GROUP ON EARTH OBSERVATIONS

GEOGLOWS
GLOBAL WATER SUSTAINABILITY

GEOGLOWS Hydrological Prediction on the Global Scale

From Global Water Intelligence to Local Decisions

Workshop on Global Tools for Flood and Drought Prediction
December 8-11, 2025

Angelica Gutierrez, Ph.D.
Director GEOGLOWS Program

WORLD METEOROLOGICAL ORGANIZATION

ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Joint Research Centre JRC

MASHAV Aid From Israel

IMS השירות המטאורולוגי

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.

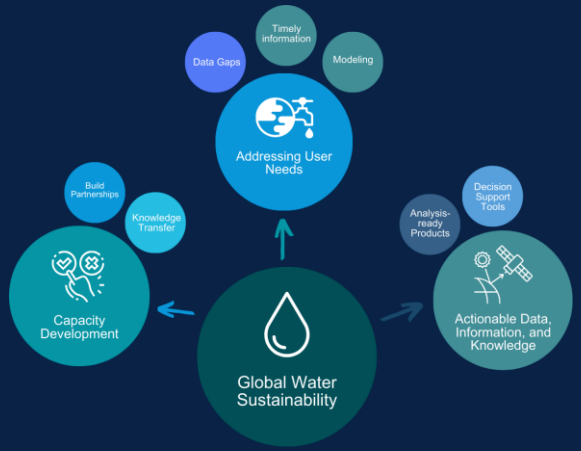
Organizations

- NASA
- NOAA
- ECMWF
- BYU
- Aquaveo
- Esri
- WMO
- World Bank
- Google.org
- Amazon Web Services

Who we serve?

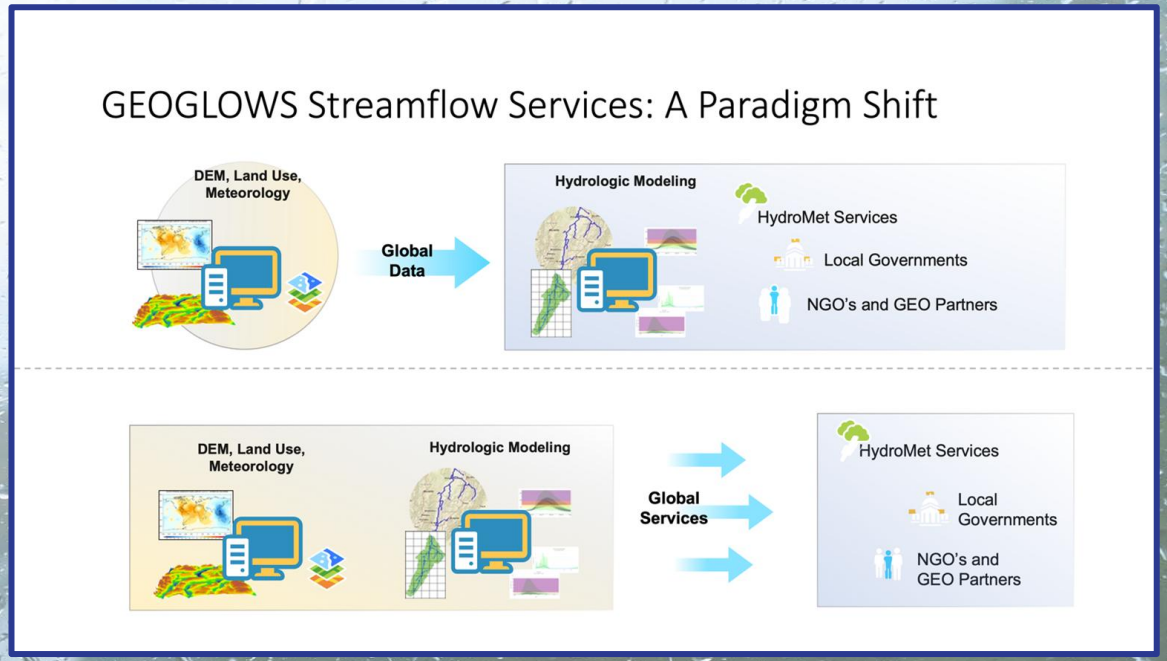
- NMHSs,
- basin orgs,
- humanitarian & development partners,
- universities.

