SERVIR

Connecting Space to Village

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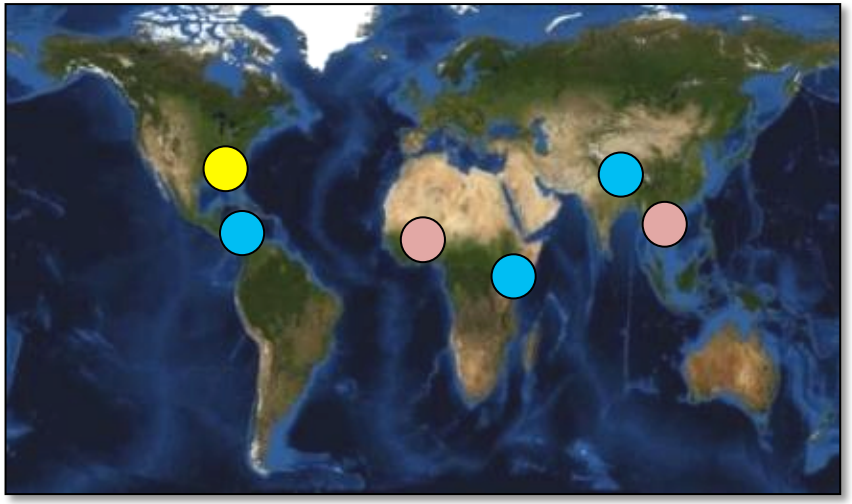
SERVIR Project Scientist

NASA Marshall Space Flight Center

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

SERVIR Network



SERVIR Hub

Program Office (NASA/MSFC)

Potential Future Hubs

SERVIR Network

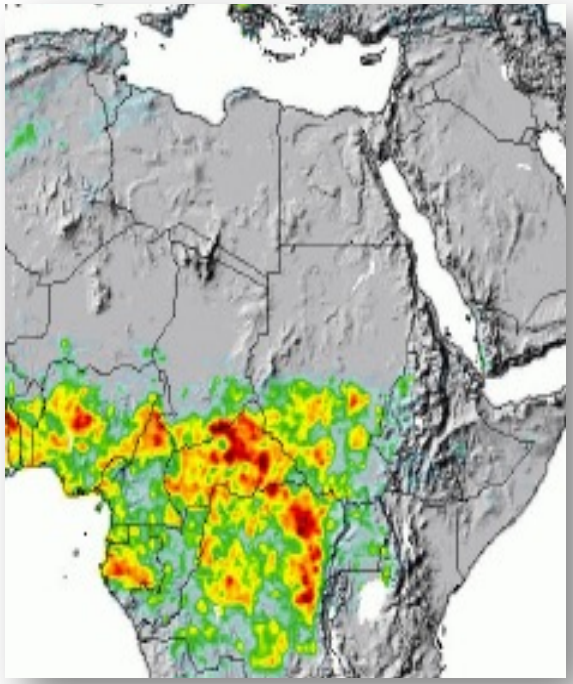
RCMRD – Host of SERVIR-East Africa

ICIMOD – Host of SERVIR-Himalaya

CATHALAC– Host of SERVIR-Mesoamerica

What We Do

- Identify needs in SERVIR regions
- Link science products from US institutions to meet those needs through improved access to data, models, online maps, and visualizations
- Build capacity of regional institutions, stakeholders, and young professionals
- Strengthen partnerships and foster collaboration across SERVIR network

