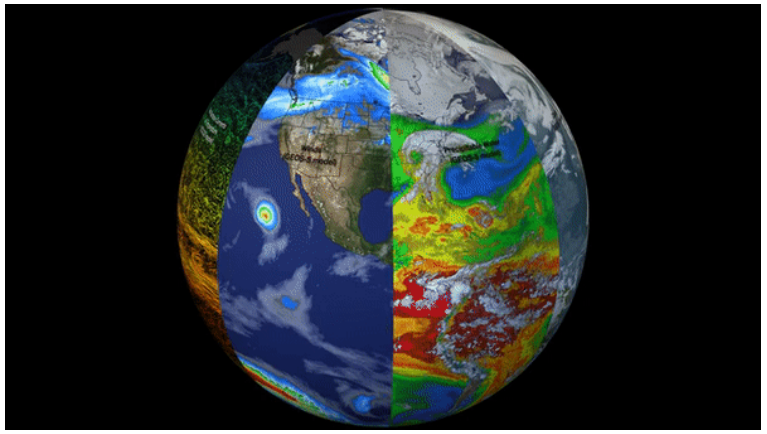
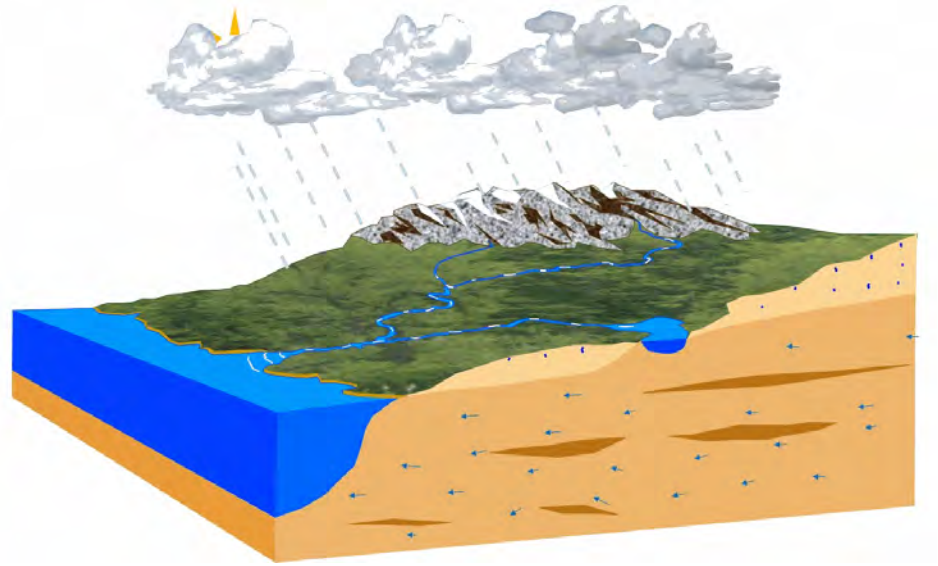




“Disrupting” Groundwater Management

Nagaraja Rao Harshadeep (Harsh)

Global Lead (Disruptive Technology)

Environment, Natural Resources & Blue Economy Global Practice

Disruptive Technology

WORLD BANK GROUP

Disruptive KIDS (Knowledge, Information & Data Services) Helpdesk

Mashreq Water Knowledge Series

Disruptive Technologies for Improved Groundwater Management in the Mashreq Region

15-17 June 2021

Groundwater Management Challenges

Information

Understanding and monitoring groundwater systems (e.g. aquifers, extraction, recharge, quality)

Analytic insights into specific groundwater links to water cycle and inform longer-term planning and shorter-term operational decision support

Institutions

Institutional arrangements to work across spatial and sectoral scales

Capacity, policies, and instruments to effectively manage groundwater effectively and sustainably

Investments

Planning and operation of extraction and recharge investments in a systems context

Development and climate scenario-based investment planning considering technical, environmental, social, economic, financial, institutional, and other sustainability aspects

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

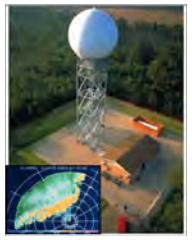
- Virtual social networks/ Digital Platforms…
- Sharing economy…
- Crowdsourcing, gamification, competitions (e.g. *hackathons*, *appathons…*)
- Mobile money, fintech, cryptocurrency…
- Maker movement/DIY/Tech Incubators…
- Virtual learning/re-skilling…

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

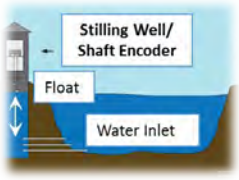
“Bottom-up” Monitoring Systems


Automatic Rain Gauges



Doppler Radar


Snow Pack



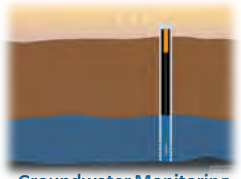

Shore-mounted Radar

Bridge-mounted Radar


Non-Contact Measurement of Stage & Discharge

ADCP

Automatic Cableway System



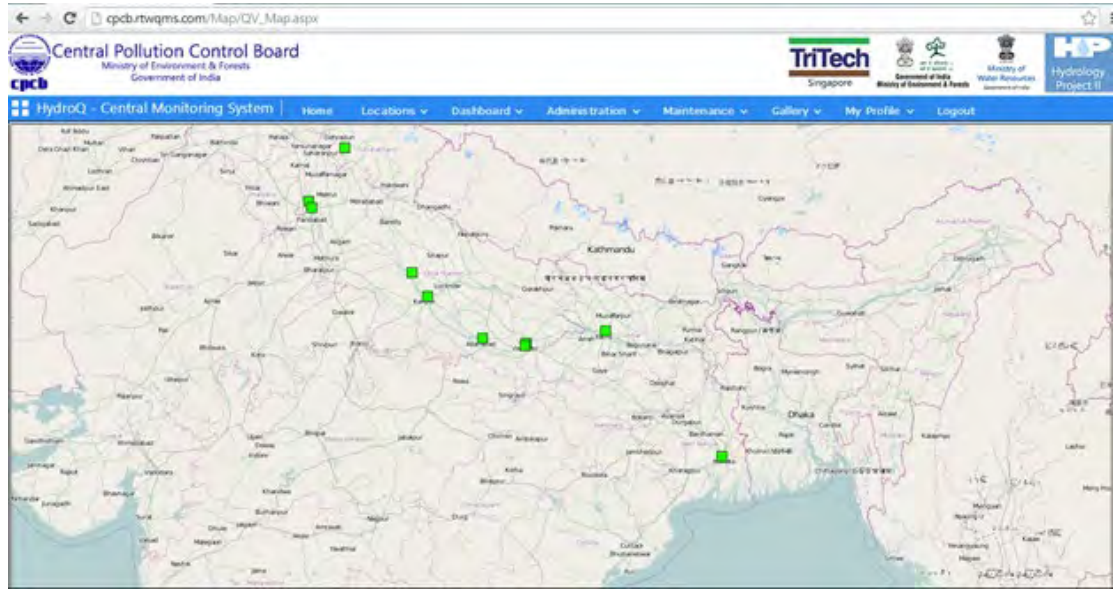
Groundwater Monitoring


Water Quality Monitoring

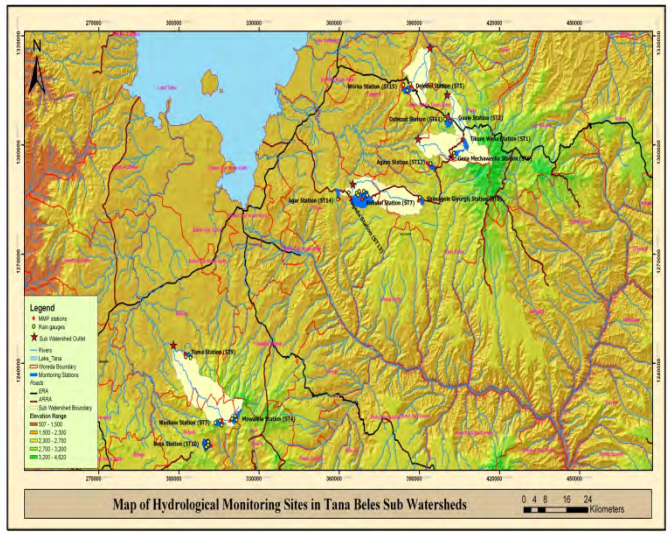
Field Kits

Laboratories


Crowdsourcing Monitoring



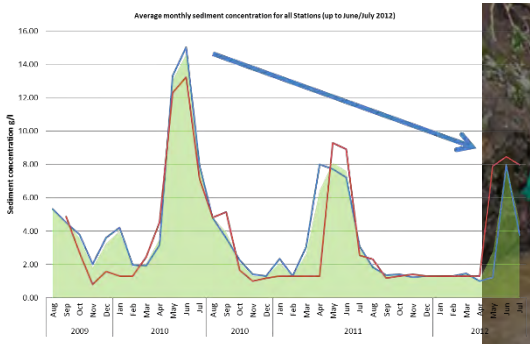
Emerging Citizen Science



	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



Ethiopia: Tana and Beles Integrated Water Resources Management Project
Thanks JB for some of the photos!

VR Systems and Products

Experience Sierra Leone Sugarloa

youvisit.com/tour/wbg/139366

REPORT

Sierra Leone Sugarloaf Mudslide

Freetown Landslide

Freetown Flooding

Freetown Flooding

More than one thousand people are dead or missing after unprecedented mudslides affected Sierra Leone on August 2017. World

Freetown L...

Map Data | Terms of Use

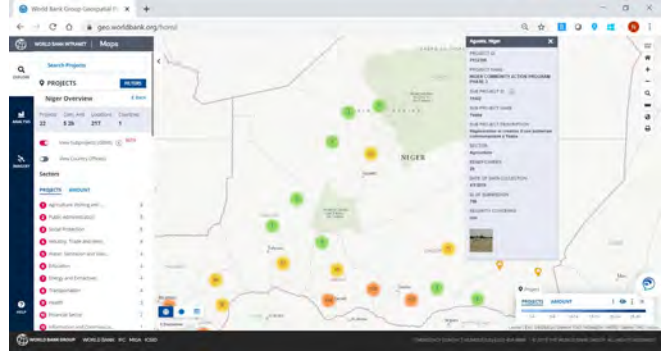
Powered By YOU | VISIT

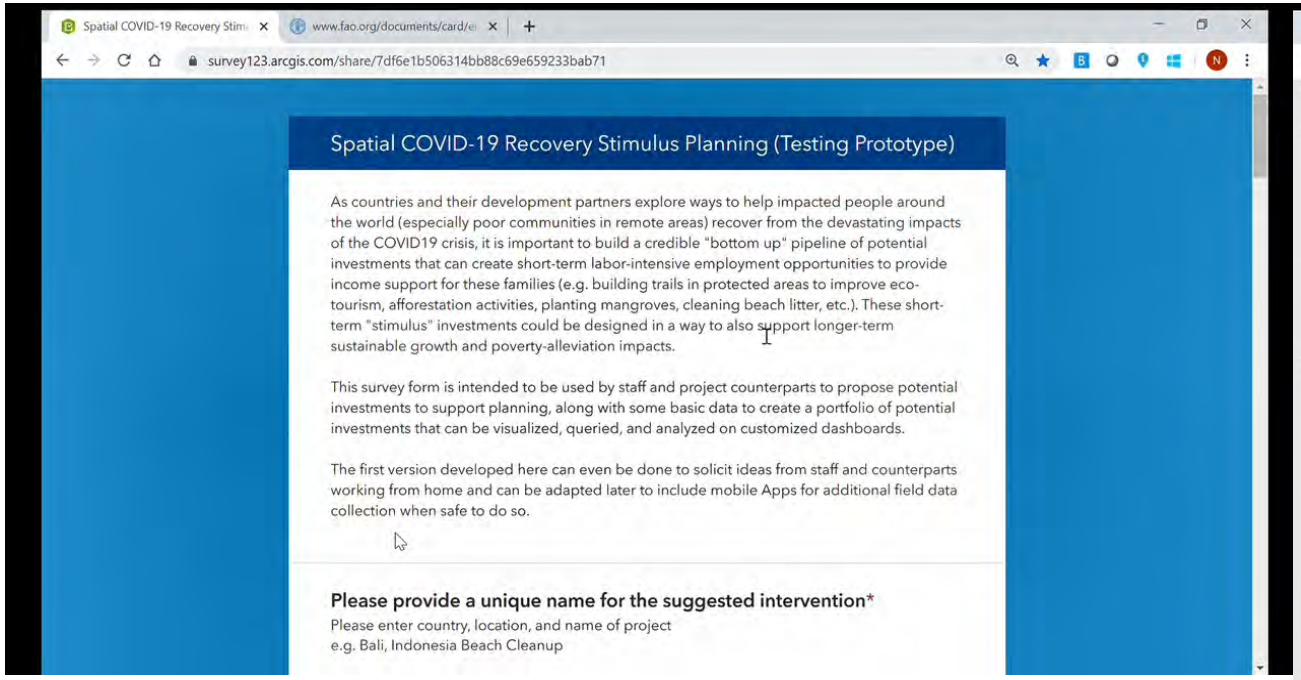
360° Cameras for photos/videos

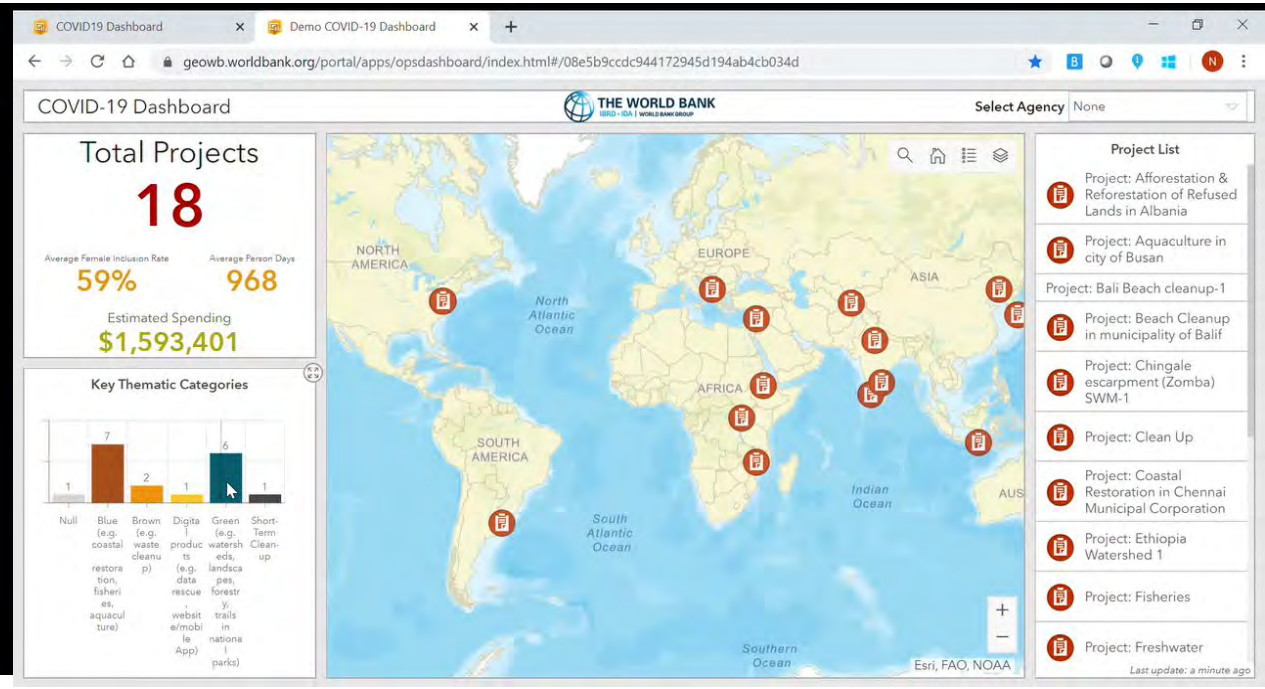
360º Cameras for photos/videos

Field/Virtual Surveys

- Online Spatial Surveys
- Mobile ODK – KoboToolBox, Survey123…
- Interactive Dashboards

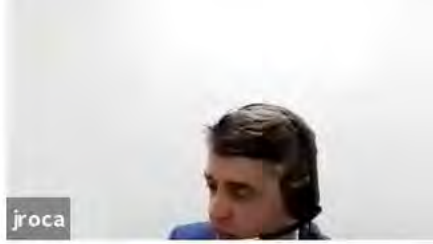






Phone/Tablet LiDAR Scanning

Collect Field Data – 3D iOS Models in the Field



Lidar sensor on new iPhone 12 Pro and iPad Pro.

Field personnel can scan area of interest and create a 3D model in minutes.

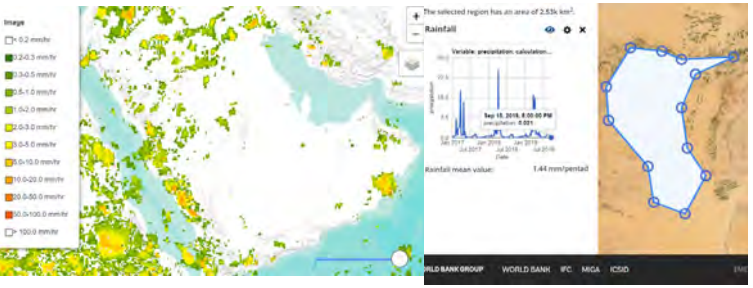
3D model can be shared with office-based personnel directly from iOS device.

[Presentation: Remote Supervision Tools for Dam Safety]

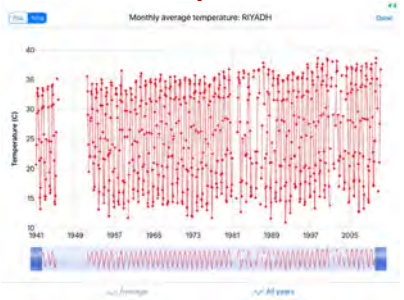
1:09:16 / 1:30:07

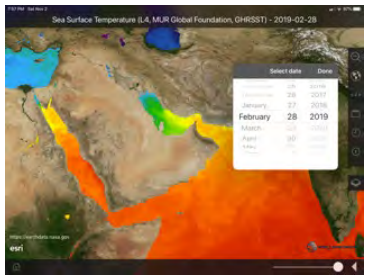
"Top-down" Earth Observation & Other Global Analytics Services

Climate

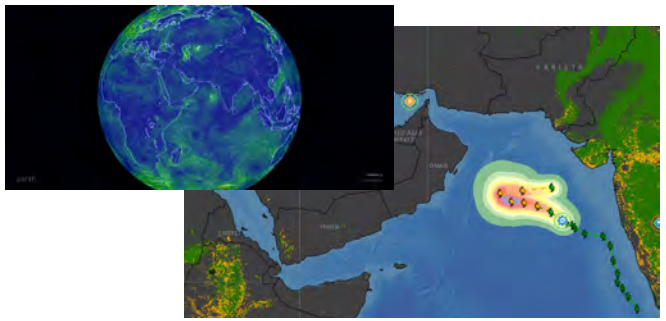


Precipitation & Forecasts



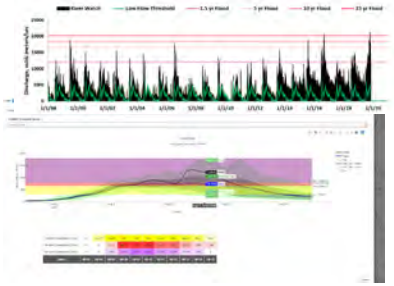


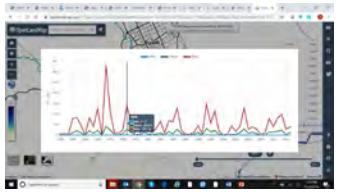
Temperature



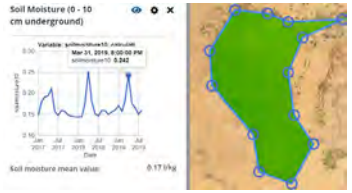
Storms

Hydrology

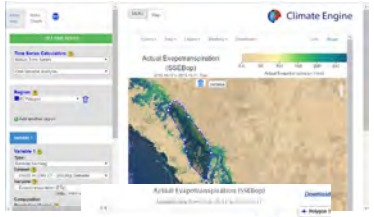


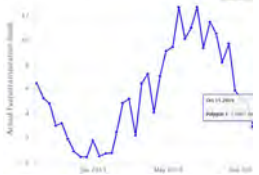


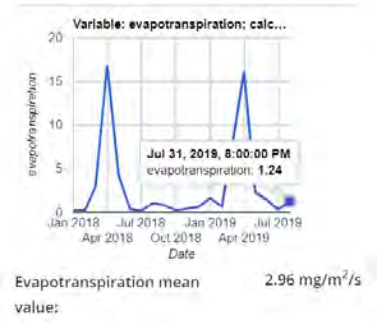
Levels, Flow & Inundation & Forecasts



Soil Moisture

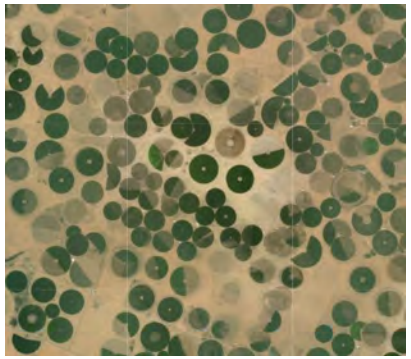




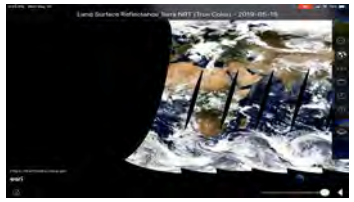


Evapo-transpiration

Other



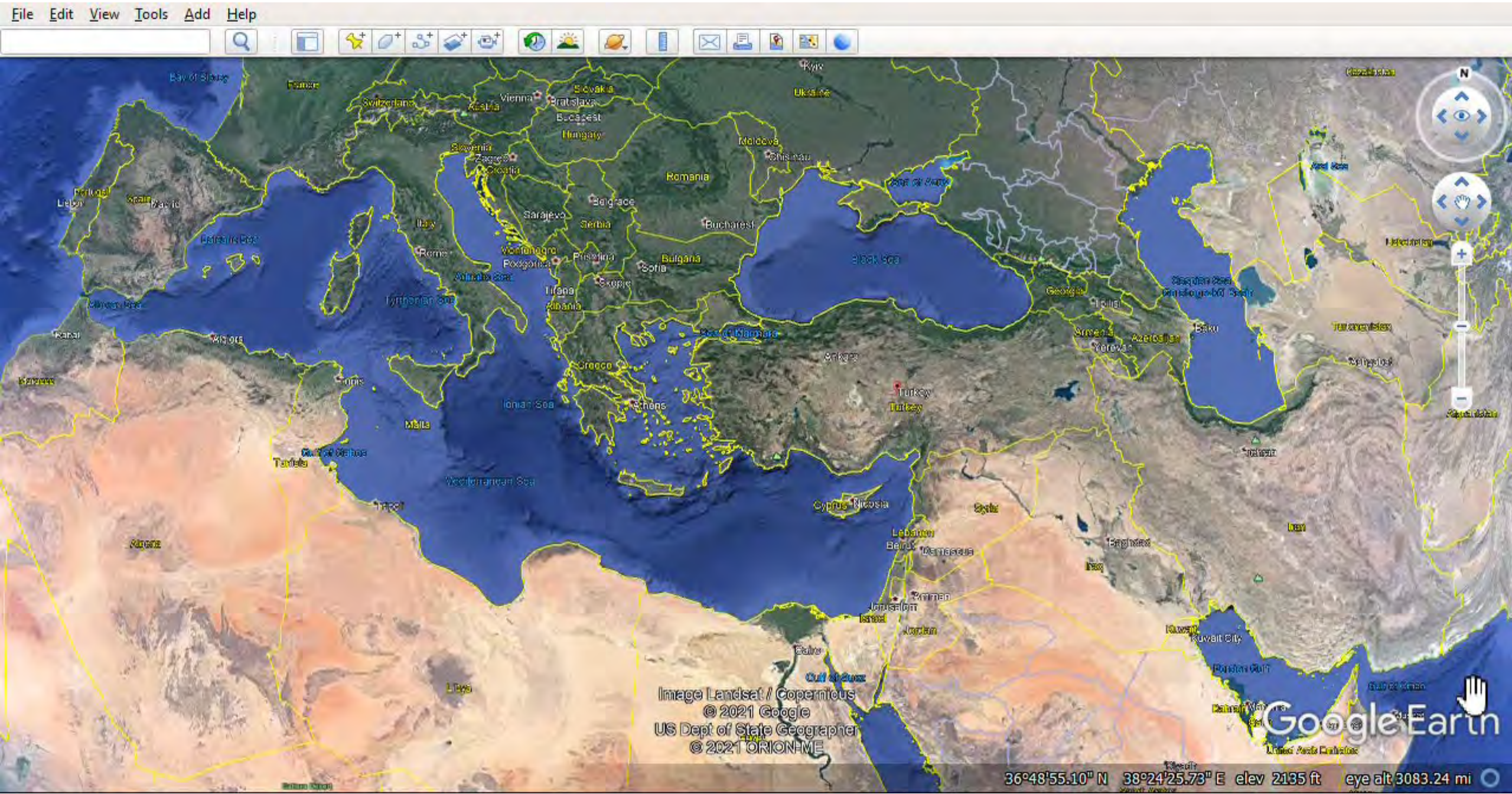
Land Cover



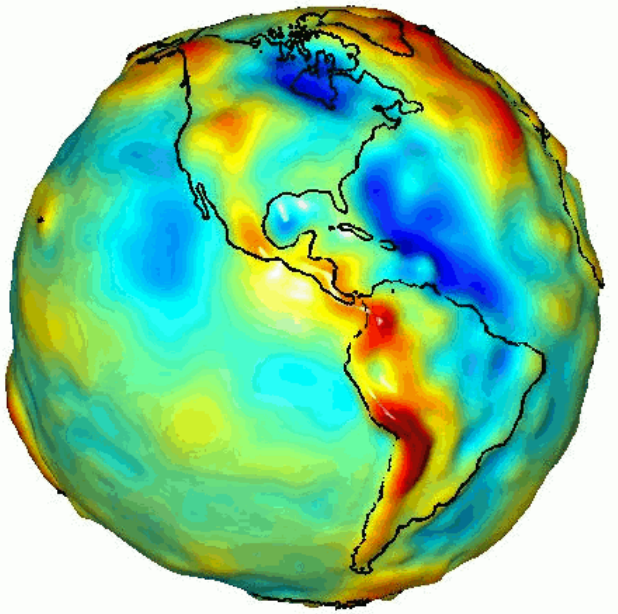
NDVI, EVI, GRACE, etc.

