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Monitoring and Forecasting of Floods Across FEWS NET Regions to Inform Food Security Outcomes

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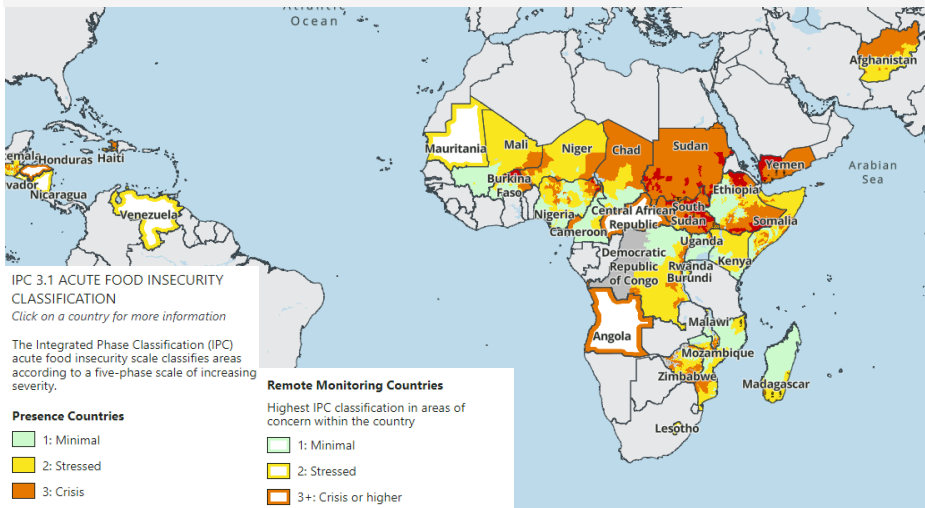
March 06, 2024



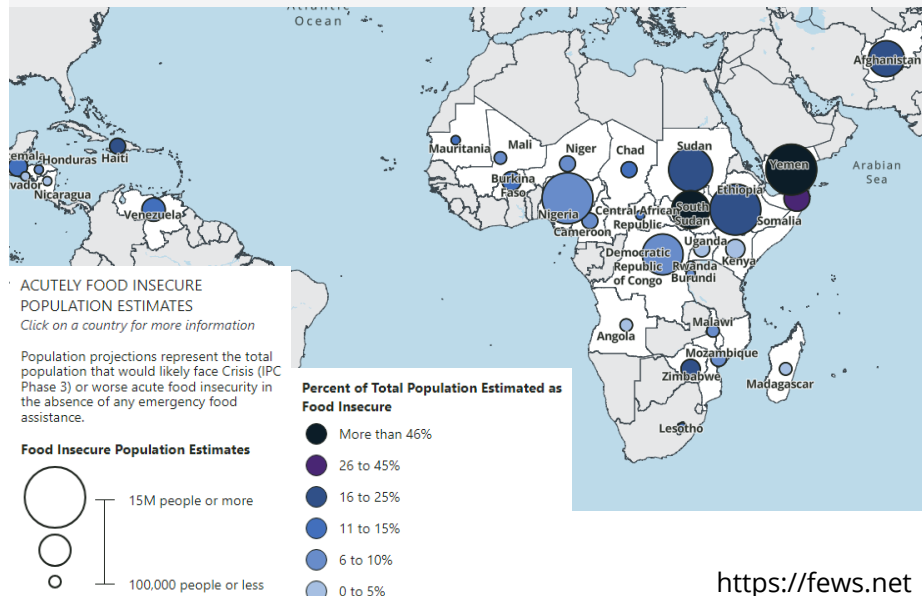
Famine Early Warning Systems Network

- FEWS NET monitors and provides early warning analysis of ongoing, imminent, or emerging threats to food security around the world.
- FEWS NET analyses advises USAID on the need for humanitarian assistance for those populations most vulnerable to food crises.

Acute Food Insecurity Area Classification February - May 2024 Near Term Projection



Acute Food Insecure Population Estimates June 2024 Medium Term Projection



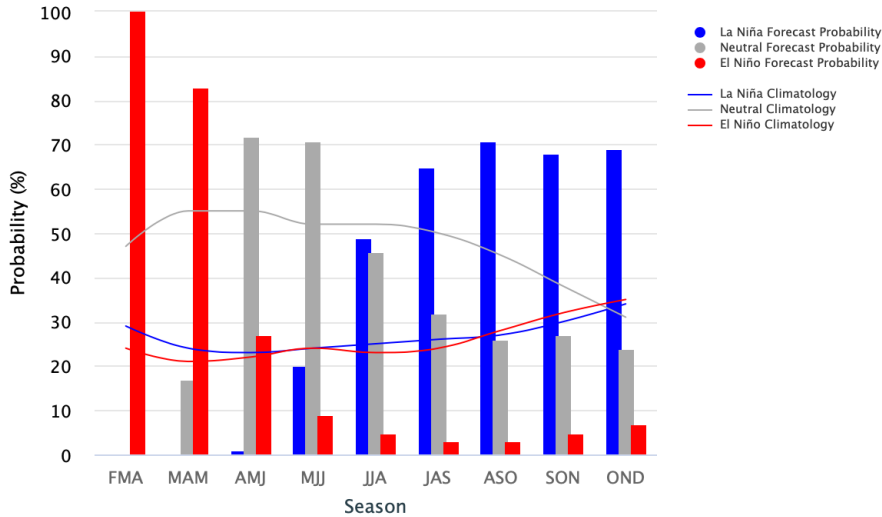
<https://fews.net>

Climate Modes

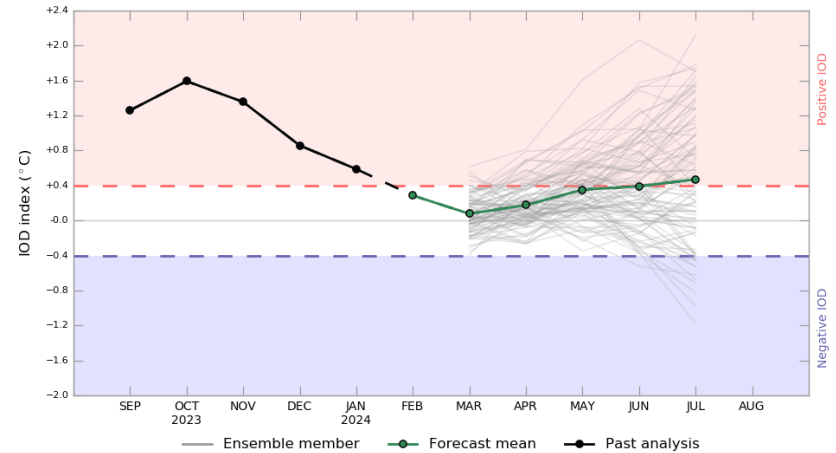
- El Niño and the Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) Forecast.

Mid-February 2024 IRI Model-Based Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly Neutral ENSO: $-0.5\text{ }^{\circ}\text{C}$ to $0.5\text{ }^{\circ}\text{C}$



Monthly sea surface temperature anomalies for IOD region



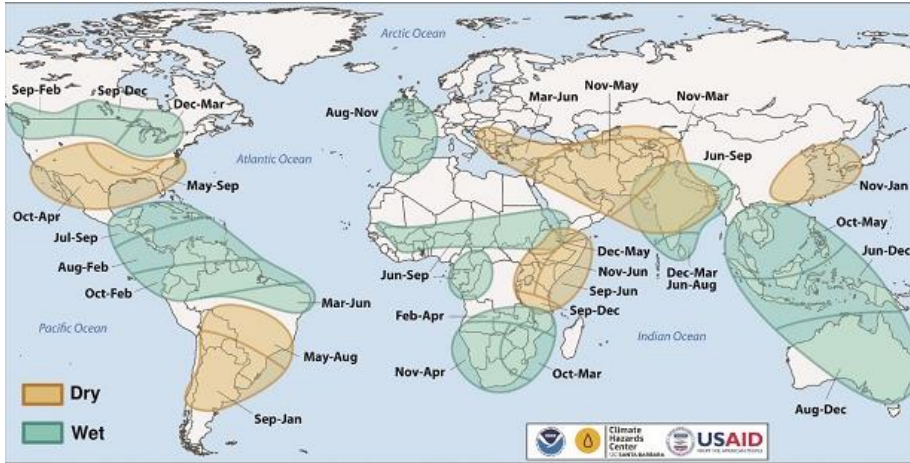
www.bom.gov.au/climate
Commonwealth of Australia 2024, Australian Bureau of Meteorology

