

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

## Flood Monitoring using NASA Remote Sensing Data

Course Dates: November 19, 26 December 3, 10  
Time: 8-9 a.m. Eastern U.S. Time (13-14 p.m. UTC)



**ARSET**

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



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

Modules in English  
and Spanish

Case  
Studies

Upcoming trainings

Sign-up to listserv<sup>2</sup>

NASA  
National Aeronautics & Space Administration  
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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
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- Publications
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### 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.](#)

**Certificates of Completion (upon request):**

**You must attend all 4 live sessions**

**You must submit the homework assignment**

**For Webinar Recording Link :**

Contact : Marines Martins

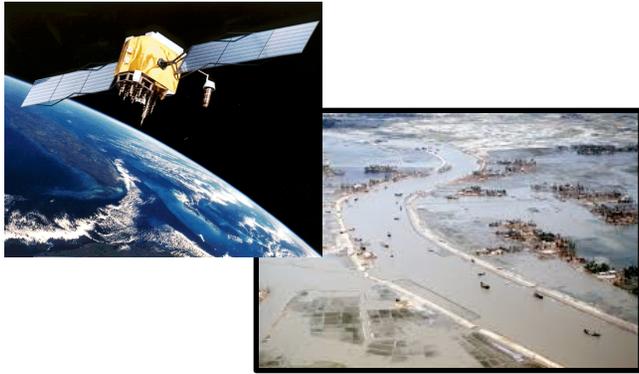
Email: [marines.martins@ssaihq.com](mailto:marines.martins@ssaihq.com)

# Assignment Link

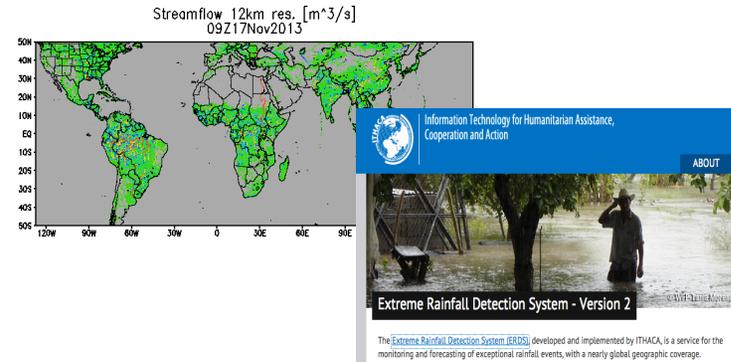
- <https://docs.google.com/forms/d/1UhetoLVRWOKP8735qio4zjd5bI5YF4CpmUZFh1x9Qn4/viewform>

Please complete the assignment on-line by  
15 January 2014

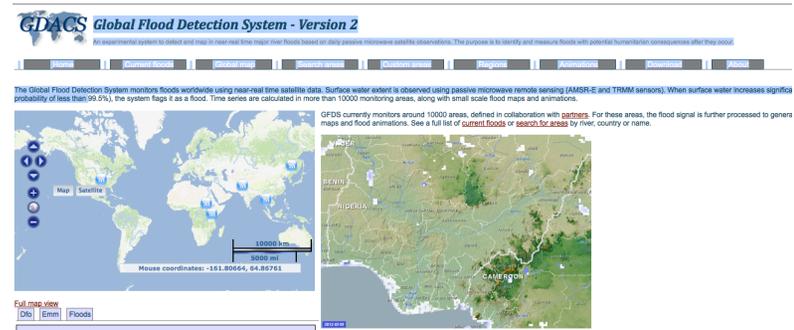
# Course Outline



Week 1: Overview of Remote Sensing and Flooding Tools



Week 2: TRMM-based Tools - Extreme Rainfall Detection System and Global Flood Monitoring System



