



National Aeronautics and
Space Administration



ARSET

Applied Remote Sensing Training

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

 @NASAARSET

Advanced Webinar on using NASA Remote Sensing for Flood Monitoring and Management

Instructors:

- Amita Mehta (ARSET)
- Elena Cristofori (Guest Speaker, TRIM)

Week-1

www.nasa.gov

Course Structure

- **One session per week on March 16, 23, 30, and April 6, 2016**
 - 8:00 a.m. – 9:00 a.m. EDT (UTC-4) for Europe, Africa, the Middle East, and Southeast Asia
 - 4:00 p.m. – 5:00 p.m. EDT (UTC-4) for the Americas and Asia-Pacific
- **Each session will include**
 - Presentations
 - Demonstrations and instructions for hands-on exercises for selected flood cases
 - A homework assignment
- **Q & A following each session or by email to Amita Mehta (amita.v.mehta@nasa.gov)**

Prerequisite

NASA Remote Sensing Observations for Flood Management

<http://arset.gsfc.nasa.gov/disasters/webinars/nasa-remote-sensing-observations-flood-management>

- Week 1: About ARSET & NASA Remote Sensing Data for Flood Management, Intro to Flood Monitoring Tools
- Week 2: Overview of TRMM-based Flood Monitoring Tools
- Week 3: Demonstration of the MODIS-based Inundation Mapping



NASA Remote Sensing Observations for Flood Management
06/08/2015 to 06/29/2015

Objective:
To introduce: 1) NASA remote sensing observations for monitoring extreme precipitation and flooding, and 2) Flood mapping tools based on the remote sensing observations for flood management and planning.

Course Agenda:

- Week-1 (June 8, 2015):** NASA Remote Sensing Data useful for Flood Management, Introduction to Flood Monitoring Tools
- Week-2 (June 15, 2015):** Overview of the i) Global Flood Monitoring System, ii) Near-real Time Global Flood Mapping Tool, and iii) Global Disaster Alert and Coordination System/Global Flood Detection System
- Week-3 (June 22, 2015):** Example of Regional Flood Management over Africa, Overview and Demonstration of the MODIS Inundation Mapping Tool and the Dartmouth Flood Observatory
- Week-4 (June 29, 2015):** Example of Floodplain Management of the Mekong River, Live Demonstration of Selected Flooding Cases using Multiple Web-Tools and GIS

GIS: True
Keywords: Flooding, Tools
Instruments/Missions: Aqua, GPM, MODIS, Terra, TRMM

Week	Title	Presentations	Recordings	Homework
1	NASA Remote Sensing Data for Flood Management, Introduction to Flood Monitoring Tools	Week 1 Presentation (English) Week 2 Presentation (Spanish)	Week 1 Recording	
2	Overview of TRMM-based Flood Monitoring Tools	Week 2 Presentation (English) Week 2 Presentation (Spanish) Exercise	Week 2 Recording	
3	i) Regional Flood Management over Africa ii) Demonstration of the MODIS-based Inundation Mapping	Week 3 Presentation (English) Week 3 Presentation (Spanish)	Week 3 Recording	
4	Floodplain Management of the Mekong River, Demonstration of Selected Flooding Cases using Multiple Web-Tools and GIS	Presentation (English) Week 4 Presentation (Spanish) Portals and Tools URL	Week 4 Recording	Week 4 Homework Assignment (English) Week 4 Homework Assignment (Spanish)

Course Material

<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

Webinar presentations, exercises, homework assignments, and recordings

The screenshot shows the ARSET website interface. At the top, there are navigation tabs for 'Earth Sciences Division', 'Applied Sciences', and 'ASP Water Resources'. Below this is the ARSET logo and a search bar. A main navigation bar includes 'DISASTERS', 'ECO FORECASTING', 'HEALTH & AIR QUALITY', and 'WATER RESOURCES'. The 'Disasters' section is active, showing 'Disasters Webinars' and 'Disasters Workshops'. The 'Fundamentals of Remote Sensing' section offers 'On-Demand Training on Fundamentals of Remote Sensing'. The 'Upcoming Training' section lists an 'Ecoforecasting Advanced Webinar: Creating and Using Normalized Difference Vegetation Index (NDVI) from Satellite Imagery' from 02/10/2016 to 03/02/2016. The main content area features the title 'Advanced Webinar on Using NASA Remote Sensing for Flood Monitoring and Management' with dates '03/16/2016 to 04/06/2016' and times '8:00 a.m. - 9:00 a.m. EDT (UTC-4) and 4:00 - 5:00 p.m. EDT (UTC-4)'. Below the text are two satellite images of a river basin, labeled '2006' and '2011', showing changes in water levels and land cover. A paragraph below the images describes the webinar's content, including remote sensing observations, flood mapping tools, and GIS frameworks.

