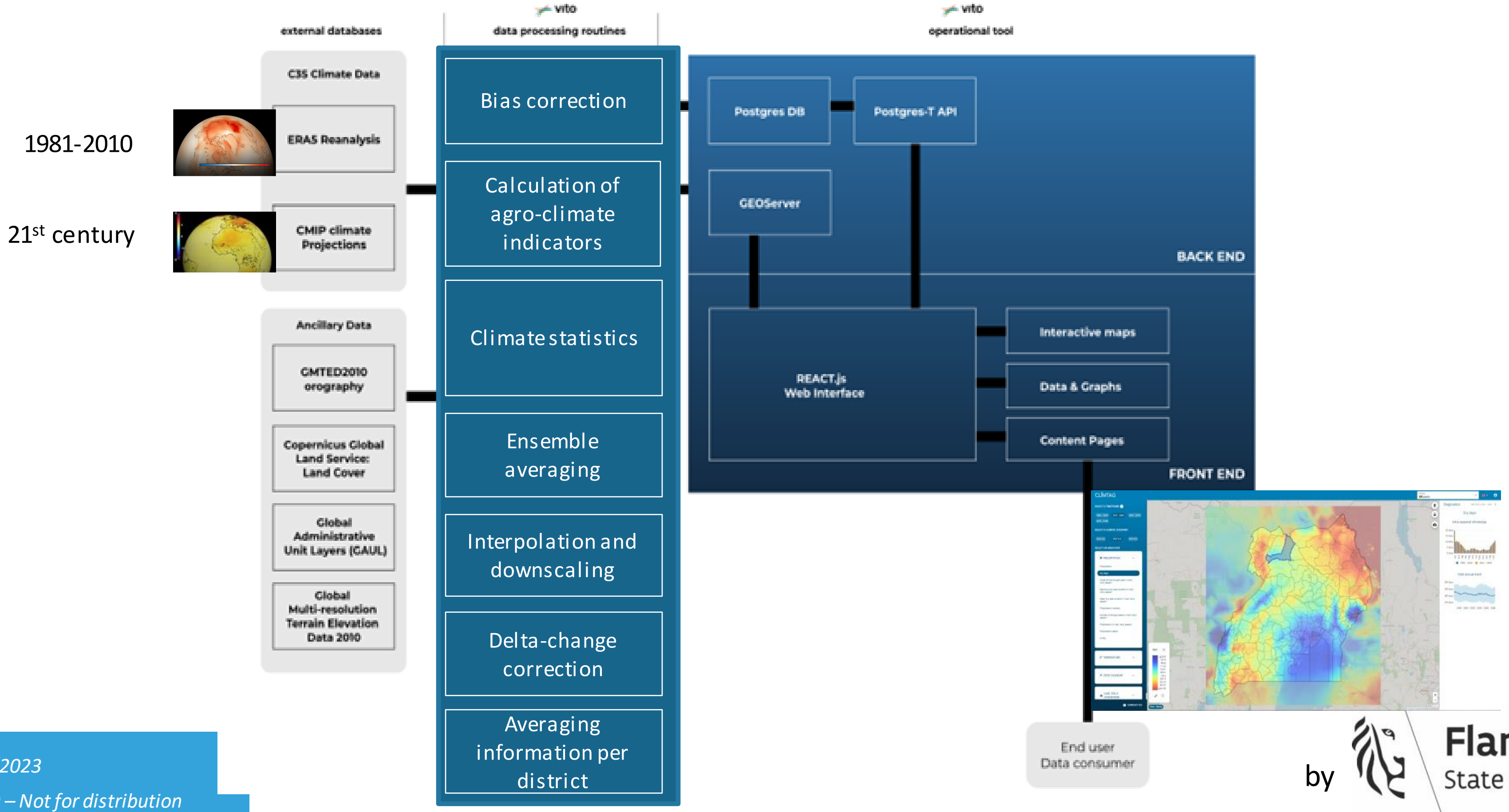
Methods

- Agro-climate indicators from reanalysis and climate projections
- Agro-seasonal weather indicators from seasonal forecasts
- Crop suitability indicators (tomorrow)

