Addressing Malawi's NAP recommendation for Medium and Long Term Adaptation Planning:

DEMO -

Integration of GEOGloWS-ECMWF Streamflow Forecasting into the Community-Based Flood Early Warning System in Malawi.

NAP Expo 2022
Gaborone, Botswana

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OBJECTIVE OF GEOGLOWS SERVICE

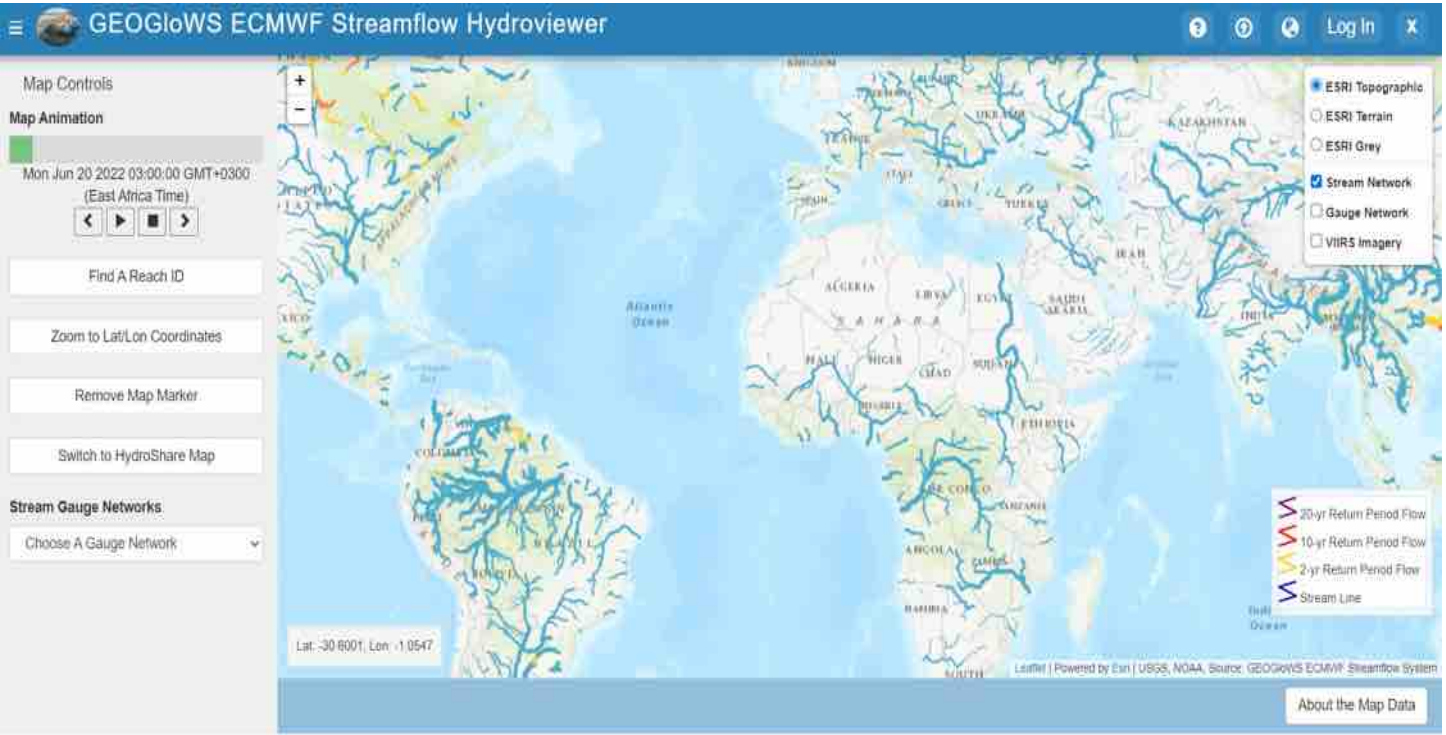
AIM: To provide inexpensive, timely, accurate and reliable user driven river flow data/information for;

(a) Water resources monitoring, planning, allocation and management decisions (Ecosystem, domestic water supply, Irrigation hydropower).

(b) Forecasting and monitoring of hydrological extreemes (droufght and Flood to enhance preparedness for and disasters risk reduction.

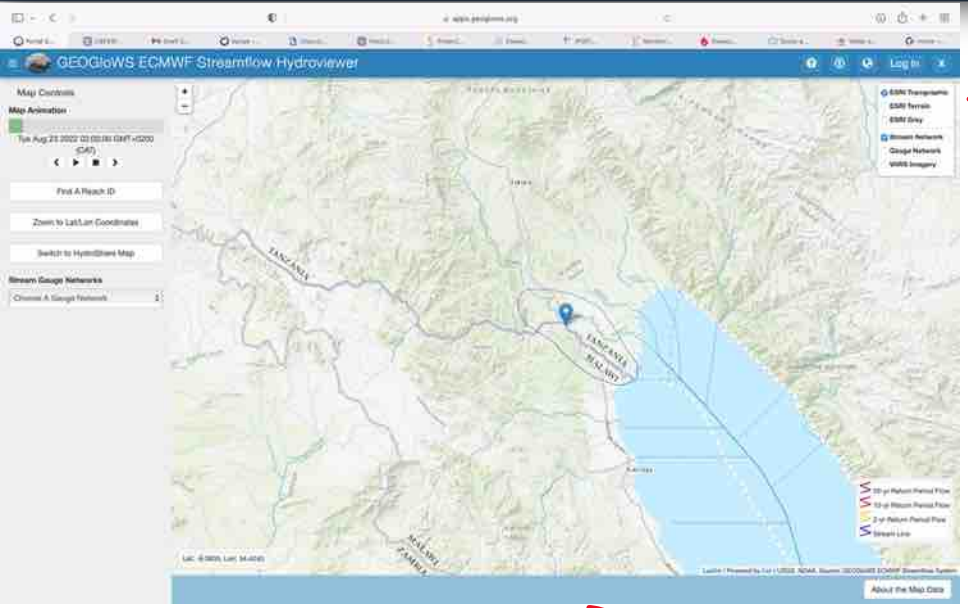
GEOGLOWS ECMWF STREAMFLOW VIEWER

https://apps.geoglows.org/apps/geoglows-hydroviewer/

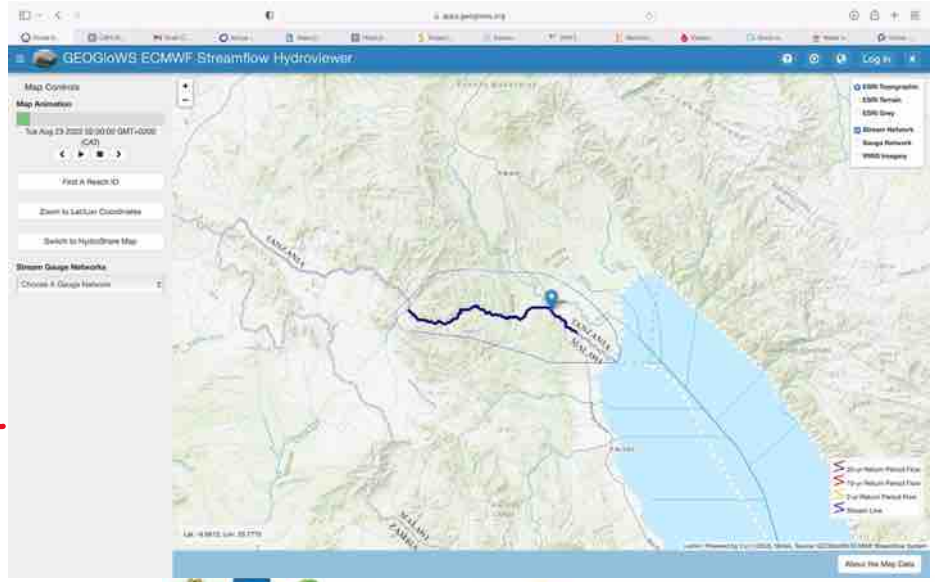


- Combines modern computing technologies & cyber-infrastructure with hydrological and hdraulic science to deliver a web-based service & cloud computing operational hydrological data necessary for water resources planning and management.

