NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

Highlights

- Satellite observations show that during July to September the Nile Basin recieved rainfall especially in Blue Nile, Tekeze Atbara, Baro akobo Sobat , White Nile and parts of the Bahr el Ghazal Subbasins.
- Highest rainfall in the basin was detected in the Blue Nile Subbasin during the month of August.
- There was little or no rainfall in the Nile Equatorial Lakes region because of the dry season.
- Rainfall excess maps (P-E) for July to September show high values in the Eastern Nile Subbasins and also in the White Nile and Bahr el Ghazal subbasins. P-E gives an indication of available water for runoff.
- Lake Tana showed an increase in the water level during July to September because the region was experiencing a wet season.

MONITORING THE NILE BASIN USING SATELLITE OBSERVATIONS

July - September 2018

MONITORING THE NILE BASIN USING SATELLITE OBSERVATIONS

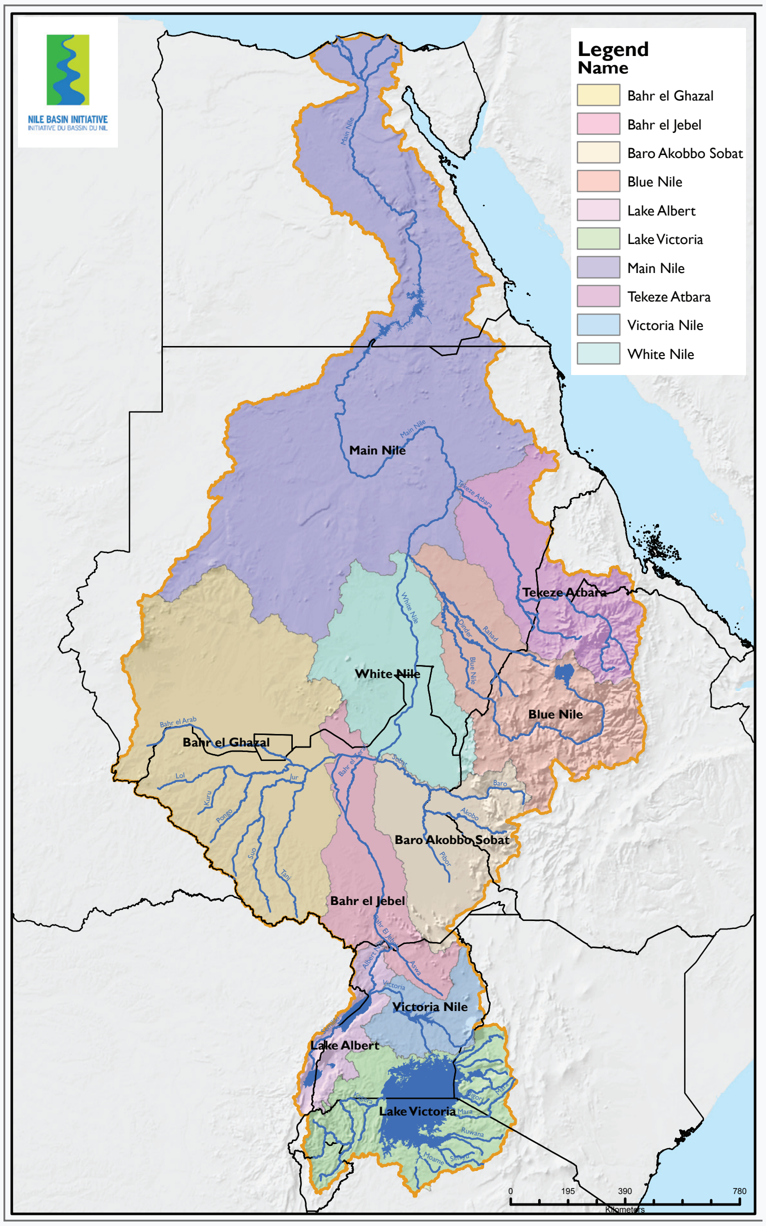
July - September 2018

The Nile Basin Initiative (NBI) is an intergovernmental partnership of ten Nile riparian countries that is seeking to manage and develop the common Nile water resources in a cooperative manner and promote regional peace and security.

Nile Basin Initiative Secretariat (NBI)
P.O. Box 192, Entebbe, Uganda
Tel: +256 414 321 424/ +256 417 705 000
Fax: + 256 414 320 971
Email: nbisec@nilebasin.org
Website: www.nilebasin.org

For Further Information Contact
Milly Mbuliro
mmbuliro@nilebasin.org
GIS/Remote Sensing Specialist
Nile Basin Initiative

INTRODUCTION



Major Sub-Basins of the Nile Basin.

The River Nile Basin covers about 3,176,541 square kilometers, which represents about ten percent of Africa's land mass area. The river presents an array of opportunities for a sustainable future. This can only be realized if riparian countries can jointly plan, manage and develop the shared resources in a coordinated manner. Since time immemorial, the river plays a central role in human settlement and in the development of a rich diversity of cultures and livelihoods. The basin includes world class environmental assets such as River Nile being the longest river in the world, Lake Victoria being the second largest fresh water lake by surface area; and the Sudd wetlands in South Sudan being one of the largest in Africa.

The Nile basin region is a land of increasing population and rapidly changing landuse patterns; changes that have profound local, regional and global environmental significance. In addition, the region experiences diverse climatic conditions which result in changes in seasonal and annual flows of the river. Monitoring of such processes is a pre-requisite to sound water resources management.

It was with this realization that the Nile Basin countries established the all-inclusive Nile Basin Initiative (NBI) on February 22, 1999 with the shared vision objective: 'To achieve sustainable social economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.

According to its 10 year Strategy (2017-2027), NBI aims at strengthening evidence-based transboundary water resources planning and management through improved monitoring of the Basin using satellite observations.

The NBI in collaboration with its member states has designed a regional HydroMeteorological monitoring system to enhance basin monitoring. In addition, use of satellite data has been identified as one way of supplementing the existing monitoring system.

This Basin Monitoring bulletin aims at providing a shared understanding of patterns of some of the water cycle components in our changing environment based on satellite data. Estimates of water cycle parameters provide insights on available opportunities for water use, water conservation and thereby enhance water use efficiencies.

This issue provides an analysis of Rainfall, Actual Evapotranspiration in the 10 major sub-basins, and an analysis of Water levels in some lakes from July to September 2018 in addition to the seasonal analysis of the July - August - September (JAS) seasonal anomaly over the Nile basin.

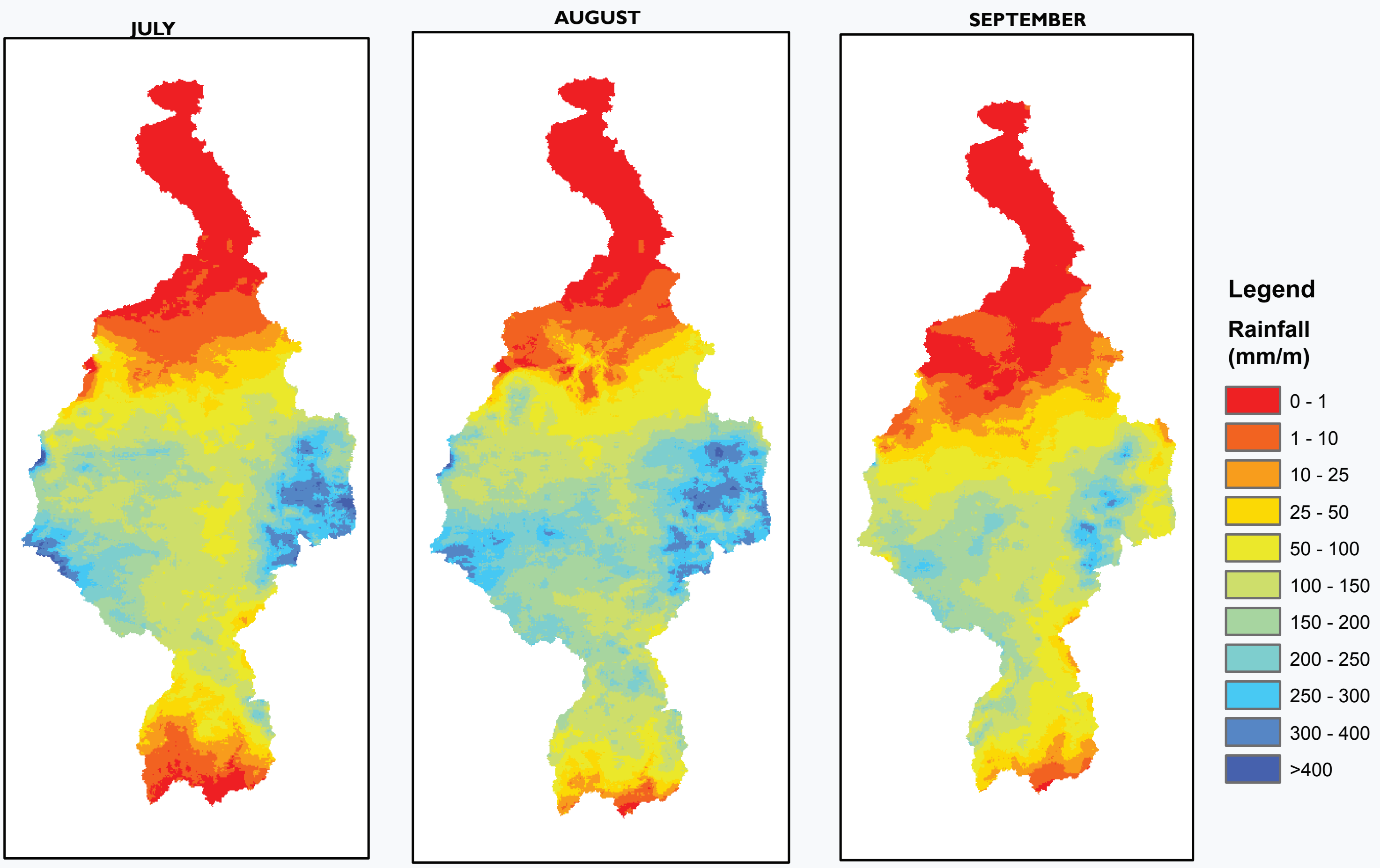
VARIABILITY OF RAINFALL IN THE NILE BASIN

Rainfall in the Sub-basins of the Nile Basin has been estimated using CHIRPS v2.0. Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. Spanning 50°S-50°N (and all longitudes), starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

By combining high resolution (0.05°) rainfall mean fields with current satellite-derived rainfall estimates, the Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) estimates provide daily, pentadal(5-day), dekadal (10-day), and monthly precipitation fields suitable for crop monitoring and drought monitoring.

