

Technological Disruption of Transboundary Water Data & Information

Nagaraja Rao Harshadeep
Global Lead (Disruptive Technology)



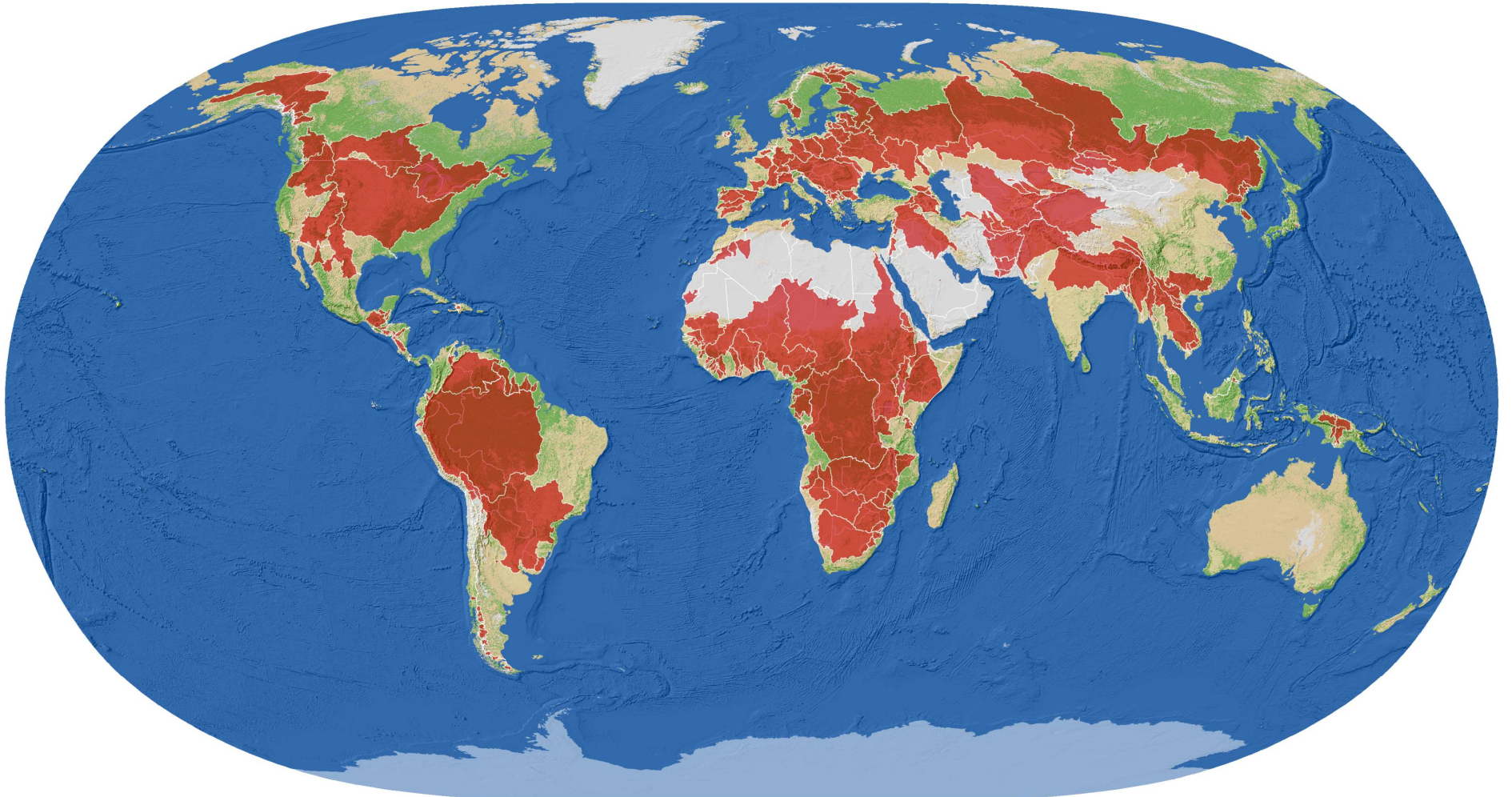
Session III Improving Transboundary Data Availability, Access & Exchange

Workshop on Strengthening Legal and Institutional Arrangements for Transboundary Water Cooperation and Data and Information Exchange

Beirut, Lebanon

30-31 May, 2023

GLOBAL TRANSBOUNDARY BASINS



■ TRANSBOUNDARY BASINS

Data Source: Transboundary Water Assessment Program (TWAP)

Global Transboundary Basins Facts

Every Watershed is Unique!

ARAL SEA

GANGES-BRAHMAPUTRA

INDUS

LAKE CHAD

MEKONG

NIGER

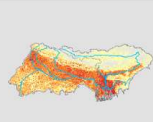
NILE

TARIM

TIGRIS-EUPHRATES



54 Million



732 Million



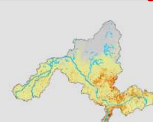
201 Million



48 Million



67 Million



115 Million



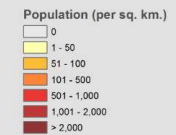
238 Million



11 Million



60 Million



Total Pop. (2012)



38 Billion



395 Billion



134 Billion



20 Billion



46 Billion



42 Billion



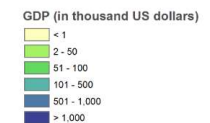
168 Billion



19 Billion



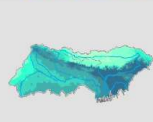
83 Billion



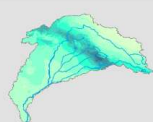
Total GDP (2014)



318 mm



1,215 mm



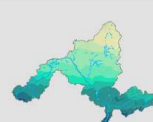
424 mm



358 mm



1,531 mm



662 mm



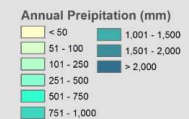
628 mm



94 mm



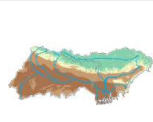
318 mm



Basin Avg. (1950-2000)



9 °C



18 °C



12 °C



27 °C



21 °C



27 °C



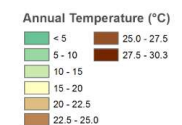
25 °C



3 °C



18 °C



Basin Avg. (1950-2000)



18 Mil Ha



71 Mil Ha



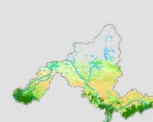
22 Mil Ha



30 Mil Ha



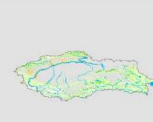
27 Mil Ha



50 Mil Ha



57 Mil Ha



4 Mil Ha



27 Mil Ha

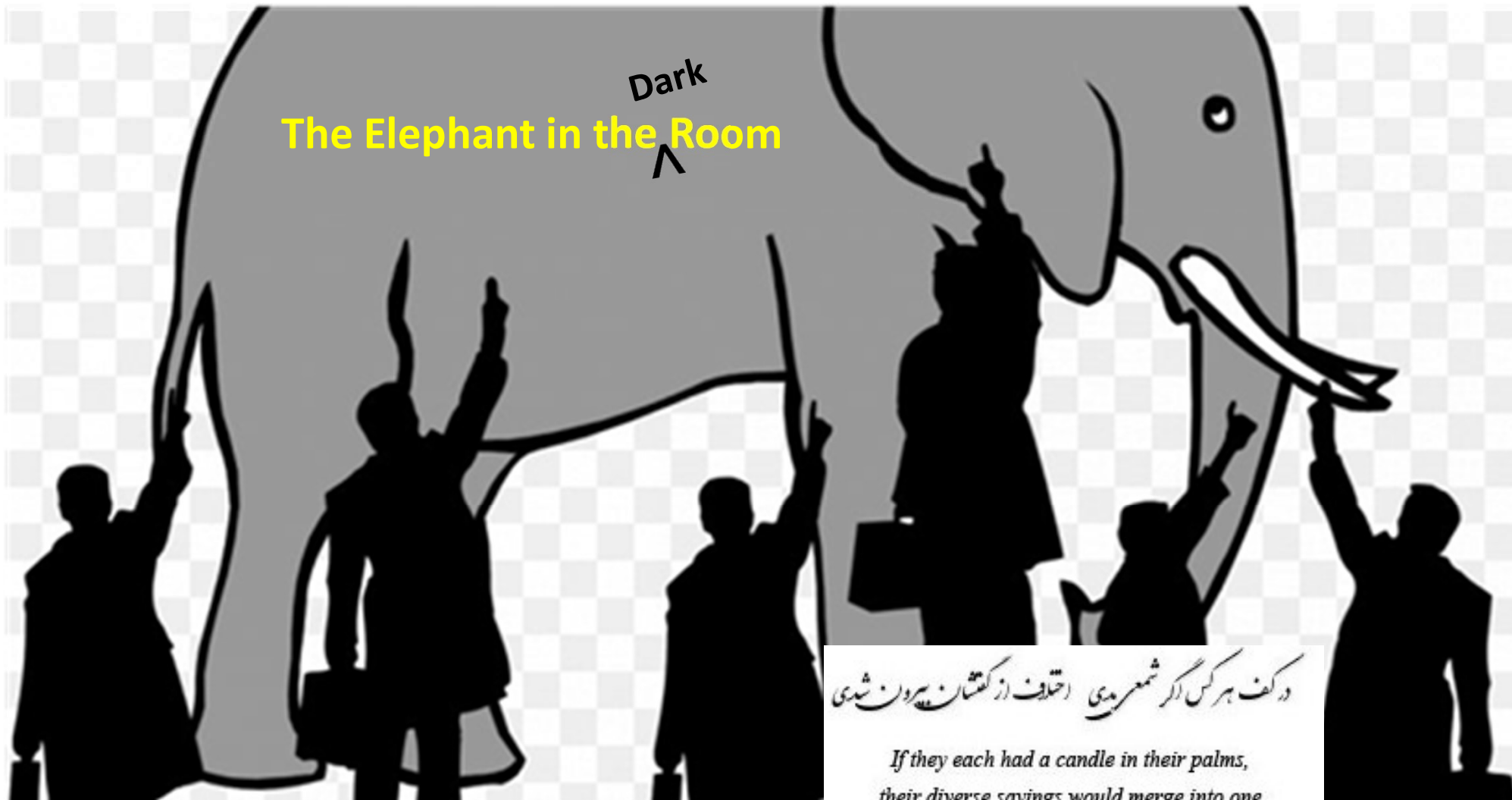


Total Cropland (2015)

Population: Oak Ridge National Laboratory (ORNL); GDP: DECRG, The World Bank; Landcover: ESA; Climate Data: World Clim

Note: Total and average figures are derived using GIS processing.

Transcending narrow sectoral perspectives...

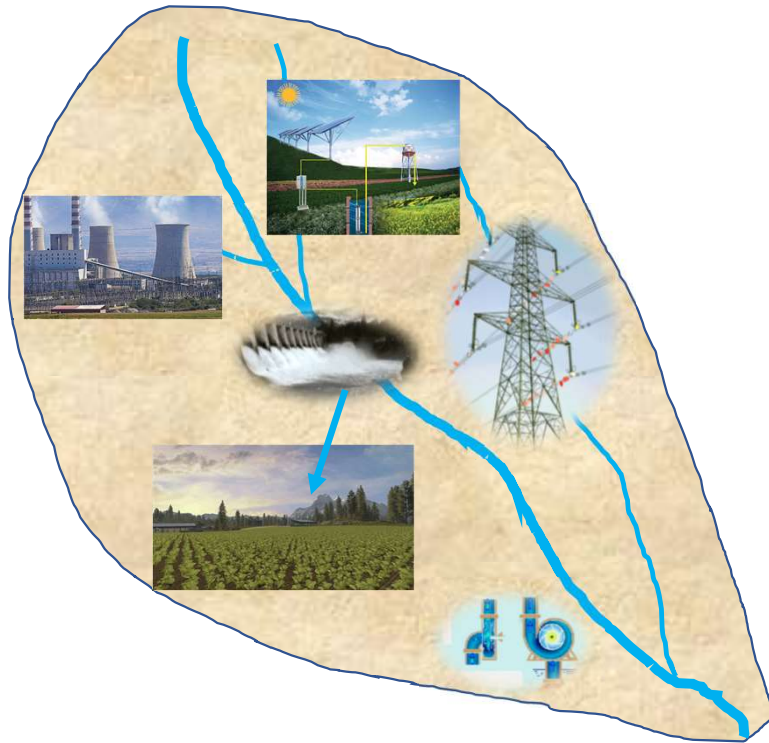


Dark
The Elephant in the Room
^

د کف هر کس اگر شمعی می داشت از گفتار بیرون شدی

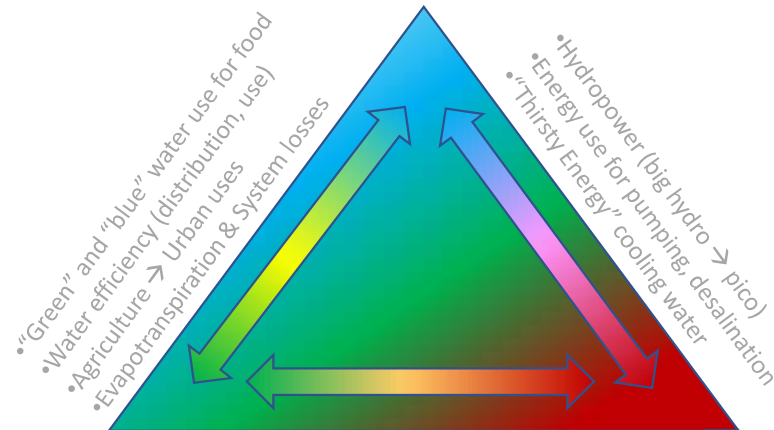
*If they each had a candle in their palms,
their diverse sayings would merge into one.*

The Water-Energy-Food Nexus



- Basin planning
- Monitoring
- Water infrastructure (storage, distribution) system operations

Water Security



Food Security

- Sustainable production
- Value chain mgmt. from inputs to consumption (e.g. agriculture, livestock, fisheries)

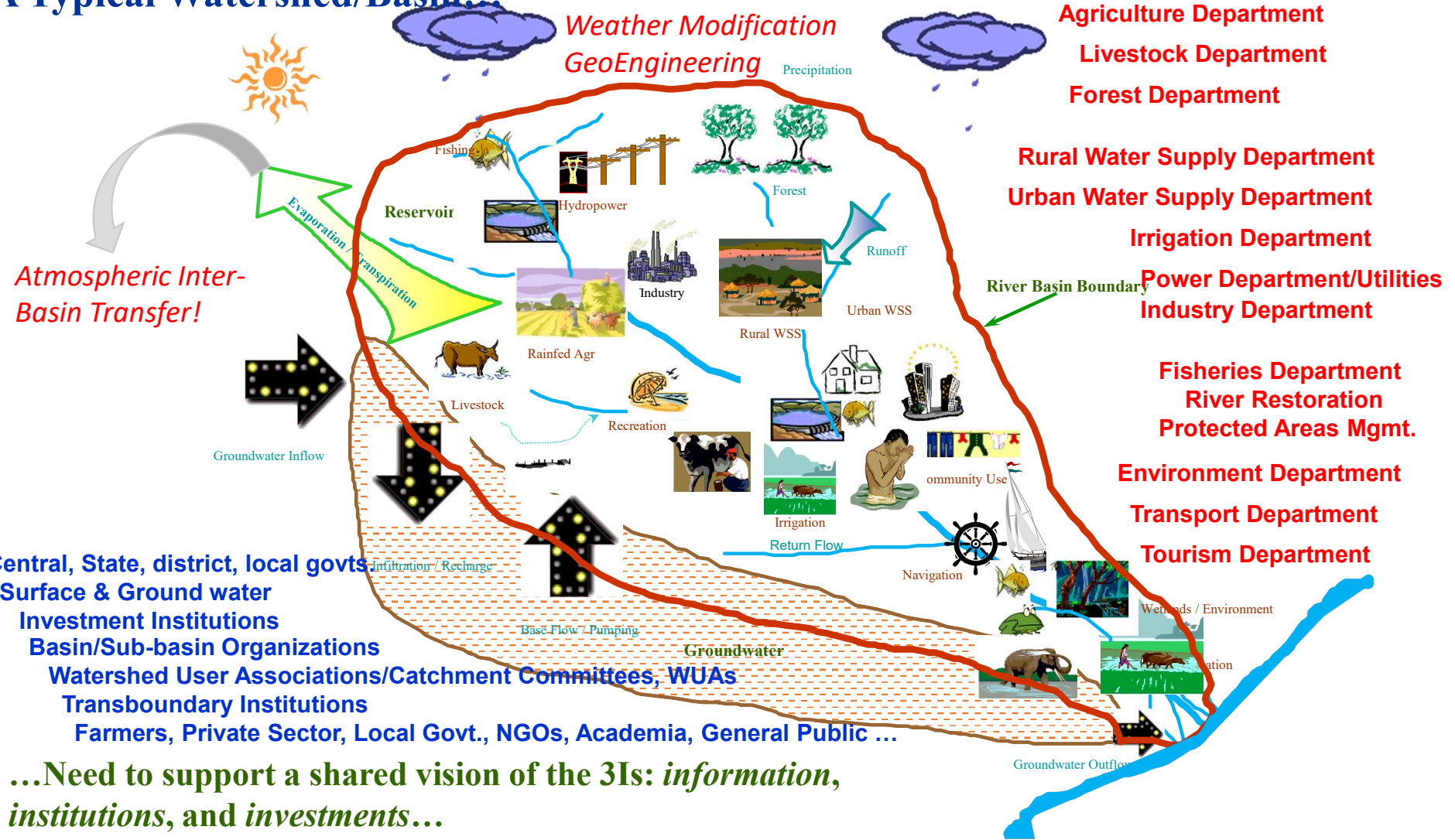
- Agricultural energy use (e.g. pumping)
- Solar Pumps
- Biofuels
- Energy use for Inputs, Processing

