

# Status of NASA Earth observation sensors, data and methods for SERVIR: Agriculture, Water, Disasters, and Ecosystem services

Ashutosh Limaye, Eric Anderson, Africa Flores, Bill Crosson, Dan Irwin, 2016



- SERVIR is a link between research institutions and end user decision making.
- SERVIR efforts are led by the needs of the region. Some examples include hydrologic modeling, crop yield estimation, land cover change detection, and hydro-meteorological hazard monitoring
- Presence of SERVIR Hubs, such as RCMRD, ICIMOD, and ADPC, with regional governmental support, makes the linkage sustainable.



- ClimateSERV for water and agriculture
- RHEAS framework for agriculture
- GPM mission for rainfall and hydrology applications
- SMAP mission for hydrology applications
- SRTM-2 DEM for various applications
- JASON-3 mission for oceans, tropical cyclones, hydrology
- *Under Study:* SWOT (Surface Water and Ocean Topography) mission
- *Under Study:* NISAR (NASA-ISRO Synthetic Aperture Radar) mission
- Landsat series

<http://ClimateSERV.nsstc.nasa.gov/>

Many users do not need global data for each day, instead need only information for their geographic area of interest and for their time period of interest.




SERVIR has built the ClimateSERV data processing system to analyze and deliver global or regional data for the time period and area of interest.

- *Built on the following free and open datasets:*
  - CHIRPS global rainfall data (FEWS NET)
    - 0.05° spatial resolution (~5 km)
    - Consistent, daily rainfall records since 1981
  - NMME Seasonal climate forecasts (NASA/SERVIR)
    - 0.5° spatial resolution (~50 km).
    - Daily rainfall and temperature for 180 days in advance, updated monthly
  - eMODIS vegetation index (NDVI, for West Africa, USGS)
    - 250 m spatial resolution. Pentadal, available since 2001

# ClimateSERV Data Processing



### Create Area of Interest Or choose predefined geometry



### Select parameters, data type and date ranges

New Search

Select Data Type: CHIRPS Precip

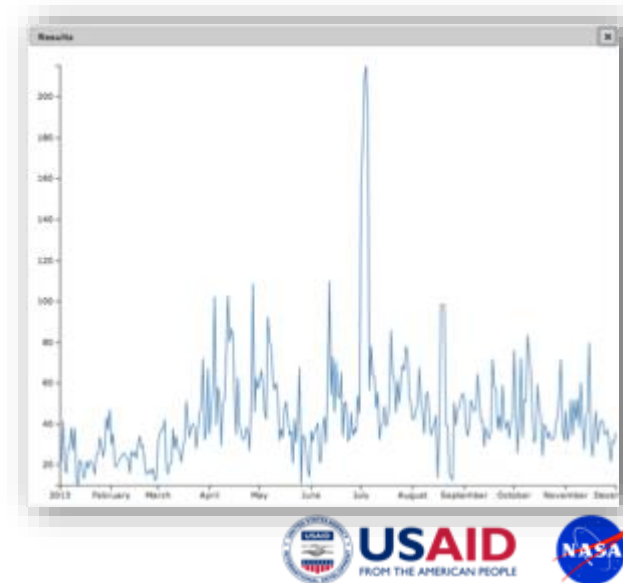
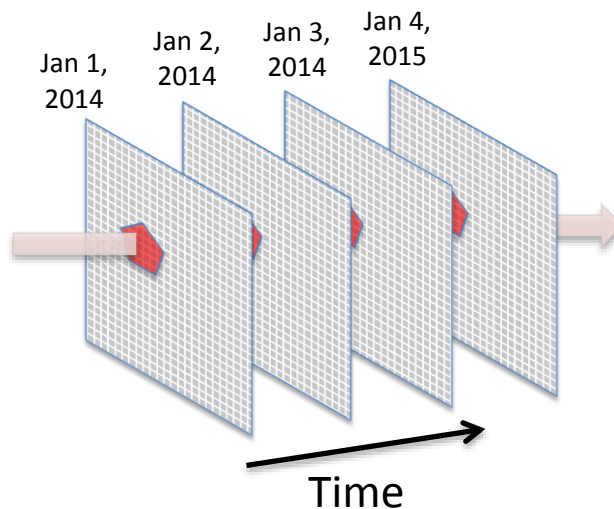
Select operation Type: Average

