GEOGloWS ECMWF Streamflow Services:

Open Source Online Hydrologic Analysis Leveraging Disruptive Technology

Jim Nelson – BYU

Michael Souffront - Aquaveo

GEOGLOWS

GLOBAL WATER SUSTAINABILITY

NASA

USAID
FROM THE AMERICAN PEOPLE

ICIMOD

Azure

THE WORLD BANK

ECMWF

BRIGHAM YOUNG UNIVERSITY
FOUNDED
BYU
1875
PROVO, UTAH

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

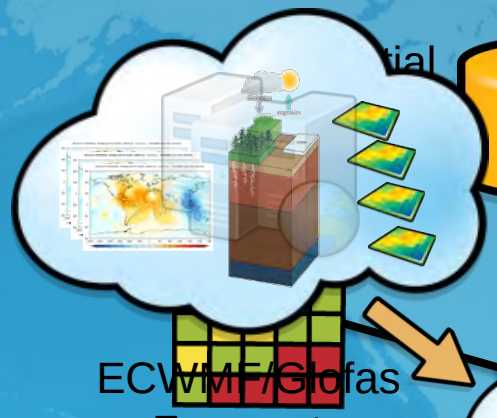
SERVIR

esri

Copernicus
Europe's eyes on Earth

European Commission

Stakeholders – They Make the Decisions

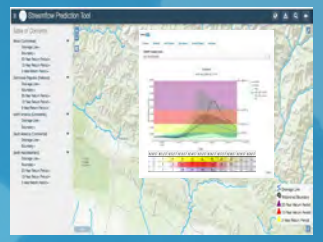


ECWMF/Glofas Forecasts

Model Files

Streamflow Forecast Services

Custom Python Scripts

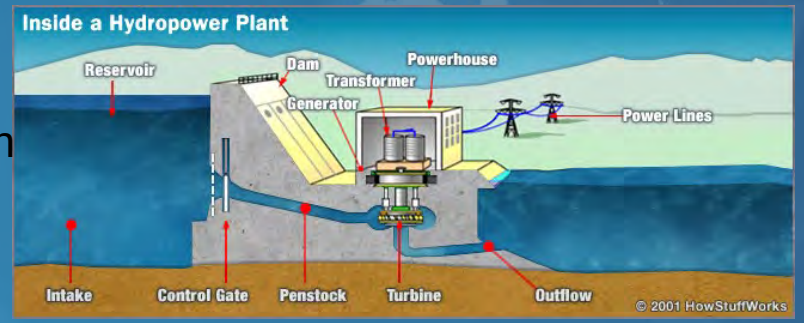


Streamflow Prediction Tool

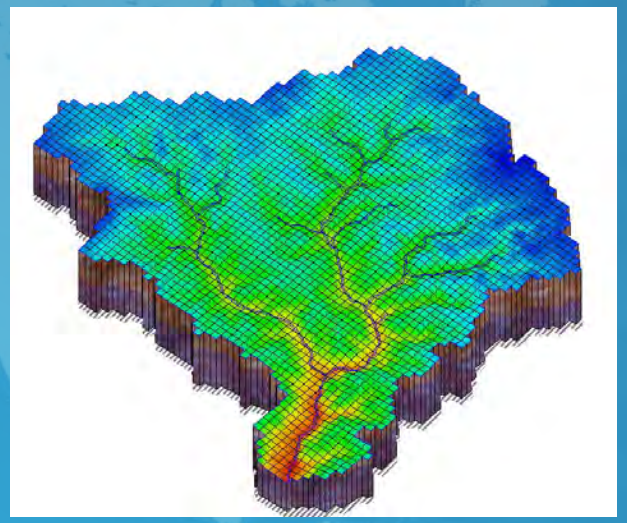
Simple Web Interfaces

Engineers, Decision Makers, Water Managers

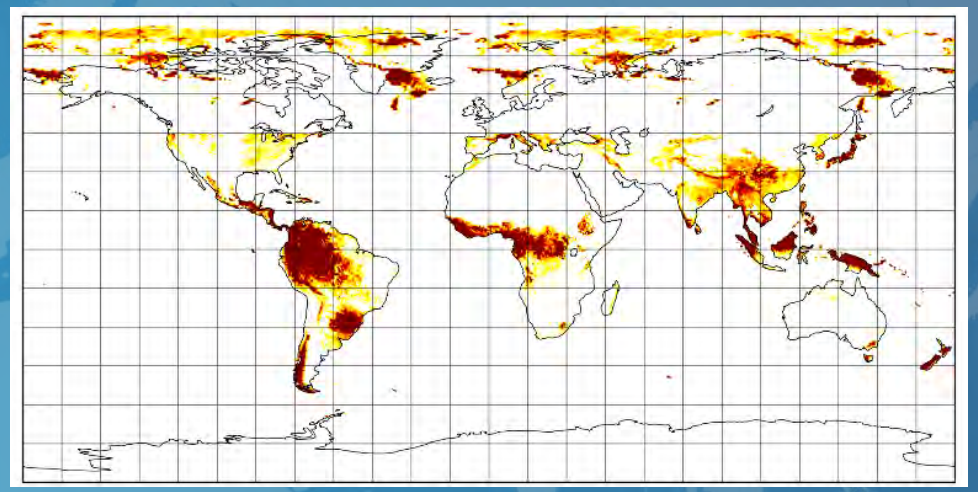
Hydrologists, Advocacy Groups, Public



A little bit of history



VS



The Grand Challenge:

Creating an operational global high-resolution hydrologic model

Overcoming Global Modeling Barriers

Cyberinfrastructure and Workflows

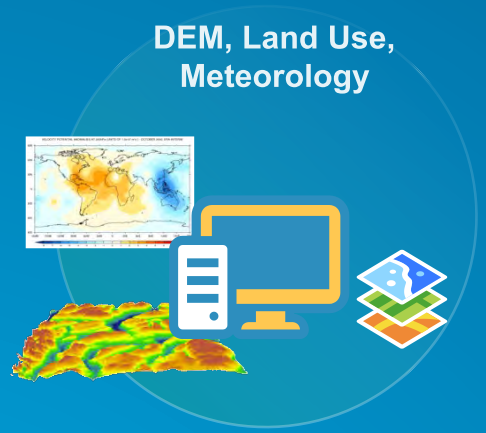
Web apps and web services

Partnerships, trainings, and collaboration

Accessibility tools and programmatic extraction

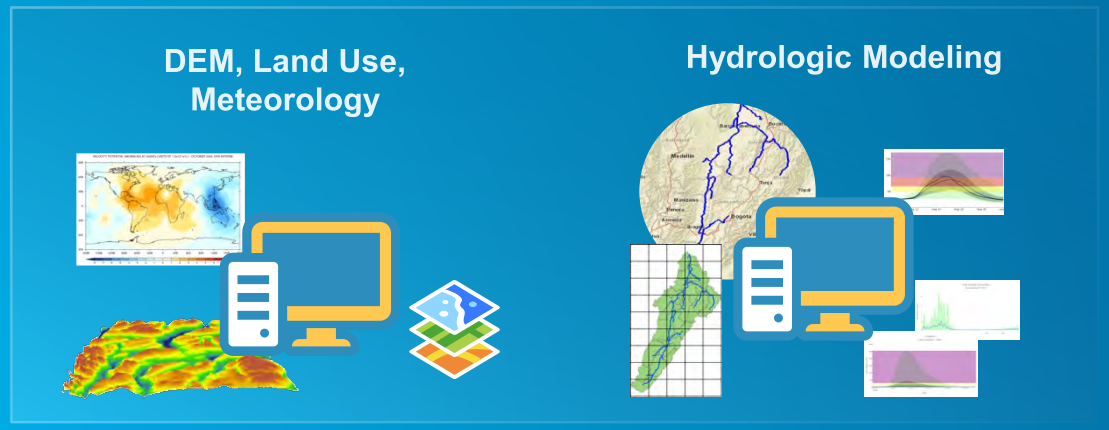
Global Streamflow Services – A Disruptive Technology

From This



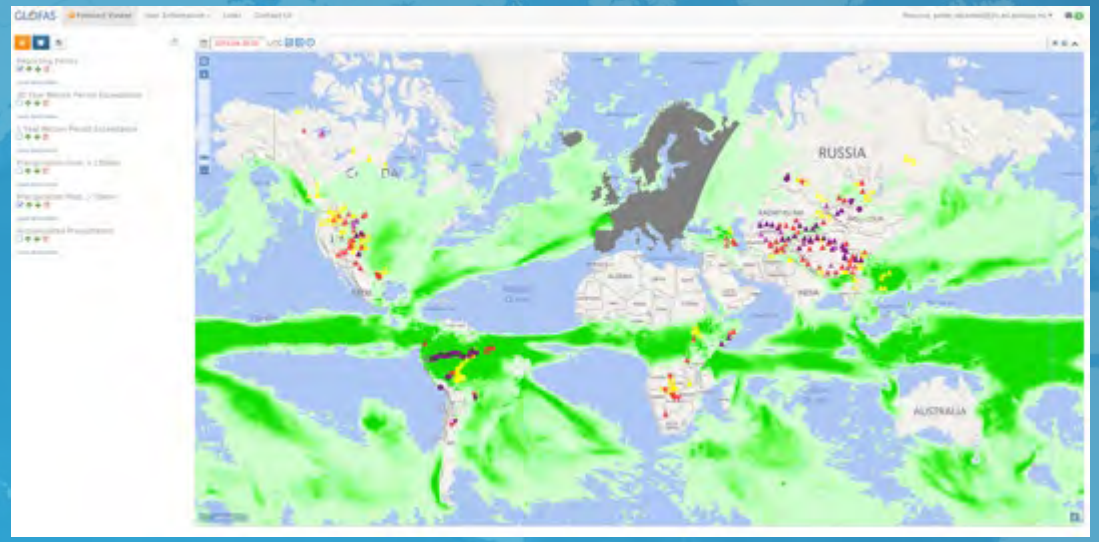
Global Data

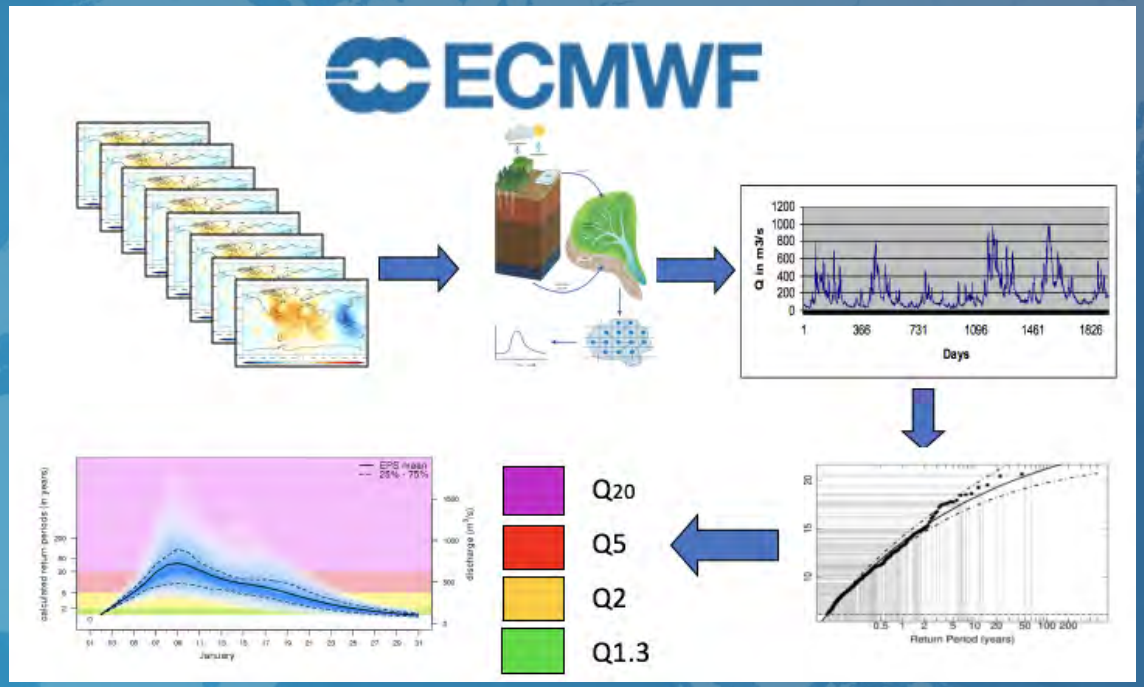
To This

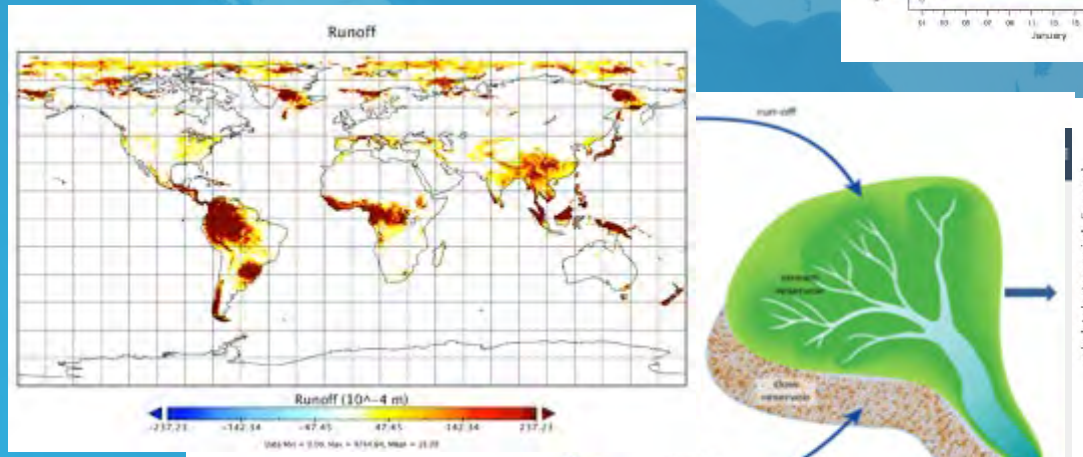


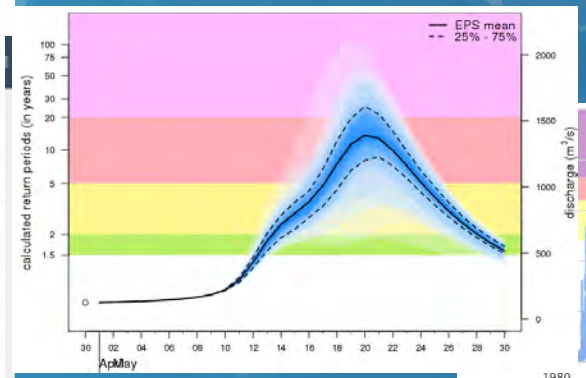
Global Services

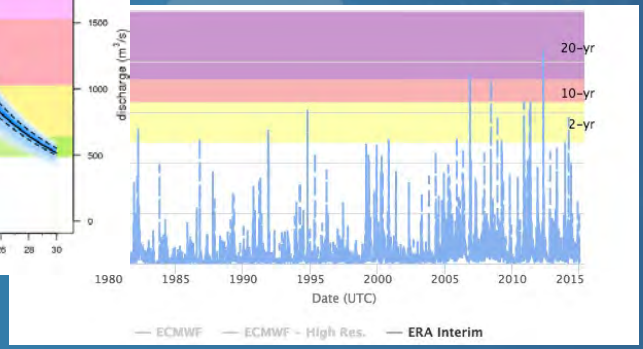
GEOGloWS ECMWF Streamflow Services is built on GloFAS