Model: ACCESS-S2
Model run: 3 Feb 2024 Base period 1981-2018

- High probability for El Niño to continue (> 80%) through May 2024

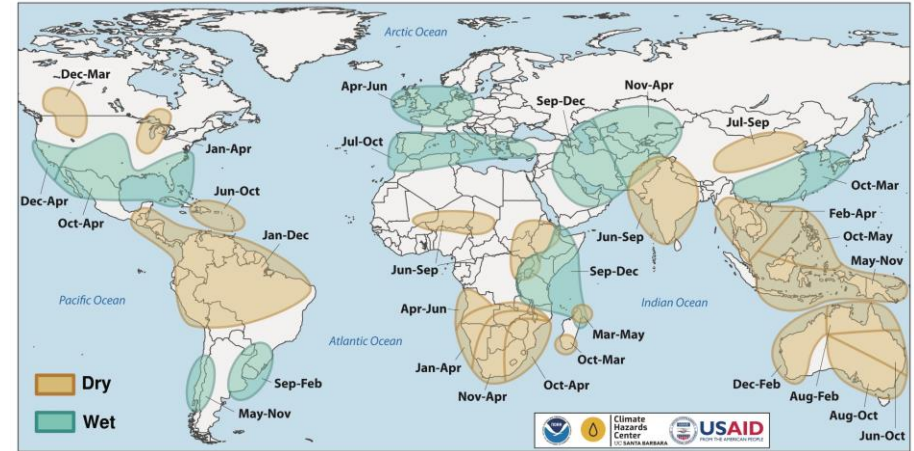
- IOD in neutral mode (+0.17), and likely to persist through July 2024

Climate Mode Impacts



During La Niña

- **La Niña:** wetter than average in Western and Southern Africa.
- **El Niño:** Wetter than average in Eastern Horn of Africa and Central Asia.



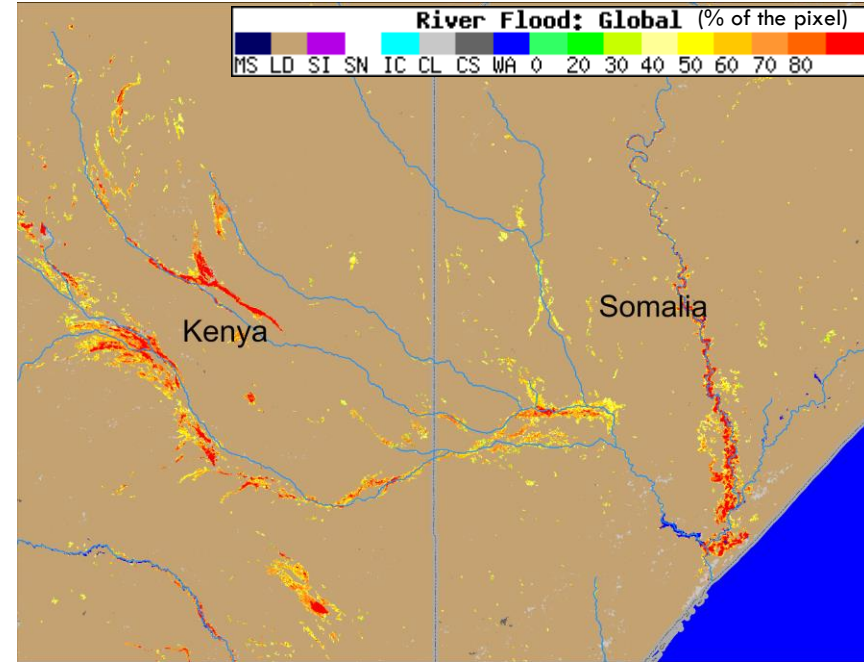
During El Niño

Visible Infrared Imaging Radiometer Suite (VIIRS)

- The VIIRS flood products provide maximal flood extent during a flood event from the VIIRS Near Real Time flood maps of Suomi-NPP and NOAA-20.
- Routinely provides daily and 5-day compositing flood product at 375m x 375m resolution.

The composite products are available at this link:
<https://www.ssec.wisc.edu/flood-map-demo/ftp-link/ftp-link-VIIRS5day/>

Historical data are available here: https://noaa-jpss.s3.amazonaws.com/index.html#JPSS_Blended_Products/VFM_5day_GLB/ShapeZIP/



VIIRS 5-day composite.: 22 – 26 Nov 2023



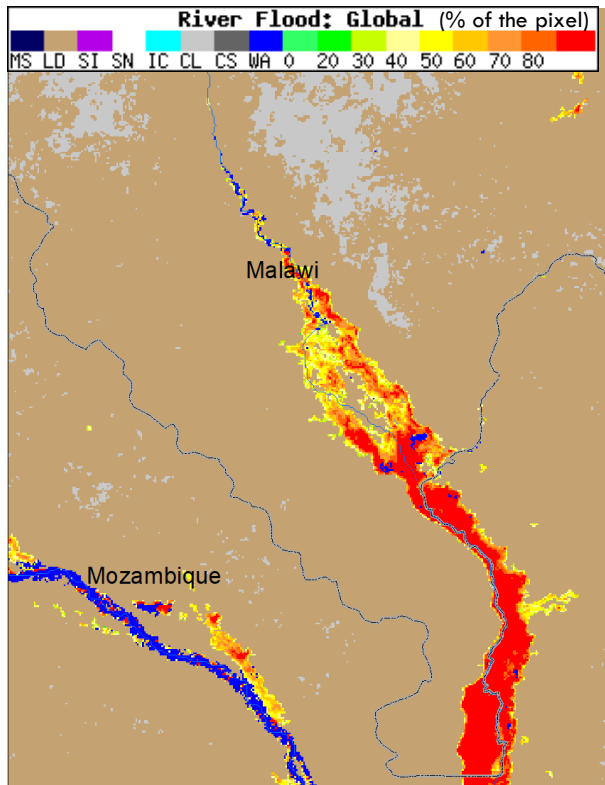
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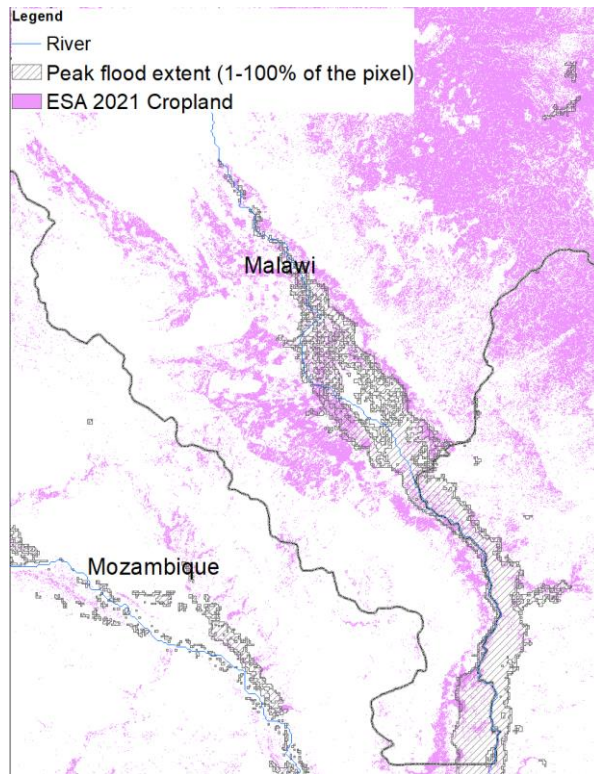
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Flooding Impacts in Malawi