Links will be available here

Course Materials

Date	Title	Materials
March 15, 2016	View Week 1, Week 2, and Week 3 of NASA Remote Sensing Observations for Flood Management	Homework - due March 15
March 16, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall	Recording Slides Homework
March 23, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover	Recording Slides Homework
March 30, 2016	Overview and Access to Ancillary NASA Data for Flood Management	Recording Slides Homework
April 6, 2016	Flooding Case Studies Using NASA Web Tools and GIS	Recording Slides Homework

Homework and Certificate

- **Homework**

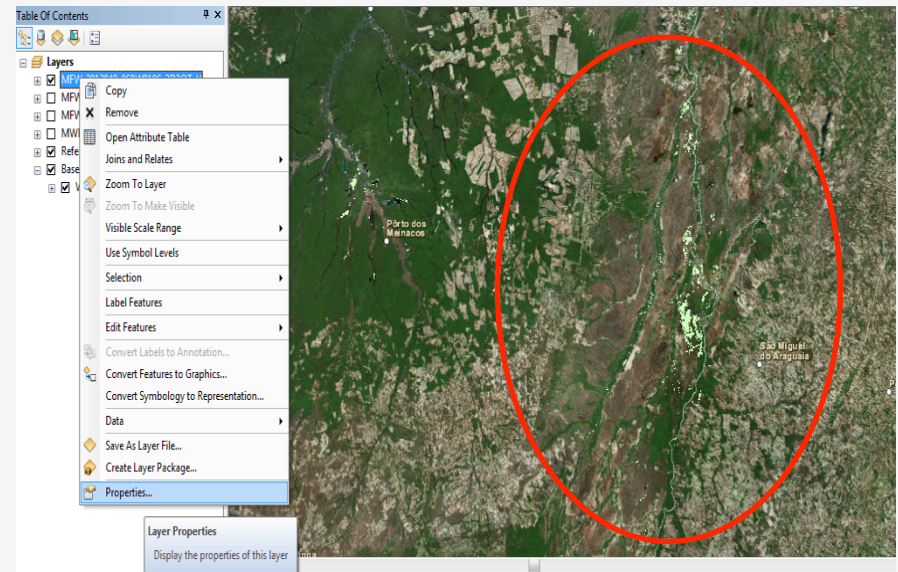
- Hands-on exercises
- Answers to homework questions via Google form
- Available at <http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

- **Certificate of Completion**

- Attend all 4 webinar sessions
- Complete all 4 homework assignments
- Certificates will be emailed approx. 2 months after the course finishes by Marines Martins (marines.martins@ssaihq.com)

Course Objectives

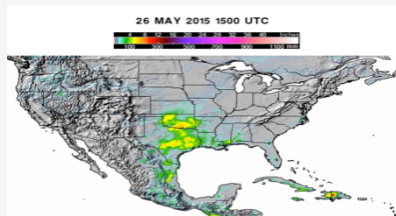
- Provide demonstrations and step-by-step instructions of NASA remote sensing-based flood monitoring tools
 - Access rainfall, streamflow, and flood intensity maps
 - Access surface inundation maps
 - Access terrain and socioeconomic data
- Provide hands-on exercises of select flood cases to learn flood risk assessment and post-flood relief planning using NASA remote sensing and ArcGIS



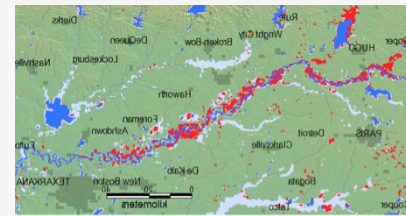
MODIS-based inundation mapping

Course Outline

Week 1: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall



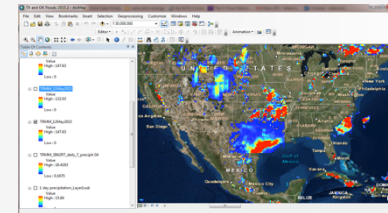
Week 2: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover



