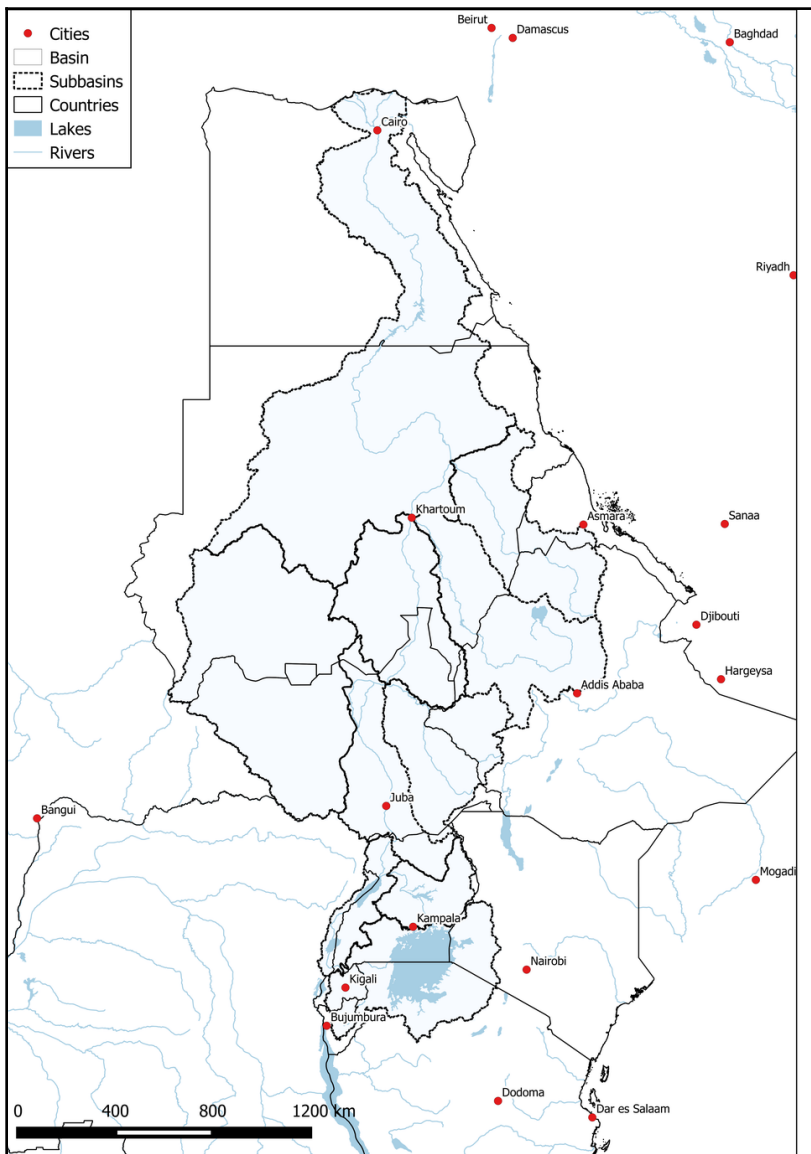


Bulletin of the Drought Monitoring and Forecasting Component of the Nile Basin River Flow Forecasting System (NB-RFFS)



OPERATIONAL DROUGHT REPORT **Date of issue: 12 April 2021**

This report has been automatically generated

1 Introduction

This report has been automatically generated by the Flood and Drought Data Portal¹. This report contains the latest satellite imagery used to monitor **precipitation, soil moisture, and vegetation health** in order to support drought early warning systems. It aims at describing the current drought situation in the basin with the objective of providing better information to manage emerging crop losses or water shortages and prevent or mitigate possible related disasters.

Based on the latest available climate data as well downscaled seasonal forecast, drought indices are computed to monitor and forecast different types of droughts. Typically, drought indices are divided into three main categories: Meteorological, Hydrological and Agricultural drought.

Assessment of drought status is carried out with interpretation of different types of drought hazards:

- **Climate status** based on observation and forecast of rainfall, as well as observation of temperature day temperature.
- **Soil moisture status:** based on the observation of soil moisture content in the top layer of the soil.
- **Vegetation status:** based on the observation of the Normalized difference vegetation index (NDVI) providing information about the vegetation canopy greenness.

The drought is described using a number of **drought hazard categories**, see Table 1. Each of the drought indices are translated into drought categories from specific intervals of the index values.

Table 1 Drought hazard categories inspired by the U.S. Drought Monitor Classification Scheme²

Category	Description	Possible Impacts
Normal	Normal	No impact
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies

¹ Flood and Drought monitor site accessible at: <http://www.flooddroughtmonitor.com>

² Read more about the U.S. Drought Monitor Classification Scheme at : <http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx>

2 Climate status

Rainfall

Monitoring the rainfall in the basin to understand how the rainy season compares with previous year is vital to detect any signs of meteorological drought. The observation of rainfall based on the GPM product, provides a long-term historical data set since March 2000³. This product has been selected for the Eastern Nile for its good coverage, resolution as well as availability. Latest data can be downloaded with only a day of delay.

Historical rainfall

The historical rainfall provides information about climatology, which corresponds to the long mean. From the long term record of rainfall observation the 25th and 75th percentiles are also computed and represented with the long term mean in Figure 1. The data might be used as rainfall ensembles for forecasted climate.

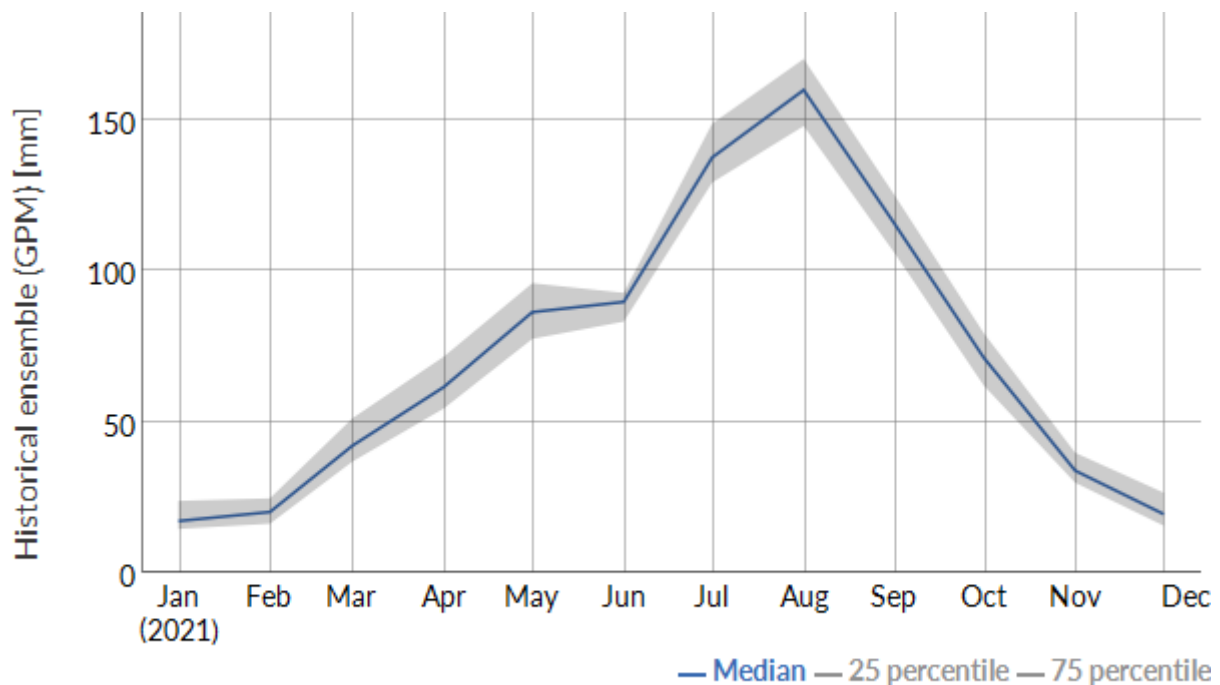


Figure 1 Long term mean of rainfall represented with the 25th and 75th percentile for the Eastern Nile basin.