NOAA VIIRS 5-day comp.: 16 - 20 Mar 2023

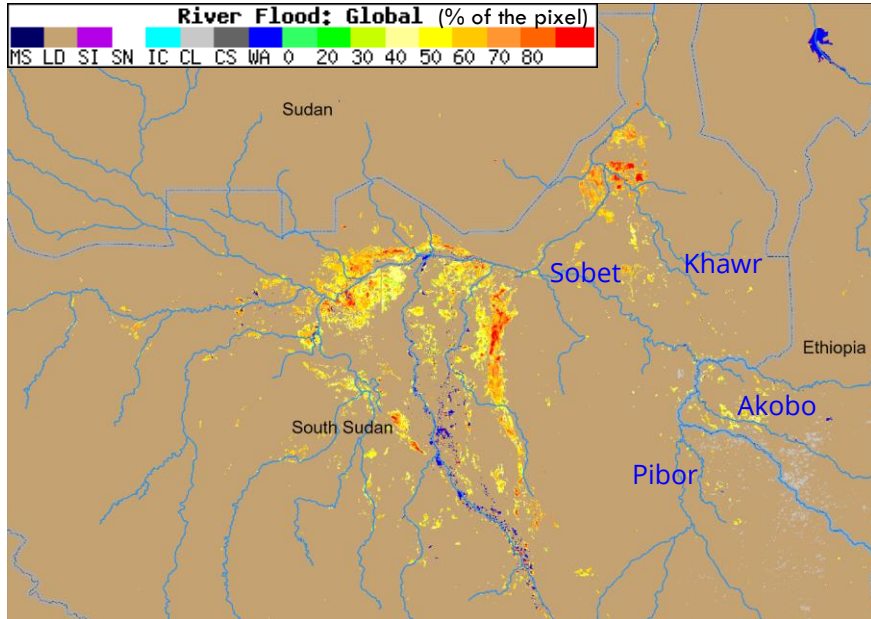


Inundated areas overlaid on ESA cropland

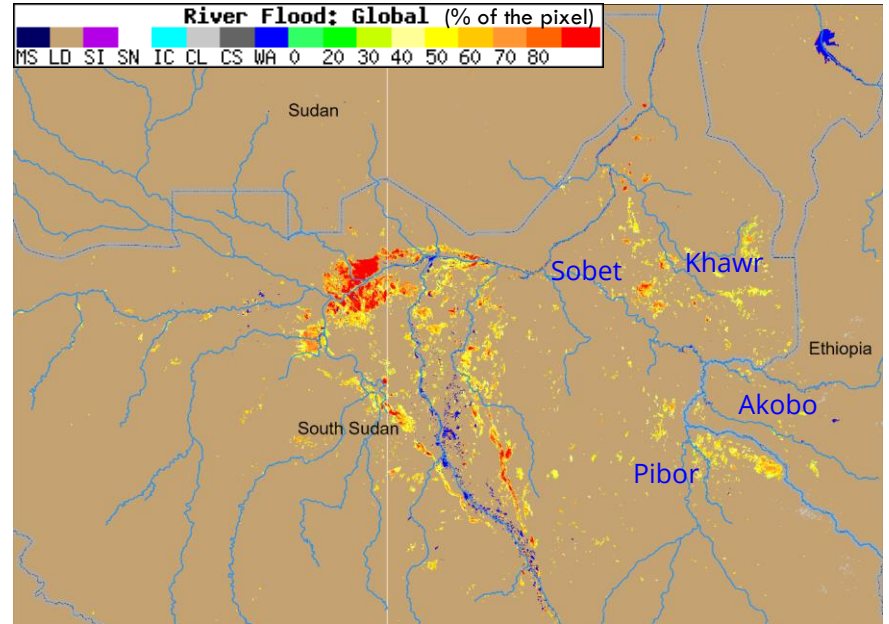
Admin_Name	Affected cropland in Hectares	
	1-100% water pixel	40-100% water pixel
Machinga	25,730	24,483
Chikwawa	11,955	11,472
Nsanje	10,903	10,771
Zomba	7,030	6,694
Phalombe	6,906	6,721
Mzimba	3,796	3,557
Nkhotakota	2,685	1,786
Kasungu	2,426	1,950
Karonga	2,381	1,507
Salima	2,307	1,919
Mangochi	1,381	1,196
Mulanje	1,185	1,148
Ntcheu	1,165	698
Rumphi	1,086	999
Nkhata Bay	935	630
Dedza	706	451
Lilongwe	467	327
Dowa	414	288
Balaka	384	367
Mwanza	241	195
Blantyre	209	209
Mchinji	183	137
Thyolo	5	4
Likoma	3	3

Impacted cropland by district

Flooding Conditions in South Sudan



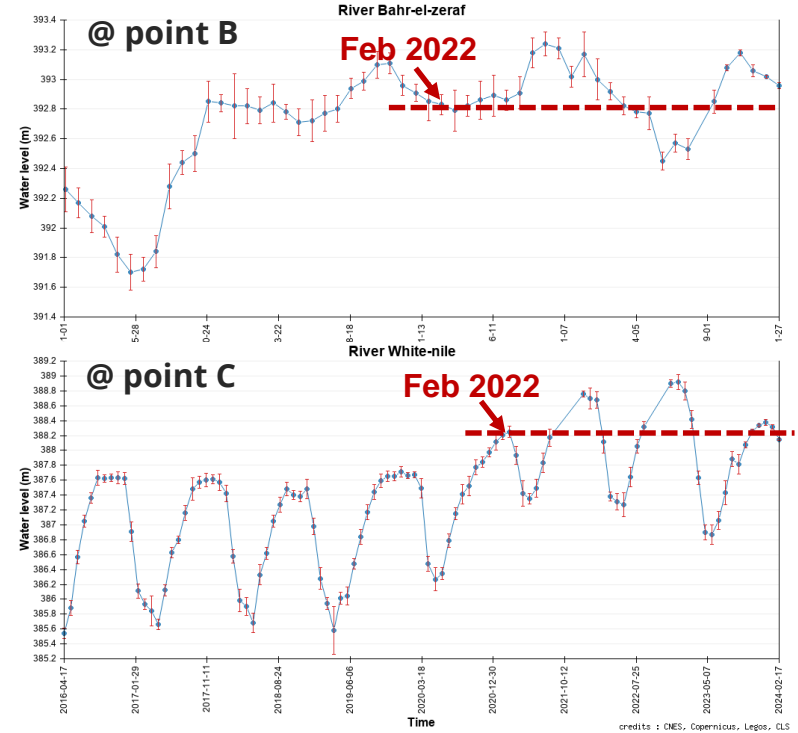
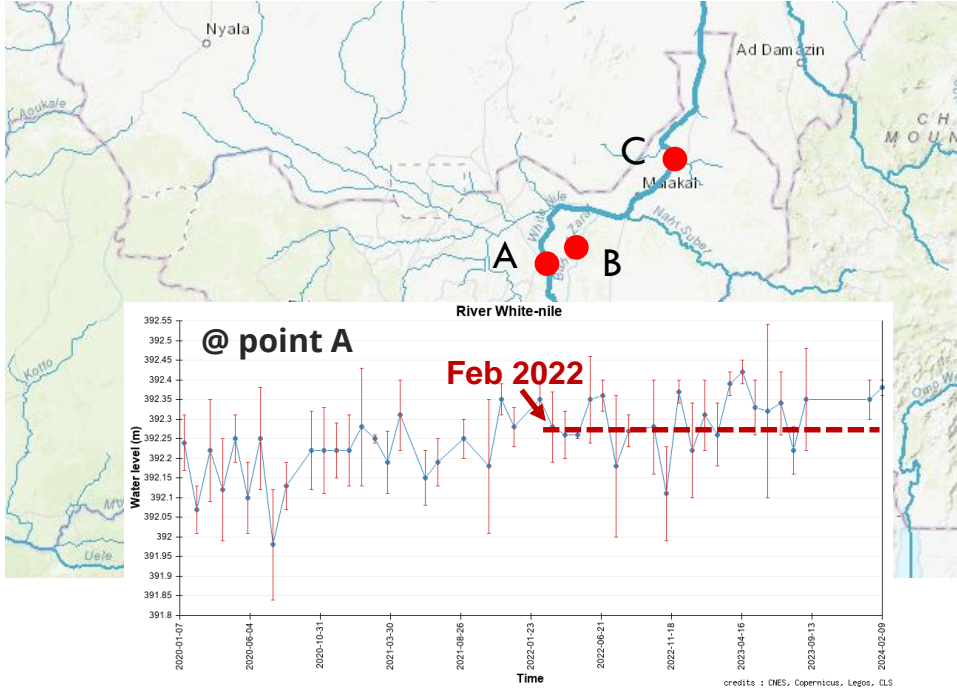
NOAA VIIRS 5-day comp.: **23 – 27 Feb 2022**



NOAA VIIRS 5-day comp.: **15 – 19 Feb 2024**

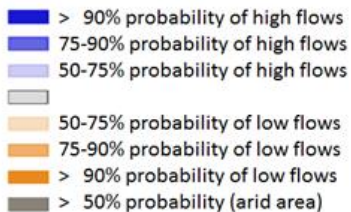
- Very similar pattern of inundation during Feb of 2022 and 2024. Additionally, there are more areas currently under water in the Khawr, Sobet, and Akobo catchments.

