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Enabling Land Surface applications with CERES Radiative Fluxes: A SERVIR Perspective

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Acknowledgements: Jayanthi Srikishen, Kristi Arsenault, Clay Blankenship, Colin McLaughlin, Ryan Zamora

Countries Around the World Need Satellite Data

SERVIR

CHALLENGE:

Climate change impacts are accelerating around the world.

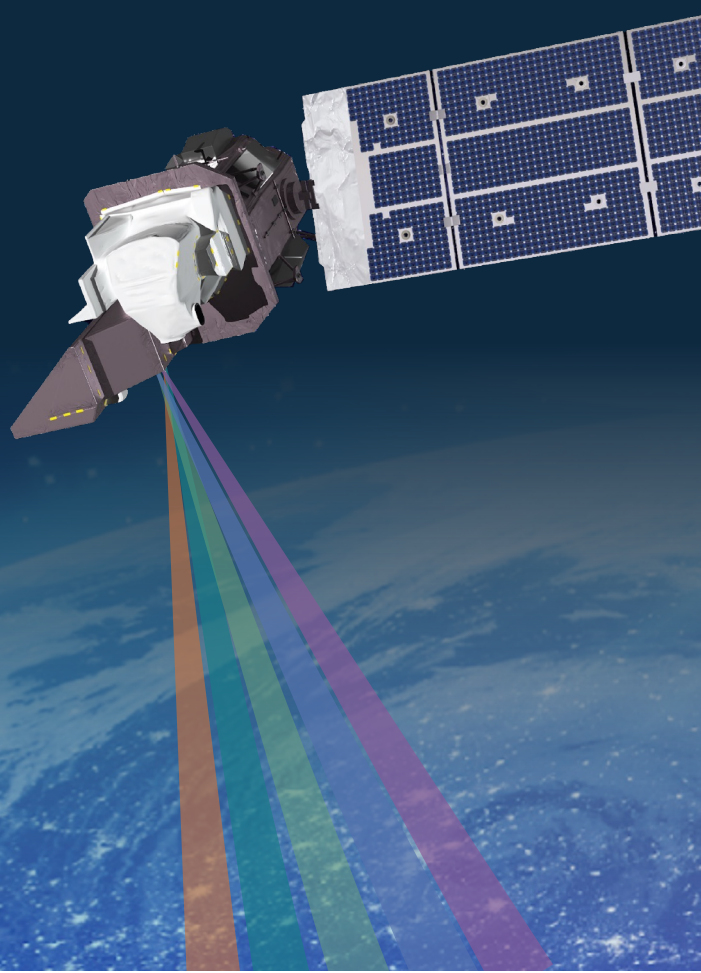
Disadvantaged and marginalized people are most adversely affected.

The power of satellite data helps partner countries identify and manage climate risks.

CONNECTING
SPACE TO **VILLAGE**

SERVIR is a joint initiative of NASA, USAID, and leading geospatial organizations in Asia, Africa, and Latin America that partners with countries and organizations to address challenges in climate change, food security, water and related disasters, land use, and air quality.

Using satellite data and geospatial technology, SERVIR co-develops innovative solutions through a network of regional hubs to improve resilience and sustainable resource management at local, national and regional scales.



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CONNECTING
SPACE TO **VILLAGE**

Agriculture &
Food Security

Water Security

Ecosystem & Carbon
Management

Weather & Climate
Resilience

Air Quality &
Health

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Who Is SERVIR?

SERVIR

USAID
FROM THE AMERICAN PEOPLE

Poverty reduction & resilience
Data-dependent issues in data-scarce places
International field presence

NASA

30+ Earth observing satellite missions, free & open data
Major research portfolio
Societal benefit from space

Private sector collaborators:

Google mapbox developmentSEED planet. esri aws MAXAR TECHNOLOGIES

USG collaborators: NOAA USGS science for a changing world USFS

Intergovernmental, NGO collaborators:

Food and Agriculture Organization of the United Nations
WFP World Food Programme
MERCY CORPS

Research collaborators: 20+ US universities & research centers through the SERVIR Applied Sciences Team; ITC, in-region university networks

Regional Hub Host Institutions:

ALLIANCE Bioversity International CIAT
ICRISAT INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS
ICIMOD
adpc

Hub Consortium Members:

Deltares
SEI Stockholm Environment Institute
Spatial Informatics Group
Conservación Amazónica ACCA
imaflora
eco ciencia
CILSS
AFRIGIST
CERSGIS
CSE Centre de Suivi Ecologique
AIMS
ISESTEL
COLUMBIA UNIVERSITY
University of Florida 1853

What Makes SERVIR Unique?

