International Charter

Space & Major Disasters

Annual Report 2021

V1

CONTENTS

Introduction

1.1 Purpose and scope of this document

This document describes the activities of the International Charter “Space & Major Disasters” that took place in 2021.

1.2 Structure of the report

This report is based on the following inputs:

- Working documents, notes and actions of the Charter’s Executive Secretariat and Board
- Input from the Charter’s Communication Group
- Input from each Charter member concerning EO resources and publications
- Project Managers’ reports for each activation
- Data, statistics and reports from EM-DAT and other reports on disasters prepared by Insurance companies.

This report adheres to the following structure:

Chapter 1 - Introduction

Chapter 2 - The International Charter Space and Major Disasters; overview and lead agencies of the Charter in 2021

Chapter 3 – Charter operations: depicts internal business regarding operations, resource consumption and technical updates (in particular the development of COS-2).

Chapter 4 - Assessment of the Charter operations: provides an assessment of the overall impact of the Charter as a service in supporting disaster response, and details the operational system performance, including generation of products and services, user appraisal and communication.

Chapter 5 – External relations: explains the integration of new members, the Universal Access process, and relationships with Cooperating Bodies.

Chapter 6 – Communication: reports on all communication activities undertaken throughout the reporting period.

Chapter 7 – Conclusions: outlines the significant achievements and outcomes throughout the reporting period.

1.3 Applicable documents

[AD1] Text of the Charter “Space and Major Disasters” - http://www.disasterscharter.org
[AD2] Charter Implementation Plan, RSCSA-PL0098
[AD3] Project Manager Procedure, RSCSA-PR0419
[AD4] Emergency On-Call Officer Procedure, RSCSA-PR0418

1.4 List of figures

1.5 List of tables

1.6 List of acronyms

ABAE	Bolivarian Agency for Space Activities
AOI	Area of Interest
ADRC	Asian Disaster Reduction Center
AU	Authorized User (of the Charter)
CEMS	Copernicus Emergency Management Service
CENAD	Centro Nacional de Gerenciamento de Riscos e Desastres (Brazil)
CEOS	Committee on Earth Observation Satellites
Charter	The International Charter Space & Major Disasters
CNES	Centre National d’Etudes Spatiales (French space agency)
CNSA	China National Space Administration
CONAE	Comisión Nacional de Actividades Espaciales (Argentina)
CONRED	Coordinadora Nacional para la Reducción de Desastres (Guatemala)
COS-2	Charter Operational System-2
CRED	Centre for Research on the Epidemiology of Disasters
CSA	Canadian Space Agency
DLR	Deutsches Zentrum für Luft und Raumfahrt (German Aerospace Centre)
DLR/ZKI	DLR Zentrum für Satellitengestützte Kriseninformation (Center for Satellite Based Crisis Information)
DRM	Disaster Risk Management
ECO	Emergency On-Call Officer (of the Charter)
EM-DAT	Emergency Events Database
EO	Earth Observation
ERS	Emergency Response Service
ESA	European Space Agency
ESRIN	ESA Centre for Earth Observation
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GDACS	Global Disaster Alert and Coordination System
GEO	Group on Earth Observations
HDDS	(USGS) Hazards Data Distribution System
HR	High Resolution
ICT	Information and Communication Technology
INPE	National Institute for Space Research (Brazil)
ISRO	Indian Space Research Organization
JAXA	Japan Aerospace Exploration Agency

KARI	Korea Aerospace Research Institute
MBRSC	Mohammed Bin Rashid Space Centre
MR	Medium Resolution
NDRCC	National Disaster Reduction Centre of China
NOAA	National Oceanic and Atmospheric Administration
NRSC	National Remote Sensing Centre (India)
ODO	On-Duty Operator
PA	Partner Agency
PHIVOLCS	Philippine Institute Of Volcanology and Seismology
PM	Project Manager (of the Charter)
ROSCOSMOS	Russian State Space Corporation
SA	Sentinel Asia
SAR	Synthetic Aperture Radar
SARE	Semi-Annual Refresher Exercise
SEO	Search Engine Optimization
SERTIT	Service Régional de Traitement d'Image et de Télédétection (France)
UA	Universal Access
UAESA	United Arab Emirates Space Agency
UCL	Université Catholique de Louvain
UKSA	United Kingdom Space Agency
UNITAR/UNOSAT	United Nations Institute for Training and Research/ United Nations Operational Satellite Applications Programme
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
URF	User Request Form
USGS	United States Geological Survey
VAR	Value-Added Reseller
VAP	Value-Added Provider
VHR	Very High Resolution

1.7 Authors of the report

The report has been prepared by CNES, DLR, ESA, EUMETSAT, and ROSCOSMOS based on contributions and reviews by all the Charter members.

