

# Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

## Introduction to Remote Sensing Data for Water Resources Management

Course Dates: October 17, 24, 31 November 7, 14  
Time: 8-9 a.m. and 1-2 p.m. Eastern U.S. Time



**ARSET**

**Applied Remote SEnsing Training**  
A project of NASA Applied Sciences



# Important Information

**Presentations URL:**

<http://water.gsfc.nasa.gov/webinars>

**Contact for Requesting Recorded Link for the Webinars:**

Marines Martins : [marines.martins@ssaihq.com](mailto:marines.martins@ssaihq.com)

**ARSET Water ListServ URL:**

<https://lists.nasa.gov/mailman/listinfo/nasa-water-training>

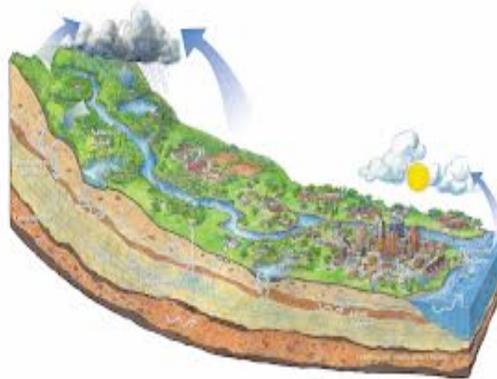
# Course Outline

## Week 1



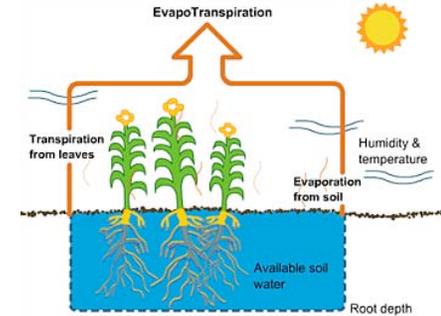
**Overview of Remote Sensing and Earth System Modeling**

## Week 2



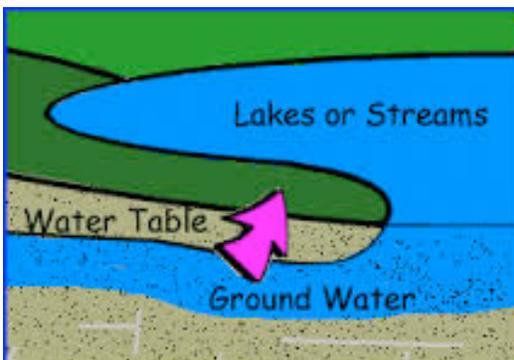
**Precipitation and Run Off**

## Week 3



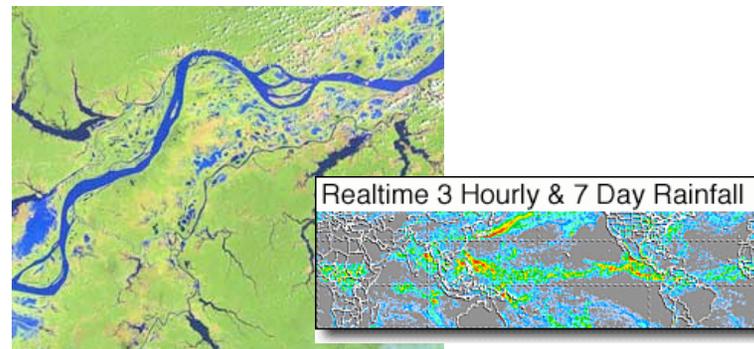
**Soil Moisture and Evapotranspiration**

## Week 4



**Reservoir and Ground Water**

## Week 5



**Web-tools for Data Access/ Imaging**

<http://water.gsfc.nasa.gov/>

Modules in English  
and Spanish

Case  
Studies

Upcoming trainings

Sign-up to listserv

NASA National Aeronautics & Space Administration  
Goddard Space Flight Center

Flight Projects | Sciences and Exploration

## Applied Remote Sensing Training Water Resource Management

NASA Earth Science Division      NASA Applied Sciences Program

- Home
- Workshops
- Webinars
- Applications
- Case Studies
- Visualization & Analysis
- ARSET: Air Quality
- Publications
- Personnel

### Project Description

The goal of this NASA Applied Remote Sensing Education and Training project is to increase the utility of NASA Earth Science and model data for decision-makers and applied science professionals in the area of Water Resources Management Applications. The project conducts trainings and other capacity building activities on utilization of NASA satellite remote sensing and model data for a variety of water management applications including floods and snow related topics. Training activities are a combination of lectures and hands-on activities that teach professionals how to access, interpret, and apply NASA rainfall, snow, cloud, and atmospheric humidity products at regional and global scales with an emphasis of Case Studies. This website provides access to educational materials and regular updates on upcoming events and workshops.

If you would like more information about any of the activities and materials available on this site or to request a training please contact: [Ana.I.Prados@nasa.gov](mailto:Ana.I.Prados@nasa.gov)

### Scheduled Trainings

**Webinar: NASA Remote Sensing Data for Water Resources Management**

October 17 - November 14, 2013  
Thursdays at 1 pm EDT (5 pm UTC)

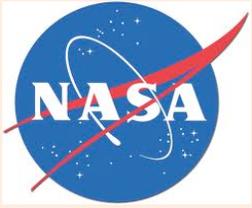
**For further Information**  
**contact:** [amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)

Course is free but you must register [here](#)

▶ [Webinar Agenda - pdf, 111.69 kB:](#)

### Stay Informed

If you would like to be informed of upcoming workshops and project activities please sign up for List Serv.



# Applied Remote Sensing Training (ARSET) Webinar on Flood Monitoring using NASA Remote Sensing Data

November 19 – December 10, 2013

8-9 AM U.S. Eastern Standard Time (13 PM UTC)

Tuesdays (4 webinars: one hour per week)

Webinar Agenda Available at: <http://water.gsfc.nasa.gov/>

Registration link: <https://attendee.gototraining.com/r/4746203923002627585>



## Course Objective:

To introduce NASA remote sensing data and web-based tools for flood monitoring and inundation mapping

## Course Participation:

This course is intended for water resources managers, water user associations, NGOs, international development agencies, and private sector organizations. ***Space is limited, preference will be given to these and other environmental professionals.***

## For more information Contact:

[amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)

[aprados@umbc.edu](mailto:aprados@umbc.edu)

# Outline

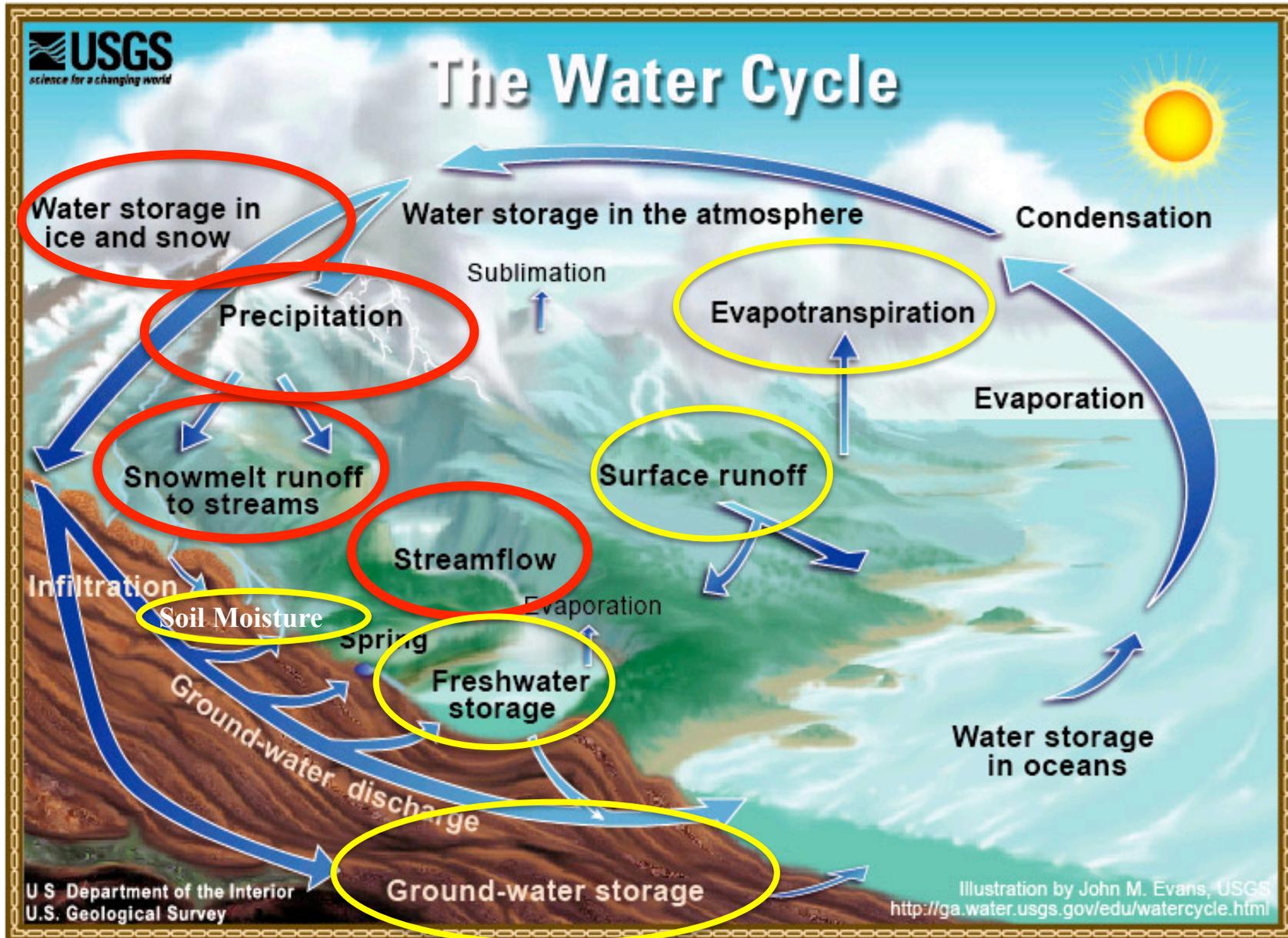
- **Brief review of last week**
- **Satellite Data Processing Levels**
- **Week 2 : Overview of Precipitation, Runoff**

*Overview of Satellites, Sensors, and Models for monitoring precipitation and runoff*

*Examples of Data Applications:*

*Extreme Precipitation and Flood Monitoring*

# Fresh Water Components



## NASA Satellites and Earth Systems models provide global scale water cycle quantities on hourly, daily, seasonal, multi-year time scales useful for water resource management

- Rain
- Temperature
- Humidity
- Winds
- Soil Moisture
- Snow/Ice
- Clouds
- Terrain
- Ground Water
- Vegetation Index
- Evapotranspiration
- Run off

**Water resources management over land need :**

**Rain amount**  
**Snow/Ice, Snowmelt**  
**Run off**  
**Soil moisture**  
**Evapotranspiration**  
**Ground water**

All these quantities are available from satellite observations as well as from models  
Quantities in green are derived from satellite observations  
Quantities in red are from land and atmosphere-land models in which satellite observations are assimilated

**Before talking about specific data quantity  
you need to have a basic understanding of  
Levels of Processing of Satellite data**

## Levels of Data Processing

Level 1	Source Data: L1a are raw radiance counts and L1b are calibrated radiances
Level 2	Derived geophysical variables at the same resolution and location as Level 1 source data
Level 2G	Level 2 binned data mapped on a uniform space-time grid
Level 3	Geophysical variables mapped on a uniform space-time grid in derived spatial and/or temporal resolutions

# Levels of Data Processing

## Level 1 Products

Orbital data

Used to produce

## Level 2 Products

Orbital data

Used to produce

## Level 3 Products

composites  
of level 2 products

## Less Processing

- More user control
- Highest spatial/temporal resolution
- Harder to use

## More Processing

- Less user control
- Lower spatial/temporal resolution but gridded and may be available at multiple spatial/temporal resolutions
- More web-tools available for analysis/access
- Easier to use

Advanced  
Webinar/Hands-on  
Training)

This Webinar

# Precipitation: Rain and Snow

## NASA Remote Sensing Data for Rain and Snow

Satellite	Sensors	Quantities
<b>TRMM</b>	Precipitation Radar (PR) TRMM Microwave Imager (TMI) Visible Infrared Scanner (VIRS)	<b>Rain Rate</b> , Vertical Rain Rate Profile, <b>Accumulated Rain</b>
<b>Terra and Aqua</b>	<b>MODerate Resolution Imaging Spectroradiometer (MODIS)</b>	<b>Snow Cover</b> , Vegetation Index, Leaf Area Index, Land Cover
<b>Aqua</b>	Atmospheric Infrared Sounder (AIRS)  Advanced Microwave Scanning* Radiometer for EOS (AMSR-E)	3-dimensional Atmospheric Temperature and Humidity  Snow Water Equivalent, Sea Ice, Soil Moisture, Rain Rate
Landsat	(Enhanced) Thematic Mapper (ETM)	Vegetation Index, Leaf Area Index, Land Cover
Grace	K-Band Ranging Assembly	Terrestrial Water