Date Interval: Daily

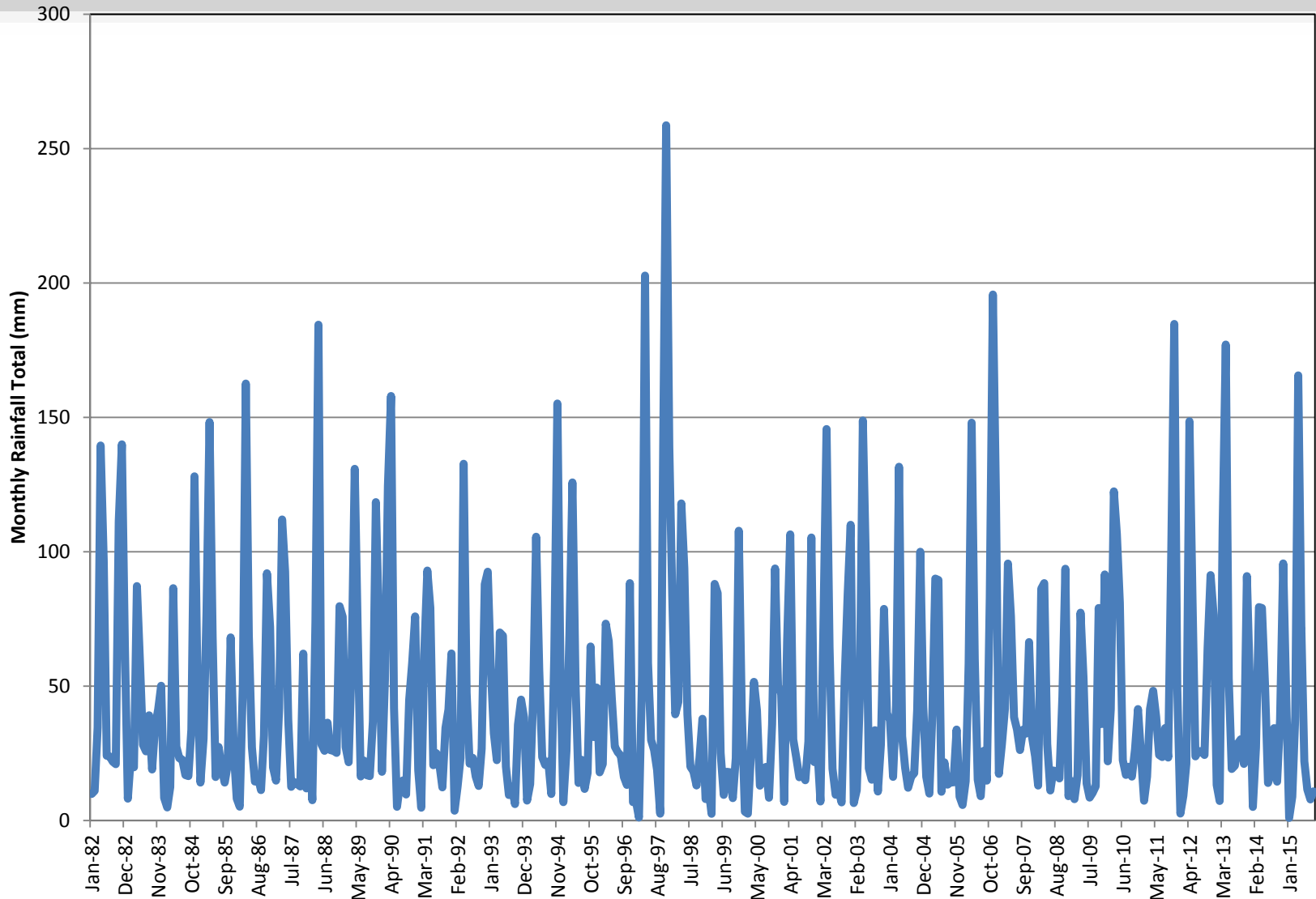
Begin Date: 01/01/1982

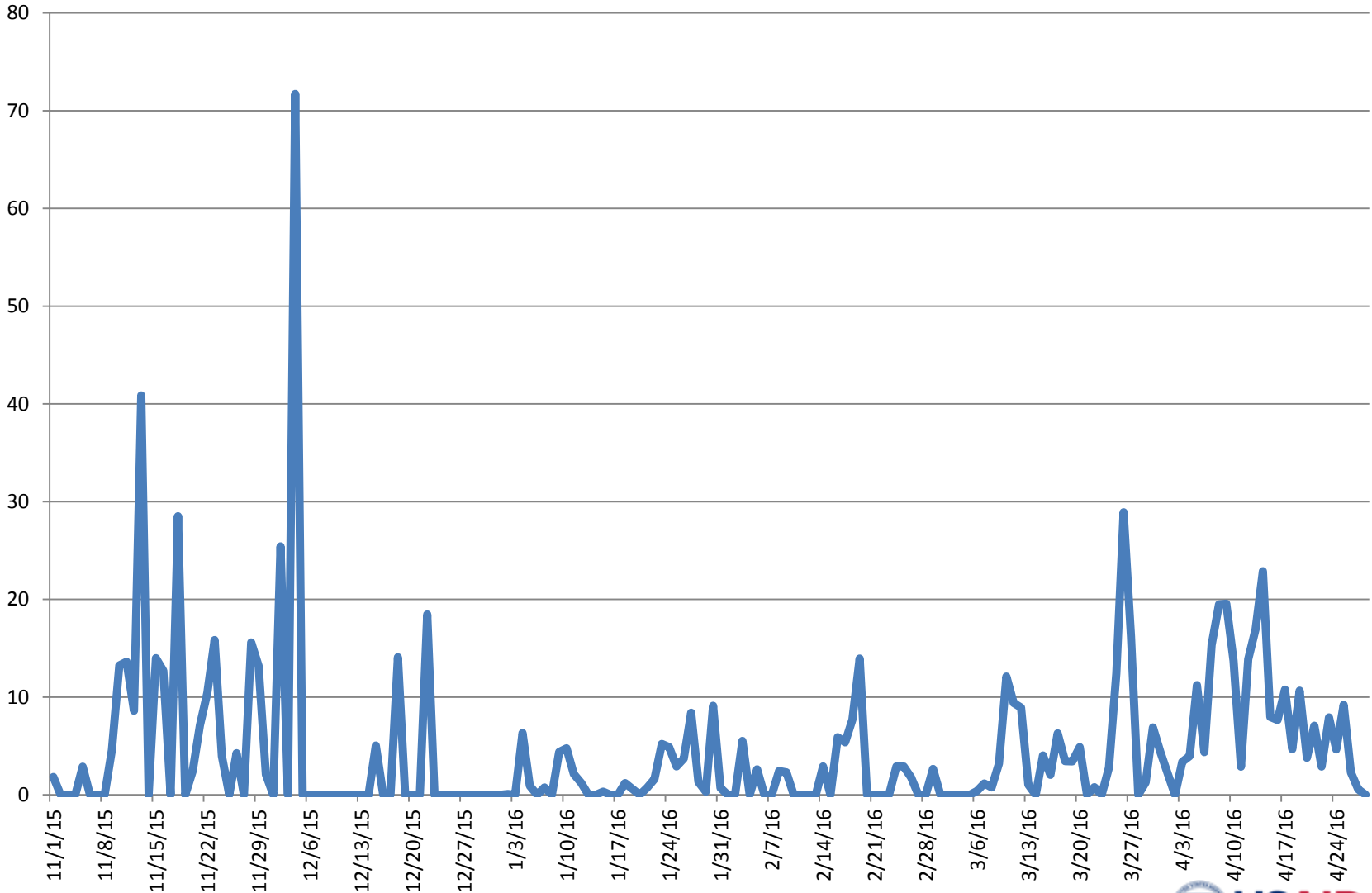
End Date: 01/31/2015

Submit Cancel



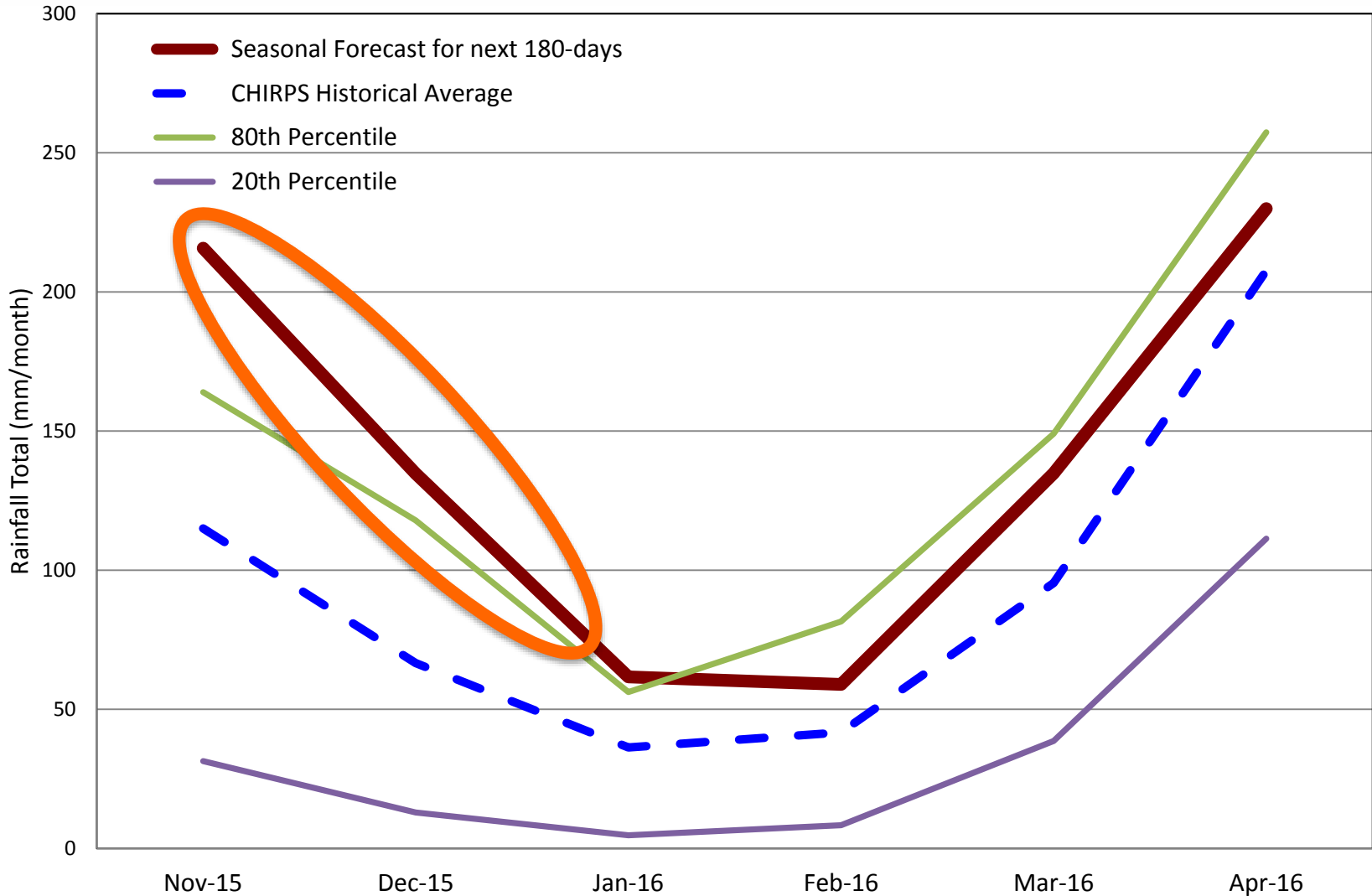
# Kenya CHIRPS Monthly Rainfall





# Monthly Rainfall for Kenya for next 180 days

## Combining CHIRPS and Seasonal Rainfall Forecasts





# Next Steps and Request for Feedback on ClimateSERV



- We are adding more functionality to this portal.