Methods

- **Agro-climate indicators from reanalysis and climate projections**
- Agro-seasonal weather indicators from seasonal forecasts
- Crop suitability indicators (tomorrow)

DATA PROCESSING AND VIZUALIZATION IN THE WEB TOOL



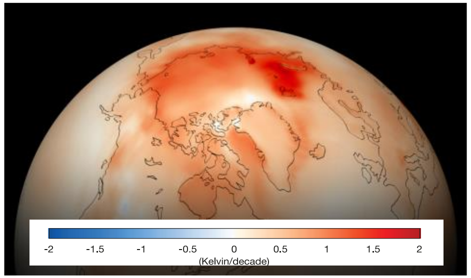
by

DAILY INPUT DATA

- Raw data
  - 2m temperature;
  - total precipitation;
  - 10m wind speed;
  - 2m specific humidity;
  - volumetric soil moisture at the upper surface layer (10 cm);
  - downward shortwave radiation;
  - surface sensible heat;
  - surface latent heat.
- Derived data (next slides)
  - Reference potential evaporation

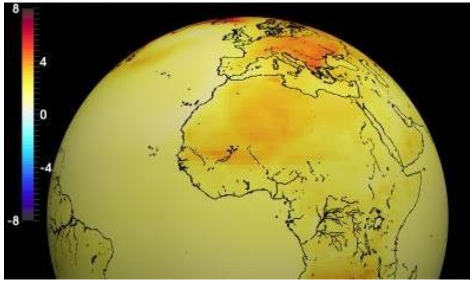
- Data from the Copernicus data store:
  - ERA5 reanalysis, a reconstruction of the historic gobal climate, based on ground-based observations, satellite imagery and atmospheric modelling at 0.25⁰ x 0.25⁰ resolution
  - CMIP5 projections to represent the future climate trends towards 2100, consisting of 15 climate models and 3 scenario's

Reanalysis: recent climate (ERA5)



1979-2018

Future climate: CMIP projections



21^{st} century

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DAILY INPUT DATA

Table 3. Data description of ERA5 hourly data on single levels

Horizontal coverage	Global
Horizontal resolution	0.25° x 0.25°
Vertical resolution	Surface level
Temporal coverage	1979-present
Temporal resolution	Hourly
File format	GRIB

Table 4. Data description of CMIP5 daily data on single levels

Horizontal coverage	Global
Horizontal resolution	0.125°x0.125° to 5°x5° (depending on the model)
Vertical resolution	Surface level
Temporal coverage	1850-2100
Temporal resolution	Daily
File format	GRIB

Model	Origin	Atmospheric grid	
		Lat	Lon
inmcm4	INM, Russia	1.5	2
FGOALS-g2	IAP-THU, China	2.7906	2.8125
BNU-ESM	BCC, China	2.7906	2.8125
GFDL-ESM2G	NOAA, USA	2.0225	2.5
GFDL-ESM2M	NOAA, USA	2.0225	2.5
IPSL-CM5A-LR	IPSL, France	1.2676	2.5
IPSL-CM5A-MR	IPSL, France	1.2676	2.5
IPSL-CM5B-LR	IPSL, France	1.2676	2.5
NorESM1-M	NCC, Norway	1.8947	2.5
MPI-ESM-LR	MPI, Germany	1.87246	1.875
MPI-ESM-MR	MPI, Germany	1.87246	1.875
CSIRO-Mk3-6-0	CSIRO, Australia	1.87246	1.875
GFDL-CM3	NOAA, USA	2	2.5

