The SERVIR Program: using geospatial information to enable climate-resilient decisions in the developing world

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Jenny Frankel-Reed[3], Carrie Stokes[3]

[1]NASA HQ Earth Sciences Division Applied Sciences Program
[2]NASA MSFC SERVIR Program
[3]USAID/Washington SERVIR Program

SERVIR

ESIP Winter Conference, January 9. 2013

RCMRD

ICIMOD

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About SERVIR

A NASA-USAID partnership to improve environmental management and resilience to climate change by strengthening the capacity of governments and other key stakeholders to integrate earth observation information and geospatial technologies into development decision-making

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Space to Village

NASA Sub-Goal 3A:
Study Earth from space to advance scientific understanding and meet societal needs.

USAID has renewed focus on integrating science, technology, and innovation in the practice of development to solve today's most pressing development challenges around the globe.

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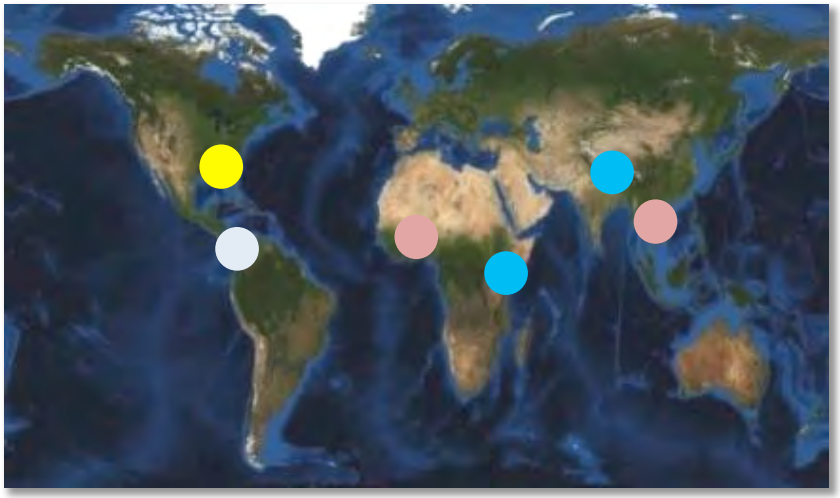
SERVIR Network



- Current Hub
- Graduated Hub
- Program Office (NASA/MSFC)
- Potential Future Hubs

SERVIR Network

RCMRD – Host of SERVIR-East Africa

ICIMOD – Host of SERVIR-Himalaya

CATHALAC– Graduated Hub/Network Affiliate

SERVIR-Mesoamerica @ CATHALAC

City of Knowledge, Panama

Dedicated 2005
Graduated 2011

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SERVIR-Africa @ RCMRD

Nairobi, Kenya

Dedicated on
November 21, 2008

SERVIR-Himalaya @ ICIMOD
Kathmandu, Nepal

Dedicated on October 5, 2010

ICIMOD

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‘South-South’ Collaboration

SERVIR GLOBAL

Centers are exchanging ideas and sharing experiences

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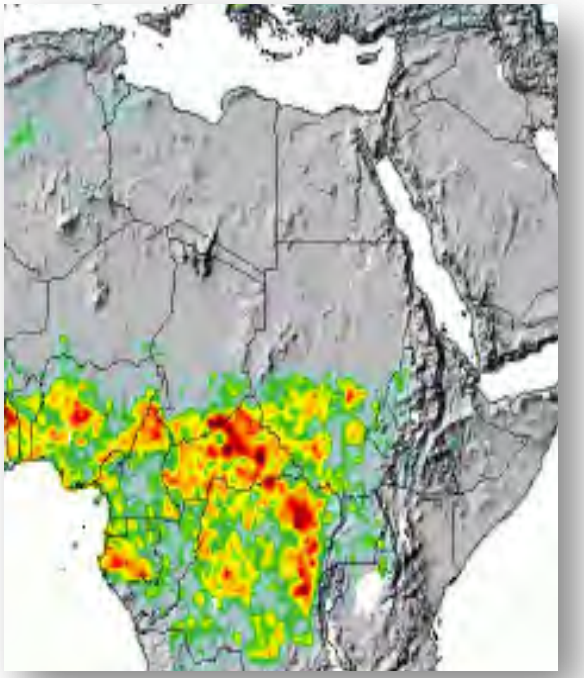
What We Do

- Capacity Building of Regional Institutions, Stakeholders, and Young Professionals
- Improved Access to Data, Models, Online Maps, Visualizations
- Development of Decision Support Tools and Services
- Strengthening Partnerships and Fostering Collaboration Across SERVIR Network



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SERVIR Thematic Areas

- Agriculture
- Biodiversity
- **Climate**
- Disasters
- Ecosystems
- Energy
- Health
- Water
- Weather

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USAID's Climate Change & Development Strategy (2012 – 2016)

- 3 objectives (SERVIR contribution):
  1. Invest in clean energy technology and reduce deforestation to decrease greenhouse gas emissions.
  2. Help countries and communities prepare for and respond to changes in climate.
  3. Make climate change considerations part of all aspects of USAID's programs and operations.

USAID's Climate Change & Development Strategy (2012 – 2016)

- USAID Criteria for prioritizing dedicated climate change funds for adaptation:
  1. Vulnerable countries – exposure to physical impact & socio-economic sensitivity to those impacts.
  2. Least developed countries (especially in sub-Saharan Africa), small island developing states, and glacier-dependent countries.
- SERVIR hubs serve countries that meet these criteria.

Global partnerships

- World Bank
- UN
- GEO
- CEOS
- USWP
- Region-specific
  - Mesoamerica - e.g. Committee Regional Water Resources of Central America (CRRH)
  - East and South Africa – e.g. Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC)
  - Hindu-Kush Himalaya – e.g. South Asian Network for Development and Environmental Economics (SANDEE)

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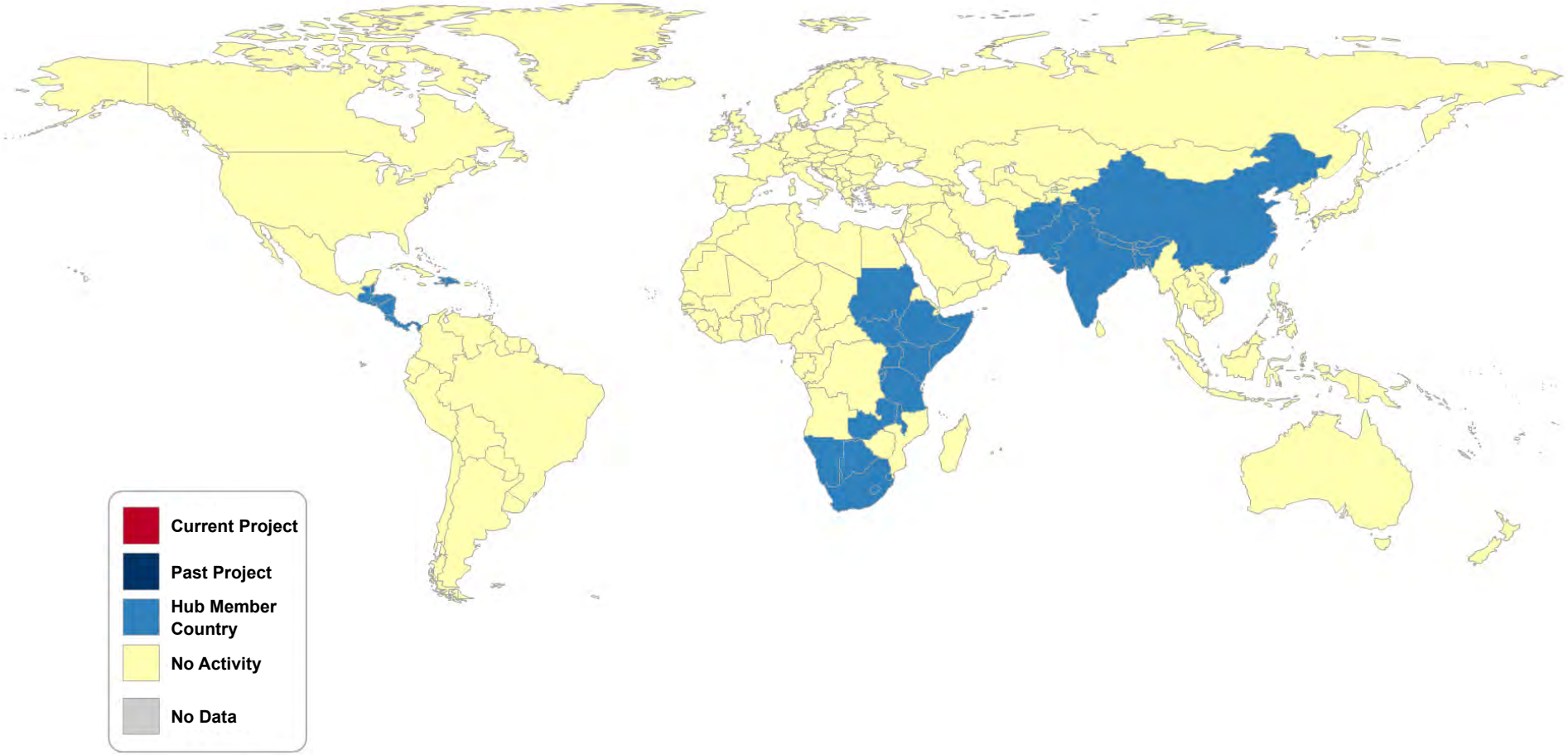
SERVIR Country Impact:
Partners & Projects



