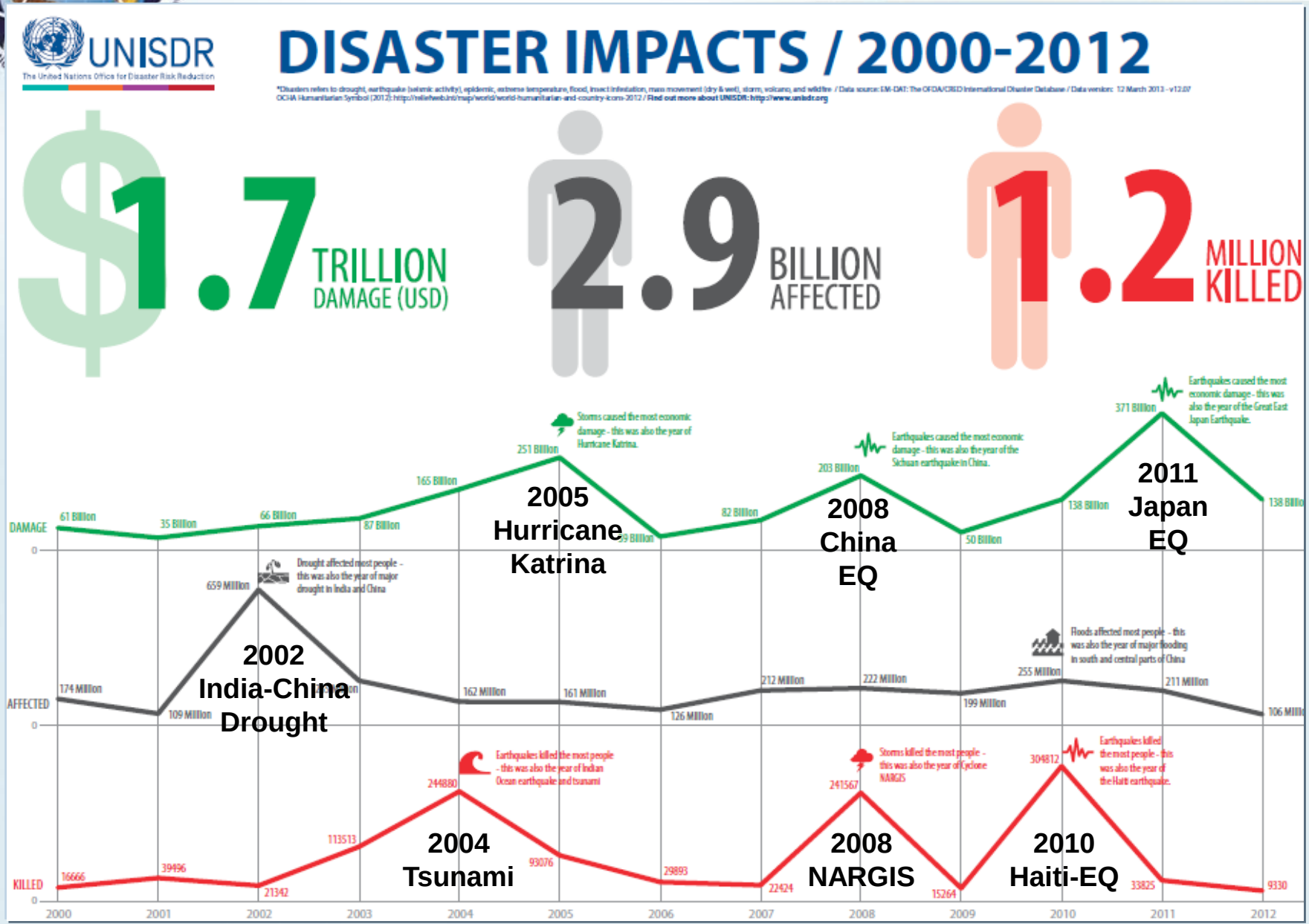
International Charter
Space and Major Disasters

International Charter ‘Space and Major Disasters’ : Universal Access

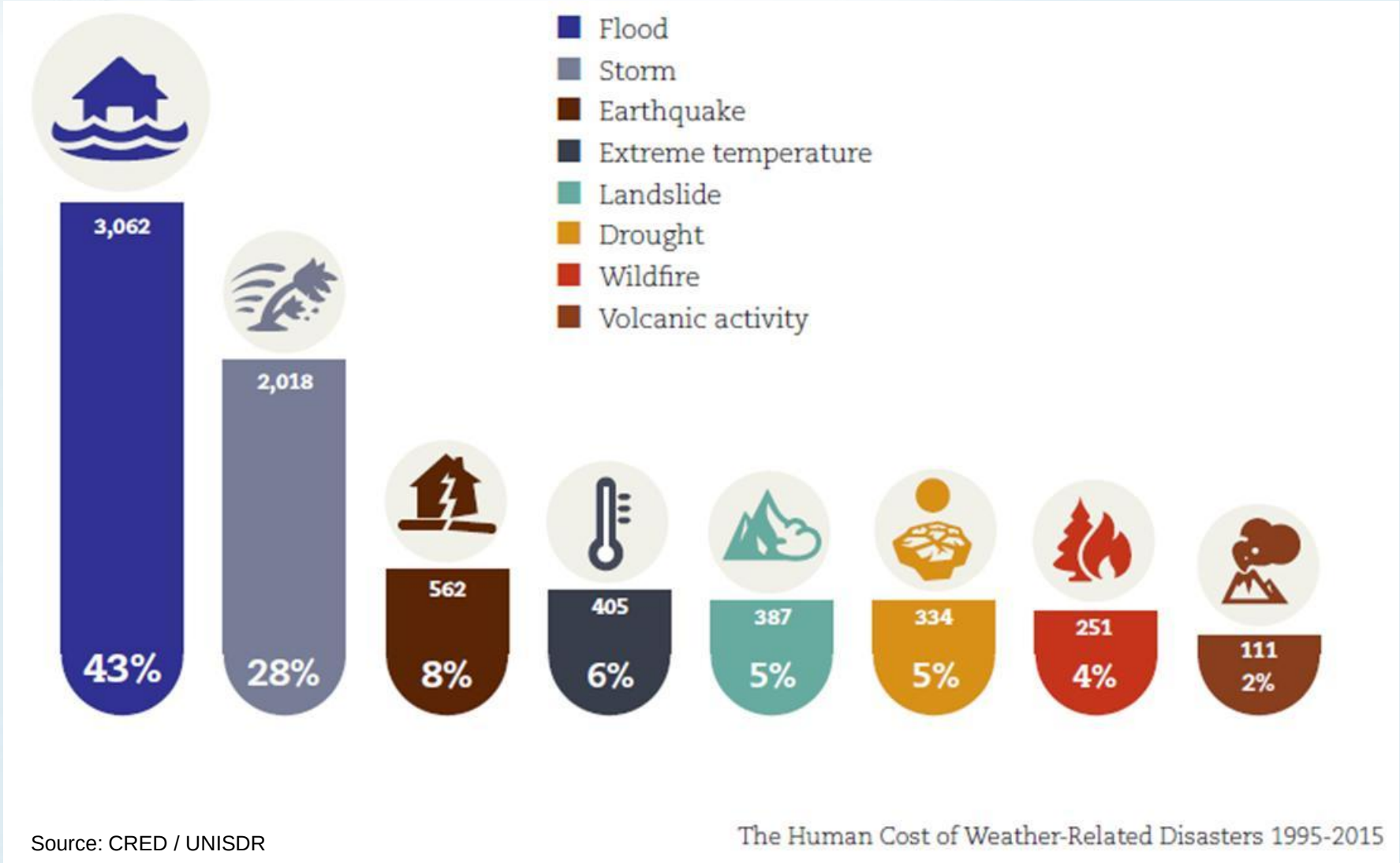
G. Srinivasa Rao
NRSC / ISRO representing
Charter’s Executive Secretariat

Global Disasters - Impacts



Disasters in the World

1995-2015



Source: CRED / UNISDR

The Human Cost of Weather-Related Disasters 1995-2015

Nepal Earthquake - 2015

- **Rapid and Comprehensive Info through Space Technology**
- **Space Faring Nations**
  - **India, China - Limited Space Resources**
- **Non-Space Faring Nations**
  - **Nepal, Bangladesh**

Solution:

International Charter ‘ Space and Major Disasters’

Date	25 April 2015
Origin time	11:56:26 NST[1]
Magnitude	7.8 M_w[1] or 8.1 M_s[2]
Depth	8.2 km (5.1 mi)[1]
Epicenter	28.147°N 84.708°E[1]
Type	Thrust[1]
Areas affected	• Nepal • India • China • Bangladesh
Total damage	≈$5 billion (about 25% of GDP)[3]
Max. intensity	IX (*Violent*)[1]
Aftershocks	7.3 M_w on 12 May at 12:50[4] 6.7 M_w on 26 April at 12:54[5] 430 aftershocks of 4 M_w and above as of 10 Feb 2016 [6]
Casualties	8,959 dead in Nepal and 9,050 in total[7][8] 23,447 injured [7]