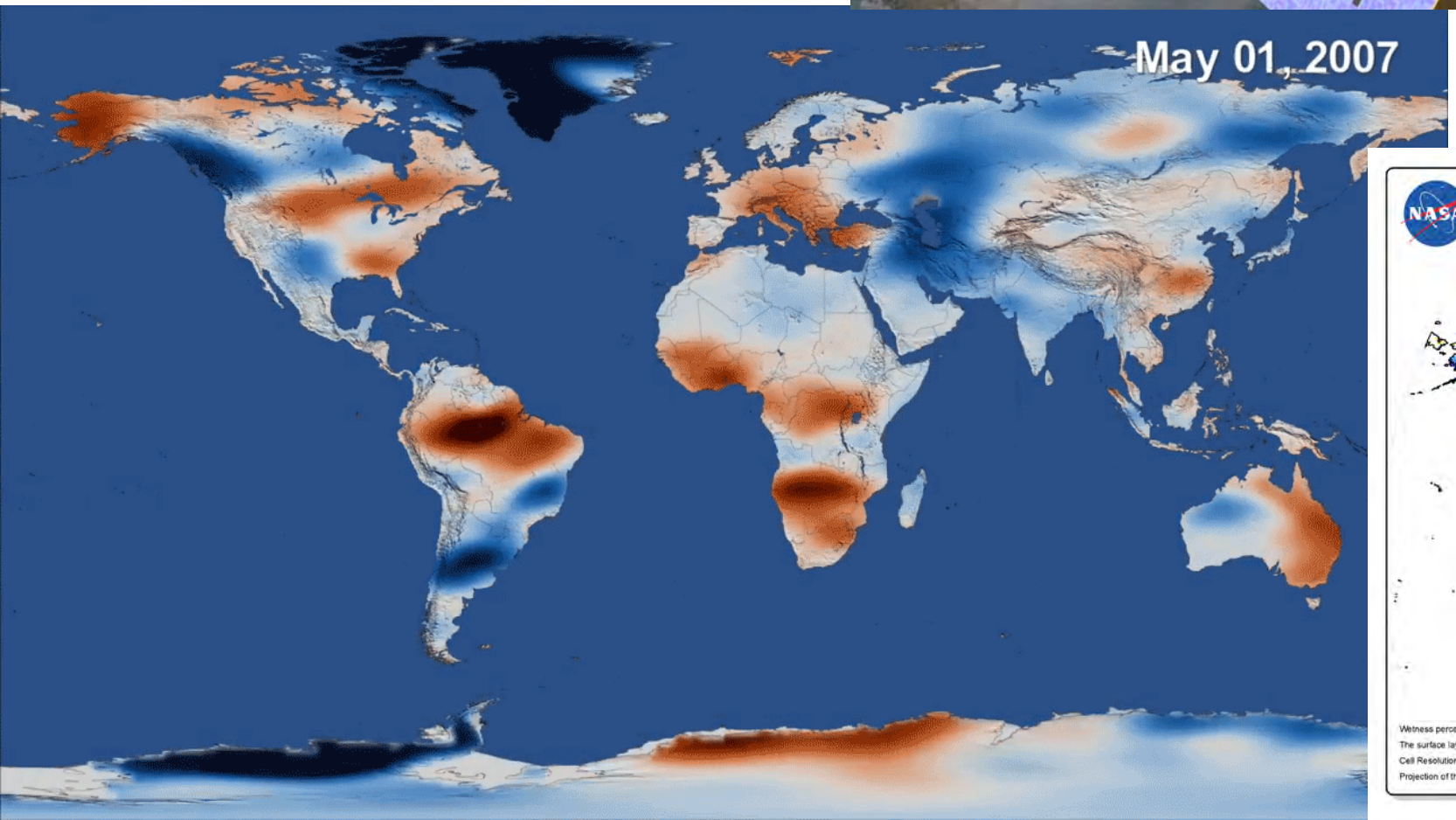
Social, Economic, Environmental, etc.

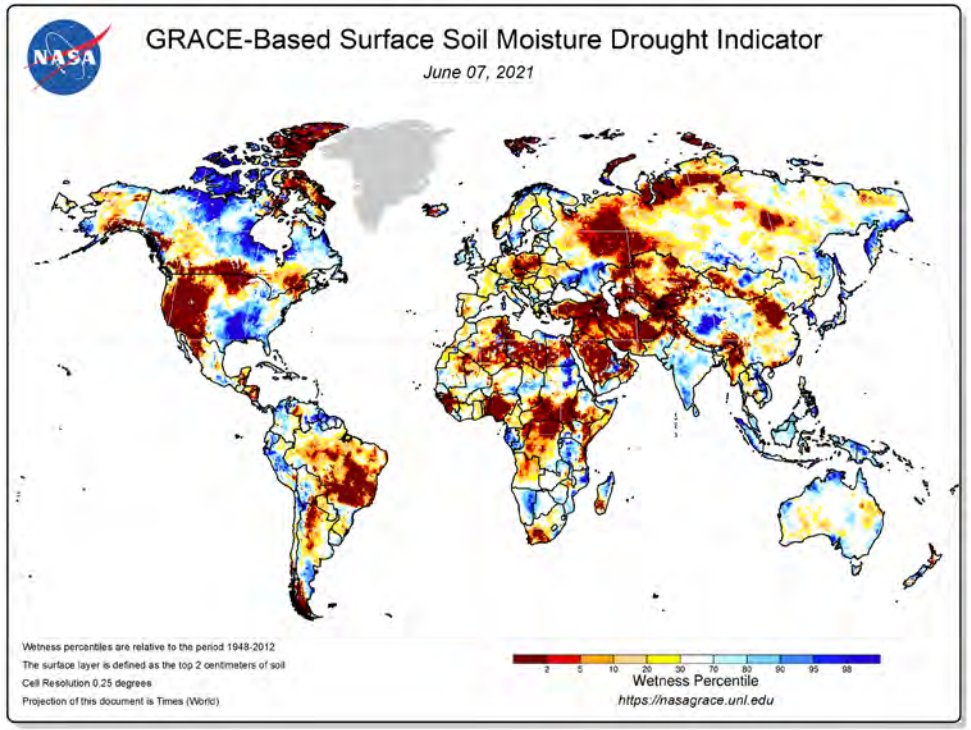
High-Resolution Satellite Imagery



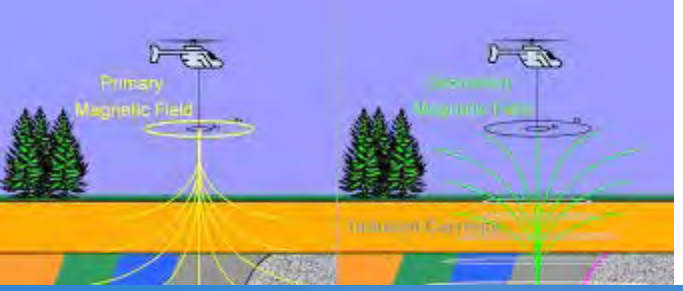
Gravity Recovery and Climate Experiment (GRACE)

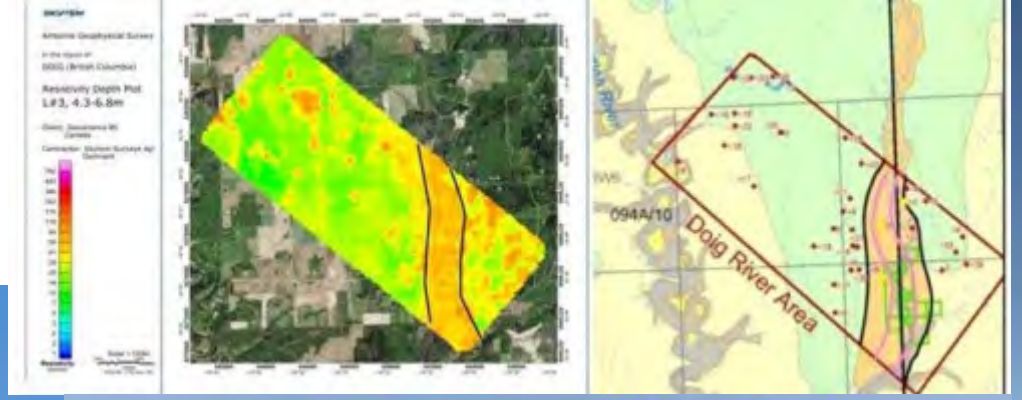


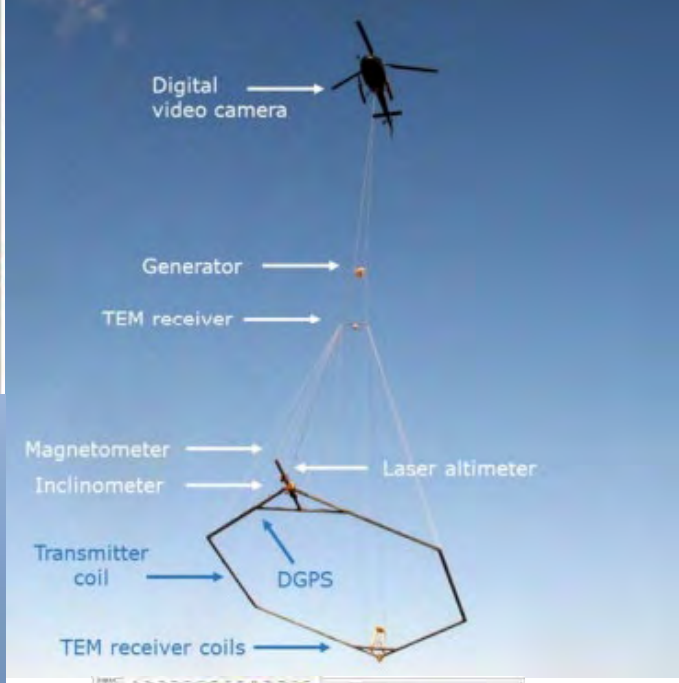


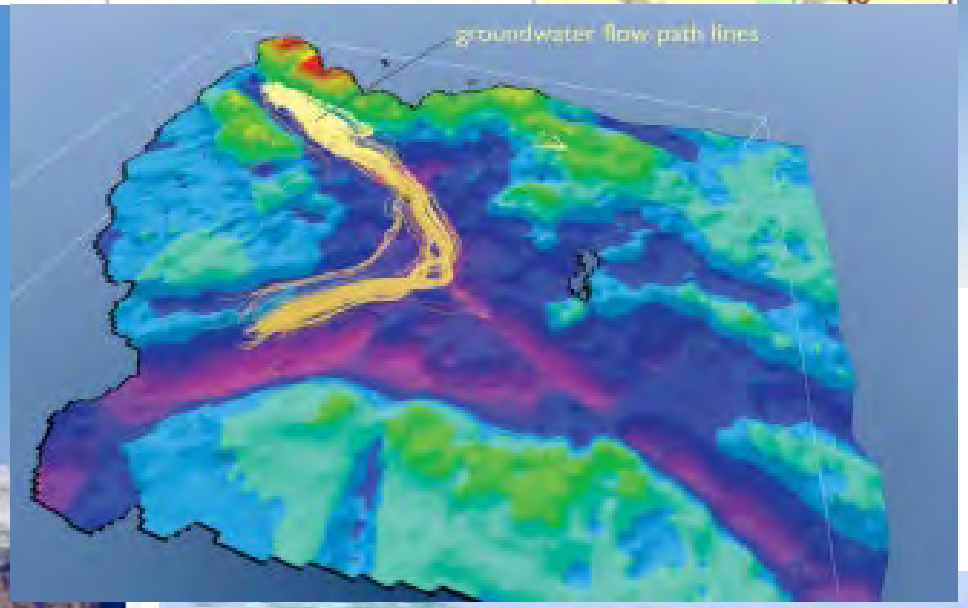


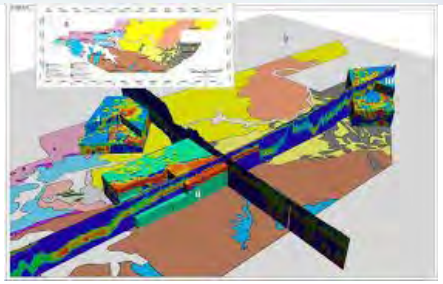
Heliborne Geophysical Surveys of Aquifers

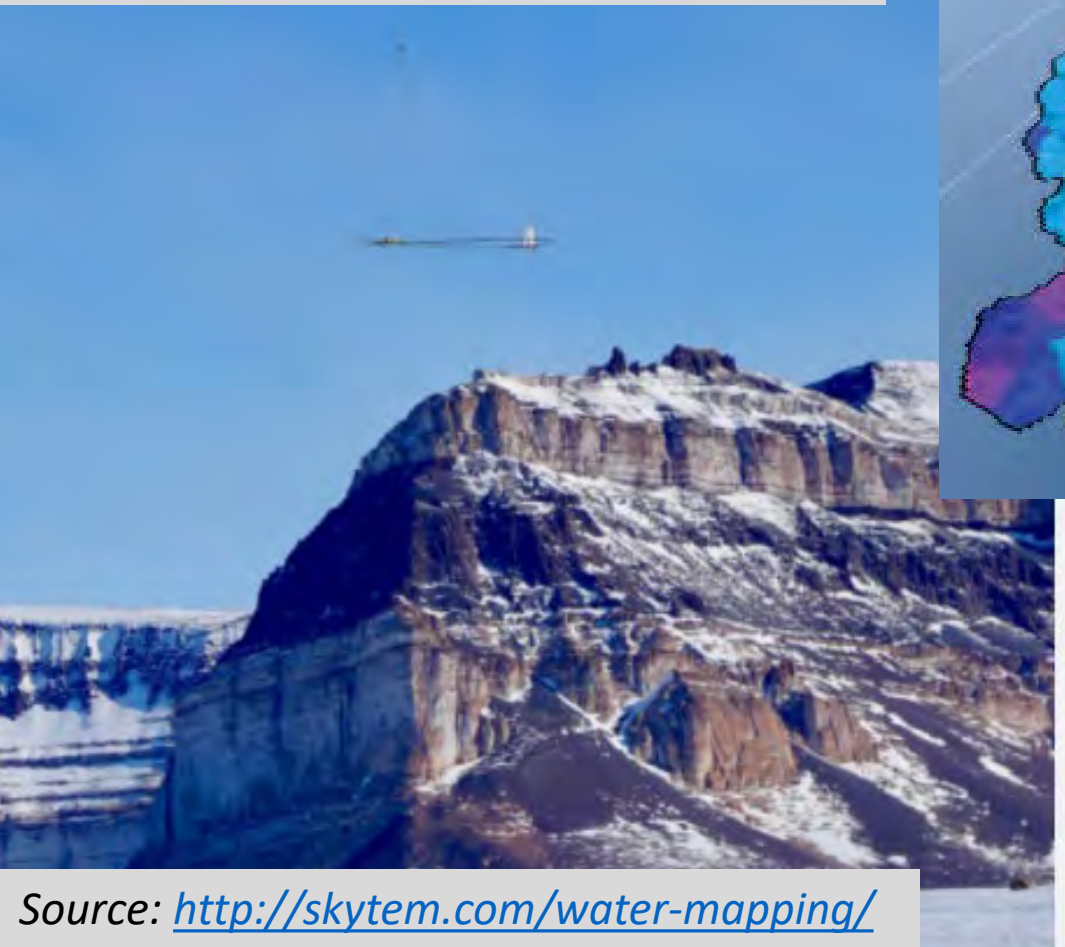


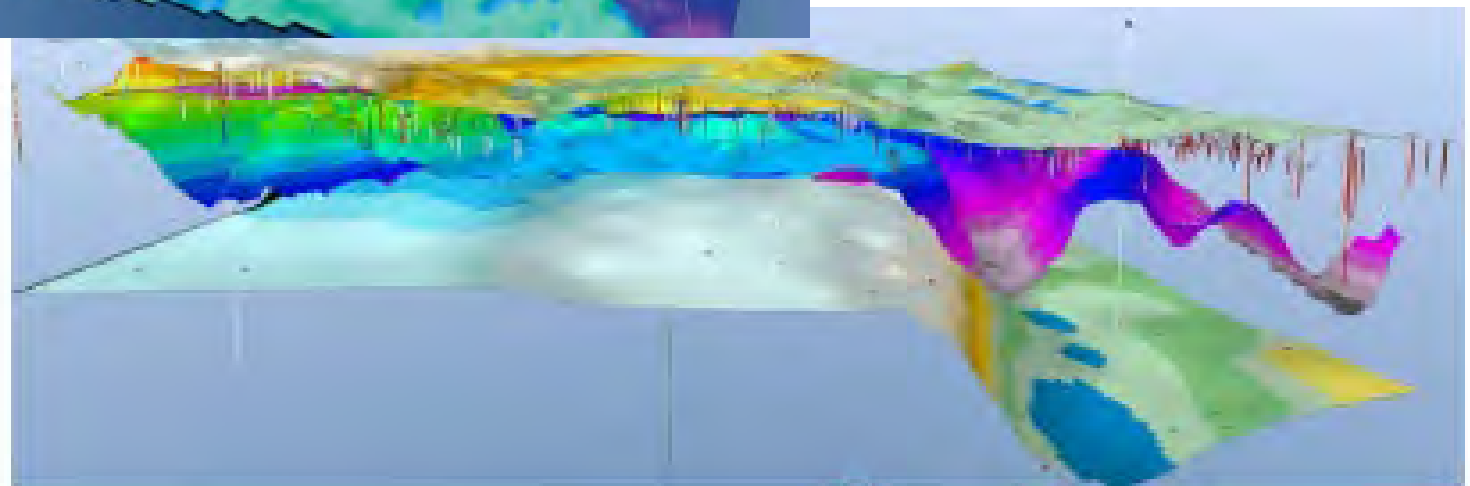






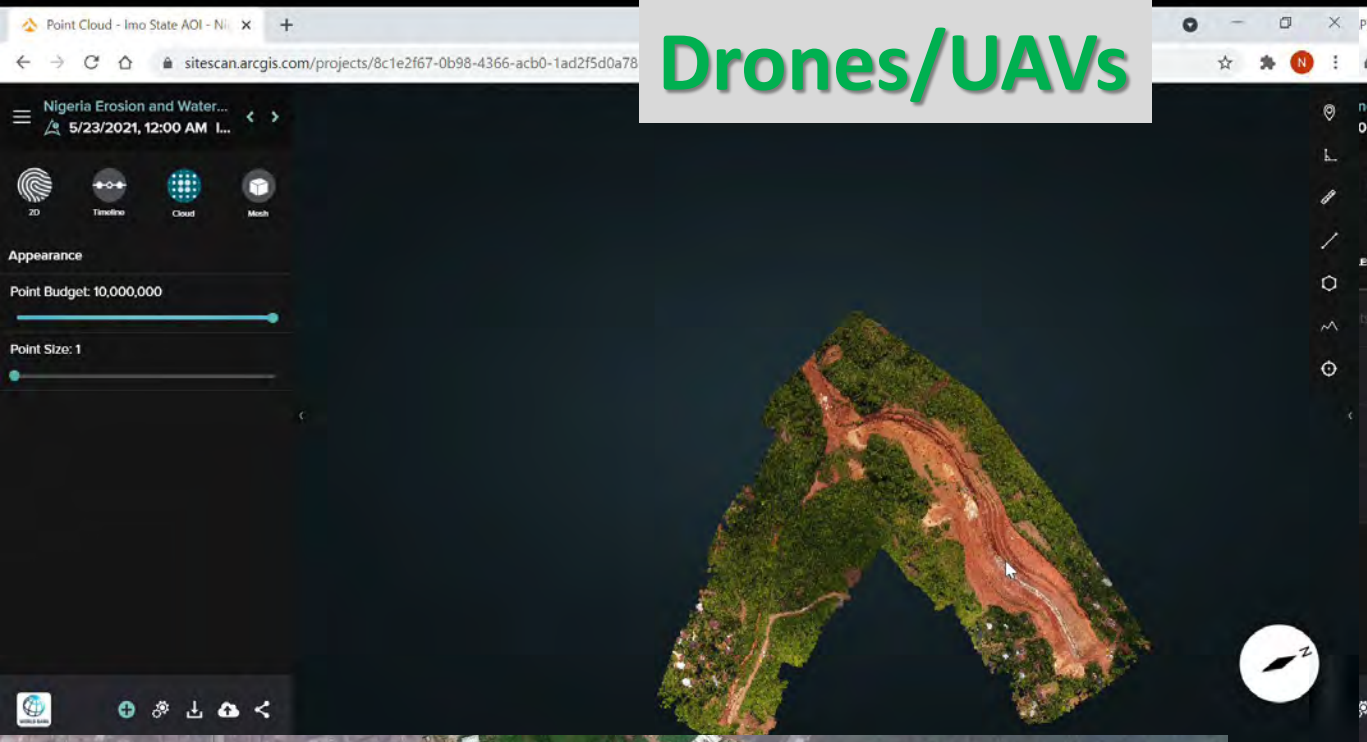






Source: http://skytem.com/water-mapping/

Drones/UAVs


Point Cloud - Imo State AOI - Ni
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Nigeria Erosion and Water...
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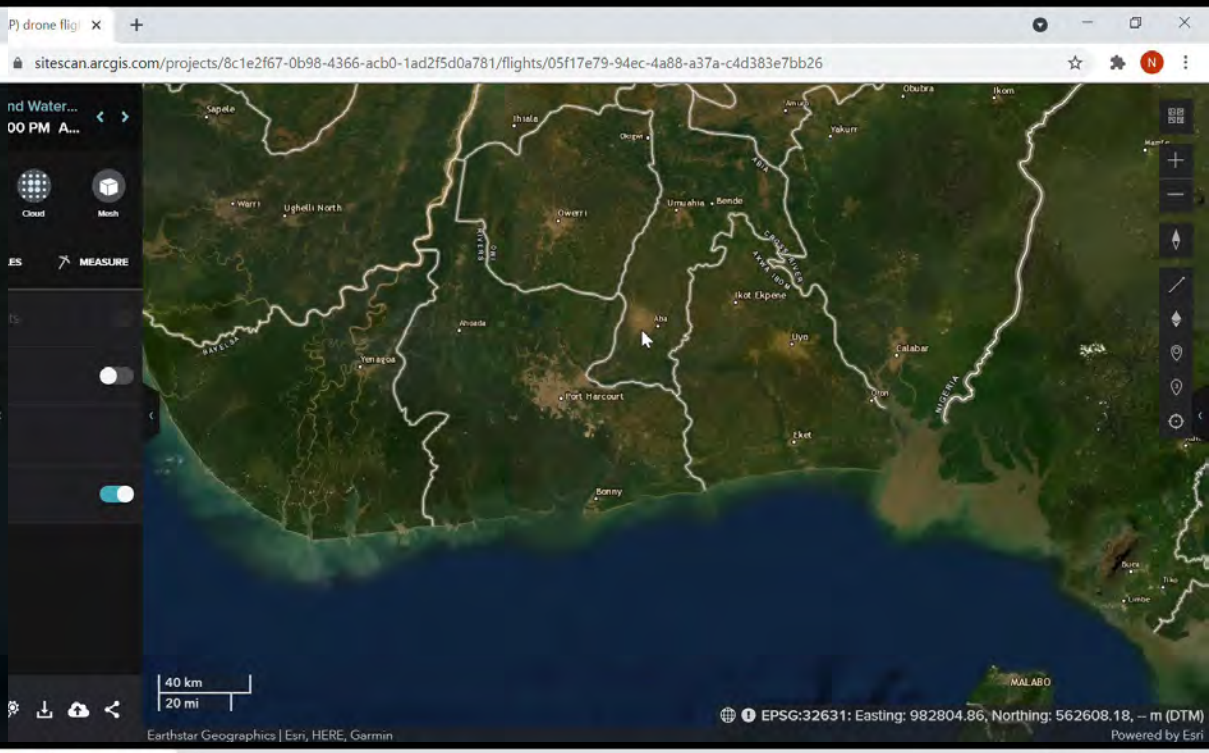
P) drone flig
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Ughelli North
Warri
Owerri
Umuahia
Bende
Ikot Ekpene
Aba
Ahoada
Yenagoa
Port Harcourt
Uyo
Calabar
Eket
Bonny
NIGERIA
MALABO
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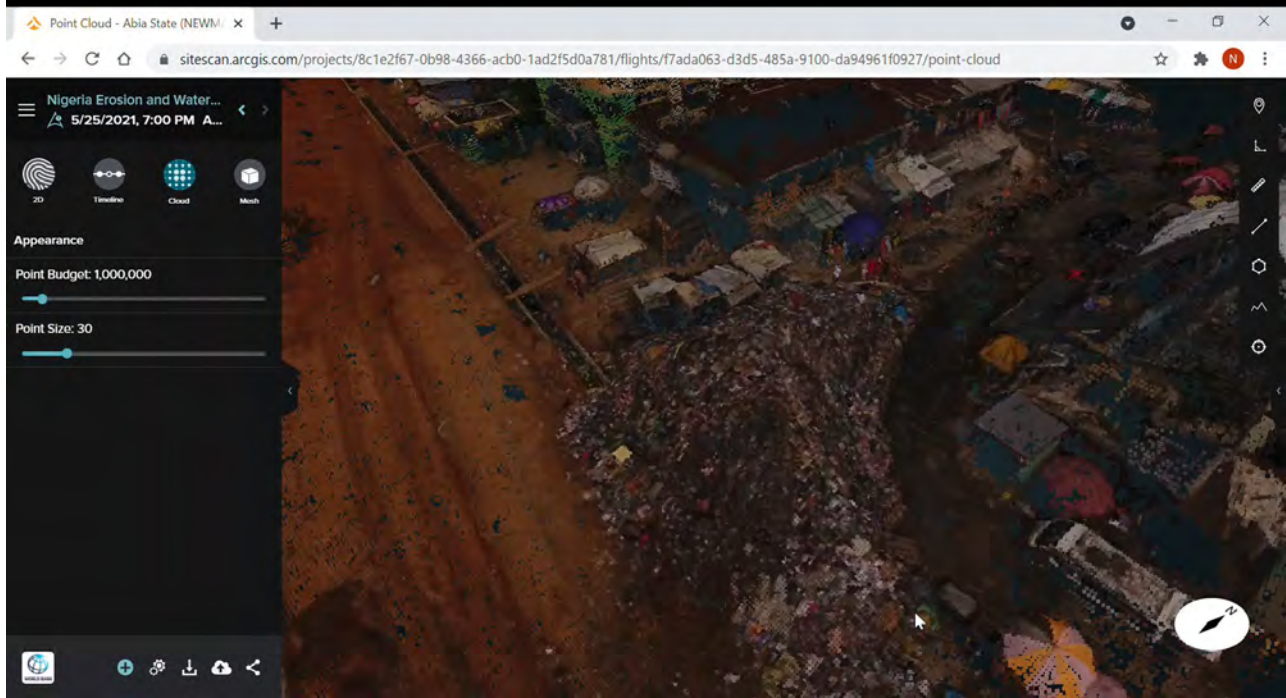
Earthstar Geographics | Esri, HERE, Garmin
Powered by Esri


Point Cloud - Abia State (NEWM
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Nigeria Erosion and Water...
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Imo State AOI - Nigeria Erosion a
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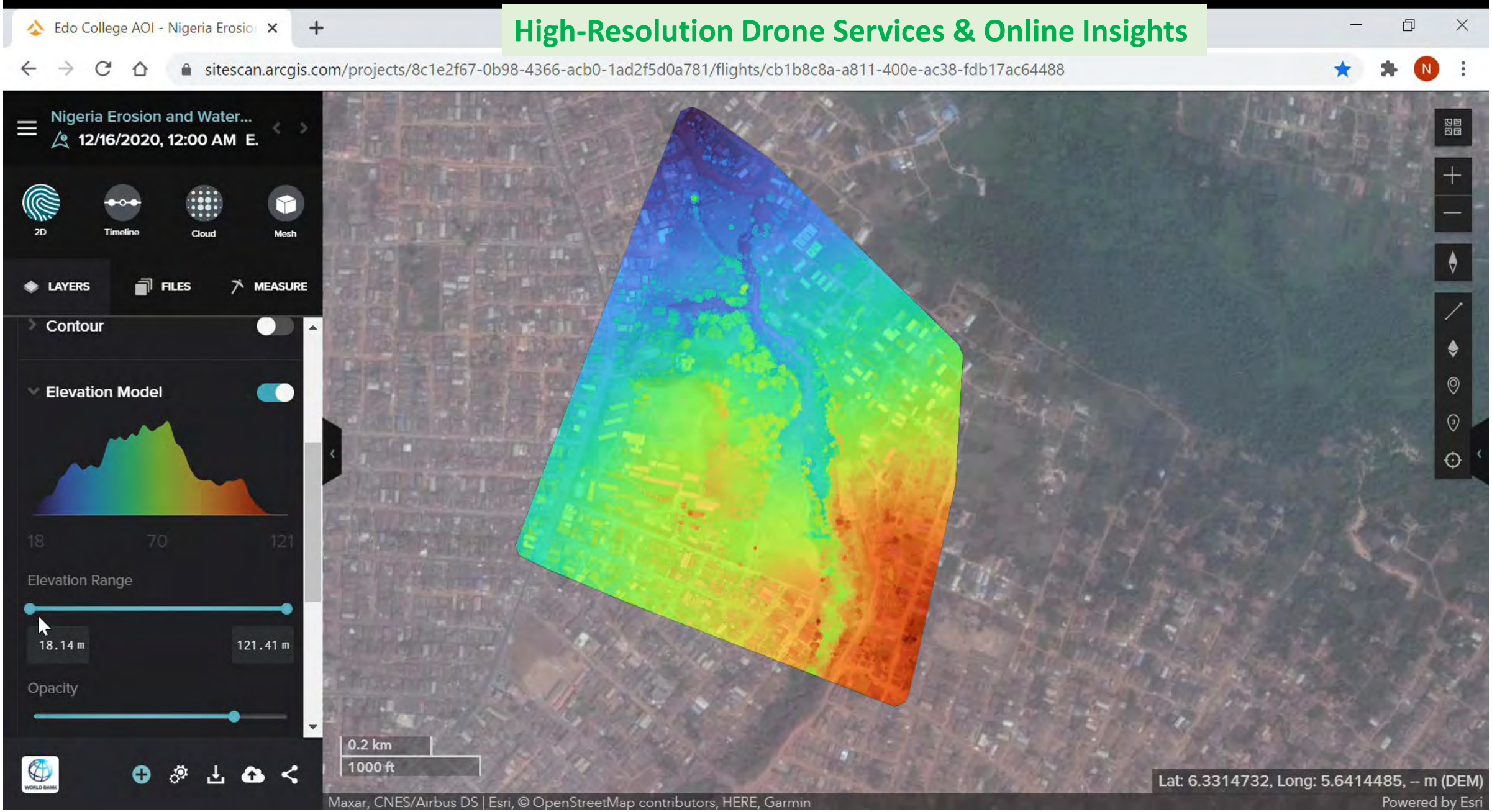
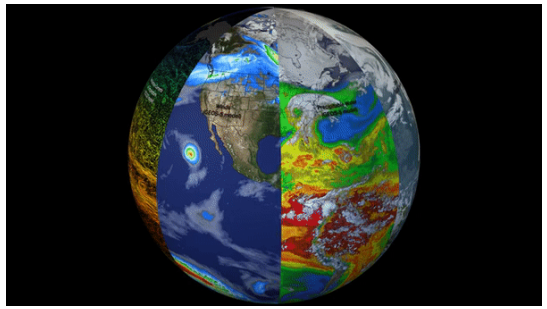
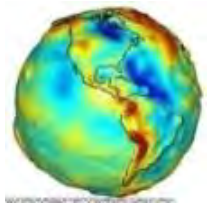
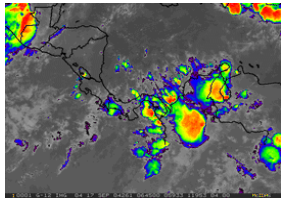
Nigeria Erosion and Water...
5/23/2021, 12:00 AM I...
2D
Timeline
Cloud
Mesh
LAYERS
FILES
MEASURE
Ground Control Points
Photos (1,213)
Elevation Data
Orthomosaic
Ideato North
Orlu
0.2 km
1000 ft
EPSG:32631: Easting: 949425.25, Northing: 650263.68, 83.057 m (DEM)
Maxar | Esri, © OpenStreetMap contributors, HERE, Garmin
Powered by Esri

