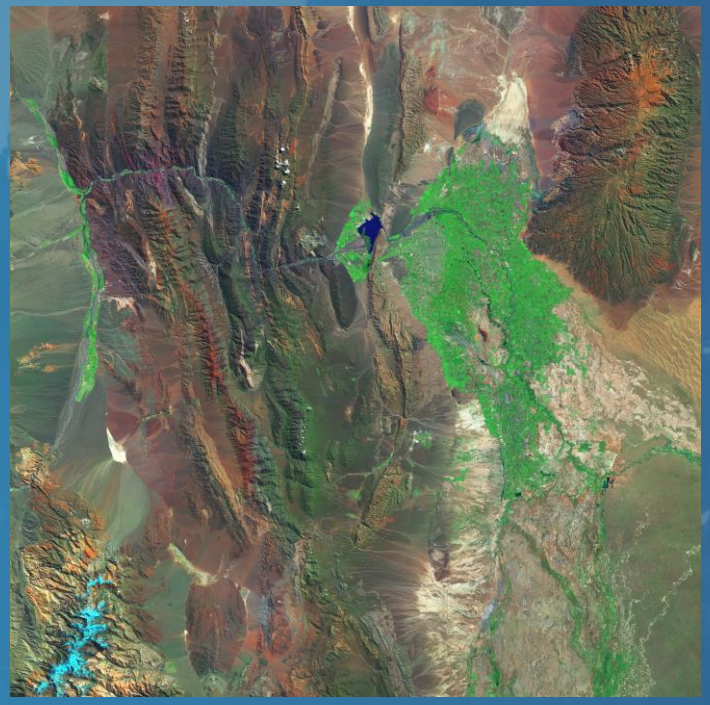
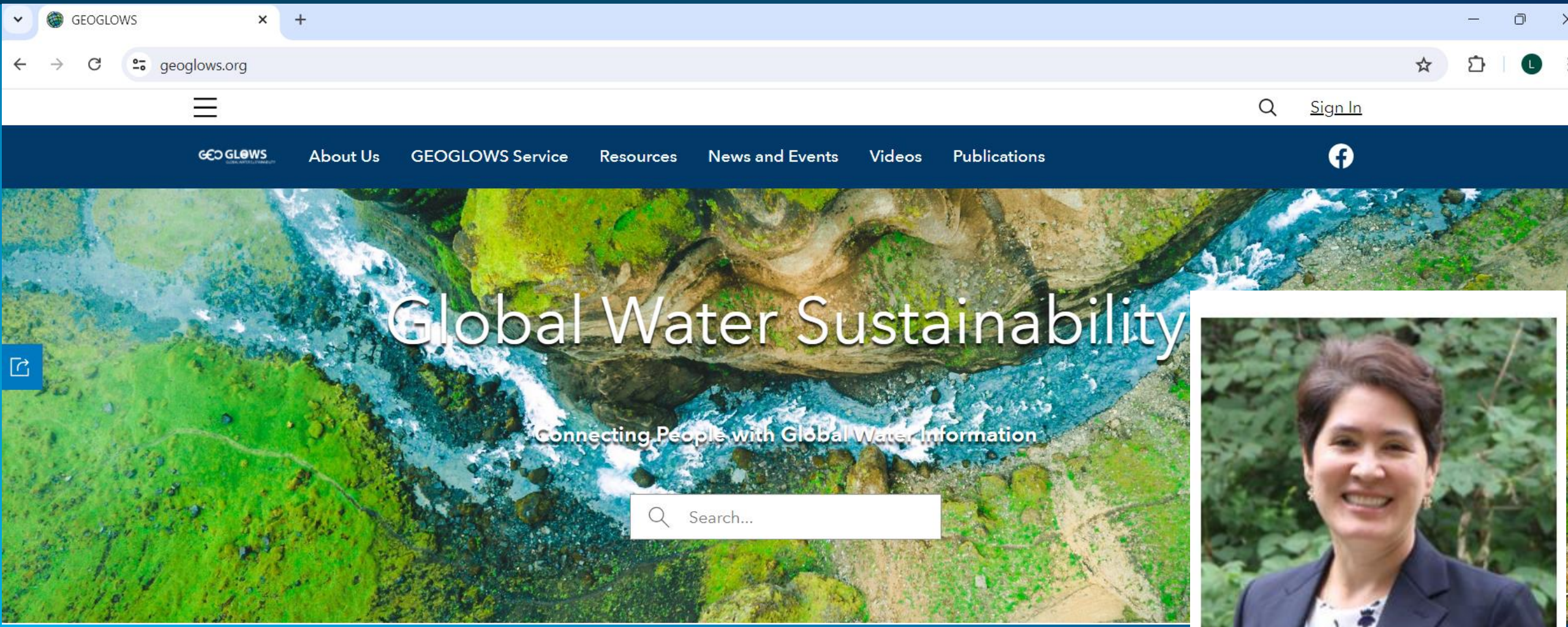

GEOGLOWS
GLOBAL WATER SUSTAINABILITY
Providing a service to deliver global water information for local decision-making
On behalf of the GEOGLOWS Team
NASA
USAID
SERVIR
AQUAVEO
THE WORLD BANK
European Commission
BYU
WMO
NOAA
aws
esri
ECMWF
copernicus

Group on Earth Observations

GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that **envisions a future where *decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations***.



GEO Global Water Sustainability Initiative



Dr. Angélica Gutiérrez | GEOGloWS Co-chair
National Oceanic and Atmospheric Administration (NOAA) - USA
Office of Water Prediction

GEOGLOWS - Overview

Objective Summary:
GEOGLOWS leverages partnerships, resources, and data, to deliver accurate, open, and accessible hydrological predictions on a global scale, playing a vital role in addressing complex water resource management challenges.

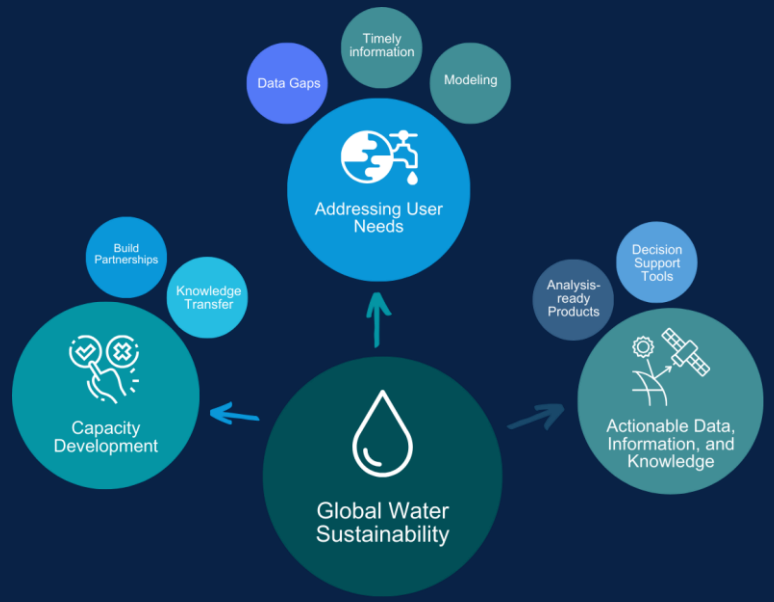
Organizations

- NASA
- NOAA
- ECMWF
- BYU
- Aquaveo
- Esri
- USAID
- WMO
- World Bank
- Amazon Web Services

Programs

- NASA - SERVIR
- NASA - Water Resources
- NOAA\NASA Satellites for flood mapping

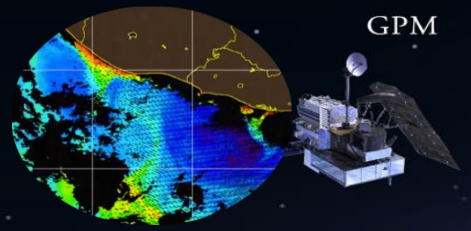
GEOGLOWS Objectives



GEOGLOWS GLOBAL WATER SUSTAINABILITY Partnerships

SERVIR GLOBAL

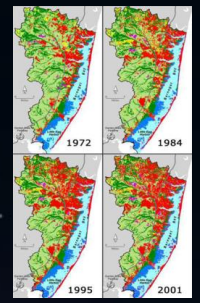
Weather and Climate

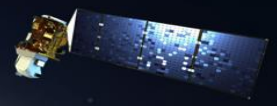


Food Security

Water and Disasters

Land Use Change





Resilience In…

ICIMOD

CILSS

RCMRD

adpc

CIAT

Biodiversity International

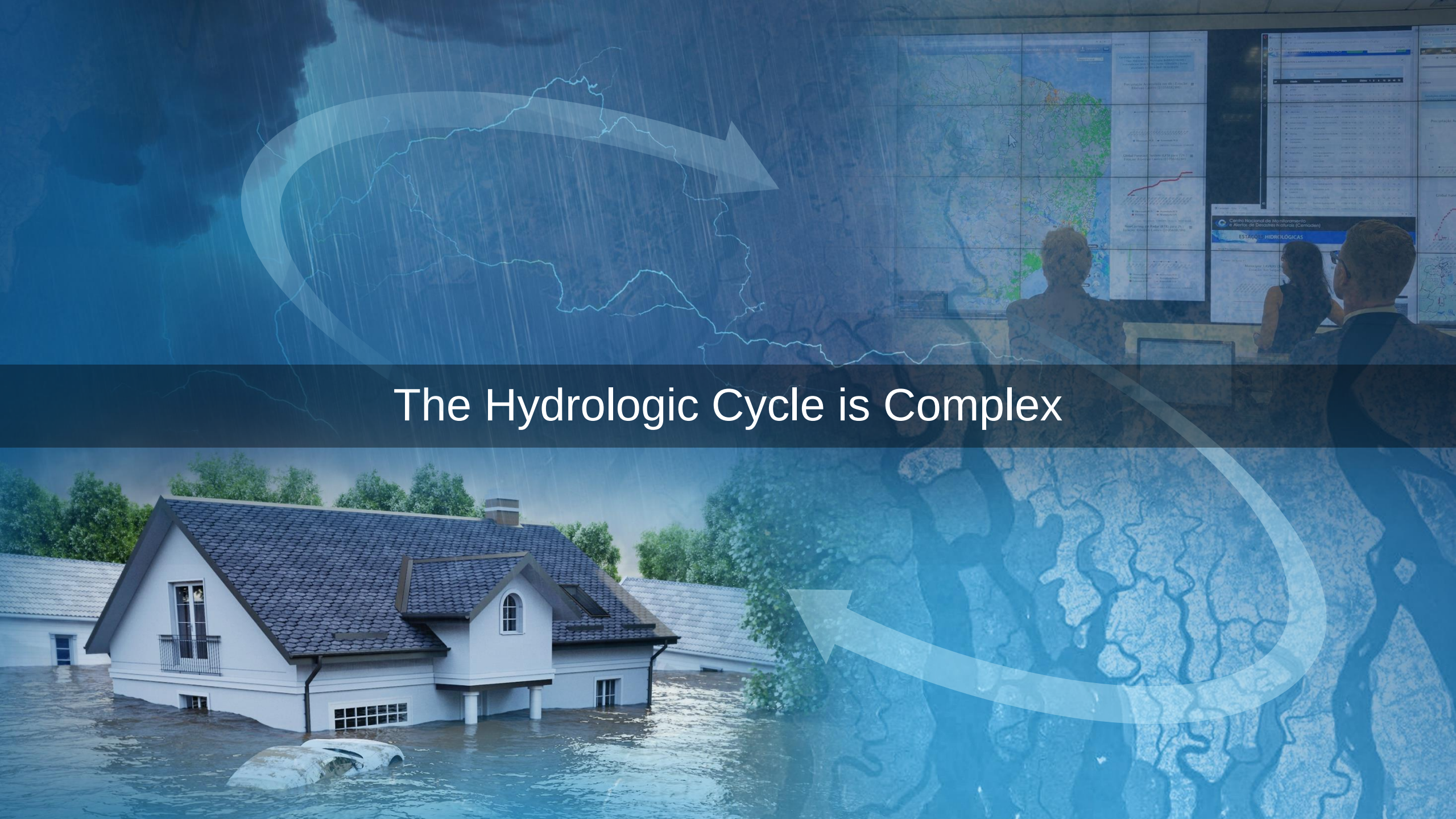
NASA

SERVIR

Connecting Space To Village

USAID FROM THE AMERICAN PEOPLE

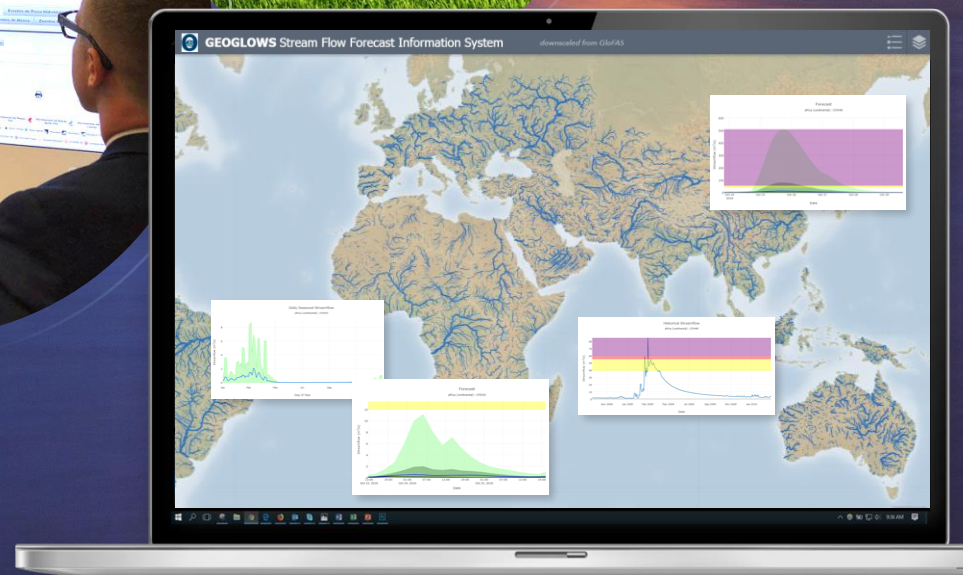
NASA



The Hydrologic Cycle is Complex

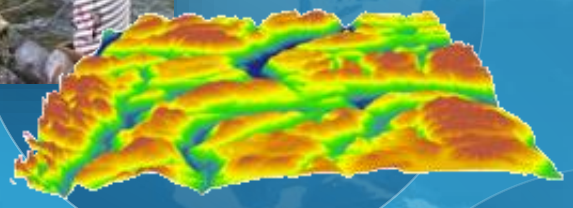
Improving Water Intelligence…

- Understanding of the hydrologic system is incomplete
- Lack of information = Uninformed decisions
- It is our responsibility to find better solutions

