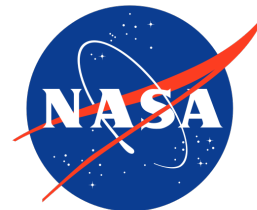




Improving Flood Warning in the Amazon

Jim Nelson – BYU (and many others)



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

Droughts in the Amazon

Scientists have documented deepening droughts in the Amazon Basin



Floods in the Amazon



One of the most recurrent and costly natural disasters around the world



Water Security



Water quantity and quality for livelihoods, ecosystems, and production.



Acceptable water-related risks to people, environments, and economics.

Water Information is Critical



... adopted by ~200 countries

GEO Global Water Sustainability Initiative



Connect People with Global Water Information

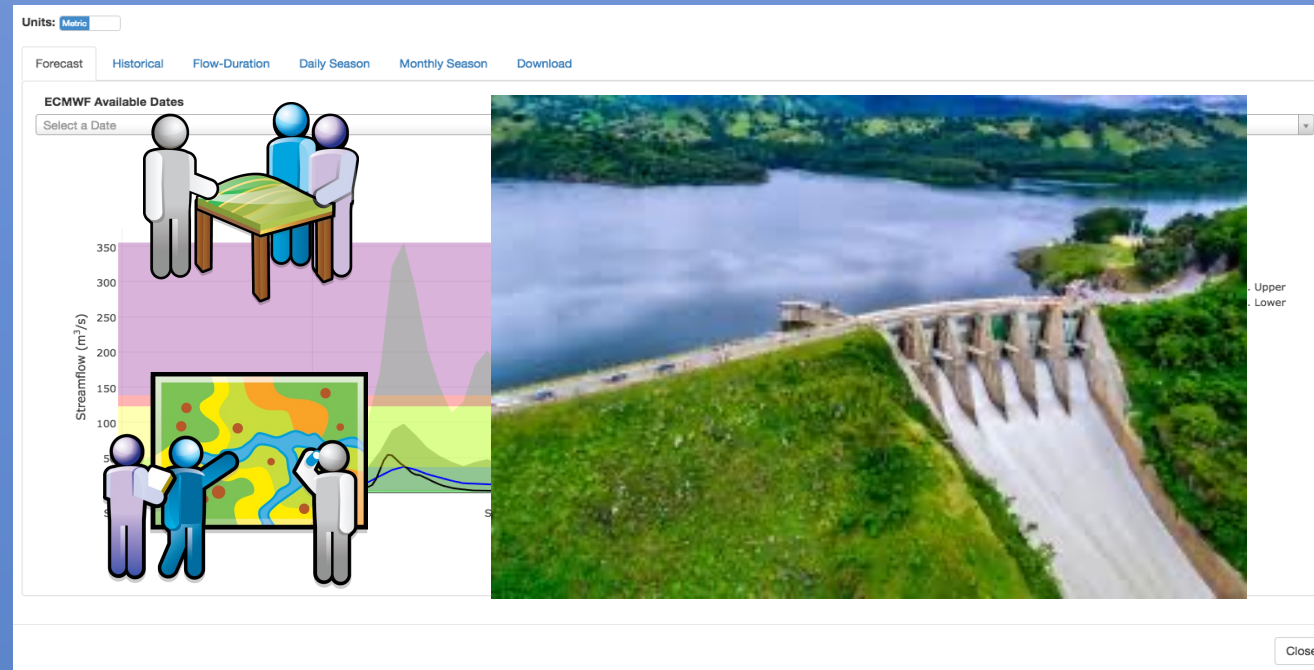
Role of Hydrologic Modeling

Understand

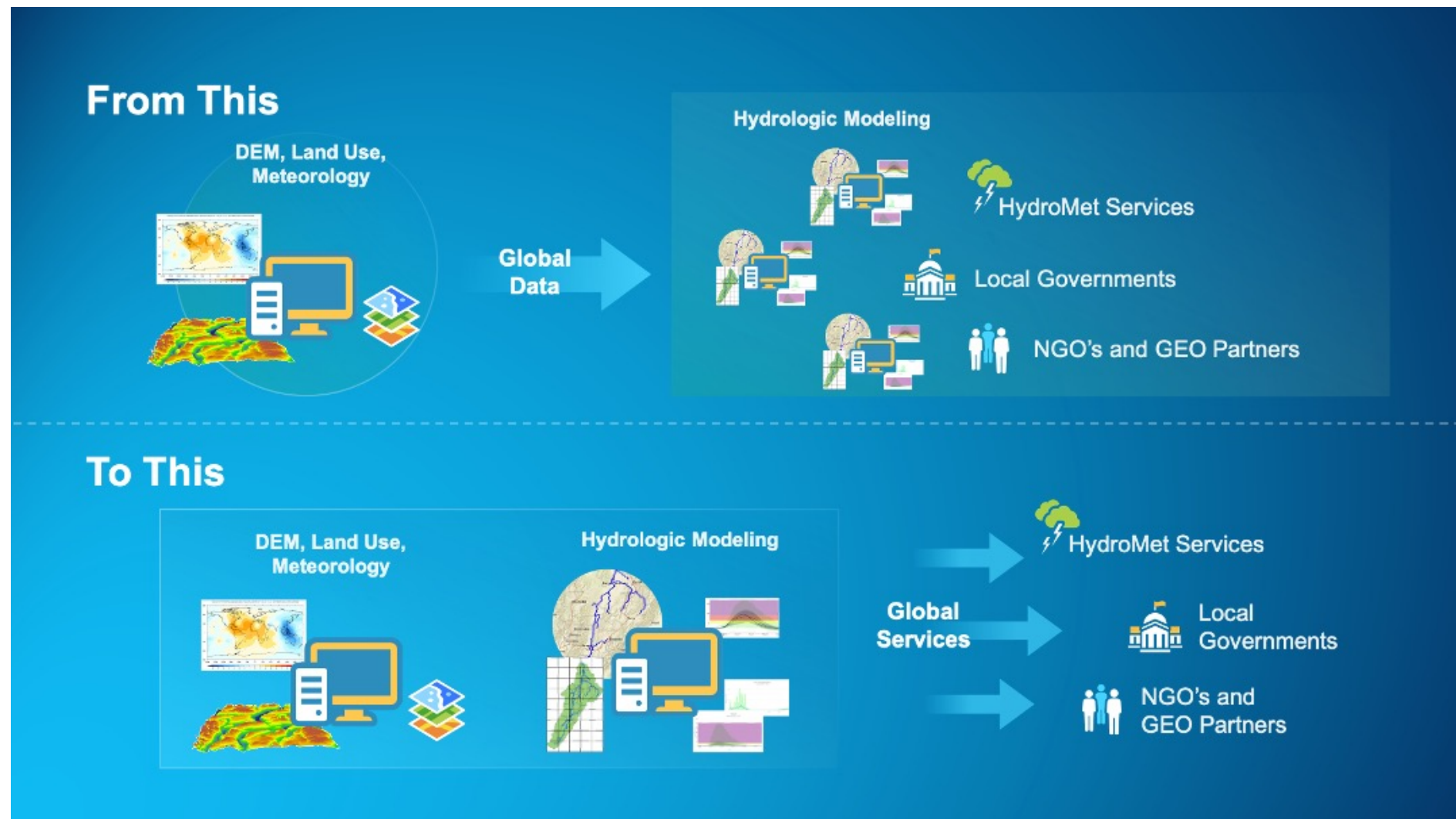
- Watersheds
- Waters
- Rivers

Predict

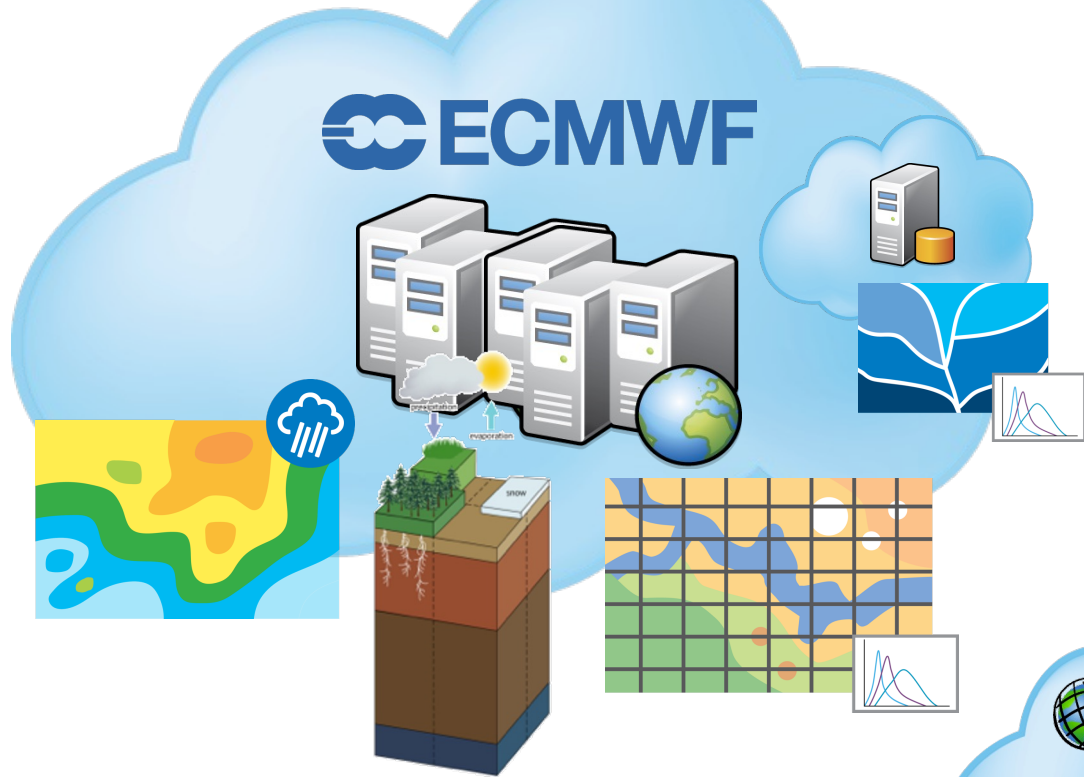
Manage



Global Models Support Local Decision Makers



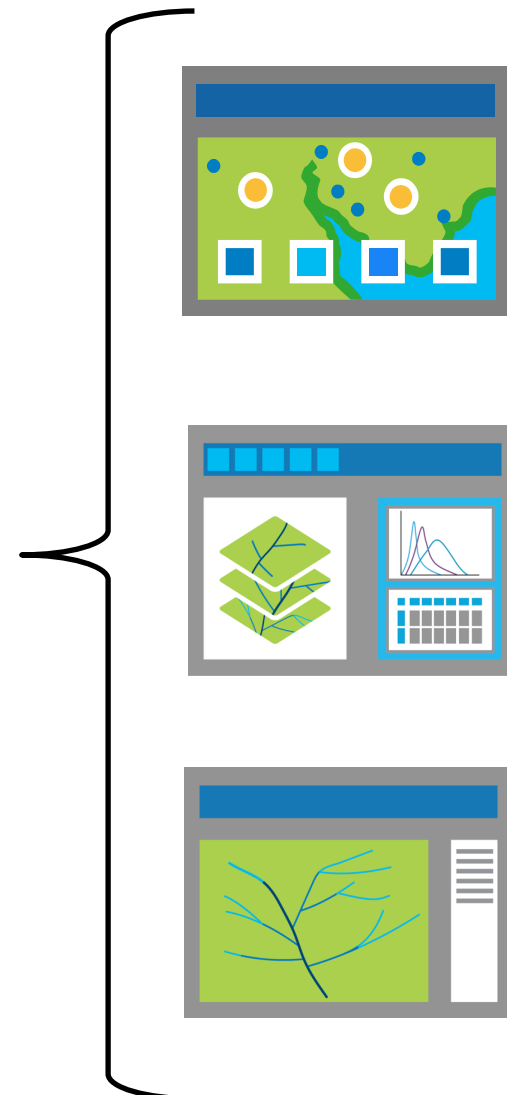
GEOGIOWS ECMWF Streamflow Services



Streamflow API at ECMWF



Global WMS at Living Atlas



How to get results from the REST API

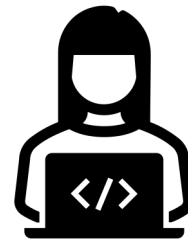
Global Model Dataset



Gets back a CSV of streamflow data

Feb 1 22	5
...	m ³ /s
Feb 2 22	6
...	m ³ /s
etc...	etc...

