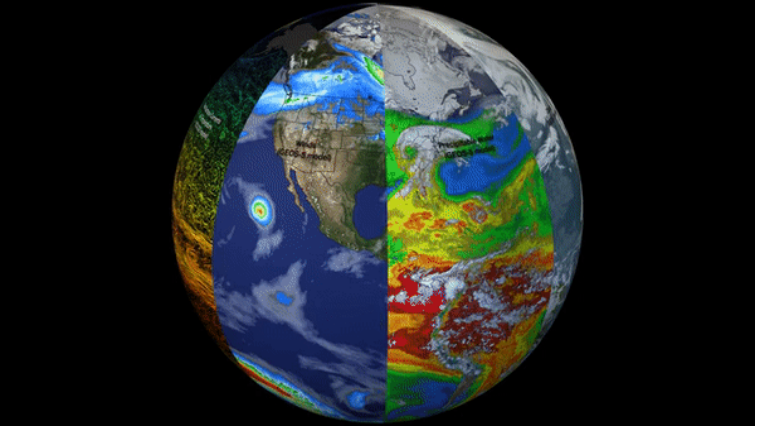
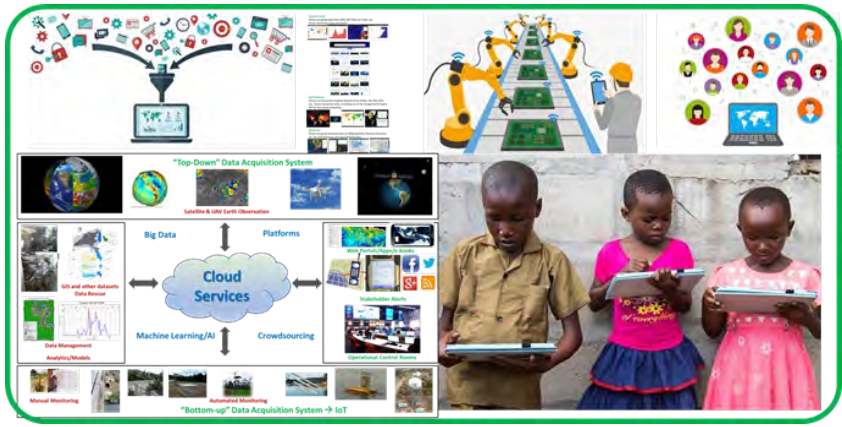




Mashreq Water Resources Portal

Leveraging Public-Domain Services

Nagaraja Rao Harshadeep (Harsh)

Global Lead (Disruptive Technology)

Environment, Natural Resources & Blue Economy Global Practice

WORLD BANK GROUP

Mashreq Waters Knowledge Series

December 2, 2020

A new world of “Disruptive Technology”

“Disrupt” data value chains

- ***Data Collection***: Monitoring/Surveys (in-situ sensors/IoT/Biometrics, earth observation (satellite, aerial, UAVs), crowdsourcing, digitization…
- ***Data Management:*** Telemetry, 5G, cloud services, open data, Blockchain, …
- ***Data Analysis:*** Big data, Geospatial/ AI/Machine Learning, modeling/ scenario analysis, script repositories, Cloud/Edge/Quantum computing…
- ***Data Access:*** Open data APIs, data visualization, gamification, mixed reality-AR/VR, …
- ***Outreach:*** Platforms/Social Media/Portals/ Apps/e-books/Competitions…

“Disrupt” production value chains

- 3D/4D printing/additive manufacturing…
- Digital Twin
- Automation/SCADA…
- Robotics/ Autonomous transport…
- Advanced materials/nanotech/ biotech/genomics/energy tech/ green tech, ag tech…

http://www.appsolutelydigital.com/dt/

“Disrupt” stakeholder value chains

- Virtual social networks/ Digital Platforms…
- Sharing economy…
- Crowdsourcing, gamification, competitions (e.g. *hackathons*, *appathons…*)
- Mobile money, fintech, cryptocurrency…
- Maker movement/DIY/Tech Incubators…
- Virtual learning/re-skilling…

We have NO data…

Of course we have data…

Data, data everywhere…

Information & Analysis Trends

What's Out?	What's In?
Paper Records/Publications	Digital Data/Portals/Apps/e-books…
Desktop Databases	"Analysis Ready" Cloud Data Services/APIs
Static, Infrequent data	Real-time data services & visualizations
Data Secrecy	Open, Public-Domain, Available
Unclear data pricing	Free open basic data services
Sectoral approaches	Multi-sectoral/ spatial approaches
Fragmented activities	Shared vision partnerships; Interoperability
Desktop Modeling – "Retail"	Cloud Analytics – "Wholesale" AI Platforms
Supply-side inputs	Demand-driven to support decisions
"Come to my website & see my bit of data…"	Integrative, Collaborative Data Services & Customized Platforms/Dashboards/Apps

The “Old” Ways…

Are YOU part of the problem?

“But all you need is to fill a form…”

“Please write a letter to us why you want the data…”

“That department does not share data with us…”

“I know someone who knows someone with some of the data…”

“Its on the website – somewhere - all you need is a password that you can get when you register for free…”

“All the data is accessible in pdf format…”

“I remember seeing some of that on some website somewhere…”

“We can download and install a model to analyze the data…”

“I’m waiting to publish a few papers and then I will release the data…”

…

The “New” Ways:

Can YOU be part of the solution to reduce the barriers?

Online Analysis-Ready Interoperable Open Data Services

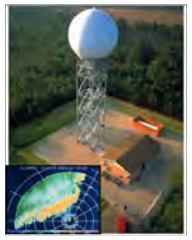
- Open Data APIs (Application Programming Interfaces)
- Use common standards – e.g. Open Geospatial Consortium (OGC) formats for spatial data

Online Analytical Services

- Cloud analytics
- Modeling services using open APIs and drawing upon online data services
- Open collaboration – script repositories

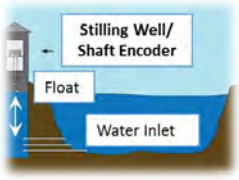
“Bottom-up” Monitoring Systems


Automatic Rain Gauges



Doppler Radar


Snow Pack



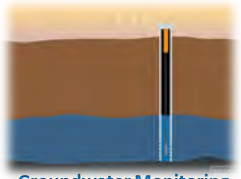

Shore-mounted Radar

Bridge-mounted Radar


Non-Contact Measurement of Stage & Discharge

ADCP

Automatic Cableway System



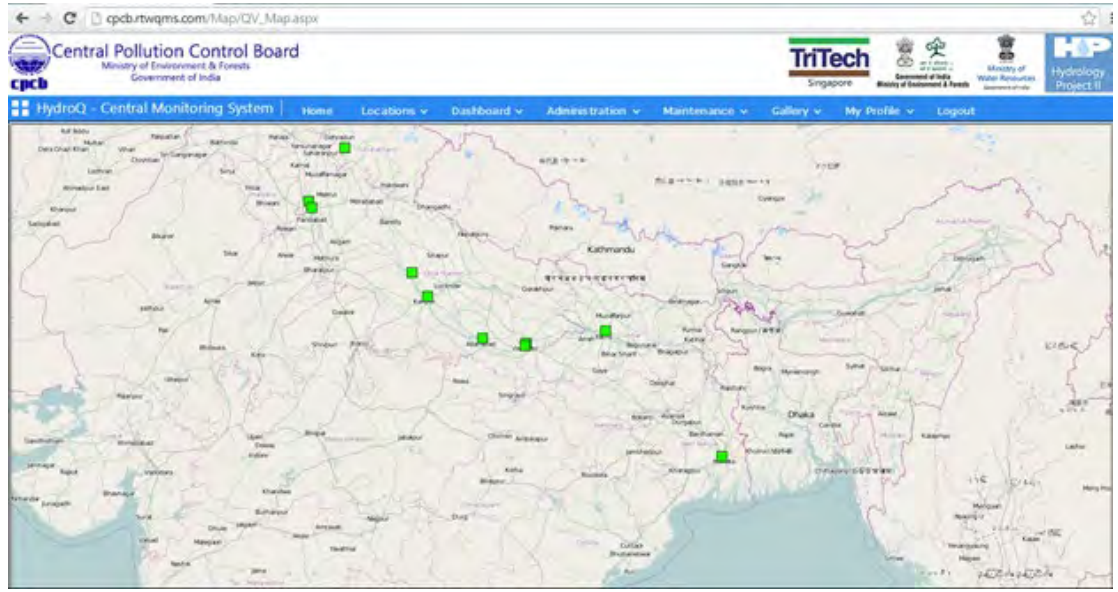
Groundwater Monitoring


Water Quality Monitoring

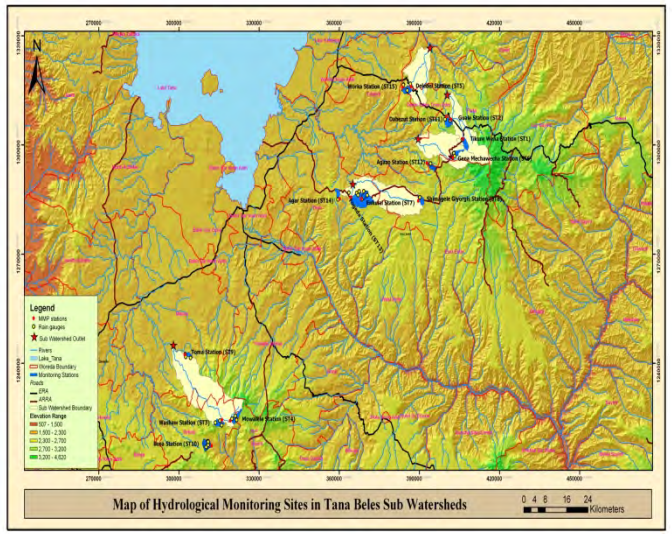
Field Kits

Laboratories


Crowdsourcing Monitoring



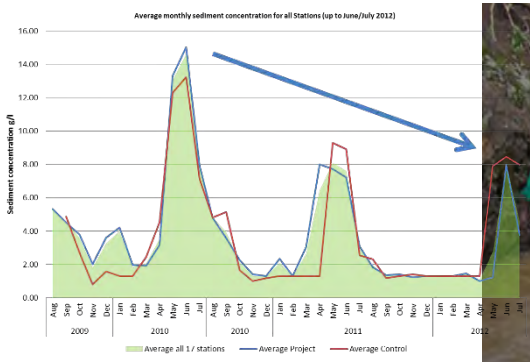
Citizen Science



	2009	2010	2011	2012	Total
Staff	3132	11812	12409	6522	33875
Turbidity	3131	12069	12469	6624	34293
Rain	3116	>12777	>15000	>15000	>47000
Flow					>500
Sed samples	1425	4176	3139	1216	9956

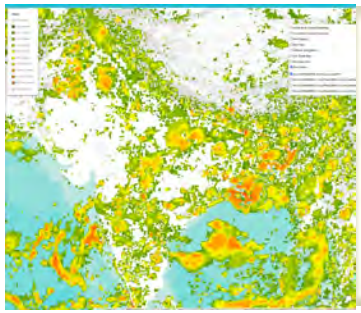
Secchi Jug for turbidity

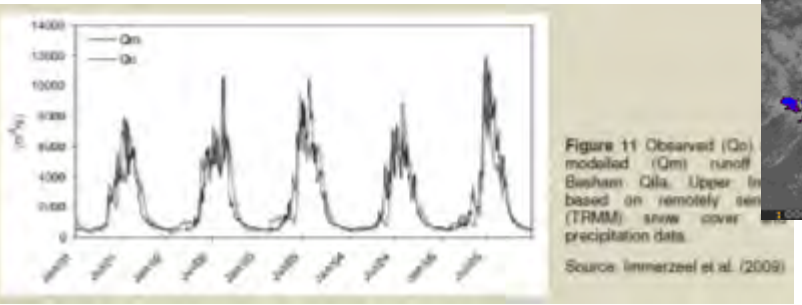
Sediment Concentration Analyses

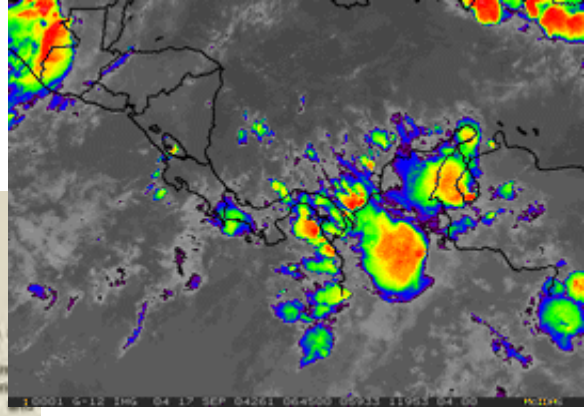


“Top-down” Monitoring Systems

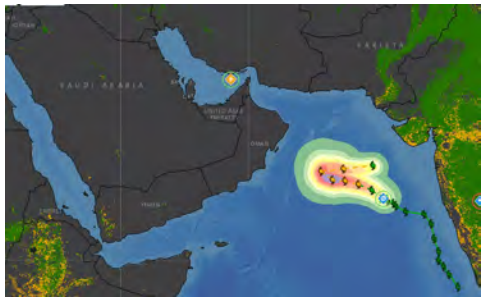
Weather Products



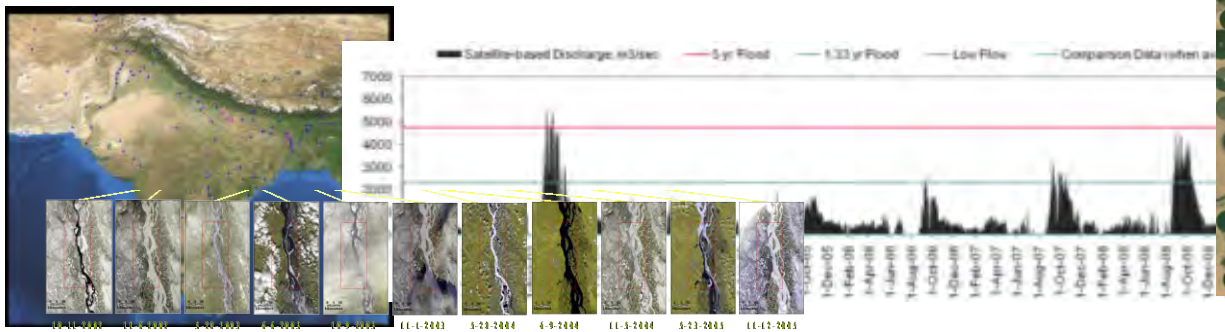




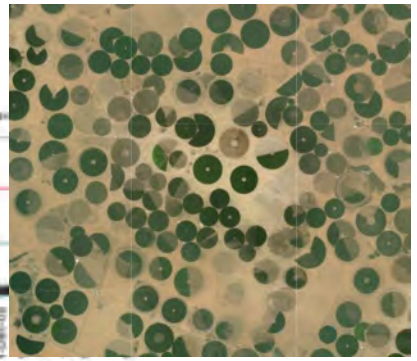
Disasters

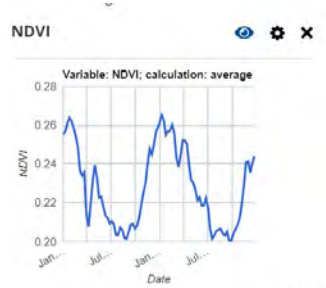


“Space-based Stream Gauge”

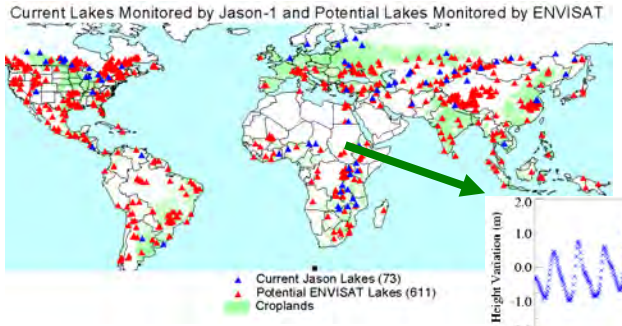


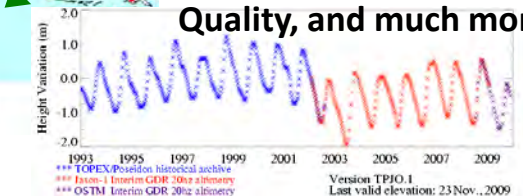
Land Cover Monitoring

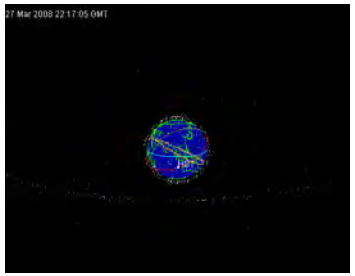




“Space-based Reservoir Levels”

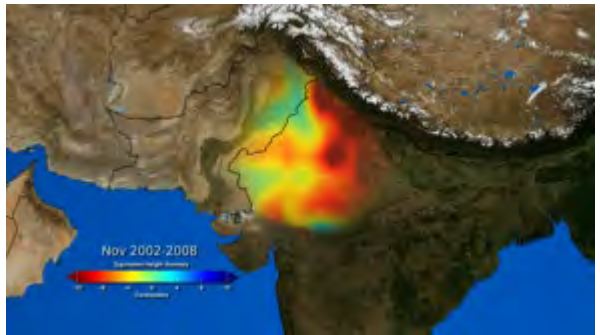


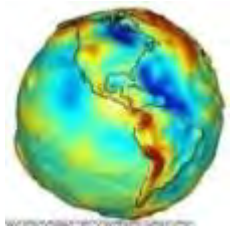


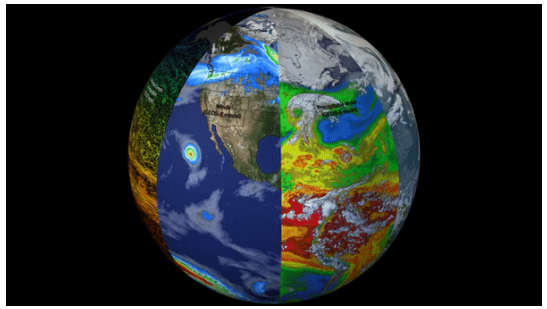


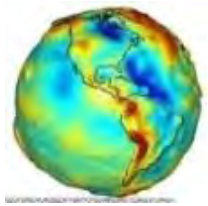
+ Snowcover, Glaciers, Soil Moisture, Temperature, Evapo-transporation, Landcover, Soil Moisture, Water Quality, and much more…