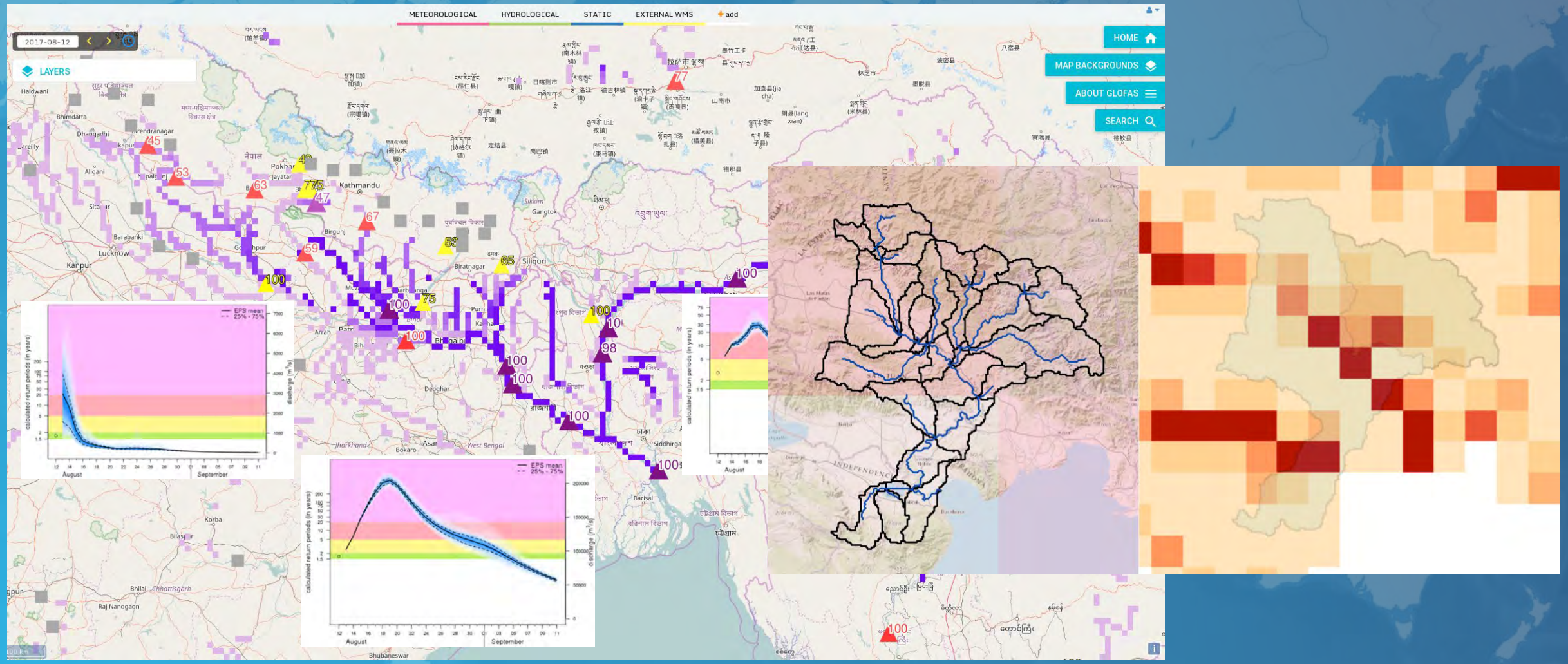




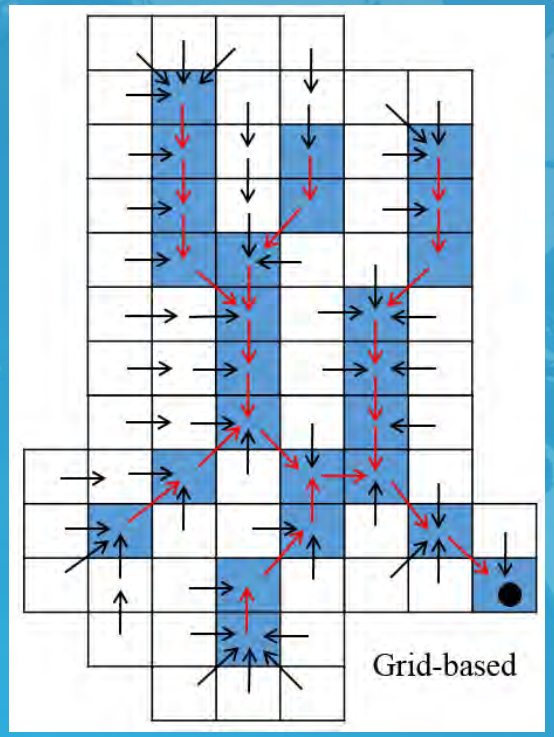


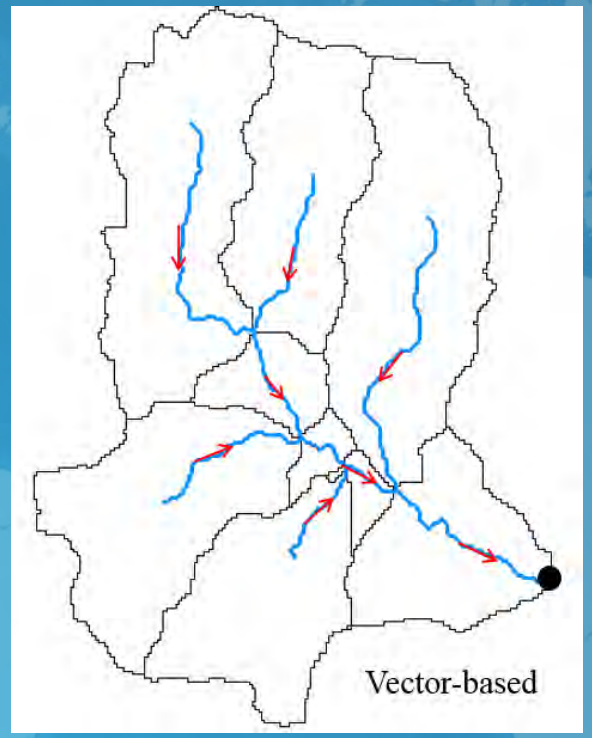


GloFAS - Limited to larger drainage areas

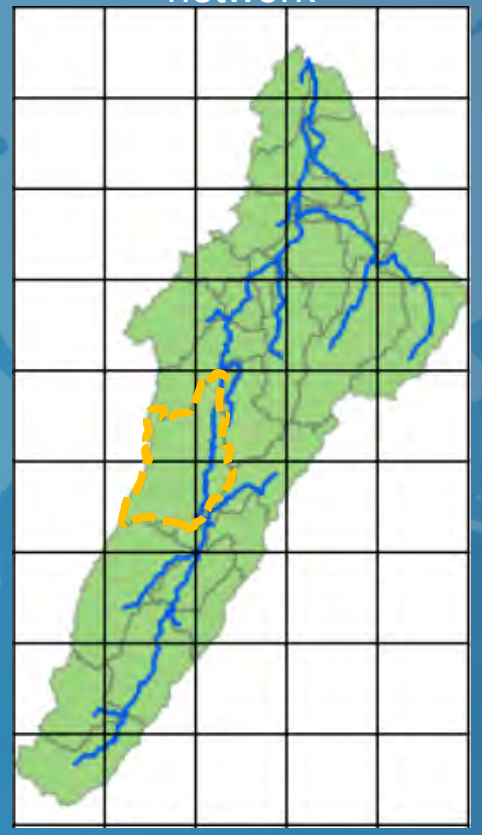


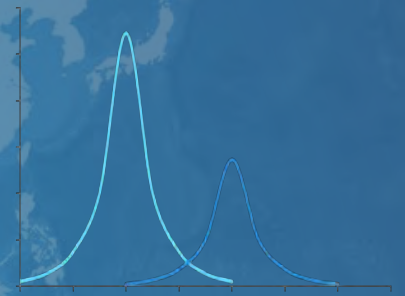
Downscaling process





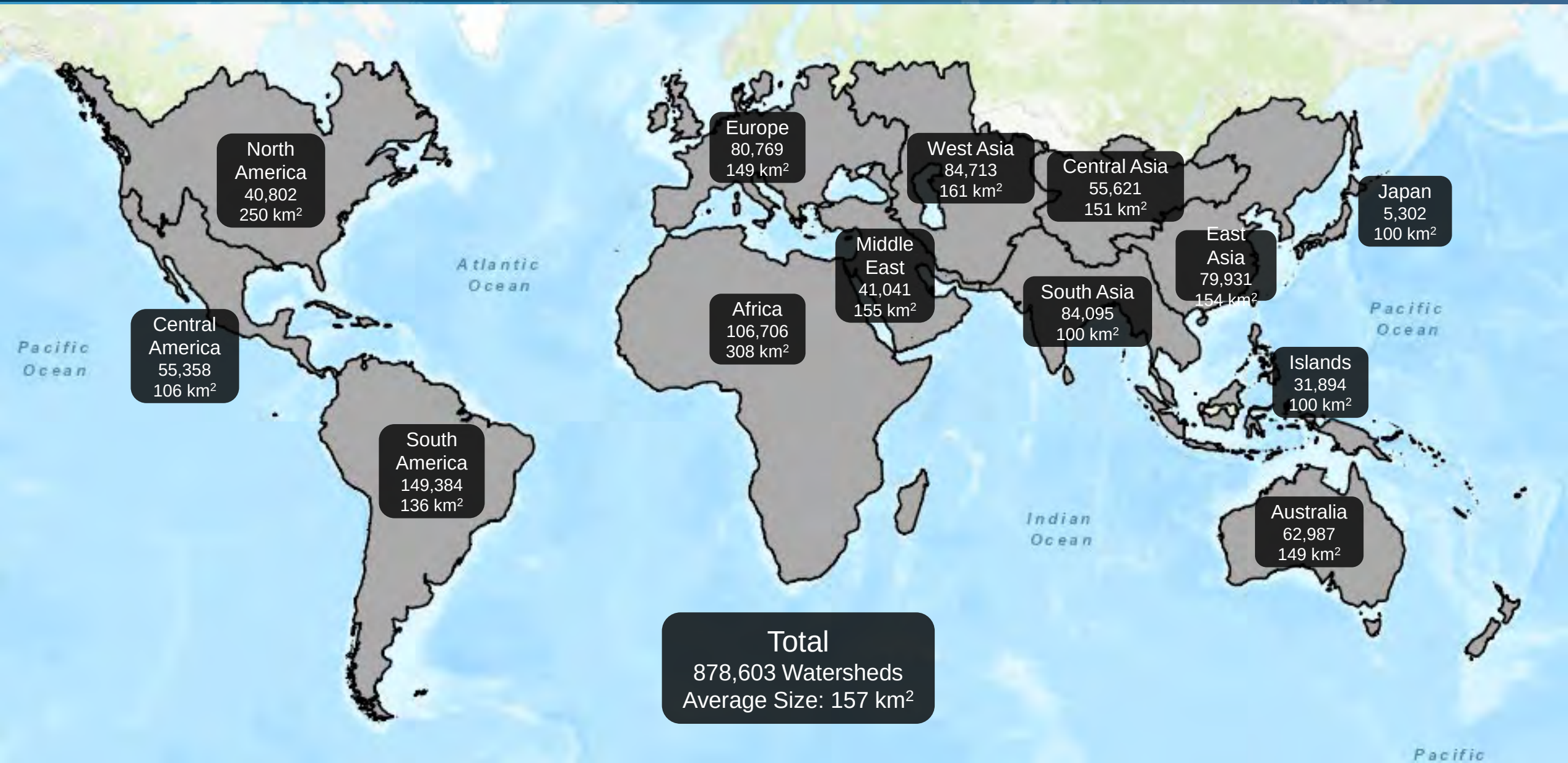
Mapping gridded runoff to basins/stream network