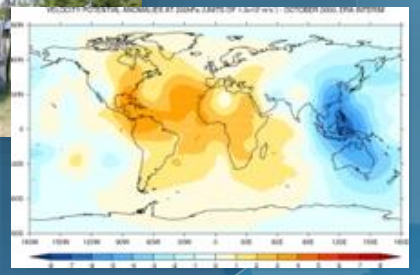


In Situ Streamflow Monitoring Systems

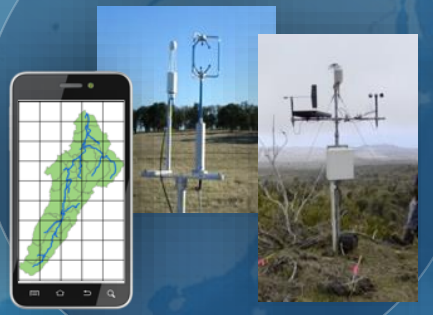
Water Quantity and Quality



Rainfall & Snow

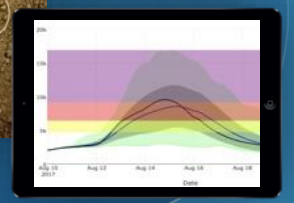


Meteorology

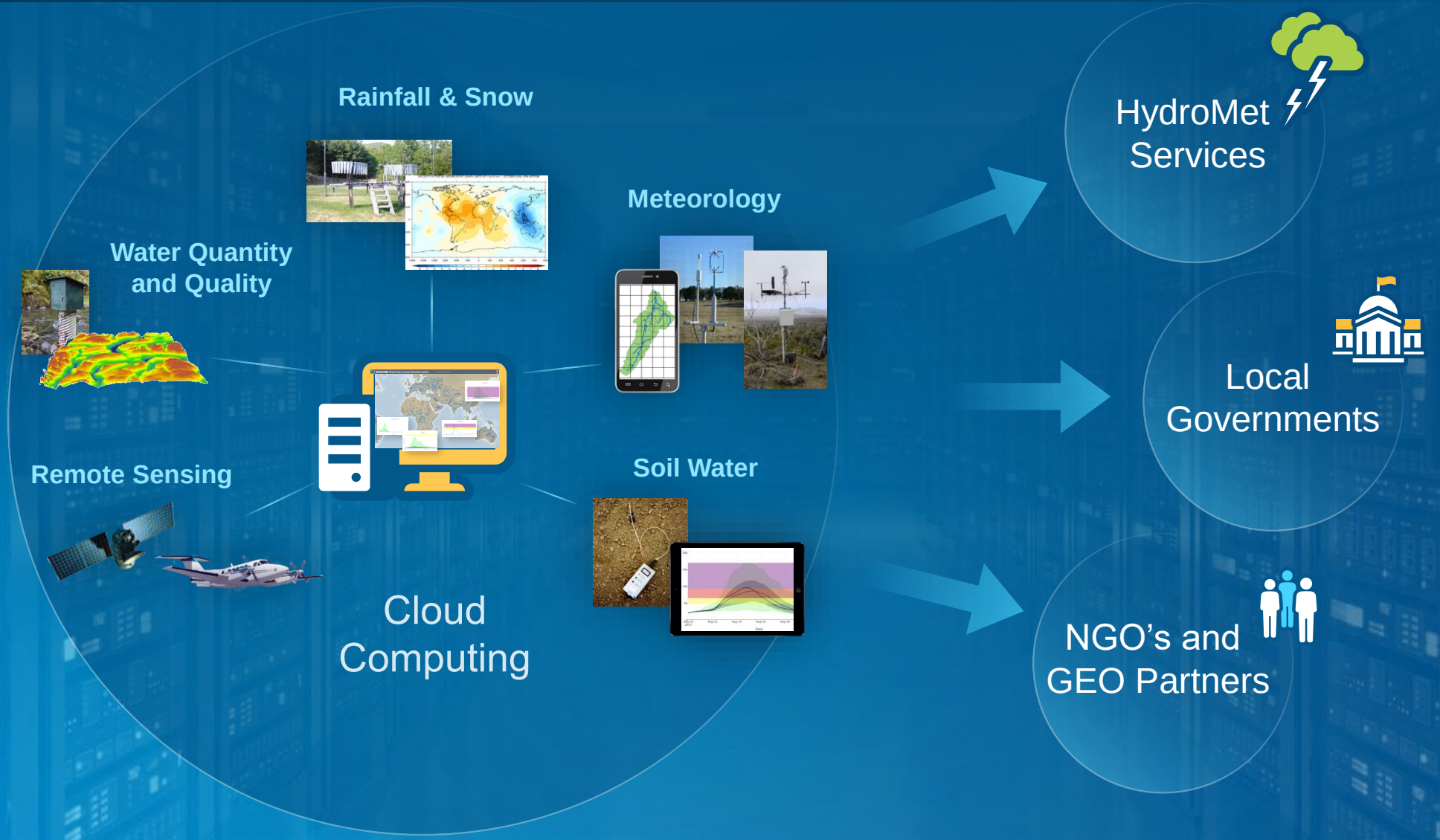


Remote Sensing

Soil Water



Leveraging Advances in Earth Observations



Actionable Intelligence: Hydrologic Modeling

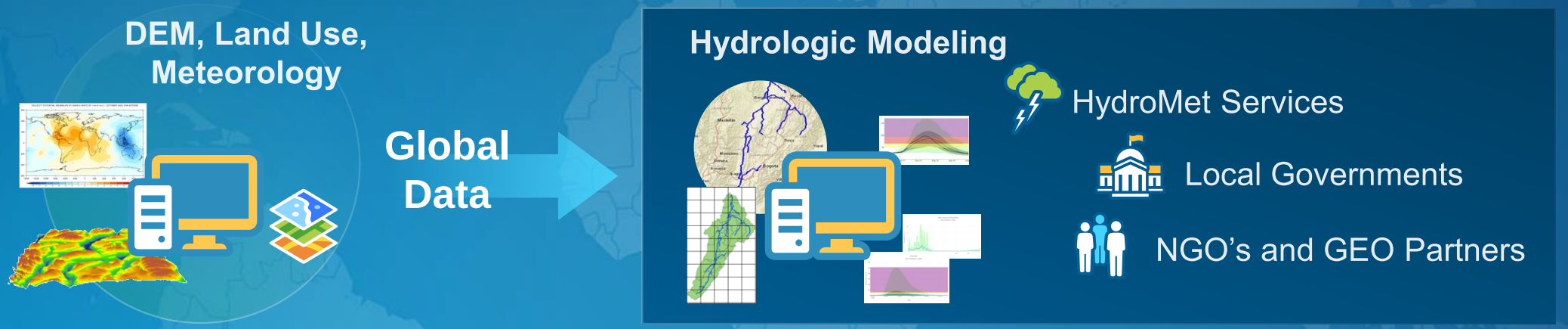
Understand

Predict

Manage

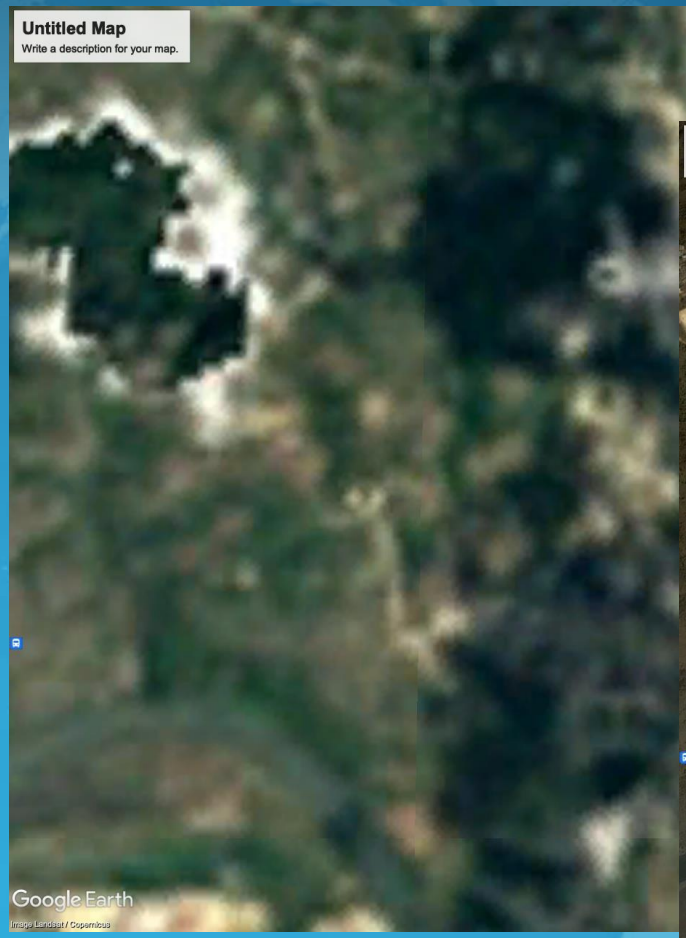
Global Streamflow Services – A Paradigm Shift

PAST – Individual Hydrologic Forecasting

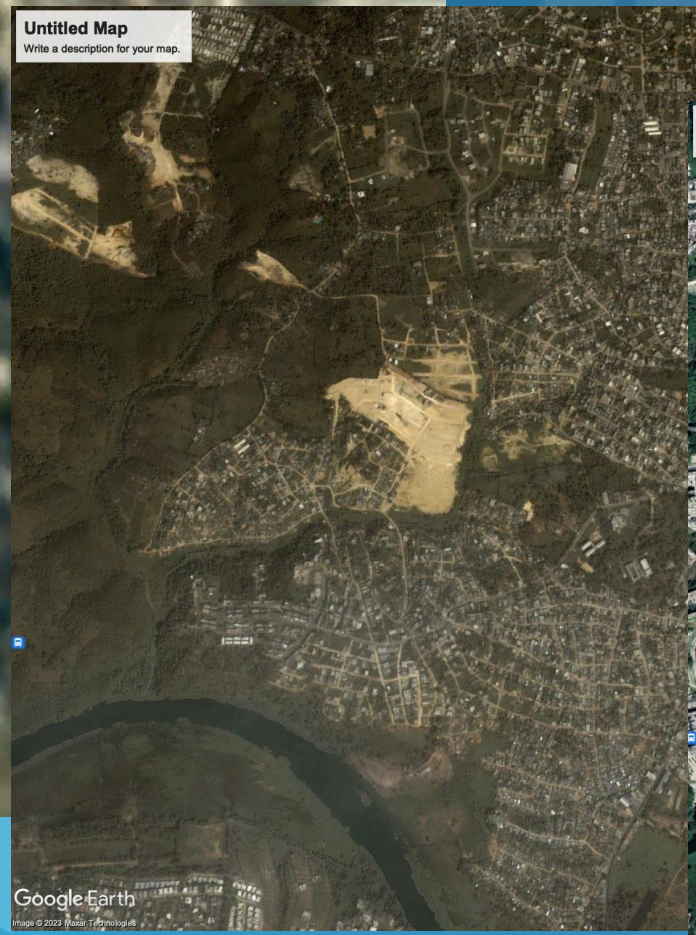


NOW – Global Hydrologic Forecasting

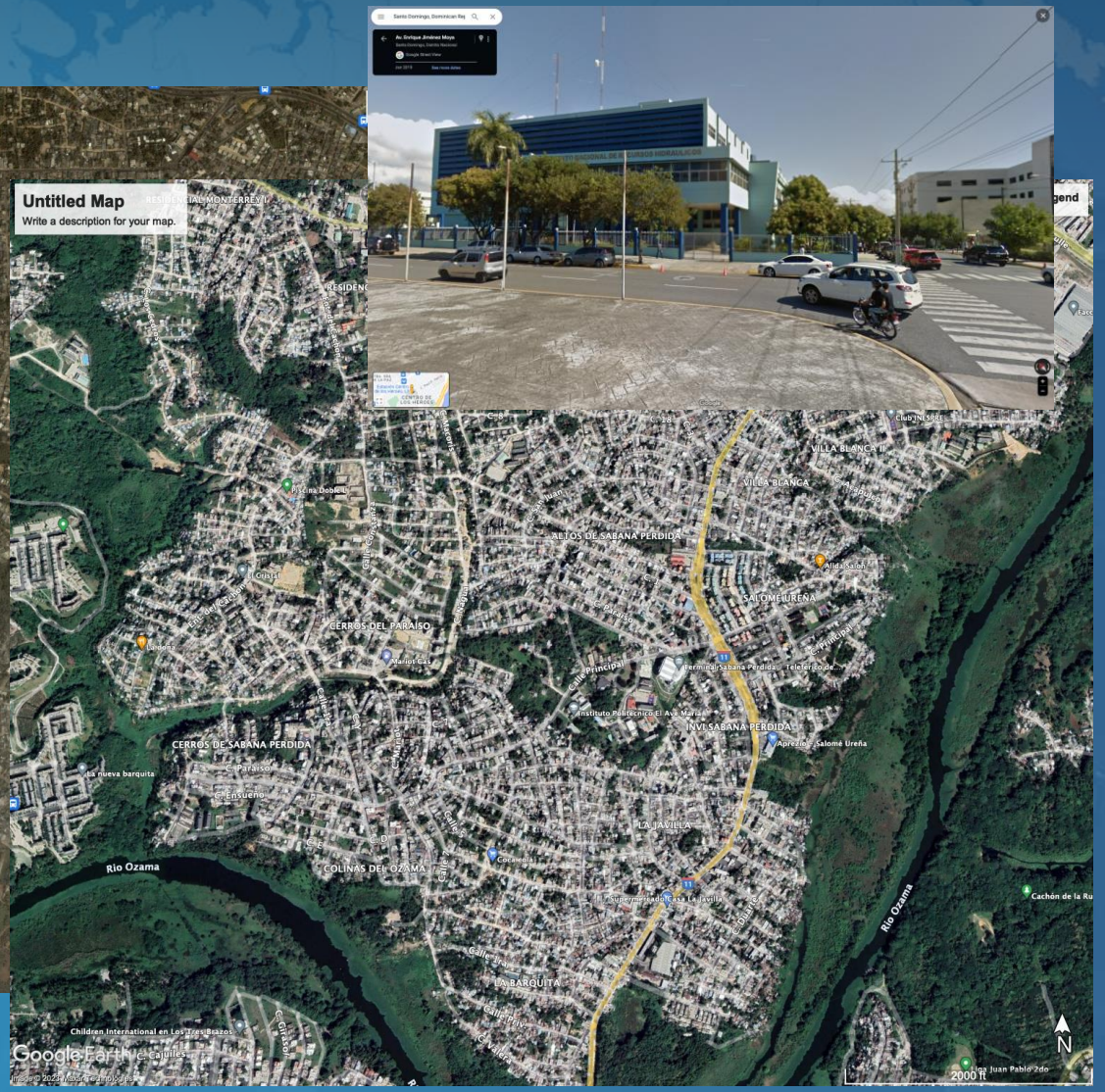
Like Google Earth Imagery – Benefits Over Time Help All



1985

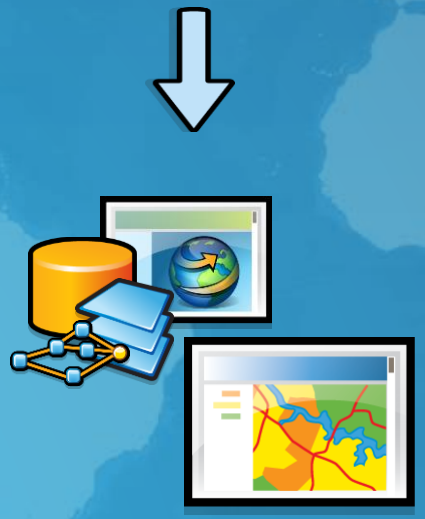


2000



2022

Global Modeling Barriers to Overcome



Cyberinfrastructure and Workflows

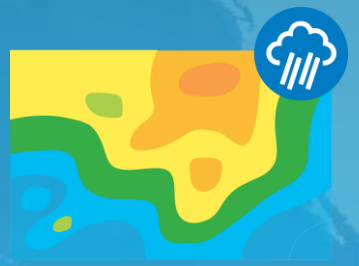
Web apps and web services

Partnerships, trainings, and collaboration

Accessibility tools and programmatic extraction

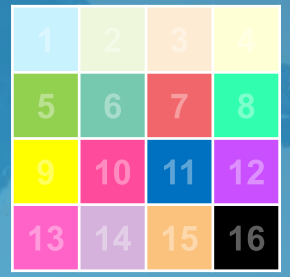
GEOGLOWS Basic Model Formulation

Meterological Forecast

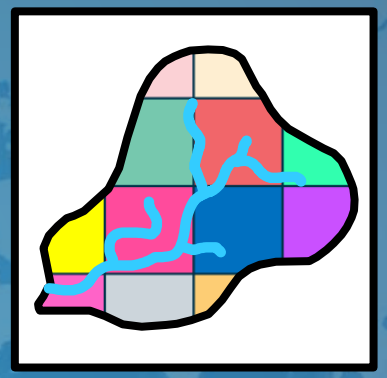


ECMWF land surface model (GloFAS, ERA 5)

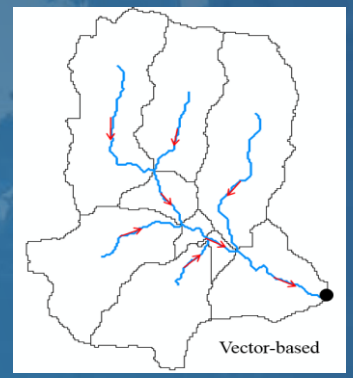
Runoff Grids



GIS Overlay (grid runoff to basins)



Muskingum Routing

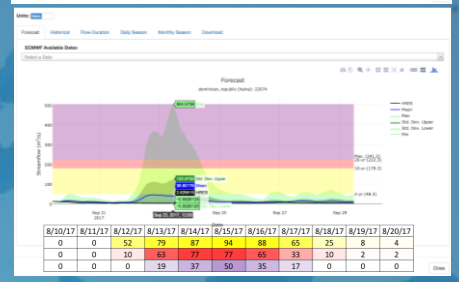


Watersheds (new data product)

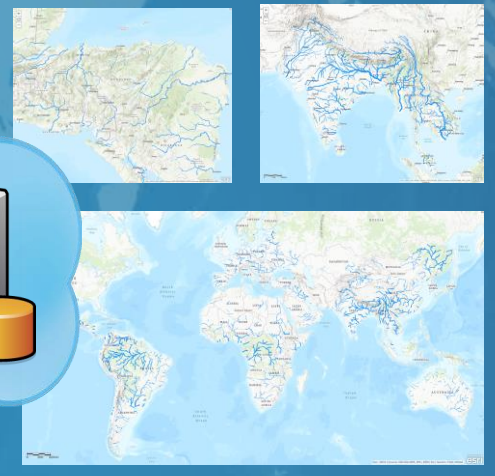
GEOGLOWS ECMWF Streamflow Services

Web Services

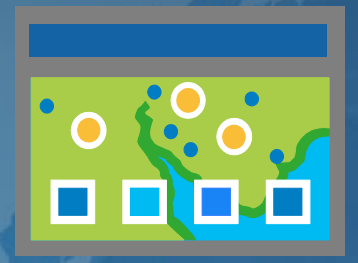
Custom Web Apps



Streamflow API at ECMWF

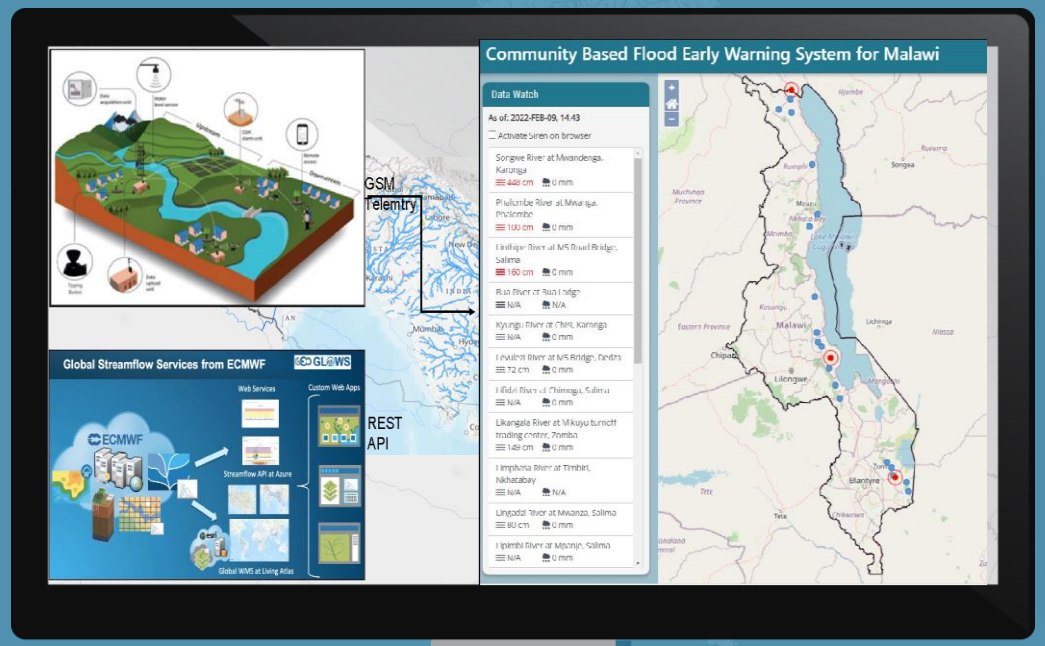


Global WMS at Living Atlas



Providing Actionable Information

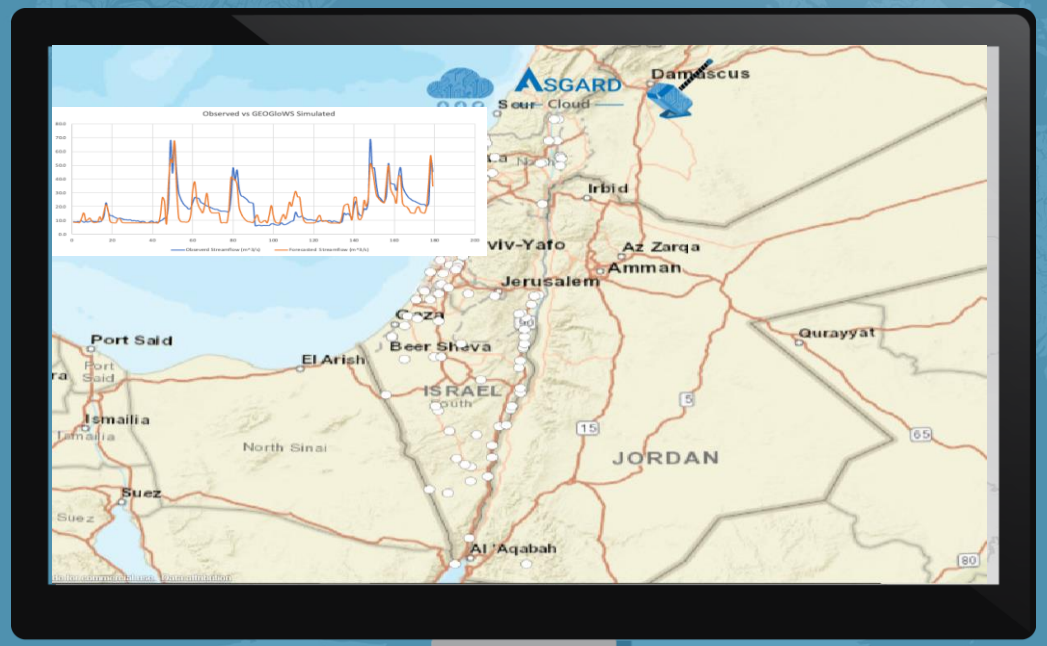
Malawi



Samuel Gama

"... GEOGLOWS has extended warning lead time from hours to days"