“Space-based Groundwater monitoring” e.g. GRACE

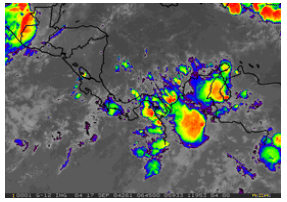


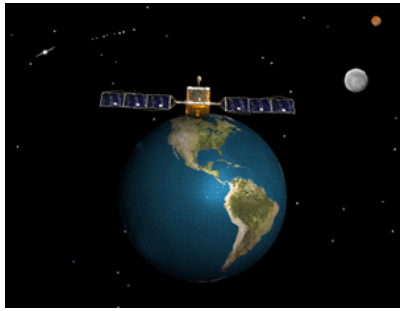




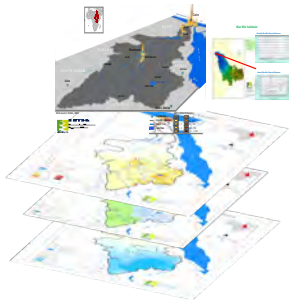


"Top-Down" Data Acquisition System

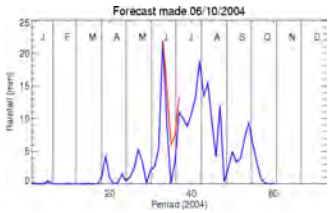




Satellite & Aerial Earth Observation



Data Rescue
GIS and other datasets



Data Management

Analytics/Models

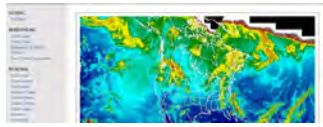
Big Data
Data Science

Platforms
APIs

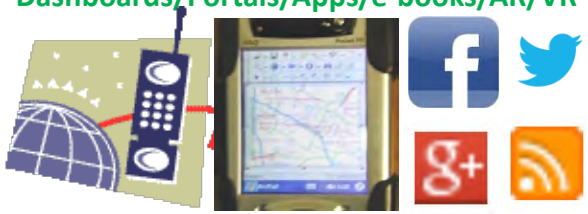
Cloud Services

Machine Learning
& other AI

ChatBots
Crowdsourcing



Dashboards/Portals/Apps/e-books/AR/VR



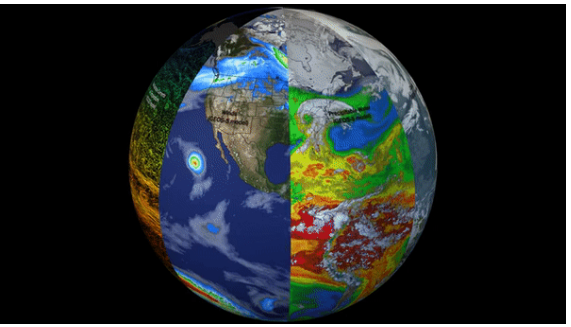
Stakeholder Alerts

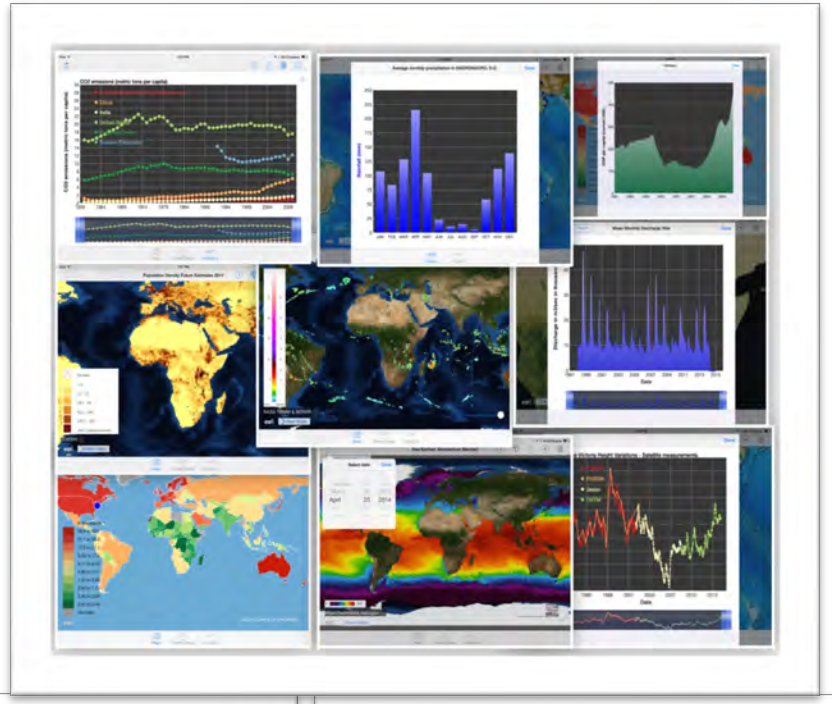
Operational Control Rooms

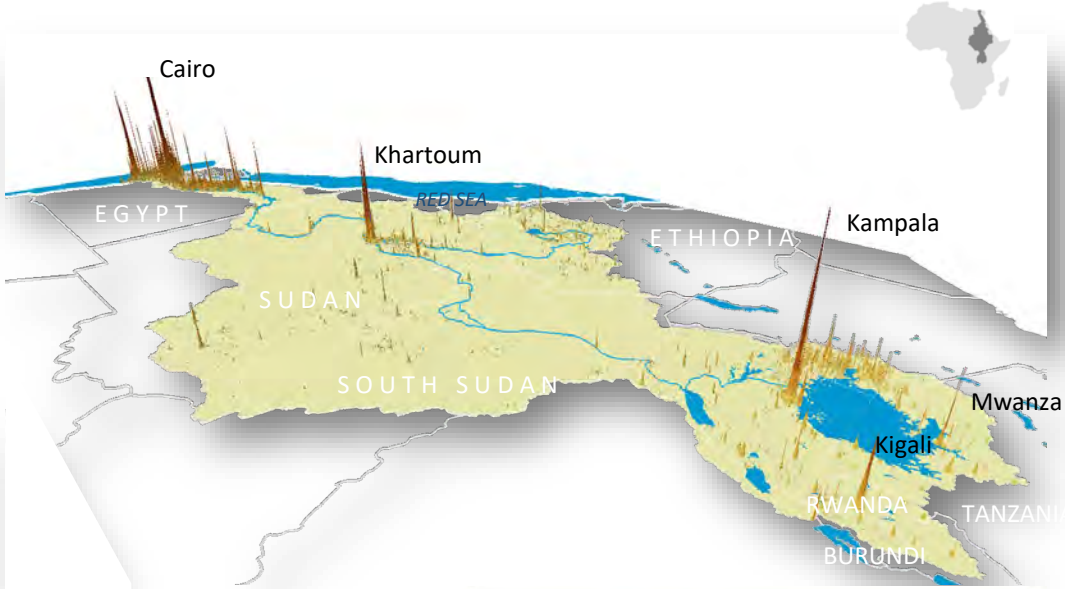
Manual Monitoring
Crowdsourcing

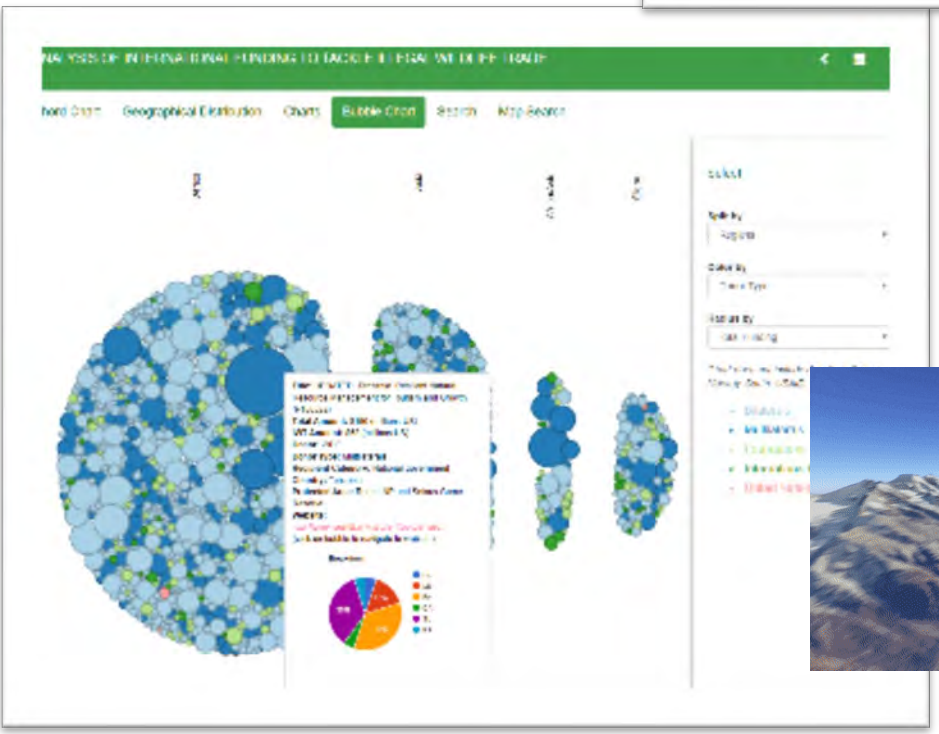
Automated Monitoring

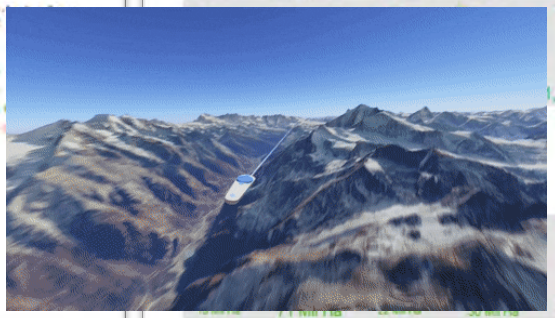
"Bottom-up" Data Acquisition System → IoT



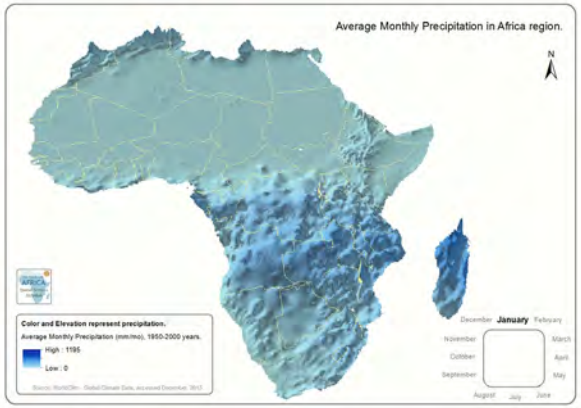


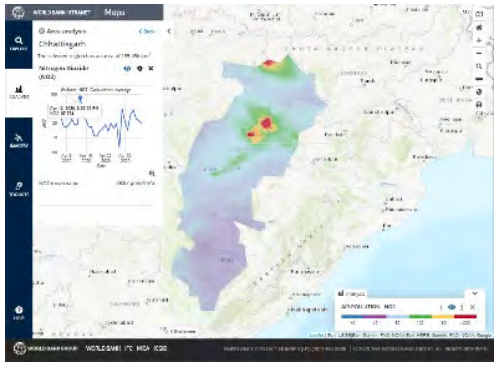

Cairo
Khartoum
RED SEA
EGYPT
ETHIOPIA
Kampala
SUDAN
SOUTH SUDAN
Mwanza
Kigali
RWANDA
TANZANI
BURUNDI


Geographical Distribution
Charts
Bubble Chart
Search
Map Search



ARAL SEA
GANGES-BRAHMAPUTRA
INDUS
LAKE CHAD
MEKONG
NIGER
NILE
TARIM
TIGRIS-EUPHRATES
Global Transboundary Basins Facts
54 Million
732 Million
201 Million
48 Million
67 Million
115 Million
238 Million
11 Million
60 Million
Total Pop. (2012)
38 Billion
395 Billion
134 Billion
20 Billion
46 Billion
42 Billion
168 Billion
19 Billion
83 Billion
Total GDP (2014)
1,531 mm
662 mm
628 mm
94 mm
318 mm
Basin Avg. (1950-2000)
21 °C
27 °C
25 °C
3 °C
16 °C
Basin Avg. (1950-2000)
27 Mil Ha
50 Mil Ha
57 Mil Ha
4 Mil Ha
27 Mil Ha
Total Cropland (2015)


Average Monthly Precipitation in Africa region.
Color and Elevation represent precipitation.
Average Monthly Precipitation (mm/mo), 1950-2000 years.
High : 1195
Low : 0
January



Complex Water Systems Models

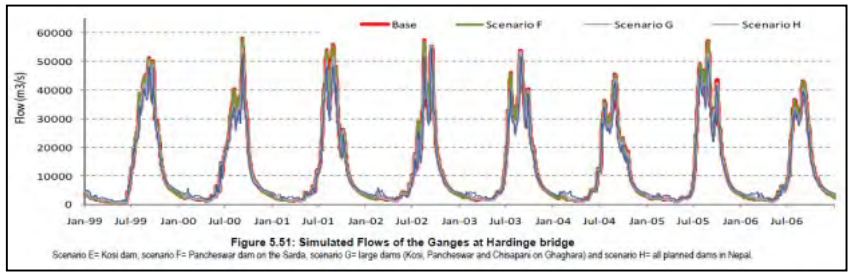
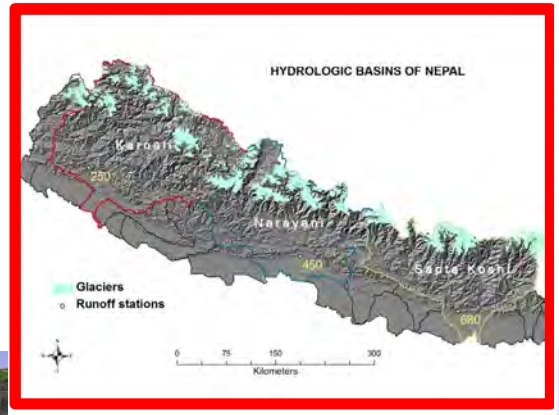
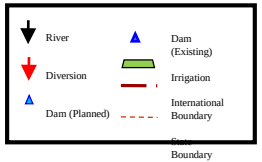


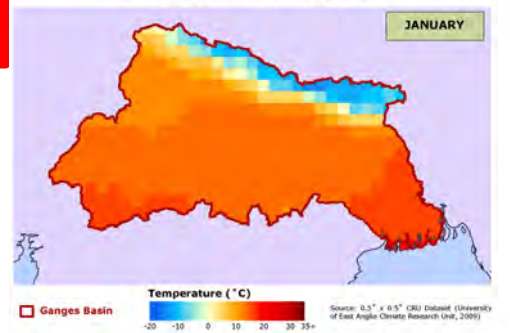
Figure 5.51: Simulated Flows of the Ganges at Hardinge bridge

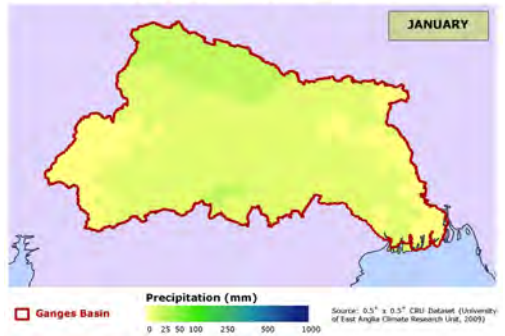
Scenario E= Kosi dam, scenario F= Pancheswar dam on the Sarda, scenario G= large dams (Kosi, Pancheswar and Chisapani on Ghaghara) and scenario H= all planned dams in Nepal.