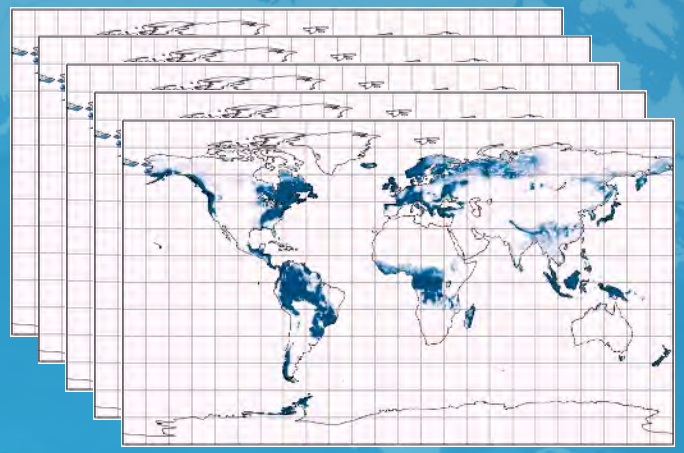
Muskingum Routing with RAPID

Global Network



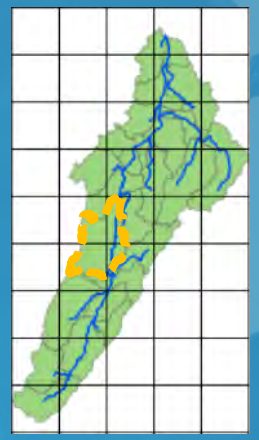
Total
878,603 Watersheds
Average Size: 157 km²