Overall, monthly rainfall estimates with in the year indicate a wide spatial and temporal rainfall variability in the basin. Minimum rainfall is normally seen in the arid areas in the northern part of the basin and the maximum rainfall estimates are normally observed in the equatorial lakes region in the areas around Lake Victoria and the Ethiopian Highlands. Monthly distribution of rainfall over the basin is characterized by monomodal rainfall patterns (June-July-August (JJA)) in the Ethiopian plateau especially in the Blue Nile and Tekeze subbasins and bimodal rainfall pattern (March-April- May (MAM) and September- October- November (SON) in the equatorial lakes region especially in the Lake Victoria, Lake Albert, Victoria Nile sub-basins.

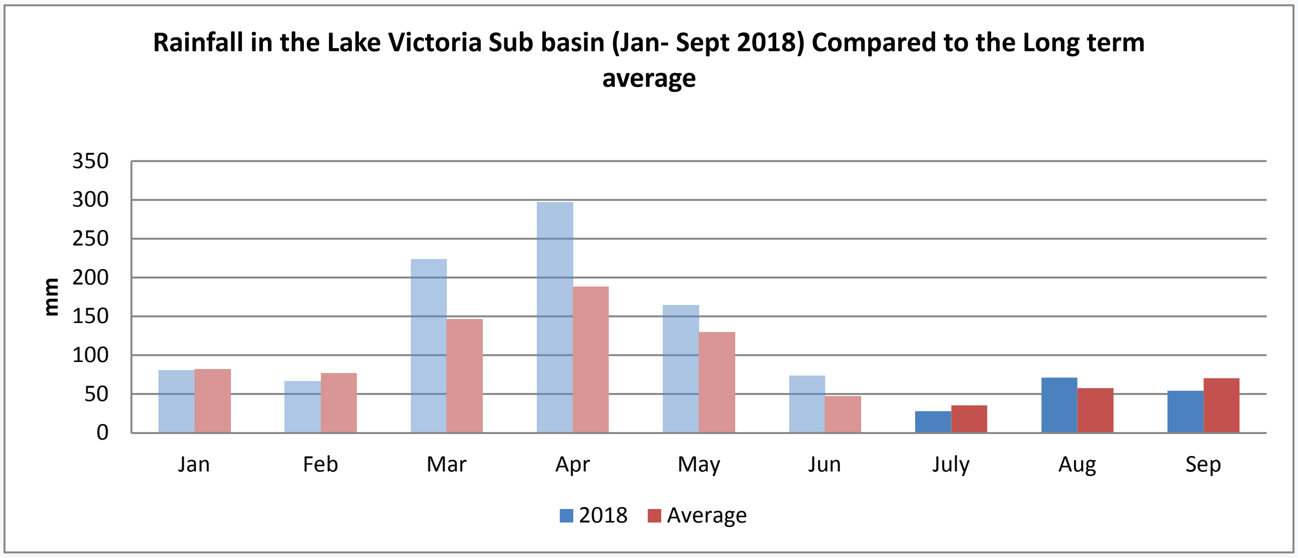
During 2018, from July to September, rainfall was observed in the Eastern Nile subbasins such as Blue Nile (240mm), Baro Akobo Sobat (180mm), Bahr el Ghazal (180mm), Bahr el Jebel (170mm), and Tekeze atbara (170mm). The Equaltorial lakes subbasins such as Lake Victoria subbasin, Victoria Nile subbasin and the Lake Albert Subbasin recieved less rainfall during the period as seen in the maps below. A full analysis for each of the sub basins is given in this quarterly bulletin.



Monthly Rainfall (mm) July - Sept 2018 , CHIRPS v 2.0

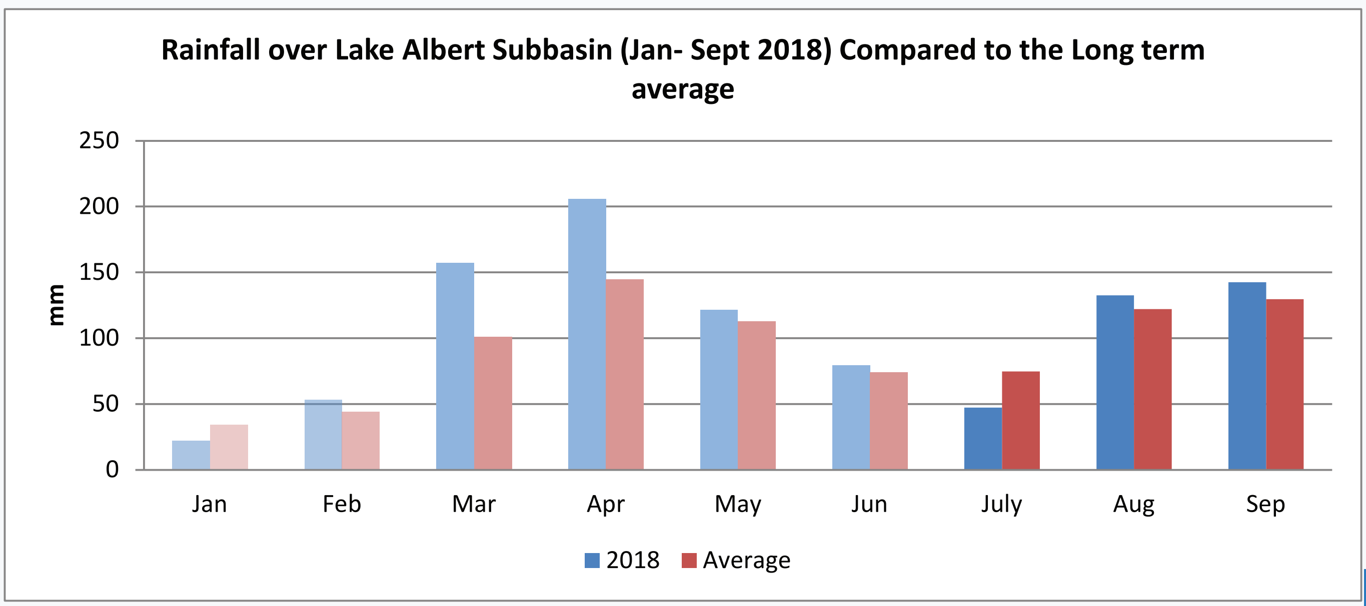
RAINFALL OVER LAKE VICTORIA SUBBASIN

The Lake Victoria subbasin normally experiences a bimodal rainfall pattern with two rain seasons MAM and SOND. Monthly rainfall estimated by CHIRPS v2.0 from January to September in 2018 shows a similar pattern of increasing rainfall during the MAM rainfall season and dry in the following months of June to September. In July and September of 2018, the lake Victoria subbasin experienced less rainfall than the long term average by 21% and 23% respectively with a slight increament of 23% in August above the long term average as shown in the chart below. Generally, this subbsbasin was experiencing a dry season during this reporting time.



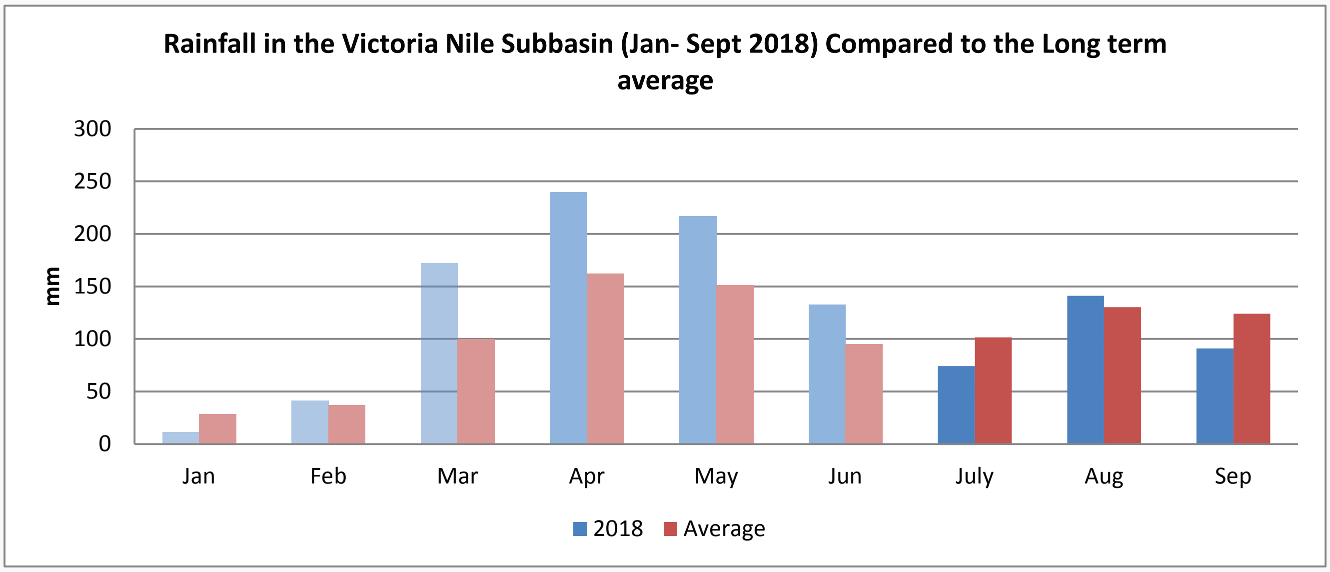
RAINFALL OVER LAKE ALBERT SUBBASIN

Lake Albert subbasin normally experiences a bimodal rainfall pattern with two rain seasons in MAM and SOND. In 2018, CHIPRS v2.0 estimated rainfall shows the same pattern with increasing rainfall during the MAM rainfall season with a dry season during in June and July. Highest recorded rainfall was experienced during August and September of about 120mm as shown in the chart below. Compared to the long term average, the Lake Albert Subbasin recieved less rainfall in July 2018 by 36% with a slight increment of 8% and 9% in August and September 2018 respectively.