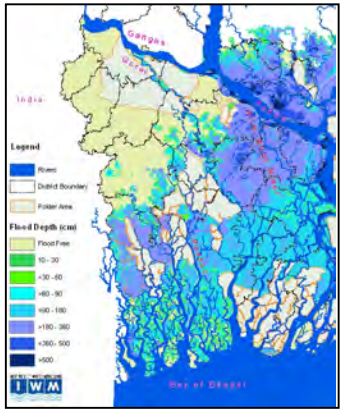


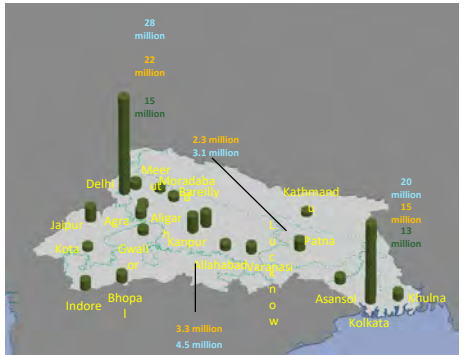
1025 Structures





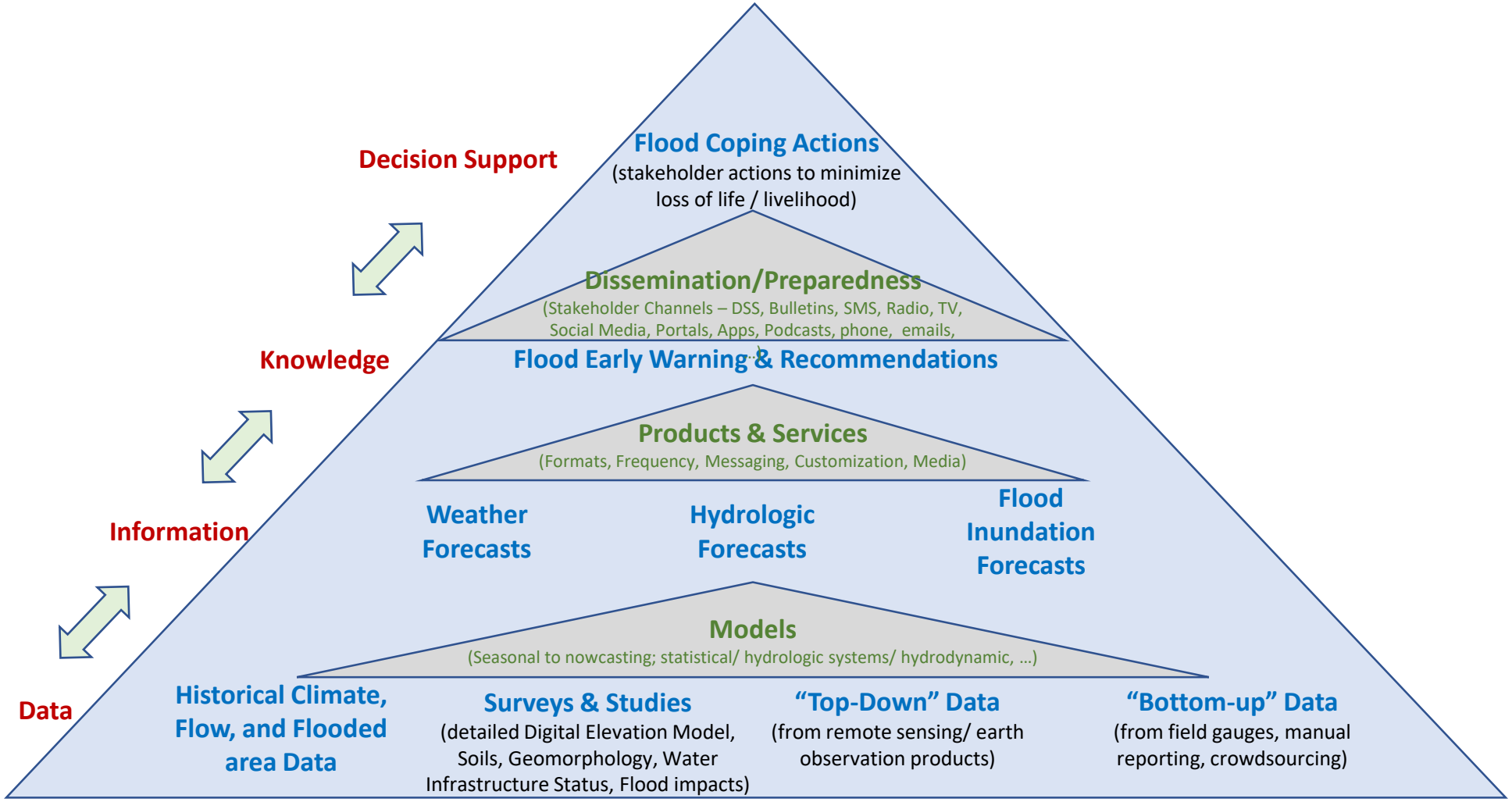






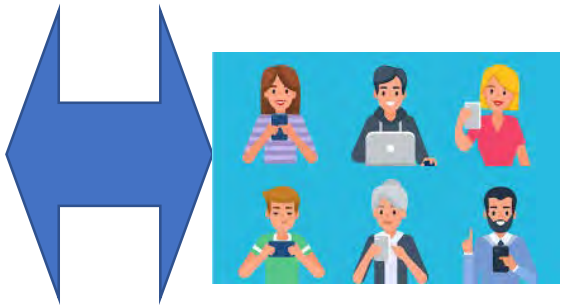
The Data Value Chain

Example: Deciding on Coping with Floods



Key Elements of a Water Information System Ecosystem

- **Collect Data:** In-situ (gauges, Apps/Logs) and Earth Observation
- **Quality Management:** Proprietary/open systems for data integration and quality management - traditionally desktop systems but heading towards low-cost cloud-based online systems for data storage and quality management.
- **Serve Data:** Use free/open OGC standard services and open APIs for making national/sub-national data accessible (including provisional real-time data) so that multiple customized systems can be created to access them. Create Data Services Catalog with public and restricted services.
- **Access Data:** Use free/open systems for creating dashboards/portals/Apps using these national/sub-national services with other global data services and free cloud analytics (e.g. online GIS, analysis scripts tools e.g. CUAHASI, Tethys that use Python, R, etc., Google Earth Engine, etc.), open scripting repositories (e.g. GitHub, Bitbucket, etc.) and interactive data visualization libraries e.g. https://d3js.org/).
- **USE Data:** Trends, Benchmarking, Modeling; Decision Support; Interactive Dashboards, E-Books; Hackathons



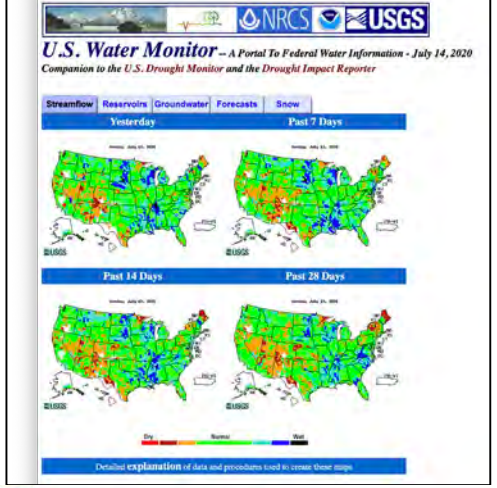
Interactive Dashboards: Illustrative Data & Functionality

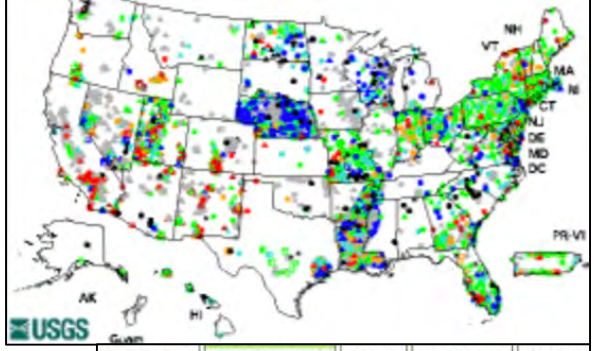
Historical Trends and Future Projections:

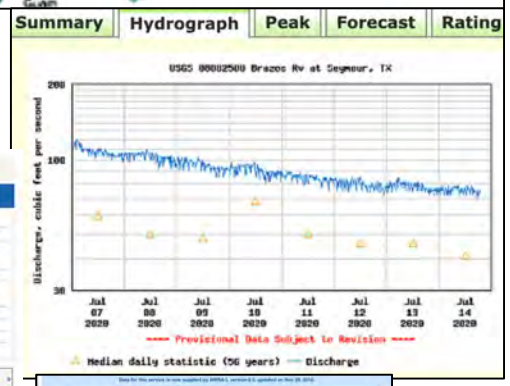
- *Climate* (historical climate, ET, climate change scenarios – temp, precipitation, etc. and hydrological implications)
- *Water Resources* (surface and ground water resources, snow, glaciers, rivers, lakes, bathymetry)
- *Disasters* (floods, droughts, storms – hazard/exposure/risk, forecasts)
- *Land* (detailed elevation, soil characteristics, lithology, geology, landcover, agriculture – incl. rainfed and irrigation, erosion/sedimentation; satellite imagery – especially free)
- *Environment* (surface and groundwater pollution sources, water quality incl. sedimentation and salinity, land degradation, forests, ecotourism, fisheries/aquaculture)
- *Social* (demography/census, settlements, occupations, poverty)
- *Economic* (gridded gdp, transport, administrative, crop/transport prices)
- *Water Investments* (incl. storage, headworks, embankments, diversions, irrigation, pumps, water supply and wastewater treatment infrastructure, etc.) with appropriate attribute data

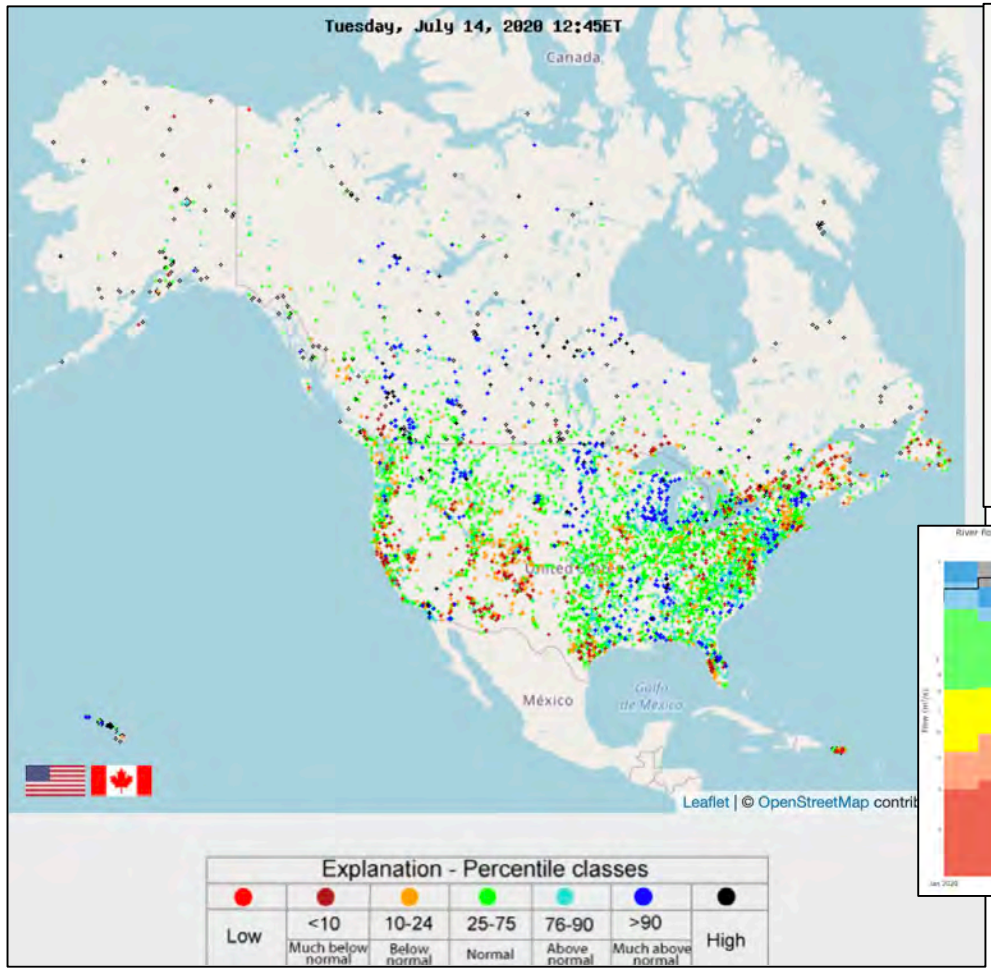
Functionality:

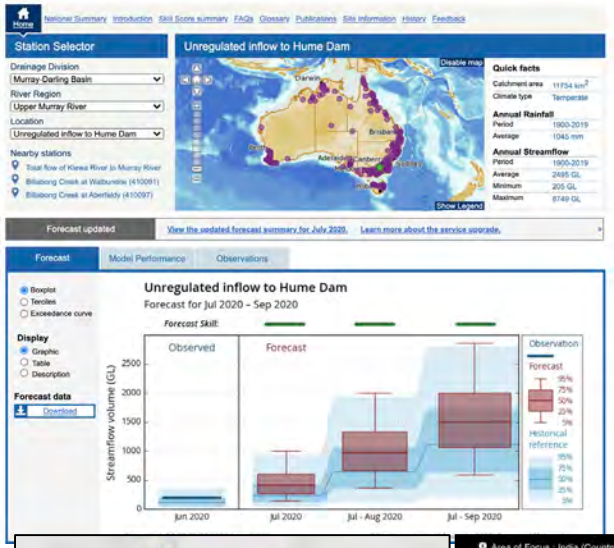
- Open Access (additionally a secure version if necessary) responsive-design web portal and mobile App (Android and iOS) to visualize and interact with data –accessible on computers, tablets, smartphones and touchscreens/touchtables
- Updatable data and analytical services catalog with appropriate metadata
- Interactive knowledge base (relevant articles, reports, videos, websites)
- Spatial and temporal data visualization (interactive maps and graphs, swipe tools, animations)
- Spatial analytics (e.g. for selected area, pre-defined admin or hydrological or other areas, selected shapefiles) – incl. use of free cloud analytics
- Ability to export catalog data services and visualizations as images, spreadsheets/CSV where possible, deep URL links and embeds in other portals, mobile Apps, e-books, storymaps or blogs
- Scenario visualization using the data and existing model outputs
- Help tools (e.g. interactive documentation, screen-capture videos)

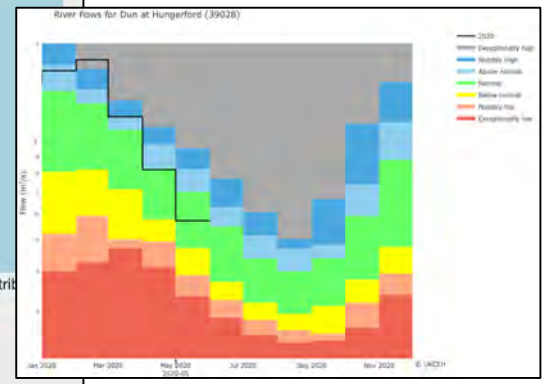

NRCS
USGS
U.S. Water Monitor -- A Portal To Federal Water Information - July 14, 2020
Companion to the U.S. Drought Monitor and the Drought Impact Reporter
Streamflow
Reservoirs
Groundwater
Forecasts
Snow
Yesterday
Past 7 Days
Past 14 Days
Past 28 Days
Detailed explanation of data and procedures used to create these maps

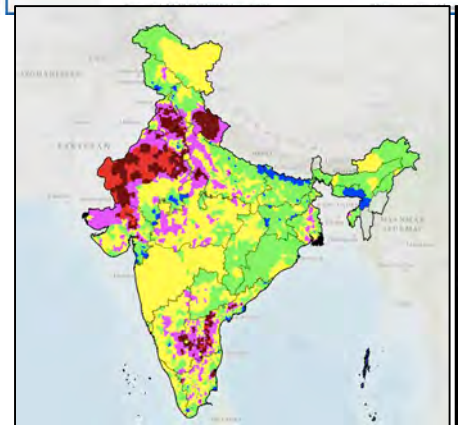

USGS
NH
VT
MA
CT
NJ
DE
MD
DC
PR-VI
AK
HI


Summary
Hydrograph
Peak
Forecast
Rating
USGS 08082500 Brazos Rv at Seymour, TX
Discharge, cubic feet per second
Jul 07 2020
Jul 08 2020
Jul 09 2020
Jul 10 2020
Jul 11 2020
Jul 12 2020
Jul 13 2020
Jul 14 2020
---- Provisional Data Subject to Revision ----
Median daily statistic (56 years)
Discharge

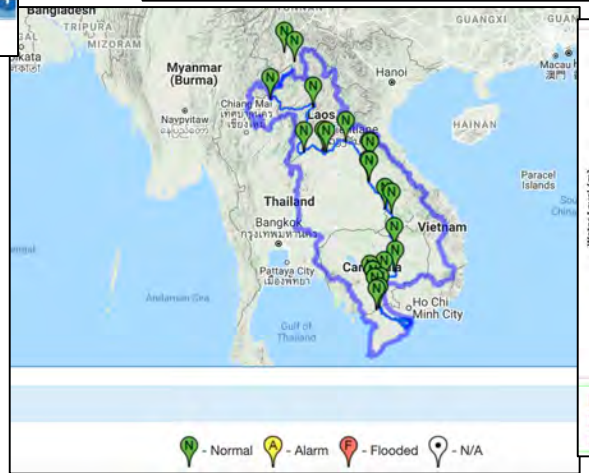

Tuesday, July 14, 2020 12:45ET
Canada
United States
México
Golfo de México
Leaflet | © OpenStreetMap contrib
Explanation - Percentile classes
Low
<10
Much below normal
10-24
Below normal
25-75
Normal
76-90
Above normal
>90
Much above normal
High

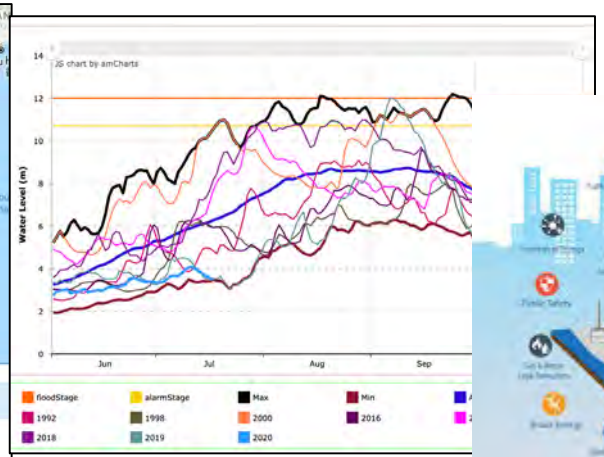

Station Selector
Drainage Division
Murray-Darling Basin
River Region
Upper Murray River
Location
Unregulated inflow to Hume Dam
Nearby stations
Unregulated inflow to Hume Dam
Quick facts
Annual Rainfall
Annual Streamflow
Forecast updated
Forecast
Model Performance
Observations
Unregulated inflow to Hume Dam
Forecast for Jul 2020 - Sep 2020
Forecast Skill:
Observed
Forecast
Streamflow volume (GL)
Jun 2020
Jul 2020
Jul - Aug 2020
Jul - Sep 2020