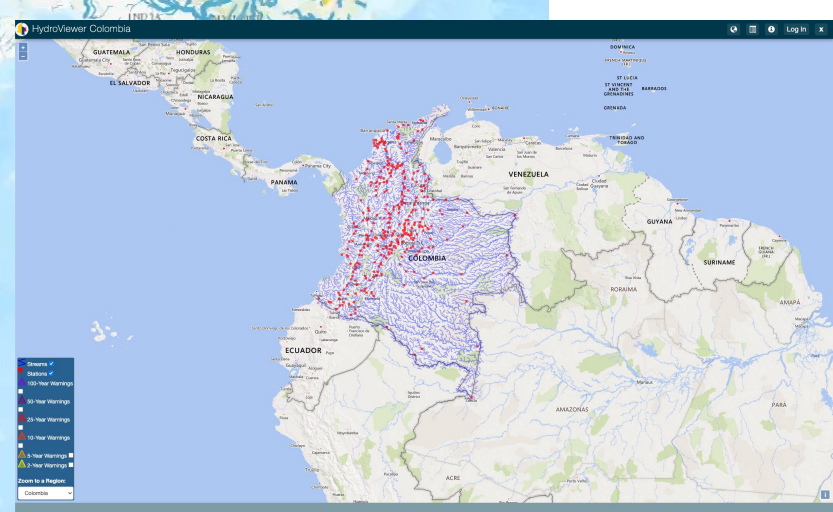
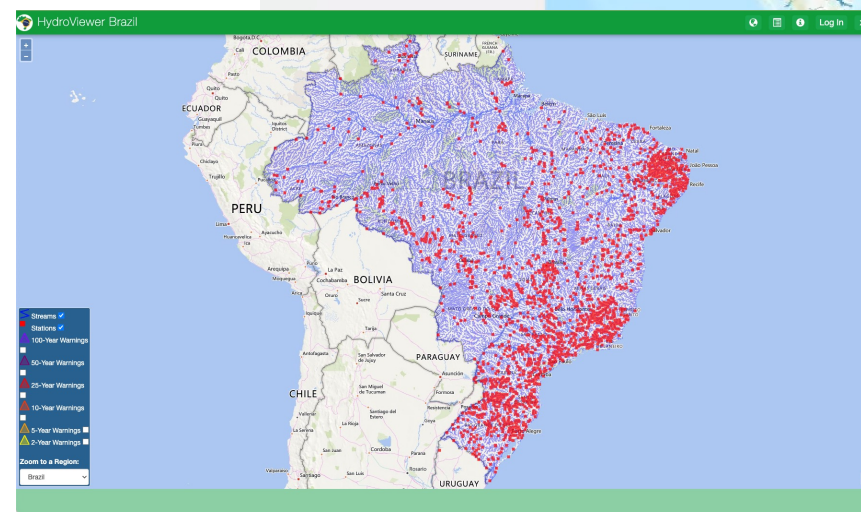
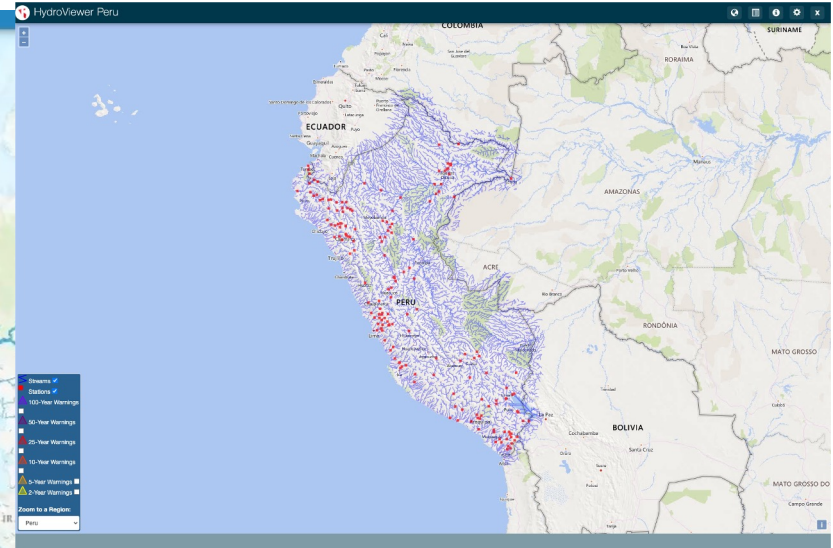