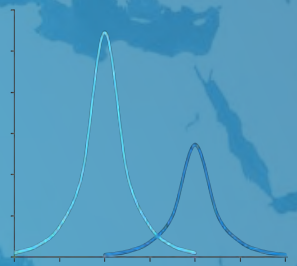
Historical Simulation

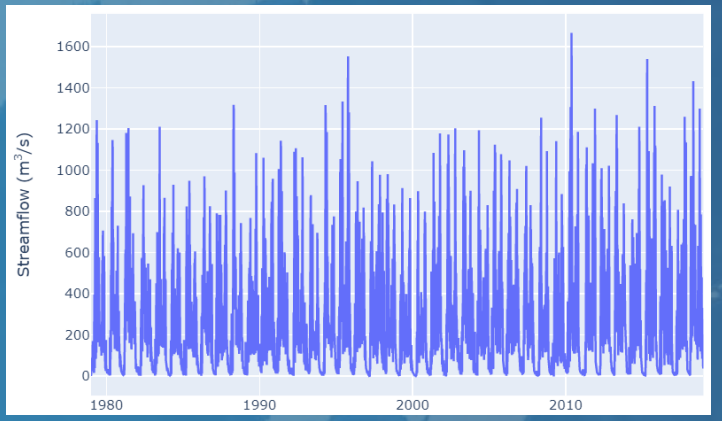


ECMWF

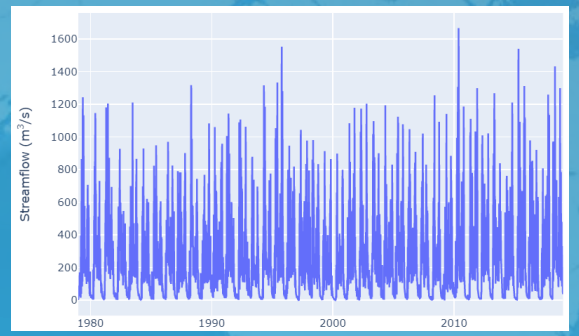
1979-2018

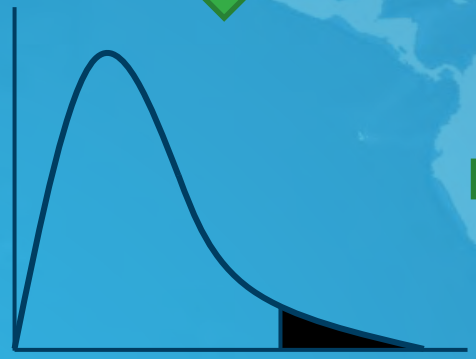




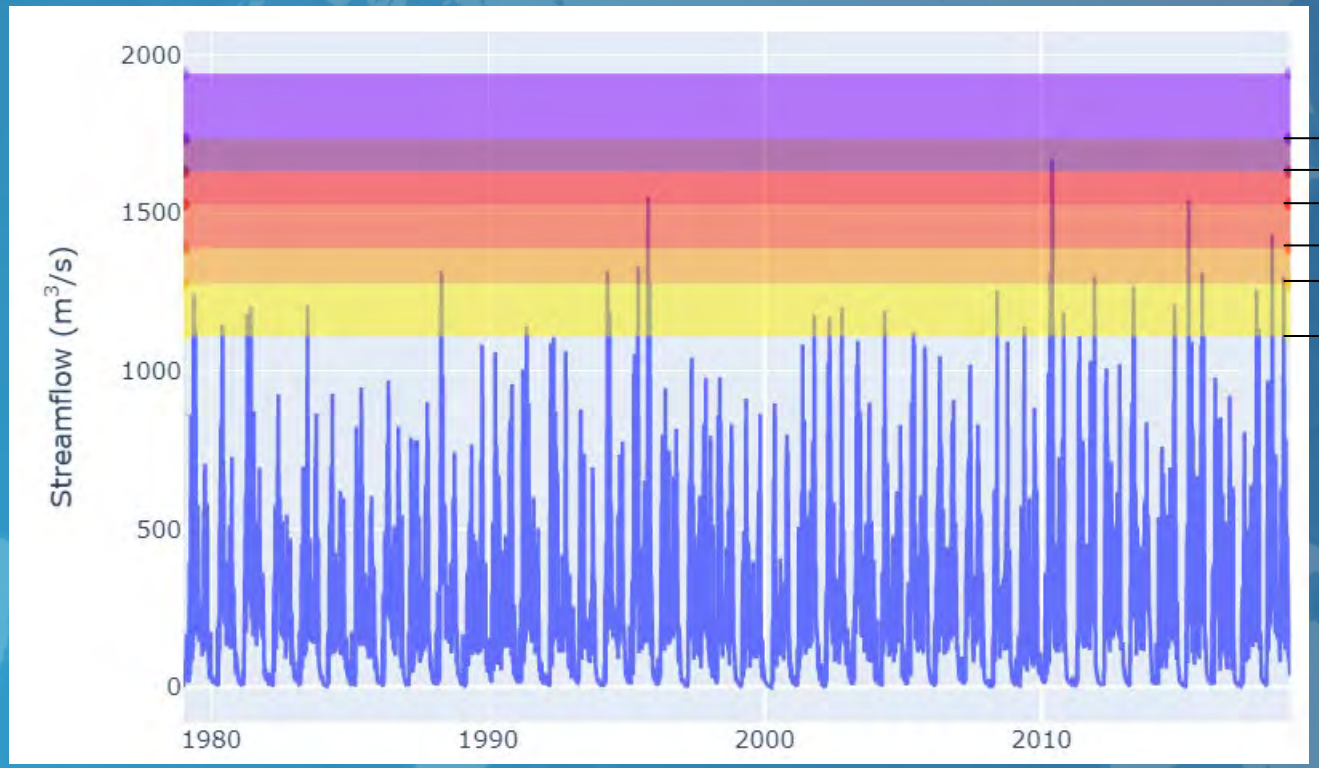


Return Periods

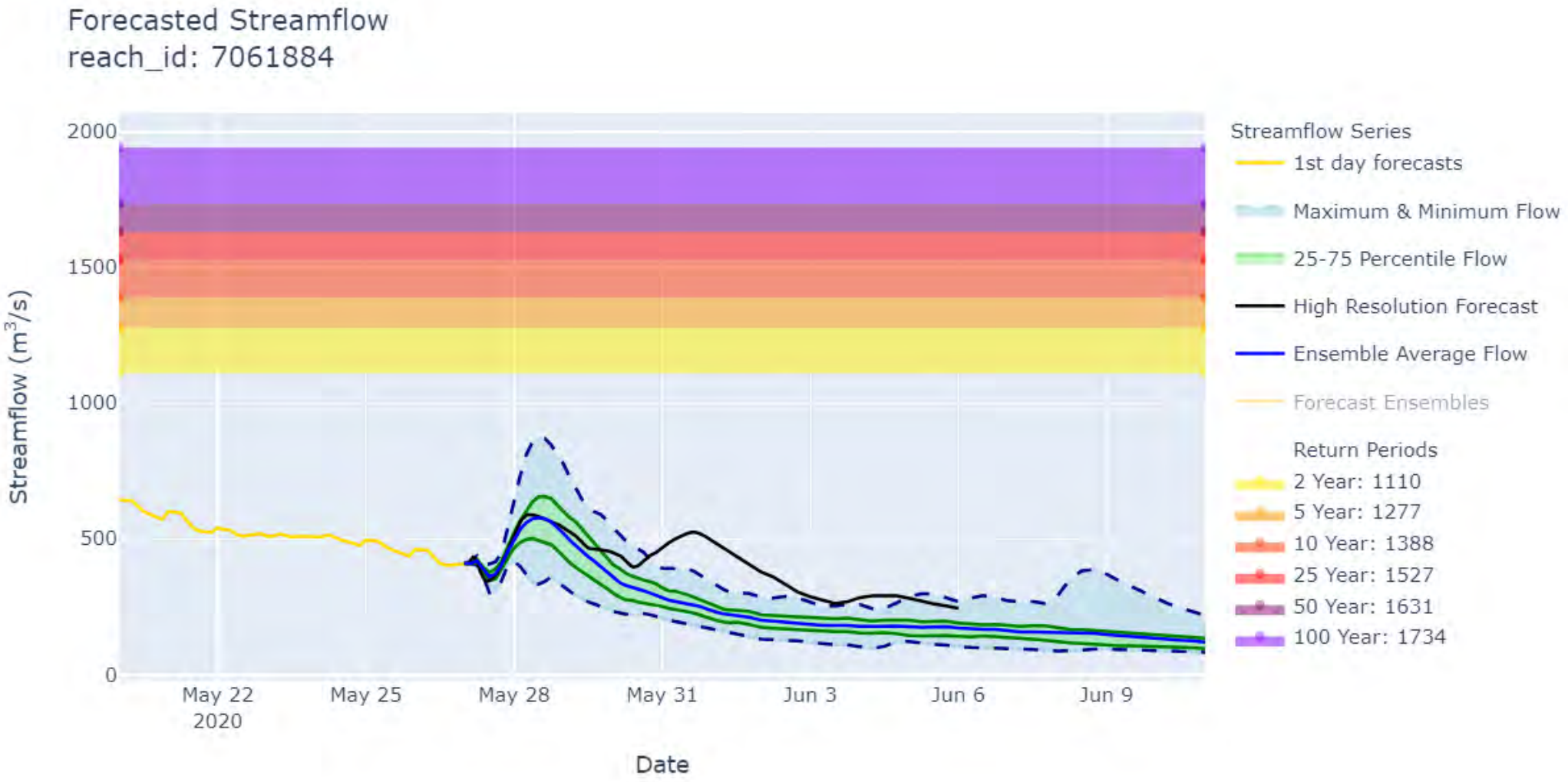




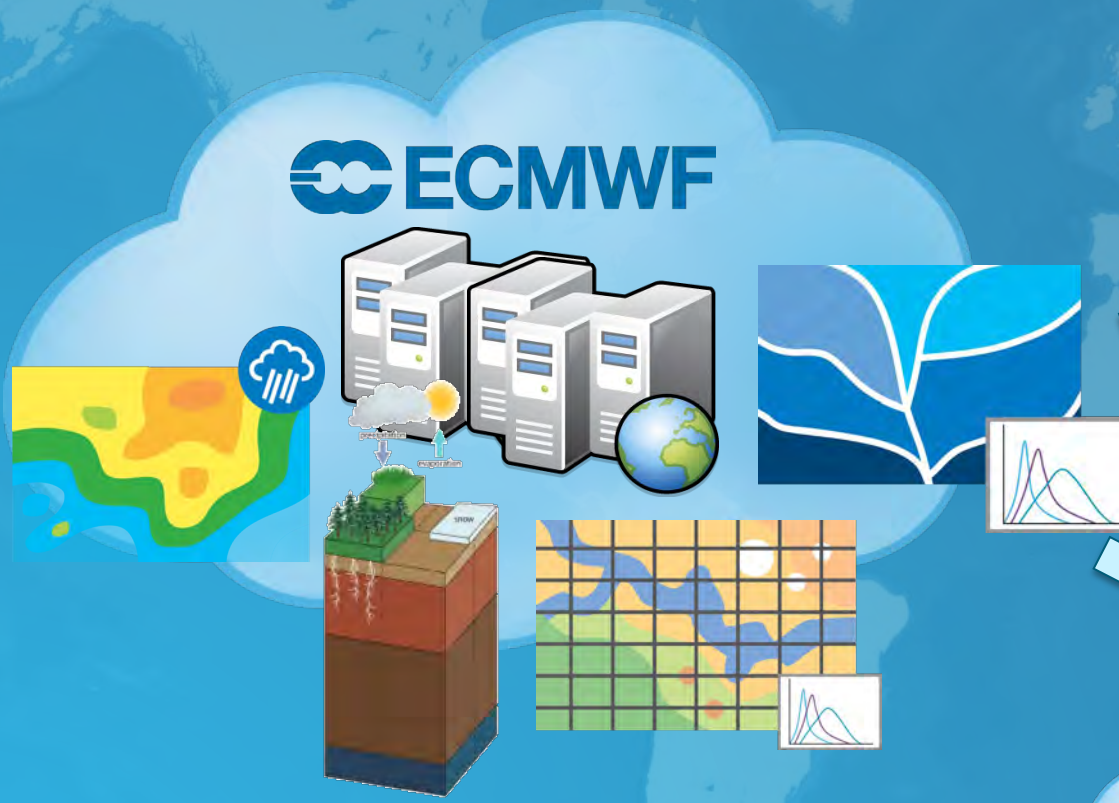
Gumbel Distribution



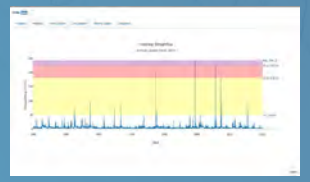
Streamflow Forecasts

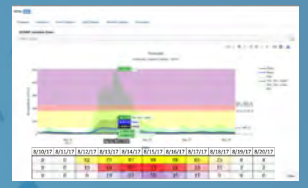


Global Streamflow Services from ECMWF

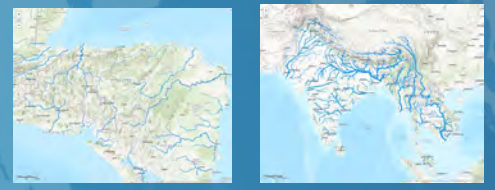


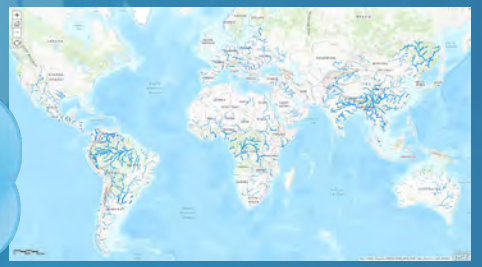
Web Services





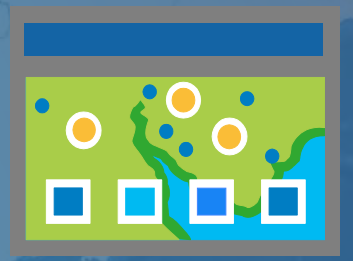
Streamflow API

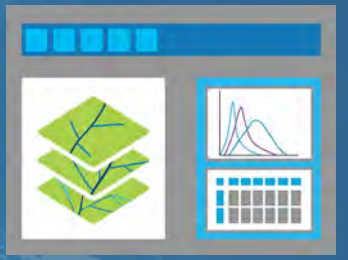


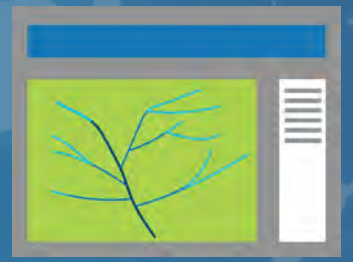


Global WMS at Living Atlas

Custom Web Apps

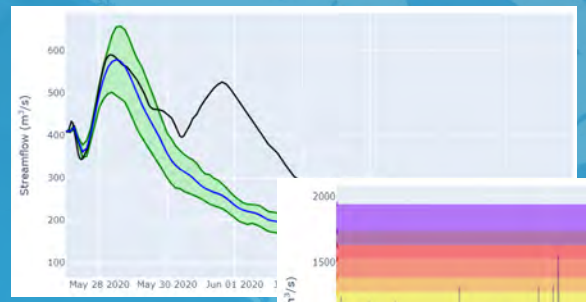






Streamflow Services

Products



15
Fo

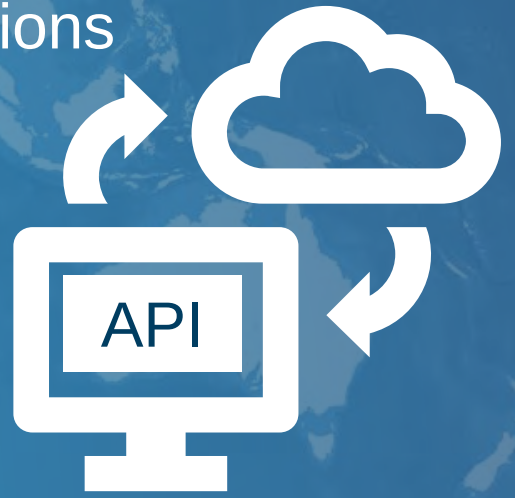
40-yr His
Simula

comid	stream_order	stream_lat	stream_lon	max_flow	date_r2	date_r10	date_r20
7088373	2	-13.175418	34.734576	1.583960	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00
7088058	2	-12.914583	34.637917	0.783468	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00
7087329	2	-12.159113	34.319213	5.707321	2020-05-27 00:00:00	NaN	NaN
7082034	2	-7.471365	30.330647	6.314908	2020-05-27 00:00:00	2020-05-27 00:00:00	NaN
7080390	2	-6.034400	29.374605	38.883274	2020-05-27 00:00:00	NaN	NaN
7080111	2	-5.785656	37.792871	26.787642	2020-05-27 00:00:00	NaN	NaN
7080307	2	-6.021502	29.255398	80.980751	2020-05-27 00:00:00	NaN	NaN
7079969	2	-5.707459	38.573907	71.166985	2020-05-27 00:00:00	NaN	NaN
7079855	2	-5.544495	38.322260	54.125420	2020-05-27 00:00:00	NaN	NaN
7079990	3	-5.755827	38.681257	94.953659	2020-05-27 00:00:00	NaN	NaN
7079904	3	-5.681796	38.817762	124.044678	2020-05-27 00:00:00	NaN	NaN
7079814	4	-5.500474	29.555745	2732.678467	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00
7080136	5	-5.788296	27.000914	8944.719727	2020-05-27 00:00:00	NaN	NaN
7079570	2	-5.269085	29.404018	13.499873	2020-05-27 00:00:00	NaN	NaN
7079568	4	-5.333432	29.509887	2581.337646	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00

Forecast
Warning Points

Accessibility

Web Applications



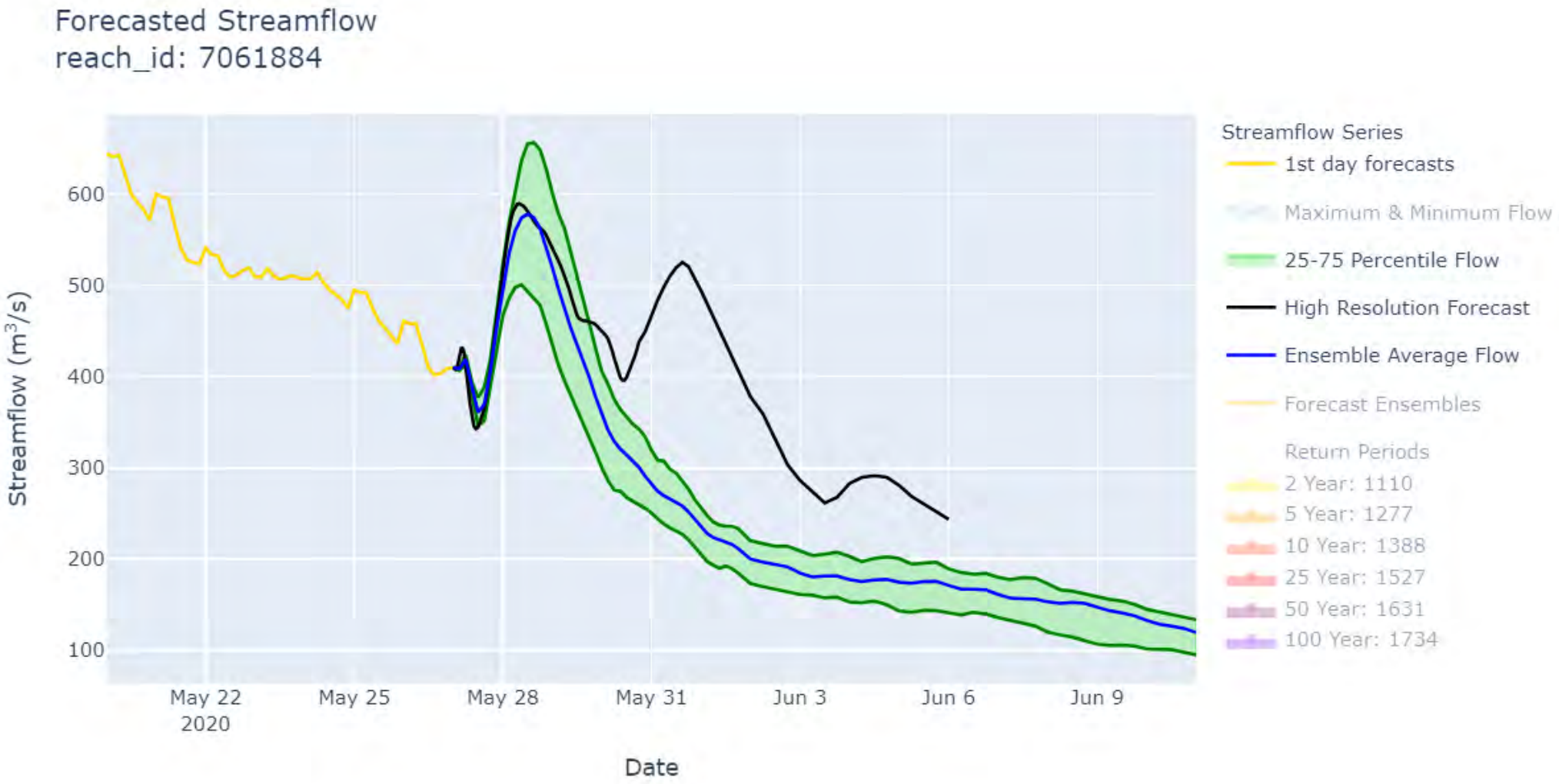
REST API (https://geoglows.ecmwf.int)

GEOGloWS ECMWF Streamflow Service | About | Publications | REST API Documentation | Source Code

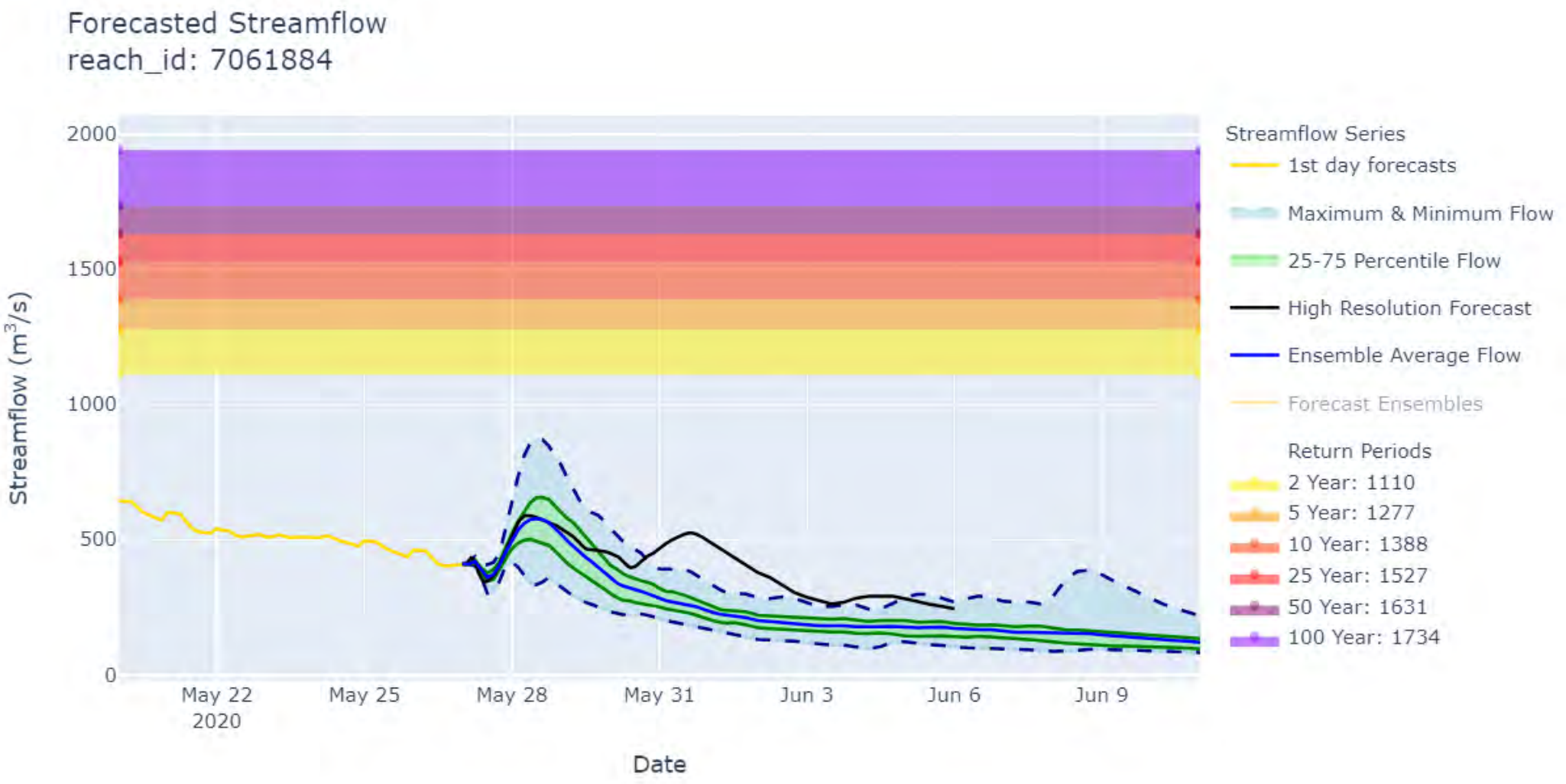
GEOGloWS ECMWF Streamflow Service

Welcome to the GEOGloWS ECMWF Streamflow Service. This website contains information about the model. It also hosts a REST API for accessing the results of the model and documentation about how to use it. Click on the map below to begin exploring the forecasted streamflow around the world.