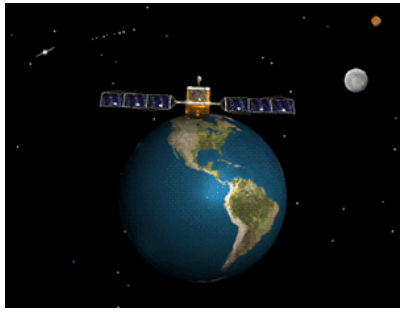
High-Resolution Drone Services & Online Insights



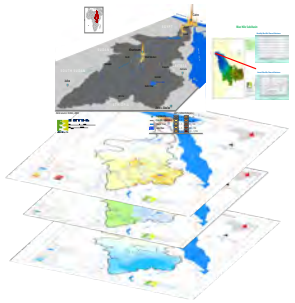


"Top-Down" Data Acquisition System

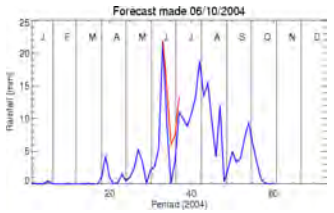



Satellite & Aerial Earth Observation

Data Rescue
GIS and other datasets

Data Management

Analytics/Models

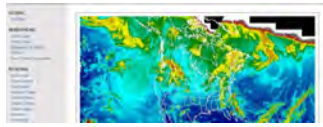
Big Data
Data Science

Machine Learning
& other AI

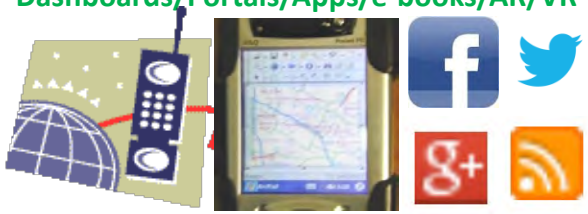
Cloud
Services

Platforms
APIs

ChatBots
Crowdsourcing




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



Stakeholder Alerts

Operational Control Rooms


Manual Monitoring
Crowdsourcing

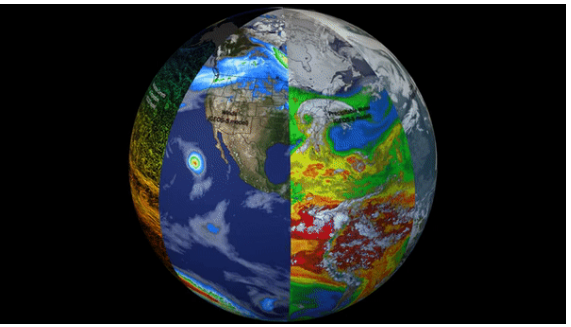


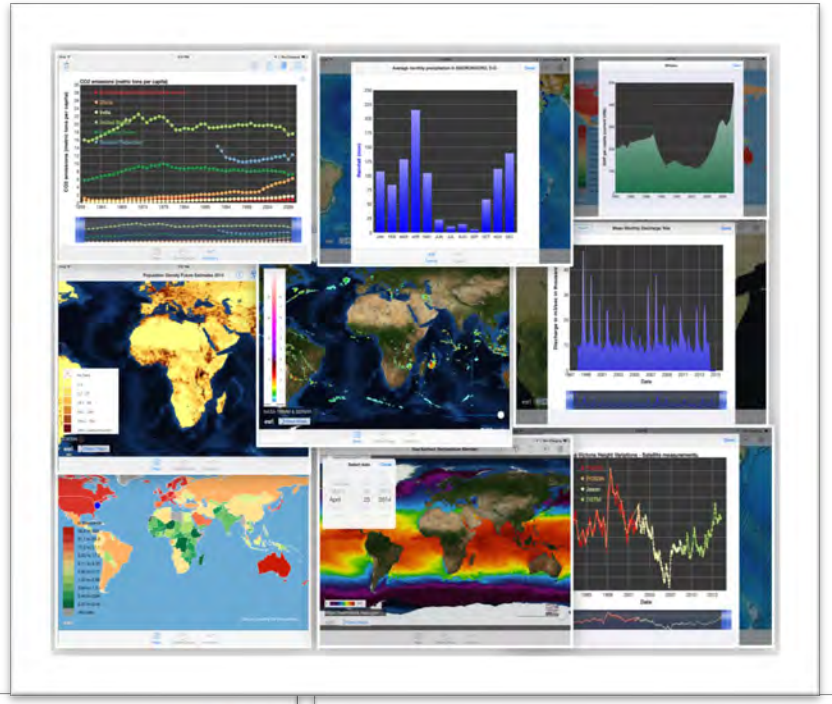


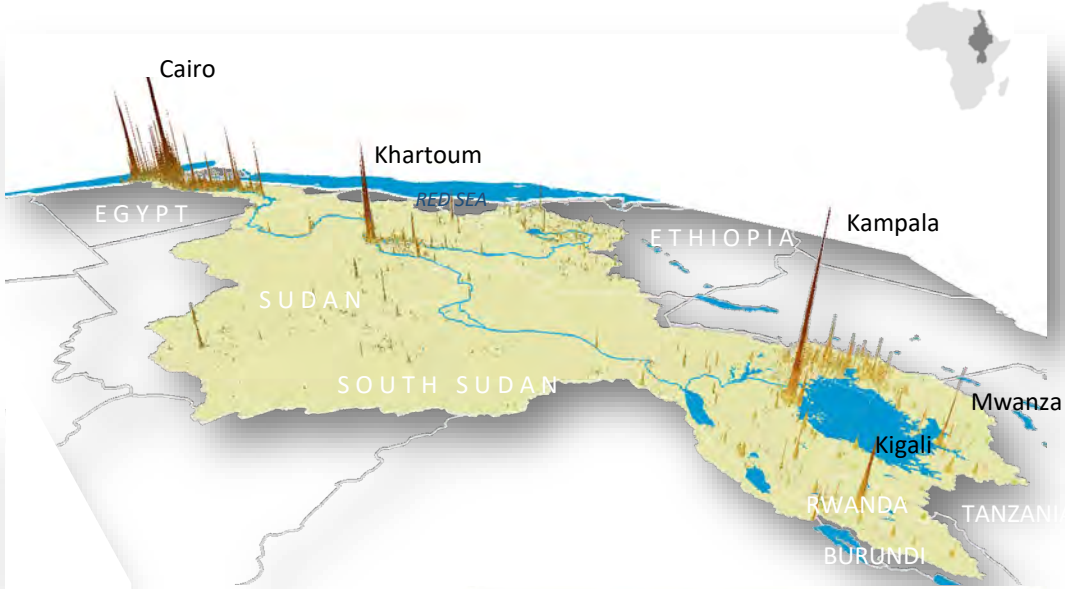


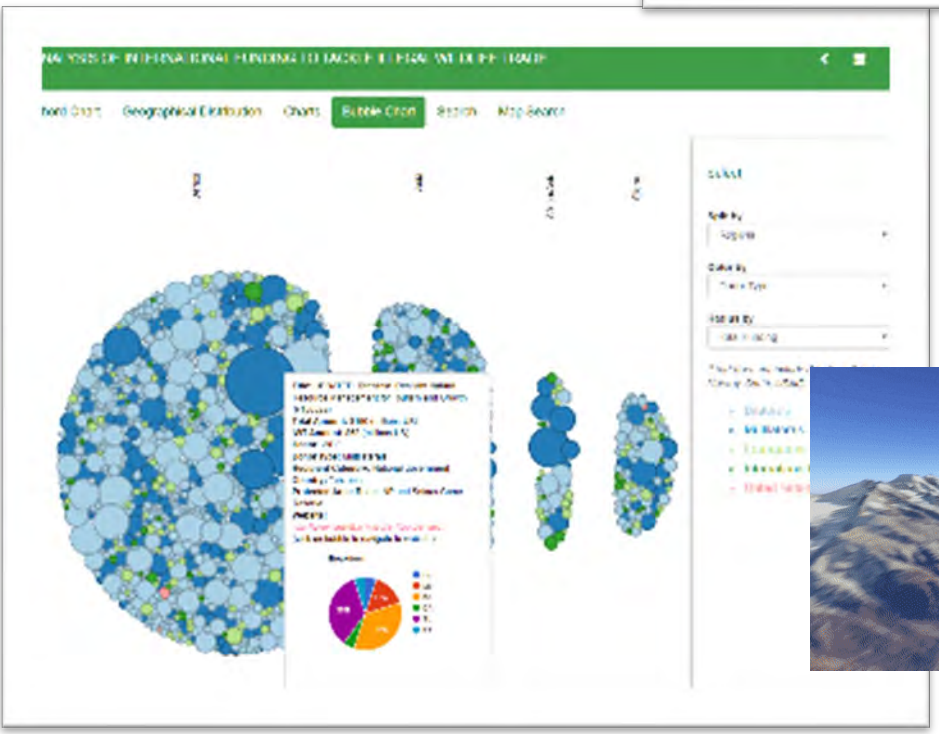
Automated Monitoring

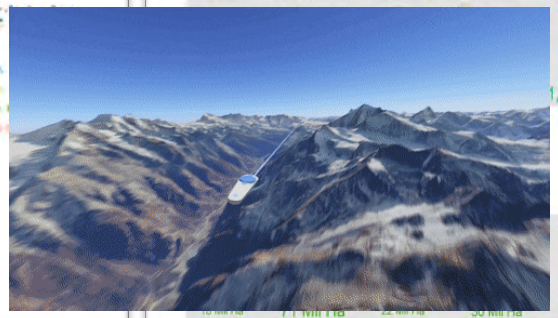
"Bottom-up" Data Acquisition System → IoT



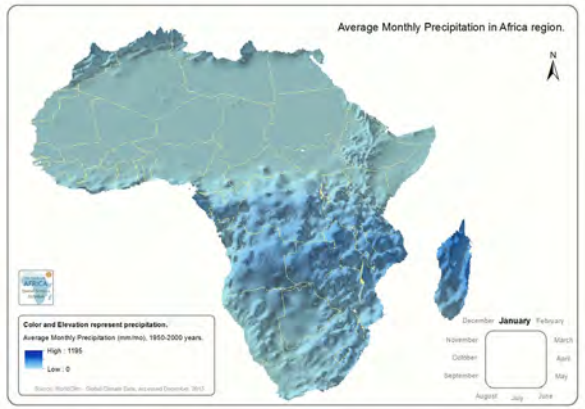


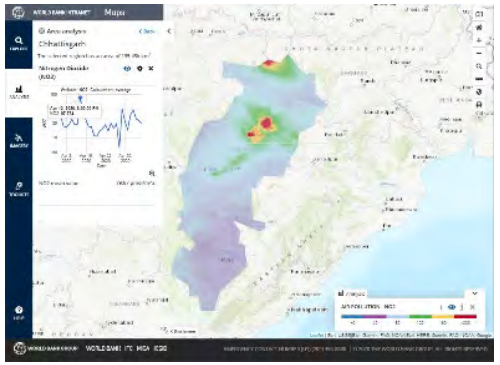

Cairo
Khartoum
RED SEA
EGYPT
ETHIOPIA
Kampala
SUDAN
SOUTH SUDAN
Mwanza
Kigali
RWANDA
BURUNDI



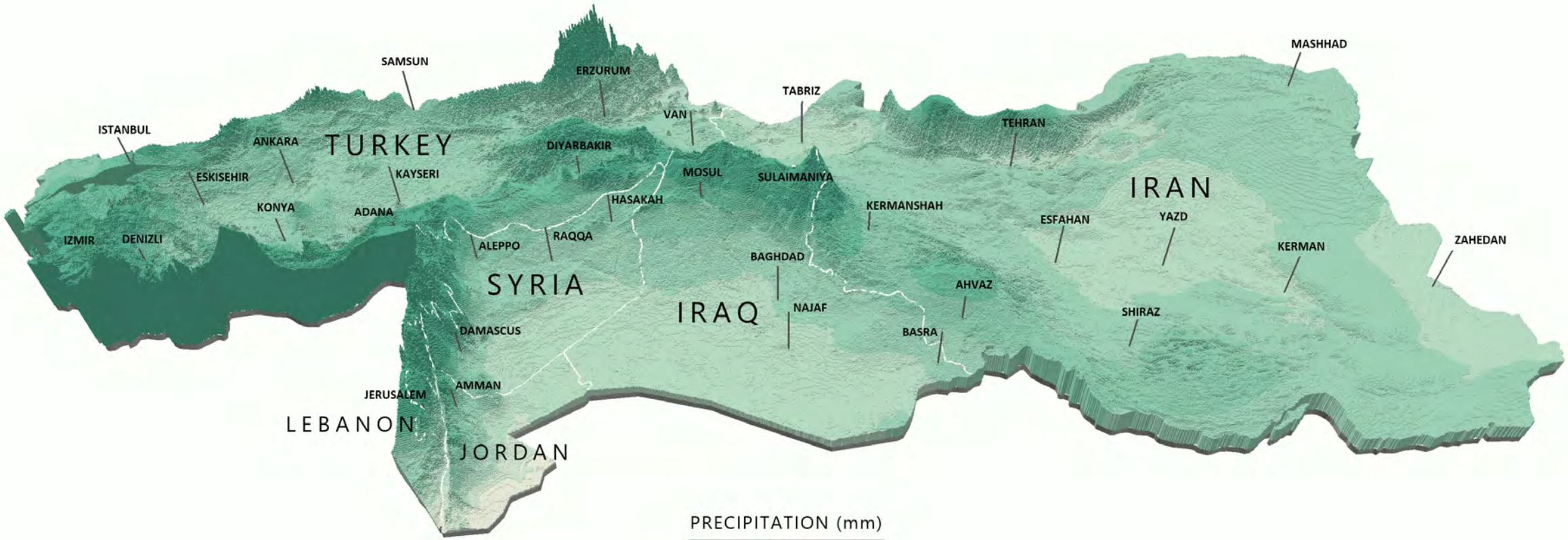


ARAL SEA
GANGES-BRAHMAPUTRA
INDUS
LAKE CHAD
MEKONG
NIGER
NILE
TARIM
TIGRIS-EUPHRATES
Global Transboundary Basins Facts
54 Million
732 Million
201 Million
48 Million
67 Million
115 Million
238 Million
11 Million
60 Million
Total Pop. (2012)
38 Billion
395 Billion
134 Billion
20 Billion
46 Billion
42 Billion
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
18 °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.



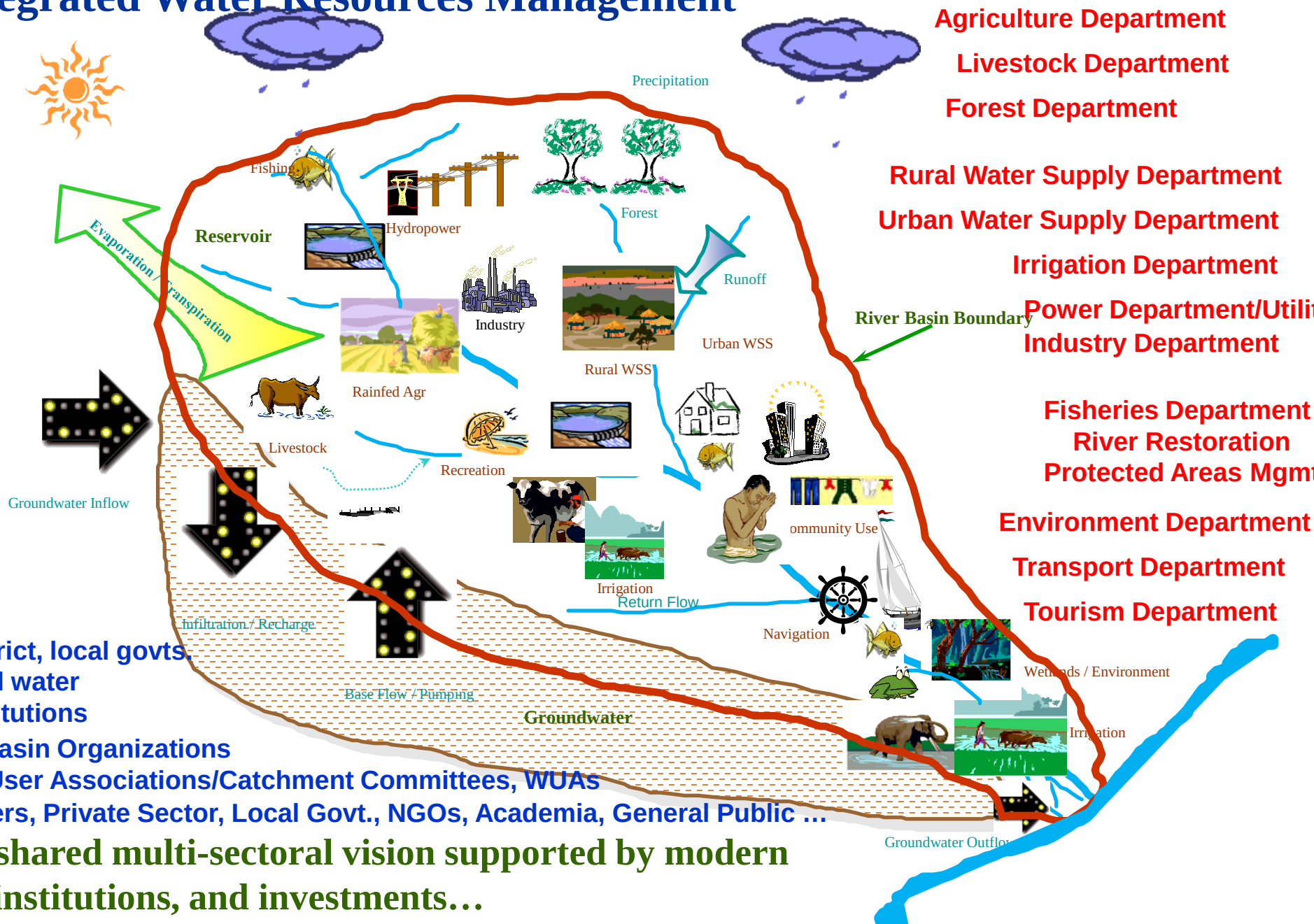
JANUARY



Data Source: Worldclim

Multiple sectors, multiple institutions, linked by water and natural resources…

Need for Integrated Water Resources Management



Agriculture Department

Livestock Department

Forest Department

Rural Water Supply Department

Urban Water Supply Department

Irrigation Department

Power Department/Utilities

Industry Department

Fisheries Department

River Restoration

Protected Areas Mgmt.

Environment Department

Transport Department

Tourism Department

Central, State, district, local govts.

Surface & Ground water

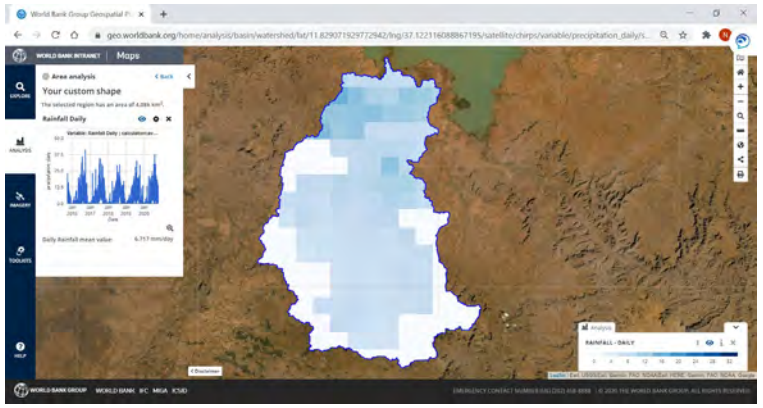
Investment Institutions

Basin/Sub-basin Organizations

Watershed User Associations/Catchment Committees, WUAs

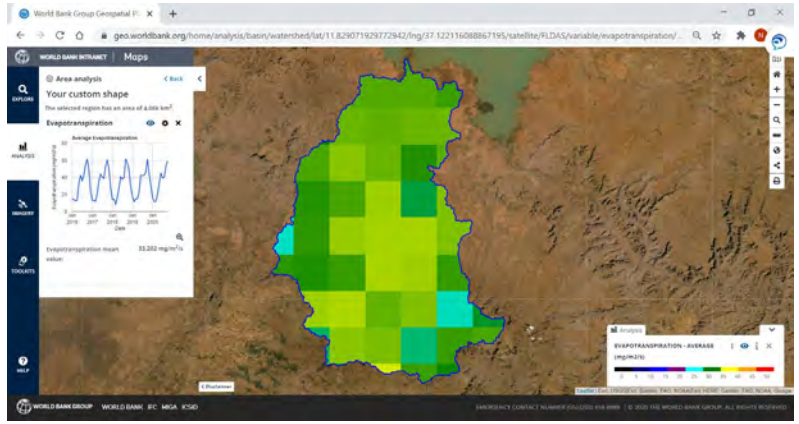
Farmers, Private Sector, Local Govt., NGOs, Academia, General Public …

…Need for a shared multi-sectoral vision supported by modern information, institutions, and investments…