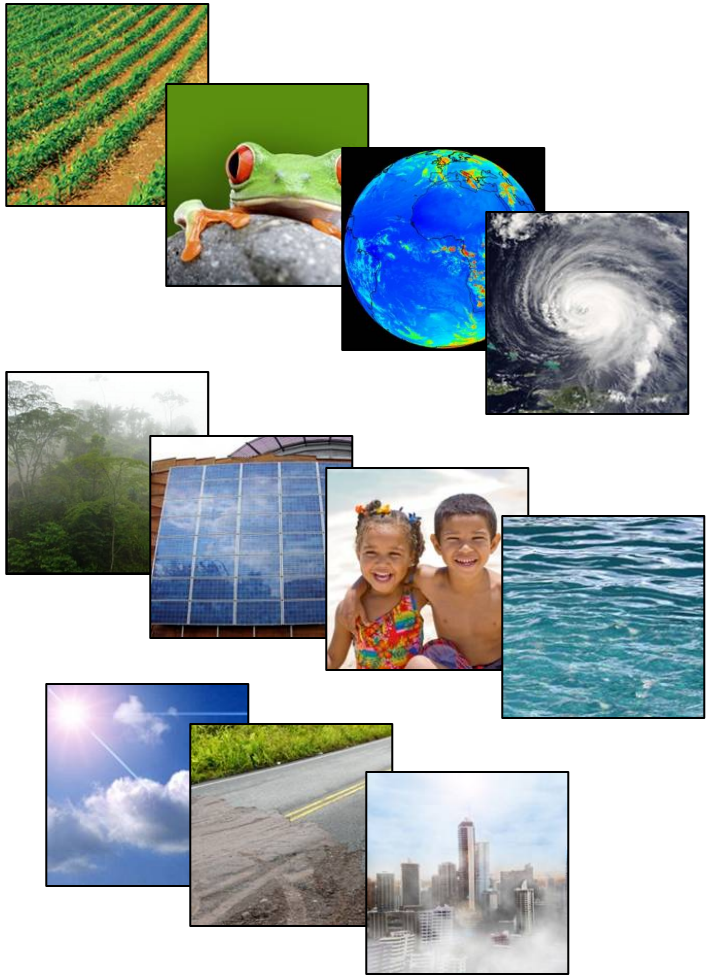


SERVIR GLOBAL

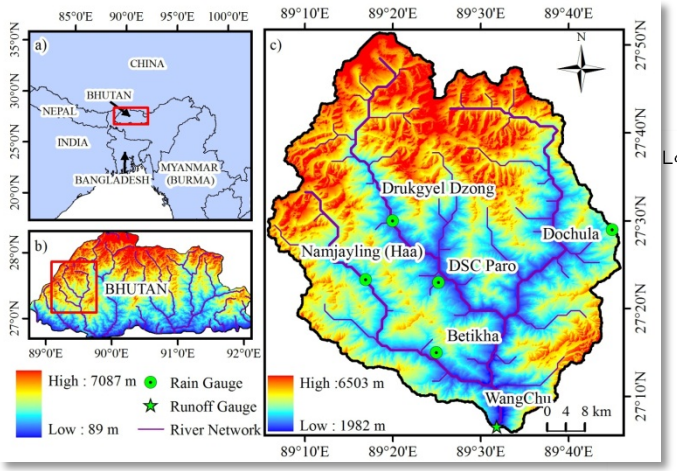
Connecting Space To Village

SERVIR Thematic Areas

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

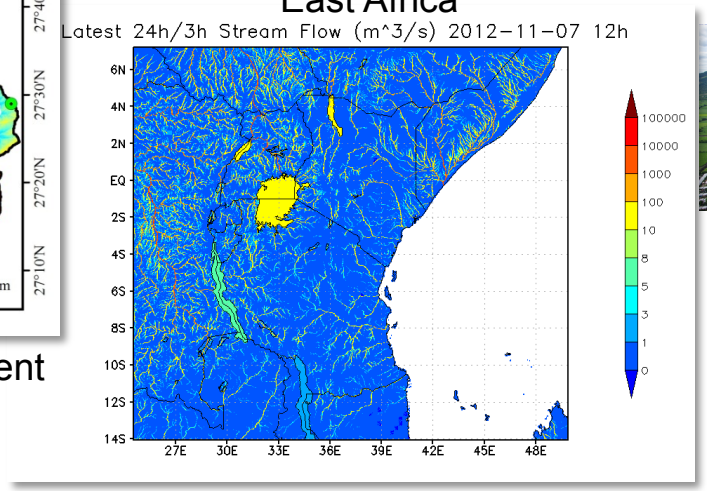


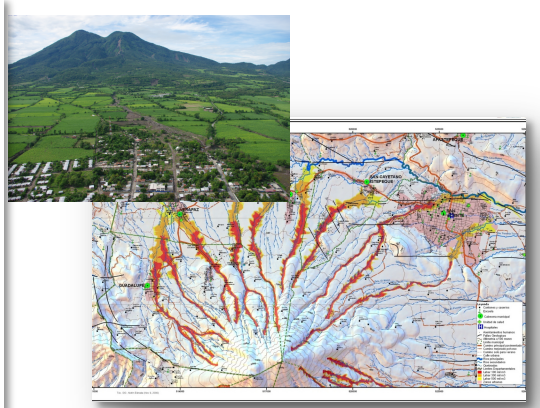
SERVIR Science Applications for Decision Making