Streamflow Forecasts

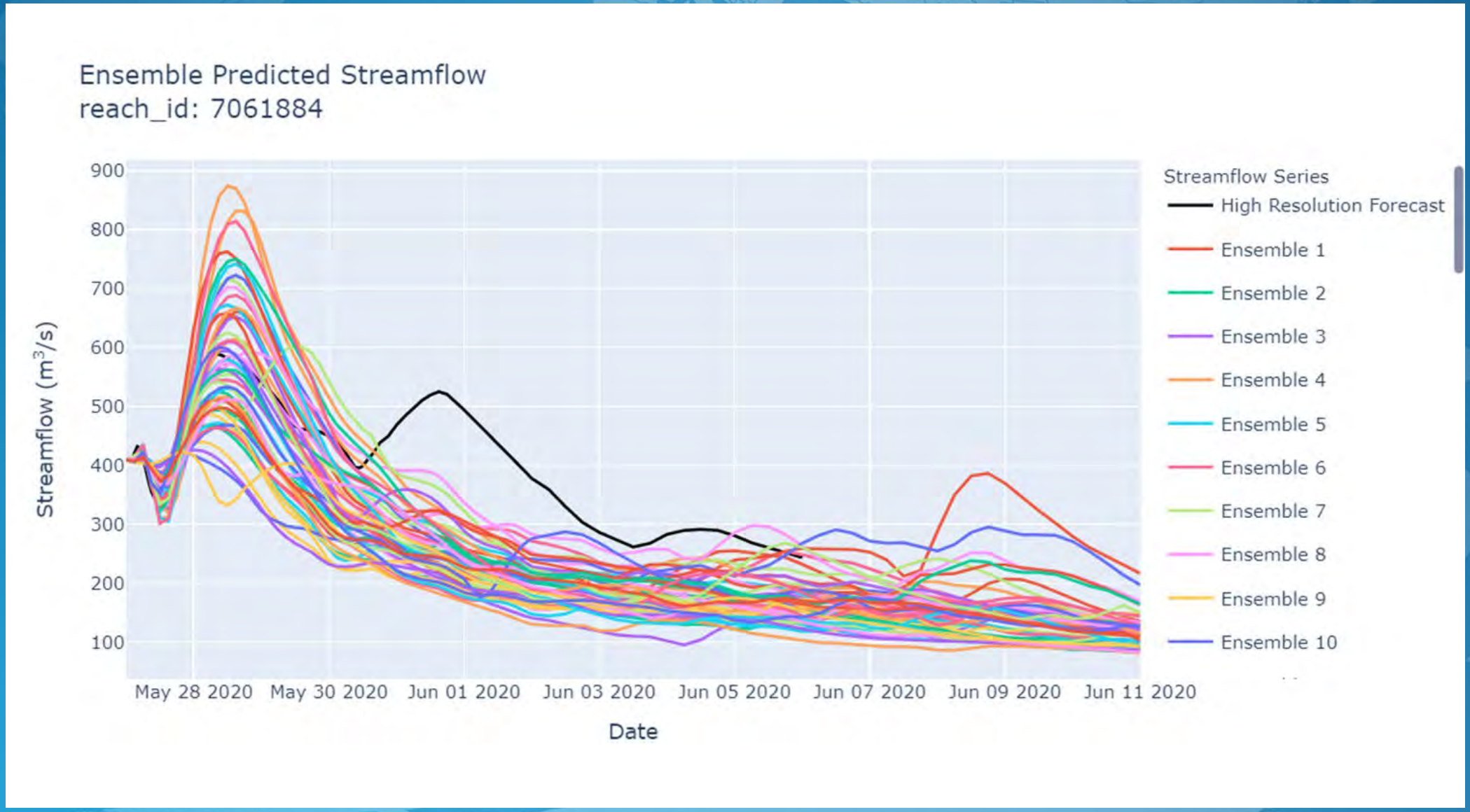


Streamflow Forecasts

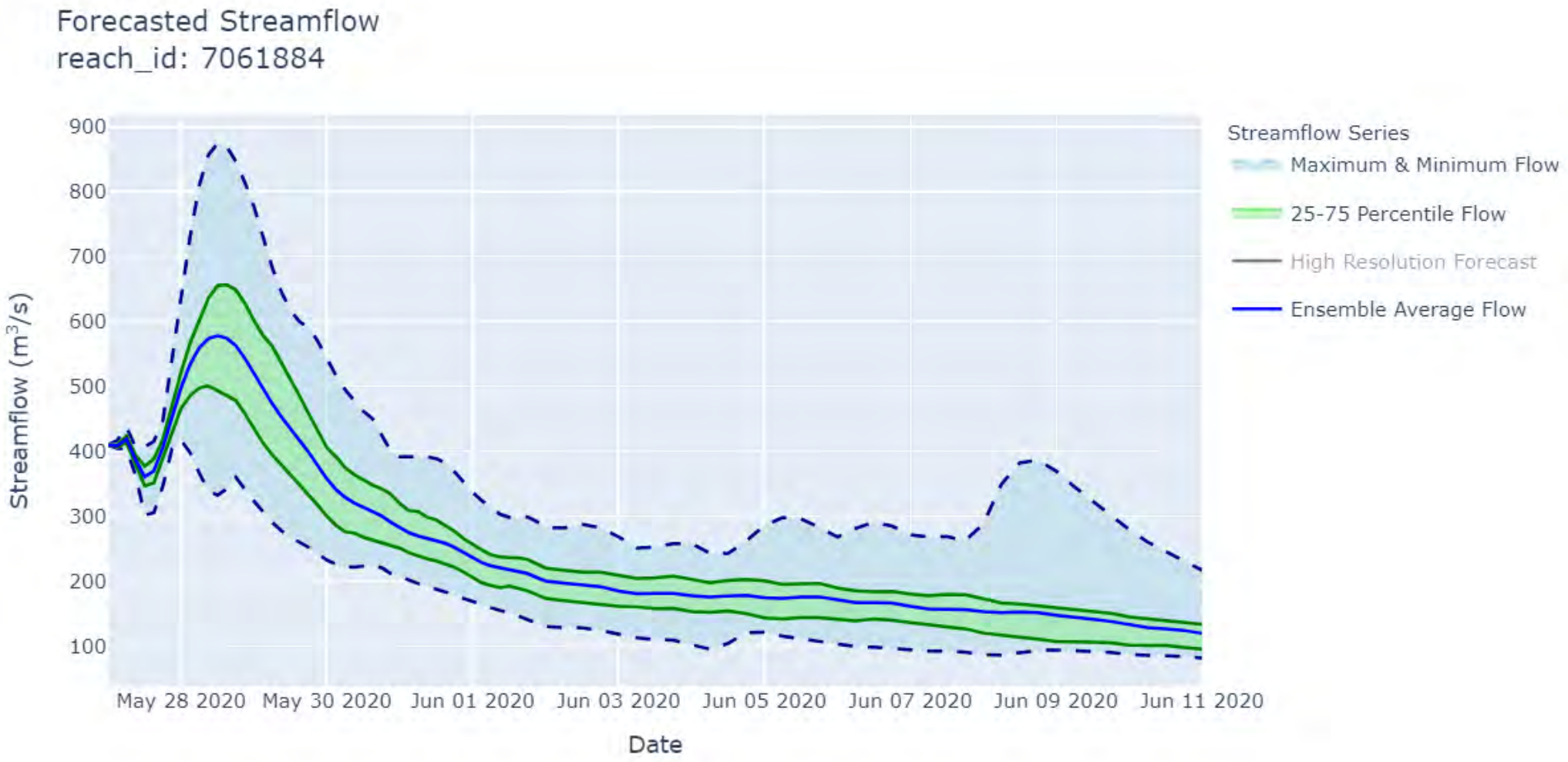


Forecast Record

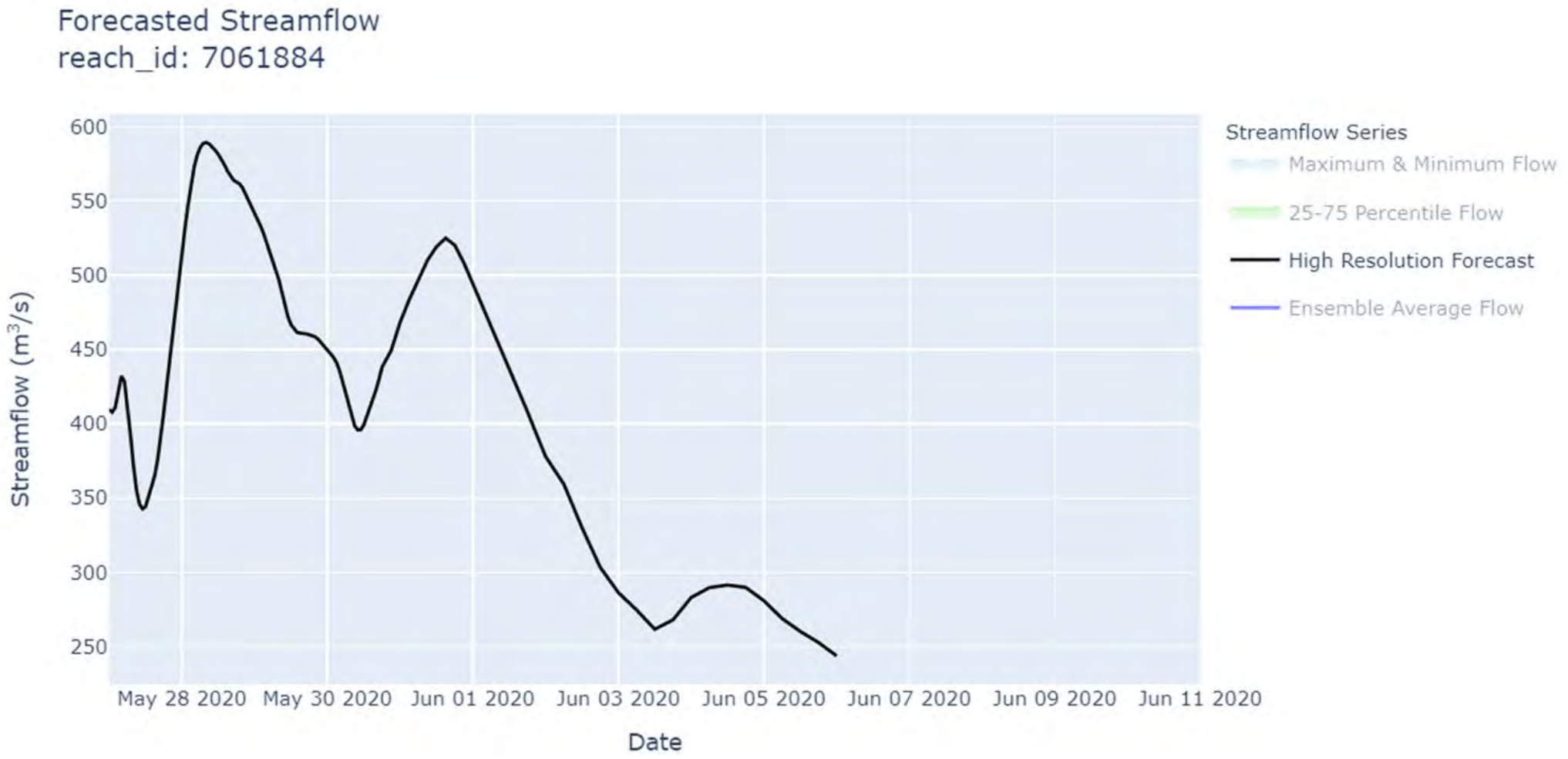
Probabilistic Forecasts



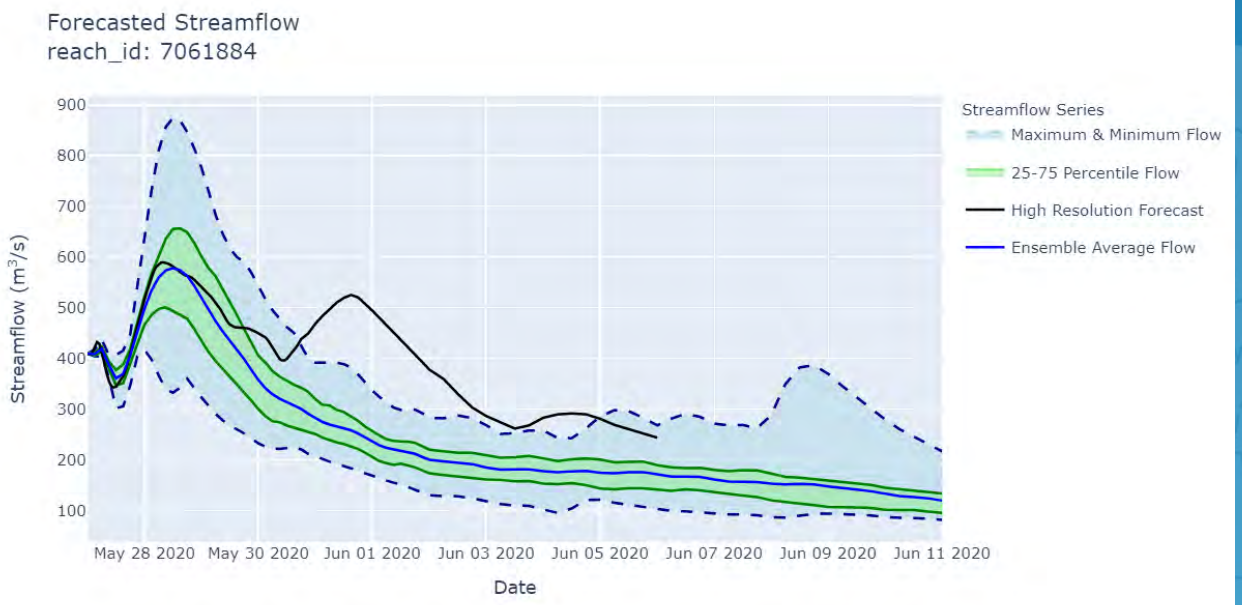
Probabilistic Forecasts

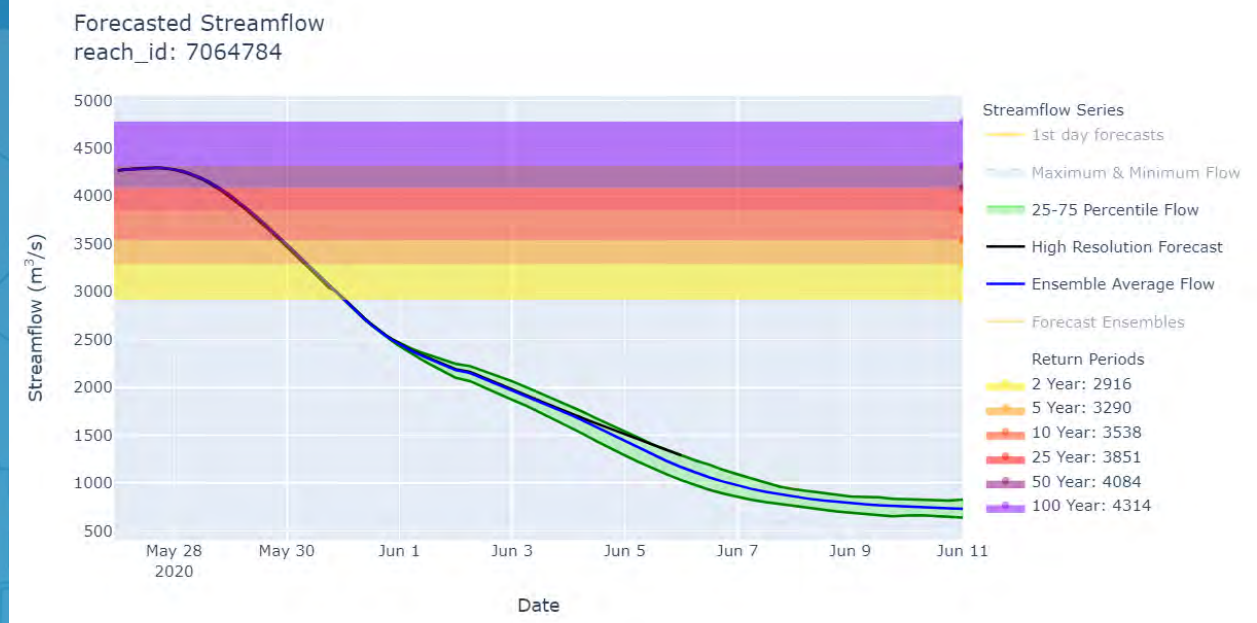


High Resolution Forecast



Exceedance Probability





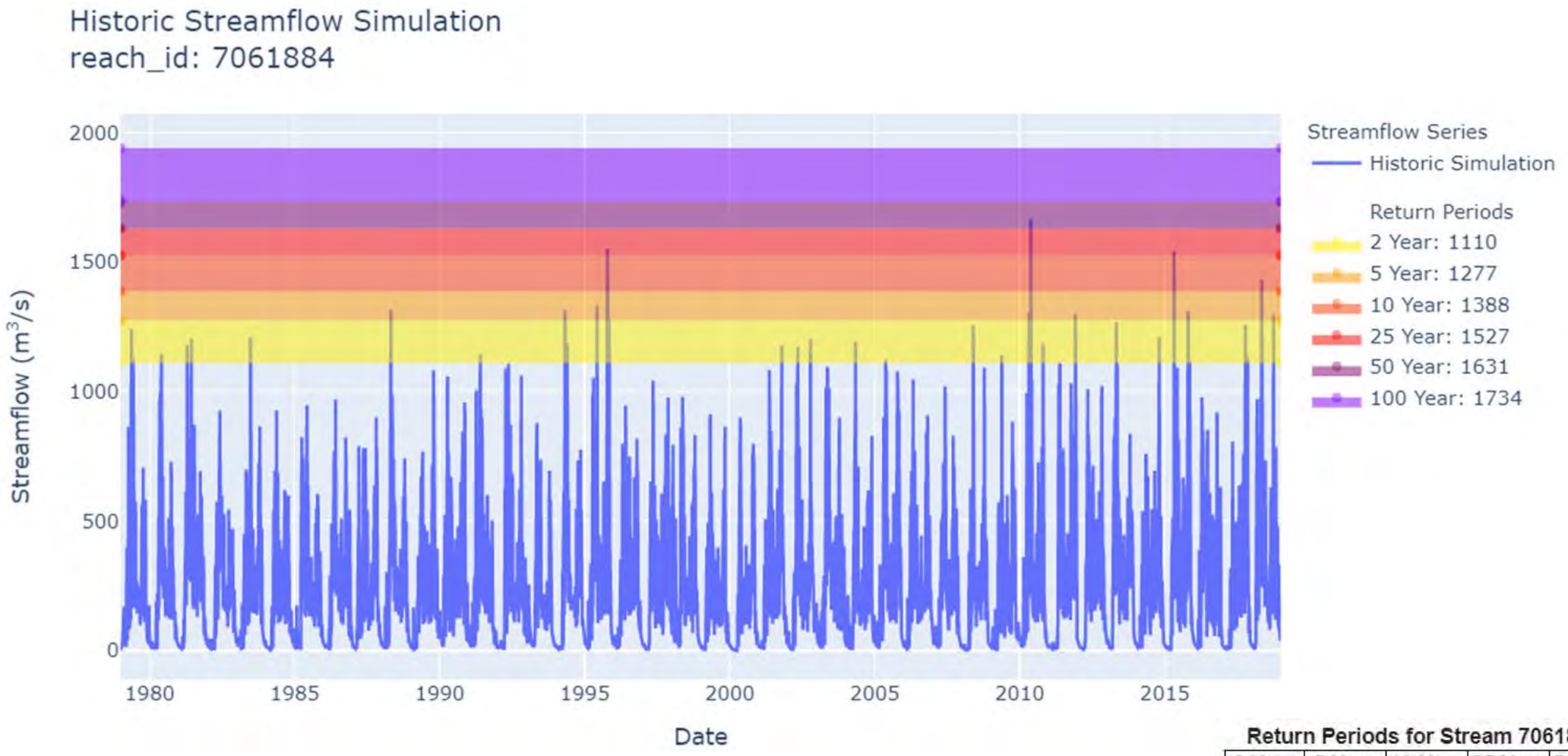
Percent of Ensembles that Exceed Return Periods

Dates	May 27	May 28	May 29	May 30	May 31	Jun 01	Jun 02	Jun 03	Jun 04	Jun 05	Jun 06	Jun 07	Jun 08	Jun 09	Jun 10	Jun 11
2-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Percent of Ensembles that Exceed Return Periods