SERVIR Country Impact:
Partners & Projects to May 2012

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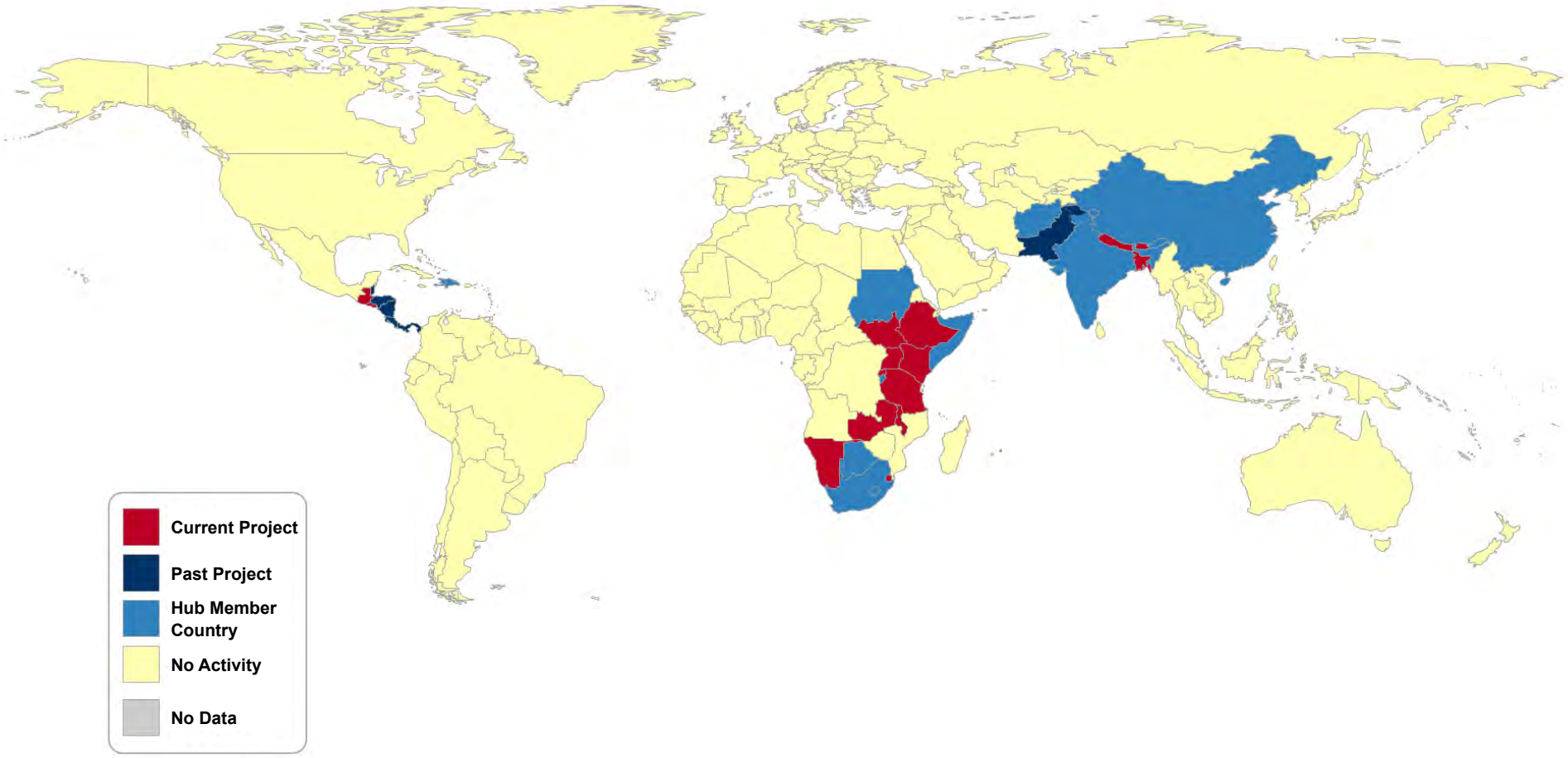

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SERVIR Applied Science Team (AST)

PI Last name	Title	Institution	Theme	Region
Laporte	Forest carbon assessment for REDD in the East Africa SERVIR region	The Woods Hole Research Center	Carbon	East Africa
Kargel	Interdisciplinary science applications to glacier and alpine hazards in relation to development and habitation in the Hindu Kush-Himalaya: SERVIR Science Team project	University of Arizona	Disasters	Hindu Kush-Himalaya
Hossain	A Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan region	Tennessee Technological University	Water	Hindu Kush-Himalaya
Verdin	A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa	U.S. Geological Suvey	Agriculture	East Africa
Blackman	Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic	Resources for The Future, Inc.	Carbon	Mesoamerica
Huff	Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR Mesoamerica and Himalaya Regions	Battelle Memorial Institute	Air Quality	Mesoamerica, Hindu Kush-Himalaya
Robertson	Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for SERVIR East Africa Climate Projections	NASA / MSFC	Climate Scenarios	East Africa, Hindu Kush-Himalaya, Mesoamerica
Granger	East Africa Drought and Agricultural Productivity Assessment and Prediction System	Jet Propulsion Laboratory	Disasters, Agriculture	East Africa
Valdes	SERVIR Water Africa-Arizona Team (SWAAT)	The University of Arizona	Water	East Africa
Kirschbaum	Landslide Hazard Assessment and Forecasting System using near real-time remote sensing information over SERVIR-Mesoamerica	NASA Goddard Space Flight Center	Disasters	Mesoamerica
Ceccato	Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring and Climate Information for Disaster Management and Human Health (integration within SERVIR)	Columbia University	Public Health	East Africa