Bhutan Water Resource Assessment

Real Time Streamflow in East Africa

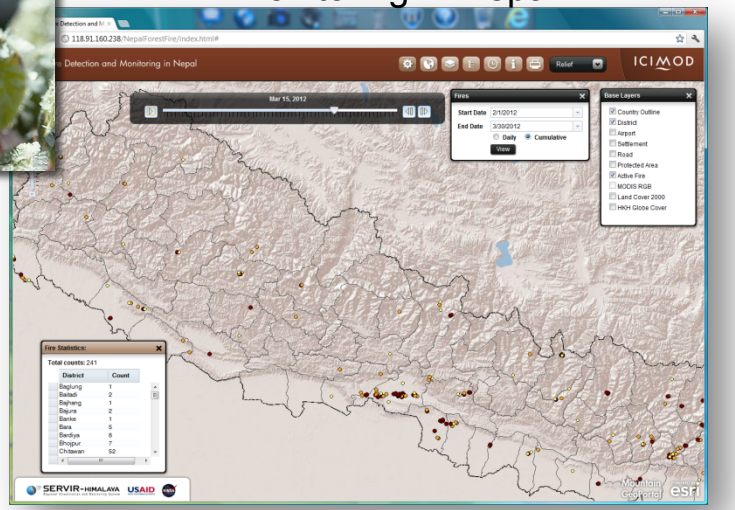


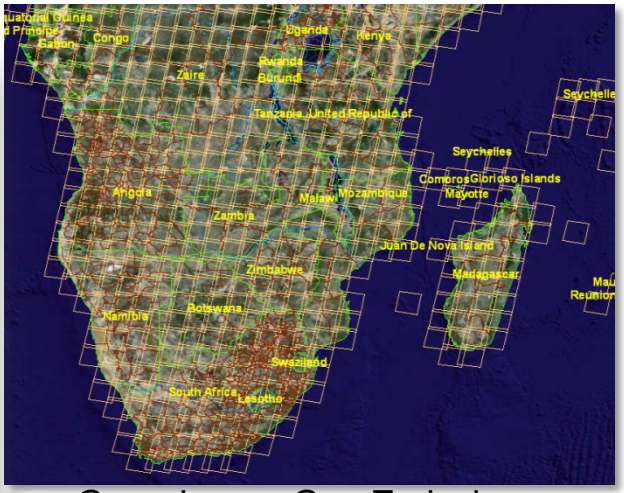


Landslide Prediction System in Mesoamerica

Frost Mapping in Africa

Near Real-time Forest Fire Monitoring in Nepal

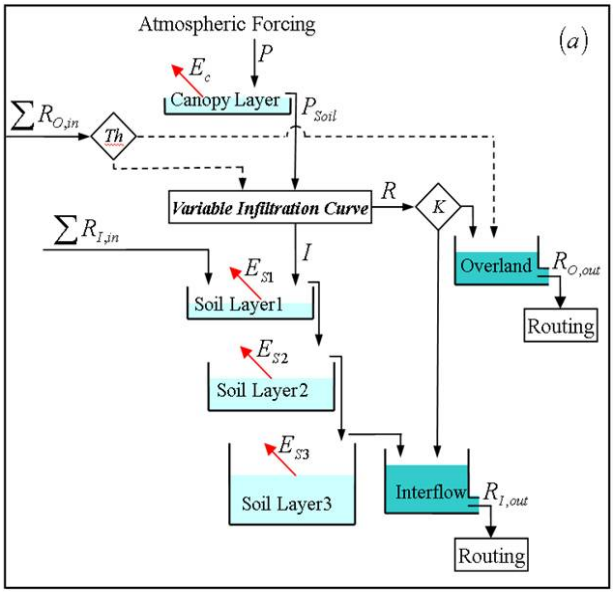


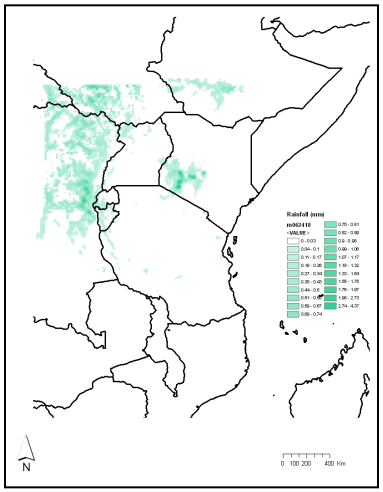


Greenhouse Gas Emissions Inventory in Africa

SERVIR Africa and the Hydrological Modeling

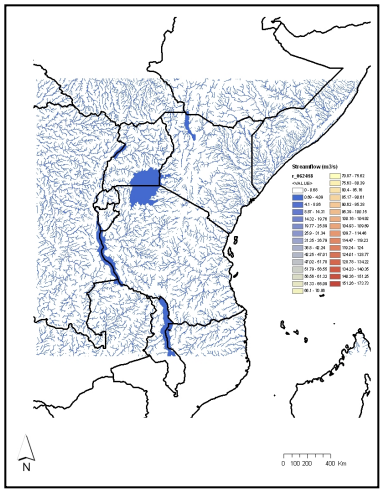
- Spatially distributed hydrologic model CREST (based on Variable Infiltration Capacity (VIC) model)
- Spatial resolution 1km, run every 3 hours using near real time data in the Amazon cloud
- Uses near real-time satellite rainfall estimates from TRMM microwave radiometer and forecasts from Kenya Meteorological Department (KMD) to produce soil moisture & streamflow
- Soil moisture and streamflow estimates enable Kenya Department of Water Resources to issue early flood warning, especially in the flood prone watersheds in western Kenya.

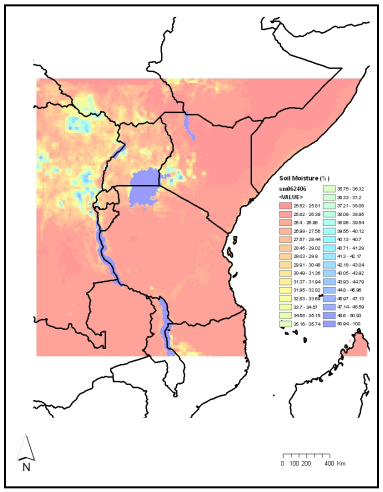




KMD QPF

Streamflow





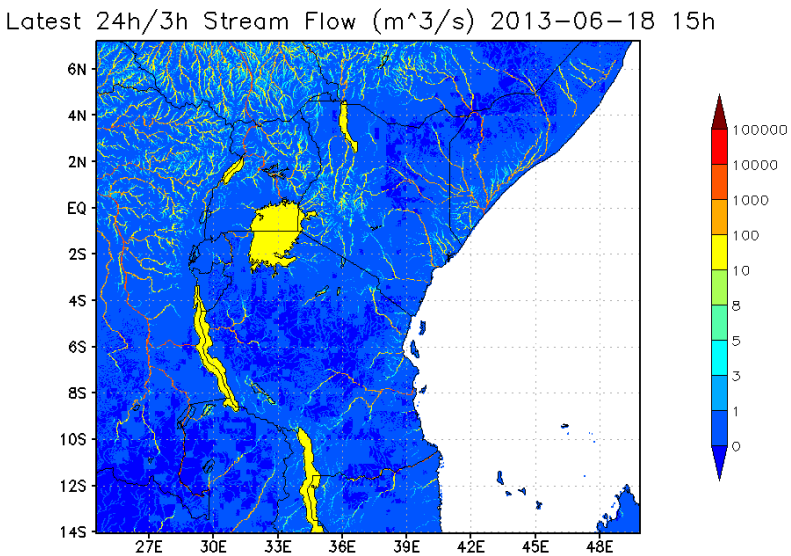
Soil Moisture

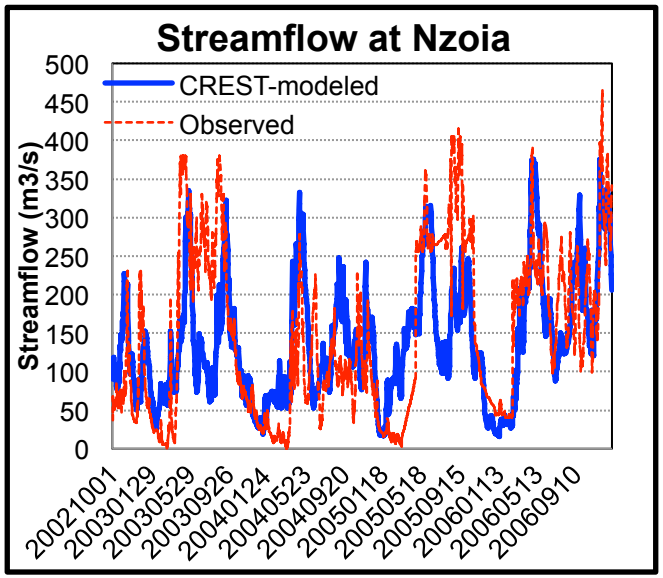
Historical Data Perspective

- SERVIR has used 10-year historical satellite rainfall data to drive the CREST model, which has resulted in historical daily streamflow at 1 km resolution.

- Those historical and near real time data are shared with Kenya Department of Water Resources (KDWR) for ~850 stream gage locations of their choice. SERVIR Africa makes the data available on our web portal and through automated emails to KDWR-identified field hydrologists.

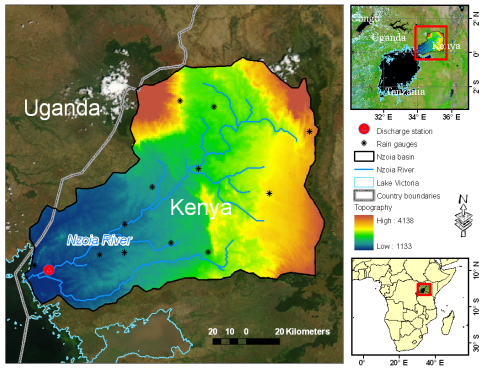
- We have used the historical data to assess 5th, 20th, 80th and 95th percentiles for each 1 km pixel to put the real time streamflow in context.