Israel



"... Separately calibrated GEOGLOWS to several stations in Israel and Gaza "

Amir Givati

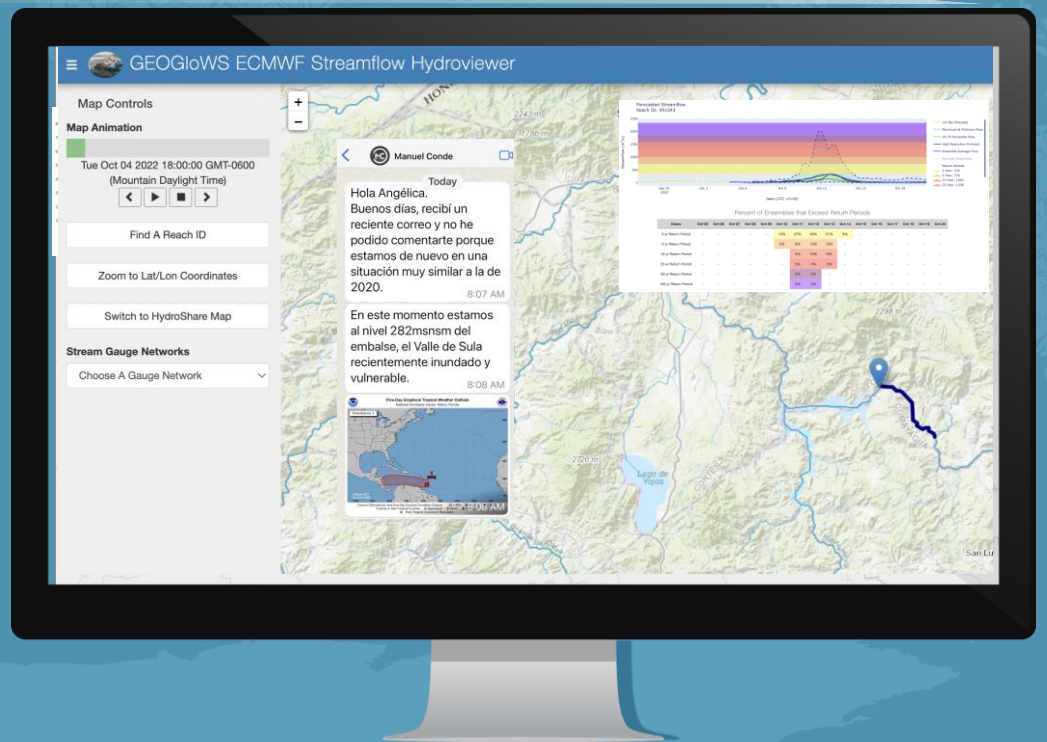
Honduras

“… Helped manage reservoir releases during back-to-back hurricanes Eta and Iota”

Manuel Conde

Guatemala – Central America

"… GEOGLOWS is used by CEPREDENAC to provide hurricane early warnings"

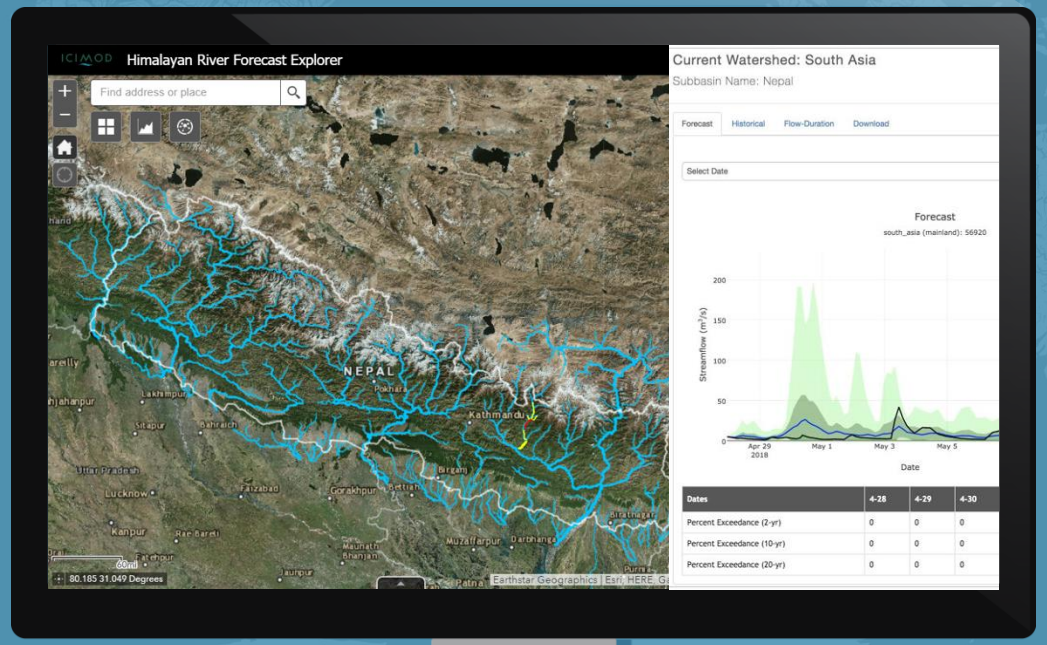


Claudia Herrera

Nepal

"... important supplement to other data and models used by DHM, with the real possibility of saving lives and property"

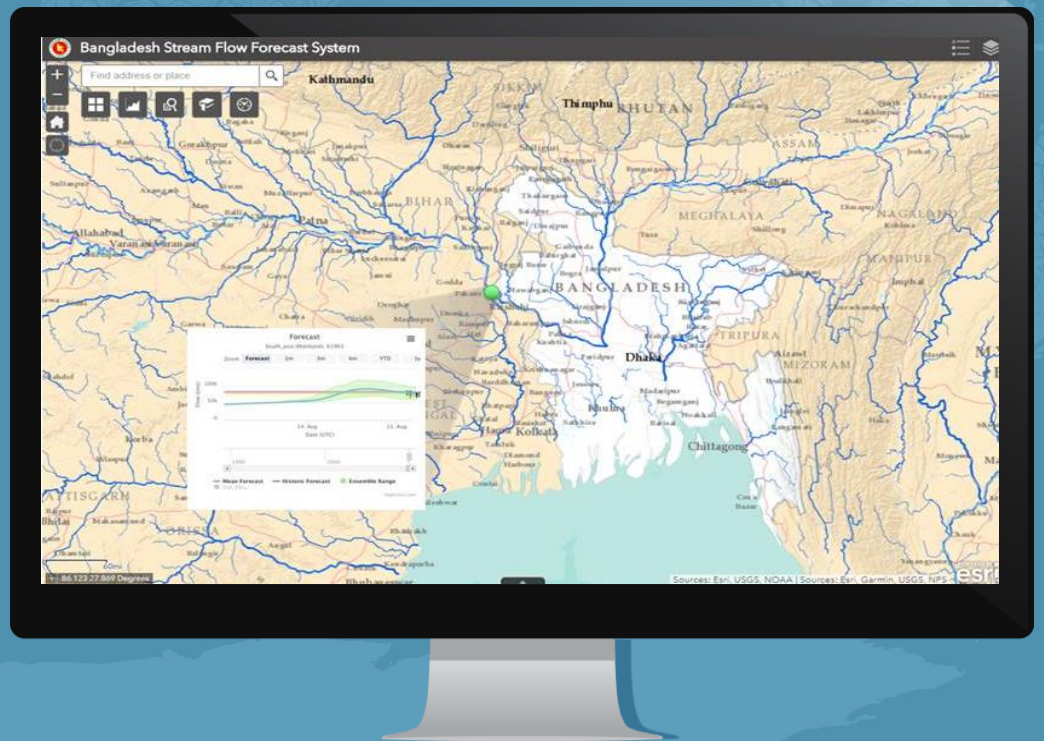
Ram Gopal
Deputy Director DHM



Bangladesh

Saiful Hossain
Superintendent Engineer
FFWC

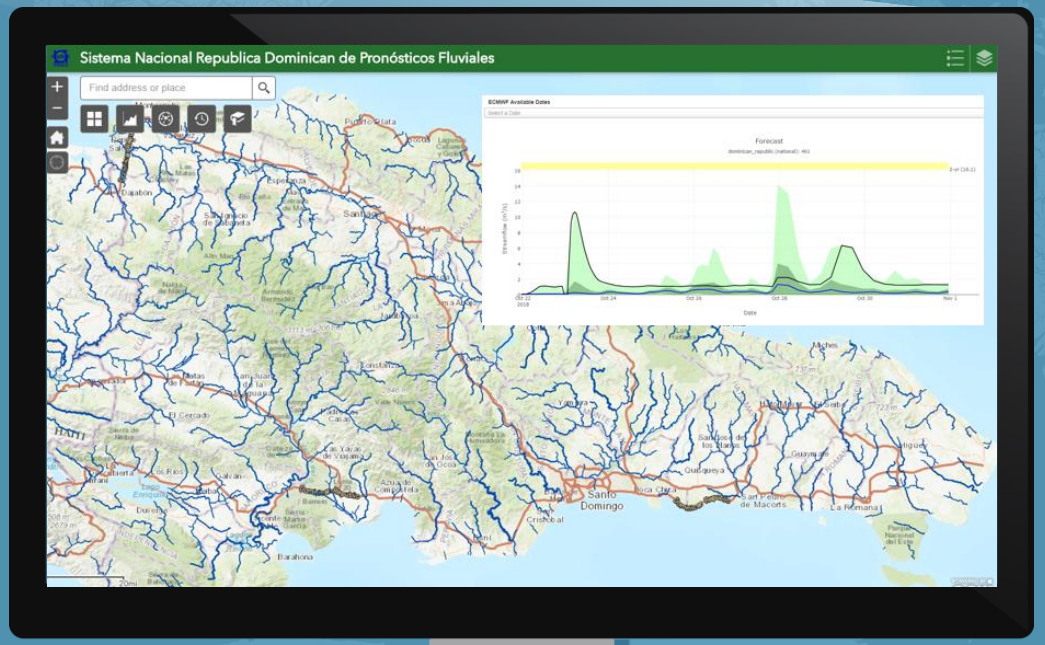
"... fills the critical need of forecasting transboundary flows with greater lead time"



Dominican Republic

Reservoir Inflows

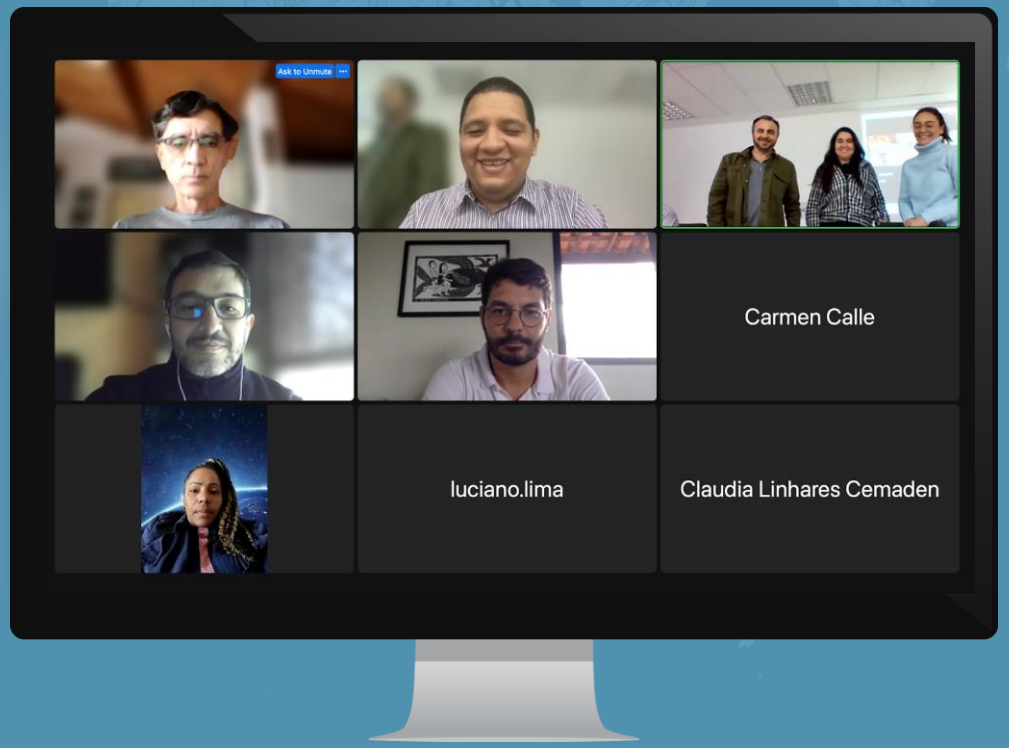
Combined with
WMO Flash Flood Guidance



Israel Acosta
Directory Hydrology
INDRHI

"... providing a benefit where otherwise we do not have the internal capacity."

SERVIR Amazonia

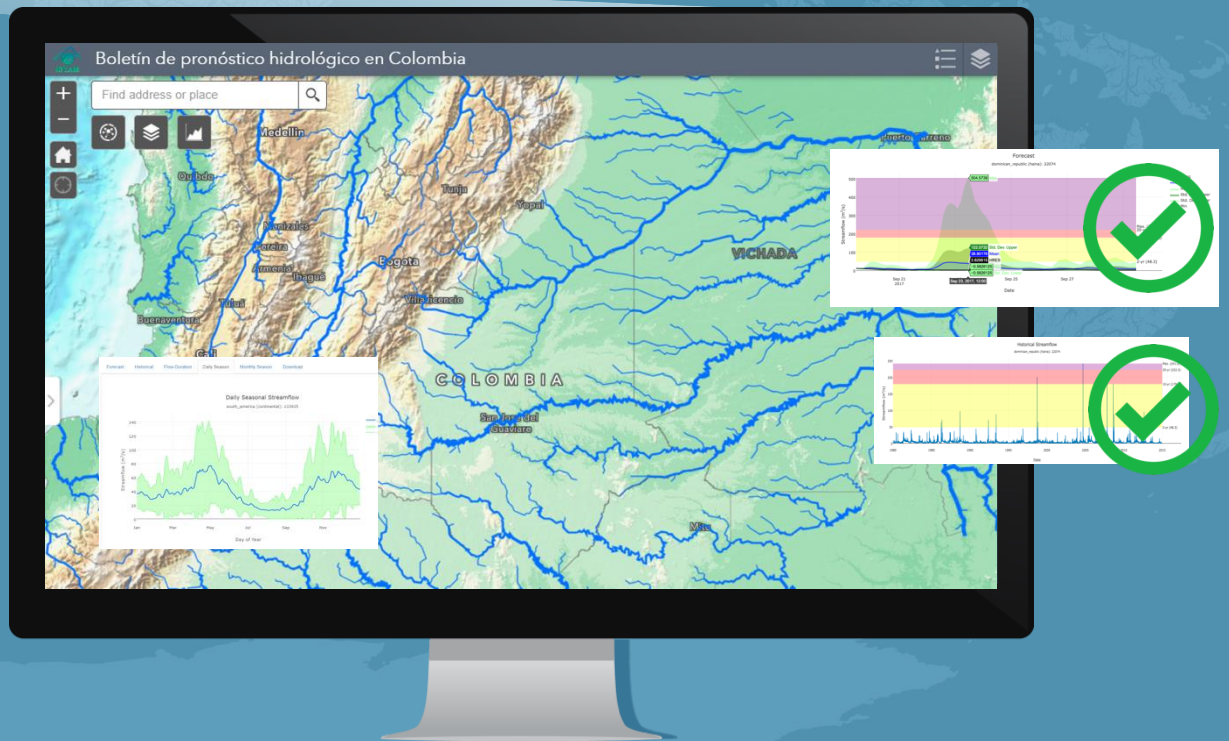


"... held 28 capacity building workshops training more than 300 in the last three years"

Colombia

Yolanda González Hernández
Director IDEAM

"... better understand the climate in vast areas of our country where we are lacking information."



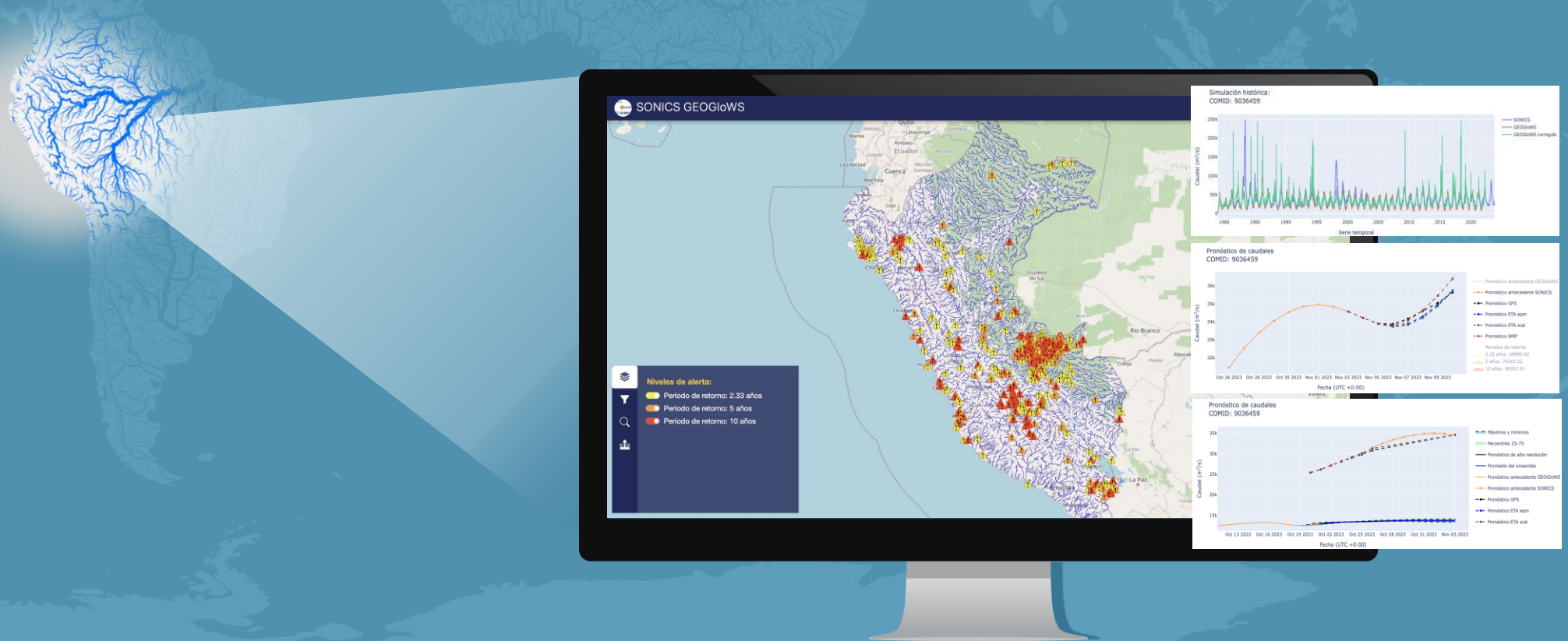
Ecuador

Bolivar Erazo
Director Inamhi

"... Increased capacity at Inamhi to provide hydroinformatics to stakeholders"

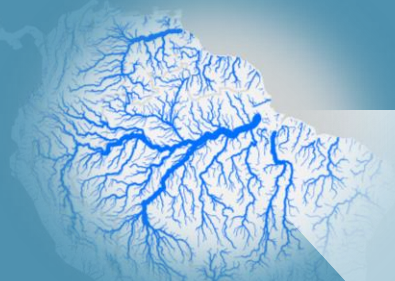
Peru

"... combined with local hydrological model SONICS"

