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: Linking Science to End User Needs

• 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.
Outline

- 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
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

Jan 1, 2014
Jan 2, 2014
Jan 3, 2014
Jan 4, 2015

Time

Create Area of Interest
Or choose predefined geometry

Select parameters, data type and date ranges

Jan 1, 2014
Jan 2, 2014
Jan 3, 2014
Jan 4, 2015

Time
ClimateSERV
Kenya CHIRPS Monthly Rainfall

Monthly Rainfall Total (mm)
ClimateSERV
Seasonal Forecast for Kenya, 1 Nov 2015 - 28 Apr 2016
ClimateSERV
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
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.

### RHEAS

<table>
<thead>
<tr>
<th>Stakeholder Engagement</th>
<th>Accessible Information</th>
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<tbody>
<tr>
<td>Assimilation code is complete</td>
<td>OpenGeo database implemented (PostGIS)</td>
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<td>Hydrologic model run in hindcast, nowcast and forecast modes (using IRI Net Assessments)</td>
<td>Prototype WebGIS using OpenGeo Suite</td>
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<td>VIC and DSSAT models loosely coupled</td>
<td>Outputs in GeoTiff and as Web Map Services</td>
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<td>Maize module completed (cultivar data acquired for Kenya, Tanzania, Ethiopia)</td>
<td></td>
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</tbody>
</table>

### Stakeholder Engagement

- Adapted capacity building model from public health sector
- Developed training materials
- Held National Workshops in 5 countries

### Accessible Information

- OpenGeo database implemented (PostGIS)
- Prototype WebGIS using OpenGeo Suite
- Outputs in GeoTiff and as Web Map Services

Now open source: [https://github.com/nasa/RHEAS](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

[http://servircatalog.net/Product?product_id=6](http://servircatalog.net/Product?product_id=6)
• IMERG Web Map Service
  – https://servirglobal.net/Global/Articles/Article/1452/servirs-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
JASON-3 Ocean Surface Topography

- Successful launch, 17 Jan 2016
- 4th 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

Under Study: SWOT - Surface Water and Ocean Topography mission

- **New key objectives for hydrology**
  - Global inventory and change patterns of surface water bodies >250m² and rivers >10km long and >100m wide
  - 21 day repeat coverage; accuracy within 10cm

- **Science application to improve river discharge estimates**

- **2020 launch planned**

Pavelsky et al., 2014

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

https://swot.jpl.nasa.gov/applications/
Under Study: NISAR NASA-ISRO Synthetic Aperture Radar (SAR) 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

http://nisar.jpl.nasa.gov
• 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](http://earthexplorer.usgs.gov)
  – Surface reflectance (atmospheric correction)
  – Land surface temperature
The Landsat Mission continues...

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

SERVIR Product Catalog

http://servircatalog.net / http://servircatalogue.net
Backup slide: ClimateSERV input data details

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 10th 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
The CHIRPS, eMODIS, and NMME data are available from a variety of sources

- **Famine Early Warning System (FEWS NET)**
  - eMODIS: [http://earlywarning.usgs.gov/fews](http://earlywarning.usgs.gov/fews)

- **NOAA National Centers for Environmental Prediction (NCEP)**