ZOOM TO RIVER OF INTEREST

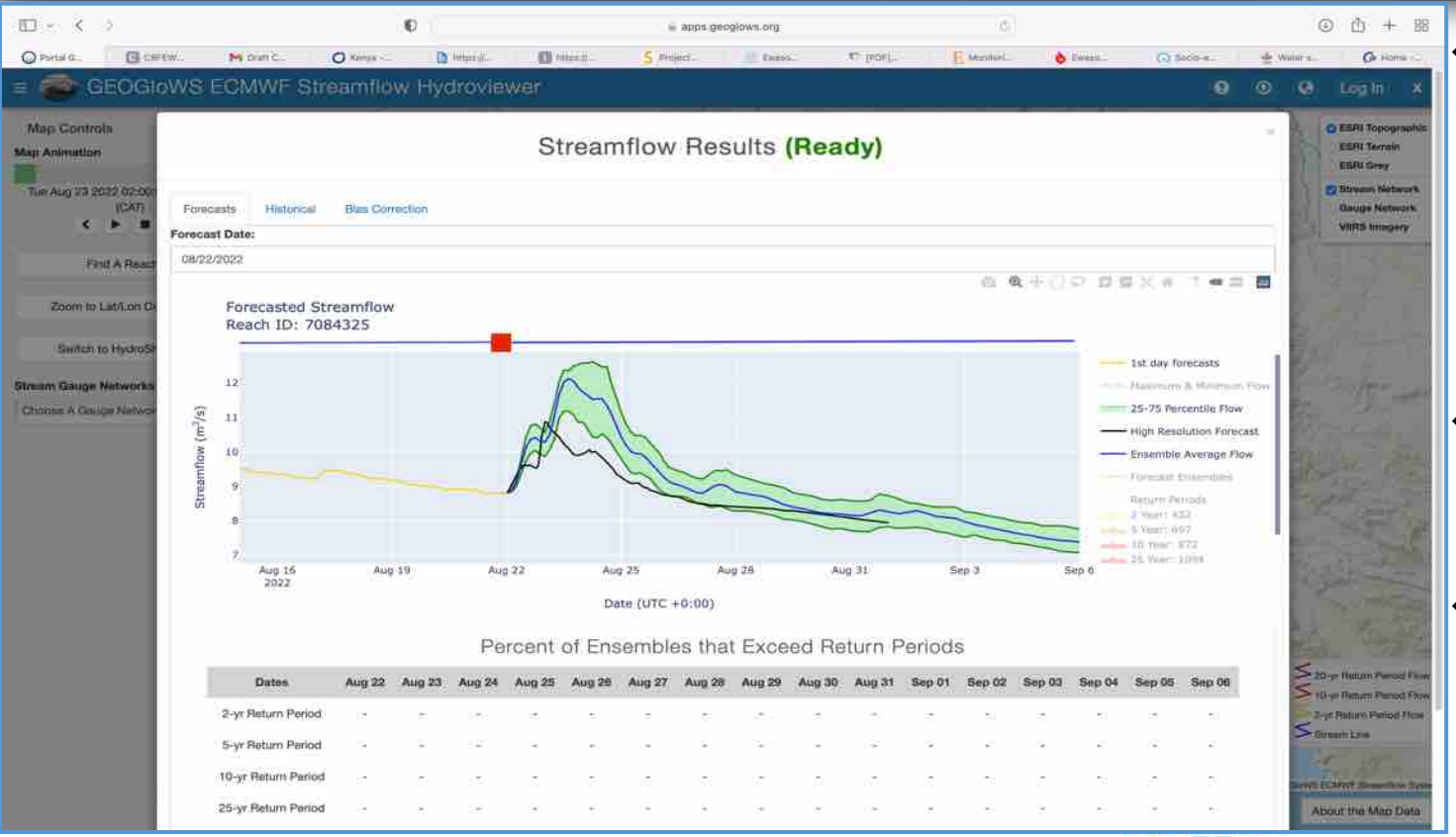


- The GEOGloWS streamflow forecasting allows local stakeholders to develop tailored applications to solve water management problems such as flooding, drought, and water/food/energy security issues.



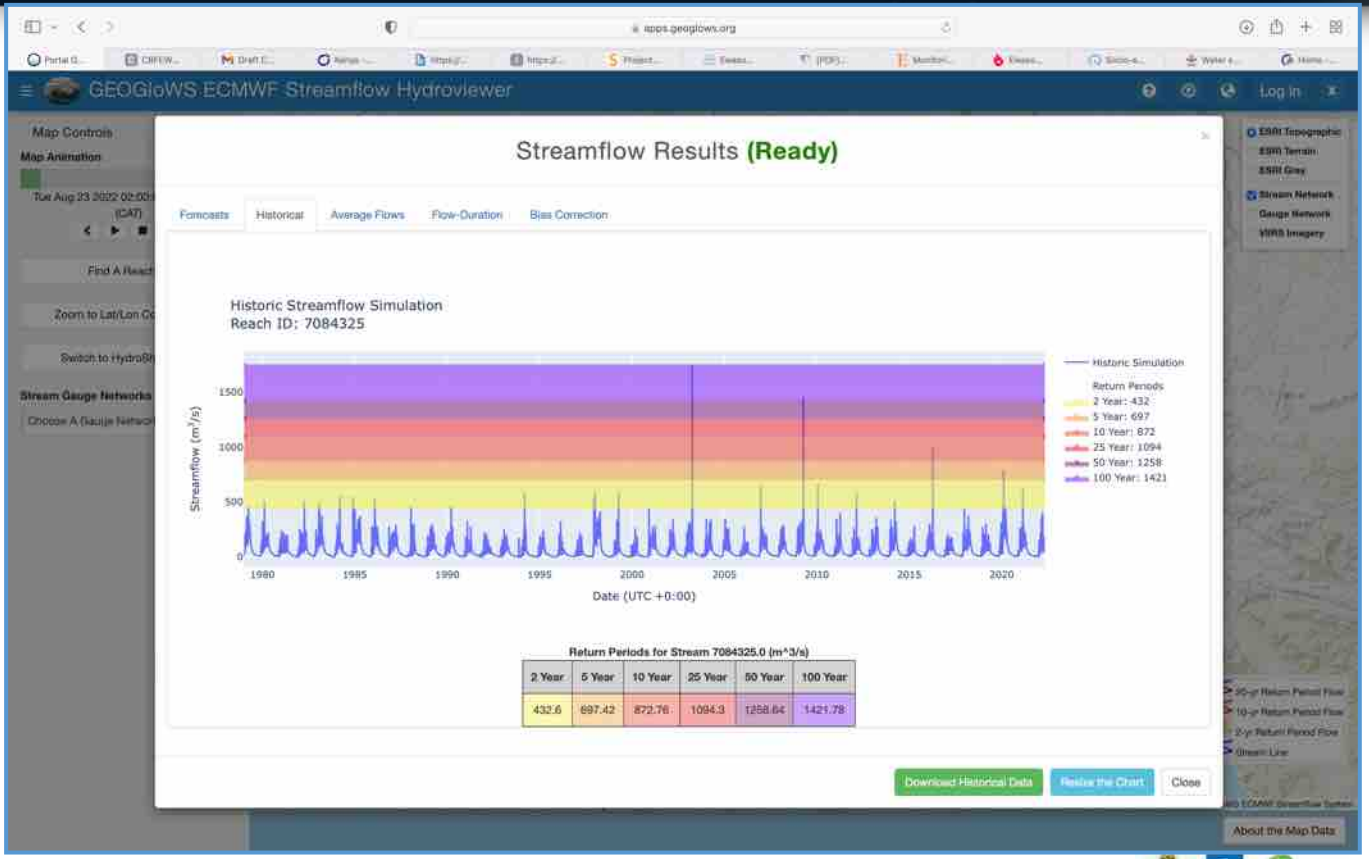
- The forecast service requires and leverages the local data and local expertise to tailor the global forecast to local applications.

FORECAST STREAMFLOW DATA



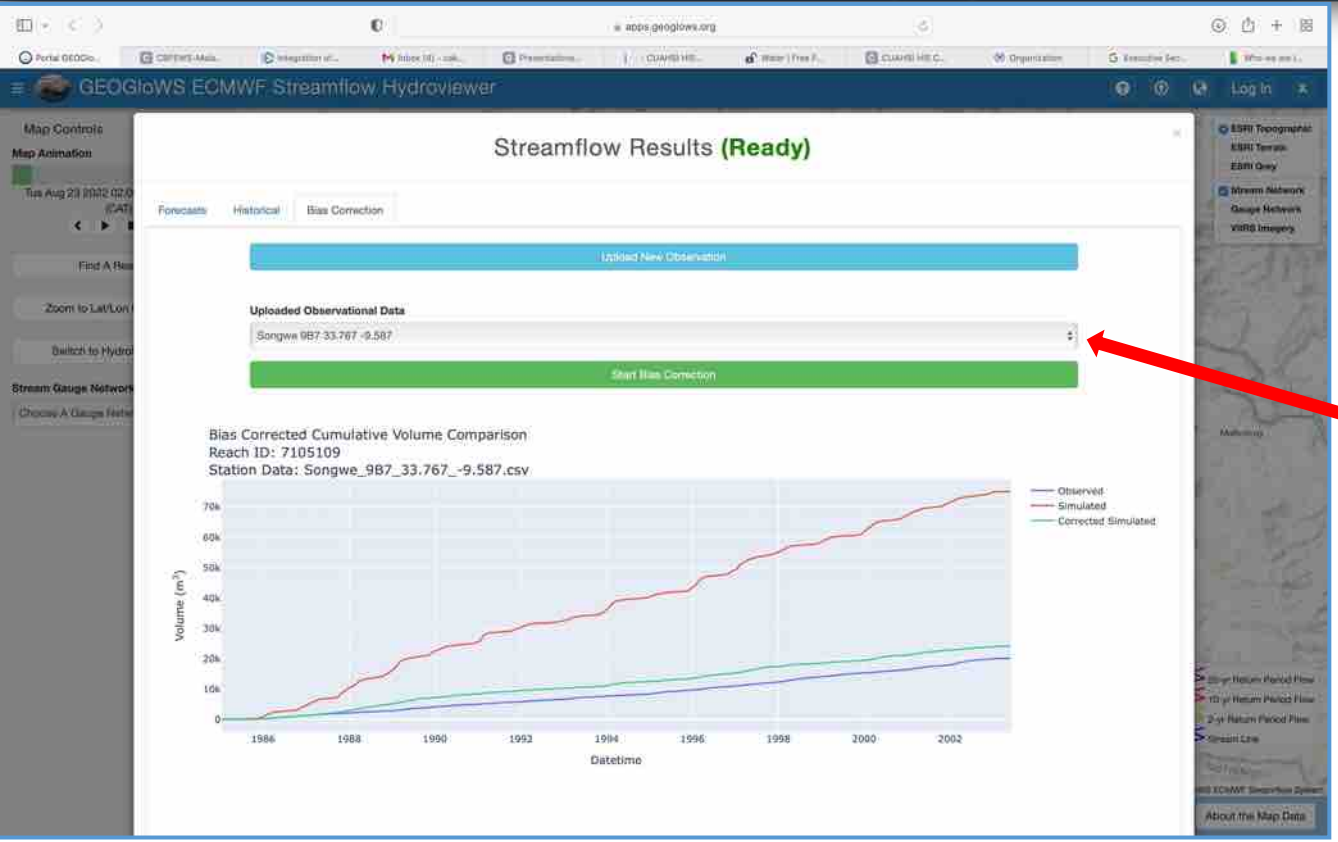
- Provides timely streamflow short range forecast from ECMWF - 51 member ensemble with **15 days, for 3 hrs resolution**.
- Generating single 1-hr high resolution 10-day forecast.
- Near-real-time data is also generated to allow bias correction with observed data.

Historical Streamflow Data

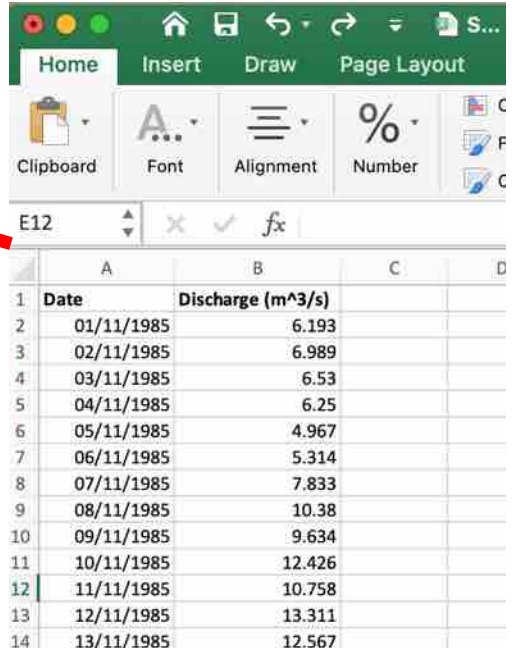


- The GEOGloWS service provides for every river in a 40 years of simulated historical data with computed statistical indices hence a breakthrough for data scarcity and gaps hence complementing the national efforts resulting in better planning, allocation and operation of dams, irrigation systems, and flood management.