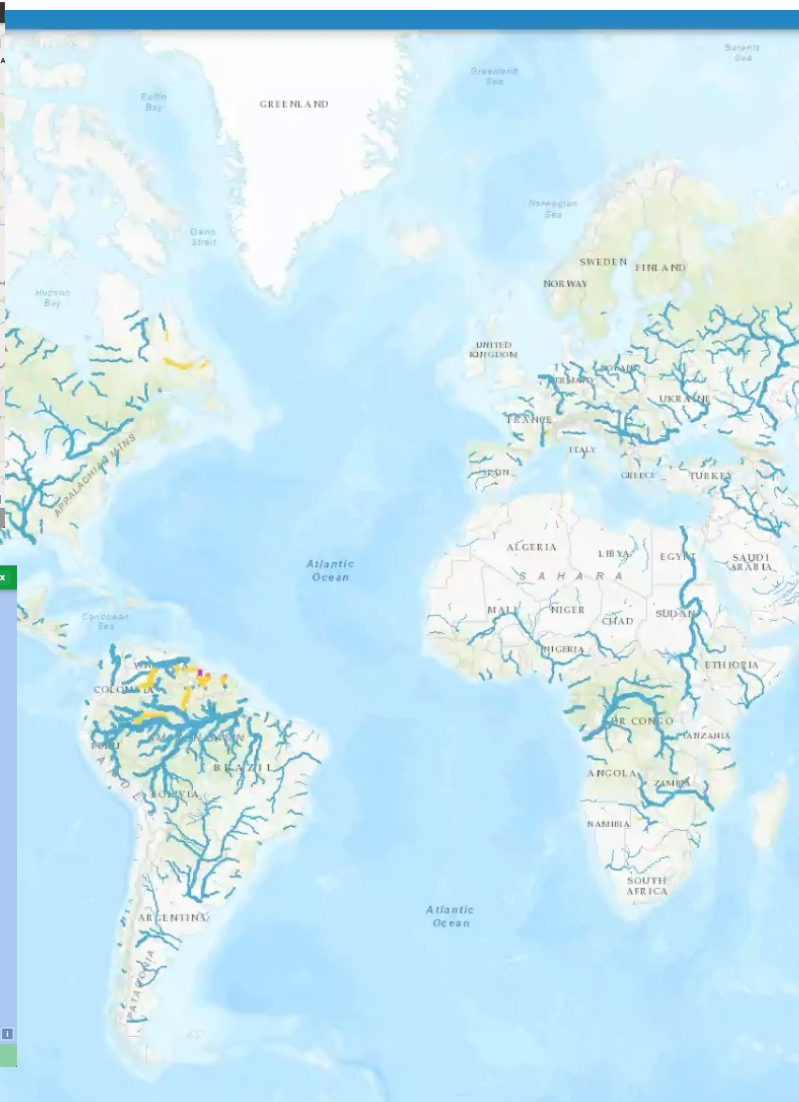
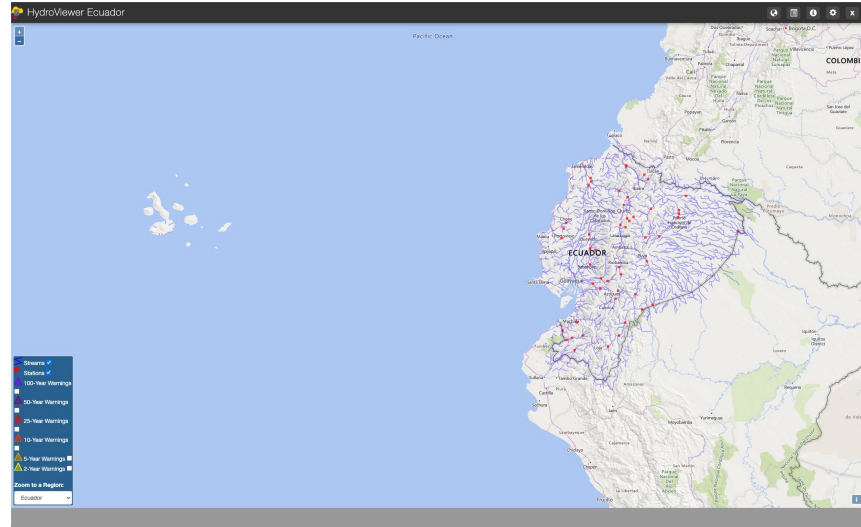
geoglows.ecmwf.int/api/v2/Forecast/13006789