Rainfall deviation

The rainfall deviation indicates how the current seasonal deviates from averaged year. The averaged year is calculated from the long-term mean with observation since 2000.

The map in Figure 2 indicates the monthly rainfall deviation for the last month.

³.It measures precipitation with a spatial resolution of 0.1 degree and temporal aggregation is done on the daily basis from 2000 to present. Source: <https://pmm.nasa.gov/GPM>

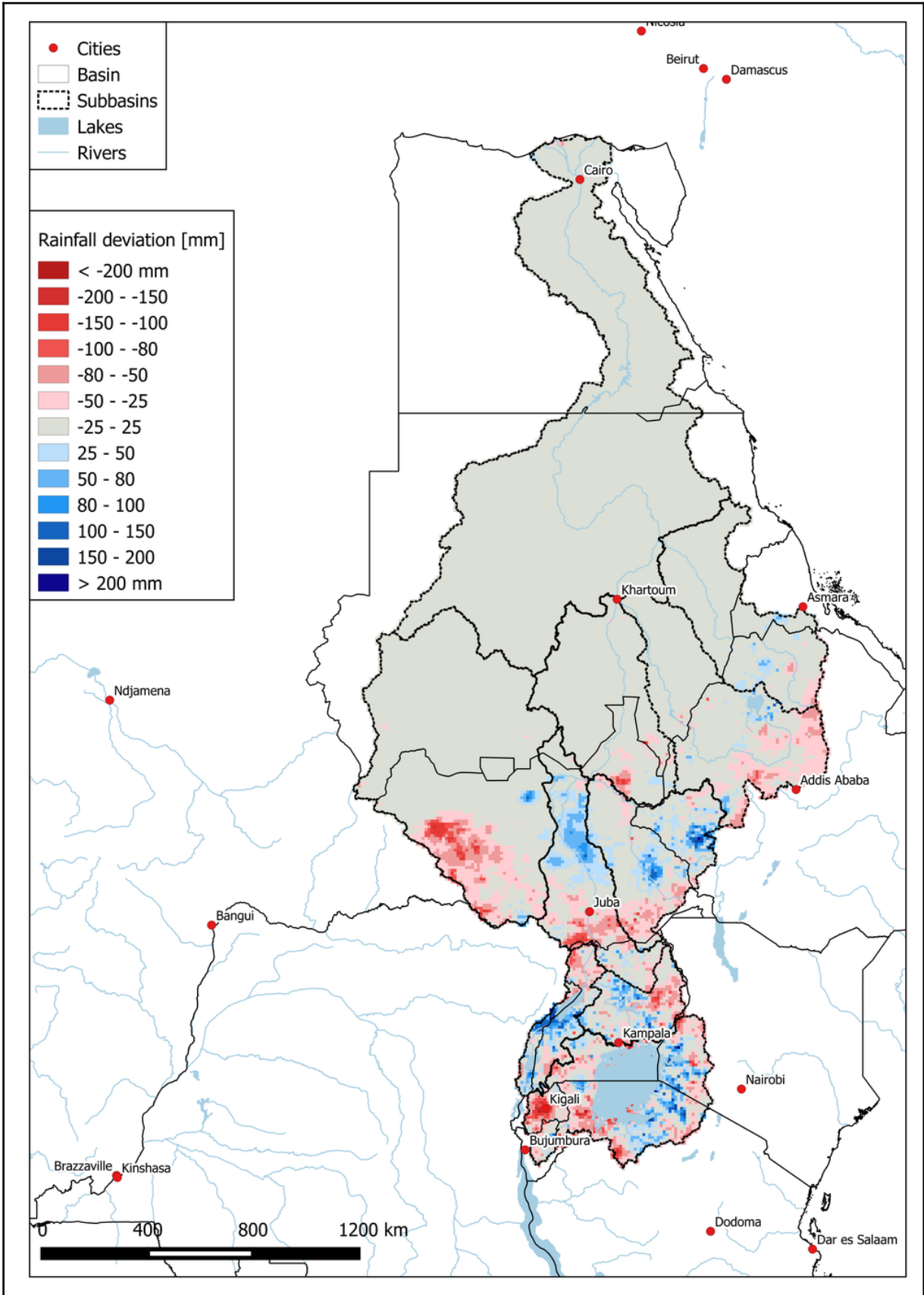


Figure 2 Maps of the rainfall deviation from the long term mean during the period from 2020-09-08 to 2020-10-07

Rainfall index

The Standardized Precipitation Index (SPI) is a widely used index to characterize meteorological drought on a range of timescales. The SPI values can be interpreted as the number of standard deviations by which the observed anomaly deviates from the long-term mean. The SPI can be compared across regions with different climates.

The three-month SPI provides a comparison of the precipitation over a specific 3-month period with the precipitation totals from the same 3-month period for all the years included in the historical record. For example, a 3-month SPI at the end of February compares the December–January–February precipitation total in that particular year with the December–February precipitation totals of all the years.

A 3-month SPI reflects short- and medium-term moisture conditions and provides a seasonal estimation of precipitation.

The map in Figure 3 shows the SPI-3 month rainfall index. The details of the drought categories (Normal to D4) used in the map are given in Table 1.