\*Ended in October 2011

## NASA Models for Precipitation and Runoff Data

Models	Quantities
<b>MERRA</b>	3-dimensional Winds, Temperature, Humidity, Clouds, <b>Rain Rate, Snow Mass, Snow Cover, Snow Depth</b> , Surface Snowfall Rate, Evapotranspiration
<b>GLDAS/NLDAS</b>	Evapotranspiration, Multi-layer Soil Moisture, <b>Rainfall, Snowfall Rate, Snow Melt, Snow-Water Equivalent, Surface and Sub-surface Runoff</b>

# NASA Rain Data Sources

- Global Precipitation Climatology Project (GPCP)
- Tropical Rainfall Measuring Mission (TRMM) satellite observations

*The TRMM Multi-satellite Precipitation Analysis (TMPA):  
Quasi-Global, Multiyear, Combined-Sensor Precipitation  
Estimates at Fine Scales*

# NASA Rain Data : GPCP

<http://precip.gsfc.nasa.gov/>

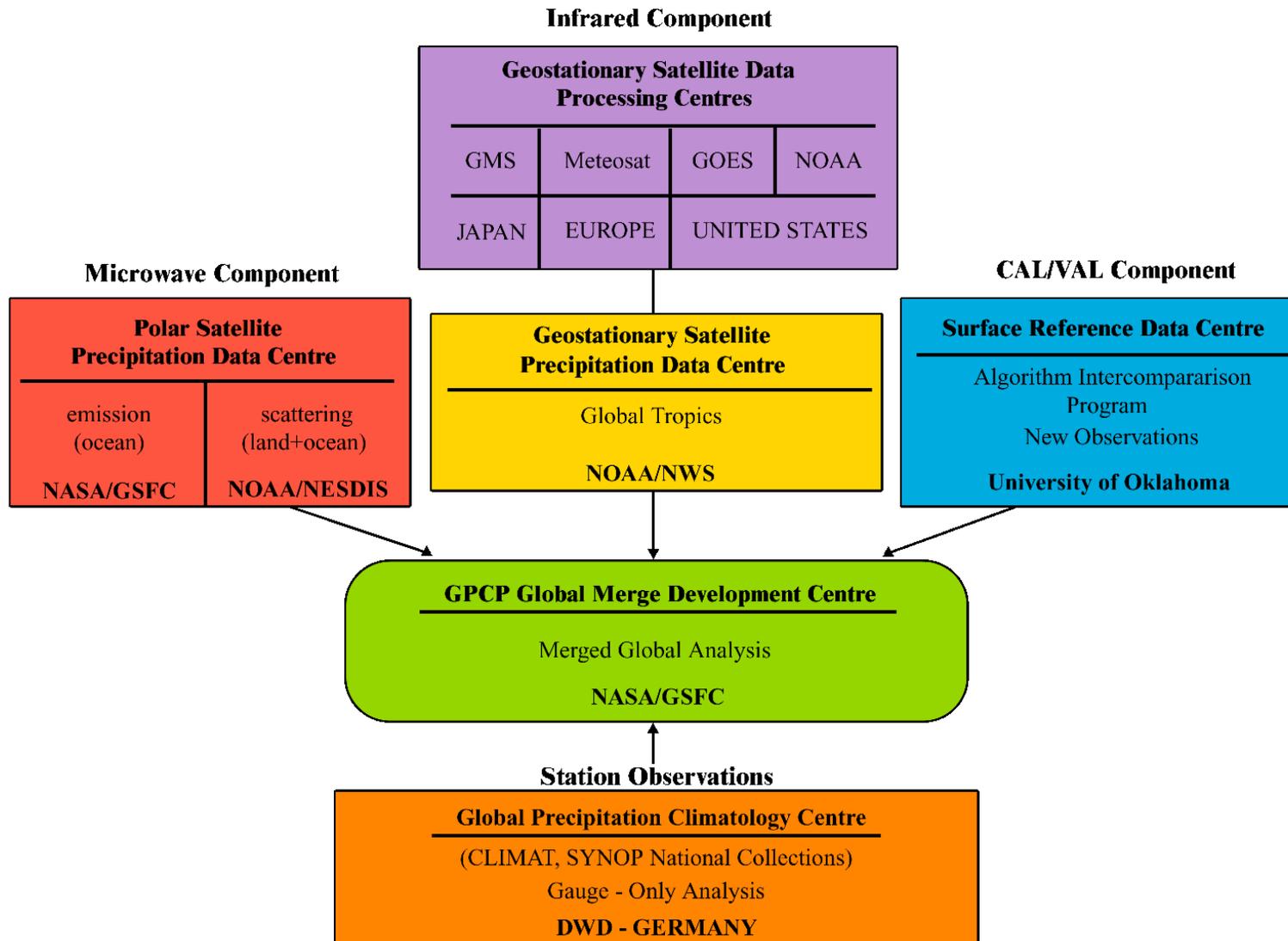
National and international satellites and surface rain gauge measurements merged together:

- **Rain measurements from over 6,000 global rain gauge stations**
- **Rain retrievals from satellites:** geostationary and low-orbit infrared, passive microwave, and infrared sounding observations

Spatial Resolution:	2.5°x2.5° latitude-longitude
Spatial Coverage:	Global
Temporal Resolution:	Daily, Monthly
Temporal Coverage:	1979-present

# NASA Rain Data : GPCP

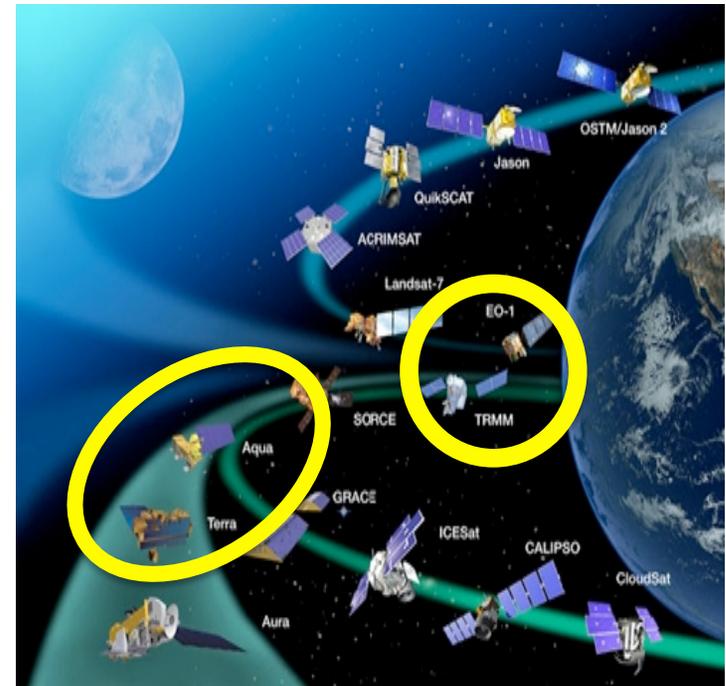
## For Large-scale and Climate Applications



# TRMM: Tropical Rainfall Measuring Mission

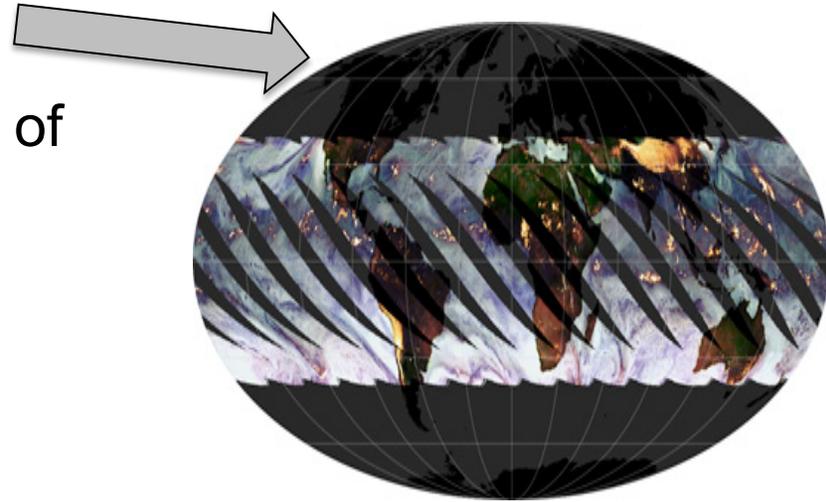
<http://trmm.gsfc.nasa.gov>

- The first satellite mission **dedicated to measuring tropical and subtropical rainfall** - Launched on 27 November 1997
- First satellite to carry a microwave Precipitation Radar
- Predecessor to Global Precipitation Measurement (GPM) mission to be launched in 2014.



# TRMM

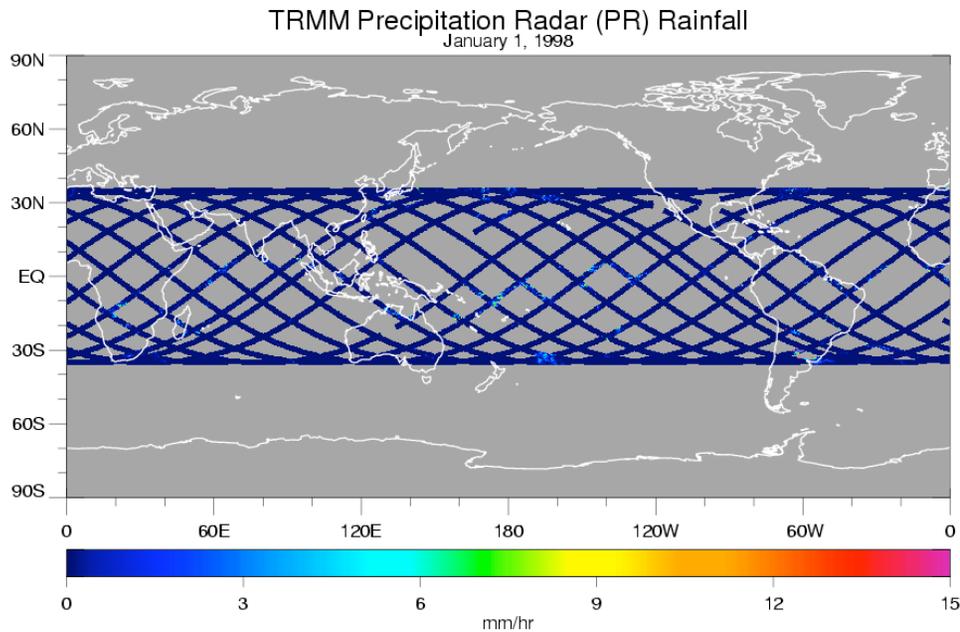
- A non-polar, low inclination orbit  
Revisit time ~11-12 hours, but time of observation changes daily
- One active and two passive rain sensors
- *Precipitation Radar (PR)*
- *TRMM Microwave Imager (TMI)*
- *Visible and Infrared Scanner (VIRS)*
- Multiple rain products available from individual sensors, at varying spatial resolutions, (details given in Appendix)



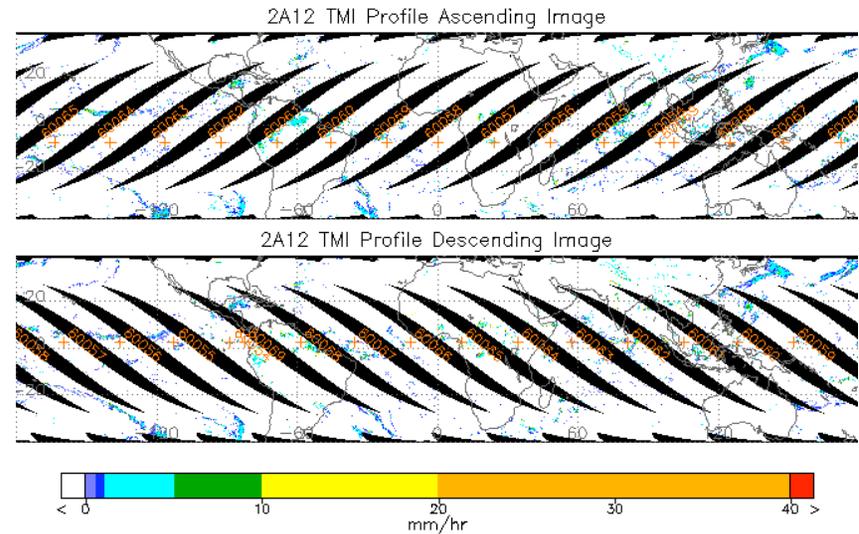
There are 16 TRMM orbits a day **covering global tropics between 35° S to 35°N latitudes**

Altitude - of approximately 350 Km, raised to 403 Km after 23 August 2001

# TRMM PR and TMI Rain Data



PR: Swath = 220 km (247 km)  
Pixel Size: 5 km



2008/05/31 image contains 16 orbits, orbit numbers from 60054 to 60069

TMI: Swath = 760 km (870 km)  
Pixel Size : 5 to 45 km  
(channel-dependent)

**Strength:** High pixel resolution, Accurate measurements

**Limitation:** No global coverage on daily basis

# TRMM Multi-satellite Precipitation Analysis (TMPA)

Product Name 3B42

(Used in Hydrology and Decision Support Models)

## TRMM 3B42:

Combines PR and TMI rain rates

Inter-calibrates passive microwave rain rates from  
**SSM/I, AMSR** and **AMSU-B** satellite sensors

Inter-calibrates with national and international **geostationary and NOAA low earth orbiting satellites infrared measurements** by using **VIRS**

Final rain product is calibrated with rain gauge analyses on monthly time scale.