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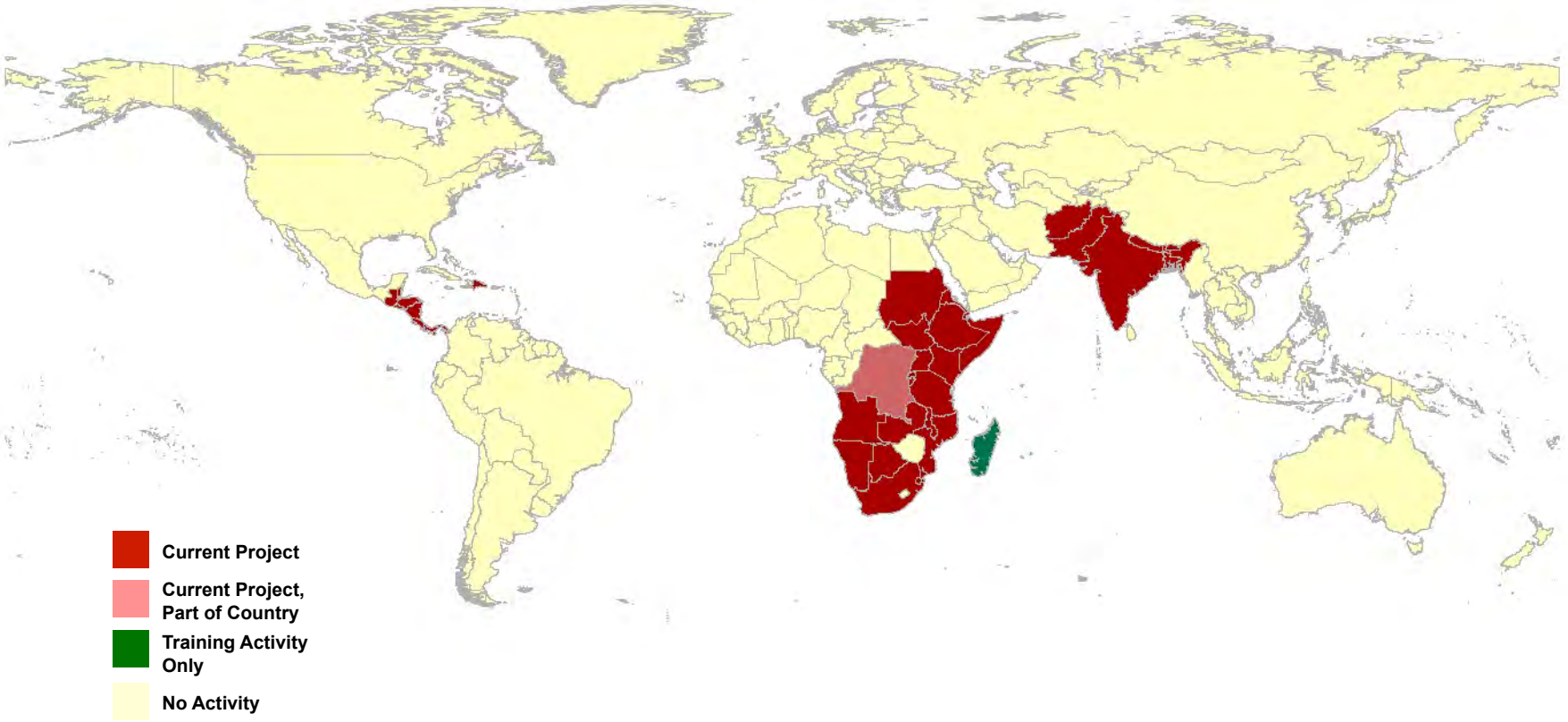
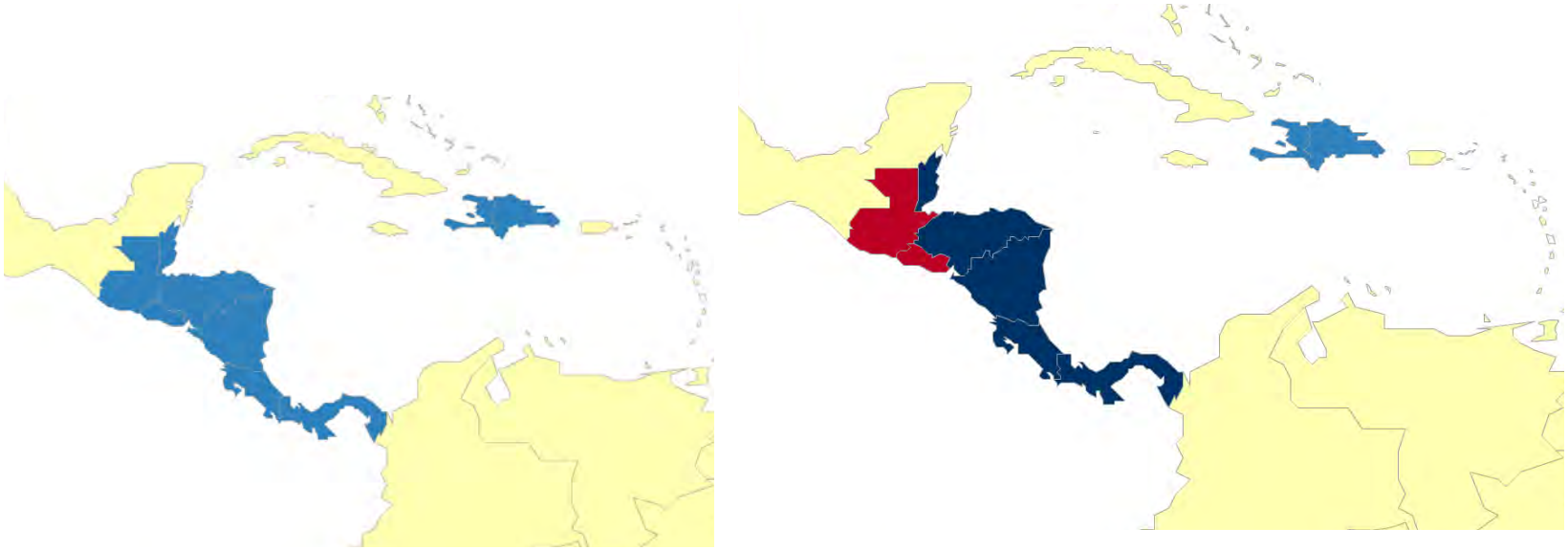
SERVIR Country Impact
SERVIR Applied Sciences Team – Q3 2012



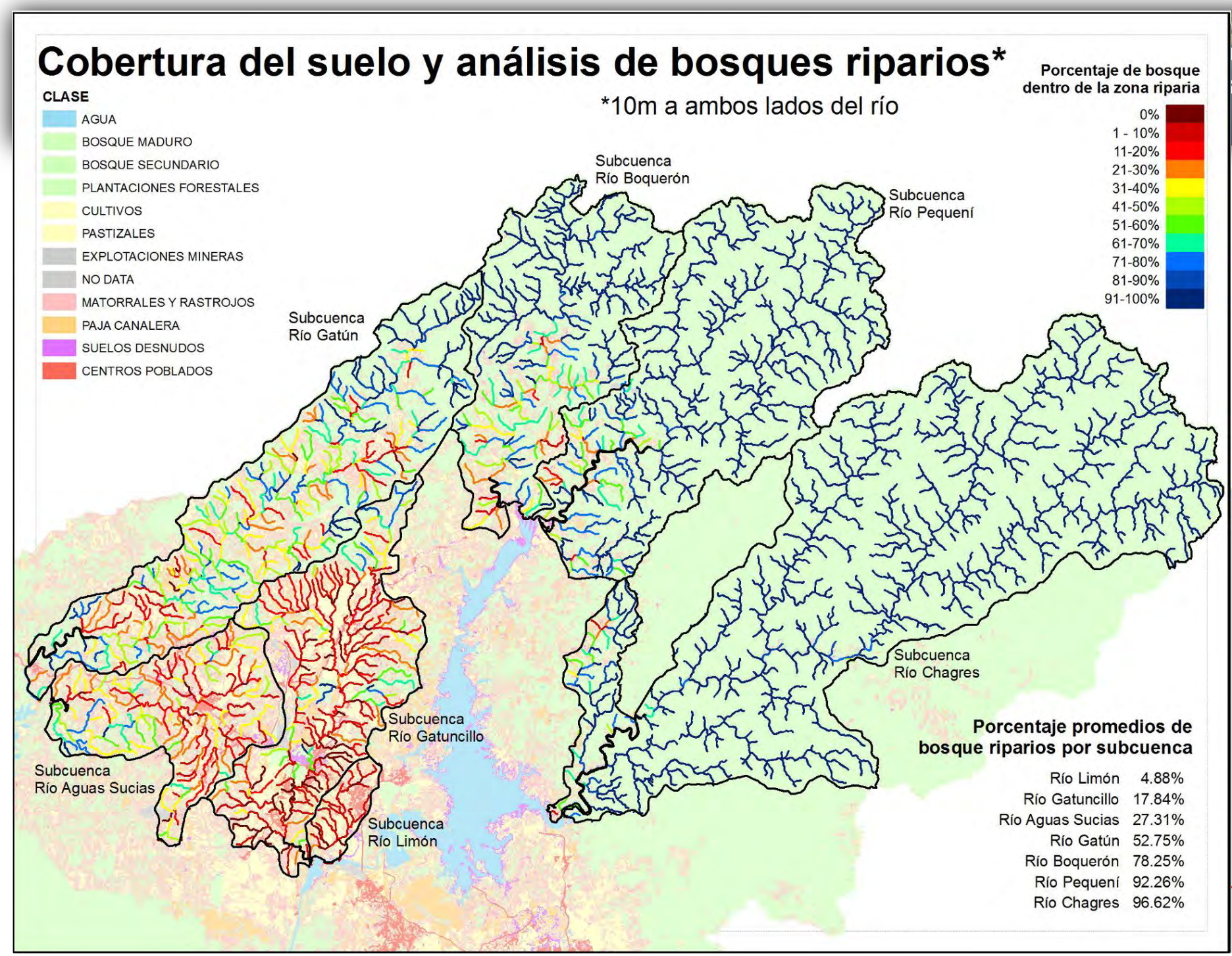
SERVIR Country Impact:
Partners & Projects to May 2012



