

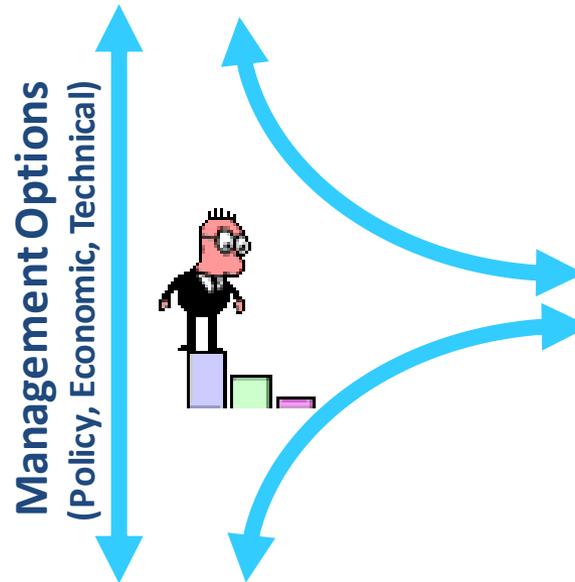
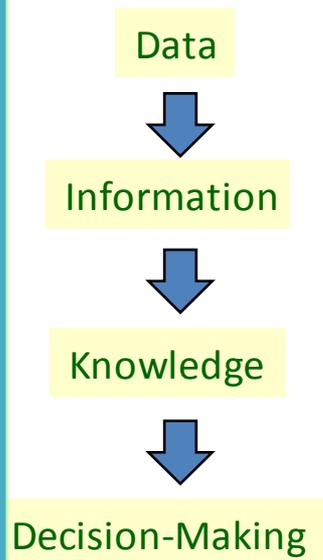
# Innovative Data Access and Visualization for Central Asia

**Nagaraja Rao Harshadeep**  
Senior Environmental Specialist  
The World Bank

**Session 7: Cool Data for a Warming World (Part 1)**  
May 14, 2014

# Towards Meaningful Decision Support Systems...

**Stakeholder Interaction**  
To meaningfully engage, build awareness & consensus

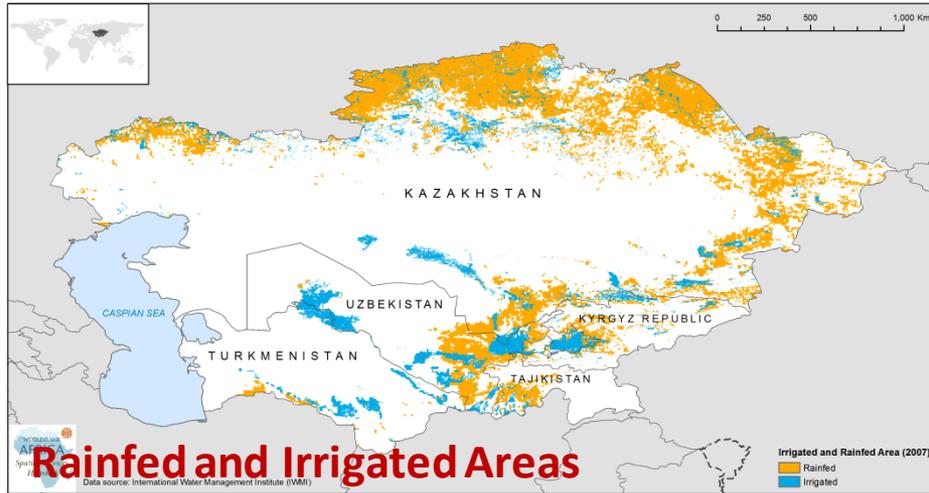


**Knowledge Base/Knowledge Products**  
Spatial and other data and analysis, Documents, Web, Products

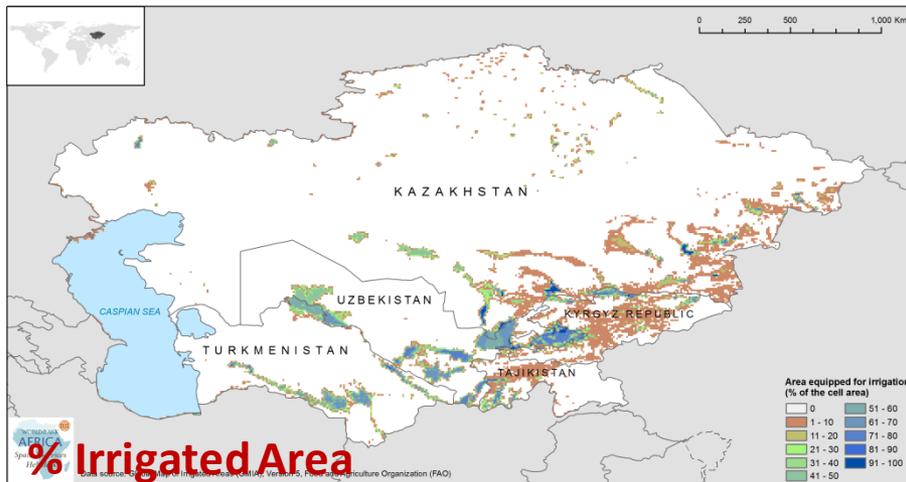
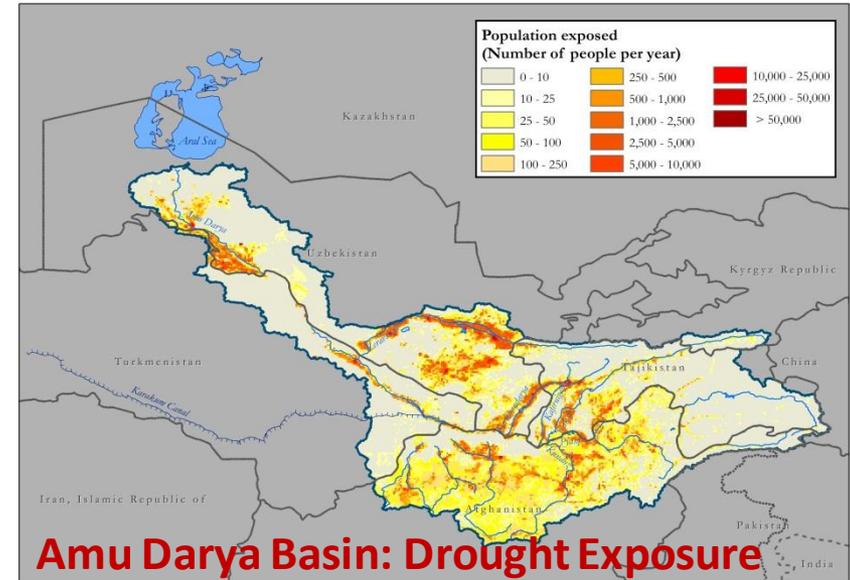
**Decision Support Services**  
Investments  
Operations  
Collaboration