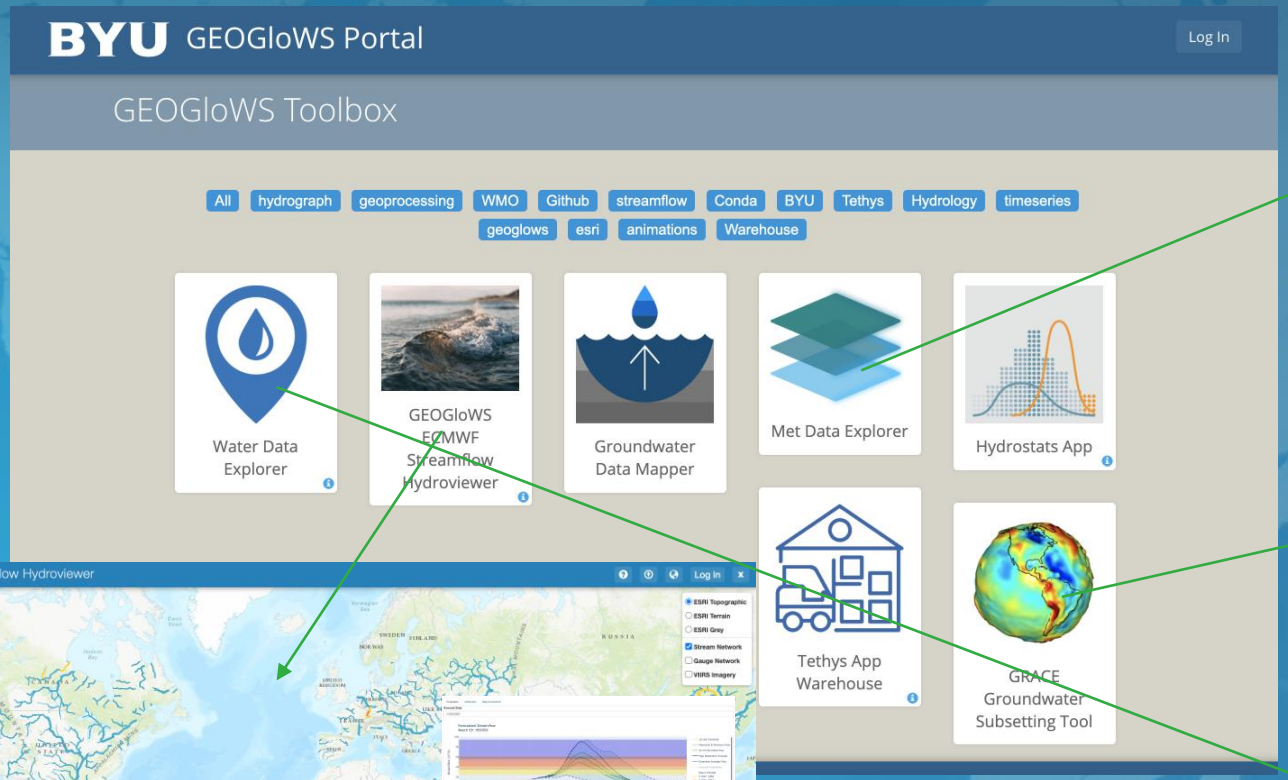


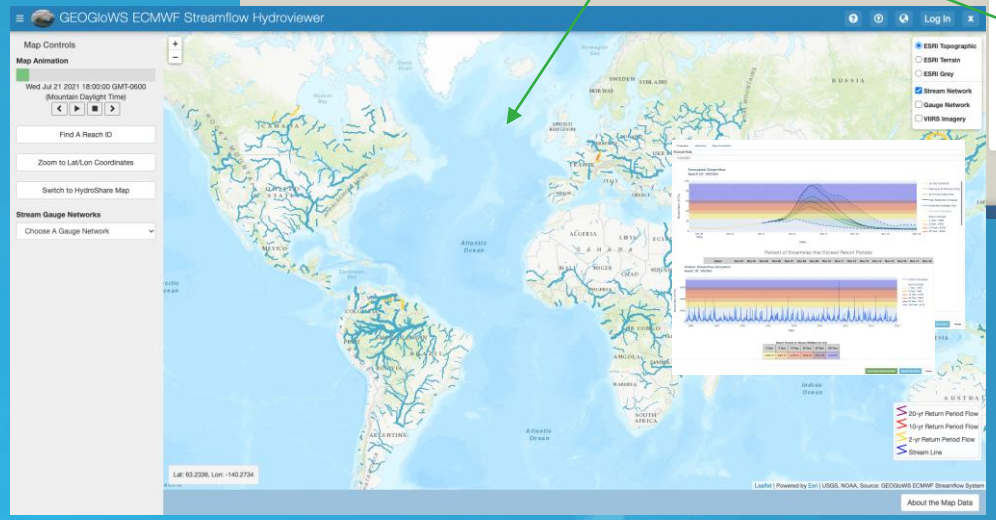
Brazil

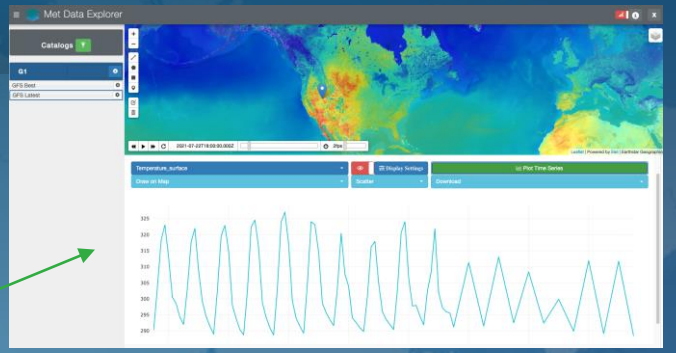
"... adding to the capability of CEMADEN to provide disaster warnings"

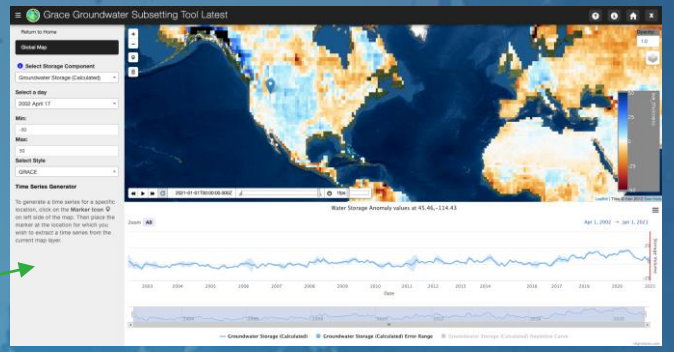


GEOGLOWS Toolbox Customization









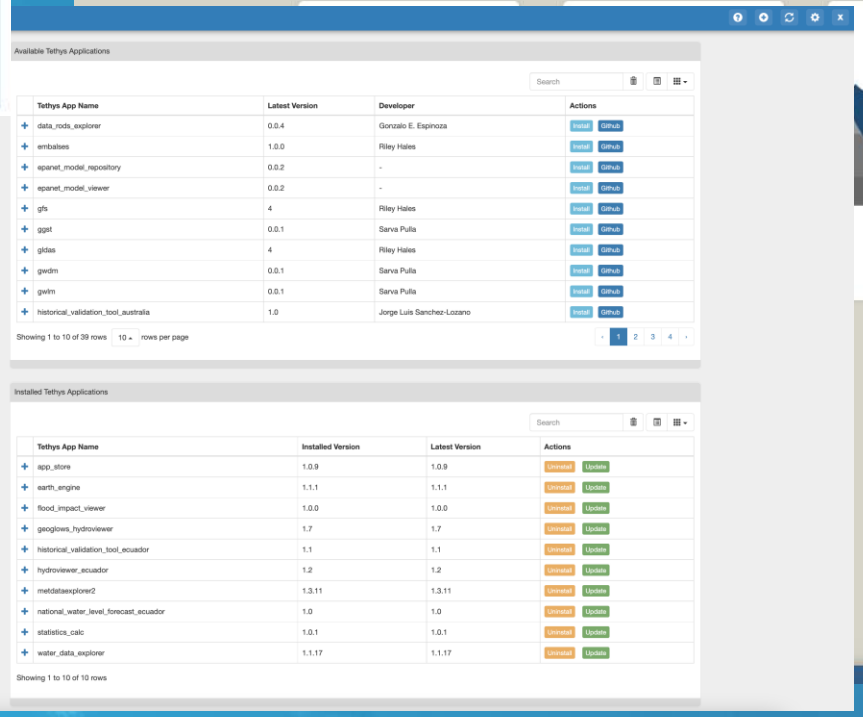
The App Store – Sharing Resources

BYU GEOGloWS Portal

Log In

GEOGloWS Toolbox

All | hydrograph | geoprocessing | WMO | Github | streamflow | Conda | BYU | Tethys | Hydrology | timeseries | geoglows | esri | animations | Warehouse

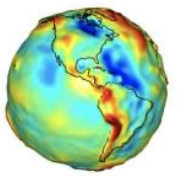


Groundwater Data Mapper

Met Data Explorer

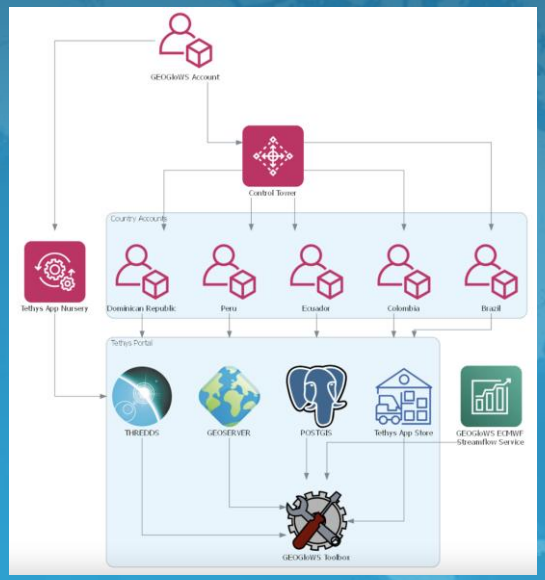
Hydrostats App

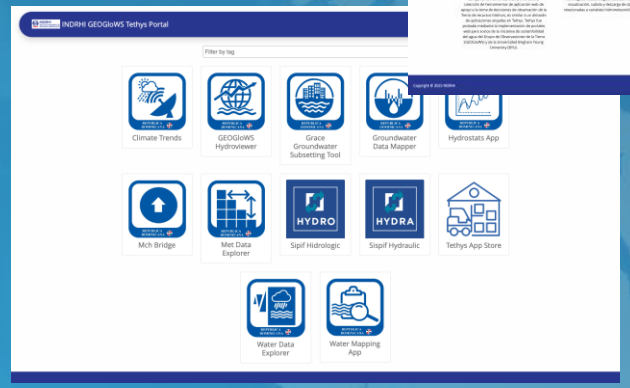
Tethys App Warehouse

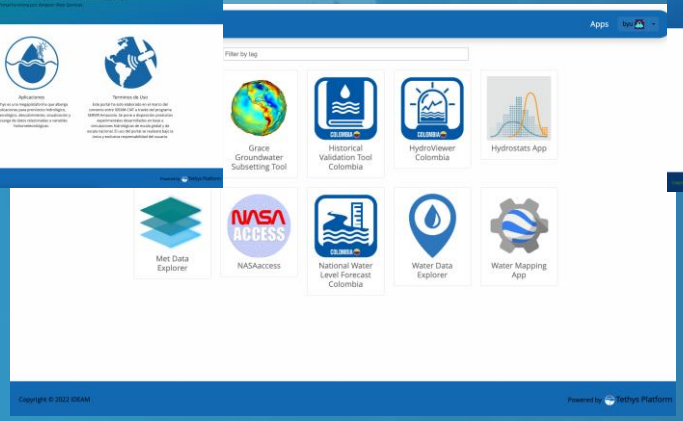


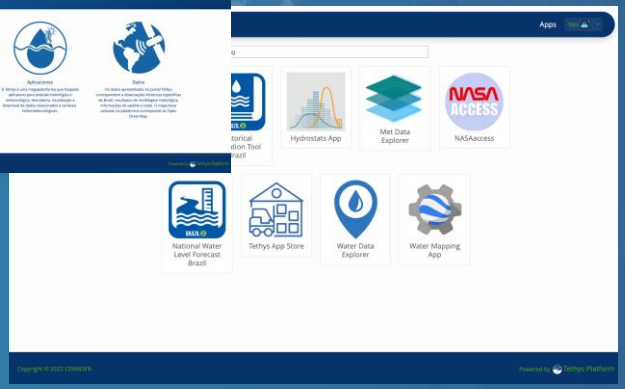
GRACE Groundwater Subsetting Tool

App Nursery – AWS Data Sustainability Initiative (ASDI)







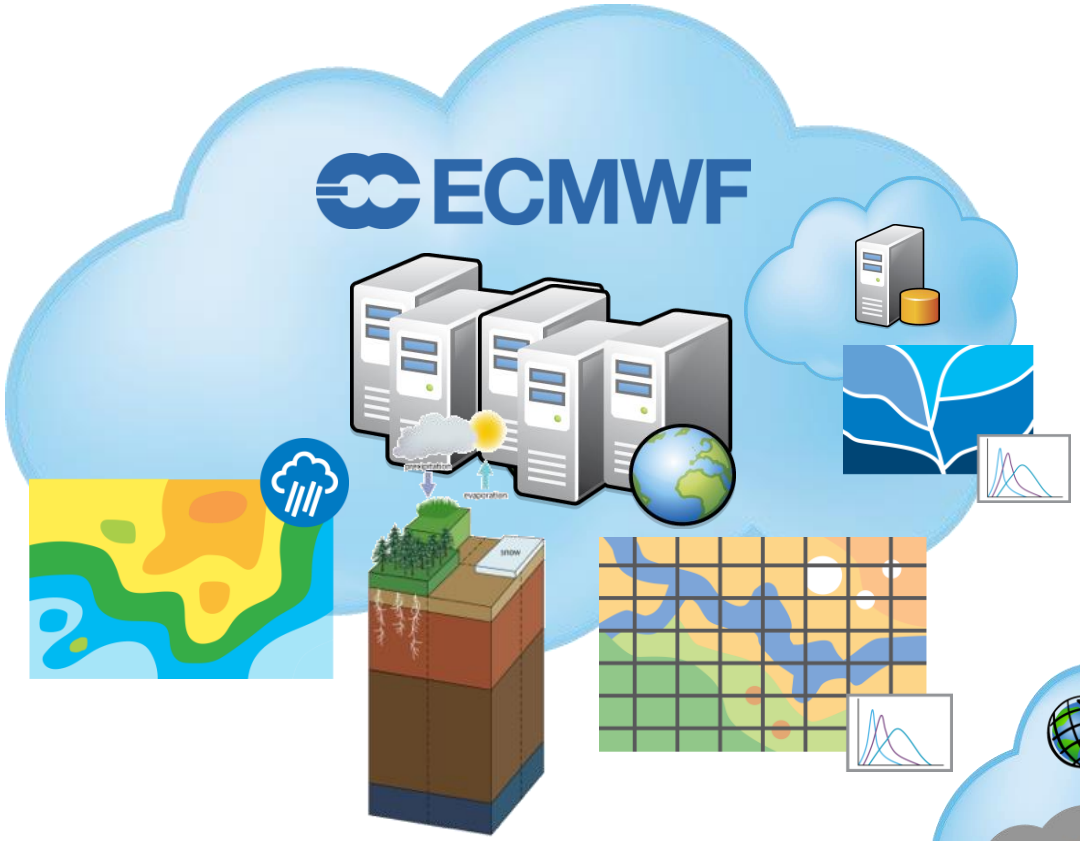


GEO GLOWS
GLOBAL WATER SUSTAINABILITY

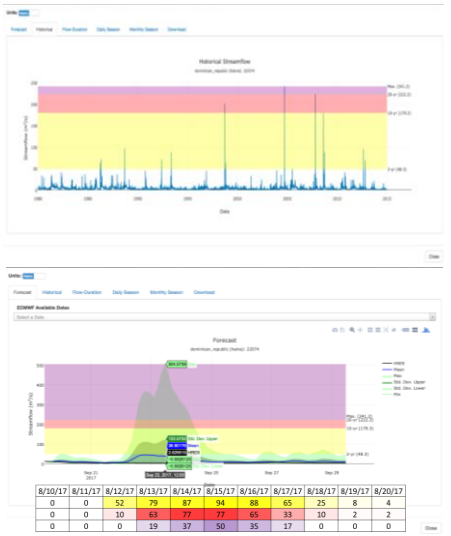
Understanding the GEOGLOWS Data

BYU Civil & Construction Engineering
IRA A. FULTON COLLEGE OF ENGINEERING

GEOGLOWS Data



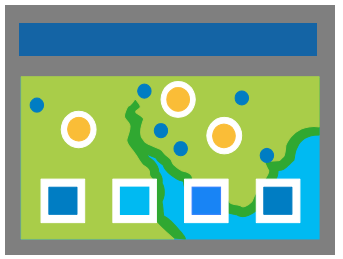
Web Services



Streamflow API at ECMWF

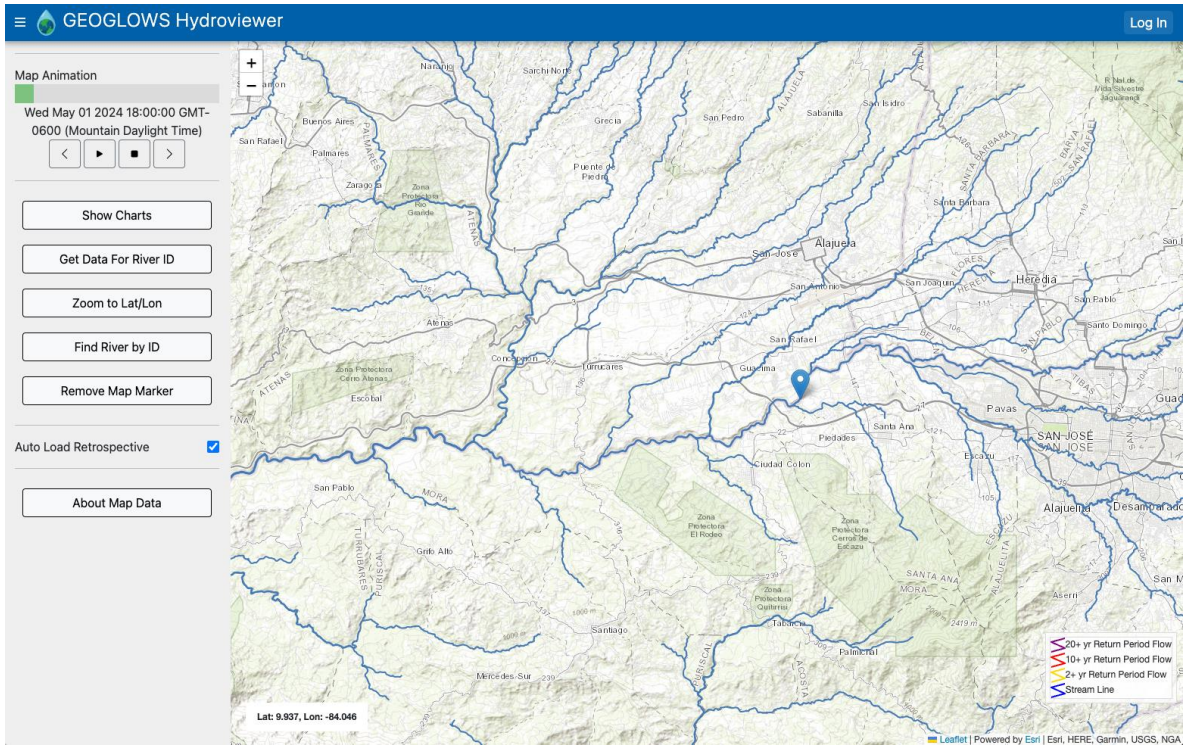
Global WMS at Living Atlas

Custom Web Apps



Version 1 and Version 2 Comparisons

	GEOGLOWS V1	GEOGLOWS V2
Stream Network	• Streams are comparable to HydroSHEDS • About 1 million streams • 13 computational watershed groups • Uniform method for estimating routing parameters applied to all river reaches	• Streams are a subset of TDX Hydro Version 1.0 • About 7 million streams • 125 computational watershed groups • Data-driven regression to estimate routing parameters for each river individually
Retrospective Simulation	• Daily average streamflow • Begin date 1 January 1979 • Updated every month • Lag from real-time between 2 and 3 months • Full dataset download only available on request • Full time range available for a single river available via data service	• Daily average streamflows • Begin date 1 January 1940 • Updated every week • Lag from real-time up to 1 week • Full dataset freely available to download on Box and AWS S3 • Data from 1990 to present for a single river available on data service • Full-time period available on demand through AWS
Data Services	• https://geoglows.ecmwf.int	• https://geoglows.ecmwf.int • Implement endpoint versioning • Planned future OGC API patterns implemented