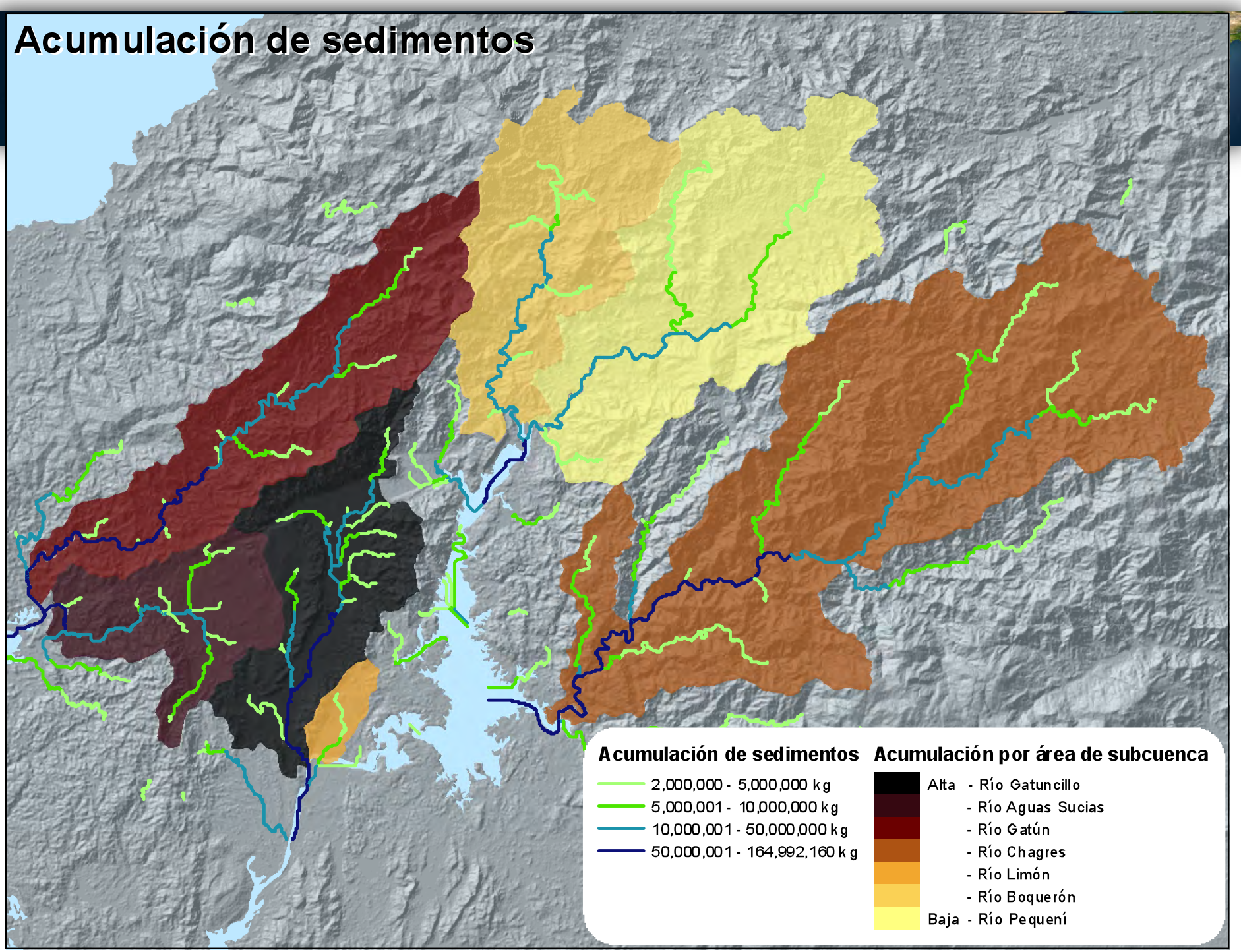
- Current Project
- Past Project
- Hub Member Country
- No Activity
- No Data