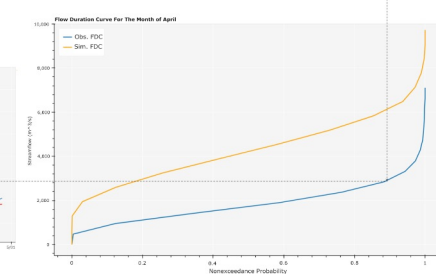
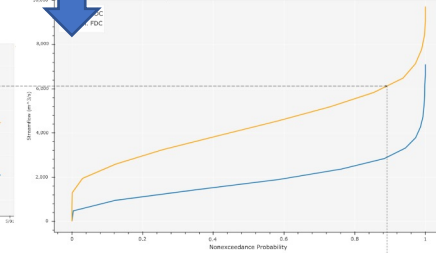
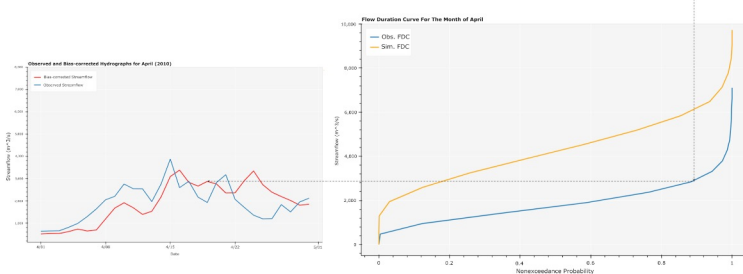
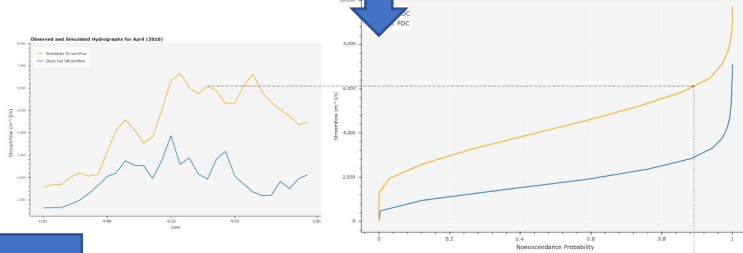
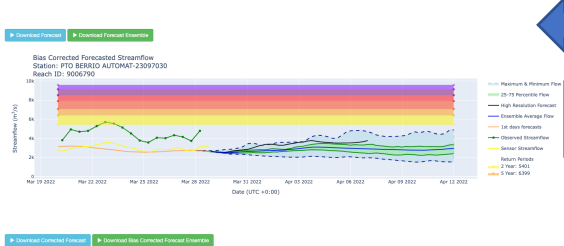
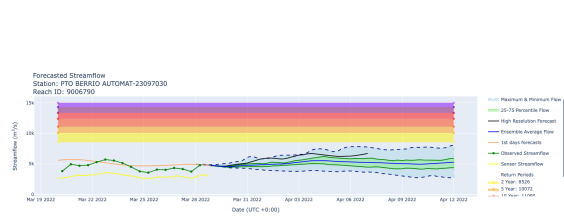
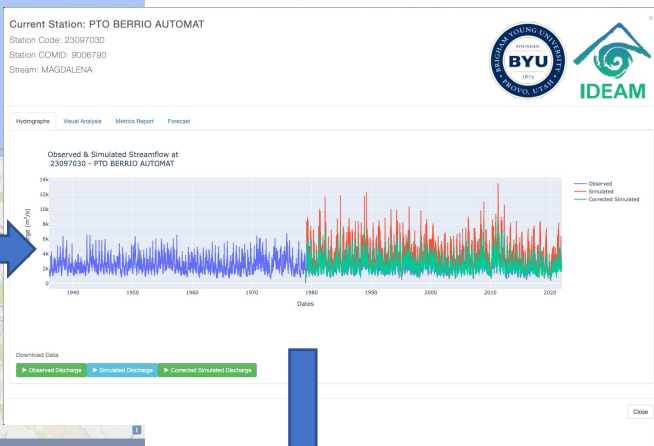
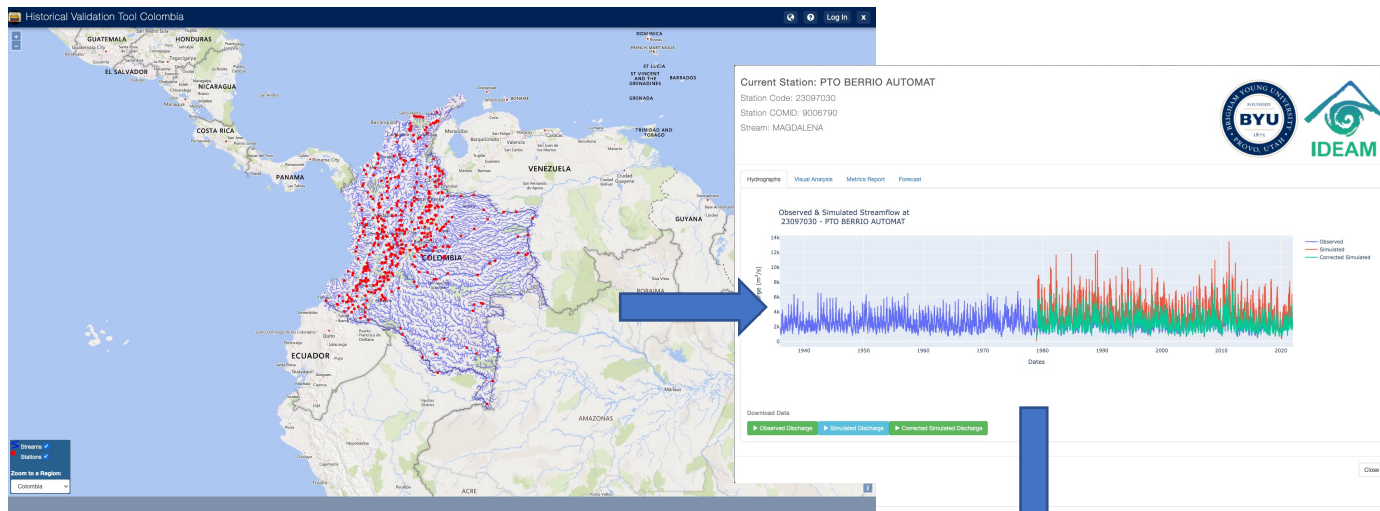
Hydrologist