GEOGLOWS Objectives



GEOGLOWS Partnerships

GEOGLOWS: A Paradigm Shift



GEOGLOWS is a paradigm shift because it replaces hundreds of isolated models with a single, standardized, and open global system, with 80 years of historical data and consistent forecasts up to 15 days ahead for more than 7 million rivers.

It eliminates fragmentation and empowers national and local institutions, who integrate their in-situ monitoring data, to adjust and refine predictions at the local scale.

Creating GEOGLOWS: The convergence of individual and complementary efforts

2003

Group on Earth Observations (GEO) Promoting open data access and global collaboration.

1950

The World Meteorological Organization, standardizing and connecting data since 1950.

2016-Present

GEOGLOWS was established under the Group on Earth Observations (GEO) as a collaboration among Switzerland, U.S. GEO agencies, and public, private, and academic partners. including: BAFU (CH); Esri, ECMWF, NASA, NOAA, USGS, USAID, Brigham Young University (BYU), the World Bank, and a community of early adopters across government and industry.

1

1970s-2000s

2 The European Centre for Medium-Range Weather Forecasts (ECMWF) develops global forecasting capabilities.

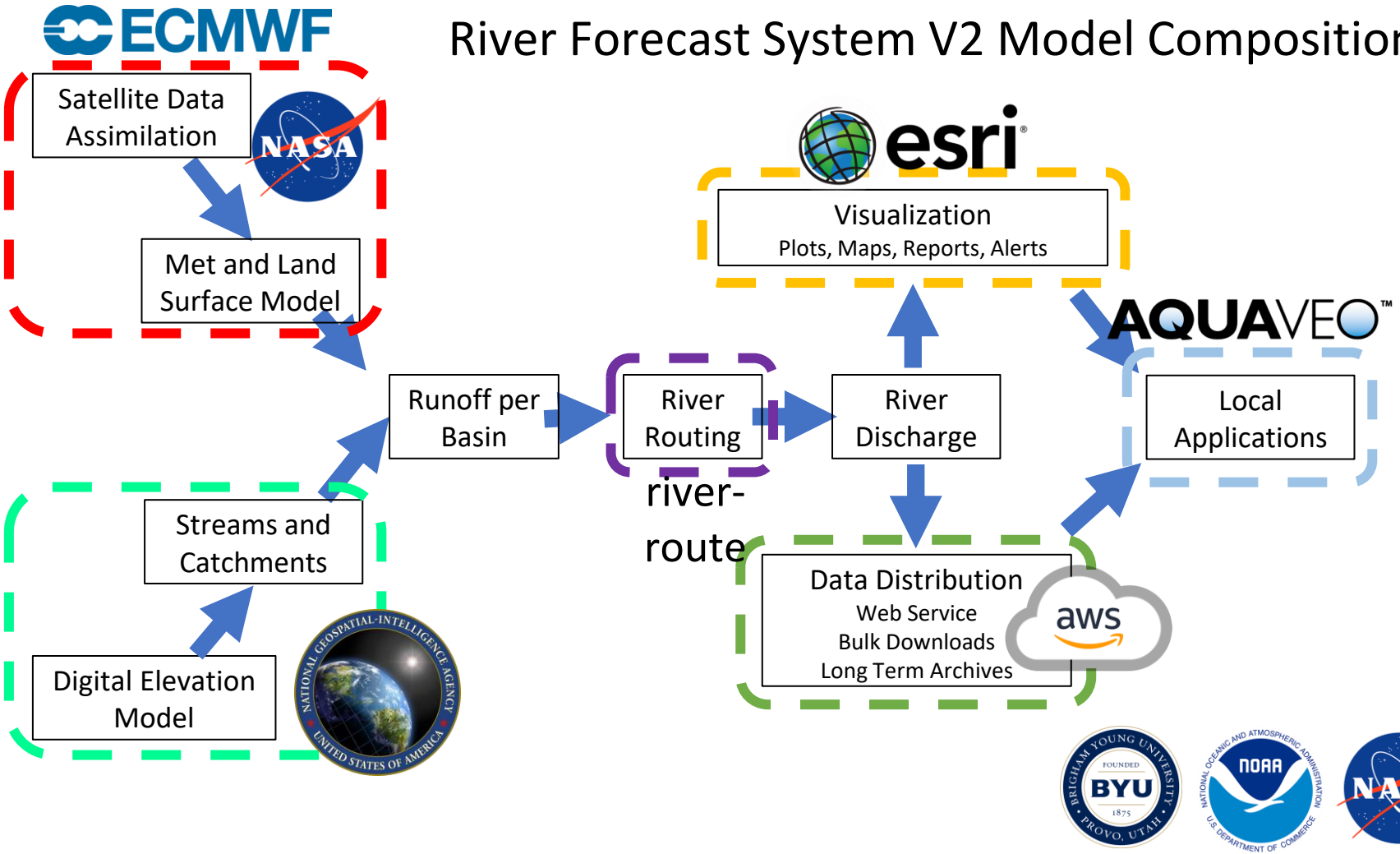
3

4

5

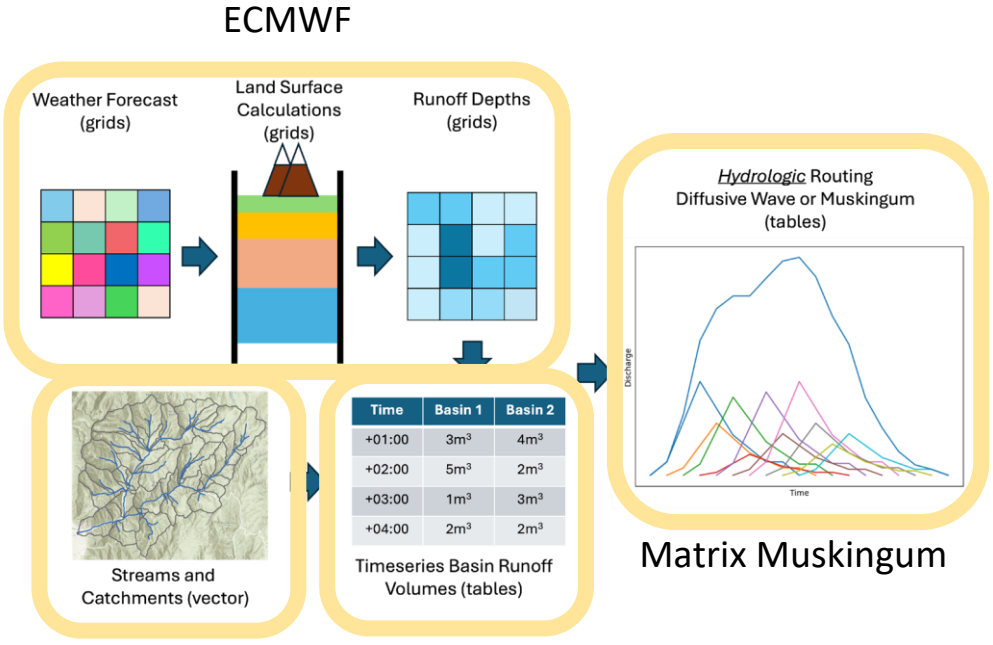
BYU's Hydroinformatics Lab has been a pioneering center for hydroinformatics in the U.S. since the mid-1990s, and today leads the implementation of the GEOGLOWS global streamflow services."