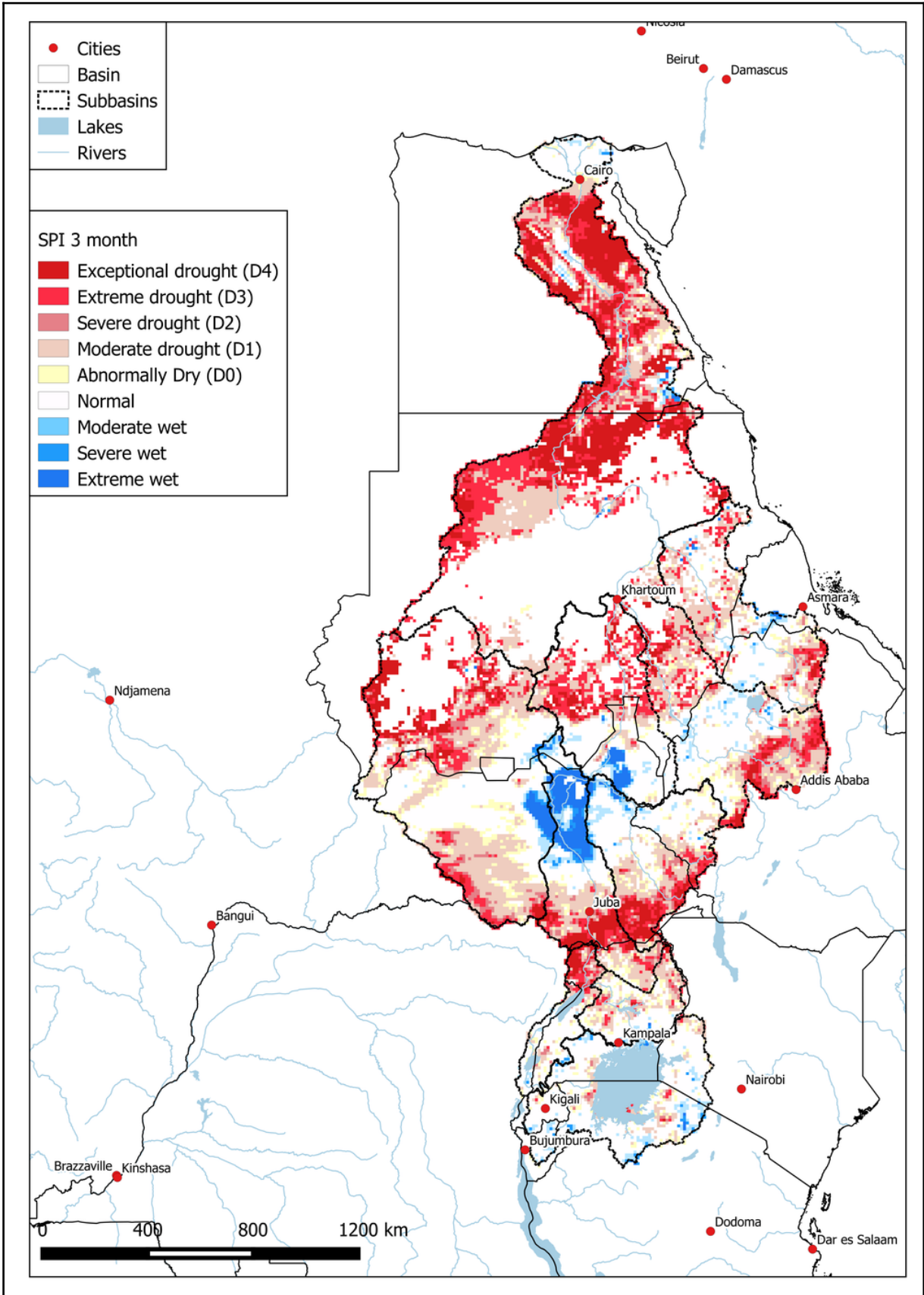


Figure 3 Maps of the SPI-3month during the period from 2020-07-10 to 2020-10-07.

Seasonal rainfall forecast

The Climate Forecast System (CFS), sometimes called the Coupled Forecast System, is a medium to long range numerical weather prediction and a climate model run by the National Centers for Environmental Prediction (NCEP) to bridge weather and climate timescales. Version 2 became operational as CFSv2 in 2011⁴. "Coupled" refers to the fact that the model couples atmospheric to oceanic modelling.

It provides a 20-member ensemble forecast with 9-month lead time. This product is downscaled using historic TRMM data based on a monthly scale factor⁵. The mean as well as the 25th and 75th percentile of the forecast are represented for the 4 large subbasins in Figure 4, Figure 5, Figure 6 and Figure 7.

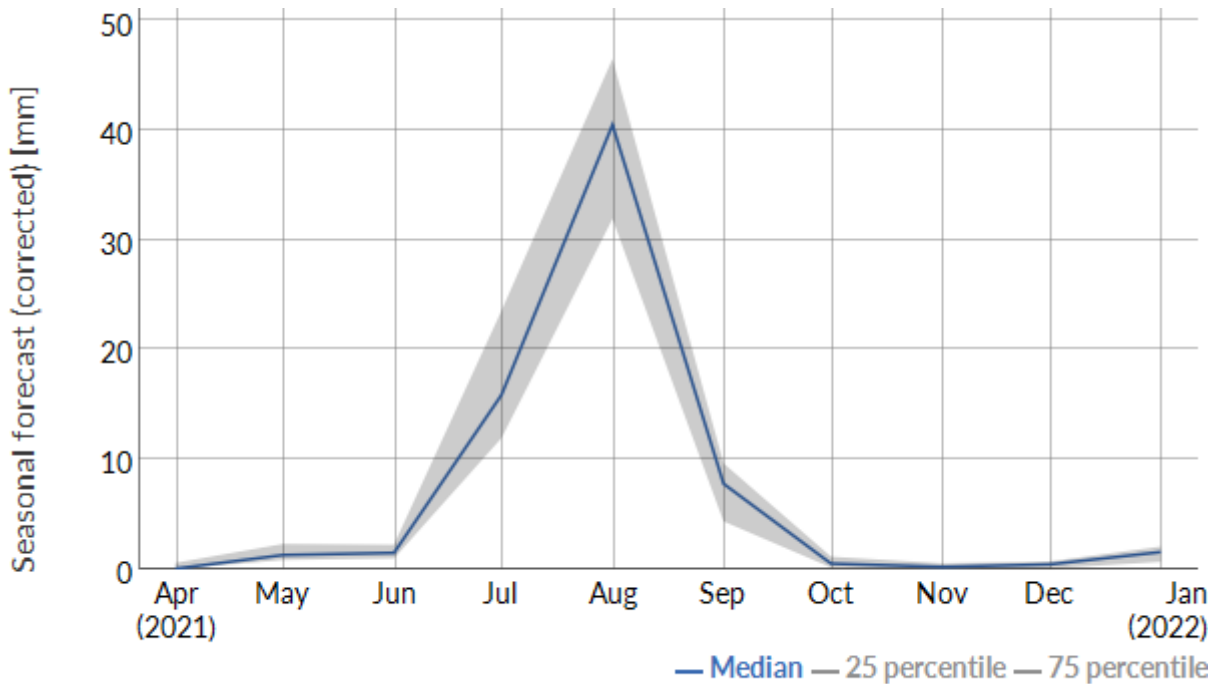


Figure 4 Seasonal rainfall forecast as ensemble forecast in the Main Nile

⁴ Climate Forecast System (CFS), sometimes called the Coupled Forecast System, is a medium to long range numerical weather prediction and a climate model run by the National Centers for Environmental Prediction (NCEP). Source: <http://cfs.ncep.noaa.gov/cfsv2.info>

⁵ The TRMM dataset from 2000 to 2019 combined with CFS reforecast dataset has been used to derive monthly bias-correction factors, which are applied operationally to correct the forecast.