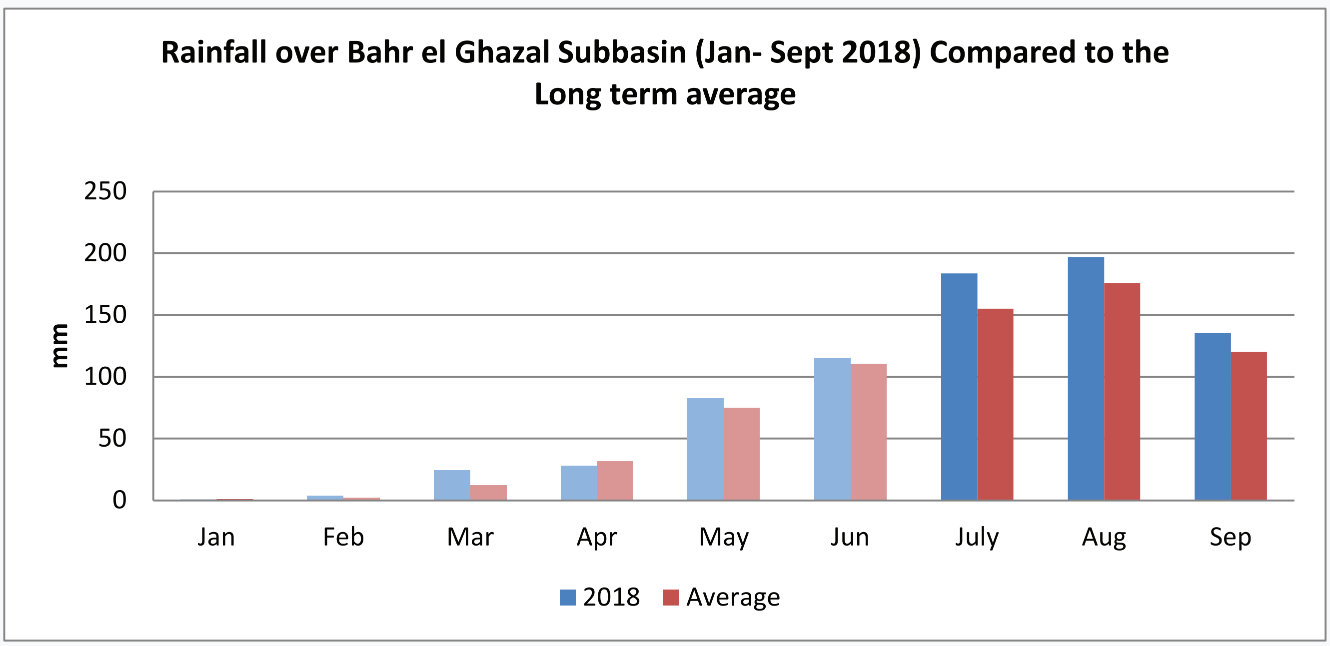
RAINFALL OVER VICTORIA NILE SUBBASIN

The Victoria Nile subbasin, like the other Nile Lakes Equatorial sub basins, normally experiences bimodal rainfall seasons of MAM and SOND with June to August as the dry months . The Sub basin recieved 74 mm, 140mm and 91mm in July to September respectively. July and September showed a reduction by 26% compared to the long term average.



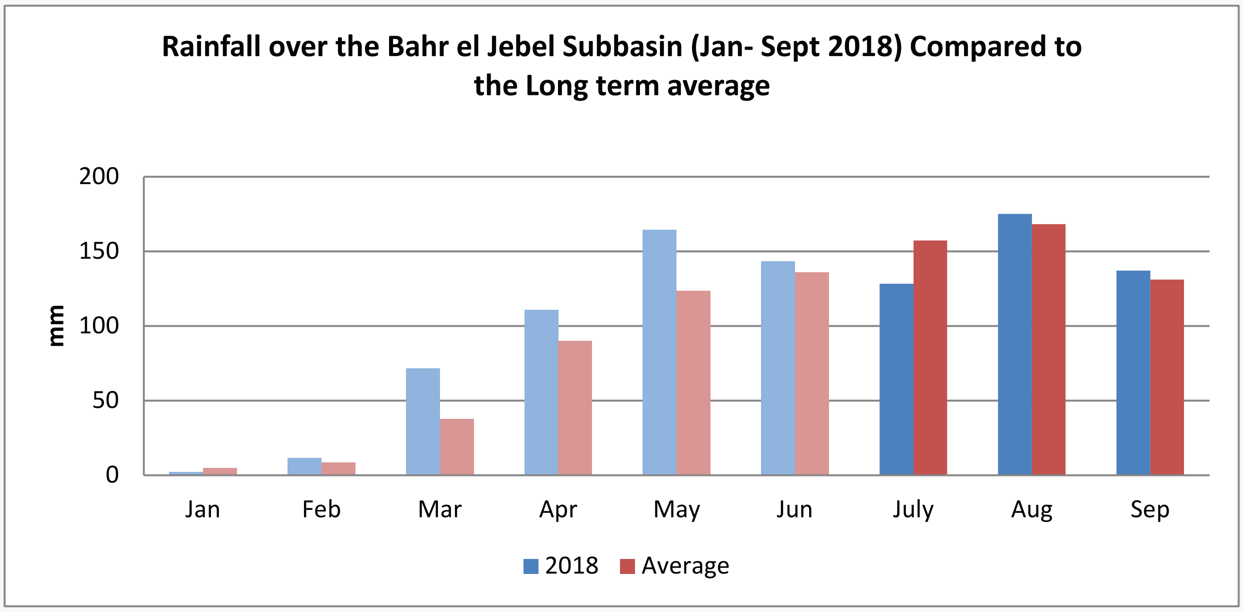
RAINFALL OVER BAHR EL GHAZAL SUBBASIN

Bahr el Ghazal normally experiences a monomodal rainfall pattern. However, the northern part of the basin which lies in Sudan is dryer than the southern part of the basin in South Sudan. In July to September, the subbasin was experiencing a wet season with rainfall amounts of 183mm, 196mm and 135mm respectively slightly higher than the long term average as shown in the chart below.



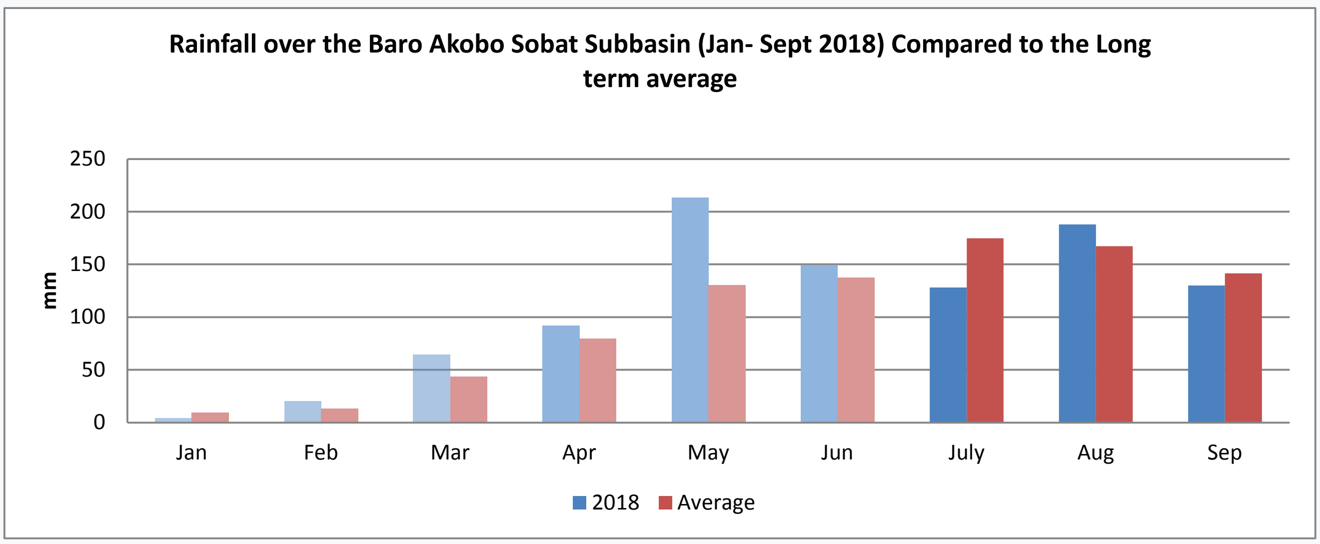
RAINFALL OVER BAHR EL JEBEL SUBBASIN

Bahr el Jebel sub-basin normally experiences a monomodal rainfall pattern. Monthly estimated rainfall in the period July to September 2018 shows highest amount recorded in August (175mm) while the month of July in 2018 recieved less rainfall by 18% compaared to the long term average as shown in the chart below.



