



Developing modern platforms to effectively share, analyze, and use data for development

Nagaraja Rao Harshadeep (Harsh)

Global Lead (Watersheds)

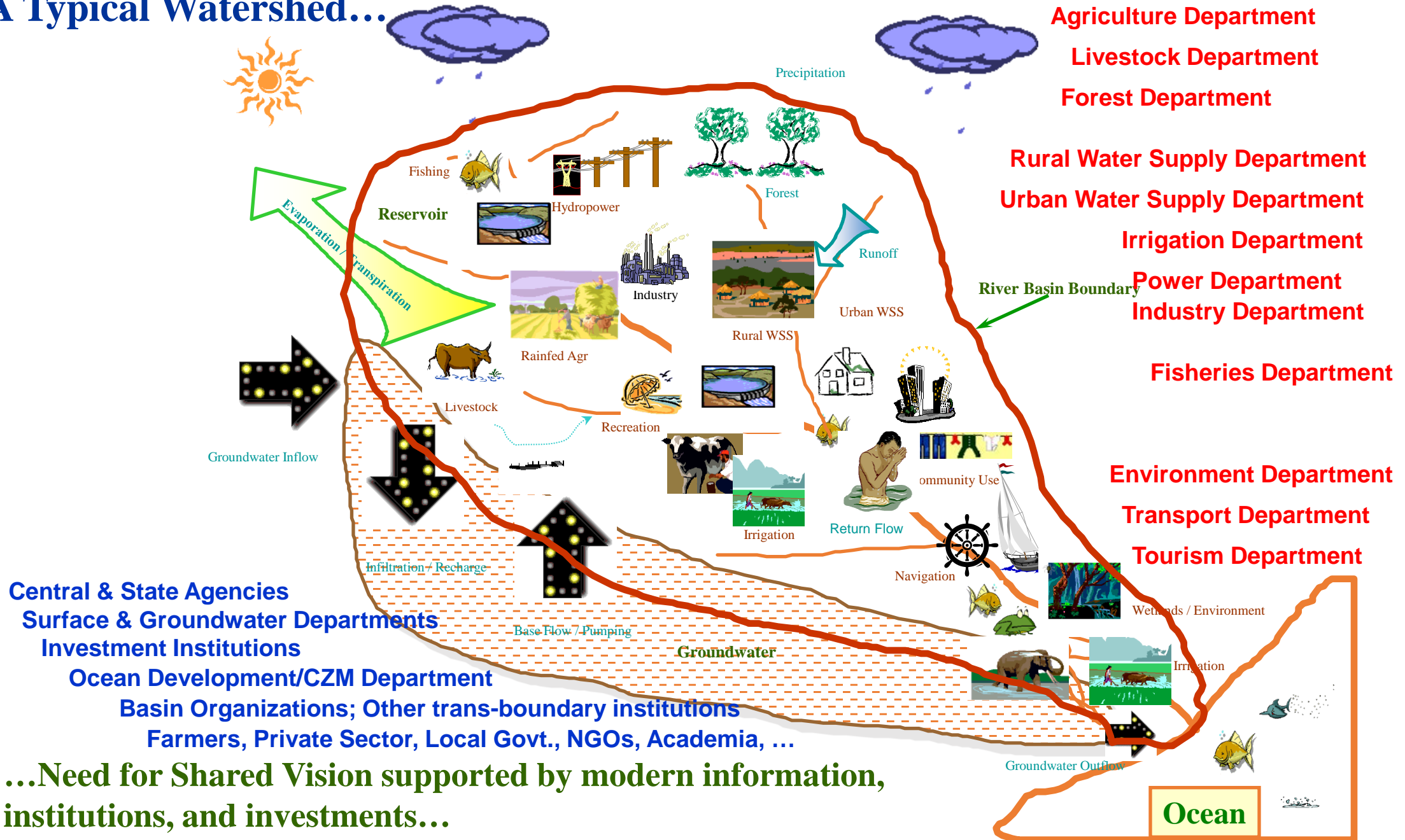
The World Bank

Lunch Keynote
4th Annual Cooperative Institute for Climate and Satellites (CICS)-MD Science Meeting
College Park, MD
November 24, 2015

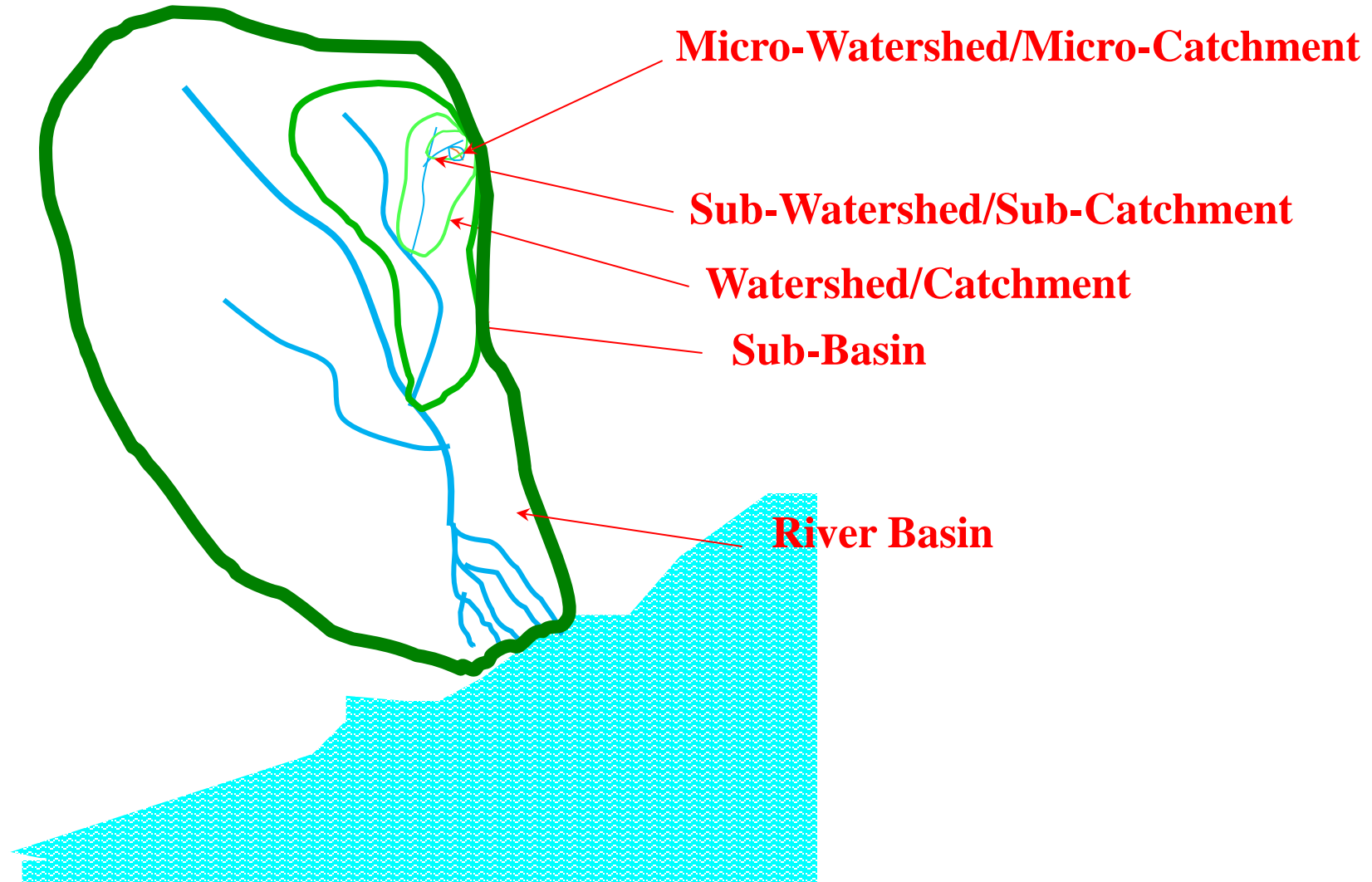


Multiple sectors, multiple institutions, linked by water and natural resources...

A Typical Watershed...



Basin? Watershed? Catchments?

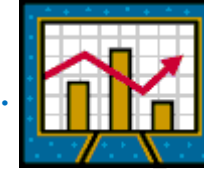


Multiple Development Objectives

Triple Bottom-Line Needs

Economic

- Fueling sustainable growth and shared prosperity
- Investment net benefits, O&M
- Balanced Trade
- Enhancing regional cooperation...



Social

- Access to basic services
- Poverty Alleviation/Jobs/ Livelihoods
- Equity/Gender/ Affordability/ Vulnerable/Indigenous People
- Reducing Resettlement/ Migration
- Managing climate stresses...

Environmental

- Resource Sustainability
- Managing water quality, ecosystem services
- Managing climate risks
- Reducing erosion/siltation...



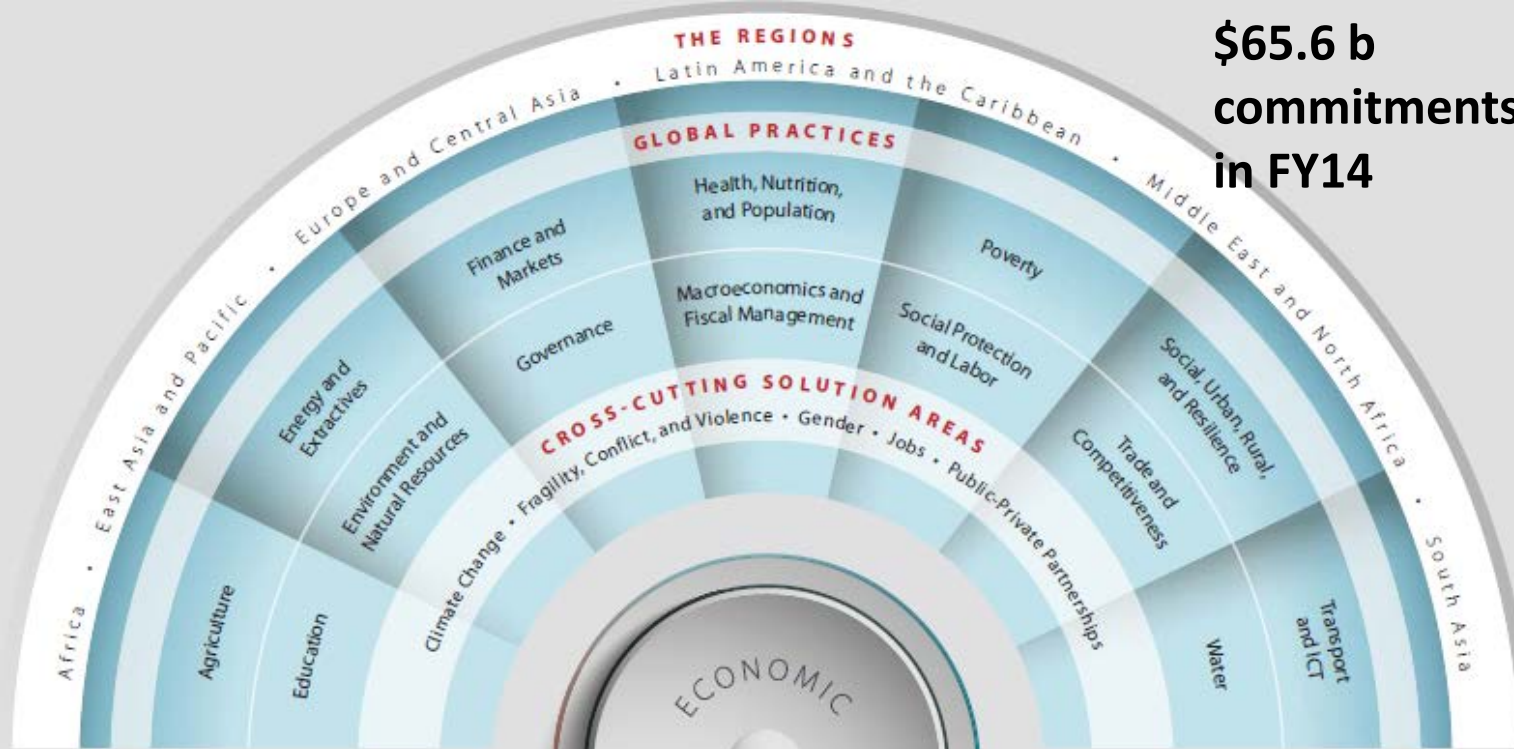
Sustainable Development Goals (SDGs) post-2015



17 SDGs, 169 targets

<https://sustainabledevelopment.un.org/>

**\$65.6 b
commitments
in FY14**



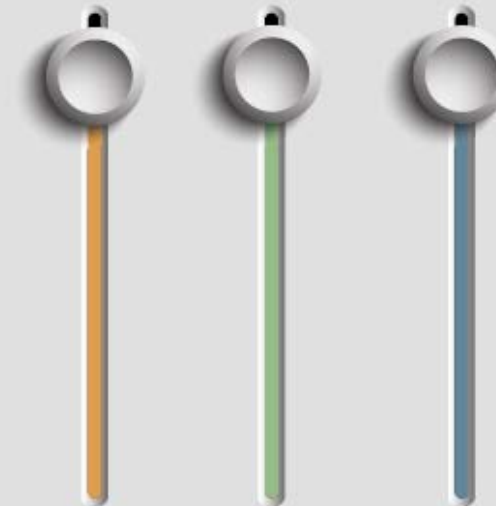
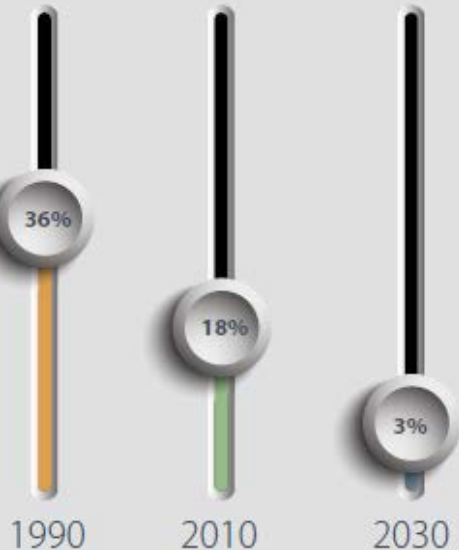
END EXTREME POVERTY

BOOST SHARED PROSPERITY

"To end extreme poverty by 2030, 1 million people each week will have to lift themselves out of poverty. That's each week for the next 16 years. And we strongly believe this can happen."