SERVIR services are…

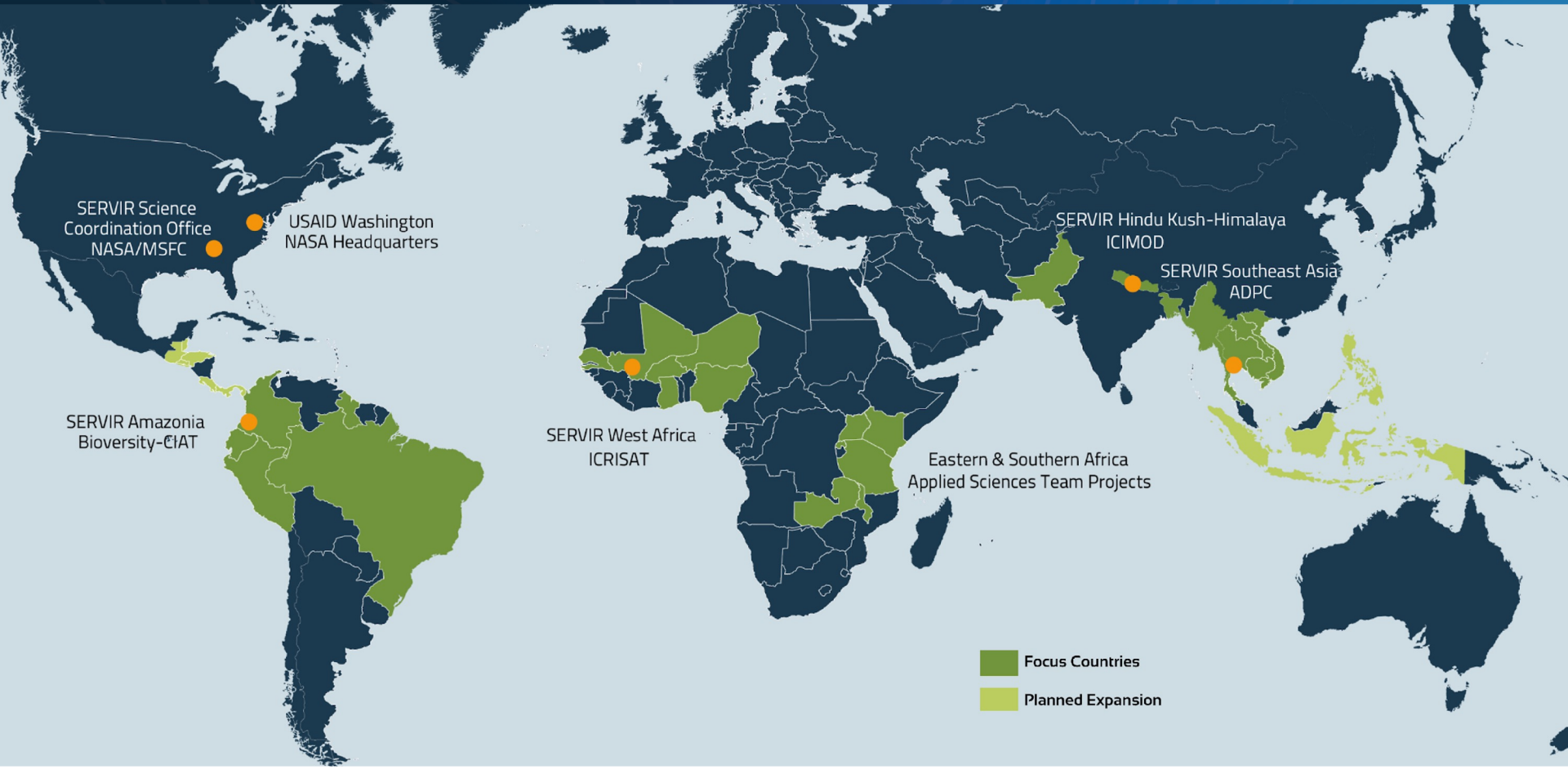
Demand-driven to ensure each community's needs and values are prioritized throughout the process

Co-developed with regional experts to bring together NASA science and in-depth local knowledge

Inclusive, emphasizing that services must be accessible and represent the needs of women and indigenous communities

Built to last, prioritizing trainings and resources to strengthen capacity and foster sustained capabilities

SERVIR Focuses on Countries in Asia, Africa, & the Americas



SERVIR

So …

How are radiative fluxes being used across the SERVIR network?

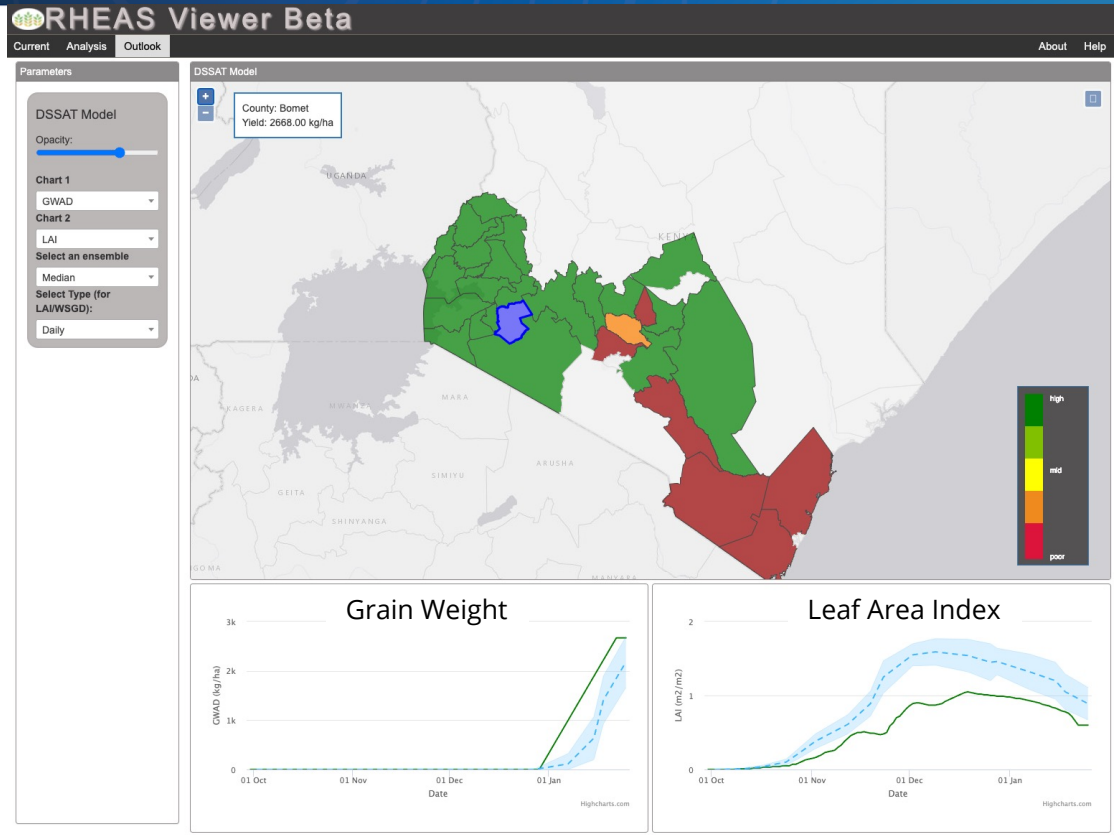
3 Common Applications:

- ✓ *Crop modeling*
- ✓ *Land surface modeling*
- ✗ *Solar Energy*

The Regional Hydrologic Extremes and Assessment System (RHEAS)

Framework for providing nowcast and forecasts of hydrologic and agricultural forecasts - e.g., streamflow and crop yields

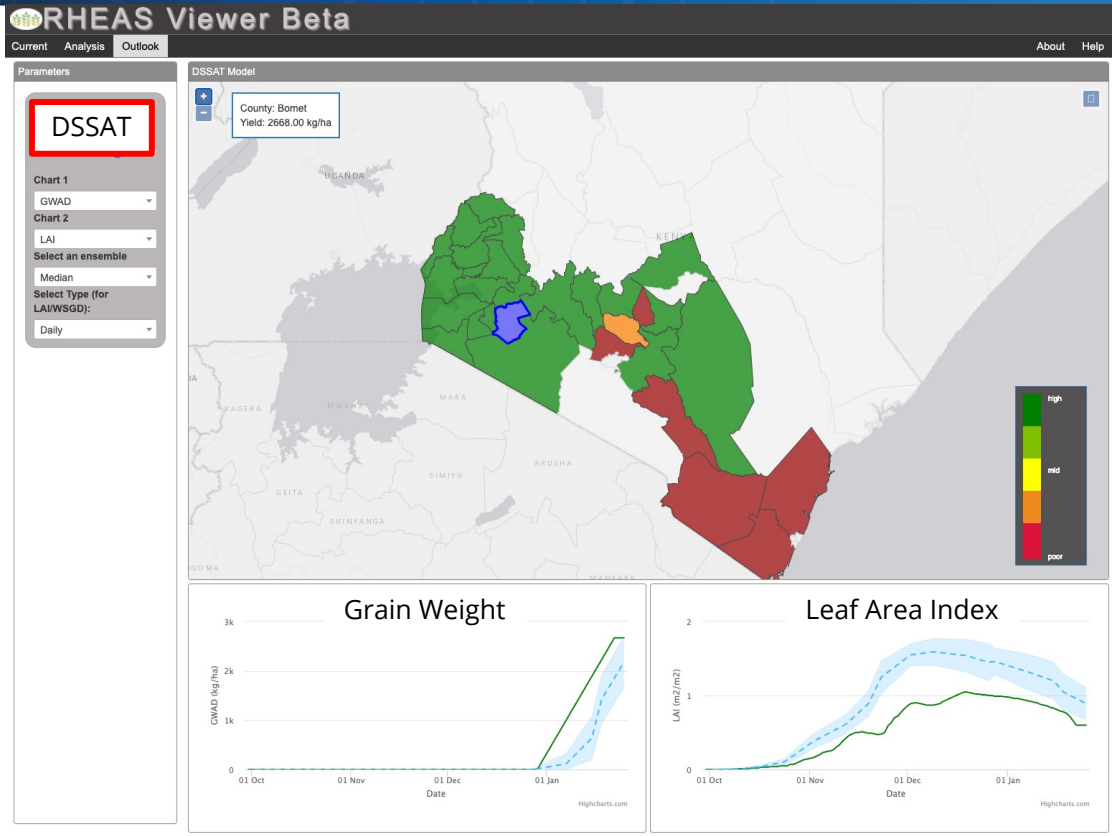
Deployed this system in multiple regions including Eastern Africa and Southeast Asia



The Regional Hydrologic Extremes and Assessment System (RHEAS)

What users need is not always what is directly available from weather and climate models