Source: Wikipedia

Charter-Space Infrastructure

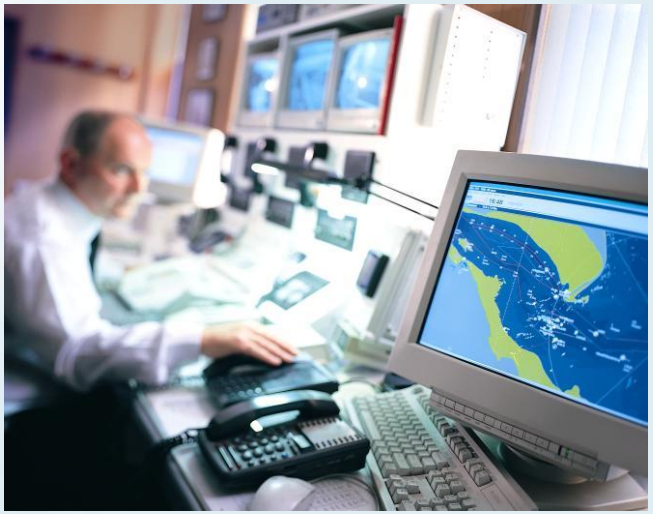
Optical and Microwave satellites, with different resolutions

Agency	Satellites
CNES	PLEIADES SPOT
ESA	Sentinel-1 Envisat* ERS-2*
CSA	RADARSAT
ISRO	IRS-P5 Resourcesat-2 Oceansat-2
ISRO	IRSP6 * Cartosat-2 Risat-1 IMS-1
CONAE	SAC-C*
NOAA	POES GOES
USGS	LANDSAT VHR Commercial
DMCii	DMC MRI DMC VHRI
JAXA	ALOS -2 ALOS* KIBO HDTV-EF
CNSA & INPE	CBERS*
CNSA	SJ-9A GF-1 FY-3C
DLR	TerraSAR-X/TanDEM-X RapidEye
KARI	KOMPSAT-2 KOMPSAT-3
ROSCOSMOS	Meteor-M Kanopus-V Resurs-P
ROSCOSMOS	Resurs-DK*

SAR VHR MR ISS LR * Archival

What is the Charter?

The Charter brings together efficient space-based technologies to support disaster management.



The Charter's capacities can be activated through a **single access point** which is available 24 hours, seven days a week.

Space agencies contribute

- **Priority satellite tasking**
- Archive Retrievals
- Organisation of map production

Purpose

- An International agreement among Space Agencies to support with space-based data and information relief efforts in the event of emergencies caused by major disasters.
  - **Disaster response**
  - **Multi-satellite data acquisition planning**
    - Fast data turn-around – priority acquisition
  - **Archive retrievals and spacecraft tasking**
  - **Data processing at pre-determined level**
  - **Space Agency contribution in image/data**
  - **Space Agency initiative for value-added-data fusion**

Disasters Types Supported

The International Charter executes priority tasking of different EO missions in a rapid fashion; it is designed to address requests concerning major disasters caused by:

Natural events

- Earthquakes
- Fires
- Floods
- Ice jams
- Landslides
- Tsunamis
- Ocean storms
- Volcanic eruptions

Man-made events

- Oil spills
- Industrial accidents





Charter History

- Following UNISPACE III in Vienna in July 1999, ESA (European Space Agency) and CNES (Centre national d'études spatiales) initiated the International Charter in July 1999.
- CSA (Canadian Space Agency) signed the Charter on October 20, 2000.
- Charter declared operational as of November 1, 2000 after formal rehearsals and qualification tests.
- 484 disasters covered to date in 118 countries worldwide.
- Now composed of 15 members.

Charter History

- The US National Oceanic and Atmospheric Administration (NOAA), and the Indian Space Research Organization (ISRO) became members in September 2001.
- In July 2003, the Comision Nacional de Actividades Espaciales (CONAE) joined the Charter.
- In 2005, the Japanese Aerospace Exploration Agency (JAXA) joined the Charter in February, the United States Geological Survey (USGS) in April as part of the US membership, and the UK space agency (UKSA/DMCii) in November.
- The China National Space Administration (CNSA) joined in May 2007.
- The German Aerospace Center (DLR) joined the Charter in October 2010.
- The Korea Aerospace Research Institute (KARI), the Brazilian Instituto Nacional de Pesquisas Espaciais (INPE) joined the Charter in 2011.
- EUMETSAT joined the Charter in 2012.
- The Russian Federal Space Agency (ROSCOSMOS) joined the Charter in 2013.

Charter Members

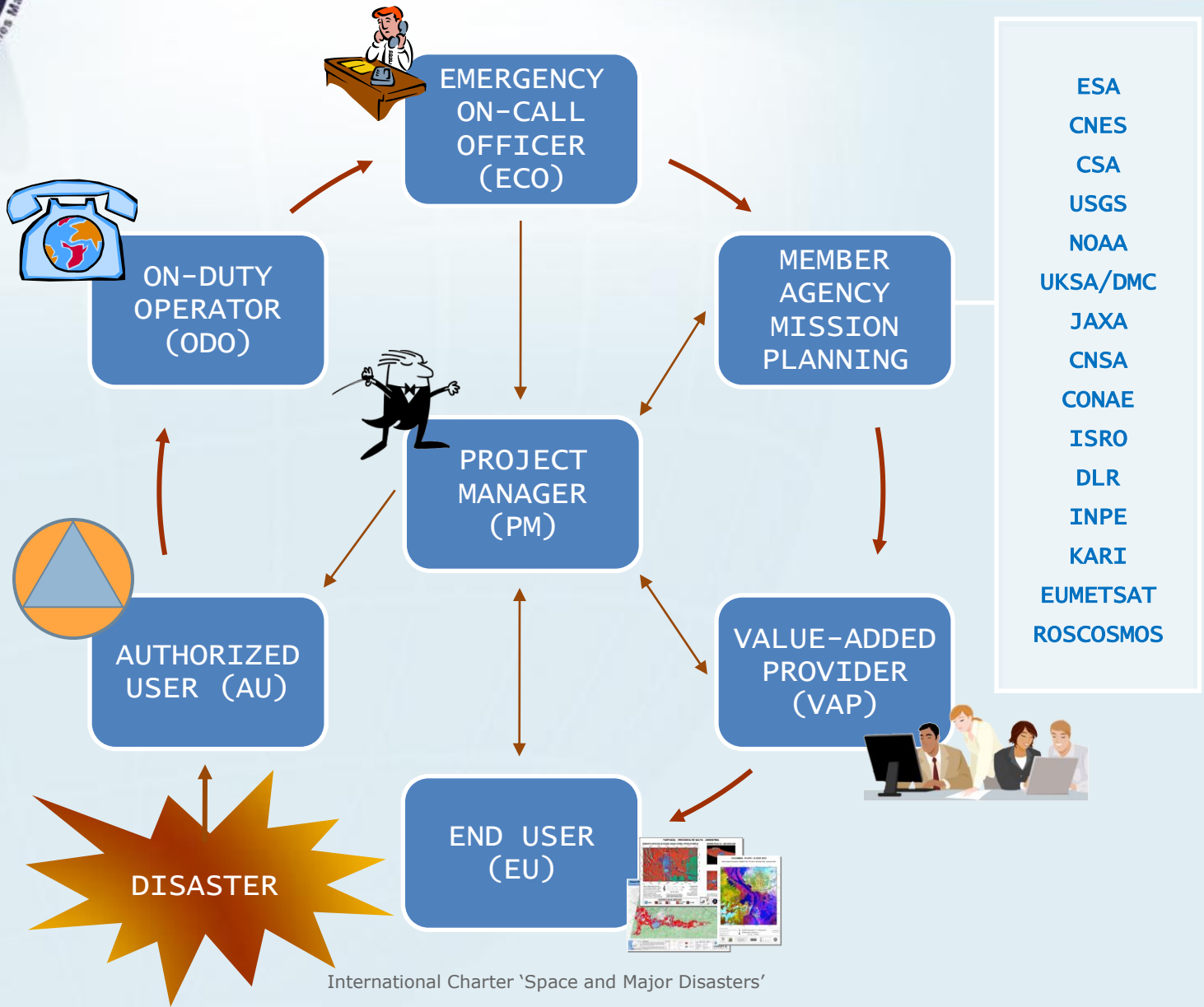
Mechanisms to Activate the Charter

- **Direct activation:** The only bodies authorized to directly request the Charter to be activated for a disaster occurring in their country are the 'Authorized Users' (AUs). They are typically civil protection agencies, governmental relief organizations, or other authorities with a mandate related to disaster management.
- **Activation via an Authorized User on behalf of a user from another country without AU:** Authorized Users can access the Charter to request support for a disaster in another country with which they cooperate for relief purposes.
- **Activation via the UN for UN users:** The Charter has an agreement with UN OOSA (Vienna) and UNITAR/UNOSAT (Geneva) to provide support to UN agencies. UN OOSA and UNITAR/UNOSAT may submit requests on behalf of users from the United Nations.
- **Activation for Asia Pacific users via Sentinel Asia:** Sentinel Asia is a regional collaboration for satellite based emergency response in Asia Pacific. Since 2009 the Charter has granted the Asian Disaster Reduction Centre the right to submit activation requests on behalf of national users of Sentinel Asia.