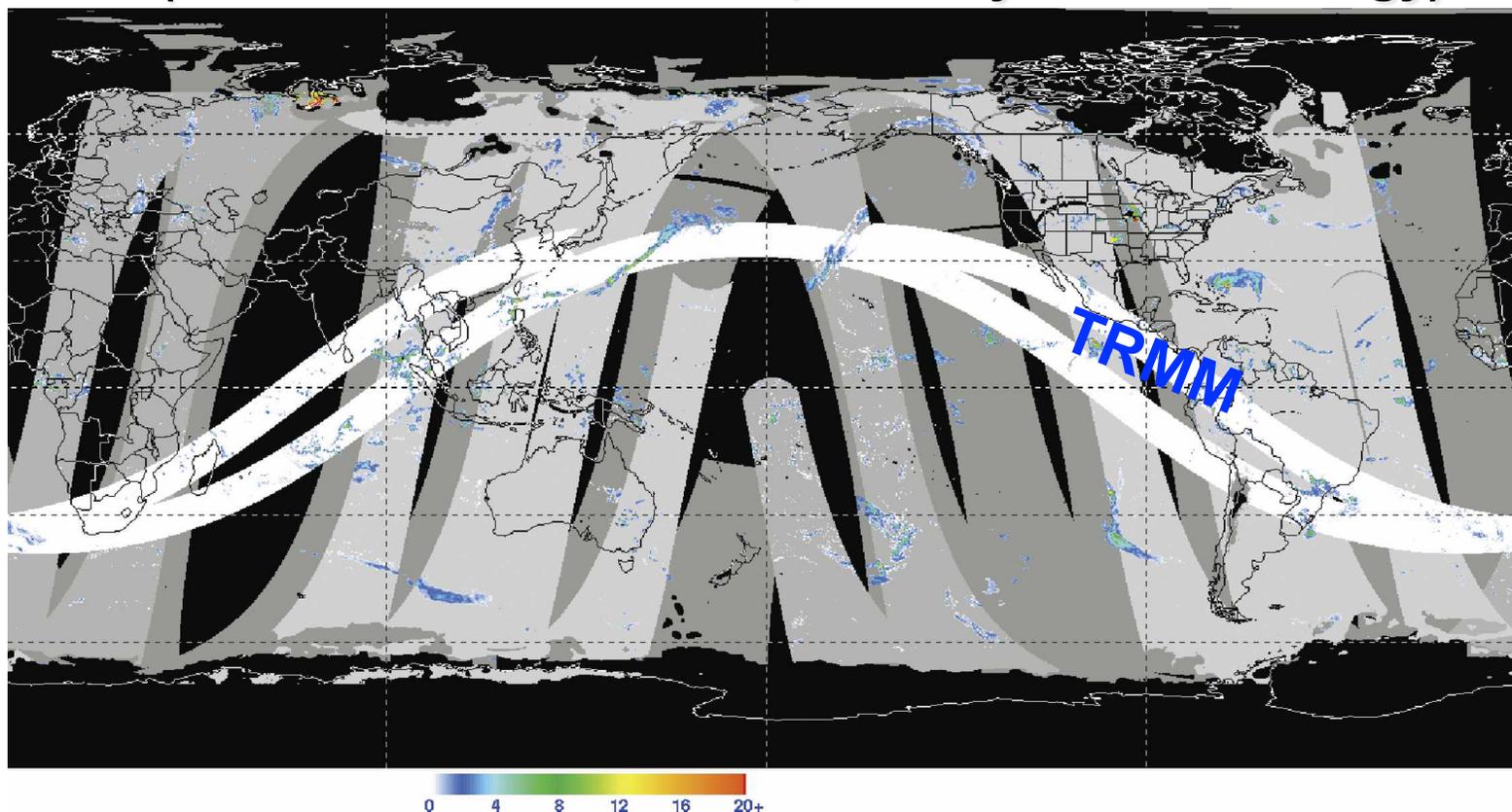
SSM/I: Special Sensor Microwave Imager

AMSR: Advanced Microwave Scanning Radiometer

AMSU: Advanced Microwave Sounding Unit

# The TRMM Multi-satellite Precipitation Analysis – Combined Microwave Estimates

(From Huffman et al. 2006, J. of Hydrometeorology)



Combined microwave precipitation estimate for the 3-h period centered at 0000 UTC 25 May 2004 in mm h<sup>-1</sup>. Blacked-out areas denote regions that lack reliable estimates, while the zero values in the remaining areas are color-coded to depict the coverage by the various sensors. The order of precedence for display and corresponding zero color are TMI (white), SSM/I (light gray), AMSR-E (medium gray), and AMSU-B (dark gray). (In the TMPA the TMI, SSM/I, and AMSR-E are averaged where overlaps occur.)

# TRMM TMPA Surface Rain Rate Data

**TRMM 3B42RT** : Near-Real Time

**TRMM 3B42** : Adjusted with surface rain gauge measurements on monthly bases

Spatial Resolution: 0.25°x0.25° latitude-longitude

Spatial Coverage: 50° S to 50° N, Global

Temporal Resolution: 3-hourly, Daily,

Temporal Coverage: 1998 to present

**TRMM 3B43** : Monthly Mean

# Rain: Giovanni Hydrology Portal

TRMM Online Visualization and Analysis System (TOVAS)

<http://giovanni.gsfc.nasa.gov/>

**NASA GES DISC** Goddard Earth Sciences Data and Information Services Center Search GES DISC Search

**GES DISC Home** **Data Services** **Science Portals** **Mission Portals**

Analyze Data with Giovanni Search for Data with Mirador Simple Subset Wizard More...

*Giovanni - The Bridge Between Data and Science*

» **OVERVIEW**

- + What is Giovanni?
- + Who Uses Giovanni?
- + Giovanni Parameters
- + Giovanni Plot Types
- + How to Use Giovanni
- + How to Acknowledge Giovanni
- + Acknowledgements

**Additional Features**

- + News
- + Users Manual
- + Publications
- + Newsletters
- + Feedback
- + **FAQ**

You are here: [GES DISC Home](#) » [Giovanni](#) » [Overview](#) » Giovanni

## Giovanni

**Giovanni Portals** **Giovanni Parameter List**

- ▶ **Atmospheric Portals (scroll down to view complete list)**
- ▶ **Application and Education Portals**
- ▶ **Meteorological Portals**
- ▶ **Ocean Portals**
- ▼ **Hydrology Portals**
  - [Global Land Data Assimilation System Monthly Data](#)
  - [Global Land Data Assimilation System 3-Hourly Data](#)
  - [North American Land Data Assimilation System Hourly Data](#)
  - **[TRMM Online Visualization and Analysis System \(TOVAS\)](#)**

Hide News ▼

# Mirador – Simple Search

<http://mirador.gsfc.nasa.gov/>

A simple, clean interface that employs the Google mini appliance for metadata keyword searches.

The screenshot shows the Mirador search interface. At the top, there is a NASA logo and the text 'National Aeronautics and Space Administration' and 'Goddard Earth Sciences Data and Information Services Center'. A search bar labeled 'Search DISC' with a '+ GO' button and a link to '+ Advanced Search' is present. Below this is a navigation bar with links for '+ ACDISC', '+ AgDISC', '+ A-TRAIN', '+ AIRS', '+ HURRICANES', '+ NEESPI', '+ OCEAN COLOR', and '+ PDISC'. On the left, there is a sidebar with '+ GES DISC Home', 'Mirador', '+ OVERVIEW', '+ HELP CENTER', '+ DATA HOLDINGS', '+ VIEW CART', '+ CHECK OUT', and 'Additional Features' including '+ News', '+ Restricted Data', '+ Feedback', and '+ FAQ'. The main content area features a banner for 'Mirador Data Access Made Simple' with a 'You are here: Keyword Search' breadcrumb. Below the banner is a search form with fields for 'Keyword', 'Location' (containing 'chesapeake'), 'Time Span' (with 'From' and 'To' sub-fields containing 'Jan 1, 1989' and '12-31-2007'), and 'Event'. The form is annotated with colored circles and arrows: a green circle around the 'Keyword' field, an orange circle around the 'Time Span' fields, a purple circle around the 'Location' field, and a red circle around the 'Event' field. Arrows point from these circles to labels on the right: 'Keyword' (green), 'Time span' (orange), 'Location' (purple), and 'Event' (red). A black arrow points from the 'Semantic Mirador' label to the search form. At the bottom, there is an 'Available:' section listing sensors (AIRS, OMI, MLS, HIRDLS, TOMS, UARS, TRMM, GLDAS, SORCE, and Subsets from A-Train), a 'What's New:' section with 'Download Files using HTTP protocol', and an 'Acknowledgements:' section listing data sources like 'National GeoSpatial Information Agency', 'Unisys', 'EPA', and 'Smithsonian Global Volcanism Program'. An 'OpenSearch' logo is also visible.

**Mirador supports**  
Searching by:

**Keyword**

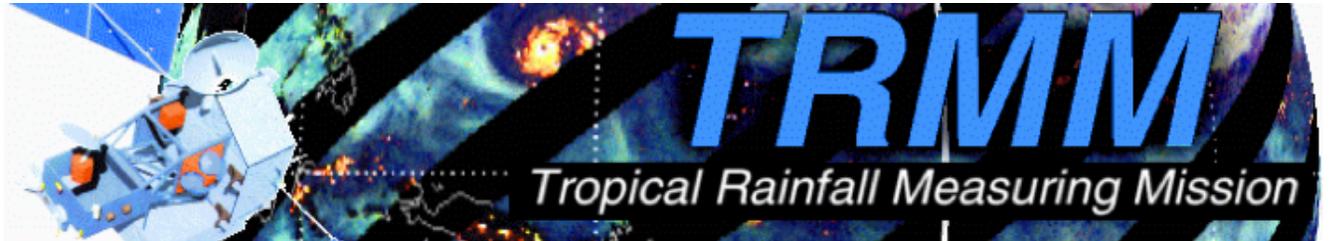
**Time span**

**Location**

**Event**

**Semantic  
Mirador**

<http://pmm.nasa.gov/TRMM>

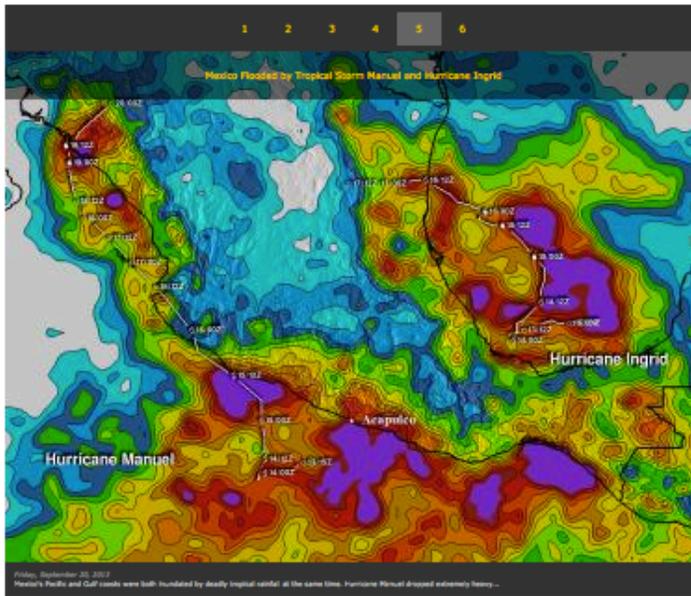


The Tropical Rainfall Measuring Mission (TRMM) is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) designed to measure rainfall for weather and climate research.

TRMM is a research satellite designed to improve our understanding of the distribution and variability of precipitation within the tropics as part of the water cycle in the current climate system. By covering the tropical and sub-tropical regions of the Earth, TRMM provides much-needed information on rainfall and its associated heat release that helps to power the global convection circulation that shapes both weather and climate. In coordination with other satellites in NASA's Earth Observing System, TRMM provides important precipitation information using several specialized instruments to increase our understanding of the interactions between clouds, aerosols, and precipitation, that are central to regulating Earth's climate.