— Jim Yong Kim

Global share of people living on less than \$1.25 a day



Boost the income growth of the bottom 40%

IBRD/IDA

- 95,000 km of roads constructed and rehabilitated
- 250.9 m people received health, nutrition, and population services
- 903 m tons of CO2 equivalent emissions expected to be reduced annually
- 15.3 m people and micro, small, and medium enterprises reached with financial services
- 37.4 m beneficiaries covered by social safety net programs
- 35.3 m with access to an improved water source
- 6.8 m with access to improved sanitation facilities
- 6.9 m with access to direct electricity
- 57 countries with strengthened public financial management systems

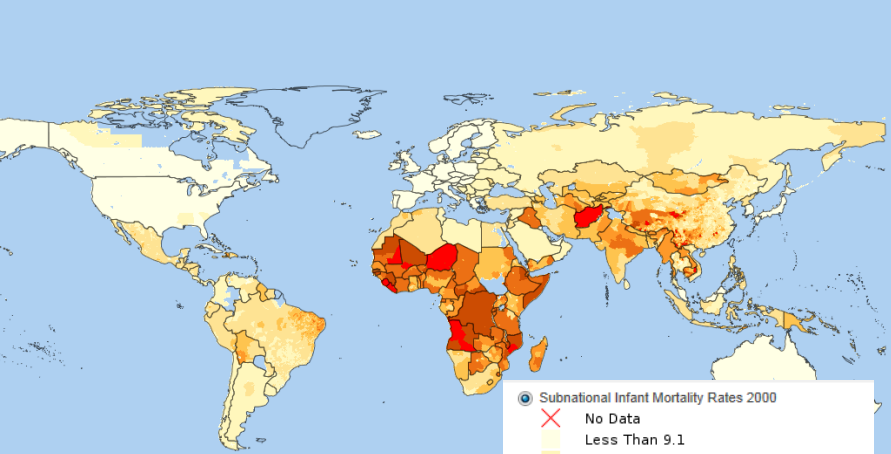
IFC

- 2.6 m jobs provided
- 2.9 m farmers assisted
- 5.5 m metric tons of greenhouse emissions expected to be reduced
- 94 m customers supplied with power, water, and gas
- 2.5 m students received educational benefits
- \$18.7 b in government revenues generated by IFC clients

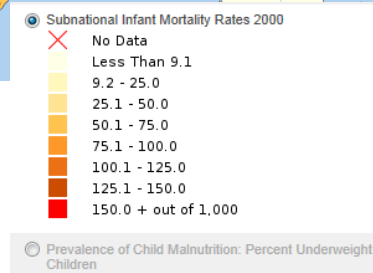
MIGA

- 52,100 jobs provided
- 47 m people provided access to power
- 3.3 m people provided access to clean water
- \$6.1 b new business loans issued by MIGA clients
- 15 m people provided access to transport
- \$1.6 b in government revenues generated by MIGA clients

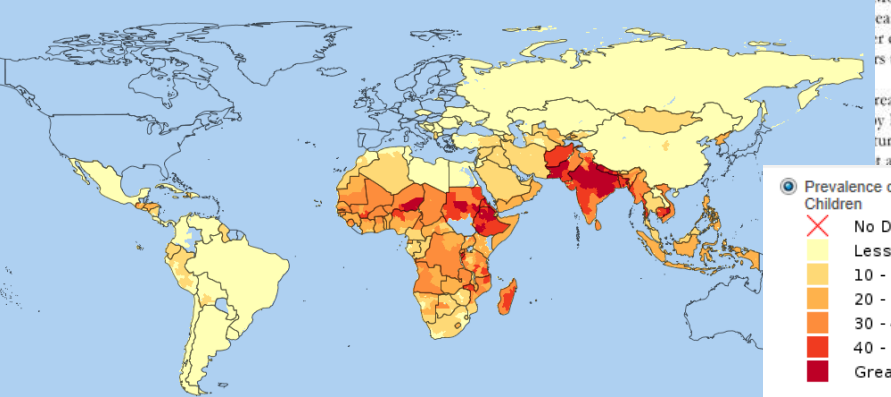
Poverty is widespread...



Infant Mortality



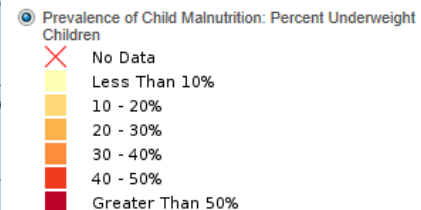
Child Malnutrition



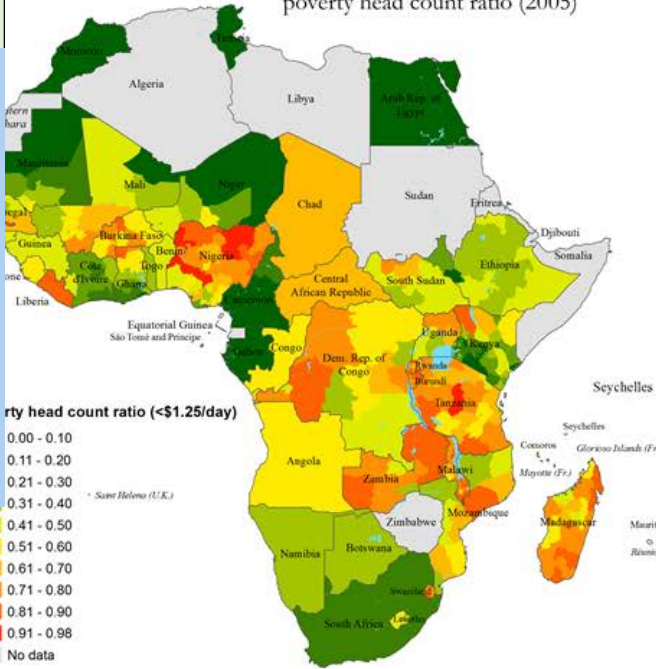
Poverty Head Count Ratio (<\$1.25 per day PPP)

The sub-national level poverty data are based on household surveys conducted around the year 2005 (+/- 2 years). The mapping was done for 24 Sub-Saharan nations. Morocco, Tunisia and Egypt's data were taken from Africa Development Index database of The World Bank. The data for Morocco is for the year 2007 which falls near threshold of 2005. For rest of the 'No data' or data is not available or the data year is greater than threshold.

Area polygons over 3D maps (right panels) by Natural Earth using MODIS sensor data. The nature of the representation from a single source for all urban polygons are clearly visible.

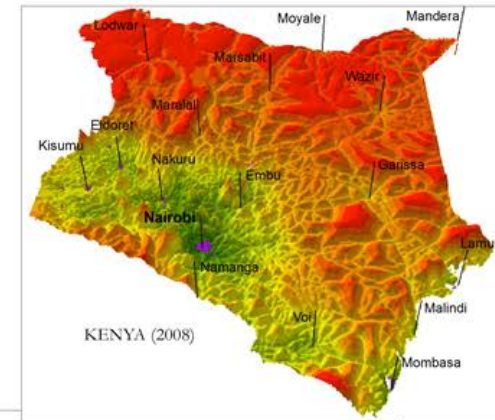


Sub-national and national level poverty head count ratio (2005)



Data source: Harvest Choice; International Center for Tropical Agriculture (CIAT); The World Bank

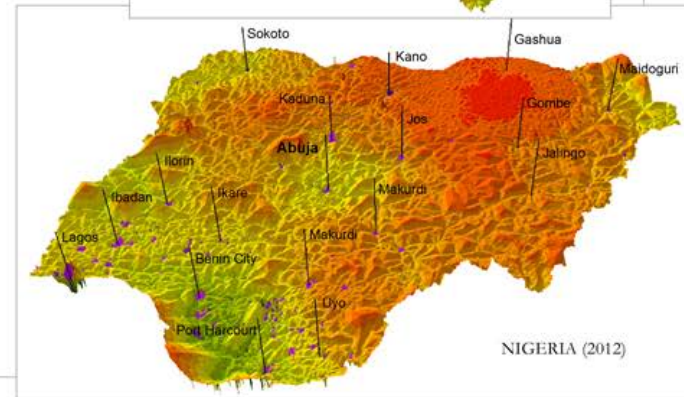
3D gridded poverty head count ratio (<\$1.25/day/sq. km.) for selected countries



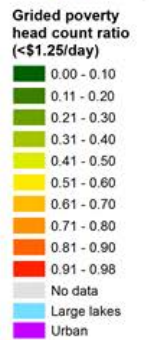
KENYA (2008)



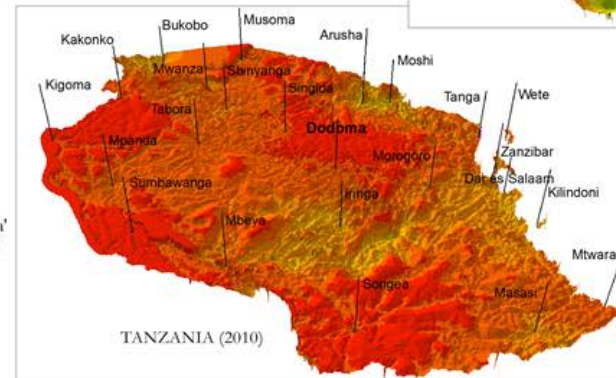
MALAWI (2011)



NIGERIA (2012)



Note: Vertical black lines denote major urban area locations



TANZANIA (2010)



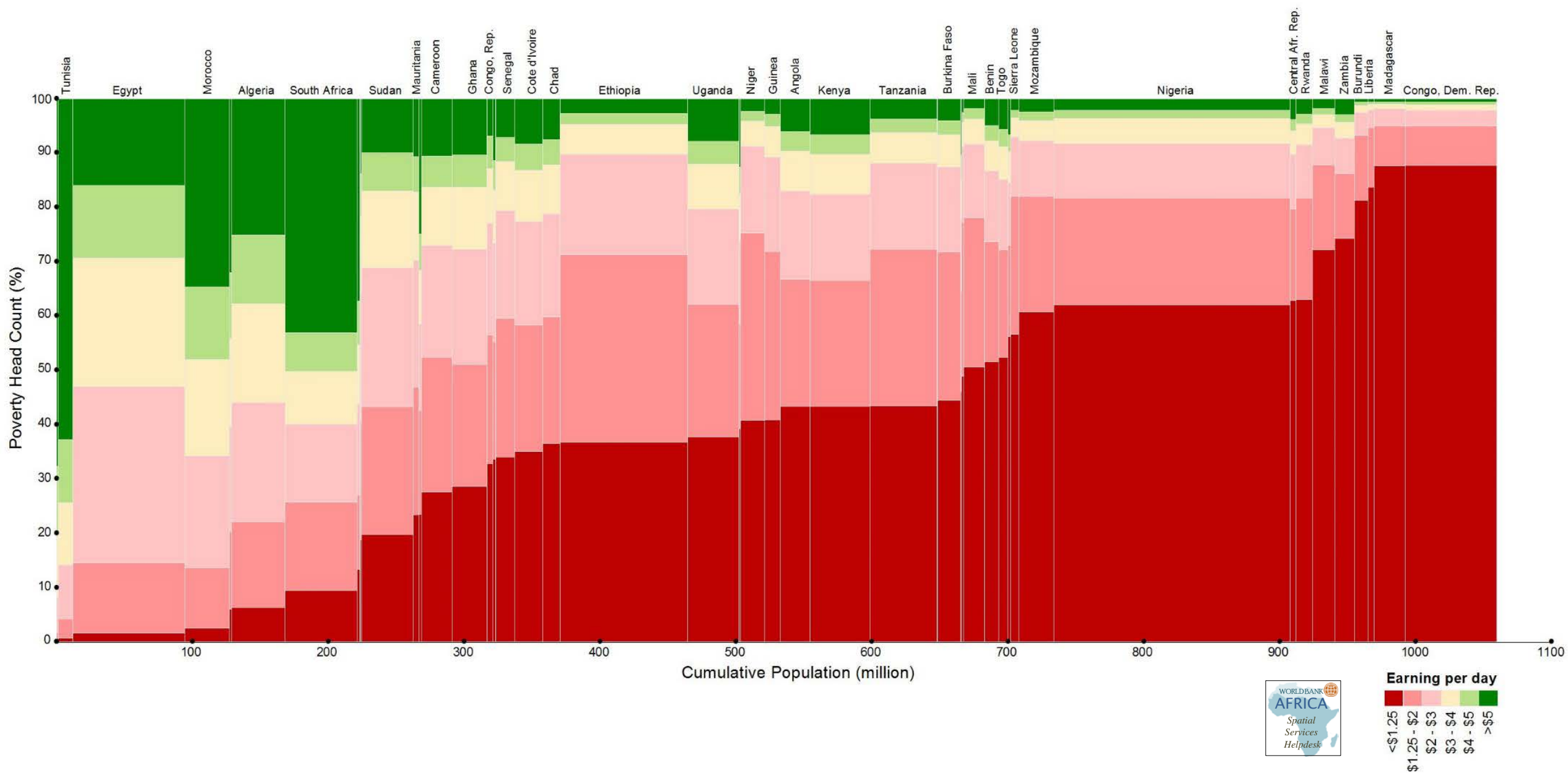
UGANDA (2010)