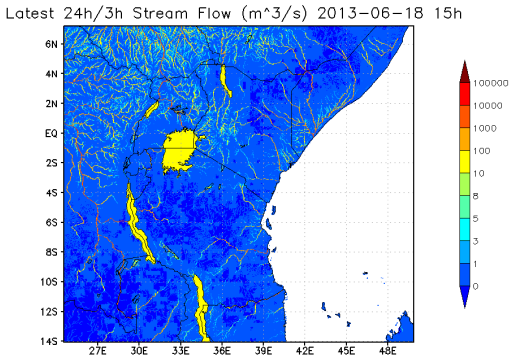




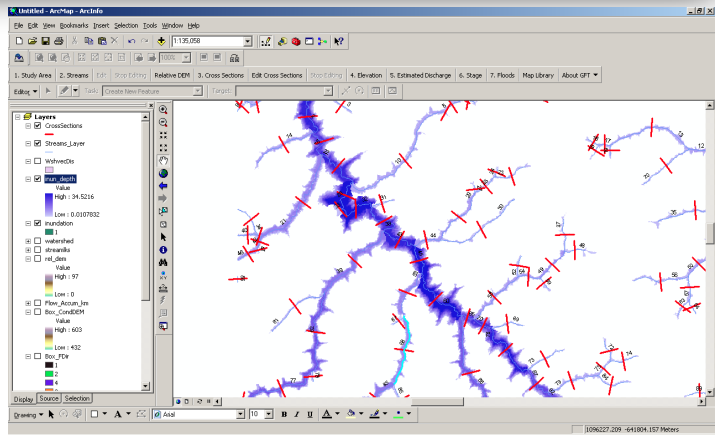
SERVIR Africa and the CREST model- Forecasting for Flood-Prone Watersheds

Hydrologic Model CREST Developed for Single Watershed in Kenya

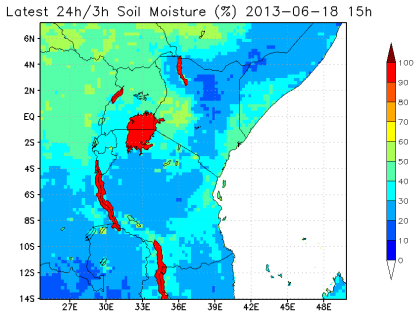




Real Time, Historic and Seasonal Streamflow

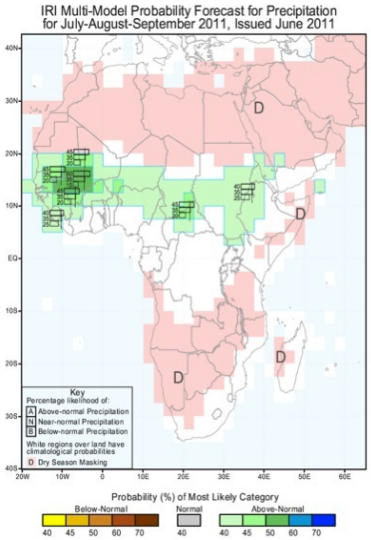


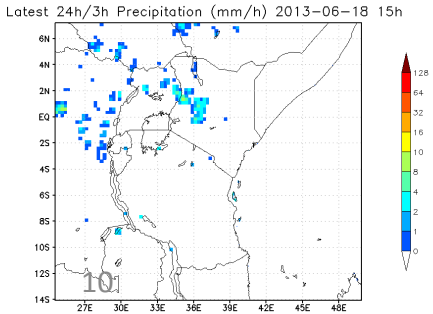
Flood mapping tool is an upcoming tool at RCMRD, which will translate the hydrologic model product into a better visualization and decision making tool. Under flooding conditions, the streamflow from the model can be visualized in the form of spatial flooding extent using this tool.