  - Multiple ensembles on the same plot, download
  - Cumulative rainfall
  - Combined historical perspective on the forecast plots
- We request you to use this system to see whether it provides the desired capabilities.
  - Request you to send what you would like to see added
- Two types of feedback requested via email
  - Functionality on existing features (statistics, data processing, plotting, raw data access)
  - Additional features, and datasets

# RHEAS framework to link hydrological and crop productivity models



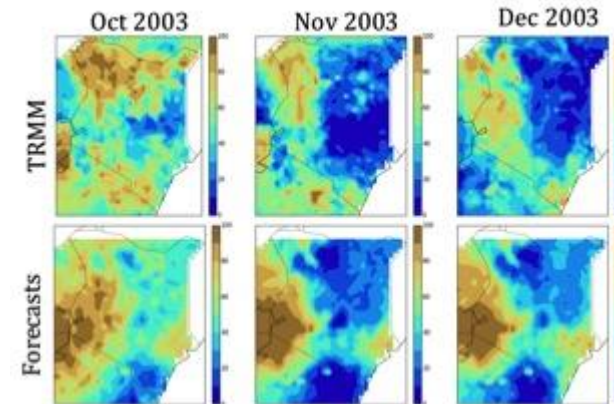
S. Granger<sup>1</sup>, K. Andreadis<sup>1</sup>, A. Behrangi<sup>1</sup>, N. Das<sup>1</sup>, J. Fisher<sup>1</sup>, E. Han<sup>2</sup>, A. Ines<sup>3</sup>, S. Li<sup>2</sup>, B. Lyon<sup>2</sup>, D. Stampoulis<sup>1</sup><sup>1</sup>Caltech/NASA Jet Propulsion Lab, <sup>2</sup>IRI Columbia University <sup>3</sup>Michigan State University