TRMM: Extreme Weather

[Learn More about TRMM](#)



## Extreme Rain

[View the Extreme Weather Archive](#)

For TRMM Inquiries  
Contact Hal Pierce

## TRMM Data Applications

- Realtime 3 Hourly & 7 Day Rainfall
- Global Flood & Landslide Monitoring
- Hurricanes & Typhoons
- Rain Averages & Anomalies + ESPI
- TRMM based Climatology

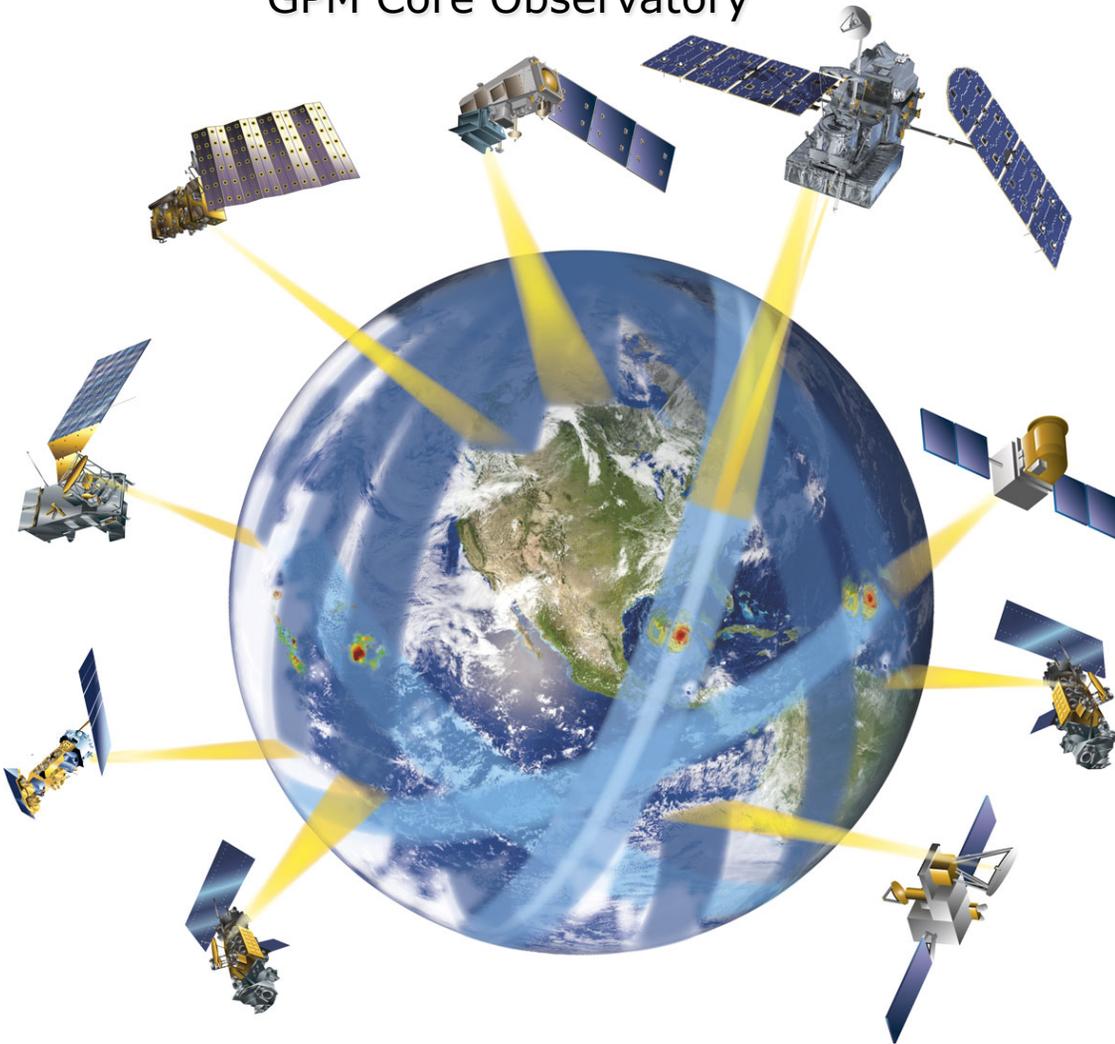
## TRMM Rainfall Data Applications

- Monitor near-real time rainfall – including extreme rain events
- Monitor regional wet/dry periods
- Input/forcing to hydrological models for mapping flood and landslide potential, and for water management
- Agricultural monitoring

# Upcoming Precipitation Mission

## Global Precipitation Measurement (GPM) Mission

GPM Core Observatory



GPM is an international mission co-led by NASA and JAXA and will use inputs from an international constellation of satellites to provide improved space and time coverage of precipitation (rain, snow) over the globe

Launch: February, 2014  
Launch site: Japan

<http://gpm.nasa.gov>

# Why Global Precipitation Measurement?

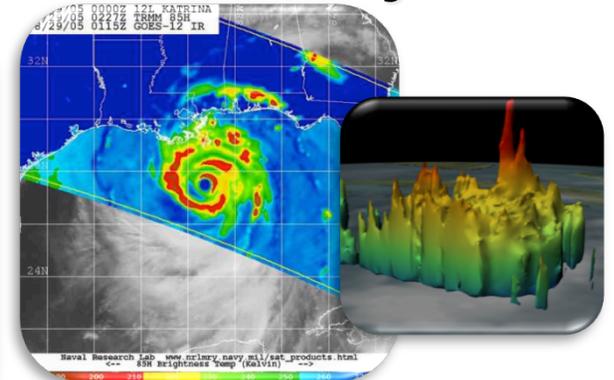
Flooding



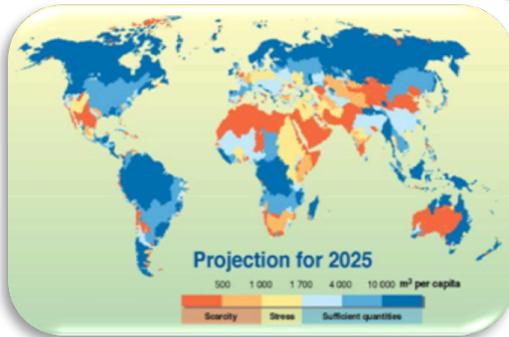
Landslides



Hurricane Monitoring & Prediction



Freshwater Availability



Extreme Snow Events

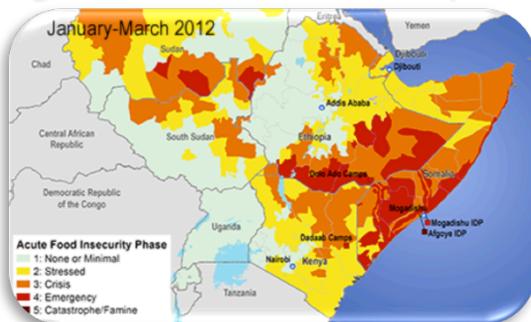


Global observations of precipitation every three hours at a 10 km spatial resolution.

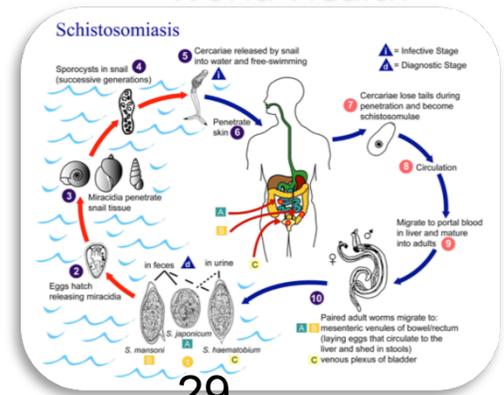
The rain and snow data will extend our capabilities to study a wide range of applications for scientific research and societal benefit.

<http://pmm.nasa.gov>

Agriculture/Famine Early Warning



World Health

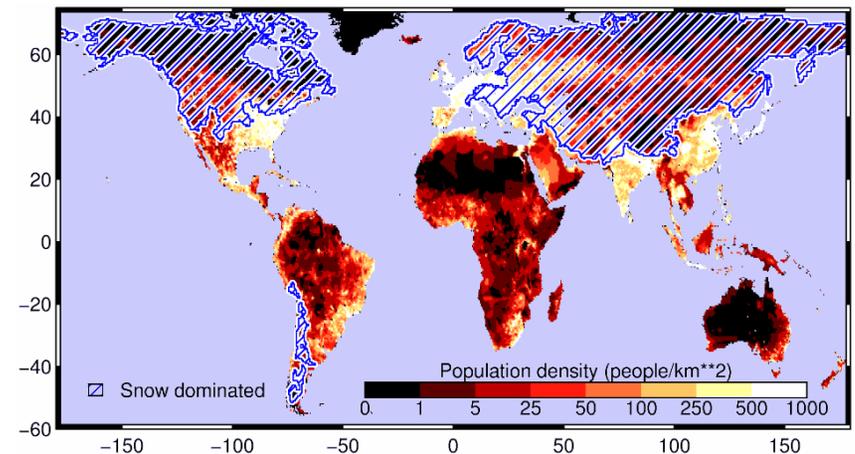


# MODIS Snow Standard Product

# NASA Snow Data Sources

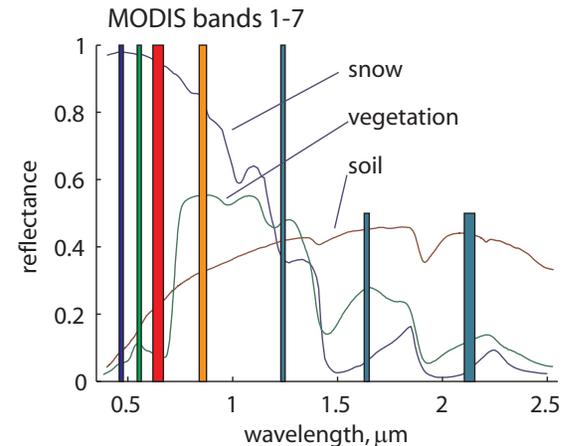
- Standard MODIS Product: Fractional Snow Cover
- MODSCAG (MODIS Snow Covered Area and Grain-size) Product : Fractional Snow Cover, Grain Size, Snow Water Equivalent

## Snow Dominated Regions



# Terra and Aqua MODerate Resolution Imaging Spectroradiometer (MODIS)

- 36 spectral bands ranging from 0.41 to 14.385 microns.
- Many applications, including **clouds, snow/ice**, vegetation, aerosol
- Available in various resolution (depends on product)



**Aqua: MODIS**



January 19, 2013 - Snow across the United States

**Table 2. MODIS snow data products.**

**From Dorothy Hall NASA-GSFC**

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Long Name	Earth Science Data Type (ESDT)	Spatial Resolution
MODIS/Terra Snow Cover 5-Min L2 Swath 500m	MOD10_L2	500-m resolution, swath of MODIS data
MODIS/Terra Snow Cover Daily L3 Global 500m SIN Grid (includes daily snow albedo)	MOD10A1	500-m resolution, projected, gridded tile data
MODIS/Terra Snow Cover 8-Day L3 Global 500m SIN Grid	MOD10A2	500-m resolution, projected, gridded tile data
MODIS/Terra Snow Cover Daily L3 Global 0.05Deg CMG	MOD10C1	0.05° resolution, lat/lon climate modeling grid
MODIS/Terra Snow Cover 8-Day L3 Global 0.05Deg CMG	MOD10C2	0.05° resolution, lat/lon climate modeling grid
MODIS/Terra Snow Cover Daily L3 Global 0.25Deg CMG	Not yet a standard product	0.25° resolution, lat/lon climate modeling grid
MODIS/Terra Snow Cover Monthly L3 Global 0.05Deg CMG	MOD10CM	0.05° resolution, lat/lon climate modeling grid
MODIS/Aqua Snow Cover 5-Min L2 Swath 500m	MYD10_L2	500-m resolution, swath of MODIS data
MODIS/Aqua Snow Cover Daily L3 Global 500m SIN Grid (includes daily snow albedo)	MYD10A1	500-m resolution, projected, gridded tile data
MODIS/Aqua Snow Cover 8-Day L3 Global 500m SIN Grid	MYD10A2	500-m resolution, projected, gridded tile data
MODIS/Aqua Snow Cover Daily L3 Global 0.05Deg CMG	MYD10C1	0.05° resolution, lat/lon climate modeling grid
MODIS/Aqua Snow Cover 8-Day L3 Global 0.05Deg CMG	MYD10C2	0.05° resolution, lat/lon climate modeling grid
MODIS/Aqua Snow Cover Monthly L3 Global 0.05Deg CMG	MYD10CM	0.05° resolution, lat/lon climate modeling grid