River Forecast System V2 Model Composition



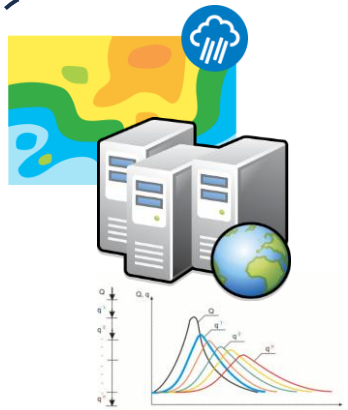
GEOGLOWS V2.0 Model Architecture:

- Runoff data
  - ECMWF Integrated Forecast System – 51 Ensembles + HRES
  - ECMWF Reanalysis v5 (ERA5) Retrospective Met + LSM
- Streams + Catchments: NGA TDX-Hydro (7 million rivers)
- Inflow Calculations: Custom
- Routing: Matrix Muskingum Cunge (RAPID software)



GEOGLOWS V2.0 Production Cycle

GEOGLOWS V2 → Delivers → 3 (Free!) Data and Web Service Sources https://training.geoglows.org → Which Power → Locally Adaptable Open-Source Code and Web Apps https://training.geoglows.org



ECMWF Supercomputing Center – Bologna, Italy

ECMWF

GEOGLOWS GLOBAL WATER SUSTAINABILITY

1. Weekly Historical Data → powered by aws → Store and Share Data

2. Daily Animated Maps → esri → Map Visualizations

3. Daily New Forecasts → GEOGLOWS GLOBAL WATER SUSTAINABILITY → API Data On-demand

GEOGLOWS V2.0 Main Data Products (S3)

GIS + Model data

- Stream centerlines
- Catchments
- Model config files
- River names
- Country names
- Geopackage
- CSV, Parquet

Forecast

- 50+1 Ensemble
- 3 hourly average
- 15 days lead time
- Every midnight UTC
- Zarr

Retrospective

- Deterministic
- 1940-Present (5-12 days lag) Weekly updates
- Hourly average
- Daily, monthly, yearly precomputed
- Return Period Estimates

https://training.geoglows.org

GEOGLOWS V2.0 Access Tools

Data Service + AWS Storage

- Data service serves daily forecasts and retrospective simulations
- Free to query (1 river) or bulk download (many rivers)
- Examples scripts and and authoritative python package client