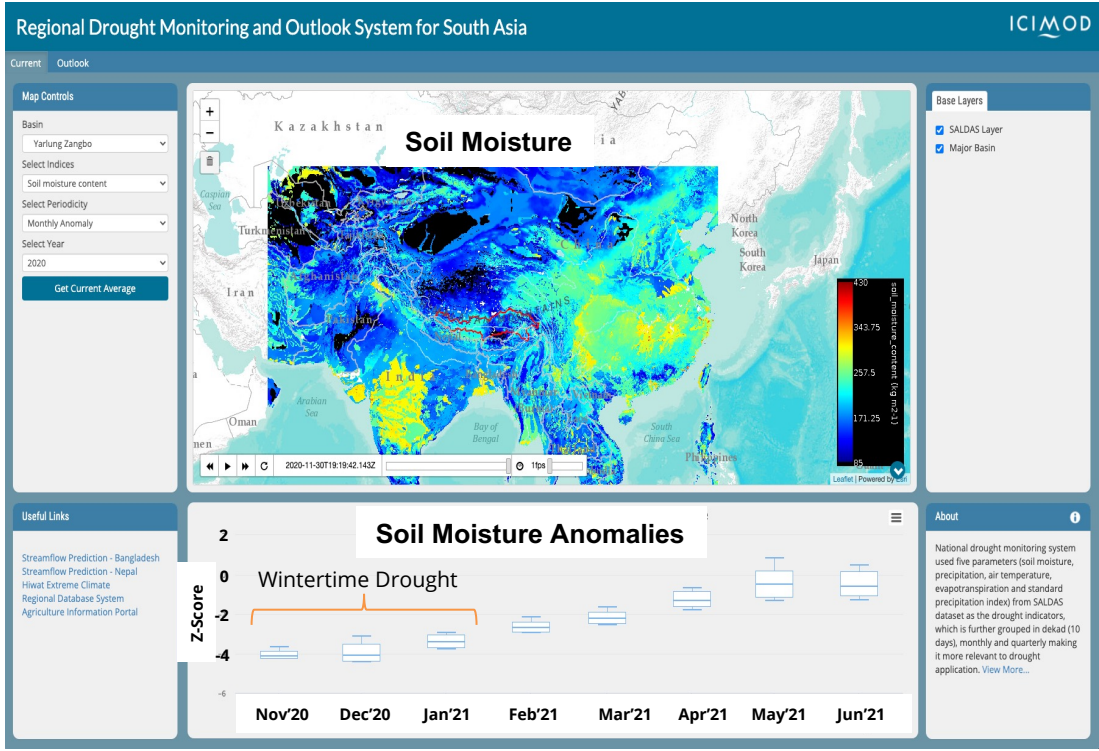
Advanced planning often requires the use of application models such as DSSAT or hydrologic models forced by hydrometeorological information



South Asia Land Data Assimilation System (SALDAS)

An integrated land data assimilation system providing real-time monitoring and outlooks based on seasonal forecasting

Tailored system for South and Southeast Asia and currently deployed by ICIMOD

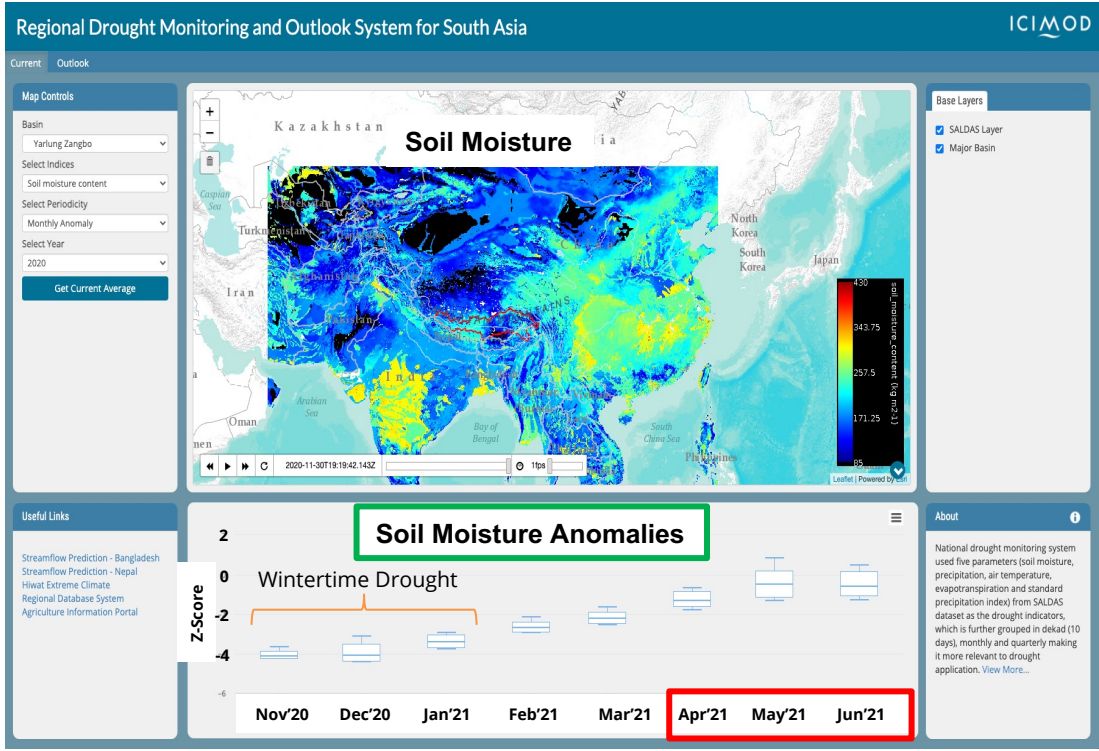


South Asia Land Data Assimilation System (SALDAS)

Long-term outlooks require subseasonal to seasonal forecasting systems

SALDAS is powered by forecasts from the NASA Goddard Earth Observing System S2S prediction system (GEOS-S2S)

Users need forecasts placed into historical context. Long-term observational records or hindcasts are used to evaluate climate anomalies.