Elevated River Water Levels



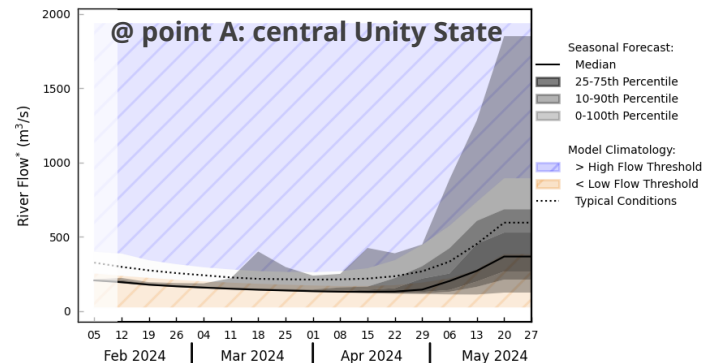
- Feb 2024 water levels in the Sudd Wetlands are higher compared to the water levels in Feb of 2022.
- Persistent high-water levels especially in the White Nile (Point A) through the dry season.

Seasonal Streamflow Forecast

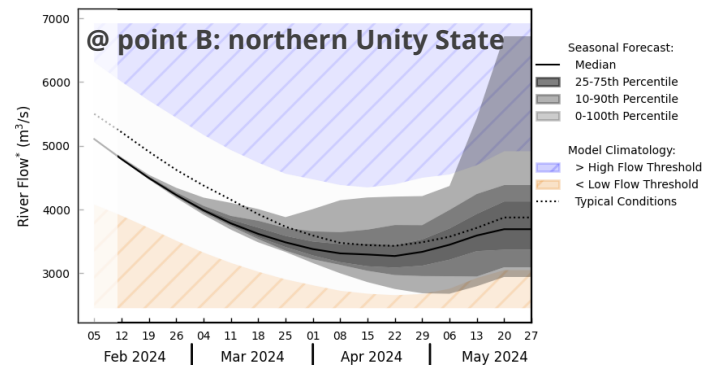


GloFAS streamflow forecast: Feb – May 2024

- Feb - May still in the dry period, streamflow likely to increase from May.

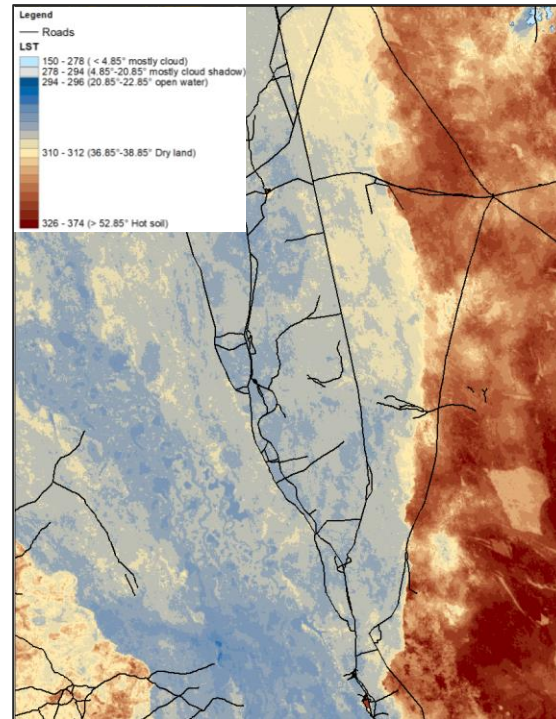
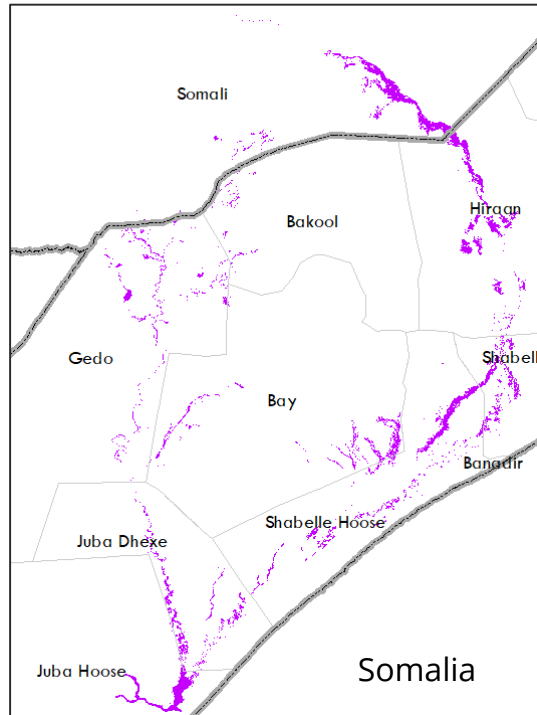
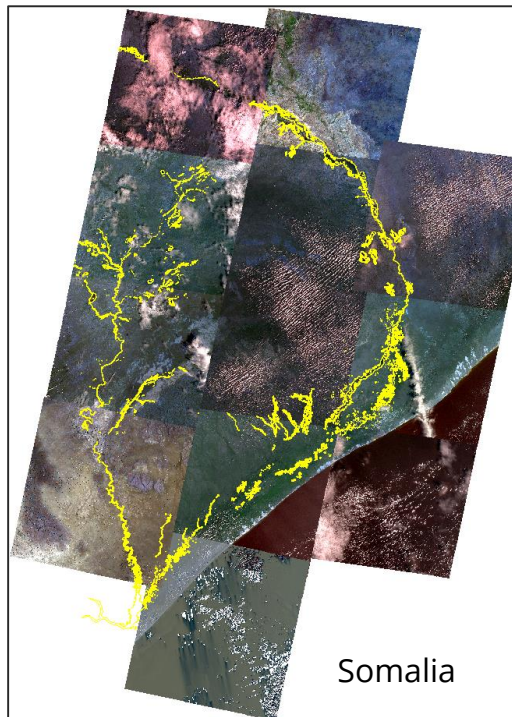


*River flow is a weekly average, displayed at start of week (dates shown)
 **High and low flow thresholds refer to the 80th and 20th percentiles of the model climatology