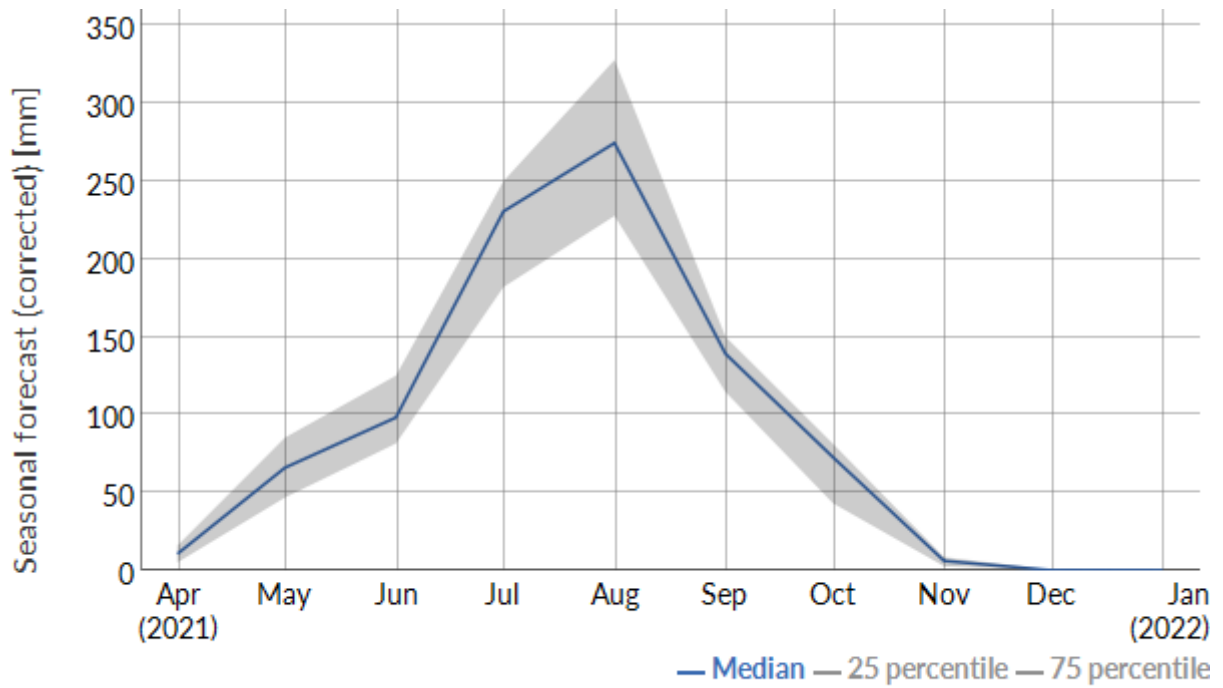


Figure 5 Seasonal rainfall forecast as ensemble forecast in the White Nile

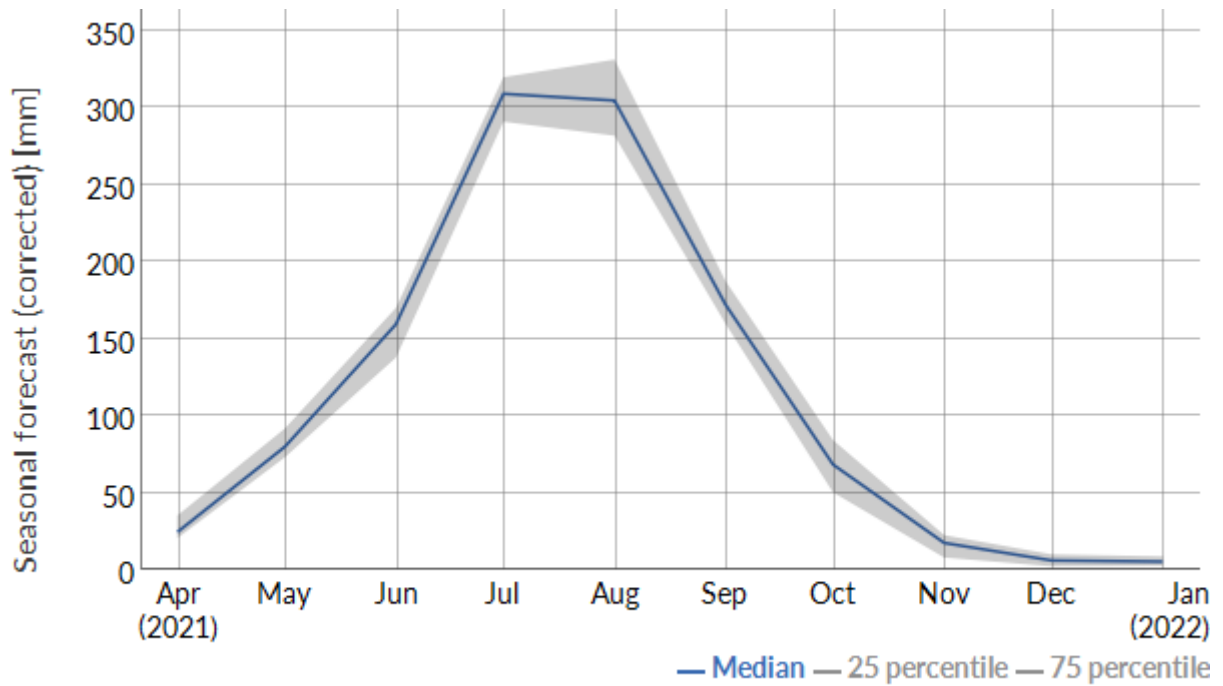


Figure 6 Seasonal rainfall forecast as ensemble forecast in the Blue Nile

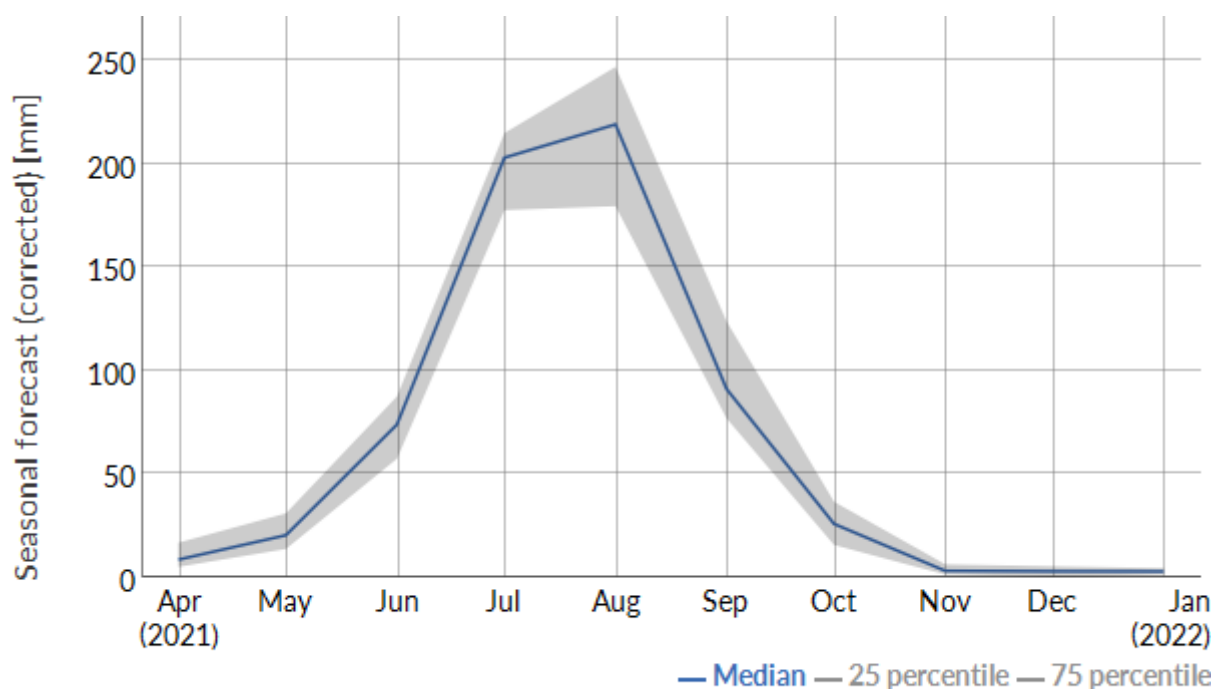


Figure 7 Seasonal rainfall forecast as ensemble forecast in the Tkeze Atbara

3 Soil moisture status

Hydrological drought occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought.

Hydrological drought can be monitored with the soil moisture content. Soil moisture content is important for crop production and is therefore an important indicator to detect drought events.

3.1 Soil Water Index (SWI)

Soil moisture content is monitored using the Soil Water index (SWI) product⁶.

Soil moisture can indicate plant water deficiencies earlier than vegetation indices can do.

SWI deviation

The SWI deviation is used as a drought index and describes the deviation from the long-term mean calculated for the period 2007-present. The values are transformed into drought categories related to the values of the deviation.