Courtesy of ICIMOD: http://tethys.icimod.org/apps/regionaldrought/

Problem: Spatial and Temporal Resolution

SERVIR services are providing actionable climate information for regional and local decision-makers

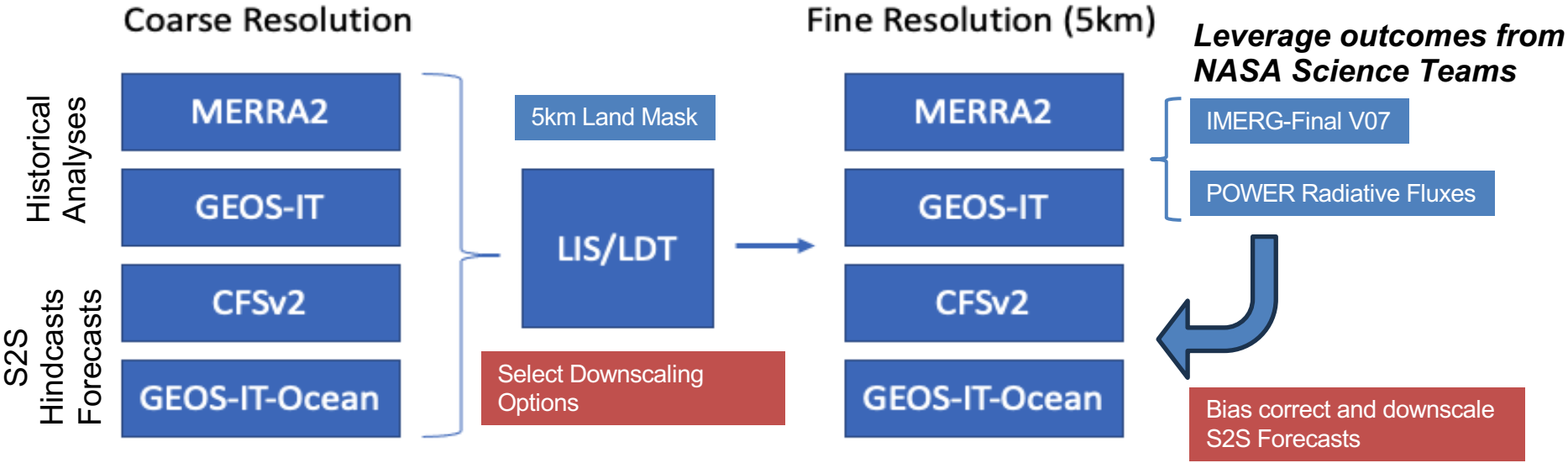
- Most users want data products provided at fine spatial resolution and need outputs from application models that typically require multiple hydrometeorological inputs.
- There needs to be a ***focus on both accuracy and stability*** of those inputs since most application models — both physical and statistical (e.g., AI/ML) — require their own calibration/tuning procedures

Product	Spatial	Temporal	Period of Record	Variables	Comments
SERVIR "Desirements"	**1km-5km**	**Hourly to Daily**	1981 to +6 months	P, T, Tmin, Tmax, p, q, RH, V, **Rsw, Rlw** + LSM Outputs: RefET, PET, ET, Runoff, SM, SWE, PDSI, VPD, Water Deficit	Long records are desired to establish **climatological norms**. Further they are required to support hindcast simulations of application models that are often required to **support tuning/calibration**. Users are also interested in understanding how best to **leverage ensemble estimates for decision support**.

Closing the gap

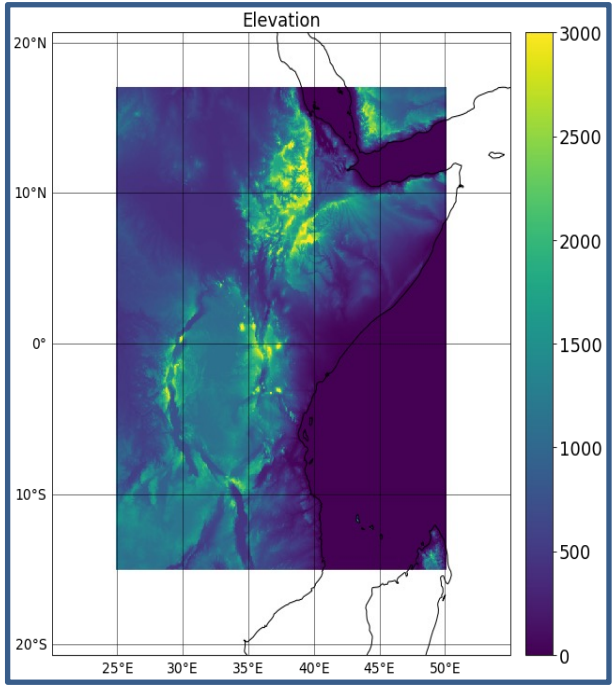
In collaboration with GSFC, the SERVIR SCO is working to address this divide leveraging existing tools and downscaling approaches