Week 3: MODIS-based Tools – MODIS Inundation and Dartmouth Flood Observatory

Week-4: Flooding case studies with GIS, Global Flood Detection System

# Interactive Flood Tools

## **TRMM Rainfall-based Tools** (Week 2, 26 November)

- **NASA-TRMM Current Heavy Rain, Flood, and Landslide Estimates**
- **Global Flood Monitoring System (GFMS)**
- **Extreme Rainfall Detection System (ERDS)**

## **MODIS Reflectance-based Tools** (Week 3, 3 December)

- **Global MODIS Inundation Mapping**
- **Dartmouth Flood Observatory (DFO)**

# Outline for Week-4

## ➤ **Demonstration of Flooding Cases with:**

- TRMM Extreme Rainfall
- Global Flood Monitoring System
- MODIS Inundation Tool

## ➤ **Overview and Demonstration of:**

Global Flood Detection System/Global Disaster Alert and Coordination System

## ➤ **Course Summary**

# **Flooding Case Studies with GIS Applications**

## **Global Flood Detection System (GFDS)**

<http://www.gdacs.org/flooddetection>

## Global Flood Detection System (GFDS)

<http://www.gdacs.org/flooddetection>

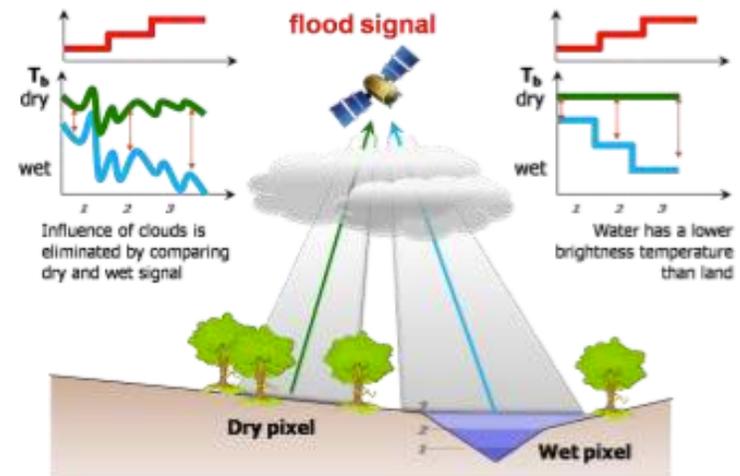
- A component of Global Disaster Alert and Coordination System (**GDACS**) – Developed by European Commission - Joint Research Center
- Provides global, **event-based** information
- Utilizes remote sensing information for flood detection
- Open for collaboration with water authorities and researchers
- As a part of GDACS, augment humanitarian and disaster information

# Global Flood Detection System (GFDS)

<http://www.gdacs.org/flooddetection>

- Monitors floods worldwide using near-real time NASA satellite data (TRMM, Aqua).
- Surface water extent is observed using passive microwave remote sensing (37 Ghz measurements from Aqua/AMSR-E and TRMM Microwave Imager) – Similar to the methodology used by the the Dartmouth Flood Observatory

Microwave measurements change substantially from dry to wet land - the change in microwave measurement signal from dry to wet is used to detect the presence of surface water over previously dry land



# Global Flood Detection System (GFDS)

<http://www.gdacs.org/flooddetection>

- Flood signal and magnitude are derived at  $8 \times 12 \text{ km}^2$  from AMSR-E ( $9 \times 16 \text{ km}^2$  for TRMM). Data are available since 1998 from TRMM and since 2002 from AMSR-E
- At a number of river sites, the remote sensing measurements are used to generate flooding time series, maps, and animations