This product is normalised by the long term mean and expresses the deviation in relation to the mean root zone storage value. The map in Figure 8 shows the deviation for the latest 10-day period of SWI values compared to the long term mean for the entire Eastern Nile basin. The details of the drought categories (Normal to D4) used in the map are given in Table 1.

⁶ The soil water index (SWI) product contains daily synthesis of Soil Water Index derived from ASCAT SSM data at 25 km resolution (then resampled to 0.1 degree).

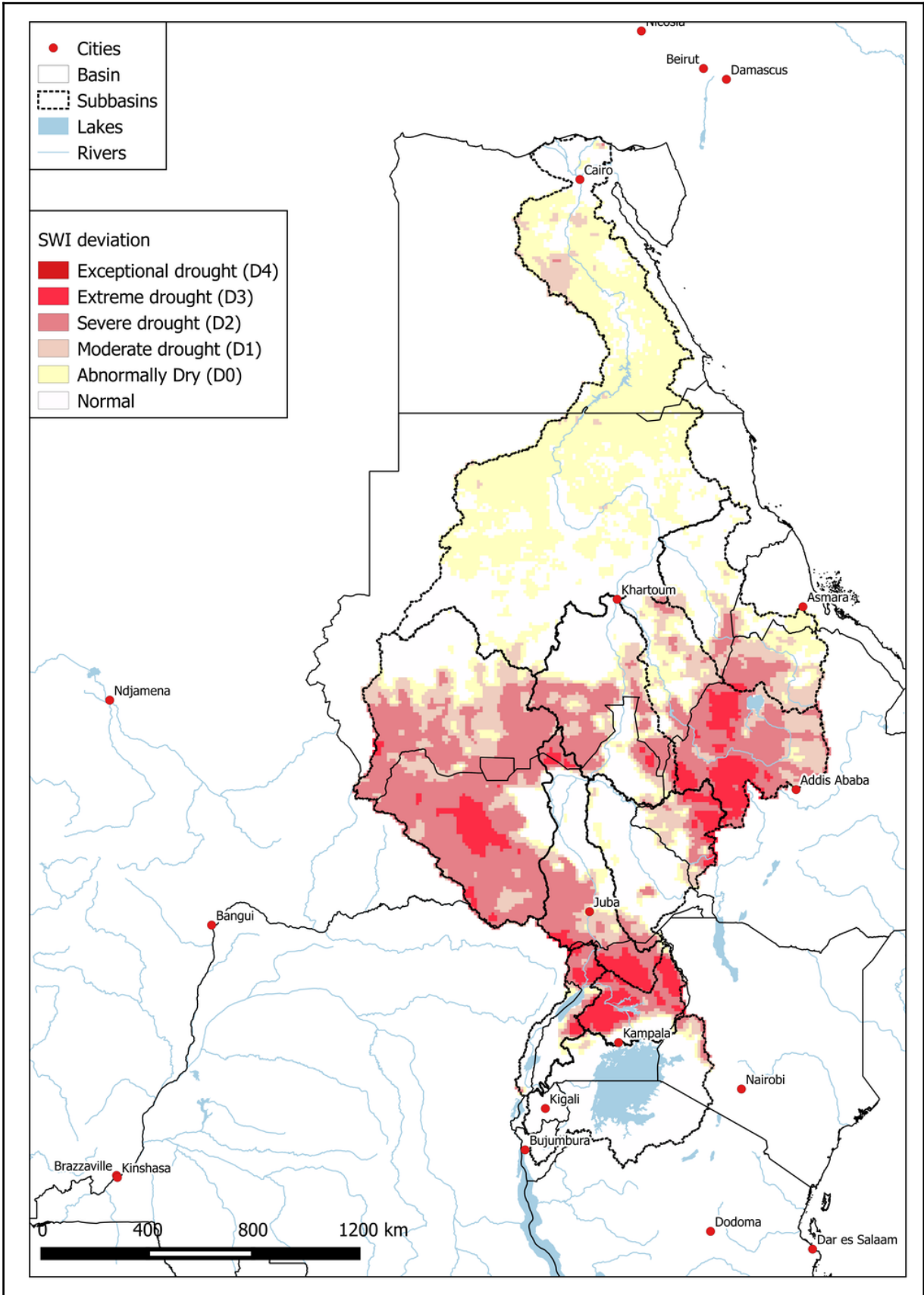


Figure 8 Map of the SWI deviation for the latest 10-day period from 2020-09-21 to 2020-09-30.

3.2 Root Zone storage from GHM

The root zone storage is a result of the Global Hydrological Model (GHM)⁷. The GHM is currently in development but allows first results to be output.

Root zone storage deviation (historical)

The Root zone storage deviation is used as a drought index and describes the deviation from the long-term mean calculated for the period 2000-present. The values are transformed into drought categories related to the values of the deviation.

This product is normalised by the long term mean and expresses the deviation in relation to the mean root zone storage value.

The map in Figure 9 shows the deviation for the latest 10-day period of the root zone storage compared to the long-term mean. The details of the drought categories (Normal to D4) used in the map are given in Table 1.

⁷ The Global Hydrological Modelling approach is based on a global coverage of NAM models using a common approach for defining model parameters and execution. The model is set up with a resolution of 0.1 x 0.1 degrees allowing for near-real time and forecasted hydrological responses (based on NAM models auto-calibrated on global parameters). The model is applied for the Eastern Nile and used for assessment of deviations in model-based drought indicators as water availability in the root zone.