GEOGLOWS Data bias correction to local data

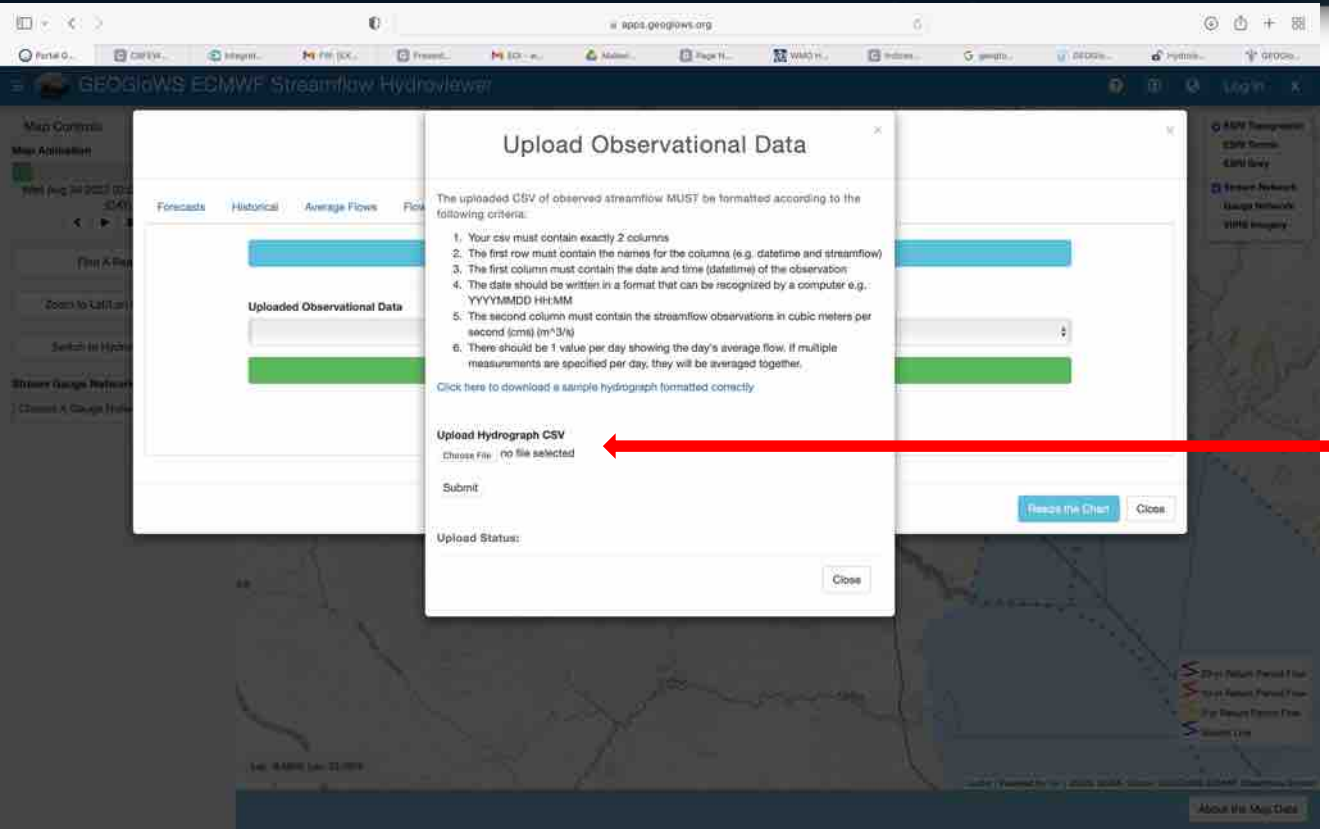


- Allows the for bias correction with local observed data.

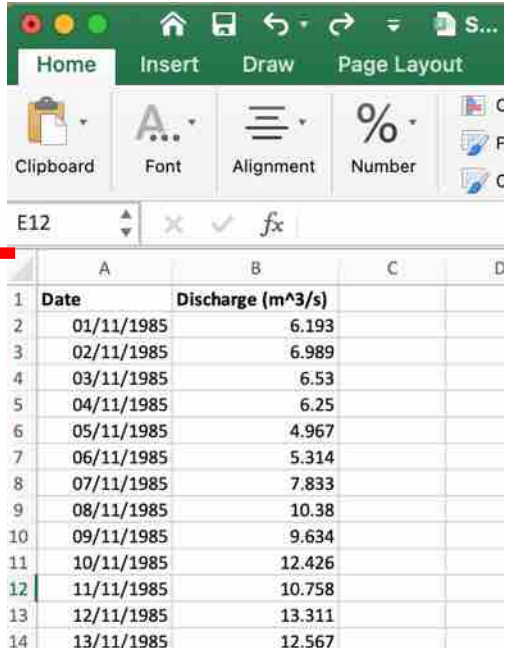


	A	B	C
1	Date	Discharge (m^3/s)	
2	01/11/1985	6.193	
3	02/11/1985	6.989	
4	03/11/1985	6.53	
5	04/11/1985	6.25	
6	05/11/1985	4.967	
7	06/11/1985	5.314	
8	07/11/1985	7.833	
9	08/11/1985	10.38	
10	09/11/1985	9.634	
11	10/11/1985	12.426	
12	11/11/1985	10.758	
13	12/11/1985	13.311	
14	13/11/1985	12.567	

GEOGLOWS Data bias correction to local data



- Allows the opportunity for bias correction with local observed data



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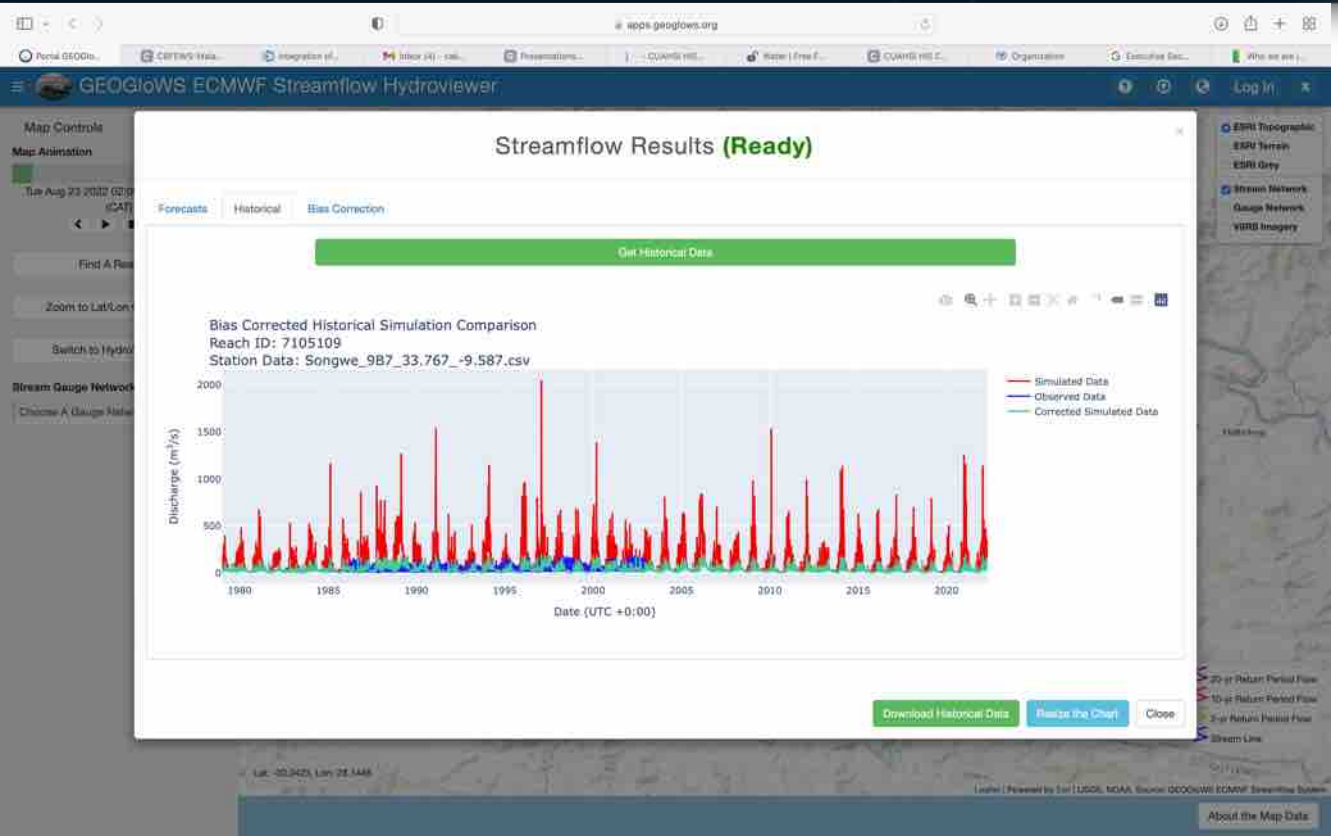
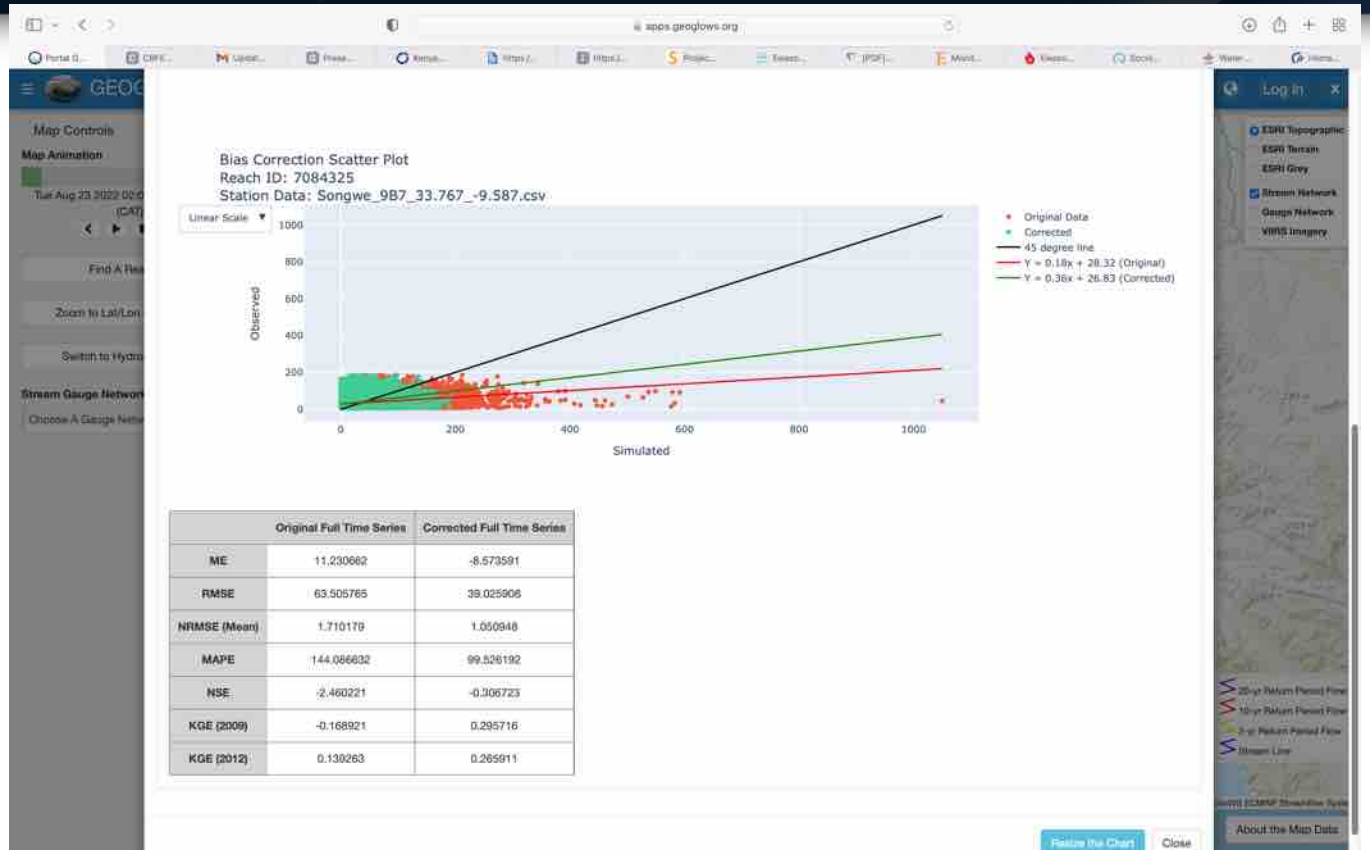
GEOGloWS Bias Correction on Historical Observed