Data source: Afripop, FAO; Natural Earth

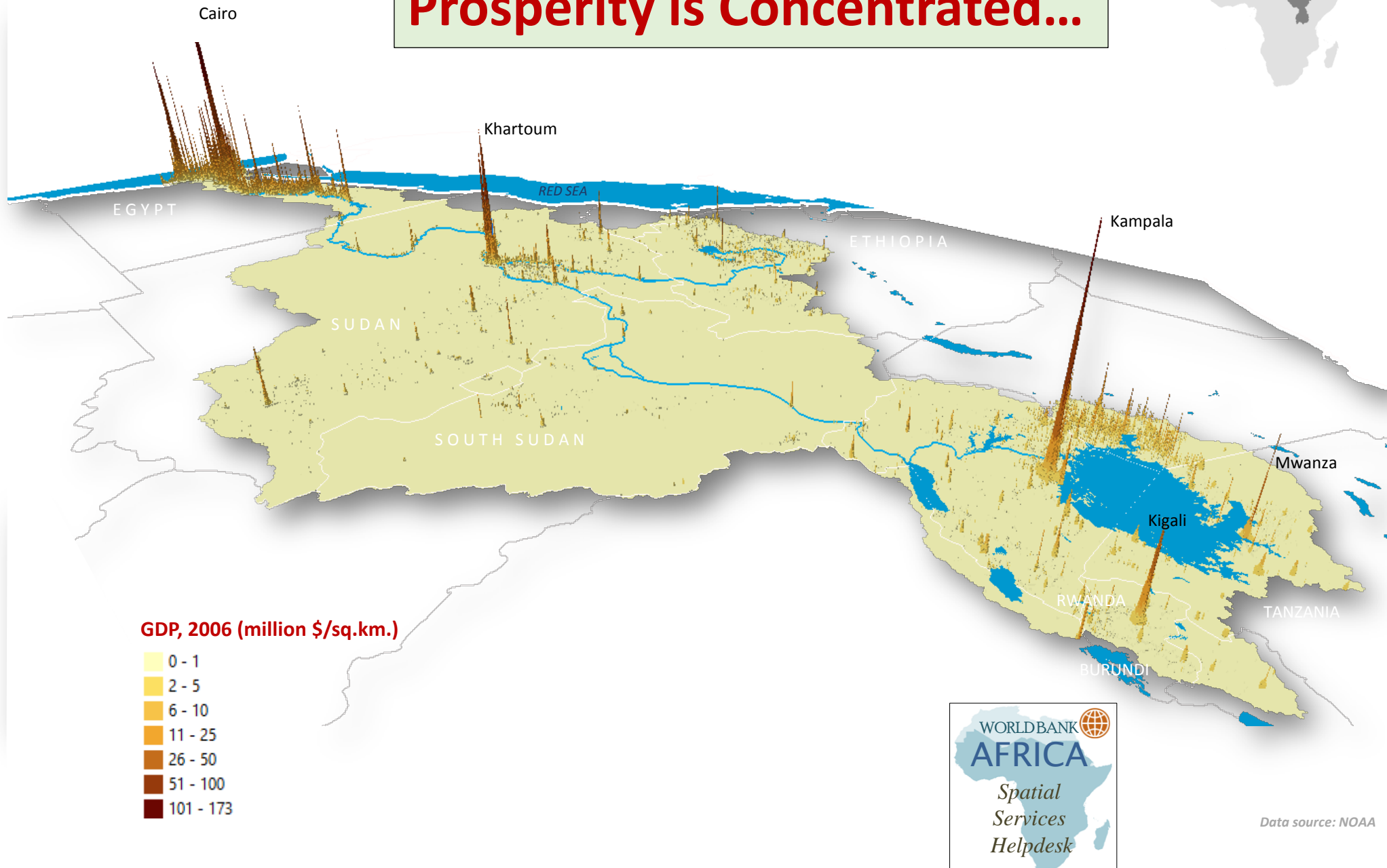


Poverty Head Count Ratio

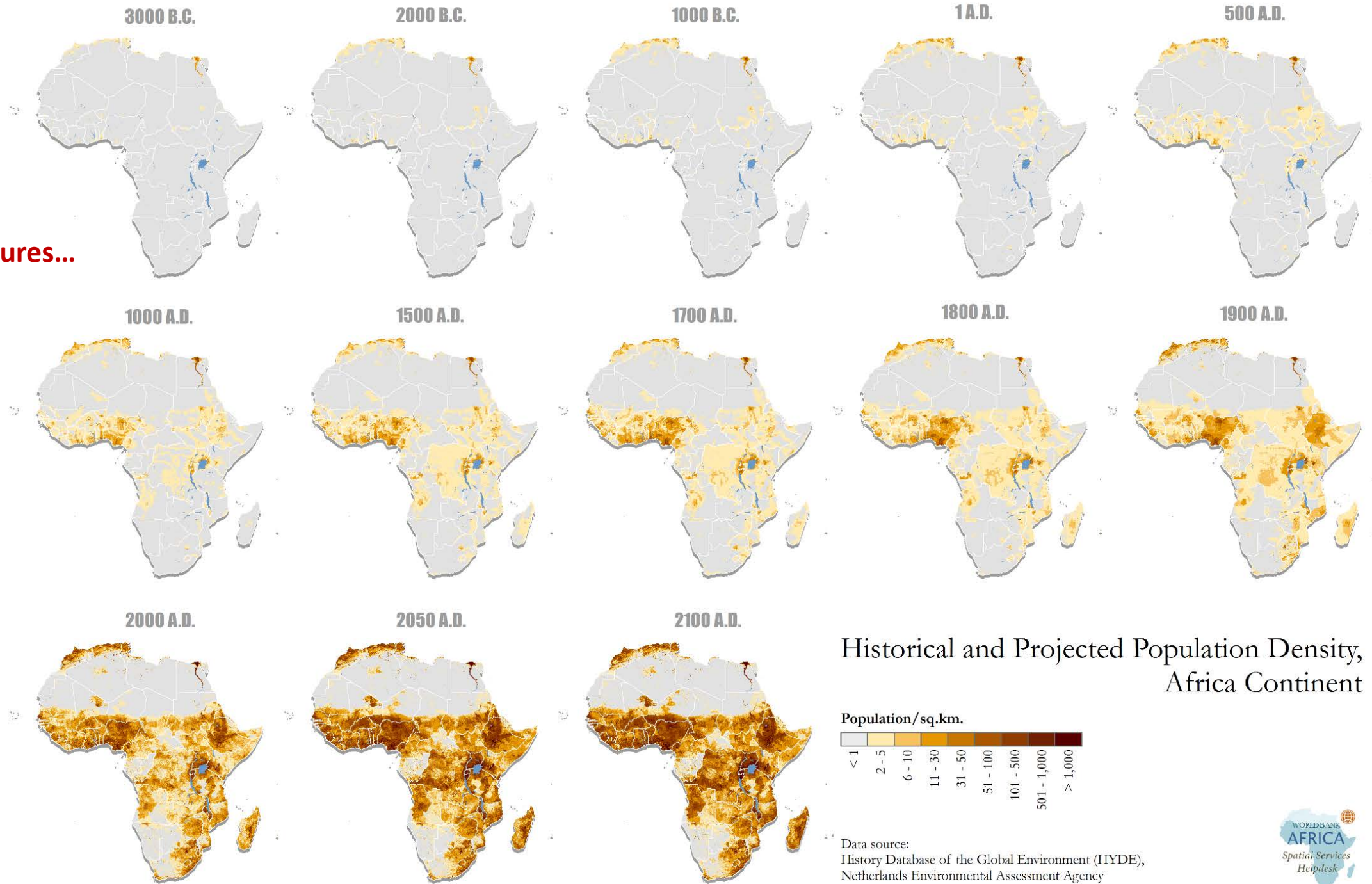
Affecting most of the population...



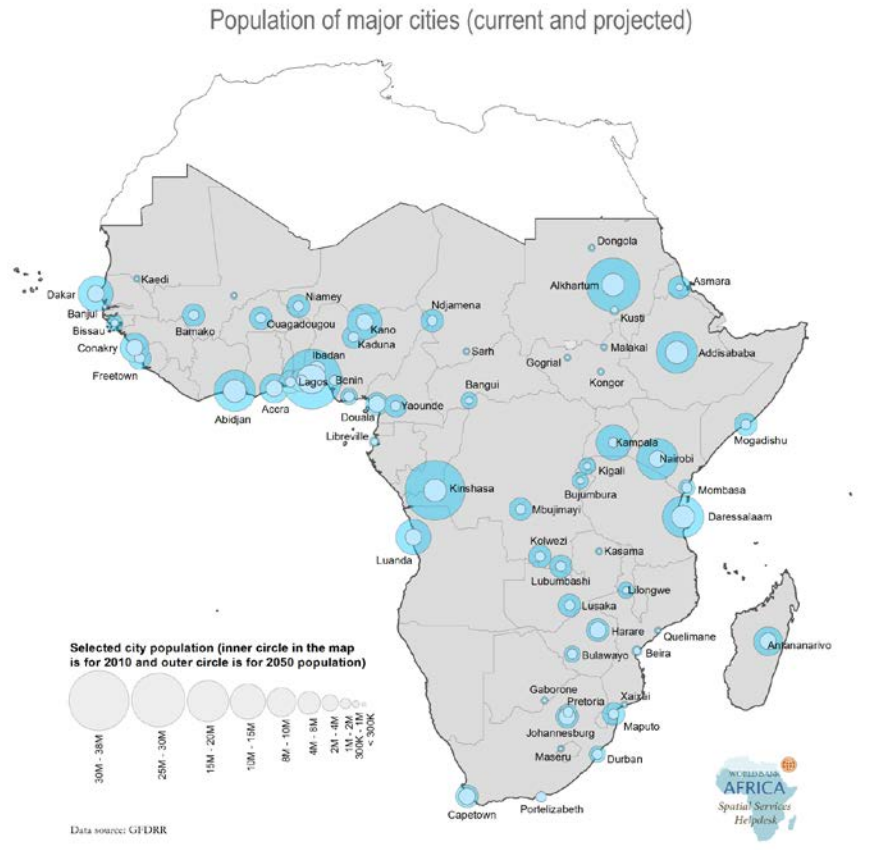
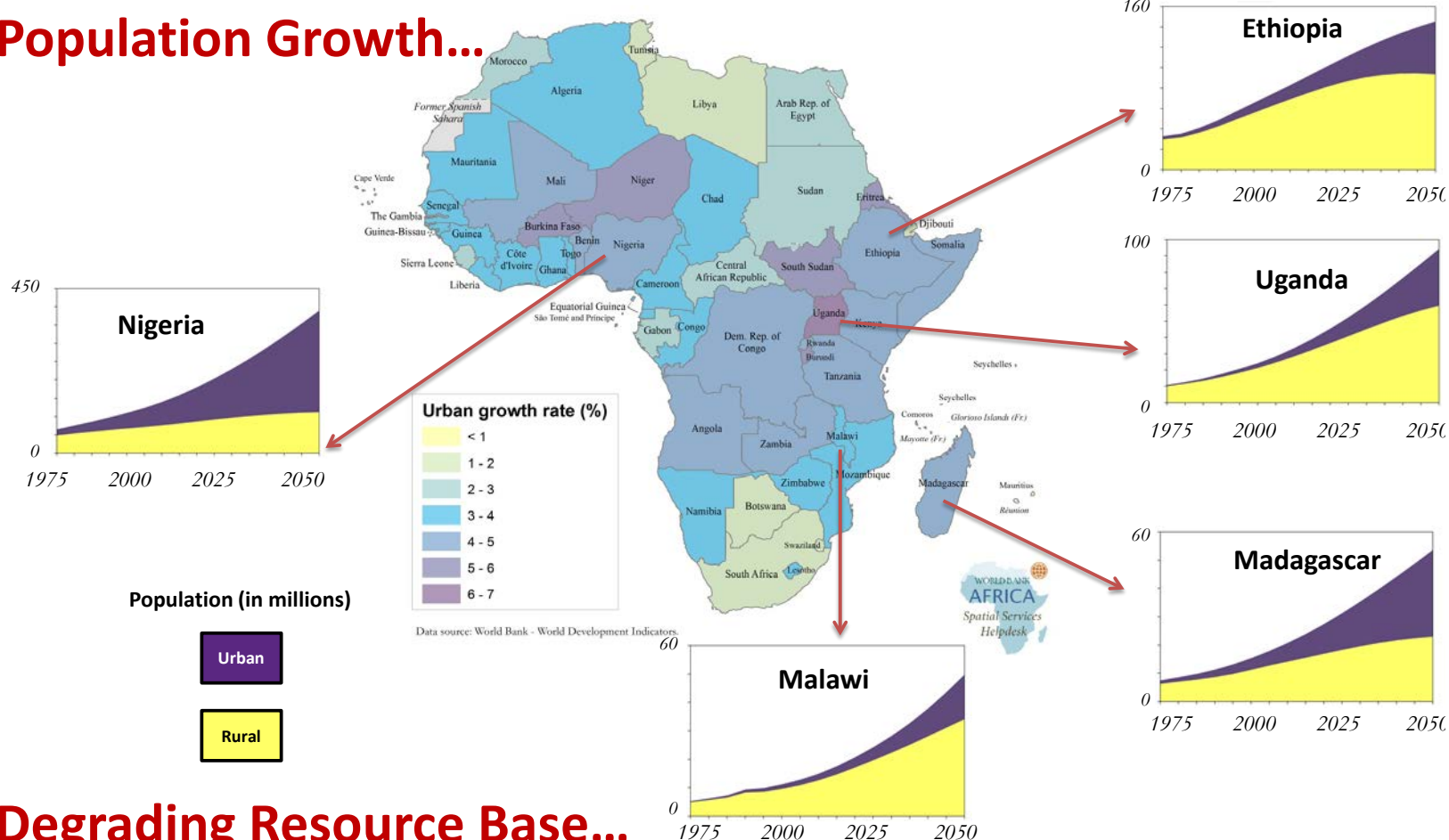
Prosperity is Concentrated...



