# Use of Earth Observation for Disaster Response: Case Study From Sri Lanka



Srimal Samansiri Assistant Director Disaster Management Centre Sri Lanka

# 1974 – 2016 Trend Analysis



#### **Disaster Damage and Loss is 0.5 GPS**

Source: World Bank







Colombo Floods May 2016 Char.

### Summary of Earth Observation by Sentinel Asia / Intnl Charter

	Disaster Type	Activation Requeste d	Observation Conduc ted	Map Disseminat ed	Peak Time of Disaster	Data	Result
1	Floods	17th Dec 2009	18 Dec 2009	No map generated	16 Dec 2009	ALOS Prism	Un successful due to cloud
2	Floods	17 May 2010	19 May 2010	20 May 2010	18 May 2010	ALOS Palsar	Successful
3	Floods	08 Dec 2010	09 Dec 2010	10 Dec 2010	8-10 Dec 2010	ALOS Palsar	Successful
4	Floods	11 Jan 2011	13 Jan 2011	14 Jan 2011	10-12 Jan 2011	ALOS Palsar	Successful
5	Floods	04 Feb 2011	06 Feb 2011	07 Feb 2011	03-05 Feb 2011	ALOS Palsar	Successful
6	Landslide	01 Nov 2014	02 Nov 2014	Not generated	30 Oct 2014	ALOS 2	Observation was Successful Results was <b>not Successful</b>
7	Floods	29 Sep 2015	01 Oct 2015	02 Oct 2015	30 Sep 2016	ALOS 2	Successful
8	Floods Landslide	1 <sup>st</sup> observation 14 May 2016	16 May 2016	18 May 2016	30 Oct 2014	ALOS 2 / TerraSARx	Successful
9	Floods Landslide	1 <sup>st</sup> observation 26 May 2017	28 May 2017	29 May 2017	26 May 2017	TerraSARx / Intnl Charter	Successful

# Sri Lanka with Sentinel Asia



**Disaster Management Centre** officially started SAS Operations since **February 2009** 

08 emergency successful activations

Became Data Analysis Node (DAN) in 2010

WINDS receiver has been

# Efficiency of Satellite Activation (Case – May 2010)

Date	Time	Action				
2010.05.17	-	Third consecutive day received heavy rain to Western province.				
2010.05.17	14.00	ConsItation with Met. Department, Mr. UWL Chandradasa, Dr. Ananda Mallawatantri and Mr. RMS Bandara				
2010.05.17	18.00	Request image activation via SMS to JAXA Satellite tracking Centre @Tsukuba				
2010.05.18	8.30	Received satellite observation plan, to be utilize ALOS PALSAR				
2010.05.19 17.30   2010.05.20 8.30		Emergency observation over Western Province				
		Received ALOS Palsar raw data from JAXA				
2010.05.20	16.30	Produced draft inundation maps and uploaded to the web				

#### Observation can be made within 48 hours

RADAR is an acronym that stands for:

Radio Detection and Ranging



# Flood 2008 May

Use of Near Real Time Earth Observation for Emergencies Maps are available <u>www.dmc.gov.lk</u>



Kalutara District - Floods 2008/06/03 ALOS Data

### Flood May 2010 Western Province





### Flood February 2011 Eastern Province Sri Lanka



10.30 am 06th Feb. 2011 PALSAR 6m

11.45 pm 06th Feb. 2011 PALSAR 100m



### Meeriyabedda Landslide – Sentinel Asia (ALOS2)



Acquisition 31 Oct 2014

### Meeriyabedda Landslide – Intnl Charter (Terra SAR X)



Acquisition 04 Nov 2014

### Meeriyabedda Landslide – International Charter (ASTER)



disaster images were acquired by ASTER satellite. Please note that the accuracy of the product is not guaranteed.

Pre Image: World View 2 Resolution: 2m Acquisition Date: 08 - April-2012 Copyright: (C) COPYRIGHT 2012 DigitalGlobe Post Image: ASTER Resolution: 15m Acquisition Date: 06-Nov-2014 Coordinate System: Geographic Datum: WGS 1984 Unit: Degree



### Flood Southern Province – September 30, 2015

#### Mapping Floods in Southern Provinces - Sri Lanka using ALOS-2 PALSAR-2 Satellite Images



IWMI and DMC in close association with Sentinel Asia System (SAS) and JAXA activated the charter on October 1, 2015 to provide satellite images covering the Southern Provinces. SAS quickly provided images of 30 September 2015 and 1st October 2015 for its use in emergency response and relief operation. IWMI using the IFMAN tool processed the flood extent covering the districts of Hambantota, Galle, Matara, Monaragala and Ratnapura.