Dates	May 27	May 28	May 29	May 30	May 31	Jun 01	Jun 02	Jun 03	Jun 04	Jun 05	Jun 06	Jun 07	Jun 08	Jun 09	Jun 10	Jun 11
2-yr Return Period	100%	100%	100%	100%	98%	-	-	-	-	-	-	-	-	-	-	-
5-yr Return Period	100%	100%	100%	100%	-	-	-	-	-	-	-	-	-	-	-	-
10-yr Return Period	100%	100%	100%	2%	-	-	-	-	-	-	-	-	-	-	-	-
25-yr Return Period	100%	100%	100%	-	-	-	-	-	-	-	-	-	-	-	-	-
50-yr Return Period	100%	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100-yr Return Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

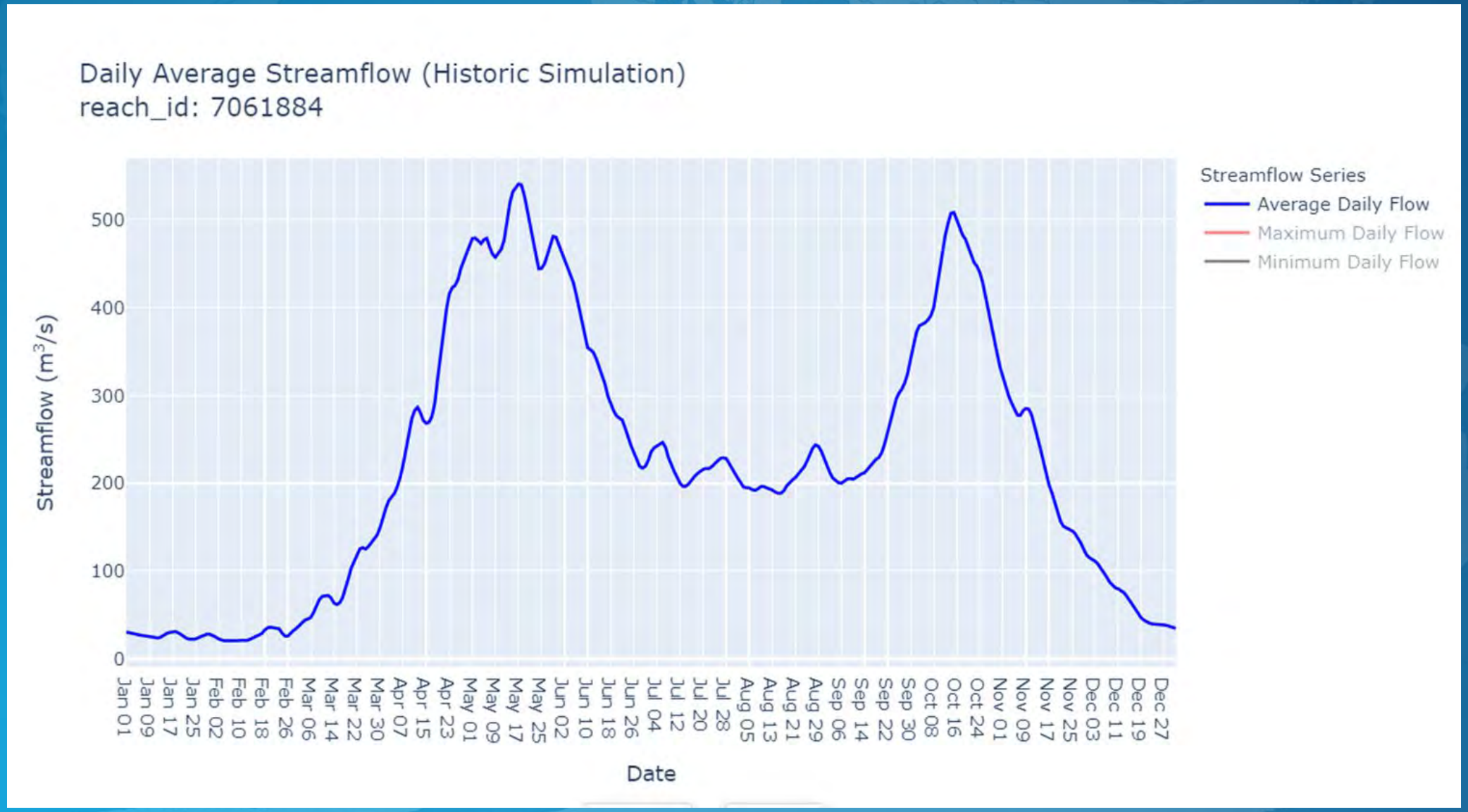
Historical Simulation



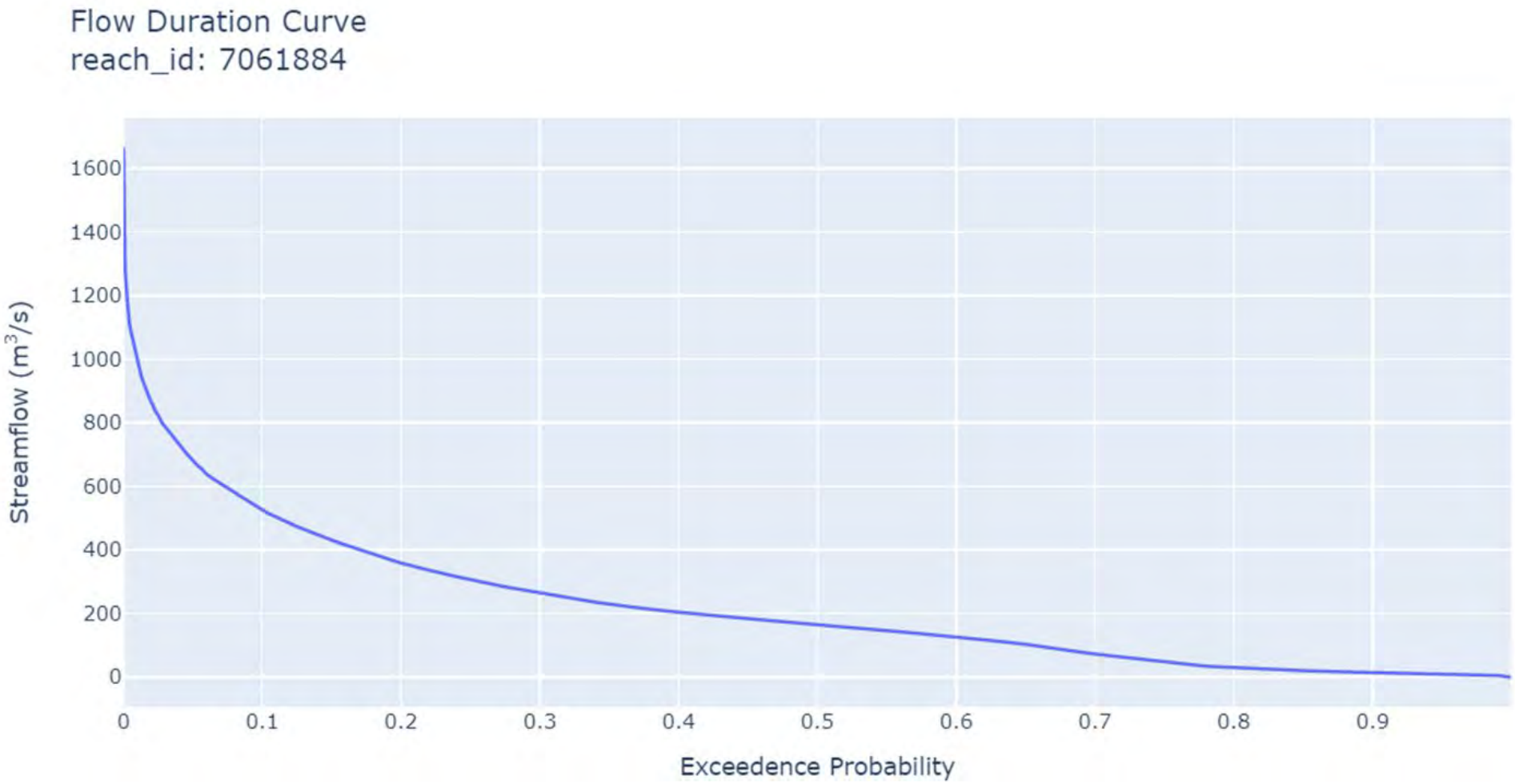
Return Periods for Stream 7061884.0 (m^3/s)