Cobertura del suelo y análisis de bosques riparios*

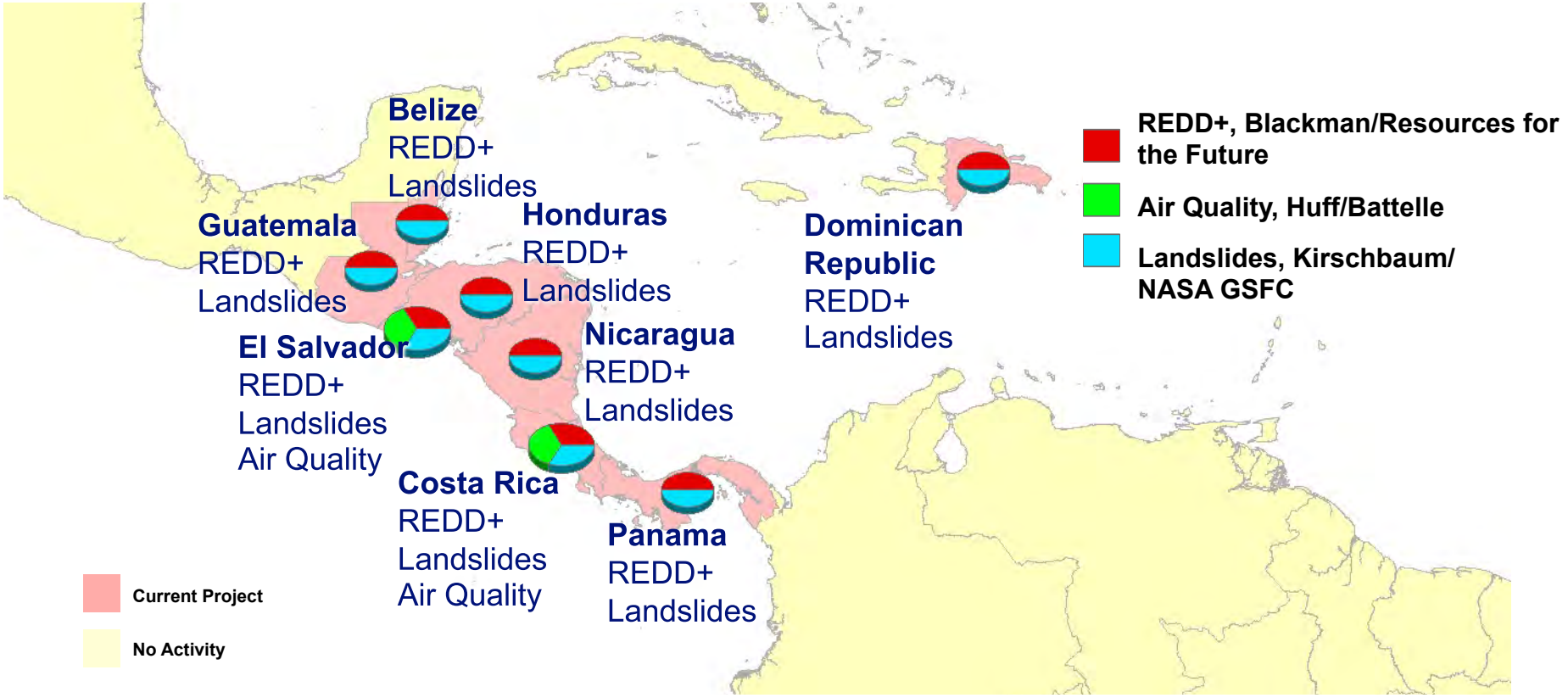
*10m a ambos lados del río



Acumulación de sedimentos



SERVIR Country Impact
SERVIR Applied Sciences Team



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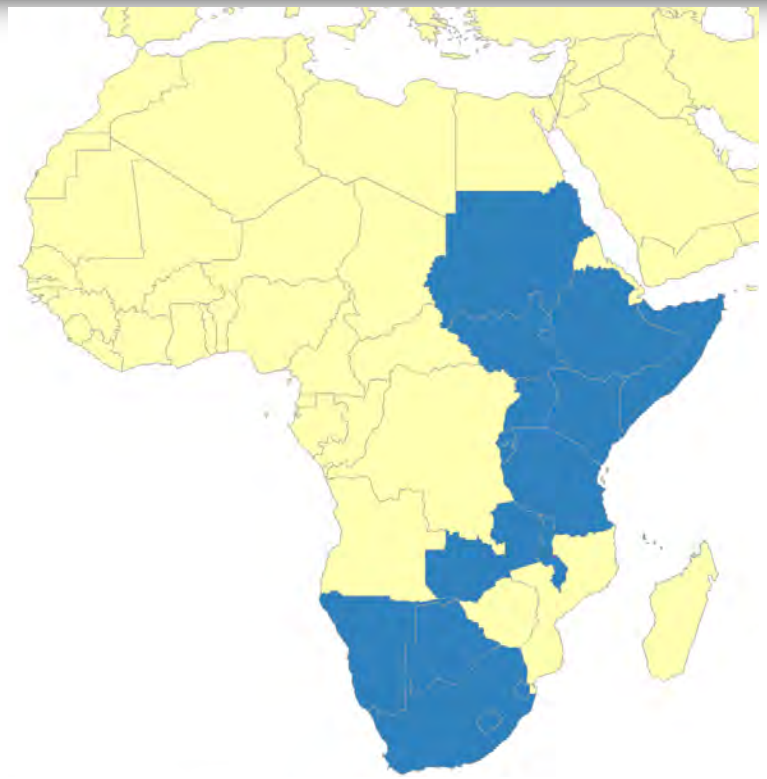
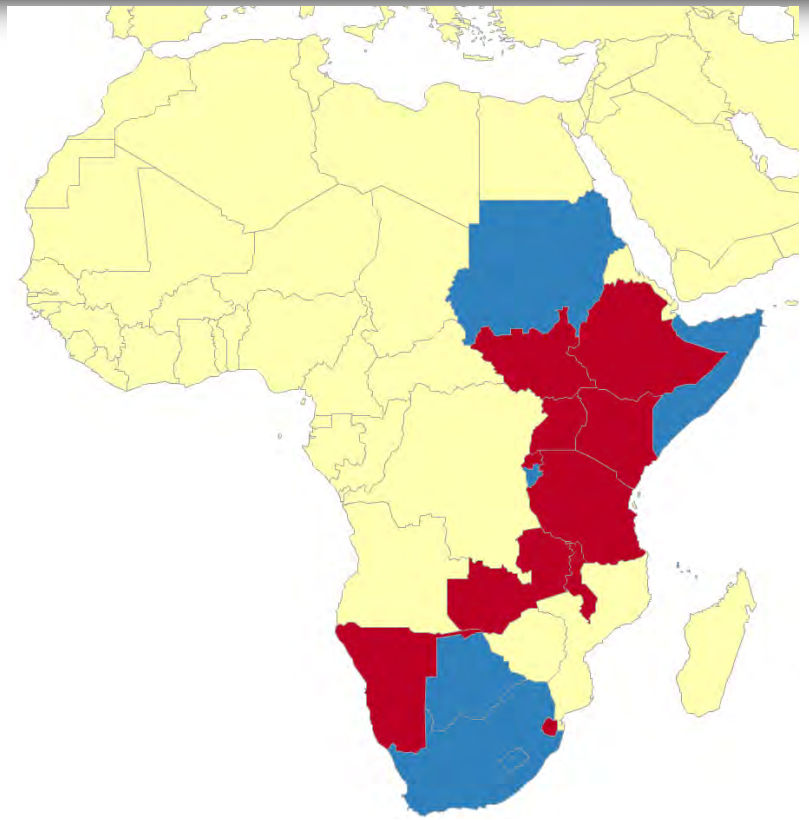
SERVIR Country Impact:
Partners & Projects





Current Project
Past Project
Hub Member Country
No Activity
No Data

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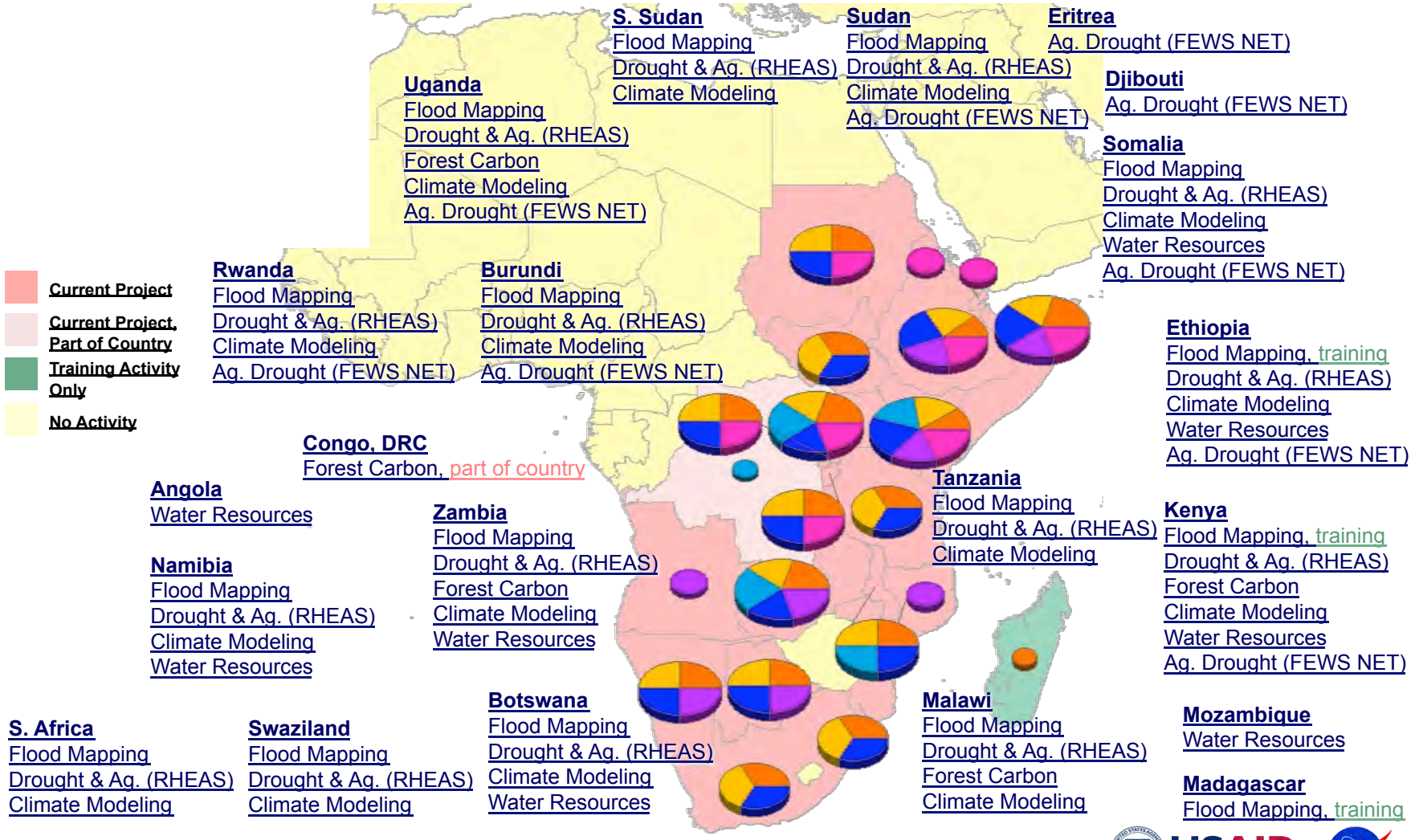
SERVIR Country Impact
SERVIR Applied Sciences Team



S. Sudan
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling

Sudan
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Ag. Drought (FEWS NET)

Eritrea
Ag. Drought (FEWS NET)

Djibouti
Ag. Drought (FEWS NET)

Somalia
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Water Resources
Ag. Drought (FEWS NET)

Uganda
Flood Mapping
Drought & Ag. (RHEAS)
Forest Carbon
Climate Modeling
Ag. Drought (FEWS NET)

Rwanda
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Ag. Drought (FEWS NET)

Burundi
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Ag. Drought (FEWS NET)

Ethiopia
Flood Mapping, training
Drought & Ag. (RHEAS)
Climate Modeling
Water Resources
Ag. Drought (FEWS NET)

Congo, DRC
Forest Carbon, part of country

Angola
Water Resources

Tanzania
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling

Kenya
Flood Mapping, training
Drought & Ag. (RHEAS)
Forest Carbon
Climate Modeling
Water Resources
Ag. Drought (FEWS NET)

Zambia
Flood Mapping
Drought & Ag. (RHEAS)
Forest Carbon
Climate Modeling
Water Resources

Namibia
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Water Resources

Botswana
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling
Water Resources