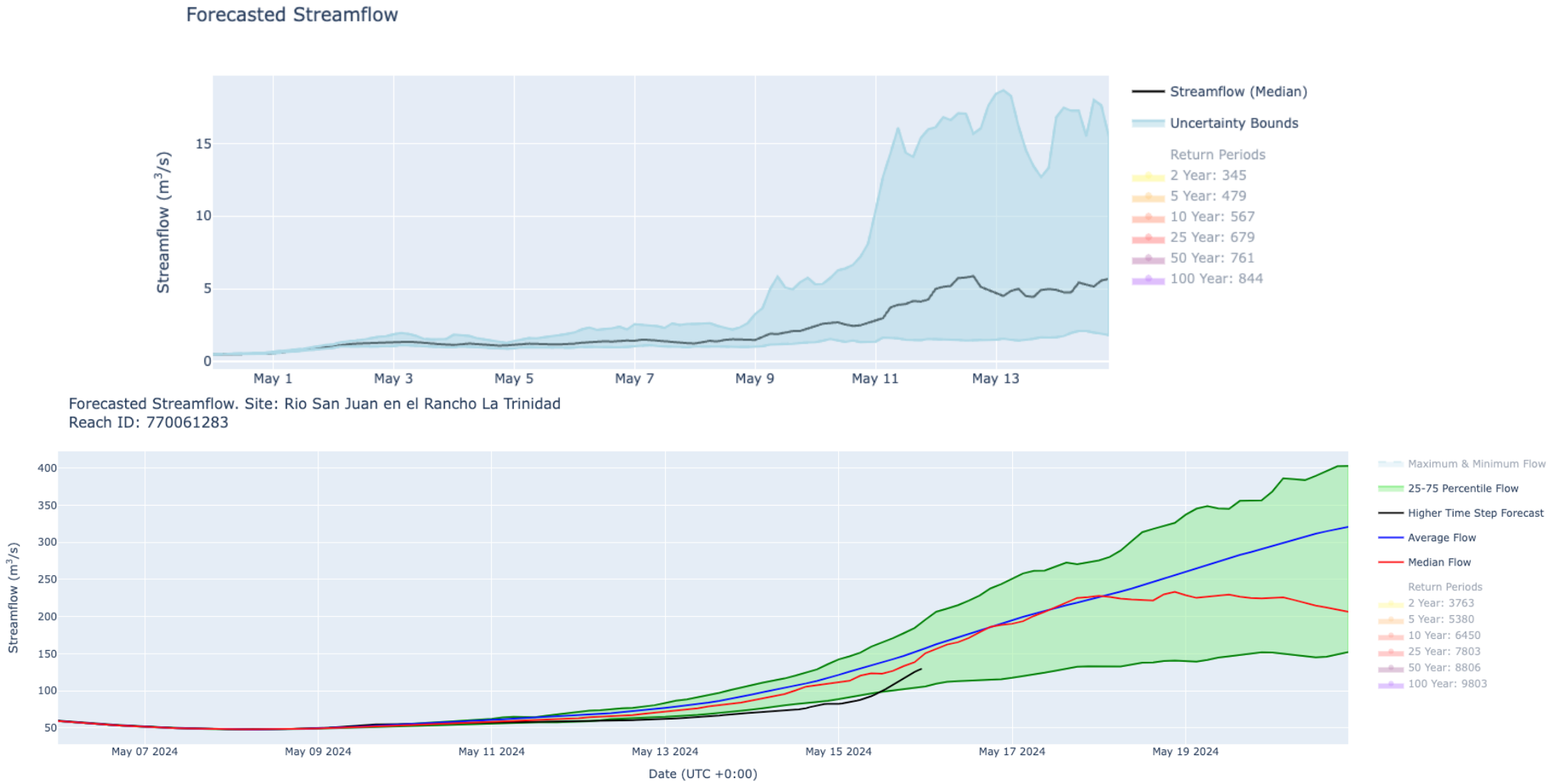
V1 HydroViewer

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

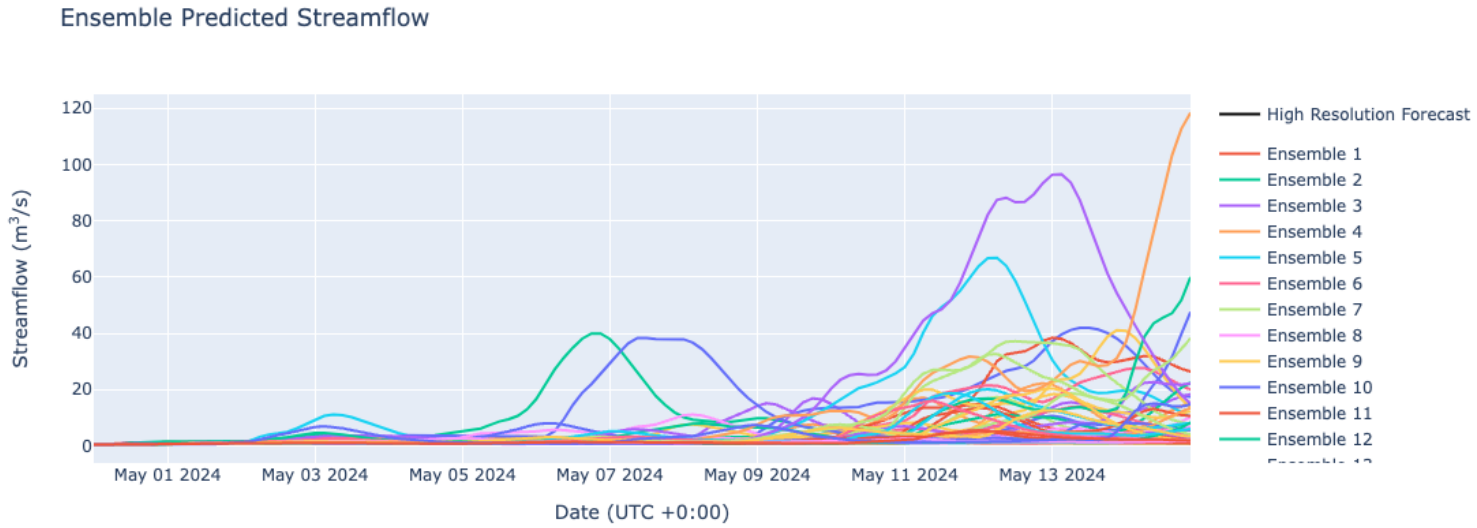
V2 HydroViewer

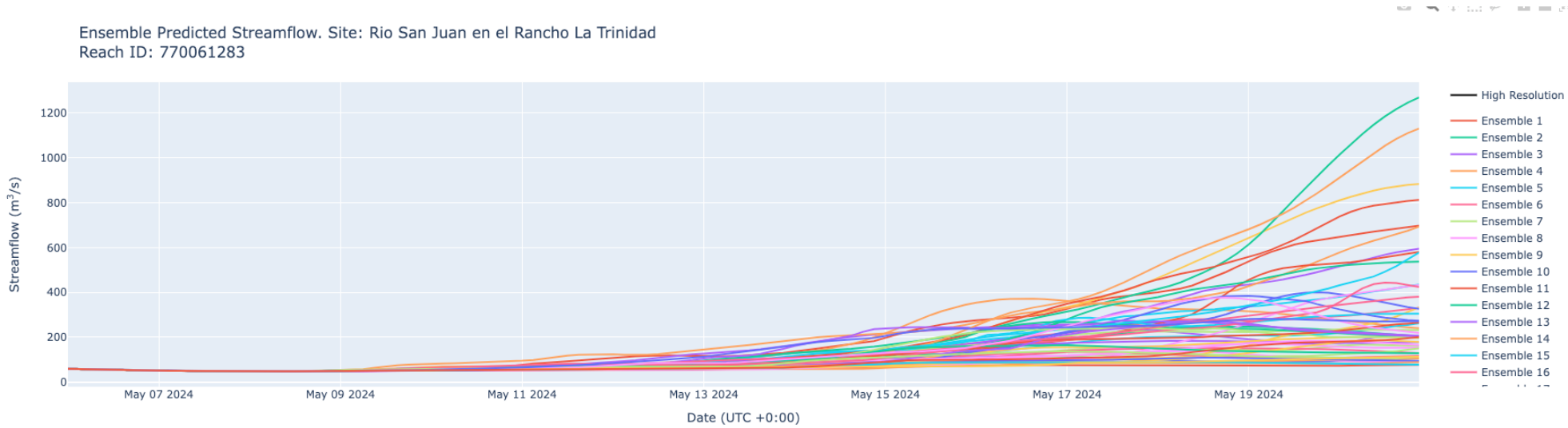
https://beta.apps.geoglows.org/

Forecast (stats)



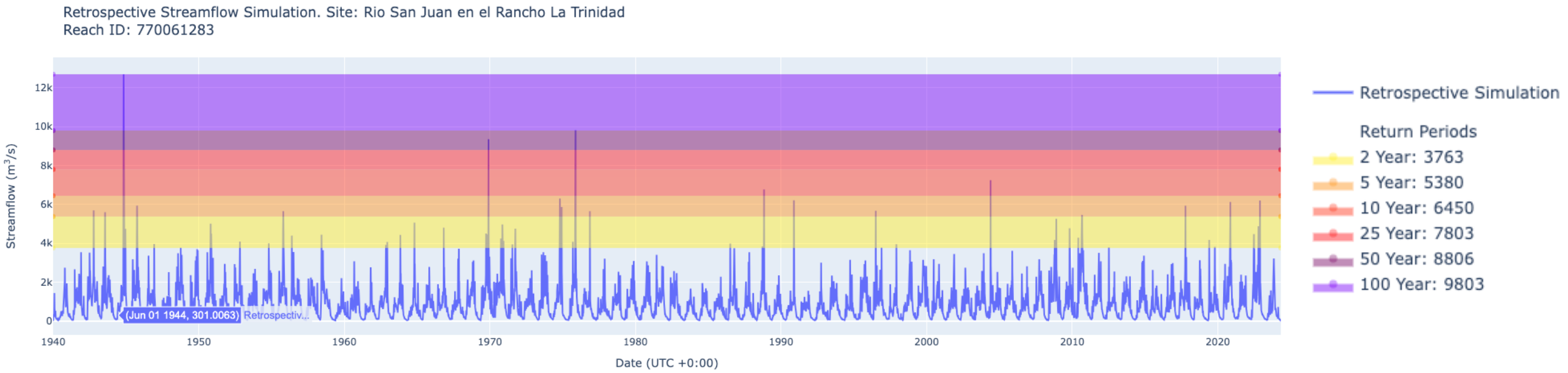
Forecast (ensembles)





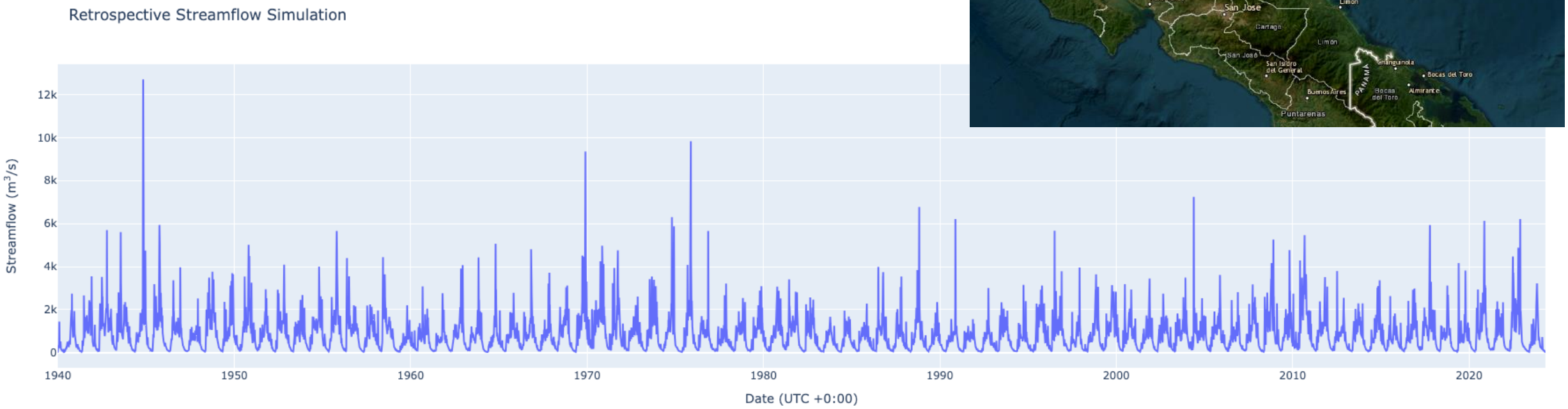
Return Periods

Are used to classify extreme events. They require historical values to be calculated. A 100 year is expected to occur approximately once every 100 years. This does not mean multiple 100-year events can not occur sooner.



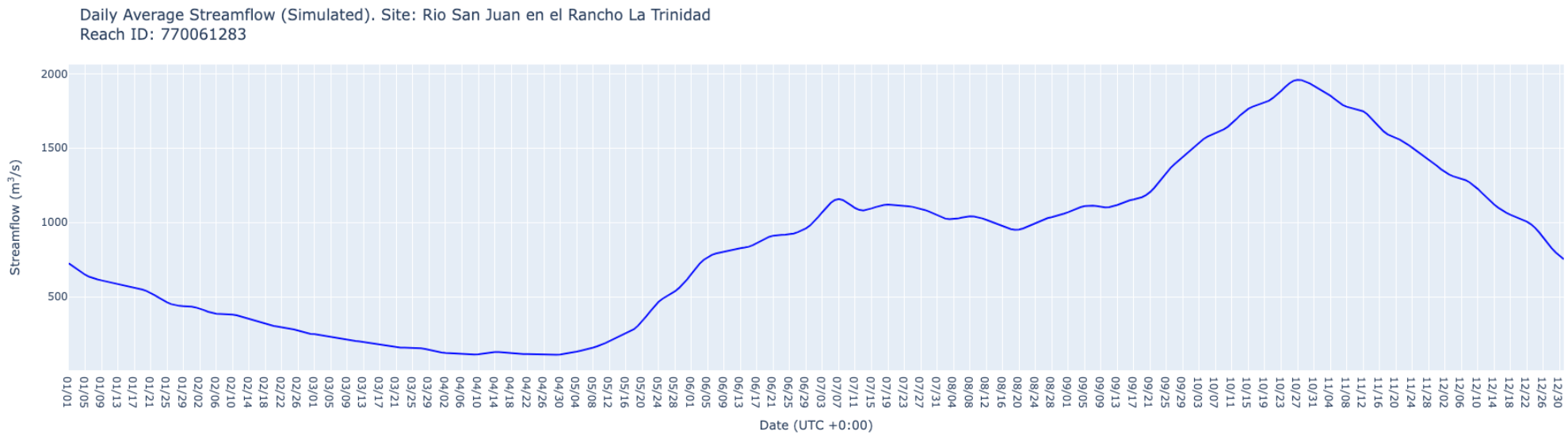
Retrospective Simulation (80 years)

Simulated flow data, calculated from historical meteorologic data. Useful for understanding river behavior or comparing forecasts to previous events.

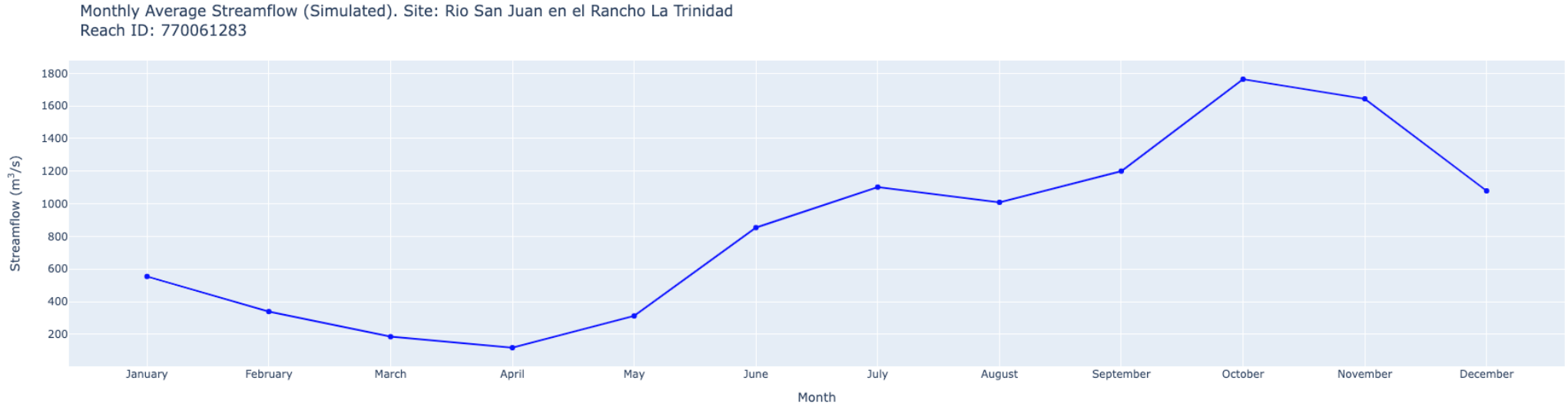


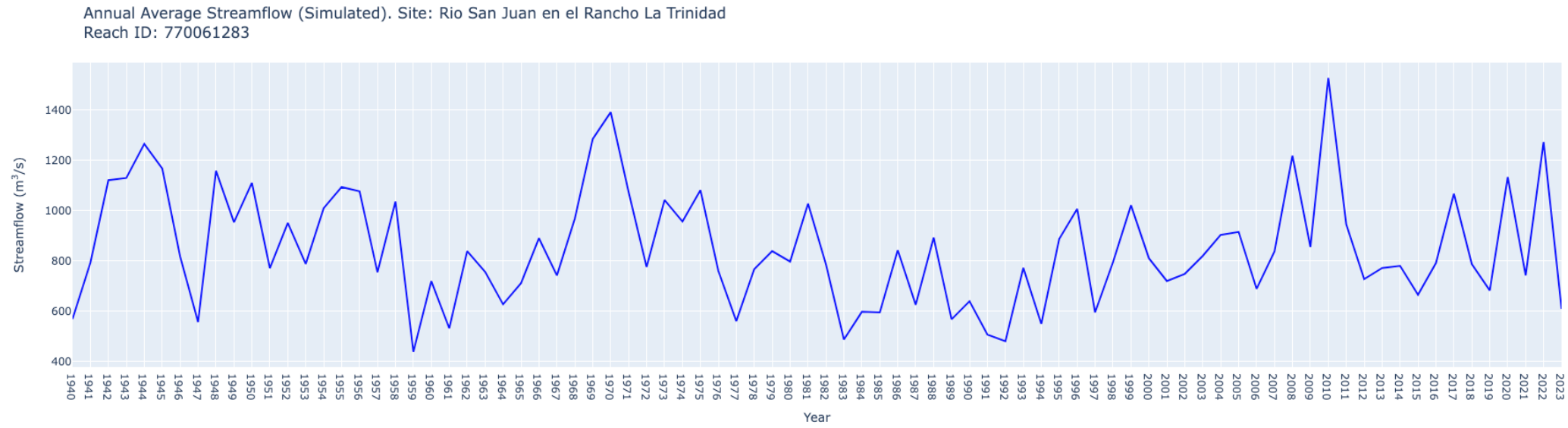
Daily Average Flow

Value of the average flow on every day of the year for a certain river segment. Is useful for understanding current flows based on season changes in normal.