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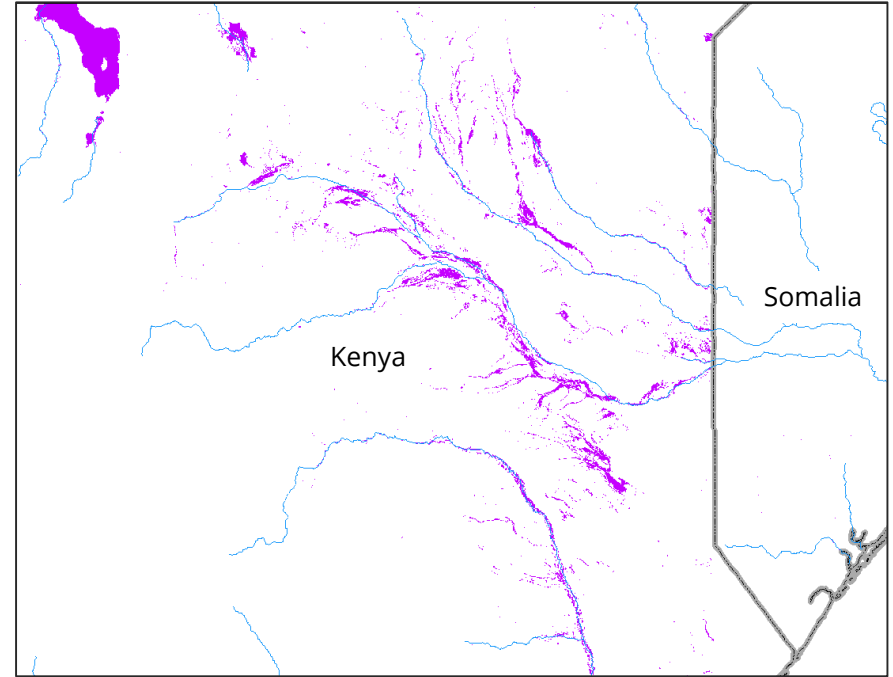
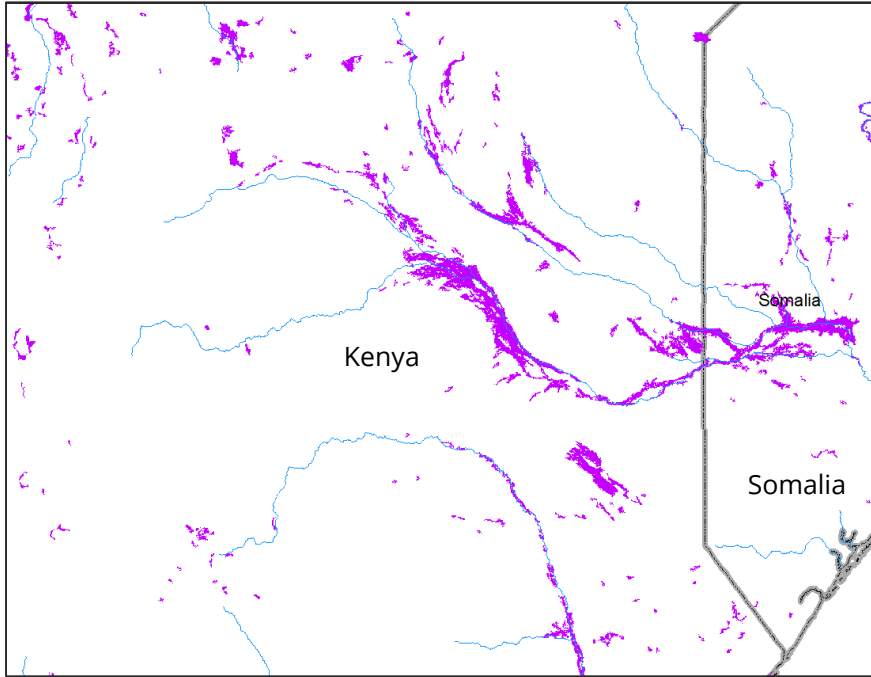
Mapping Floods from Other Sources of Data



- Oct-Dec 1997 Flooding from Landsat using AWEI (Automated Water Extraction Index) Feyisa et. al., 2014 method

Landsat Land Surface Temperature
June 01, 2021 (South Sudan)

Comparison of the VIIRS Flood Maps



- Oct-Nov 2023
- VIIRS at 375 m resolution

- Oct-Nov 2023
- FloodBase map at 10 m resolution (sentinel 1)

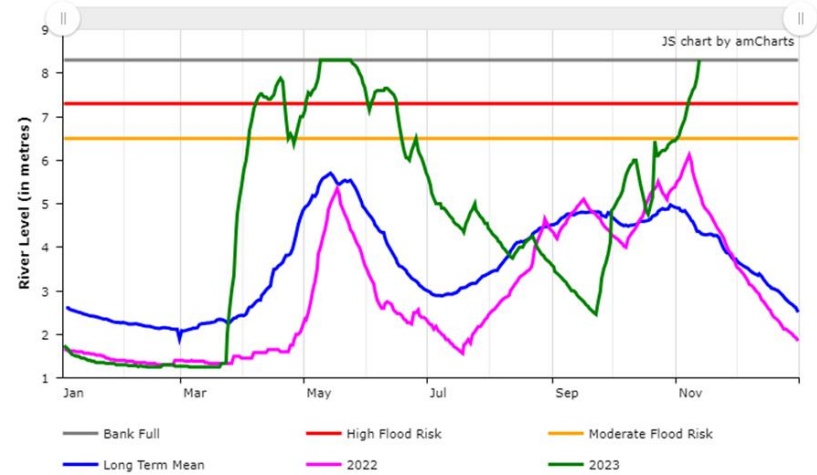
Observed Water Level

River	Station	Date	Observed River Level (m)	Moderate Risk Levels (m)	High Risk Levels (m)	Bankfull (m)
Jubba River	Dollow	27-11-2023	5.30	4.50	5.00	6.00
Jubba River	Luuq	27-11-2023	7.00	5.50	6.00	7.00
Jubba River	Bardheere	08-11-2023	10.40	7.40	8.20	10.40
Jubba River	Buaille	27-11-2023	12.00	9.00	10.00	12.00
Shabelle River	Belet Weyne	27-11-2023	8.30	6.50	7.30	8.30
Shabelle River	Bulo Burti	27-11-2023	8.00	6.50	7.20	8.00
Shabelle River	Jowhar	27-11-2023	5.00	5.00	5.25	5.50

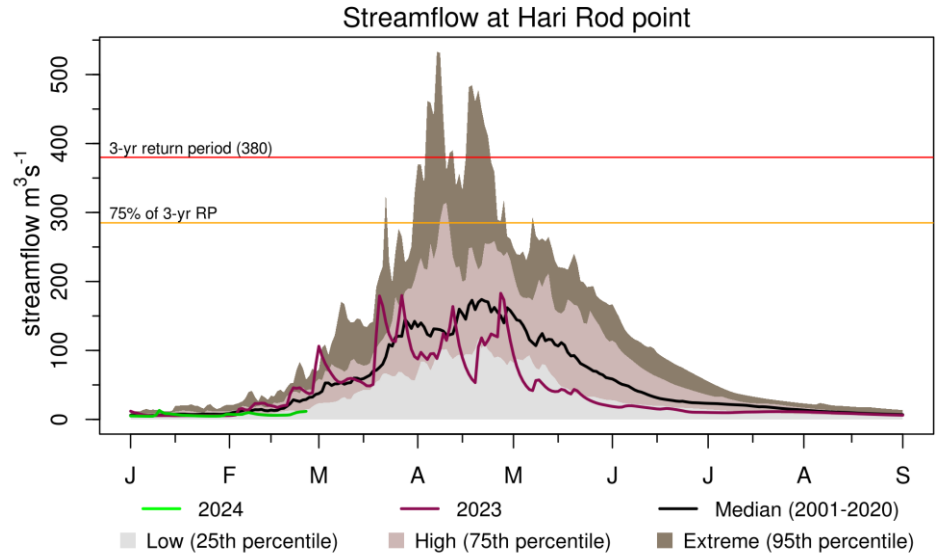
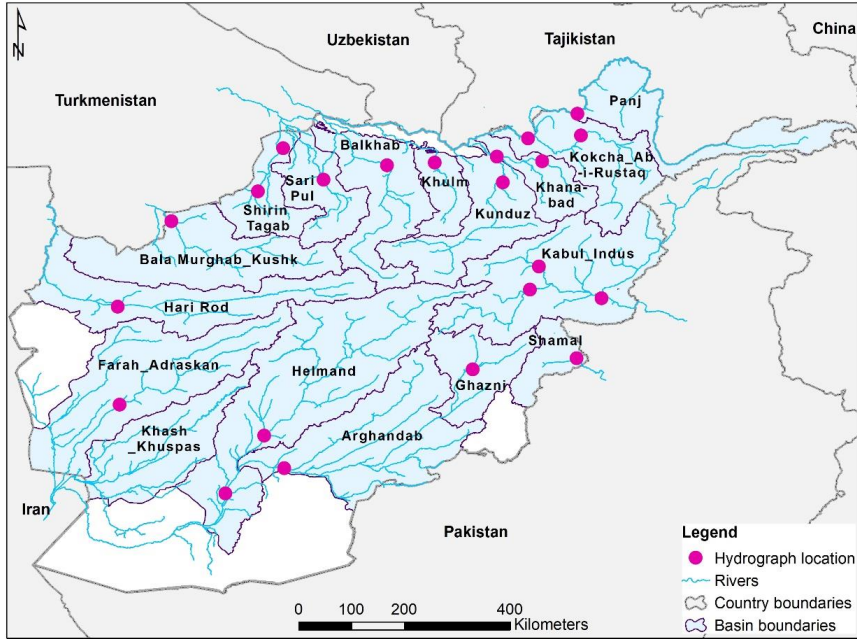
Gage Location: **RED** – at bankfull