Malawi
Flood Mapping
Drought & Ag. (RHEAS)
Forest Carbon
Climate Modeling

Mozambique
Water Resources

Madagascar
Flood Mapping, training

S. Africa
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling

Swaziland
Flood Mapping
Drought & Ag. (RHEAS)
Climate Modeling

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SERVIR Country Impact:
Partners & Projects to May 2012

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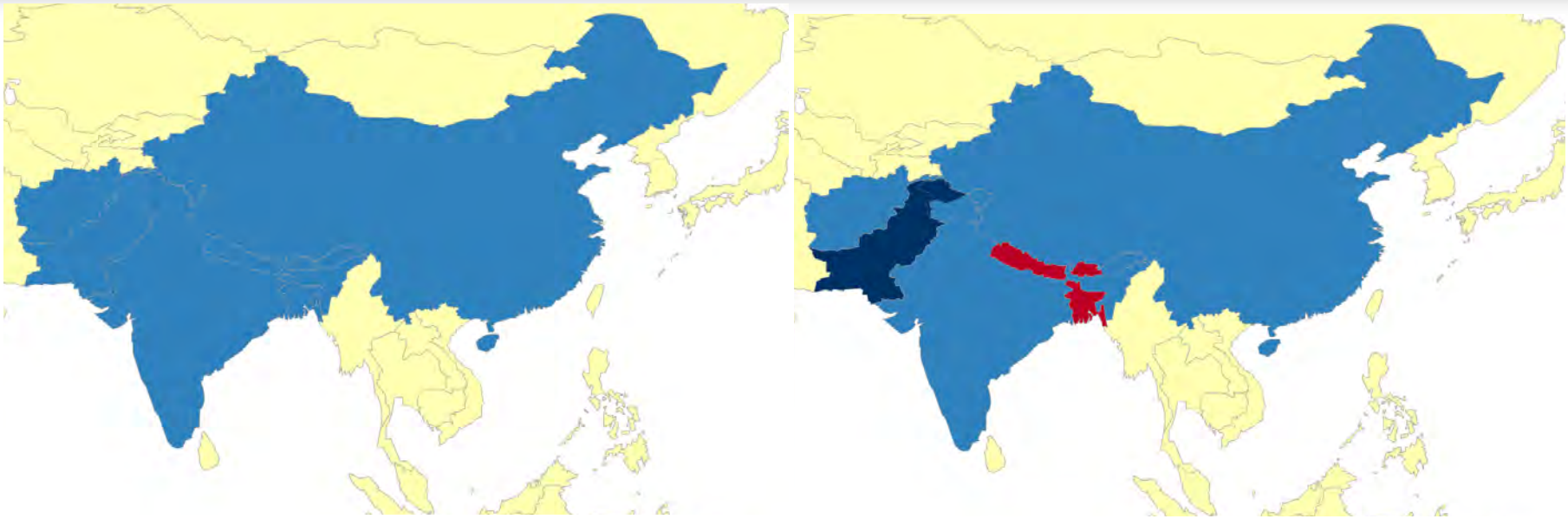

- Current Project
- Past Project
- Hub Member Country
- No Activity
- No Data

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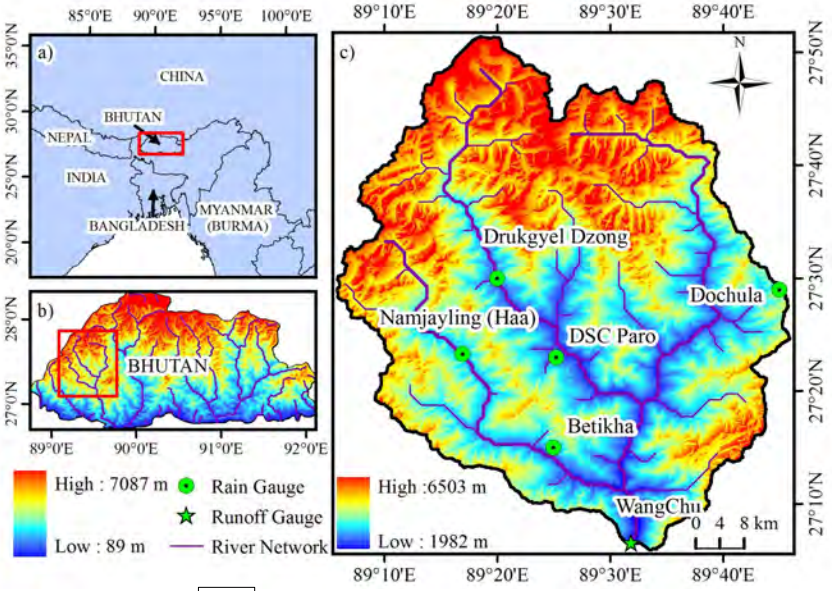
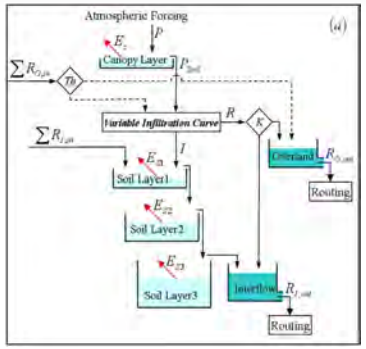
Bhutan Water Resource Assessment using Climate Change Scenarios and Hydrologic Model

SERVIR GLOBAL

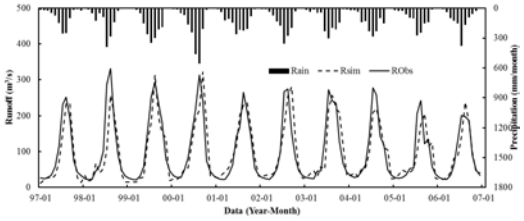
Wangchu Basin in Western Bhutan, which feeds a critical reservoir atop a Hydroelectric power plant. Bhutan's 50% of GDP is generated by Hydroelectric power.