Charter Functional Units

- Authorized Users (AUs)
- On-Duty Operator (ODO)
- Emergency on-Call Officer (ECO)
- Project Manager (PM)
- Data processing and distribution facilities
- Value-Added Providers (VAPs)

Charter Operational Loop



Authorized User (AU) Interfaces

- AU – On-Duty Operator (ODO)
  - AU submits the User Request Form (URF)
  - ODO checks the identity of the caller
  - ODO confirms the reception of the URF and its completeness

AU Interfaces

- AU/End User (EU) – Emergency on-Call Officer (ECO)
  - ECO calls the AU/EU for information on the Disaster
    - Geographical location of the affected area
    - Type of disaster
    - Extent of disaster
    - Type of data processing/product (if applicable)
    - Target delivery time
    - Delivery medium and address
    - Any additional information

AU Interfaces

- AU/EU – Project Manager (PM)
  - PM contacts directly the AU/EU if required
  - PM obtains further information on the requirement
  - PM apprises the AU/EU with regard to the data acquisition planning
  - PM solicits AU/EU's appraisal of the Charter activation

Charter Activations
(disaster types)

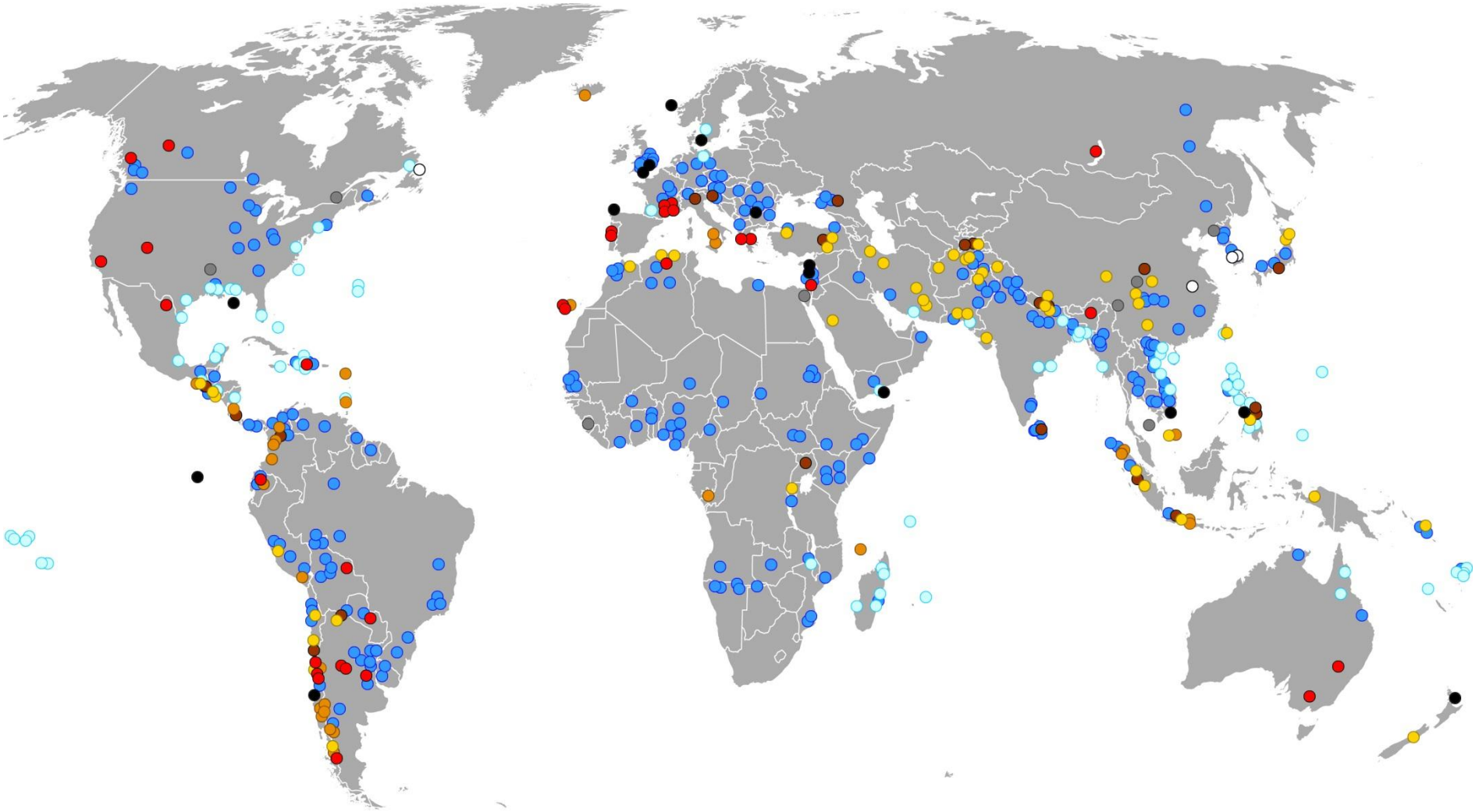
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sub-totals	
Solid Earth																			
Earthquake		*3*	*1*	*3*	*5*	*3*	*2*	*5*	*4*	*3*	*5*	*5*	*3*	*4*	*1*	*5*	*1*	*53*	
Landslide	*1*	*1*	*2*	*2*			*1*			*4*	*2*	*2*		*1*	*4*	*2*		*22*	**105**
Volcano		*1*	*1*	*2*	*2*	*1*	*1*	*2*	*3*	*3*	*2*	*2*	*1*	*3*	*2*	*4*		*30*	
Technological																			
Oil spill		*3*	*2*				*4*	*3*			*1*	*1*				*1*		*15*	**23**
Others					*1*						*3*			*1*	*2*	*1*		*8*	
Weather / Atmospheric																			
Fire				*5*	*1*	*2*		*4*	*2*	*4*	*1*	*3*	*2*	*2*	*3*	*2*		*31*	
Flood/Ocean wave*		*3*	*8*	*4*	*9*	*13*	*16*	*22*	*23*	*19*	*25*	*16*	*25*	*21*	*22*	*18*	*1*	*245*	**356**
Ice/Snow hazard								*1*			*1*	*1*			*1*			*4*	
Storm/Hurricane**			*1*	*2*	*3*	*6*	*1*	*8*	*8*	*7*	*11*	*2*	*9*	*6*	*6*	*5*	*1*	*76*	
Total / year	**1**	**11**	**15**	**18**	**21**	**25**	**25**	**45**	**40**	**40**	**51**	**32**	**40**	**38**	**41**	**38**	**3**		
TOTAL																			**484**

*Includes solid earth related phenomenon of a tsunami.