**Analytical Tools/Models**  
Optimization/Simulation/Multi-Criteria  
For Planning/Management/Operation/...

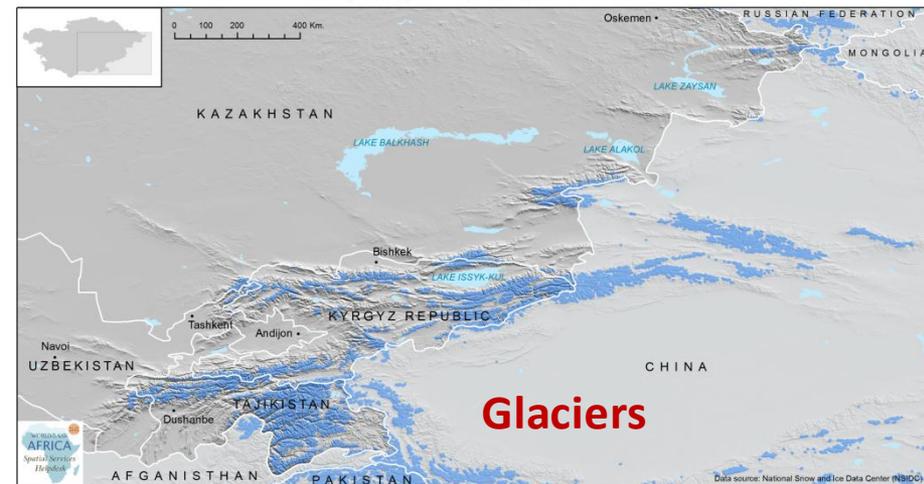
# Knowledge Base Illustrations: Maps



Amu Darya Basin: Exposure to Droughts



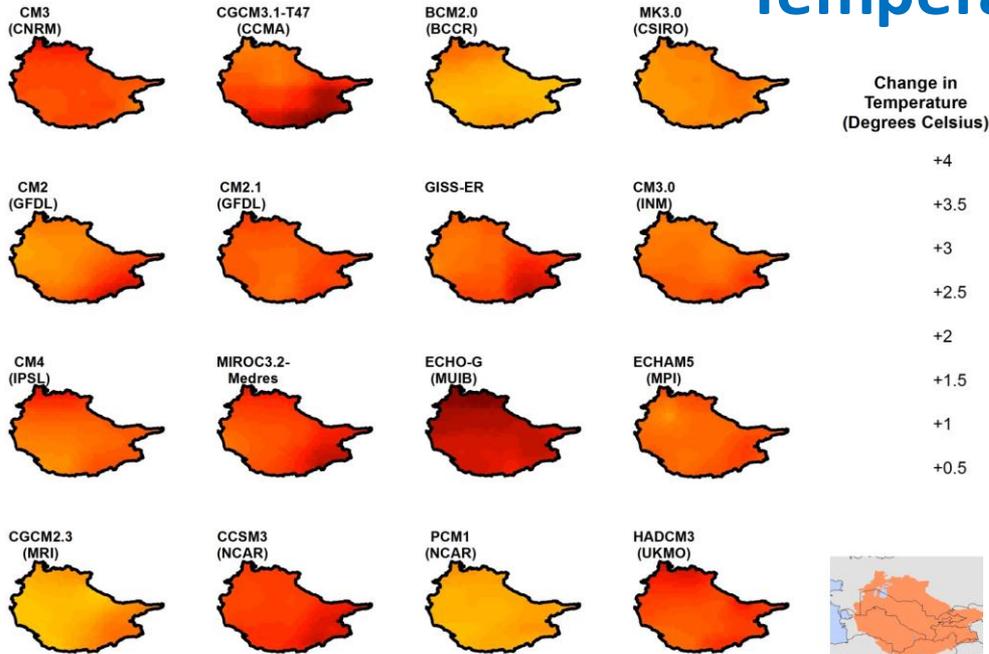
Glacier, Ice Cap, Ice Field, Ice Shelf, Continental Ice Sheet



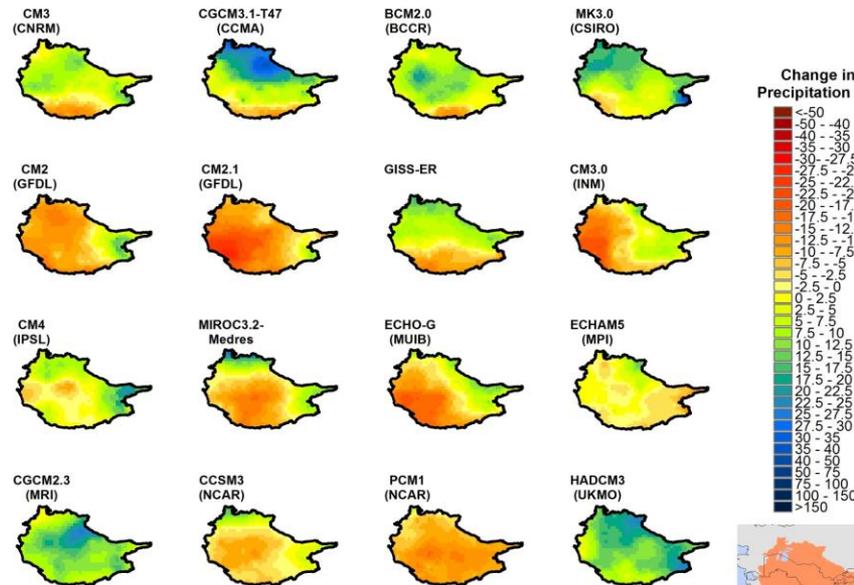
# Spatial Comparisons (e.g. Climate Change Models)

Aral Sea Basin - Differences between GCMs, in terms of Change in Annual Temperature by the 2050s

## Temperature



Aral Sea Basin - Differences between GCMs, in terms of Change in Annual Precipitation by the 2050s

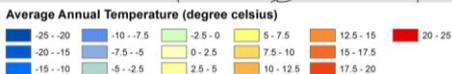
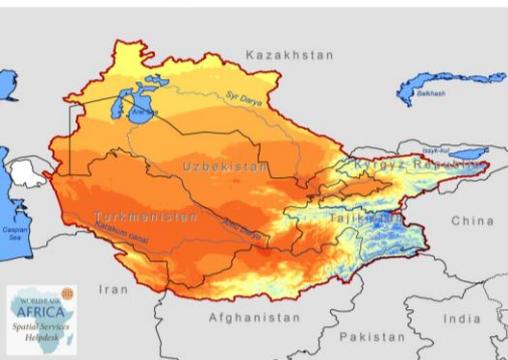


This map shows the precipitation change projected by the considered climate model, under the A2 scenario for 2040 - 2069 as compared to 1961 - 1990. Map displays gridded data (cellsize=0.5dd). Disclaimer: The boundaries, colors, denominations, and other information shown in any map do not imply any judgment on the part of the World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries. Sources: WCRP's CIMP3 (Meehl et al. 2007), downscaled by Maurer et al. (2008).

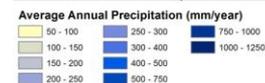
This map shows the precipitation change projected by the considered climate model, under the A2 scenario for 2040 - 2069 as compared to 1961 - 1990. Map displays gridded data (cellsize=0.5dd). Disclaimer: The boundaries, colors, denominations, and other information shown in any map do not imply any judgment on the part of the World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries. Sources: WCRP's CIMP3 (Meehl et al. 2007), downscaled by Maurer et al. (2008).

## Precipitation

Aral Sea Basin: Temperature



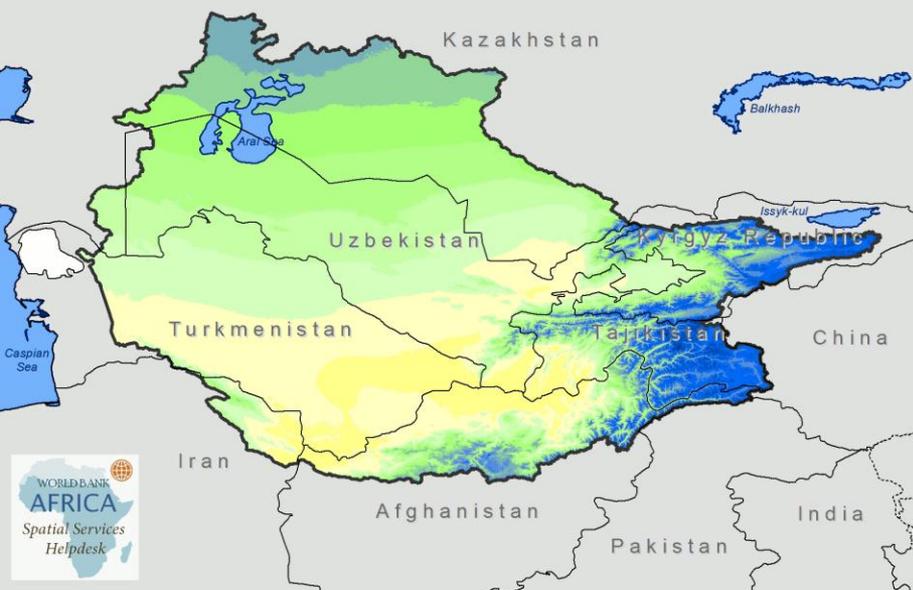
Aral Sea Basin: Precipitation



## Illustrative Visualizations

## Animations

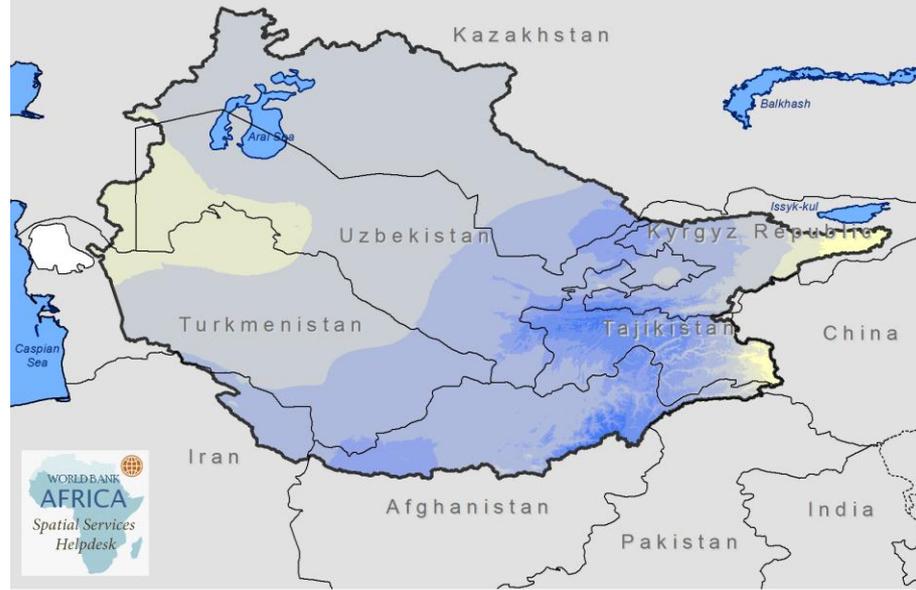
JANUARY



**Average Temperature (degree celsius)**



JANUARY

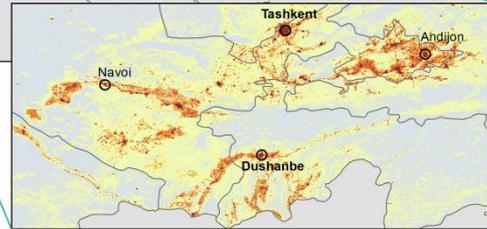
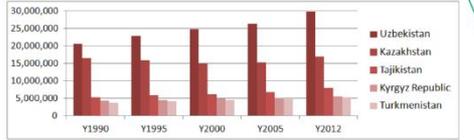