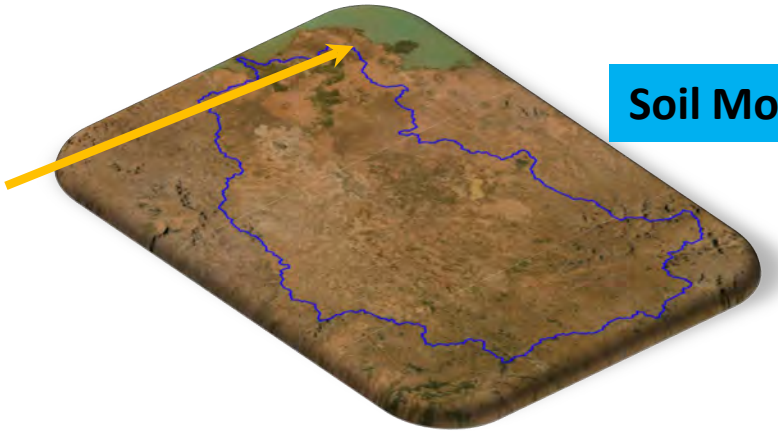


Precipitation

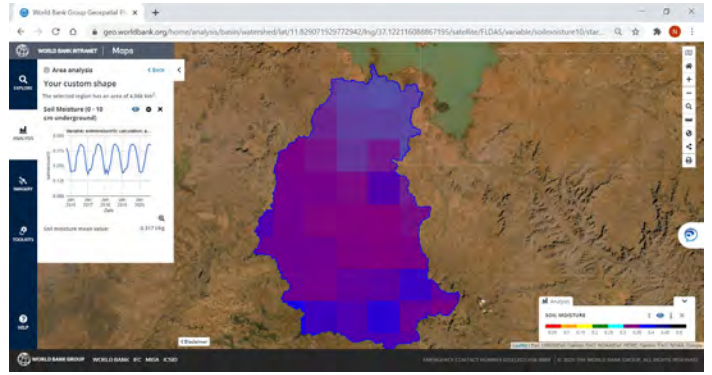
Evapotranspiration

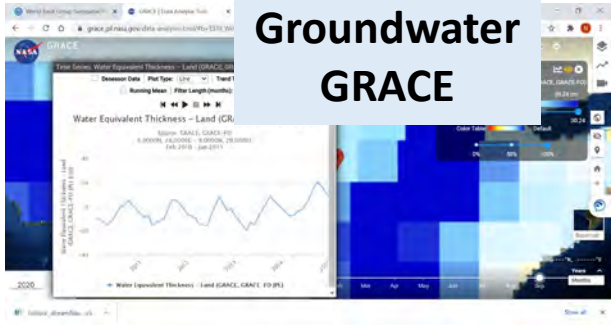


Streamflow



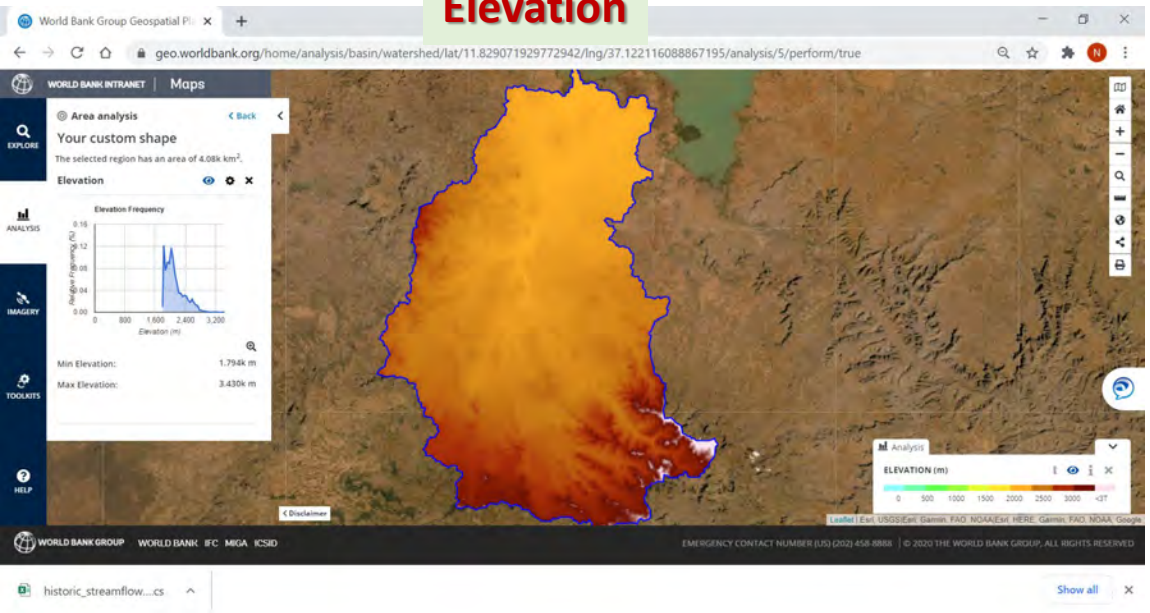
Soil Moisture





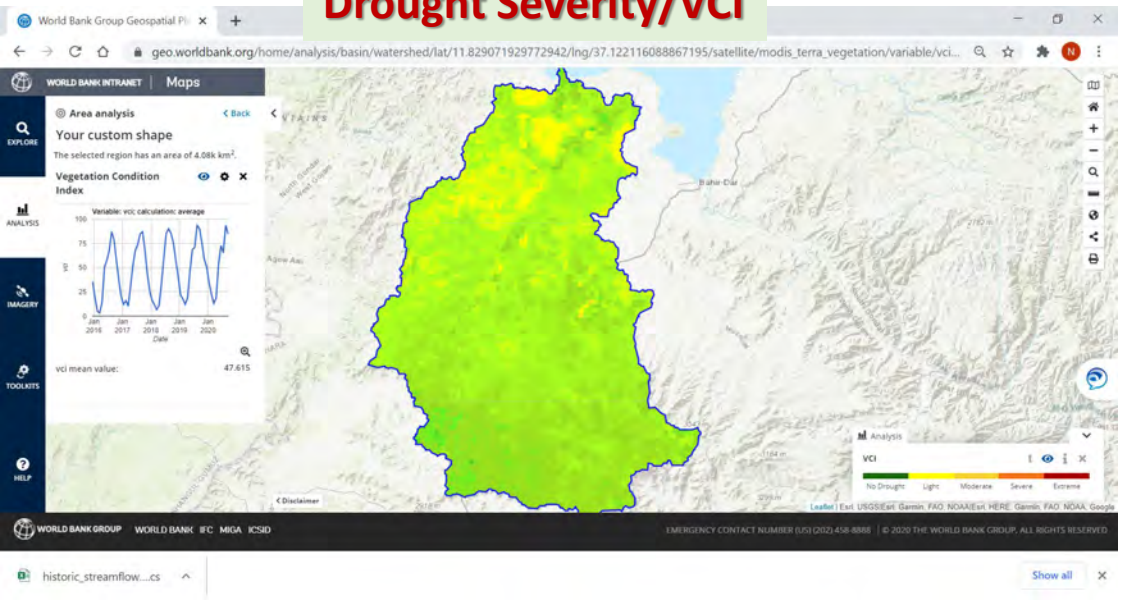
Groundwater
GRACE

Elevation

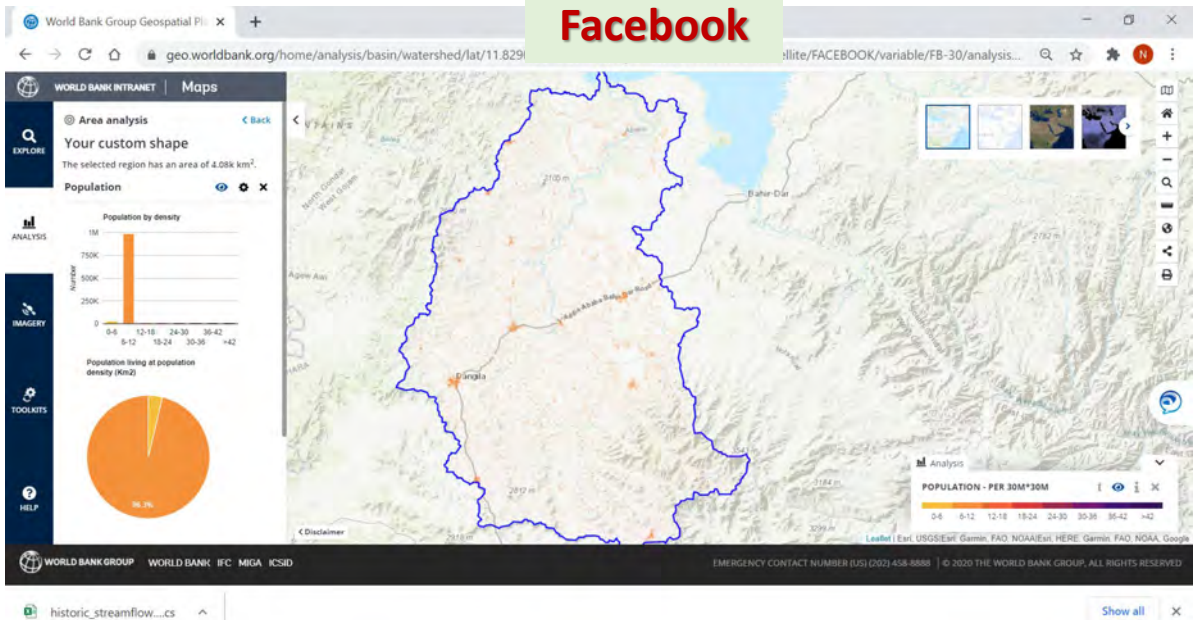


Population CIESIN

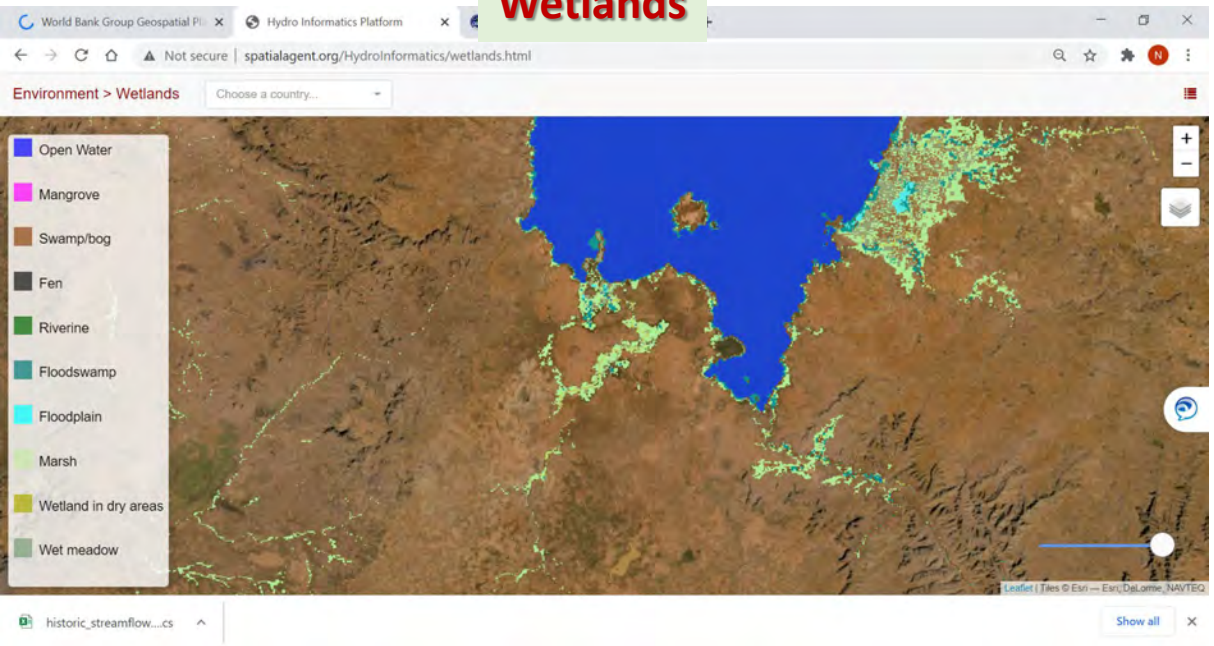
Drought Severity/VCI



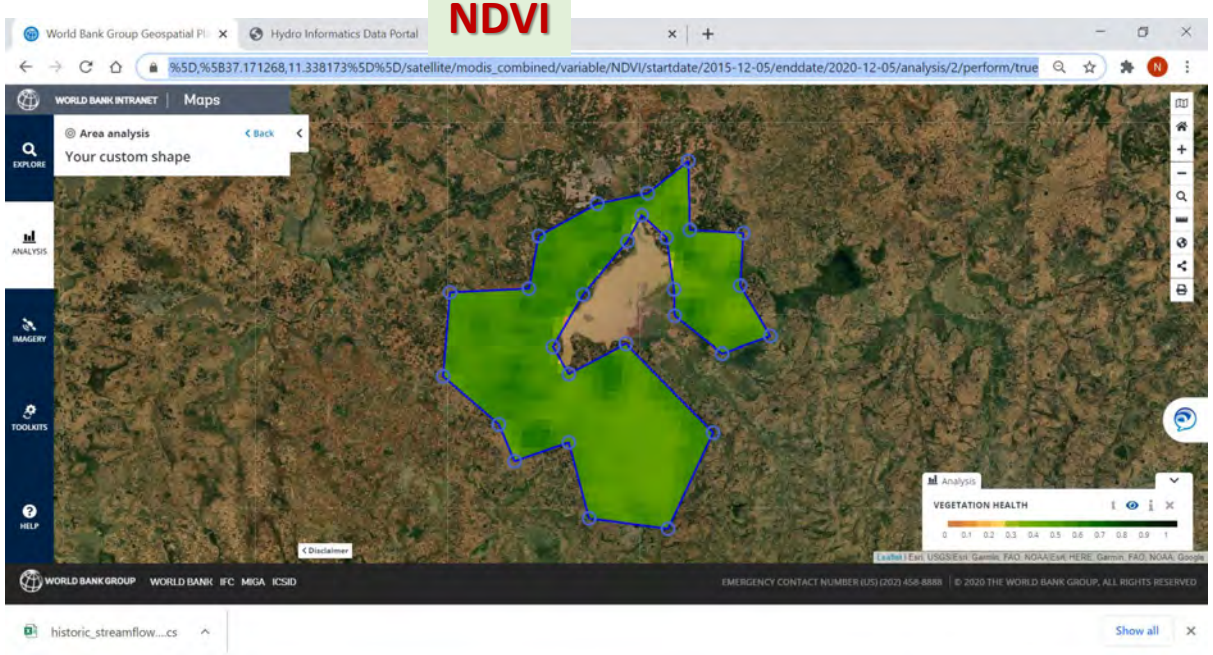
Population Facebook



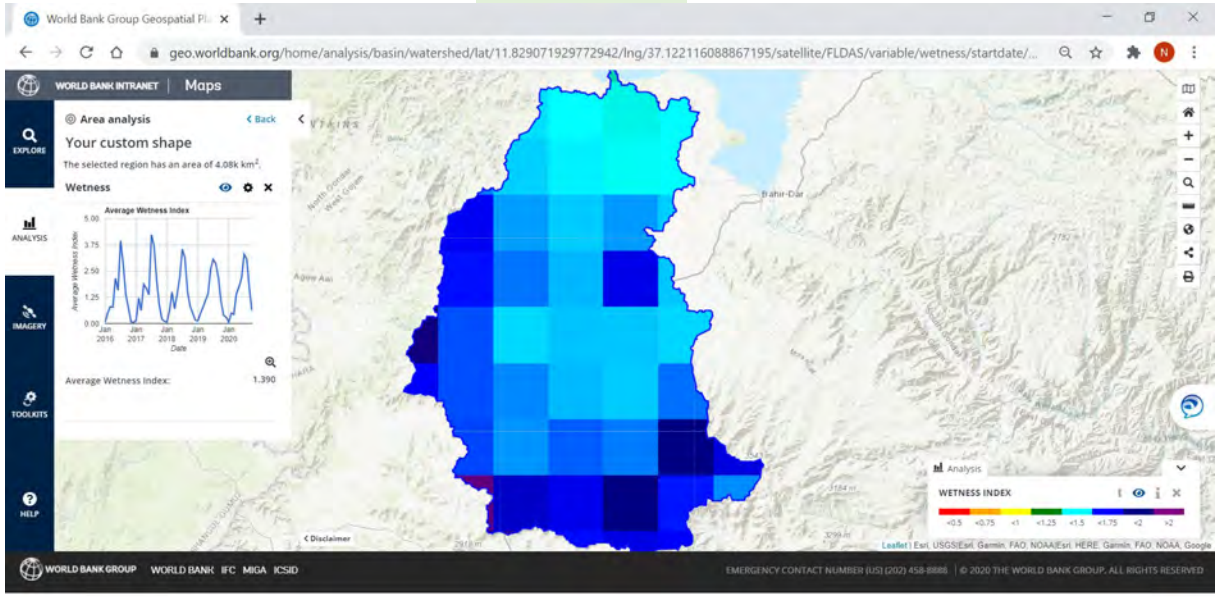
Wetlands



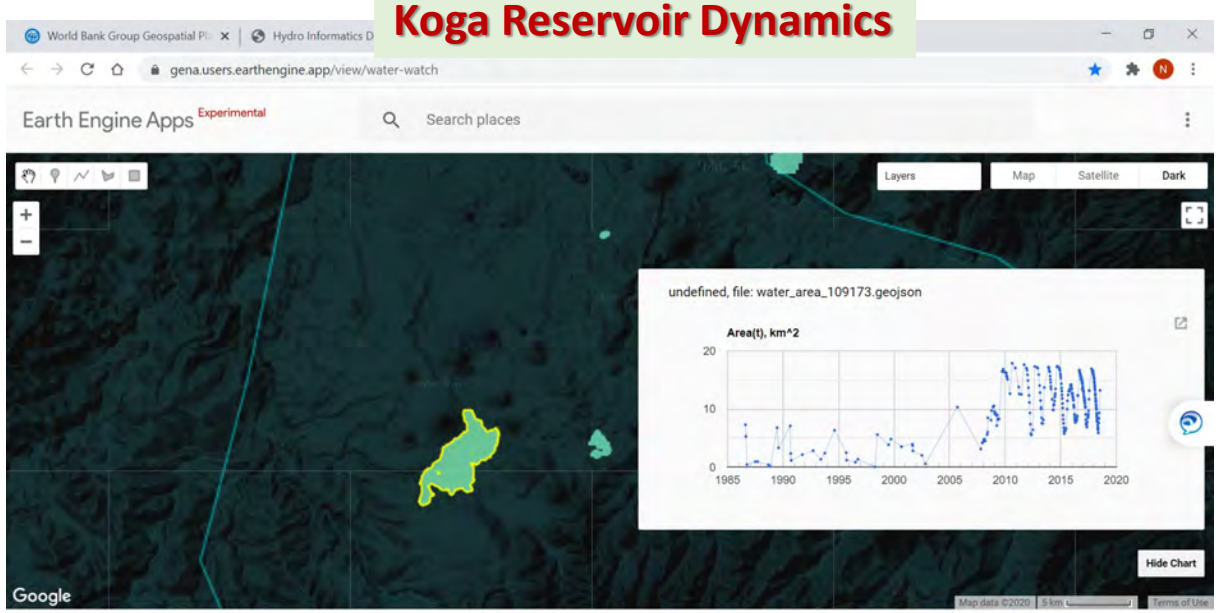
NDVI



Wetness



Koga Reservoir Dynamics



Complex Water Systems Models

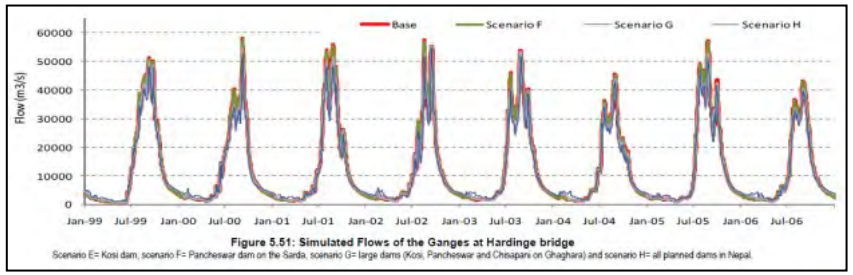
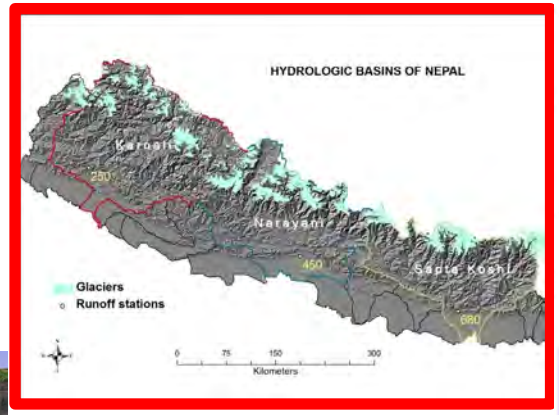
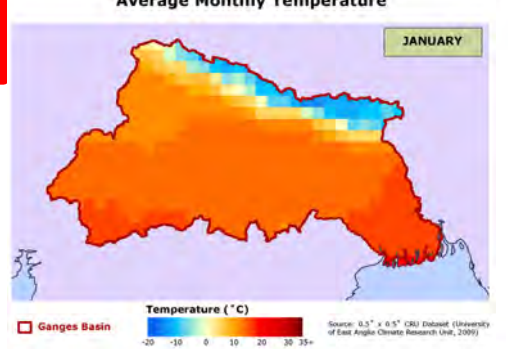
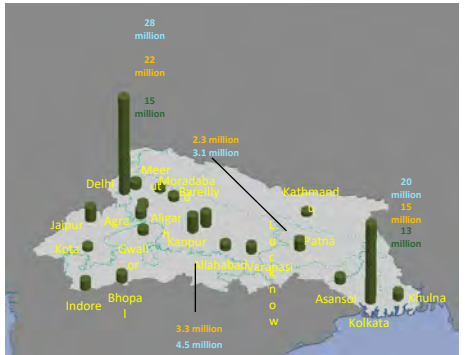


Figure 5.51: Simulated Flows of the Ganges at Hardinge bridge

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

Mashreq Water Data Portal

https://spatialagent.org/Mashreq (also has links to Knowledge Explorer & E-Book)

Mashreq Data Portal

MASHREQ WATER RESOURCES PORTAL

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


GW Knowledge Resources Explorer


Mashreq Groundwater DT eBook


Water Transition

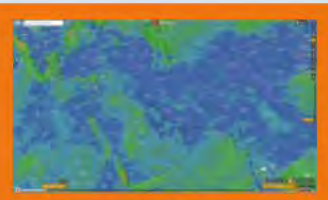

RICCAR


JRC Urban Explorer

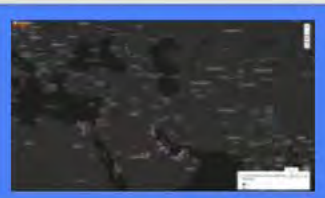

Water Inventory


Fishing Watch


Aqueduct Food


Windy


GEOGloWS Streamflow Explorer

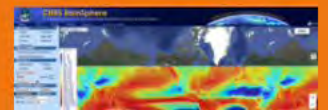

Power Plants


GRDC


Watershed Delineation

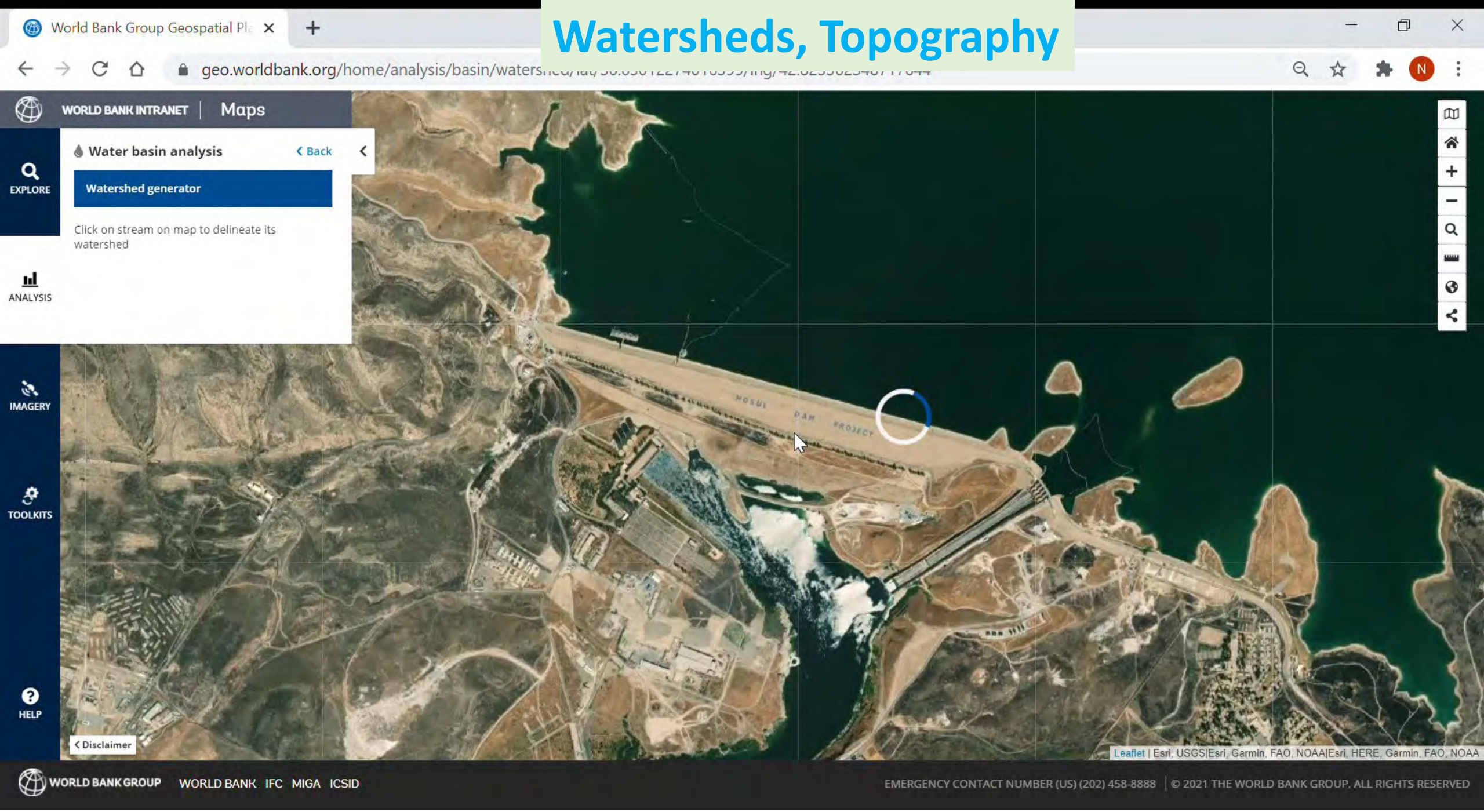

NASA Disasters Portal


Climate Stations



High-Resolution Satellite Imagery

Watersheds, Topography



Population

World Bank Group Geospatial Pla

geo.worldbank.org/home/analysis/basin/watershed/lat/...348717644/analysis/0/perform/true

WORLD BANK INTRANET | Maps

EXPLORE

ANALYSIS

IMAGERY

TOOLKITS

HELP

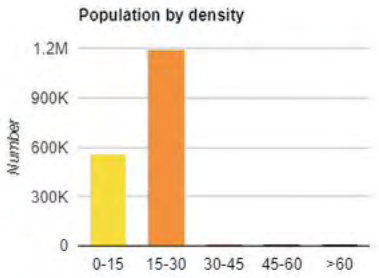
Area analysis

Back

Your custom shape

The selected region has an area of 50.89k km^2.

Population



Total Population in 2018 : 1.744 m

Population Density in 2018: 34.274 per km^2

Disclaimer

Analysis

POPULATION PER GRID CELL - 30*30M

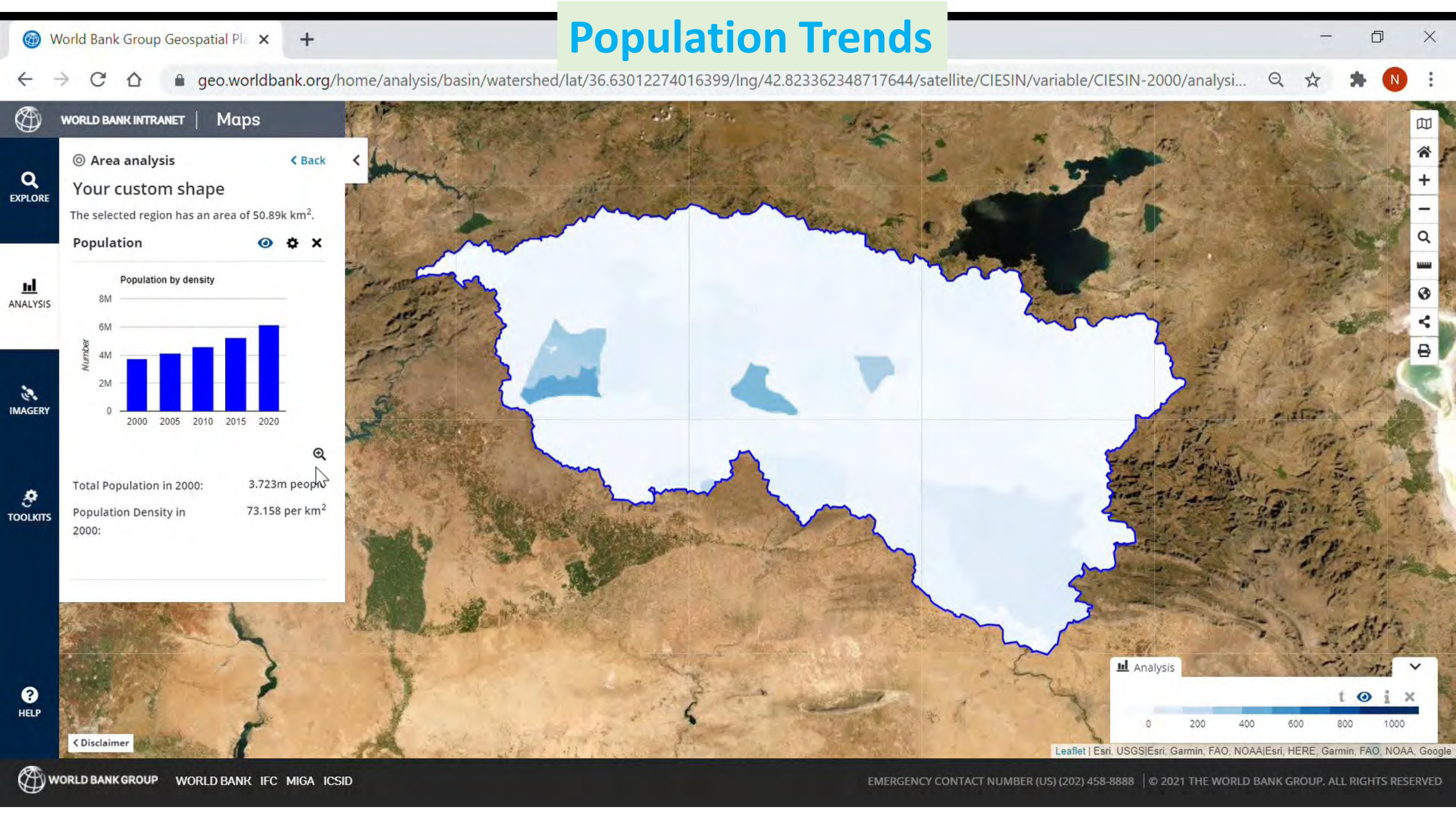
0-15 15-30 30-45 45-60 >60

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

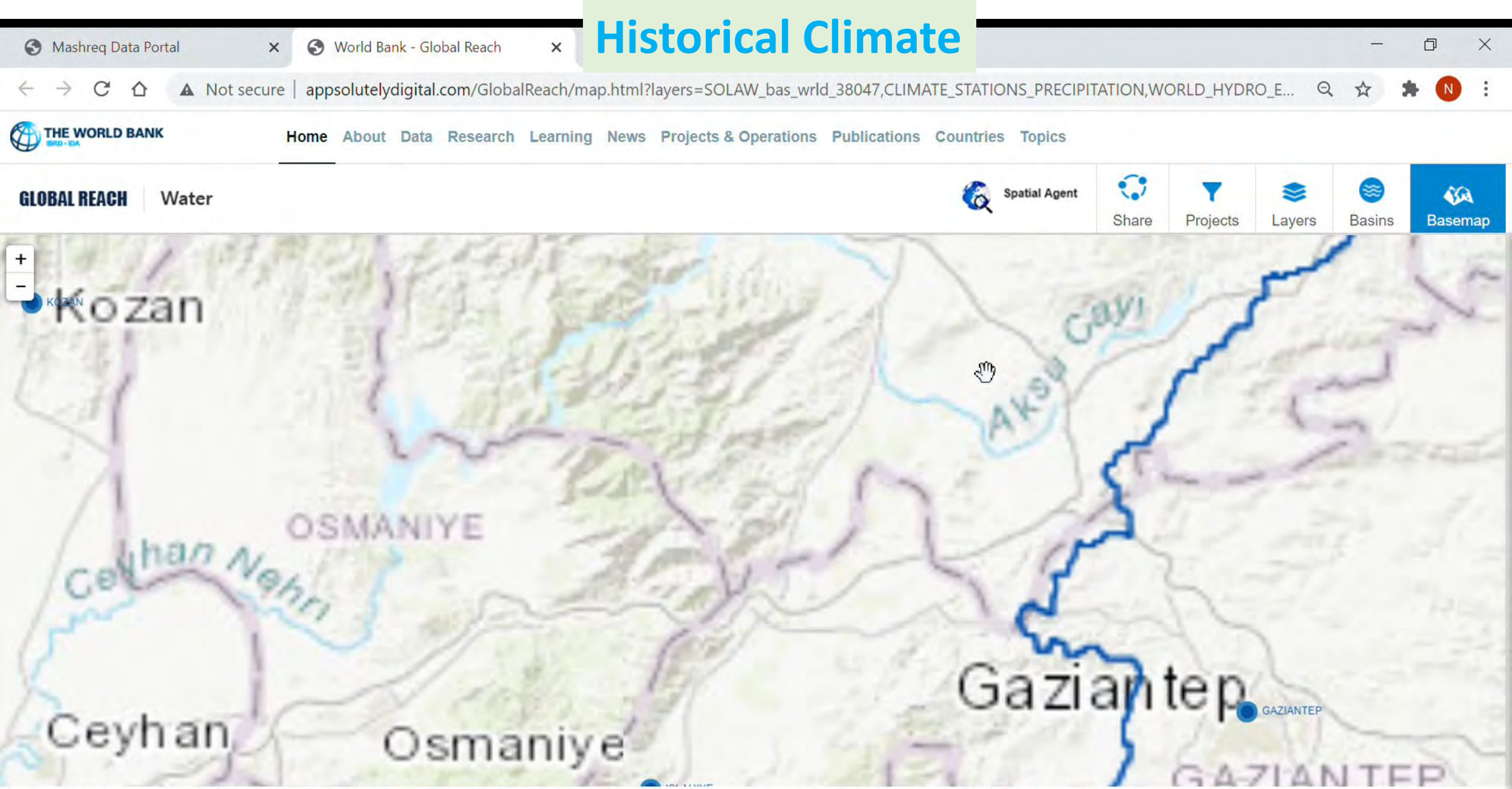
WORLD BANK GROUP WORLD BANK IFC MIGA ICSID