Energy Security

- Energy systems optimization - planning & operation
- Energy access
- Energy efficiency

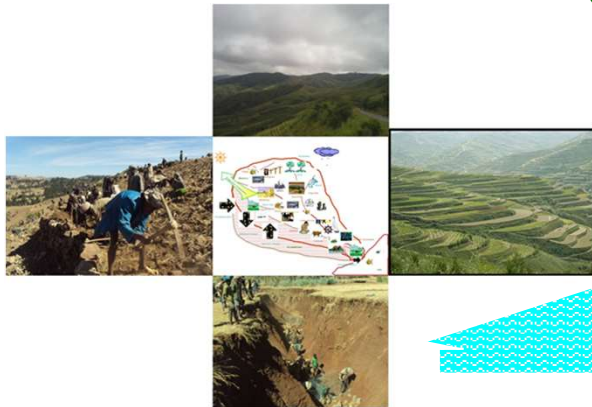
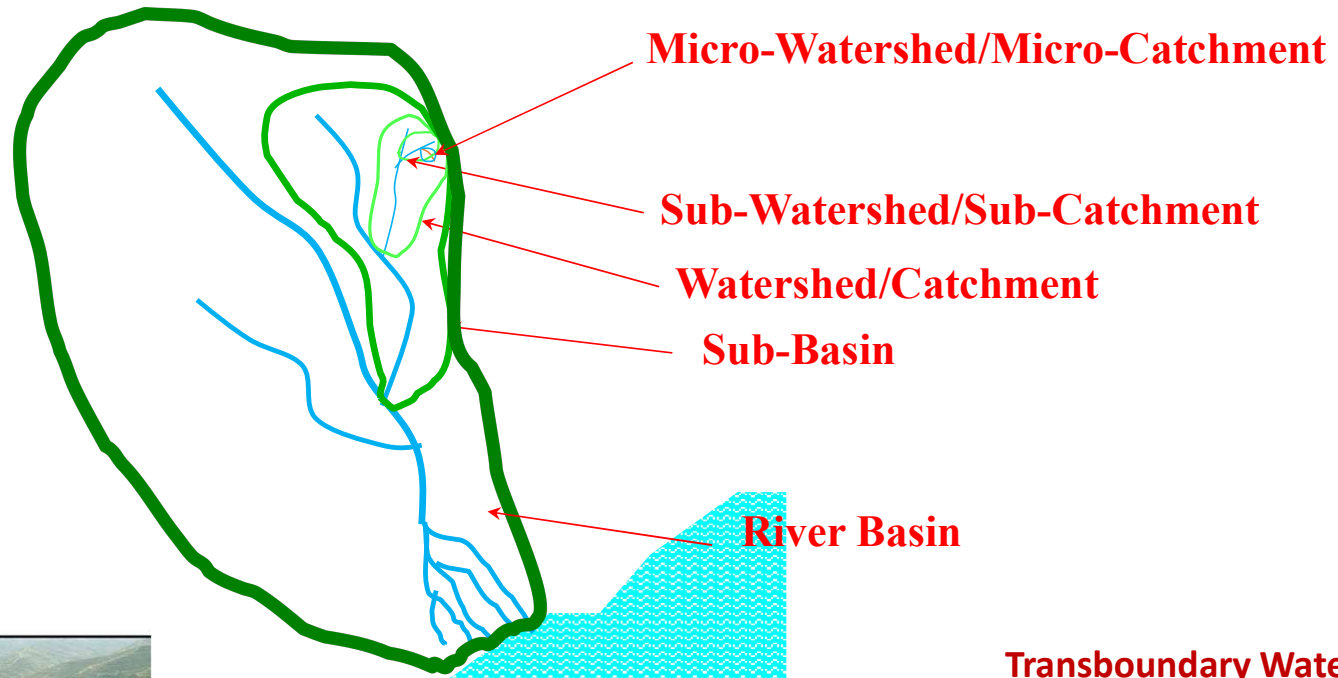
Multiple sectors, multiple institutions, linked by water and natural resources...

A Typical Watershed/Basin...



...Need to support a shared vision of the 3Is: *information, institutions, and investments...*

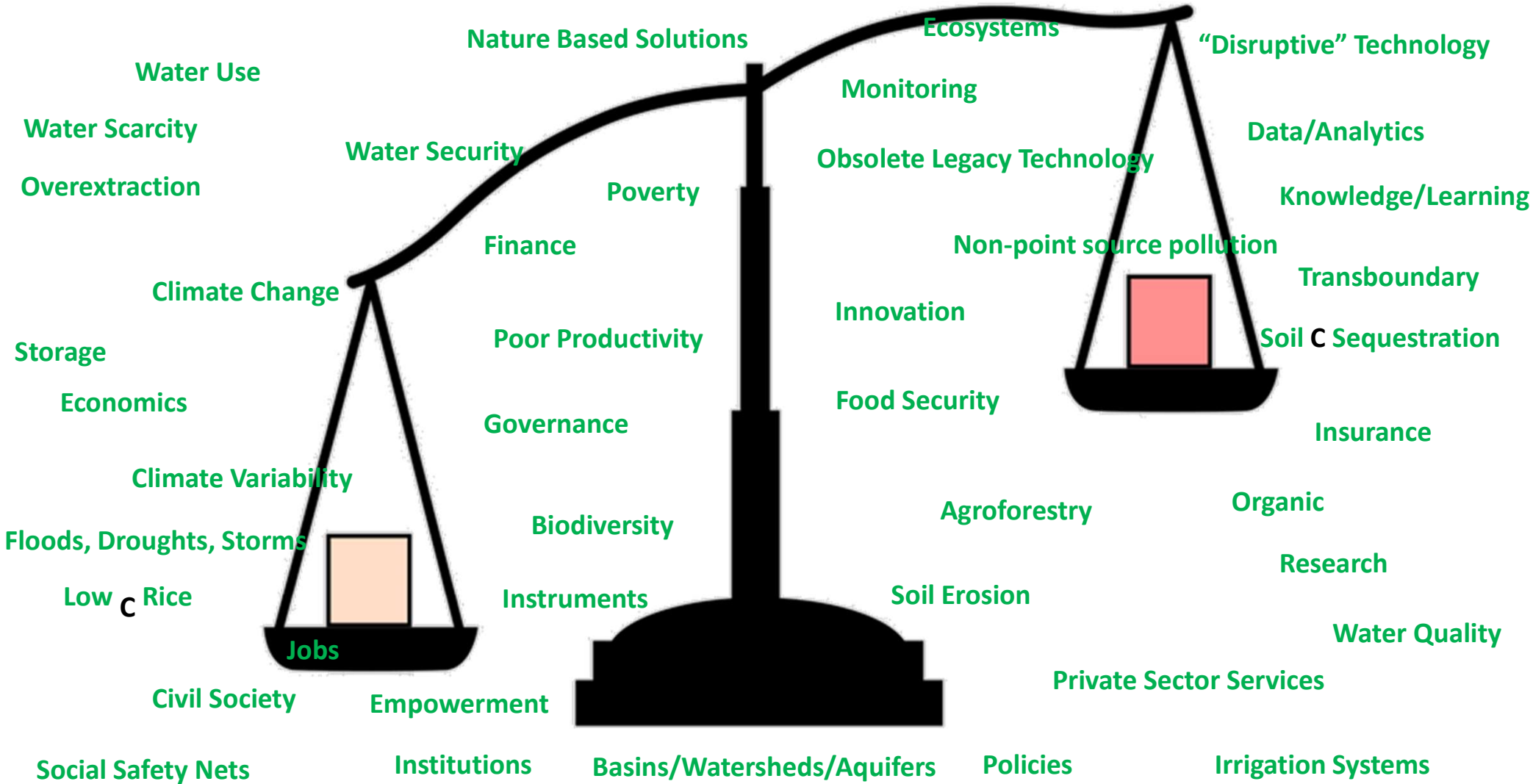
Scales



Transboundary Water Contexts:

- River Basins
- Lake/Inland Sea Basins
- Groundwater Aquifers
- Marine Areas





Major Transboundary Waters Challenges

Information

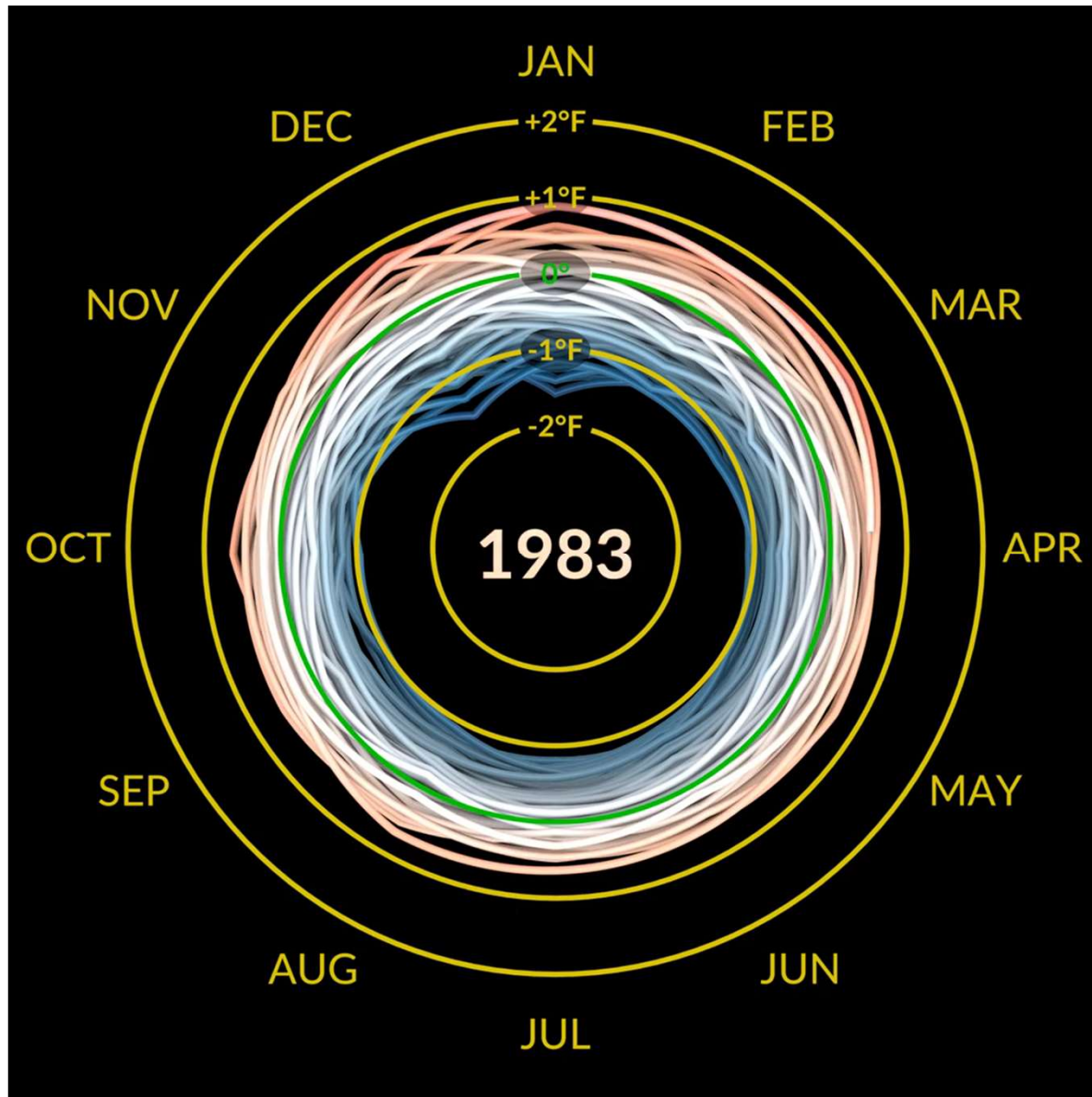
- Inadequate monitoring (e.g. real-time, coverage) – weather, snow, glaciers, levels, flows, groundwater, water quality, biodiversity, etc.
- Poor data access (especially in the public domain)
- Poor knowledge base (e.g. elevation in flood-prone areas, groundwater, water quality)
- Poor mainstreaming of climate risks (e.g. historical variability, climate change)
- Poor tools for planning (investment, resource) and management (e.g. forecasting, system operations within and across boundaries)

Institutions

- Inadequate institutional arrangements (e.g. transboundary water institutions/coordination)
- Poor institutional capacity and country commitment to regional organizations
- Poor access to global good practice
- Poor contribution to global good practice
- Poor use of ICT/modern tech
- Poor links with potential partners (e.g. academia, CSOs, private sector, etc.) at various levels (global, regional, national, local)

Investments

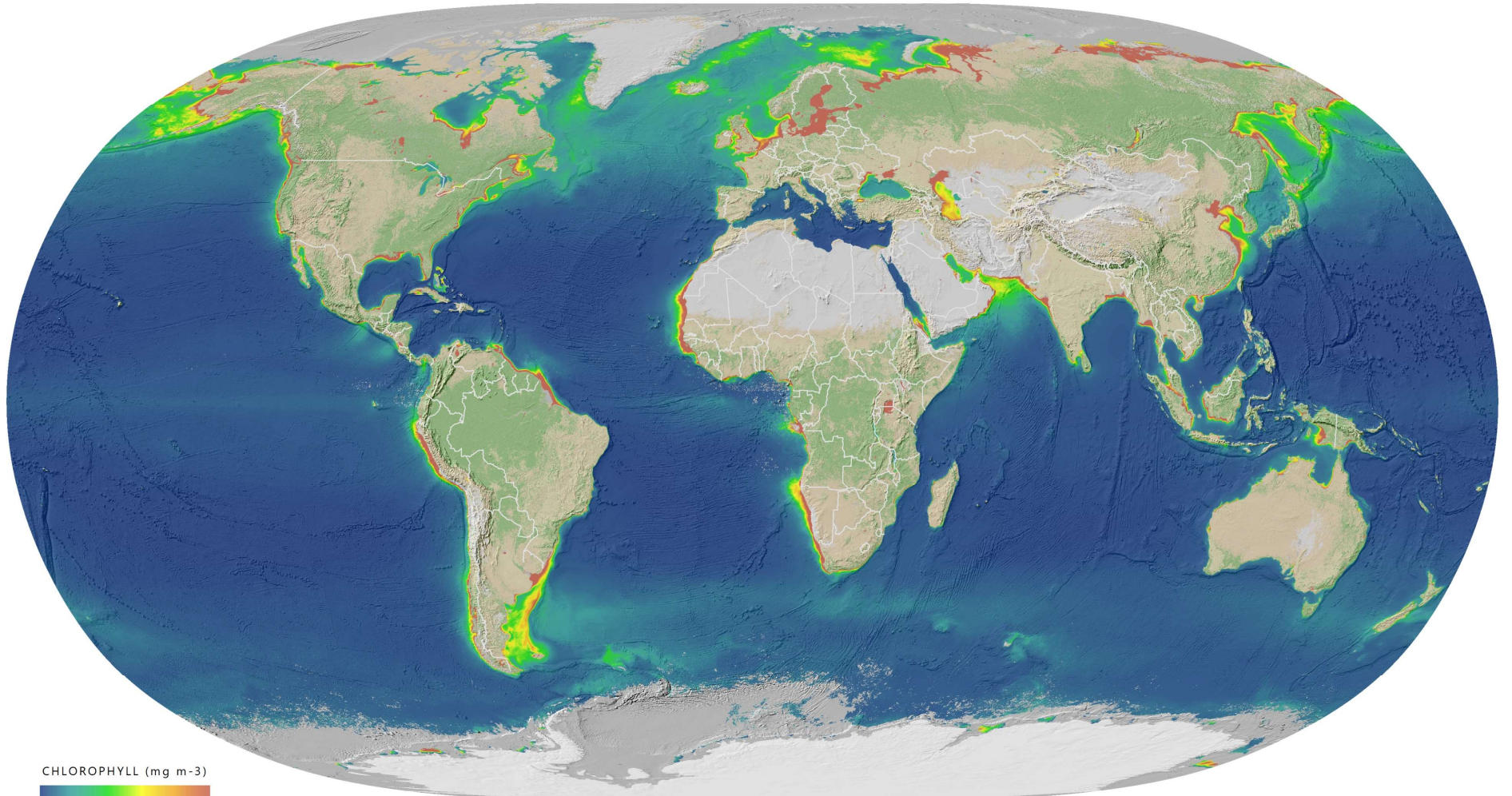
- Poor monitoring infrastructure
- Poor institutional infrastructure (operational centers/control rooms, computer training rooms, VCs, etc.)
- Inadequate investments (e.g. water infrastructure, watersheds, complementary and enabled infrastructure) contributing to, enabled by, or requiring regional cooperation
- Disputes during infrastructure creation/operation