2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
1110.12	1277.35	1388.07	1527.96	1631.74	1734.76

Additional Historic Simulation Products



Additional Historic Simulation Products



Warning Points

comid	stream_order	stream_lat	stream_lon	max_flow	date_r2	date_r10	date_r20
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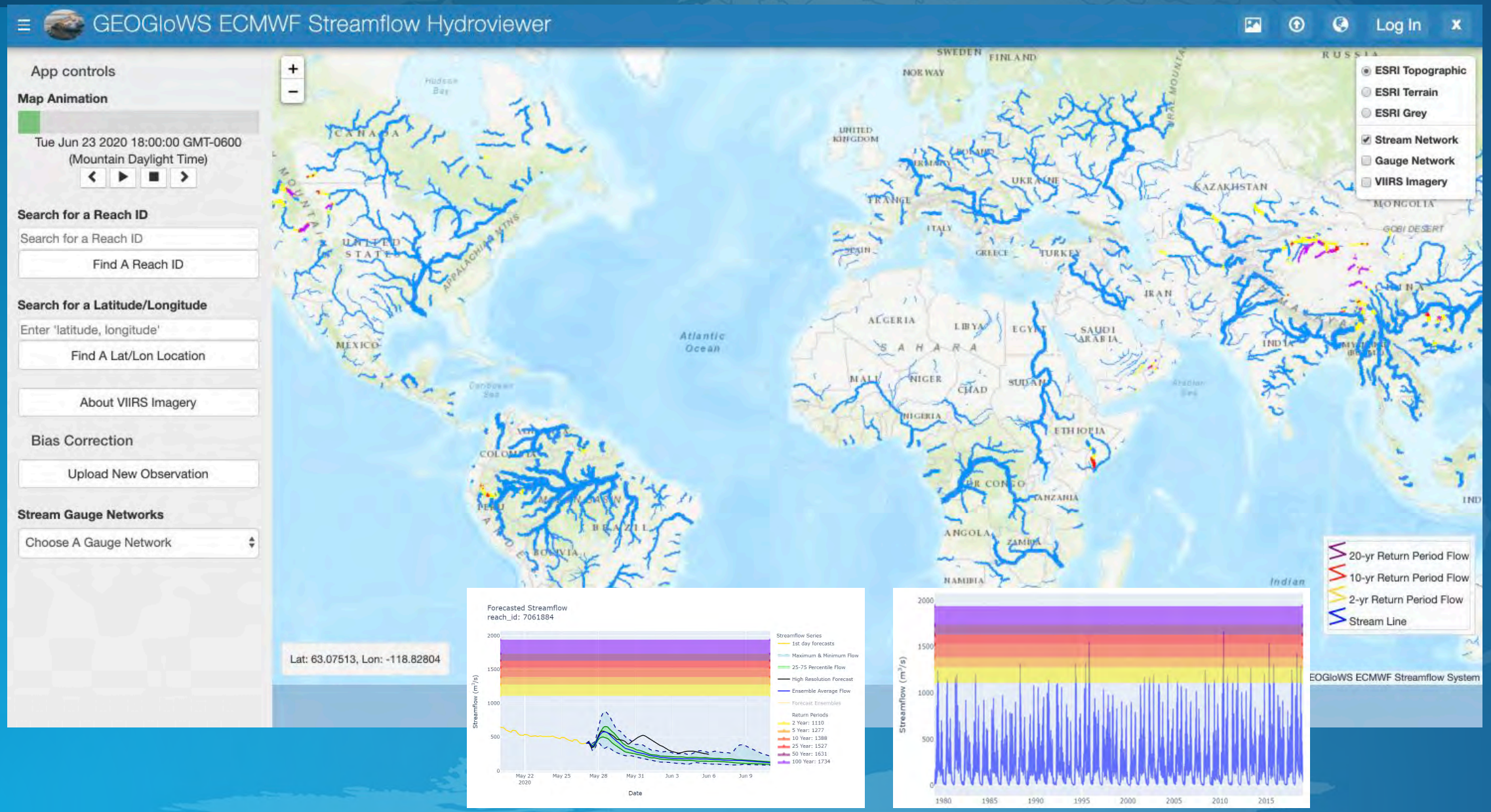
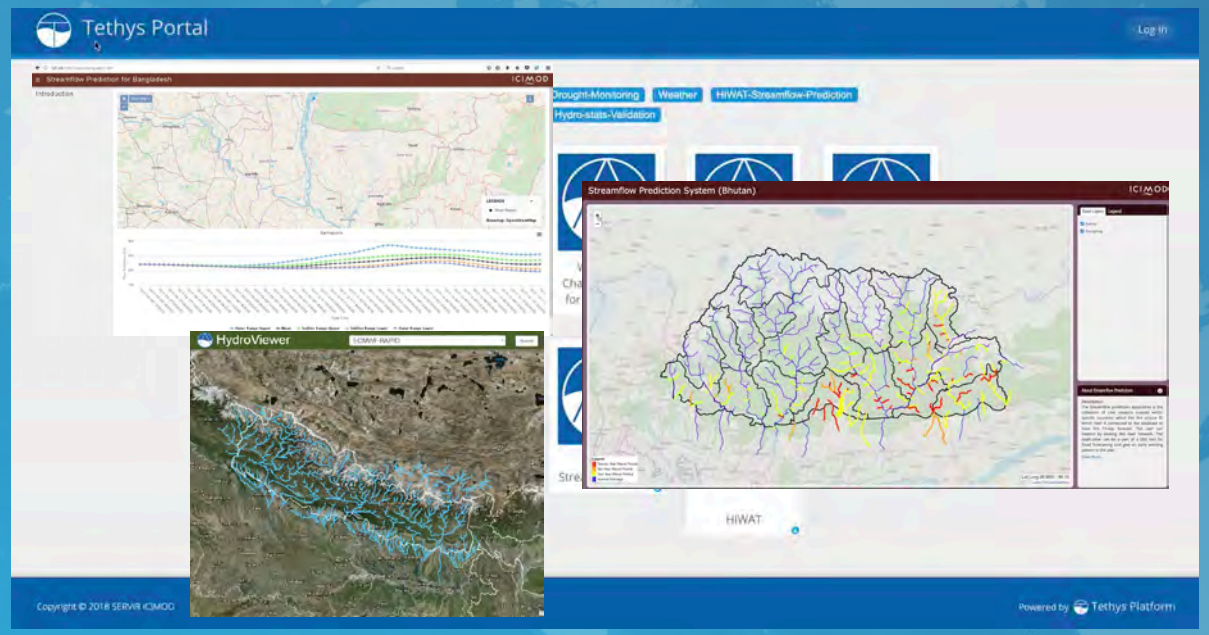
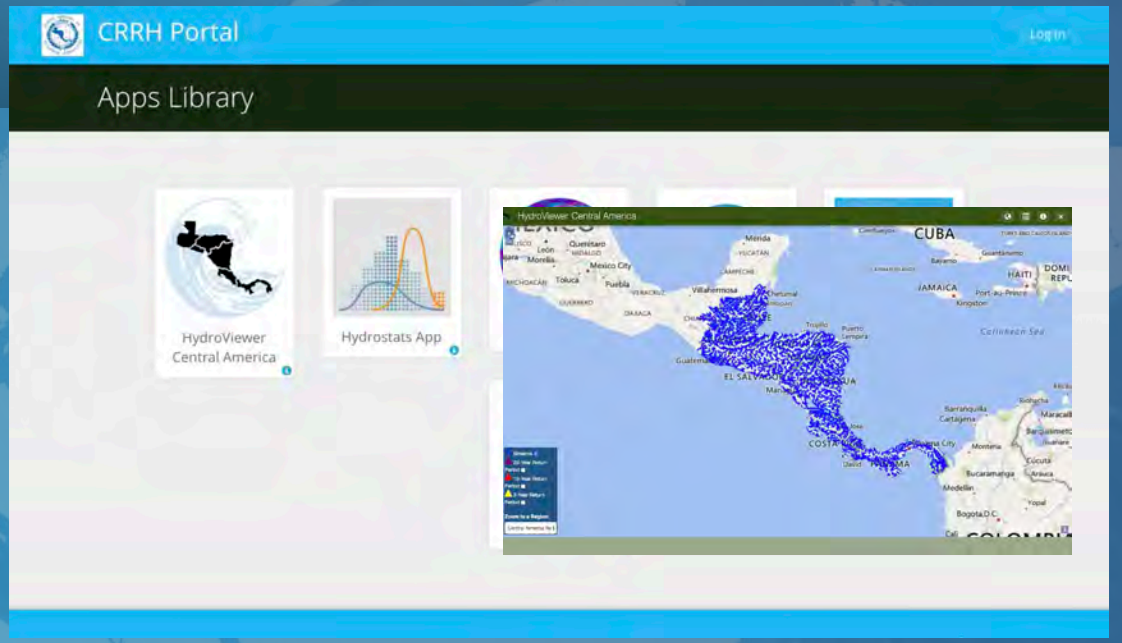
7088058	2	-12.914583	34.637917	0.783468	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00
7087329	2	-12.159113	34.319213	5.707321	2020-05-27 00:00:00	NaN	NaN
7082034	2	-7.471365	30.330647	6.314908	2020-05-27 00:00:00	2020-05-27 00:00:00	NaN
7080390	2	-6.034400	29.374605	38.883274	2020-05-27 00:00:00	NaN	NaN
7080111	2	-5.785656	37.792871	26.787642	2020-05-27 00:00:00	NaN	NaN
7080307	2	-6.021502	29.255398	80.980751	2020-05-27 00:00:00	NaN	NaN
7079969	2	-5.707459	38.573907	71.166985	2020-05-27 00:00:00	NaN	NaN
7079855	2	-5.544495	38.322260	54.125420	2020-05-27 00:00:00	NaN	NaN
7079990	3	-5.755827	38.681257	94.953659	2020-05-27 00:00:00	NaN	NaN
7079904	3	-5.681796	38.817762	124.044678	2020-05-27 00:00:00	NaN	NaN
7079814	4	-5.500474	29.555745	2732.678467	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00
7080136	5	-5.788296	27.000914	8944.719727	2020-05-27 00:00:00	NaN	NaN
7079570	2	-5.269085	29.404018	13.499873	2020-05-27 00:00:00	NaN	NaN
7079568	4	-5.333432	29.509887	2581.337646	2020-05-27 00:00:00	2020-05-27 00:00:00	2020-05-27 00:00:00