Week 3: Overview & Access to Ancillary NASA Data for Flood Management



Week 4: Flooding Case Studies Using NASA Web Tools and GIS



Flood Cases for In-Session Exercise

- Morning Session:
 - Flooding in Malawi (10-12 Jan 2015)



Image Credit: Preliminary Response Plan – Malawi Floods 2015, UN Office for the Coordination of Humanitarian Affairs, Government of Malawi

- Afternoon Session
 - Flooding in Oklahoma & Texas (12-15 May 2015)

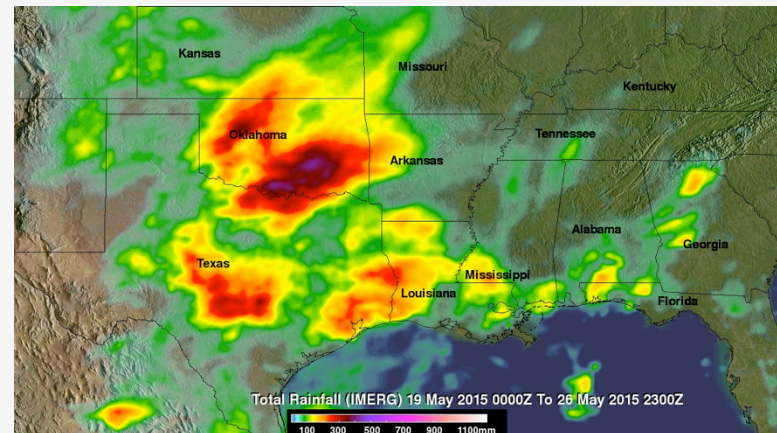


Image Credit: IMERG/GPM Total Rainfall

Flood Cases for Homework Exercise

- Morning Session:

- Flooding in Pakistan (Jul-Aug 2015)
- Flooding in India (Nov-Dec 2015)



Image Credit: Indian Navy

- Afternoon Session

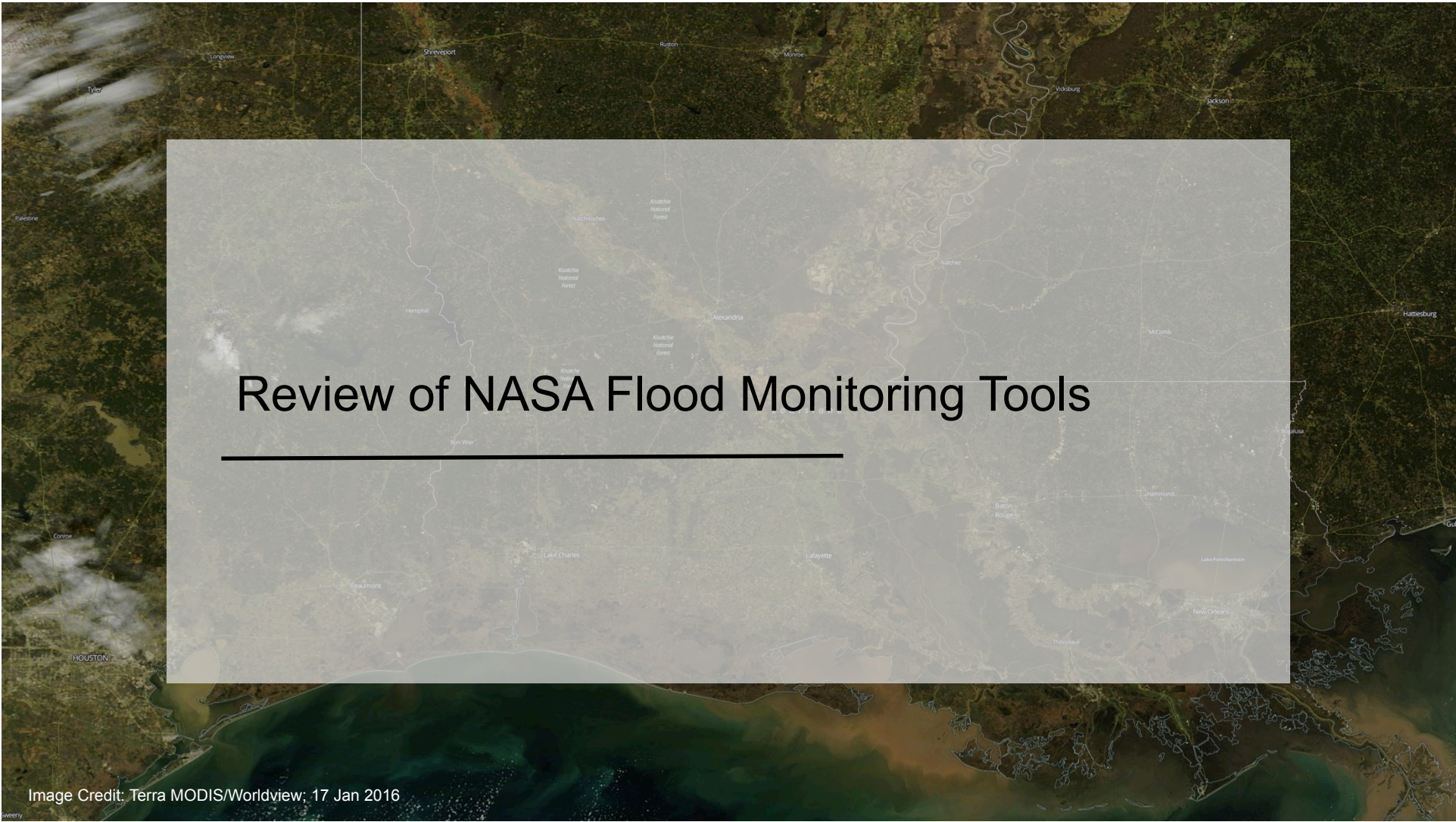
- Mississippi River Flooding (Jan 2016)
- Flooding in Bolivia & Peru