Source: [NASA](#)

WATER CHLOROPHYLL

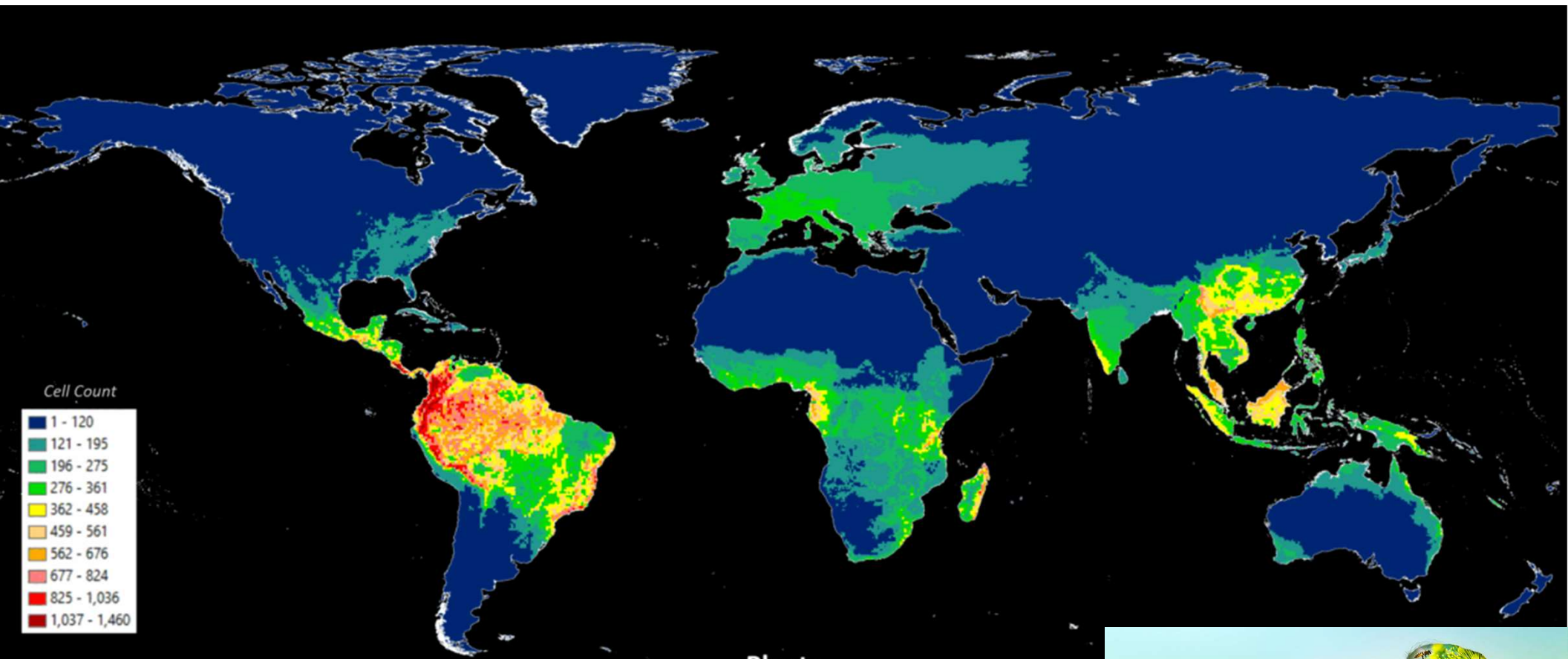
(2002-2021 AVERAGE)



CHLOROPHYLL (mg m⁻³)

Low : 0.019 High : 66.5

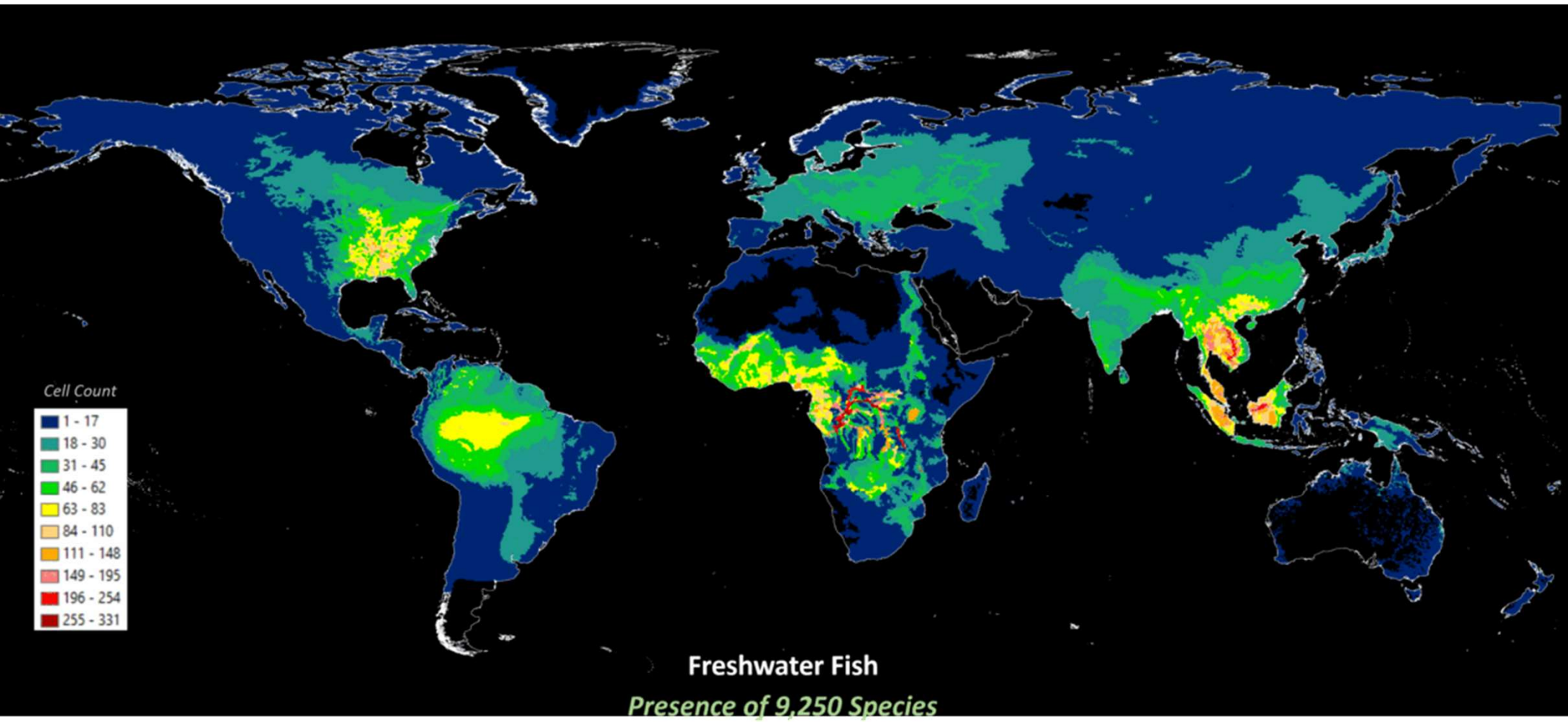
Data Source: MODIS-Aqua, NASA



Plants

Presence of 33,080 Species



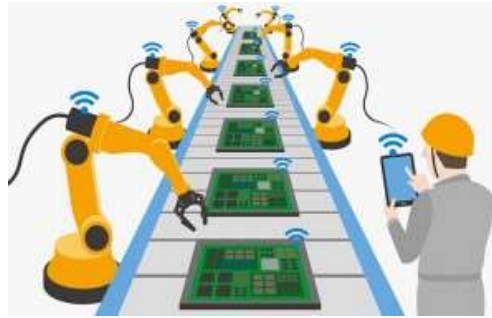


A new world of “Disruptive Technology”



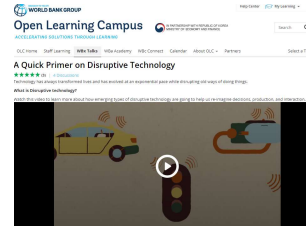
“Disrupt” data value chains

- **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 Twins”
- 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...
- Blockchain enabled value chains
- Maker movement/DIY/Tech Incubators...
- Virtual learning/re-skilling...

Disruptive tech could help us reimagine global development

Making "smart development" wrt climate, water and natural resources, energy, food, waste, mobility, knowledge, services, networks



Online Services



Broadband & Smartphone Access

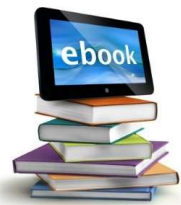
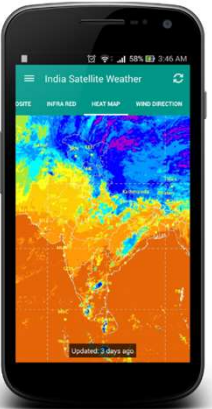
Apps, e-services & e-learning



Planning



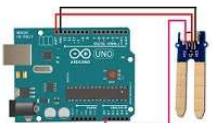
Access to a new world of Data, Information, Knowledge and Services



3D Printed Infrastructure



Sensors/IoT (e.g. for soil moisture)



Drones/UAVs (e.g. for monitoring, seeding, delivery)



Looking Ahead in the Transboundary Water World...



Tech-facilitated Transboundary Waters Solutions

Information

- Comprehensive Knowledge base (hydrology, environmental/climate, socio-economic, infrastructure, ...)
- Online data services & cloud services
- Real-time monitoring/analysis (e.g. nowcasting, forecasting – weather, flows/levels, flood, drought)
- Climate risk management (variability, change)
- E-packaging (dashboards, interactive documentation, eBulletins,...)
- Investment and Resource Planning and operational coordination decision support systems (DSS)

Institutions

- Innovative capacity development (e.g. tech awareness/skills, e-learning)
- Basin/sub-basin organization collaboration platforms
- Partnerships/ outreach (internships, diaspora, hackathons, private sector services)
- Access and contribution to global good practice

Investments

- In-situ monitoring
- Modern Institutional Infrastructure (e.g. for basin/sub-basin coordination)
- Shared innovative water systems infrastructure design, planning, financing, implementation
- Coordinated water infrastructure filling/operating

Information & Analysis Trends

What's Out?

Are we part of the problem?



What's In?

Can we be part of the solution?



Paper Records/Publication

Inadequate and Inaccessible Data

“Retail” info systems & modeling

Reliance on Websites and Pdfs

“Have you registered first?”

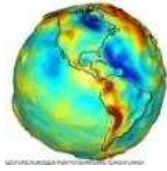
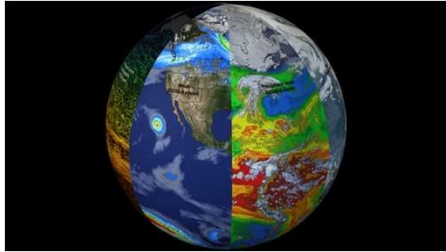
“Tell me why you need the data”

Online interoperable OGC data service formats/ Open APIs

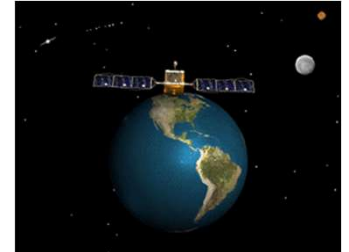
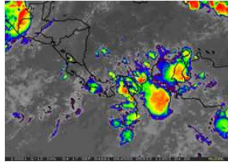
Free and subscription services

“Wholesale” Cloud Analytics

Separate data services and consumption platforms (e.g. dashboards, Interactive documentation)



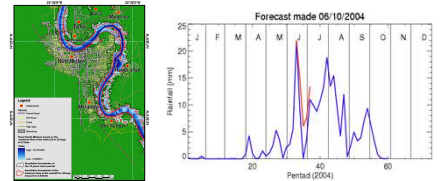
“Top-Down” Data Acquisition System



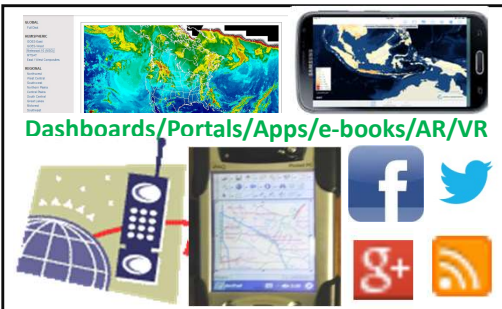
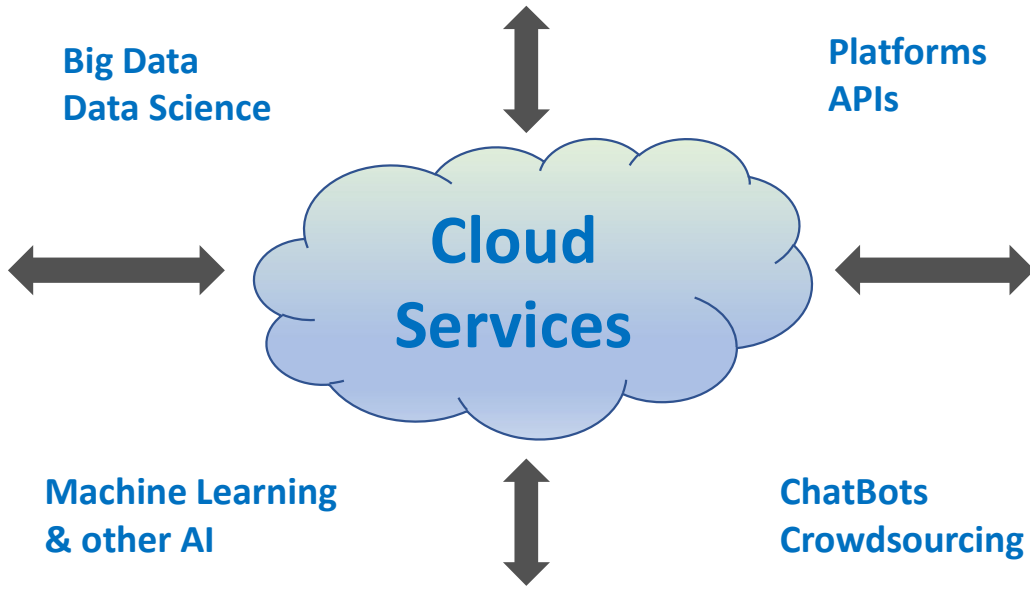
Satellite & Aerial Earth Observation



Data Rescue
GIS and other datasets



Data Management
Analytics/Models



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



Stakeholder Alerts

Operational Control Rooms



Manual Monitoring
Crowdsourcing



Automated Monitoring

“Bottom-up” Data Acquisition System → IoT



3D Printed Monitoring Stations, Kenya

[3D PAWS](#)

3D Kenya

CHORDS EarthCare 3D PAWS

About Help Dashboard Sites Instruments Map Visualization Sign In

http://3d-kenya.chordst.com/measurements/url_create?instrument_id=4&ws=0.00&key=hidden

● Kenya_GLOBE_04 (id: 4) (sensor_id: 4) located at Thomas Mboya High School
 Description: 3D-PAWS at Thomas Mboya Secondary School, Kenya
 This instrument is designated as: ACTIVE
 (If 'INACTIVE', the instrument will not appear in the dashboard.)

Measurements
 1551068 measurements were reported.
 This instrument is expected to report a measurement every 600 seconds.
 The first measurement was measured at 2018-08-18 12:19:48 UTC.
 The last measurement is 12 days old: it was measured at 2021-03-11 12:45:33 UTC.