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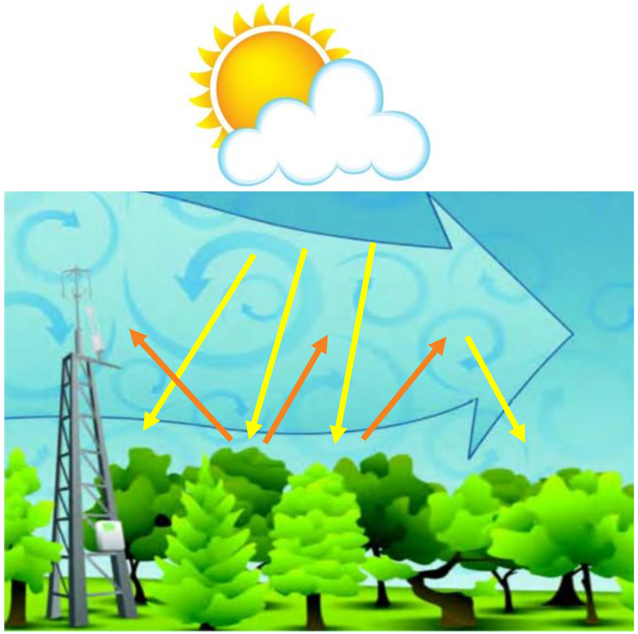
DAILY REFERENCE POTENTIAL EVAPORATION

- **'Potential evaporation'**: a measure of **atmospheric water demand** that, combined with soil drought conditions, can put **crops** and **agriculture** activity under **water stress**
- **'Reference'**: considering a **reference hypothetical grass patch free from water stress**
  -> so **only depending on the atmospheric condition** (temperature, air humidity, radiation, pressure, and wind) **and available surface energy (net radiation – heat flux into the ground)**
  -> **Independent of the surface condition including** crop type or agricultural activity (at least when neglecting additional atmospheric feedbacks)
  -> **Different from the actual evaporation**, which also depends on the land-cover type (soil properties, crop type, vegetation, urbanization...) and conditions (soil moisture, soil temperature)
- In combination with precipitation and soil type/drought parameters, this parameter **can be used to select suitable crop types** for cultivation, cfr. precipitation deficit, aridity and soil moisture indicators



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DAILY REFERENCE POTENTIAL EVAPORATION

Combination of 2 methods:

- Air humidity and available surface energy are not available on a daily basis for many climate models, so we start from the temperature-only definition by Hargreaves ($E_{p,\ H}$)
- They are still available on a monthly basis so we perform a correction to incorporate their effect on the long-term trend using the definition of Penmann-Montheith ($E_{p,\ PM}$)
- We combine the two definitions as follows:

$$E_{p,\ i} = E_{p,\ H,\ i} \times \sum_{j=i-15}^{i+15} E_{p,\ PM,\ j} / \sum_{j=i-15}^{i+15} E_{p,\ H,\ j}$$

with i and *j* a particular day in time

Daily values according to Hargreaves ($E_{p,\ H}$)

$$E_{p,\ H} = 0.0022 * R_A * \delta'_T{}^{0.5} * (T + 17.8) \qquad (15)$$

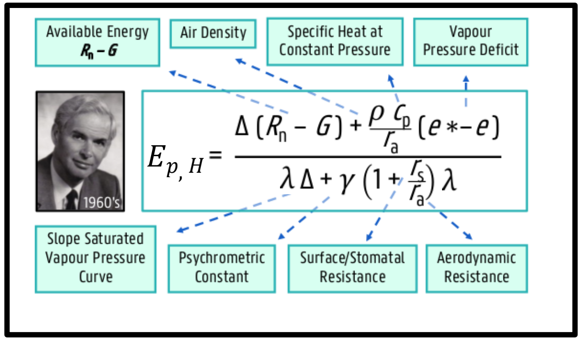
where:

R_A = mean extra-terrestrial radiation [mm/day], which is a function of the latitude f, (equation 8)

δ'_T = temperature difference = mean monthly maximum temperature - mean monthly minimum temperature for the month of interest [°C].

T = mean air temperature [°C].