Population Pressures...



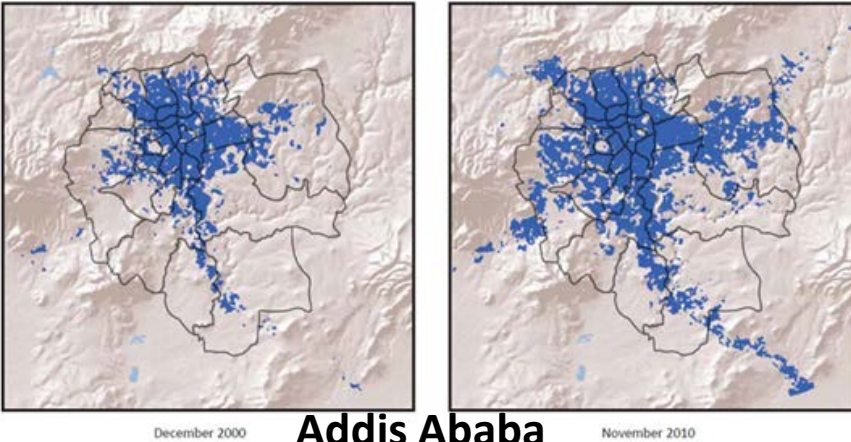
Population Growth...



Urbanization...

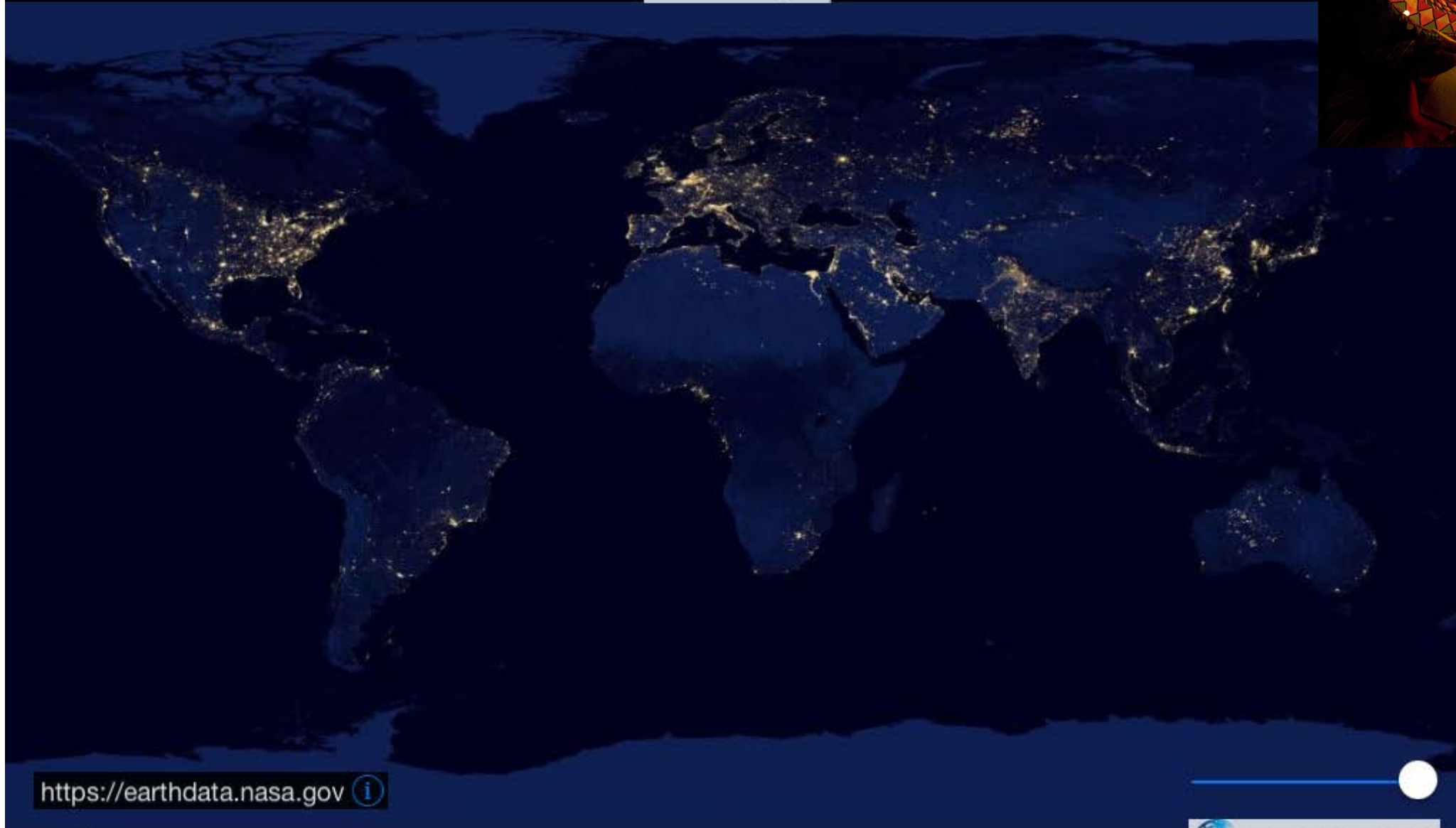
Degrading Resource Base...

Rising Development Expectations...

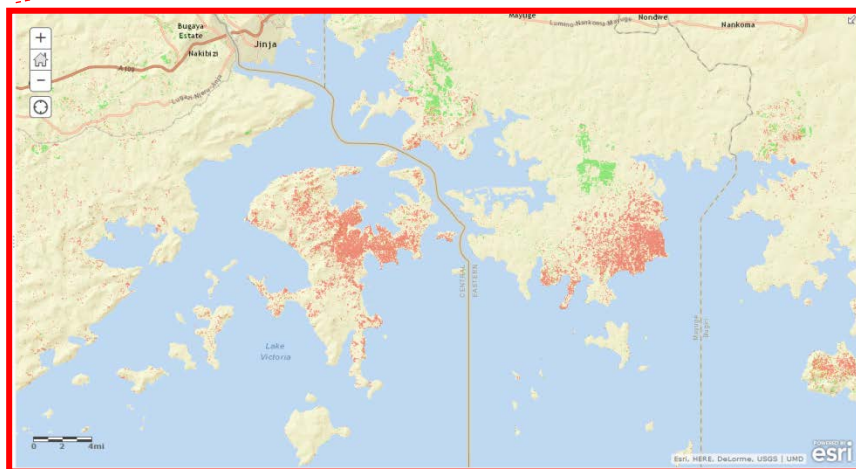
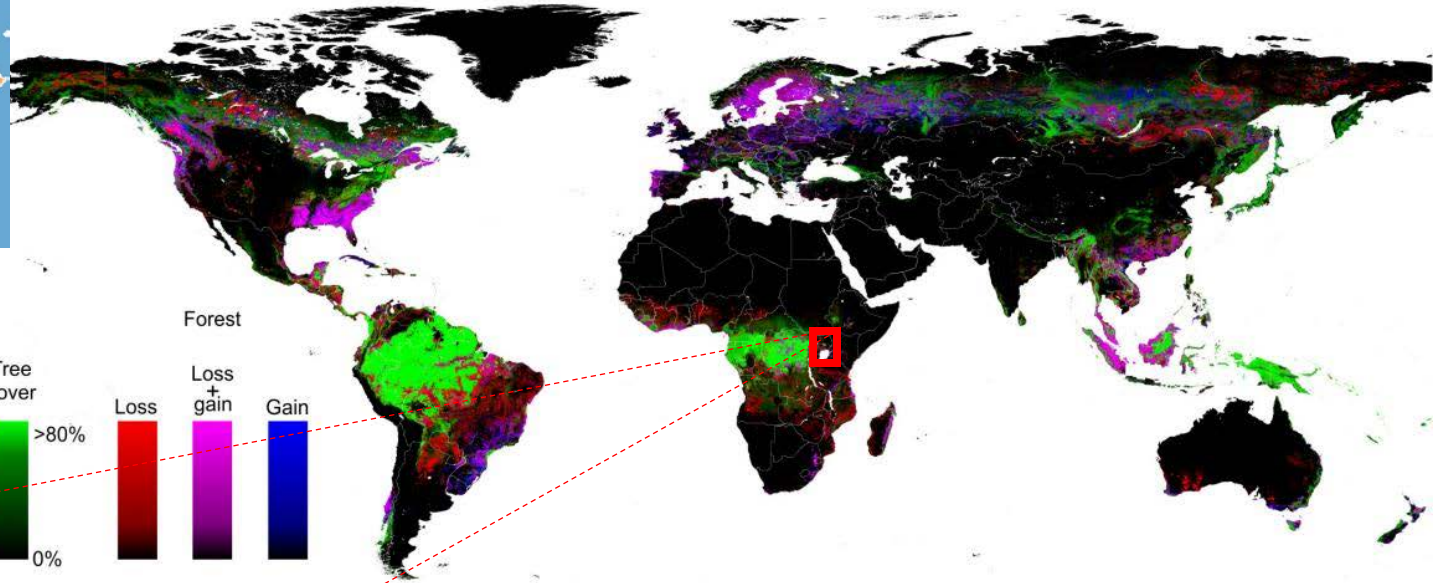
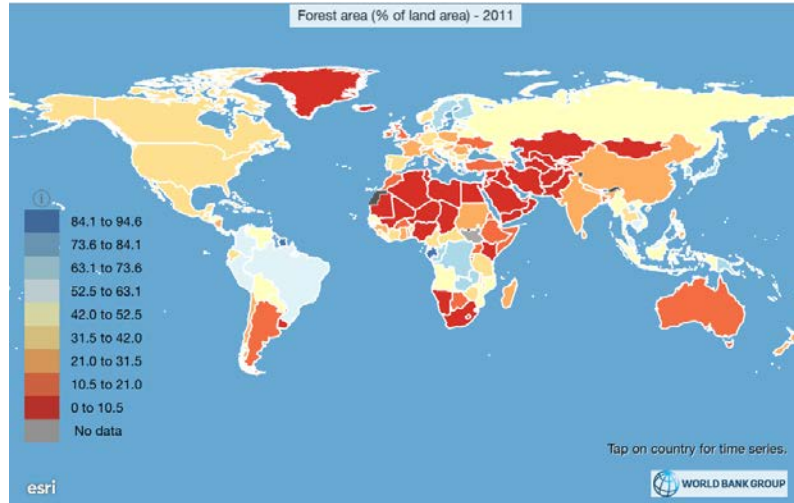


Energy Access

Earth at Night



Forest Loss



The deforestation story is spatially complex...