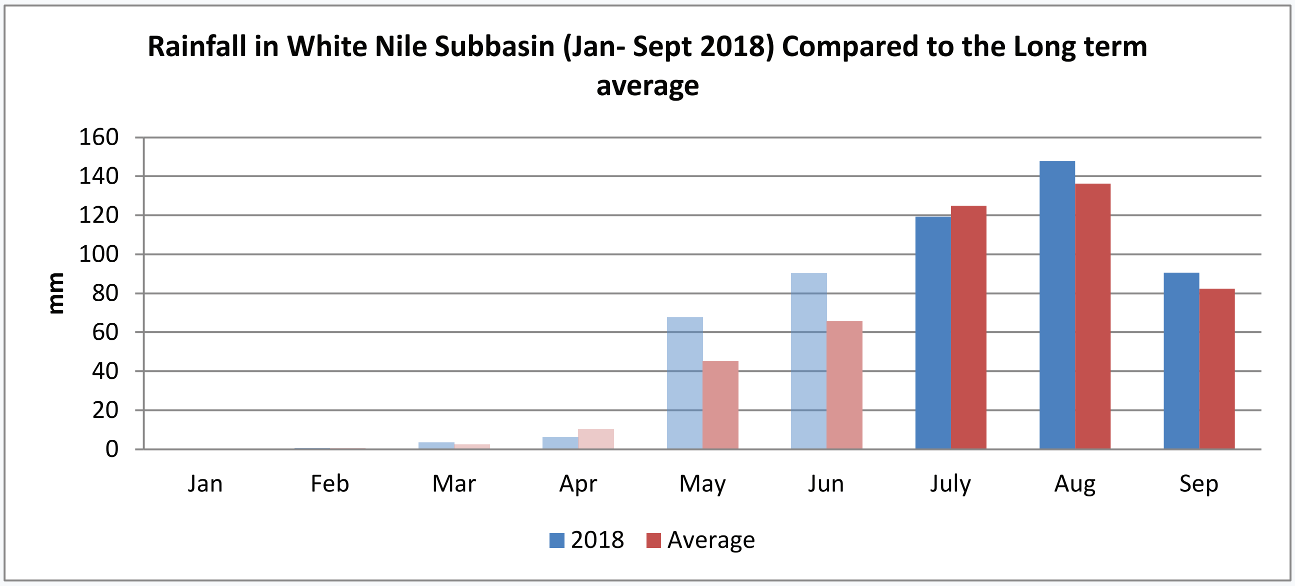
RAINFALL OVER BARO AKOBO SOBAT SUBBASIN

The Baro Akobo Sobat subbasin normally experiences a monomodal wet season between May – October. Monthly rainfall estimated by CHIRPS v2.0 from July to September 2018 shows highest rainfall of 187mm in August which is 12% more than the long term average. July and September recieved less rainfall by 26% and 8% respectively compared to the long term average as shown in the chart below.



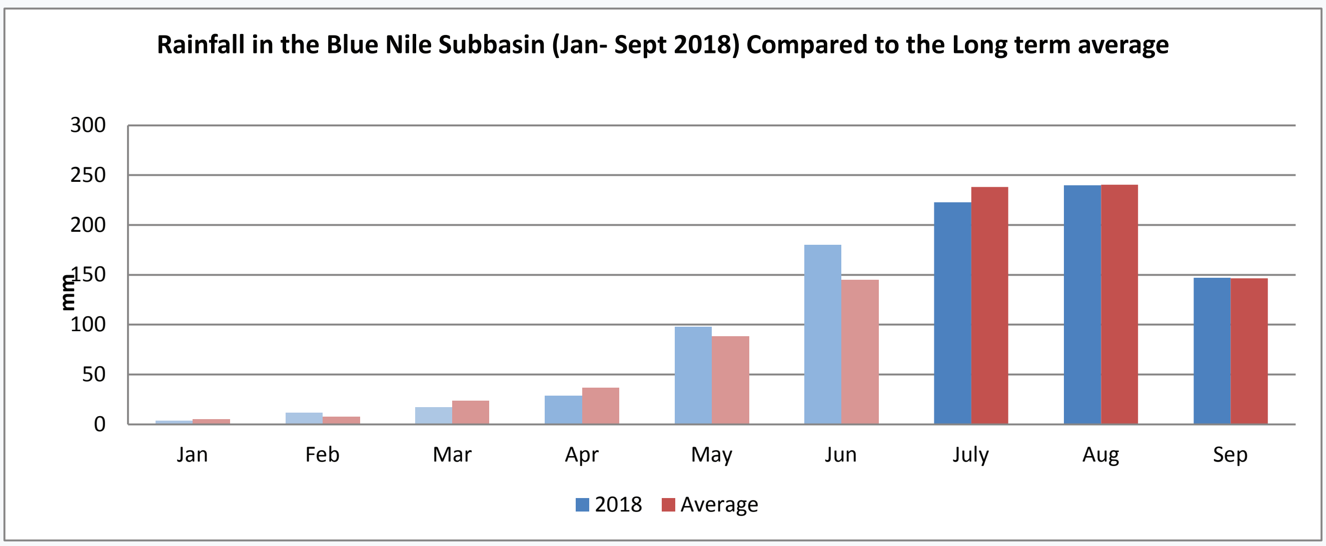
RAINFALL OVER WHITE NILE SUBBASIN

The White Nile subbasin normally experieinces a monomodal pattern from May to October. This sub basin covers parts of north-eastern South Sudan, a small part of south western Ethiopia and the south part of Sudan. In 2018, CHIRPS V2.0 shows a similar pattern of monthly rainfall confirming that the subbasin was experieincing a wet season during July to September. Highest rainfall amount was recieved in August of 147mm which was slightly higher than the long term average by 8% as shown in the chart below.



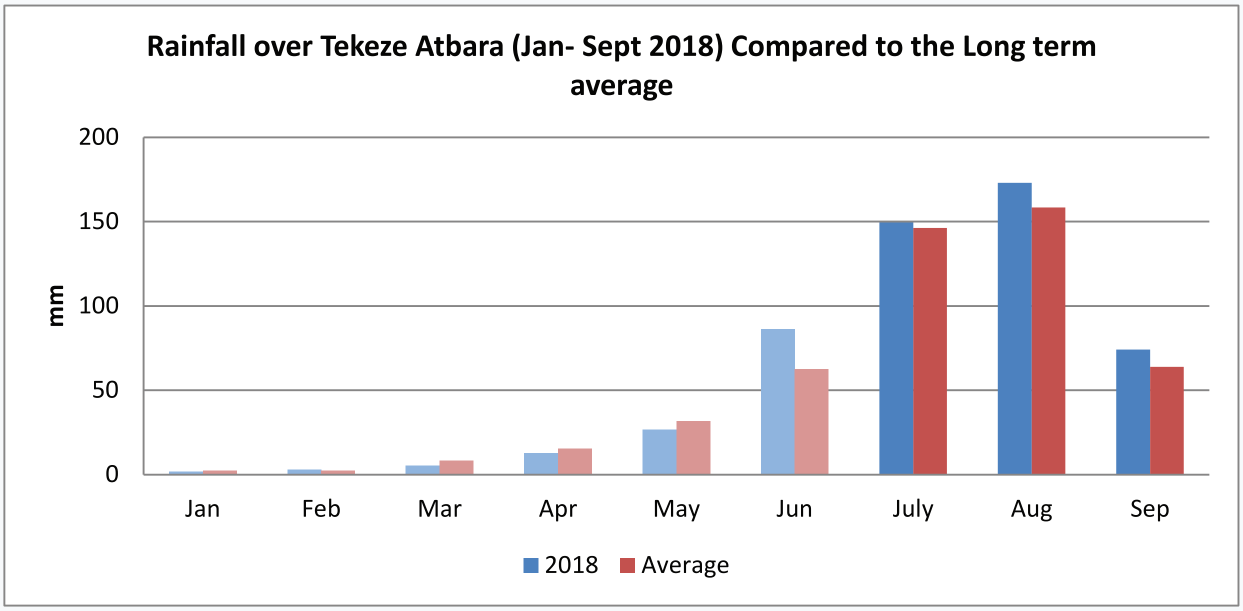
RAINFALL OVER BLUE NILE SUBBASIN

The Blue Nile Subbasin is shared between Sudan and Ethiopia and experieinces monomodal rainfall from May to October. In 2018, CHIRPS V2.0 shows a similar pattern of monthly rainfall from July to September as the subbasin was experiencing the wet season as shown in the chart below. Highest recorded rainfall between July and September was 240mm in the month of August.



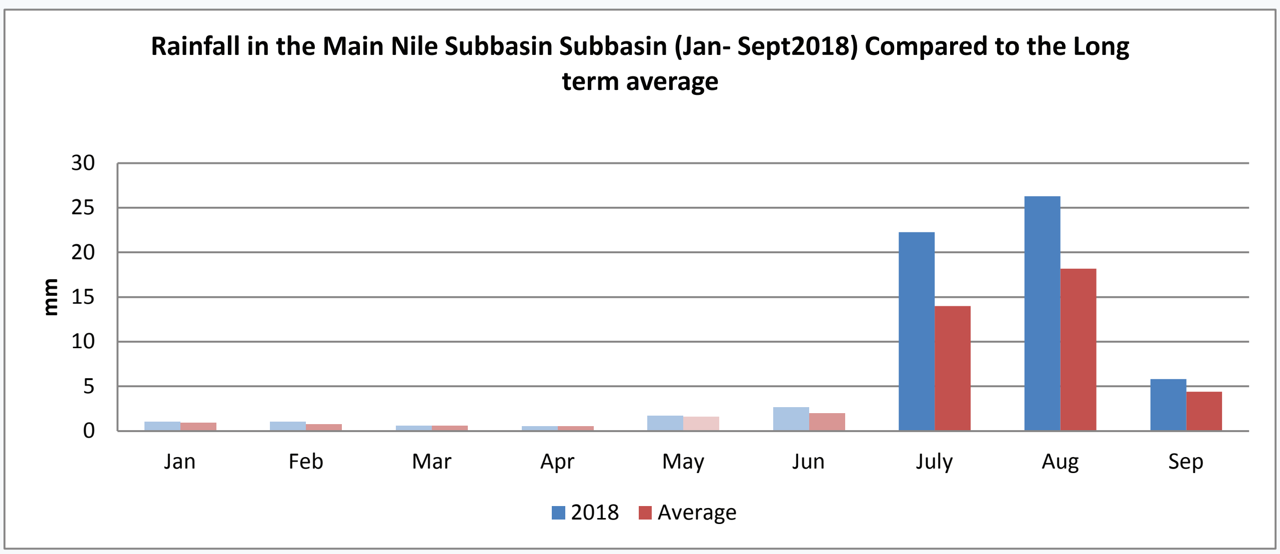
RAINFALL OVER TEKEZE ATBARA SUBBASIN

The Tekeze Atbara subbasin is shared by Ethiopia and Sudan and normally experiences a monomodal rainfall pattern with the wet season normally experienced between May and October. During July to September of 2018, the subbasin was experiencing the rain season and highest amount was recieved in August of 172mm which was higher compared to the long term average by 9%. July and September also show a higher amount of 2% and 16% respectively compared to the long term average as shown in the chart below.