**Includes all wind type storms (hurricane, cyclone, typhoon and tornado).

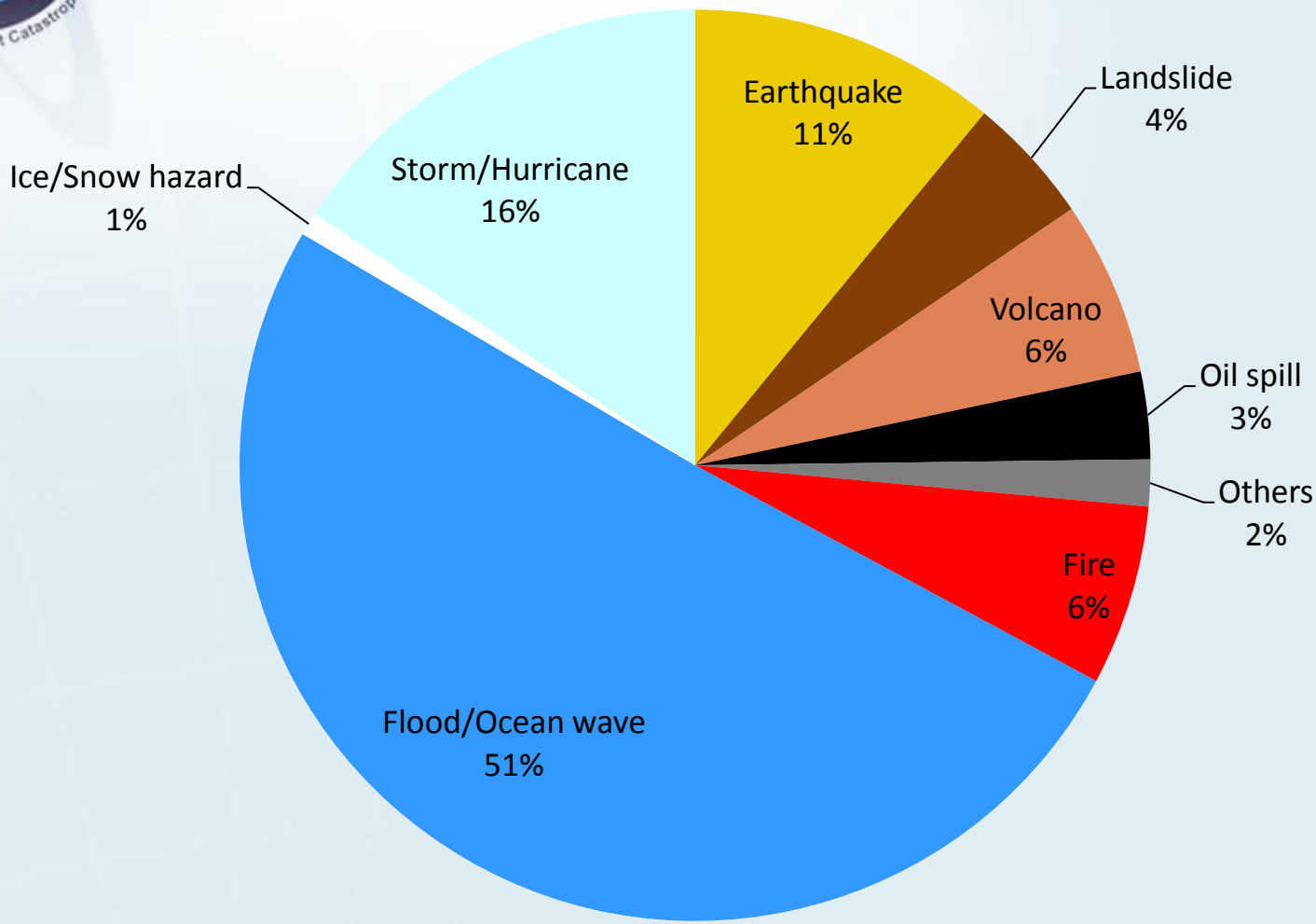
As of March 3, 2016 – 484 Activations

Activation Distribution



As of March 3, 2016 – 484 Activations

Activations by Disaster Type



As of March 3, 2016 – 484 Activations

Number of Activations

November 2000 to March 2016:

484 Charter Activations

The Charter's response to plain flood disasters

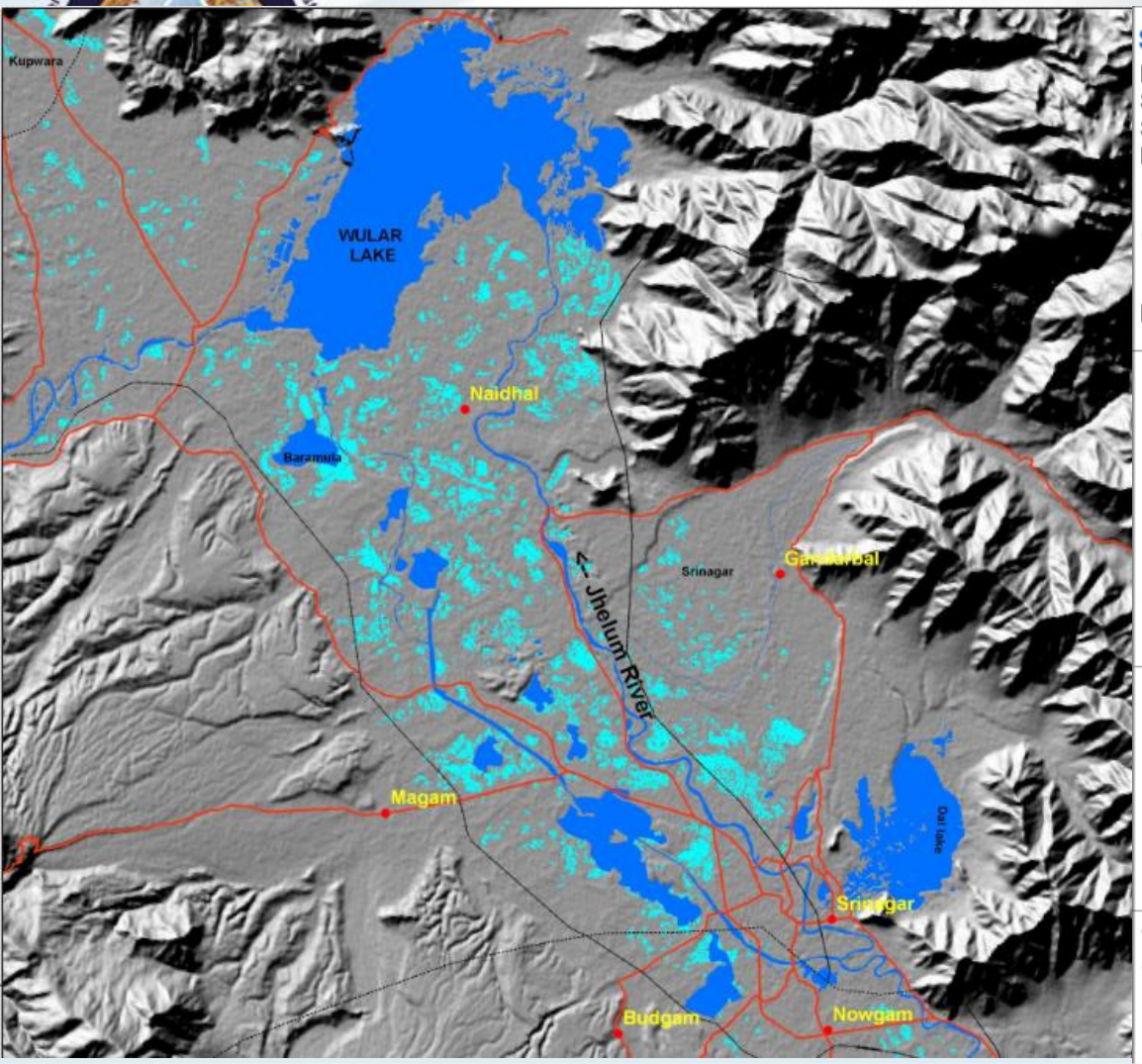
Issues:

- Flooded areas frequently under cloud cover
- Sometimes huge areas affected

Solution:

- Radar satellite data allows mapping of inundated areas independent from daylight and weather conditions.

Flood disaster example: India 2015



Satellite data used

Pre Flood:
Satellite:RISAT-1
Sensor: SAR
Date of Pass: 14-Aug-2014

Post Flood:
Terra Sar X data of 02-April-2015 (0600hrs)
RISAT-1 data of 02-April-2015 (1800 Hrs)

Other data used

Base details from Bhuvan & OSM

Background data -- Shaded Relief

Legend

- Settlements
- Taluk Boundary
- State Boundary
- Railway
- Major Roads
- Normal River/Water bodies
- Inundation

N W E S

0 2.5 5 10

Kilometers

This product is prepared using TerraSAR-X satellite image received under International Charter, Call ID-527 and Indian RISAT-1 data

Deutsches Fernerkundungs-Datenzentrum (DFD)

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

This product is prepared on rapid mapping mode for immediate use and sharing amongst official agencies. This provides preliminary results.

Inundation may include flood water in low lying areas also.

All geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials.

No ground verification is done.

DSC / NDEM
National Remote Sensing Centre, ISRO
Dept. of Space, Govt. of India
Hyderabad- 500 037
E-Mail: flood@nrsc.gov.in
www.nrsc.gov.in

nrsc

Inundation due to heavy rains in parts of Jammu & Kashmir state – map prepared by NRSC based on RISAT-1 and TerraSAR-X

The Charter's response to earthquake disasters

Issues:

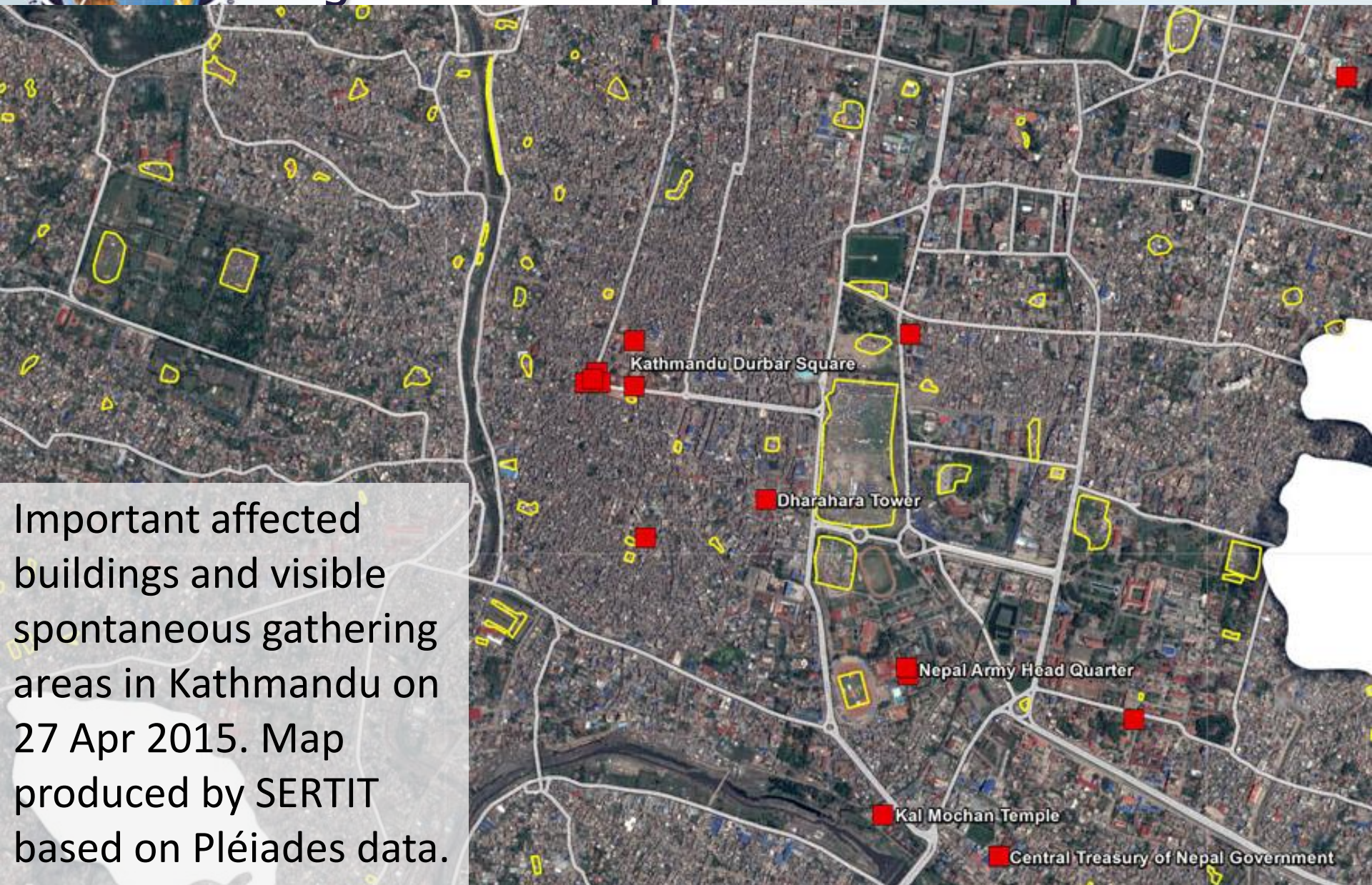
- Different damage types may occur in combination: direct damage, landslides in mountaineous areas, technological disasters…

Solution:

- Damage assessment and detection of gathering places based on VHR optical data
- Radar-based change detection possible only if pre-event data is available

(Interferometric analyses are not supported by the Charter)

Example: Kathmandu after the major earthquake on 25 Apr 2015



Important affected buildings and visible spontaneous gathering areas in Kathmandu on 27 Apr 2015. Map produced by SERTIT based on Pléiades data.

The Charter's response to tsunamis disasters

Issues:

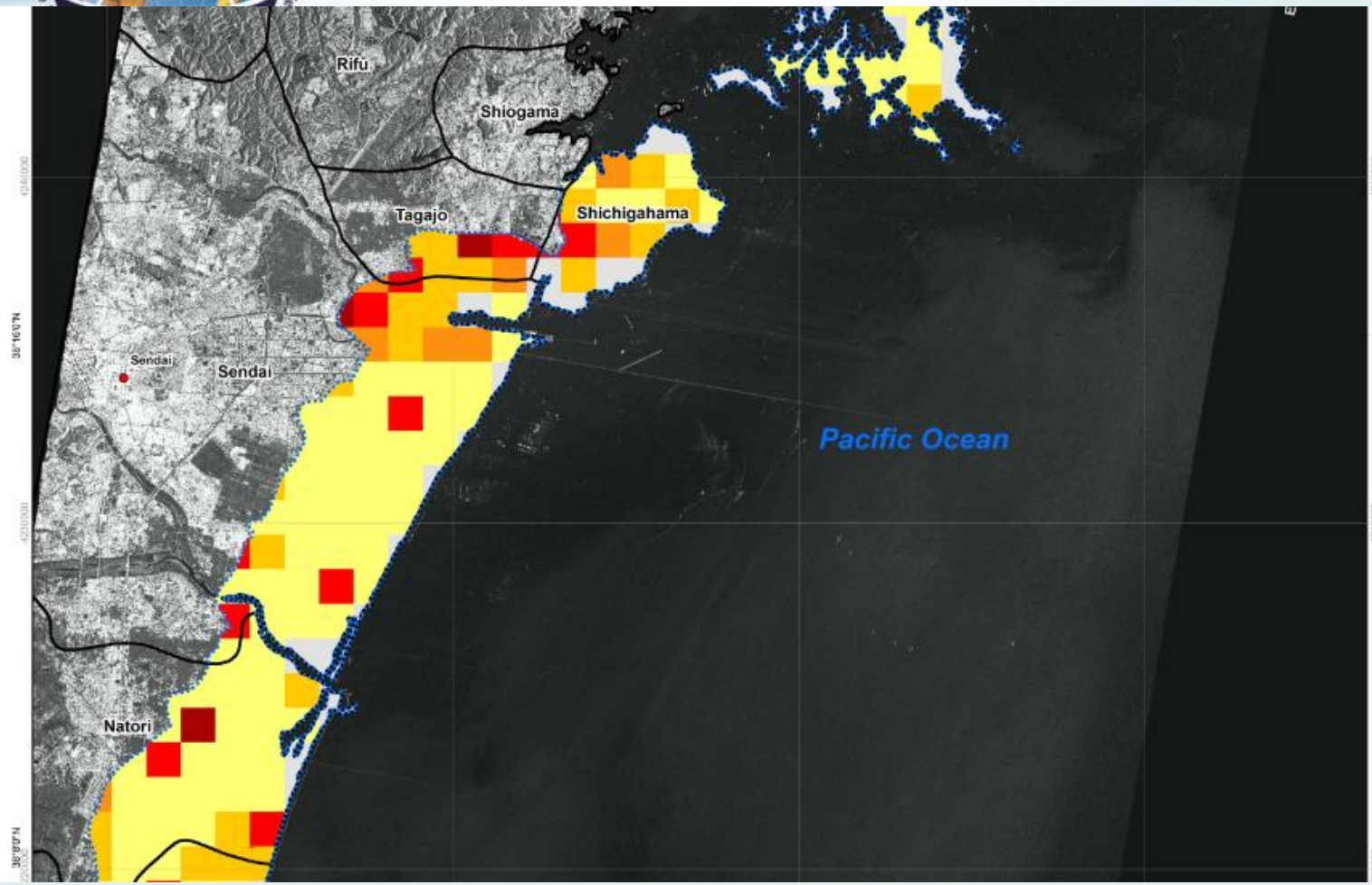
- Large area affected (in cases of major tsunamis)
- High risk of technological disasters caused by Tsunami

Solution:

- Acquisition of many data and all different image types
- Combination of flooded area detection and damage assessment

Tsunami in Japan, March 2011

Tsunami in Japan, March 2011



Legend

Population

Town/Village

City district boundaries

Inundation Assessment

Tsunami inundation extent as of 12 March, 2011

Estimated directly affected inhabitants

- > 4.000 - 6200 people/km²
- > 2.000 - 4.000 people/km²
- > 1.000 - 2.000 people/km²
- > 500 - 1.000 people/km²
- ≤ 500 people/km²
- no data

Important note: This estimation of inhabitants of the affected areas does not allow to assess the number or victims or even casualties. It is just an indication of the potential number of people that have been living in the area of tsunami inundation and debris deposit as stated by the Landscan data from 2009.

Interpretation

On March 11, 2011 an earthquake with a magnitude of 8.8 hits north-east Japan followed by a series of powerful aftershocks of magnitudes up to 7.5. The epicenter was located 250 miles (400km) from the capital Tokyo at a depth of 20 miles (32km). Numerous roads and towns have been inundated and destroyed by a tsunami triggered by the earthquake. Thousands of people lost their lives.

The map shows the eastern coastline of Honshu of the areas around Sendai that have been affected by the tsunami. In total about 120.000 people are estimated to live in the area of inundation and debris deposit within the image extent. The estimated affected inhabitants are shown as inhabitants/km² (population density) and classified into 5 classes as seen in the legend above.

This data has been calculated from the estimated directly affected inhabitants derived from Landscan data of 2009 which was combined with the observed inundation and debris extent derived by a semi-automatic analysis of TerraSAR-X imagery as of March 12, 2011, which further

Estimated directly affected population
(product made by DLR/ZKI, based on flood extent derived from TerraSAR-X data and Landscan 2009™ population data)

The Charter's response to tropical storm disasters

Issues:

- Different damage types may occur in combination: direct storm damage, flooding, landslides…
- Areas of most severe damages not always known immediately after landfall
- High probability of cloud cover
- Very high resolution (VHR) images needed for detection of direct storm damages

Solution:

- Redundant tasking of all VHR satellites (hoping for breaks in the clouds…)
- Radar and lower resolution optical for floods, landslides etc.