Image Credit: USGS

Agenda: Week 1

- Review of NASA flood monitoring tools
- Overview of NASA/USAID SERVIR
- Demonstration and hands-on exercise of accessing Rainfall, Streamflow, and Flood Intensity from Global Flood Monitoring System (GFMS)
- Overview and hands-on exercise of using Extreme Rainfall Detection System (ERDS) for Flood Early Warning



Review of NASA Flood Monitoring Tools

Image Credit: Terra MODIS/Worldview; 17 Jan 2016


NASA Remote Sensing Observations for Flood Monitoring


http://arset.gsfc.nasa.gov/sites/default/files/users/Flood_Week1_8June2015_Final.pdf

There are primarily 3 types of flood monitoring tools that use remote sensing observations:

1. Derive streamflow & runoff to monitor flooding conditions by using rainfall and weather data in a hydrology model
 - Global Flood Monitoring System (GFMS) <http://flood.umd.edu>
 - NASA and US Agency for International Development SERVIR : <http://www.servirglobal.net>
2. Infer flooding conditions by using satellite-derived precipitation
 - Extreme Rainfall Detection System (ERDS):
<http://playground.ithacaweb.org/apps/world/leaflet/erds2.html/#layers>
3. Detect flood water on previously dry land surfaces by using satellite-derived land-cover observations
 - MODIS NRT Global Flood Mapping: <http://oas.gsfc.nasa.gov/floodmap/>
 - Dartmouth Flood Observatory: <http://floodobservatory.colorado.edu/>

Flood Monitoring Using NASA Rainfall Observations

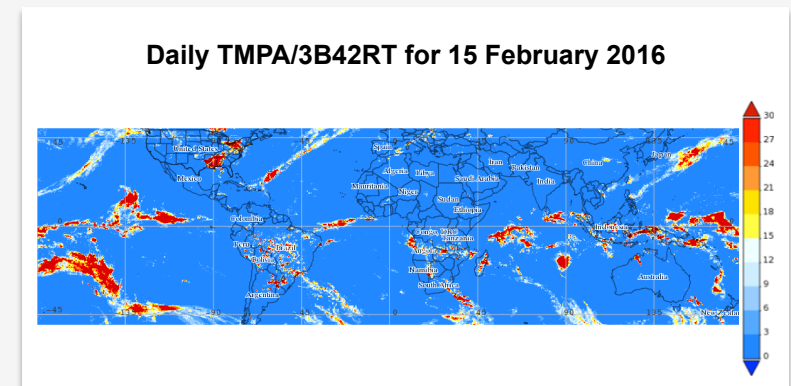
1. Derive streamflow & runoff to monitor flooding conditions by using rainfall and weather data in a hydrology model
 - Global Flood Monitoring System (GFMS) <http://flood.umd.edu> 
 - NASA and US Agency for International Development SERVIR : <http://www.servirglobal.net>