**Precipitation (in mm)**

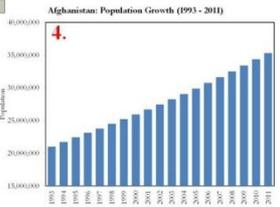
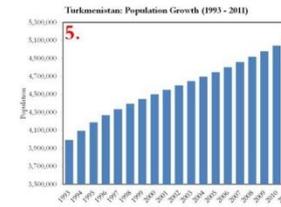
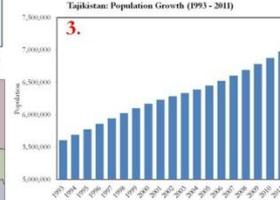
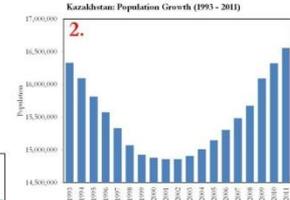
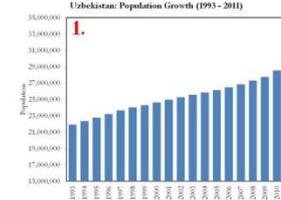


# Illustrative Visualization

## Combining Graphics



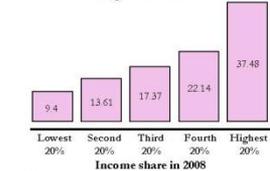
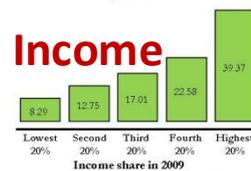
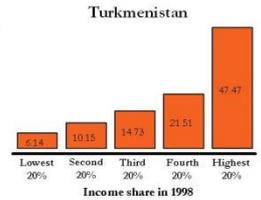
## Population



Data Source: World Bank - World Development Indicators

Developed by The World Bank

## Amu Darya Basin Countries: Population Income Distribution



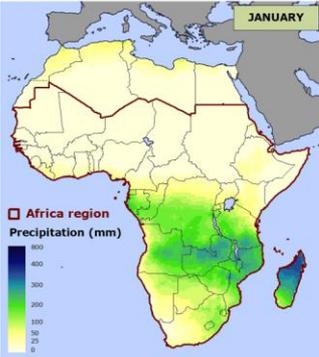
Data Source: World Bank, 2012. World Development Indicators Database

Developed by The World Bank

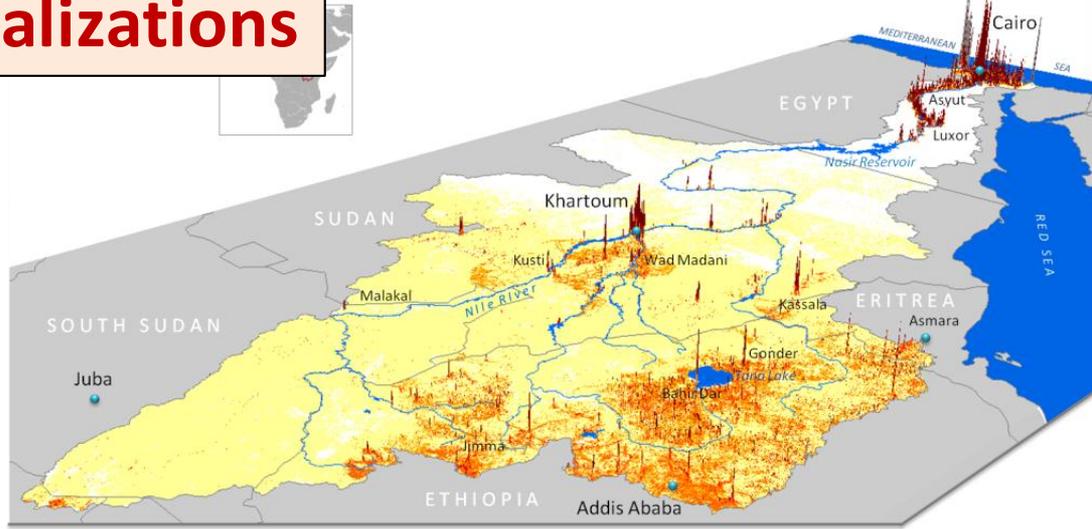
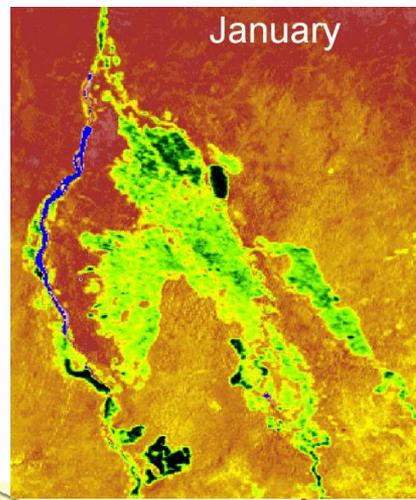
# New Types of Data & Visualizations

Population density perspective of the Eastern Nile Basin

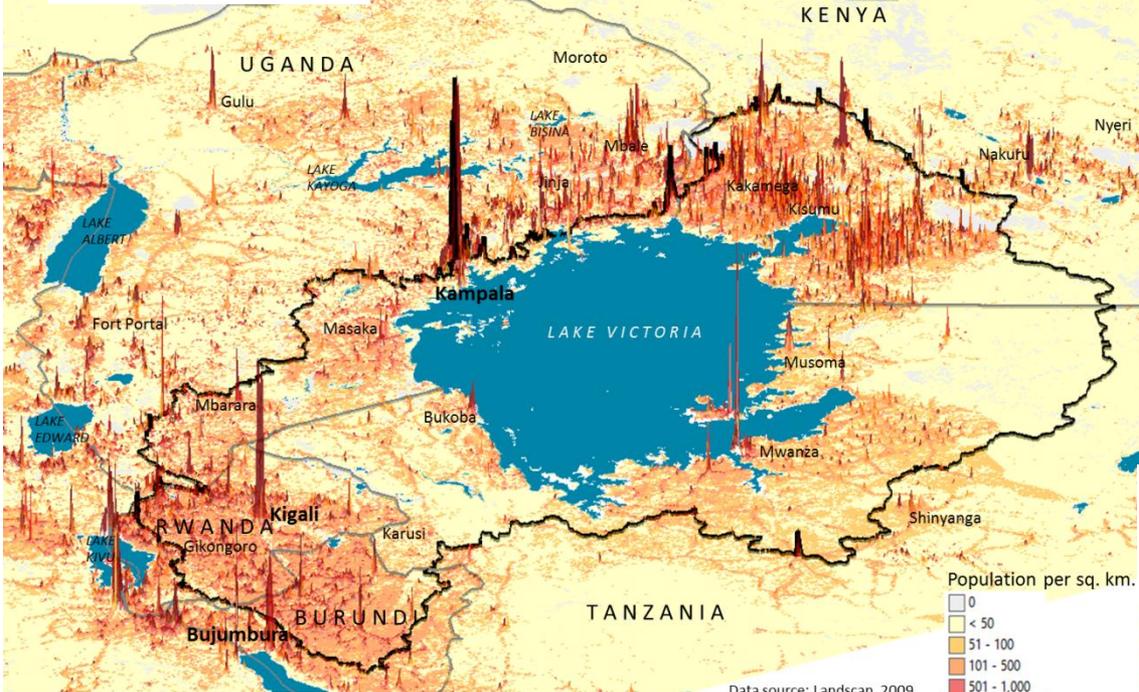
Average Monthly Precipitation



Source: 0.5° x 0.5° CRU Dataset (University of East Anglia Climate Research Unit, 2009)