2 The International Charter Space and Major Disasters

2.1 Overview

The Charter is an international collaboration amongst space agencies and space operators – the Charter members. Initiated by the European Space Agency (ESA), the French Space Agency (CNES) and the Canadian Space Agency (CSA) in 2000, 14 other space agencies joined between 2000 and 2018, named below in chronological order:

- U.S. National Oceanic and Atmospheric Administration, NOAA
- Comisión Nacional de Actividades Espaciales, Argentina, CONAE
- Indian Space Research Organization, ISRO
- Japan Aerospace Exploration Agency, JAXA
- United States Geological Survey, USGS
- UK Space Agency, UKSA
- China National Space Administration, CNSA
- German Aerospace Centre, DLR
- Korea Aerospace Research Institute, KARI
- Instituto Nacional de Pesquisas Espaciais, Brazil, INPE
- European Organization for the Exploitation of Meteorological Satellites, EUMETSAT
- Russian State Space Corporation, ROSCOSMOS
- Bolivarian Agency for Space Activities, ABAE
- United Arab Emirates Space Agency, UAESA / Mohammed Bin Rashid Space Centre, MBRSC

The Charter provides a mechanism for the rapid tasking of satellites for sudden emergencies, including but not limited to earthquakes, storms, landslides, volcanic eruptions, and flooding. Satellite-based information is provided at no cost to nationally mandated disaster management authorities and humanitarian aid organizations to specifically support the immediate response to major natural or man-made disasters.

The founding agreement of the Charter is intentionally limited in scope and is not intended to serve the entire disaster management cycle (mitigation, preparedness, alert, response and recovery, rehabilitation and reconstruction). The Charter's support for disaster response with space technology on a global level, when requested by users, is based on carefully defined policies and rules. Natural or man-made disasters that are slow onset events such as droughts are beyond the scope of the Charter; for these events, satellite-based monitoring can be provided with other EO capabilities and services that do not require rapid response. The Charter does not support humanitarian emergencies beyond those related to natural or man-made hazards; for example acts of war, refugee crises, etc. are not covered.

The lead agency function rotates among all Charter members on a six-month basis. The lead agency has the overall responsibility of the implementation of the Charter to oversee and coordinate its operations, administration, communications and external relations. At the start of each leadership period, the new lead agency hosts meetings of the Charter Board and Executive Secretariat.

The Charter can be activated by a predefined list of appointed users, known as 'Authorized Users' (AUs). Before 2013, AUs were typically national disaster management authorities from countries of Charter member agencies, and were able to request Charter support for emergencies in their own country or in a country with which they cooperate for disaster relief. In another effort to expand the number of users who can benefit from the Charter, the Universal Access initiative was created and formally adopted in 2012 (see section 5.2).

The Charter has consistently demonstrated a strong commitment to expanding its number of users. Initiatives include collaboration with UNOOSA and UNITAR/UNOSAT, both of which are active in many countries and can submit requests to support in-country UN relief agencies. Another collaboration is with Sentinel Asia, a regional network for Earth Observation-based Emergency response that is active in 28 countries. Additionally, Sentinel Asia's partner, the Asian Disaster Reduction Center can submit activation requests on behalf of Sentinel Asia users.

Based on the requester, four activation modes are in place since 2010:

- Mode 1: direct activation by an Authorized User (AU) for a disaster occurring in their country.
- Mode 2: activation by an Authorized User on behalf of a user from another country.
- Mode 3: activation by UNOOSA or UNITAR/UNOSAT for UN users.
- Mode 4: activation for national users from the Asia-Pacific region via Sentinel Asia's partner, the Asian Disaster Reduction Center.

Since its inception in 2000 the Charter **has been activated for 742 disasters (as of the end of 2021), in 130 countries. In 2021 alone, the Charter was activated 50 times for disasters taking place in 28 countries.**

The Charter gives access to a virtual constellation of satellites equipped with radar and optical sensors.