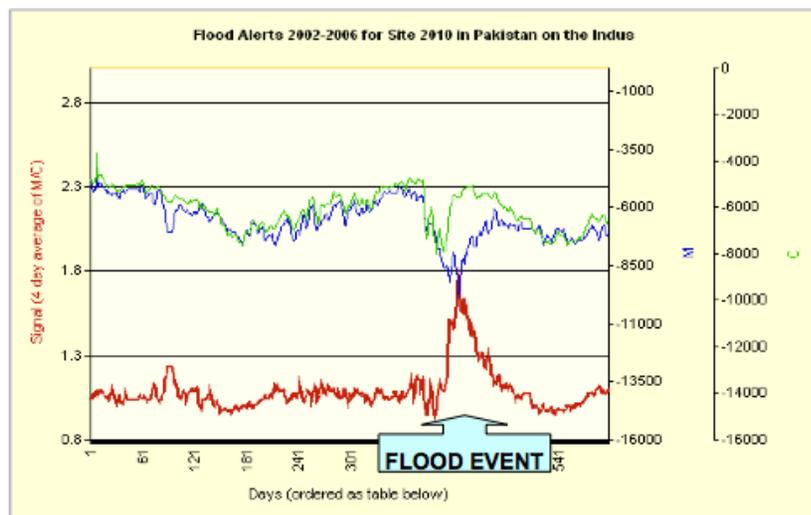


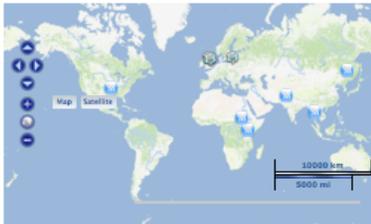
Figure 5. Flood event detected on the River Indus in Pakistan in September 2003 from the M/C time series (red line).

- No river gauging data or hydrologic model are used for the flood magnitude mapping as used by the DFO
- Pats time series of microwave signals are used to assess the the flood magnitude

# Global Flood Detection System

<http://www.gdacs.org/flooddetection/>

The Global Flood Detection System monitors floods worldwide using near-real time satellite data. Surface water extent is observed using passive microwave remote sensing (AMSR-E and TRMM sensors). When surface water increases significantly (anomalies with probability of less than 99.5%), the system flags it as a flood. Time series are calculated in more than 10000 monitoring areas, along with small scale flood maps and animations.



GDACS currently monitors around 10000 areas, defined in collaboration with partners. For these areas, the flood signal is further processed to generate time series, flood maps and flood animations. See a full list of [current floods](#) or [search for areas](#) by river, country or name.

Full map view:  
Site | Emiss | Floods

- Site 12317 in Syria (on river Euphrates) | 5.85714159158855: Magnitude detected: Site 11937 ( River Euphrates)
- Site 11897 in China (on river Mekong) | 5.93688888888889: Magnitude detected: Site 11440 ( River Mekong)
- Site 11808 in Sudan (on river Nile) | 5.833002875362: Magnitude detected: Site 11377 ( River Nile)
- Site 12316 in Iran (on river Euphrates) | 5.834338671905: Magnitude detected: Site 11906 ( River Euphrates)
- Site 11403 in Democratic Republic of the Congo (on river Ubang) | 5.802977135075: Magnitude detected: Site 10950 ( River Ubang)
- Site 10890 in Peru (on river Purus) | 5.4397: Magnitude detected: Site 10425 ( River Purus)
- Site 12386 in China (on river Huang He) | 5.428041348888: Magnitude detected: Site 11976 ( River Huang He)
- Site 12348 in Iraq (on river Euphrates) | 5.315538826142: Magnitude detected: Site 11938 ( River Euphrates)
- Site 12170 in Iraq (on river Shatt al Arab) | 5.0534752653796: Magnitude detected: Site 11753 ( River Shatt al Arab)
- Site 15132 in Brazil (on river Doce) | 4.85181163197481: Magnitude detected: ANA Doce Maria de Carvalho

All data are available as global raster maps. The brightness temperature measured by AMSR-E and TRMM sensors is normalized into a water signal (showing the amount of surface water in each pixel). For each pixel, anomalies in surface water are calculated by comparing the values to the normal surface water (see methodology). The flood magnitude is defined as the number of standard deviations above the mean.



We're open for collaboration with water authorities and researchers. You can [request](#) access to the data, [download client software](#) or set up your own monitoring sites.