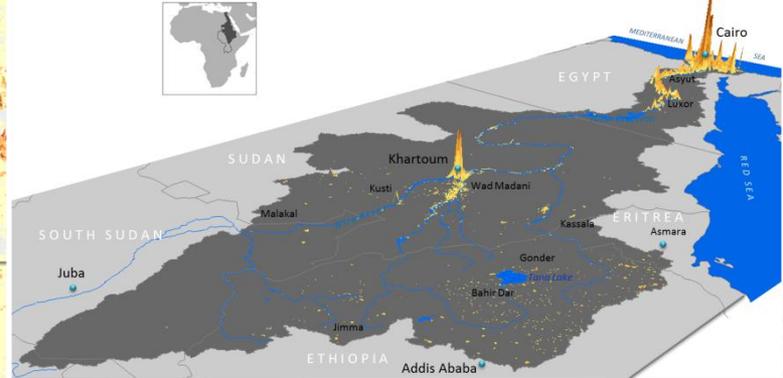


Data source: Landsat, 2008

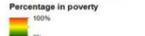
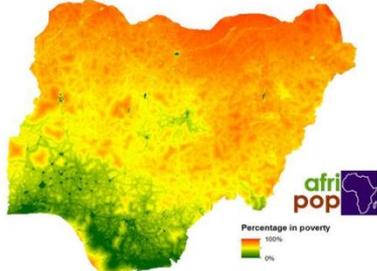