https://apps.geoglows.org

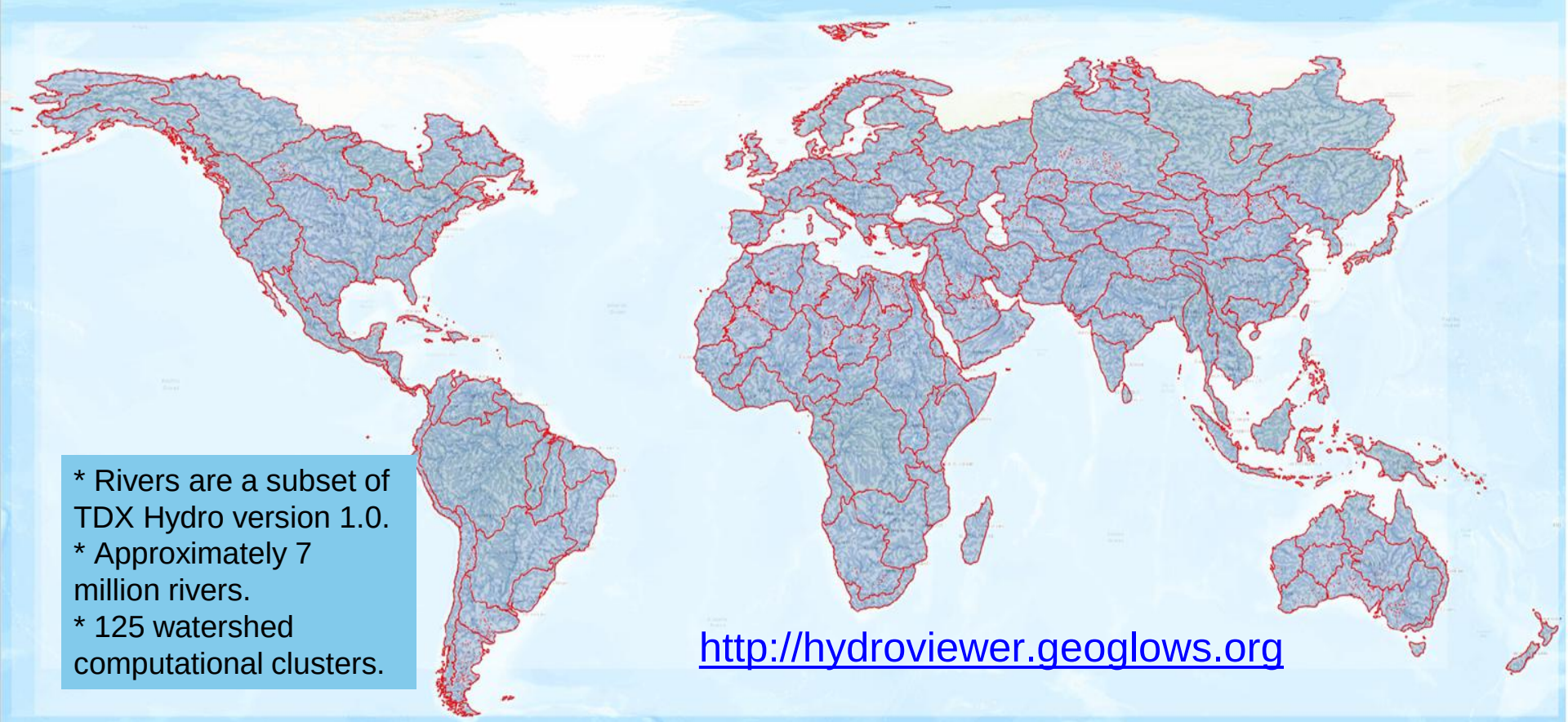
Web Map (ArcGIS Living Atlas)

- 10-day animated streams layer shows forecast results
- Free to use/view in *any* website or GIS

Hydroviewer

- Authoritative web app viewer and data retrieval tool
- Combines web maps and data services

GEOGLOWS V2.0 Hydrofabric lineage:
DLR TanDEM-X → NGA TDX-Hydro → GEOGLOWS v2.0



* Rivers are a subset of TDX Hydro version 1.0.
* Approximately 7 million rivers.
* 125 watershed computational clusters.