# MODIS Standard Snow Product Data Access and Visualization

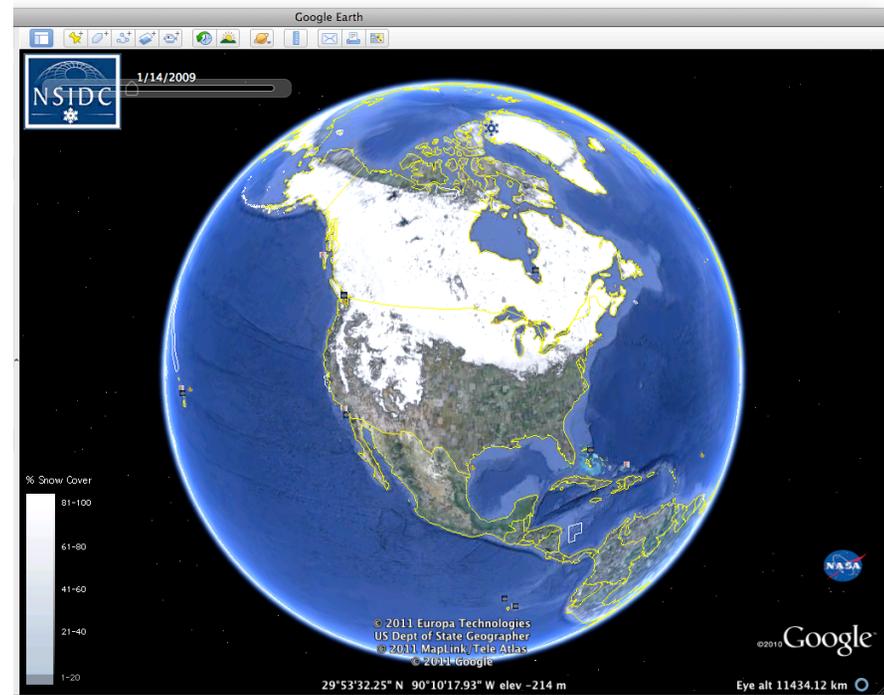
MODIS Snow Products are available from the National Snow and Ice Data Center <http://nsidc.org/>

MODIS snow cover can be visualized on Google Earth maps from [http://nsidc.org/data/virtual\\_globes/index.html](http://nsidc.org/data/virtual_globes/index.html)

**Data Start Date: 2000-02-24**  
**Daily, 8-Day, Monthly**

**Coverage: Global**

**Multiple Spatial Resolutions**



# Selected Aqua-MODIS Snow Product from Reverb/ECHO <http://reverb.echo.nasa.gov/reverb>

The screenshot displays the Reverb/ECHO web interface. At the top, the NASA logo and "National Aeronautics and Space Administration" are visible on the left, and "Reverb | ECHO The Next Generation Earth Science Discovery Tool" is on the right. Below the header, there are navigation links for "EOSDIS Home", "Reverb Home", "About", and "Tutorial". The main content area is divided into two panels. The left panel, titled "Spatial Search", features a "Bounding Box" input field with the example coordinates "-50.736, 163.477, -11.144, 105.680 (S,E,N,W)", "Reset", and "Clear" buttons. Below this is a satellite imagery map with navigation controls (directional arrows, a person icon, and zoom in/out buttons). A "Satellite" dropdown menu is positioned above the map. The right panel, titled "Temporal Search", includes a "Search Terms" field with "MYD10CMV5" and a "Clear" button. Below this are "START" and "END" date selection fields, each with a calendar icon and a "Clear" button. A note at the bottom of the temporal search section states "\* all times must be specified in GMT". At the very bottom of the interface, there are "Date Range" and "Annual Repeating Dates" buttons.

This screenshot shows the "Step 2: Select Datasets" interface. The title bar at the top reads "Step 2: Select Datasets" and includes a help icon "[?]". On the right side, it indicates "Found 1 dataset. Total Query Time: 0.15s". A search result is listed with a checkbox on the left: "MODIS/Aqua Snow Cover Monthly L3 Global 0.05Deg CMG V005". Below the product name, it shows "Archive Center: NSIDC", "Short Name: MYD10CM", and "Version: 5". To the right of the search result are three icons: a gear (settings), a plus sign with a list (add to cart), and an information icon (i).

Swath, Daily, and Monthly products are available

# Near-real Time and Standard MODIS Products

<http://lance-modis.eosdis.nasa.gov/>

The screenshot shows the NASA Earth Data website interface. At the top, there is a navigation bar with links for 'Data Discovery', 'Data Centers', 'Community', and 'Science Disciplines'. Below this is the NASA logo and the text 'National Aeronautics and Space Administration'. The main header features the 'EOSDIS' logo and 'NASA's Earth Observing System Data and Information System'. A search bar is located on the right side of the header.

The main navigation menu includes 'Home', 'About EOSDIS', 'Data', 'Our Community', 'User Resources', 'ECE', and 'Labs'. Below this, there is a secondary menu with 'Discovering Data', 'Data Tools', 'Data Centers', 'Near Real-Time Data', and 'Standards and References'. The 'Near Real-Time Data' section is highlighted.

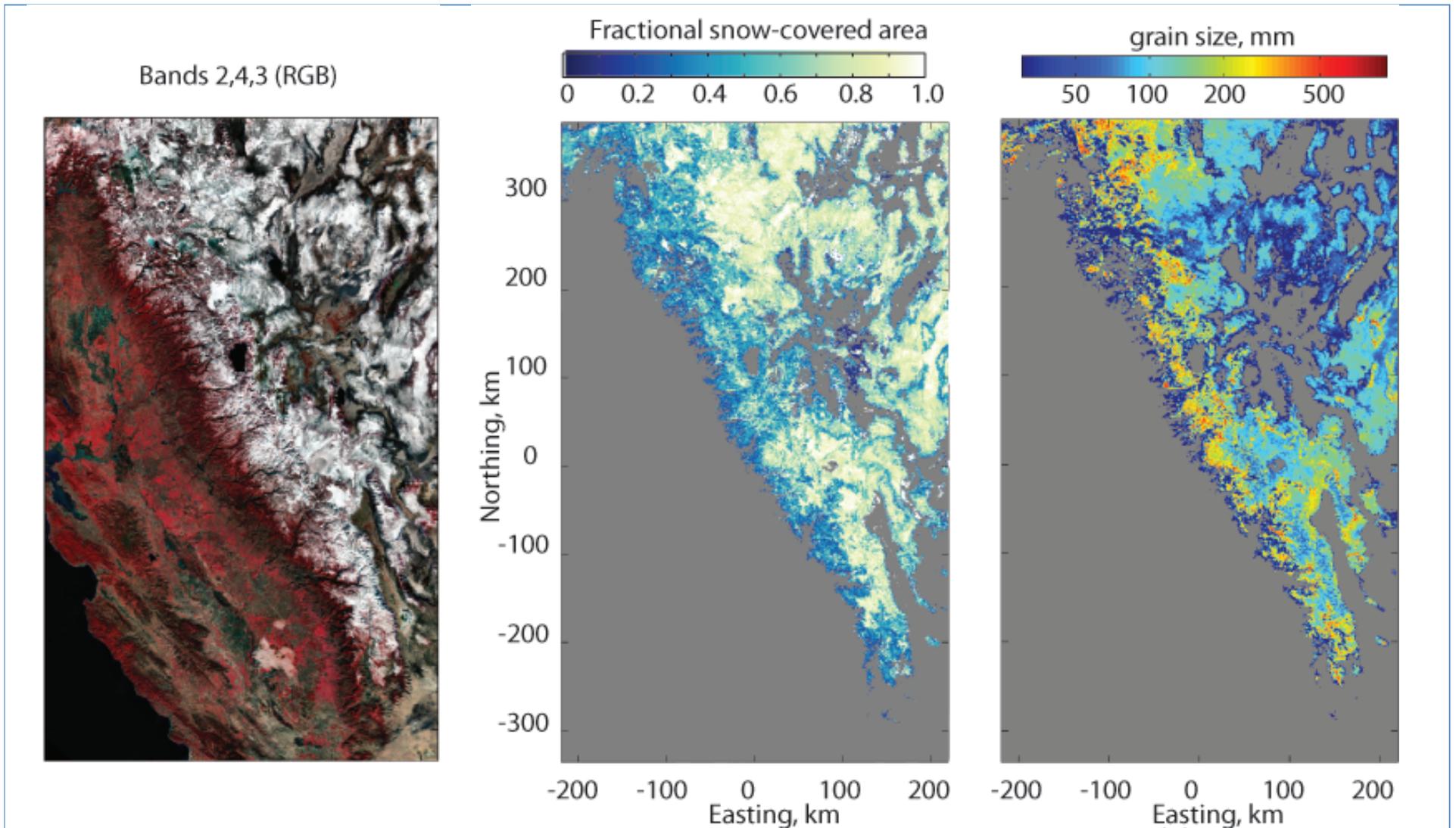
The sidebar on the left contains a 'Near Real-Time Data' section with a 'Data' dropdown menu. The 'MODIS' option is circled in blue. Other options in the sidebar include 'AIRS', 'MLS', 'OMI', 'Platform', 'Hazards and Disasters', 'Fire Email Alerts', 'Active Fire Data', 'Science Quality Products', 'Datacasting', and 'External Data'.

The main content area is titled 'Near Real-Time Data' and 'Land Atmosphere Near Real-time Capability for EOS'. It includes a breadcrumb trail: 'Home > Data > Near Real-Time Data > Data > Instrument > MODIS > Download MODIS Data'. There is a small globe image and a survey announcement: 'LANCE Survey Underway - Give us feedback to improve LANCE!'. The survey text asks users to register to rate near real-time products and services. Below the survey, there is a section for 'Download MODIS NRT data' with instructions on how to select products and download them from either of two FTP servers. A list of links is provided: 'Learn about MODIS', 'Visualize imagery through MODIS Browse images, Rapid Response MODIS images or in Worldview', and 'Read the disclaimer for more information about using the data'. The page footer indicates 'MODIS / Terra'.

# MODSCAG Snow Products

# MODSCAG Snow Products

From: Thomas H. Painter and Chris Mattmann (NASA JPL)



# MODSCAG

Hindu Kush April 9/2009



**Limitation of MODIS Data : No Snow Mapping Under Clouds**

<http://snow.jpl.nasa.gov/portal/browse/dataset/urn:snow:MODSCAG>

The screenshot shows the NASA Jet Propulsion Laboratory (JPL) Snow Data System interface. At the top left is the NASA logo and the text "Jet Propulsion Laboratory California Institute of Technology". To the right, there are navigation links: "JPL HOME", "EARTH", "SOLAR SYSTEM", "STARS & GALAXIES", "SCIENCE & TECHNOLOGY", and "BRING THE UNIVERSE TO YOU: JPL Email News | RSS | Mobile | Video". Below the header, a breadcrumb trail reads "Snow Data System : Home → Data → Snow Map". A navigation bar contains "Home", "Data", "Publications", "Media", "People", and "Links", with "Data" circled in yellow. Below the navigation bar, there is a "Date:" dropdown menu set to "Fri Oct 18 2013" and a horizontal slider. Below these are checkboxes for "Snow Cover" (checked), "Grain Size", "Dust Forcing", "Clouds" (checked), and "RGB". To the right, there is a "Regions:" dropdown menu with "United States" and "High Asia" options. The main content area displays a satellite-style map of a mountainous region with snow cover. On the left side of the map, there are three icons: a plus sign, a square, and a camera icon.

**MODSACG Data Access and Mapping**



## Integration of Precision NASA Snow Products with the Operations of the Colorado Basin River Forecast Center (CBRFC) to Improve Decision Making Under Drought Conditions

Principle Investigator: Thomas Painter, Jet Propulsion Laboratory

### Abstract

The Colorado Basin River Forecast Center (CBRFC) is responsible for the entire Colorado Basin (CRB) and the eastern Great Basin (GB). From a water management perspective, the commitment of water to various users most often occurs in the spring, and is almost entirely based on estimates of the western USA snowpack. Improving seasonal drought predictions requires use of models that provide physically realistic simulations of fundamental hydrologic processes. Among these, for the western USA, representation of snow is perhaps most critical.

As drought frequency increases in the CRB and GB, it is critical that the CBRFC and the dependent water managers have more comprehensive real-time knowledge of the snow cover and its properties for more precise runoff forecasting and stakeholder decision support. The primary objective of this proposal is to integrate real-time high precision MODIS Snow Covered Area and Grain size (MODSCAG) fractional snow covered area (SCA) into CBRFC modeling and analysis systems and into stakeholder oriented data products, drastically reducing SCA uncertainties that have hampered forecasting operations for decades. A secondary objective is to ingest and study MODIS Dust Radiative Forcing in Snow (MODDRFS) radiative forcing imagery, to better understand its value as an input to modeling and forecasting approaches.