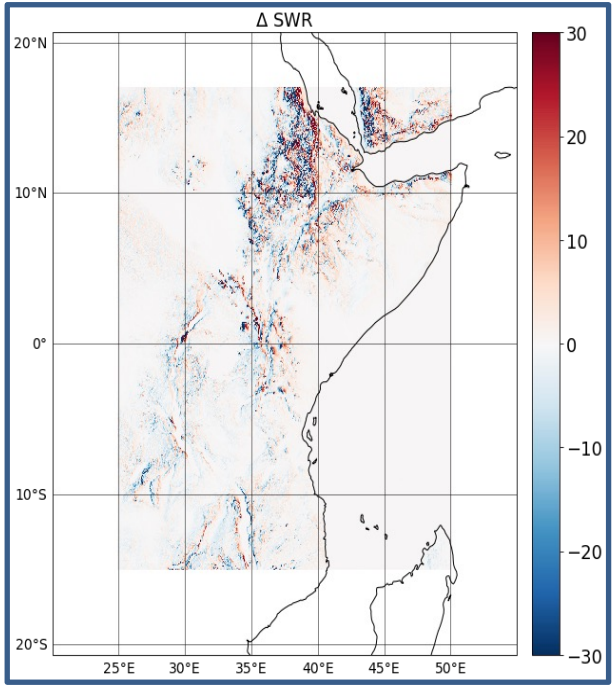
- Estimated and procured HPC requirements -> **1.1 PB archive**