(e.g. Hansen data for Southern Uganda visualized here)

Legend

Forest Change

Forest change (2000-2012)

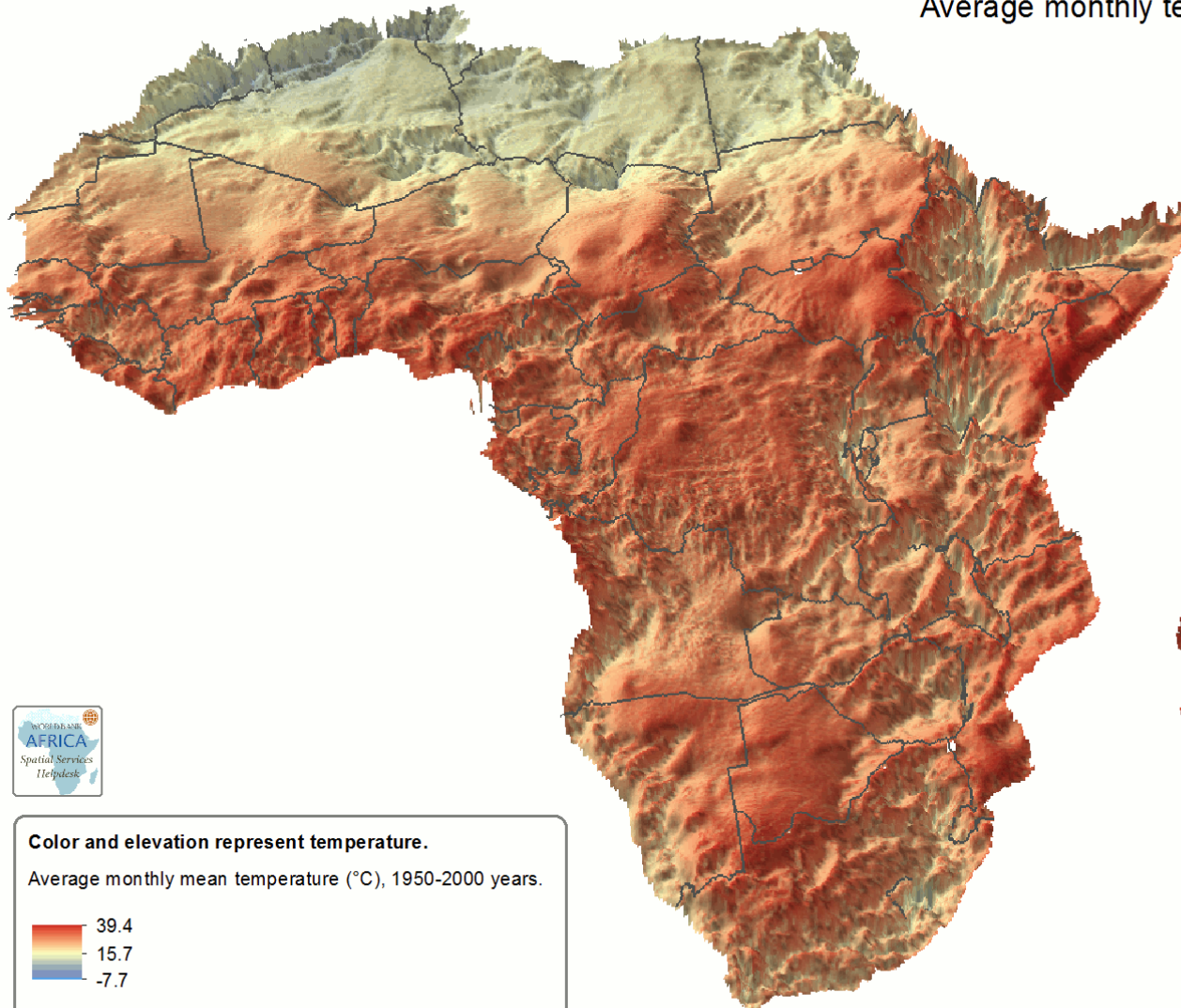
Loss

Gain

Both Loss and Gain

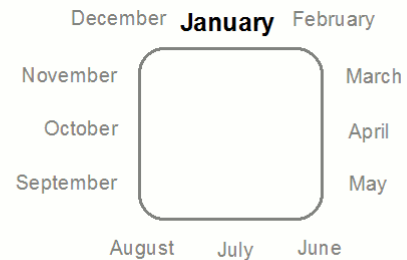
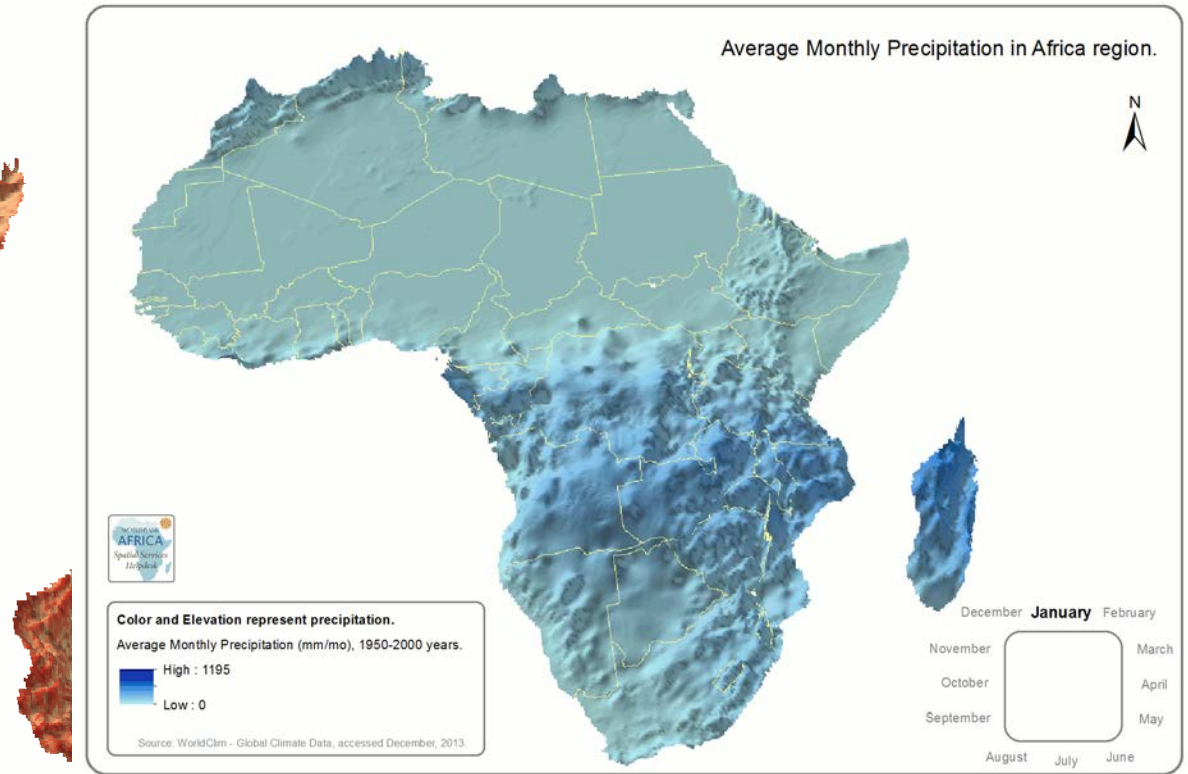
Climate Variability (within a year)

Average monthly temperature in Africa region

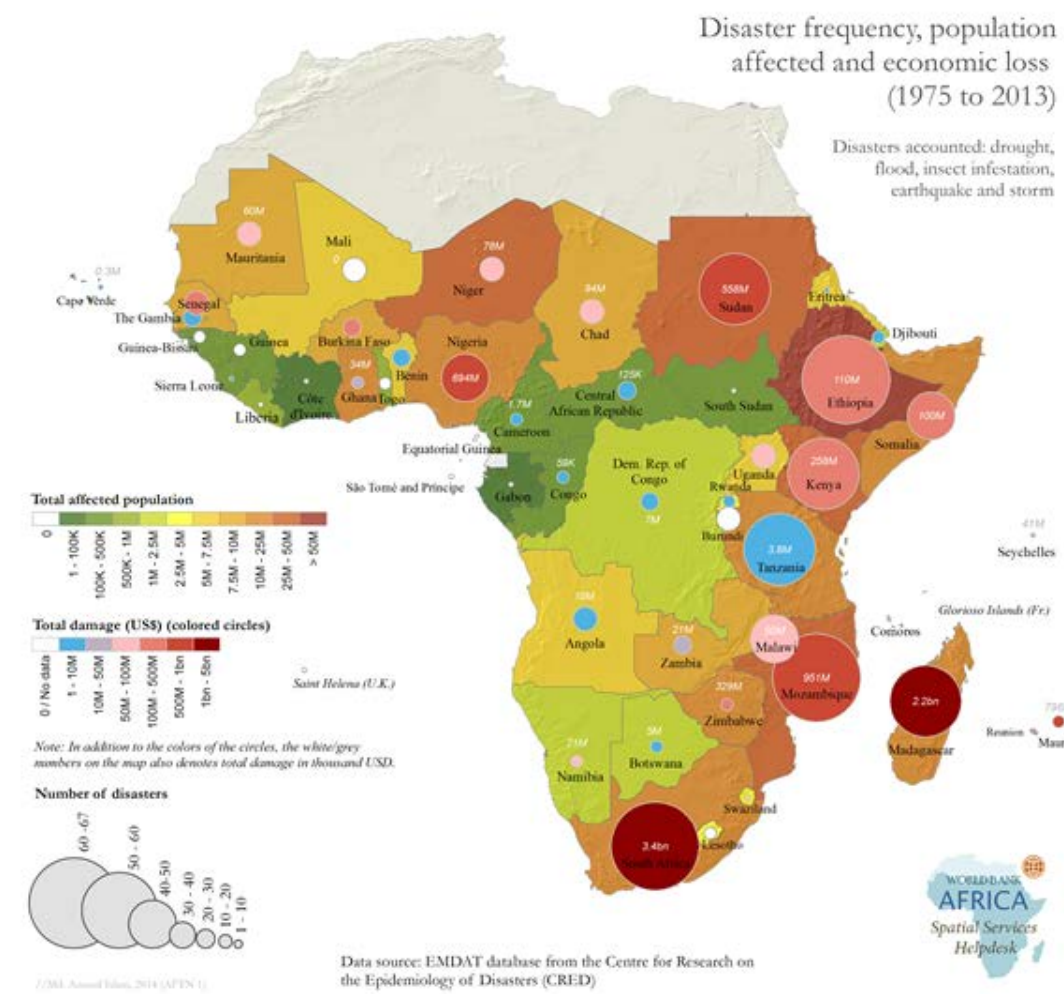
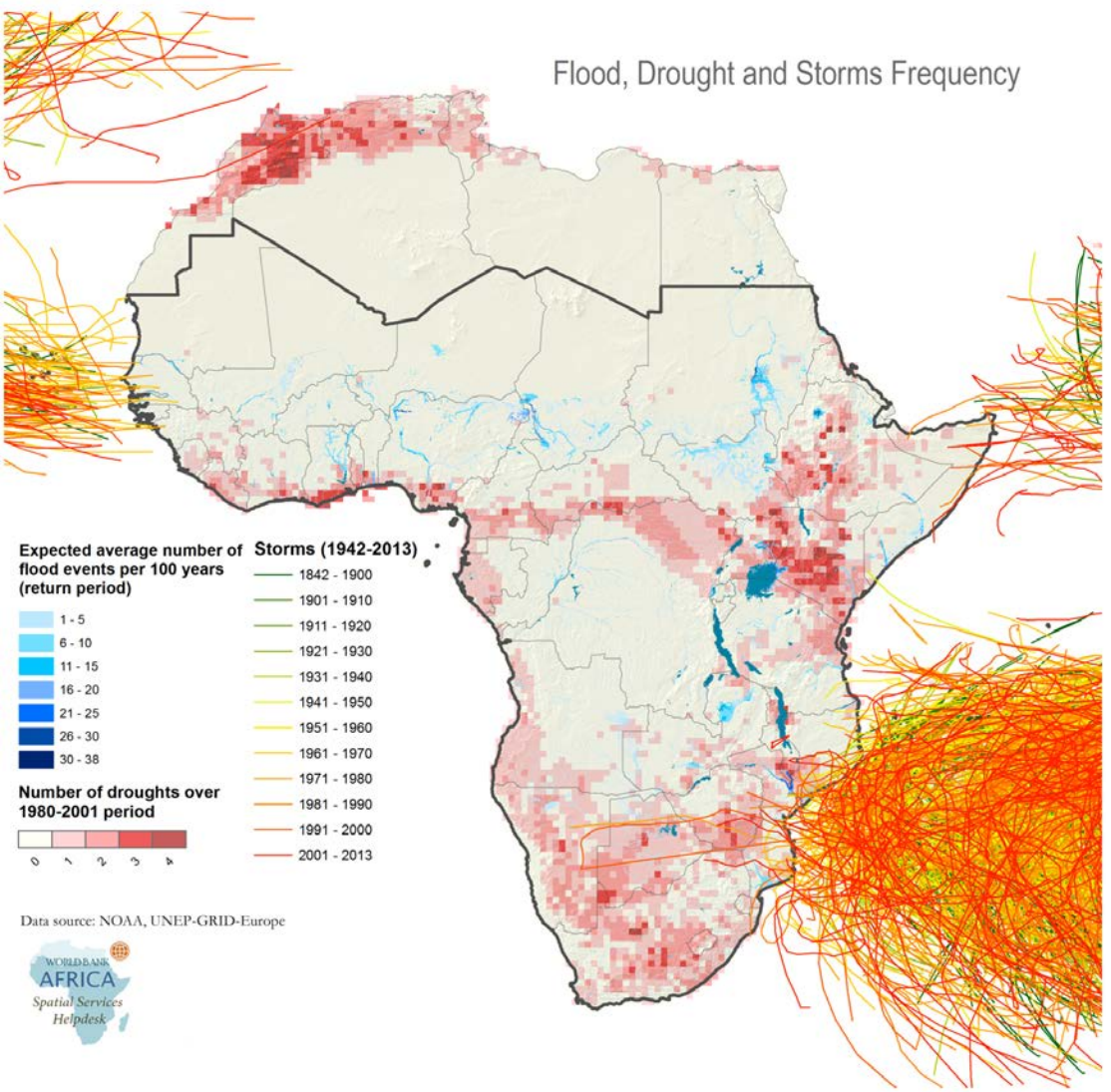