This collaboration directly addresses drought prediction, assessment, adaptation, and mitigation in support of energy security/efficiency; natural resource conservation; and household, municipal, industrial, and in-stream demands for water. It will also improve access and availability of actionable water monitoring, hence drought information. The Snow Cover and Dust Forcing products will be generated and distributed in near real-time by the JPL Snow Server for access by CBRFC. CBRFC will offer a direct connection to stakeholders (End Users) and together with other linked NWS operational centers provides an institutional home to maintain the advances of this effort beyond the project's end.

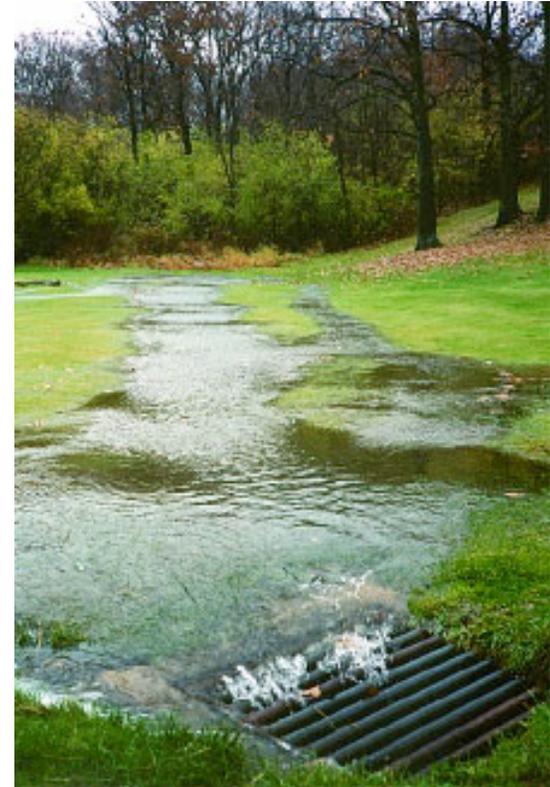
[top](#)

MODSCAG,  
Snow and Dust  
Radiative  
Forcing  
Information,  
along with  
CBRFC  
Modeling  
Analysis is  
used in  
Decision  
Making

# Runoff and Streamflow

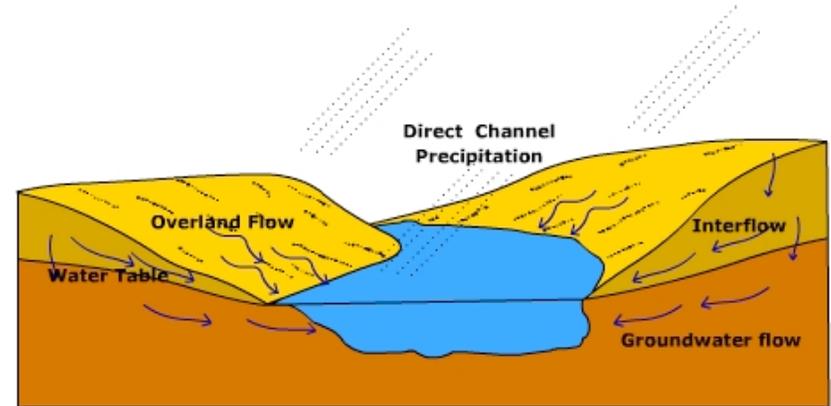
# Surface Run Off:

- Excess water from rain and/or snowmelt
- Results from soil saturation, depends on soil infiltration capacity, rain/melt water rate, terrain
- A major component of water cycle – responsible for erosion, flooding, water quality (carry pollutants)



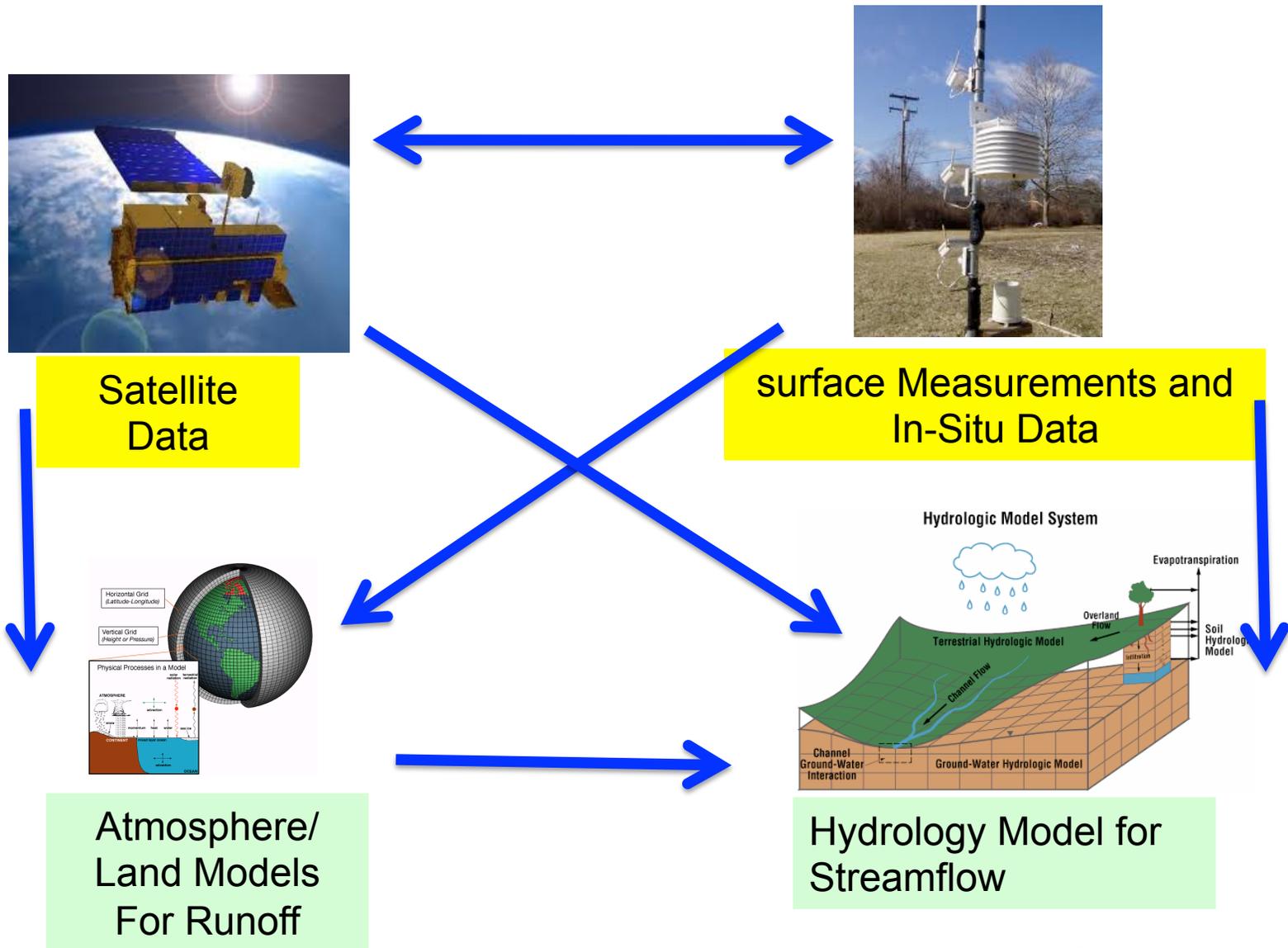
# Streamflow or Channel Runoff:

- Flow of water in rivers, streams
- Runoff that carries water from land to ocean
- *In situ* point measurements within stream by streamgauge
- A major component of water cycle – responsible for flooding when channel overflows



# NASA Surface Runoff and Streamflow Data

Calculated by using land-atmosphere and Hydrology Models



# NASA Surface Runoff Data

## Land-Atmosphere Models:

- Global runoff from the Global Land Data Assimilation System (**GLDAS**)
- Runoff over North America from the North American Data Assimilation System (**NLDAS**)

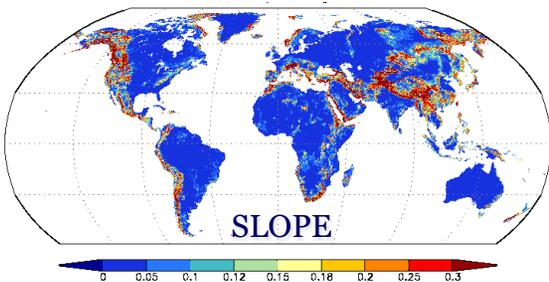
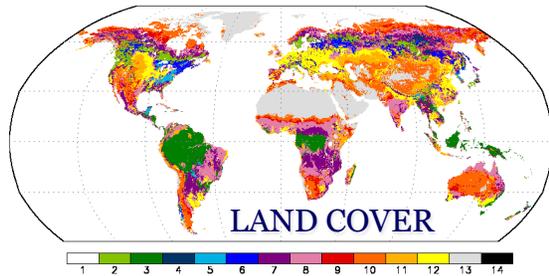
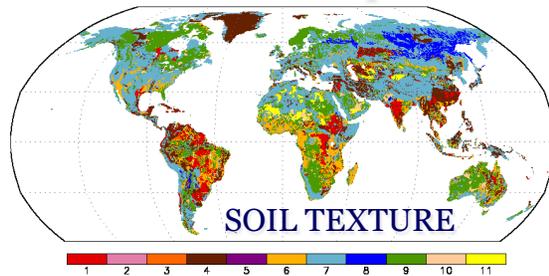
Temporal Coverage: 1979-present

Spatial Resolution: ( $1/8^\circ$ ,  $1/4^\circ$ ,  $1^\circ$ )

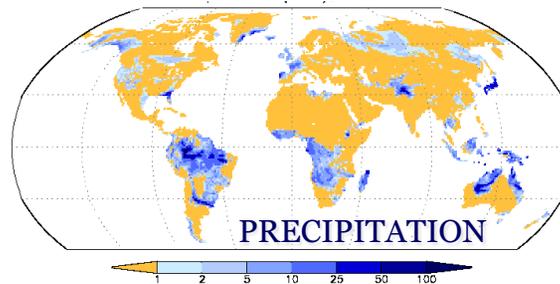
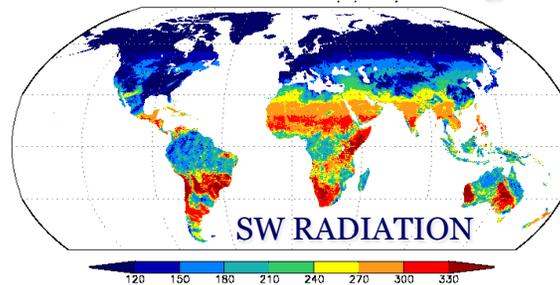
# Global Land Data Assimilation System (GLDAS)

**GOAL:** Integrate ground and satellite observations within sophisticated numerical models to produce physically consistent, high resolution fields of land surface states (e.g., snow) and fluxes (e.g., evaporation)

## Parameter Inputs

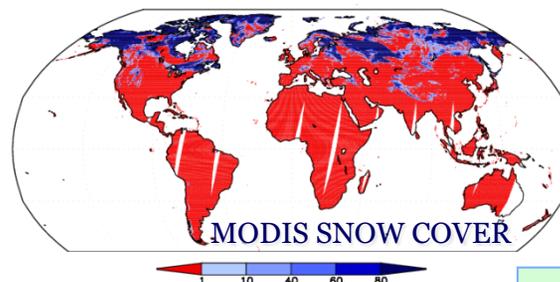


## Satellite Based Forcing



**AVAILABILITY:** Output from 1979-present simulations of Noah ( $1/4^\circ$ ;  $1^\circ$ ), CLM ( $1^\circ$ ), and Mosaic ( $1^\circ$ ), and VIC ( $1^\circ$ ), at <http://disc.gsfc.nasa.gov/hydrology/index.shtml>

## Assimilated Observations



**USES:** Weather and climate forecast initialization studies, water resources applications, hydrometeorological investigations

## Integrated Output

Soil Moisture

Evapotranspiration

**Runoff**

Snow Water Equivalent

# North-American Land Data Assimilation System (NLDAS)

- A collaboration project among : NOAA/NCEP's Environmental Modeling Center ([EMC](#)), NASA's Goddard Space Flight Center ([GSFC](#)), [Princeton University](#), the [University of Washington](#), the NOAA/NWS Office of Hydrological Development ([OHD](#)), and the NOAA/NCEP Climate Prediction Center ([CPC](#))
- Spatially and temporally consistent, land-surface model (LSM) datasets from the **best available observations and model output.**
- Currently running in near real-time on a 1/8th-degree grid over central North America; retrospective NLDAS datasets and simulations also extend back to January 1979.