2. Infer flooding conditions by using satellite-derived precipitation
 - Extreme Rainfall Detection System (ERDS):
<http://playground.ithacaweb.org/apps/world/leaflet/erds2.html/#layers> 

NASA Rainfall Observations Used in GFMS, SERVIR, & ERDS2

Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA)

- Combines precipitation from TRMM and several national/international satellites to obtain 3-hourly, $0.25^{\circ} \times 0.25^{\circ}$ resolution data with **global coverage between 50°S to 50°N**
- TMPA will be replaced with Integrated Multi-Satellite Retrievals (IMERG) for Global Precipitation Measurement (GPM) data with half-hourly, $0.1^{\circ} \times 0.1^{\circ}$ resolution and **global coverage between 65°S to 65°N**



Note: TRMM is no longer flying, but TRMM-based calibration is used to provide near real-time rainfall from a constellation of national & international satellites for flooding applications. Near real-time IMERG data is also available from: <ftp://jsimpson.pps.eosdis.nasa.gov>



Image Credit: Terra MODIS/Worldview; 17 Jan 2016

SERVIR GLOBAL

- Works in 30 countries
- Remote Sensing-based data products and training available via websites
- Flood monitoring and mapping based on TMPA rainfall and CREST hydrologic model



SERVIR GLOBAL

REGIONS PRODUCT CATALOG DATA & MAPS TRAINING ABOUT SERVIR NEWS MULTIMEDIA

CONTACT US LOGIN

SERVIR connects space to village
by helping developing countries use information provided by Earth observing satellites and geospatial technologies to manage climate risks and land use.

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SERVIR Product Catalog

Welcome to the SERVIR Global Product Catalog, a searchable clearinghouse of our applications, projects, and tools.

<https://www.servirglobal.net/>

SERVIR Regional Activities

Reducing the impact of disasters: Malawi Hazards and Vulnerability Atlas
Published: Aug 27 2015

Around the world, natural disasters and their impacts have been on the rise. Developing countries are especially vulnerable to floods, droughts, and other extreme events. Malawi is among the most at risk. The Regional Centre for Mapping of Resources for Development (RCMRD), through its NASA/USAID supported SERVIR-Eastern and Southern Africa initiative, helps nations like Malawi use geospatial technologies to reduce disaster risk and enhance capacity in disaster management. The development of a National Hazards and Vulnerability Atlas for Malawi, launched along with a web based visualization tool on 18 August 2015 in Lilongwe, Malawi, is a prime example of their approach.

RCMRD/SERVIR collaborated with the Department of Disaster Management Affairs (DoDMA) in Malawi, United Nations Development Programme (UNDP), and others* in developing the Atlas. It is intended to minimize impacts of disasters by identifying vulnerable communities and characterizing areas at risk for hazards such as floods, droughts, forest fires, and vector-borne diseases (Malaria). The Atlas features analyses and mapping of historical hazards, climate trends, and communities' susceptibility to climate hazards and ability to adapt to them.

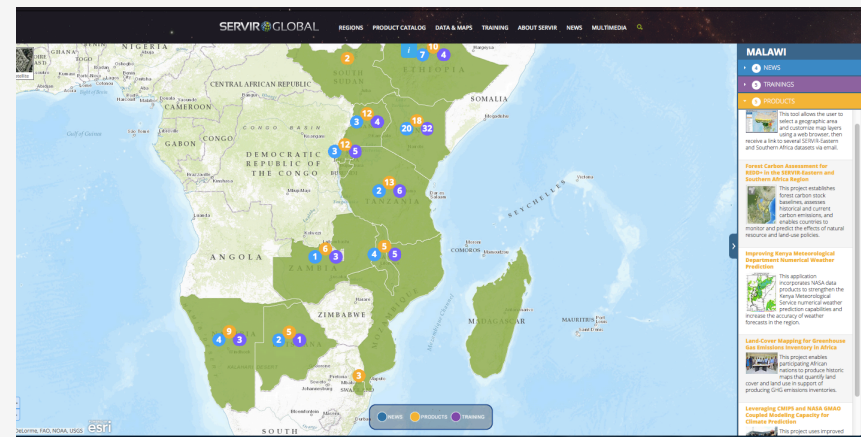
"The idea is to prepare communities so that they should know the vulnerable areas," said DoDMA Principal Secretary Bernard Sande during the launch. "In so doing, they should be able to take the necessary measures to reduce or indeed to avoid some of the disasters."