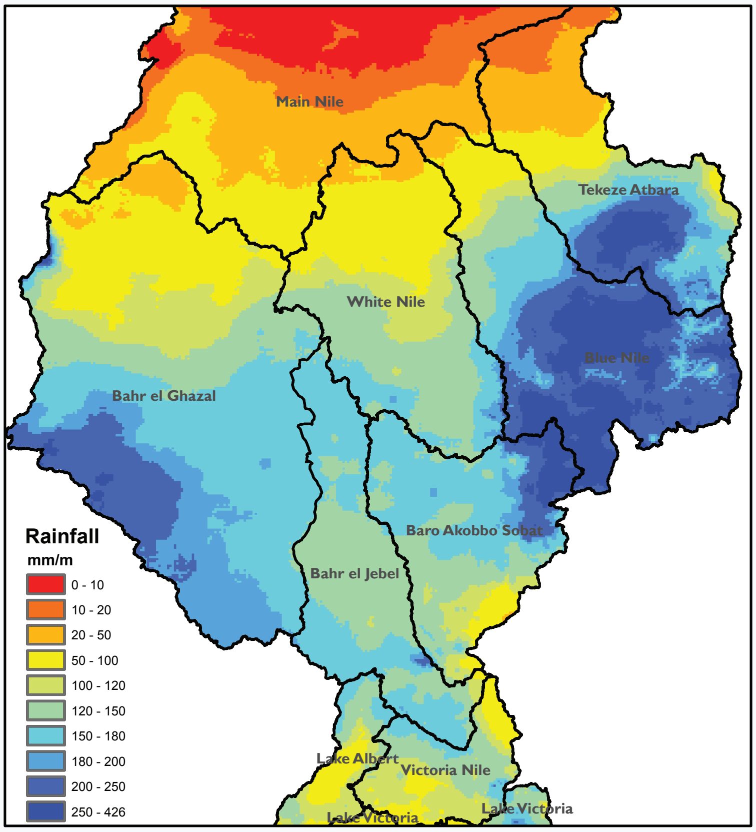
RAINFALL OVER MAIN NILE SUBBASIN

The Main Nile subbasin experiences the driest climate over the entire Nile Basin with very little rainfall amounts recorded mainly in July and August. In 2018, July and August recieved 22mm and 26mm respectively which was higher than the long term average by 59% and 44 %.

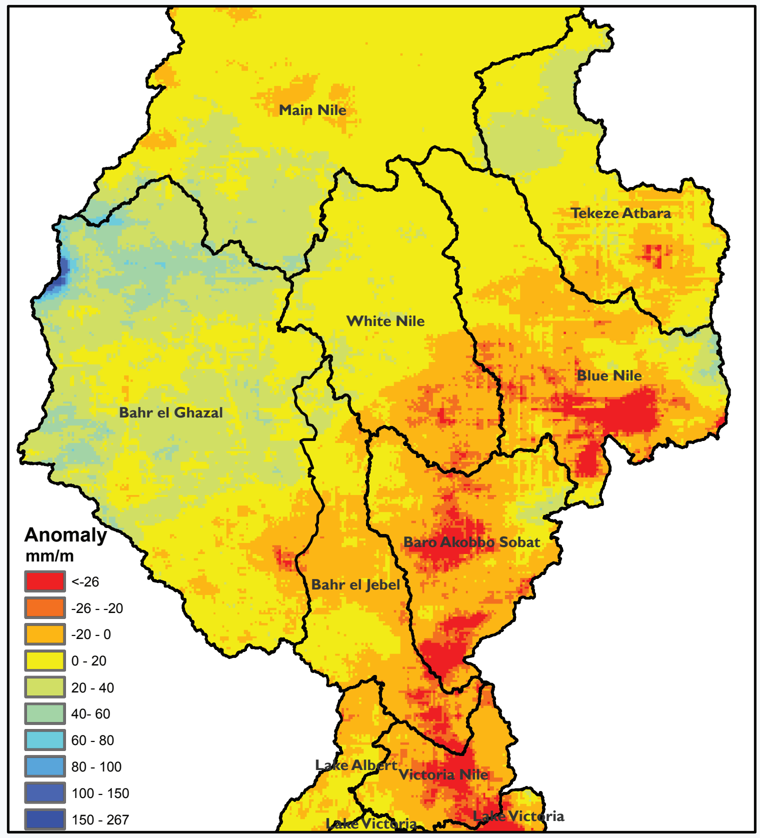


SEASONAL RAINFALL IN THE EASTERN NILE SUBBASINS

Seasonality in the Nile basin region is determined by the position of the Inter tropical convergence Zone (ITCZ) with moisture sources from the Indian and Atlantic oceans. The Eastern Nile Subbasins , unlike the Nile Equatorial Lakes region experience the wet season of the year during May to October. In 2018, during the July- August -September (JAS) season, highest rainfall amounts where detected during August in the southern parts of the Blue Nile, Tekeze Atbara, northern part of Baro Akobo Sobat, parts of White Nile and also in the western part of Bahr el Ghazal subbasin.
Compared to the long term average, parts of the Blue Nile, Parts of baro Akobo Sobat recieved slightly less rainfall during the JAS season.



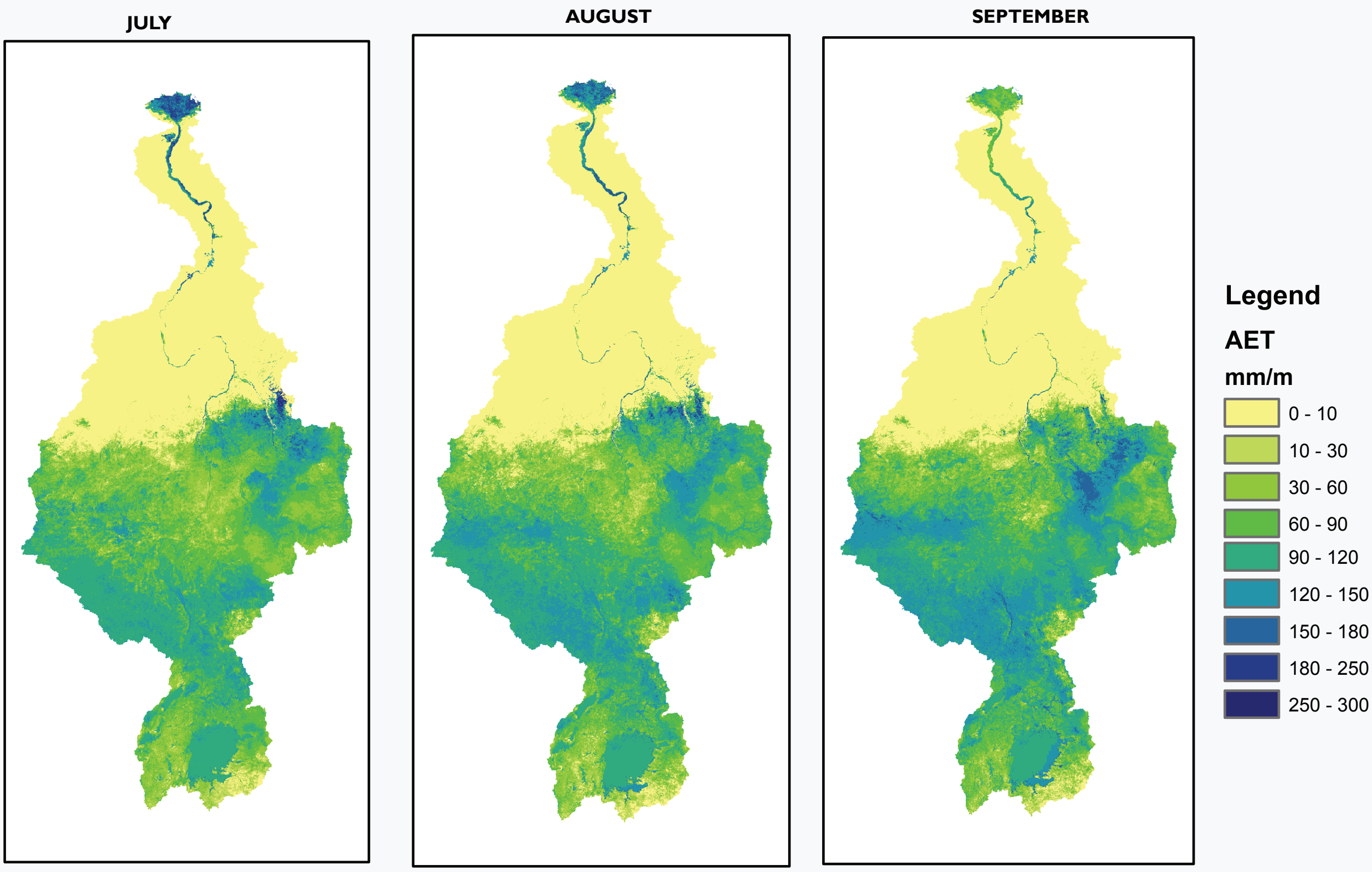
Average Rainfall, July - September 1981 - 2017 , CHIRPS v 2.0