Example: Damage analysis after Typhoon Haiyan, Philippines, November 2013

Daanbantayan, affected individual housing, detected via Pléiades data

Philippines - Daanbantayan Maya area

Potentially affected building structures Observed the 14/11/2013

Location Diagrams

Legend

Interpretation

Cartographic Information

Data Sources

Framework

The Charter's response to volcanic disasters

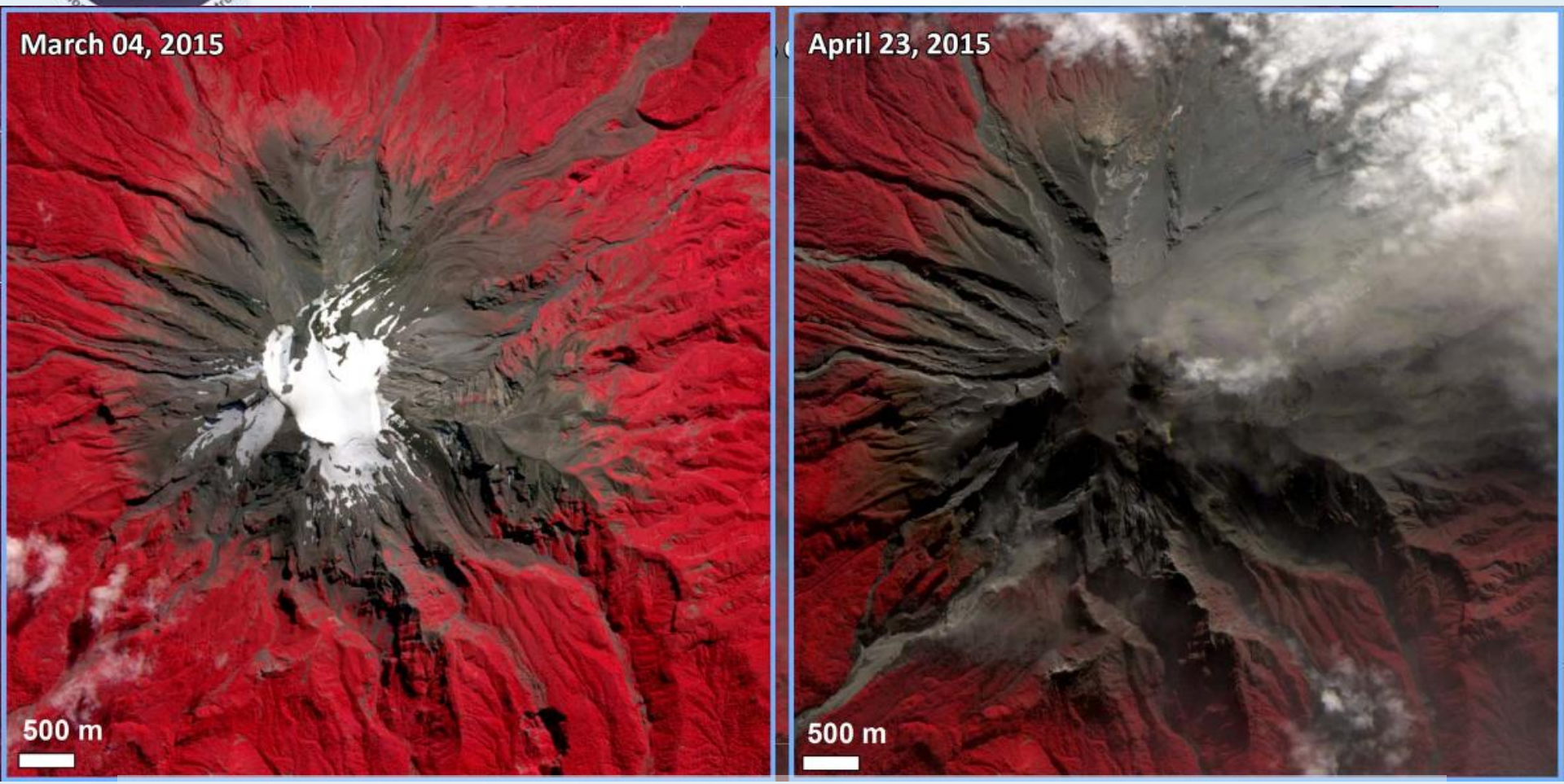
Issues:

- Surrounding area often inaccessible
- Possible combination of local devastation and wide-spread ash clouds

Solution:

- Optical observation as well as radar-based change detection

Example: Chilean volcano eruption in Apr. 2015



"Calbuco" Volcano pre- and post-eruption RapidEye images (product made by DLR/ZKI)

The Charter's response to wildfire disasters

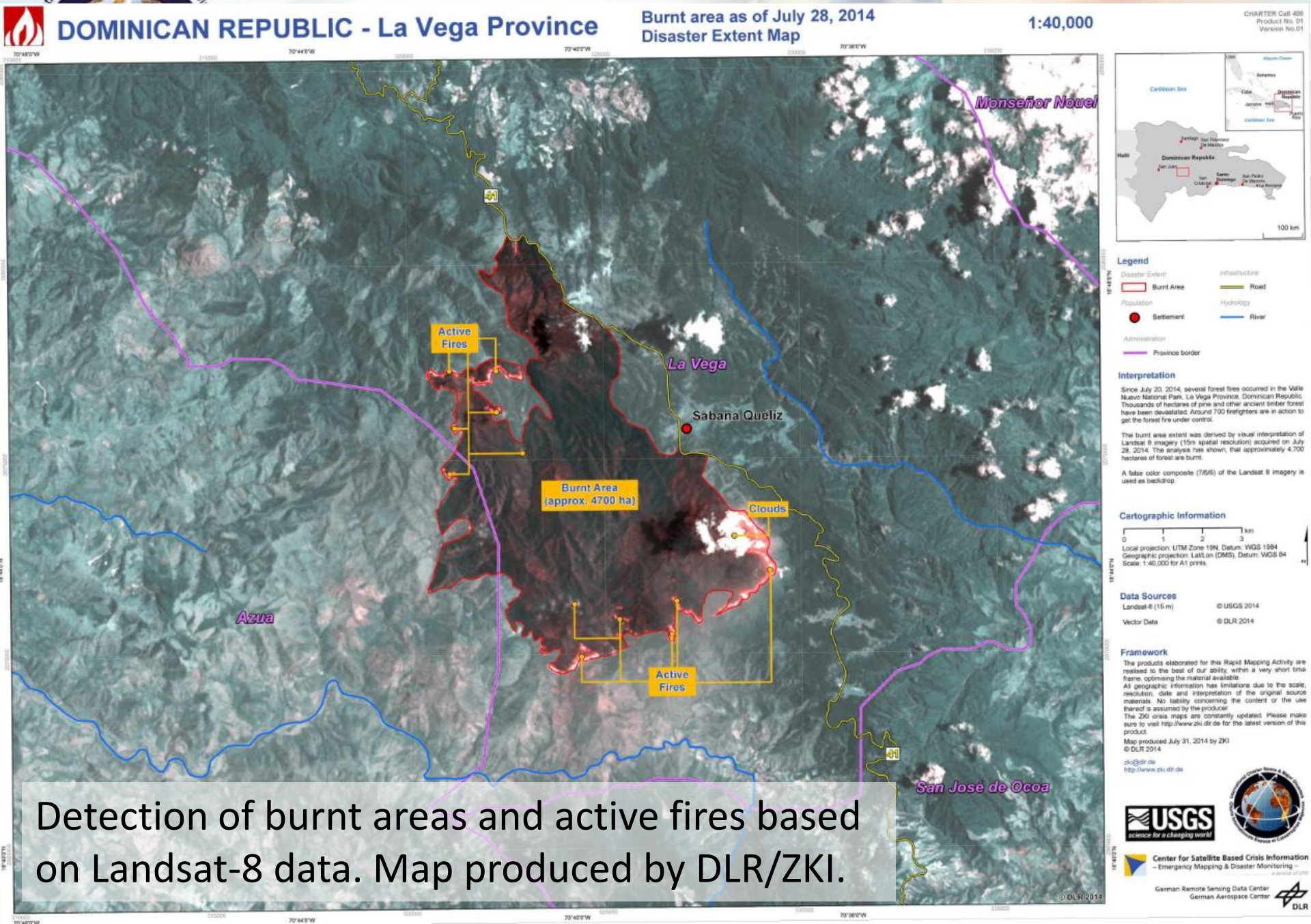
Issues:

- Very quick progression of fire fronts
- Clouds or smoke may hide fire spots

Solution:

- Optical or thermal-infrared observations
- Extra-fast preparation of maps

Wild Fire in the Dom. Rep., Aug 2014



Detection of burnt areas and active fires based on Landsat-8 data. Map produced by DLR/ZKI.