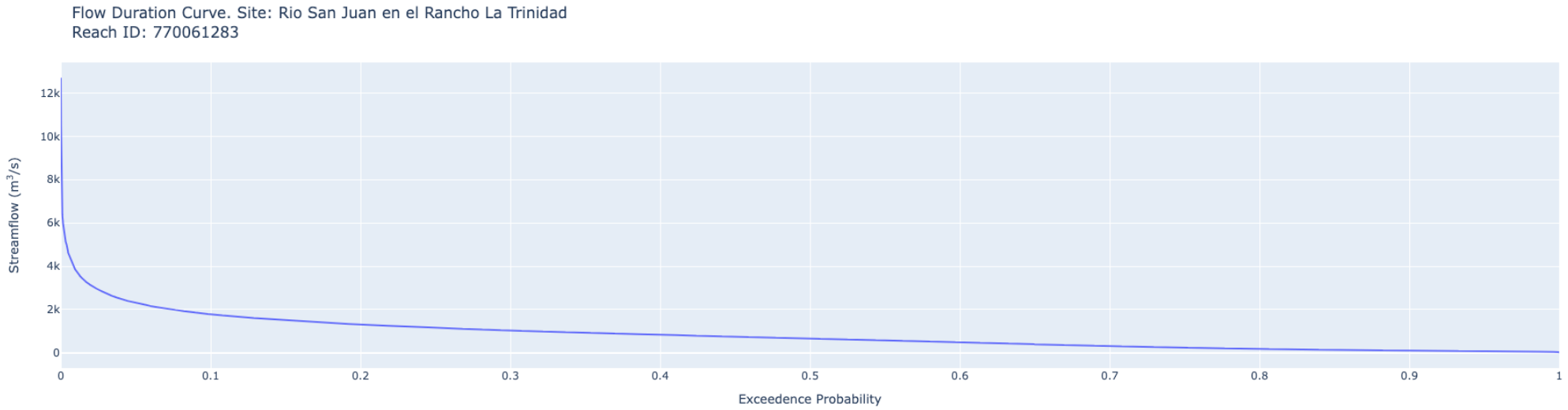
Monthly/Annual Average





Flow Duration Curve

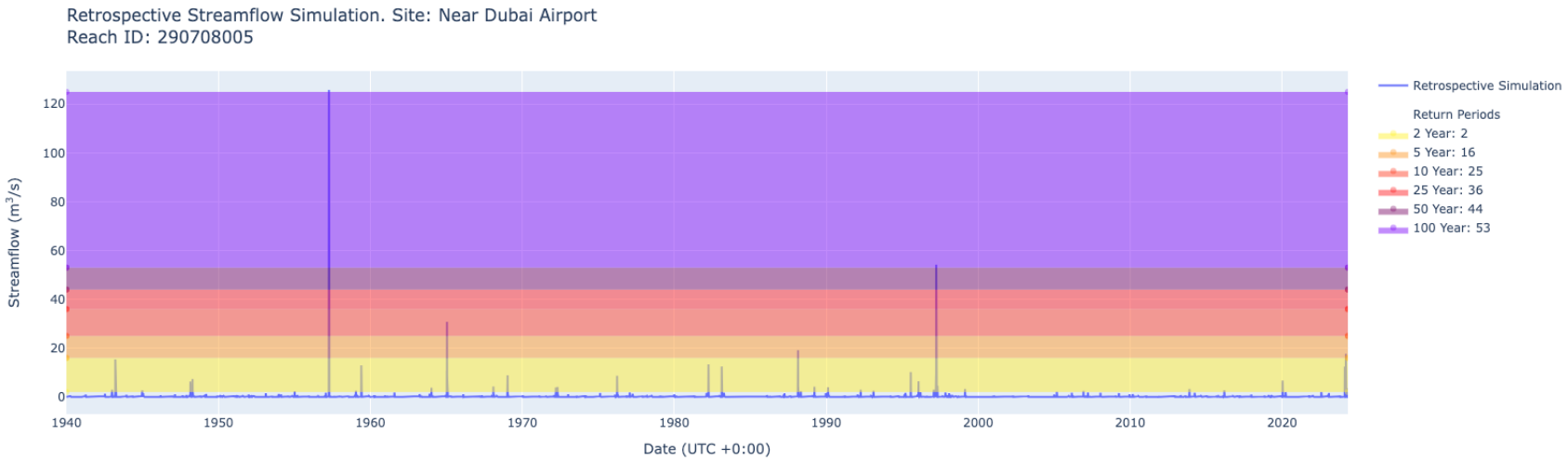
Is a measure of the probability that flow in a river exceeds a certain value.



Discussion?

- Do you have access to this kind of information?
- What challenges exist if/when you do not?
- What problems could you solve with an 80-year historical simulation (record) on your rivers?
- What problems could you solve with a daily 15-day forecast

Forecast Application in Dubai

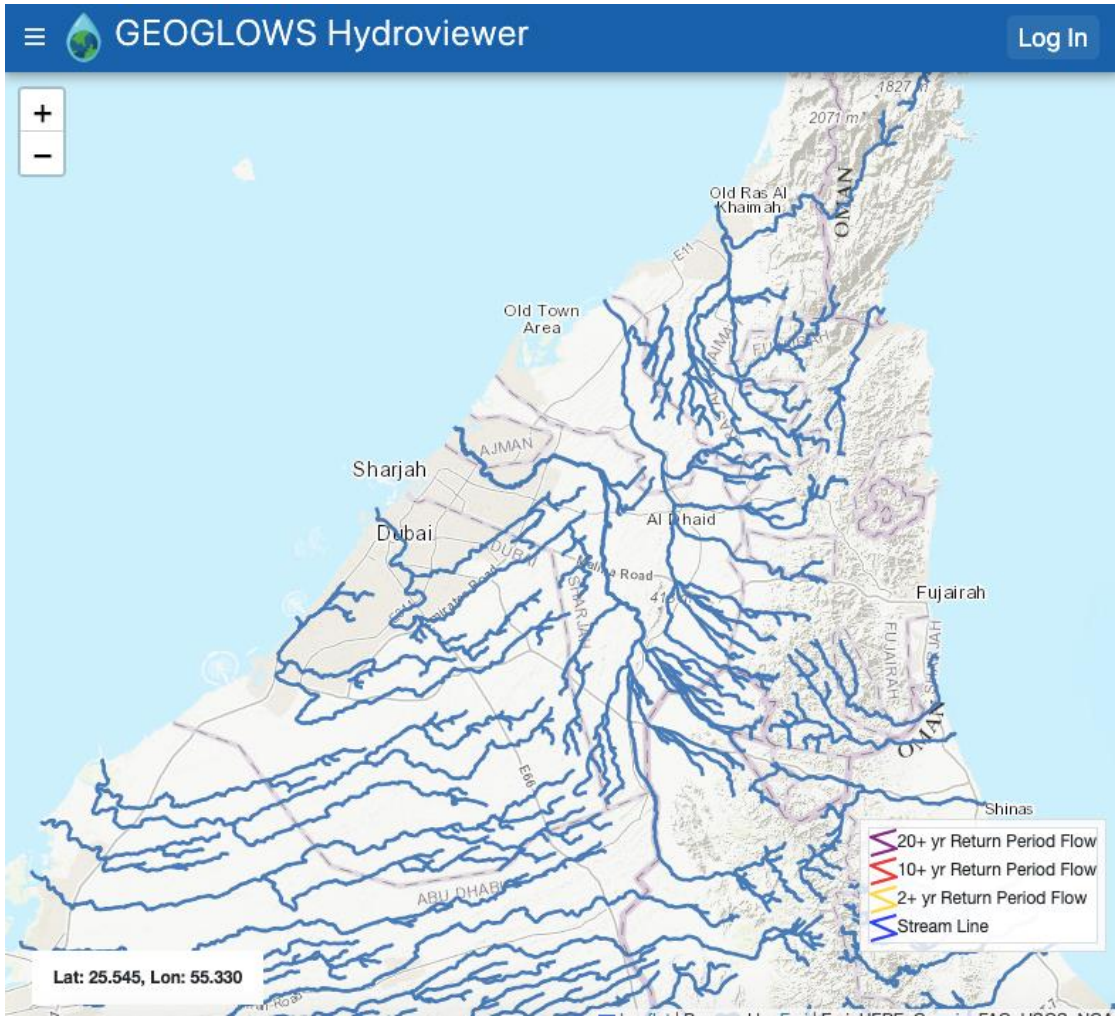


Flood forecasts based on output from the GEOGLOWS ECMWF Streamflow Services (GESS) global hydrological model, provide a global streamflow forecasting service, relevant for making informed predictions required for the emergency response decision-making process in the context of floods.

The following is a demonstration of how the NASA SERVIR GEOGLOWS forecasting services can help you make decisions in real-life scenarios.

The flood forecast response game will use flow forecast hydrograph and return periods as a basis.

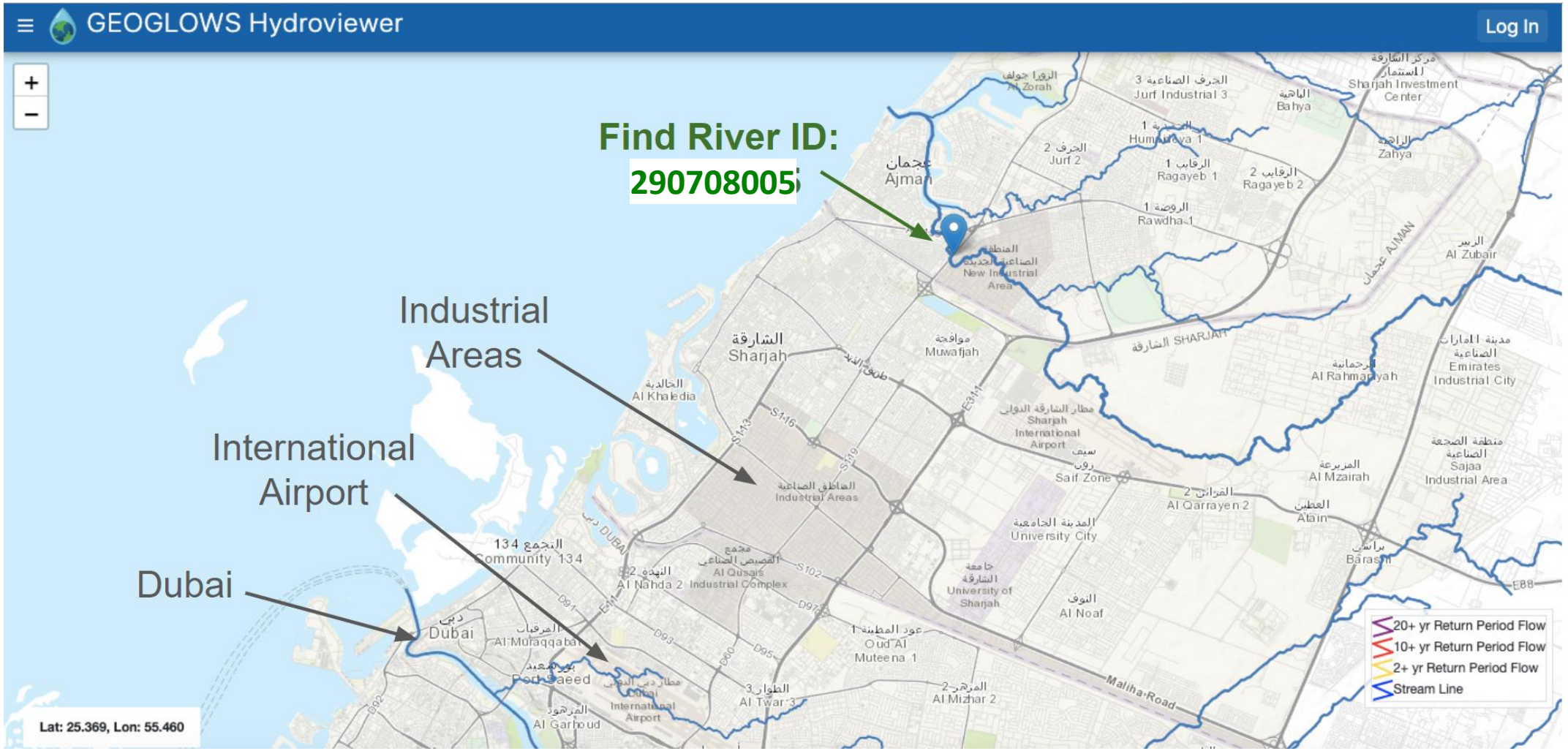
Forecast Application in Dubai



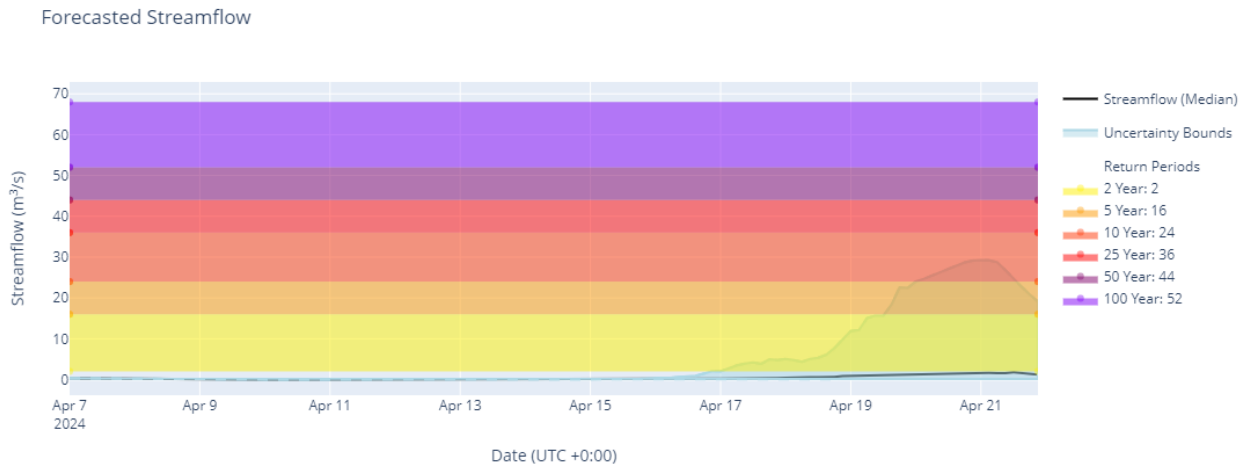
Imagine that you are engaged in the emergency response decision-making process in Dubai.

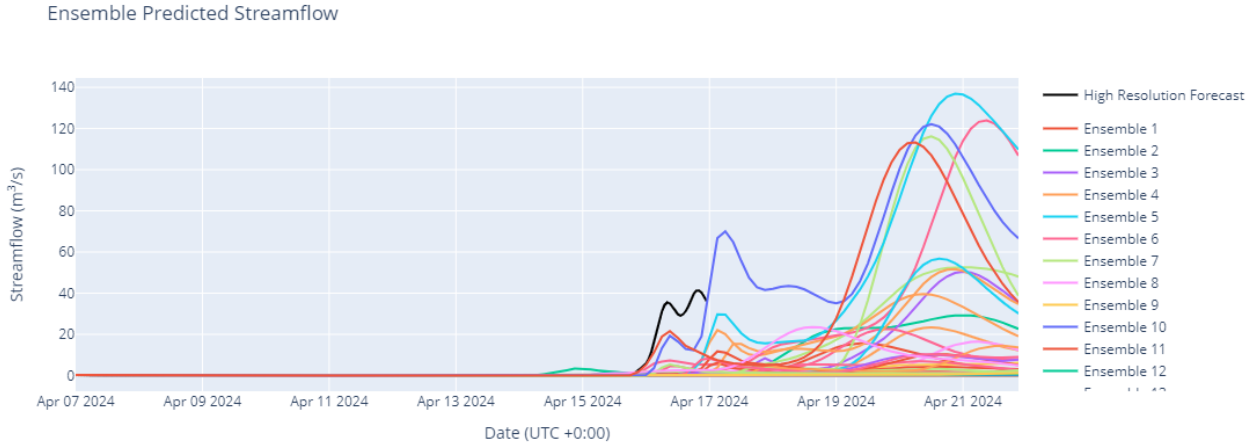
A flow forecast graph will be provided indicating a flood probability. Each day the current streamflow and the predicted flow over the subsequent 15 days will be shown. Based on the given information, how would you choose to respond considering both economic implications/limitations as well as preparation/safety?