Please note that the information provided on this website has no official status and does not replace local flood warnings. Please refer to the competent local hydrographic authorities for official information on the flood status in each country.  
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In Collaboration with the  
Dartmouth Flood Observatory

## Global Disaster Alert and Coordination System (GDACS) <http://www.gdacs.org/>

- Developed by European Commission Joint Research Center, GDACS provides a platform to share and coordinate disaster maps and satellite images
- Includes information about current and past disaster events (floods, tropical cyclones, earthquakes)
- Compiles remote sensing, *in situ*, and humanitarian information
- Used by various governmental, non-governmental entities for decision support
- Free data download possible by registered users

## Global Disaster Alert and Coordination System (GDACS) <http://www.gdacs.org/>

- Use a multitude of satellites/sensors, facilitated by the United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT): TRMM-TMPA, Terra and Aqua/MODIS, Aqua/AMSR, NOAA Operational Satellites, TerraSAR-X, SPOT-5, Worldview-1
- Integrates *Office for the Coordination of Humanitarian Affairs (OCHA) ReliefWeb* reports and maps as well as disaster related information from other sources.

# Global Disaster Alert and Coordination System (GDACS)

<http://www.gdacs.org/>

The screenshot shows the GDACS website homepage. At the top, there is a navigation bar with links for HOME, ALERTS, VIRTUAL OSOCC, DATA, MAPS & SATELLITE IMAGERY, SCIENCE PORTAL, and ABOUT GDACS. The main content area is divided into four columns: Latest disaster alerts, Current emergencies, News about GDACS, and Members. The Latest disaster alerts column lists earthquakes and tropical cyclones. The Current emergencies column features a map of the latest disaster alerts and details for Tropical Cyclone Haiyan. The News about GDACS column contains a news article about Haiyan. The Members column includes a login form with fields for Username and Password, and buttons for Virtual OSOCC and Disaster alert account.

**GDACS**  
Global Disaster Alert and Coordination System

GDACS is a cooperation framework between the United Nations, the European Commission and disaster managers worldwide to improve alerts, information exchange and coordination in the first phase after major sudden-onset disasters.

United Nations and the European Commission

HOME | ALERTS | VIRTUAL OSOCC | DATA, MAPS & SATELLITE IMAGERY | SCIENCE PORTAL | ABOUT GDACS

Latest disaster alerts	Current emergencies	News about GDACS	Members
<b>EARTHQUAKES</b> <ul style="list-style-type: none"><li>Turkey (4.8M) 27 Nov 04:13UTC</li><li>Falkland Islands (Malvinas) (7M) 25 Nov 08:27UTC</li><li>Turkey (4.9M) 24 Nov 20:49UTC</li><li>Iran, Islamic Republic of (4.7M) 24 Nov 18:03UTC</li><li>Kyrgyzstan (4.9M) 23 Nov 09:42UTC</li><li>Tonga (6.5M) 23 Nov 07:48UTC</li></ul> <b>TROPICAL CYCLONES</b> <ul style="list-style-type: none"><li>LEHAR-13 India (138.4km/h) 27 Nov 12:00UTC</li><li>ALESSIA-13 Australia (83.7km/h) 27 Nov 08:00UTC</li></ul>	<b>OPEN EMERGENCIES</b> <ul style="list-style-type: none"><li>Tropical Cyclone Haiyan (Philippines) 5-Nov- updated: 22-Nov-2013 TC-2013-000139-PHL</li></ul> <b>Overview map of latest disaster alerts</b>	<b>LATEST NEWS</b> <ul style="list-style-type: none"><li><b>Tropical cyclone Haiyan</b> 11 Nov 00:00UTC</li><li>Data about Haiyan is available in the <a href="#">GDACS report</a>. Emergency management information is in the <a href="#">Virtual OSOCC</a>. Some partners of GDACS are producing maps related to Haiyan. <a href="#">UNOSAT</a> activated the <a href="#">International Charter</a> on Space and Major Disasters. The EU Copernicus</li></ul>	<b>LOG IN</b> <ul style="list-style-type: none"><li>Username <input type="text"/></li><li>Password <input type="password"/></li><li>Log into <input type="button" value="Virtual OSOCC"/></li><li><input type="button" value="Disaster alert account"/></li><li>User name can be different for different services. To create an account, log in without username.</li></ul>