EMERGENCY CONTACT NUMBER (US) (202) 458-8888 |

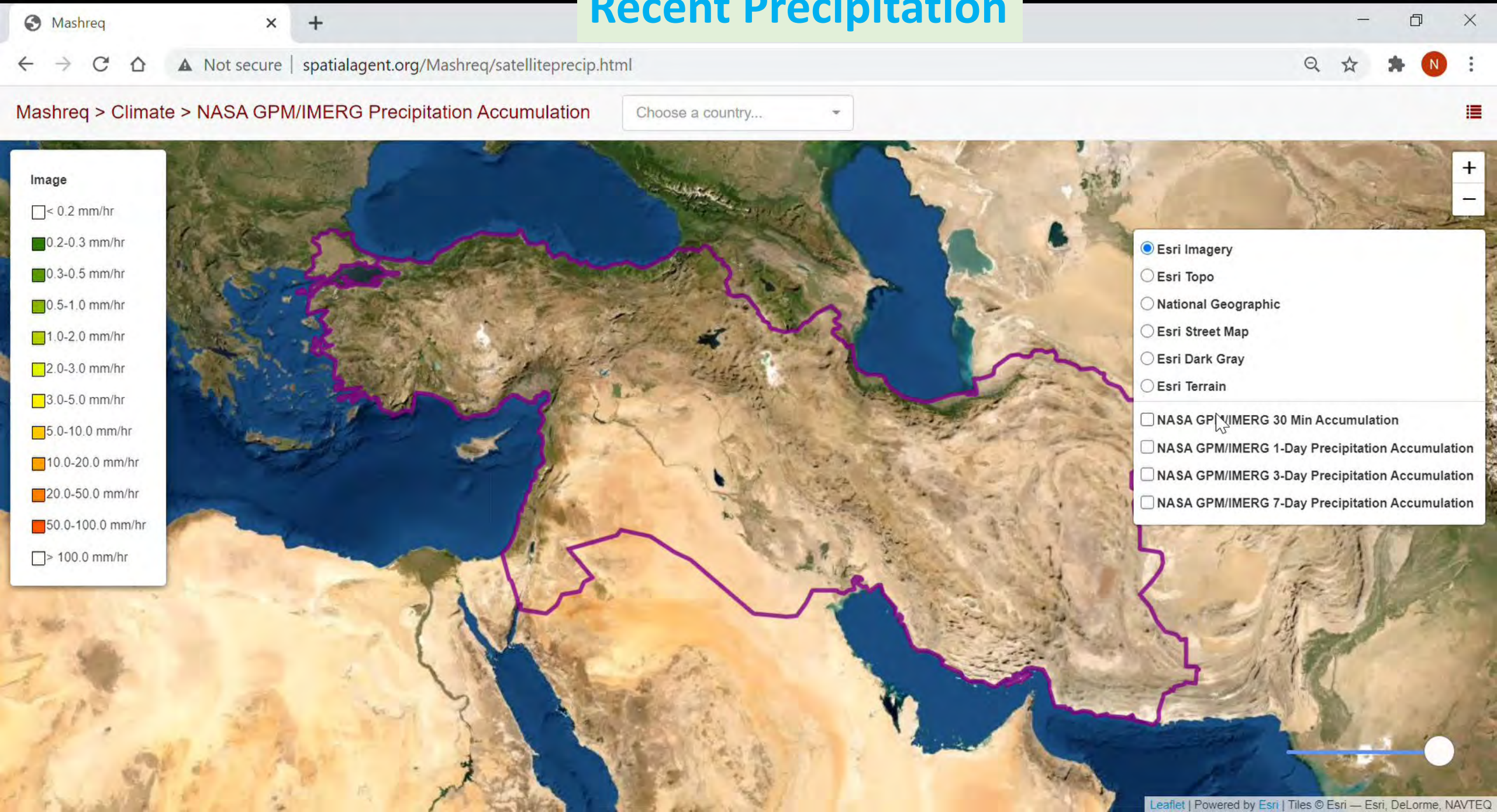
Population Trends



Historical Climate



Recent Precipitation



Real-time Weather

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

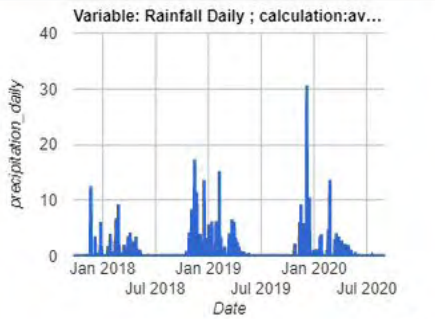
EXPLORE
ANALYSIS
IMAGERY
TOOLKITS
HELP

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

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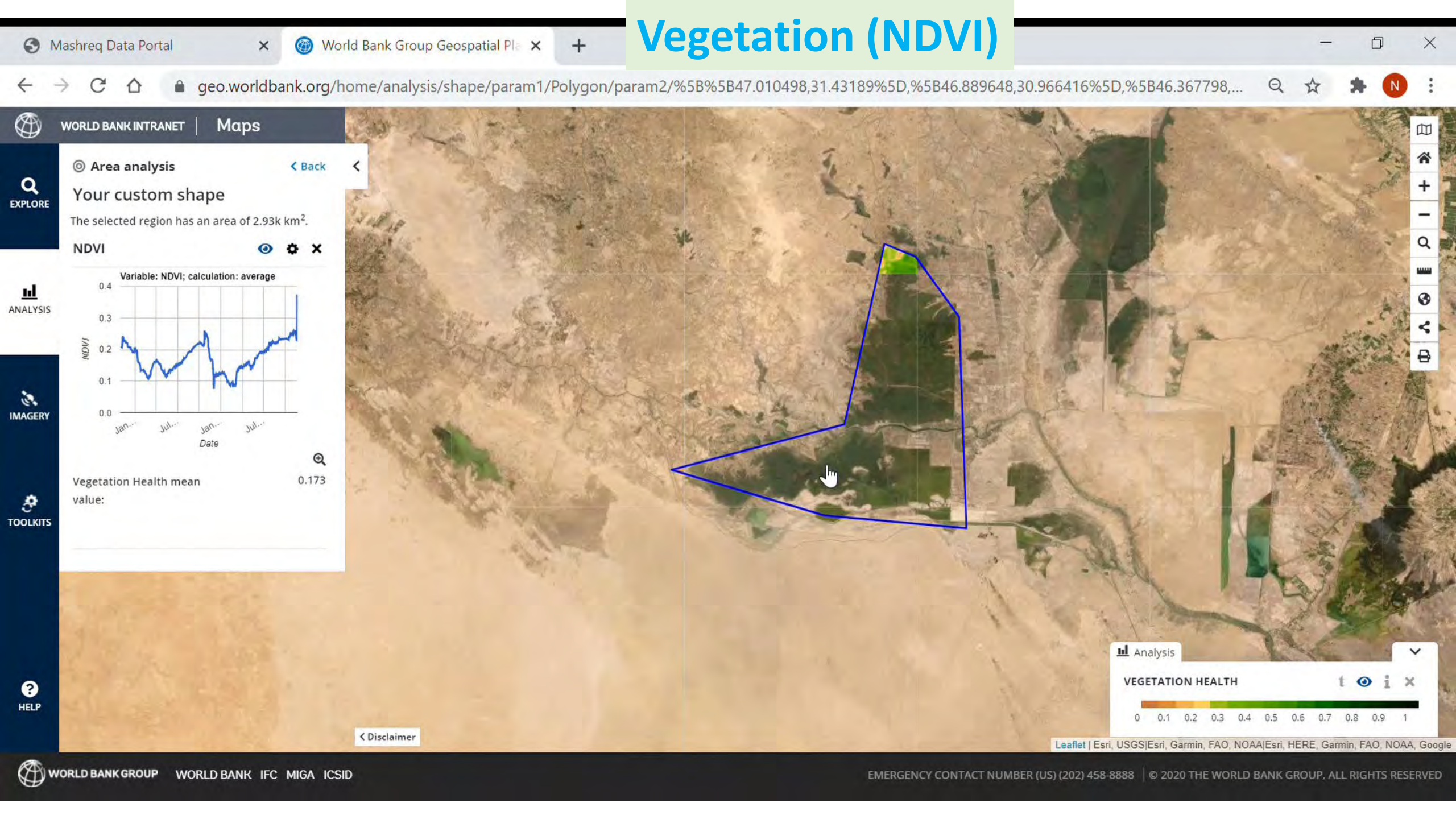
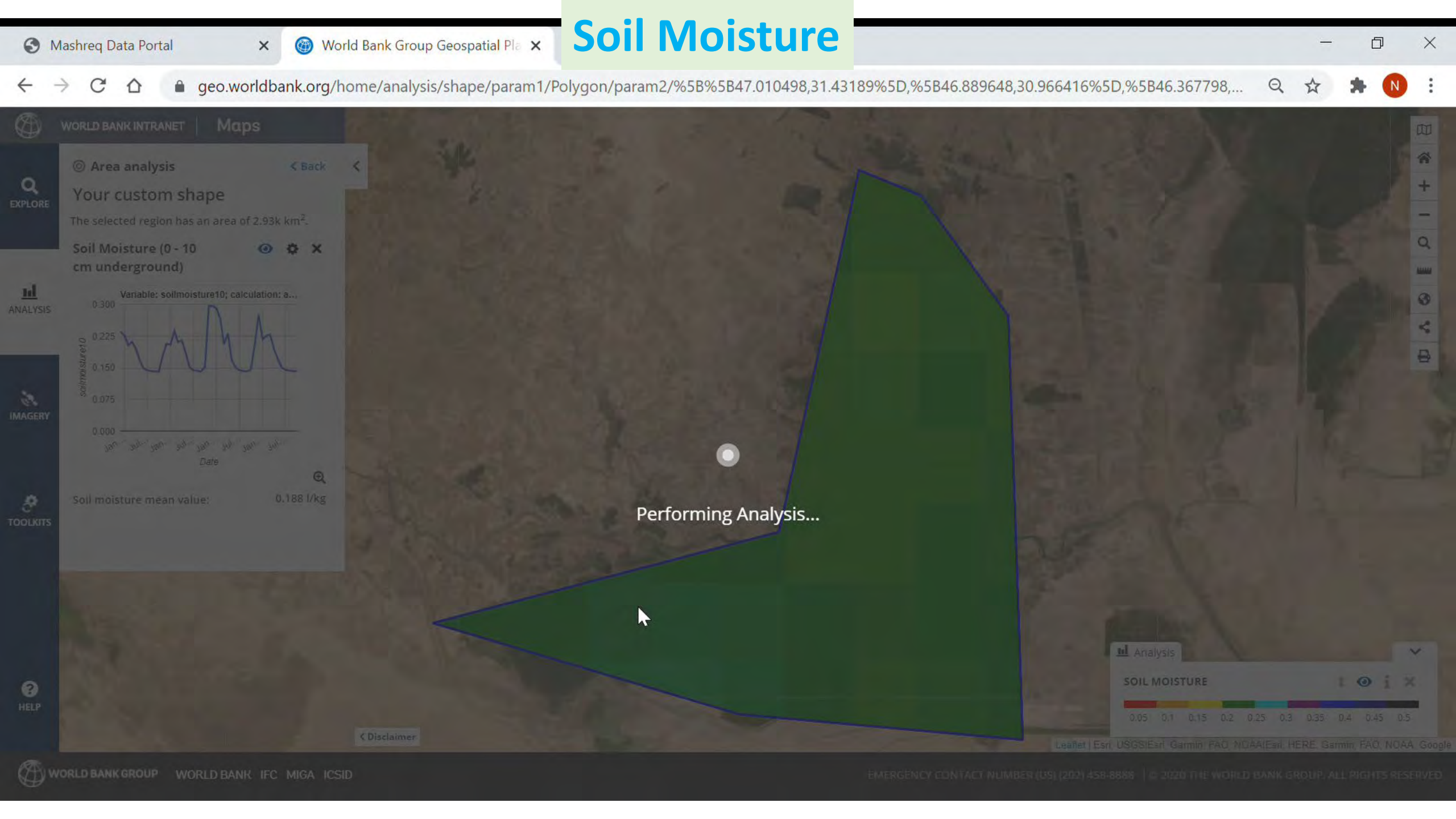
EMERGENCY CONTACT NUMBER (US) (202) 458-8888 |

Vegetation (NDVI)



Soil Moisture



Evapo-Transpiration

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

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

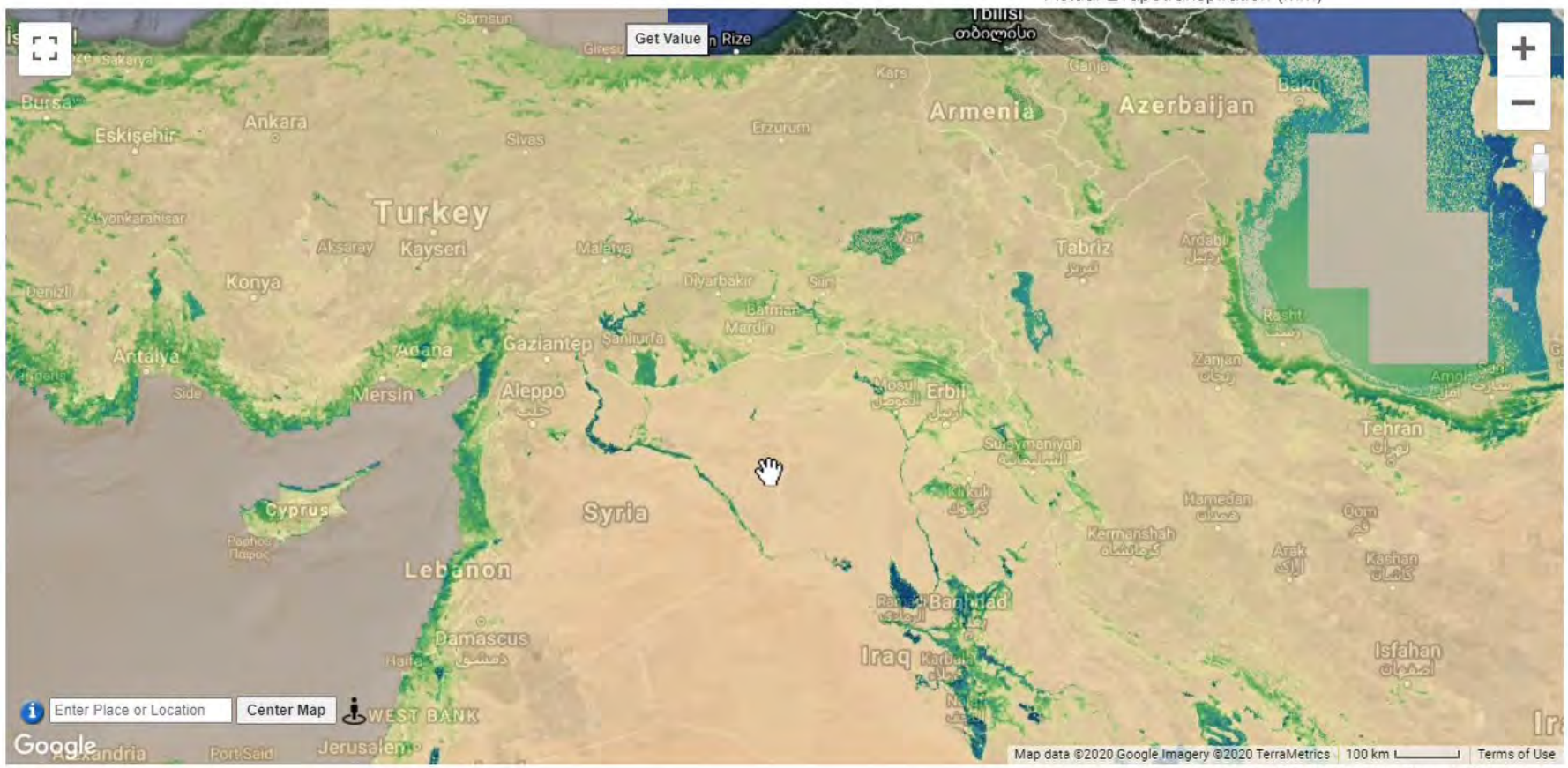
MENU | Map

Climate Engine

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

0.0 500 1,000 1,500

Actual Evapotranspiration (mm)



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Evapo-Transpiration

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

app.climateengine.org/climateEngine

Make Map | Make Graph | INFO

GET TIME SERIES

Time Series Calculation:
Native Time Series
One Variable Analysis

Region:
Polygon
Add another region

Variable 1

Variable 1
Type: Remote Sensing
Dataset: USGS MODIS ET - SSEBop Dekadal
Variable: Evapotranspiration (ETa)
Units: millimeters

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

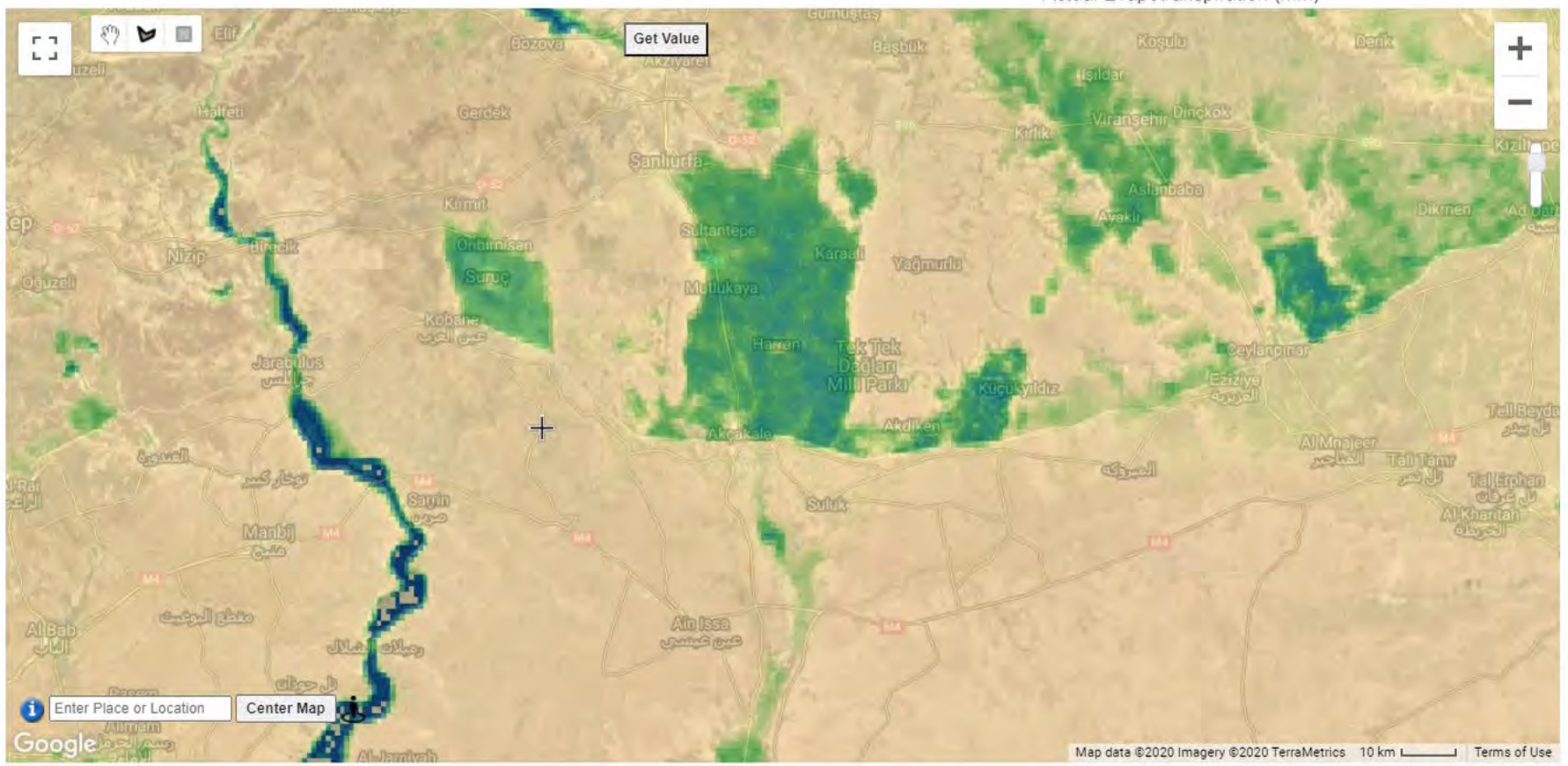
MENU | Map

Climate Engine

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

0.0 | 500 | 1,000 | 1,500

Actual Evapotranspiration (mm)



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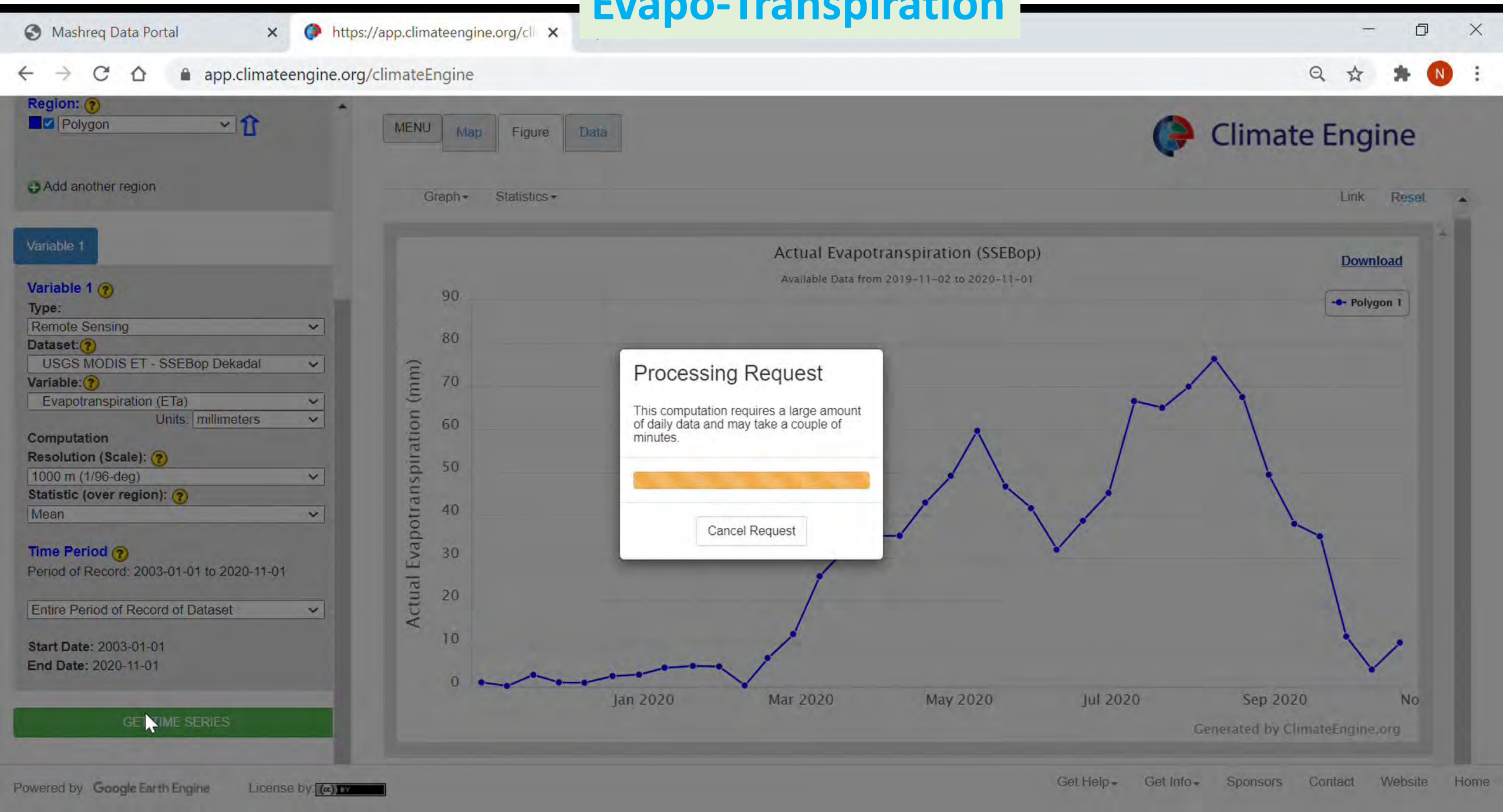
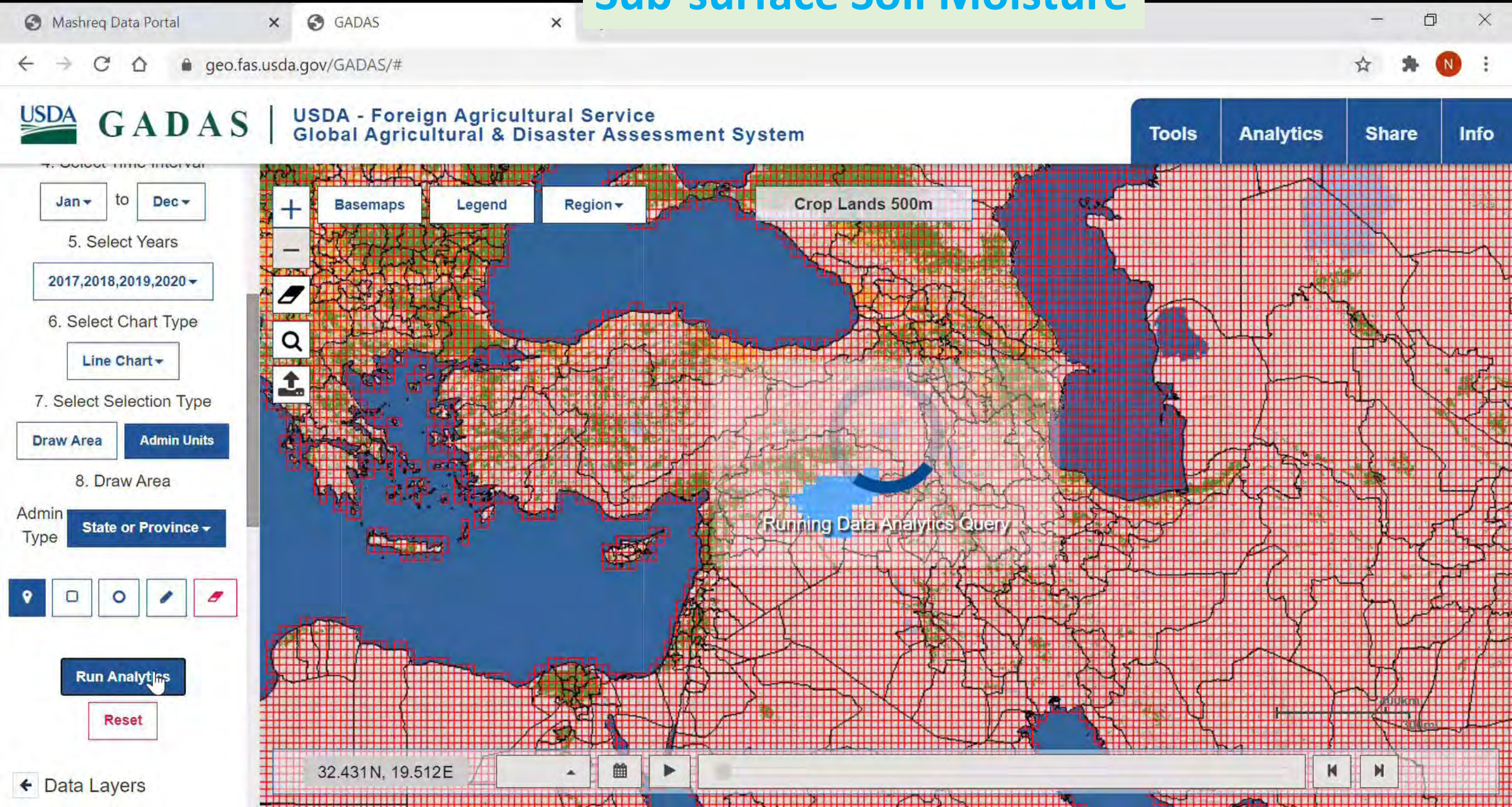
Evapo-Transpiration