Plot measurements for the last 1 weeks
 Kenya_GLOBE_04 - Live Data

From Mar 11, 2021 10:30:02 To Mar 11, 2021 12:45:04

Legend: HTU21D_T, HTU21D_RH, BMP180_SLP, BMP180_SP, BMP180_T, MCP3000, precipitation, wind speed, wind direction, SI1145_WS, SI1145_R, SI1145_LUV

Short Name	Name	Units	Min/Max (Plot)	Measured Property
t1	HTU21D_T	percent %	/	Temperature
rh1	HTU21D_RH	percent %	/	Humidity Value
msl1	BMP180_SLP	percent %	/	Sea Surface Pressure
sp1	BMP180_SP	percent %	/	Air Pressure Value

Creative Economy...pdf sustainability-12-0...pdf Show all

Community Monitoring

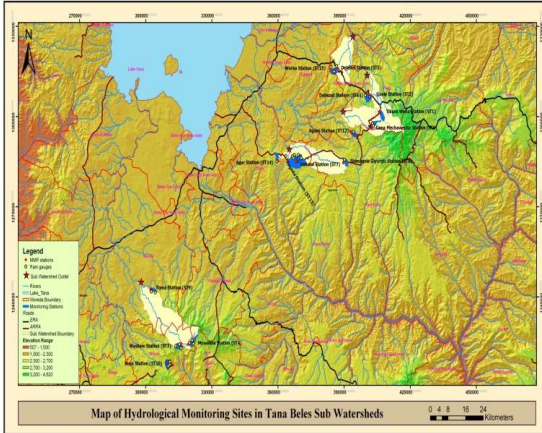
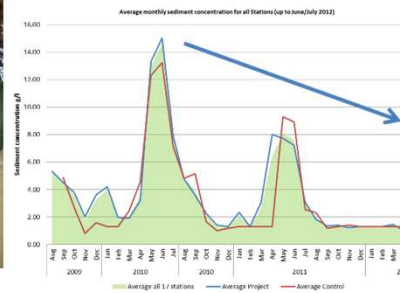


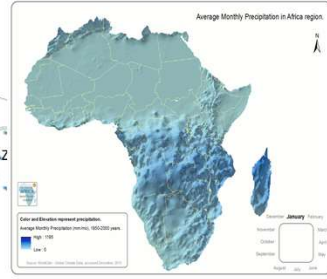
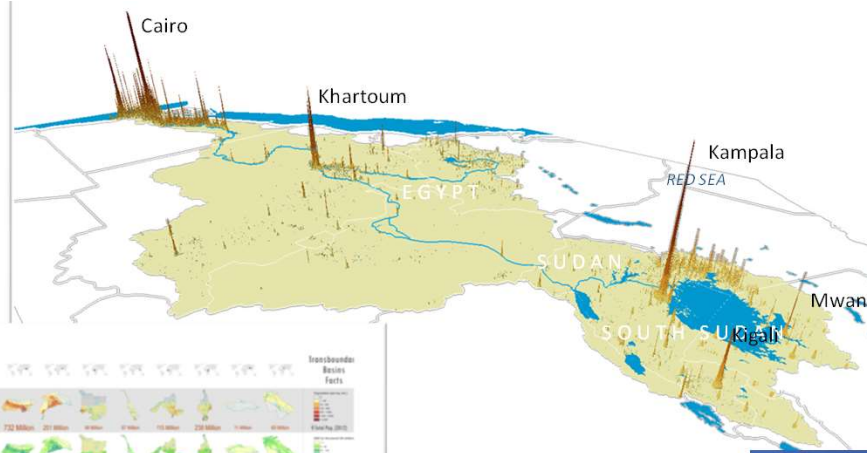
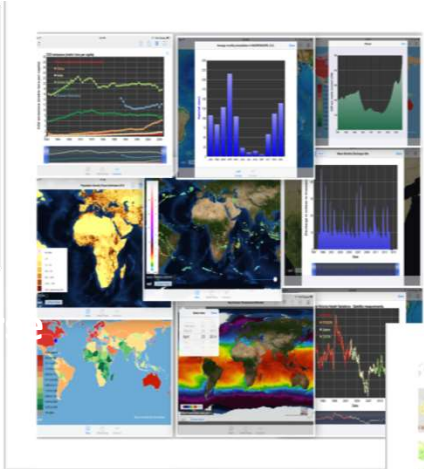
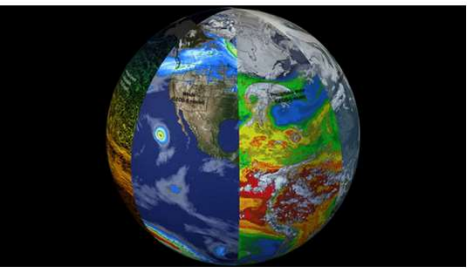
Secchi Jug for turbidity



	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

Sediment Concentration Analyses

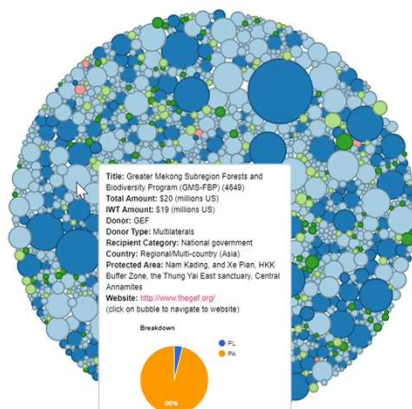
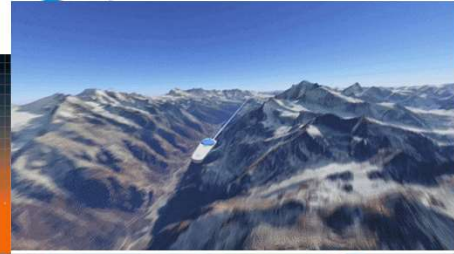
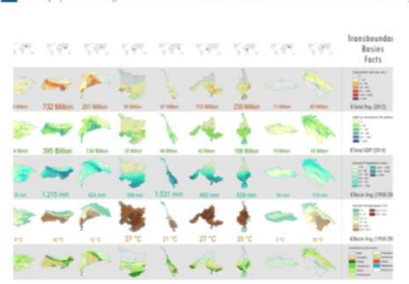




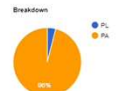
Illegal Wildlife Trade Charts x +
Not secure | appspotlutedigital.com/WildLife/charts.html

ANALYSIS OF INTERNATIONAL FUNDING TO TACKLE ILLEGAL WILDLIFE TRADE

Chord Chart Geographical Distribution Charts **Bubble Chart** Search Map Search



Title: Greater Mekong Subregion Forests and Biodiversity Program (GMS-FBP) (4549)
Total Amount: \$20 (millions US)
WT Amount: \$19 (millions US)
Donor: GEF
Donor Type: Multilaterals
Recipient Category: National government
Country: Regional/Multi-country (Asia)
Protected Area: Nam Kading and Xe Pian, HKK
Buffer Zone: the Thung Yai East sanctuary, Central Annamites
Website: <http://www.thepgef.org/>
(click on bubble to navigate to website)



Select

Split by
Show All Funds

Color by
Donor Type

Radius by
Total Funding

Chart does not include data from: Canada, Norway, Spain, USAID, EC, and WWF

- Bilaterals
- Multilaterals
- Foundations
- International NGOs
- United Nations Programmes



Pause (k)

HydroInformatics eBook

<https://spatialagent.org/HydroInformaticsEbook/>

HydroInformatics eBook

x +

spatialagent.org/HydroInformaticsEbook/

Search, Share, Star, Extensions, Notifications

"Disrupting" HydroInformatics *An Interactive E-book*

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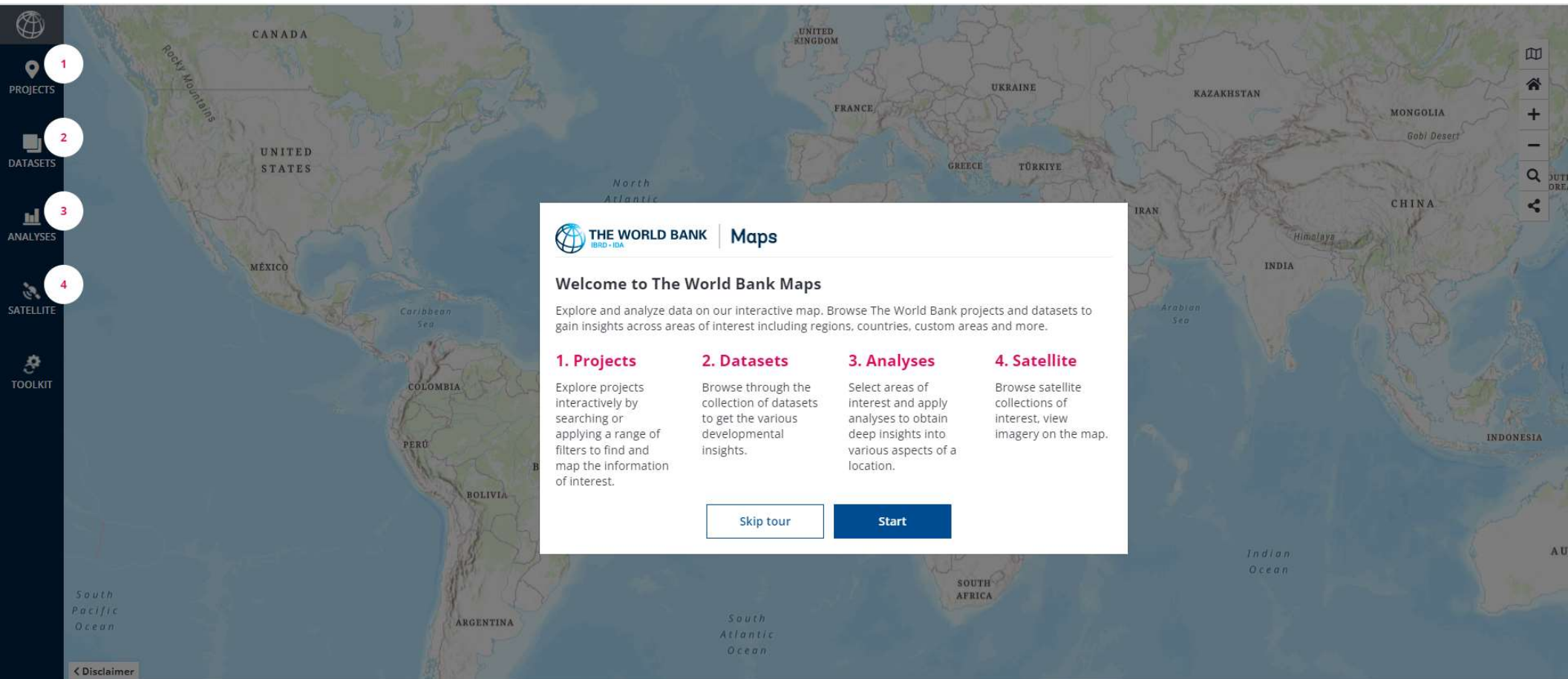
- About this Interactive e-Book
- Introduction
- Monitoring the Water Cycle
- Visualization and Access
- Data Analytics and Modeling
- Looking Ahead
- Annexes:
 - Data & Analytics Catalog
 - Knowledge Portal
 - Disrupting HydroInformatics Webinars


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PROJECTS

DATASETS

ANALYSES

SATELLITE

TOOLKIT

Analyses Types: ^

ⓘ Elevation x

Dataset Source

Shuttle Radar Topography Mission (Sf) v

Variable ⓘ

SRTM 30 v

Calculation

Average

Area of Interest ^

Admin Division Water Basin Custom Shape

Nile v

Or

Watershed generator



Disclaimer: NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodastystreisen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap.

- PROJECTS
- DATASETS
- ANALYSES
- SATELLITE
- TOOLKIT

Analyses

The selected region has an area of 5,970,676 km².

Analyses Types:

Forest Cover Change

Area of Interest

Amazon

Summary

Forest Cover Change	
Forest Loss	415,559.14 km ²
Forest Gain	14,876.73 km ²
Forest Loss and Gain	8,831.3 km ²




CLEAR Run

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Select Language

- All
- Water
- Disasters
- Climate
- Environment
- Social
- Economic



Lake Levels



Standardized Precipitation Index



GEOGIoWS Streamflow Explorer



Earth Engine Water Watch



Hydromet Catalog



Water In Agriculture Portal



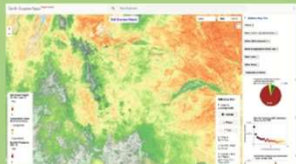
CHRS iRain



City Water Intakes



Glacier Inventory



Soil Erosion Watch




Surface Water Explorer



Cropping Extent



Water Conflicts



Population Density



Land Cover Comparison








[Click here to hide map / see product list below](#)



Navigation icons: Home, Search, Zoom, Full Screen, Menu, Settings.

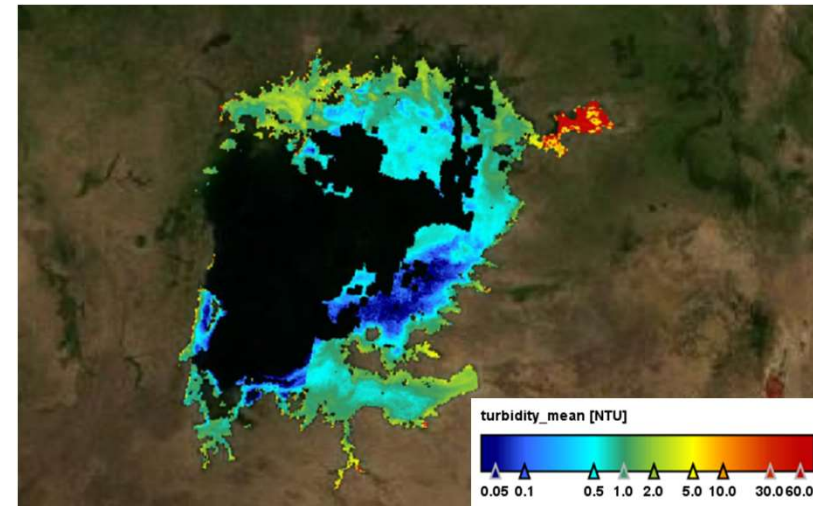
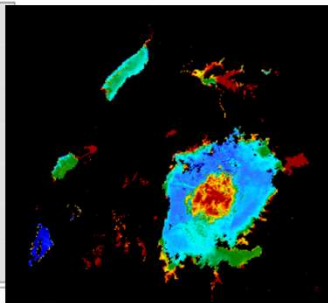
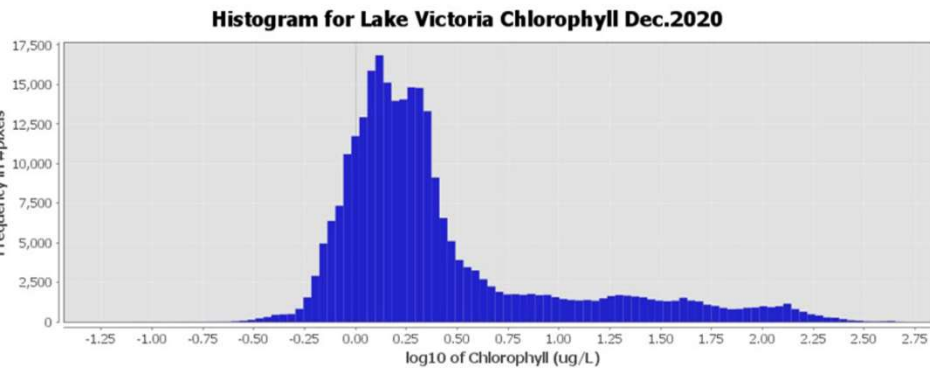
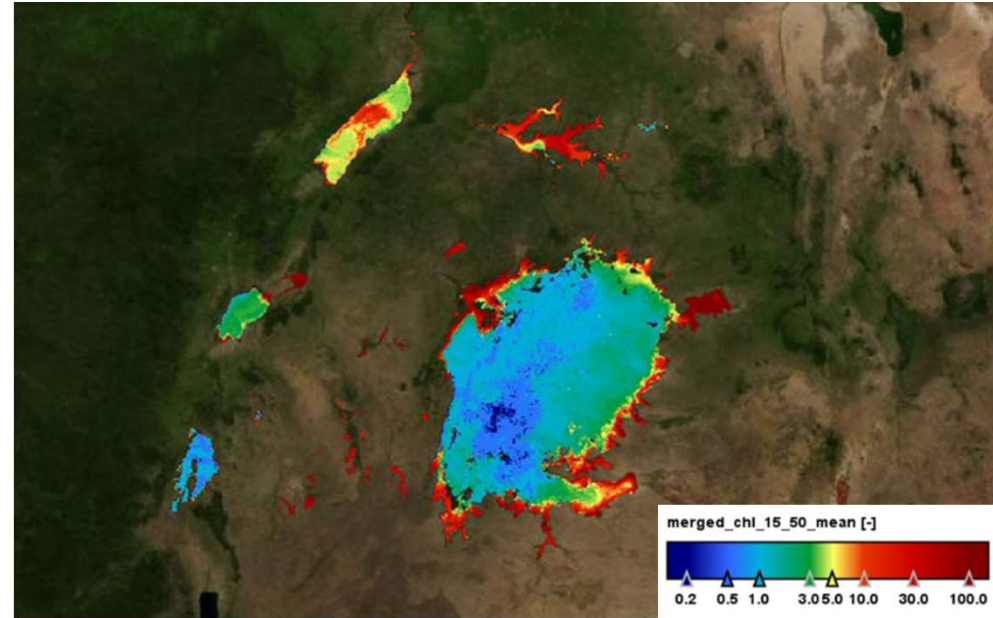
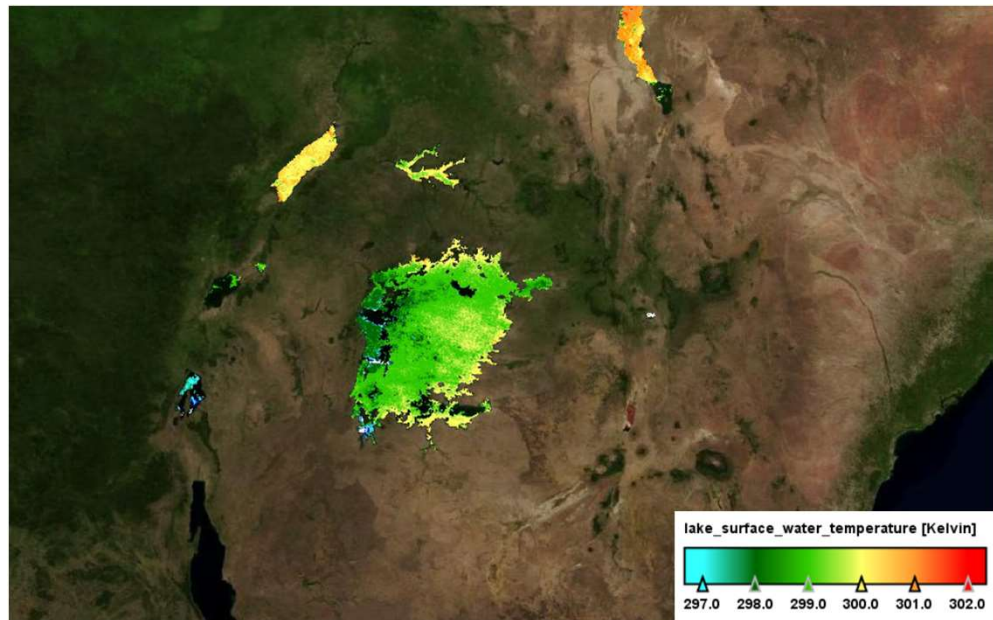
Select a basin, lake or river