Source: WorldClim - Global Climate Data, accessed November, 2013.

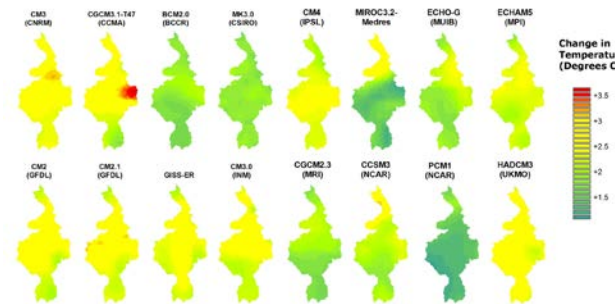
Average Monthly Precipitation in Africa region.



Climate Extremes...

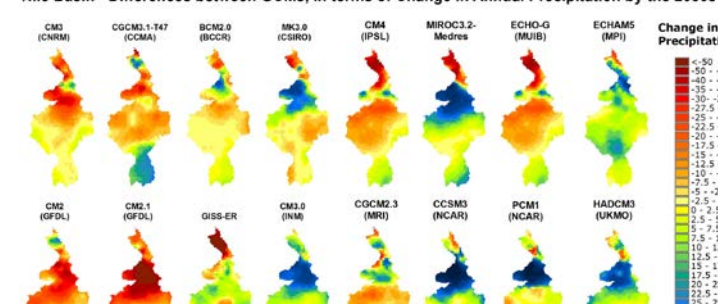


Nile Basin - Differences between GCMs, in terms of Change in Annual Temperature by the 2050s



This map shows the temperature change projected by the considered climate model, under the A2 scenario for 2040 - 2050 as compared to 1961 - 1990. Map displays gridded data (cell size=0.5°). 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.

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



Sources: WCRP's CMIP3 (Meier et al. 2007), downloaded by Maurer et al. (2008), rivers (AquaStat, FAO, 2006).

& Climate Change...

What's Broken?

Information

- Data coverage and quality
- Meaningful use of modern information and analytical tools
- Public access to data, tools, and knowledge products

Institutions

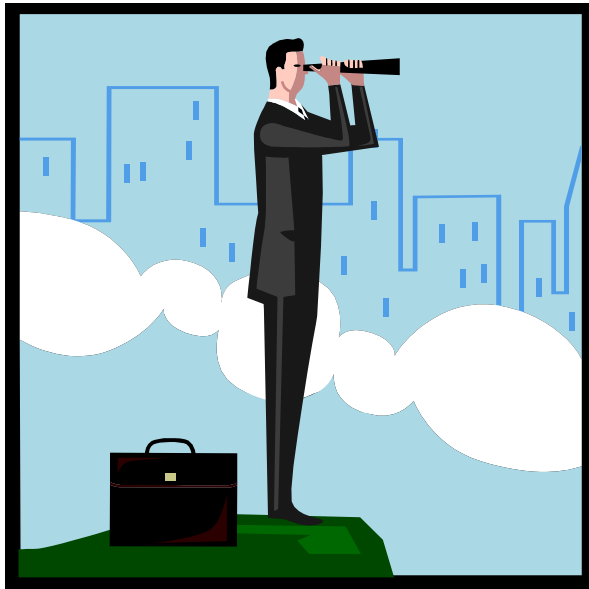
- Technical capacity
- Meaningful stakeholder involvement
- Decision making
- Collaboration

Investments

- Inadequate monitoring and forecasting systems
- Poor office infrastructure and equipment
- Huge infrastructure deficit (power, transport, agriculture, sustainable land management...)
- Investment coordination

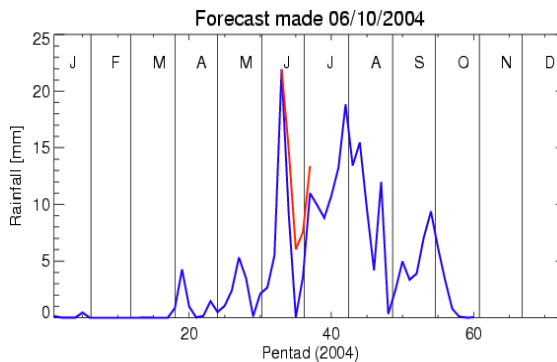
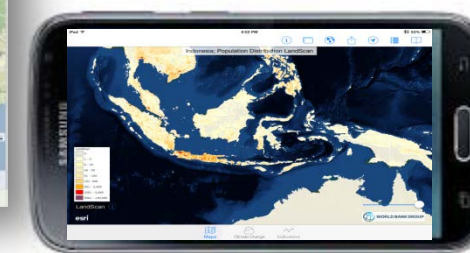
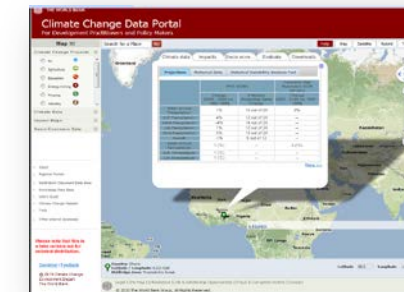
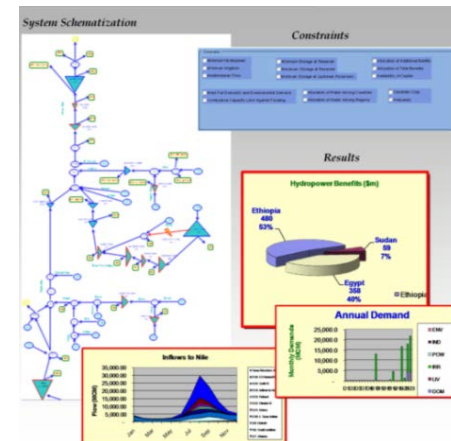
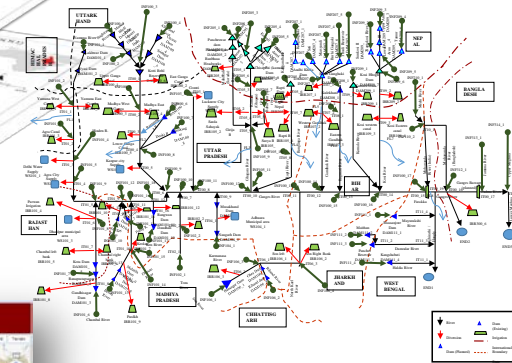
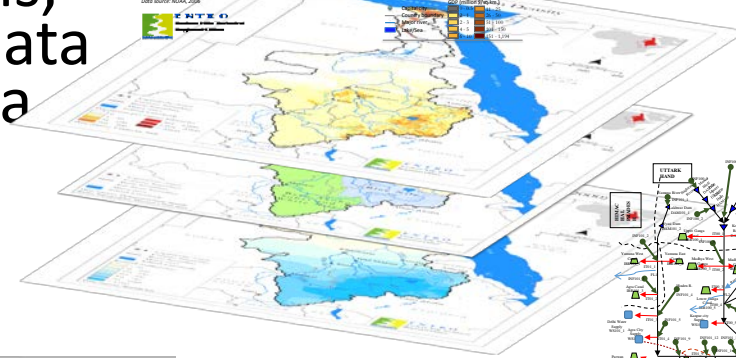
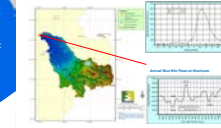
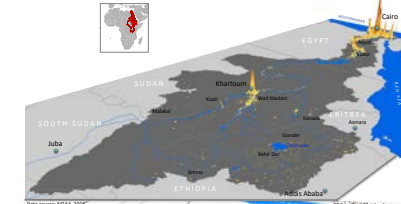
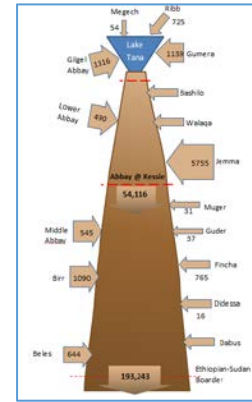
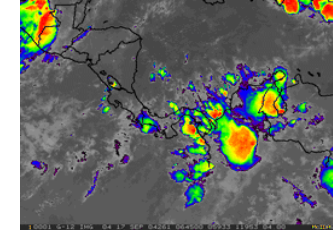


Modernizing Approaches to Address these Challenges...



Information & Analysis

- **Resource Information Base** (data rescue; monitoring; comprehensive spatial, temporal and other databases; improved use of satellite data; documents)
- **Knowledge Products/Special Studies** (maps, Atlases, interactive toolkits, surveys)
- **Access and Outreach mechanisms** (publications, web portals, Apps with public access to open data services, technical/ success stories, multi-media documentation)
- **Analytical Tools** (models/Decision Support Systems for planning/operations support in an integrated systems context)



Wisdom to
make Decisions

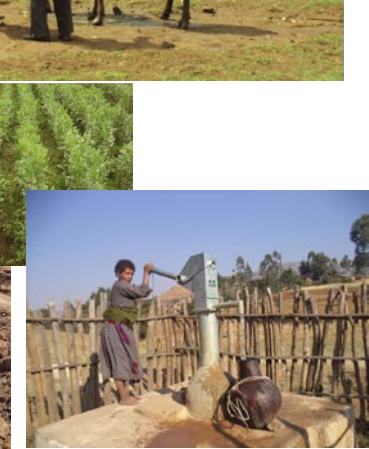
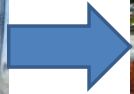
Knowledge

Information

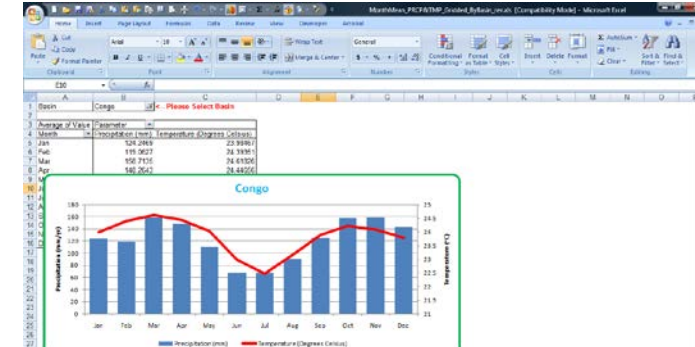
Data

Investments & Operations

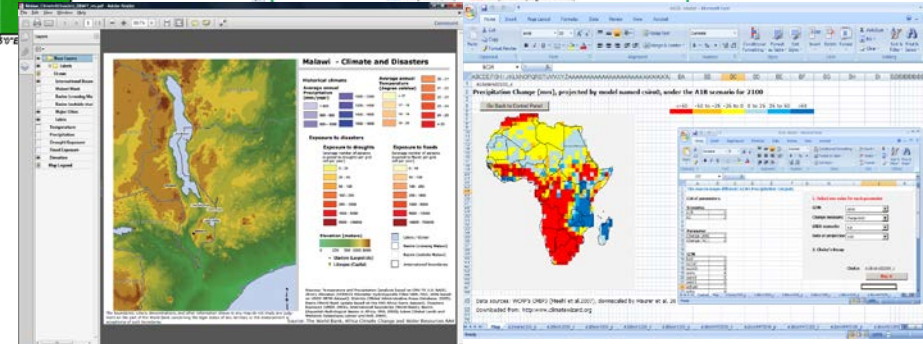
- **Preparation of robust climate-smart investments** (with adequate attention to technical, environmental, social, economic, and institutional aspects) – upgrading existing infrastructure and building new infrastructure analyzed in a systems context
- **Implementation facilitation, monitoring, and lessons** (adequate technical assistance, ownership, M&E)
- **Infrastructure planning and operational coordination**