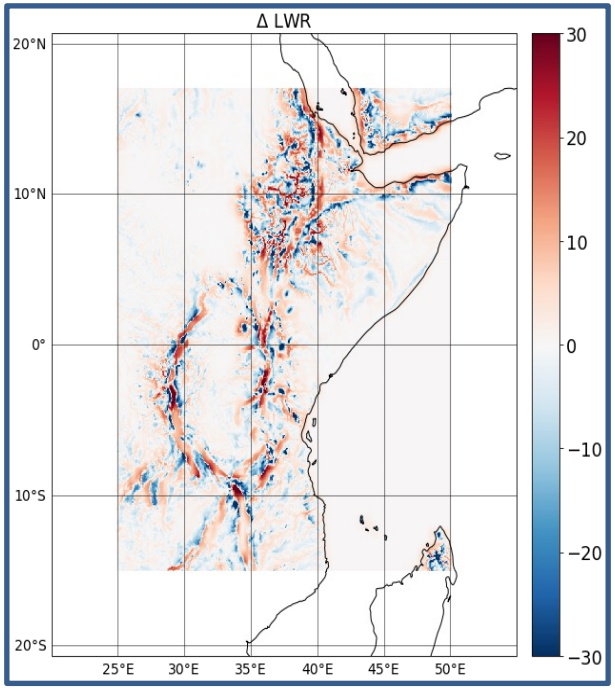


Example of Implementation

- Using LDT/LIS 7.3, 5km Domain, 1km SRTM Elevation

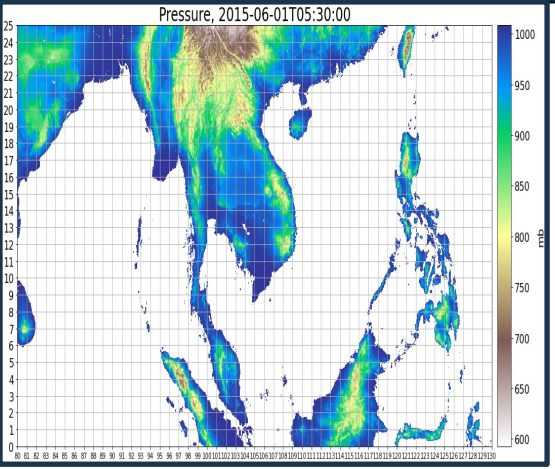


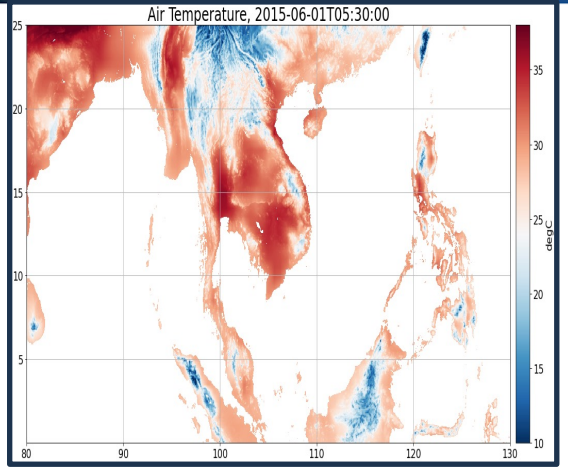


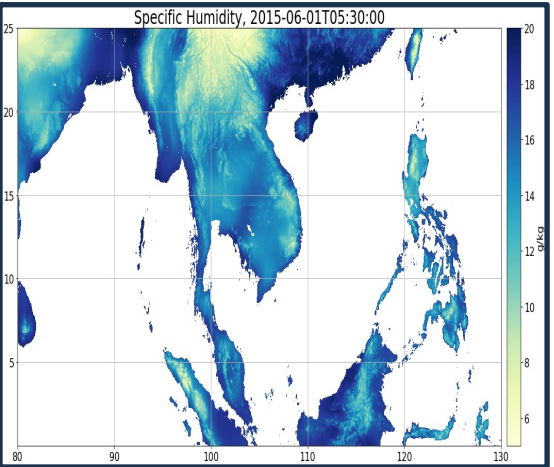


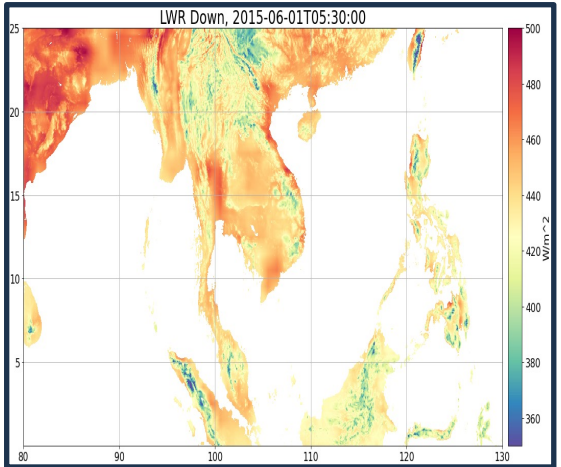
- Implements slope-aspect and lapse-rate based corrections
- Thus, corrections are generally implemented in regions of strong elevation gradients
- How can we better account for sub-grid variability associated with cloudiness?

Example of Implementation







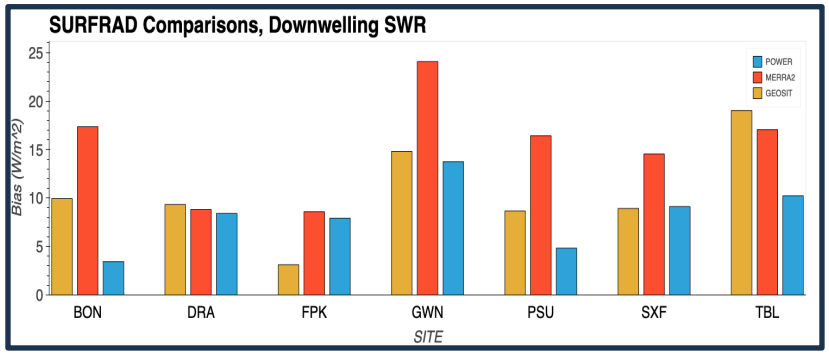


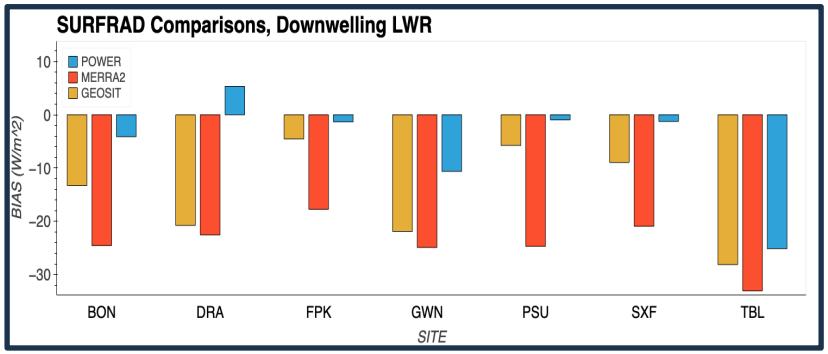
- Note: We are working to go beyond just radiative fluxes to include other common hydrometeorological forcing parameters.

Why CERES/POWER Fluxes?

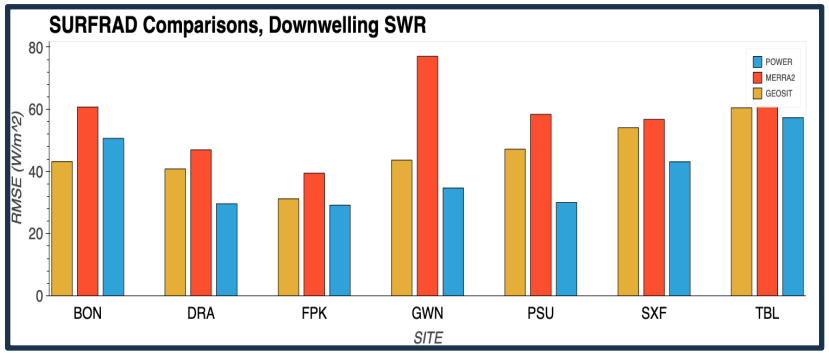
- Our users are focused on accuracy and stability — a common challenge for this community
- Comparisons to in situ data (SURFRAD, here) demonstrate accuracies of POWER/CERES data over the direct use of model analyses