 442 lake(s)	 12546 virtual station(s)	 12988 lake(s) and virtual station(s)
---	--	--

Records per page: 10

Remotely Sensed Lake Products

Source: GEO Aquawatch/WB



Precipitation

Earth Map: <https://earthmap.org/>

EARTH MAP | Enter a location

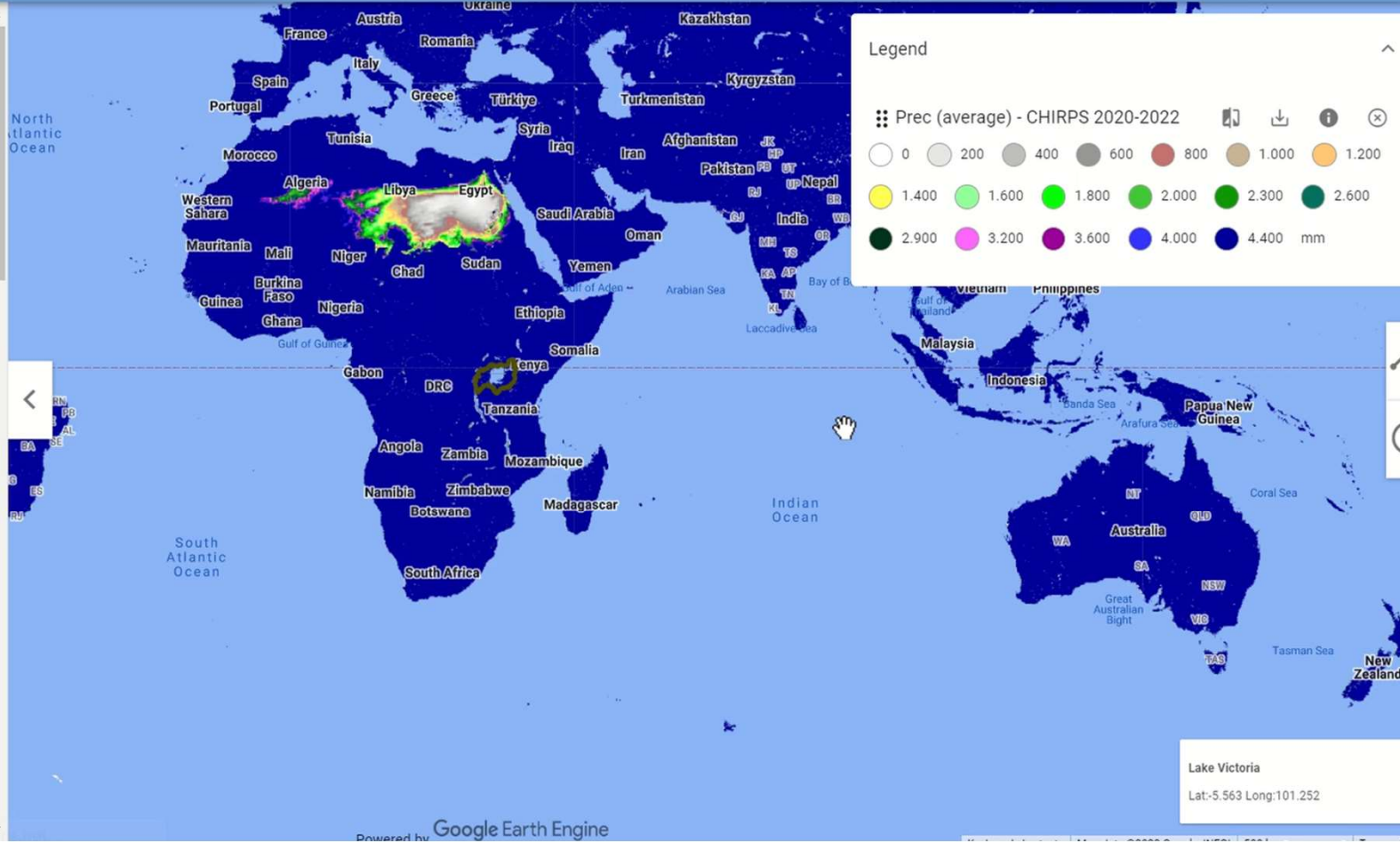
Select an area of interest
LAKE VICTORIA

Boundaries
Lake AOI

Agriculture
Biodiversity

Climate

- Aridity Index (10 year median)
- Aridity changes 2001-2020 (Prec ECMWF Land / PET MODIS)
- Climate - Aridity Index (P ECMWF Land / PET MODIS)
- Climate - Days with Prec. > 50 mm threshold - Extreme Rain (ECMWF Prec. daily)
- Climate - Days with Temp. < 0° threshold - Frost days (ECMWF Minimum daily temp)
- Climate - Days with Temp. > 32° threshold - Heat Stress (ECMWF Max daily temp)



Land Cover

Earth Map <https://earthmap.org/>

earthmap.org/?aoi=ng&boundary=level1&feature&layers=%7B%7D&map=%7B"center"%3A%7B"lat"%3A9.05342419124053%2C"ln...

Enter a location

OPEN AOI WITH...

Select an area of interest
Nigeria

Boundaries
Province

- Agriculture
- Biodiversity
- Climate
- Emissions
- Fire
- Forestry
- Geophysical
- Social
- Hydrology
- Land Cover / Land Use

Copernicus CGLS-LC100 Land Cover (Proba-V)

Map showing land cover data for Nigeria and surrounding regions (Burkina Faso, Benin, Ghana, Cameroon, Chad, Equatorial Guinea, Central African Republic). The map displays various land cover types, including agriculture, forests, and urban areas. Major cities like Niamey, Kano, Abuja, and Lagos are visible. The map is powered by Google Earth Engine.

Lat:15.771 Long:15.634

nature > articles > article

Article | Open Access | Published: 01 March 2023

Sub-continental-scale carbon stocks of individual trees in African drylands

Compton Tucker, Martin Brandt, Pierre Hiernaux, Ankit Kariyaa, Kjeld Rasmussen, Jennifer Small, Christian Igel, Florian Reiner, Katherine Melocik, Jesse Meyer, Scott Sinno, Eric Romero, Erin Glennie, Yasmin Fitts, August Morin, Jorge Pinzon, Devin McClain, Paul Morin, Claire Porter, Shane Loeffler, Laurent Kergoat, Bil-Assanou Issoufou, Patrice Savadogo, Jean-Pierre Wigneron, ... Rasmus Fensholt

+ Show authors

Nature 615, 80–86 (2023) | Cite this article

23k Accesses | 2 Citations | 371 Altmetric | Metrics

Abstract

The distribution of dryland trees and their density, cover, size, mass and carbon content are not well known at sub-continental to continental scales^{1,2,3,4,5,6,7,8,9,10,11,12,13,14}. This information is important for ecological protection, carbon accounting, climate mitigation and restoration efforts of dryland ecosystems^{15,16,17,18}. We assessed more than 9.9 billion trees derived from more than 300 000 satellite images, covering semi-arid sub-Saharan Africa

Download PDF

Associated Content

Carbon stocks of billions of individual African dryland trees estimated

Jules Bayala & Meine van Noordwijk
Nature | News & Views | 01 Mar 2023

Sections Figures References

Abstract

Main

Carbon stocks at the tree level

Current carbon map and model comparisons

Application at the tree level

Discussion

Methods

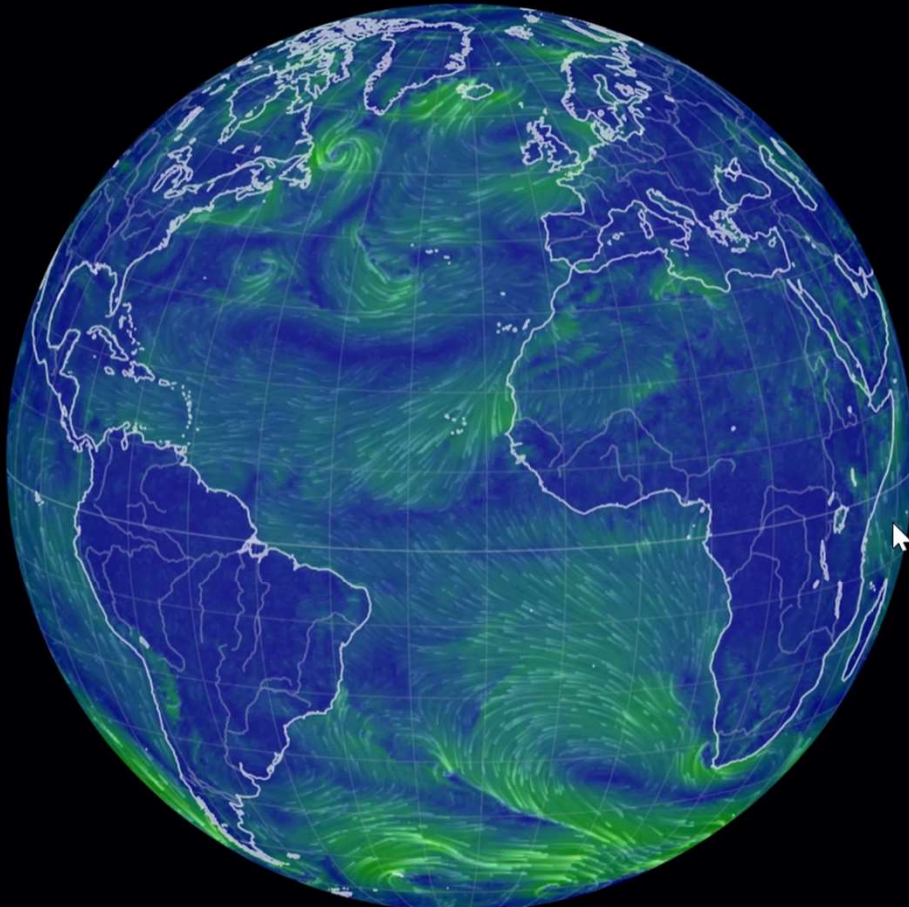
Real-time Weather: <https://earth.nullschool.net/>

<https://www.windy.com/>

earth :: a global map of wind, we

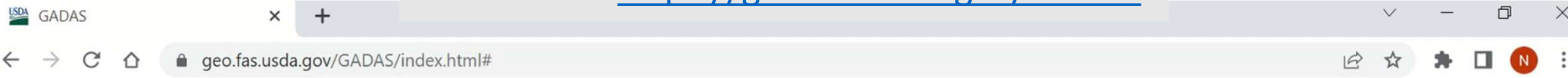
Windy: Wind map & weather fore

earth.nullschool.net/#current/wind/surface/level/orthographic=-23.44,11.82,274



earth ≡

GADAS: <https://geo.fas.usda.gov/GADAS>



2. Select Attribute
Precipitation ▾
 Include Normals

3. Select Time Aggregation
Dekadal ▾

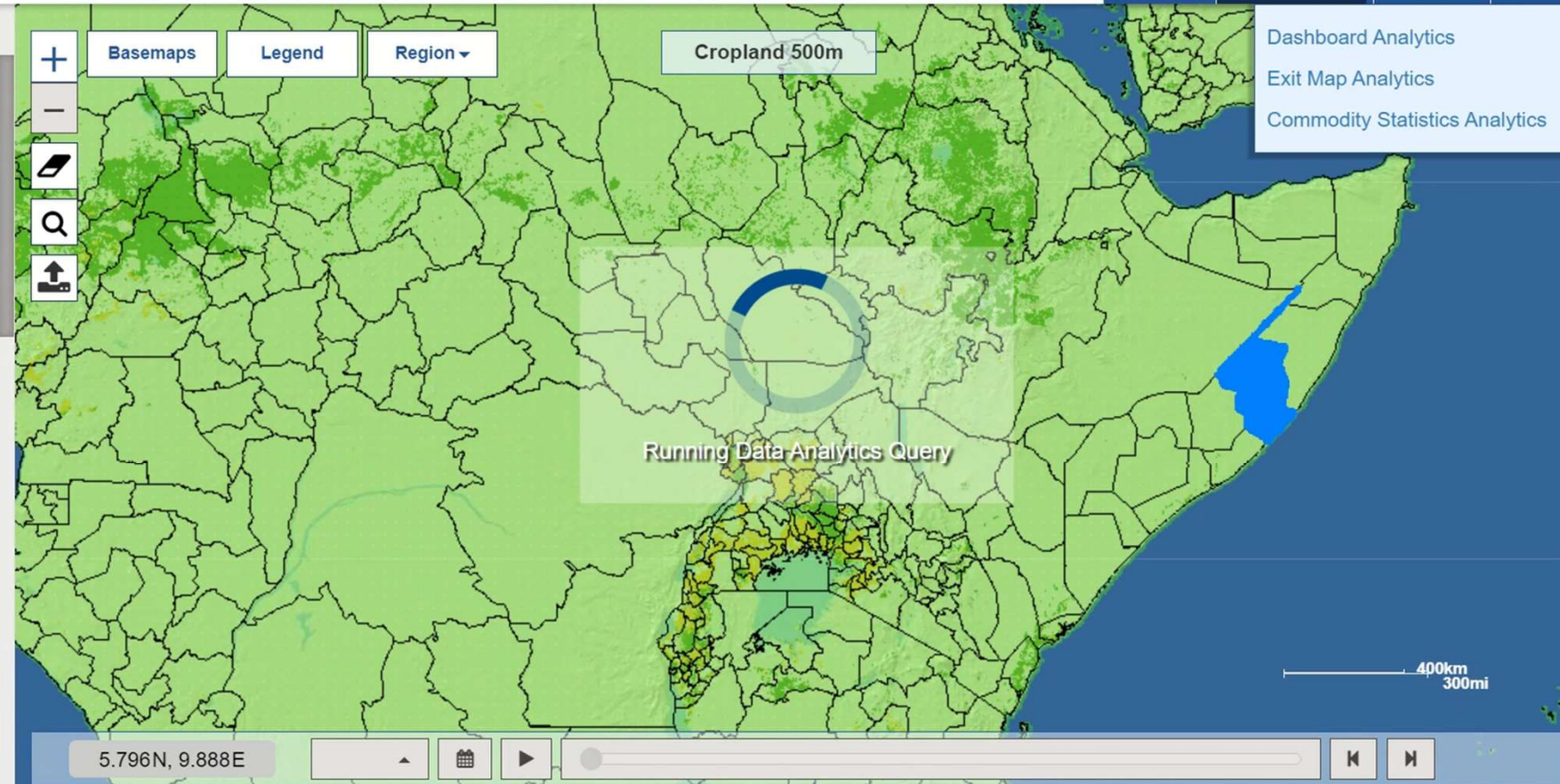
4. Select Time Interval
Jan ▾ to **Dec** ▾