River flows for Dun at Hungerford (39028)



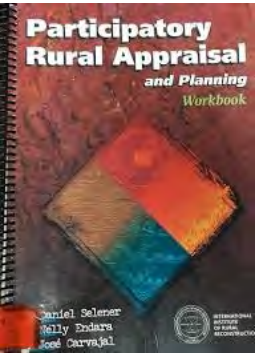

Area of Focus : India (Country)
NORMAL RAINFALL
ACTUAL RAINFALL
% DEVIATION FROM NORMAL
NORMAL (mm)
ACTUAL(< NORMAL) (mm)
ACTUAL(> NORMAL) (mm)

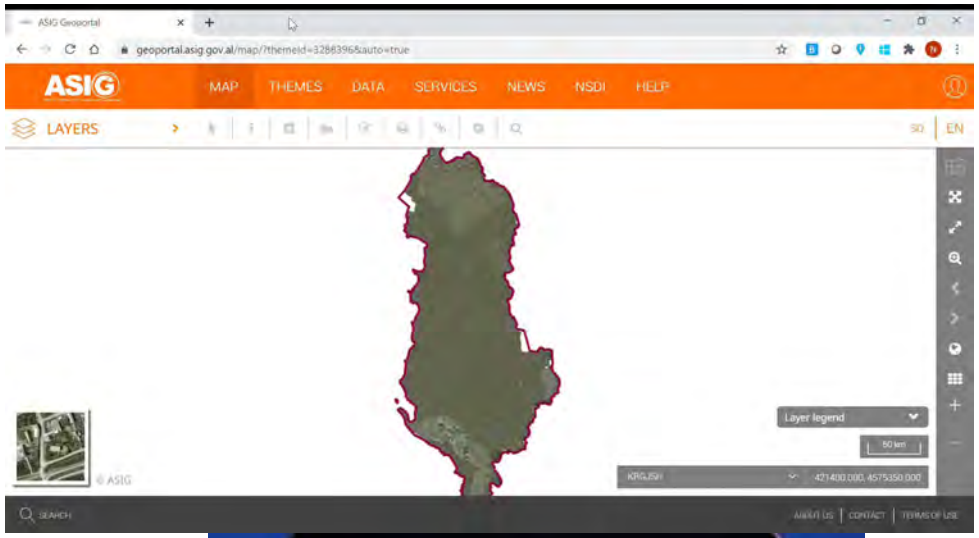

Myanmar (Burma)
Hanoi
Laos
Thailand
Bangkok
Vietnam
Pattaya City
Ho Chi Minh City
Andaman Sea
Gulf of Thailand
Paracel Islands
HAINAN
N - Normal
A - Alarm
F - Flooded
- N/A

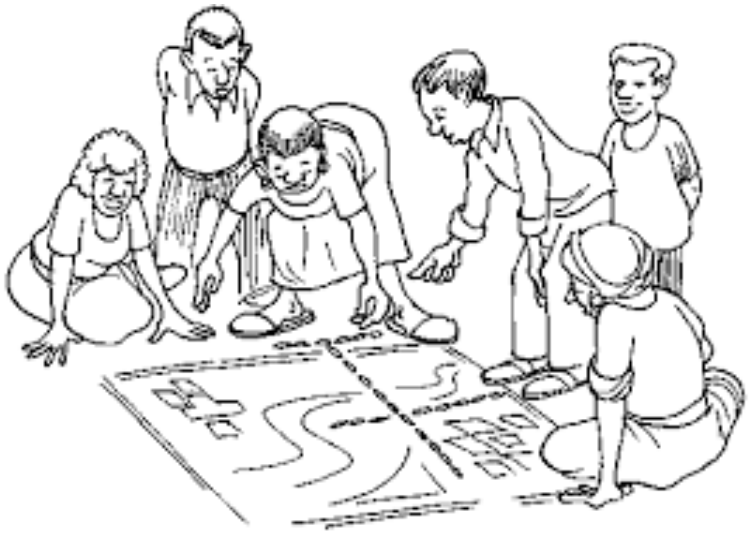

JS chart by amCharts
Water Level (m)
Jun
Jul
Aug
Sep
floodStage
alarmStage
Max
Min
1992
1998
2000
2016
2018
2019
2020


SMART CITY

Technology-Enhanced Community Discussions

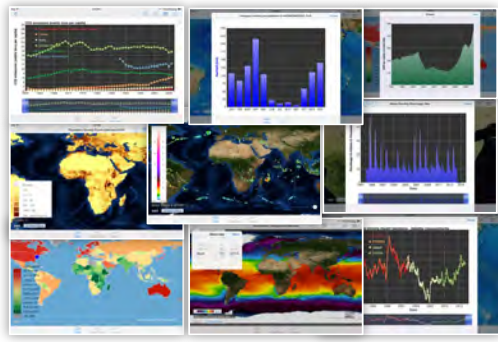




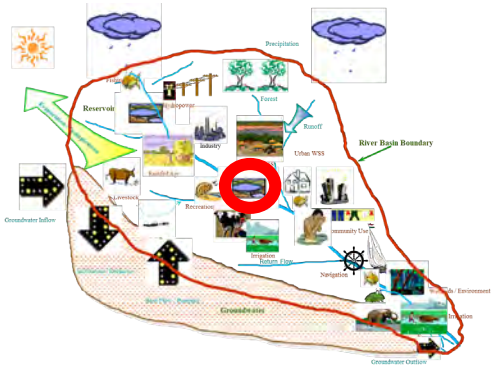


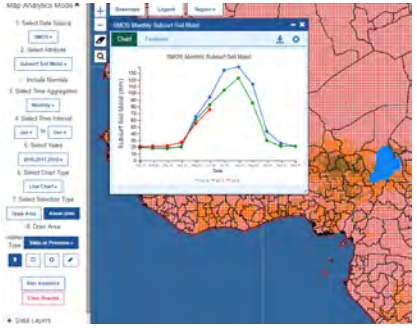
Illustrative Interactive Dashboards

Example for Dam Operation



Decisions to be Supported: When to release? How much to release?





Climate

- Rainfall in upstream watershed (GPM, in-situ gauges/radar, CHIRPS, …) – current & historical
- Weather forecasts (short-term, seasonal); Storm tracks
- Snowmelt estimates (if relevant)…

Flows

- Current and historical flows (from in-situ observations, satellite estimates where possible)
- Dam inflow forecasts (e.g. from GEOGLOWS Global Streamflow Forecasting, local forecasts)…

System Levels

- Current and historical levels of this dam's reservoir as well as other storages in system (e.g. from satellite, in-situ gauges)…

Downstream

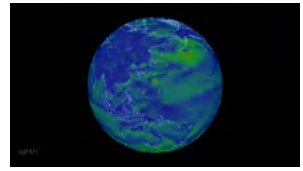
- Irrigation status (crops, crop stage from earth observation and in-situ)
- Soil and sub-surface soil moisture, groundwater (from earth observation and in-situ)…

Other Data & Analytics

- Inundation forecasts
- Systems water infrastructure needs
- Systems model to explore implications of alternative dam operations
- Hi-resolution Satellite data
- Crowdsourced data

…

Need to draw upon global and other accessible data and analytic services to make interactive maps, graphs, and analytics for such decision support dashboards that are accessible on portals, apps, e-books, touchscreens, etc.



http://spatialagent.org/Mashreq/

Mashreq Data Portal

Not secure | spatialagent.org/Mashreq/

MASHREQ WATER RESOURCES PORTAL

All | Environmental | Social | Economic | Climate | Water | Disasters

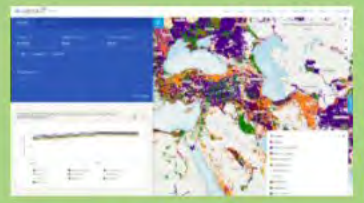

Water Transition


RICCAR


JRC Urban Explorer


Water Inventory


Fishing Watch


Aqueduct Food

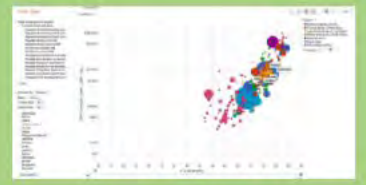

Power Plants


Watershed Delineation

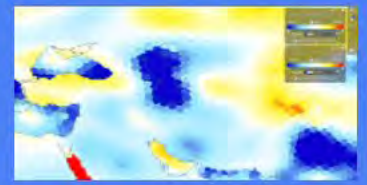
NASA Disasters Portal


GEOGLOWS Streamflow Forecast


Climate Stations


Motion Charts


ACLED Conflict Data


GRACE Groundwater


Cities

High-Resolution Satellite Imagery

Mashreq Data Portal

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MASHREQ WATER RESOURCES PORTAL

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Water Transition

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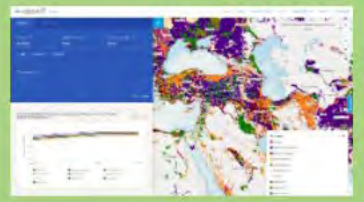


Aqueduct Food

GEOGloWS Streamflow Explorer

Power Plants

Watershed Delineation

NASA Disasters Portal

GEOGLOWS Streamflow Forecast

Climate Stations

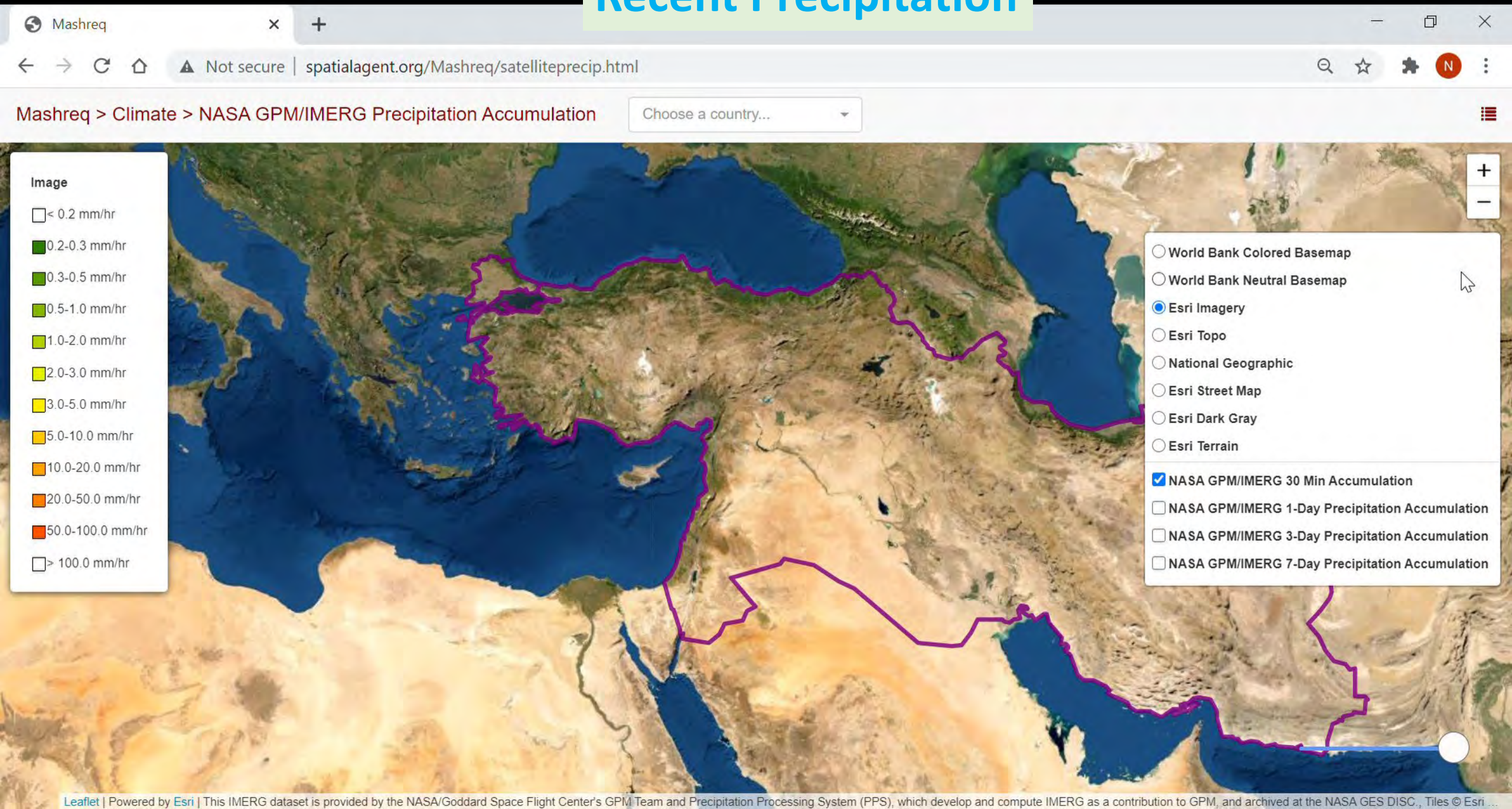
Earth Engine Water Watch

EarthMap (FAO)