## A “SERVIR Applied Sciences Team” Project. Objectives:

- Implement the Regional Hydrologic Extremes and Assessment System (RHEAS) modeling framework to provide drought and crop productivity information to agricultural communities of SERVIR-Africa.
- Engage appropriate stakeholders to ensure information we’re producing is the right information and that it’s useful.
- Ensure information is useable and accessible via GIS-ready formats and online access, and disseminate information through a prototype mobile application.

Now open source:

<https://github.com/nasa/RHEAS>



RHEAS drought severity forecasts using disaggregated IRI Net Assessments as forcings.



Breakout session – SERVIR East Africa Drought and Crop Productivity Inception Workshop and Training, Addis Ababa, Ethiopia, August 2015

<b>RHEAS</b>	Assimilation code is complete	Hydrologic model run in hindcast, nowcast and forecast modes (using IRI Net Assessments)	VIC and DSSAT models loosely coupled	Maize module completed (cultivar data acquired for Kenya, Tanzania, Ethiopia)
<b>Stakeholder Engagement</b>	Adapted capacity building model from public health sector	Developed training materials	Held National Workshops in 5 countries	
<b>Accessible Information</b>	OpenGeo database implemented (PostGIS)	Prototype WebGIS using OpenGeo Suite	Outputs in GeoTiff and as Web Map Services	

# GPM – Global Precipitation Measurement Mission

## SMAP – Soil Moisture Active-Passive Mission



- IMERG Web Map Service

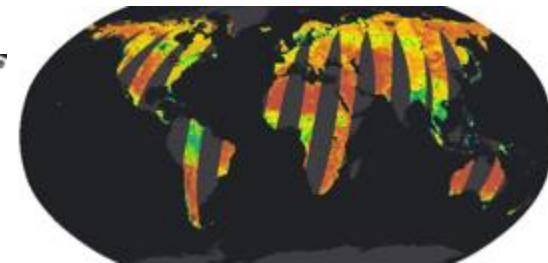
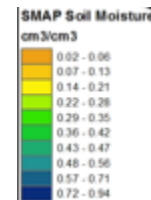
- <https://servirglobal.net/Global/Articles/Article/1452/servir-new-web-service-streamlines-use-of-key-precipitation-data>

- Hydrology applications

- Floods (<http://pmm.nasa.gov/applications/floods>)
- Landslides (<http://pmm.nasa.gov/applications/landslides>)



Follow on TRMM-based flood and landslide monitoring  
<http://pmm.nasa.gov/TRMM/flood-and-landslide-monitoring>



- SMAP applications (<http://smap.jpl.nasa.gov/science/applications/>)

- monitoring soil moisture to improving understanding of water cycle, weather and climate forecasting, droughts, fires, floods, landslides, and agricultural productivity

# SRTM-2 30m Digital Elevation Model



- Global 1 arc second elevation data
  - Freely available through <http://reverb.echo.nasa.gov/> and <https://lpdaac.usgs.gov/>

**Additional Information**

**NASA Shuttle Radar Topography Mission Global 1 arc second V003**

Archive Center: LPDAAC

Distributing Center: ECS Land Processes DAAC  
<https://lpdaac.usgs.gov/>  
Contacts  
LP DAAC User Services  
6DS-594-6116 or 1-866-573-3222 (BUSINESS)  
LPDAAC@usgs.gov