Sub-surface Soil Moisture



Streamflow Forecasts & Hindcasts

Satellite Altimetry

G-REALM - Home

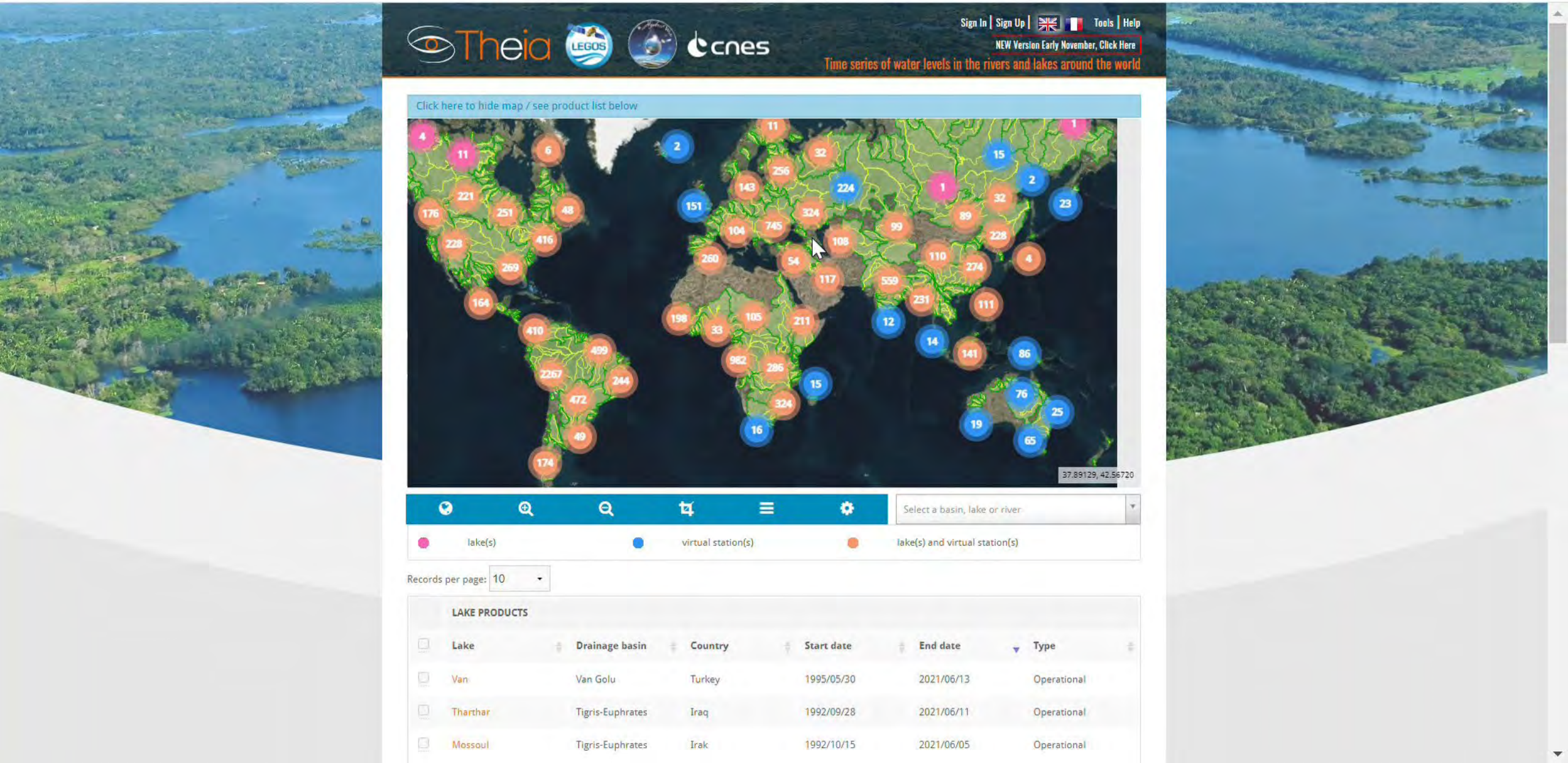
ipad.fas.usda.gov/cropexplorer/global_reservoir/

Partner Site
Global Water Monitor

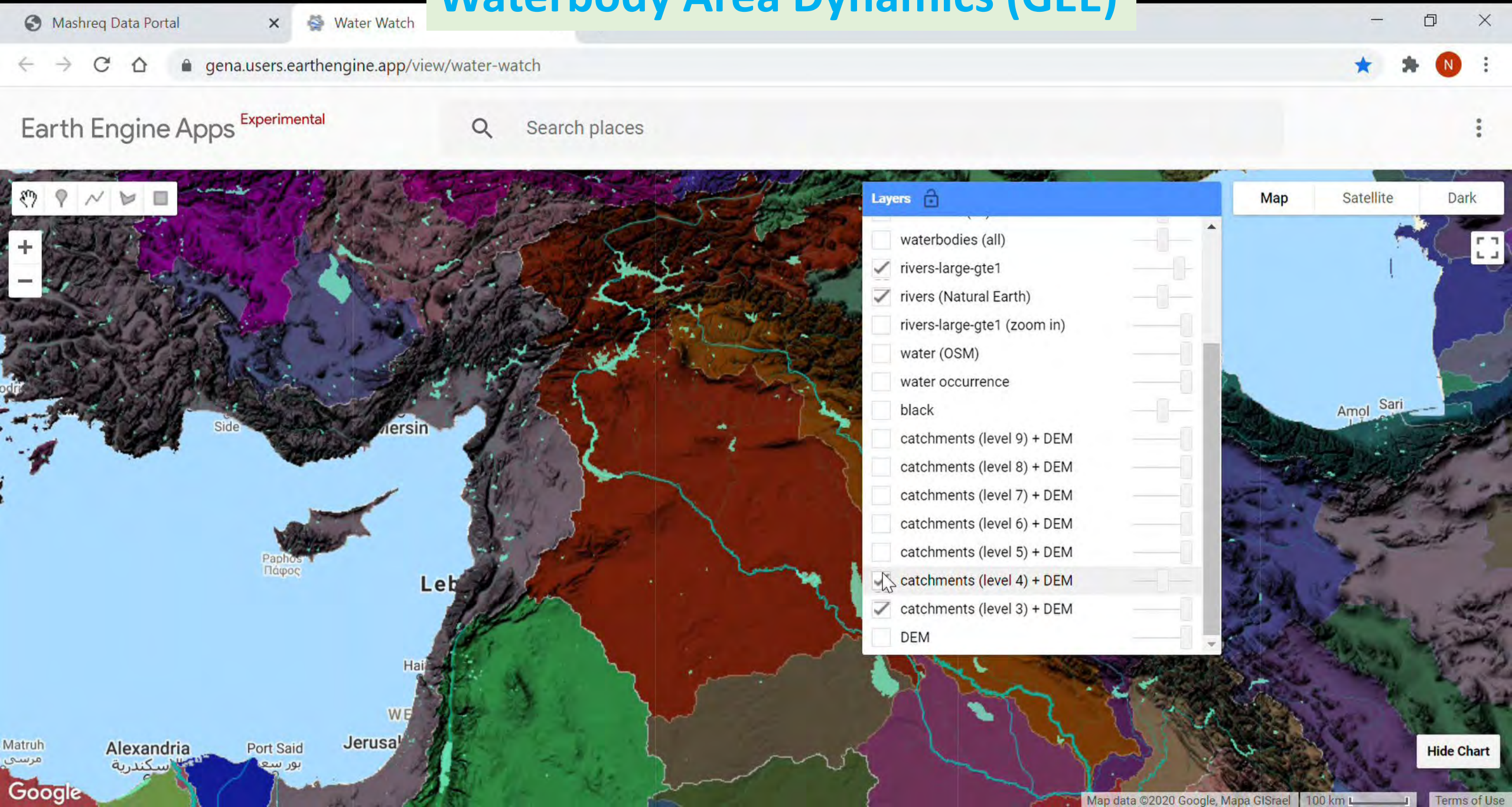
G-REALM Information
NEWS!
Lake/Reservoir Product Table (.csv)
Lake/Reservoir Status Product Table (.csv)
Background
Semi-Automated Data Processing Satellite Radar Altimetry
Advantages and Limitations
Datasets
Products
FAQ – Product Choice, Accuracy, and Datums
References
Contacts
Funding
Acknowledgement
Disclaimer
Product History

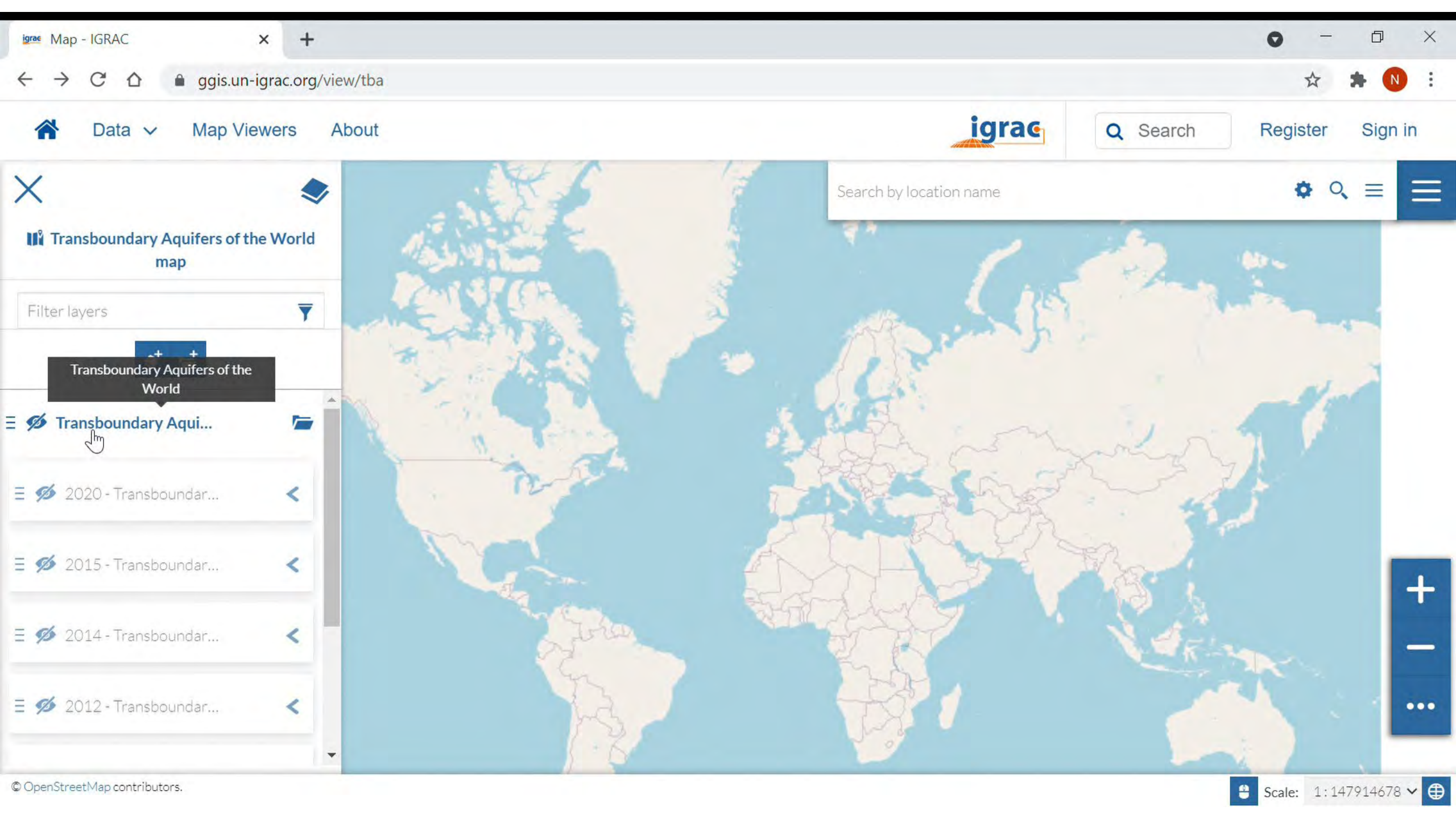
Near Real Time products with datum based on a single satellite overpass (1 day)

Satellite Altimetry



Waterbody Area Dynamics (GEE)




Map - IGRAC
ggis.un-igrac.org/view/tba
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Map Viewers
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Filter layers
Transboundary Aquifers of the World
Transboundary Aqui...
2020 - Transboundar...
2015 - Transboundar...
2014 - Transboundar...
2012 - Transboundar...
Search by location name
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Scale:
1 : 147914678

Map - IGRAC

ggis.un-igrac.org/view/well-and-monitoring-data

Data | Map Viewers | About | igrac | Search | Register | Sign in

Search by location name

Well and Monitoring Data

Lat: 38.468 - Long: -82.383

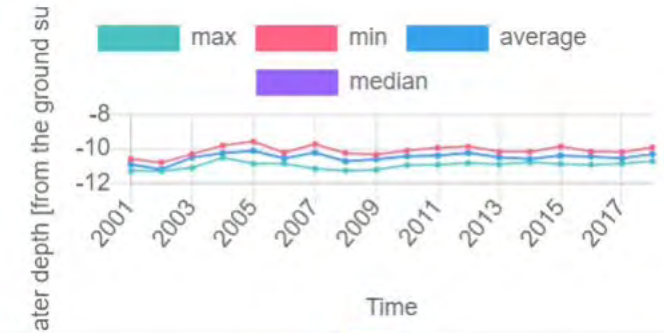
by

Last edited at 2021-01-06T06:54:16.881Z

Last edited by admin

Water depth [from the ground surface] | m

Yearly for all time



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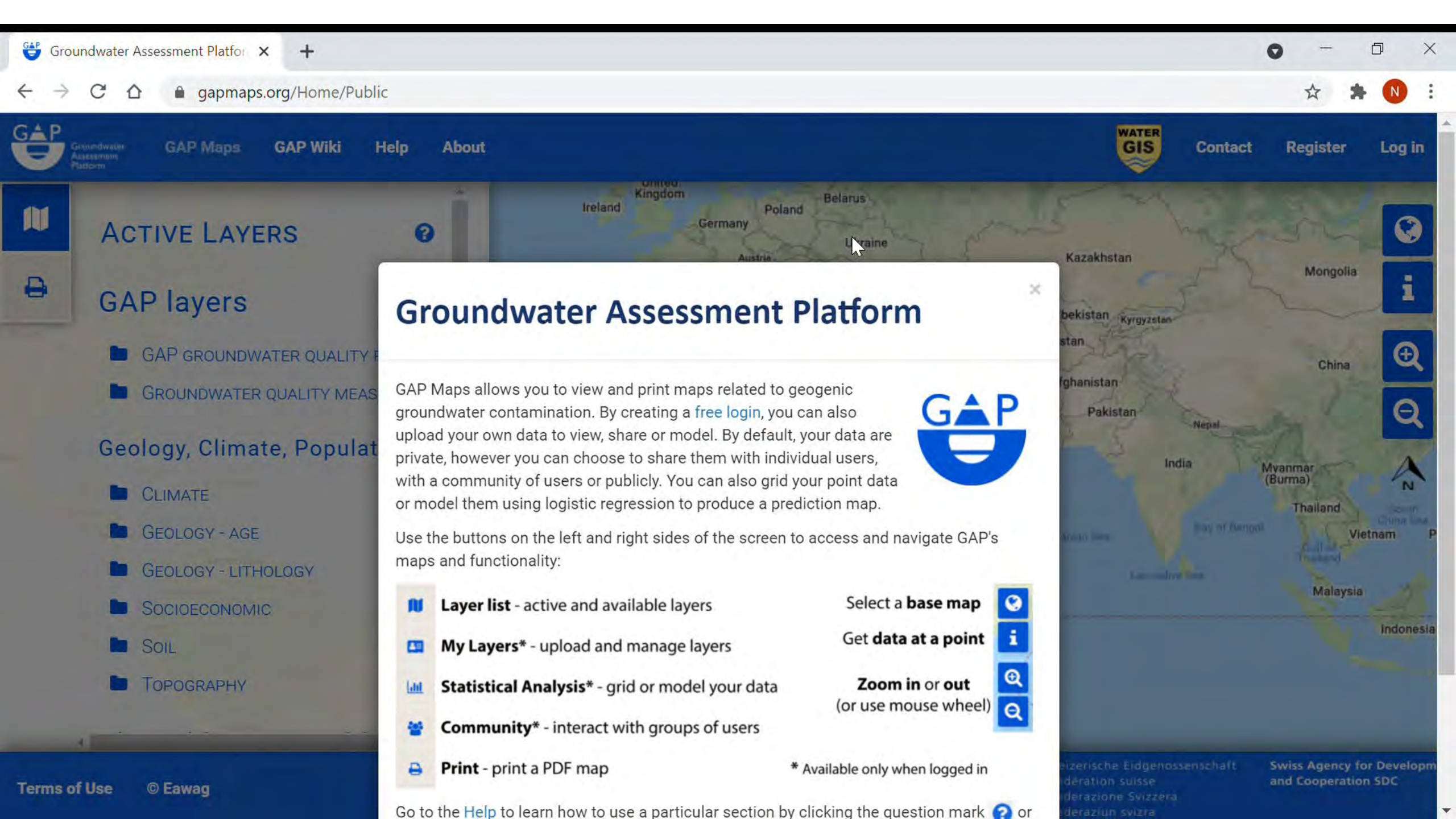
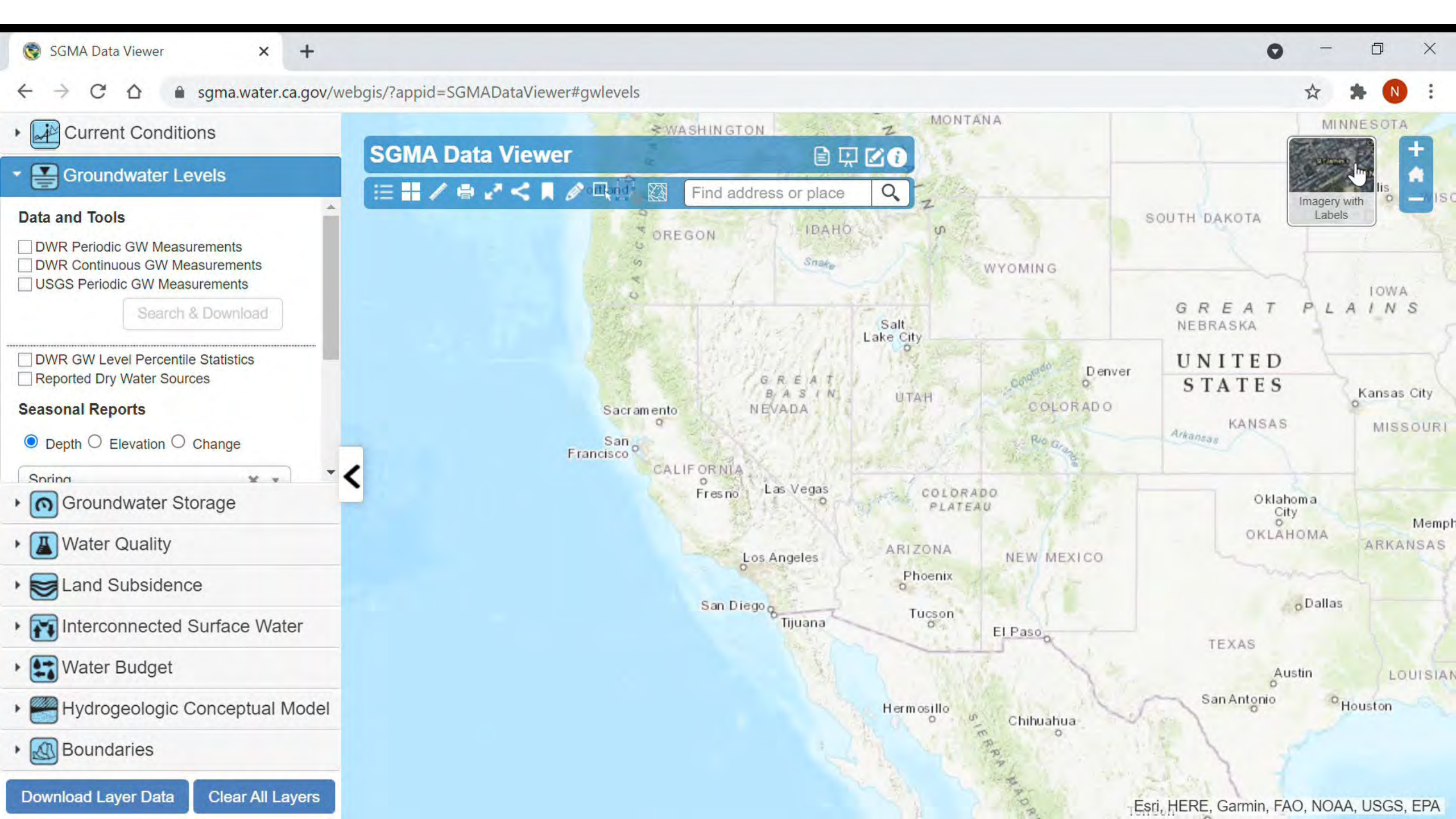

Groundwater Assessment Platfor
gapmaps.org/Home/Public
GAP Maps
GAP Wiki
Help
About
WATER GIS
Contact
Register
Log in
ACTIVE LAYERS
GAP layers
GAP GROUNDWATER QUALITY
GROUNDWATER QUALITY MEAS
Geology, Climate, Populat
CLIMATE
GEOLOGY - AGE
GEOLOGY - LITHOLOGY
SOCIOECONOMIC
SOIL
TOPOGRAPHY
Ireland
United Kingdom
Germany
Poland
Belarus
Ukraine
Austria
Kazakhstan
Mongolia
Kyrgyzstan
China
Pakistan
Nepal
India
Myanmar (Burma)
Thailand
Vietnam
Malaysia
Indonesia
Groundwater Assessment Platform
GAP Maps allows you to view and print maps related to geogenic groundwater contamination. By creating a free login, you can also upload your own data to view, share or model. By default, your data are private, however you can choose to share them with individual users, with a community of users or publicly. You can also grid your point data or model them using logistic regression to produce a prediction map.
Use the buttons on the left and right sides of the screen to access and navigate GAP's maps and functionality:
Layer list - active and available layers
My Layers* - upload and manage layers
Statistical Analysis* - grid or model your data
Community* - interact with groups of users
Print - print a PDF map
Select a base map
Get data at a point
Zoom in or out (or use mouse wheel)
* Available only when logged in
Go to the Help to learn how to use a particular section by clicking the question mark or
Terms of Use
© Eawag
Swiss Agency for Development and Cooperation SDC


SGMA Data Viewer
sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels
Current Conditions
Groundwater Levels
Data and Tools
DWR Periodic GW Measurements
DWR Continuous GW Measurements
USGS Periodic GW Measurements
Search & Download
DWR GW Level Percentile Statistics
Reported Dry Water Sources
Seasonal Reports
Depth
Elevation
Change
Spring
Groundwater Storage
Water Quality
Land Subsidence
Interconnected Surface Water
Water Budget
Hydrogeologic Conceptual Model
Boundaries
Download Layer Data
Clear All Layers
Find address or place
Imagery with Labels
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
SOUTH DAKOTA
MINNESOTA
IOWA
NEBRASKA
GREAT PLAINS
UNITED STATES
KANSAS
MISSOURI
Kansas City
Denver
COLORADO
UTAH
Salt Lake City
GREAT BASIN
NEVADA
CALIFORNIA
Sacramento
San Francisco
Fresno
Las Vegas
COLORADO PLATEAU
ARIZONA
NEW MEXICO
Los Angeles
Phoenix
San Diego
Tijuana
Tucson
El Paso
Oklahoma City
OKLAHOMA
ARKANSAS
Dallas
TEXAS
Austin
San Antonio
Houston
Hermosillo
Chihuahua
Snake
Colorado
Rio Grande
Arkansas
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

India-WRIS

indiawris.gov.in/wris/#/

भारत सरकार
GOVERNMENT OF INDIA

जल शक्ति मंत्रालय
MINISTRY OF JAL SHAKTI

जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
DEPARTMENT OF WATER RESOURCES, RD & GR

राष्ट्रीय जल सूचना-विज्ञान केंद्र
NATIONAL WATER INFORMATICS CENTRE

India Water Resources Information System

FEED BACK

NWIC

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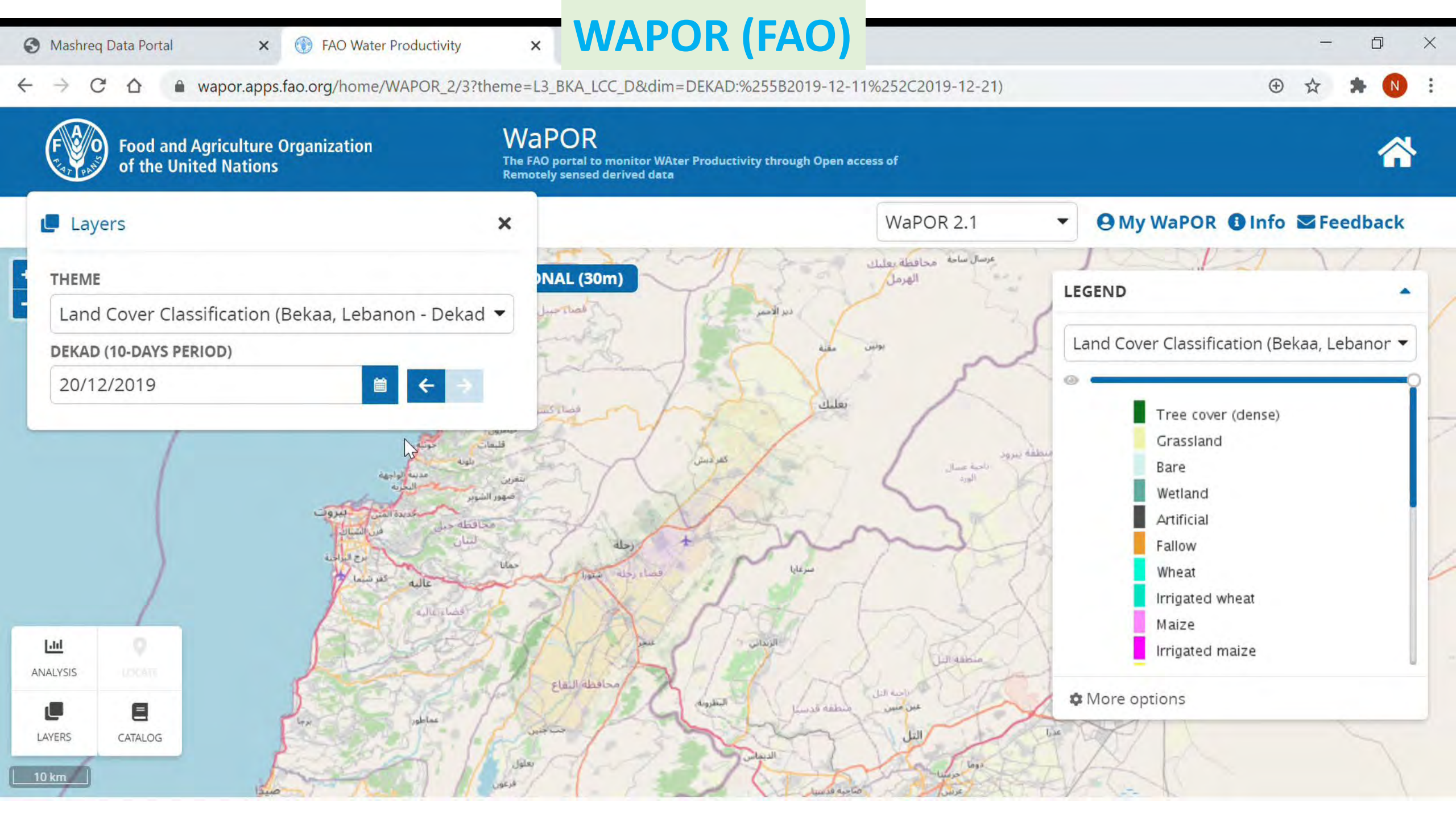
NHP

Live Telemetery

The stations established by the Central Water Commission, the Central Groundwater Board and the State agencies throughout the country measure important hydrological and meteorological parameters and provide data on a real time basis for immediate action and planning.