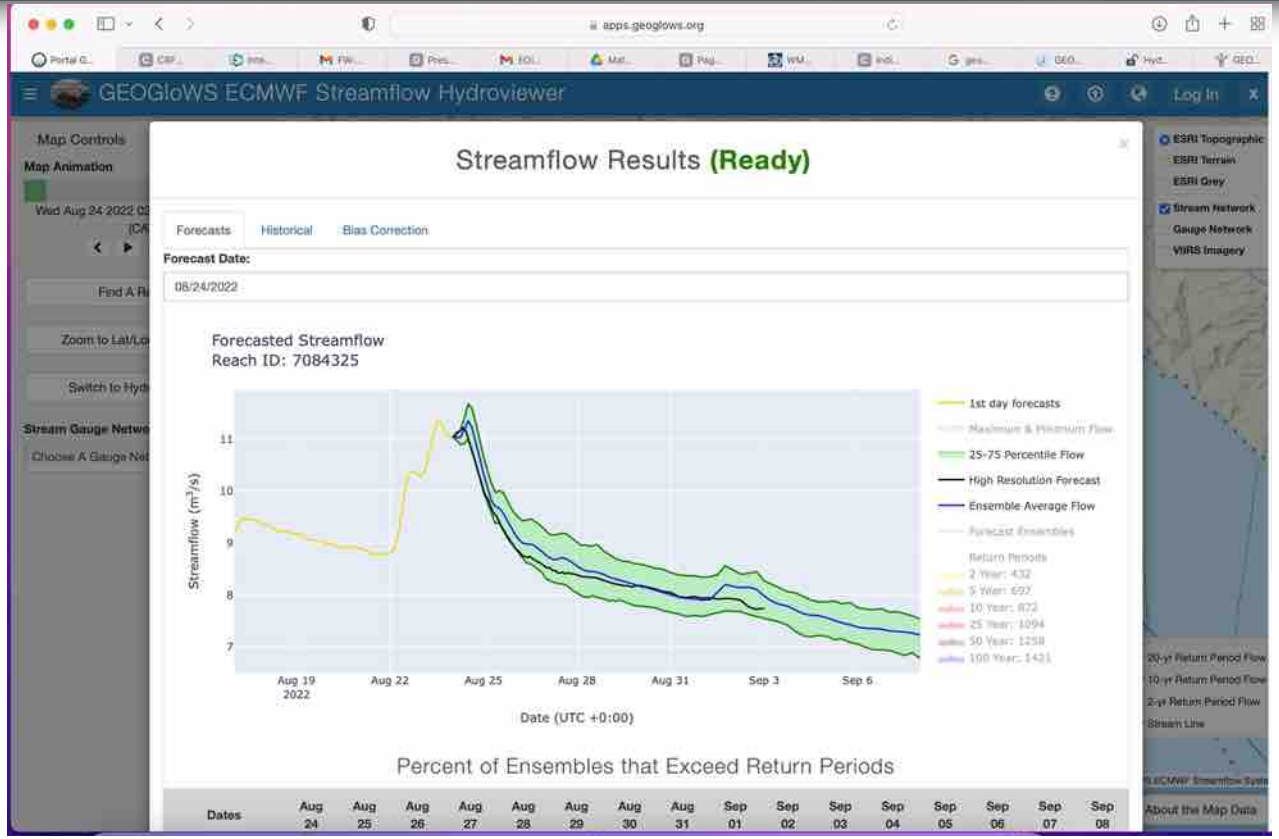
- With bias corrected GEOGloWS streamflow data, a 40-years, reliable streamflow data has been created and localized to the station and river reach levels filling the historical data gaps.
- The data can now be used for water resources assessment and planning purposes.
- Also created is bias correction factor for the forecast river flow.

GEOGloWS Bias Correction on Historical Observed



	Original Full Time Series	Corrected Full Time Series
ME	11.230662	-8.573591
RMSE	63.505765	39.025906
NRMSE (Mean)	1.710179	1.050948
MAPE	144.086632	99.526192
NSE	-2.460221	-0.306723
KGE (2009)	-0.168921	0.295716
KGE (2012)	0.130263	0.265911

GEOGloWS Streamflow Forecast



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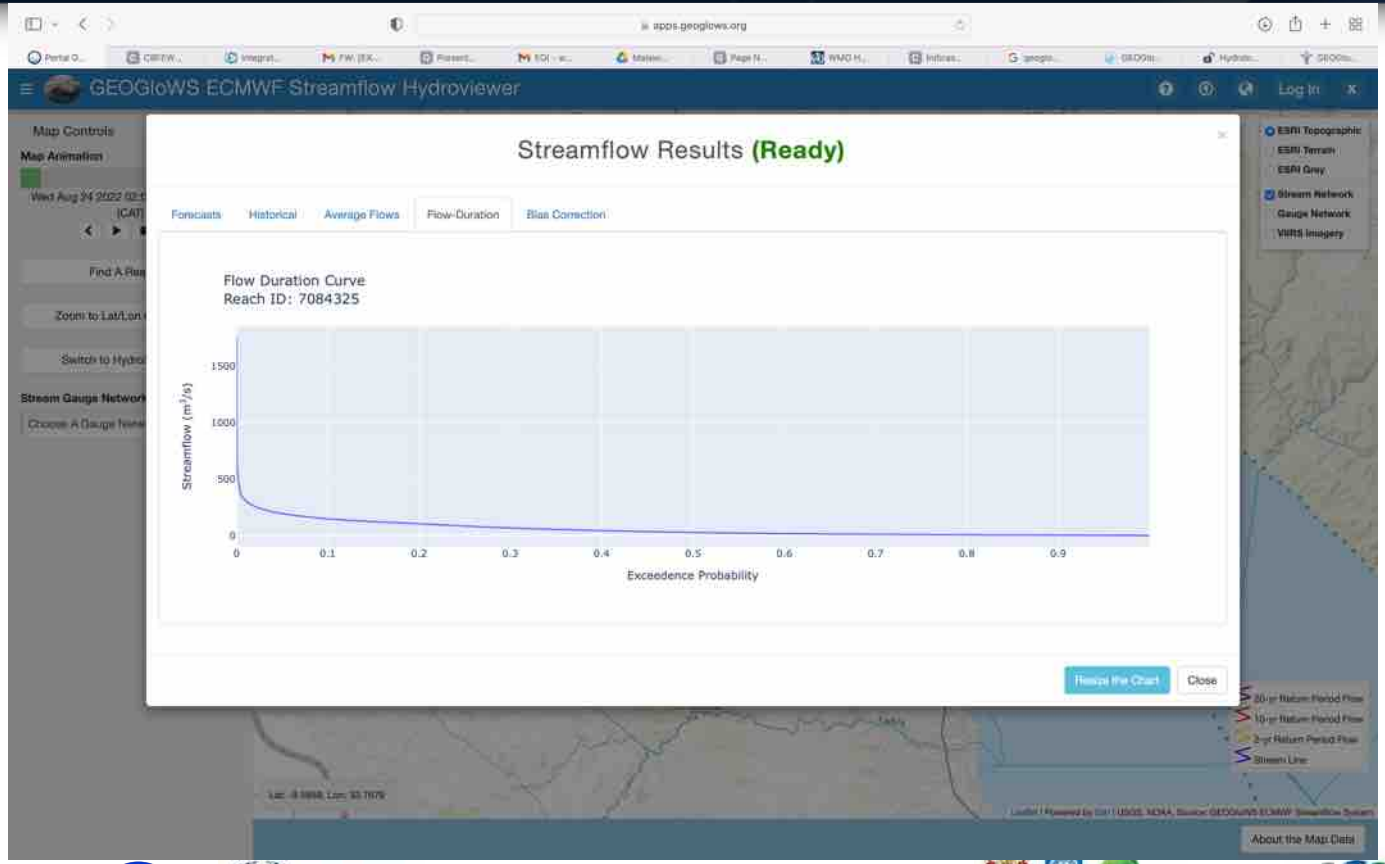
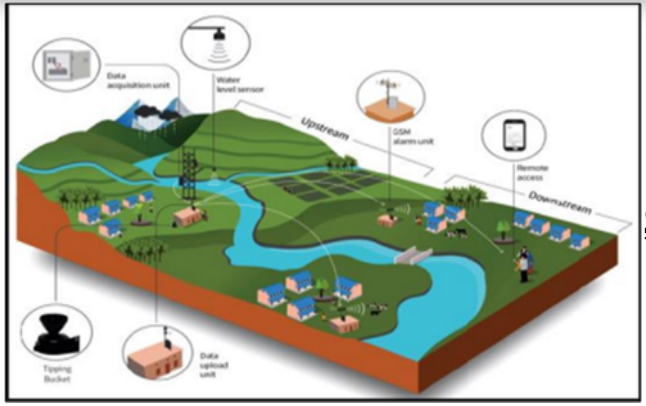
GEOGloWS Streamflow data Analysis