Data source: Landsat, 2009

3D Gross Domestic Product (GDP) of the Eastern Nile Basin



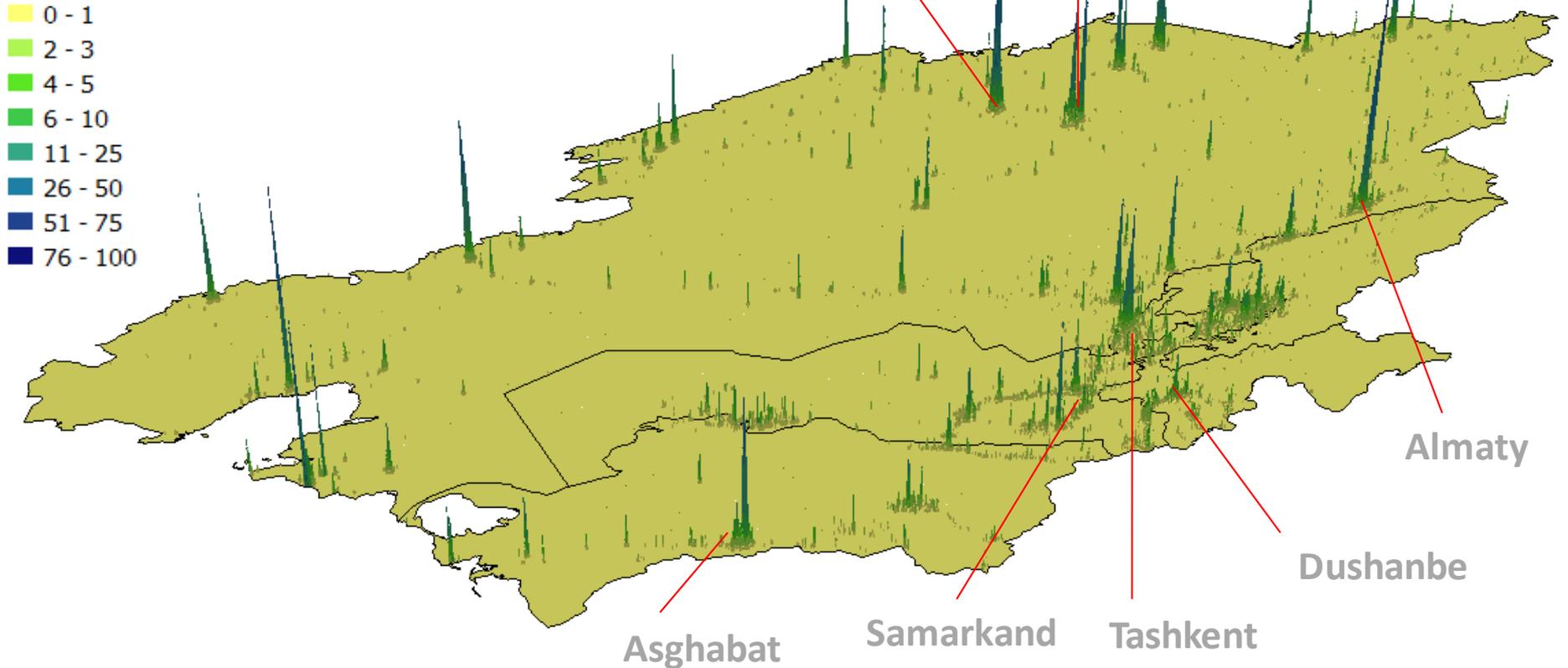
Data source: NOAA, 2006



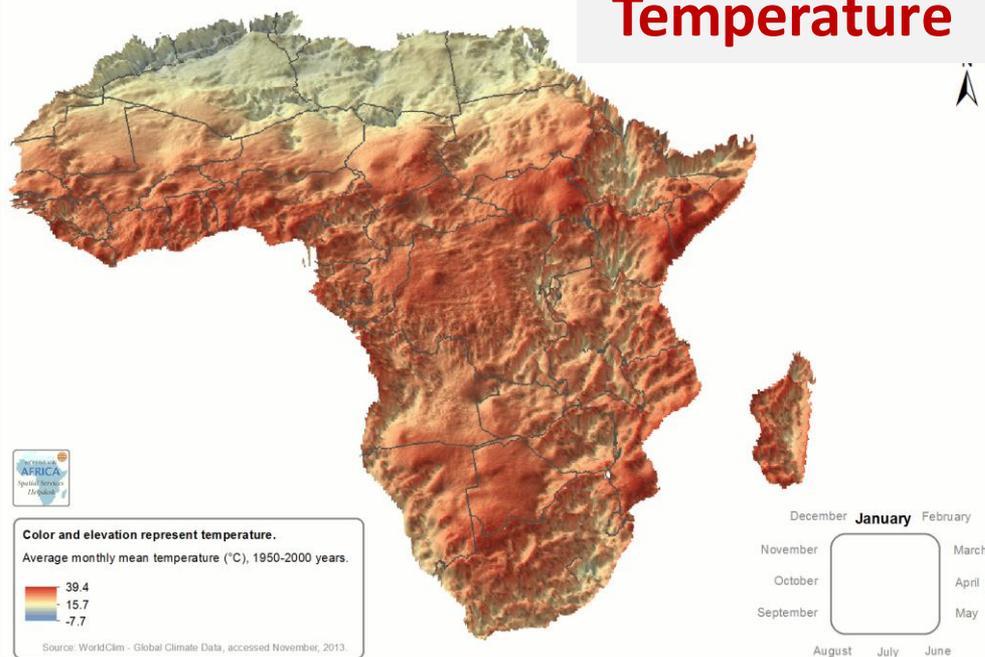
# Illustrative Visualization

## 3-D Maps

**Spatial Distribution Estimate of GDP**  
in 2007-2008 (in USD m, PPP)



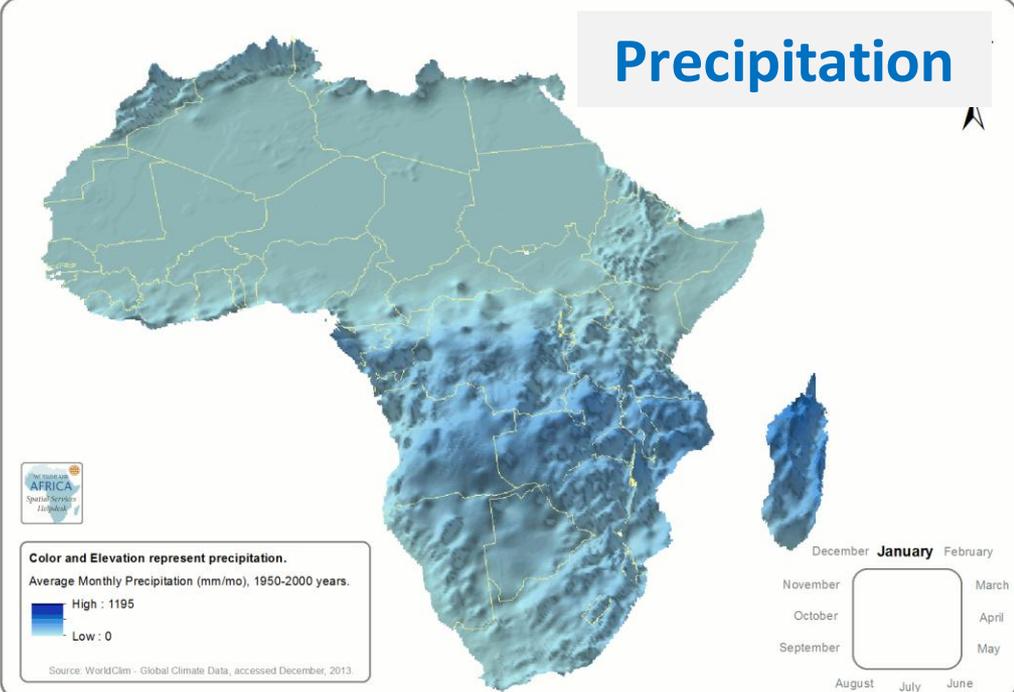
# Temperature



## Illustrative Visualization

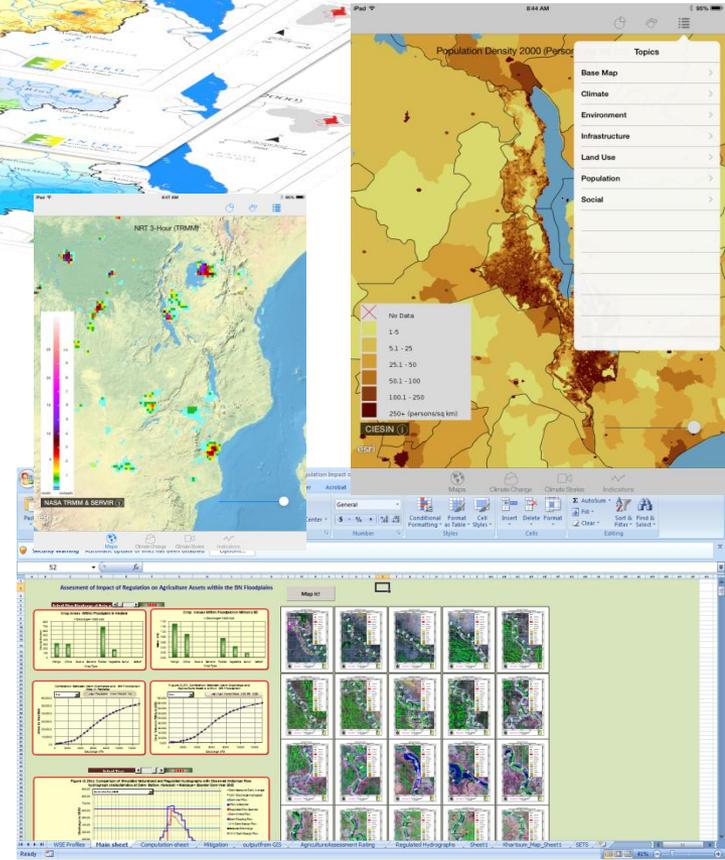
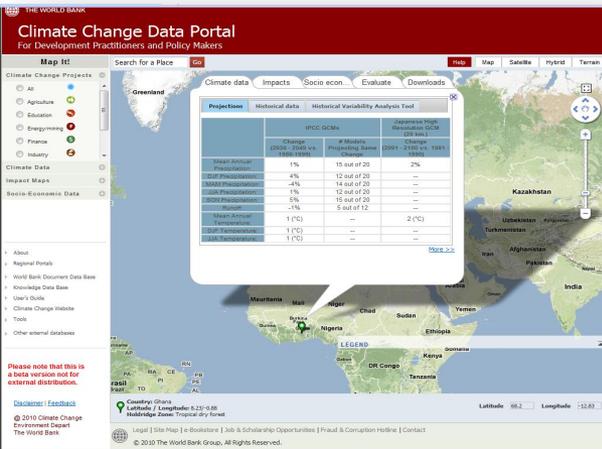
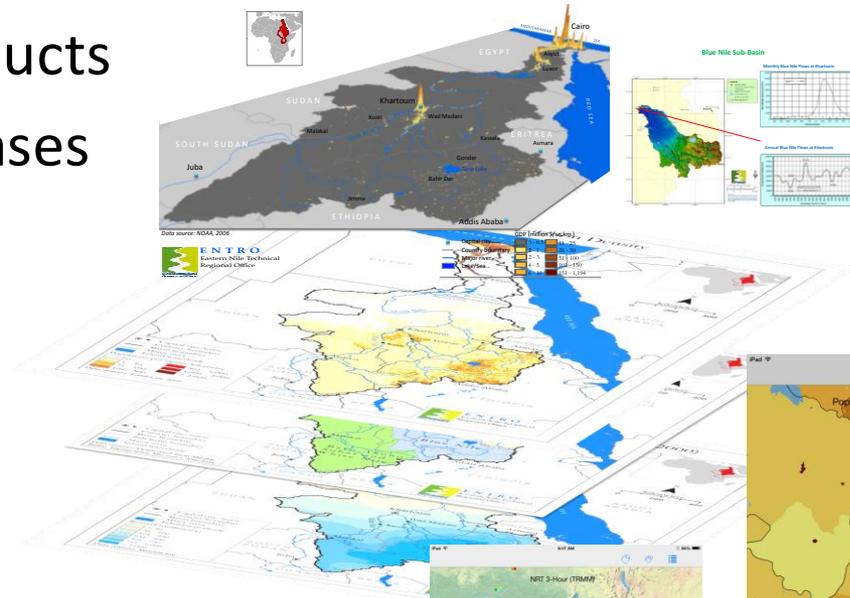
### 4-D Maps? (Animated 3D Maps)

# Precipitation



# Packaging Data into Knowledge Products

- Public Domain Datasets/Products
- Hardcopy and Interactive Atlases
- State of the Basin Reports
- Interactive Collaborative Portal/Website
- Mobile “Apps”
- Bulletins/Newsletters
- ...



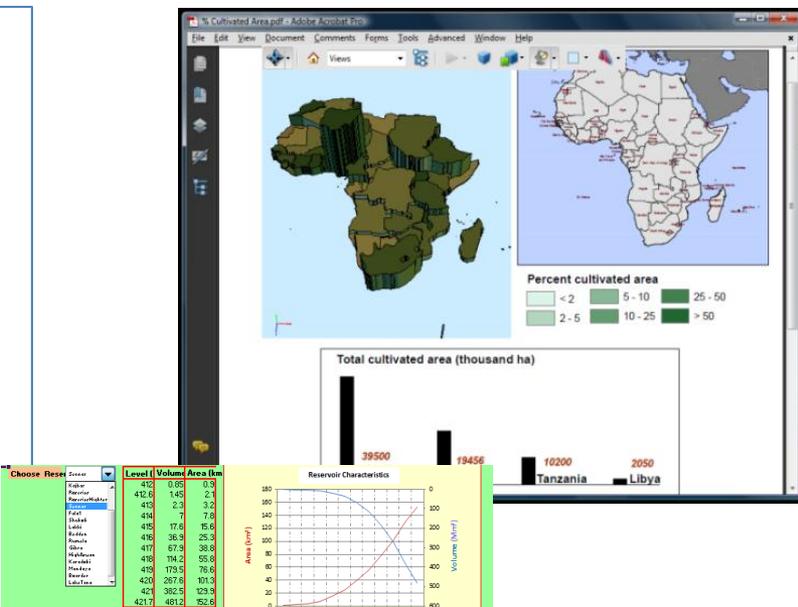
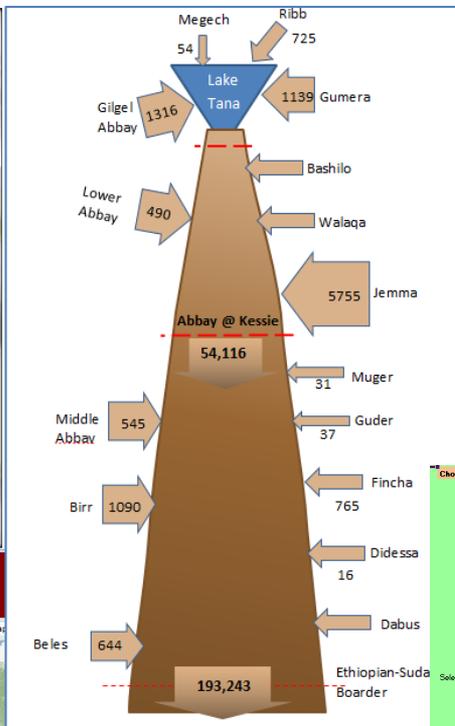
# Interactive Products

## Interactive Portals & Toolkits

**Nile Basin Initiative (NBI)**  
Eastern Nile Technical Regional Office (ENTRO)  
**EN Watershed Management Toolkit**

Tools: Erosion & Sediment Analysis, Morphological Analysis & Stream Calculations, Watershed & DMS, ENTRO Knowledge Product, EN WSM Interventions

ENTRO is a Regional Technical Office of the Government of Egypt, Ethiopia and Sudan providing support to the Eastern Nile Sub-Regional Action Program Team and the Eastern Nile Channel Mission.