- Somalia Water and Land Information Management (**SWALIM**) collects river water level data at 7 stations along Juba and Shabelle.
- Entire Juba River at bankfull with increasing magnitude at Bardheere and downstream.
- Shabelle at bankfull in Belet weyne and Bulo Burti (2 out of 3 locations) and at moderate risk of flooding near Jowhar.

Observed Water Level at Belet Weyne: **13 Nov 2023**



Streamflow Monitoring System: Afghanistan



- We model streamflow utilizing NASA FEWS NET Land Data Assimilation System (FLDAS) platform, the NOAH3.6 Land Surface Model, and the HyMAP2 routing scheme.
- Daily streamflow estimates are available from Oct 2021 to present.

<https://earlywarning.usgs.gov/fews/GDAS>



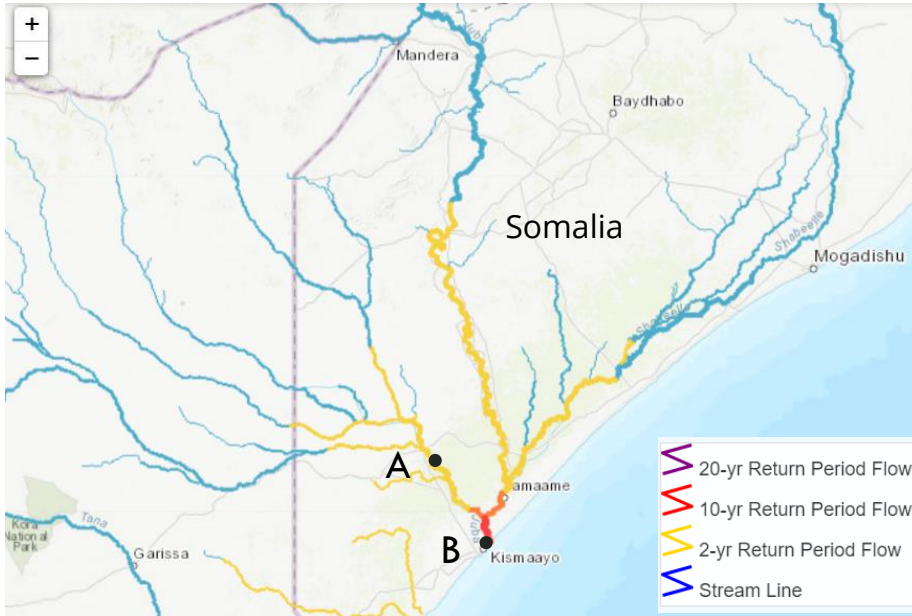
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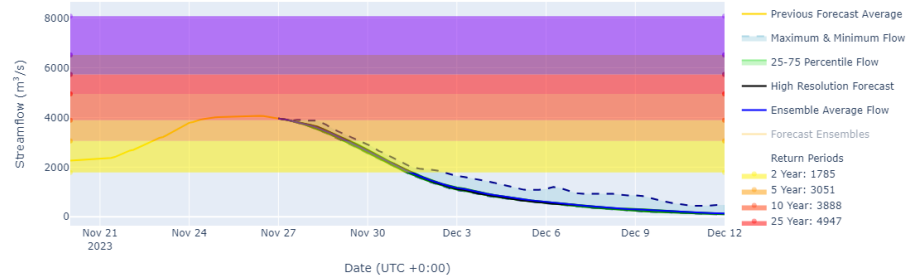
Two Weeks Streamflow Forecast



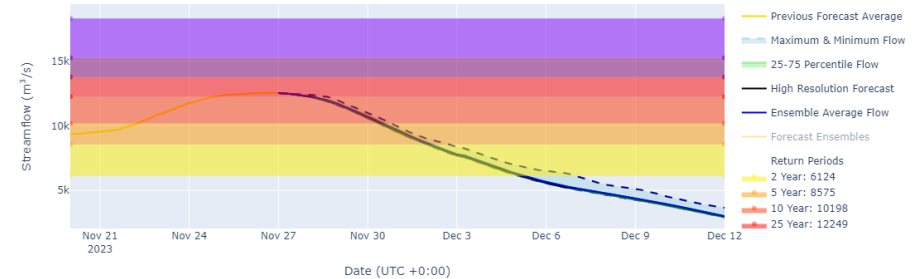
GEOGloWS Forecast.: 26 Nov – 12 Dec 2023

- Juba discharges near the outlet are expected to be at 10-year return period level for the next few days.

Forecasted Streamflow Reach ID: 7072405 @ point A: combined flow of Lagh Dera and Lagh Jura