In 2021, active satellites included (see Table 1):

- Radar (high resolution and very high-resolution sensors): RADARSAT-2, RCM -1/2/3 TerraSAR-X, TanDEM-X, Sentinel-1A/B, ALOS-2, KOMPSAT-5, GF-3, ICEYE-X2, ICEYE-X4, ICEYE-X5, Iceye-X7, SAOCOM-1A and SAOCOM-1B.
- Optical (high resolution and very high-resolution sensors): NewSat, Planetscope, WorldView-1, WorldView-2, Worldview-3, GeoEye-1, VRSS-1, VRSS-2 SPOT-6, SPOT-7, PLEIADES 1A /B, PROBA-V, GF-1/2/4, , CBERS-4, CBERS-4A, KOMPSAT-3, KOMPSAT-3A, Cartosat-2E, Resourcesat-2/2a, Kanopus-V, Kanopus-V-IK, Resurs-P, Dubaisat-2, Khalifasat, VISION-1, BKA, OHS-2A/B/C/D, JILIN-01, OVS-1A/B, OVS-2A andBeijing-2.
- Optical (medium and low-resolution sensors): ALSAT-1, Landsat 7&8, FY-3C/D/H, FY-4A , UK-DMC2 and Sentinel 2A/B, POES, GOES, Suomi NPP, Metop series, Meteosat Second Generation (MSG) and Meteor-M.

New satellites added in 2021 are:

- Iceye-X7 from ICEYE,
- BKA from NAS (Belarus),
- NewSat from Satellogic.

Moreover, satellites launched in 2019 that were integrated in 2021 are:

- JILIN-01 3/4/5/6/7/8 from ChangGuang Satellite Technology,
- OVS-1A/B, OVS-2A, OHS-2A/B/C/D from Zhuhai Orbita Aerospace Science & Technology
- Beijing-2 from 21st Century Aerospace Technology

Specific agreements with other entities allow the Charter to access additional products (both high and very high resolution) from satellites such as GeoEye and WorldView.

Table 1. List of Charter operational satellites [optical (in light blue) and radar (in light grey)]

Agency	Satellite (operational)	Agency	Satellite (operational)
ABAE	VRSS-1, VRSS-2	ISRO	Resourcesat-2
CNES	PLEIADES 1A/1B		Resourcesat-2a
	SPOT-6, SPOT-7		Cartosat-2E
CONAE	SAOCOM-1A, SAOCOM-1B	JAXA	ALOS-2
CSA	RADARSAT-2,	KARI	KOMPSAT-3
	RCM-1, RCM-2, RCM-3		KOMPSAT-3A
CNSA	GF-1 , GF-2, GF-4		KOMPSAT-5
	FY-3D, FY-3C, FY-2H, FY-4A	NAS	BKA
	JILIN-01 3/4/5/6/7/8	NOAA	POES
	OVS-1A/B, OVS-2A		Suomi NPP
	Beijing-2		
	OHS-2A/B/C/D		
	GF-3		
DLR	TerraSAR-X / TanDEM-X	PLANET	Planetscope
ESA		SATELLOGIC	NewSat
	Sentinel-1A/1B	ROSCOSMOS	Kanopus-V , RESURS-P
	Sentinel-2A/1B		Kanopus-V-IK
EUMETSAT	Metop Series		Meteor-M
	Meteosat MSG	UAESA	Dubaisat-2, Khalifasat
INPE/CNSA	CBERS-4, CBERS-4A	UKSA	ALSAT-1B, VISION-1
ICEYE	ICEYE-X2, ICEYE-X4, ICEYE-X5, ICEYE-X7	USGS	WorldView-1/2/3
			GeoEye-1
			Landsat 7 and 8

2.2 Lead agencies of the Charter in 2021

During this period, the lead agencies on a biannual rotational basis have been the Japan Aerospace Exploration Agency, JAXA (November 2020 – April 2021), ISRO (April 2021 – October 2021), INPE (October 2021 – May 2022[1]).

Figure 1. 45th Charter Board and Executive Secretariat members (virtual meeting) with 51 participants, hosted by ISRO, on 15-16 April 2021.