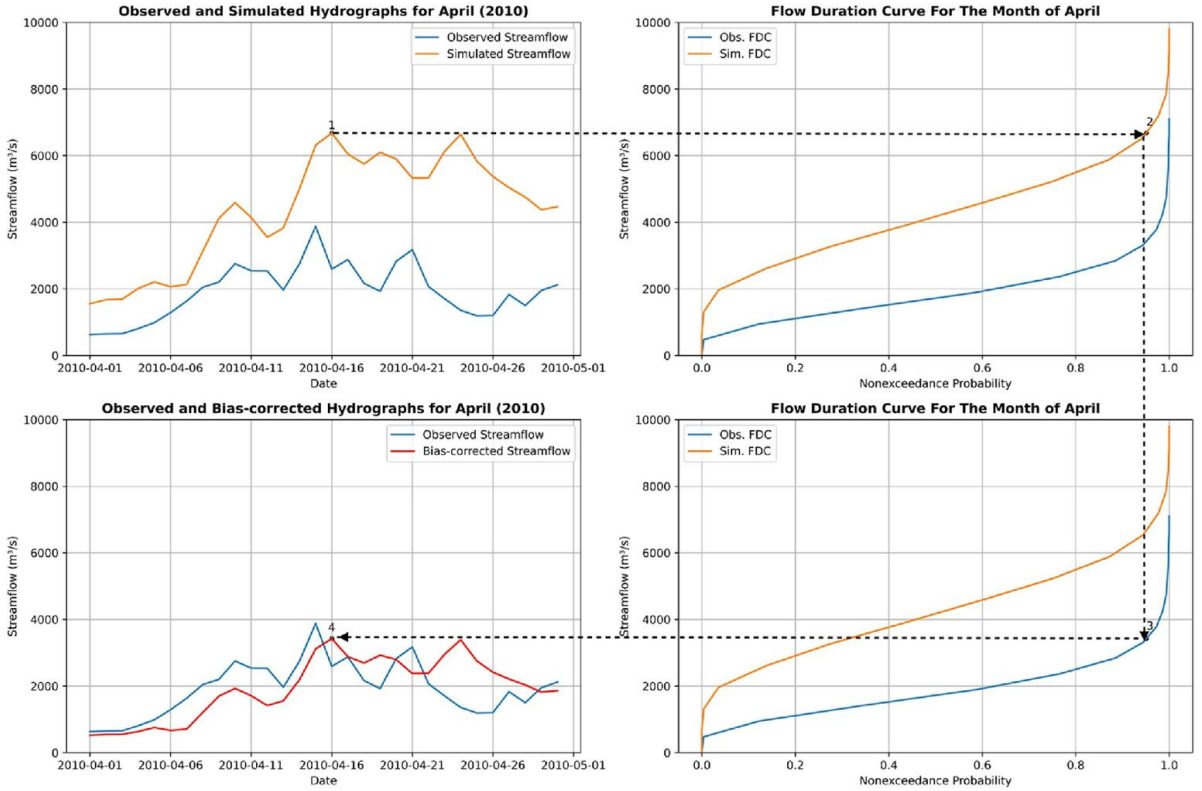
http://hydroviewer.geoglows.org

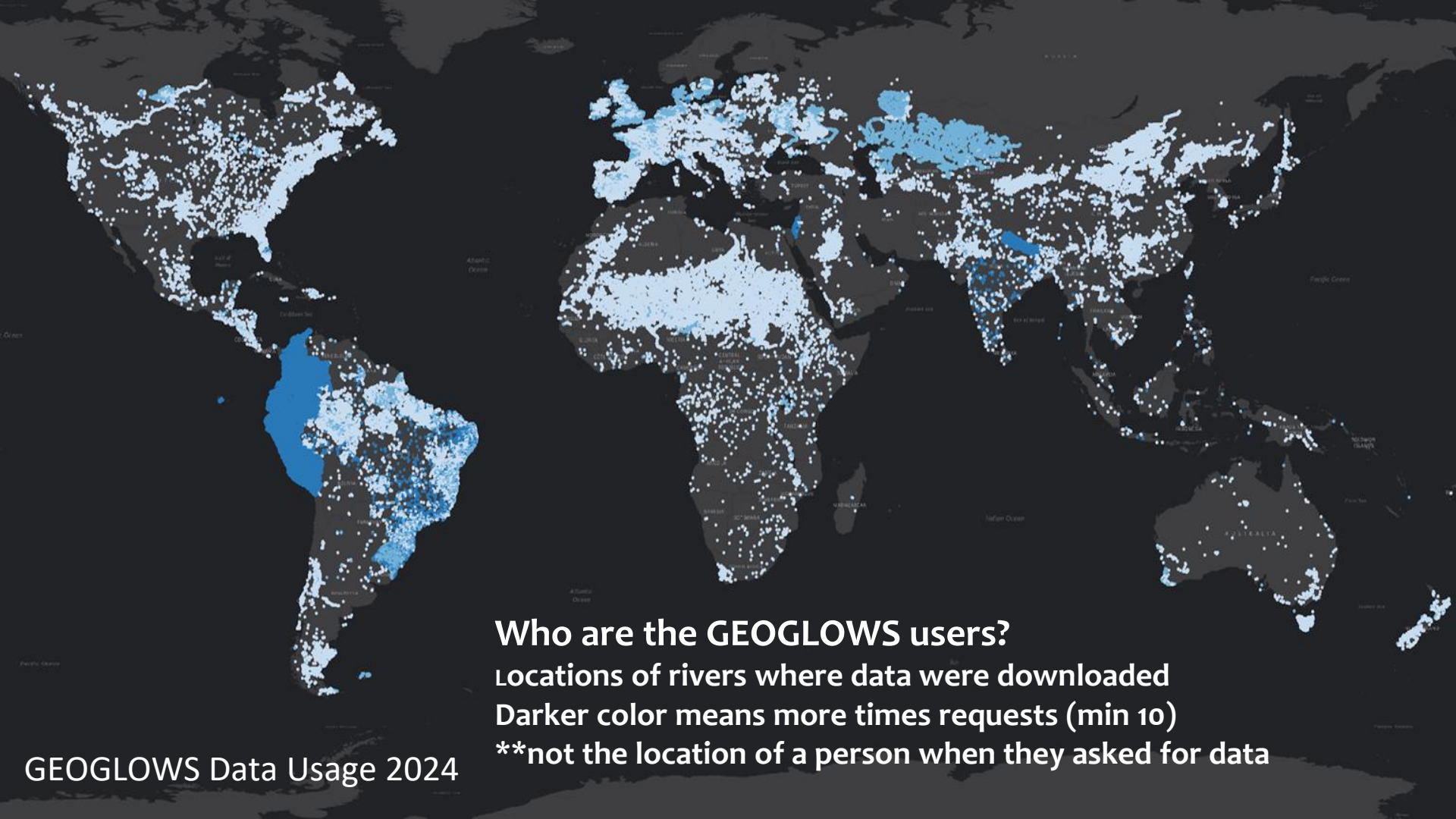
The Local Expertise: Bias Correction

Method

- Constructs monthly FDC
- Matches percentiles between observed and simulated flows
- Works with directly observed data from the same location.
- Accounts for seasonal variations.

https://training.geoglows.org/




Who are the GEOGLOWS users?
Locations of rivers where data were downloaded
Darker color means more times requests (min 10)
**not the location of a person when they asked for data
GEOGLOWS Data Usage 2024

Country	National Hydromet Service	Country	National Hydromet Service
Bangladesh (*)	ICIMOD	Honduras (*)	ENEE
Belize (*)	MNR Belize	India (*)	India Met. Department
Bhutan (*)	ICIMOD	Israel (I)	Israel Met. Service
Brazil (*)	CEMADEN	Jamaica (WMO)	WRA
Burundi (P)		Kenya (P)	Nile Basin Initiative (NBI)
Colombia (*)	IDEAM	Malawi (*)	DODMA
Costa Rica	ICE	Nepal (*)	ICIMOD/DHM
Cuba (WMO)	INRH	Nicaragua (I)	INETER
Dominican Republic (*)	INDRHI	Panamá (*)	IMHPA
DR Congo (P)		Peru (I)	SENAMHI
Ecuador (*)	INAMHI	Rwanda (P)	RWB
Egypt (P)		Sth. Sudan (P)	
El Salvador (I)	MARN	Sudan (P)	
Ethiopia (P)		Tanzania (P)	
Guatemala (I)	INSIVUMEH	Togo (WMO)	DRE
Haiti (WMO)	MARNDR/UHM	T&T (WMO)	WRA
		Uganda (P)	

GEOGLOWS implementation Status

(*) Implemented and validated as official input for national water resource management.