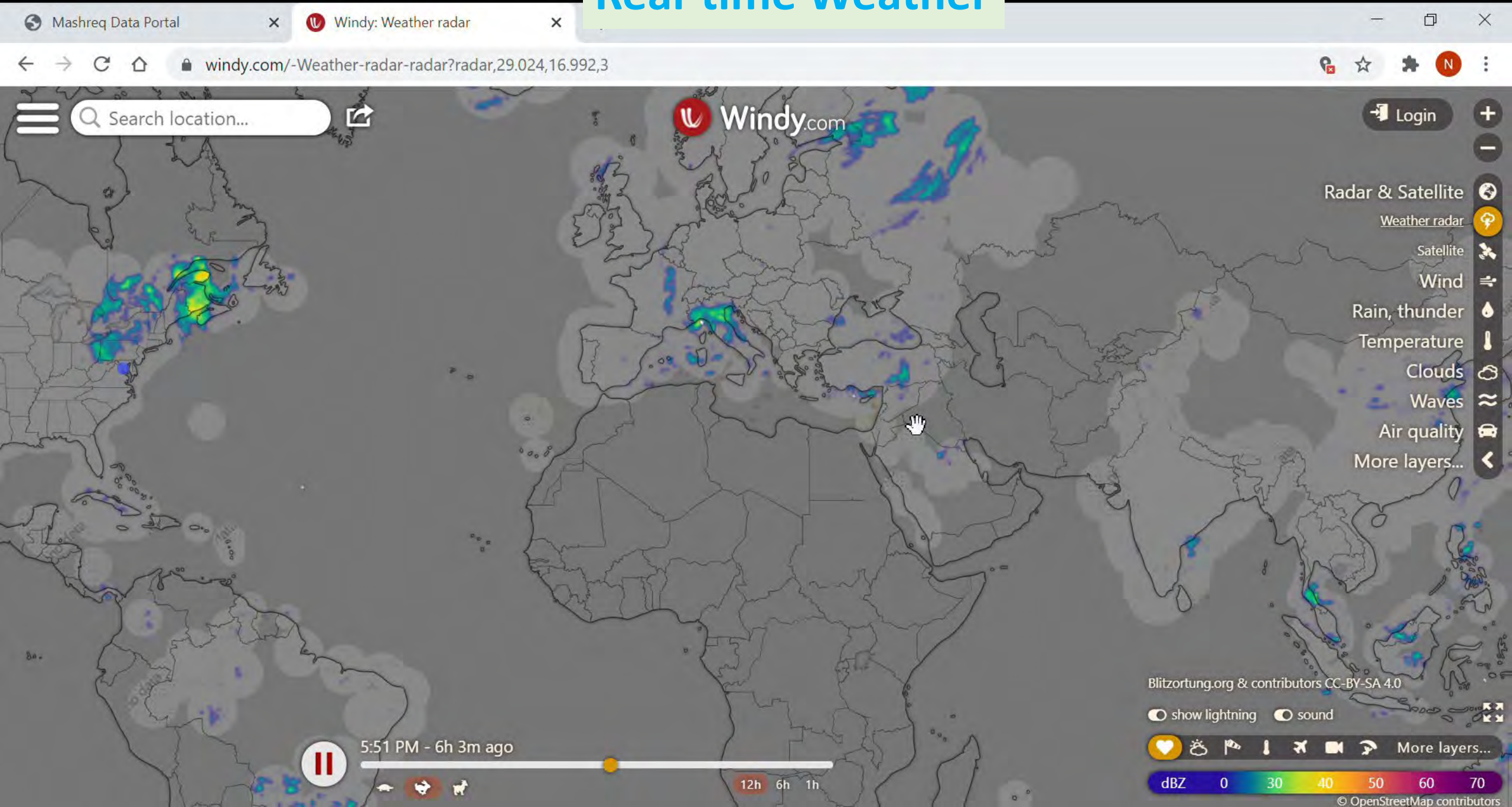
Open Data Cube

Historical Climate

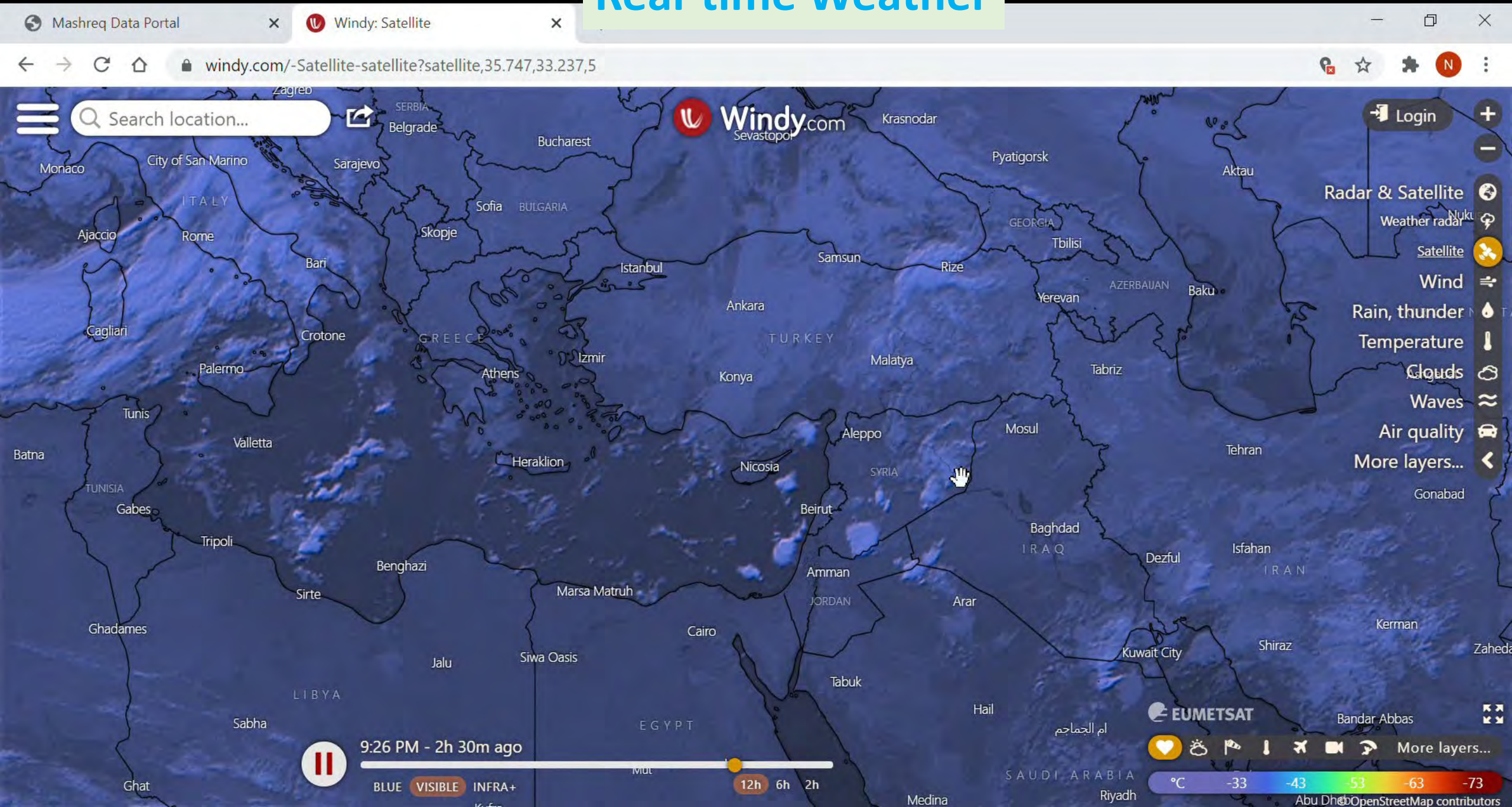
Recent Precipitation



Real-time Weather



Real-time Weather



Climate Change

Mashreq Data Portal | Home | RICCAR

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MASHREQ WATER RESOURCES PORTAL

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Water Transition


RICCAR


JRC Urban Explorer


Water Inventory


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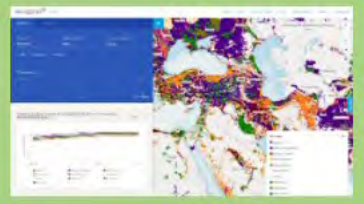

Aqueduct Food


GEOGloWS Streamflow Explorer


Power Plants


Watershed Delineation

NASA Disasters Portal


GEOGLOWS Streamflow Forecast


Climate Stations


Earth Engine Water Watch


EarthMap (FAO)


Open Data Cube

Evapo-Transpiration

Mashreq Data Portal | https://app.climateengine.org/cli

app.climateengine.org/climateEngine

GET MAP LAYER

Variable

Type:
Remote Sensing

Dataset:
USGS MODIS ET - SSEBop Dekadal

Variable:
Evapotranspiration (ETa)

Units: millimeters

Computation
Resolution (Scale):
1000 m (1/96-deg)

Processing

Statistic (over day range):
Total

Calculation:
Values

Time Period

Period of Record: 2003-01-01 to 2020-11-01

Last Year

Start Date: 2019-11-02
End Date: 2020-11-01

GET MAP LAYER

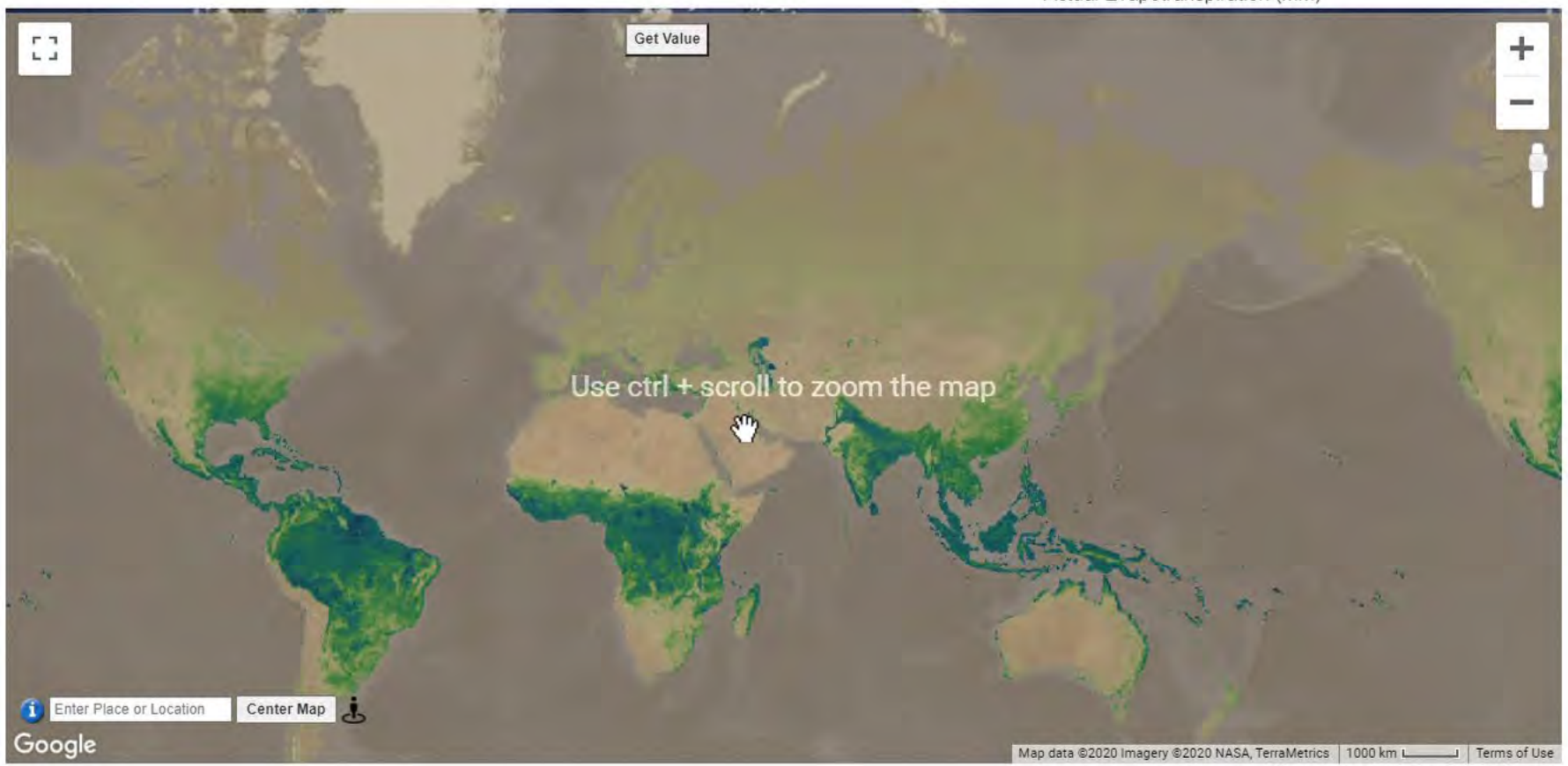
MENU | Map

Climate Engine

2019-11-02 to 2020-11-01, Total

0.0 500 1,000 1,500

Actual Evapotranspiration (mm)



Generated by ClimateEngine.org

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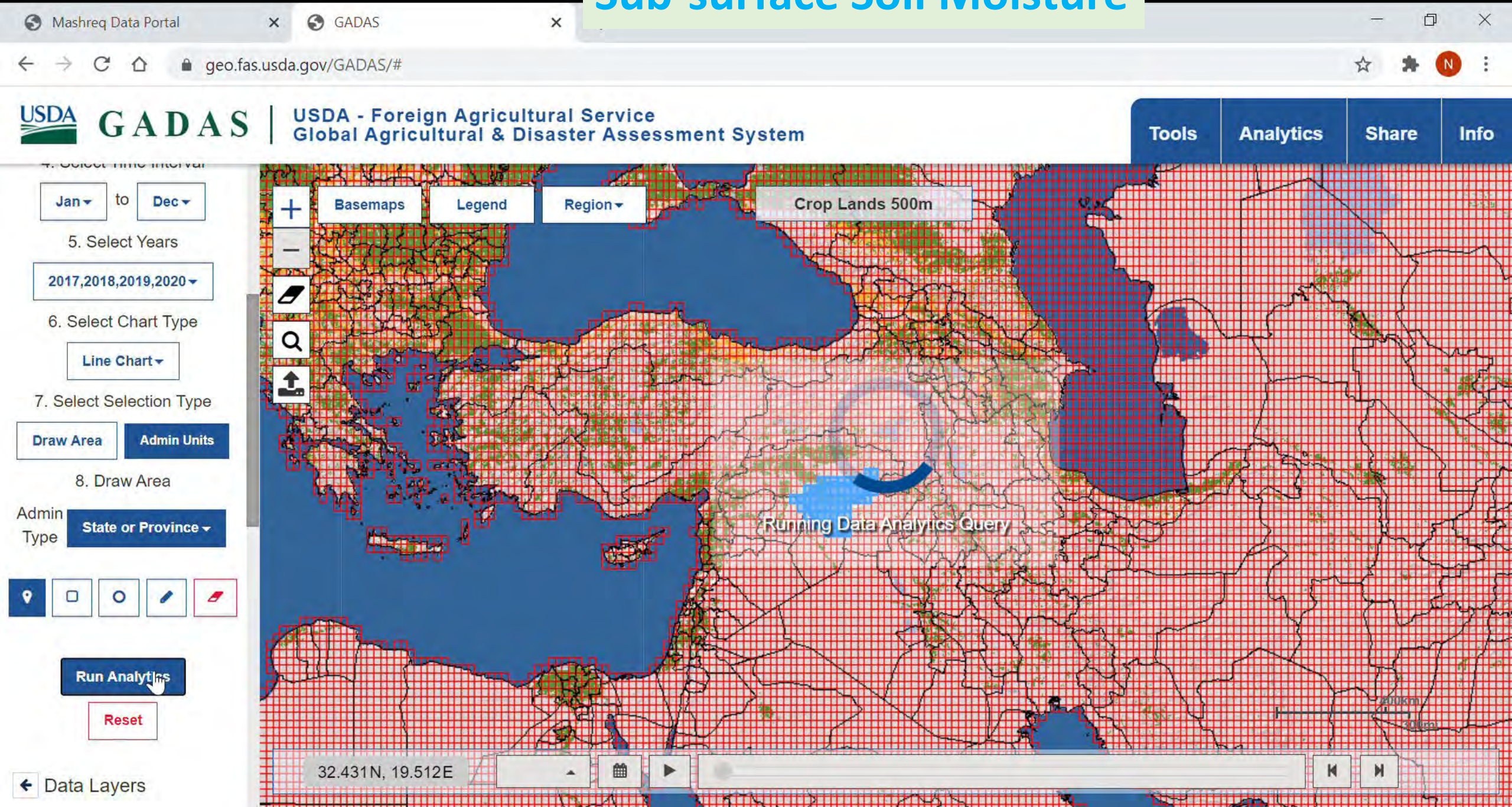
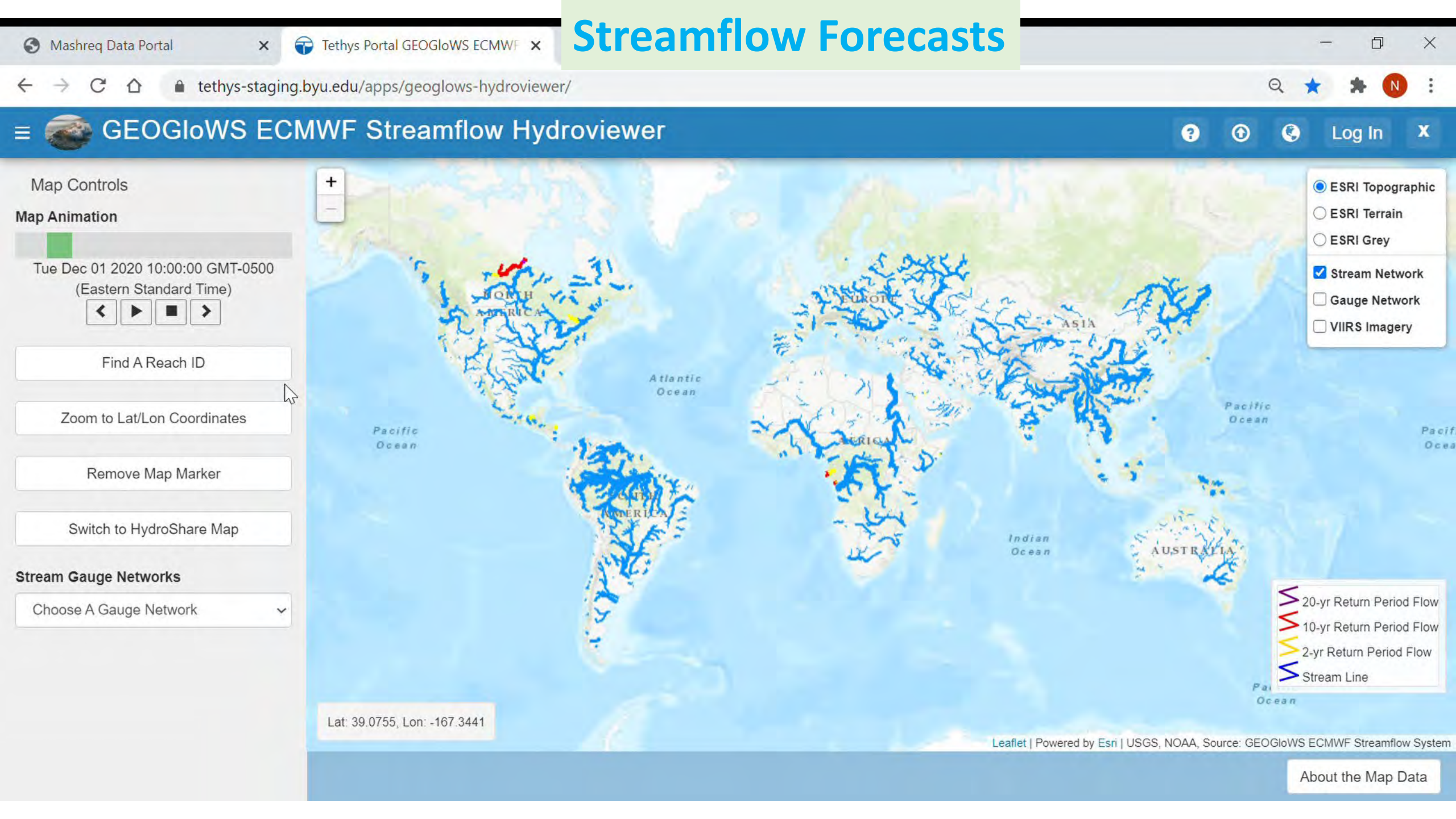
Sub-surface Soil Moisture