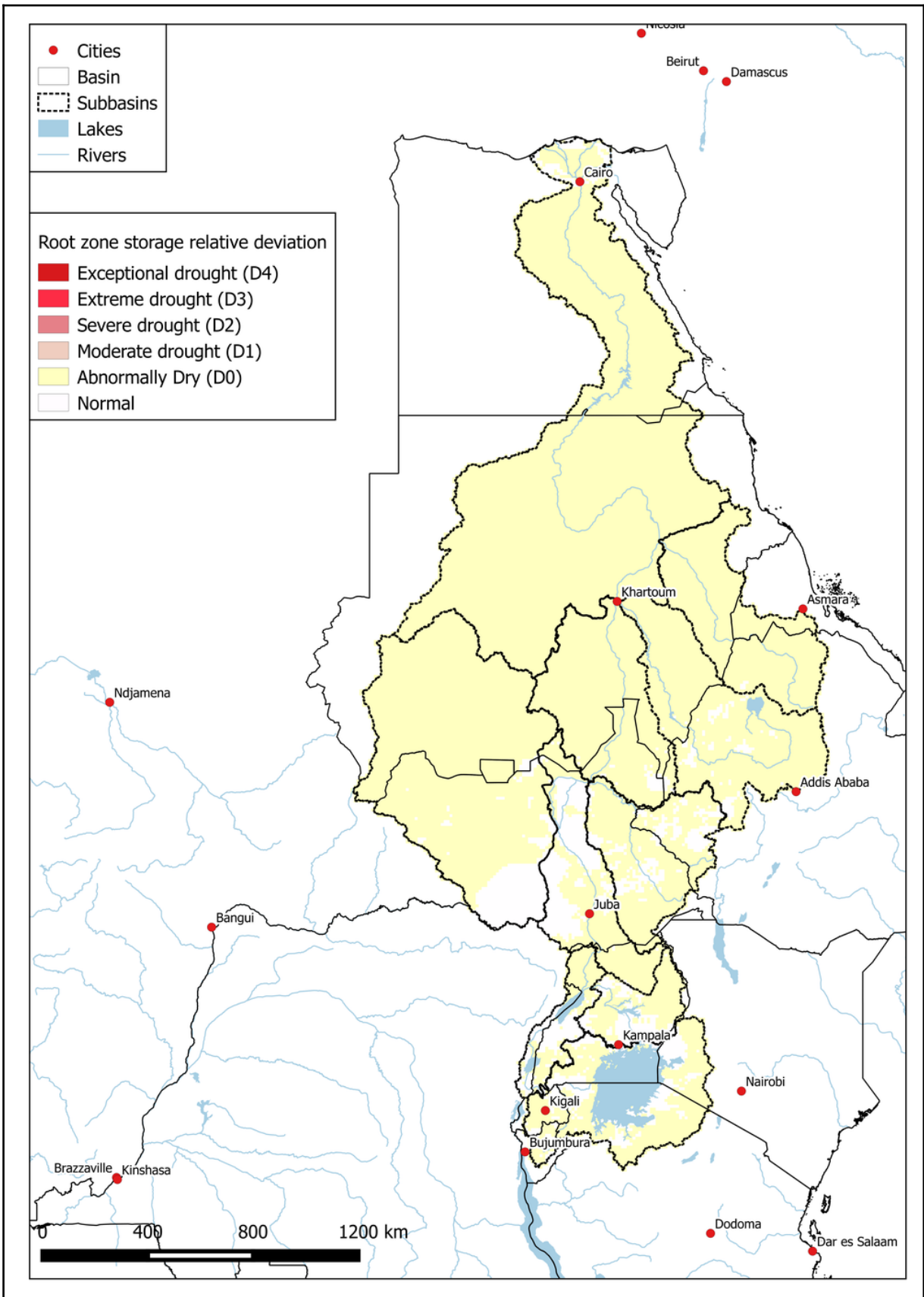


Figure 9 Map of the Root zone storage deviation for the latest 10-day period from 2020-08-01 to 2020-08-10

Root zone storage deviation (forecast)

Based on GHM model runs using forecast climate information it is possible to predict the root zone storage in the coming 9-month period. Figure 10 represents the deviation to long term mean of root zone storage averaged for the entire Eastern Nile basin. The long-term mean is calculated for the period 2000 to present.

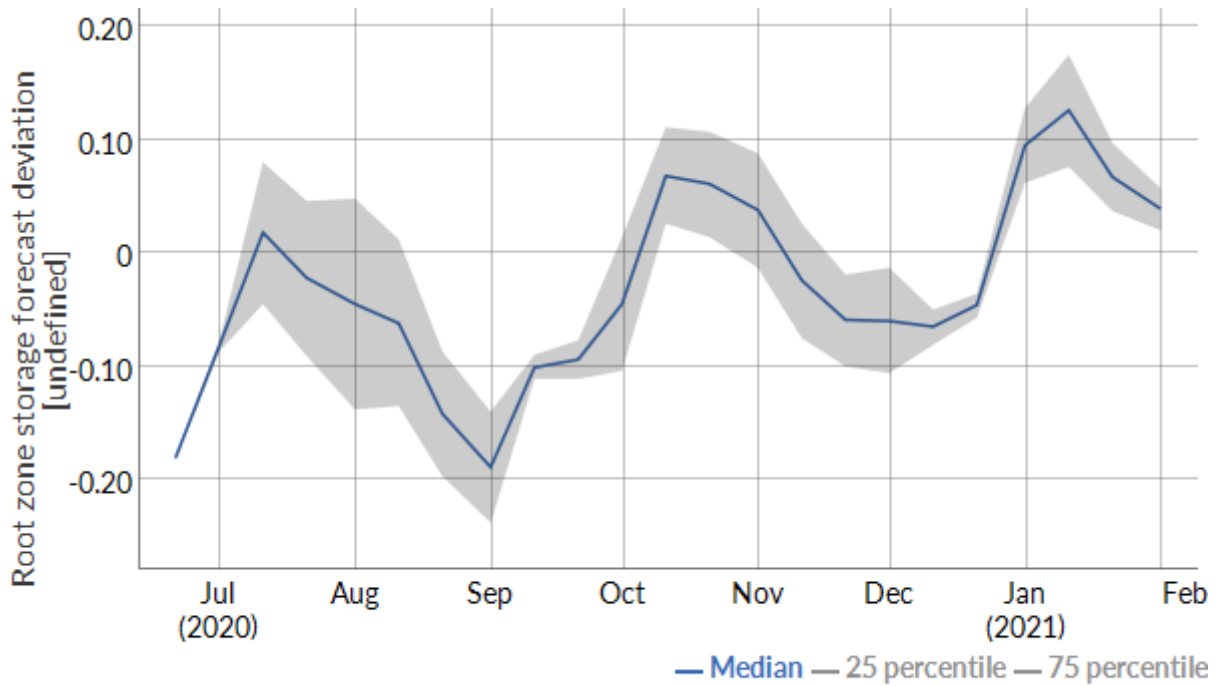


Figure 10 Plot of the Root zone storage deviation for the coming 9-month period in the Main Nile

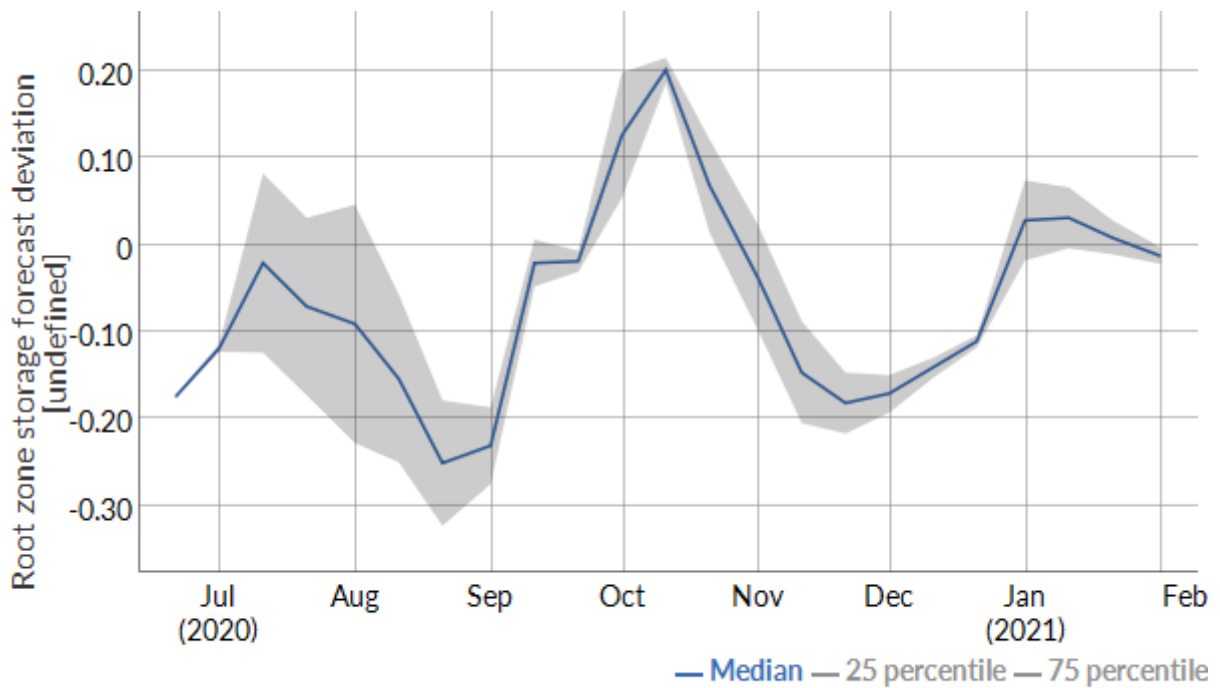


Figure 11 Plot of the Root zone storage deviation for the coming 9-month period in the White Nile