In her opening remarks at the launch ceremony, UNDP Environment Cluster Team lead Ms. Sithembiso Hlatshwako noted that the Atlas will "inform key decision making processes and ensure that vulnerable 'hot spots' are targeted, with appropriate disaster mitigating and climate adapting development interventions, so no area or community is left behind."

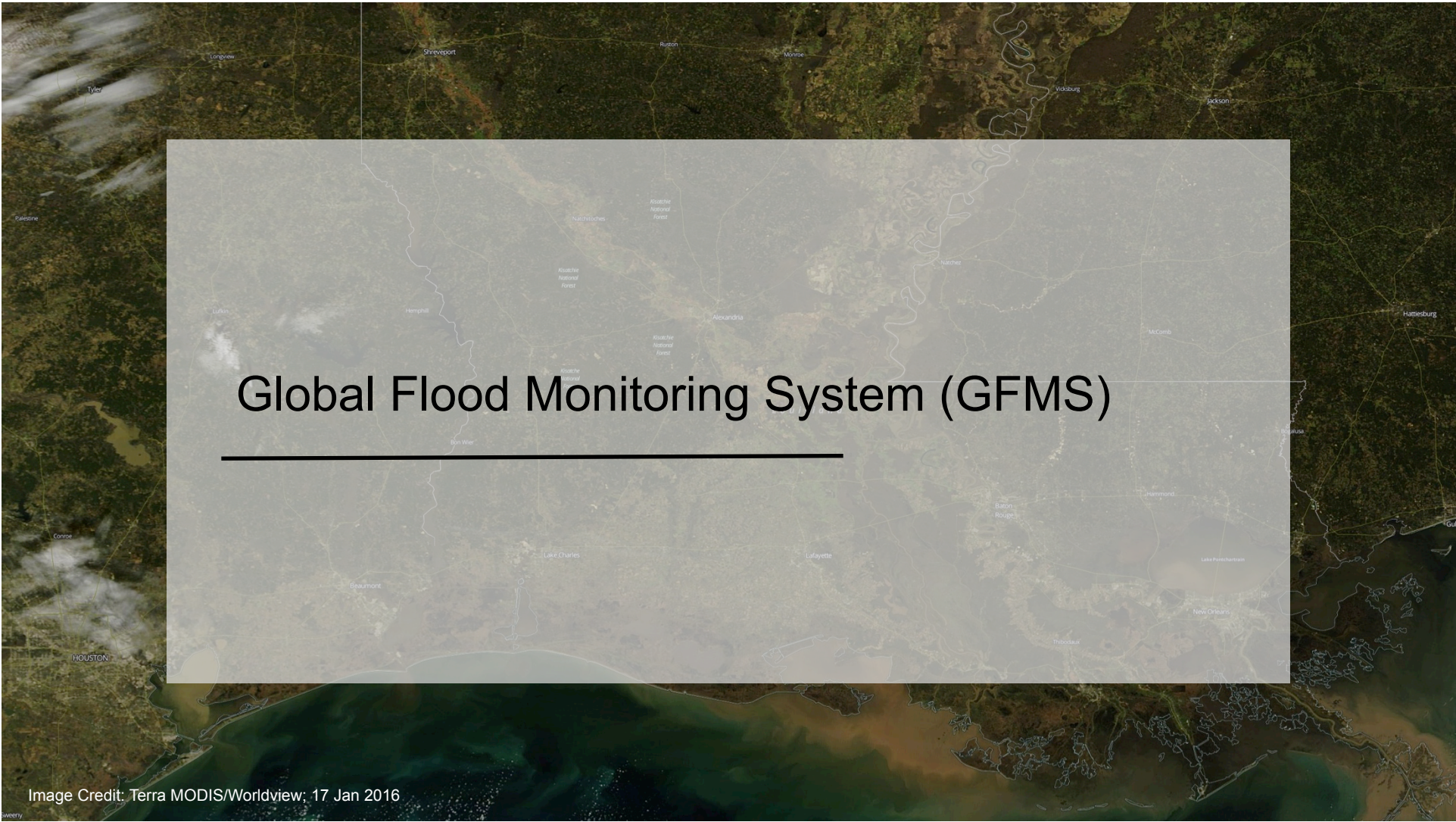
The Atlas is freely available as both hard and soft copy placed into the web.