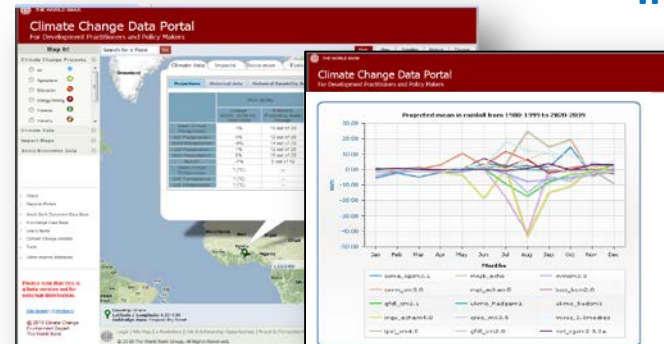
Information: Many new Innovations



GIS/Google Earth/Similar Products



Interactive Documents

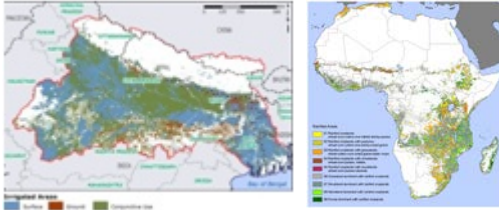


Innovative Hardware
(e.g. Tablets)

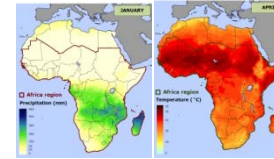
Online Portals

Cloud storage/analytics/services

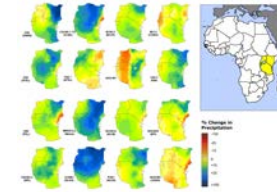
Building on curated public-domain datasets...



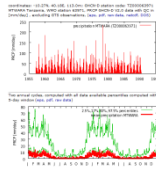
Irrigated, Rainfed Areas (IWMI, FAO)



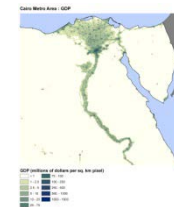
Historical Climate (CRU/UEA)



Climate Change (IPCC, TNC/WB)



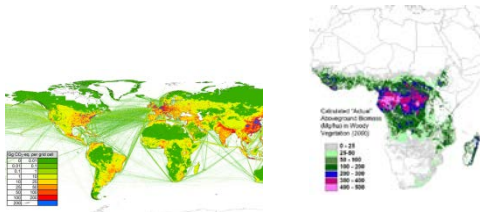
Climate/Flow data (KNMI, GRDC, ...)



Gridded GDP (Yale, NOAA)



DEM (SRTM, ASTER)



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



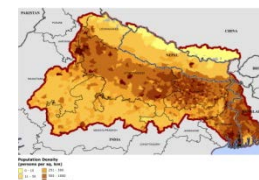
Biodiversity (CI, WWF, IUCN...)



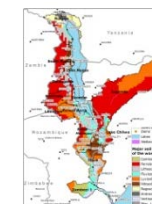
Flood/Drought (DFO, GDACS, UNEP...)



Landcover (ESA, USGS, ...)



Population (CIESIN, Landscan, ...)



Soils (UNESCO, FAO, ...)



Modern “Bottom-up” Monitoring tools



Commercial

Disaster Monitoring Constellation

Pléiades

EROS A & B

FORMOSAT-2

IKONOS

QuickBird

RapidEye

SPOT

TerraSAR-X & TanDEM-X

COSMO-SkyMed

WorldView-1

WorldView-2

GeoEye-1

Planet Labs

Earth Observing System

Aqua&Terra (MODIS)

Aura

GRACE

Jason 1

Ocean Surface Topography Mission

Orbview-2

Orbiting Carbon Observatory 2

TRMM

GOES (Geostationary Operational Environmental Satellite)

GOES 13

GOES 14

GOES 15

Polar Operational Environmental Satellites

NOAA-15

NOAA-16

NOAA-18

NOAA-19

METOP-B

METOP-A

Joint Polar Satellite System

Suomi NPP

Japan Meteorological Agency

MTSAT-1R / Himawari-6[3]

MTSAT-2 / Himawari-7[3]

Landsat program

Landsat 7

Landsat 8



Brazilian Space Agency (AEB)

CBERS-1

CBERS-2

CBERS-2B

Argentina Space Agency (CONAE)

SAC-A

SAC-B

SAC-C

SAC-D

SAOCOM

Centre National d'Études Spatiales (CNES)

SPOT

Pléiades

TOPEX/Poseidon

European Space Agency (ESA)

Envisat

ERS (1 & 2)

CryoSat-2

Sentinel 1

Indian Space Research Organisation (ISRO)

Megha-Tropiques

Oceansat-2

IMS-1

Cartosat-2A

CARTOSAT-2

IRS P5 (CARTOSAT-1)

IRS P6 (Resourcesat 1)

JAXA

MOS-1 (Momo-1)

MOS-1b (Momo-1b)

JERS-1 (Fuyo-1)

ADEOS (Midori)

ADEOS II (Midori II)

GOSAT (Ibuki)

ALOS (Daichi) PALSAR, AVNIR-2 and PRISM

Lembaga Penerbangan dan Antariksa

Nasional (LAPAN INDONESIA)

Lapan-TUBsat

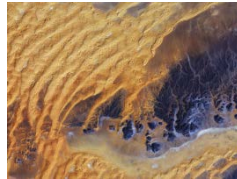
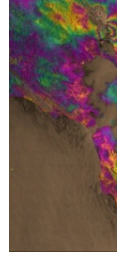
NASA

TIMED (Thermosphere Ionosphere

Mesosphere Energetics and Dynamics)

TOPEX/Poseidon

Upper Atmosphere Research Satellite



NOAA

NOAA-4

Project Vanguard

Vanguard 2

National Academy of Sciences of Republic of Belarus

BelKA

Pakistan's SUPARCO (Space and Upper Atmosphere Research Commission)

Badr-B - 2001.

Pakistan Remote Sensing Satellite - Scheduled 2014.

Russian Federal Space Agency

(Roscosmos)

Elektro-L

Monitor-E

Resurs-DK1

Resurs-P No.1

Swedish National Space Board

Munin

Bolivarian Agency for Space Activities

VRSS-1

Meteosat

MetOp

Meteosat 5

Meteosat 6

Meteosat 7

Meteosat 8

Meteosat 9

RADARSAT series

RADARSAT-1

RADARSAT-2

South Korea

Arirang-1

Arirang-2

Arirang-3

Arirang-5

Chollian

THAILAND

Thaichote

Turkey

Göktürk-2 (2012) (IMINT),

RASAT (2011), Mapping

BILSAT-1 (2003-2006)

Göktürk-1 (2013) (IMINT),

Göktürk-3- (IMINT), High

Resolution Synthetic aperture

radar (SAR) Earth observation

satellite

Weather

TIROS-1

TIROS-2

TIROS-3

TIROS-4

TIROS-5

TIROS-6

TIROS-7

TIROS-8

TIROS-9

TIROS-10

Meteor series

Meteor 1 series

Meteor 2 series

Meteor 3 series

FY (Feng Yun) series

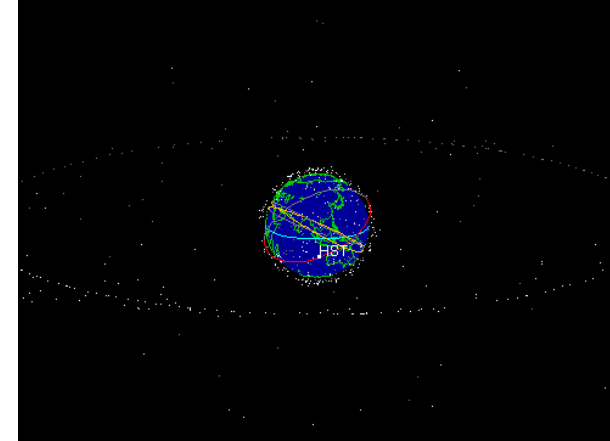
FY-1 series

FY-2 series

FY-3A

Many Eyes in the Sky...

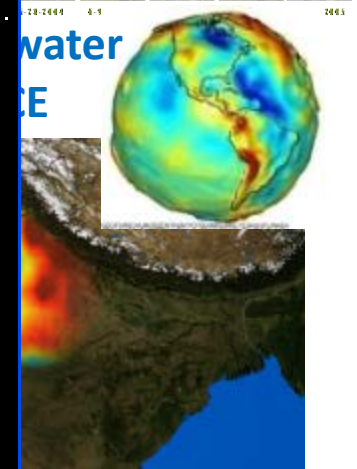
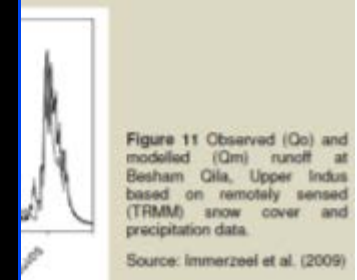
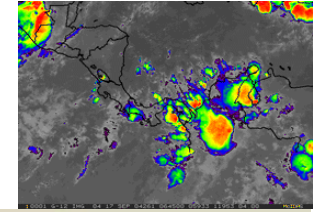
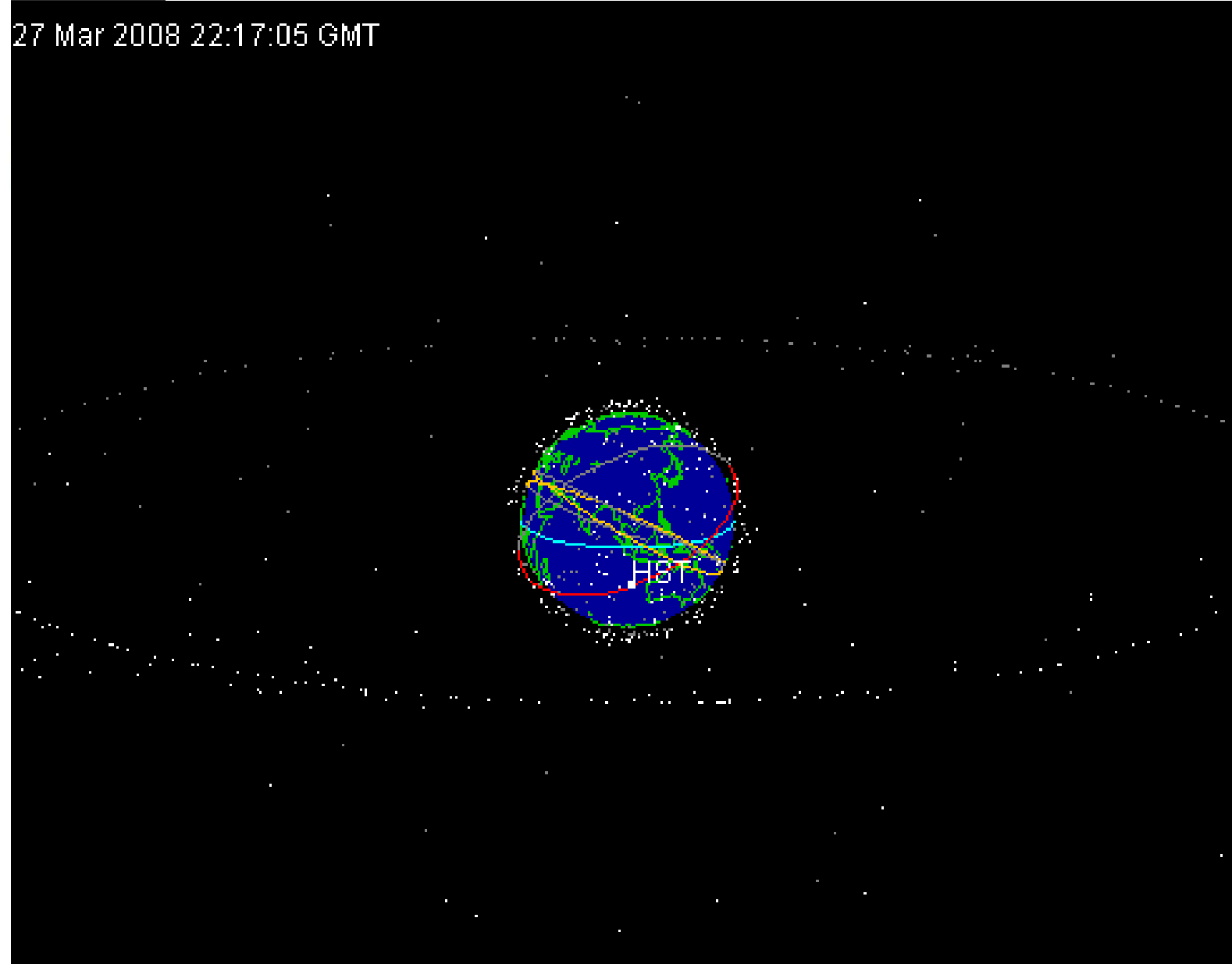
27 Mar 2008 22:17:05 GMT