ShortName: SRTMGL1

Version: 003

Description: The NASA SRTM data sets result from a collaborative effort by the National Aeronautics and Space Administration (NASA) and the National Geospatial-Intelligence Agency (NGA - previously known as the National Imagery and Mapping Agency, or NIMA), as well as the participation of the German and Italian space agencies, to generate a near-global digital elevation model (DEM) of Earth using radar interferometry. SRTM was the primary (and virtually only) payload on the STS-99 mission of the Space Shuttle Endeavour, which launched February 11, 2000 and flew for 11 days. The SRTM swaths extended from ~30 degrees off-nadir to ~58 degrees off-nadir from an altitude of 233 km, creating swaths ~225 km wide, and consisted of all land between 56 degrees south and 60 degrees north latitude to account for 80% of Earth's total landmass. The Land Processes Distributed Active Archive Center (LP DAAC) is responsible for the archive and distribution of NASA MISURES SRTM, which includes the global one-arc-second (~30 m) product. ----- Data Set Characteristics: Geographic Extent: Global between 60° North and 56° South latitude Scene Coverage: 1° x 1° tiles Image Dimensions: 3601 x 3601 Total Number Tiles: 12,677 Tile Volume: 1.05 GB Compression Type: zip File Format: Zip, HGT Map Projection: Geographic latitude and longitude Datum: WGS84/EGM96 Pixel Size: 1 arc second

Spatial Extent: Bounding Rectangle: (60.0°, -180.0°, -56.0°, 180.0°)

## Use of SRTM Data

Introductory Letter

Africa SRTM 30m Data

Africa SRTM 30m Water Bodies

Africa Tile Reference Map

SRTM 30m Data Product Information

SRTM Processing Resources

SRTM 30m Promotional Materials



- Successful launch, 17 Jan 2016
- 4<sup>th</sup> mission in US-European series to measure height of ocean surfaces
- Radar altimeter, <4cm accuracy
- Global coverage every 10 days
- Also expected to improve tropical cyclone forecasts

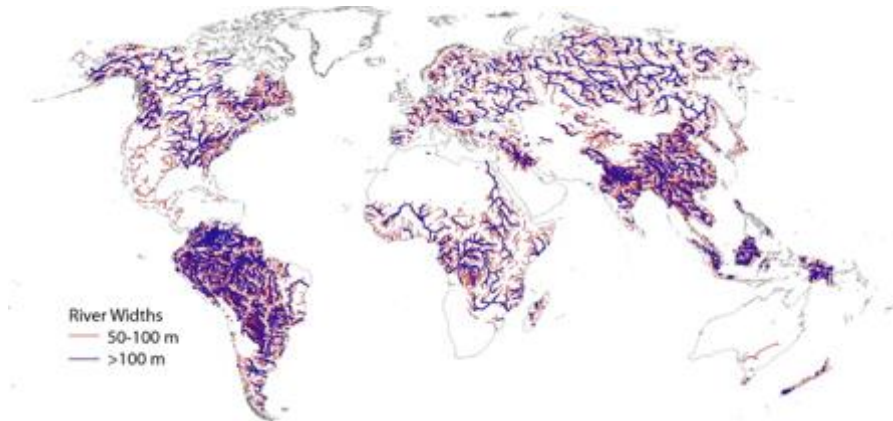


NASA/Bill Ingalls

<http://sealevel.jpl.nasa.gov/missions/jason3/>

- New key objectives for hydrology

- Global inventory and change patterns of surface water bodies  $>250\text{m}^2$  and rivers  $>10\text{km}$  long and  $>100\text{m}$  wide
- 21 day repeat coverage; accuracy within 10cm