2018 July - September Season Anomaly, CHIRPS v 2.0

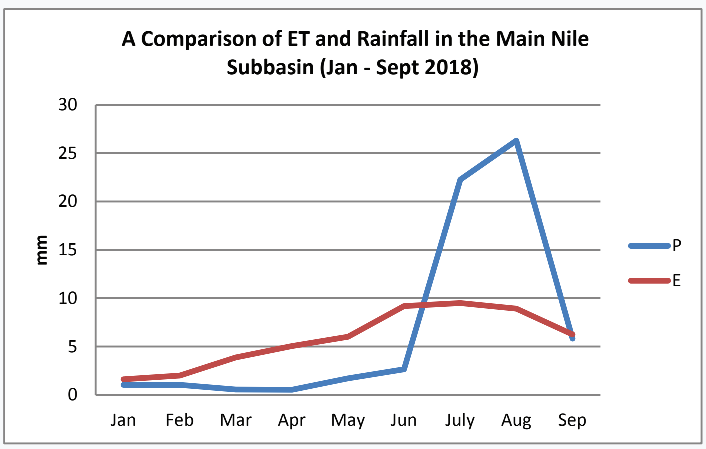
ACTUAL EVAPOTRANSPIRATION OVER THE NILE BASIN

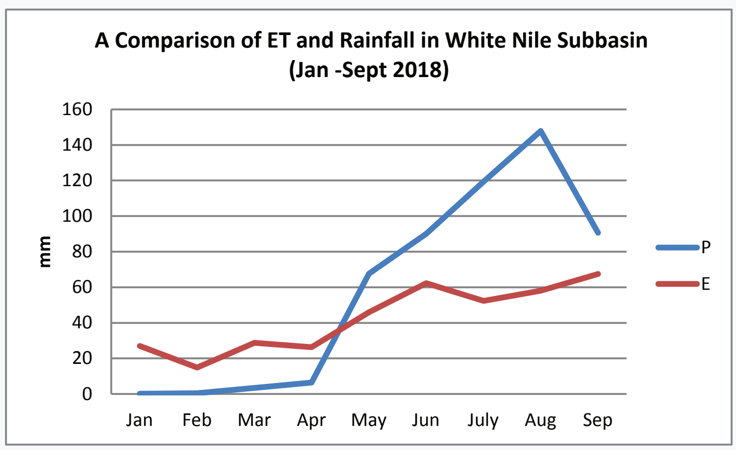
Actual Evapotranspiration is a major component of the water balance of the Nile basin. Monitoring monthly AET is based on data from FEWSNET early warning and drought monitoring data portal for July to September 2018 as shown in the maps and charts below.



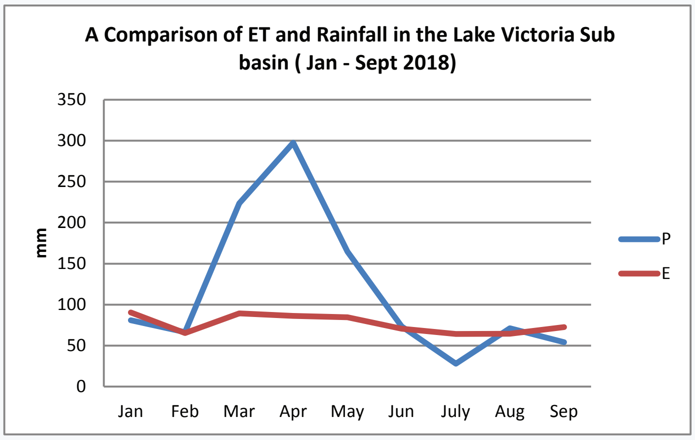
Monthly Actual Evapotranspiration over the Nile Basin July to September 2018

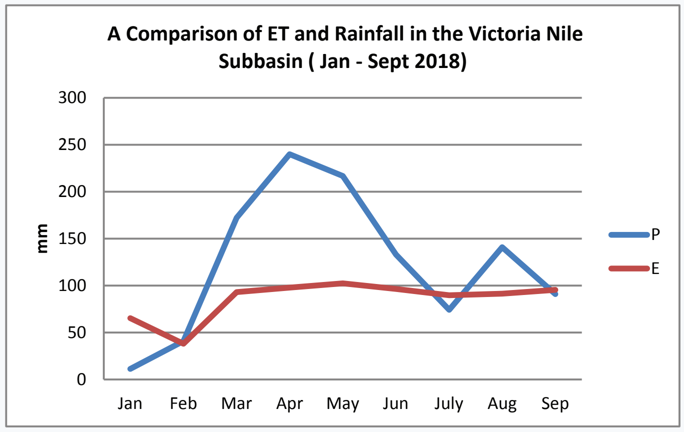
Comparison of Monthly Actual Evapotranspiration to Rainfall for the period January - September 2018

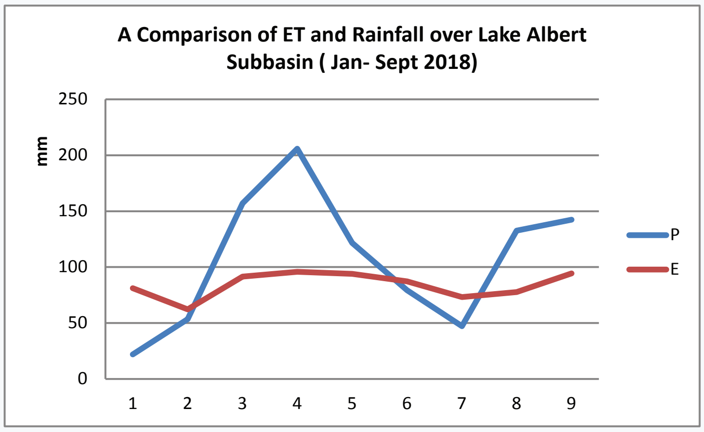


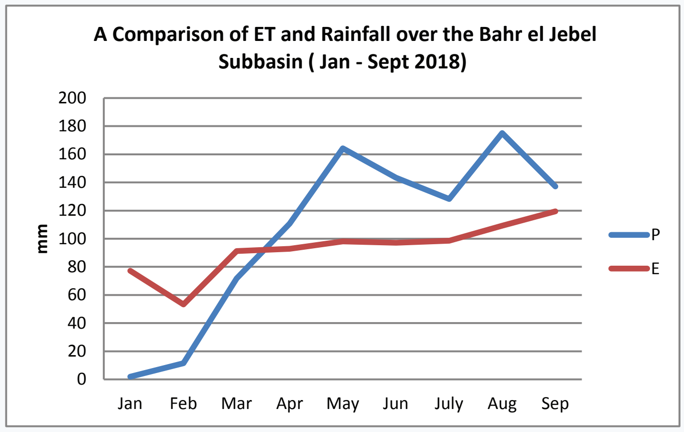


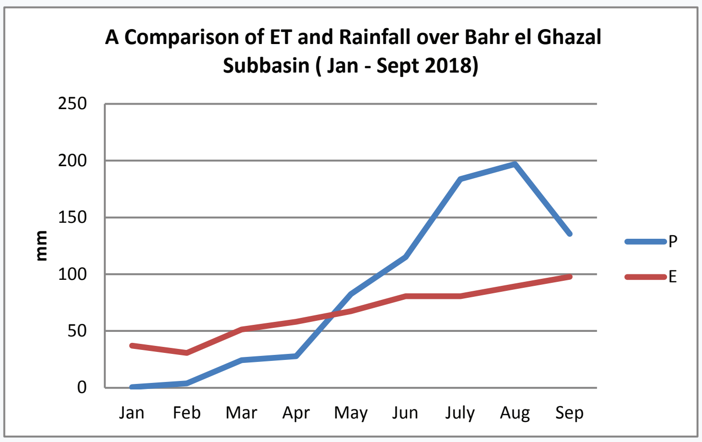
Comparison of Monthly Actual Evapotranspiration to Rainfall for the period January - September 2018