Forecast Application in Dubai



April 7, 2024

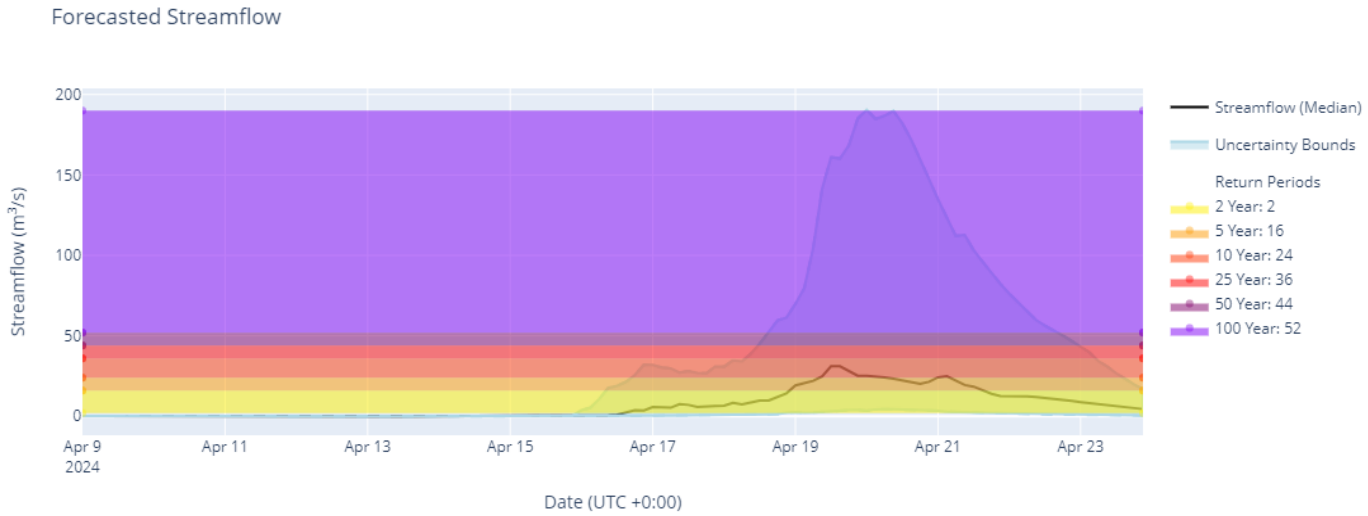


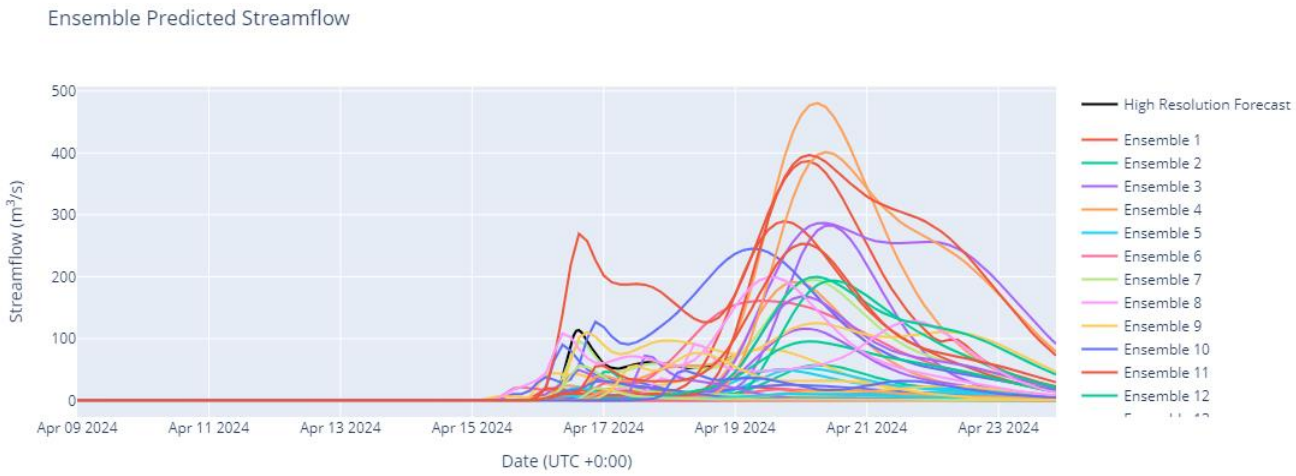


The displayed flow forecast graphs show the current streamflow and the predicted flow over the subsequent 15 days and the associated ensemble hydrograph.

What would you choose to do at this point, if anything?

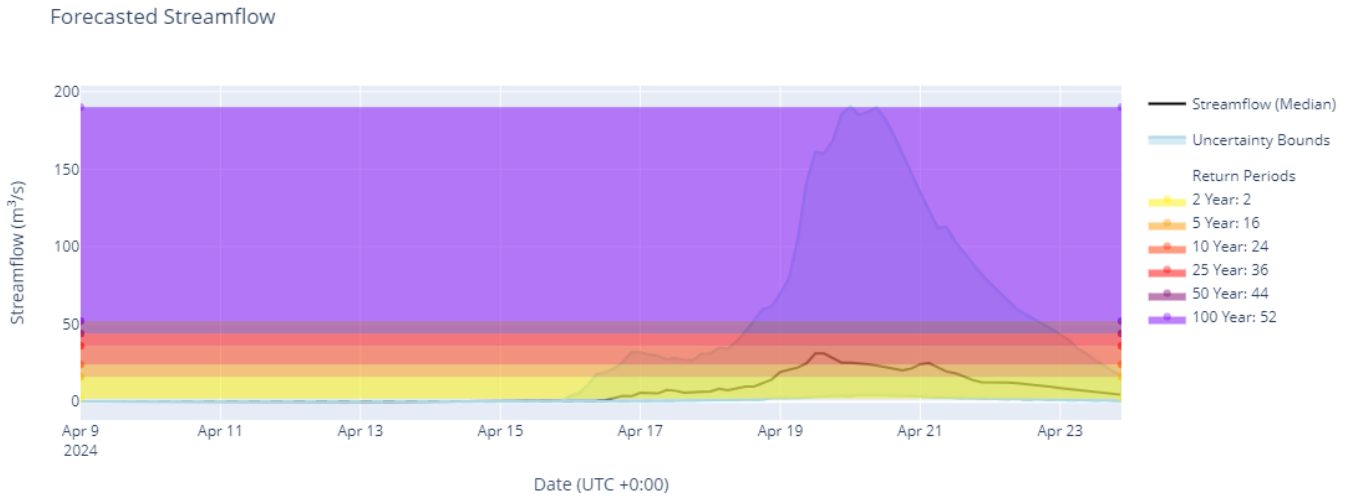
April 9, 2024

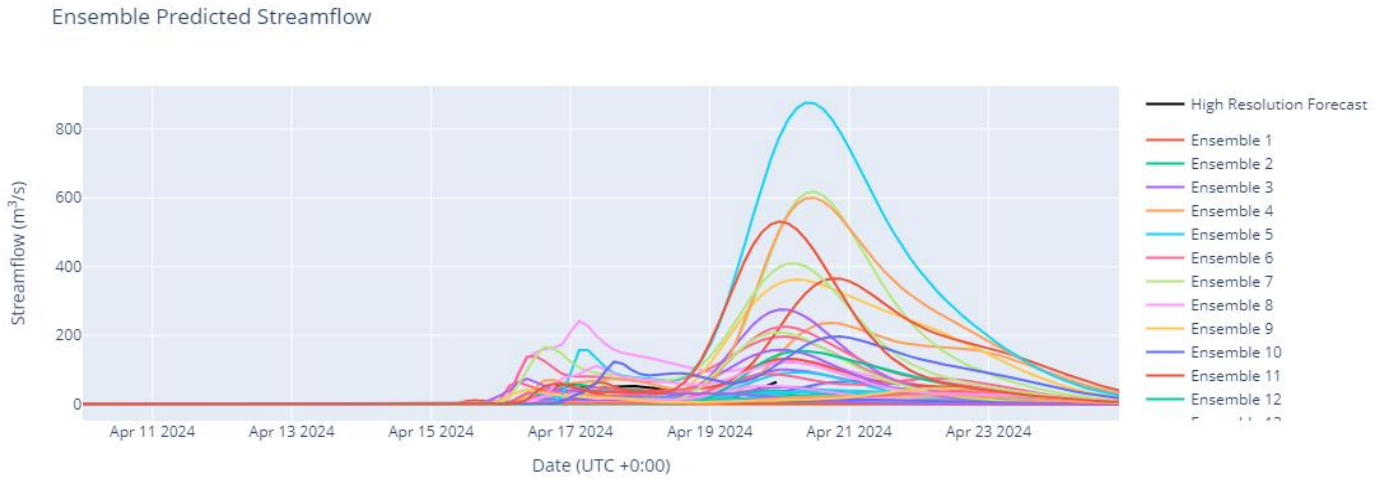




What would you do?

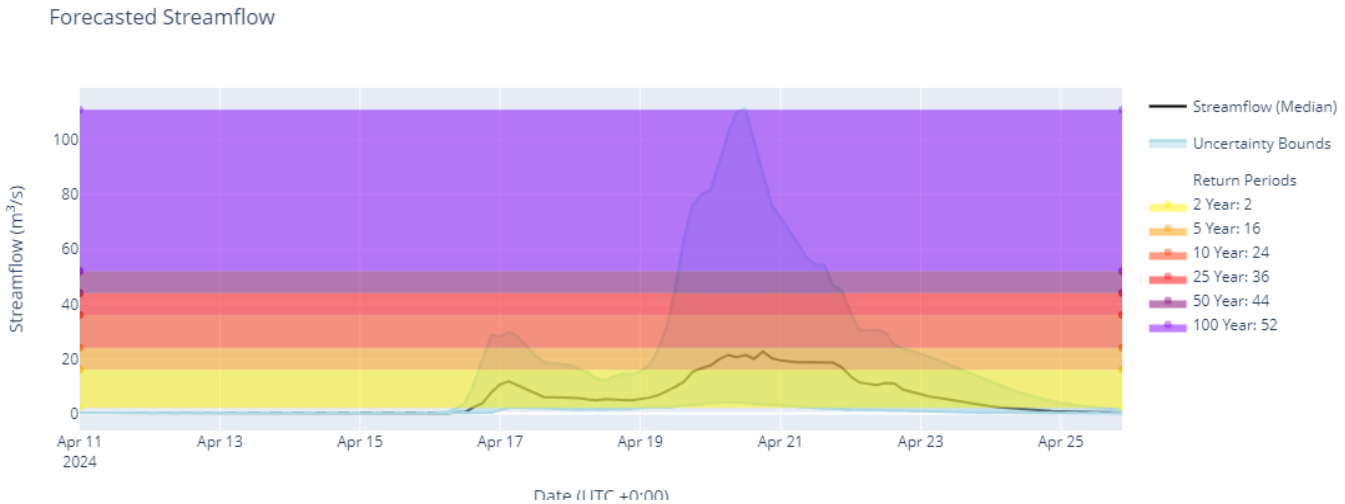
April 10, 2024

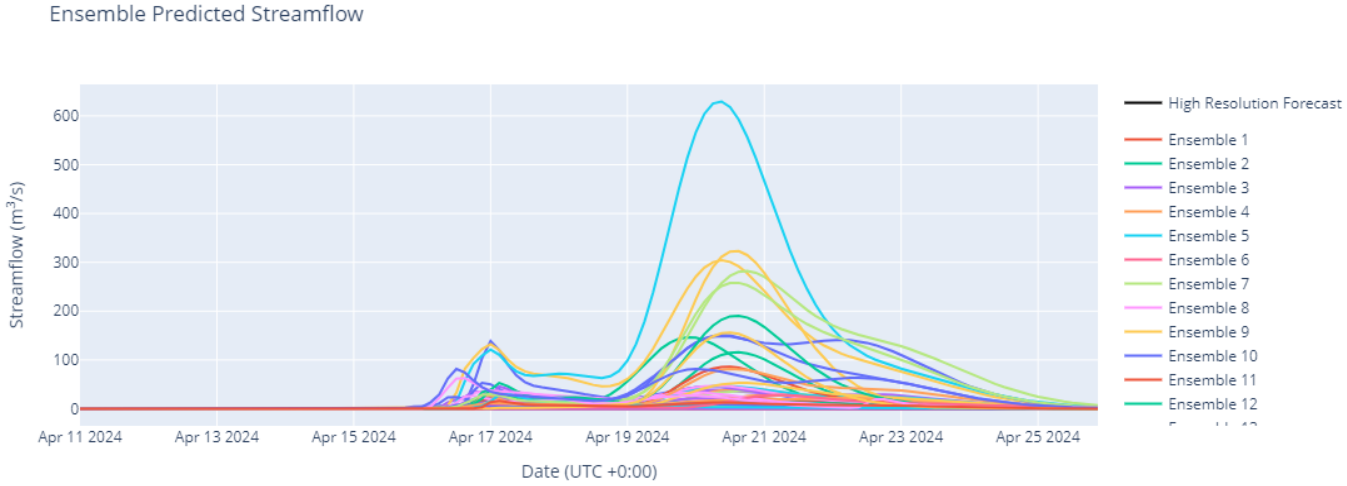




What would you do?

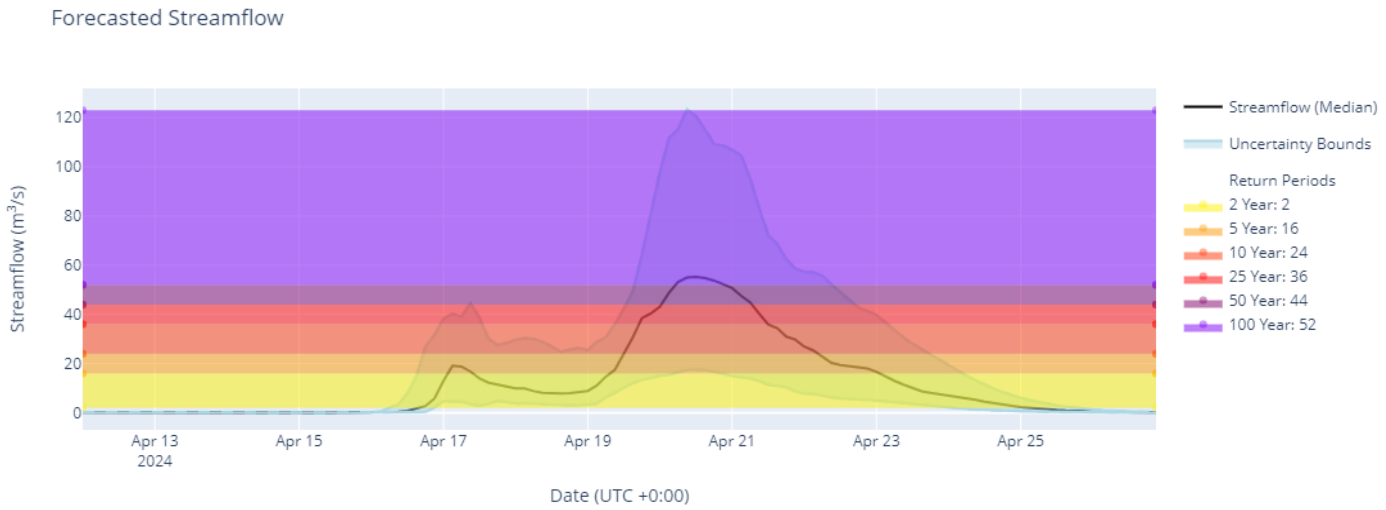
April 11, 2024

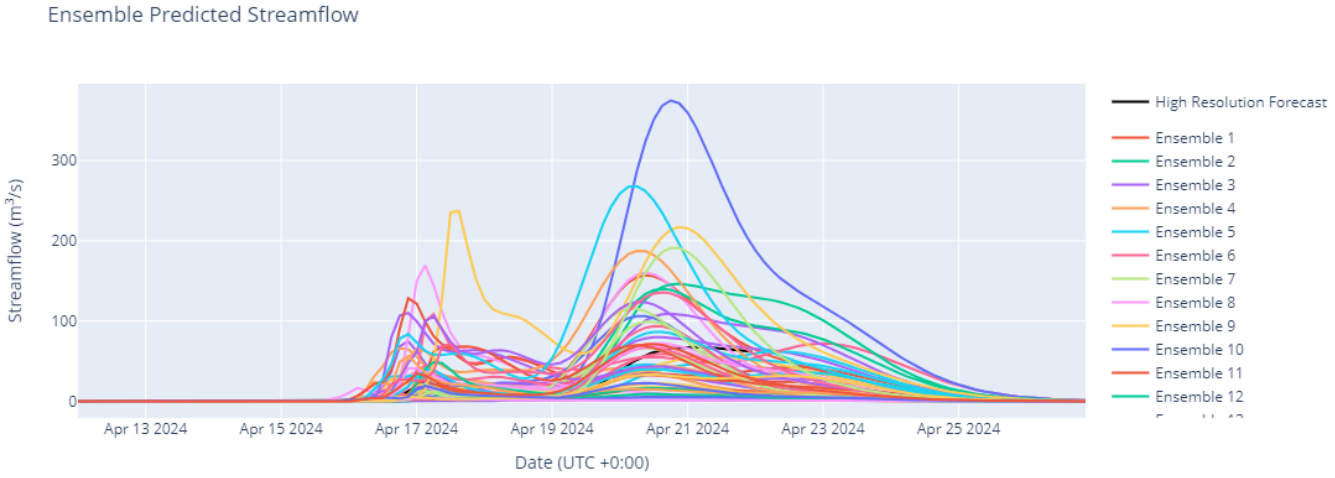




What would you do?

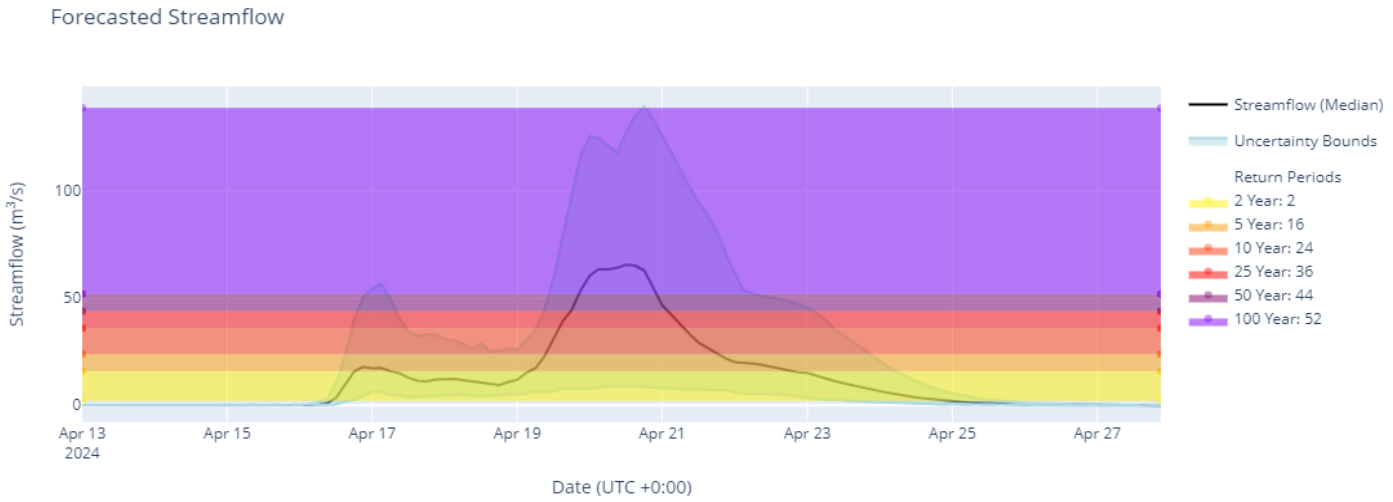
April 12, 2024

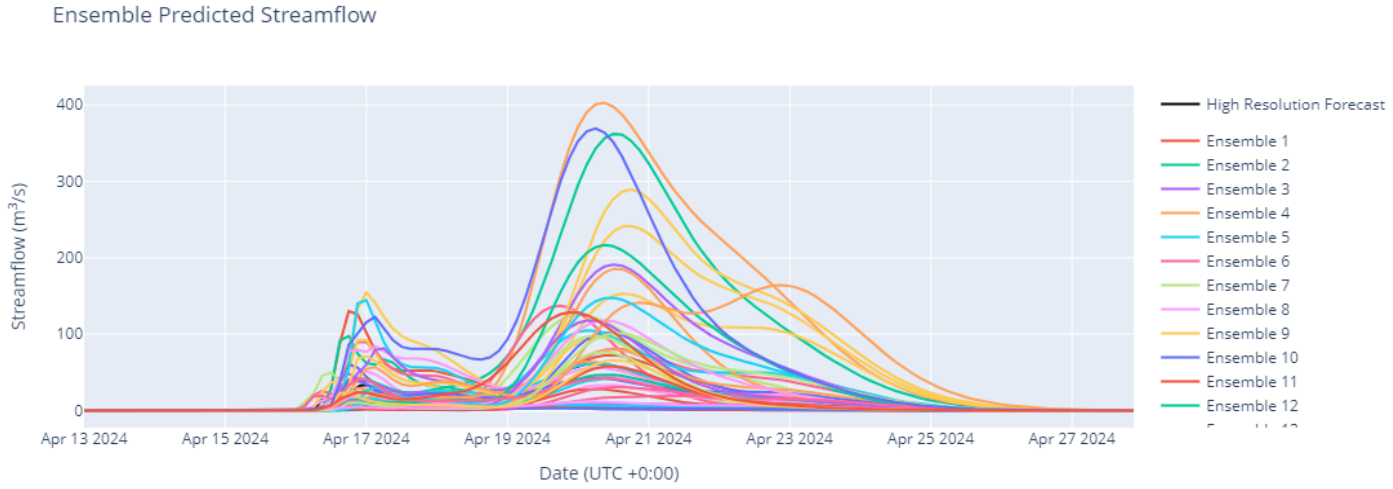




What would you do?