Pavelsky et al., 2014

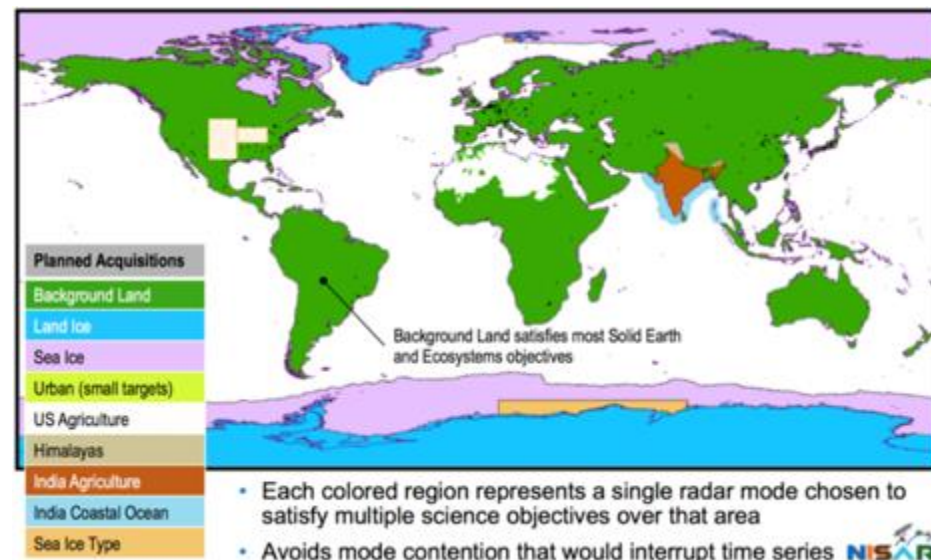
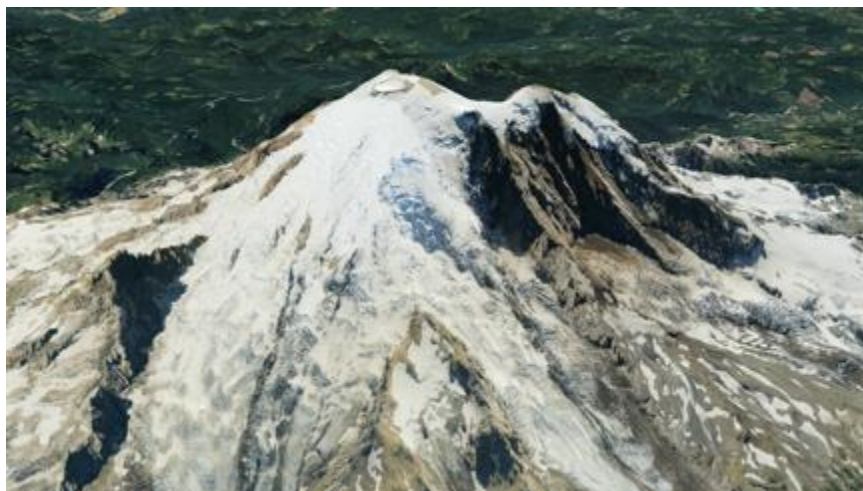
<http://dx.doi.org/10.1016/j.jhydrol.2014.08.044>

- Science application to improve river discharge estimates
- 2020 launch planned

# Under Study: NISAR (NASA-ISRO Synthetic Aperture Radar) mission



- A dedicated U.S. and Indian InSAR mission, in partnership with ISRO, optimized for studying hazards and global environmental change.
  - ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides
- L-band and S-band also provide data for ecosystem and agricultural monitoring
- 2020 launch planned



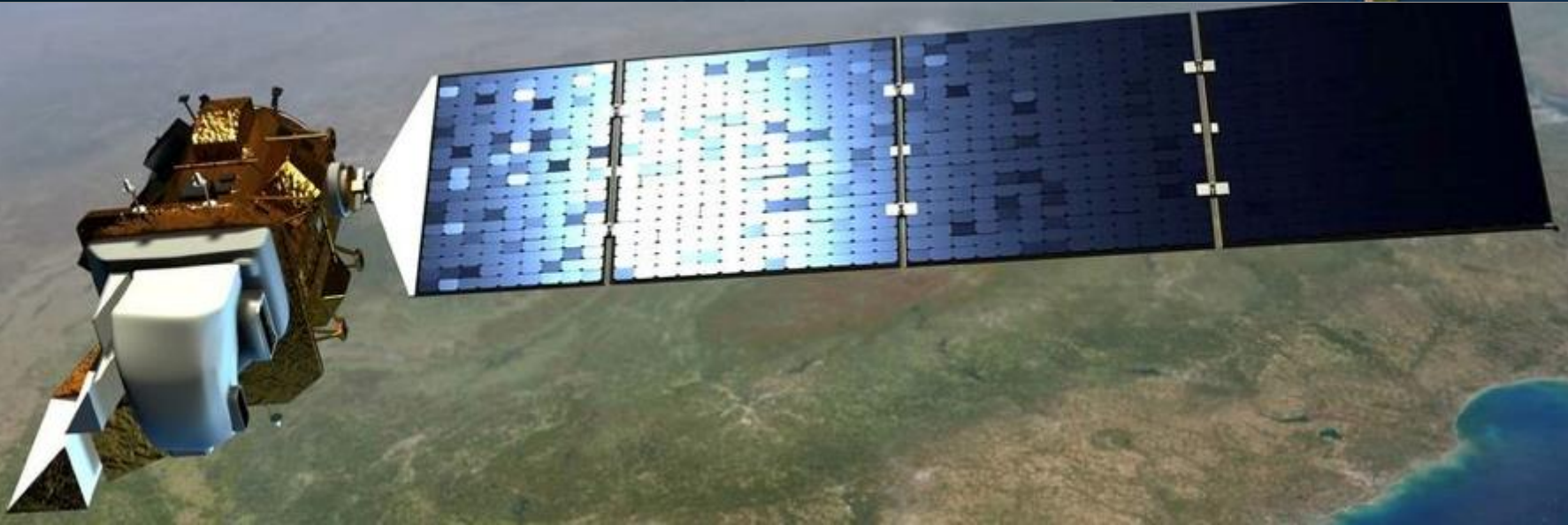
- Continuous 40+ year record of terrestrial ecosystem variables
- Further science and applications with Sentinel-2 (ESA)
- Landsat 8 higher level products available upon request from <http://earthexplorer.usgs.gov>
  - Surface reflectance (atmospheric correction)
  - Land surface temperature
  - [http://landsat.usgs.gov/CDR\\_LSR.php](http://landsat.usgs.gov/CDR_LSR.php)