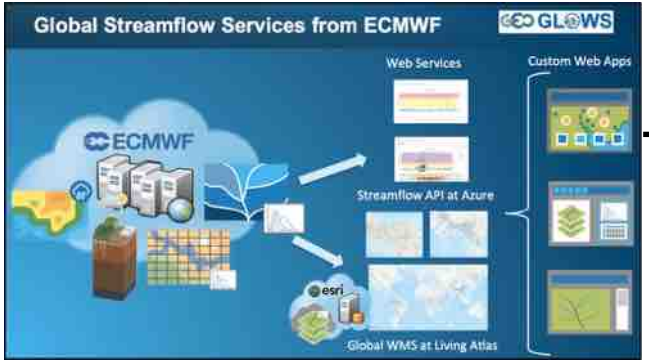
GEOGloWS Flow Duration Curve



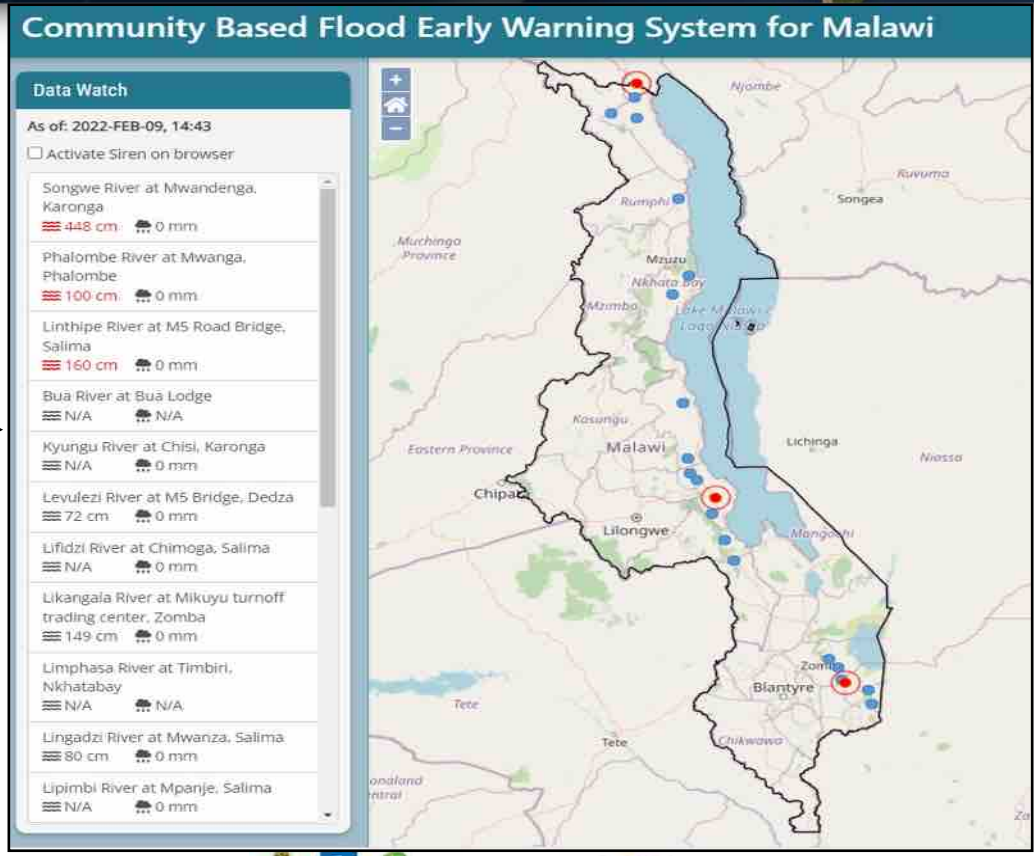
Integrated CBFEWS System Supporting DRR in Malawi



GSM Telemtry



REST API



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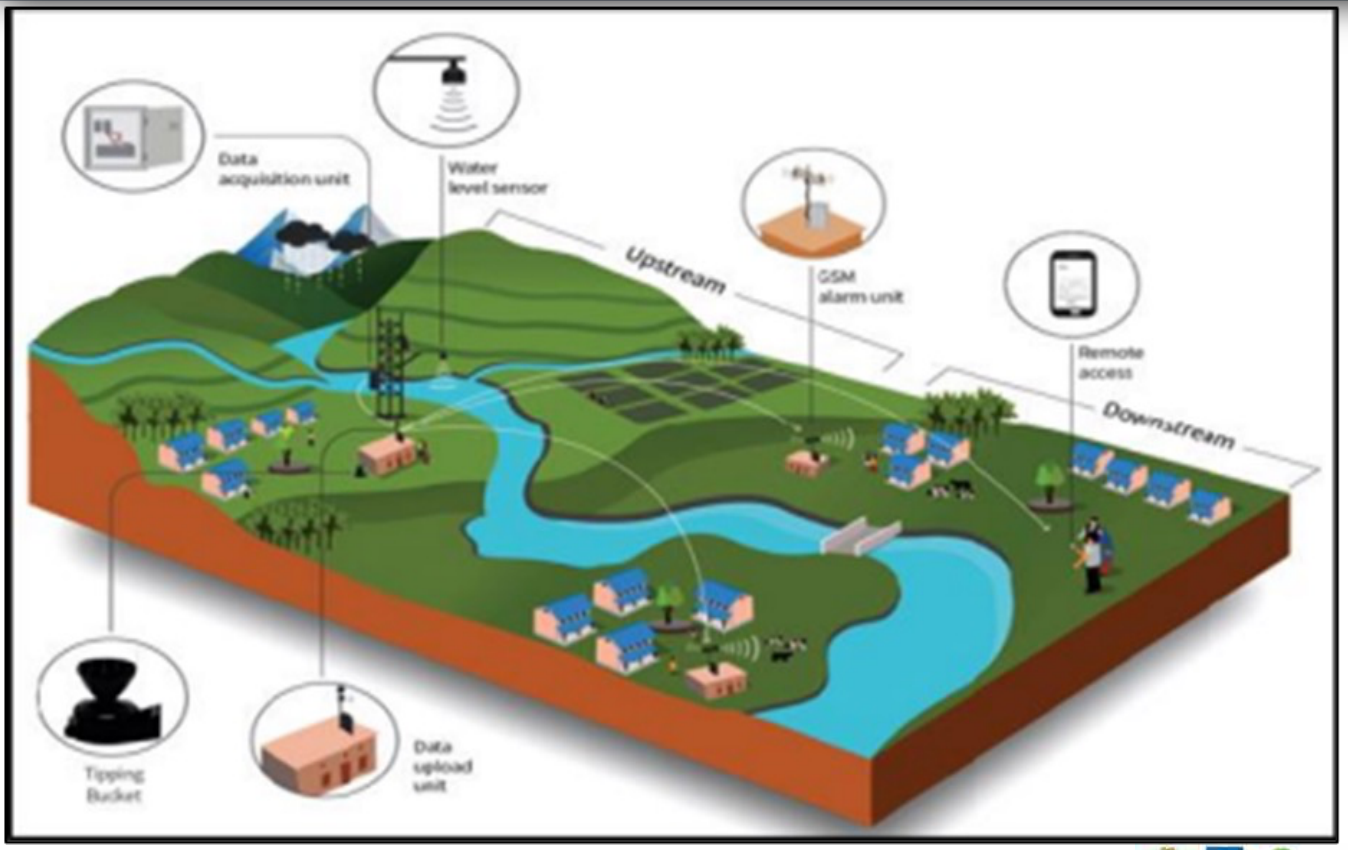
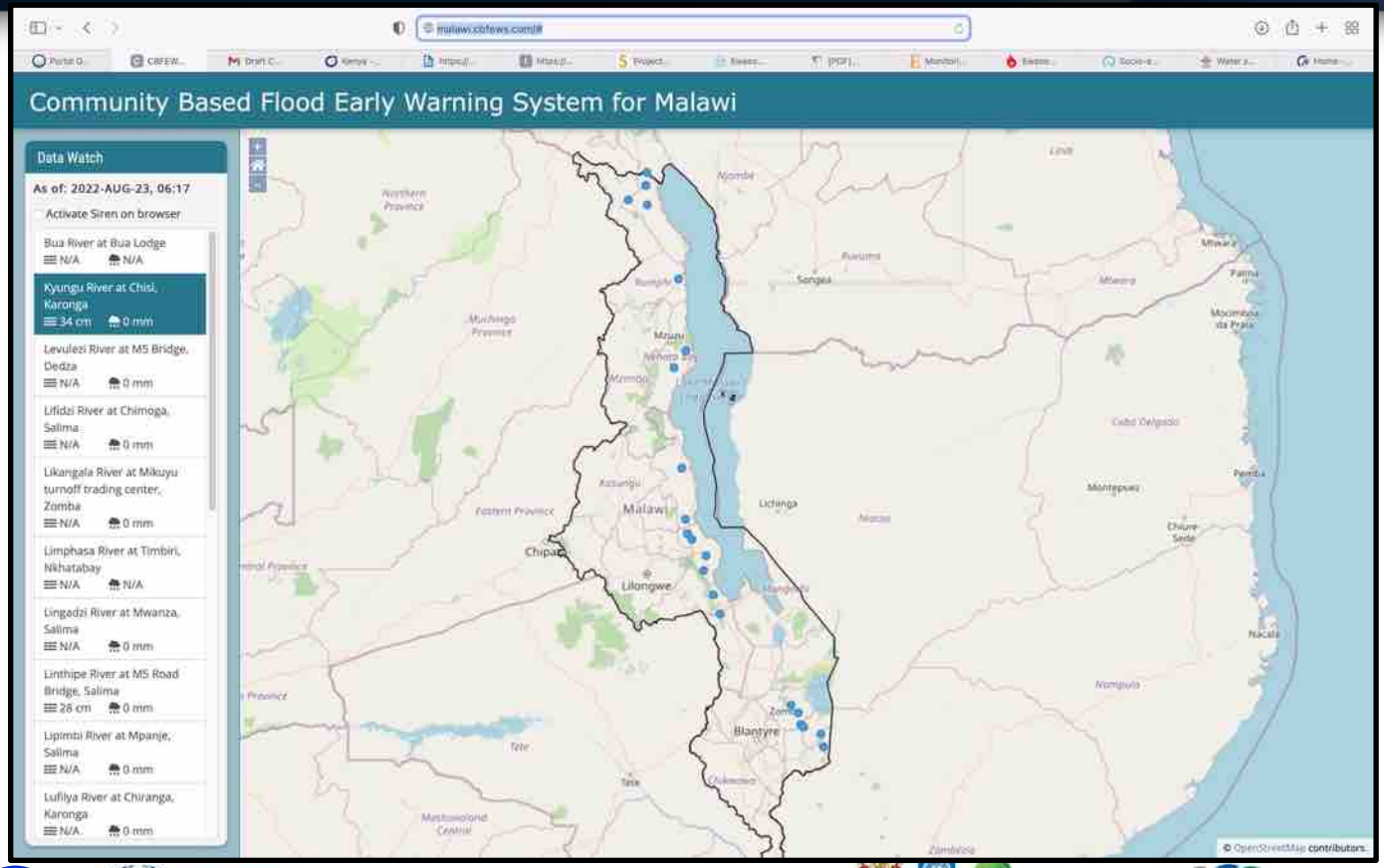
TELEMETRIC COMPONENT OF THE CBFEWS