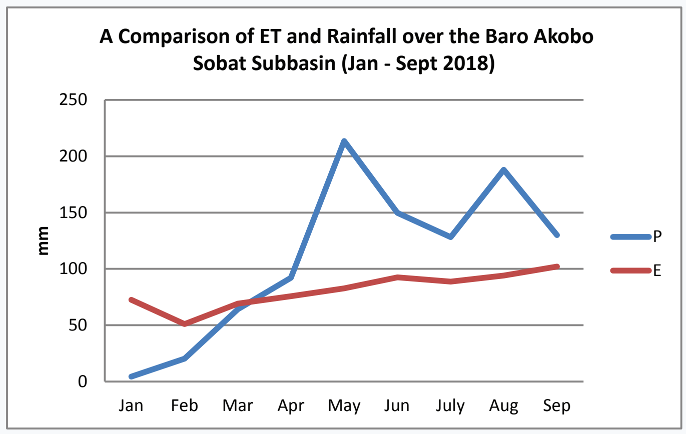


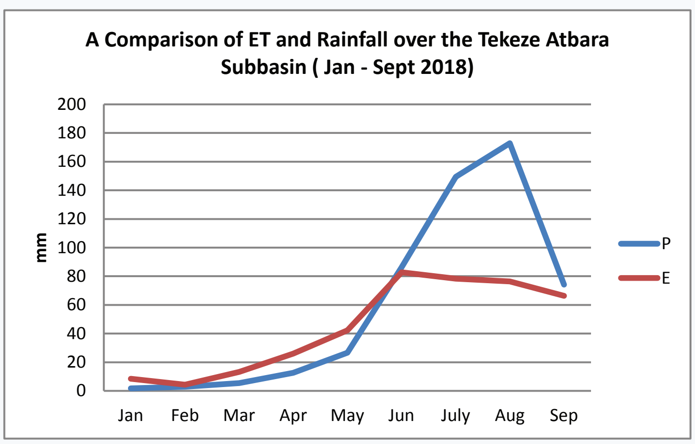


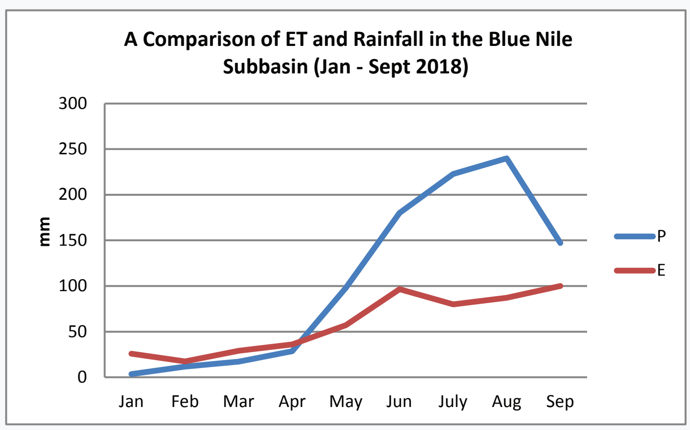








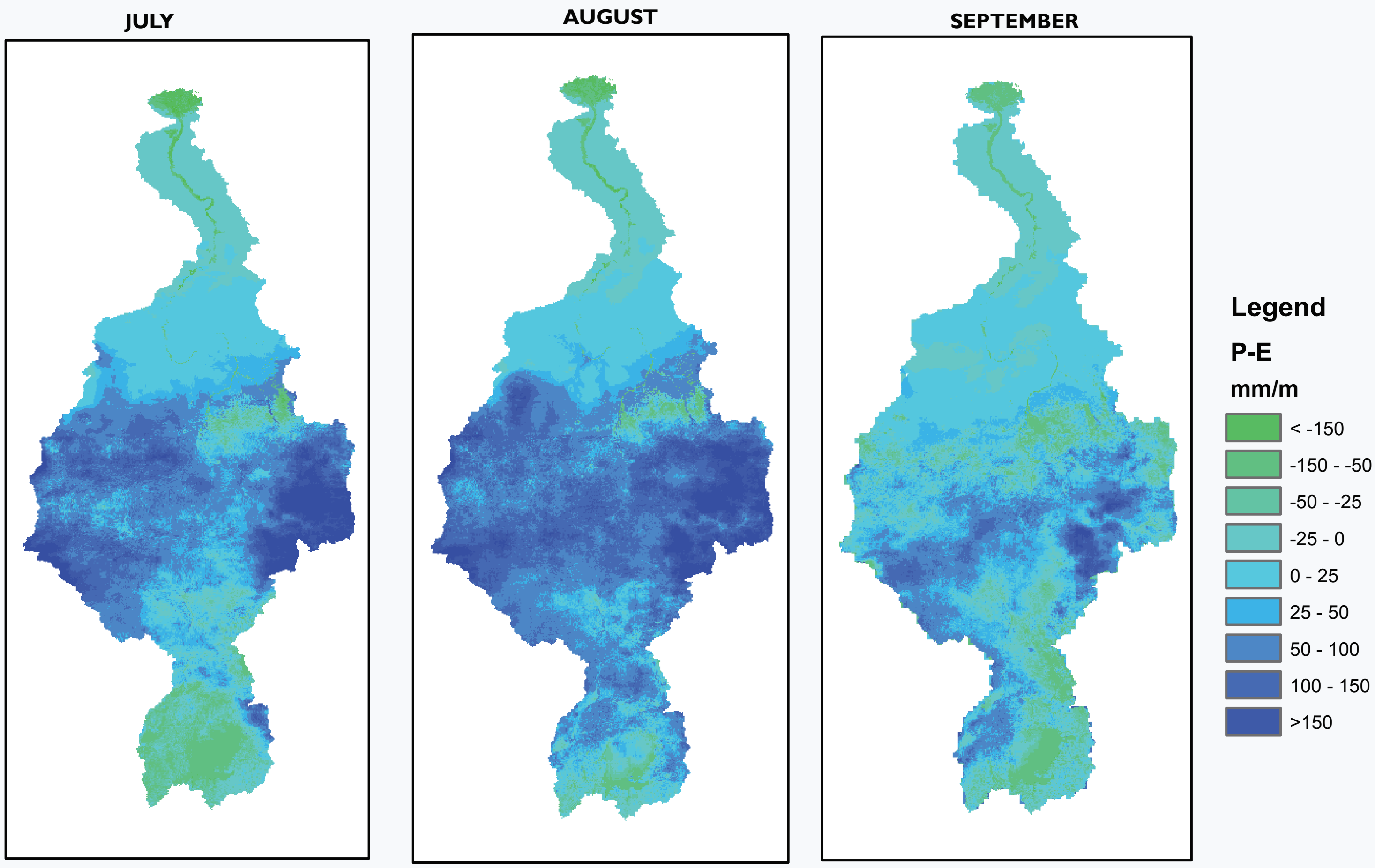




Runoff

Runoff is estimated as total precipitation less the losses caused by evapotranspiration (loss to the atmosphere from soil surfaces and plant leaves). Rainwater that is not evaporated or stored in the soil eventually runs off the surface and finds its way into rivers, streams, and lakes or recharges ground water. The difference of P-ET gives an indication of such beneficial or non beneficial losses. This serves to identify, locate or delimit regions that suffer from a deficit of available water, a condition that can severely affect the effective use of the land for such activities as agriculture or stock-farming.

In 2018, there is rainfall excess observed during the month of July and August especially in the Eastern Nile Subbasins of Blue Nile, Baro Akobo Sobat and Tekeze subbasins and also in the Bahr el Ghazal, Bahr el Jebel, White Nile Subbasins. A reduction in the rainfall excess was detected during September.

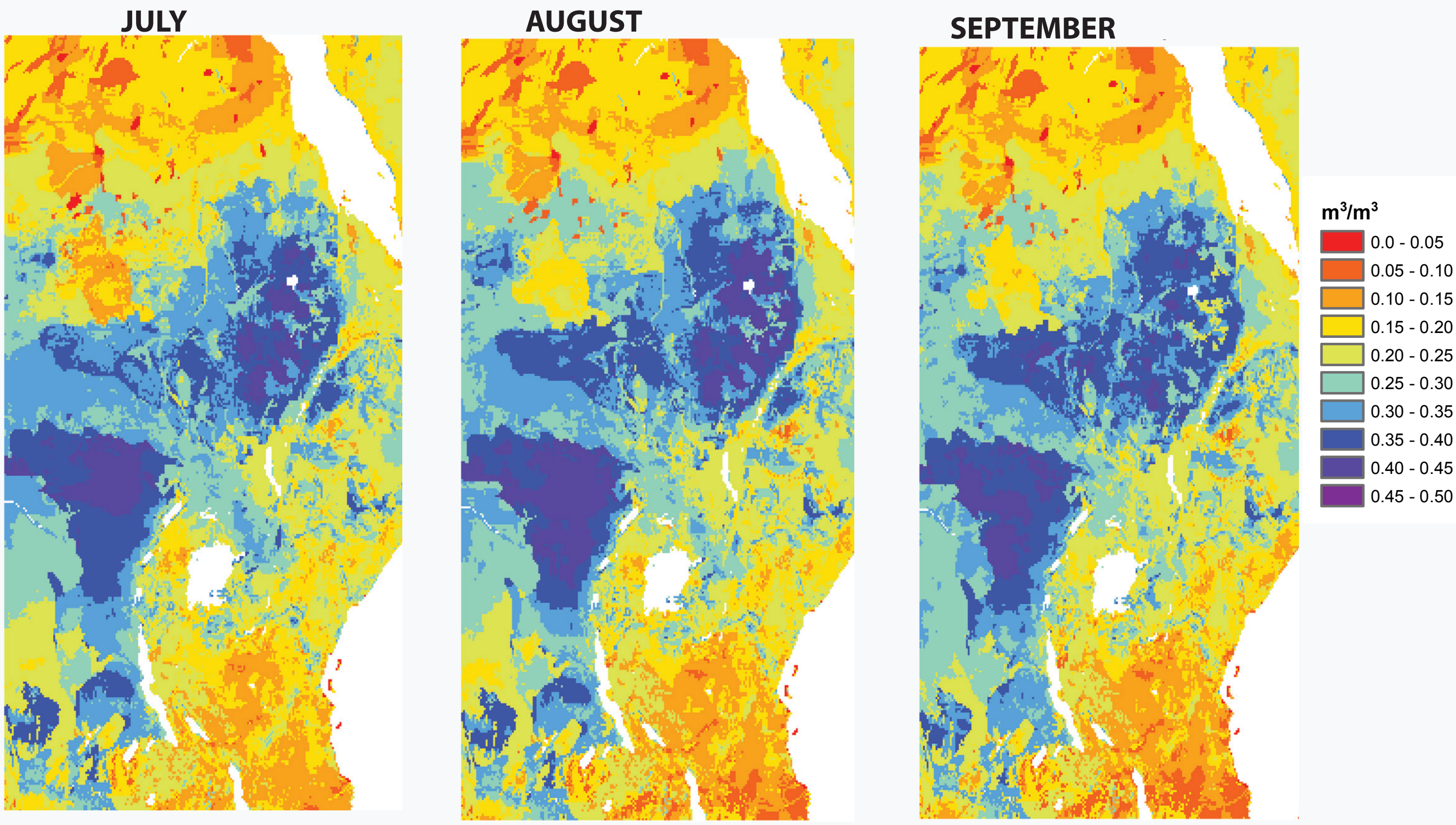


Soil Moisture Variation July to September 2018

Soils and soil moisture greatly influence the water cycle and have impacts on runoff, flooding and agriculture. Soil type and soil particle composition (sand, clay, silt) affect soil moisture and the ability of the soil to retain water. Soil moisture is also affected by levels of evaporation and plant transpiration, potentially leading to near dryness and eventual drought.
Measuring and monitoring soil moisture helps to predict or prepare for flash floods and drought. The GLDAS soil moisture data is useful for modeling these scenarios and others, but only at global scales.

The GLDAS Soil Moisture layer is a time-enabled image service that shows average monthly soil moisture from 2000 to the present, measured as the millimeters of water contained within four different depth levels. It is calculated by NASA using the Noah land surface model, run at 0.25 degree spatial resolution using satellite and ground-based observational data from the Global Land Data Assimilation System (GLDAS-2.1). The model is run with 3-hourly time steps and aggregated into monthly averages.

During July to September 2018, soil moisture is detected to be highest in the Eastern Nile Subbasin and in the Bahr el Ghazal and White Nile regions as depicted by the Rainfall excess (P-E) maps. This is an indication of availability of water for runoff.



Soil Moisture 10 - 40 cm July - September 2018, Data Source, GLDAS, FEWSNET, USGS/EROS

Water levels in major lakes in the River Nile Basin region basing on Satellite Altimetry

The River Nile and Lakes with in the Nile Basin region are sensitive to changes in rainfall with variations impacting lake levels and river discharges.