- GET /ForecastStats/ Return basic forecast statistics
- GET /ForecastEnsembles/ Return forecast ensembles
- GET /ForecastWarnings/ Returns potential warnings for the forecast
- GET /ForecastRecords/ Return rolling record of average flows
- GET /HistoricSimulation/ Return historic simulation
- GET /DailyAverages/ Return historic simulation's daily averages
- GET /MonthlyAverages/ Return historic simulation's monthly averages
- GET /ReturnPeriods/ Return historic simulation
- GET /AvailableData/ Available forecasted streamflow data
- GET /AvailableRegions/ Available regions
- GET /AvailableDates/ Available dates

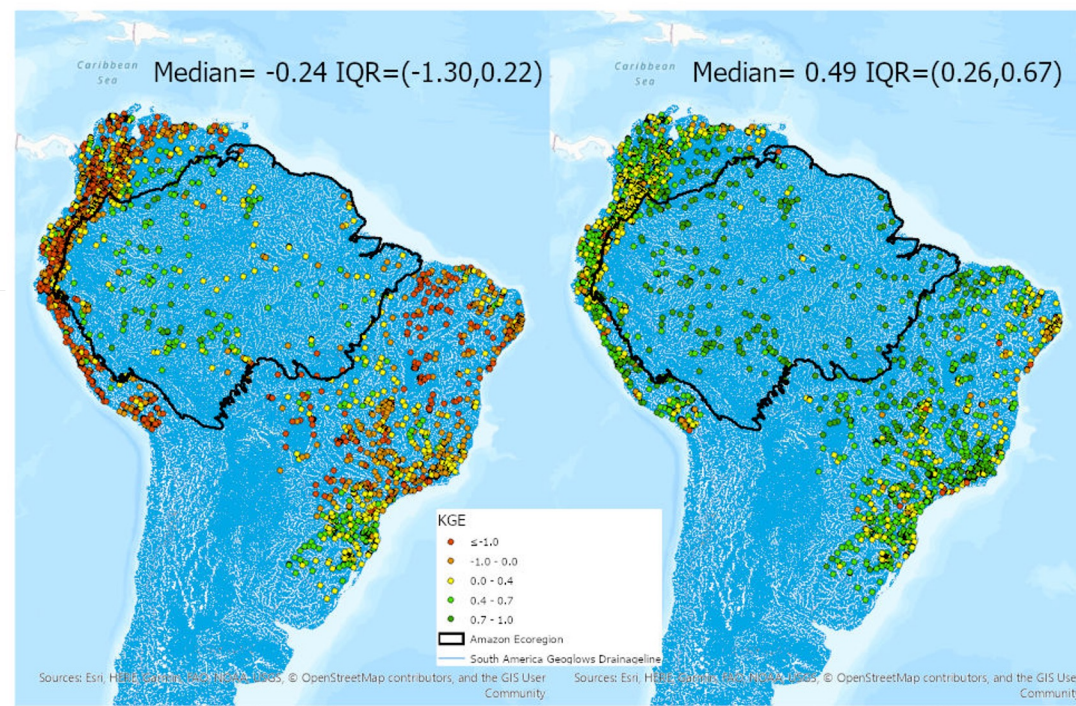
Global and Local Hydroviewers



Bias Correction with Local Data



KGE for GESS-ERA5 River Discharge Reanalysis and Observed Discharge Values



Sources: Esri, DeLorme, GeoEye, (Geo) NASA, DigitalGlobe, GeoEye, Earthstar (India), CNES-Airbus DS, USDA, AeroGRID, IGN, Esri, Mapbox, Swire, (Geo) Baidu, (Geo) Wikidata, (Geo) OpenStreetMap contributors, and the GIS User Community