- Water Level Sensor –in the river upstream (>14km)
- Community Caretaker (Upstream & Downstream - Alarm)
- Data Upload Unit
- Alarm/Siren installed in the floodplain
- Rain Guage
- Manual River flow gauge

Integrated Community-Based Flood Early Warning System

http://malawi.cbfews.com/#



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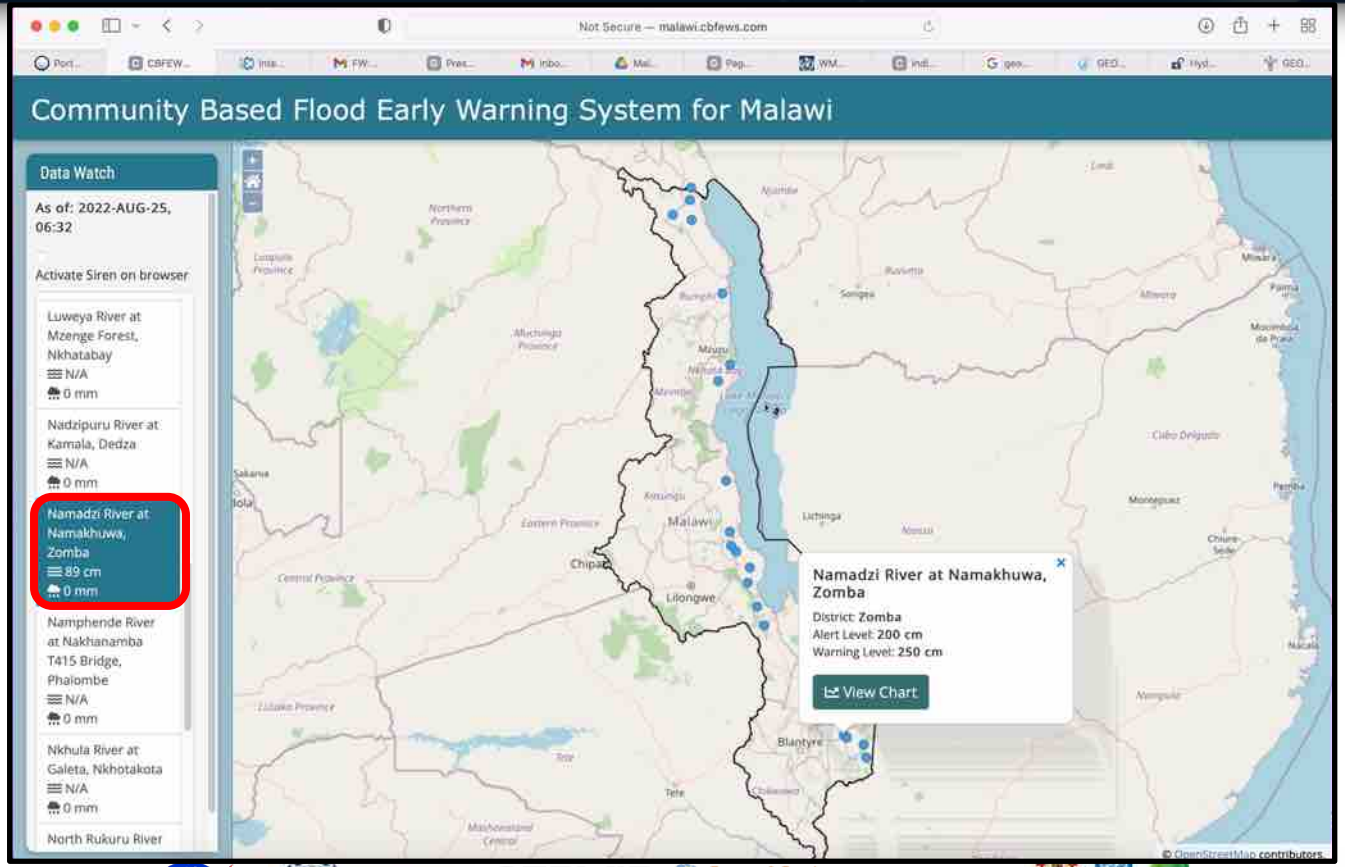
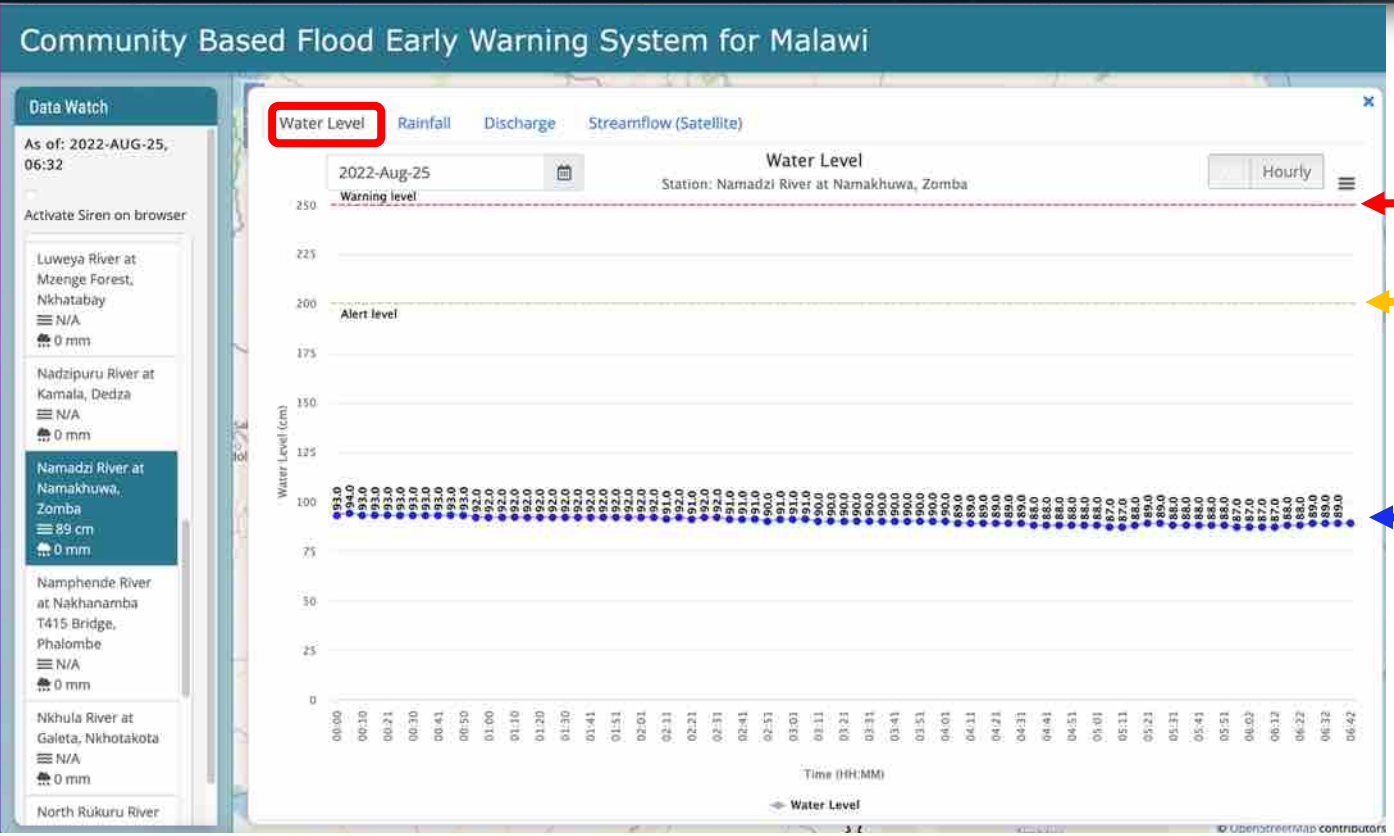
Community-Based Flood Early Warning System