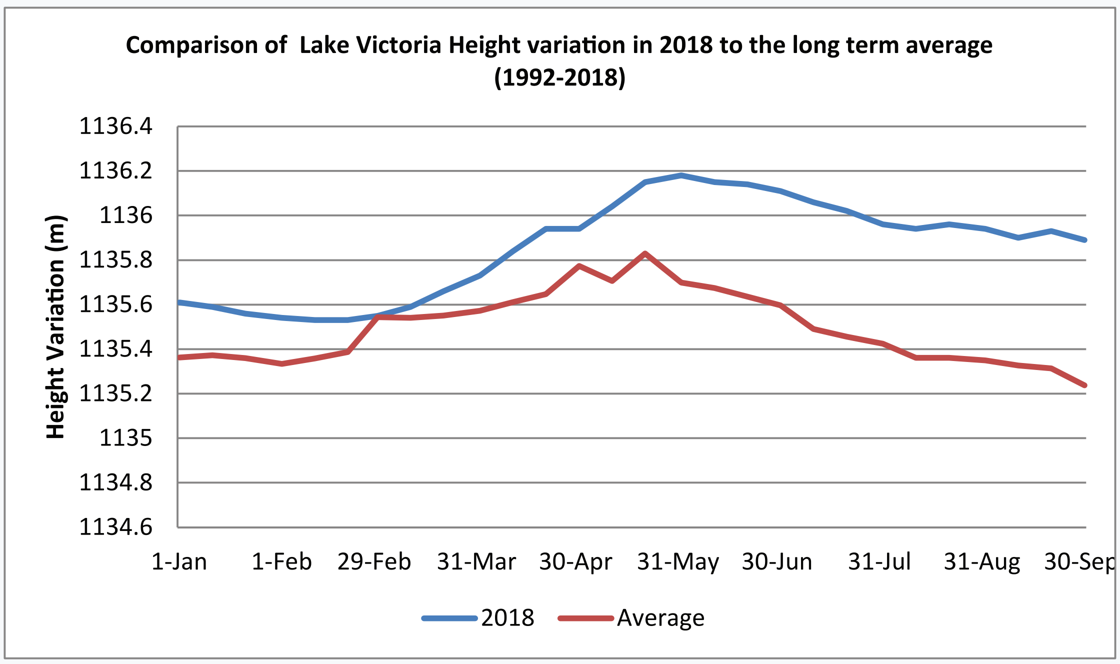
The major lakes in the Nile basin system are Lake Victoria, Lake Kyoga, Lake Albert, Lake Tana, Lake Edward, and Lake Nasser. Numerous tributary rivers flow into the upper lakes and it is essential to monitor these differences in water levels.

Relative lake height variations have been computed from TOPEX/POSEIDON (T/P), Jason-1 and Jason-2/OSTM altimetry with respect to a 9 year mean level derived from T/P altimeter observations for some of the lakes in the Nile Basin. The height variation time series has been smoothed with a median type filter to eliminate outliers and reduce high frequency noise.

Data source is USDA/NASA/SGT/UMD

Lake Victoria Water Levels

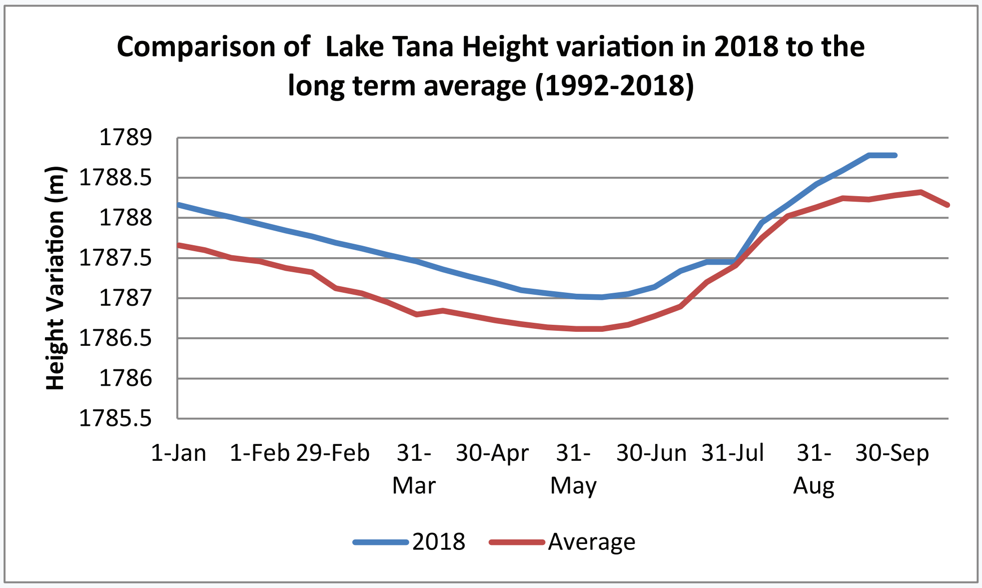
TPJOJ.2.3 : Data Processing Version ID
314 Victoria_1 : Lake database id number and name
-0.670 33.546 : Latitude and longitude (degrees East) of lake mid-point
-1.335 -0.019 : Latitude range of pass traversing lake at which data is accepted



Lake Tana Water Levels

TPJOJ.2.3 : Data Processing Version ID
402 Tana : Lake database id number and name
12.117 37.404 : Latitude and longitude (degrees East) of lake mid-point
11.950 12.199 : Latitude range of pass traversing lake at which data is accepted

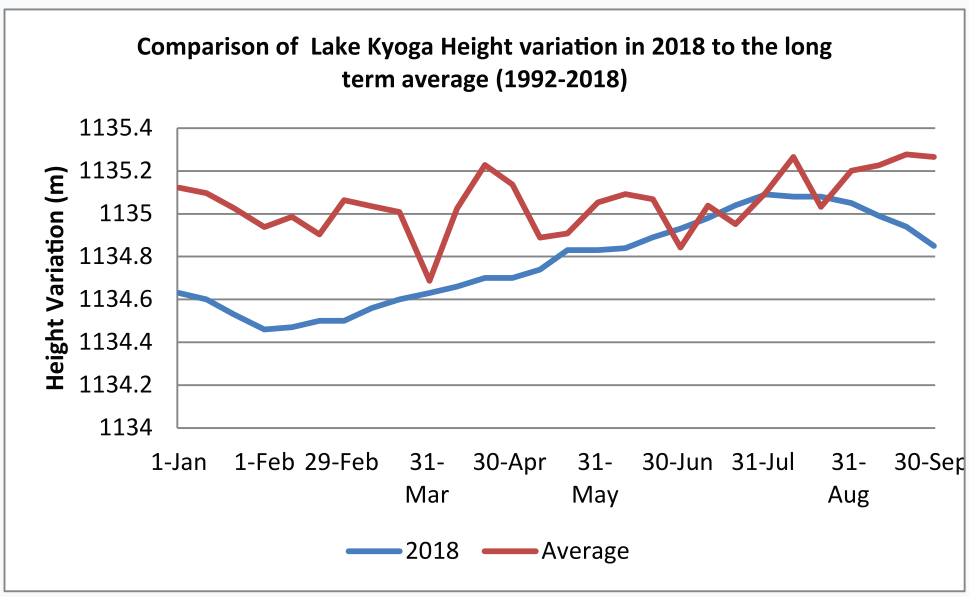
The level of Lake Tana in Ethiopia, fluctuates annually and seasonally following the patterns of changes in precipitation. With a mean depth of 8 only meters, the alternating dry and rainy seasons result in an average difference of 1.5 to 2 meters between the lowest (May-June) and highest (October-November) lake levels. During July to Spetember, the water levels are seen to increase mainly due to the wet season.



Lake Kyoga water levels

TPJOJ.2.3 : Data Processing Version ID
398 Kyoga : Lake database id number and name
1.488 32.777 : Latitude and longitude (degrees East) of lake mid-point
1.418 1.551 : Latitude range of pass traversing lake at which data is accepted

Lake Kyoga is a large shallow lake located in central Uganda north of Lake Victoria. The lake has fingerlike extensions with a surface of 1,720 sq. km at an elevation of about 1033m above sea level. Its average depth reaches 3 m, its maximum depth is 5.7 m. During July to September, the lake levels are seen to drop less than the long term average towards September.



IMPLICATION FOR WATER RESOURCES MANAGEMENT

River basin management is a complex task. It involves several inter-dependent courses and processes. Sound transboundary water resources planning requires reliable data and information on the system features, characteristics and status. While the expertise of the professional water resources planners is essential, solid understanding of the system and governing phenomena plays an equally important role. This underscores the high importance of existing comprehensive data and information within the context of river basin management.

The process entails water resources availability assessment, water demands estimates, and a suite of planning options and alternatives for the entire river basin. Hydro-meteorological monitoring systems are the most accurate source of real-time data and information. However, due to the fact that parts of the Nile Basin are not sufficiently covered by hydromet networks, earth observations represent a viable source of information that well inform basin water resources planning and development.

Monitoring the Nile Basin using satellite observation provides key information on water availability and spatial and temporal distribution of rainfall over the Nile basin can be therefore determined. Seasonality in the Nile basin region, long-term variation for each sub-basin, and actual evapotranspiration could thus be estimated. Water levels in major lakes wetlands extent, and soil moisture as well as some water quality parameters can be defined.

The detected rainfall excess (P - E) in most parts of the basin during July to September 2018 especially in the Eastern Nile Subbasins and also in the White Nile, Bahr el Ghazal and Bahr el Jebel subbasins, presents an opportunity for water harvesting and water storage.

The Nile Basin Initiative continues to collect, analyse and share remotely sensed data and information on Nile Basin hydrology to identify such opportunities for regional integration and cooperation.

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

/Nile Basin Initiative @nbiweb

#NileCooperation; #NileBasin; #OneNile

Nile Basin Initiative Secretariat
P.O Box 192
Entebbe, Uganda
Tel: +256 414 321 424
+256 414 321 329
Email: nbisec@nilebasin.org
Website: www.nilebasin.org

Burundi DR Congo Egypt Ethiopia Kenya Rwanda South Sudan The Sudan Tanzania Uganda