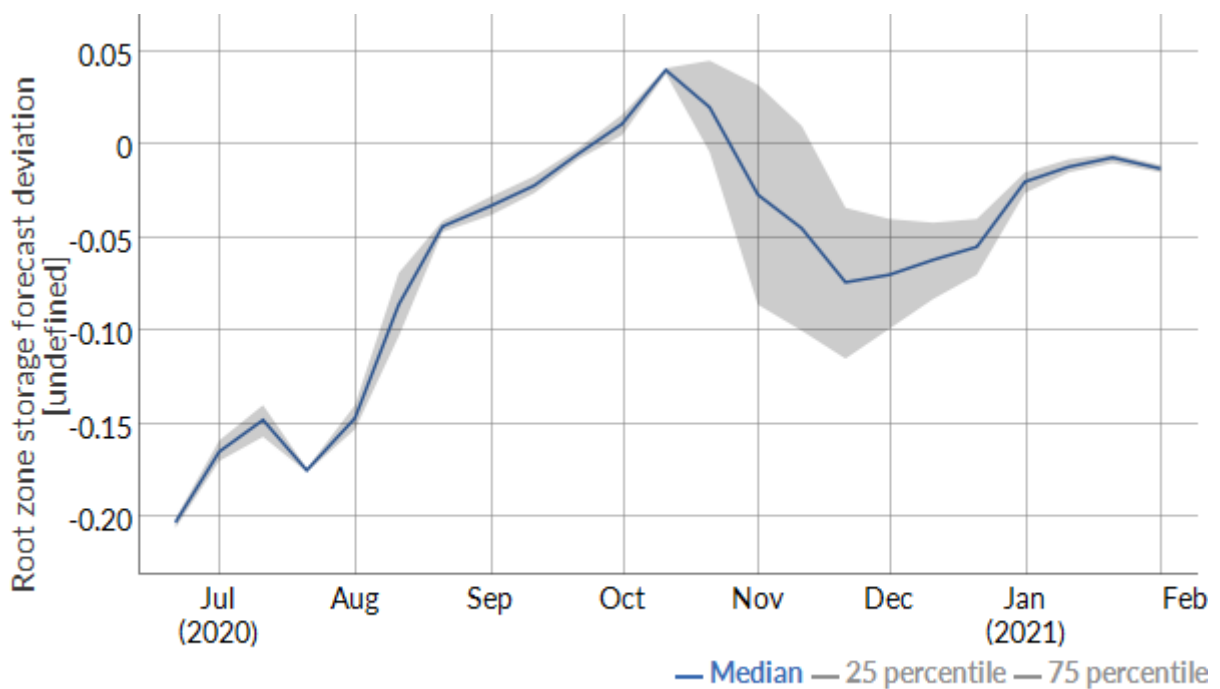


Figure 12 Plot of the Root zone storage deviation for the coming 9-month period in the Blue Nile

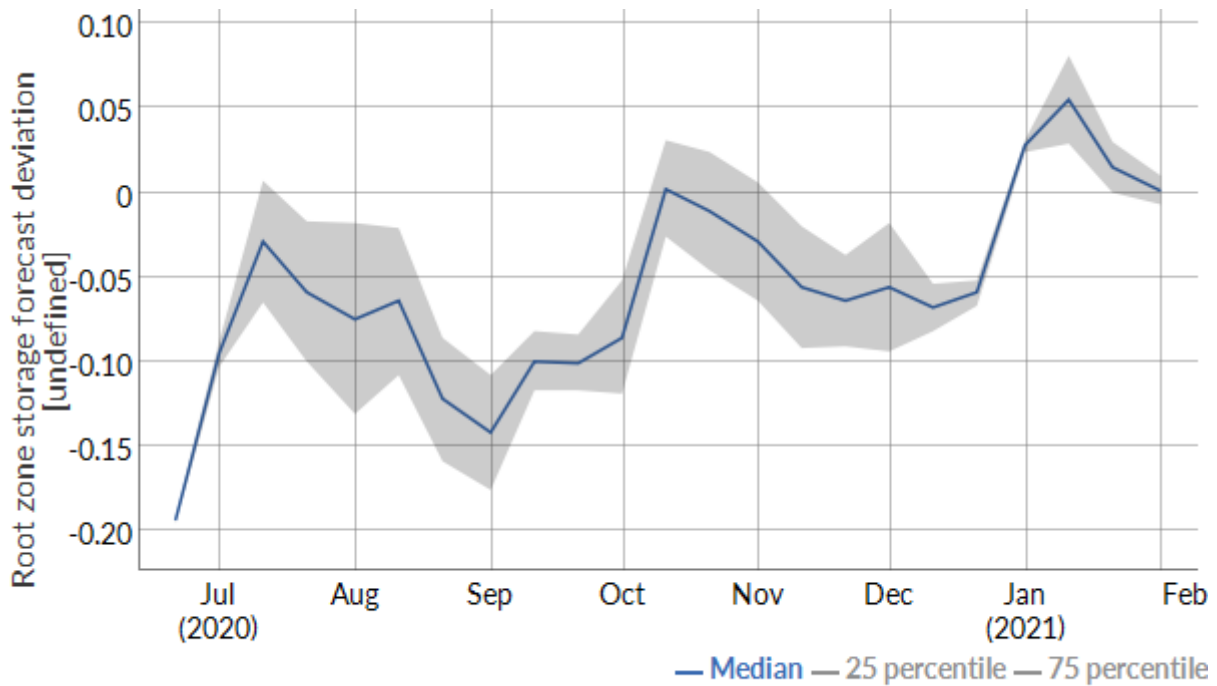


Figure 13 Plot of the Root zone storage deviation for the coming 9-month period in the Tkeze Atbara

4 Vegetation status

Agricultural drought happens when crops become affected. It normally occurs several months after the meteorological drought. Agriculture drought can be monitored with the vegetation cover and the deviation to normal conditions.

The Normalized difference vegetation index (NDVI)⁸ provides consistent spatial and temporal comparisons of vegetation canopy greenness, a composite property of leaf area, chlorophyll and canopy structure.

NDVI deviation

NDVI deviation is used to express changes in the vegetation and location of areas where the vegetation potentially might be impacted by drought. The NDVI deviation is used as a drought index to describe the deviation from the long-term mean calculated for the period from 2000 to present. Figure 14 shows the deviation for the latest 16-day period compared to the long term mean in the entire Eastern Nile basin. The details of the drought categories (Normal to D4) used in the map are given in Table 1.

⁸ The Normalized difference vegetation index (NDVI) is a MODIS vegetation index produced on 16-day intervals and at multiple spatial resolutions.