Monthly values according to Penmann-Monteith ($E_{p,\ PM}$)



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BIAS CORRECTION

- Monthly and daily raw data of CMIP5 is bias-corrected against ERA5 by a quantile-delta mapping of daily and monthly values (QDM; Cannon et al., 2017)
- Basic idea of QDM: subtract model bias that is associated to the percentile of the model values

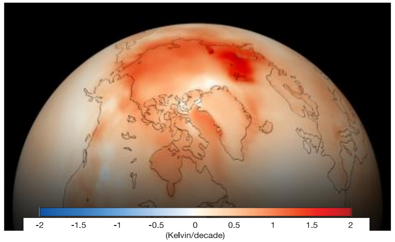
$$x_{m,corr}(t) = x_m(t) - B(p(x_m(t), t))$$

$x_m(t)$: model value for a particular time t

$p(x_m(t), t)$: Percentile of the model value $x_m(t)$ according to the time window around t

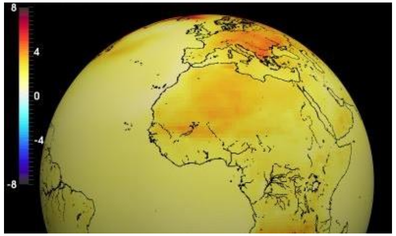
$B(p(x_m(t), t))$: Model bias associated to the percentile p

Reanalysis: recent climate (ERA5)



1979-2018

Future climate: CMIP5 projections



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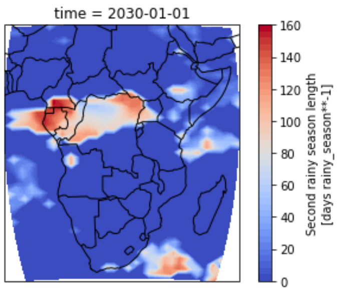
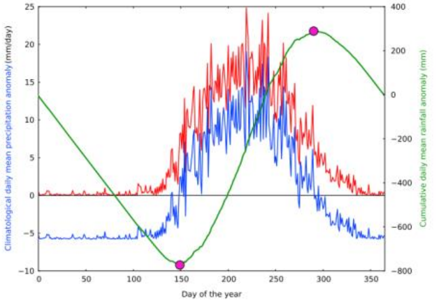
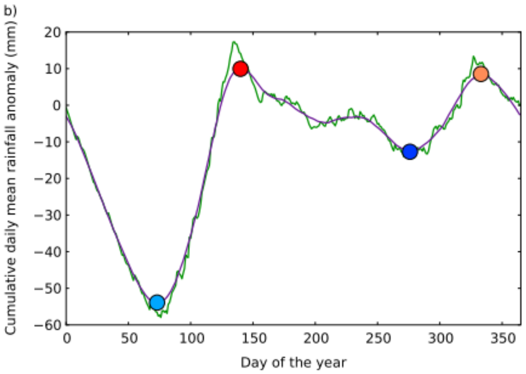
RAINY SEASON – CALCULATION WITH MULTIPLE DEFINITIONS

- **Universal** definition valid for the whole continent
- **STEP1:** identify **number** of rainy seasons (~ Dunning et al 2016: Fourier transformation)
- **STEP2:** identify search **window** (~ Dunning et al 2016: harmonic analysis)
- **STEP3: apply onset criteria** in the search window
  - ACMAD: 50 mm cumulative rainfall (ACMAD's reference)
  - Dunning et al., 2016: rainfall amount rel. to annual average (universal and peer-reviewed)
  - Ati et al., 2002: rainfall and ETo criteria (intuitive and known)
  - Sivakumar et al., 1988: first 3-day period with a cumulative precipitation of at least 20 mm and no dry spell longer than 7 days within 30 days following the determined onset.
- **Cessation:** last day of first 20-day period without rainfall







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POST-PROCESSING OF THE MODEL ENSEMBLE OF INDICATORS

- Climate statistics:
  - median and inter-quartile spread of the indicators for a 30-year moving window
- Ensemble averaging:
  - Averages of the medians and inter-quartile values are calculated to construct the final climatological spread
  - In case of rainy season indicators, we consider only the models for which the start of the rainy season start (median over 30 years) deviates less than 3 weeks than that from the climate reconstruction of the reference period (ERA5: 1981-2010). Otherwise, we keep them out of the ensemble.