View More

WAPOR (FAO)


Mashreq Data Portal
FAO Water Productivity
wapor.apps.fao.org/home/WAPOR_2/3?theme=L3_BKA_LCC_D&dim=DEKAD:%255B2019-12-11%252C2019-12-21)
Food and Agriculture Organization of the United Nations
WaPOR
The FAO portal to monitor WAter Productivity through Open access of Remotely sensed derived data
Layers
THEME
Land Cover Classification (Bekaa, Lebanon - Dekad
DEKAD (10-DAYS PERIOD)
20/12/2019
WaPOR 2.1
My WaPOR
Info
Feedback
LEGEND
Land Cover Classification (Bekaa, Lebanor
Tree cover (dense)
Grassland
Bare
Wetland
Artificial
Fallow
Wheat
Irrigated wheat
Maize
Irrigated maize
More options
ANALYSIS
LAYERS
CATALOG
10 km

Climate Change

Mashreq Data Portal | Home | RICCAR

climateknowledgeportal.worldbank.org/watershed/21/climate-data-projections

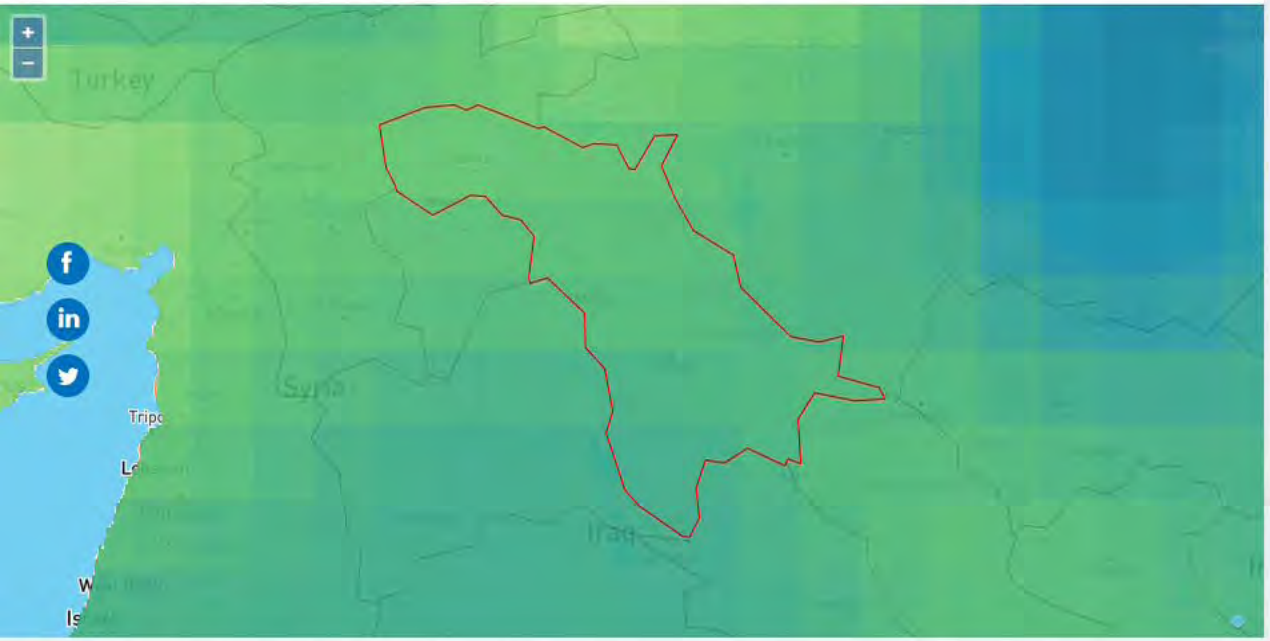
WORLD BANK GROUP | Climate Change Knowledge Portal
For Development Practitioners and Policy Makers

GLOSSARY METADATA CONTACT US

COUNTRY REGION WATERSHED DOWNLOAD DATA COUNTRY PROFILES AGRICULTURE PROFILES ABOUT TUTORIAL

VARIABLE	TIME PERIOD	STATISTIC	SCENARIO	MODEL
Monthly Precipitation	2080-2099	Change (anomaly)	RCP 8.5 (High emission)	csiro_mk3_6_0

Projected Change in Monthly Precipitation of Watershed #21 for 2080-2099 (Compared to 1986-2005)

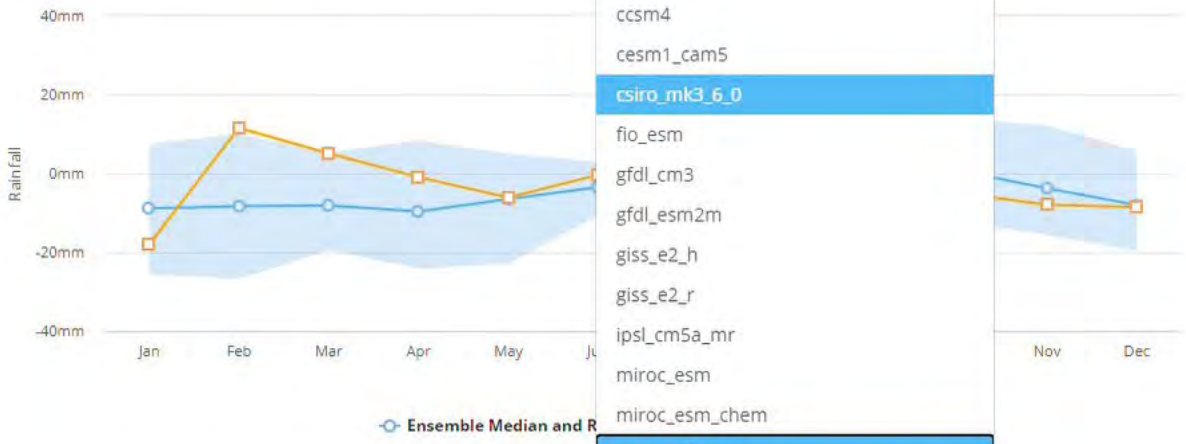


MONTHLY PRECIPITATION (MM)

-40 -30 -20 -10 -6 -2 0 2 6 10 20 30 40

METADATA

Projected Change in Monthly Precipitation for Watersl



ensemble
bcc_csm1_1
bcc_csm1_1_m
ccsm4
cesm1_cam5
csiro_mk3_6_0
fio_esm
gfdl_cm3
gfdl_esm2m
giss_e2_h
giss_e2_r
ipsl_cm5a_mr
miroc_esm
miroc_esm_chem
mri_cgcm3
noresm1_m

Historical Observed Monthly Precipitation for Watersh

MASHREQ WATER INITIATIVE - DISRUPTIVE TECH IN GROUNDWATER

Mashreq Water Initiative

Disruptive Tech in Groundwater

Table of Contents

Visualizing and Decision Support

Online web services (including spatial data using OGC standards) and open data APIs are ushering a revolution of interactive dashboards to visualize data and analytics related to groundwater.

The UN (including **UNESCWA**) has been working with **IGRAC** and others to develop a **UNESCO-IHP Groundwater Portal**. The **GGIS** is an interactive portal for sharing data and information on groundwater resources around the world. It gives access to map layers, documents, and well and monitoring data. It also contains several thematic map viewers. There are also a number of sites that provide information globally on **water points** and their status but the information is often patchy.

The World Bank has also been helping improving awareness about relevant free, public-domain water related data through its initiatives such as the **Water Data Portal**, **HydroInformatics Data Platform** , and **Water In Agriculture Data Platform** . For the Mashreq Region, a **Mashreq Water Data Platform** has been developed.

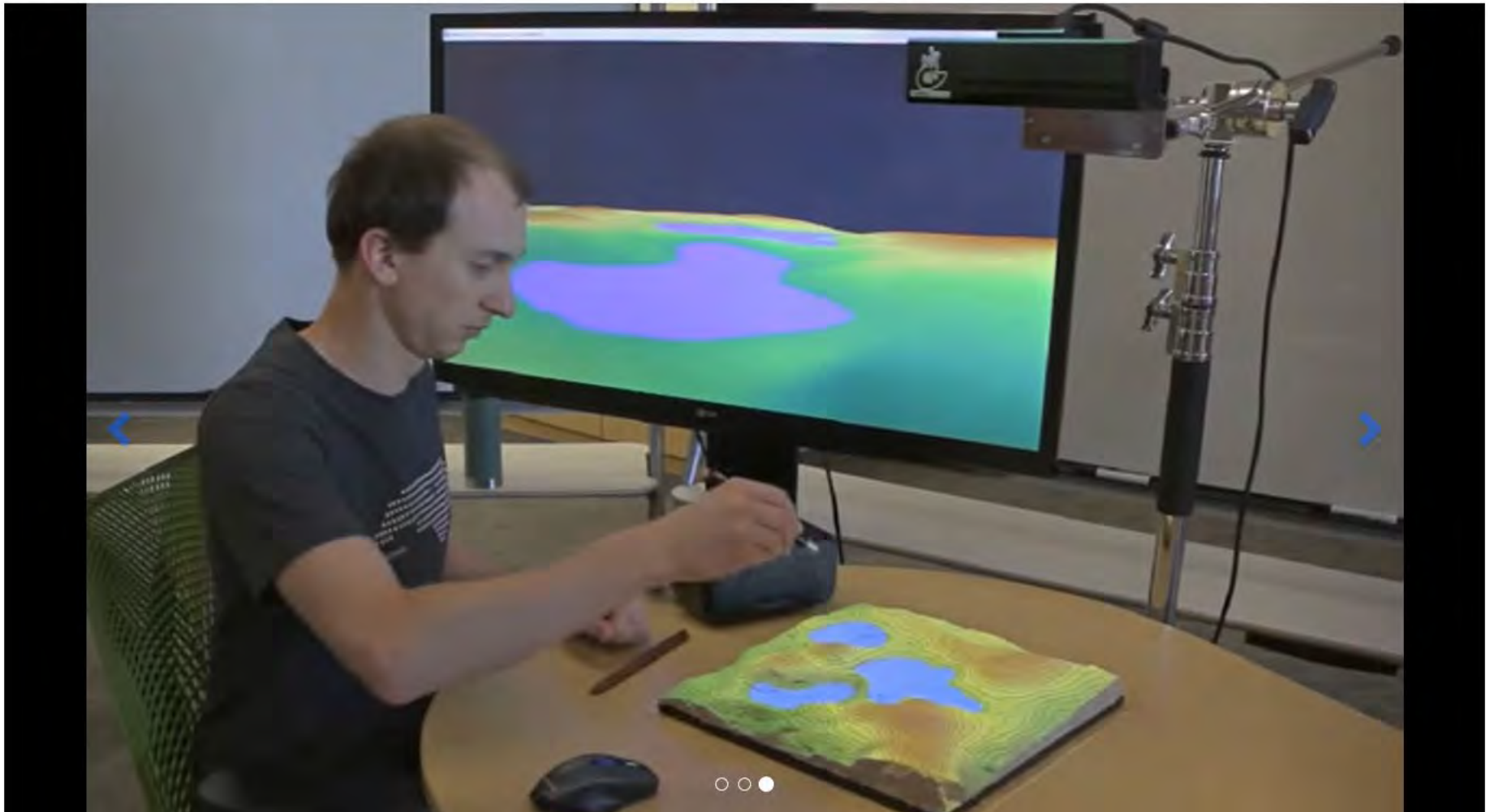
The groundwater component of the Transboundary Waters Assessment Programme (TWAP) provides aggregated information for the main transboundary aquifers and Small Island Developing States (SIDS). The data that has been made available in the **TWAP Groundwater Information System(link is external)** includes core indicators, encompassing the hydrogeological, environmental, socio-economic and governance dimensions of the systems.

Mashreq Water Initiative - Disrup

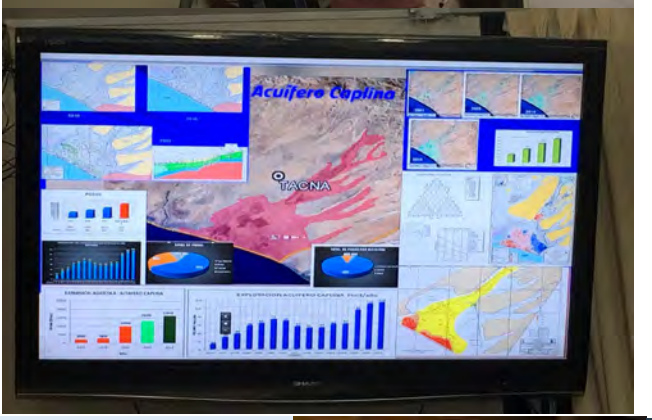
spatialagent.org/MashreqDTGW/gwdtapps.html#information

MASHREQ WATER INITIATIVE - DISRUPTIVE TECH IN GROUNDWATER

Apps, Augmented Reality/Virtual Reality, or hybrid methods such as Tangible Landscape.

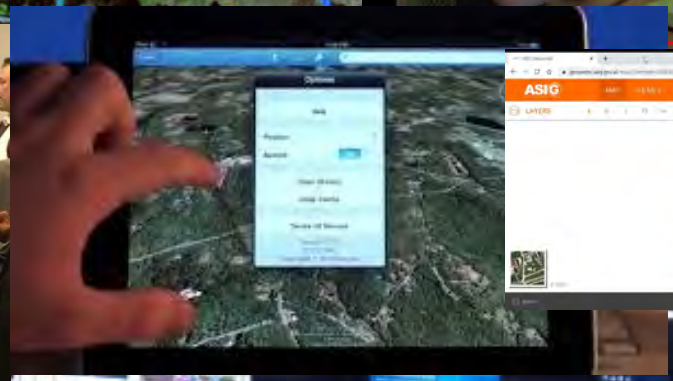


Large Displays



TouchScreens

Physical Interactive Models



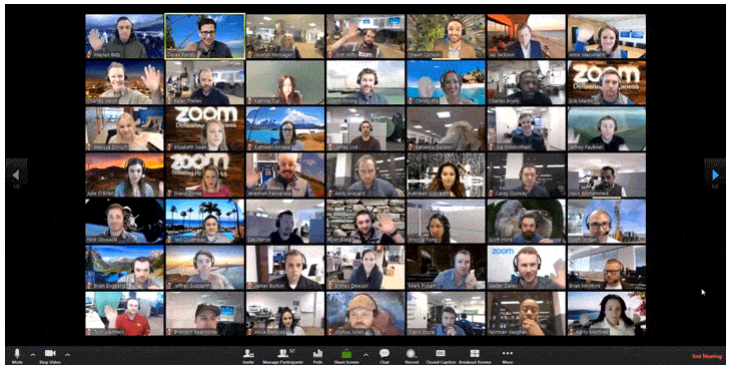
Touch Tables

VR

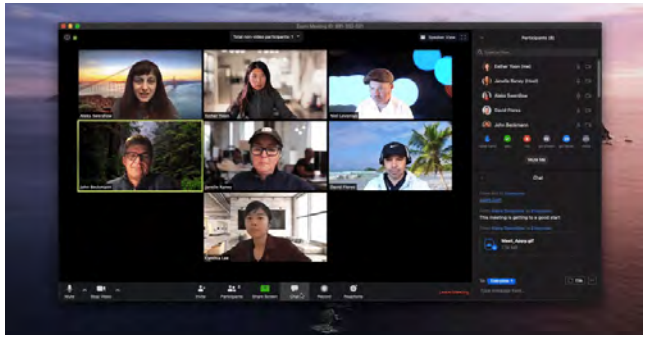
Touch Projectors

Virtual Missions

Satellite Imagery Drone Services
Cloud Analytics/Mapping
Flythroughs

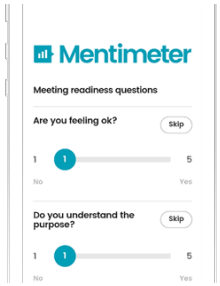


Platform, Translation, Breakouts



Recordings

Reflect in Agenda, Presentations

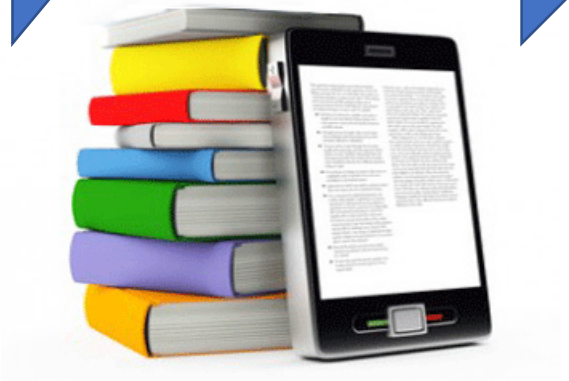


Reflect in e-*Minutes*

Prepare for next Virtual Mission

Online/In-Situ Surveys/Interviews
Digital Twins

Polls, Collaborative Work



Interactive Documents

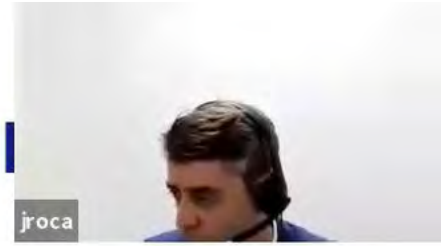
Pre-Mission

Virtual Mission

Post-Mission

Presentation: Remote Supervision Tools for Dam Safety

Collect Field Data - Photogrammetry Models (Construction I



Photogrammetry model from Drone photos

Photogrammetry model from Cell Phone photos

(3D holograms visualized in the office using a HoloLens and Ada Platform)

Pause

1:07:32 / 1:30:07

BGC ENGINEERING INC.

BYU Tethys Portal Groundwater L

tethys2.byu.edu/apps/gw/region_map/

Groundwater Level Mapping Tool

Home

Regional Map

Select Region

Texas

Select Aquifer

Select Data Type

Depth to Groundwater

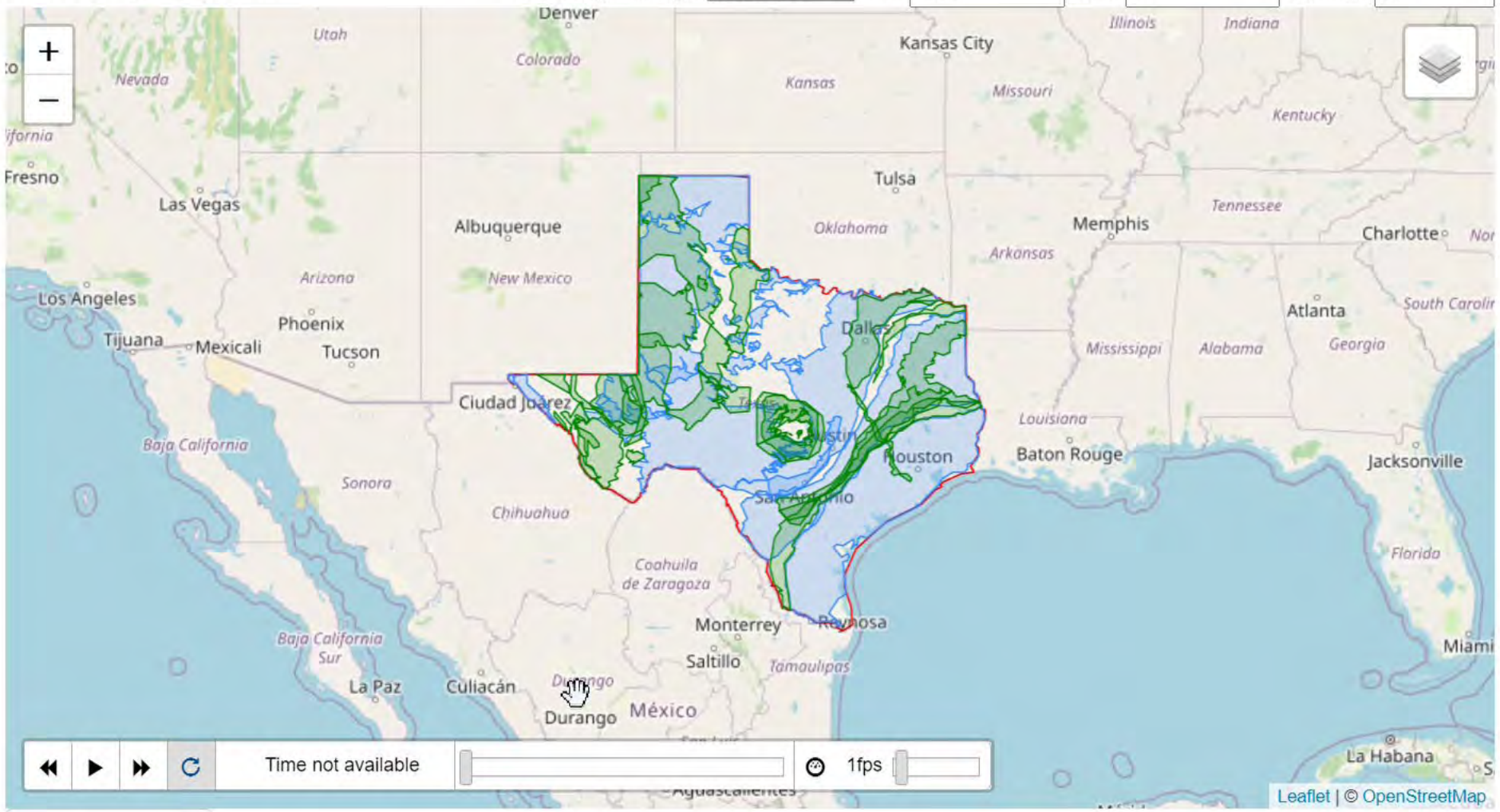
Available Raster Animations

Minimum Samples per Well

5

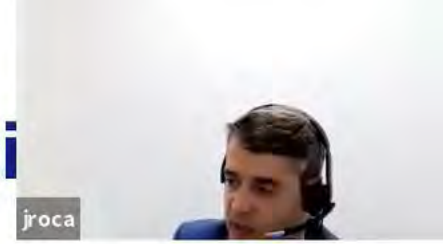
Map Height: 500 pixels

Select Symbology: GRACE Min: -500 Max: 0 Opacity: 0.7

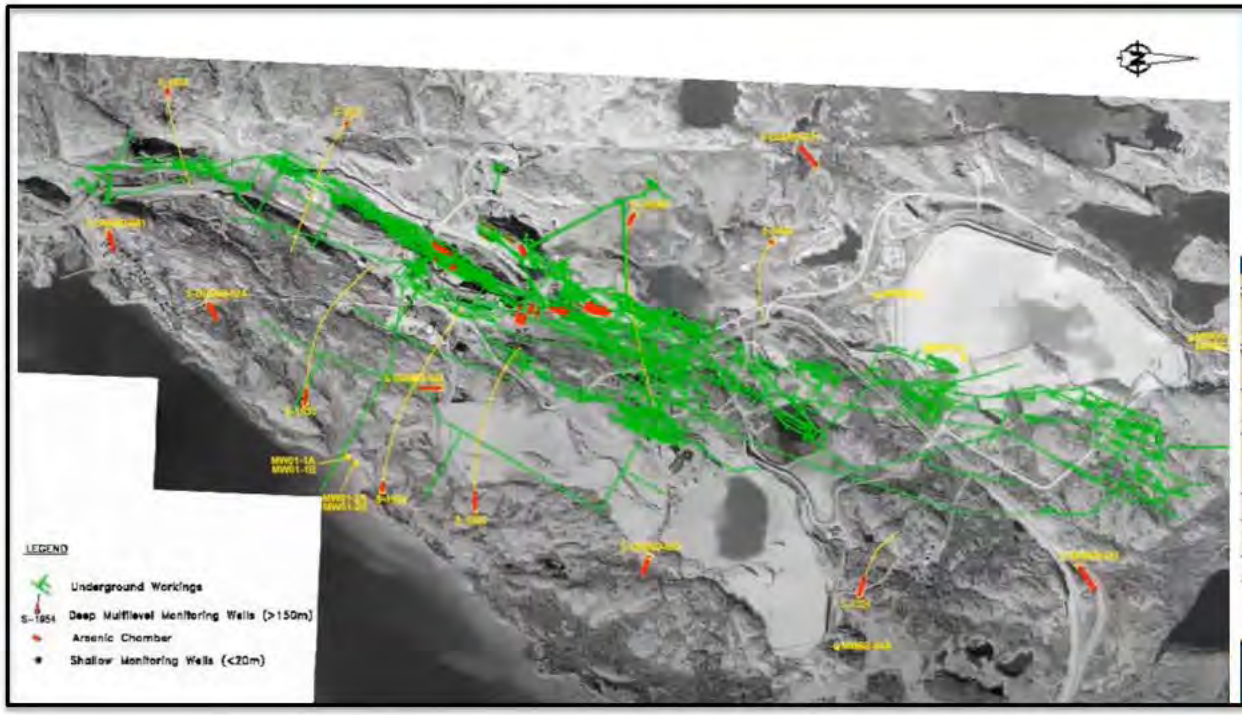


Region Home

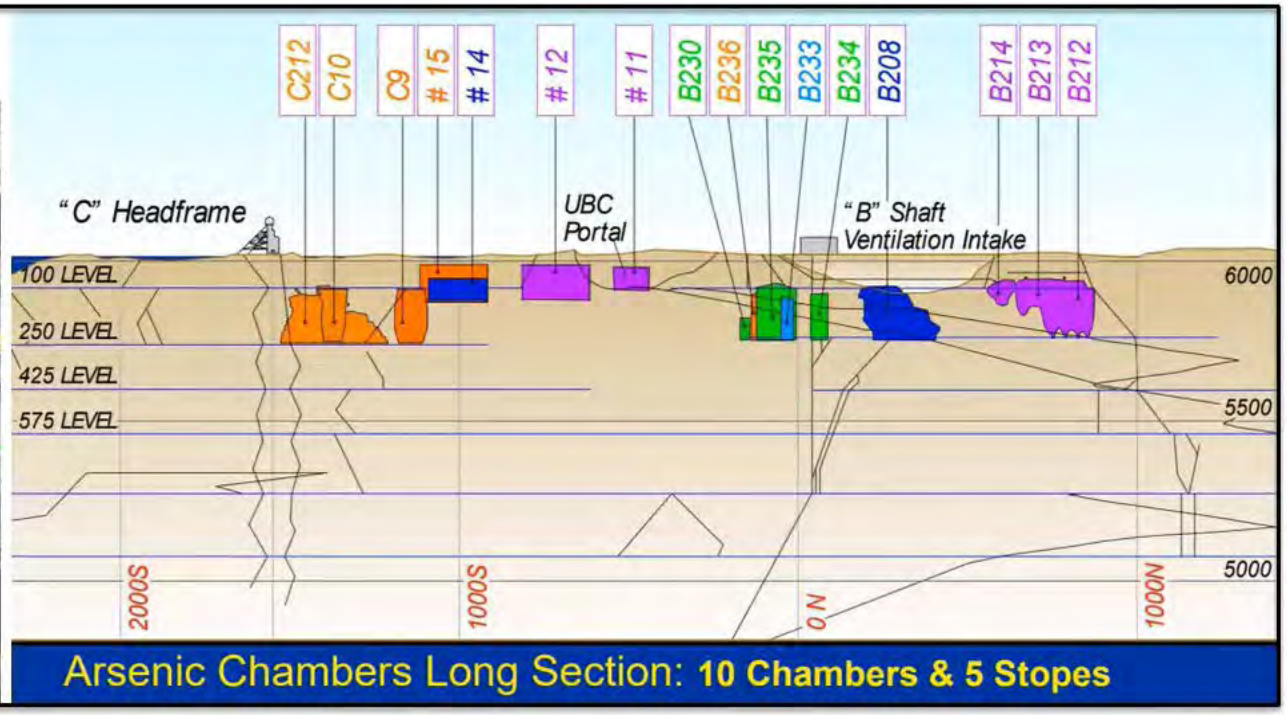
Visualization of 3D Models – Underground Visualizati