# Global Disaster Alert and Coordination System (GDACS)

<http://www.gdacs.org/>

The screenshot displays the GDACS website interface. At the top, a yellow banner reads "Overview map of latest disaster alerts". Below this is a world map with several green and yellow markers indicating disaster locations. To the left of the map, a sidebar contains a list of links under the heading "Disasters in past 4 days.", including "See smaller and archived alerts...", "Search alerts...", "About thresholds and models", and "About earthquake selection". Below the map, a text box states: "Map of disaster alerts in the past 4 days. Last 24 hours events are highlighted in yellow. Small earthquakes are shown as green boxes." The main content area is divided into four columns: "Documents" (with links to "GDACS Information Management Guidelines (draft)" and "Chairman Summary of 2011 GDACS Stakeholder Meeting"), "More..." (with links to "Satellite maps", "Global Flood Initiative", "Beta products", "GDACS platform", and "GDACS monitor"), "Mobile Apps" (with icons for Android and iOS), and "Community" (with social media icons for Facebook and Twitter, and a "Follow" section for @gdacs). At the bottom, there are icons for "RSS", "KML", "Google", and "JRC Maps". A red box highlights the "Satellite maps" link in the "More..." section, with an arrow pointing to it from a larger text box.

Disasters in past 4 days.

- [See smaller and archived alerts...](#)
- [Search alerts...](#)
- [About thresholds and models](#)
- [About earthquake selection](#)

GDACS includes Global Flood Working Group and Global Flood Detection System

Map of disaster alerts in the past 4 days. Last 24 hours events are highlighted in yellow. Small earthquakes are shown as green boxes.

Documents	More...	Mobile Apps	Community
<a href="#">GDACS Information Management Guidelines (draft)</a> 2011-05-26T15:09:42.853	<a href="#">Satellite maps</a> . Rapid post-disaster maps from various sources. <a href="#">Global Flood Initiative</a>	Get alerts on your smart phone and feed back information from the field using various apps. [Android icon] [iOS icon]	[Facebook icon] [Twitter icon]
<a href="#">Chairman Summary of 2011 GDACS Stakeholder Meeting</a> 2011-05-26T15:06:26.523	<a href="#">Beta products</a> . Social media, flood monitoring <a href="#">GDACS platform</a> . Resources for developers <a href="#">GDACS monitor</a> . View for operation rooms	<b>Disaster event feeds</b> [RSS icon] [KML icon] [Google icon] [JRC Maps icon]	<b>Follow</b> Follow @gdacs 1,990 followers +1 101 Recommend 2.7k

Feedback

Not finding your way to the new GDACS

# Summary of the Course

## The Following Flood Tools were Introduced:

- NASA-TRMM Current Heavy Rain, Flood, and Landslide Estimates  
[[http://trmm.gsfc.nasa.gov/publications\\_dir/potential\\_flood\\_hydro.html](http://trmm.gsfc.nasa.gov/publications_dir/potential_flood_hydro.html)]
- Global Flood Monitoring System (GFMS)  
[<http://flood.umd.edu/>]
- Extreme Rainfall Detection System (ERDS)  
[<http://www.ithacaweb.org/projects/erds/>]
- Global MODIS Inundation Mapping  
[<http://oas.gsfc.nasa.gov/floodmap/>]
- Dartmouth Flood Observatory (DFO)  
[<http://floodobservatory.colorado.edu/>]
- Global Disaster Alert and Coordination System (GDACS)/  
Global Flood Detection System (GFDS)  
[<http://new.gdacs.org/>] [<http://www.gdacs.org/flooddetection/>]