DOWNSCALING

- **Downscaling** of the **historical** (ERA5) **indicators** (ERA5) to 1km resolution using elevation height:

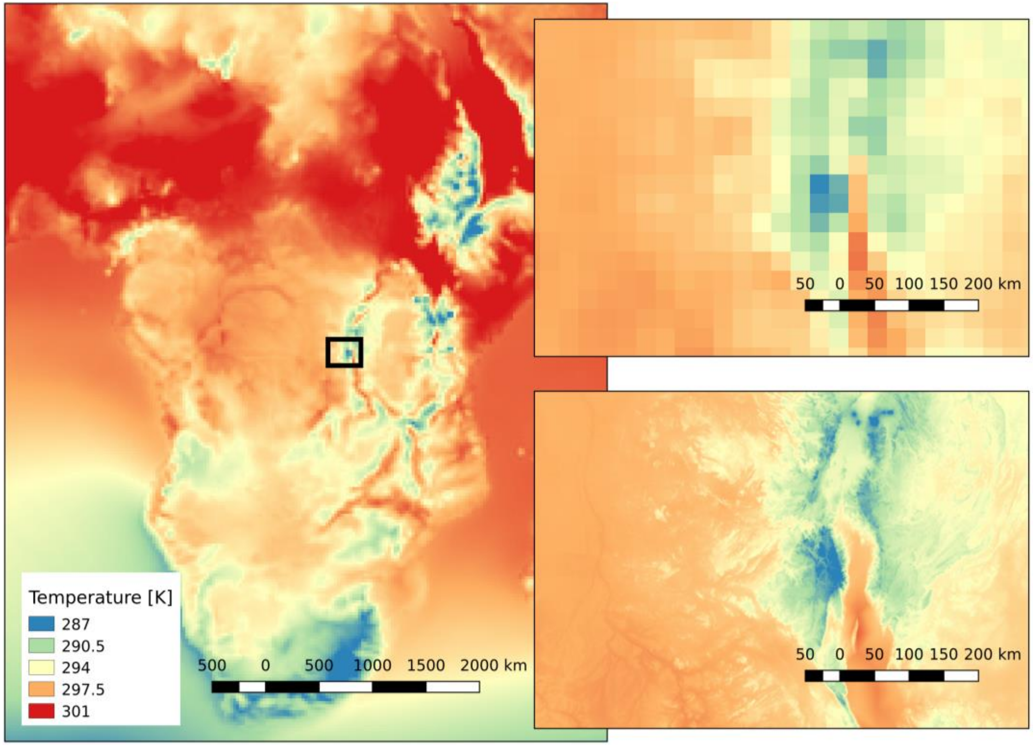
$$I_{HR,hist} = I_{CR} + \alpha_{CR}(h_{HR} - h_{CR})$$

I_{CR}: indicator on the coarse resolution interpolated to the 1km grid
h_{HR}: elevation height at 1km resolution
h_{CR}: elevation height aggregated to the coarse resolution (0.5deg) and re-interpolated to the 1km resolution.
α_{CR}: slope of the variable derived at coarse resolution with regression for the surround 250 km x 250 km and applied on the fine resolution

- **Superposition** of **future** change of the ensemble **coarse agro-climate indicators** on the downscaled historical indicators:

$$I_{HR}(t) = I_{HR,hist} + I_{CR,m}(t) - I_{CR,m}(t_0)$$

$I_{CR,m}(t)$: coarse ensemble agro-climate indicator for any time t in the future
$I_{CR,m}(t)$: coarse ensemble agro-climate indicator for any time t in the future



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Methods

- Agro-climate indicators from reanalysis and climate projections
- **Agro-seasonal weather indicators from seasonal forecasts**
- Crop suitability indicators (tomorrow)