Plan View



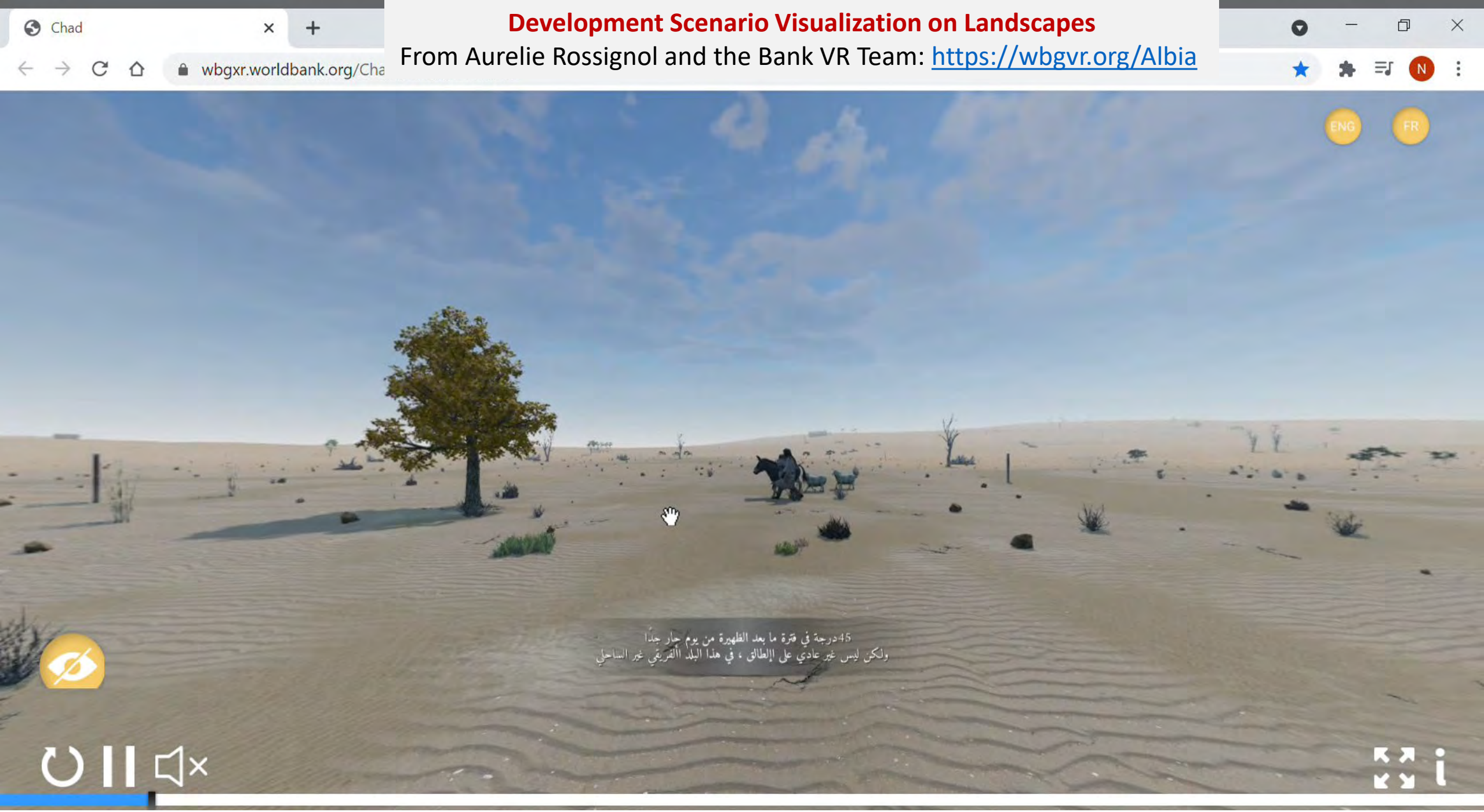
Cross-Section



INSFRASTRUCTURE, IMU SURVEY DATA, RESERVOIR MODELS, BOREHOLE DATA, GEOPHYSICS, INSTRUMENTATION, ETC.

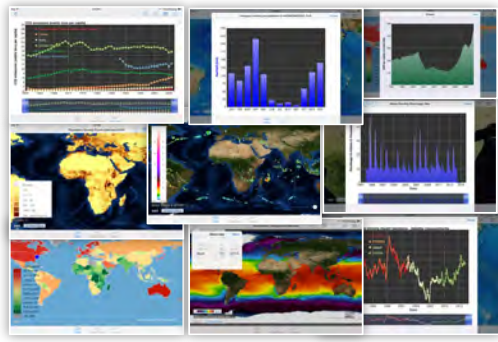
Development Scenario Visualization on Landscapes

From Aurelie Rossignol and the Bank VR Team: https://wbgvr.org/Albia

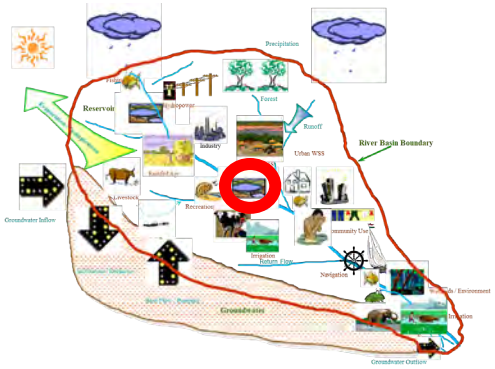


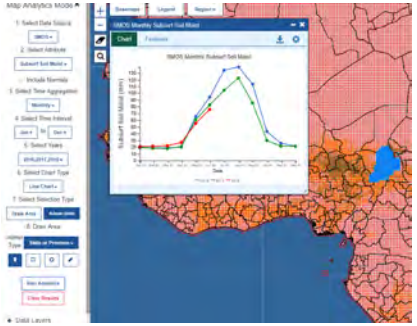
Illustrative Interactive Dashboards

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

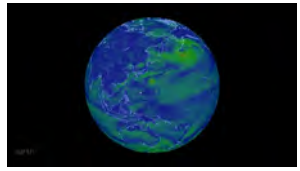
- Irrigation status (crops, crop stage from earth observation and in-situ)
- Soil and sub-surface soil moisture, groundwater (from earth observation and in-situ)…

Other Data & Analytics

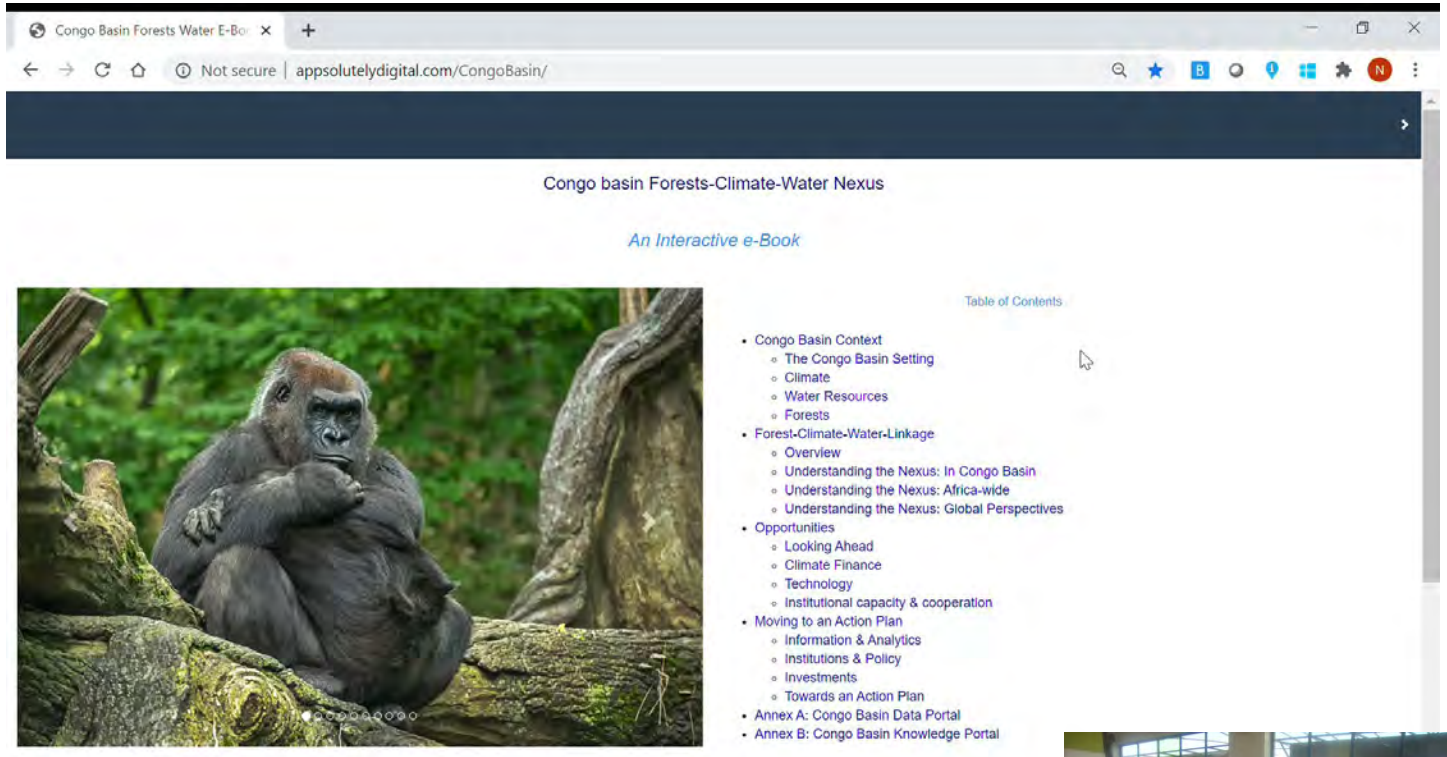
- Inundation forecasts
- Systems water infrastructure needs
- Systems model to explore implications of alternative dam operations
- Hi-resolution Satellite data
- Crowdsourced data

…

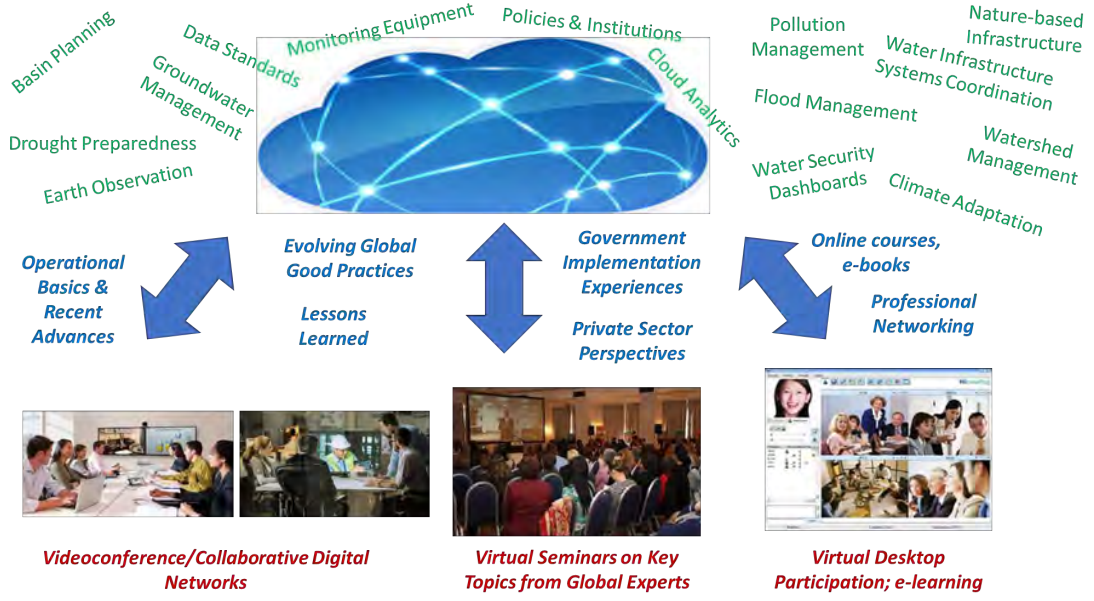
Need to draw upon global and other accessible data and analytic services to make interactive maps, graphs, and analytics for such decision support dashboards that are accessible on portals, apps, e-books, touchscreens, etc.



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



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



Groundwater Management Challenges

Information

Understanding and monitoring groundwater systems (e.g. aquifers, extraction, recharge, quality)

Analytic insights into specific groundwater links to water cycle and inform longer-term planning and shorter-term operational decision support

Institutions

Institutional arrangements to work across spatial and sectoral scales

Capacity, policies, and instruments to effectively manage groundwater effectively and sustainably

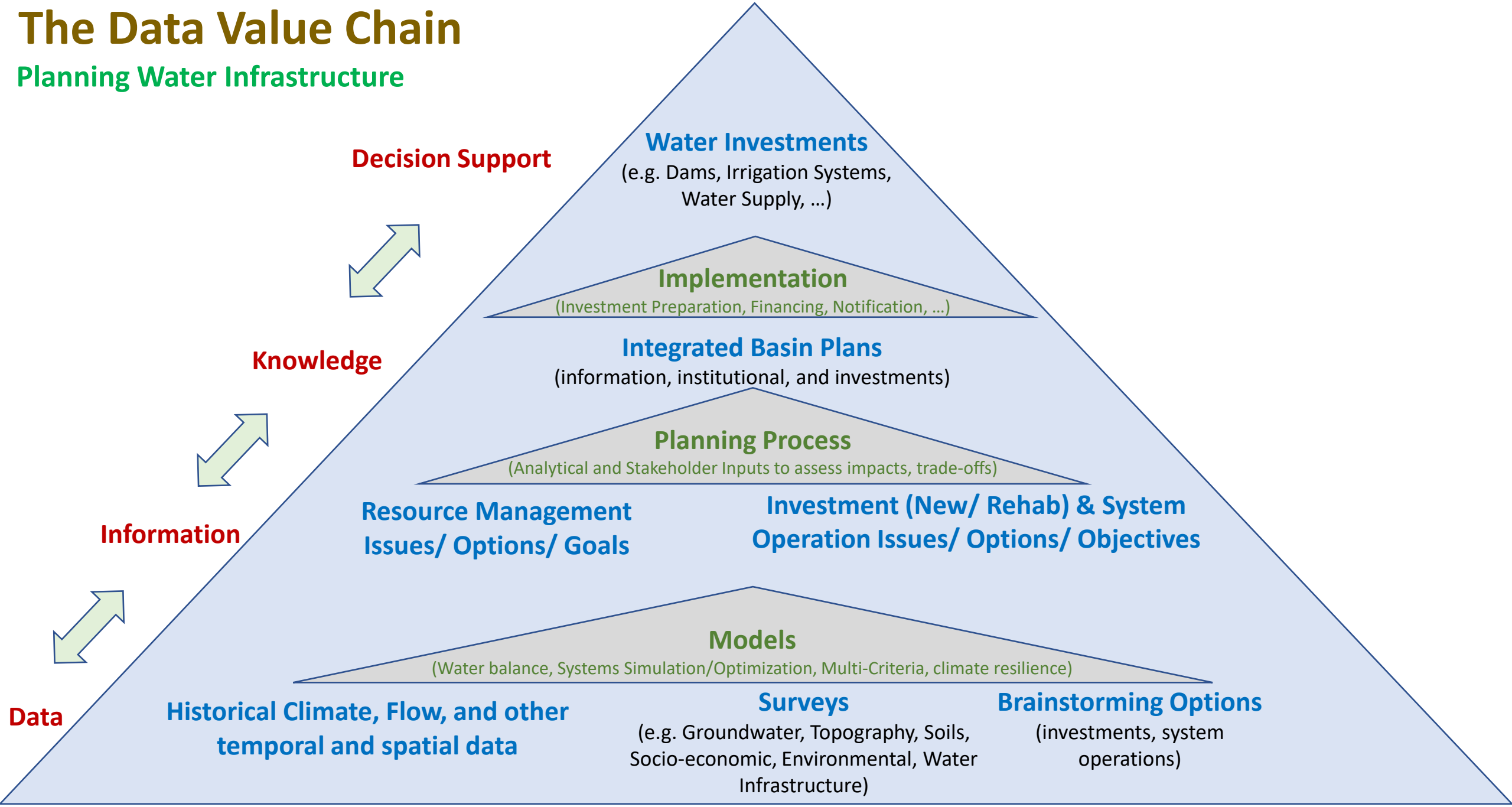
Investments

Planning and operation of extraction and recharge investments in a systems context

Development and climate scenario-based investment planning considering technical, environmental, social, economic, financial, institutional, and other sustainability aspects

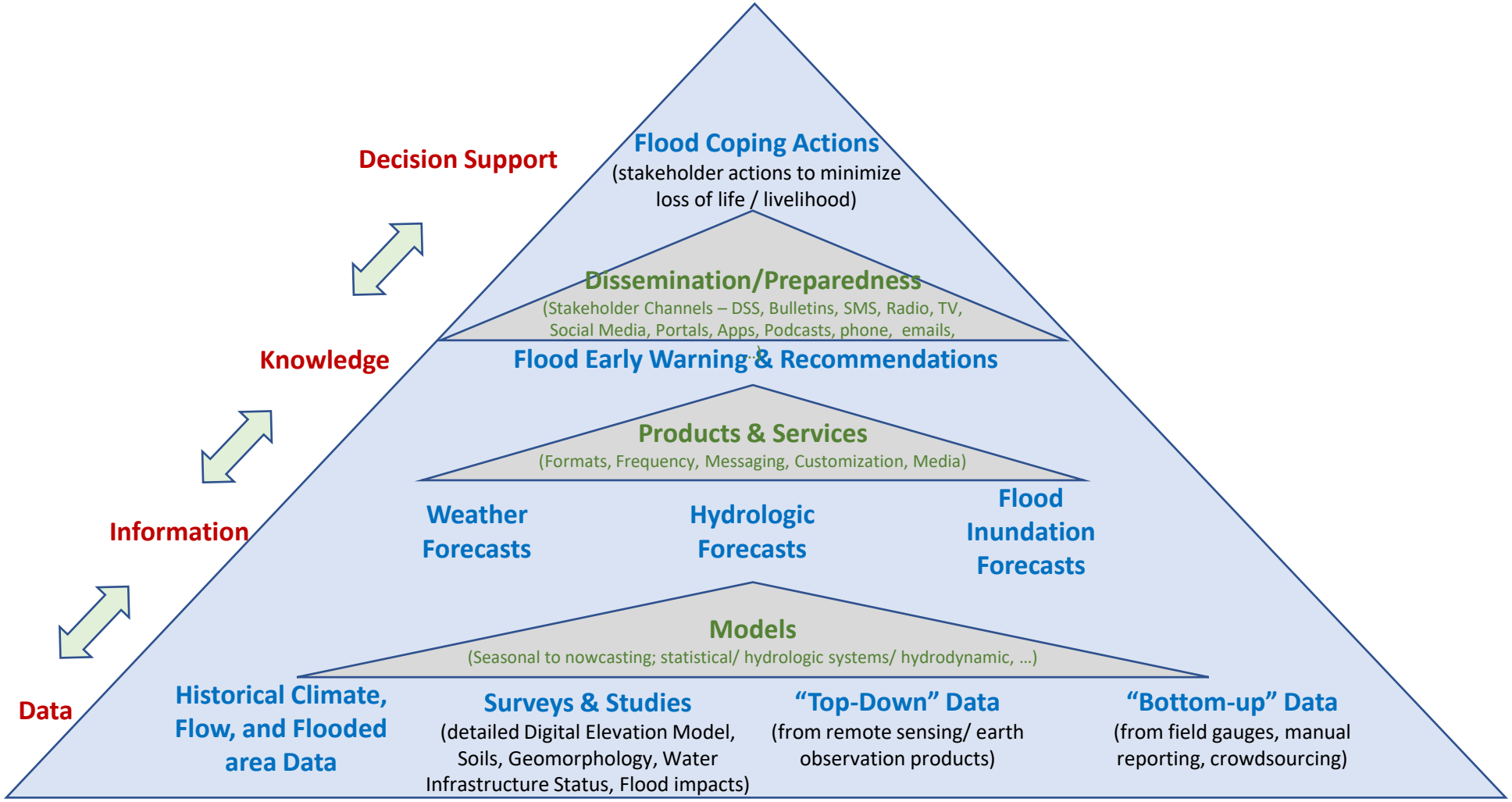
The Data Value Chain

Planning Water Infrastructure



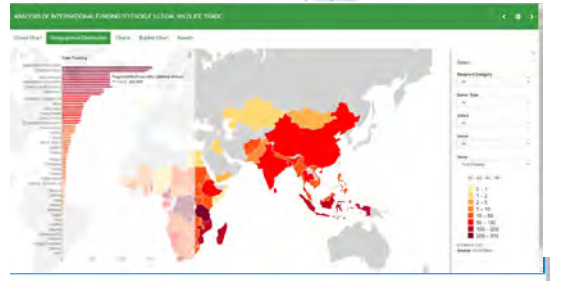
The Data Value Chain

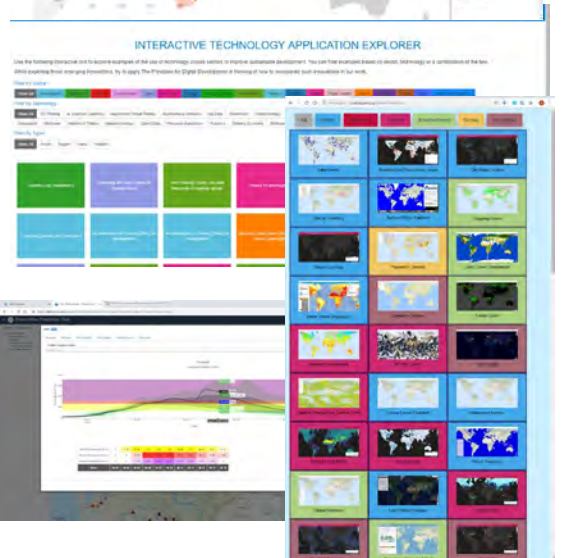
Example: Deciding on Coping with Floods



In Summary

- Rapidly evolving technologies have the potential to “disrupt” traditional challenges in groundwater management
- Reimagine Information, Institutions/Policy and Investments with a broader spatial and sectoral perspective
- Great potential to **leverage (and contribute to) global, regional, and national hydroinformatics data and analytics for local benefit**
- Improve **ecosystem of new open data services and collaboration** across sectors and countries
- **Improved access** to “wholesale” data, analytics, knowledge learning platforms and engaging all stakeholders (incl. youth)



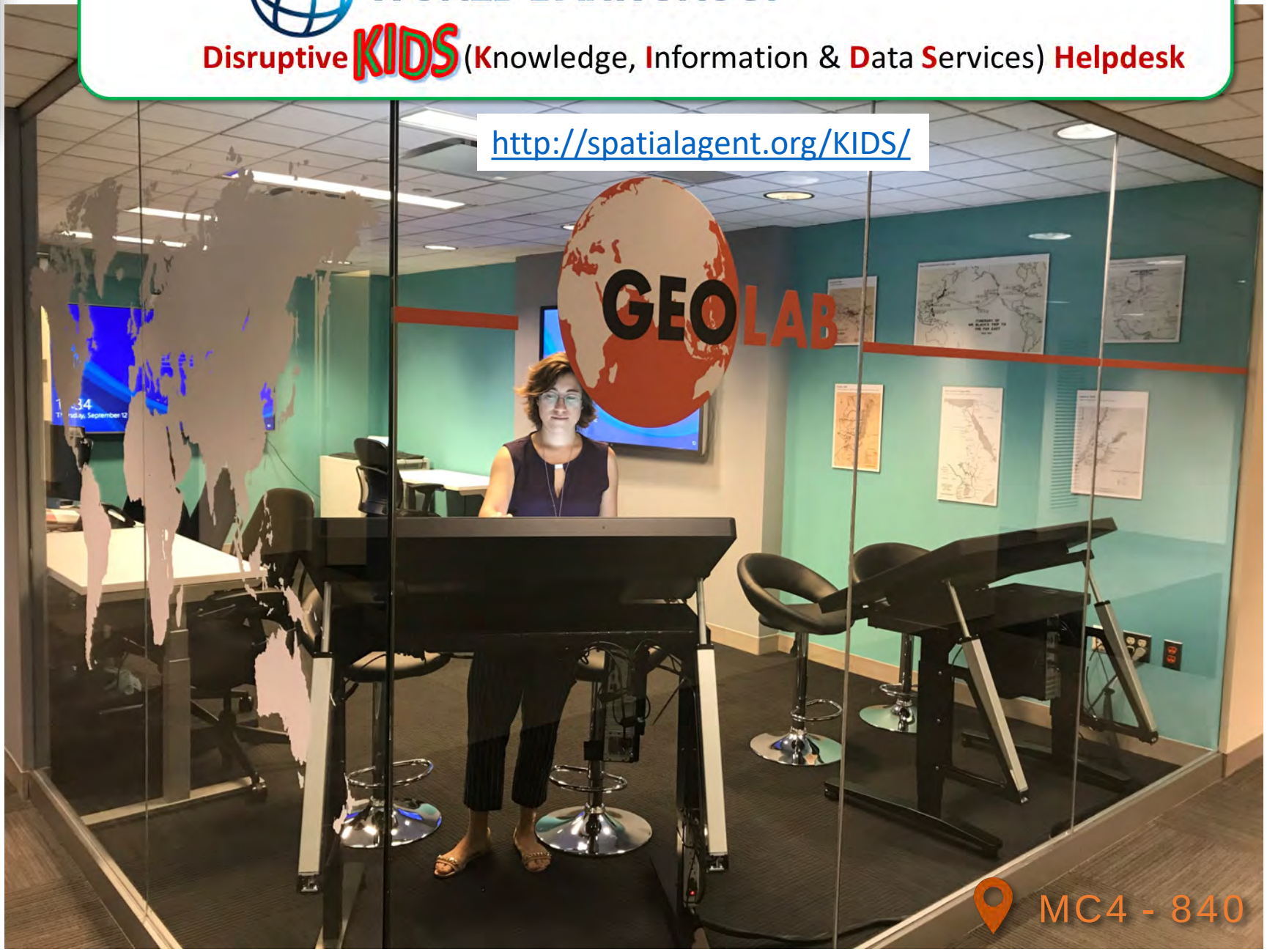


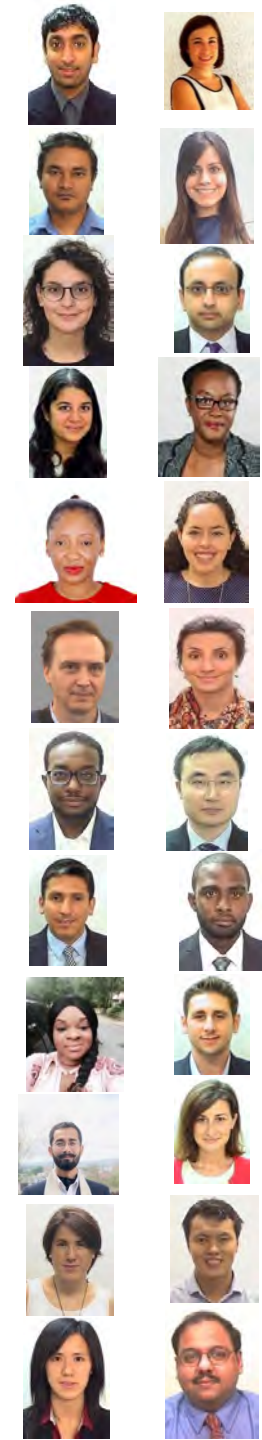
Disruptive Technology

WORLD BANK GROUP

Disruptive KIDS (Knowledge, Information & Data Services) Helpdesk

http://spatialagent.org/KIDS/





Disrupt or Be Disrupted!

Thanks!

http://spatialagent.org/Mashreq/

Nagaraja Rao Harshadeep (Harsh)
Global Lead (Disruptive Technology)
Environment, Natural Resources & Blue Economy Global Practice
The World Bank
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Washington DC 20433
harsh@worldbank.org

WORLD BANK GROUP

Disruptive Technology
WORLD BANK GROUP
Disruptive KIDS (Knowledge, Information & Data Services) Helpdesk

http://spatialagent.org/KIDS/

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