Streamflow Forecasts



Historical Flow Estimates

Mashreq Data Portal | Tethys Portal GEOGloWS ECMWF

tethys-staging.byu.edu/apps/geoglows-hydroviewer/

GEOGloWS ECMWF Streamflow Hydroviewer

Log In

Map Controls

Map Animation

Tue Dec 01 2020 (Eastern S

Find A

Zoom to Lat/L

Remove

Switch to Hy

Stream Gauge Netv

Choose A Gauge

ESRI Topographic

ESRI Terrain

ESRI Grey

Stream Network

Gauge Network

VIIRS Imagery

Dahuk

20-yr Return Period Flow

10-yr Return Period Flow

2-yr Return Period Flow

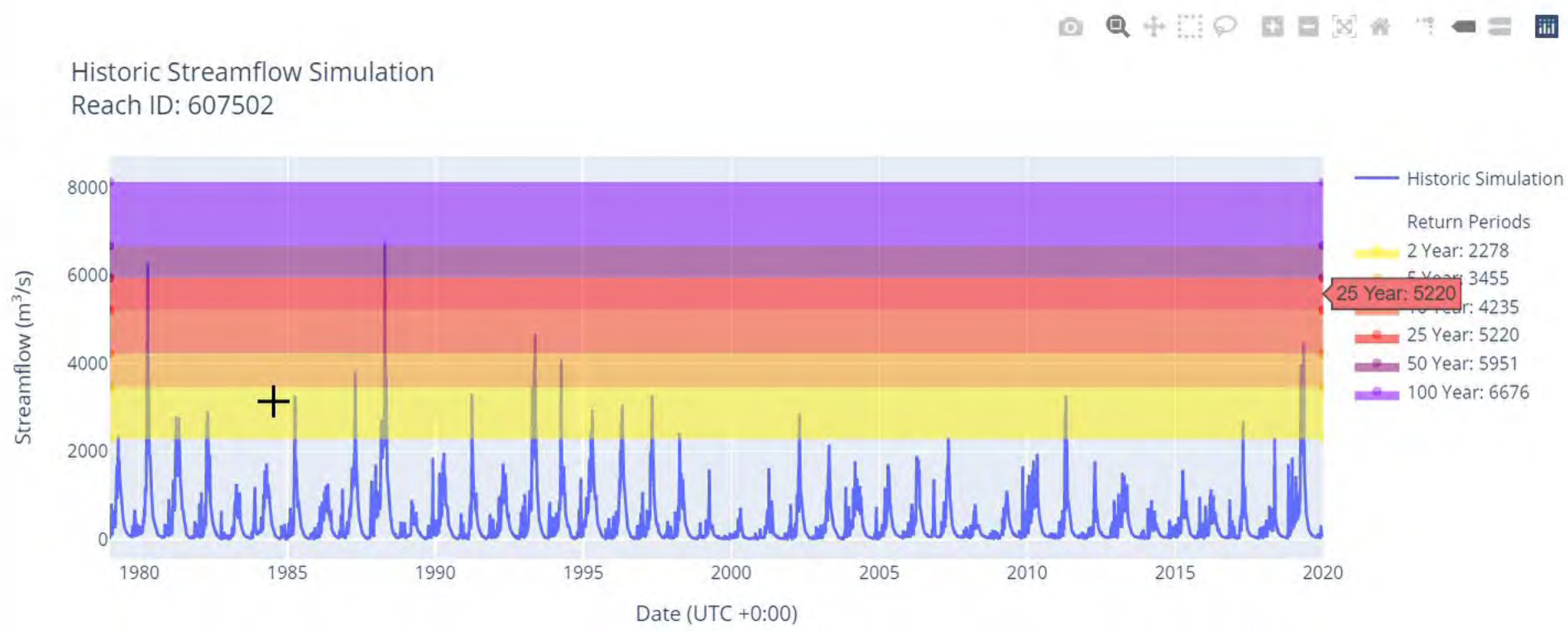
Stream Line

VS ECMWF Streamflow Syst

About the Map Data

Streamflow Results (Ready)

Forecasts | Historical | Average Flows | Flow-Duration | Bias Correction



Satellite Altimetry

Mashreq Data Portal | G-REALM - Home

ipad.fas.usda.gov/cropexplorer/global_reservoir/

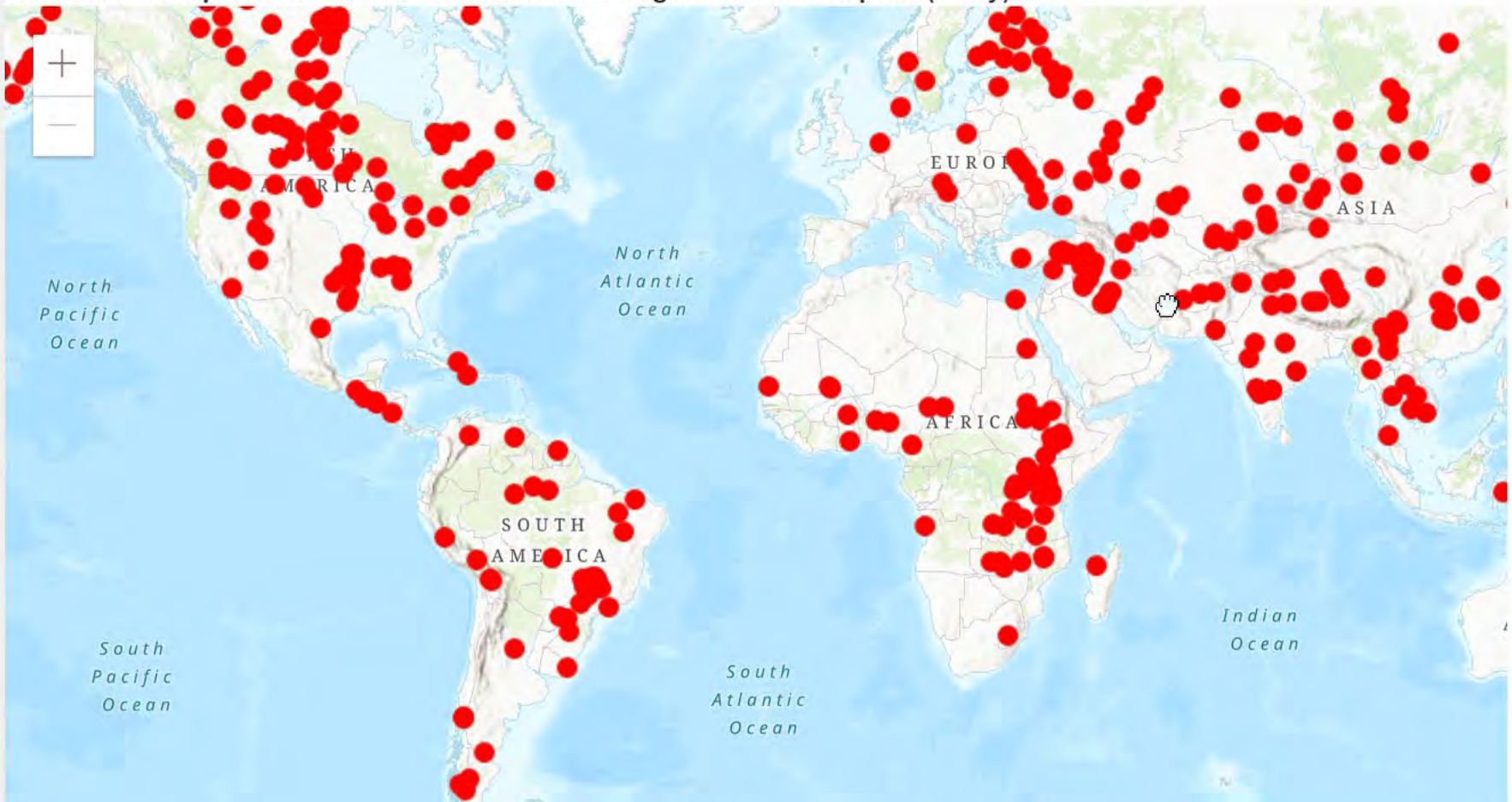
FAS Home / IPAD Home / Crop Explorer

Global Reservoirs and Lakes Monitor (G-REALM)

Partner Site
Global Water Monitor

G-REALM Information
Lake/Reservoir Product Table (.csv)
Lake/Reservoir Status Product Table (.csv)
Recent Updates
Background
Semi-Automated Data Processing
Satellite Radar Altimetry
Advantages and Limitations
Datasets
Products
FAQ – Product Choice, Accuracy, and Datums
References

Near Real Time products with datum based on a single satellite overpass (1 day)



Waterbody Area Dynamics (GEE)

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MASHREQ WATER RESOURCES PORTAL

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Water Transition


RICCAR


JRC Urban Explorer


Water Inventory


Fishing Watch


Aqueduct Food


GEOGloWS Streamflow Explorer


Power Plants


Watershed Delineation

NASA Disasters Portal


GEOGLOWS Streamflow Forecast


Climate Stations


Earth Engine Water Watch


EarthMap (FAO)


Open Data Cube

WAPOR (FAO)

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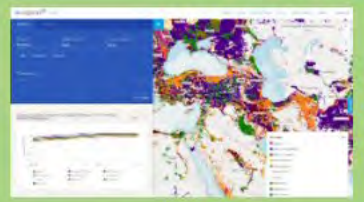

Aqueduct Food

GEOGloWS Streamflow Explorer

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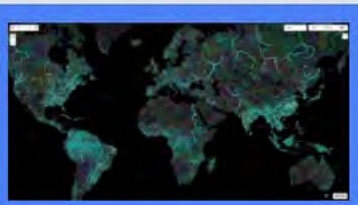
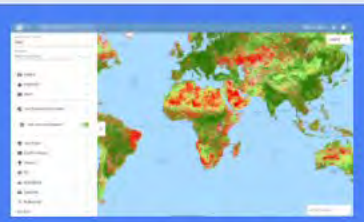


Earth Engine Water Watch



EarthMap (FAO)

Open Data Cube

Dynamic Watershed Mapping (ESRI)

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All | Environmental | Social | Economic | Climate | Water | Disasters


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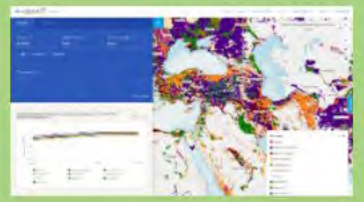
Aqueduct Food


Power Plants


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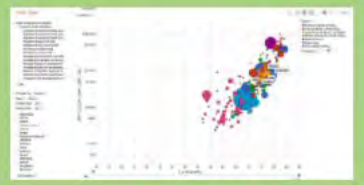
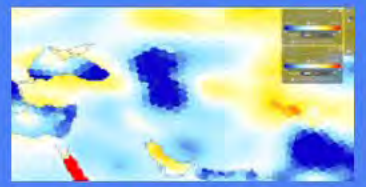
NASA Disasters Portal


GEOGLOWS Streamflow Forecast


Climate Stations

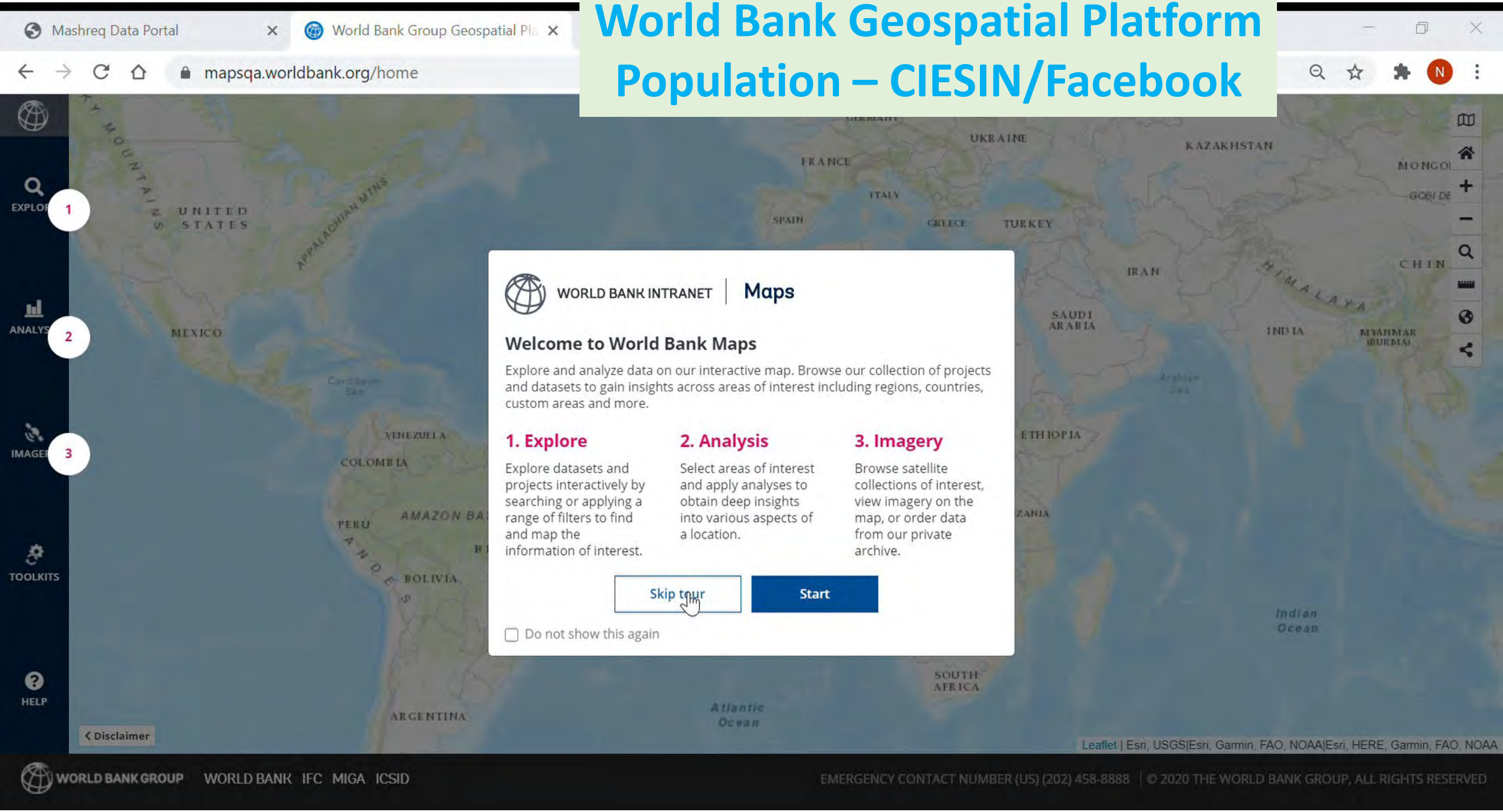

Motion Charts


ACLED Conflict Data

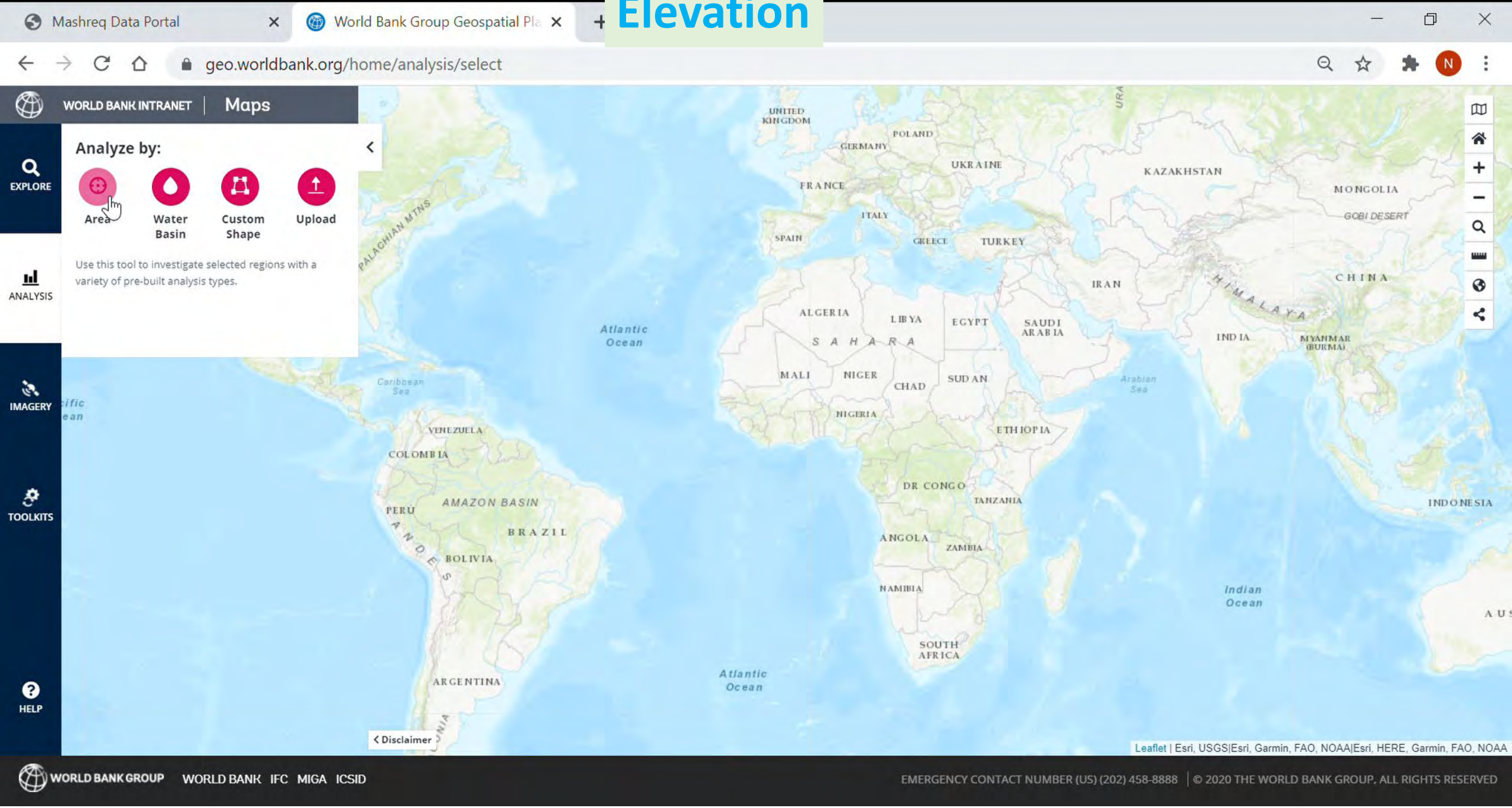

GRACE Groundwater


Cities

World Bank Geospatial Platform Population – CIESIN/Facebook



Elevation


Mashreq Data Portal
World Bank Group Geospatial Pla
geo.worldbank.org/home/analysis/select
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ANALYSIS
IMAGERY
TOOLKITS
HELP
Analyze by:
Area
Water Basin
Custom Shape
Upload
Use this tool to investigate selected regions with a variety of pre-built analysis types.
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WORLD BANK IFC MIGA ICSID
EMERGENCY CONTACT NUMBER (US) (202) 458-8888
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Daily Precipitation (CHIRPS)

Mashreq Data Portal | World Bank Group Geospatial Pla

geo.worldbank.org/home/analysis/area/param1/SYR/param2/2845/satellite/chirps/variable/precipitation_daily/startdate/2017-08-01/enddate/2020-...

WORLD BANK INTRANET | Maps

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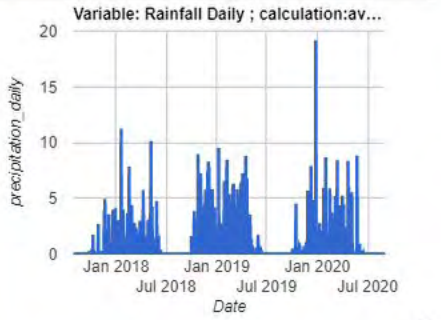
ANALYSIS
IMAGERY
TOOLKITS
HELP

Area analysis < Back

Raqqa

The selected region has an area of 17.91k km^2.