5. Select Years
2019,2020,2021,2022,2023 ▾

6. Select Chart Type
Line Chart ▾

7. Select Selection Type
Draw Area **Admin Units**

8. Draw Area
Admin Type **State or Province** ▾



Make Map, Make Graph, INFO

MENU, Map

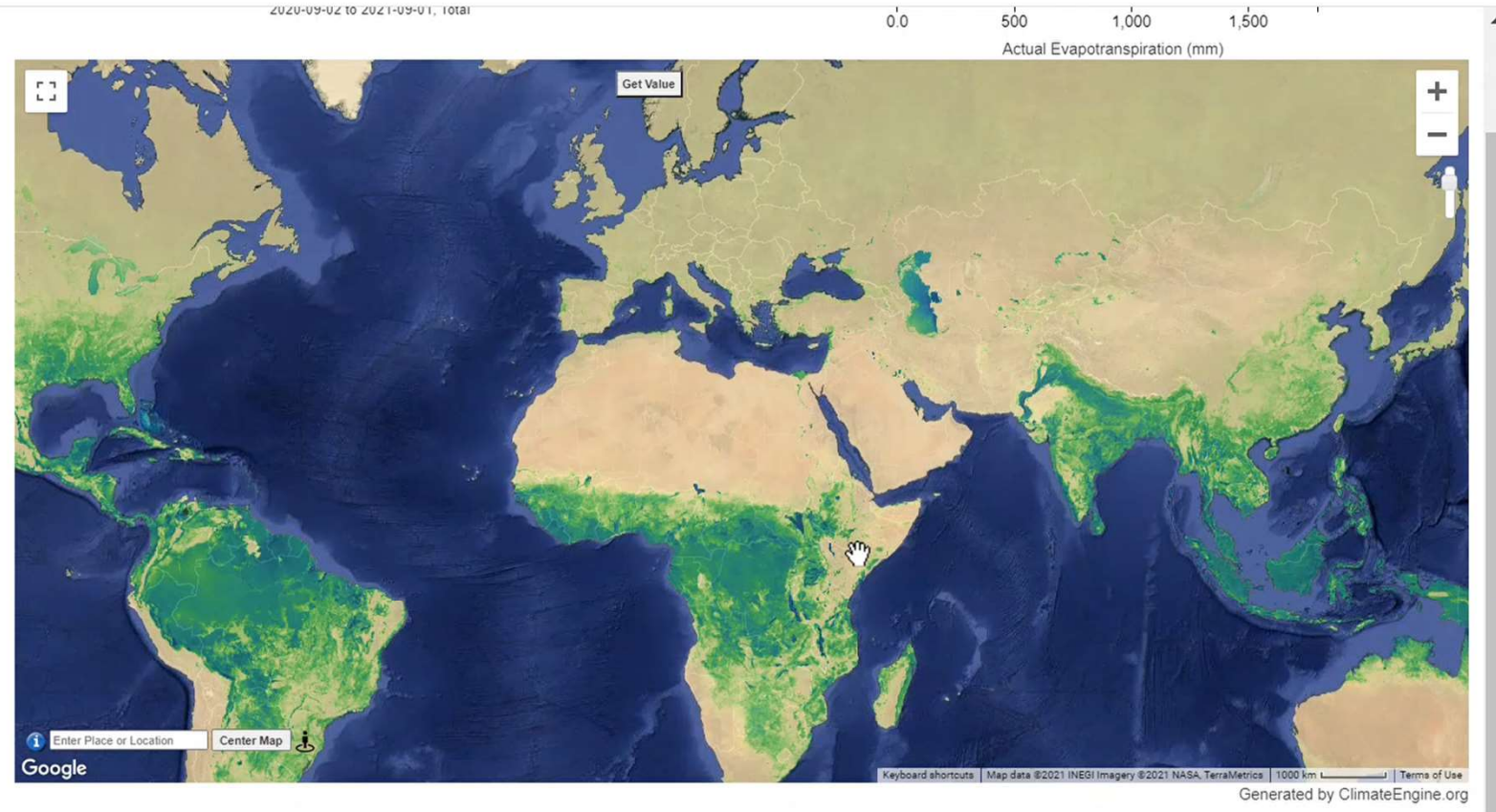
GET MAP LAYER

Variable ⓘ
Type: Remote Sensing
Dataset: 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 2021-09-01
Last Year
Start Date: 2020-09-02
End Date: 2021-09-01

GET MAP LAYER

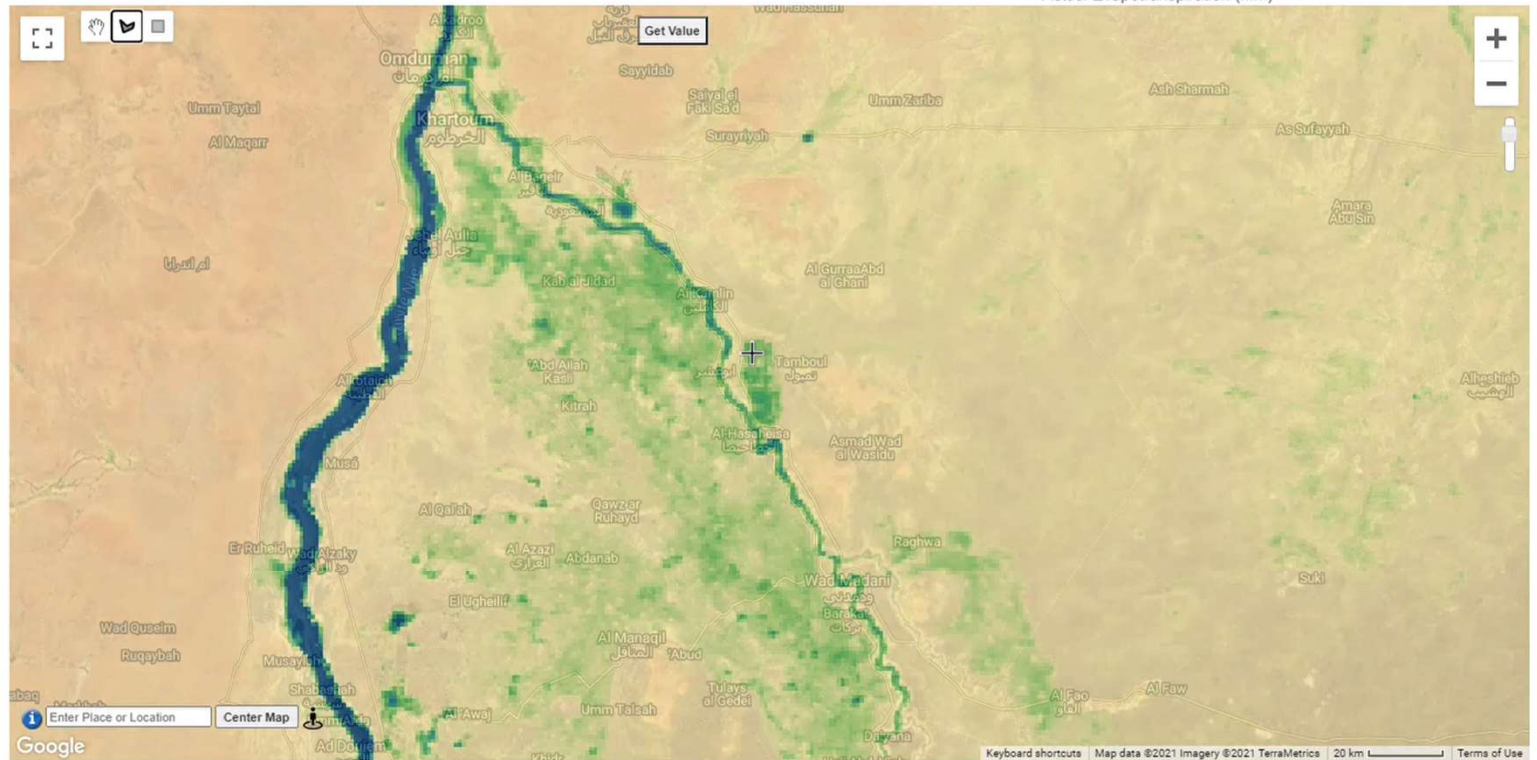


MENU Map

2020-09-02 to 2021-09-01, TOTAL

0.0 500 1,000 1,500

Actual Evapotranspiration (mm)



Google

Keyboard shortcuts | Map data ©2021 Imagery ©2021 TerraMetrics | 20 km | Terms of Use

Generated by ClimateEngine.org

Make Map Make Graph

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: MODIS ET - SSEBop Dekadal

Variable: Evapotranspiration (ETa)

Units: millimeters

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

Statistic (over region): Mean

Time Period ?

Period of Record: 2003-01-01 to 2021-09-01

Last Year

Time Series Calculation: ?
Native Time Series
One Variable Analysis

Region: ?
 Polygon
Add another region

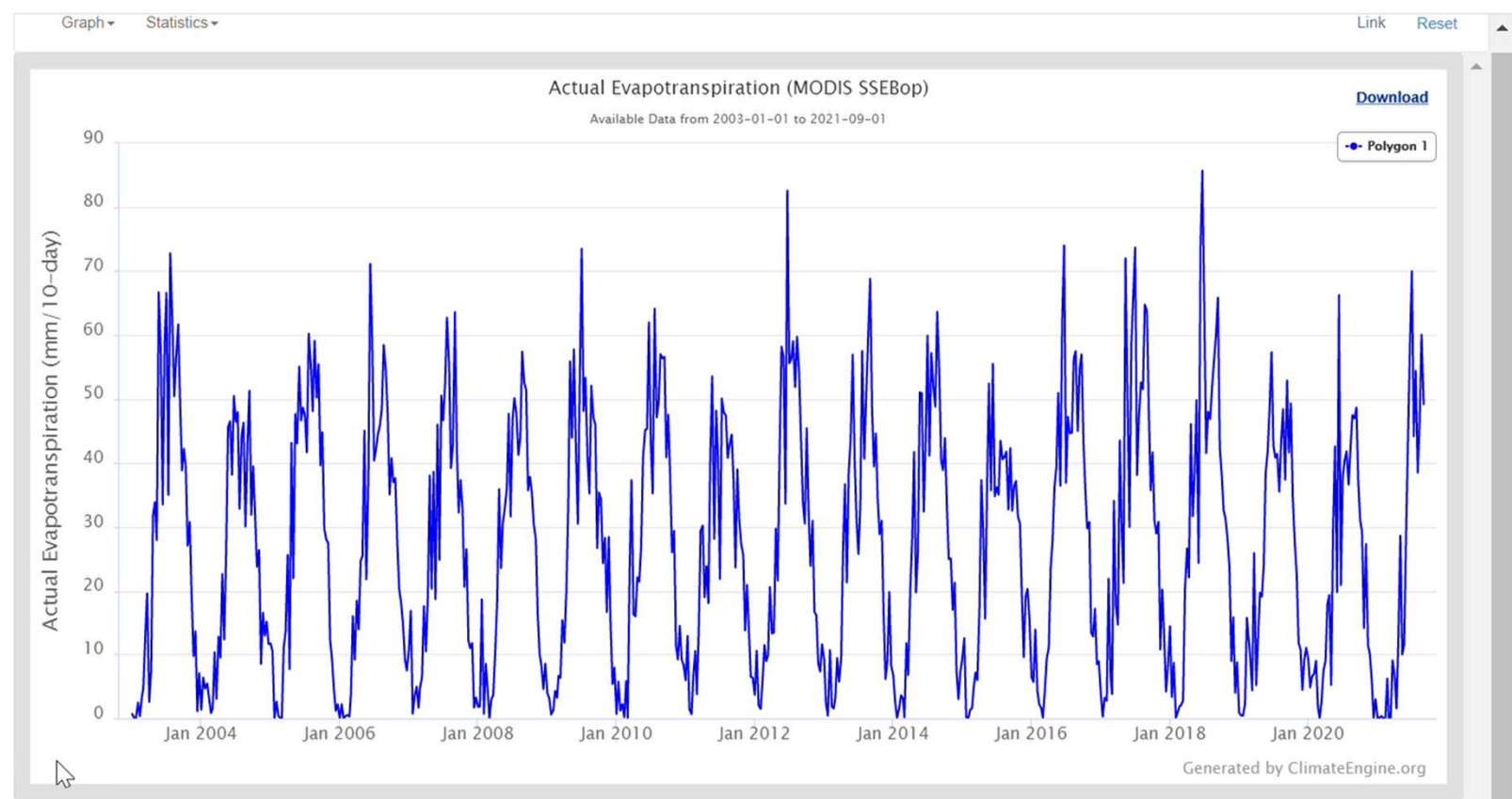
Variable 1

Variable 1 ?
Type: Remote Sensing
Dataset: MODIS ET - SSEBop Dekadal
Variable: Evapotranspiration (ETa)
Units: millimeters
Computation Resolution (Scale): 1000 m (1/96-deg)
Statistic (over region): Mean
Time Period ?
Period of Record: 2003-01-01 to 2021-09-01
Entire Period of Record of Dataset

Start Date: 2003-01-01
End Date: 2021-09-01

GET TIME SERIES

MENU Map Figure Data



GEOGloWS ECMWF Streamflow Hydroviewer

Log In

Map Controls

Map Animation

Tue Feb 28 2023 10:00:00 GMT-0500
(Eastern Standard Time)

Find A Reach ID

Zoom to Lat/Lon Coordinates

Remove Map Marker

Switch to HydroShare Map

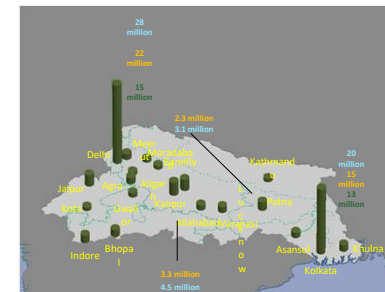
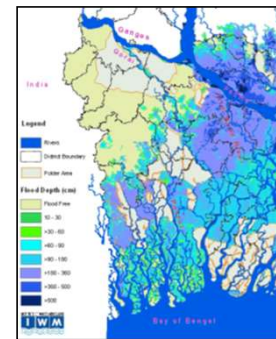
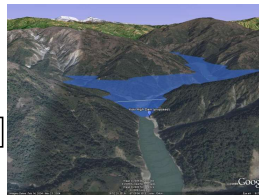
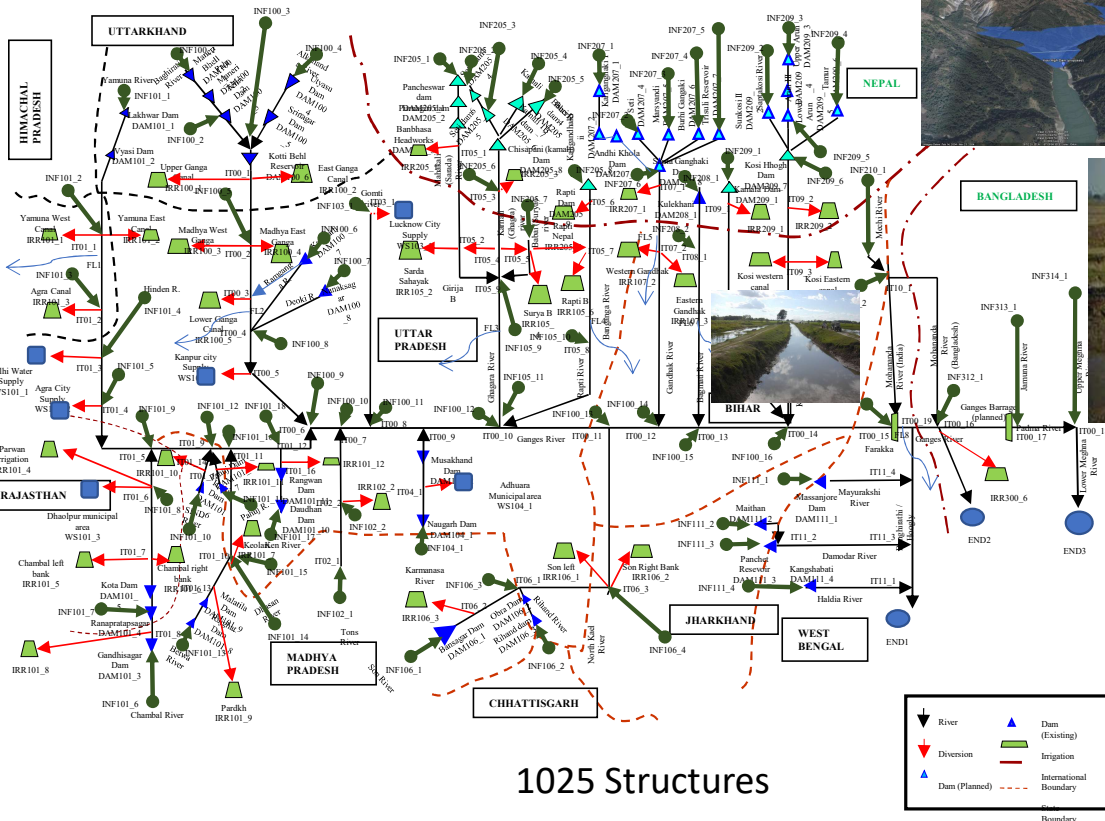
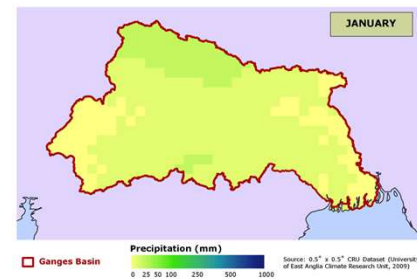
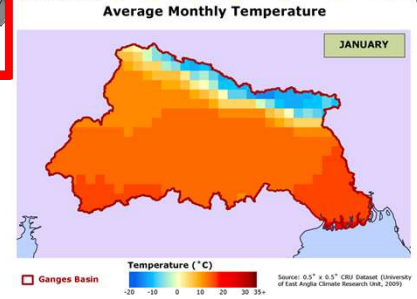
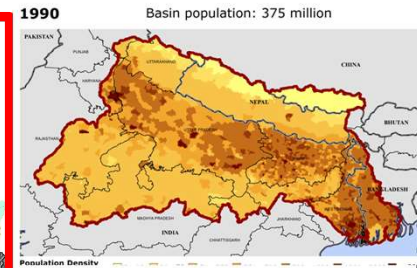
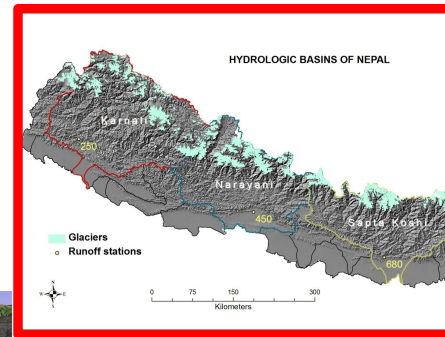
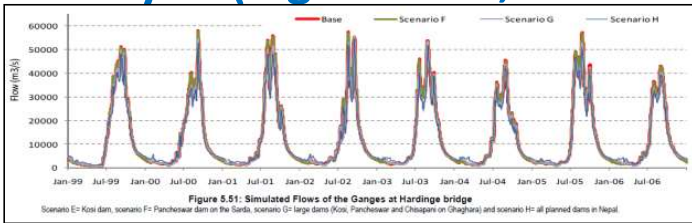
Stream Gauge Networks