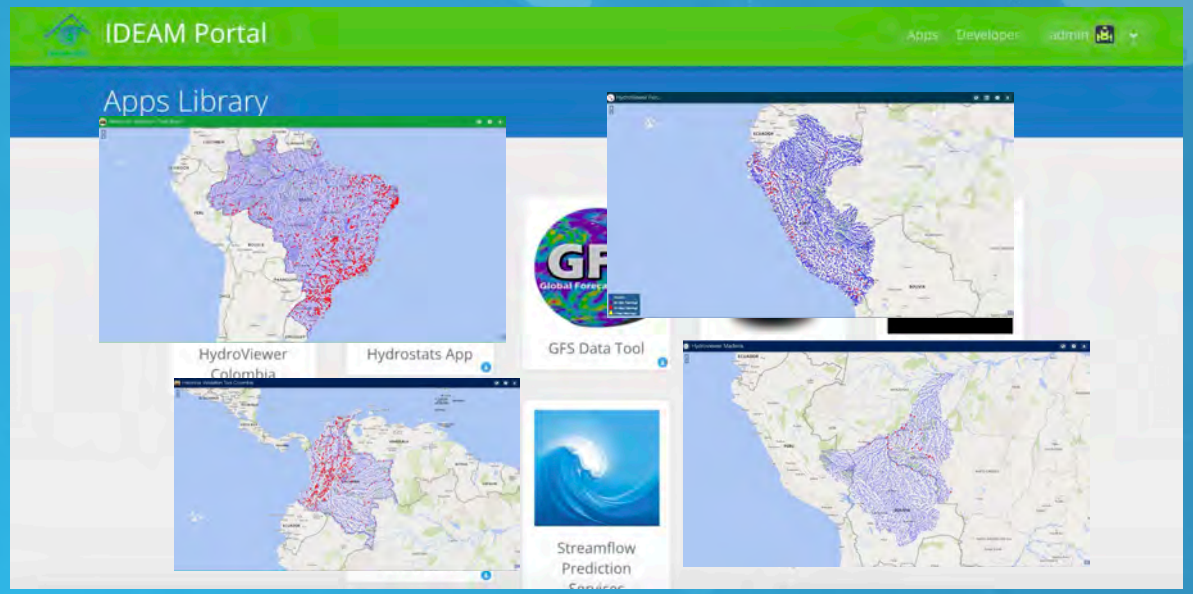
GEOGloWS ECMWF Streamflow Hydroviewer

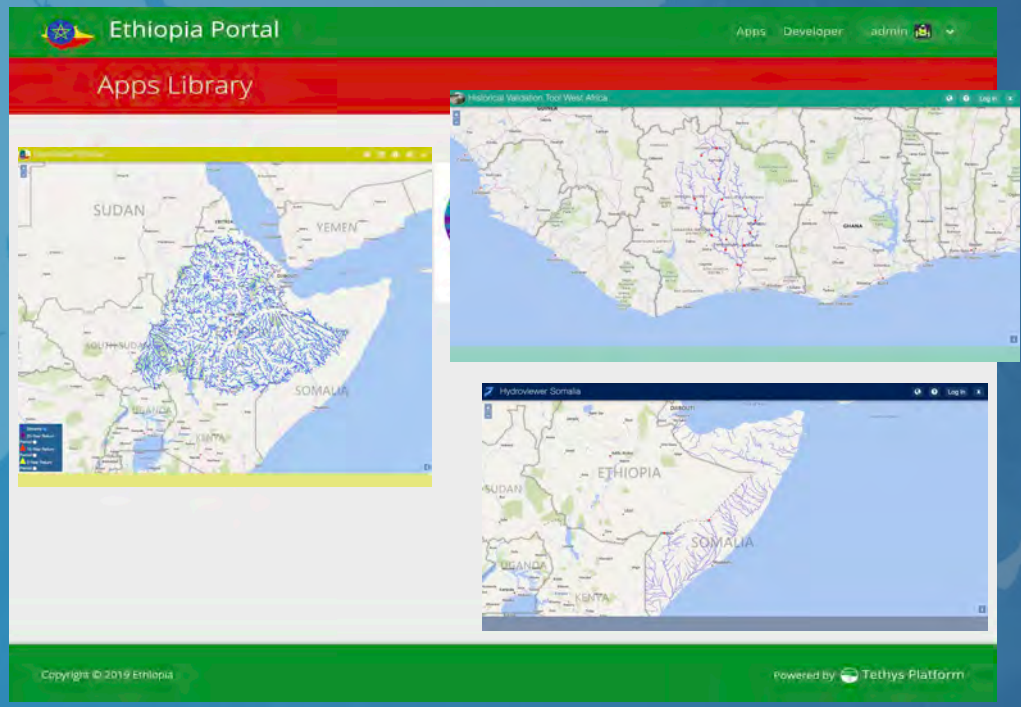


Different Customizations

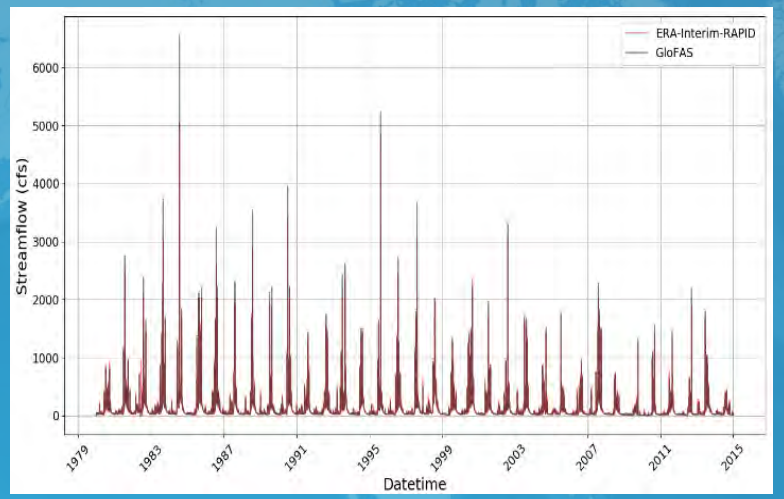


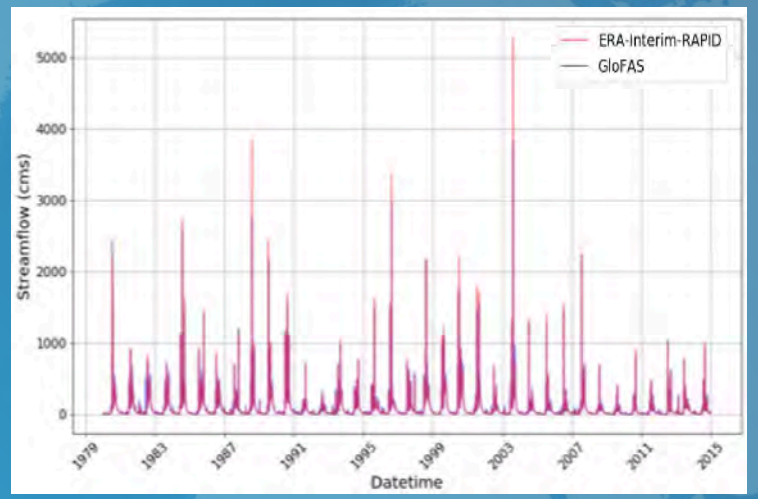


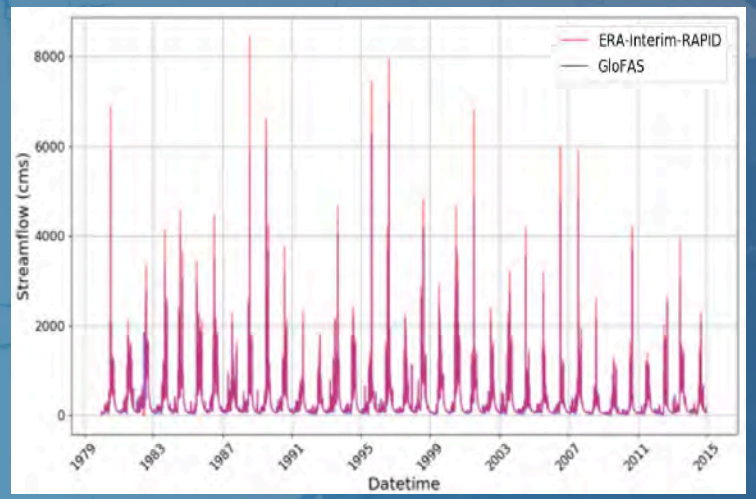


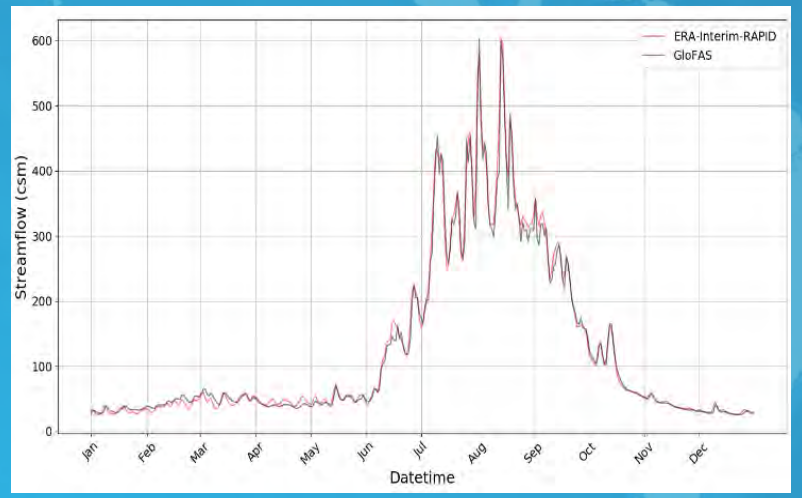


RAPID vs GloFAS

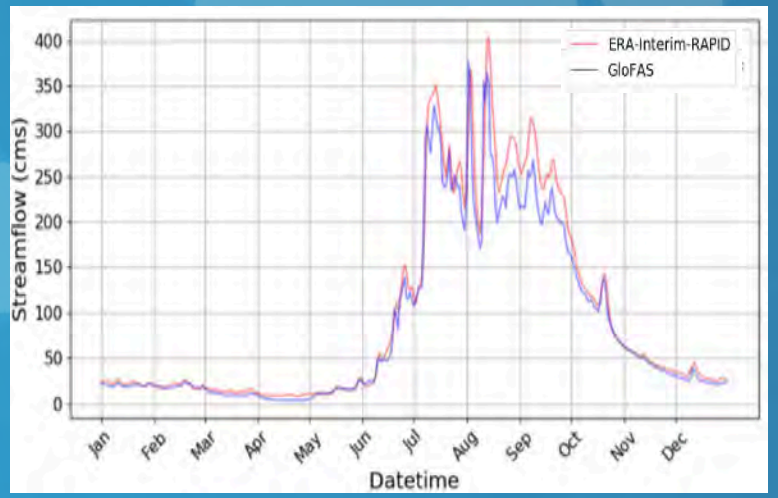




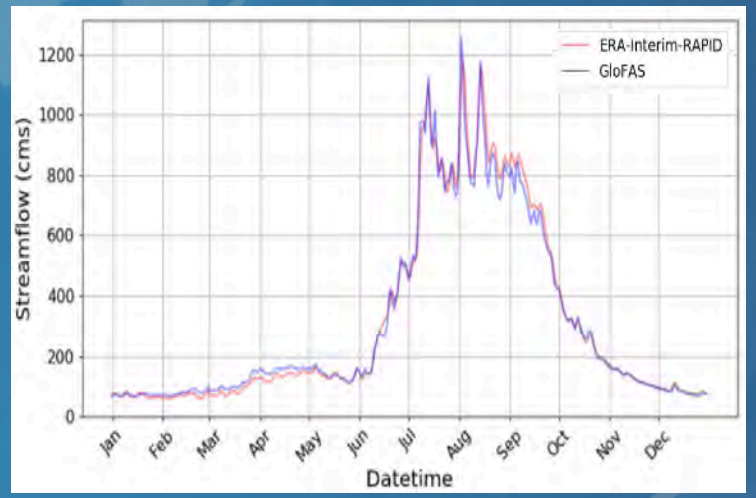




Dipayal, Nepal

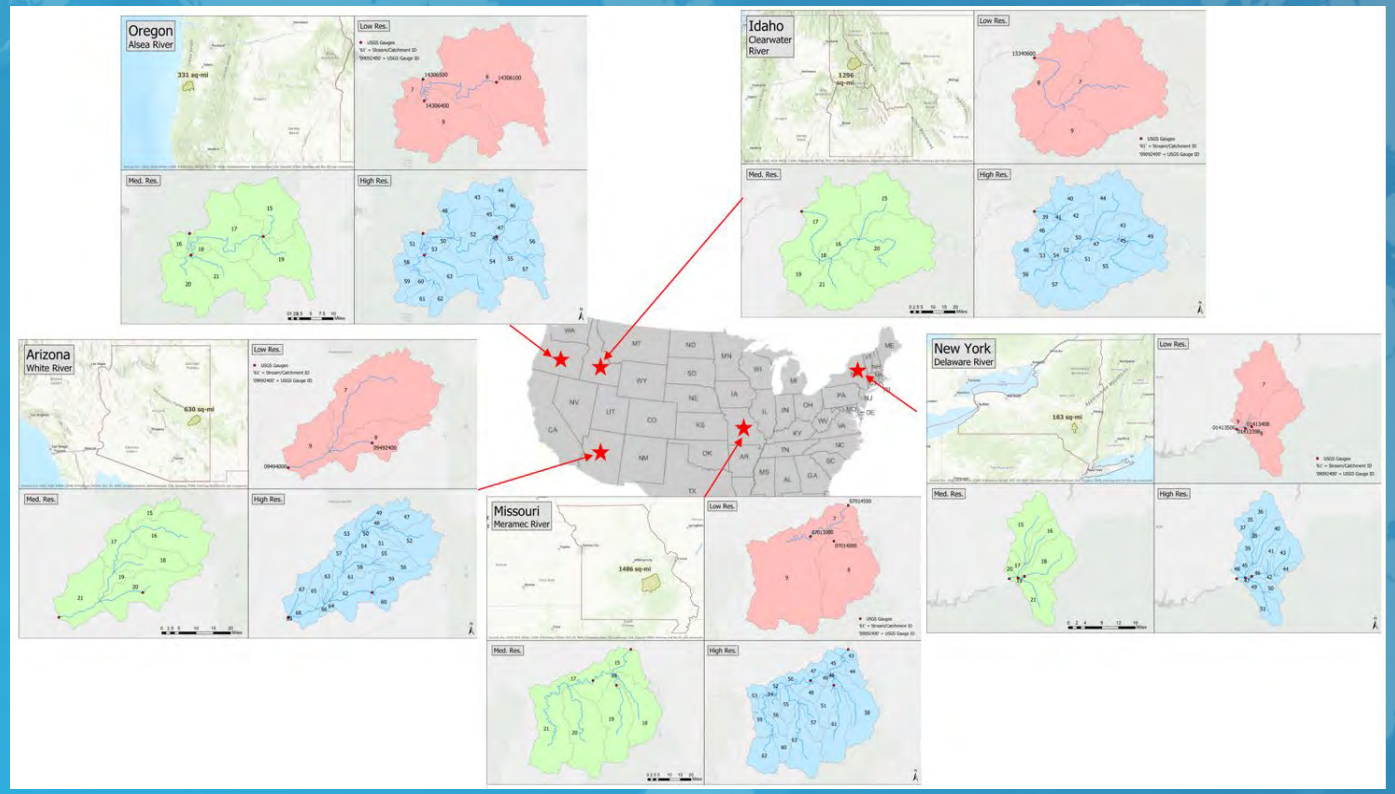


Rapti, Nepal



Bheri, India

Sensitivity of Watershed Resolution



Comparison	R	MAE[m3]	KGE
MO: Low vs. Med Res	0.9375	7.3748	0.8985
MO: Med vs. High Res	0.9979	1.2713	0.9948
MO: Low vs. High Res	0.9232	8.0400	0.8928
NY: Low vs. Med Res	0.9831	0.7209	0.8954
NY: Med vs. High Res	0.9999	0.0355	0.9963
NY: Low vs. High Res	0.9813	0.7556	0.8911
OR: Low vs. Med Res	0.9939	0.9949	0.9841
OR: Med vs. High Res	0.9987	0.4330	0.9985
OR: Low vs. High Res	0.9872	1.4190	0.9799
AZ: Low vs. Med Res	0.9943	0.1244	0.9789
AZ: Med vs. High Res	0.9976	0.0844	0.9744
AZ: Low vs. High Res	0.9849	0.2014	0.9522
ID: Low vs. Med Res	0.9982	0.8860	0.9965
ID: Med vs. High Res	0.9996	0.4632	0.9949
ID: Low vs. High Res	0.9964	1.2706	0.9959
Average: Low vs Med	0.9814	2.0202	0.9507
Average: Med vs High	0.9988	0.4575	0.9918
Average: Low vs High	0.9746	2.3373	0.9424
Total Average	0.9849	1.6050	0.9616

WHOS and GEOGloWS Global Streamflow Data Services