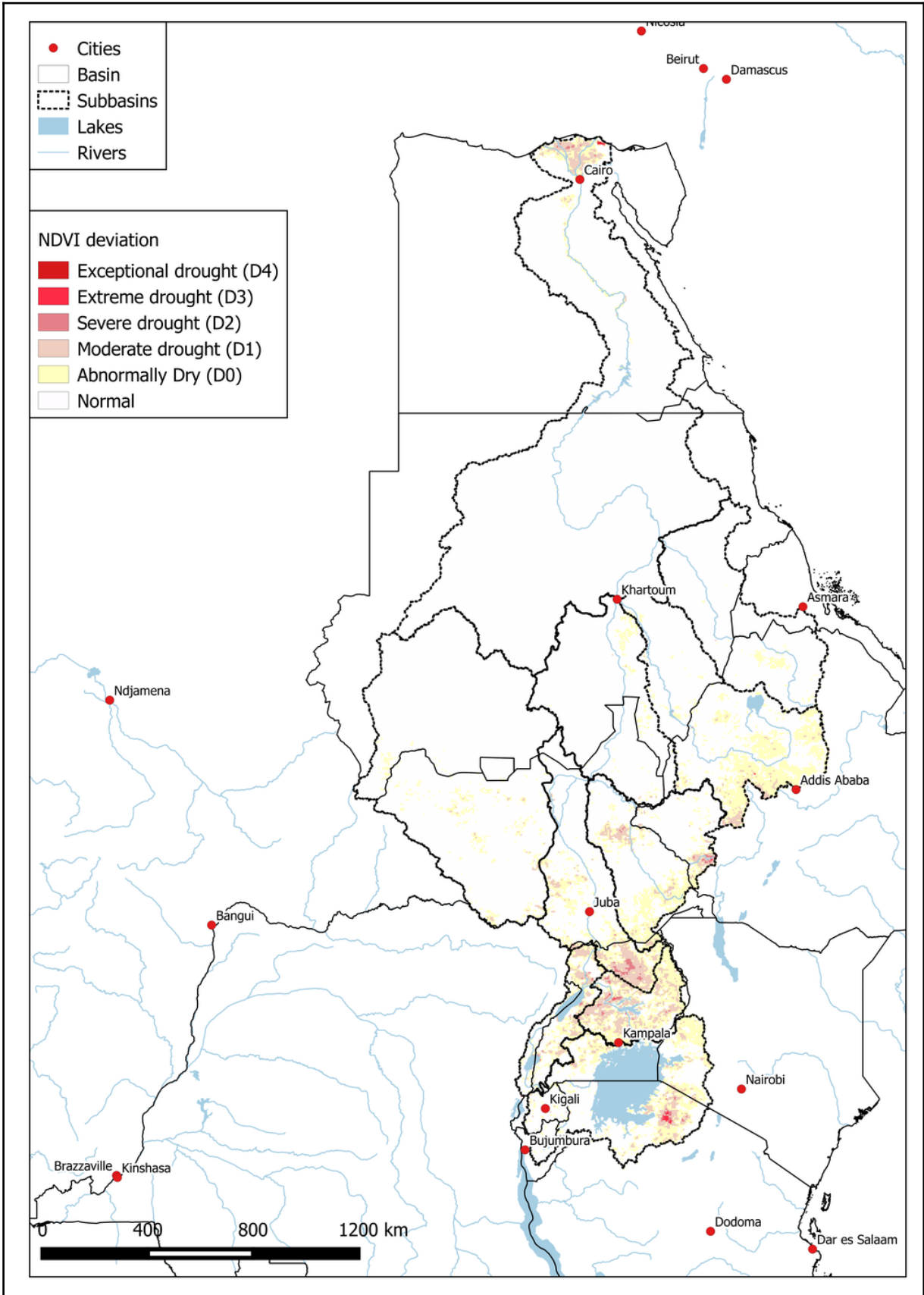


Figure 14 Map of the NDVI deviation for the period from 2020-09-13 to 2020-09-28

Temperature and Vegetation based drought index

The vegetation greenness index (VCI)⁹ can be combined with temperature drought index (TCI) to form the Vegetation health index (VHI). VCI focuses on the impact of drought on vegetation and provides information on the onset, duration and severity of drought. This index compares the current vegetation and temperature conditions in the latest 16-day period with the long-term historical values calculated for the period 2000 to present. This index might be affected by cloud.

⁹ References for VCI are available at: <https://www.droughtmanagement.info/vegetation-condition-index-vci/>

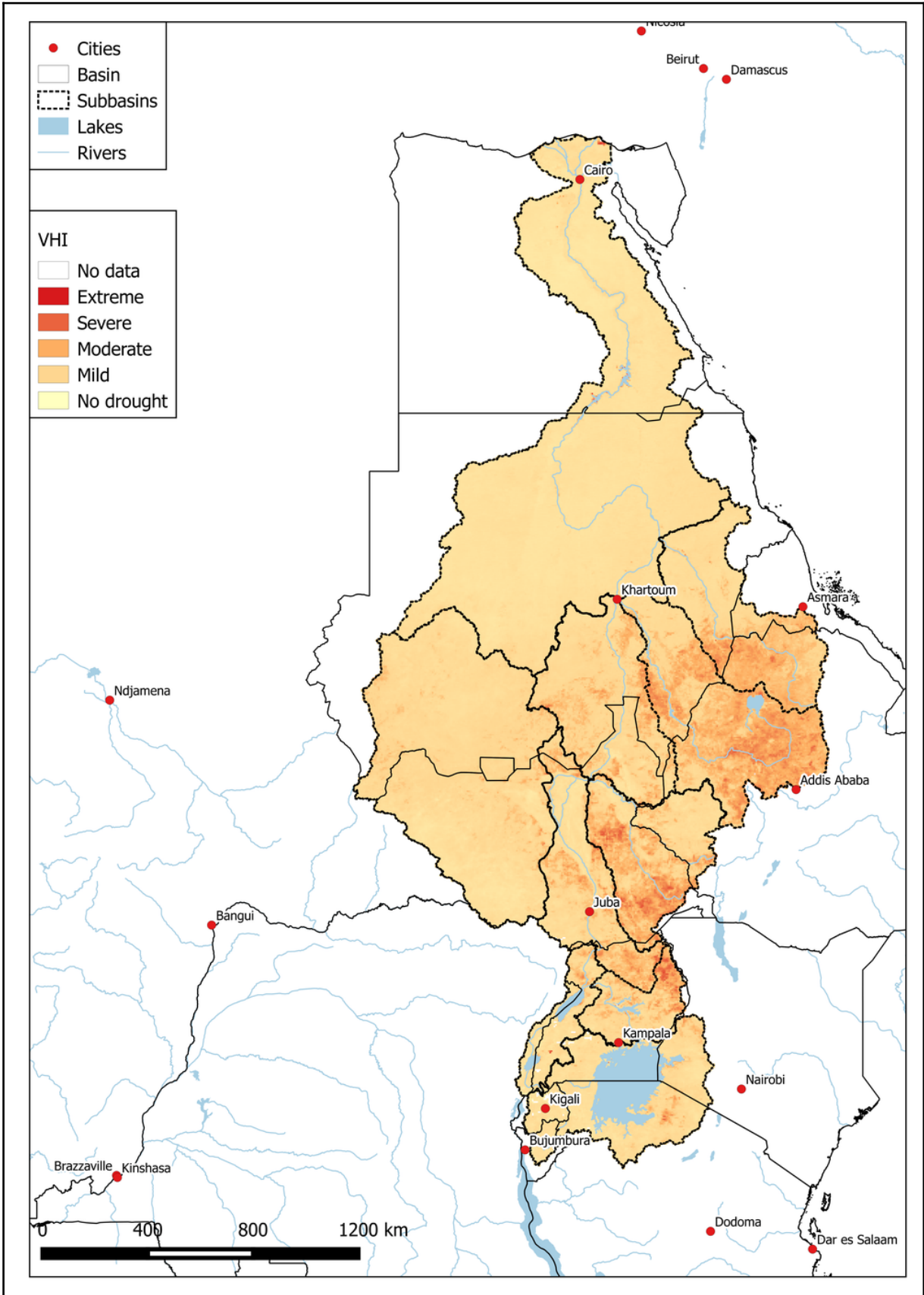


Figure 15 Map of the Vegetation health index for the period from 2020-09-13 to 2020-09-28