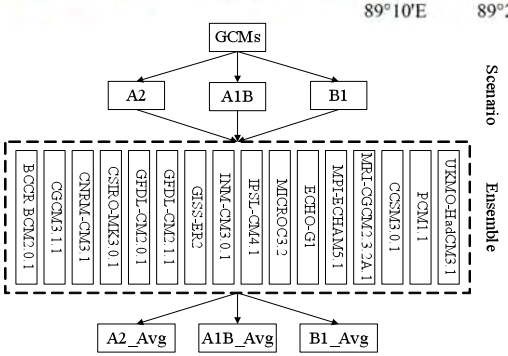


CREST hydrologic model

CREST model calibrated using observed streamflow data



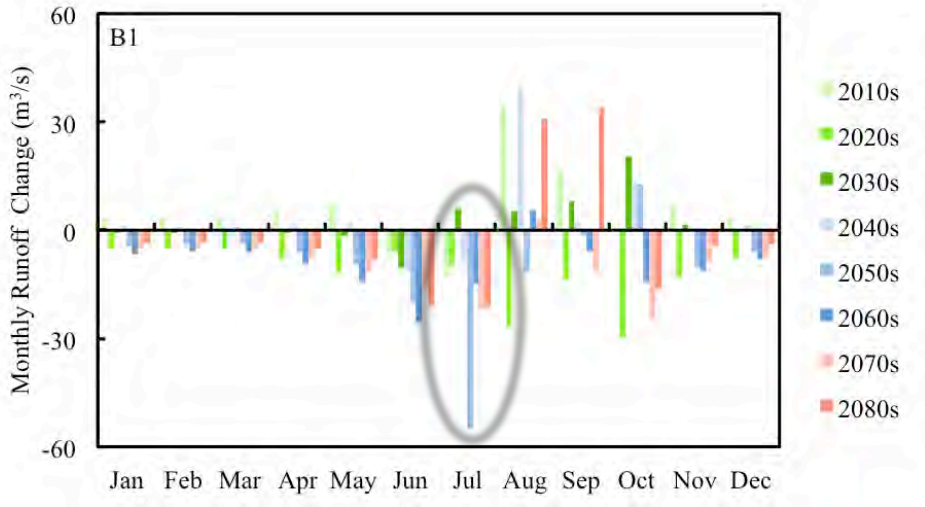
CC	0.88
NSCE	0.77
Bias(%)	-4.37



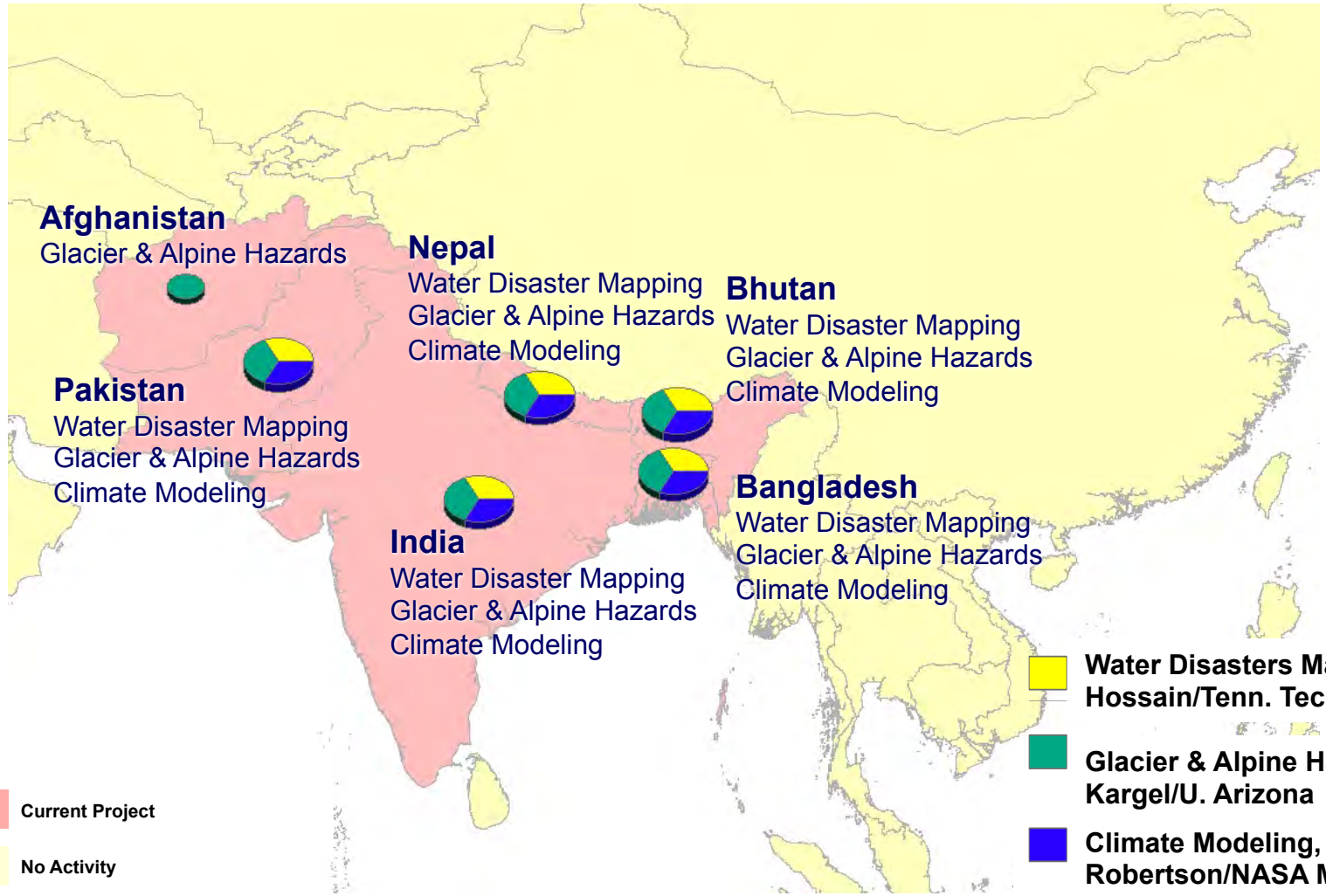
IPCC Ensemble Scenario Generation

Our preliminary analysis shows that the streamflow in early rainy season will be lower than historic amounts. The impacts on hydroelectric power generation can be severe. SERVIR plans to conduct additional analyses with Robertson data sets

Change in Streamflow under IPCC Scenarios



SERVIR Country Impact
SERVIR Applied Sciences Team

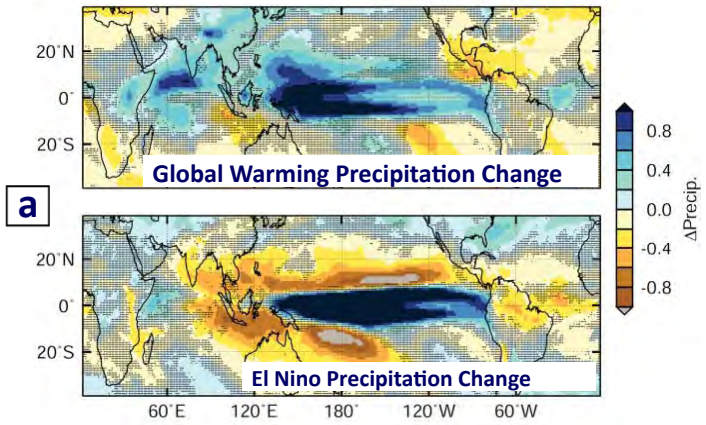


Leveraging Coupled Climate Model Projections for SERVIR Applications Science

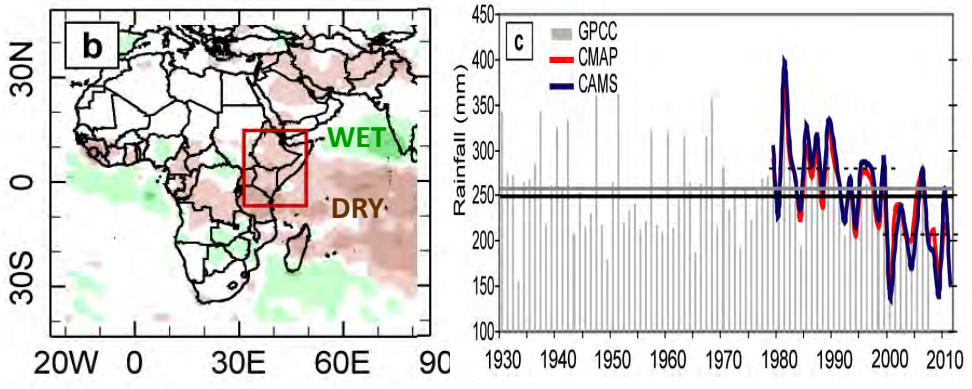
Pete Robertson, PI,; Brent Roberts, Co-I, NASA/MSFC;
Chris Funk, Co-I, USGS/UCSB; Brad Lyon, Co-I, Columbia U. /IRI;
Mike Bosilovich, Co-I & Siegfried Schubert, Collaborator, both NASA/GSFC/GMAO

A Big Challenge :
Identifying / Separating / Quantifying Natural Variability vs Anthropogenic Effects

- *Critically assess and employ CMIP5 and US NMME climate model projections of seasonal / interannual / decadal hydrometeorological climate variability / change affecting SERVIR Hub regions (Mesoamerica, E. Africa, Himalayas).*
- *Develop and refine scenarios through downscaling, and stochastic modeling to provide SERVIR Applications Science Team and Hub Scientists with information to drive decision support system models of crop production, water availability etc.*



a) CMIP models show 21st Century regionally varying precipitation trends (*top panel*) due to anthropogenic forcing. Note increased rainfall over East Africa. These expected changes will mix with natural climate variability (*lower panel*).



b) Satellite-observed Mar-May (1999-2010 avg) rainfall departure from 1979-2010 mean.

c) Mar-May observed and satellite-estimated rainfall averaged over East Africa (10S-12N, 30-53E). Why does this decadal trend contrast with model-projected increases?