In total an area of 365 sq.km were inundated as viewed by ALOS PALSAR Satellite images taken on 30 September 2015. Approximately 150sq.km of paddy fields were flooded. The data sources from Survey Department of Sri Lanka was used for this analysis purpose. Major flooded affected divisions are Hambantota, Tanamaiwila, Lunugamwehara, Tissamaharama, Wellawaya and Embilipitya. In terms of major paddy field affected division's area Hambantota, Tanamalwila, Tissamaharama, Lunugamwehara and Tangalla. For the ALOS PALSAR-2 images taken on 1st October 2015, the affected districts are mainly the Matara and Galle. The divisions that includes Thihagoda, Kamburupitiya, Malimbada, Akuressa, Mulatiyana. In total 15 divisions were affected with a maximum inundation of 89sq.km of which paddy field affected area is 47sq.km. The division with paddy field affected areas are Thihagoda, Malimbada, Kamburupitiya.





The analysis excluded permanent water bodies including reservoir, tanks and ponds and this reflects only the inundation extent. Please note the surface water extent mapped has not yet been validated in the field.

02 October 2015 | FL-2015-0001-SL | Version 1.1

The depiction and use of boundaries, geographic names and related data shown in these maps are based on the sources they have been drawn from and quoted. These are neither error-free nor do they imply official endorsement or the position of IWMI.







# **Historical Flood Mapping**

Map historical flood events by Satellites

















Figure 3: Part of the Maximum Flood Extent map in Western Sri Lanka in May 2010



Flood Map of Sri Lanka

Compiled based satellite and field observation

# Experience from Flood and Landslide May 2016

- ✓ Activated Sentinel Asia
- Activated International Disaster Charter
- ✓ Activated Humanitarian Openstreet Team (HOT)
- ✓ GFDRR provided post disaster images over Aranayake
- ✓ IWMI and OCHA Deployed at DMC
- ✓ Survey Department Ground Mapping



Source: Meteorology Department

Highest Rainfall :180.4 mm at Wagolla

Highest Rainfall :373.2 mm at KILINOCHCHI

# Rainfall 13 – 19 May 2016





# Satellites Contributed Data

### **Radar Satellites**

- 1. ALOS Palsar Japan
- 2. RISAT India
- 3. Radar Sat Canada
- 4. Terra SAR X Germany

**Optical Satellites** 

1. Plaides – France (0.5 m)

#### Aranayake – Landslide 16<sup>th</sup> May 2016



#### PRE IMAGE March 2016

POST IMAGE June 2016



#### FLOOD IN GAMPAHA, SRI LANKA - Detected by TerraSAR-X on 19.05.2016

Datum: GCS\_WGS84

# Field Mapping - Kelani





### Flood and Landslide May 2017



Palegoda

Junction

Baduraliya

Kalutar

Beruwala

vithigala

Sinharaja Suriy

God



# Satellite Activated

Satellite	Program	Observation Date	
Resource Sat 2	Sentinel Asia	27 May 2017	
TerraSAR x (Radar)	International Charter	28 May 2017	
Sentinel 2	International Charter	28 May 2017	
THEOS	Sentinel Asia	28 May 2017	
RadarSat2 (Radar)	International Charter	29 May 2017	
TerraSAR x (Radar)	International Charter	30 May 2017	
ALOS Palsar (Radar)	Sentinel Asia	30 May 2017	
Sentinel 1 (Radar)	International Charter	30 May 2017	
Resource Sat 2	Sentinel Asia	30 May 2017	
KOMPSAT5	Sentinel Asia	30 May 2017	

#### Flood May 2017 - Walawe

Mapping Inundation extent for Ambalantota (Hambantota District) in Suthern Province (Sri Lanka) using ESA Sentinel-1 Satellite Data (30 May 2017)



### Flood May 2017 – Nilwala River

Mapping Inundation extent for Gin Ganga in Southern Province (Sri Lanka) using ESA Sentinel-1 Satellite Data (30 May 2017)



### Flood May 2017 - Kalu

Mapping Inundation extent for Kalutara District in Western Province (Sri Lanka) using ESA Sentinel-1 Satellite Data (30 May 2017)