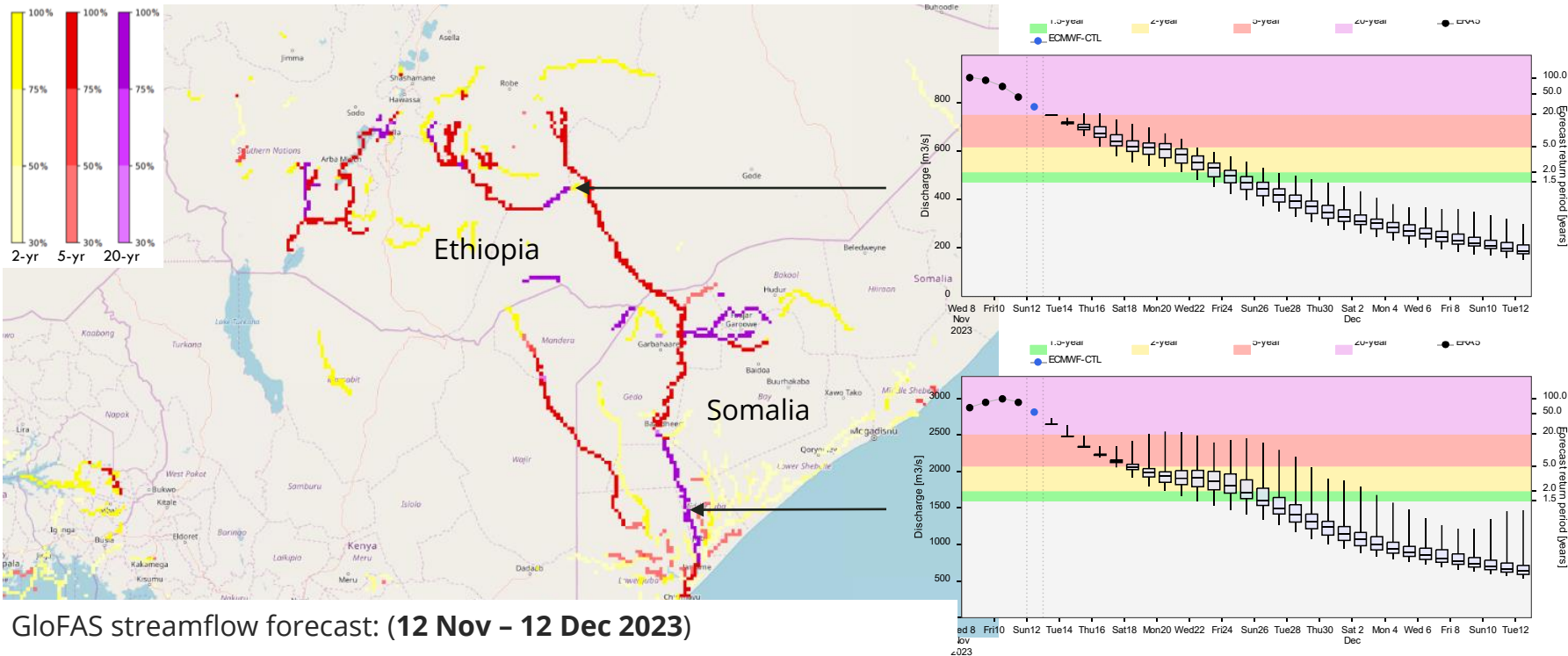


Forecasted Streamflow Reach ID: 7072700 @ point B: on Juba River near outlet



GEOGloWS Forecast.: 26 Nov – 12 Dec 2023

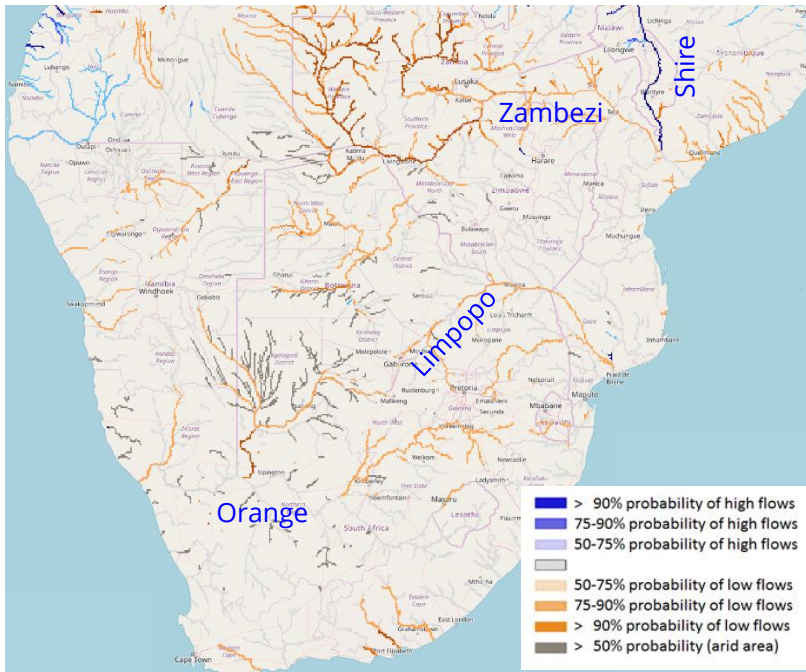
Monthly Streamflow Forecast



GloFAS streamflow forecast: (12 Nov – 12 Dec 2023)

- High likelihood of Juba discharge in Ethiopia and Somalia to be at 5-yr to 20-yr return period level until late November.

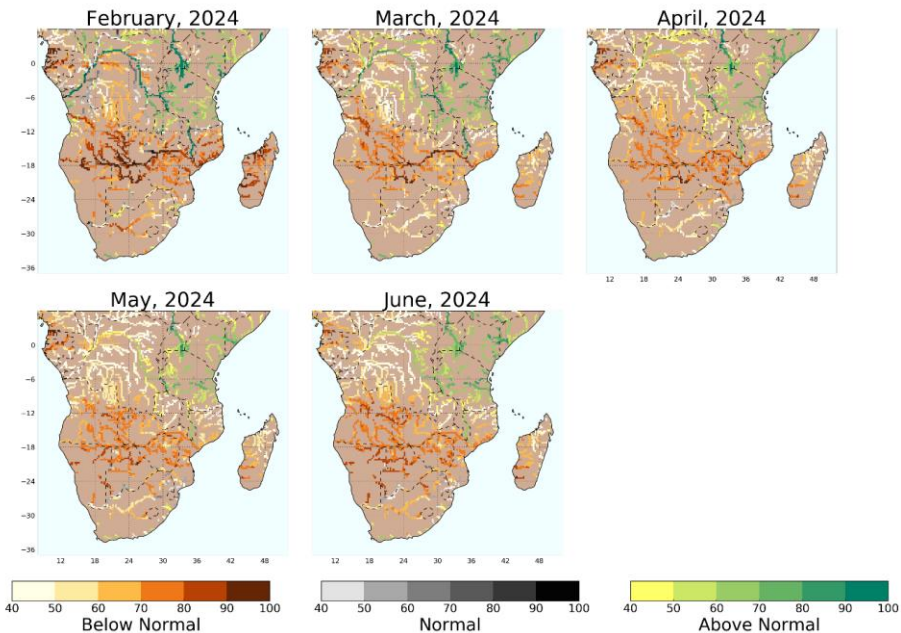
Seasonal Streamflow Forecast



GloFAS seasonal forecast **Feb - May 2024**

- Average to below average streamflow is expected across much of Southern Africa except the Shire River.

NMME Based Streamflow Forecasts, Initialized on February 01, 2024



FLDAS monthly forecast **Feb - Jun 2024**

<https://ldas.gsfc.nasa.gov/ldas>

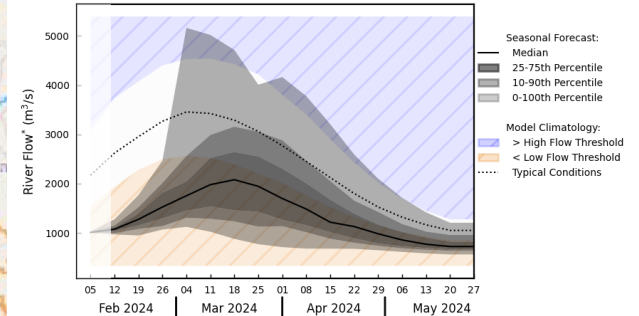
Seasonal Streamflow Forecast



GloFAS seasonal forecast Feb - May 2024

- Well below average streamflow in the upstream of Zambezi River. Not good for Lake Kariba water level recovery.
- Above average streamflow in the Shire River. Flooding possible in southern Malawi.

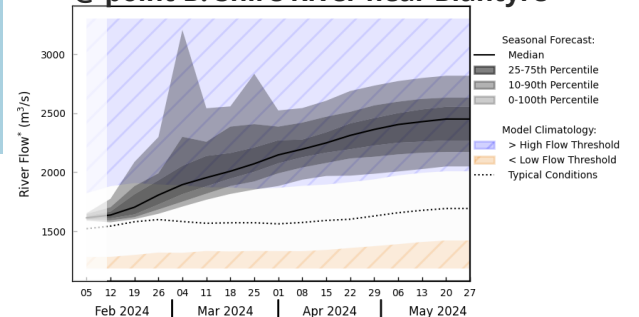
@ point A: Zambezi River before Lake Kariba



*River flow is a weekly average, displayed at start of week (dates shown)

** High and low flow thresholds refer to the 80th and 20th percentiles of the model climatology

@ point B: Shire River near Blantyre



*River flow is a weekly average, displayed at start of week (dates shown)

** High and low flow thresholds refer to the 80th and 20th percentiles of the model climatology

GloFAS monthly forecast (Feb - May 2024)