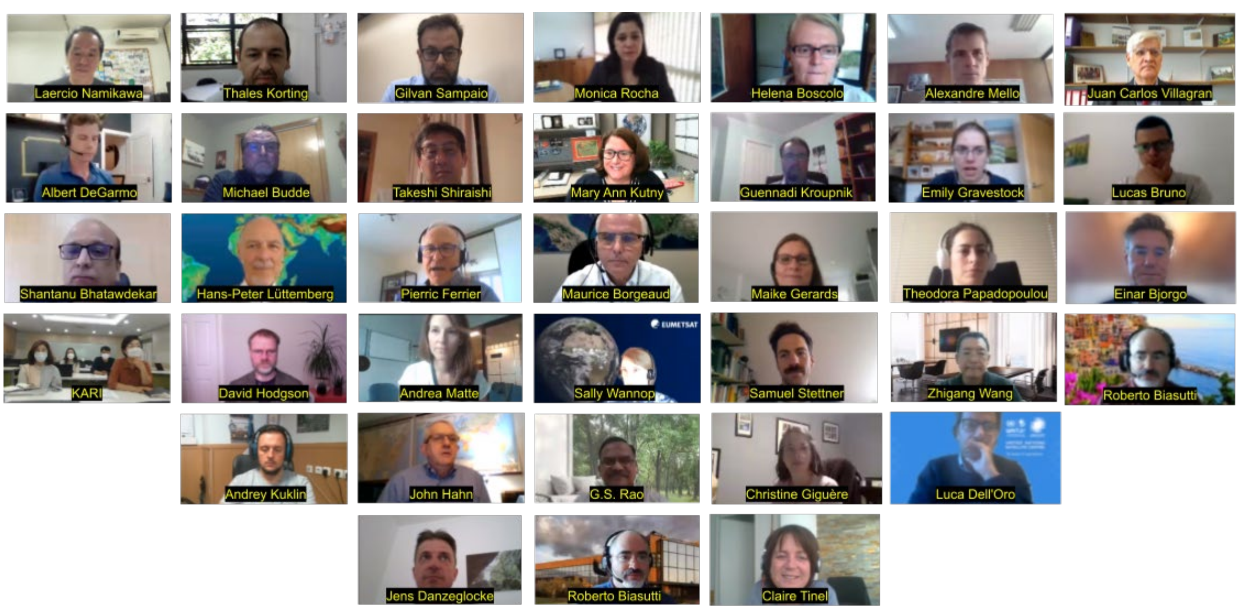


Figure 2. 46th Charter Board and Executive Secretariat members (virtual meeting) with 44 participants, hosted by INPE, on 14-15 October 2021.

[1] Longer mandate for INPE due sanitary conditions.

3. Charter operations

3.1 Charter activations

In 2021, the Charter was activated 50 times in 28 different countries. This amount of activations is higher than the annual average since 2017: the average is now 42 activations per year and ranges from 32 in 2011 to 55 in 2020 (see Figure 3).

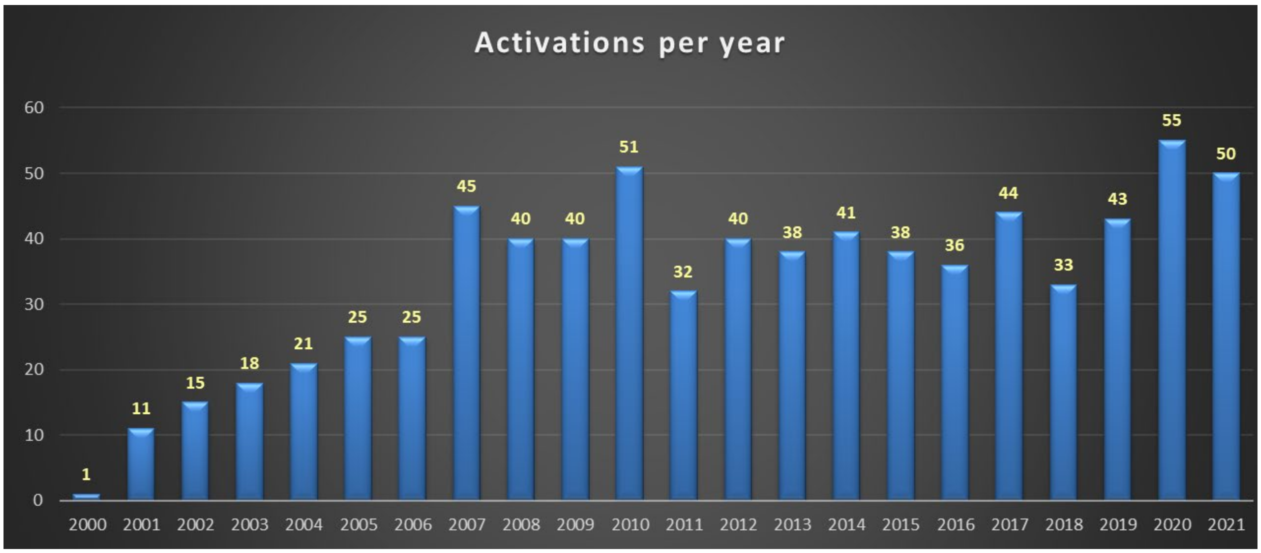


Figure 3. Number of Charter activations per year since 2000

This year, the Charter was triggered two times for man-made disasters:

- one oil spill Sri Lanka,
- one was an industrial accident (chemical explosion and wildfire) in Thailand.