**Climate Change Data Portal**  
For Development Practitioners and Policy Makers

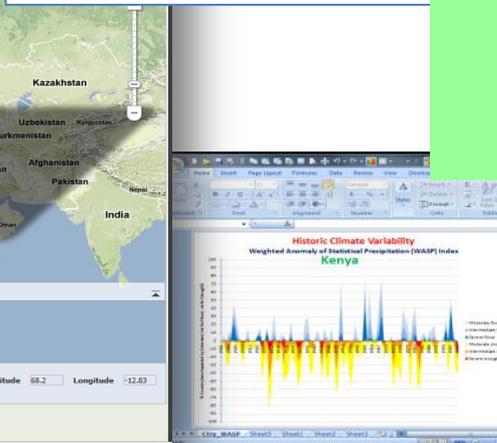
Map It! Search for a Place: Greenland

Climate data | Impacts | Socio econ... | Evaluate | Downloads

Projections	Historical data		Historical Variability Analysis Tool	
	Change (2020 - 2042 vs. 1980-1999)	# Models Projecting Same Change	Japanese High Resolution GCM (20 km)	Change (2091 - 2100 vs. 1981 - 1990)
Mean Annual Precipitation:	1%	15 out of 20	2%	2%
DJF Precipitation:	4%	12 out of 20	---	---
JJA Precipitation:	-4%	14 out of 20	---	---
JJA Precipitation:	1%	12 out of 20	---	---
SON Precipitation:	5%	15 out of 20	---	---
Ward:	-1%	5 out of 12	---	---
Mean Annual Temperature:	1 (°C)	---	2 (°C)	---
DJF Temperature:	1 (°C)	---	---	---
JJA Temperature:	1 (°C)	---	---	---

Country: Ghana  
Latitude / Longitude: 6.23/-0.86  
Holdridge Zone: Tropical dry forest

© 2010 The World Bank Group. All Rights Reserved.



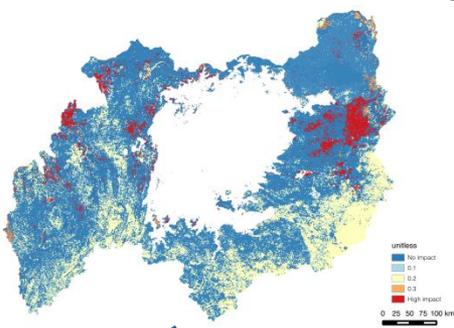
**Nile Basin Initiative (NBI)**  
Eastern Nile Technical Regional Office (ENTRO)  
**Abbay Blue Nile Basin Information Management System**

System Schematic | Dam Database | Climate | Hydrological Gauging Station

Click the sub basin map to go the detail description

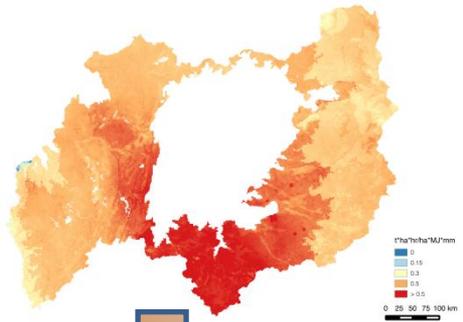
- Anger-Subbasin
- Beles-Subbasin
- Beshilo-Subbasin
- Dabus-Subbasin
- Didessa-Subbasin
- Dinder-Subbasin
- Fincha-Subbasin
- Guder-Subbasin
- Jemma-Subbasin
- Muger-Subbasin
- N/Gogum-Subbasin
- Rahad-Subbasin
- S/Gogum-Subbasin
- Tana-Subbasin
- Welaka-Subbasin
- Worbera-Subbasin

# Cover Management



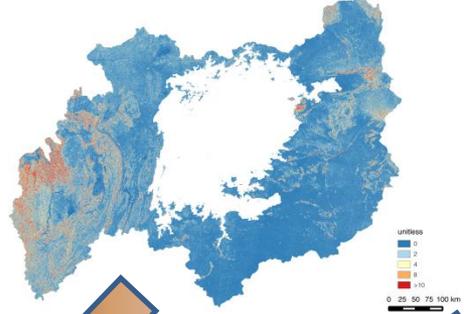
# Soil Erodibility

$$K = [2.1M^{1.14}(10^{-4})(12 - OM) + 3.25(s - 2) + 2.5(p - 3)] / 7.59$$



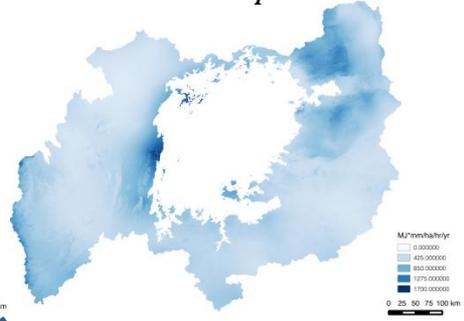
# Slope Length/Steepness

$$STCI = (m + 1) \left[ \frac{A_y}{22.13} \right]^m \left[ \frac{\sin \beta}{0.0896} \right]$$

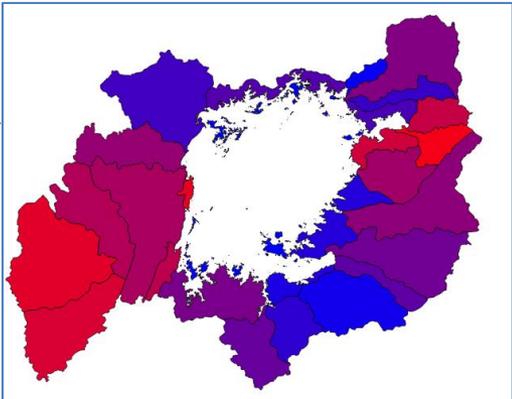
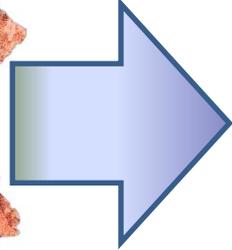
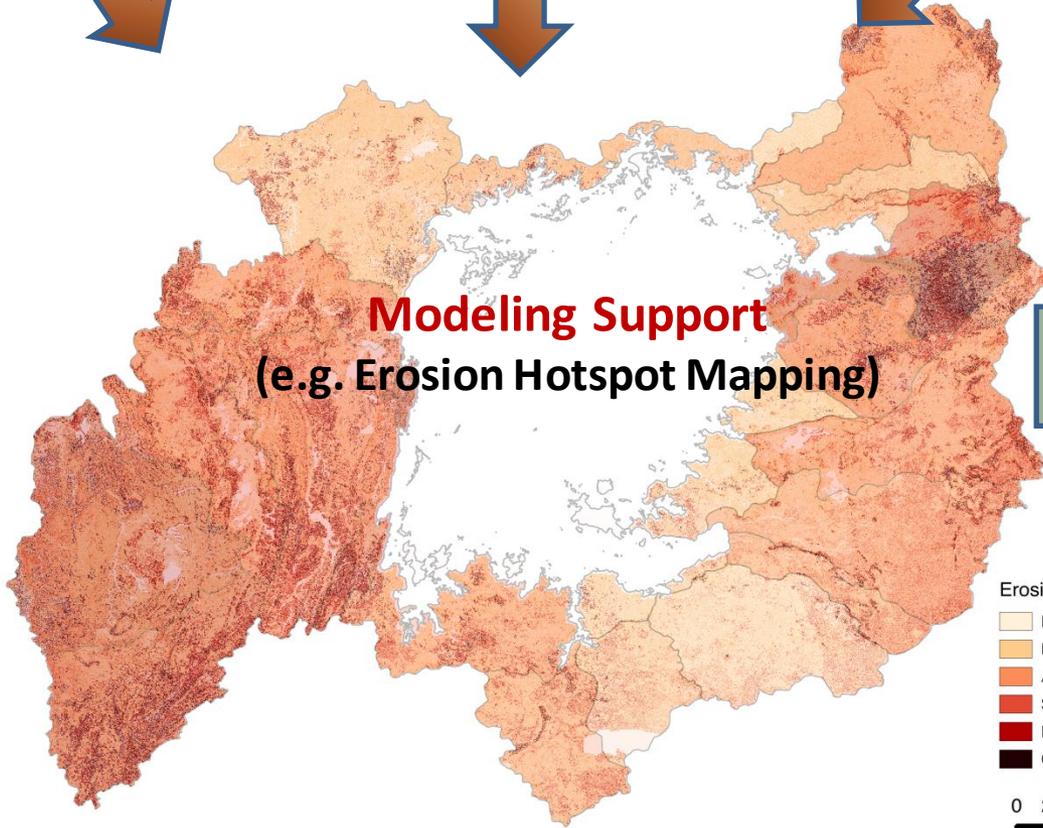


# Rainfall-Runoff

$$F = \frac{\sum_{k=1}^{12} (P_i^2)}{P}$$



**Modeling Support**  
(e.g. Erosion Hotspot Mapping)



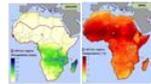
**Soil Erosion estimates**  
**at watershed level**

# There are many new types of public-domain datasets to improve landscape monitoring services...

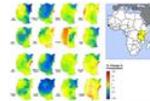
## Global Spatial Datasets



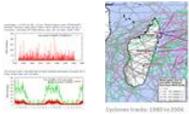
Irrigated, Rainfed Areas (IWMI, FAO)



Historical Climate (CRU/UEA)



Climate Change (IPCC, TNC/WB)



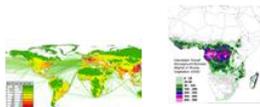
Climate/Flow data (KNMI, GRDC, ...)