Rainfall Daily



Daily Rainfall mean value: 1.484 mm/day

Gaziantep, Birecik, Sanliurfa, Viransehir, Kiziltepe, Cizre, Nusaybin, Al Qamishli, Ceylanpinar, Suruç, Kilis, Manbij, Al Bab, Aleppo, As Safirah, Idlib, Ar Raqqah, Al Hasakah, Tall Afar, Sinjar, Dayr Az Zawr, Al Mayadin, Hamah, Salamiyah, Tartus, Homs, Tall Kalakh, Tripoli, Tadmur, Abu Kamal, Al Qaryatayn

TURKEY, SYRIA, IRAQ

Euphrates, Buhayrat al Asad, Rawdah

Analysis

RAINFALL - DAILY

0 4 8 12 16 20 24 28 32

Disclaimer

Leaflet | Esri, USGS|Esri, Garmin, FAO, NOAA|Esri, HERE, Garmin, FAO, NOAA, Google

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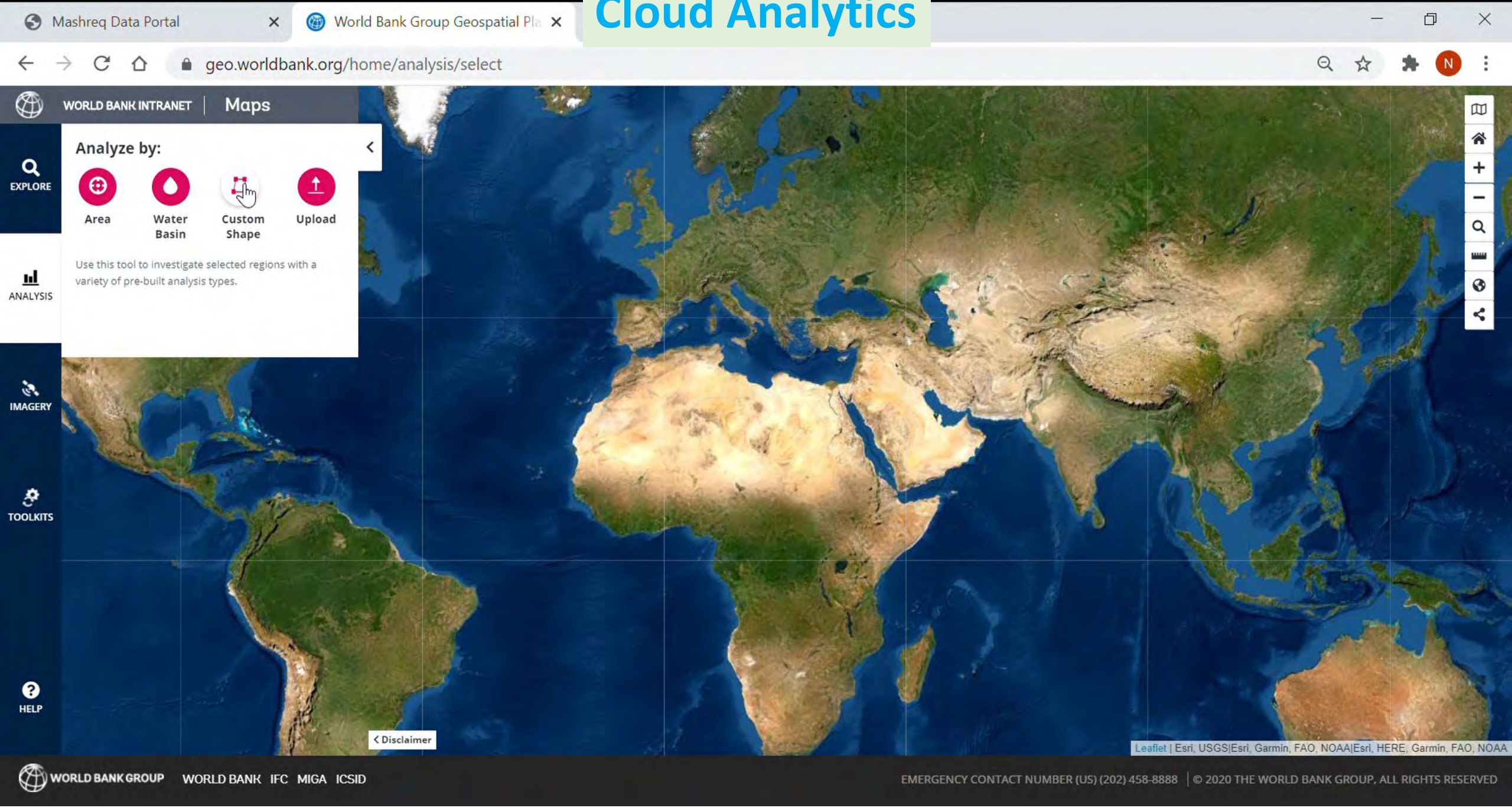
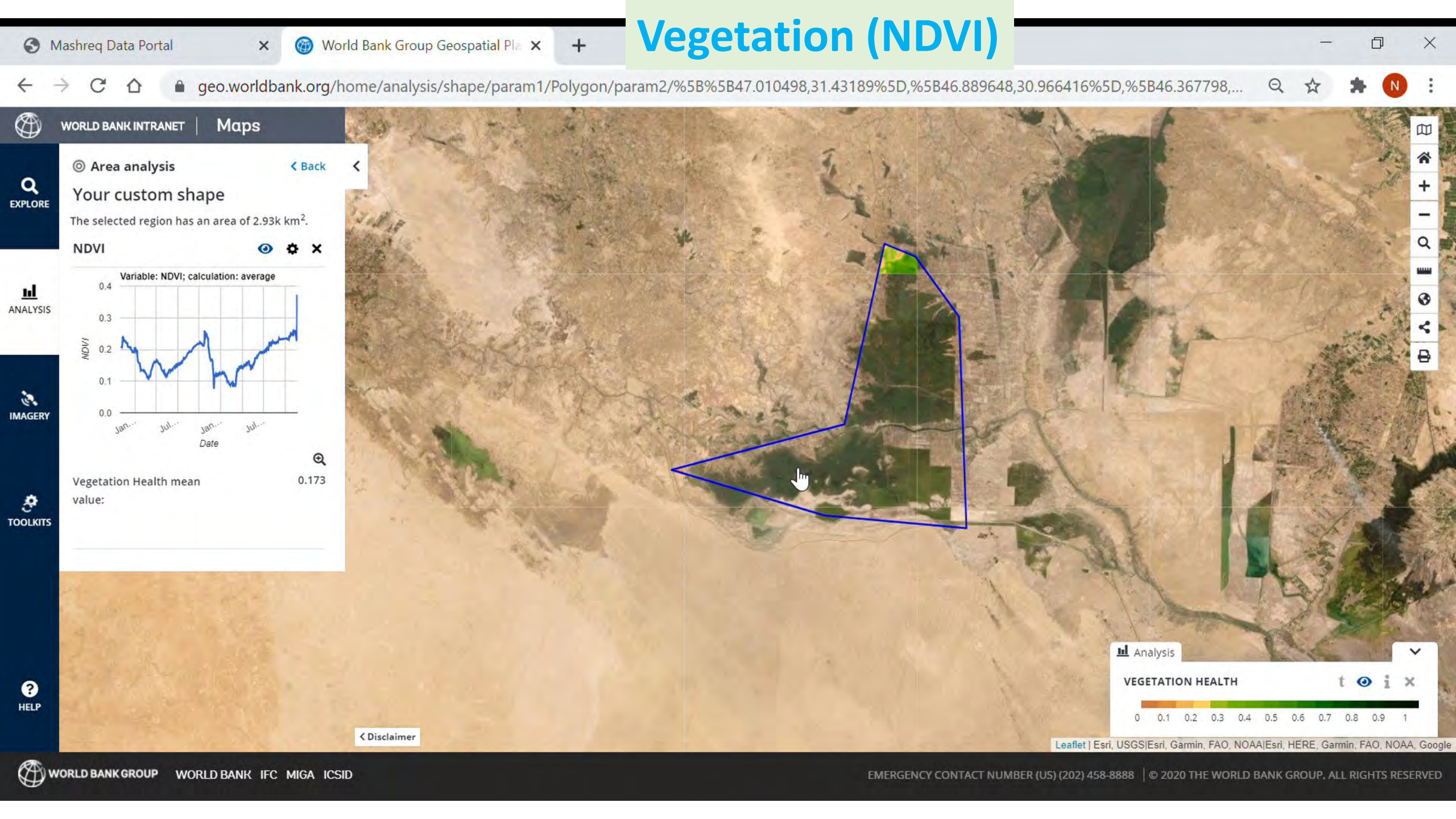
Cloud Analytics



Vegetation (NDVI)



Rainfall

Mashreq Data Portal | World Bank Group Geospatial Pla

geo.worldbank.org/home/analysis/shape/param1/Polygon/param2/%5B%5B47.010498,31.43189%5D,%5B46.889648,30.966416%5D,%5B46.367798,...

WORLD BANK INTRANET | Maps

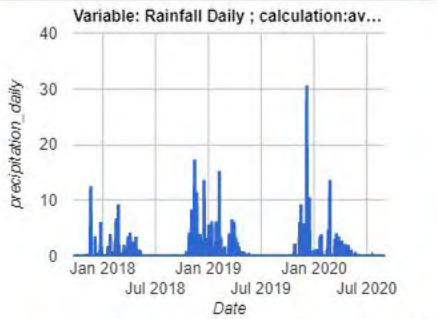
EXPLORE
ANALYSIS
IMAGERY
TOOLKITS
HELP

Area analysis < Back

Your custom shape

The selected region has an area of 2.93k km^2.