Community-Based Flood Early Warning System

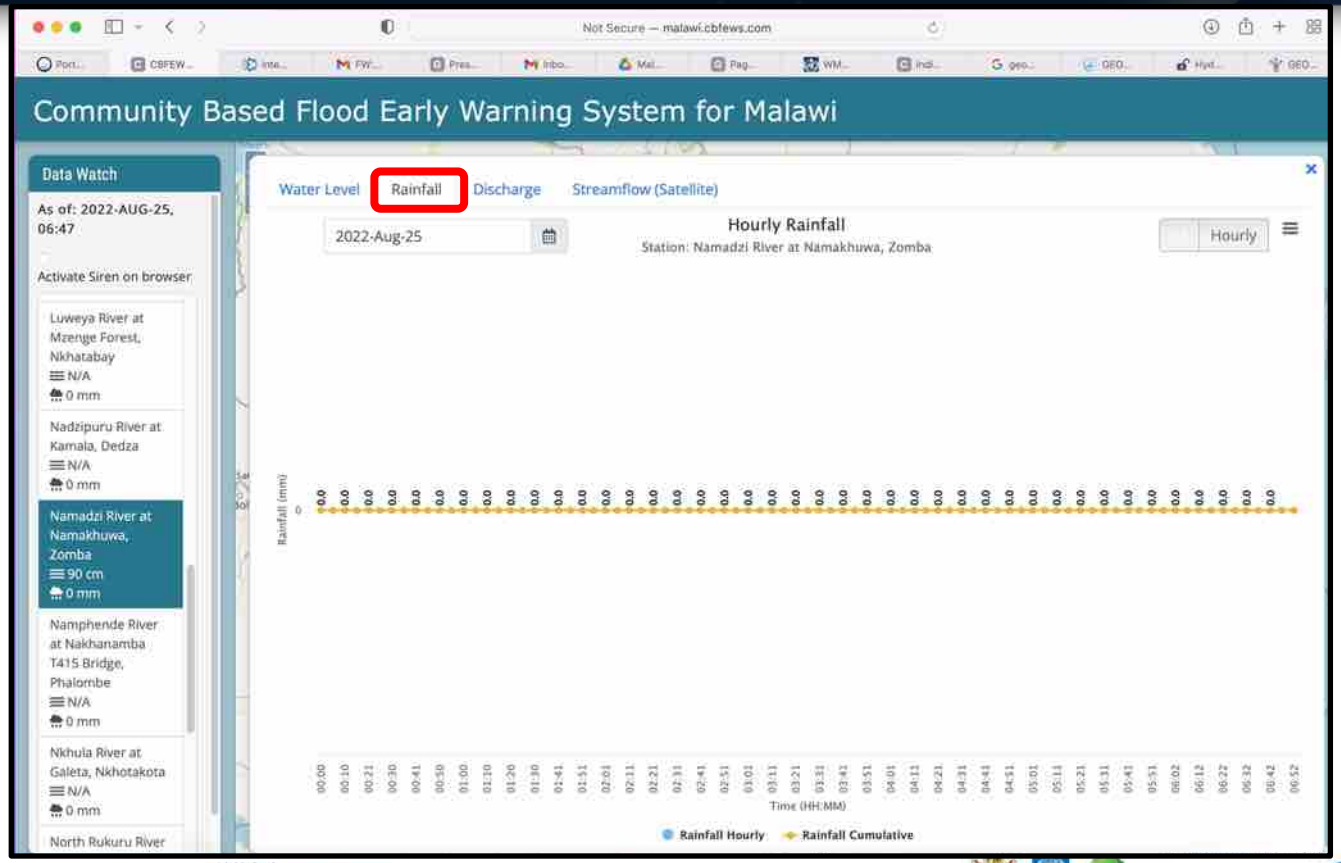


Flood Warning Level

Flood Alert Level

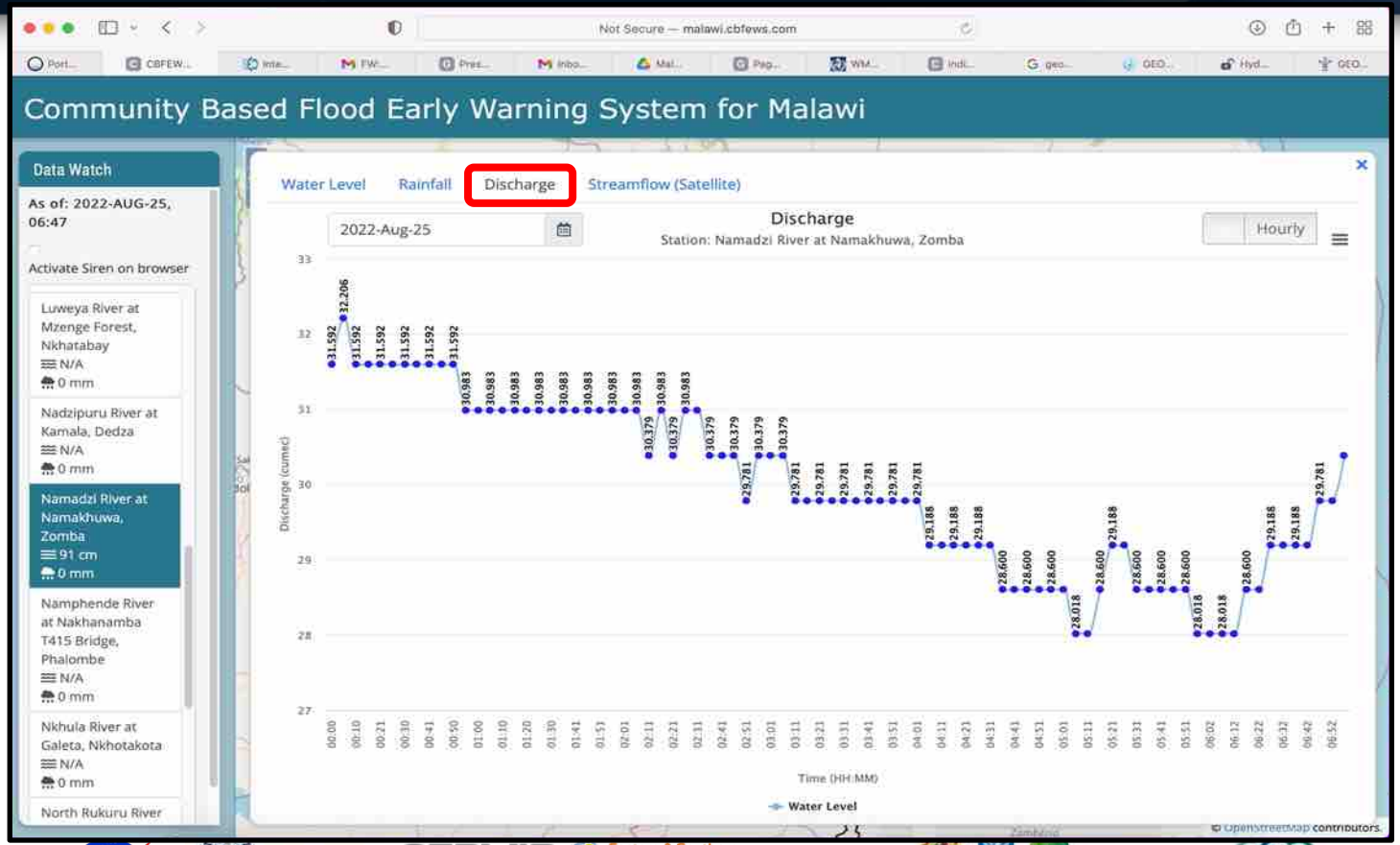
Current Water Level

Community-Based Flood Early Warning System



- Data from the Rain gauge at the Caretakers is used as a precursor to the flooding occurrence.