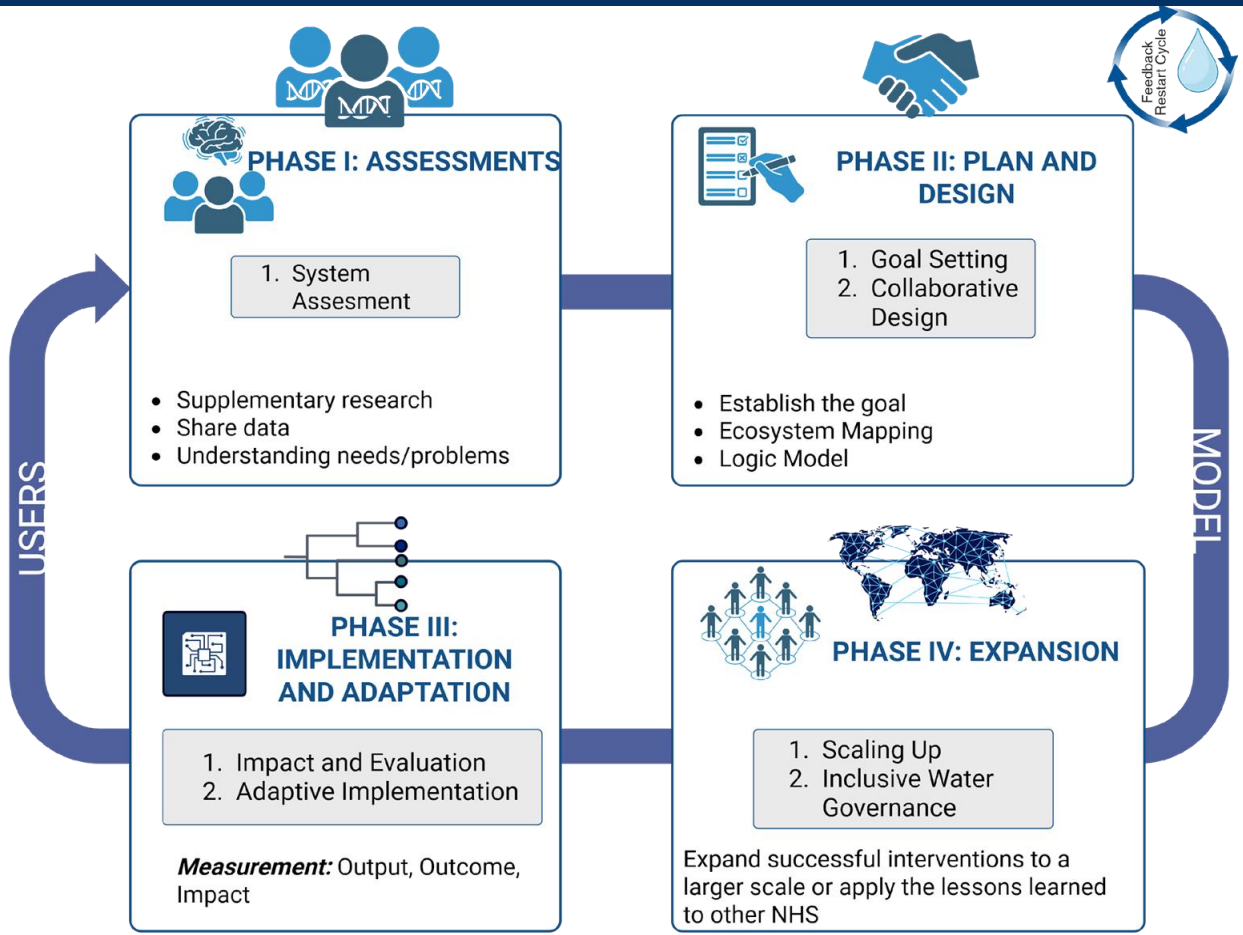
(P) USA-PREPARE

(WMO)

(I) Implemented

GEOGLOWS
GLOBAL WATER SUSTAINABILITY

“Working with Partners: From Global Service to Local Impact”



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THANK YOU

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Hydroviewer Demonstration

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