Rainfall Daily



Daily Rainfall mean value: 1.829 mm/day

Analysis

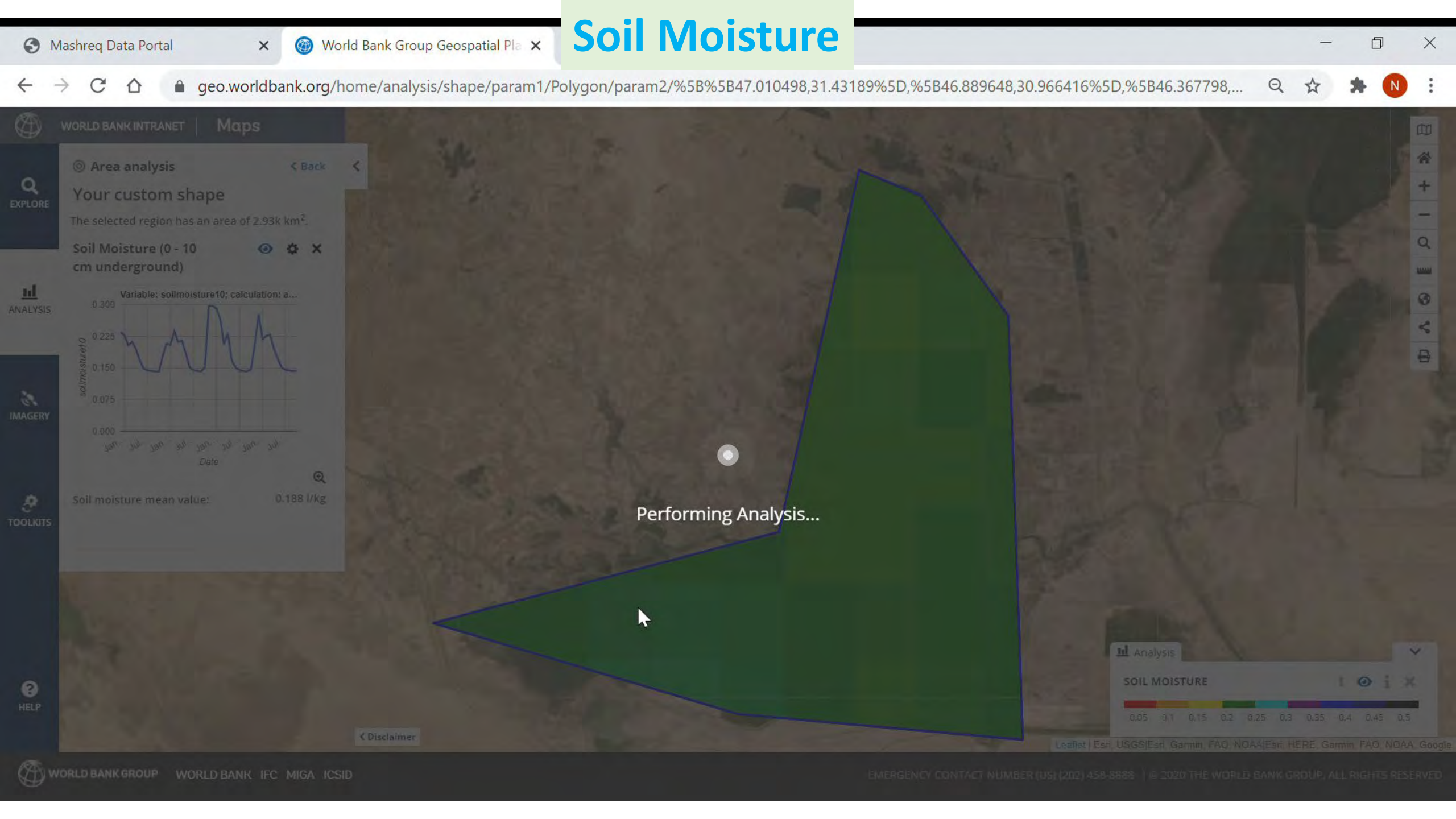
RAINFALL - DAILY

0 4 8 12 16 20 24 28 32

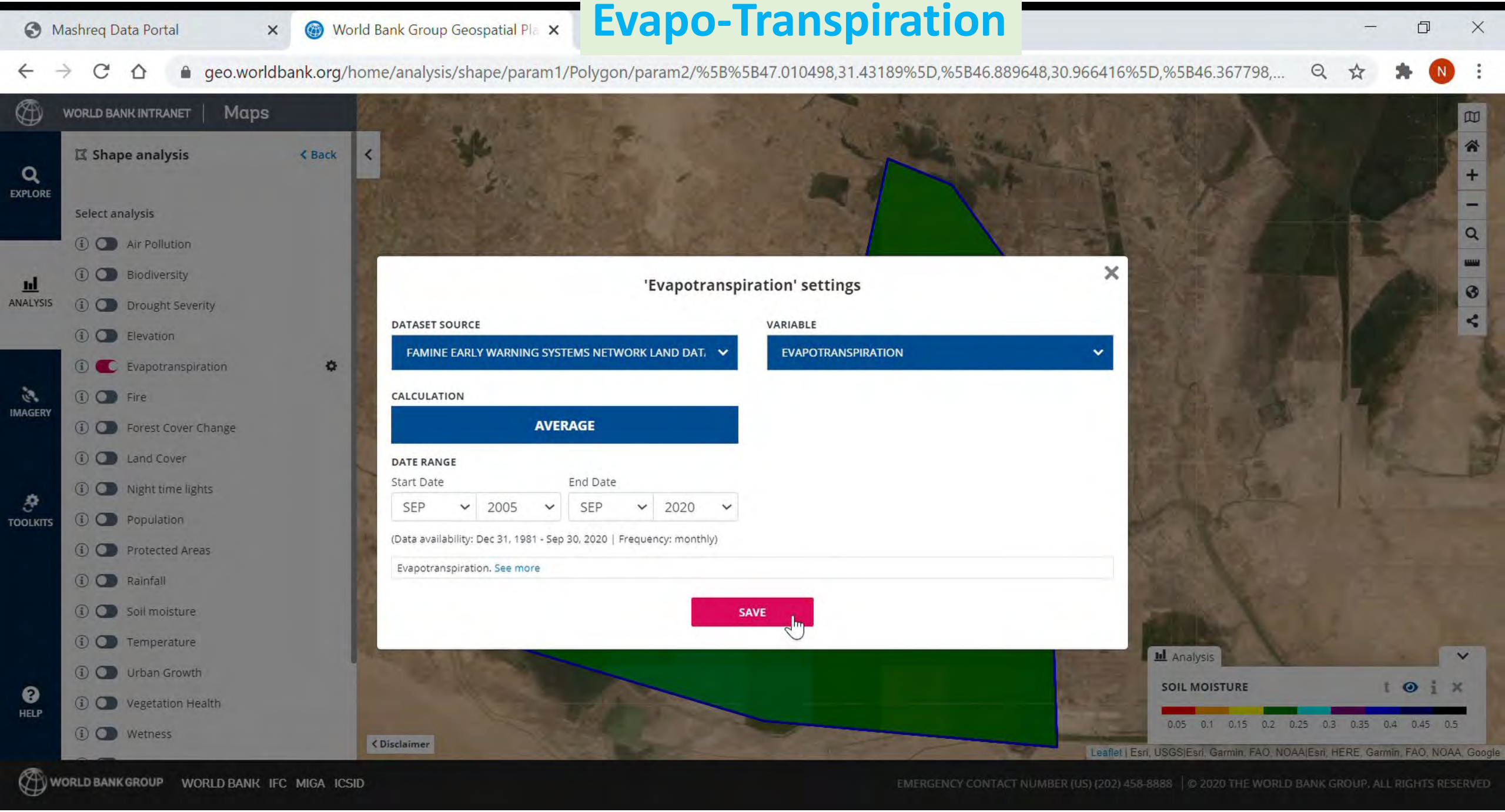
< Disclaimer

Leaflet | Esri, USGS|Esri, Garmin, FAO, NOAA|Esri, HERE, Garmin, FAO, NOAA

Soil Moisture



Evapo-Transpiration

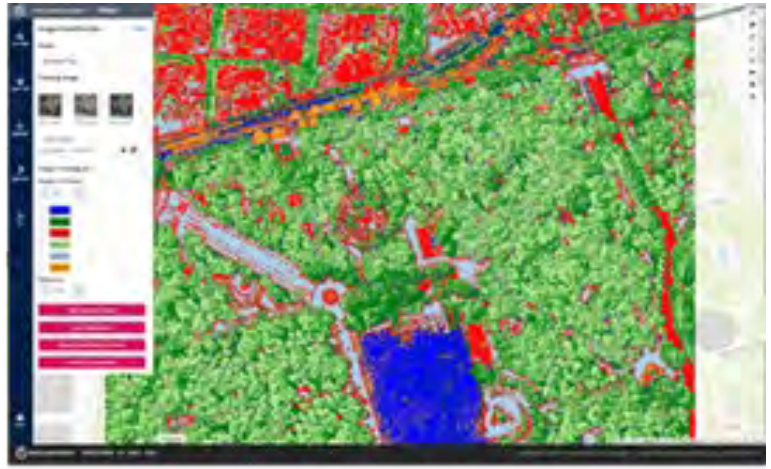


Looking Ahead: AI/Machine Learning

AI-Enabled Text and Data Mining of documents, news & social media

AI-Enabled Chatbots
Natural Language Processing

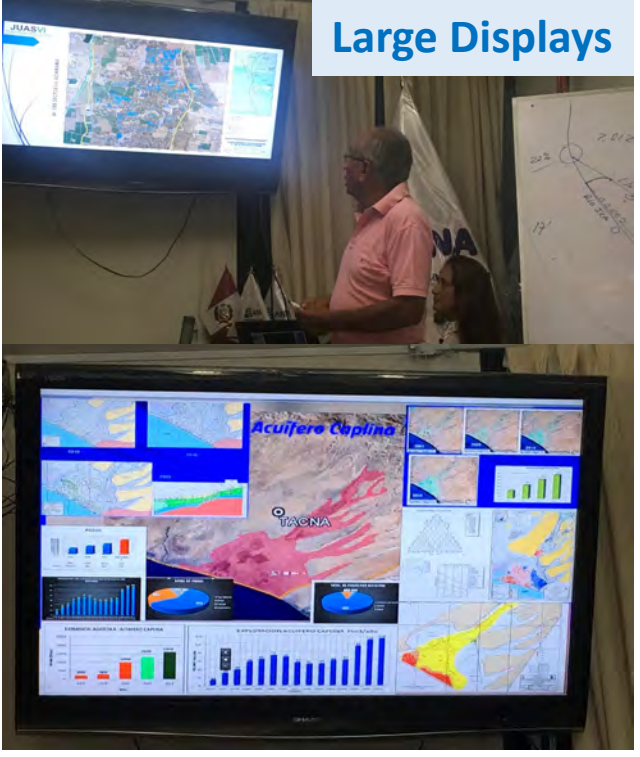
Training Data for Machine Learning Classification



Land Cover Classification using Training Data

Machine-Learning Image Classification – Earth Observation
CNN, ANN, Deep Learning…

Large Displays



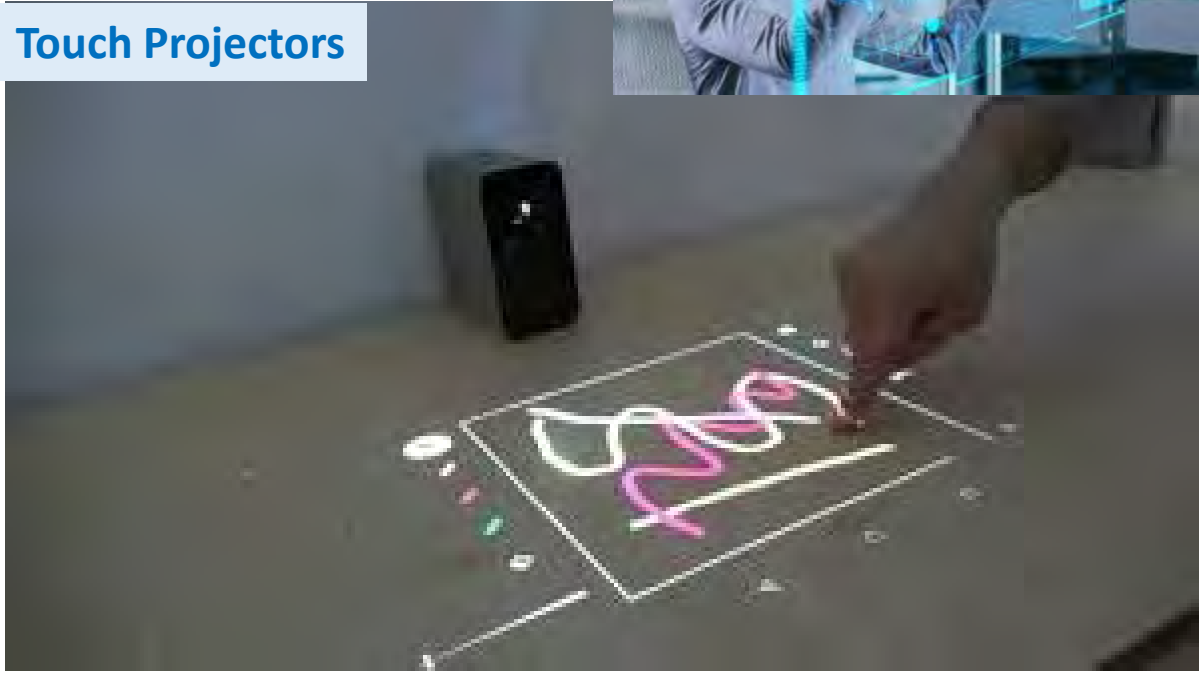
TouchScreens

Physical Models

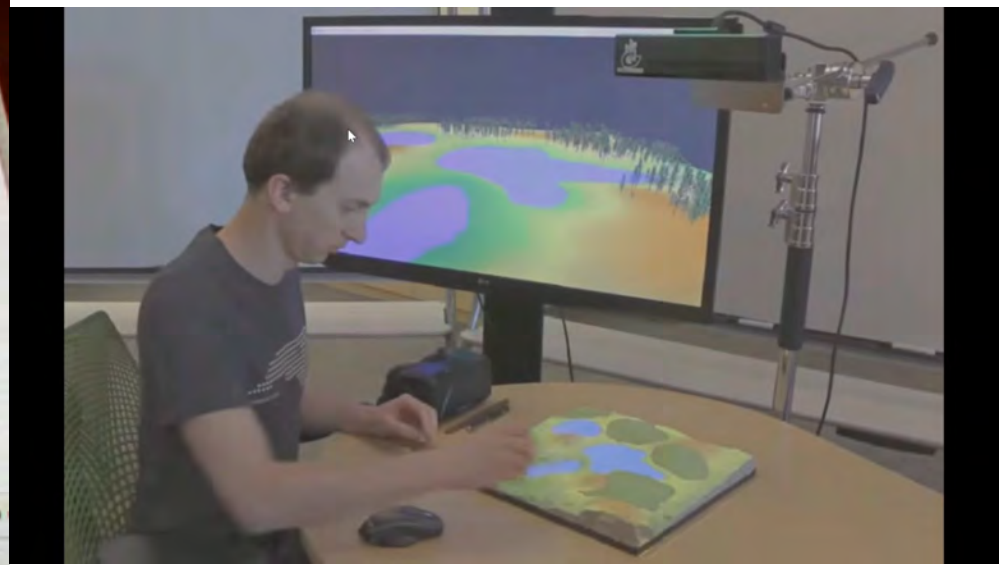
VR

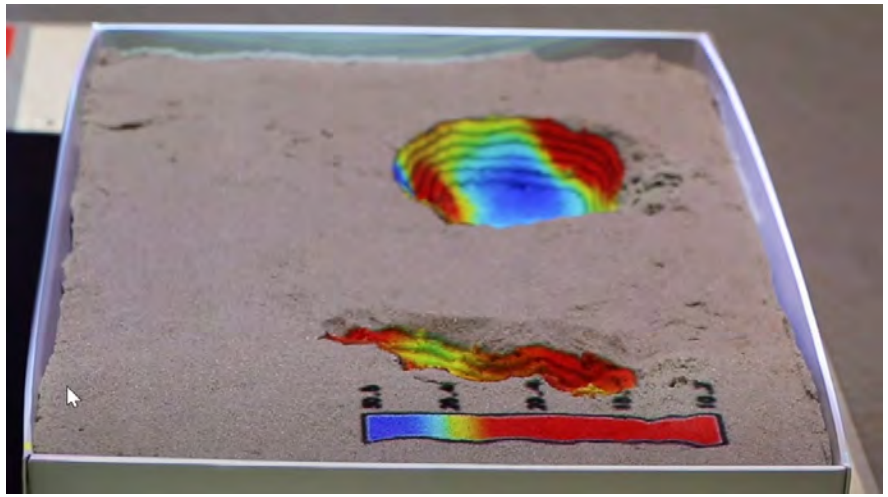
Touch Tables

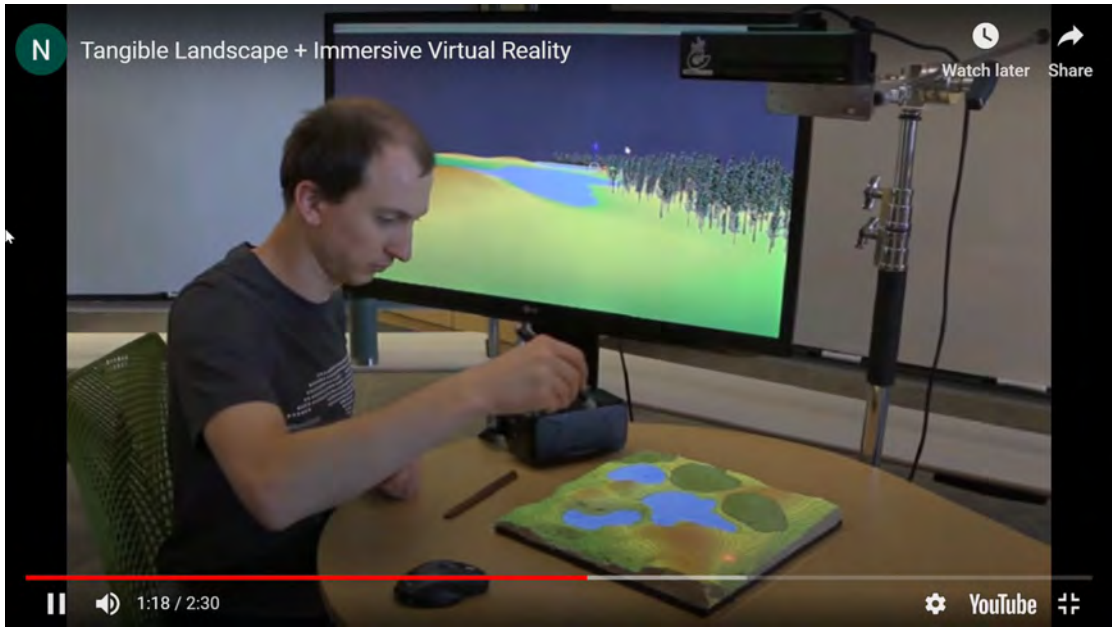
Touch Projectors



New ways of Interactive Analytics





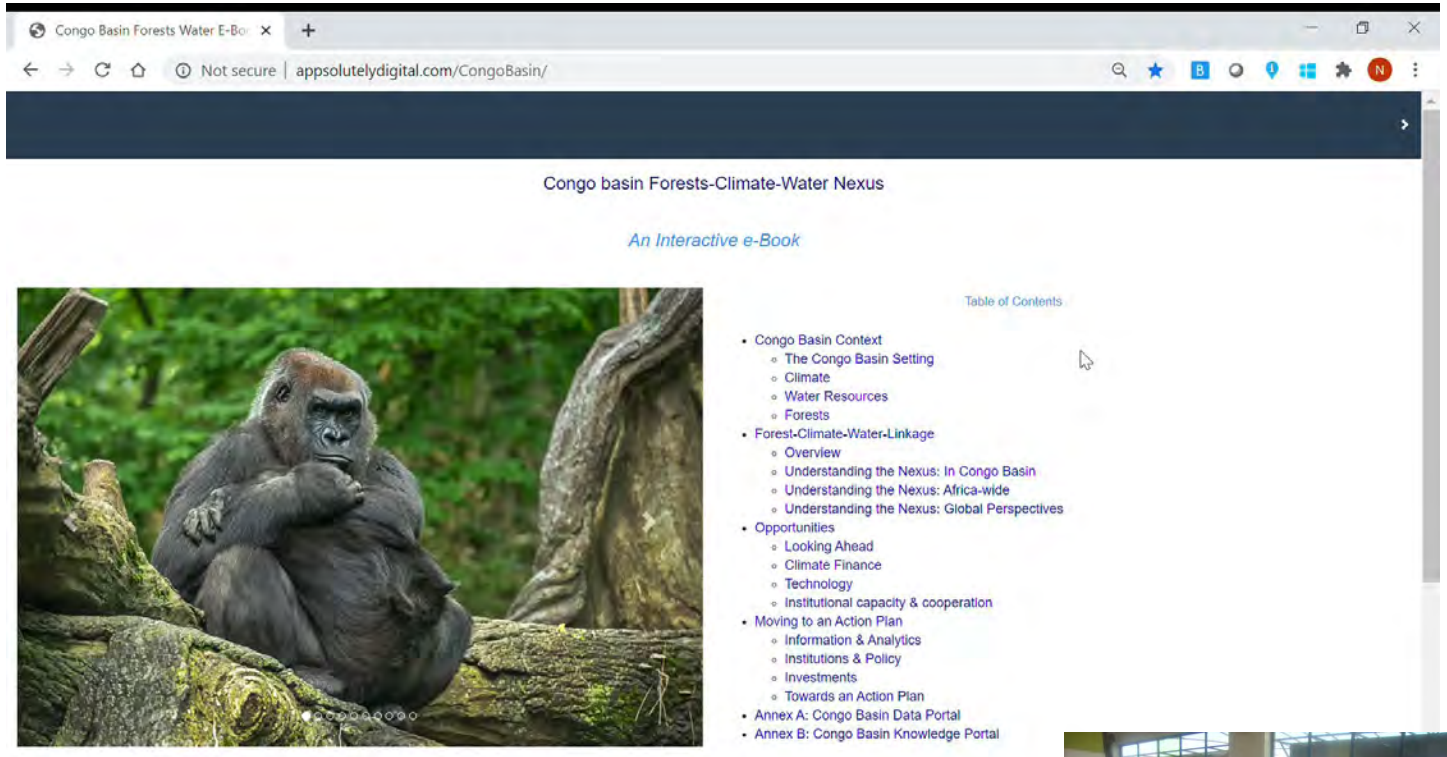


Tangible Landscape
https://tangible-landscape.github.io/

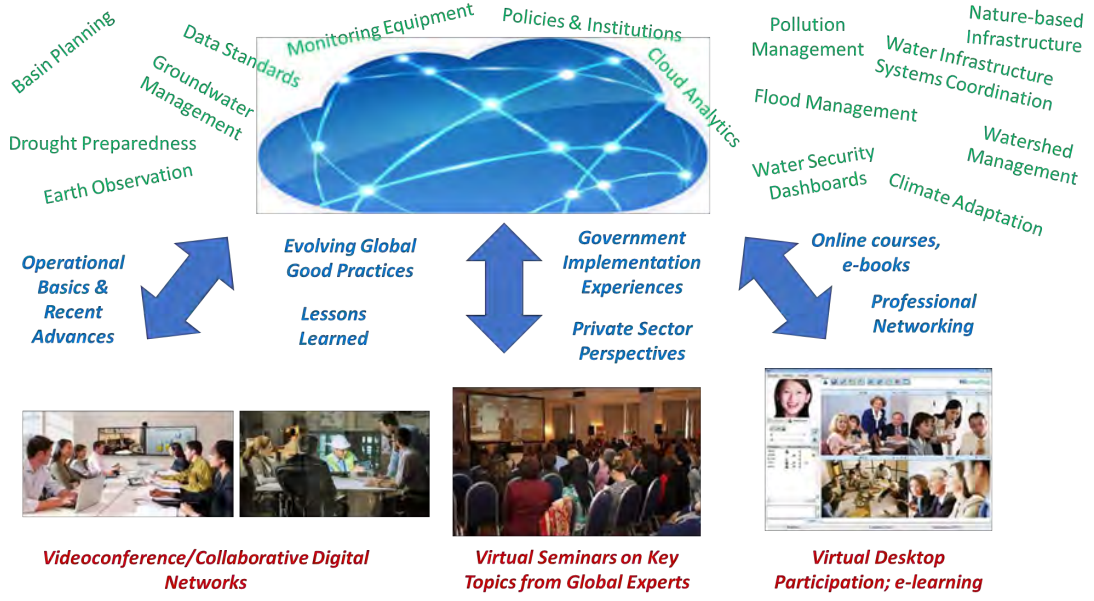

GEOLAB


Area
Depth

E-Packaging of Knowledge
(e.g. Interactive E-books/ Storymaps)



Outreach
(e.g. virtual/online learning, hackathons, Expos)



In Summary

- A **new world of HydroInformatics** is emerging with the help of **Modern "Disruptive" Technologies**

- Great potential to **leverage (and contribute to) global, regional, and national data and analytics for local benefit**

- An **enabling environment** can help development of **applications at scale**
  - **Improving awareness of** new technologies and their **benefits/risks**
  - Develop an **ecosystem of "analysis ready" open data services**
  - Enhanced **collaboration** across sectors and countries
  - **Enabling capacity/mindsets** to step out of comfort-zone and use rapidly-evolving tools

Disrupt or Be Disrupted!

Thanks!

http://spatialagent.org/Mashreq/

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