Gridded GDP (Yale, NOAA)



DEM (SRTM, ASTER)



CO2 emissions (EDGAR-JRC-PBL, ...)  
C Biomass (Winrock)



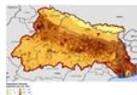
Biodiversity (CI, WWF, IUCN...)



Flood/Drought (DFC, GDACS, UNEP...)



Landcover (ESA, USGS, ...)



Population (CIESIN, Landscan, ...)



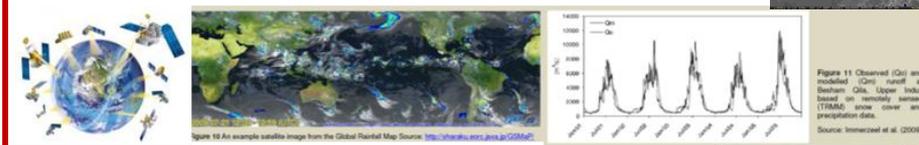
Soils (UNESCO, FAO, ...)

## Near Real-Time "Top-down" Datasets



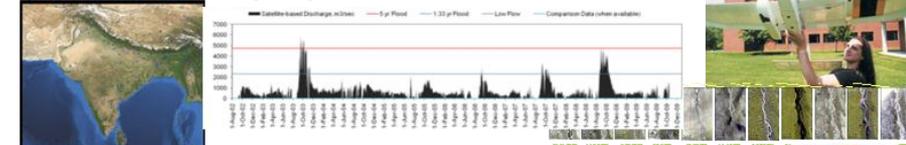
### "Top-down" Approaches

#### "Space-based Rain Gauge" e.g. TRMM

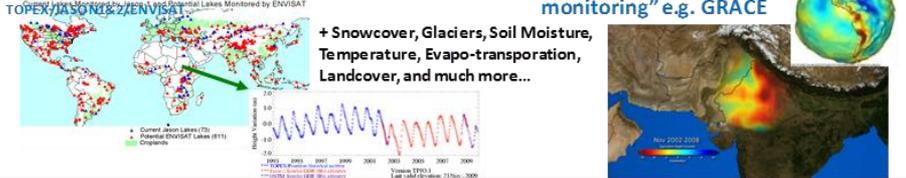


#### Weather Products

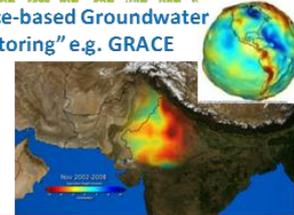
#### "Space-based Stream Gauge" e.g. AMSR



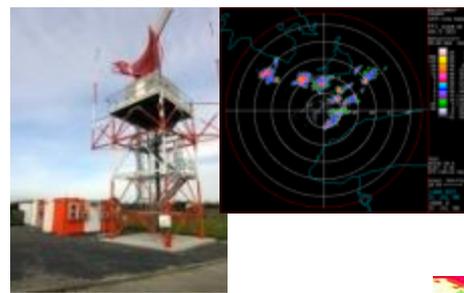
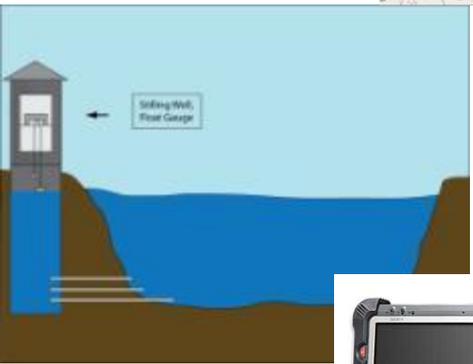
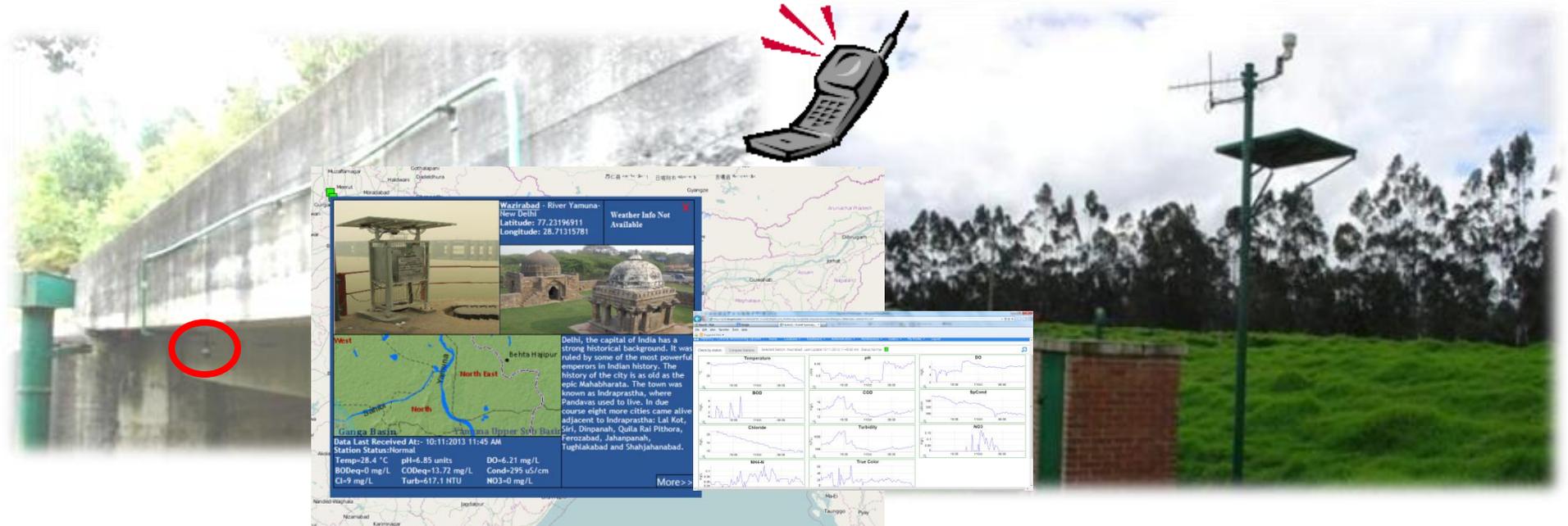
#### "Space-based Reservoir Levels" e.g. TOPEX/Poseidon & ZenithSat



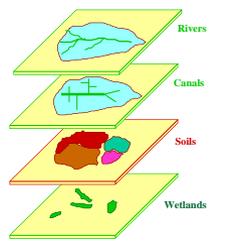
#### "Space-based Groundwater monitoring" e.g. GRACE



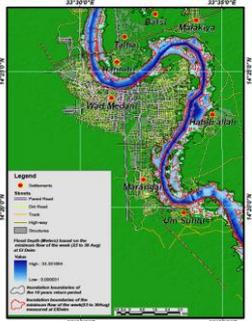
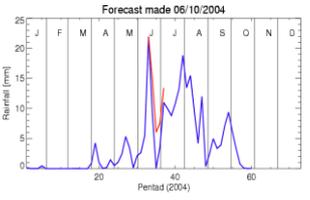
# ...and many modern "Bottom-up" Monitoring tools



...that can be integrated into an integrated Hydromet Services System (usable at regional and national levels)