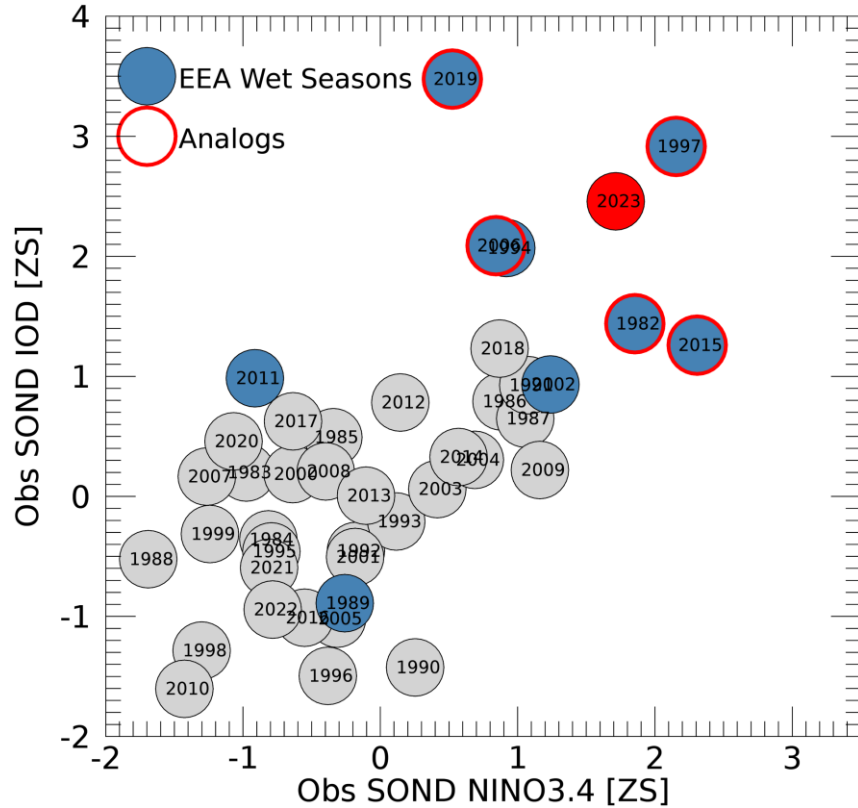
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Analog Years Based on IOD and Niño3.4



- Analysis was conducted in **Aug-Sep of 2023**

Climate Hazards Center's Selection of Analog Years (1982, 1997, 2006, 2015 and 2019) based on Sep – Dec (SOND) conditions



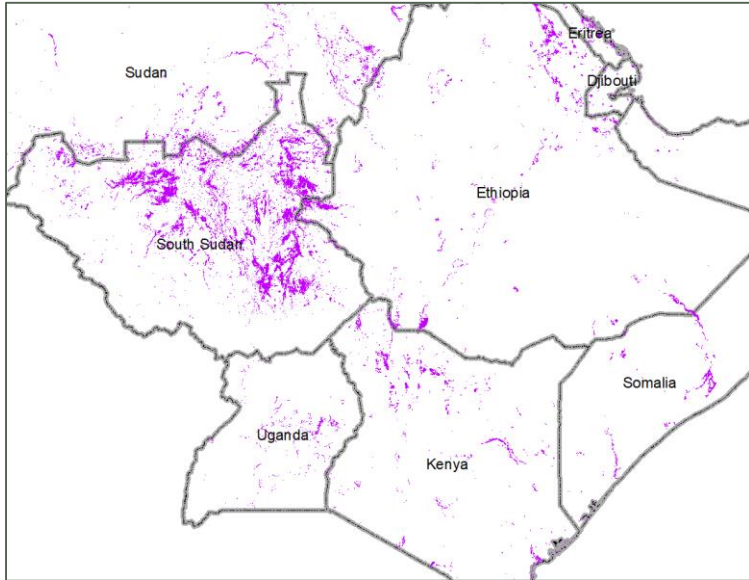
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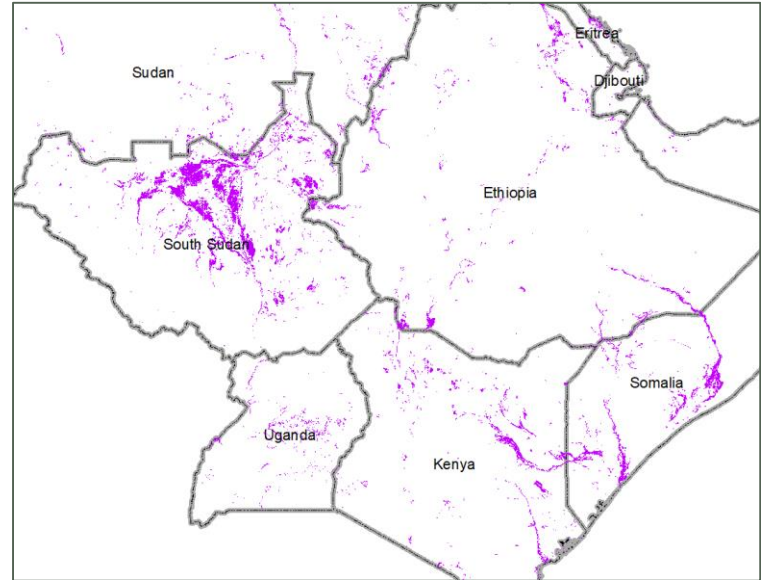
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VIIRS Flood Maps for Analogs



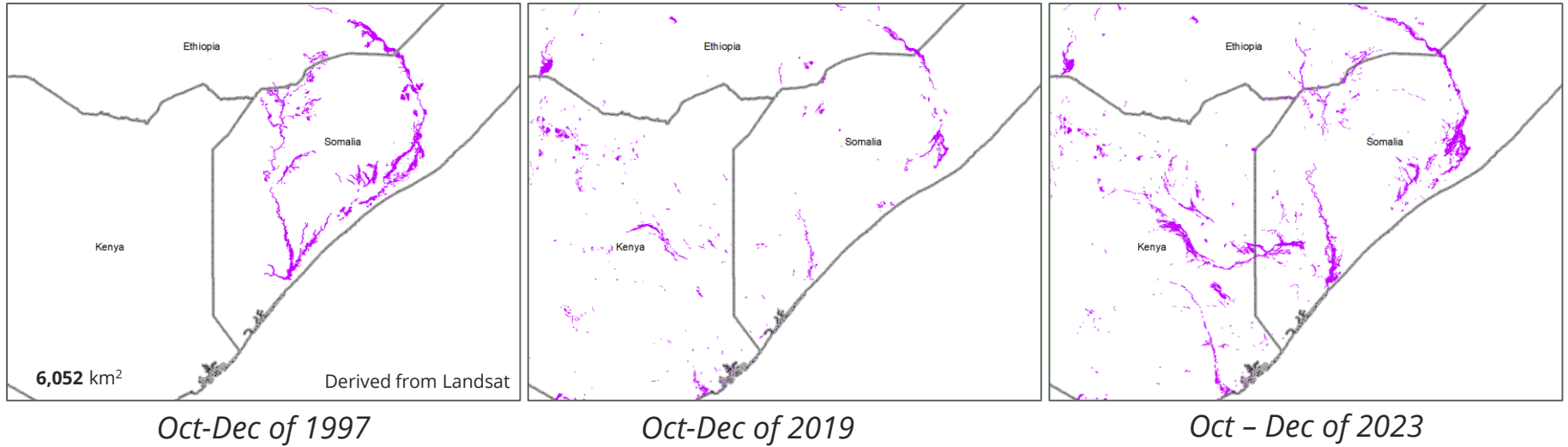
Oct-Dec of 2019



Oct - Dec of 2023

- Relatively less flooding in South Sudan but more in Kenya and Somalia compared to Oct-Dec flooding of 2019.
- Extensive geographical area over Kenya and Somalia compared to Oct-Dec flooding of 2019.

Landsat & VIIRS Flood Maps for Analogs



- Oct-Dec 2023 inundation pattern in Ethiopia and Somalia is very similar to Oct-Dec flooding of 1997.
- Extensive geographical area compared to Oct-Dec flooding of 1997.

Conclusions

- Regular monitoring and forecasting of floods is changing the dynamics of how flooding information is incorporated into food insecurity assessments.
- VIIRS flood products complemented by FloodBase maps providing the ongoing flooding conditions quite well.
- GEOGloWS and monthly GloFAS products providing the information for weekly monitoring and assessments.
- Four-month GloFAS providing flooding information for seasonal food insecurity outlooks.





Flooding along Juba River, Nov 2023



Flooding impact, Shire River, Mar 2023



Signs of catastrophic peak flood water level in Malawi, Mar 2023



Flooding along Niger River in Nigeria, Sep 2022

**Thank you
Questions?
Please feel free to email at
spervez@usgs.gov**