Soil Moisture

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





Near Real Time NASA TRMM Satellite Rainfall Data

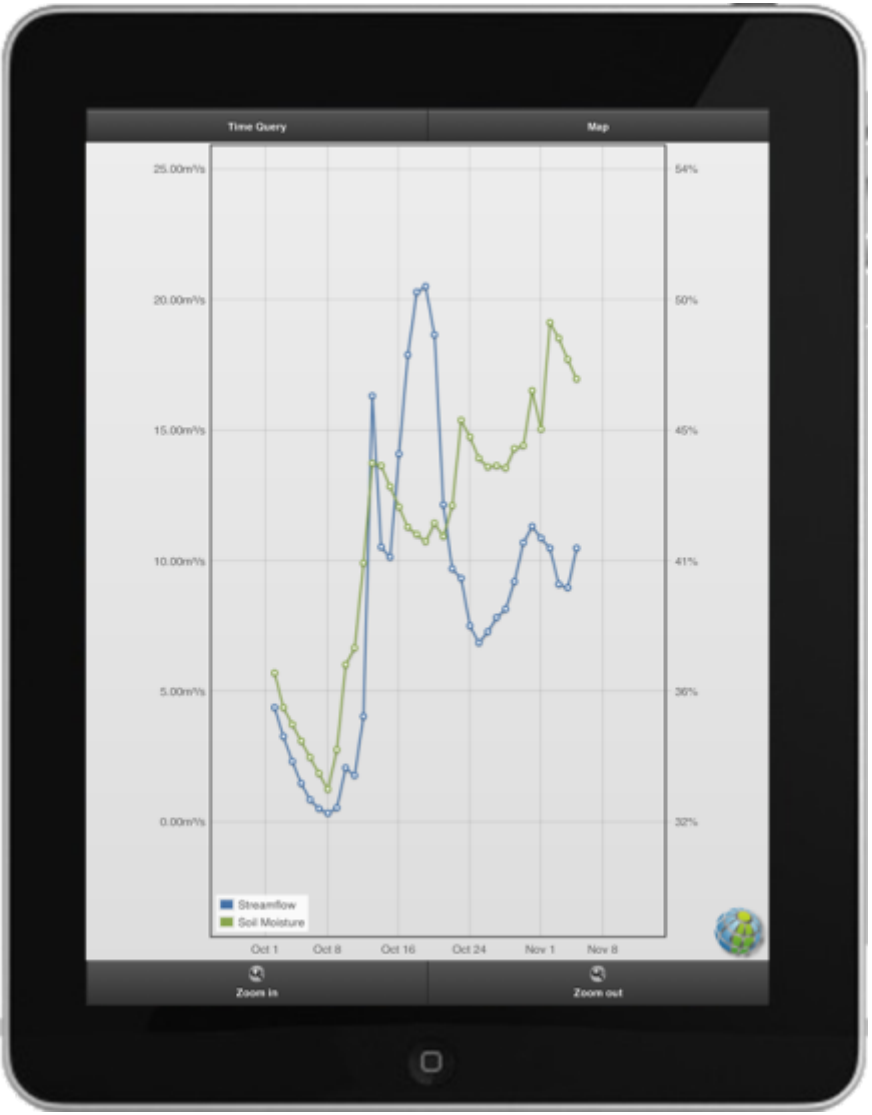
Training and Capacity Building

Comments from CREST End User

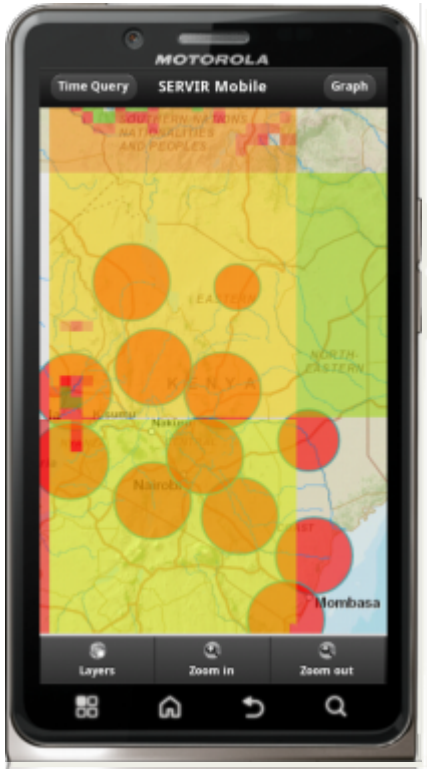
"The biggest problem we have is lack of data. When someone, like SERVIR Africa comes along to help us out it is very good because we have been missing floods."

-Simintei Kooke
Deputy Director of Water Resources,
Kenya Ministry of Water and Irrigation

CREST Mobile App



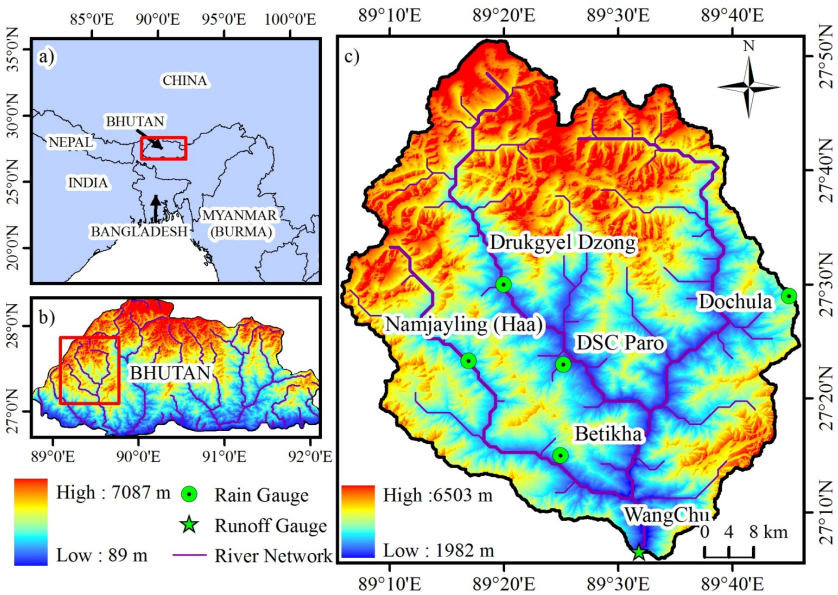
SERVIR has adapted CREST model products to fit the mobile needs.

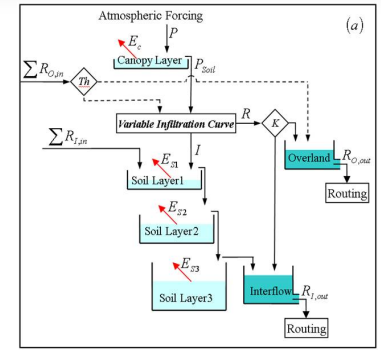


CREST Models can run on iOS and Android devices.

Bhutan Water Resource Assessment using Climate Change Scenarios and Hydrologic Model

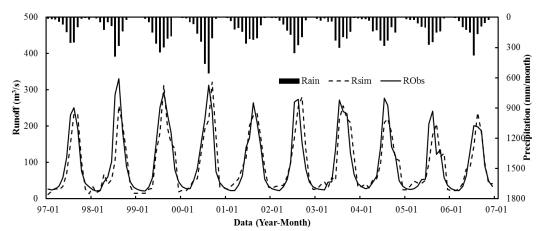
Wangchu Basin in Western Bhutan, which feeds a critical reservoir atop a Hydroelectric power plant. Bhutan's 50% of GDP is generated by Hydroelectric power.