# The Landsat Mission continues...


SERVIR 



Planned to launch in 2023, Landsat 9 will continue the longest space-based record of Earth's land—past the half century mark.

- <https://www.nasa.gov/press/2015/april/nasa-usgs-begin-work-on-landsat-9-to-continue-land-imaging-legacy>
- <http://landsat.gsfc.nasa.gov/?p=10391>

# SERVIR Product Catalog


PRODUCT CATALOGUE


[DOWNLOAD FACTSHEET](#)


Welcome to the SERVIR Global Product Catalogue  
Observations and NASA Products to inform res


**NARROW BY:**


- ▶ Region ①
- ▶ Theme ②
- ▶ Status
- ▶ Data Source ③
- ▶ Type

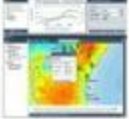
**PRODUCT CATALOGUE**












## CLIMATESERV

This tool allows development practitioners, scientists/researchers, and government decision-maker to visualize and download historical rainfall data, vegetation condition data, and 180-day forecasts of rainfall

In SERVIR regions, where long-term ground observations of rainfall are sparse, there is a critical need for satellite and model-derived rainfall data for predicting droughts, estimating crop yields, and more. Decision-makers need a way to accurately assess how severe a drought will be, how it compares to past droughts, and its potential effect on crop yields. Such assessments require accurate estimations of rainfall variations in space and time. It is important to place an evolving dryer-than-normal season into historical context in order to analyze the severity of rainfall deficits. Until now, such analyses used rainfall data from specific points on the Earth's surface. However, that data fails to show the region-wide variability that reveals comprehensive rainfall patterns.



Application Purpose

<p>Theme: Adaptation, Climate Region: Himalaya</p>	Status: Active
<p><b>ClimateSERV</b> Theme: Agriculture, Climate, Weather, Water Region: Global</p>	Status: Active
<p><b>CREST Streamflow Viewer – Eastern Africa and Bhutan</b> Theme: Adaptation, Agriculture, Climate, Disaster, Water, Weather Region: Eastern/Southern Africa, Himalaya</p>	Status: Active

<http://servircatalog.net> / <http://servircatalogue.net>

# Backup slide: ClimateSERV input data details

SERVIR 

<http://ClimateSERV.nsstc.nasa.gov/>



- CHIRPS global rainfall data (FEWS NET)
  - 0.05° spatial resolution (~5 km)
  - Consistent, daily rainfall records since 1981
  - Funk et al., 2015 doi:10.1038/sdata.2015.66 2015 and several others
- NMME Seasonal climate forecasts (NASA/SERVIR)
  - 0.5° spatial resolution (~50 km).
  - Daily rainfall and temperature records for 180 days in advance.
  - Updated every month, around the 10<sup>th</sup> of the month
  - Robertson et al., 2015 <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150000716.pdf>
  - Sikder et al., 2016 <http://dx.doi.org/10.1175/JHM-D-14-0099.1>
- eMODIS vegetation index (NDVI, for West Africa, USGS)
  - 250 m spatial resolution. Pentadal, available since 2001

# Backup slide: ClimateSERV input data availability



The CHIRPS, eMODIS, and NMME data are available from a variety of sources

- Famine Early Warning System (FEWS NET)
  - CHIRPS: <ftp://chg-ftpout.geog.ucsb.edu/pub/org/chg/products/CHIRPS-2.0/>
  - eMODIS: <http://earlywarning.usgs.gov/fews>
- NOAA National Centers for Environmental Prediction (NCEP)
  - <http://www.cpc.ncep.noaa.gov/products/NMME/>
  - <http://iridl.ldeo.columbia.edu/SOURCES/.Models/.NMME/>