Choose A Gauge Network



Lat: -20.6300, Lon: 35.7140

Complex Water Systems Models Scenario Analysis (e.g. climate, investments)



Google Earth Engine Data Catalog

Earth Engine Data Catalog

Search

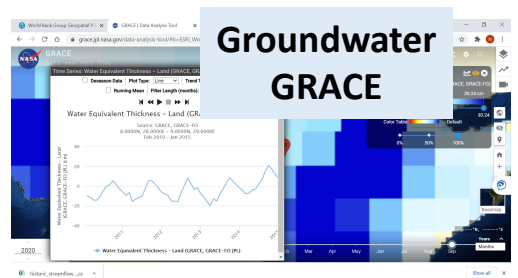
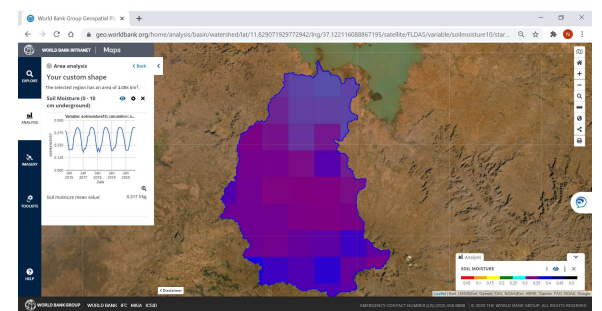
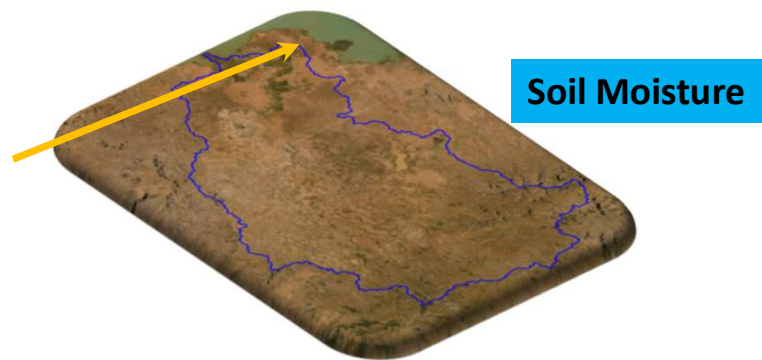
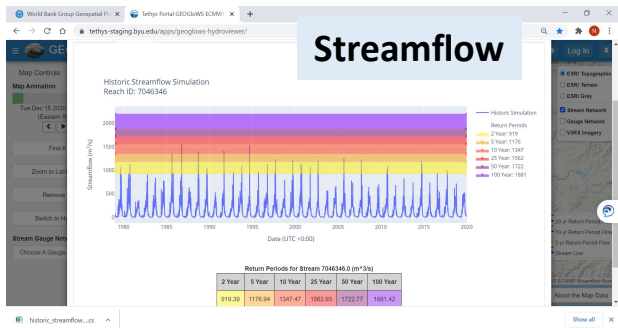
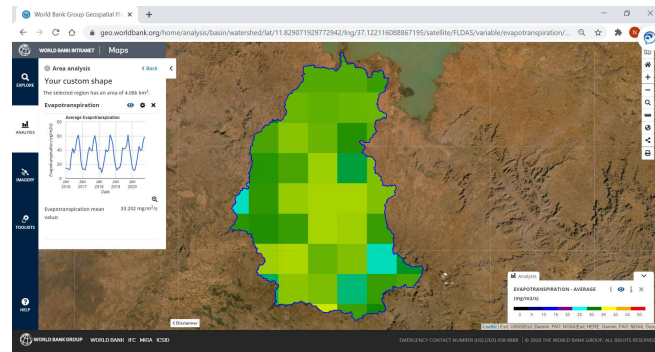
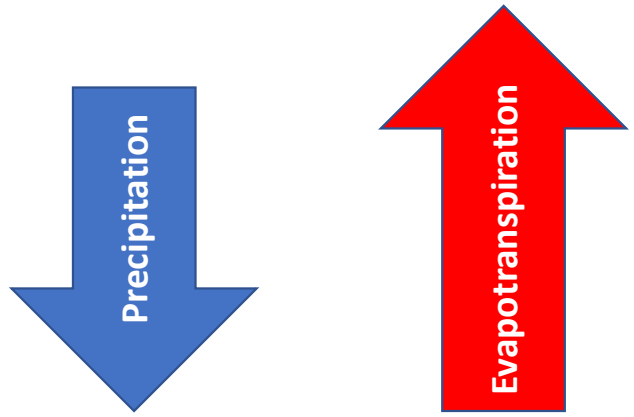
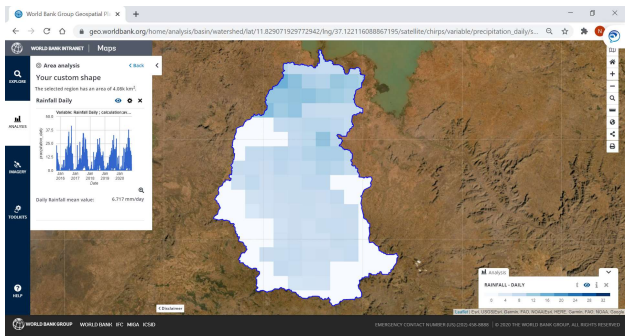
English

Home View all datasets Browse by tags Landsat MODIS Sentinel API Docs

A planetary-scale platform for Earth science data & analysis

Earth Engine's public data archive includes more than forty years of historical imagery and scientific datasets, updated and expanded daily.

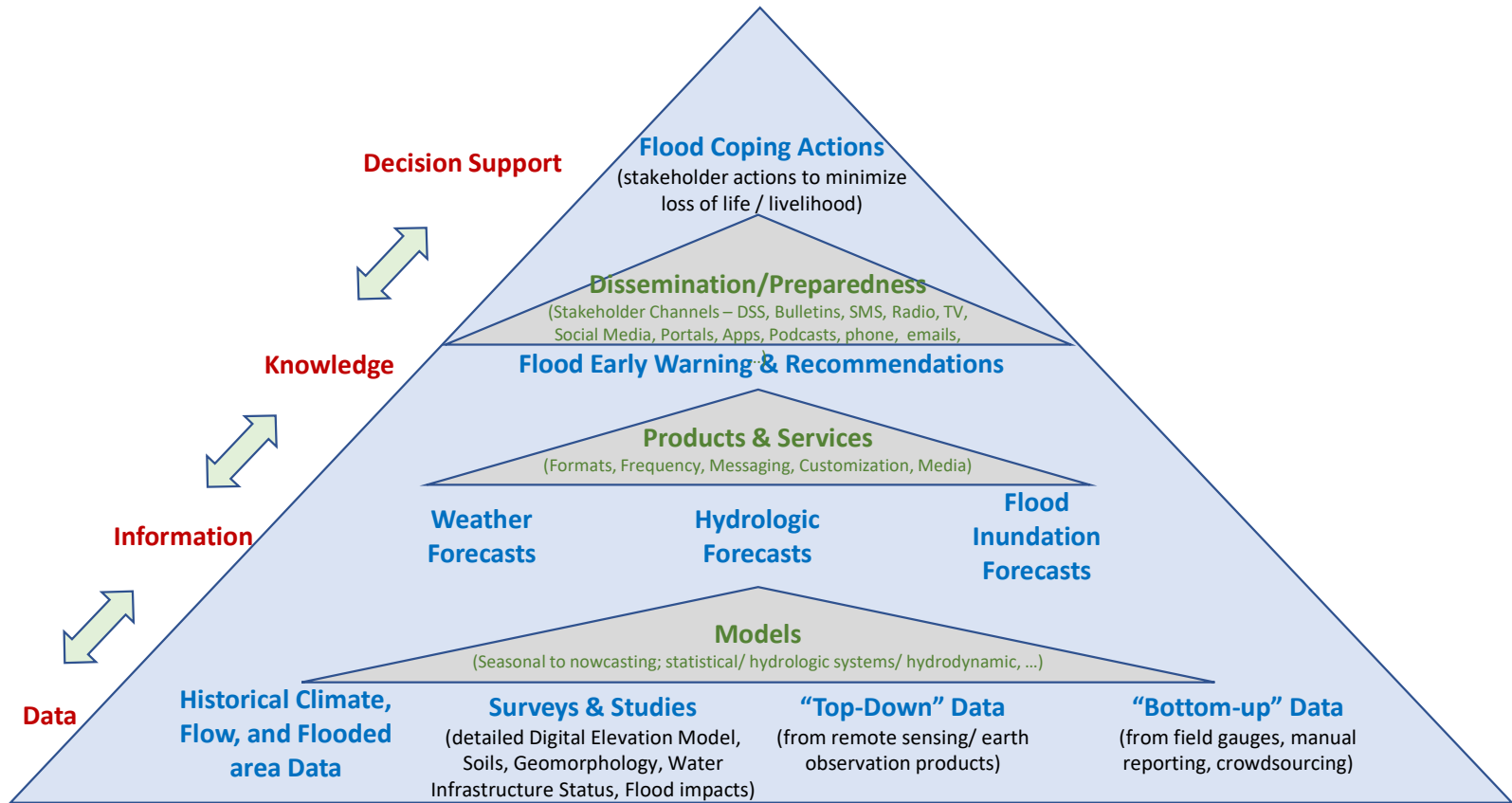
[View all datasets](#)



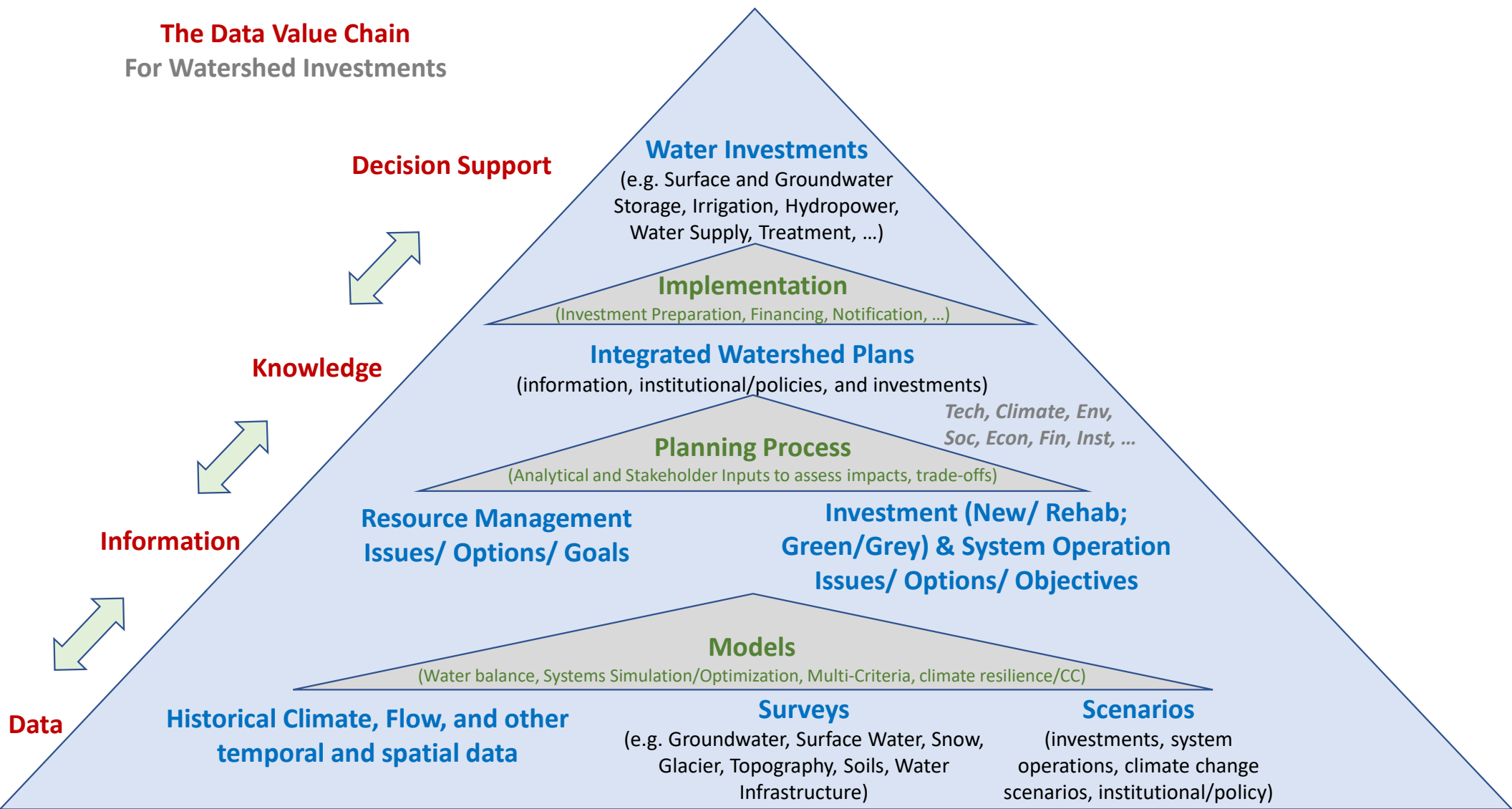


The Data Value Chain

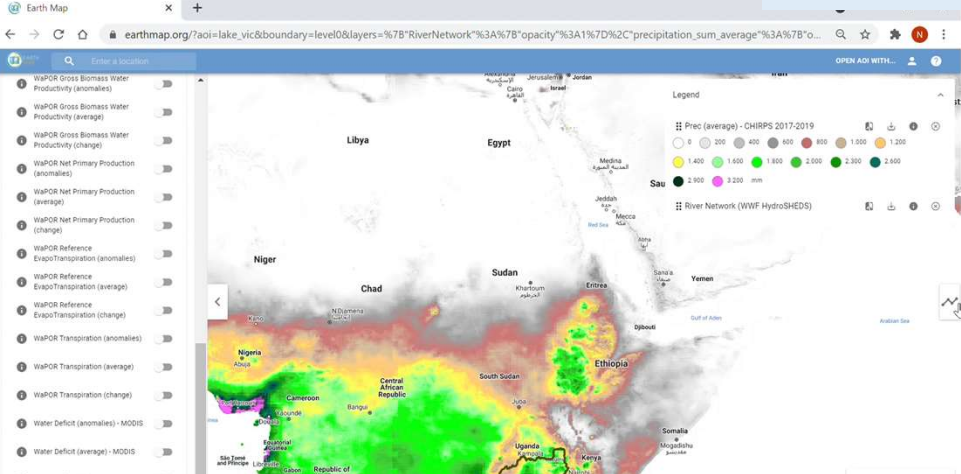
Example: Deciding on Coping with Floods



The Data Value Chain
For Watershed Investments



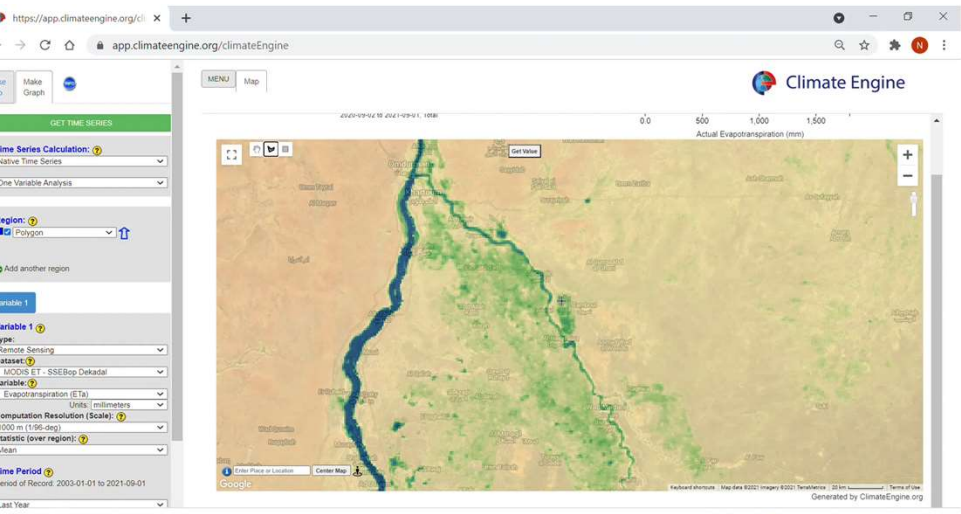
Data/Analytics Platforms



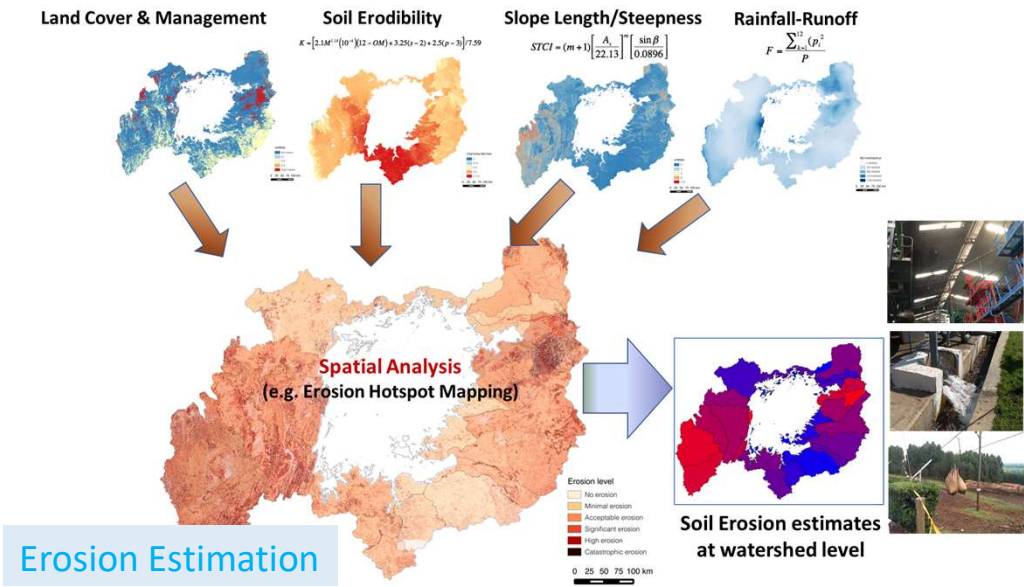
Cloud Analytics (e.g. FAO's Earthmap, UNEP, ...)