# GLDAS/NLDAS: Giovanni Hydrology Portal

<http://giovanni.gsfc.nasa.gov/>

**NASA GES DISC** Goddard Earth Sciences Data and Information Services Center Search GES DISC  
Search

**GES DISC Home** **Data Services** **Science Portals** **Mission Portals**

Analyze Data with Giovanni Search for Data with Mirador Simple Subset Wizard More...

*Giovanni - The Bridge Between Data and Science*

**» OVERVIEW**

- + What is Giovanni?
- + Who Uses Giovanni?
- + Giovanni Parameters
- + Giovanni Plot Types
- + How to Use Giovanni
- + How to Acknowledge Giovanni
- + Acknowledgements

**Additional Features**

- + News
- + Users Manual
- + Publications
- + Newsletters
- + Feedback
- + **FAQ**

You are here: [GES DISC Home](#) » [Giovanni](#) » [Overview](#) » Giovanni

## Giovanni

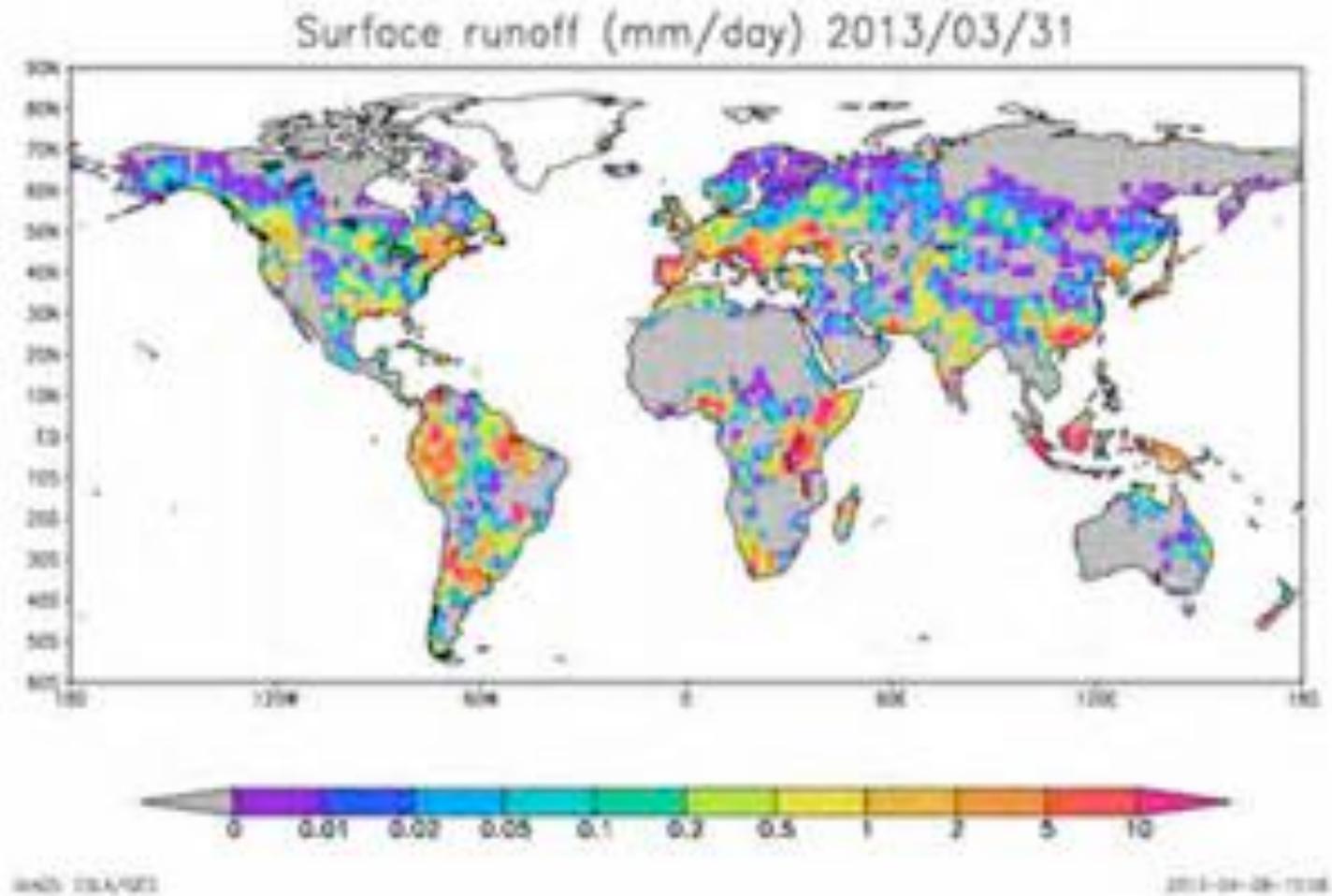
**Giovanni Portals** **Giovanni Parameter List**

- ▶ **Atmospheric Portals (scroll down to view complete list)**
- ▶ **Application and Education Portals**
- ▶ **Meteorological Portals**
- ▶ **Ocean Portals**
- ▼ **Hydrology Portals**
  - [Global Land Data Assimilation System Monthly Data](#)
  - [Global Land Data Assimilation System 3-Hourly Data](#)
  - [North American Land Data Assimilation System Hourly Data](#)
  - [TRMM Online Visualization and Analysis System \(TOVAS\)](#)

Hide News ▼

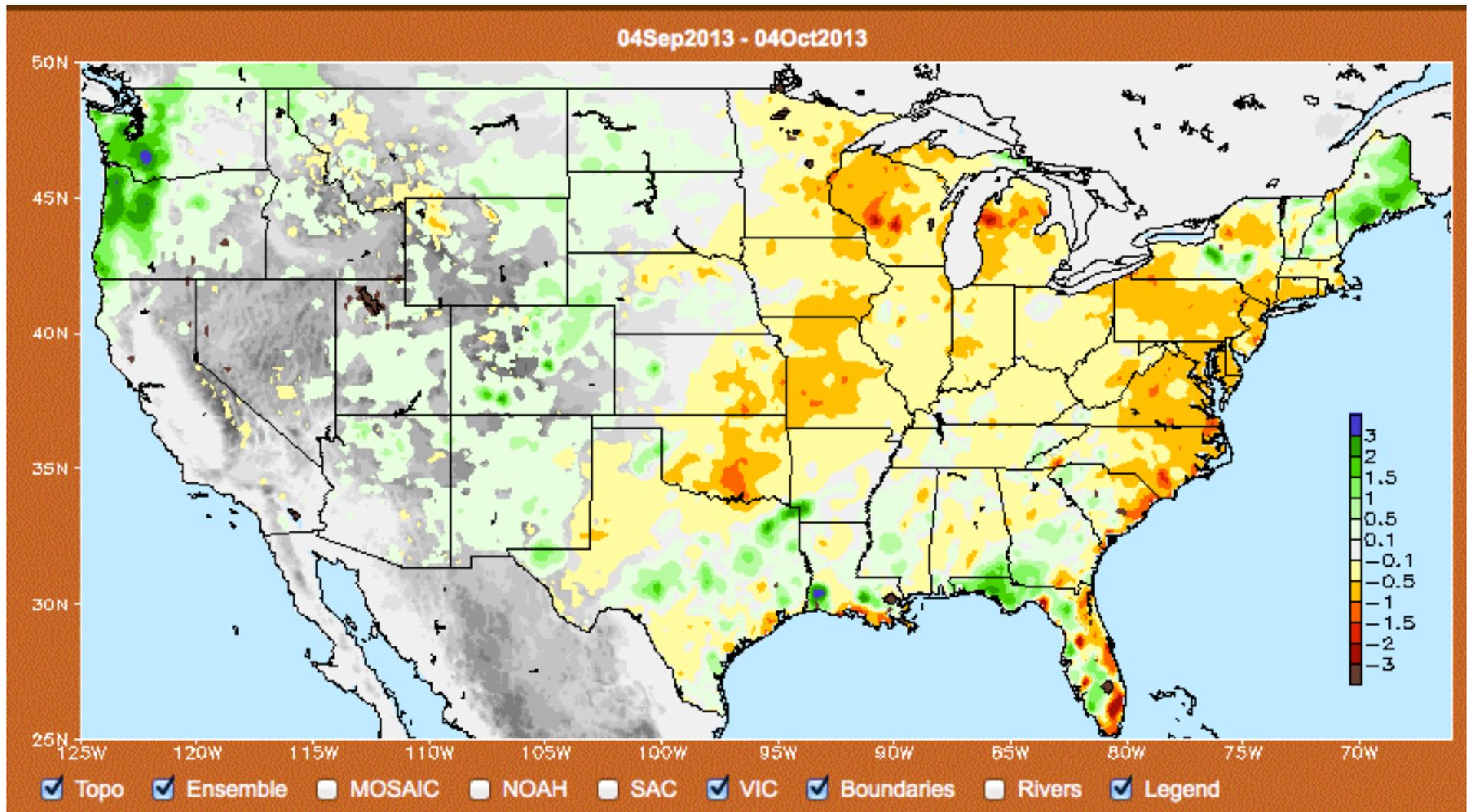
# Runoff (mm/day)

From Princeton University GLDAS (VIC)



# Recent Runoff Anomalies (mm/day)

## Monthly Departure from Average 1979-2000 Runoff from NLDAS



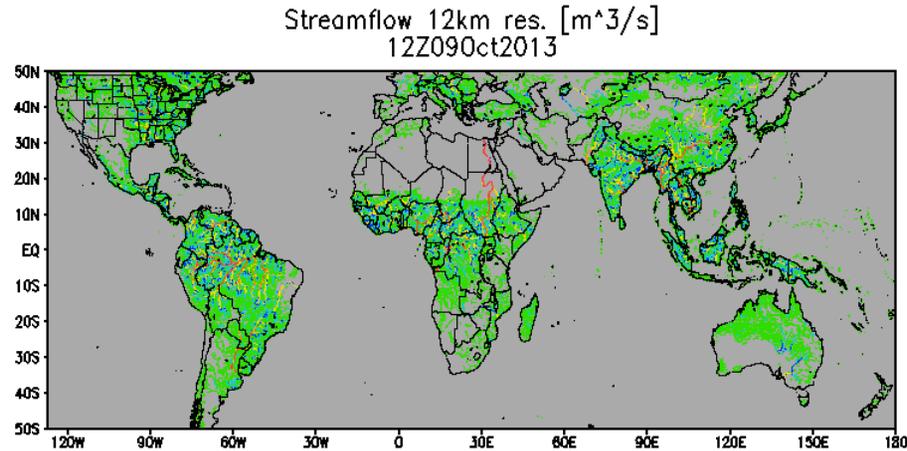
# NASA Streamflow Data

Hydrological Models using TRMM Rainfall for Streamflow and flood monitoring:

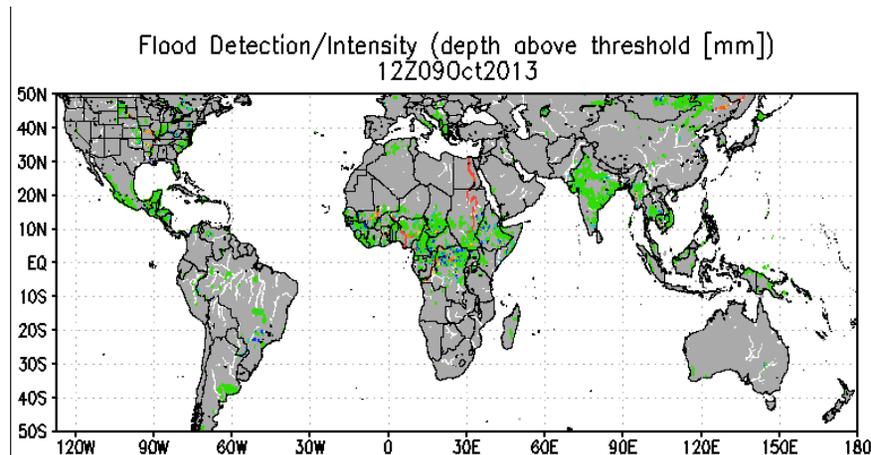
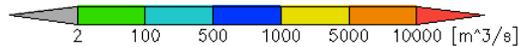
- Global Flood Monitoring System (GFMS)
- SERVIR (Regional)