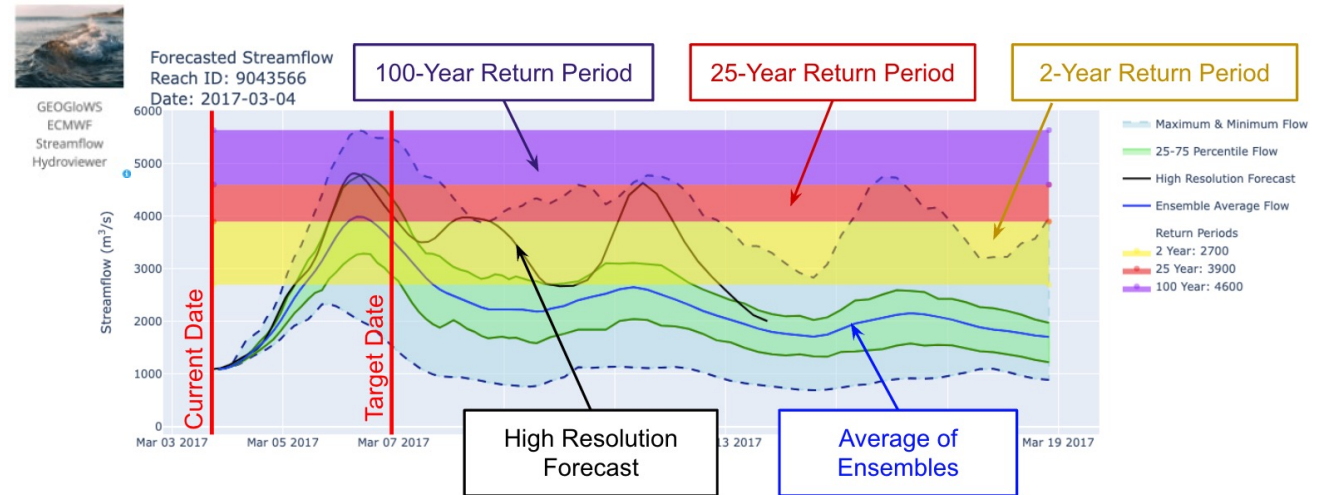
Original Simulation

Bias Corrected Simulation

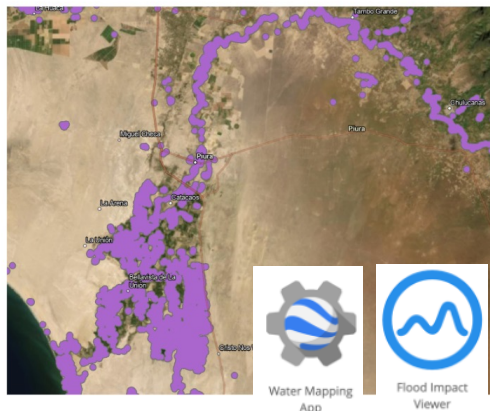
Training - Serious Game Applying GEOGloWS



Piura, Peru



100-Year Flood



100-Year Flood			
Category	Impact	Cost per unit	Sub-total
Agriculture	19191 hectares	\$4,000	\$76,764,240
Population	64425 people	\$50	\$3,221,250
Education	89	\$7,500	\$667,500
Entertainment	0	\$10,000	\$0
Financial	20	\$10,000	\$200,000
Food	11	\$10,000	\$110,000
Health Care	3	\$70,000	\$210,000
Public	13	\$15,000	\$195,000
Transportation	0	\$25,000	\$0
Waste Management	4	\$7,500	\$30,000
Total Damage			\$81,397,990

Actions		Lead Time									
		10 days	9 days	8 days	7 days	6 days	5 days	4 days	3 days	2 days	1 day
Round 1	Pre-position					X			-	-	-
	Sandbag									-	-
	Warn							X			
	Evacuate								X		

- This is how you would calculate your cost of protection:

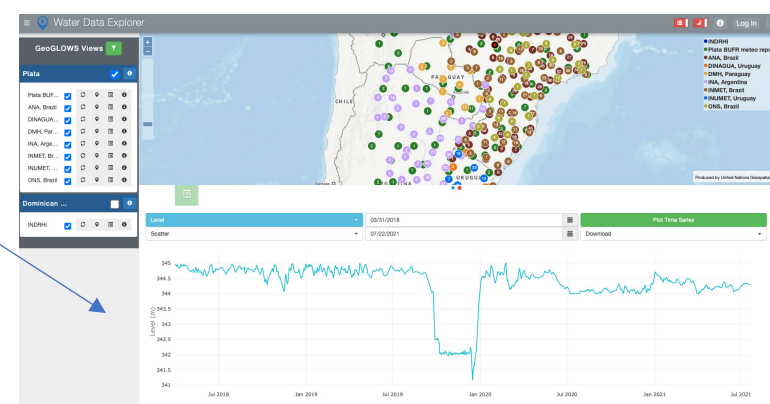
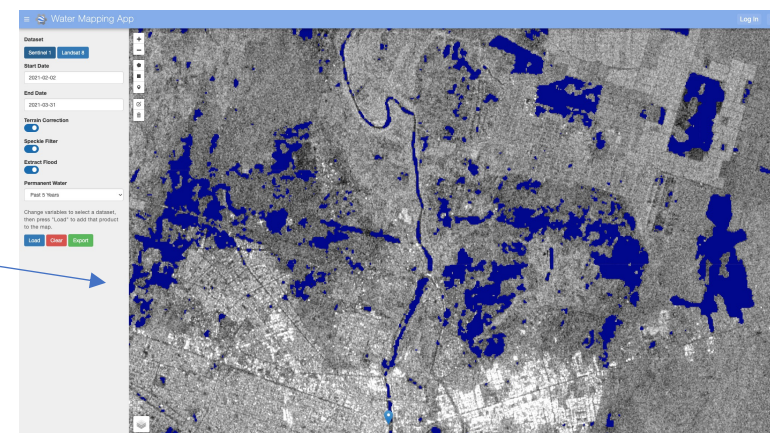
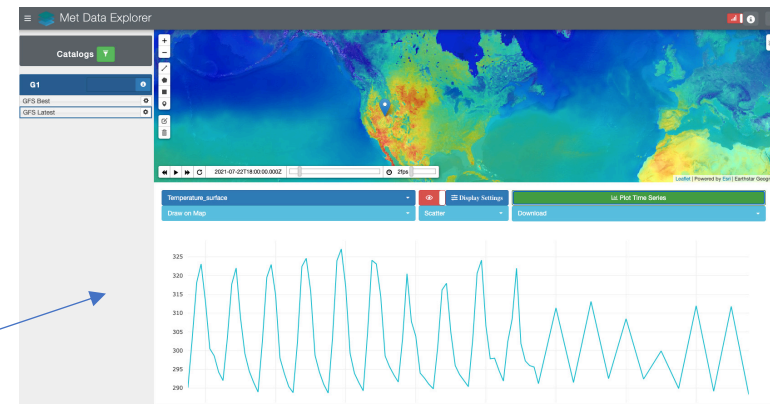
Actions		Lead Time									
		10 days	9 days	8 days	7 days	6 days	5 days	4 days	3 days	2 days	1 days
Pre-position	\$25,000	\$30,000	\$35,000	\$37,500	\$40,000	\$45,000	\$50,000	-	-	-	
Sandbag	\$30,000	\$35,000	\$40,000	\$45,000	\$50,000	\$55,000	\$60,000	\$65,000	-	-	
Warn	\$45,000	\$32,000	\$29,000	\$26,000	\$23,000	\$20,000	\$22,000	\$25,000	\$30,000	\$40,000	
Evacuate	\$100,000	\$95,000	\$85,000	\$80,000	\$75,000	\$70,000	\$65,000	\$60,000	\$90,000	\$120,000	

$$\text{Cost of Protection} = \$0 + \$30,000 + \$150,000 + \$40,000 + \$22,000 + \$60,000$$

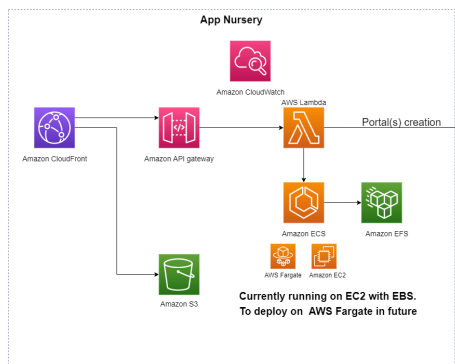
$$\text{Cost of Protection} = \$302,000$$

GEOGloWS at a Toolbox

The screenshot shows the INAMHI Tethys Portal Apps Library. The header includes the INAMHI logo and the text "INAMHI Tethys Portal" with a "Log In" button. Below the header is a yellow bar labeled "Apps Library". The main area displays a grid of application icons with labels: "Tethys App Store", "Water Mapping App", "Flood Impact Viewer", "Historical Validation Tool Ecuador", "GEOGloWS ECMWF Streamflow Hydroviewer", "Met Data Explorer", "National Water Level Forecast Ecuador", "Hydrostats App", "HydroViewer Ecuador", "Water Data Explorer", and "Grace Groundwater Subsetting Tool". At the bottom, it says "Copyright © 2022 INAMHI" and "Powered by Tethys Platform".



GEO – AWS Initiative



- Separate accounts for each individual portal
- To be hosted on different AWS regions
- Master portal to manage different accounts



- Questions
1. Currently, does the Tethys portal run on ECS?
 2. Does the database required is running on ECS?
 3. For deployment - are there any CloudFormation stacks available to be used?



TETHYS APP STORE

EarthKit	CAHRSW Viewer	HydroShare	Historical Validation Tool Colombia	HydroShare	AMEX Viewer
Lower Mekong SWAT	Flood Extent App	INAMHI	Statistics Calculator	HydroShare Hispania	Server Enabled Water Observation Explorer
GLDAS Data Visualizer	Feria Ephemeral Water Body Monitoring Dashboard	HydroShare Bangladesh	Nepal Flood Risk Viewer	HydroShare Nepal	GRACE 2.0
Groundwater Level Mapping Tool	AMEX	CHRS-GEIS Viewer	Streamflow Prediction Tool	Veg. Viewer Africa	



Dominican Republic

IRFF Applications Portal

Apps Library

Ecuador

INAMHI Tethys Portal

Apps Library

Colombia

Tethys Portal

Aplicaciones

Peru

Senamhi Tethys Portal

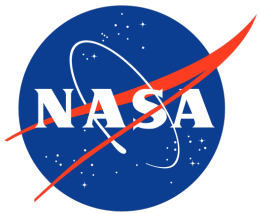
Apps Library

Brazil

Cemaden Tethys Portal

Apps Library

Thank you!



SERVIR  AMAZONIA

 **GEO GLOWS**
GLOBAL WATER SUSTAINABILITY

BYU

Civil and Construction Engineering
Hydroinformatics Lab