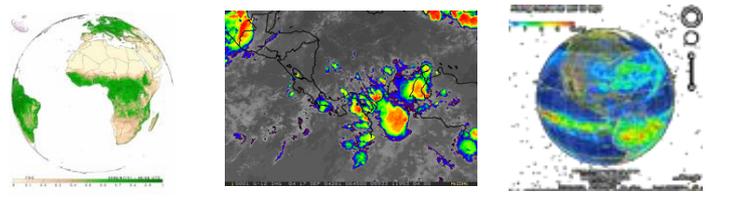


**GIS and other datasets Data Rescue**

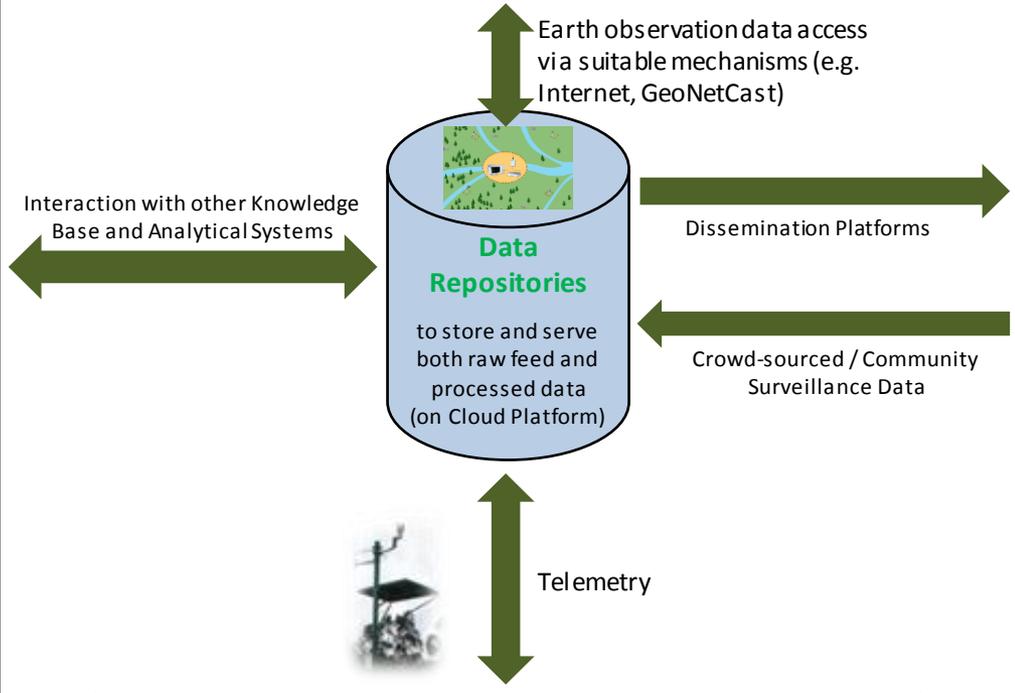



**Data Management & Modeling**  
(for weather, hydrological, inundation & other forecasts – short-term and seasonal)

**“Top-Down” Data Acquisition System**



**Satellite Earth Observation**






**Manual Monitoring    Automated Monitoring    Radars**

**“Bottom-up” Data Acquisition System**



**Web Portals**  
(e.g. integrated hydromet visualization platforms)



**Stakeholder Alerts**



**Operational Control Rooms**

# Capacity-Building and Outreach

## Internships



## University Partnerships



## Training & Workshops



## Distance Learning

## Competitions (e.g. Hackathons, Apps)

# Modernizing Information Infrastructure learning from Global Experiences

*Can we use a Climate Platform to work together to improve public-domain information and modernize institutions through improved information-based decision support?*

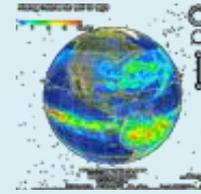


# Data Access and Visualization

## An Exciting New World Ahead!

### Earth Observation Data

(e.g. mostly global data and knowledge products on weather, land cover, floods, discharge, groundwater, etc. from NASA, ESA, NOAA, Regional and National Space Agencies, etc.)



### Datasets from Regional and Local Institutions

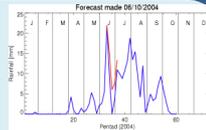
(e.g. information on measured or computed detailed datasets on weather, flows, agriculture, generation, etc. from regional institutions, ministries, Universities, NGOs, private sector, etc.)

### Integrated Mobile App/Portal



### Other Datasets

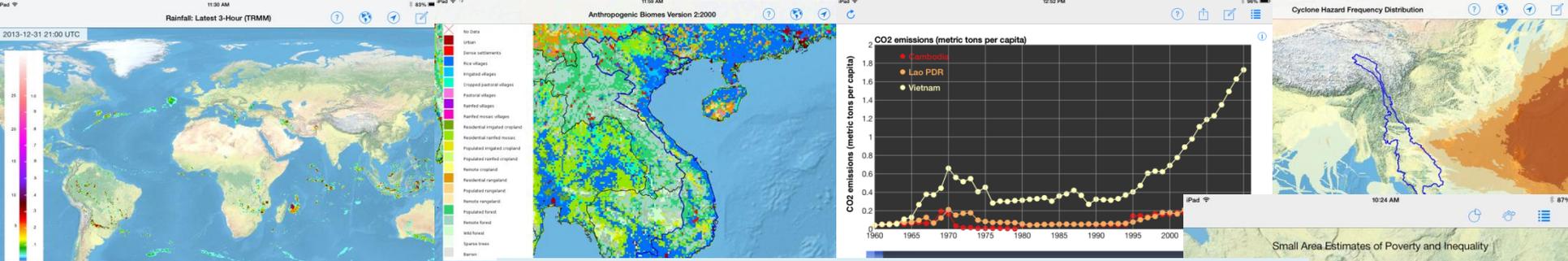
(e.g. from publications, model outputs, data rescue of legacy paper data, crowd-sourcing, research, surveys, etc.)



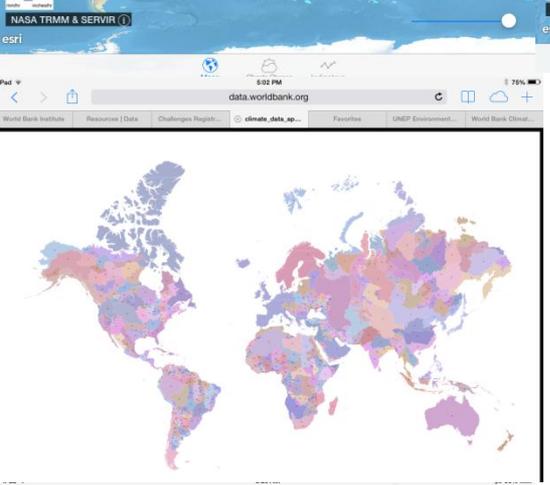
### Global Spatial Datasets

(e.g. topography, historical climate, hydrology, climate change projections, land cover, snow, population, administrative areas, gridded GDP, and a range of other social, environmental, and economic indicators)



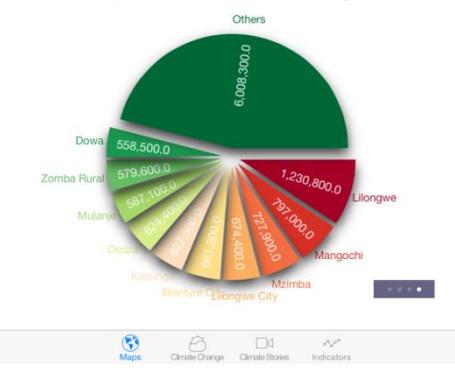
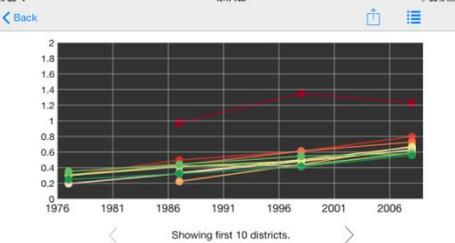
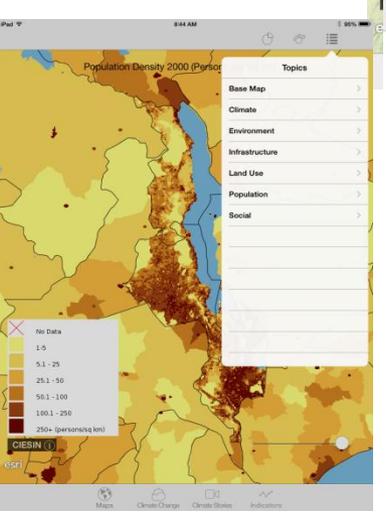
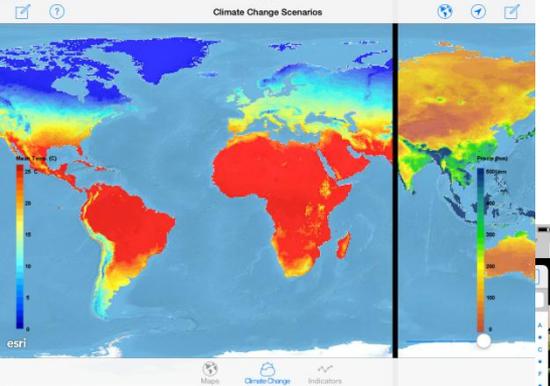


# Innovative Mobile Apps e.g. "Spatial Agent"



Small Area Estimates of Poverty and Inequality

Small Area Estimates of Poverty and Inequality dataset consists of consumption-based measures of poverty and national administrative areas of various countries (Asia, Europe, North America and South America) derived on a country-level basis, from a combination of census and survey data using small area estimation techniques developed for poverty mapping. The collection of data sets have been compiled, integrated and standardized from the original data providers into a unified, spatially referenced and globally consistent dataset. The collection is produced by the Columbia University Center for International Earth Science Information Network (CIESIN) in collaboration with a number of external data providers. Source: MASDAP



# Thanks!



*For more information, pls. contact:*

**Dr. Nagaraja Rao Harshadeep**

Senior Environmental Specialist

The World Bank

1818 H St NW, Washington DC 20433

[harsh@worldbank.org](mailto:harsh@worldbank.org)