Community-Based Flood Early Warning System



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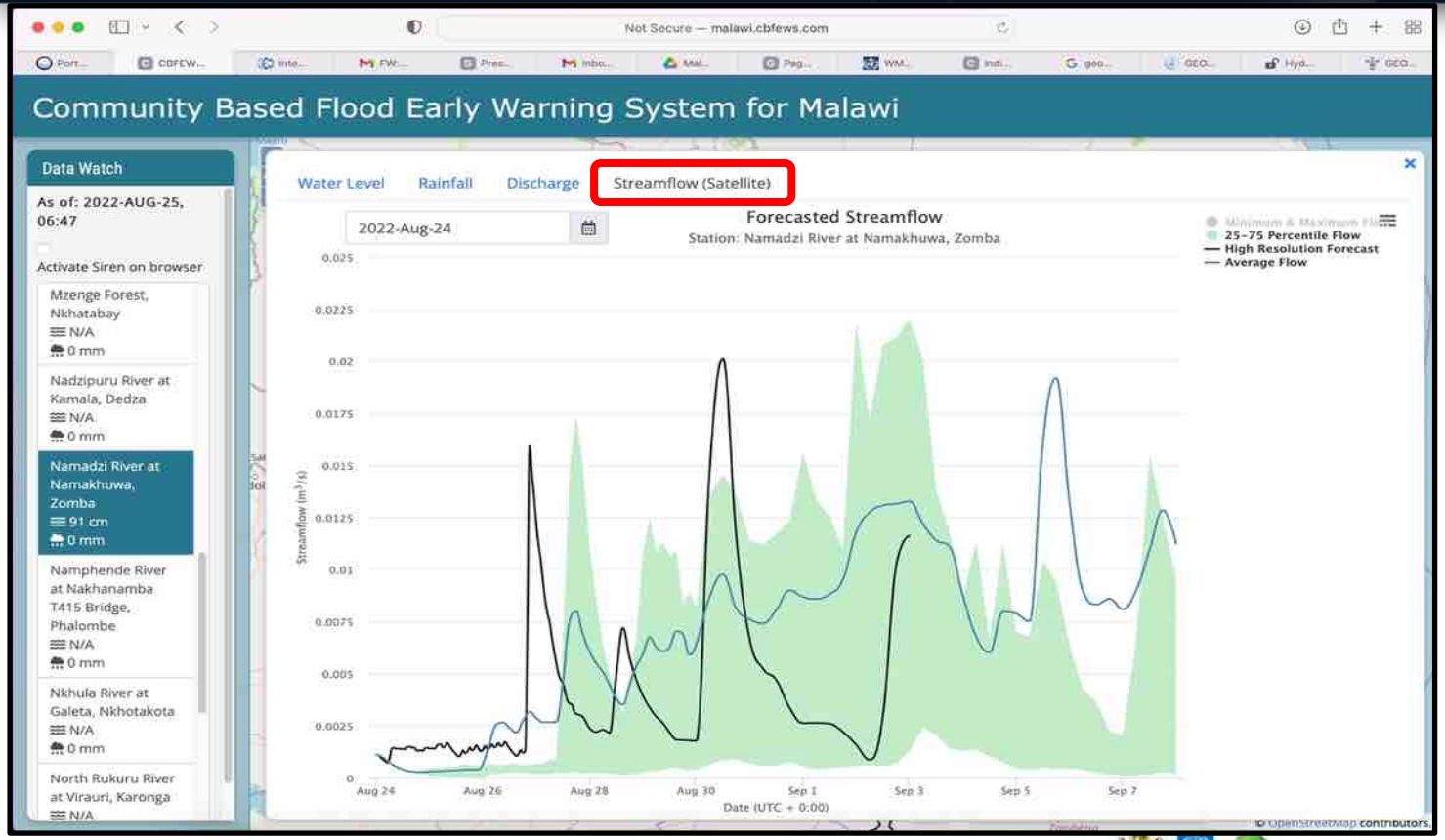
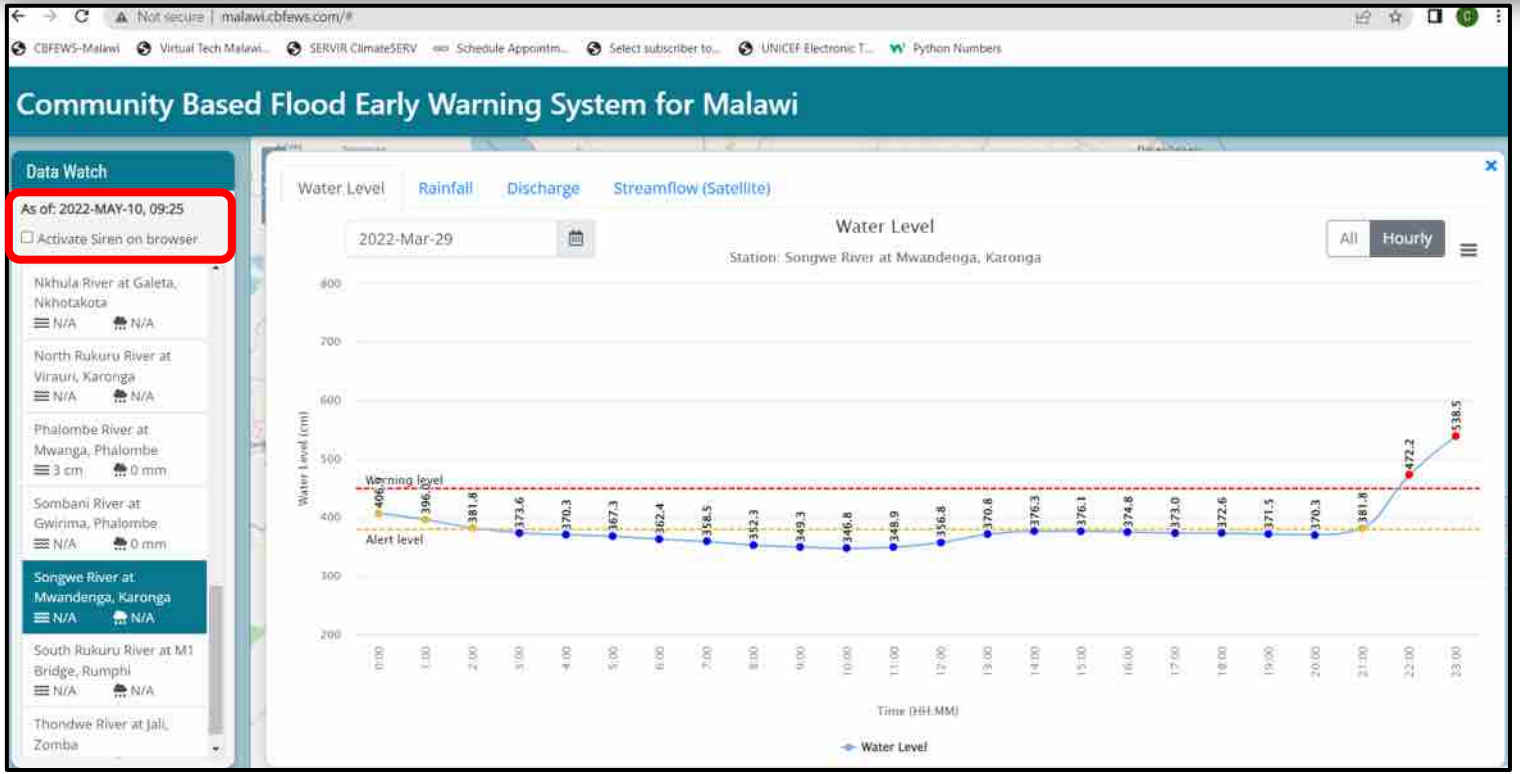


- Streamflow Satellite is from the GEOGloWS platform.
- The high resolution 10 days forecast is very necessary for anticipatory actions planning.
- Discharge values are very low and now the river is almost dry.

Community-Based Flood Early Warning System

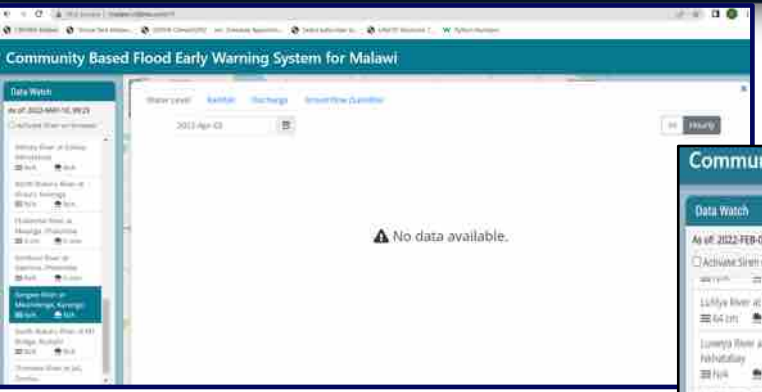


- Alarm and siren is activated when the telemetric water level reaches the Warning Level.

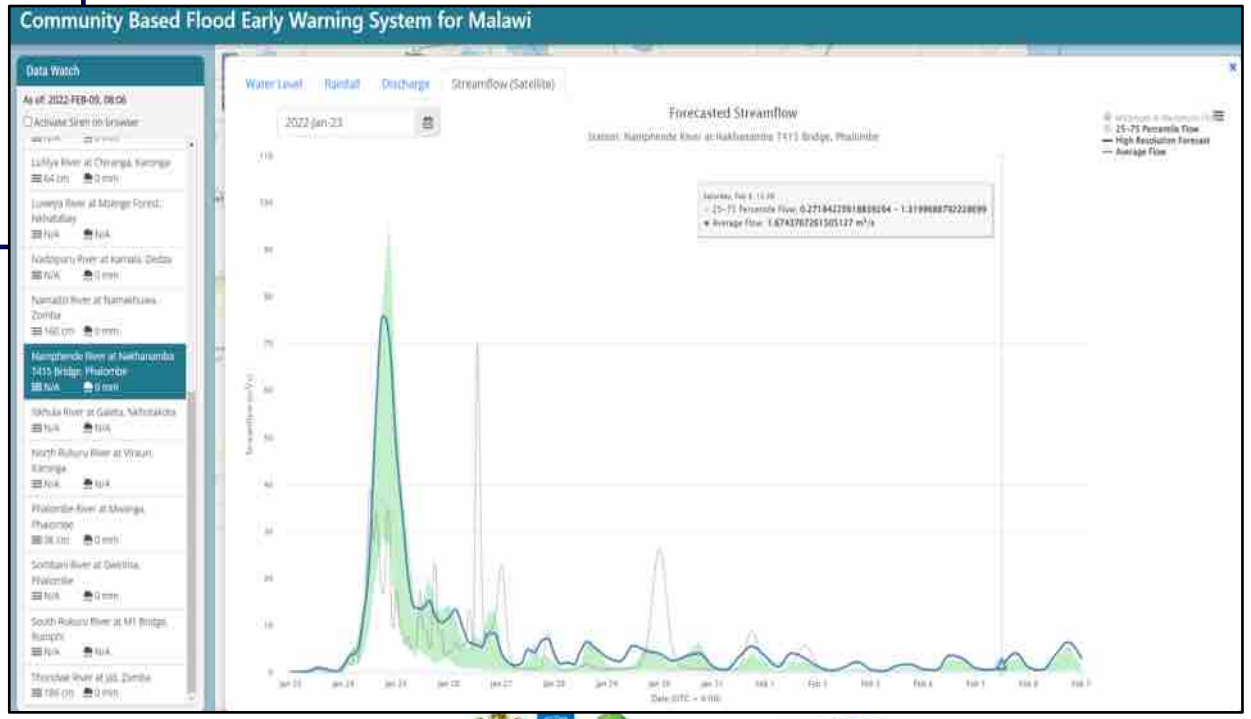
Community-Based Flood Early Warning System

- Flood recession.

Community-Based Flood Early Warning System



- GEOGloWS also compliments during the telemetric down time



CONCLUSION

- The integrated system currently support the government's efforts the upscaling and expansion of the use of Modernized Climate Information and Early Warning systems (M-CLIMES) in Malawi to enhance community preparedness and resilience and can also be used be NAP programmes,
- GEOGloWS implementation has increased the warning lead time from hours to days and complements the telemetric water level sensors during the downtime period. This capability enhances community preparedness and leads to early action that significantly reduces the flood disaster risks, as demonstrated during Cyclone Ana.
- GEOGloWS forecast data has been useful for **ANTICIPATORY ACTIONS and can be NAP programmes too.**
- The Government agency, DoDMA has planned to Upscaling the system into 10 Southern districts, frequently impacted by Cyclone related floods.
- Capacity building and inclusion of inundation forecasting and Streamline the warning information to community level understanding is key
- More partnership and collaboration for scalability and transferability is still needed.


THANK YOU
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