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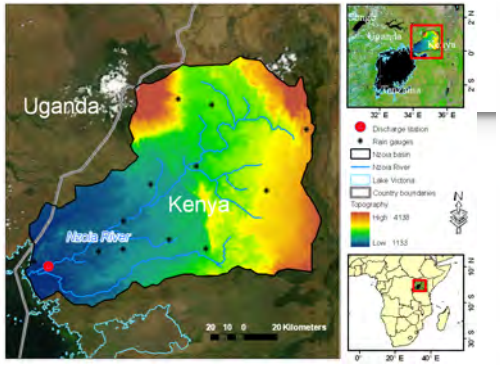
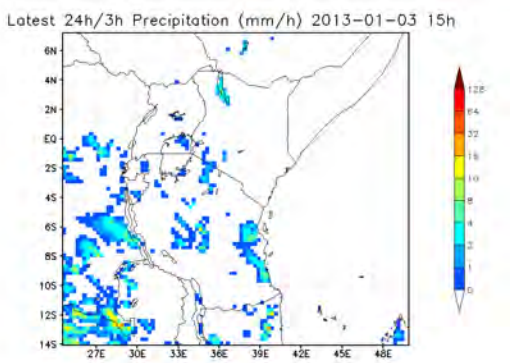
Hydrologic Modeling in East Africa with Active Engagement with End Users

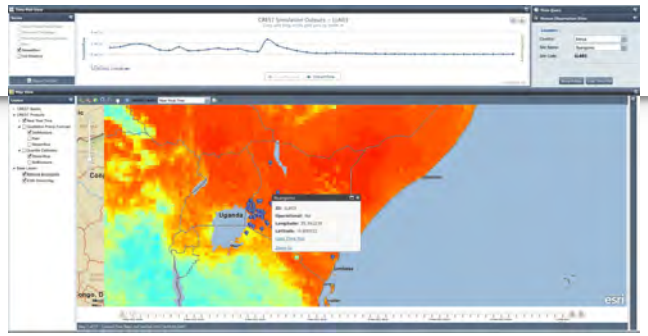
Hydrologic Model CREST Developed for Single Watershed in Kenya



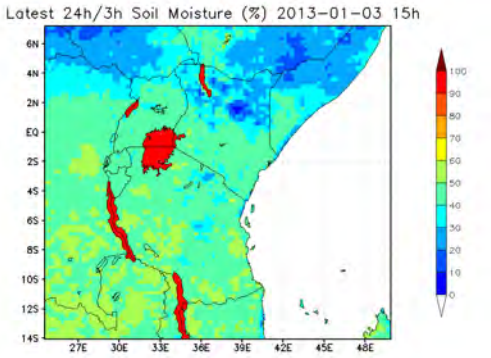
Near Real Time NASA Satellite Rainfall Data



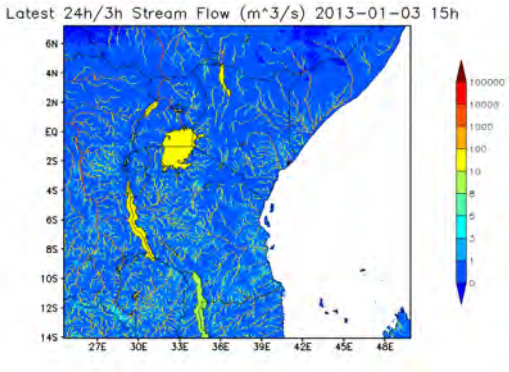
Engaged Kenya Department of Water Resources to help monitor floods



Soil Moisture

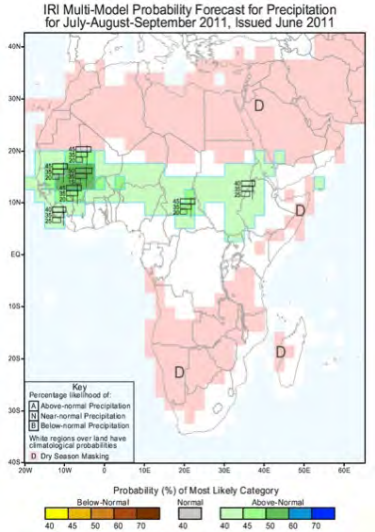


Training and Capacity Building



Real Time, Historic and Seasonal Streamflow

Working on seasonal hydrologic forecasts at the request of Kenya and Tanzanian Ministries of Water Resources



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SERVIR Linking Earth Observations to Decision Making in Kenyan Energy Sector

- The near real time CREST hydrologic modeling has sparked the interest of a large scale electric utility in Kenya, KenGen.

- KenGen approached SERVIR Africa to better forecast the short-term and long-term reservoir levels using the CREST hydrologic modeling system, with an aim to help in releasing optimal quantities of water for hydroelectric power generation.

- KenGen currently does not assimilate earth observations in their analysis. SERVIR is helping them with hydrologic modeling, which include near time assimilation of satellite datasets.

- If SERVIR is successful, KenGen will be doing the same on their own shortly.

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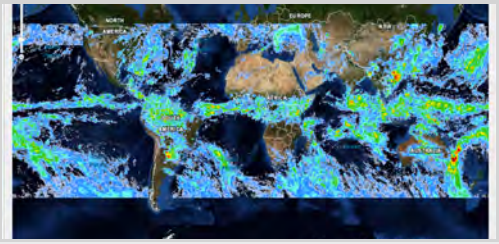
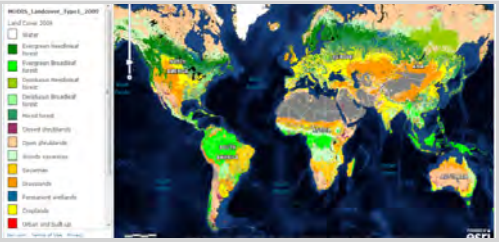
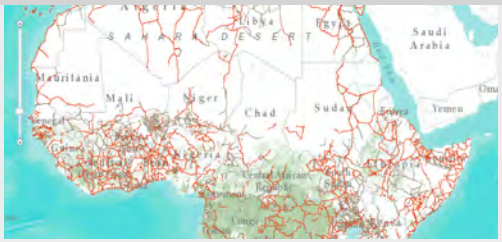
SERVIR Reference Node Patterns (recipes)

Type of Source Data	Applied to	
Raster data sets updated in near real-time from data stored in custom binary format	**TRMM** data (every 3 hours), approximately 7 MB per interval. Data structure is suitable to enable custom geoprocessing of accumulated rainfall for user defined time intervals & areas of interest.	
Vector data sets updated in near real-time from data stored in ASCII files	**MODIS NRT Active Fire** data (every 5 minutes), approximately 1 MB per day. Data is converted to polygons for accurate spatial representation. Countries, sub-national regions and populated places merged with fire vector data to support queries & aggregations by place names.	
Raster data updated periodically, stored in HDF format tiles	**MODIS Land Cover**, updated yearly, approximately 88 MB per interval. Data is imported from sinusoidal tiles and reprojected to web-friendly map projection. Caching is handled by the ETL process for faster viewing performance.	
Vector data sets updated at irregular intervals, obtained as shapefile tiles	**OpenStreetMap** complex datasets, updated by crowdsourcing. ETL process handles aggregation of OSM features and cache creation.	

SERVIR Reference Node Patterns (recipes)

Common characteristics to all patterns

- Handling of rolling archive and re-scan for missing data files (updates current and past periods within the archive interval).
- Multiple options for download (FTP/HTTP, compressed/ uncompressed files)
- Ability to add post-processing tasks (for summarization or custom format export)
- Open/standard interfaces to map & data services (OGC based)
- Extensive ETL process logs

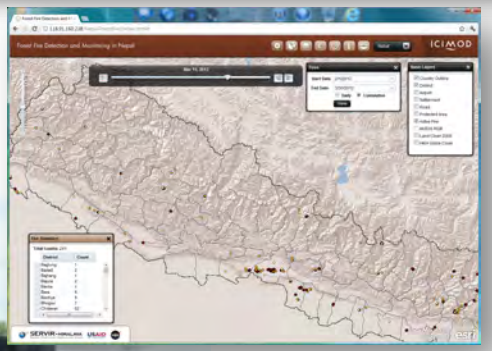
- Each pattern includes code and documentation to ease implementation for similar datasets thus facilitating capacity building.

Automated Testing

- The reference node also includes a testing framework for quickly scanning OGC services to verify compliance to OGC standards and assesses performance.

Other dissemination & collection approaches

- Fire applications & SMS service
- Mobile Apps
- Wireless sensor network
- ISS ISERV camera system



(Not to scale)

How could ESIP help?

- Could help get existing climate data layers not already on **SERVIRglobal.net** website into WMS or WCS web-friendly format – relates to ESIP GIS experiment described yesterday
- ISERV tech demo – potential data integration with data centers if extend to operational use
- How could we help end-users access earth observations from different entry points, e.g.
  - Societal Benefit Area – I am experiencing a drought, how can RS help me?
  - Geographic – I am a national user in Kenya and want to understand…. Or I am a local farmer in Kenya and want to understand…
- Could help us reach a broader audience with information of interest to NGO's, the public decision-makers
- Could help build capacity to understand climate data
- 2 hubs currently getting MODIS receivers – help us build their data management "good practices"?

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Thank you!

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NASA Applied Sciences Program
Appliedsciences.nasa.gov

Earth Science Data Access
Earthdata.nasa.gov

USAID Global Climate Change Initiative
http://www.usaid.gov/climate

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