SERVIR-Eastern & Southern Africa Disasters Program Lead
Denis Macharia presents during the launch

SERVIR-Eastern and Southern Africa initiative, helps nations like Malawi use geospatial technologies to reduce disaster risk and enhance capacity in disaster management.



<https://www.servirglobal.net/Global/Activity-Mapper?hub=africa>



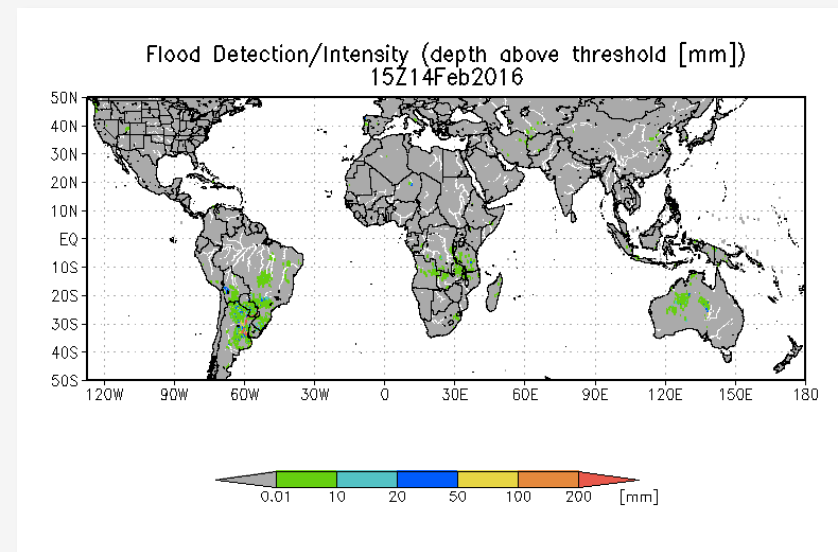
Global Flood Monitoring System (GFMS)

Image Credit: Terra MODIS/Worldview; 17 Jan 2016

GFMS

<http://flood.umd.edu>

- Provides global maps, time series, and animations (50°S-50°N) of instantaneous and accumulated rain over 24, 72, and 168 hours
- Streamflow rates and flood detection at 1/8th degree (~12km) and 1km
- Uses a hydrological model together with:
 - TMPA
 - Surface temperature and winds from NASA reanalysis model MERRA
 - Runoff generation from UW Variable Infiltration Capacity (VIC)
 - Runoff routing model from UMD





Exercise:
Global Flood Monitoring System

Image Credit: Terra MODIS/Worldview: 17 Jan 2016

A satellite image of Louisiana, showing the state's outline and major cities. A semi-transparent grey box is overlaid on the map, containing the title and URL. The background shows the Gulf of Mexico to the south and the Mississippi River delta region.

Extreme Rainfall Detection System (ERDS)