### Flood May 2017 - Kalu

Mapping Inundation extent for Southern and parts of Western and Sabaragamuwa Provinces in Sri Lanka using TerraSAR-X Satellite Data



#### Mapping Inundation extent for Matara and its surroundings in Southern Province (Sri Lanka) using TerraSAR-X Satellite Data (28May2017)



#### Mapping Inundation extent for Kalu Ganga basin in Western Province (Sri Lanka) using TerraSAR-X Satellite Data (28May2017)



### **DROUGHT 2017 from the space**



Dec 2016

Jan 2017

Feb 2017

Mar 2017

Apr 2017

May 2017

#### Measurement of VCI and NDVI







#### **Drinking Water Scarecity**

### Two Extremes DROUGHT & FLOODS 2017 MAY



**FLOODS** - 0.7 Million Population Affected

**DROUGHT** 1.0 Million Population Affected

### 2017 FLOOD IMPACT RAPID ASSESSMENT



### 2017 FLOOD IMPACT RAPID ASSESSMENT













Organization	Satellite Data Acquisition	Airborne Data Acquistion	UAV Acquisition	Field Data Collectio n	Data Processing/ Analysis
Disaster Management Centre	Yes	No	No	Yes	Yes
Survey Department of Sri Lanka	No	No	Yes	Yes	Yes
Arthur C Clerk Centre for Modern Technology	Yes	No	Yes	No	Yes
Department of Irrigation	No	No	No	No	Yes
Department of Meteorology	No	No	No	Yes	Yes
National Aquatic Resources Research and Development Agency (NARA)	No	No	No	No	Yes
Coast Conservation and Coastal Resources Department	No	No	No	No	Yes
National Building Research Organization (NBRO)	No	No	Yes	Yes	Yes
Mahaweli Authority of Sri Lanka	No	No	No	Yes	Yes
Centre for Research and Development (CRD), Ministry of Defense	No	No	Yes	Yes	Yes
Sri Lanka Air force	No	Yes	Yes	No	No
Sri Lanka Navy	No	No	No	Yes	No
Sri Lankan Army	No	No	Yes	Yes	Yes
PGIC/University of Peradeniya	No	No	Yes	Yes	Yes
UCSC/ University of Colombo	No	No	No	Yes	Yes
ERE/ University of Moratuwa	No	No	No	Yes	Yes
Department of Census and Statistics	No	No	No	Ves	Ves

#### Strategy

- Common Data
- Standard Procedures
- Pre-agreed output

#### Outcome

- -Reduce duplication
- -Efficient resource mobilization
- -Timely outputs







Memorandum of Understanding

eation of an inter-institutional **National Emergency Mapping Mechanism** (NEMM) lead by the lanagement Center and the Survey Department of Sri <u>lanka</u>, to be on-call and activate upon n of disasters and emergencies in order to coordinate efforts for the rapid delivery of maps atial analysis to all stakeholders involved in disaster response and relief.

#### ound:

emergency mapping using various datasets and tools provides spatial information on the impact saster and assures the effectiveness of response and relief efforts. In past disasters, the Disaster gement Centre (DMC) as well as other agencies <u>have</u> contributed to rapid mapping by using ble datasets and obtaining satellite images through regional and international mechanisms such tinel Asia and the International Charter for major disasters.

ver, past experience has shown that more coordination is needed among all institutions involved pping disaster-struck areas. A formal rapid mapping mechanism is essential for efficient ency response, with minimal duplication of information and effort. Such a <u>system</u>, needs to be te as part of a disaster preparedness strategy.

toposed mechanism fits with disaster preparedness initiatives in Sri Lanka that include the prment of an National Spatial Data Infrastructure, the use of the WFP-lead 72 hour rapid mapping framework and theuse of WFP's PRISM system, among others. The proposed mechanism's main objective is to have protocols in place before a disaster strikes in order for rapid and coordinated mapping response to disasters.

d) As outlined in the "Concept of Operations for establishing a Rapid Emergency Mapping Mechanism in Si Lanka", there is a strong legal mandate to establish such a mechanism, given by the Disaster Management Act, the National Policy on Disaster Management (NDMP) and the National Emergency Operations Plan (NEOP).

e) Internationally, standards that call for and mandate the establishment of the Rapid Emergency Mapping Mechanism are set forth by the UN Committee of Experts on Global Geospatial Information

# Thank You