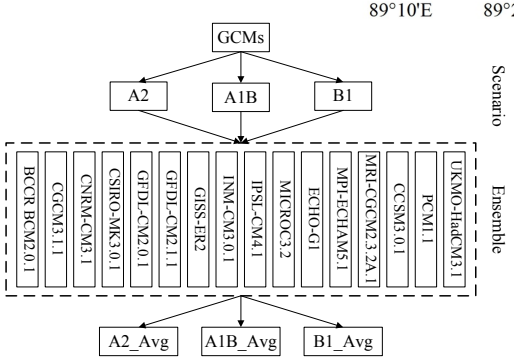


CREST hydrologic model

CREST model calibrated using observed streamflow data



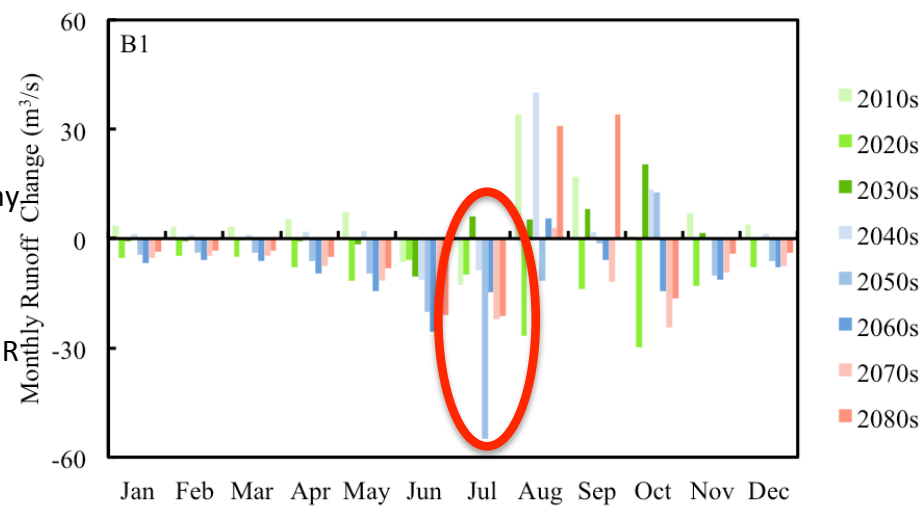
CC	0.88
NSCE	0.77
Bias(%)	-4.37



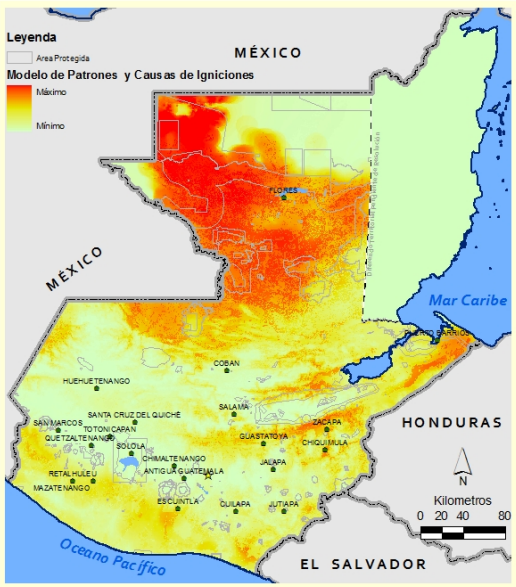
IPCC Ensemble Scenario Generation

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

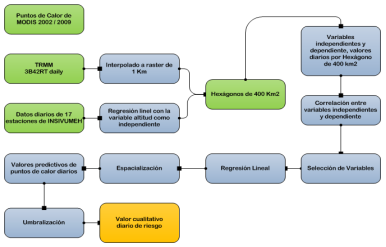
Change in Streamflow under IPCC Scenarios

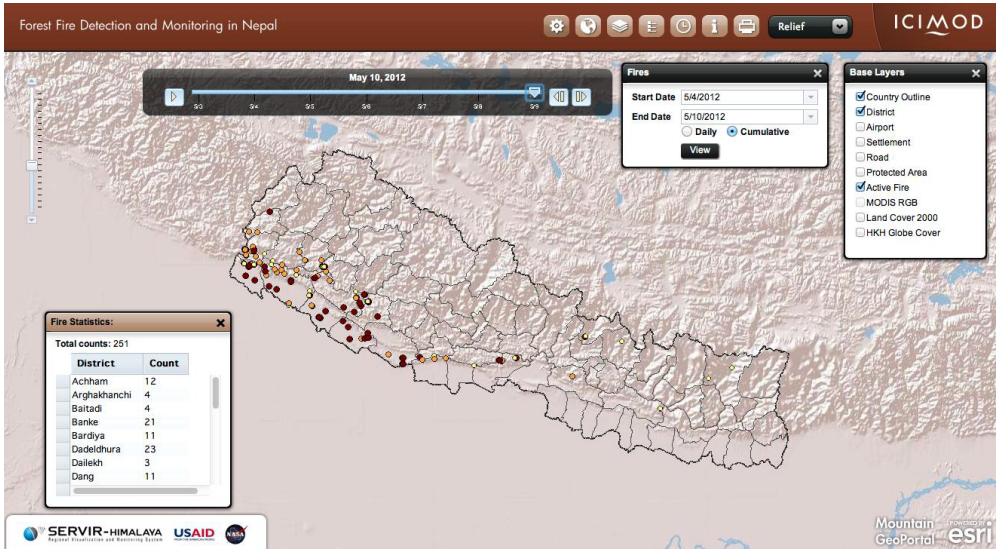


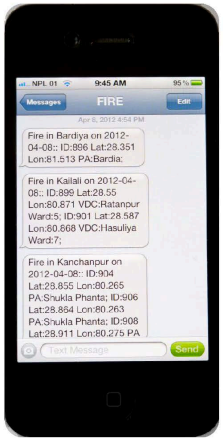
Forest Fire Detection and Monitoring System



- **In 2009, SERVIR Mesoamerica used MODIS fire hotspots to generate Guatemala Fire Monitoring System.**
- **Recently, SERVIR HKH developed SMS Forest Fire Detection and Monitoring System in Nepal.**
- **Over 200 Forest Officers in Nepal are receiving real-time information about current fires in their district.**
- **In near future, the system will be transferred over to Nepal Ministry of Forest for their continued operational use.**