## The Flood Tools used three basic concepts:

TRMM provides direct observation of rainfall. The rainfall data are either directly used for inferring to flooding or are used in conjunction with hydrologic models to derive streamflow or runoff. (GFMS, ERDS)

MODIS provides observations of land-surface. MODIS reflectance from various bands indicate presence of water on land surface. (MODIS NRT, DFO)

AMSR-E and TRMM microwave data provides information about surface conditions (dry or wet) (DFO, GFDS)

## Flood Tools Using TRMM Rainfall

Flood Tool	Satellite/ Instrument Or Model	Quantities Used as Inputs	Hydrological Model
NASA- TRMM	TRMM/ TMPA-RT	Rain Rate	NRC-CN <sup>1,2</sup>
GFMS	TRMM/ TMPA- RT  MERRA	Rain Rate  Surface Temperature Winds	VIC- UMD DRTR <sup>3</sup>
ERDS	NOA-GFS <sup>4</sup>	Rain Rate	N/A

<sup>1</sup>Natural Resources Conservation Service (NRCS) runoff curve number (CN) method

<sup>2</sup>The Couples Routing and Excess Storage (CREST) distributed hydrology model

<sup>3</sup>The University of Washington Variable Infiltration Capacity (VIC) land surface model coupled with the University of Maryland Dominant River Tracing Routing (DRTR) model

<sup>4</sup>NOAA Global Forecasting System

# Flood Tools Using TRMM and Aqua Microwave Measurements

Flood Tool	Satellite/ Instrument Or Model	Quantities Used as Inputs	Hydrological Model
DFO	TRMM/TMI and Aqua/ AMSR-E	37 Ghz Brightness Temperature	Global Water Balance Model
GFDS	↓	↓	N/A

# Flood Tools using MODIS Reflectance Data

Flood Tool	Satellite/ (Instrument	Quantity Used
MODIS NRT	Terra and Aqua/MODIS	Reflectance Bands 1, 2, 7
DFO	Terra and Aqua / MODIS	Reflectance Bands 1, 2, 7

# Information Provided by the Flood Tools

## Flooding Monitoring Output

Flood Tool	Flood potential/ Intensity	River Discharge/ Streamflow	Inundation Map
NASA-TRMM	Near-real Time		
GFMS	Near-real Time and Archives	Near-real Time and Archives	
ERDS	Near-real Time and Forecast		
MODIS/NRT			Near-real Time and Archives
DFO		Near-real Time and Archives	Near-real Time
GFDS	Near-real Time and Archives		

# More About the Flood Tools

Flood Monitoring Tool	Spatial Coverage and Resolution	Comment
NASA-TRMM NRT	50°S-50°N 12 Km	Includes GFMS, Landslide Potential
GFMS	50°S-50°N 12 Km	Will be available at 1Km resolution. Predictive capability will be added soon
ERDS	50°S-50°N 25 Km	Advanced flood warning
MODIS NRT	Global 250 M	May not be effective in presence of clouds
DFO	Global 250 m and 10 km →	Same as MODIS NRT. River discharge data derived from TMI and AMSR
GFDS	Global About 10 km	Flood Detection and Magnitude

## Advanced Webinars/Hands-on Trainings

Include specific applications/decision support activities and relevant data product(s) and tool(s).

- High resolution satellite data access tools
- 'Hands-on' case studies for data access/download and import in to GIS
- Data accuracy and validation for specific data products
- Additional data access: weather and climate, terrain, land use, socioeconomic data



## To Conclude:

- The Flood Tools are free and easy to use
- ARSET Team works with end-users/ organizations to design and provide advanced webinars and ‘hands-on’ trainings that facilitate the use of NASA data for decision support





## Upcoming ARSET Trainings in 2014

- Webinar On NASA Land Products
- Webinar/hands-on Training on NASA Water Resources/  
Drought Monitoring
- Hands-on Training about NASA Snow Products for  
Applications in California (US)

**Please join our ListServ for  
Training Announcements:**

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

# Thank You

**ARSET**

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

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