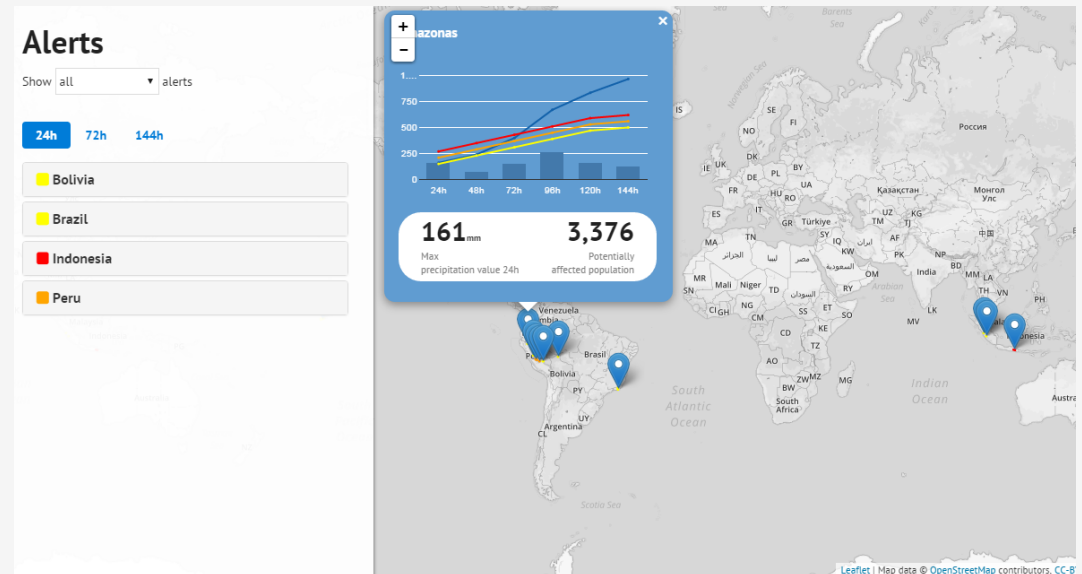
<http://erds.ithacaweb.org/>

Image Credit: Terra MODIS/Worldview; 17 Jan 2016

ERDS

<http://erds.ithacaweb.org/>

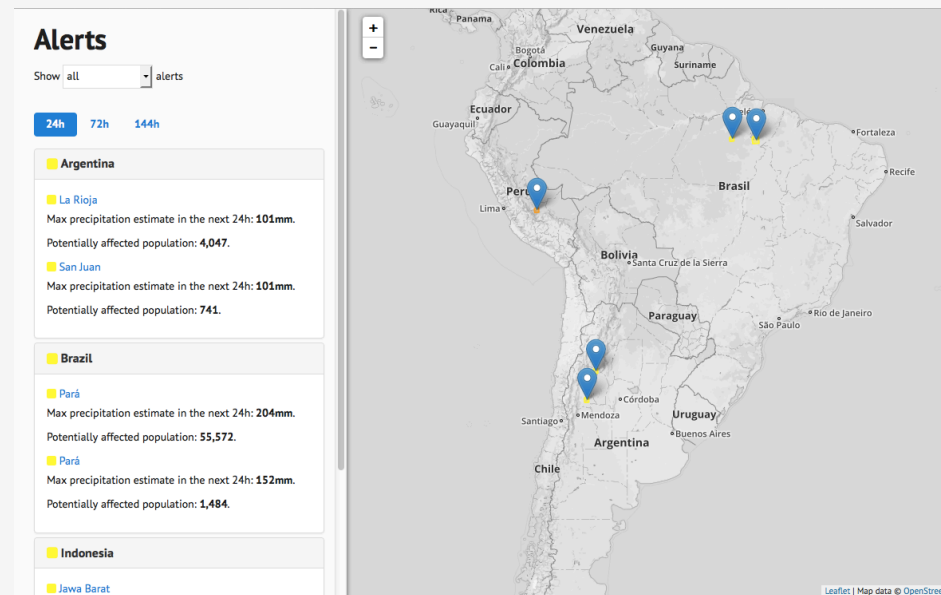
- Uses near-real time TRMM and NOAA-Global Forecasting System (GFS) data for the monitoring and forecasting of accumulated rainfall
- TRMM historical archive is used for the calculation of extreme rainfall thresholds
- The combination of TRMM near real-time rainfall amount and GFS forecasted rainfall information, along with reference data are used to generate value-added and flooding event-specific information



ERDS

<http://erds.ithacaweb.org/>

- Provides global maps and time series of near-real time (50°S-50°N) and forecasted accumulated rainfall over 24, 48, 72, 96, 120 and 144 hours
- Provides extreme rainfall alerts at at 0.25°x0.25° level and at administrative districts level
- Provides event-specific information such as the list of the affected countries and an estimation of the affected population
- Currently the ERDS system is one of the tools used by OMEP, UN World Food Programme (WFP) Emergency Preparedness Unit





Exercise:
Extreme Rainfall Detection System (ERDS)

Image Credit: Terra MODIS/Worldview; 17 Jan 2016

Coming Up Next Week

Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover

- Demonstration and hands-on exercises on inundation mapping using remote sensing of land cover from Terra and Aqua – Moderate Resolution Imaging Spectroradiometer (MODIS)
 - Dartmouth Flood Observatory
 - MODIS Near Real-Time Global Flood Mapping
 - Exercise of MODIS Flood Mapping using QGIS

Thank You

The recording of today's session will be available shortly at
<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>