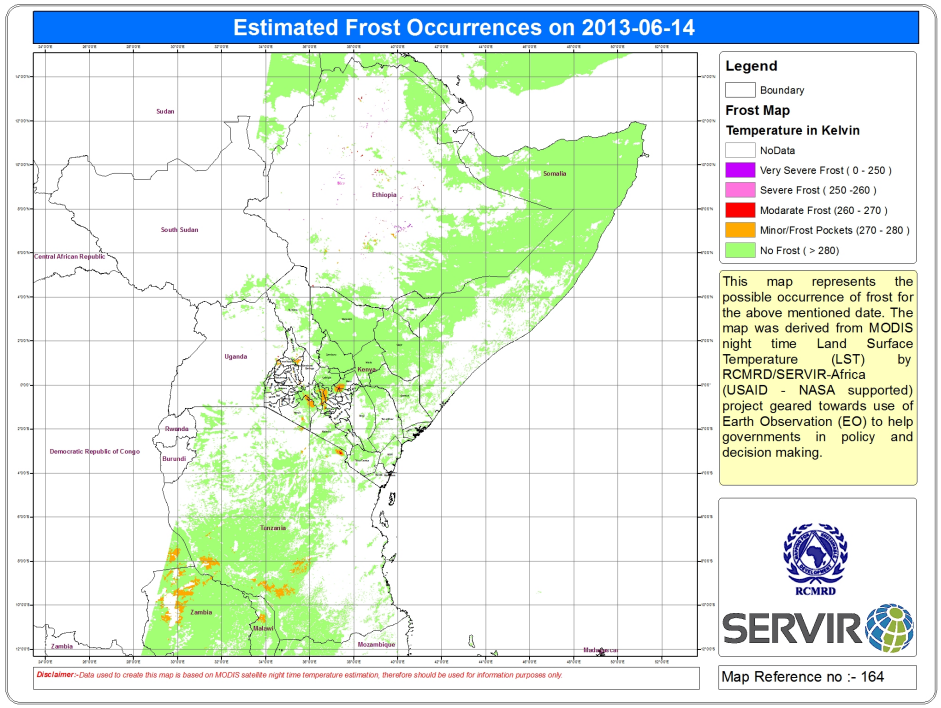






USAID FROM THE AMERICAN PEOPLE

Frost Monitoring and Early Detection

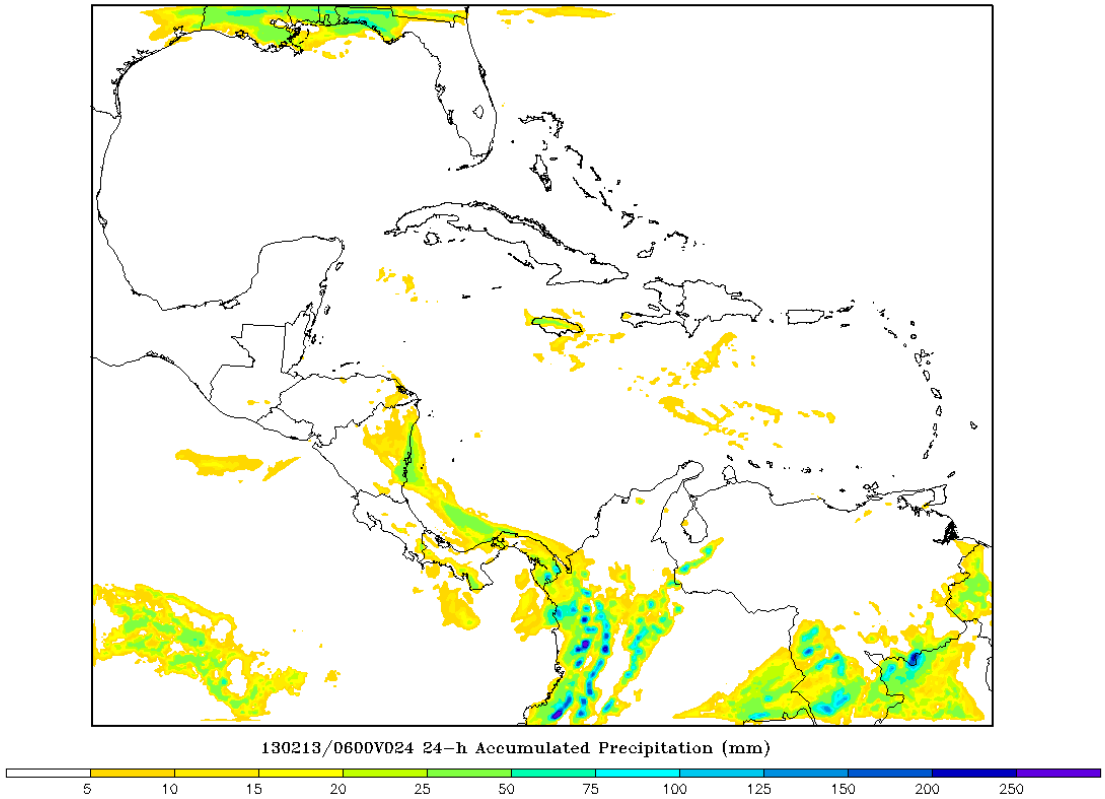


- SERVIR is keen on getting satellite data and products to end users in the agricultural community to improve decision making.
- In Kenya, as with many other countries in Africa, frost damages are a significant threat to agriculture.
- Kenya Meteorological Department requested SERVIR to help with identifying the frost damaged areas, for public dissemination and damage assessment purposes.
- Using satellite and KMD datasets, SERVIR Africa has put together a system for early detection of frost and for damaged area assessment. Next phases will include near real time temperature observations and forecasts of frost areas.

Mesoscale Atmospheric Modeling
WRF for Mesoamerica and Improvements in East Africa

- SERVIR, with the help of NASA Short-term Prediction Research and Transition Center (SPoRT), is producing real-time numerical weather forecasts for Mesoamerican region at the request from Meteorological Services in the region.

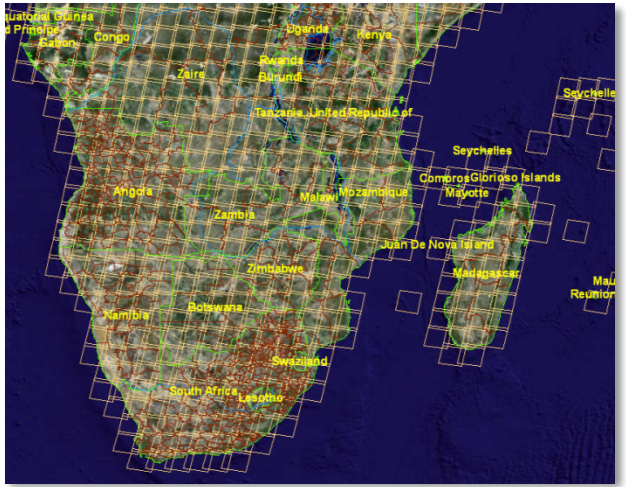
- SERVIR/SPoRT collaboration is helping Kenya Meteorological Department in improving KMD's operational WRF modeling system



Land Cover Mapping for GHG Emissions Inventory

- USEPA and UNFCCC are leading development greenhouse gas (GHG) emissions inventory for six African countries. SERVIR is providing the land use land cover mapping for that overall project.
- The effort is to targeted at developing capacity in the Forest Ministries in the countries. In collaboration with the Ministries, SERVIR is harmonizing existing maps, teaching the Ministry personnel to classify Landsat images, and leading ground validation efforts.