Methods

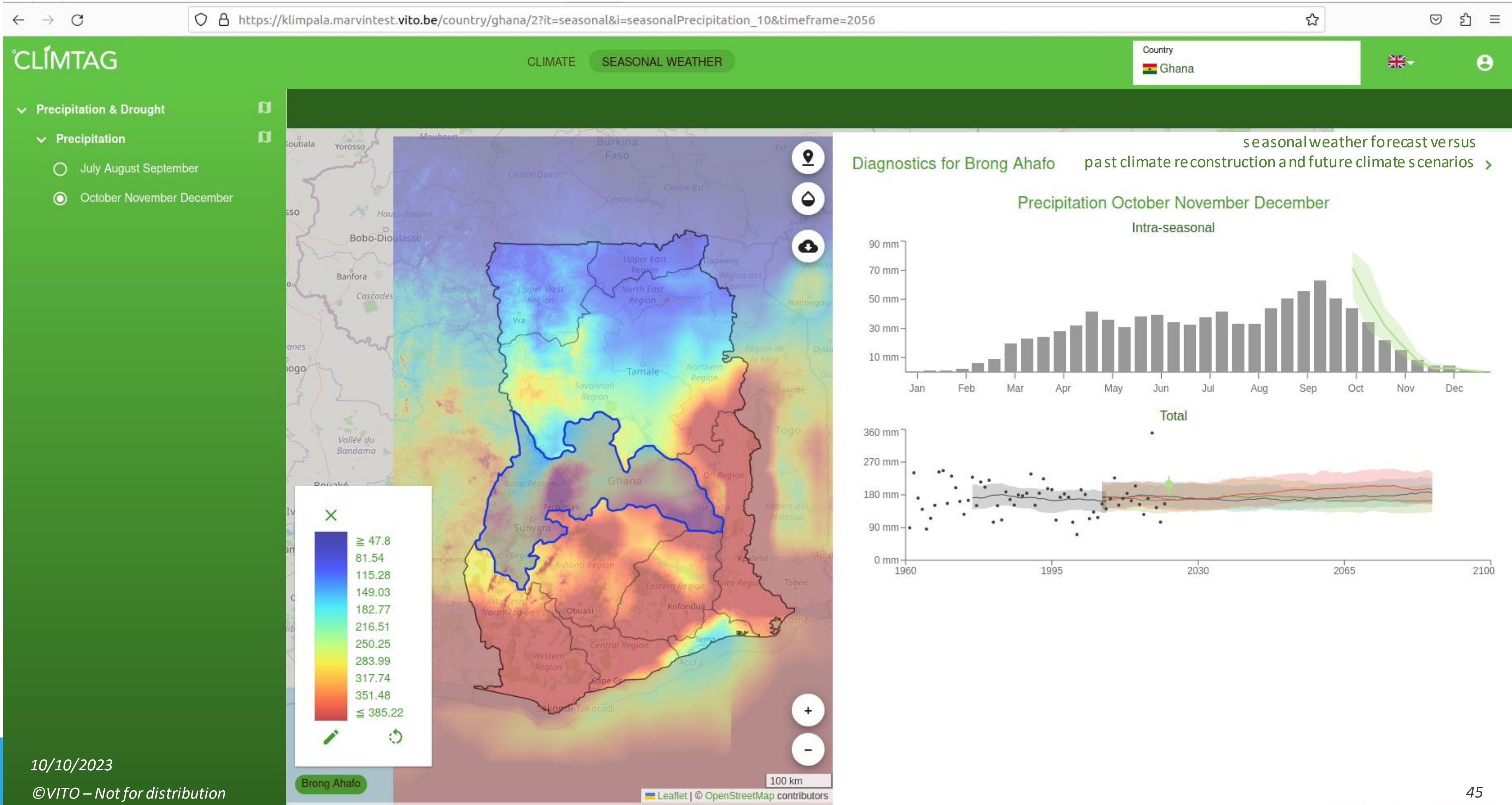
Agro-seasonal weather indicators

- 3-monthly precipitation statistics indicating the overall wetness or dryness of the season ahead, particularly for 1 to 3 months ahead and for 4 to 6 months ahead.
  - median and inter-quartile range of 3-monthly precipitation over the different seasonal forecast model members.
  - ‘tercile summary’ is provided, that indicates the chance of being wetter (that is, >40% of the forecast members are above second tercile value, ie., the 66.7th percentile; orange color) or drier (that is, >40% of the forecast members are below the first tercile value, ie., the 33.3th percentile; green color) than usual.
  - Median and interquartile ranges are also provided for 10-daily (decadal) precipitation to show the overall evolution of precipitation for the season ahead.