World Bank Geospatial Platform
 Internal: <https://geo.worldbank.org/>
 External: <https://maps.worldbank.org/>



Climate/ET Analytics



Erosion Estimation

E-Packaging Platforms

Hydro Informatics Data Portal

spatialagent.org/HydroInformatics/

All Water Disasters Climate Environment Social Economic

Lake Levels Standardized Precipitation Index GEOIoWS Streamflow Explorer Earth Engine Water Watch

Water In Agriculture Portal CHRS iRain City Water Intakes Glacier Inventory

Dashboards e.g. <https://spatialagent.org/HydroInformatics/>

Disrupting HydroInformatics
An Interactive E-book

Table of Contents

- About this Interactive e-Book
- Introduction
- Monitoring the Water Cycle
- Visualization and Access
- Data Analytics and Modeling
- Looking Ahead
- Annexes:
 - Data & Analytics Catalog
 - Knowledge Portal
 - Disrupting HydroInformatics Webinars

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Storymaps/Ebooks

Nigeria Blue Sector Viewer

geowb.worldbank.org/portal/apps/webappviewer/index.html?id=5fed4127f8e247a4a7a5a5e9af2b2e59#

Find address or place

CHAD

BURKINA FASO

NIGERIA

BENIN

GHANA

TOGO

CÔTE D'IVOIRE

GUINEA

SIERRA LEONE

LIBERIA

GUINEA-BISSAU

SIERRA LEONE

CÔTE D'IVOIRE

GHANA

TOGO

NIGERIA

CAMEROON

CENTRAL AFRICAN REPUBLIC

Equatorial Guinea

Gabon Republic of the Congo

Democratic Republic of the Congo

Rwanda

Uganda

Kenya

THE WORLD BANK

Interactive WebApps

Water Harvesting Explorer

Inspector

Click on the map to show possible interventions.

Algeria

Libya

Egypt

Sudan

South Sudan

Uganda

Kenya

THE WORLD BANK

Water Harvesting Explorer

AI/Machine Learning



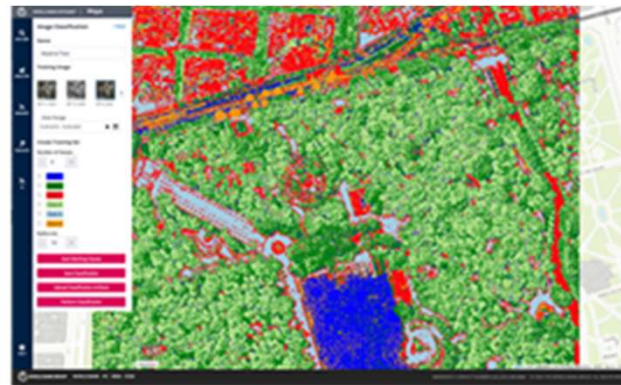
AI-Enabled Text and Data Mining of documents, news & social media



AI-Enabled Chatbots
Natural Language Processing



Training Data for Machine Learning Classification



Land Cover Classification using Training Data

Machine-Learning Image Classification – e.g. from Earth Observation, Photos, ...
CNN, ANN, Deep Learning...

ChatGPT

Examples	Capabilities	Limitations
"Explain quantum computing in simple terms" →	Remembers what user said earlier in the conversation	May occasionally generate incorrect information
"Got any creative ideas for a 10 year old's birthday?" →	Allows user to provide follow-up corrections	May occasionally produce harmful instructions or biased content
"How do I make an HTTP request in Javascript?" →	Trained to decline inappropriate requests	Limited knowledge of world and

ChatGPT Feb 13 Version. Free Research Preview. Our goal is to make AI systems more natural and safe to interact with. Your feedback will help us improve.

NDVI values (indicating high vegetation), and yellow representing moderate NDVI values.

HA google earth engine script to estimate NDVI in Gezira using Sentinel

Here's a sample script in JavaScript to estimate Normalized Difference Vegetation Index (NDVI) in Gezira using Sentinel-2 satellite imagery in Google Earth Engine:

```
javascript Copy code  
  
// Load Sentinel-2 imagery  
█
```

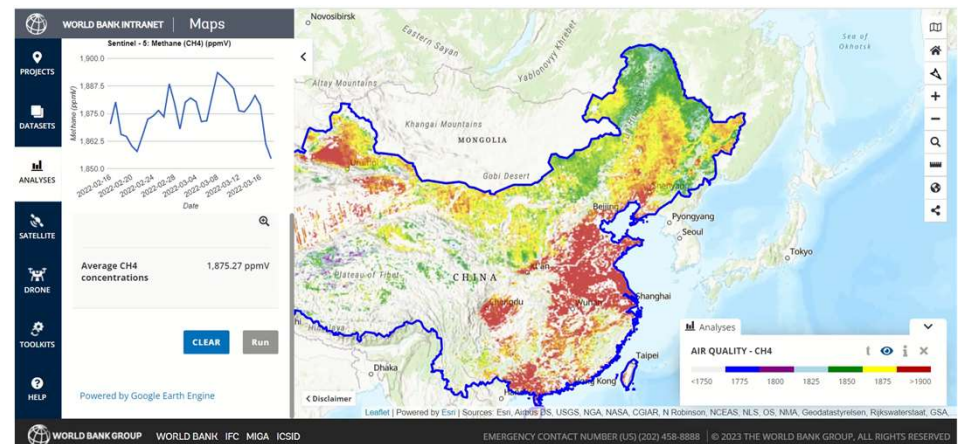
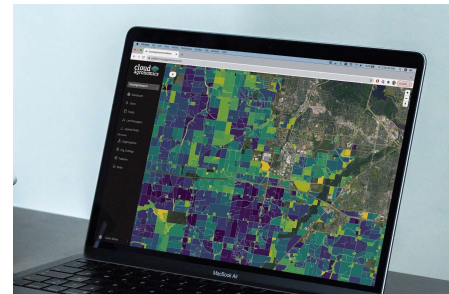
Stop generating

..

Scalable Platforms to Incentivize Services for a Healthier Planet

New **Global** Investment Platforms (e.g. Apps with automated/simplified MRV and flexible financing sources and digital payments) to incentivize **Local** action on:

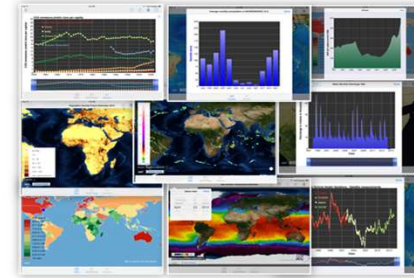
- **Climate** (e.g. for Mitigation and Adaptation) – e.g. for Low C Rice, Soil C Sequestration, agroforestry, Blue Carbon, Insurance
- **Ecosystems** (e.g. PES for biodiversity protection, sustainable soil and water management)
- ...



Customized Interactive Dashboards

Example for Check 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

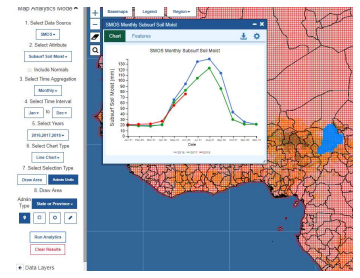
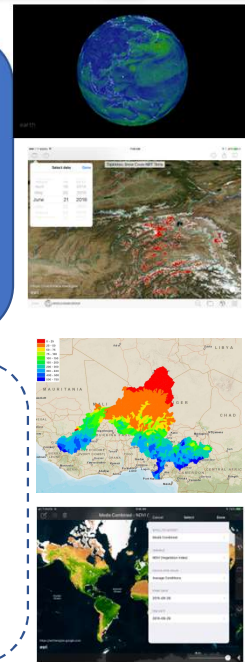
- Current and historical levels of this dam's reservoir as well as other storages in system (e.g. from satellite, in-situ gauges)...

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



Critical to draw upon thousands of data and analytic services to develop customizable dashboards to provide the right information in the right formats to empower everyone to make their decisions more data-driven!



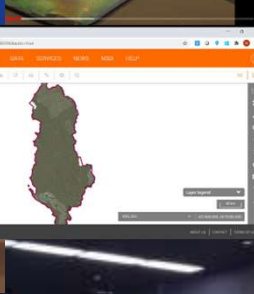
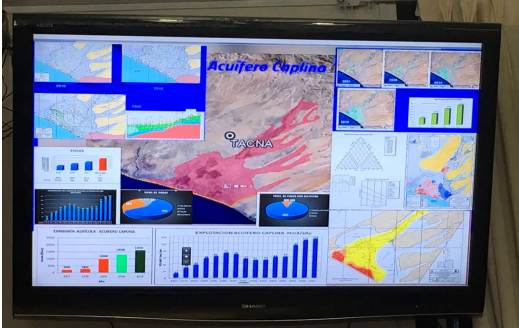
Large Displays



TouchScreens



Physical Interactive Models



Touch Tables



VR



Touch Projectors



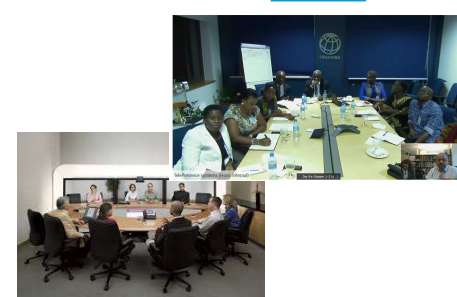
Modernizing Institutions



Situation/ Decision Rooms



Collaborative Workspaces/Internships



Audio/Video-Conferencing/ Distance Learning/ Helpdesk



Computer Training Room



Document, Map & Digital Library



Innovation Marketplace



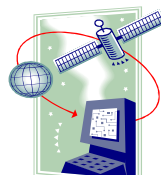
Competitions (e.g. Hackathons)



Knowledge Repository



Monitoring Hub



Knowledge Tools/Products



Targeted Research



Outreach & Capacity-Building



Institutional Support

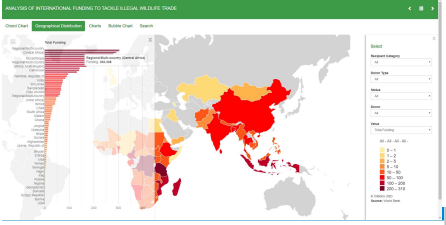




"Disrupting" Development
An Interactive Primer on Disruptive Technology in Development

Table of Contents

- Introduction
- Acknowledgments
- Key Development Challenges
 - Environmental
 - Economic
 - Social
- Emerging Disruptive Technology
 - Types of Disruptive Technology
 - Examples of Disruptive Technology
- Disruptive Tech in Development
 - Enabling Development
 - Identifying Key Challenges
 - Exploit Global Resources at your Fingertips
 - Interactive Tech Application Explorer
 - Considerations
- Looking Ahead
 - Regulatory Environment
 - Working Ahead!



INTERACTIVE TECHNOLOGY APPLICATION EXPLORER

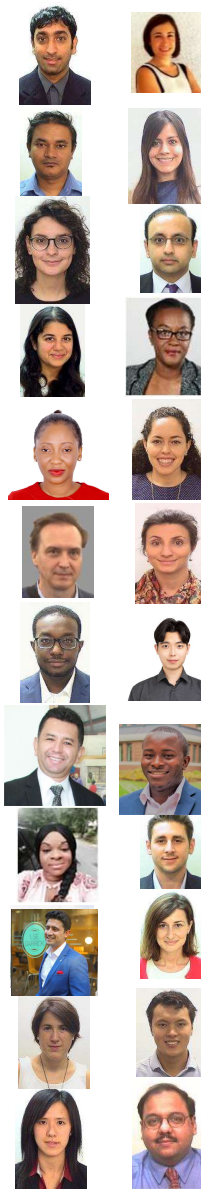
Use the following interactive tool to explore examples of the use of technology across sectors to promote sustainable development. You can filter examples based on sector, technology or a combination of the two. With clicking on the emerging technologies, the tool displays the Principles to Digital Development in Working Order documents and illustrates their use.

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

<http://spatialagent.org/KIDS/>



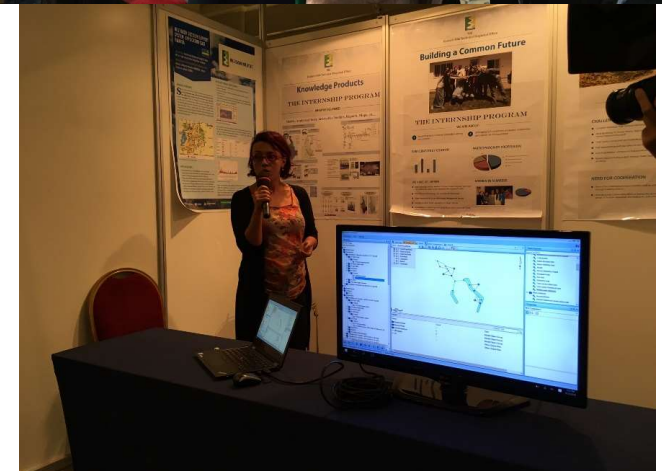
MC4 - 840



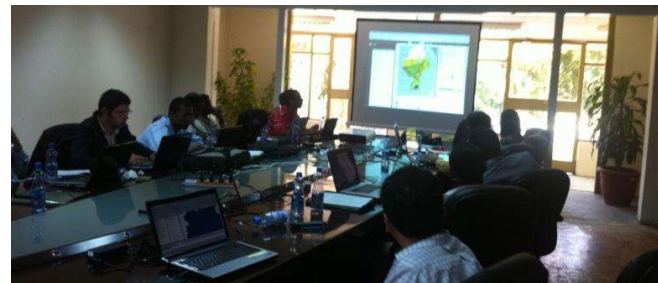
Professional Interactions

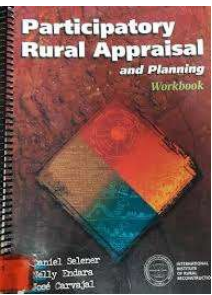
Learning from national and global good practices; Building Capacity

Forum, Expos, Training

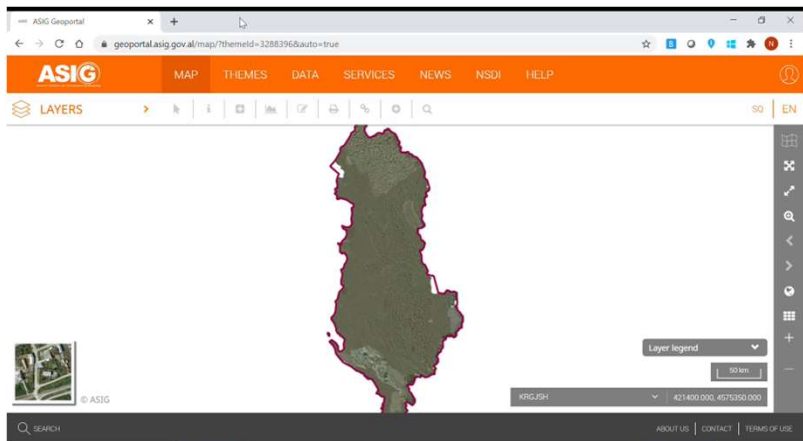


Internships, Competitions





Improving Community Interactions



In Summary...

- There is a **new world of emerging technologies** that can “disrupt” the way transboundary waters are planned, developed, and managed
 - **Information:** More relevant hydroinformatics information and insights at everyone’s fingertips (but can be made much better with more open in-situ data access in harmonized formats)
 - **Institutions:** Learn quickly from global good practices (enhanced collaboration, cross-learning, engaging with global expertise, and tapping into their own young talent can be transformational) – everyone can facilitate with open data services, open science, enabling policies/regulations/laws
 - **Investments:** Many opportunities to tap into innovative designs - e.g. NBS, climate-smart investments, finance, and partnerships (but require open-minded leadership and meaningful collaboration)
- **Keep learning and disrupting!**

Disrupt or Be Disrupted!

Thanks!



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<https://spatialagent.org/KIDS/>

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