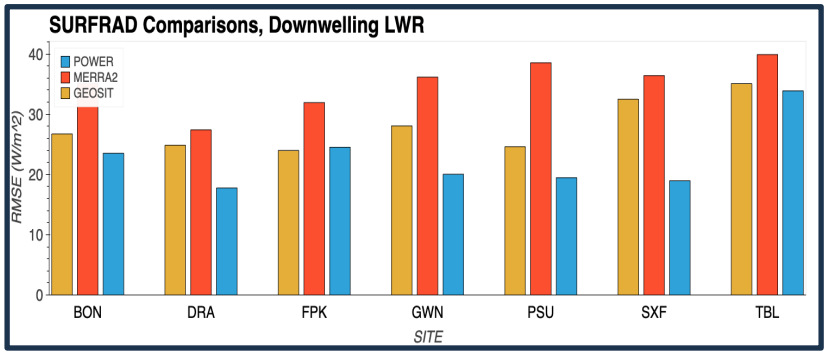
Bias





RMSE





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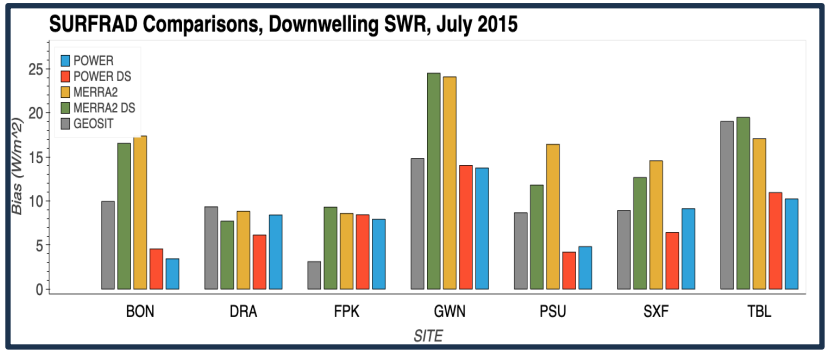

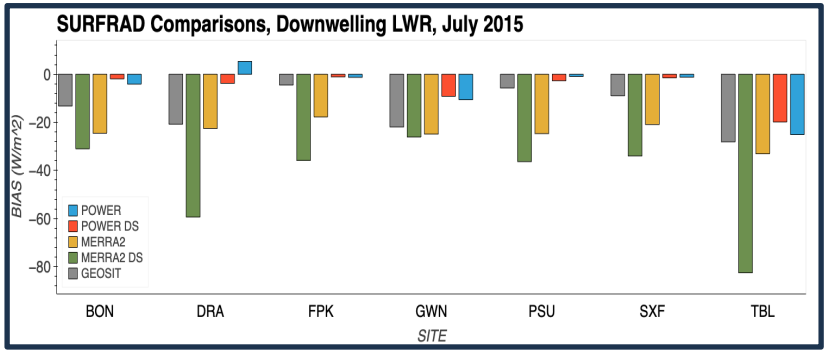

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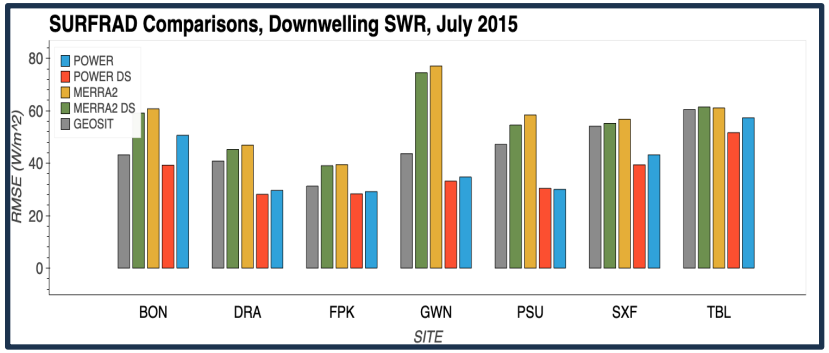

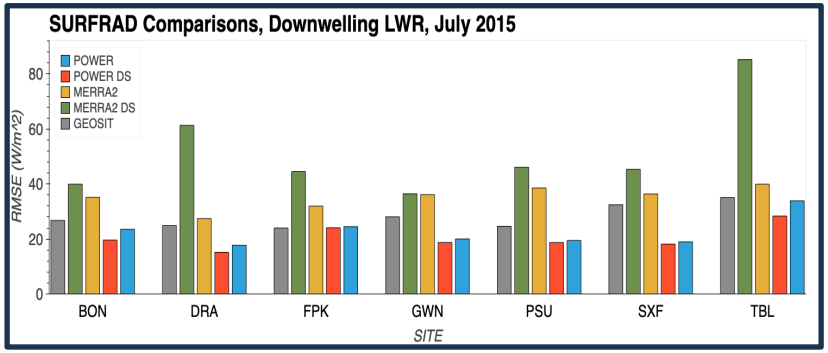

Opportunities Moving Forward

- Refining the downscaling approach to take advantage of satellite-based radiative fluxes
  - “Do no harm” - Maintain performance and potentially increase skill
  - Support for evaluating the downscaled radiative fluxes

- Connections to other ongoing activities
  - Sharing of data and approaches — and lessons learned — between activities

Summary

Key Points [SERVIR]:

- Demand-Driven: Follow service planning approach
- Co-Development: Focus on working with end-users and developing tools and building capacity to use those tools
- Interdisciplinary: Multiple thematic areas address agriculture and food security, water resources, land cover and land use change, and weather and climate risks

Key Points [Radiative Fluxes]

- Application modelers and decision-makers are demanding high-resolution information
- We are working to develop hydrometeorological forcing data that is suitable
- The CERES/POWER radiative fluxes are a specific element we are trying to incorporate and there are areas where we can collaborate