Methods

Agro-seasonal weather indicators

- Prior to calculating the seasonal weather indicators, daily values of the seasonal forecasts are bias-corrected with the quantile-delta mapping approach similar as for the climate models. Quantile values and their associated biases are determined for a reference period 1993 until 2022. The bias is determined by the difference between the seasonal forecast and ERA5 and subtracted from the daily values of the forecasts.
  - To account for a possible intra-seasonal variation of the model bias. This is done by performing the bias correction of each month separately, in which quantile values are determined from the month before, the month itself and the month after.
  - the bias-correction accounts for a possible change in bias of the seasonal forecasts over time. For that, biases associated with the quantile values are determined separately for the months that are 0, 1 ,…, 5 months ahead of the initialization of the forecast.
  - In the same way as the climate projections, the seasonal forecasts for precipitation are downscaled by overlaying a (ERA5-based) high resolution map over the seasonal forecasts interpolated to the 1km grid.
- Finally, CLIMTAG also includes the same seasonal weather indicators (ie., 3-monthly and 10-daily statistics) based on the ERA5 climate reconstruction (from 1961 until the same season of the previous year) and the future (bias-corrected) climate model scenarios (from 1950 until 2100). Thanks to the bias-correction on the seasonal forecasts, the seasonal weather indicators of the upcoming season are directly comparable, hence CLIMTAG shows at a glance how the upcoming season is similar to—or exceptional with respect to— the past climate record and future climate scenarios.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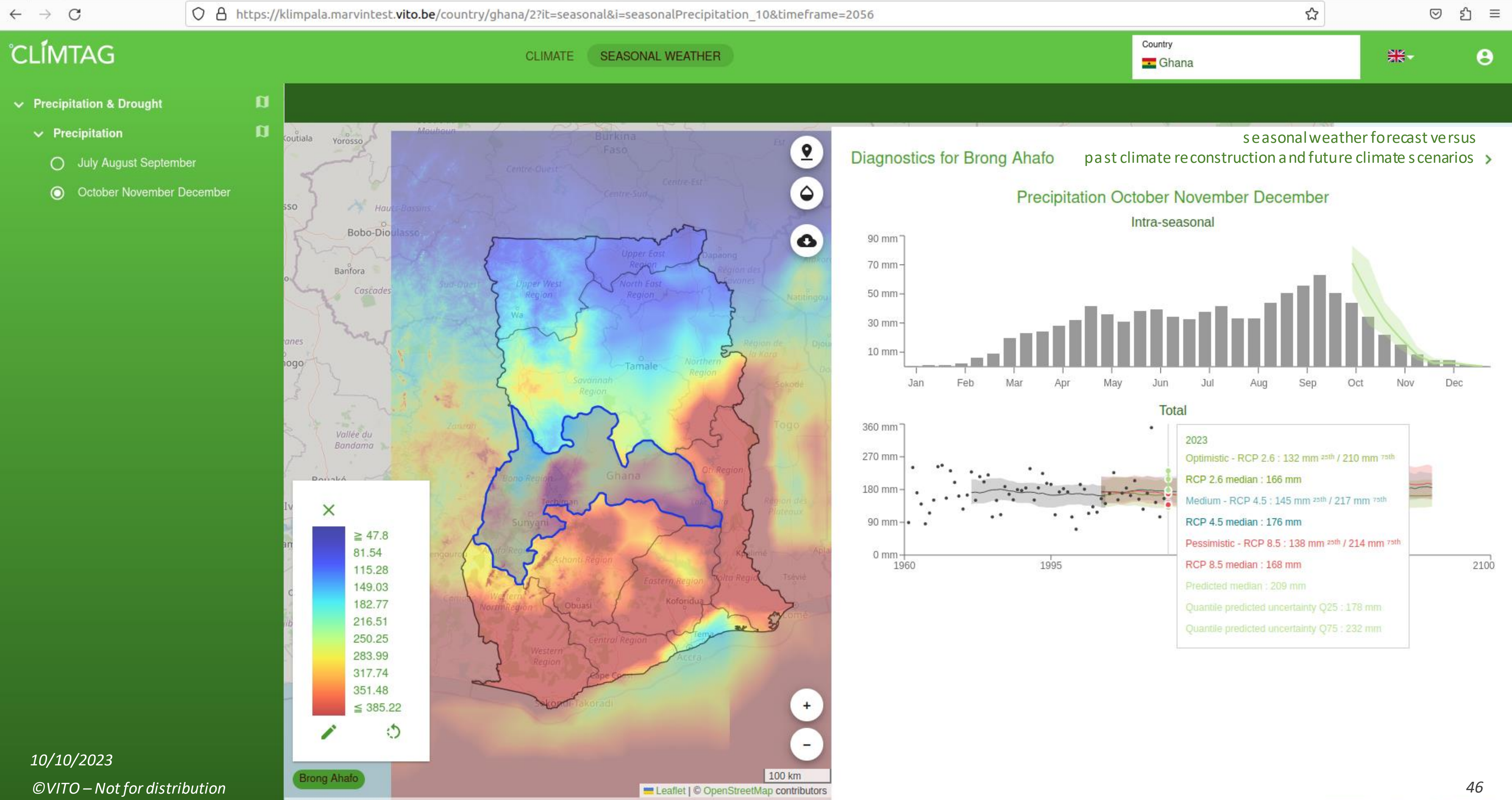