The Charter's response to landslide disasters

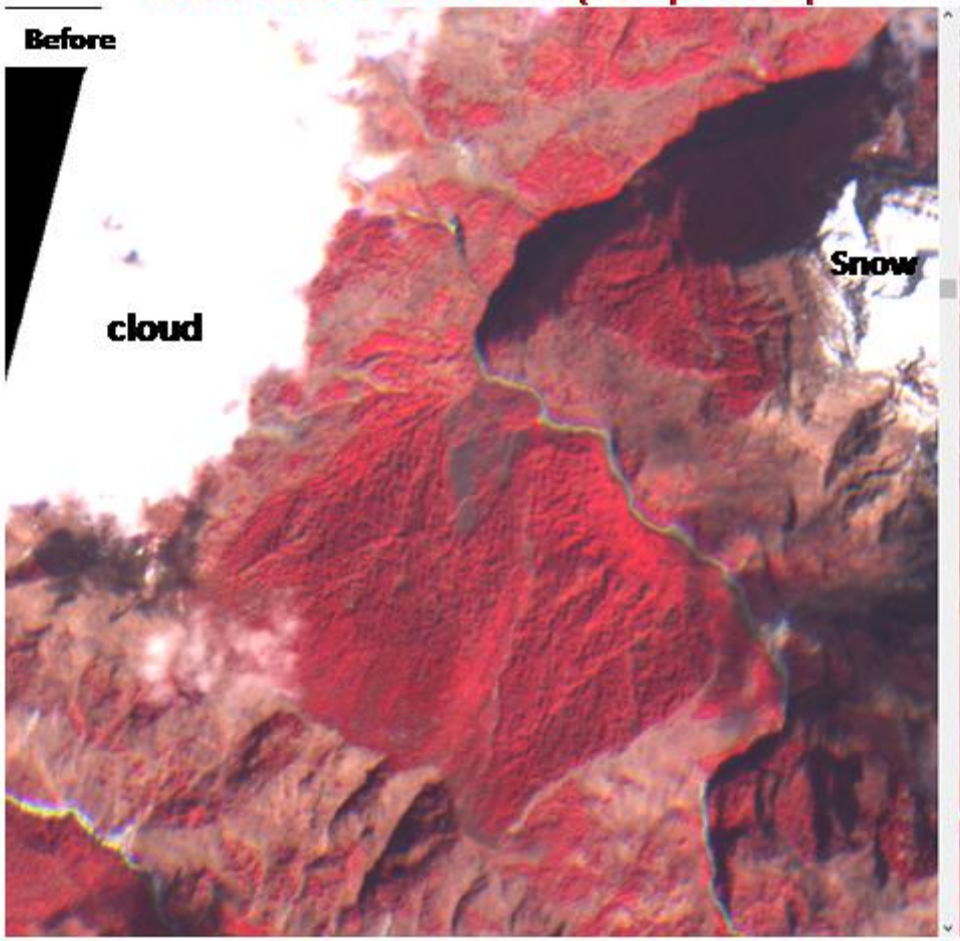
Issues:

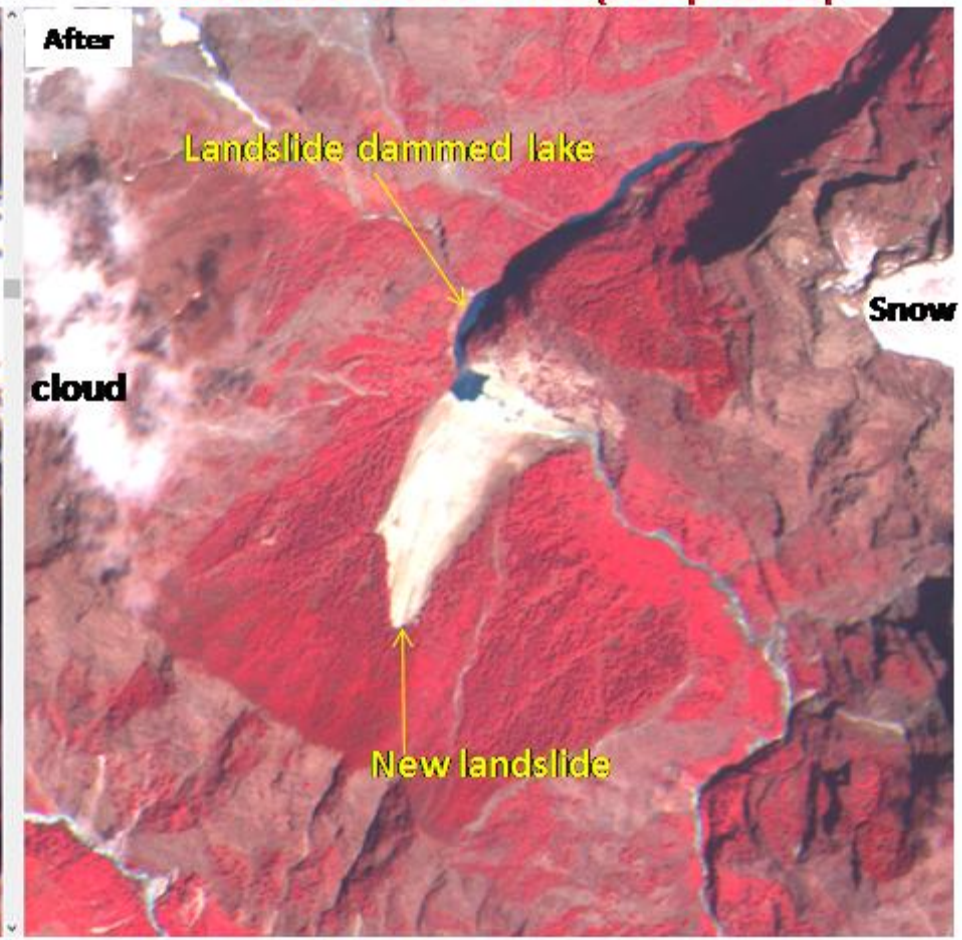
- Possible combination of direct landslide damage and indirect effects
  - mountain communities separated from "outer world"
  - damming of rivers followed by flash floods

Solution:

- Optical NIR imagery often used to visualise new landslides
- Change detection based on pre- and post-disaster radar imagery

Example: Landslide caused by the Nepal earthquake on 25 Apr 2015





Observation: A new major landslide has blocked the valley resulting in development of a lake. Several other small new landslide are also seen.

Location of the landslide: 84° 47′ 30″ E & 28° 33′ 8″ N

The Charter's response to oil spill disasters

Issues:

- Detection of floating oil on open sea
- Detection of polluted coastal environments

Solution:

- Mainly radar satellites used for detection of floating oil in not too curly sea
- Optical observations of polluted coastal environments.

Oil spill in the Gulf of Mexico

Deep Water Horizon Oil spill extent, Radarsat-2 image acquired 28 April 2010

Universal Access

launched in September 2012

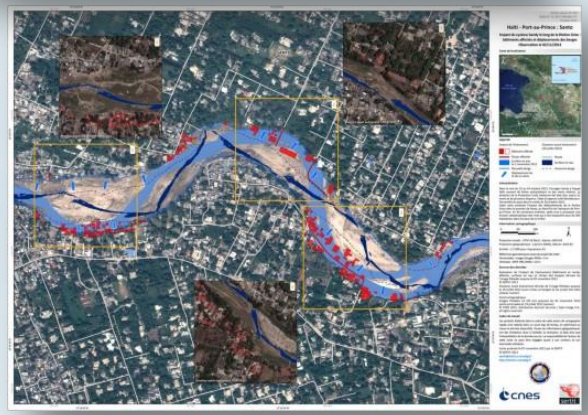
Any **national disaster management authority** can apply to become a Charter Authorized User