# Global Flood Monitoring System (GFMS)

<http://flood.umd.edu>



Global Stream  
flow in  $\text{m}^3/\text{s}$

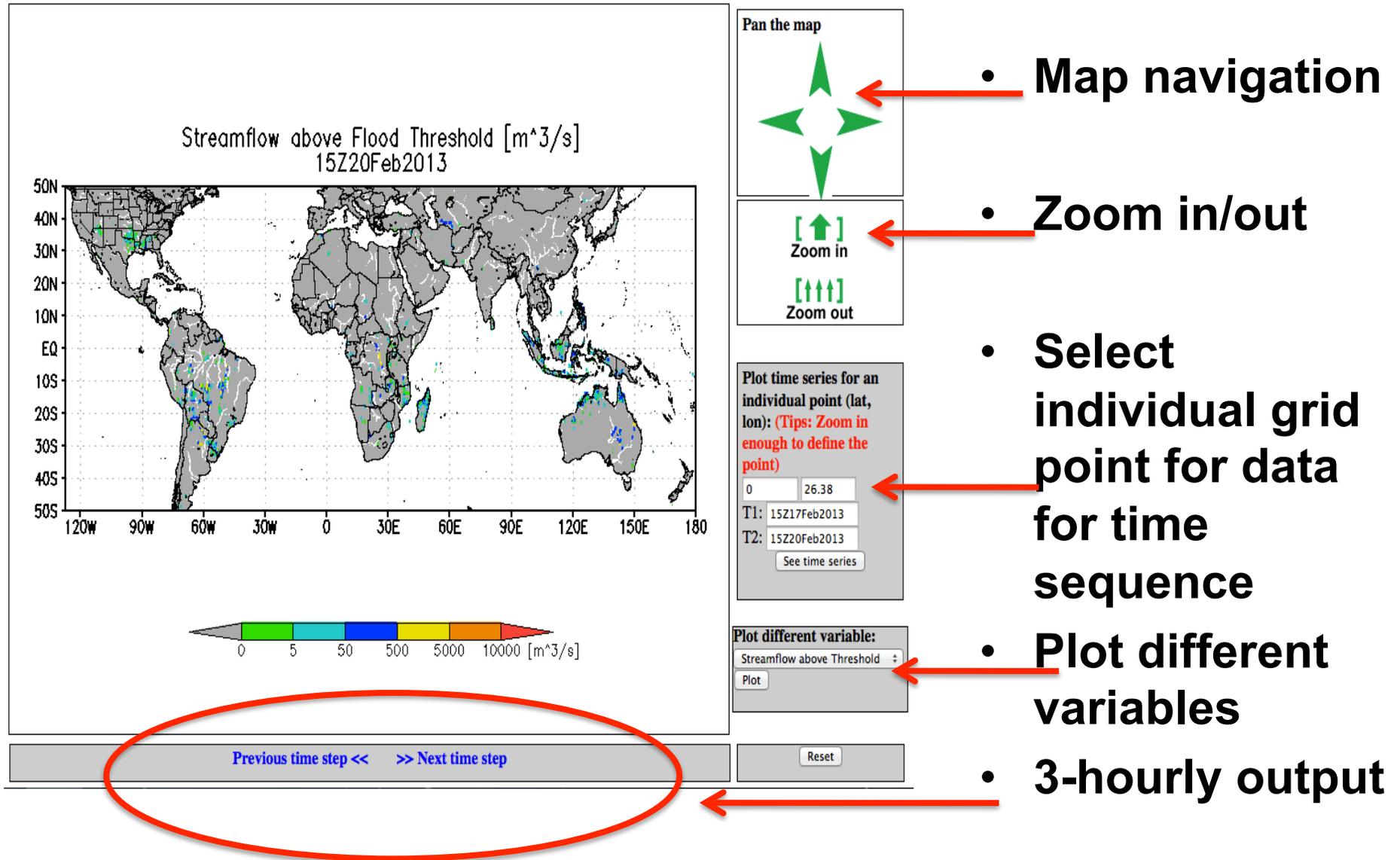


Flood Detection:  
Depth of channel  
water above  
threshold depth



# Global Flood Monitoring System (GFMS)

<http://flood.umd.edu>



**Example of TRMM Data Application:**

**SERVIR**

# SERVIR

(<https://www.servirglobal.net/Global.aspx>)

Near-real  
Time NASA  
Satellite  
Data used in  
a Hydrologic  
Model

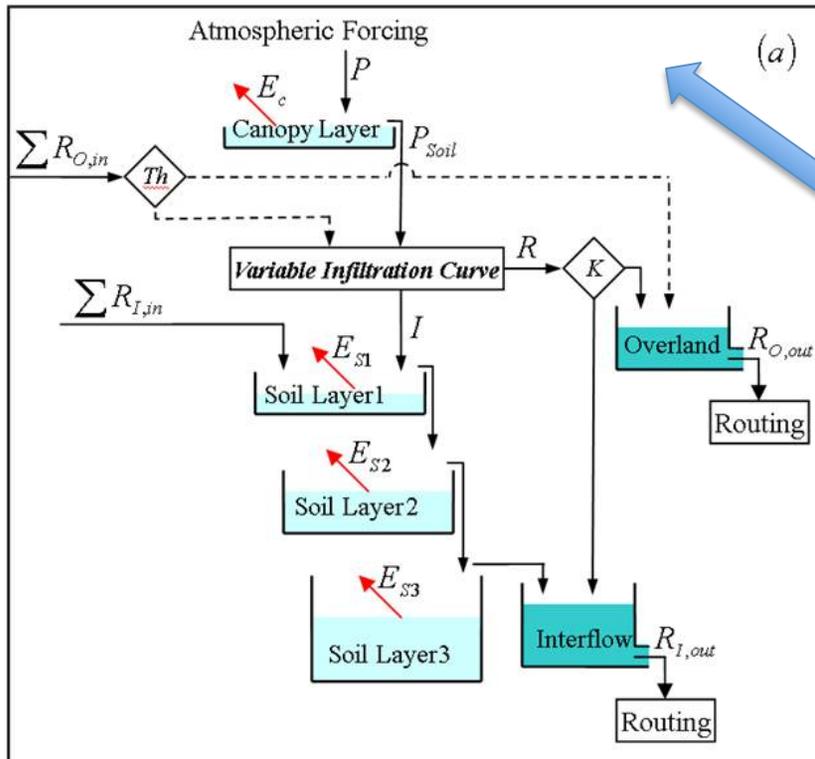
The screenshot shows the SERVIR GLOBAL website interface. At the top, there's a navigation bar with logos for USAID and NASA. Below that is a search bar and a menu with categories like GLOBAL, MESOAMERICA, AFRICA, HIMALAYA, and MyCOE Opportunities. The main content area features a large world map with three regions highlighted: North America (red circle), Africa (yellow circle), and Asia (green circle). Red arrows point from these circles to a box at the bottom labeled 'Focusing on three regions'. Below the map are sections for 'Success Stories' and 'Latest News'. A vertical sidebar on the right is labeled 'DISASTER SUPPORT ACTIVITIES'.

Focusing on three regions

# CREST Hydrology Model Forcing Data: Satellite TMPA RT and Forecast

**CREST**

Coupled Routing and Excess Storage



Atmospheric Forcing for CREST

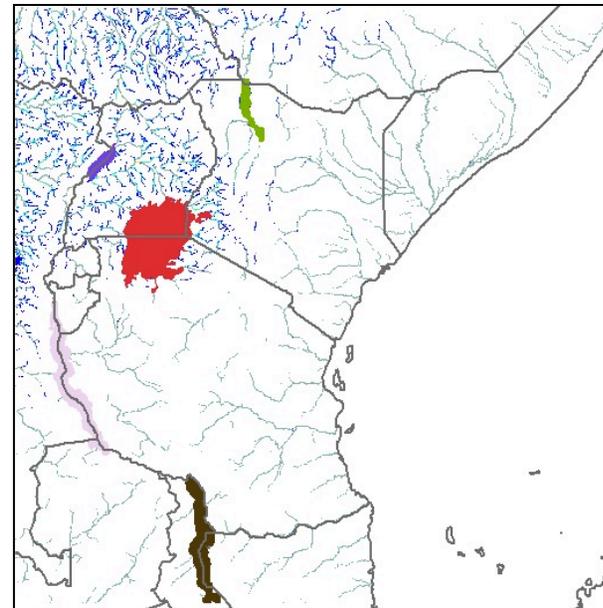
**1. TMPA 3B42RT**

**2. NCEP Global Ensemble Forecast System (1-5 day forecast)**

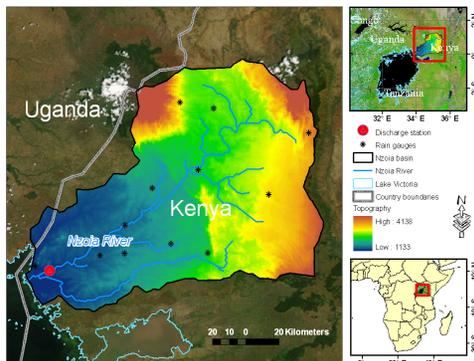
**3. NASA GEOS-5 (1-5 day forecast)**

**4. Regional: WRF 1-5 day Forecast**

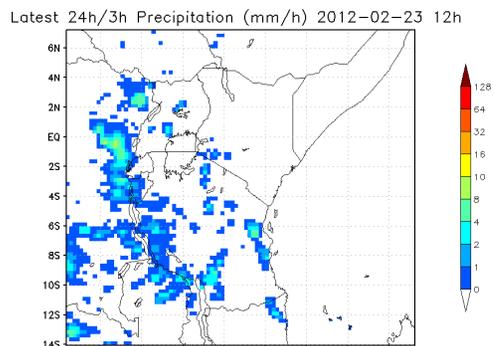
- Near Real Time Hydrologic Datasets
  - Streamflow
  - Soil moisture
  - Quantiles of Streamflow, Soil Moisture
- Short Term Forecasts using KMD QPF
  - Rainfall
  - Streamflow
  - Soil moisture



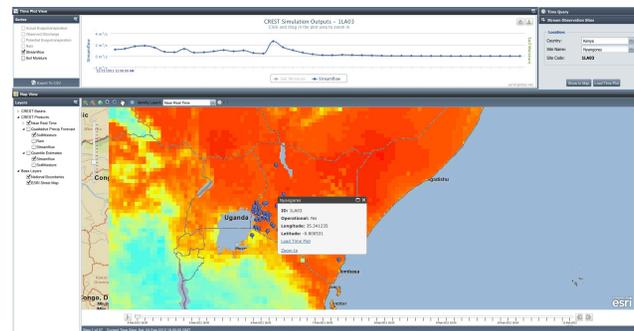
# Hydrologic Model CREST Developed for Single Watershed in Kenya



# Near Real Time NASA Satellite Rainfall Data

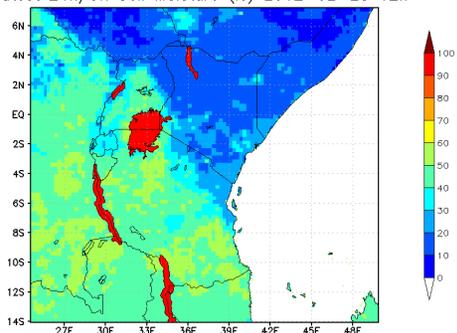


# Engaged Kenya Department of Water Resources to help monitor floods



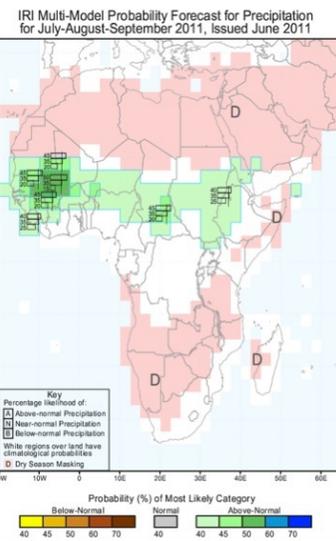
# Soil Moisture

Latest 24h/3h Soil Moisture (%) 2012-02-23 12h



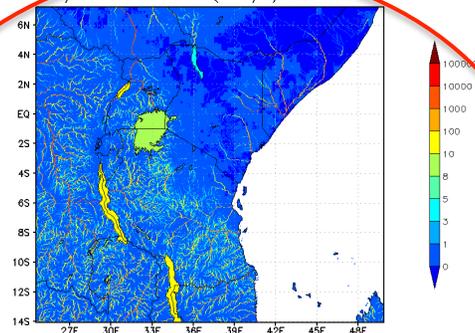
**SERVIR- Hydrologic Modeling using NASA Data in East Africa with Active Engagement with End Users**

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



Training and Capacity Building

Latest 24h/3h Stream Flow (m<sup>3</sup>/s) 2012-02-23 12h



**Real Time, Historic and Seasonal Streamflow**

**From: Dan Irwin (SERVIR)**

# Summary

- There are multiple sources of precipitation (rain and snow) products with different spatial and temporal resolutions and coverage, accuracy, and limitations
- Runoff and streamflow can be calculated with land-atmosphere and hydrology models which utilize NASA satellite observations as inputs.
- The most appropriate data products or model depend on the specific application or end-user requirement.
- There are NASA Web-based tools available to access and analyze these data **(to be covered in Week-5 webinar)**

# Coming up next week!

**Week 3 (31 October 2013)**

**Overview of Soil Moisture and Evapotranspiration**

# Thank You!