CLIMTAG
CLIMATE
SEASONAL WEATHER
Country
Ghana
Precipitation & Drought
Precipitation
July August September
October November December
seasonal weather forecast versus
past climate reconstruction and future climate scenarios
Diagnostics for Brong Ahafo
Precipitation October November December
Intra-seasonal
90 mm
70 mm
50 mm
30 mm
10 mm
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
360 mm
270 mm
180 mm
90 mm
0 mm
1960
1995
2030
2065
2100
≧ 47.8
81.54
115.28
149.03
182.77
216.51
250.25
283.99
317.74
351.48
≦ 385.22
Brong Ahafo
100 km
Leaflet | © OpenStreetMap contributors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CLIMTAG
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Precipitation October November December
Intra-seasonal
90 mm
70 mm
50 mm
30 mm
10 mm
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
360 mm
270 mm
180 mm
90 mm
0 mm
1960
1995
2100
2023
Optimistic - RCP 2.6 : 132 mm 25th / 210 mm 75th
RCP 2.6 median : 166 mm
Medium - RCP 4.5 : 145 mm 25th / 217 mm 75th
RCP 4.5 median : 176 mm
Pessimistic - RCP 8.5 : 138 mm 25th / 214 mm 75th
RCP 8.5 median : 168 mm
Predicted median : 209 mm
Quantile predicted uncertainty Q25 : 178 mm
Quantile predicted uncertainty Q75 : 232 mm
≧ 47.8
81.54
115.28
149.03
182.77
216.51
250.25
283.99
317.74
351.48
≦ 385.22
Brong Ahafo
100 km
Leaflet | © OpenStreetMap contributors
Burkina Faso
Upper West Region
Upper East Region
North East Region
Northern Region
Savannah Region
Tamale
Bono Region
Sunyani
Ghana
Oti Region
Ashanti Region
Eastern Region
Western North Region
Obuasi
Koforidua
Central Region
Western Region
Accra
Togo