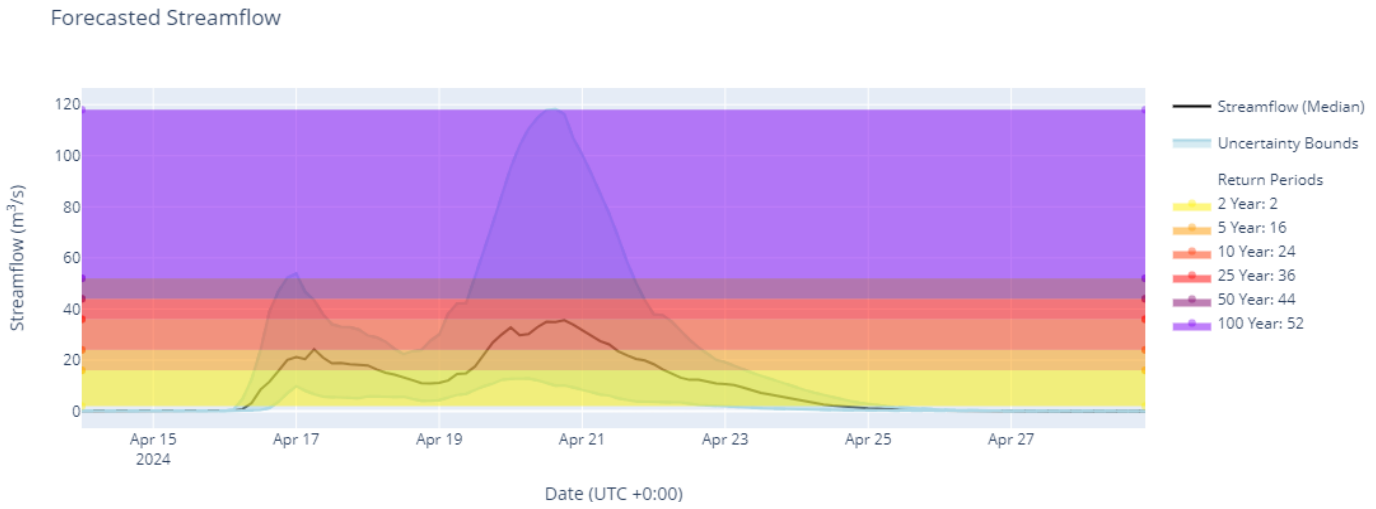
April 13, 2024

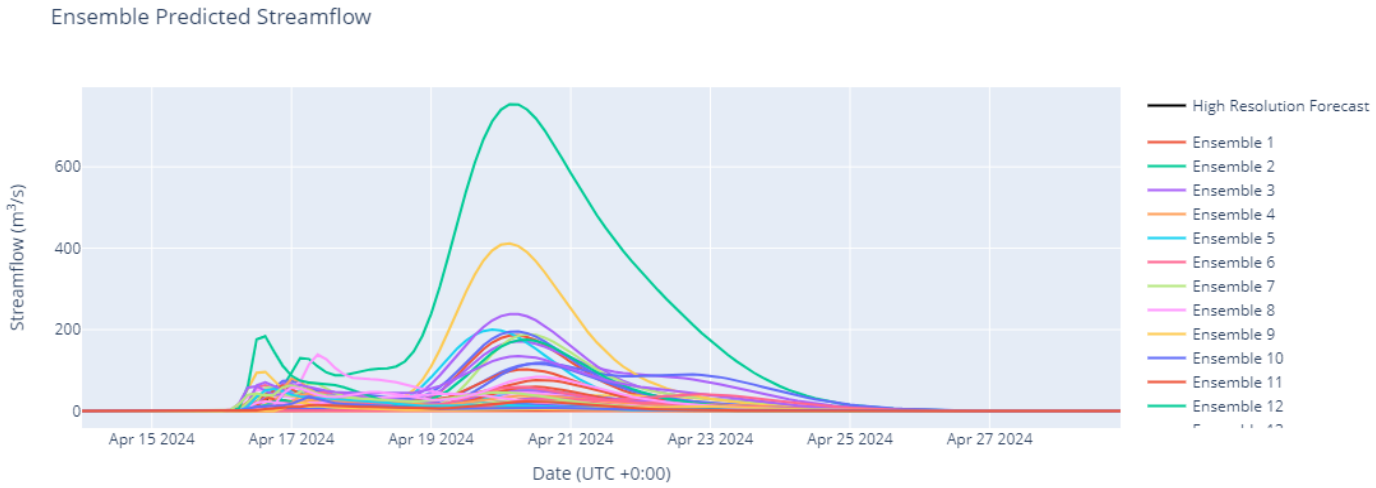




What would you do?

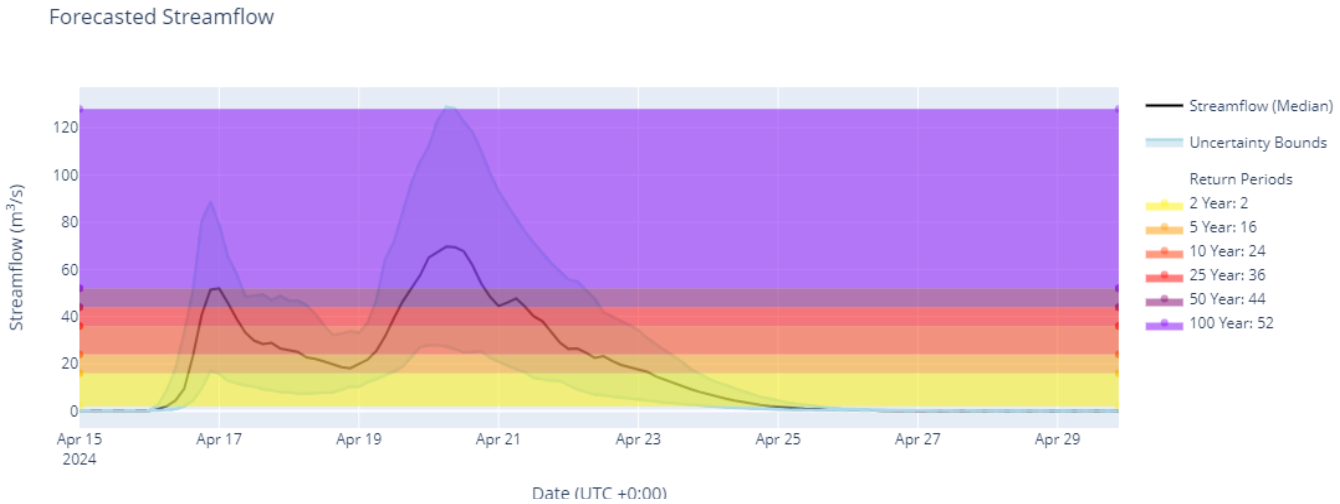
April 14, 2024

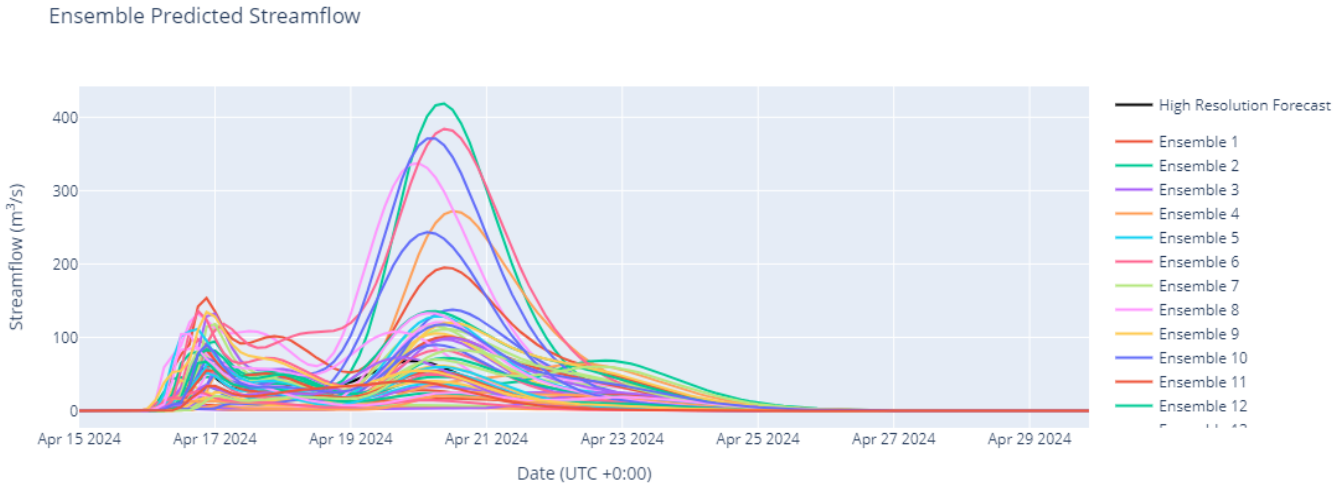




What would you do?

April 15, 2024





What would you do?

Dubai Flooding April 2024

https://www.news24.com/citypress/trending/watch-dubai-gets-a-years-worth-of-rain-in-a-day-20240418

In April 2024, the United Arab Emirates experienced unprecedented and devastating floods due to heavy rains, described as the country's heaviest rainfall in 75 years. The slow-moving storm began on April 14 and intensified on April 16, breaking records for the most rainfall in a 24-hour period since meteorological records began in 1949. Cities such as Dubai and Sharjah were severely affected, with Dubai recording a year's worth of rain in just 12 hours, and areas farther east receiving nearly 2 years' worth of rain within 24 hours.

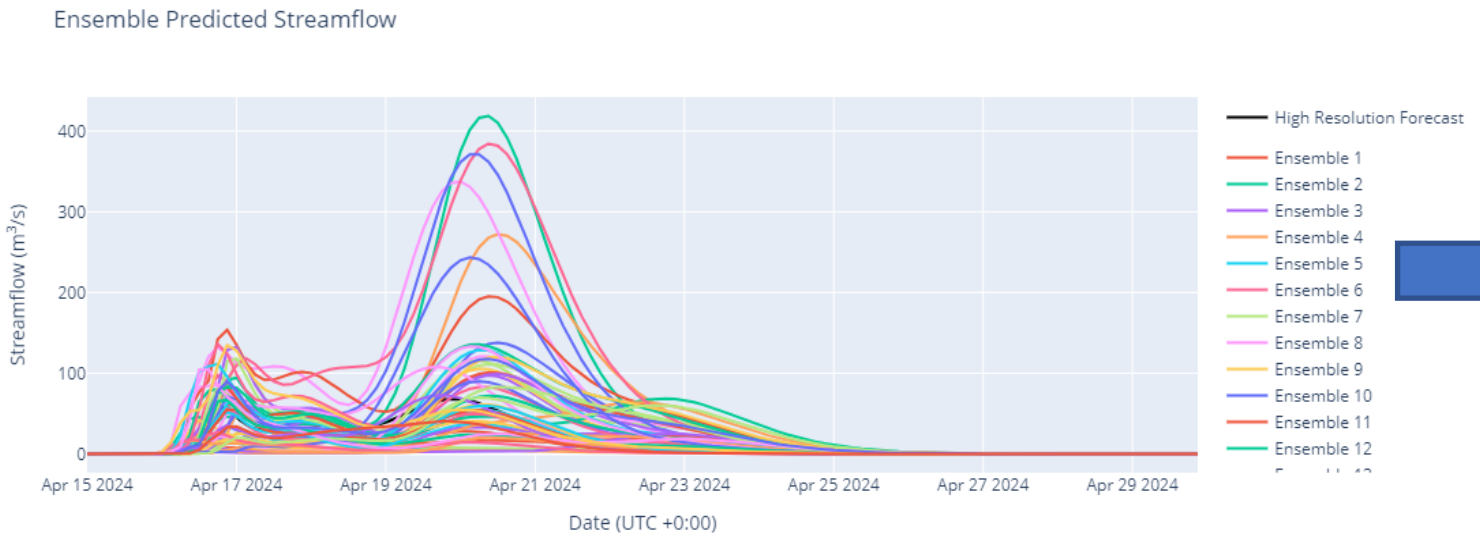
Floodwaters rose rapidly, disrupting transportation and inundating roads. Some areas remained flooded even after the rain stopped, with up to 10 inches of rain measured in less than 24 hours, far exceeding the typical annual rainfall of 5.5 to 8 inches. The situation was so severe that even days after the rains ceased, satellites were still able to detect the extent of the flooding from space.

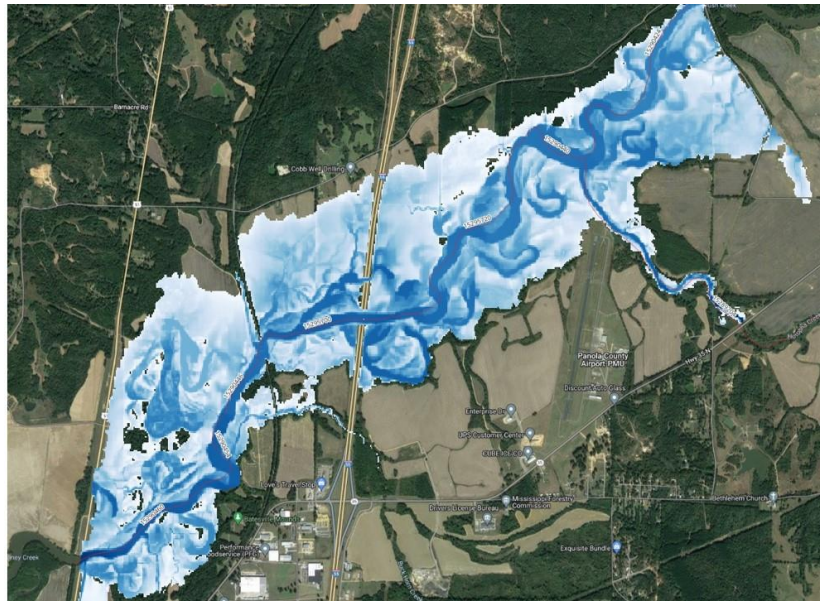
Dubai Flooding April 2024

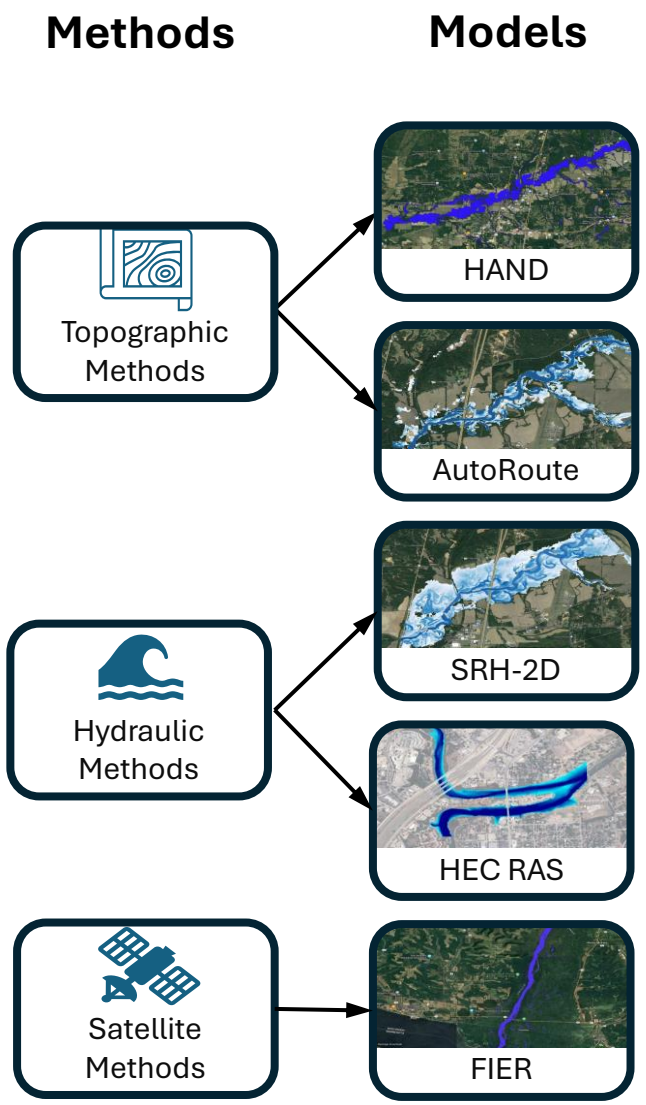
Dubai International Airport experienced significant disruption, with flights temporarily halted due to the deluge. As of April 18, the UAE was still in the process of recovery from the catastrophic flooding, with Dubai's international airport facing ongoing delays.

Dubai International Airport, the world's busiest for international travel, experienced a surge in passenger numbers in 2023, reaching a total of 86.9 million passengers. The airport is a vital hub, connecting to 262 destinations in 104 countries worldwide through over 100 international carriers. Additionally, Dubai reported its best-ever tourism numbers, hosting 17.15 million international overnight visitors in 2023, contributing significantly to the city's economy. With projections estimating an increase to 88.8 million passengers this year, the airport faces mounting pressure, especially considering the recent flooding events that disrupted operations. This underscores the airport's significance to the country's economy and the challenges posed by the need to accommodate increasing passenger volumes amidst such impactful natural occurrences.

Understanding Impacts







Flood Inundation Mapping

- Topographic Models fill up based on the geography of an area. They are relatively computationally light, and give a rough estimate of flooded areas.
- Hydraulic modeling methods, solve equations representing the mass and momentum of fluid flow. They are more computationally expensive, but when created and calibrated correctly can be more accurate.
- Satellite methods, like FIER, seek to leverage the power of observed satellite images. They created flood inundation maps through statistical methods.

Questions?

Thank You!!