Authorized Users

1. Must be a **national disaster management authority** or its delegated agency in that country

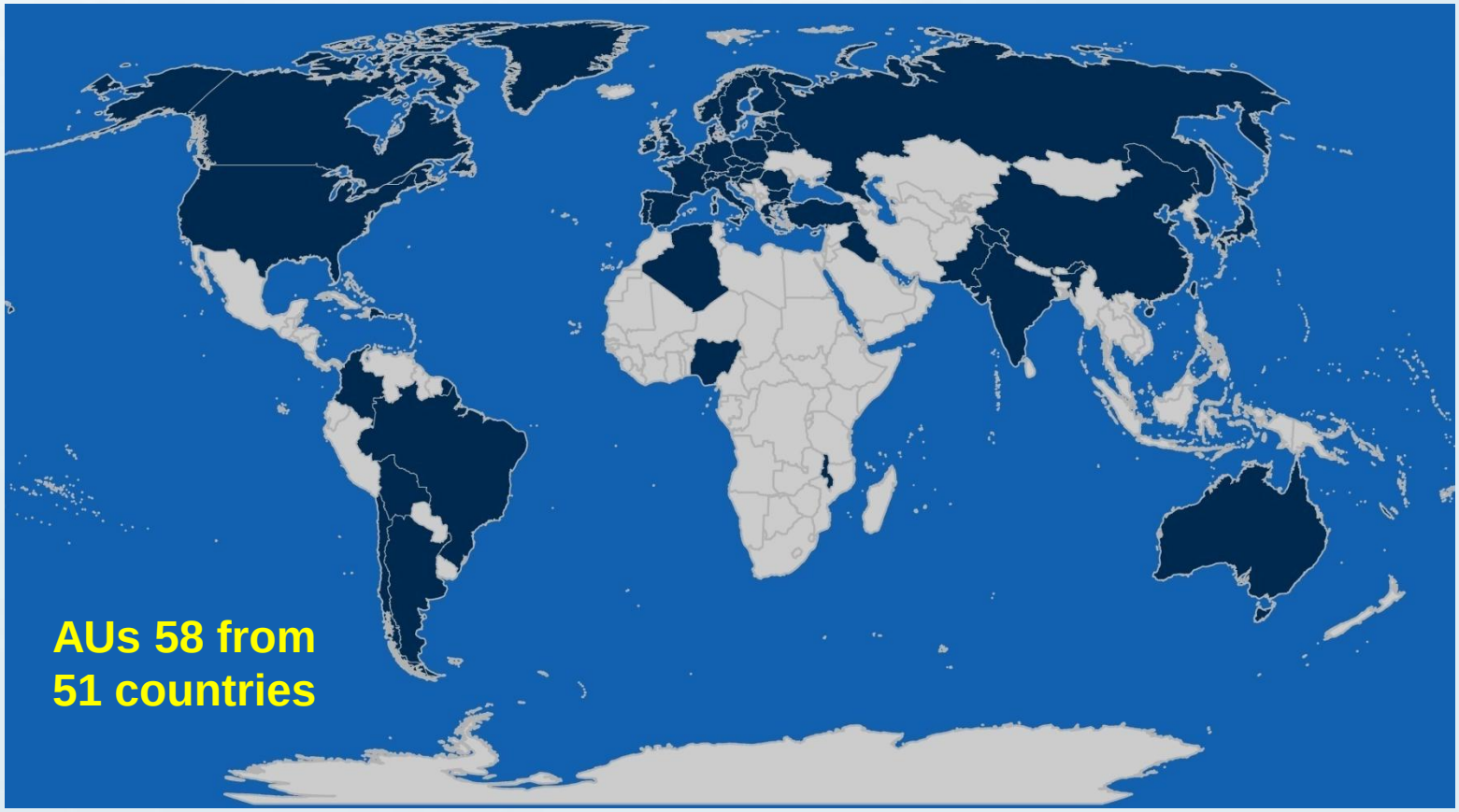
2. Must have the **capacity to download and use maps**

3. Must be able to **submit and pursue an activation request in English**



Activating the Charter:
Authorized Users (AU)

The only bodies authorized to **directly** request the Charter to be activated are the **Authorized Users** - AUs (typically civil protection agencies, governmental relief organizations, or other authorities with a mandate related to disaster management).



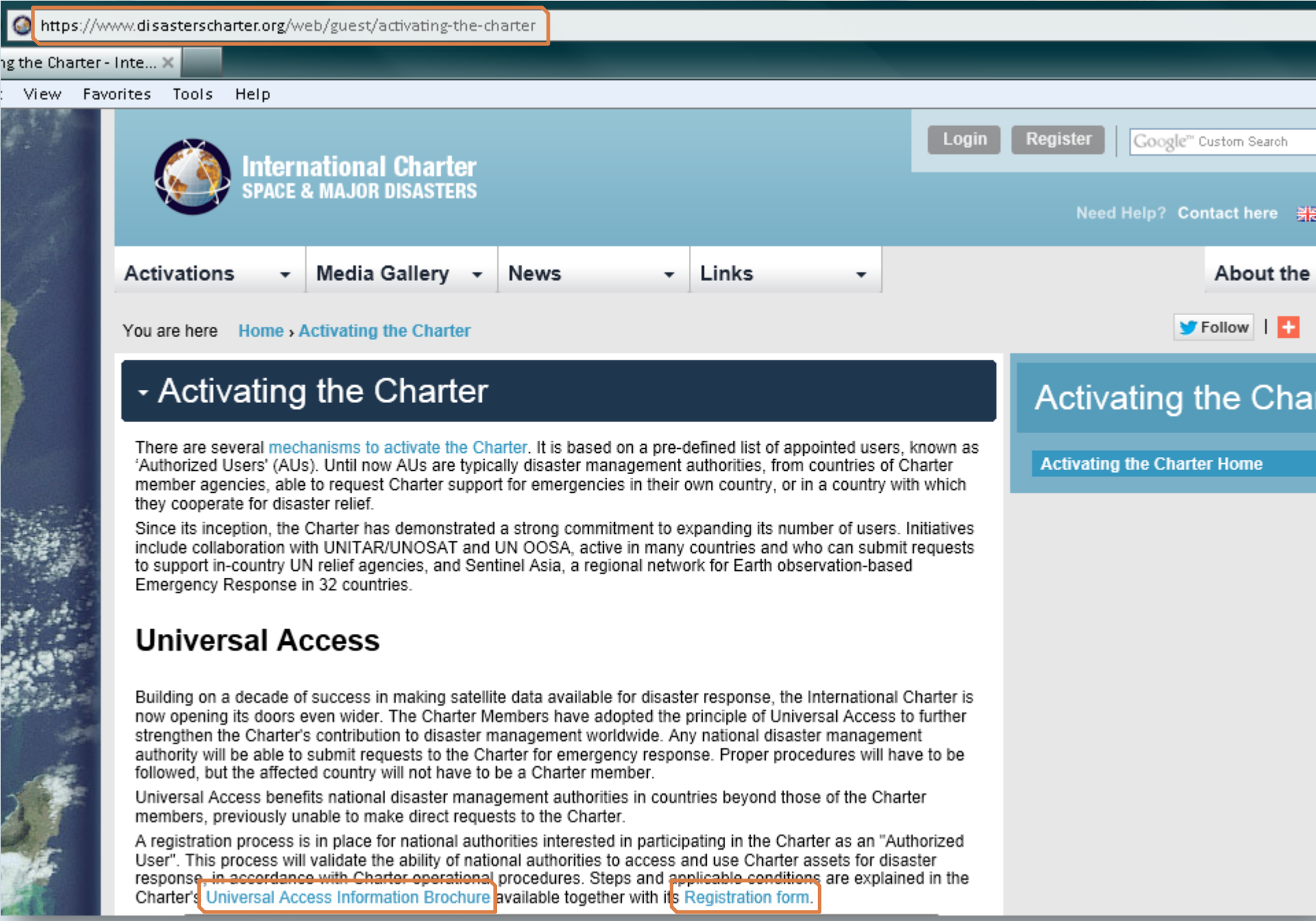
Registration

A registration form* is available for national authorities to express interest in becoming a Charter Authorized User.

1. The candidate fills in the questionnaire providing all required information.
2. The questionnaire, *with an official cover letter from the organisation,* must be sent to: ExecutiveSecretariat@disasterscharter.org
3. The request is assessed by the Charter members.

*The form **may be downloaded** together with the **UA Information brochure** from the Charter website:

www.disasterscharter.org/web/guest/activating-the-charter


https://www.disasterscharter.org/web/guest/activating-the-charter
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Activating the Charter
There are several mechanisms to activate the Charter. It is based on a pre-defined list of appointed users, known as 'Authorized Users' (AUs). Until now AUs are typically disaster management authorities, from countries of Charter member agencies, able to request Charter support for emergencies in their own country, or in a country with which they cooperate for disaster relief.
Since its inception, the Charter has demonstrated a strong commitment to expanding its number of users. Initiatives include collaboration with UNITAR/UNOSAT and UN OOSA, active in many countries and who can submit requests to support in-country UN relief agencies, and Sentinel Asia, a regional network for Earth observation-based Emergency Response in 32 countries.
Universal Access
Building on a decade of success in making satellite data available for disaster response, the International Charter is now opening its doors even wider. The Charter Members have adopted the principle of Universal Access to further strengthen the Charter's contribution to disaster management worldwide. Any national disaster management authority will be able to submit requests to the Charter for emergency response. Proper procedures will have to be followed, but the affected country will not have to be a Charter member.
Universal Access benefits national disaster management authorities in countries beyond those of the Charter members, previously unable to make direct requests to the Charter.
A registration process is in place for national authorities interested in participating in the Charter as an "Authorized User". This process will validate the ability of national authorities to access and use Charter assets for disaster response, in accordance with Charter operational procedures. Steps and applicable conditions are explained in the Charter's Universal Access Information Brochure available together with its Registration form.
Activating the Cha
Activating the Charter Home

Conclusion

- Space technologies can deliver key information that brings benefit to the definition, planning, implementation, monitoring & assessment of disaster relief operations.
- The Charter is focused on the immediate response phase and services of national disaster management centres and the International Humanitarian community (e.g. UN).
- It is growing: 484 disasters covered since 2000 in 118 countries worldwide.
- Building on a decade of success in making satellite data available to users for disaster response, the Charter is now opening its doors even wider with Universal Access.
- Universal Access benefits national users in countries beyond those of the Charter members, who were previously unable to make direct requests to the Charter during emergency situations.

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International Charter
Space and Major Disasters

www.disasterscharter.org

Emergency enquiries from users requiring direct access to Charter resources should be addressed to:

ExecutiveSecretariat@disasterscharter.org

General requests for information should be addressed to

webmaster@disasterscharter.org