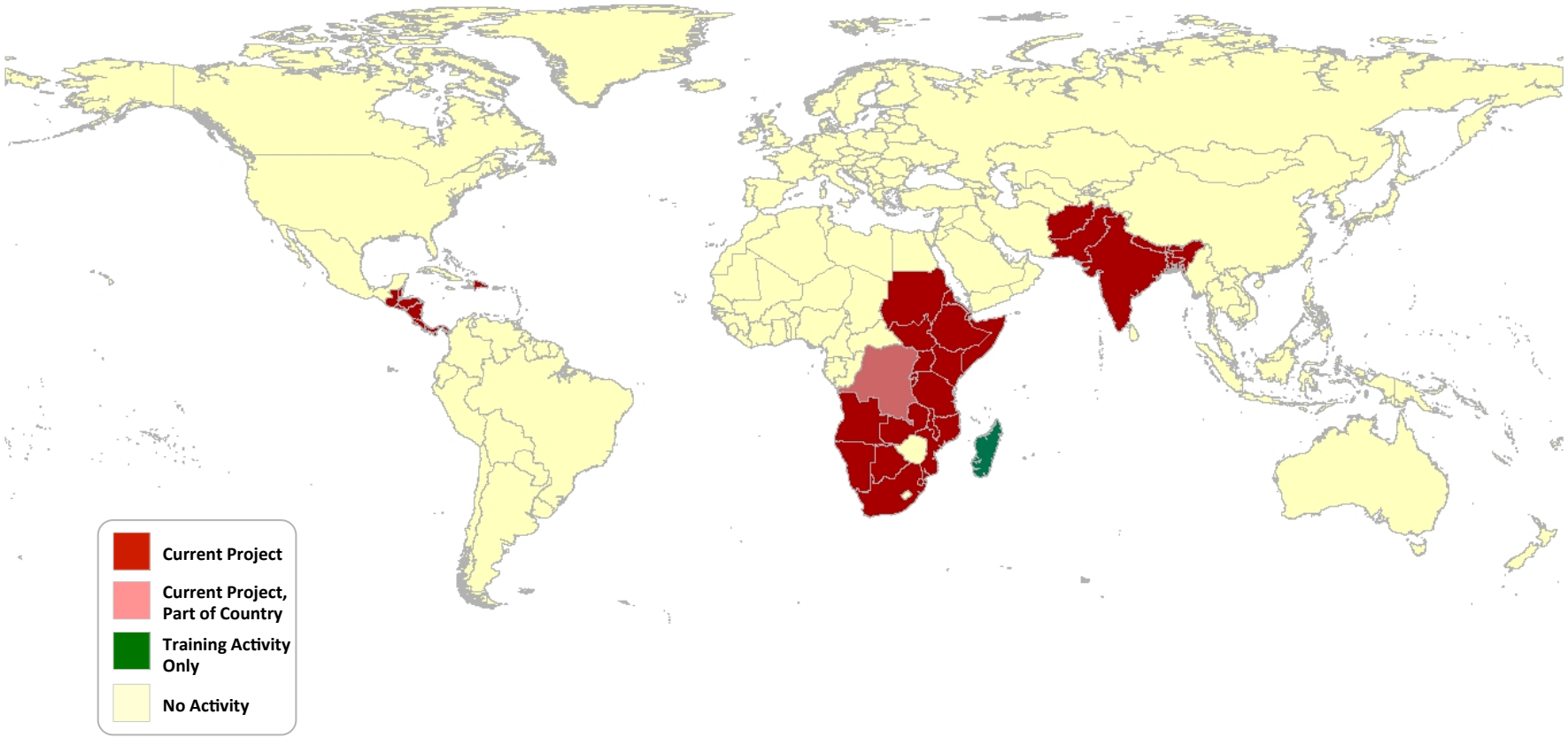
Land Use Land Cover Mapping for Greenhouse Gas Emissions Inventory in Africa



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

SERVIR Country Impact
SERVIR Applied Sciences Team



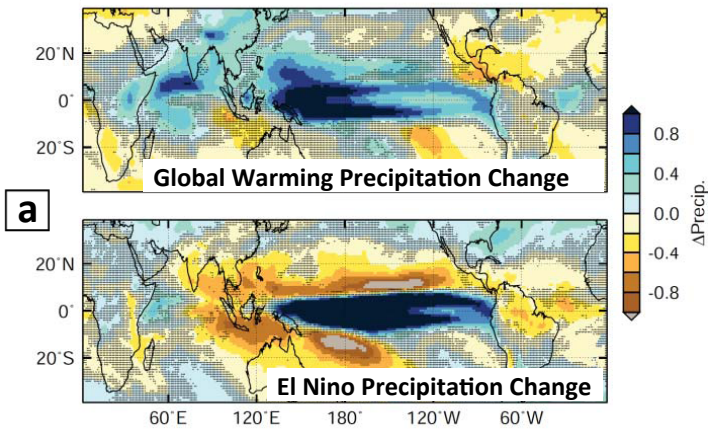
Leveraging Coupled Climate Model Projections for SERVIR Applications Science

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, NASA/GSFC/GMAO; Siegfried Schubert, Collaborator, NASA/GSFC/GMAO

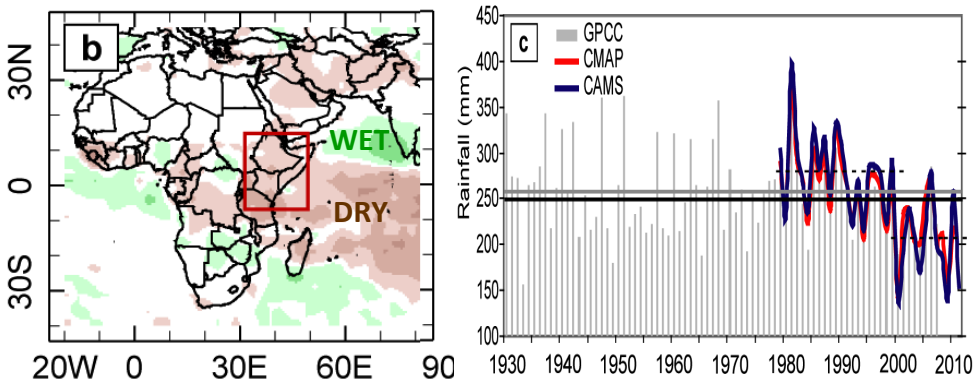
- *Critically assess and employ CMIP5 and US NMME climate model projections of seasonal / interannual / decadal hydrometeorological climate variability / change affecting SERVIR Hub regions (Mesoamerica, E. Africa, Himalayas).*
- *Develop and refine scenarios through downscaling, and stochastic modeling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

A Big Challenge :

Identifying / Separating / Quantifying Natural Variability vs Anthropogenic Effects



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?

Maximizing the Value of Scientific Discovery by Bridging the Gap

https://www.SERVIRGLOBAL.net

Summary

- SERVIR is a link between US research institutions and end user decision making.

- SERVIR efforts are led by the needs of the region. Some examples include hydrological modeling, frost monitoring, fire alert system, and land cover change assessment

- Presence of SERVIR Hub, a technical institution with regional governmental support, makes the linkage sustainable.

More information:

NASA Earth Science: http://science.nasa.gov/earth-science/

NASA Applied Sciences Program: http://appliedsciences.nasa.gov

SERVIR Global: http://www.servirglobal.net

SERVIR Contacts:

Daniel Irwin – Project Director

Nancy Searby – NASA HQ Program Manager

Ashutosh Limaye – Project Scientist (Ashutosh.Limaye@nasa.gov)