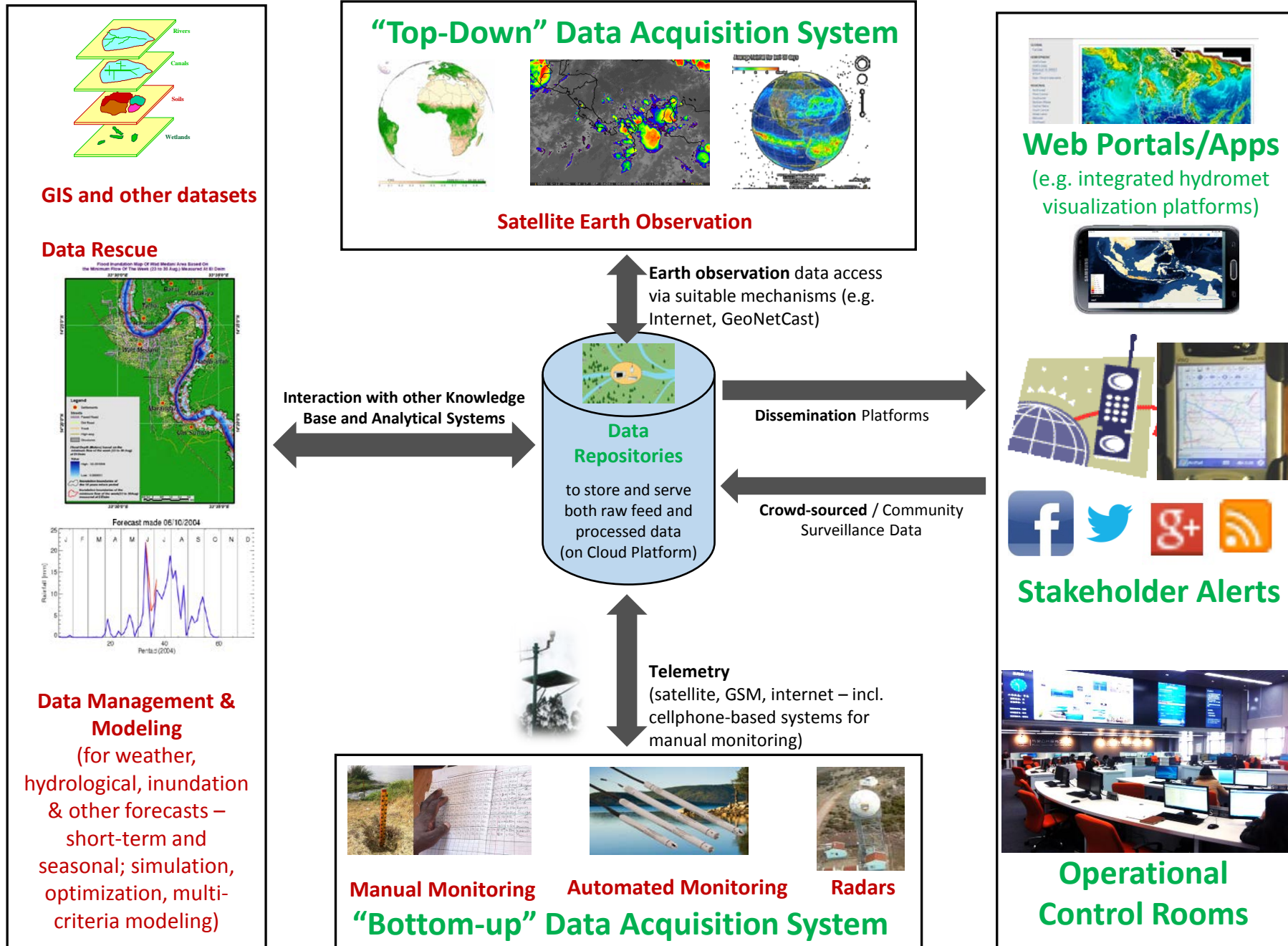
“Top-down” Measurements from Space



27 Mar 2008 22:17:05 GMT

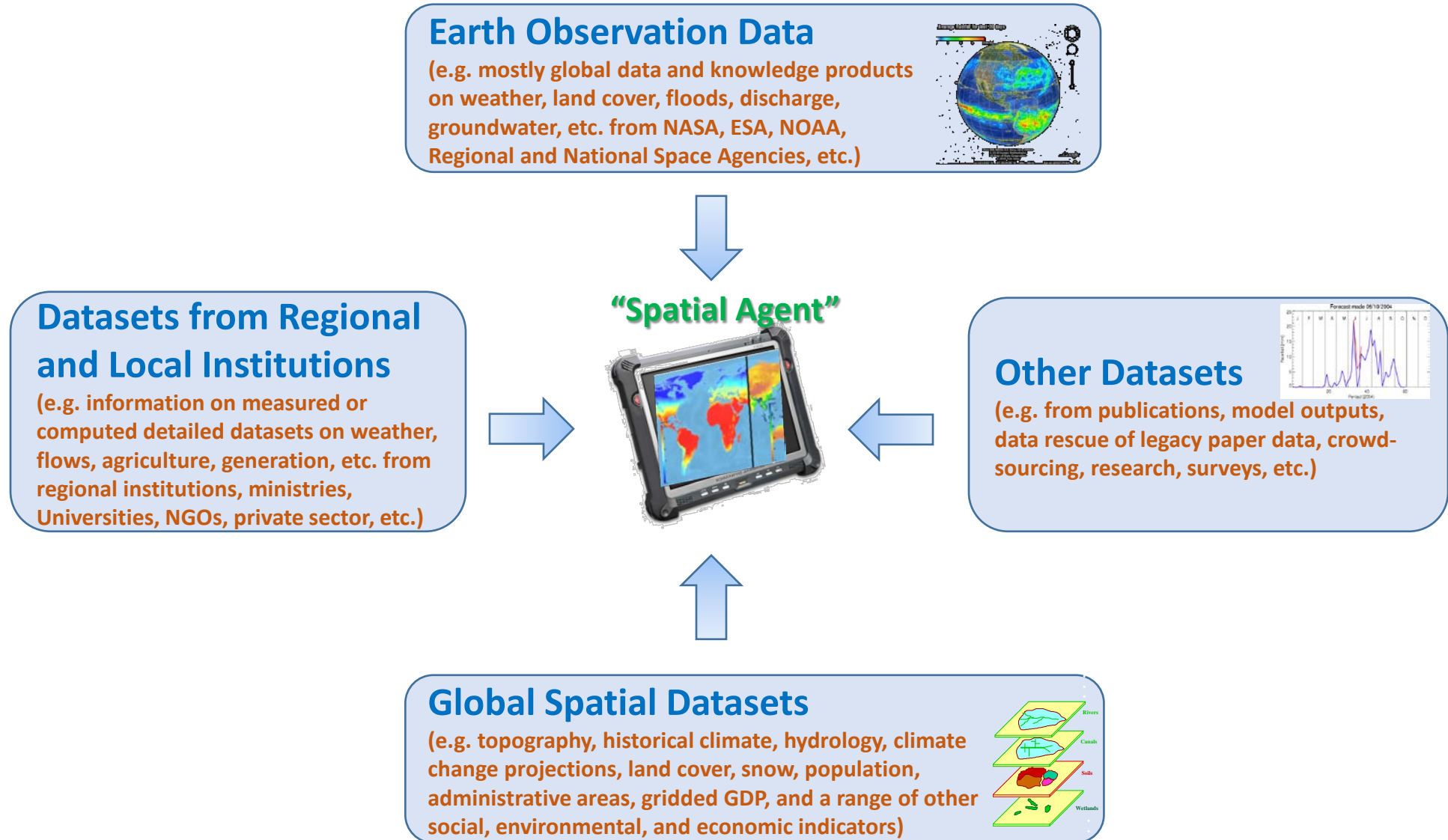


...that can be integrated into a modern Water Resources Information Services Platform (usable at national, state, and local levels)



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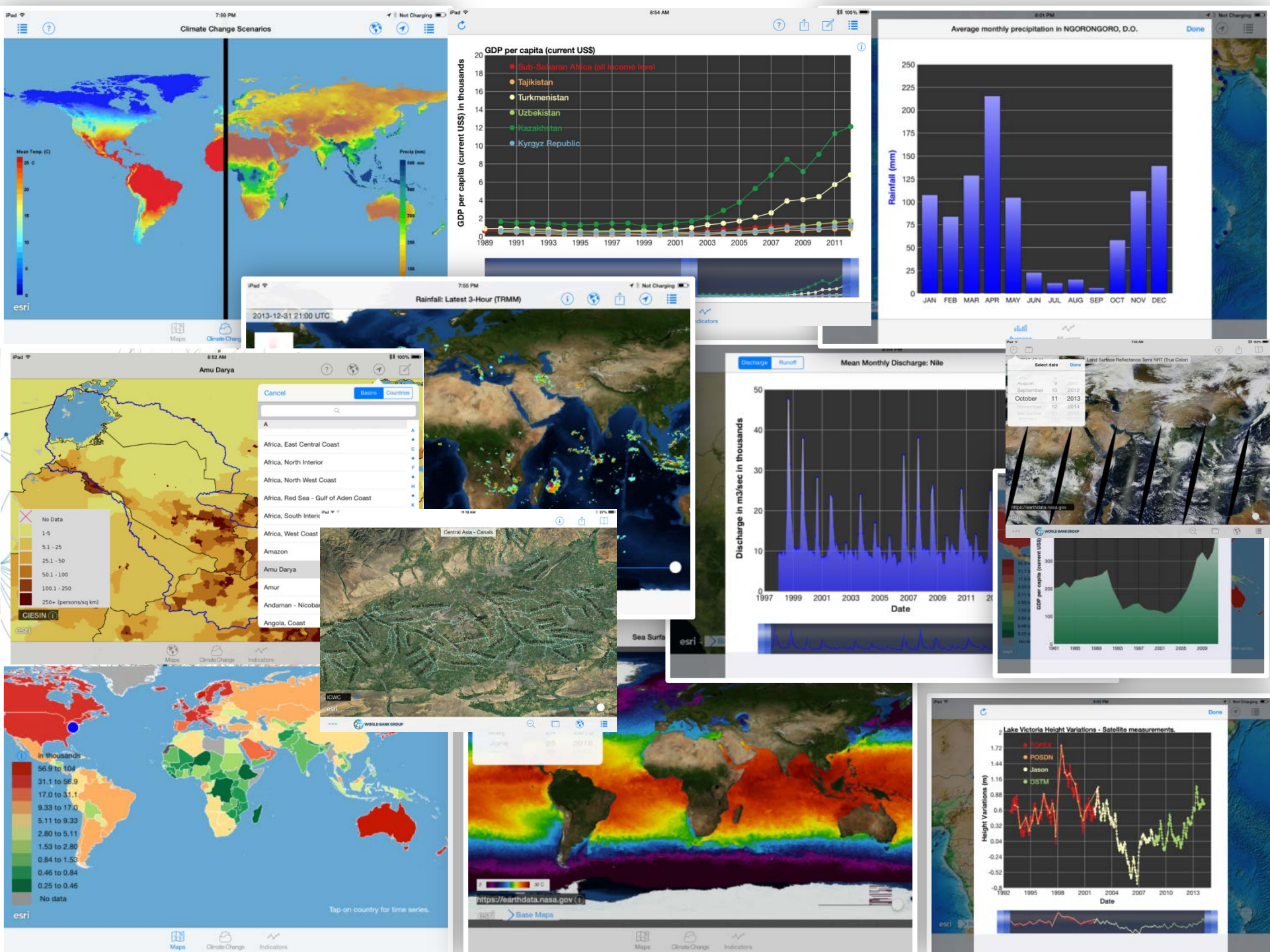
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Thanks!



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