By the end of 2021, the Charter had been triggered for 742 disasters in 130 countries since 2000 (Figure 4, Figure 5 and Figure 6).

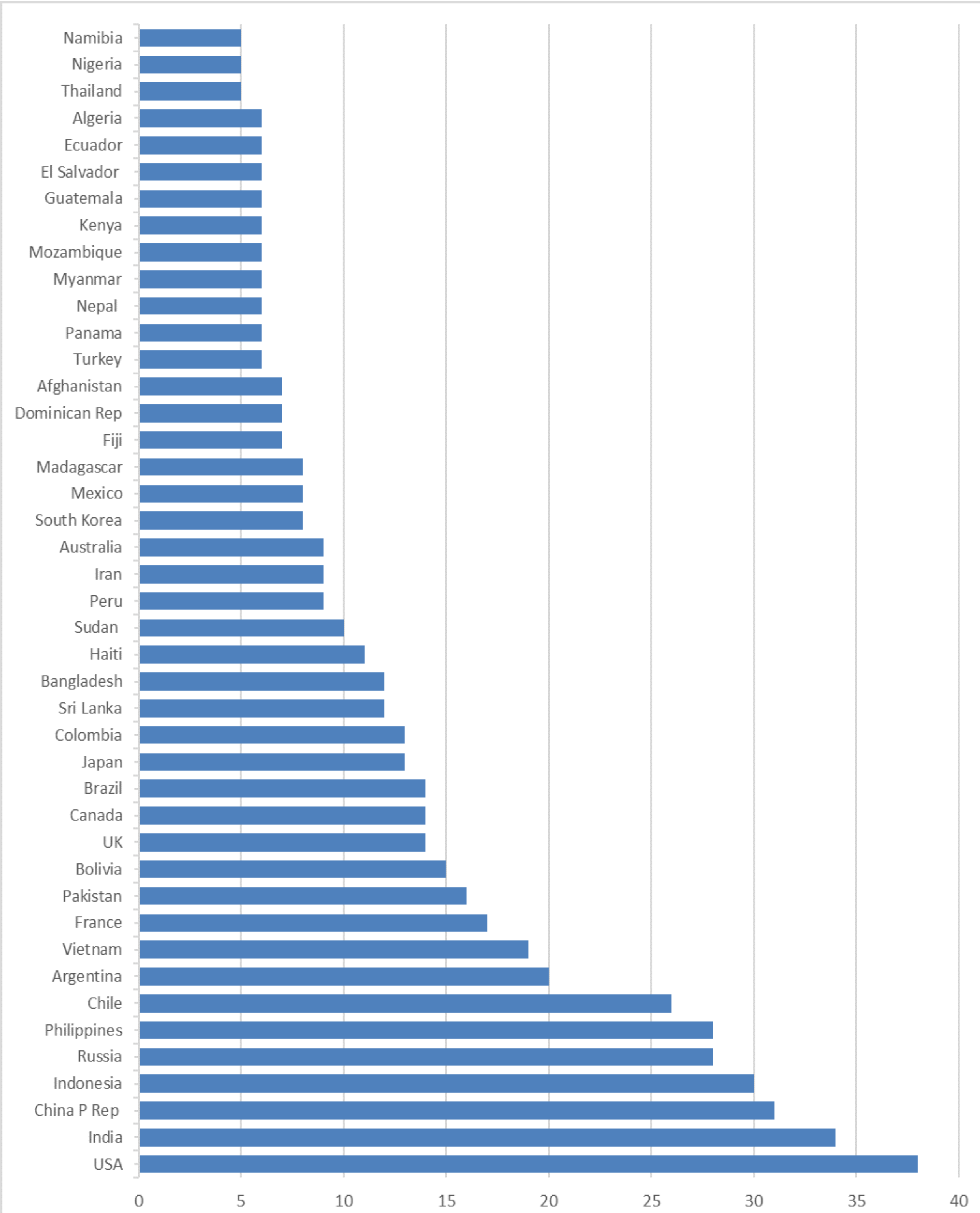


Figure 4. 2000-2021 breakdown of Charter activations by beneficiary country (countries with 5 or more disasters covered by the Charter)

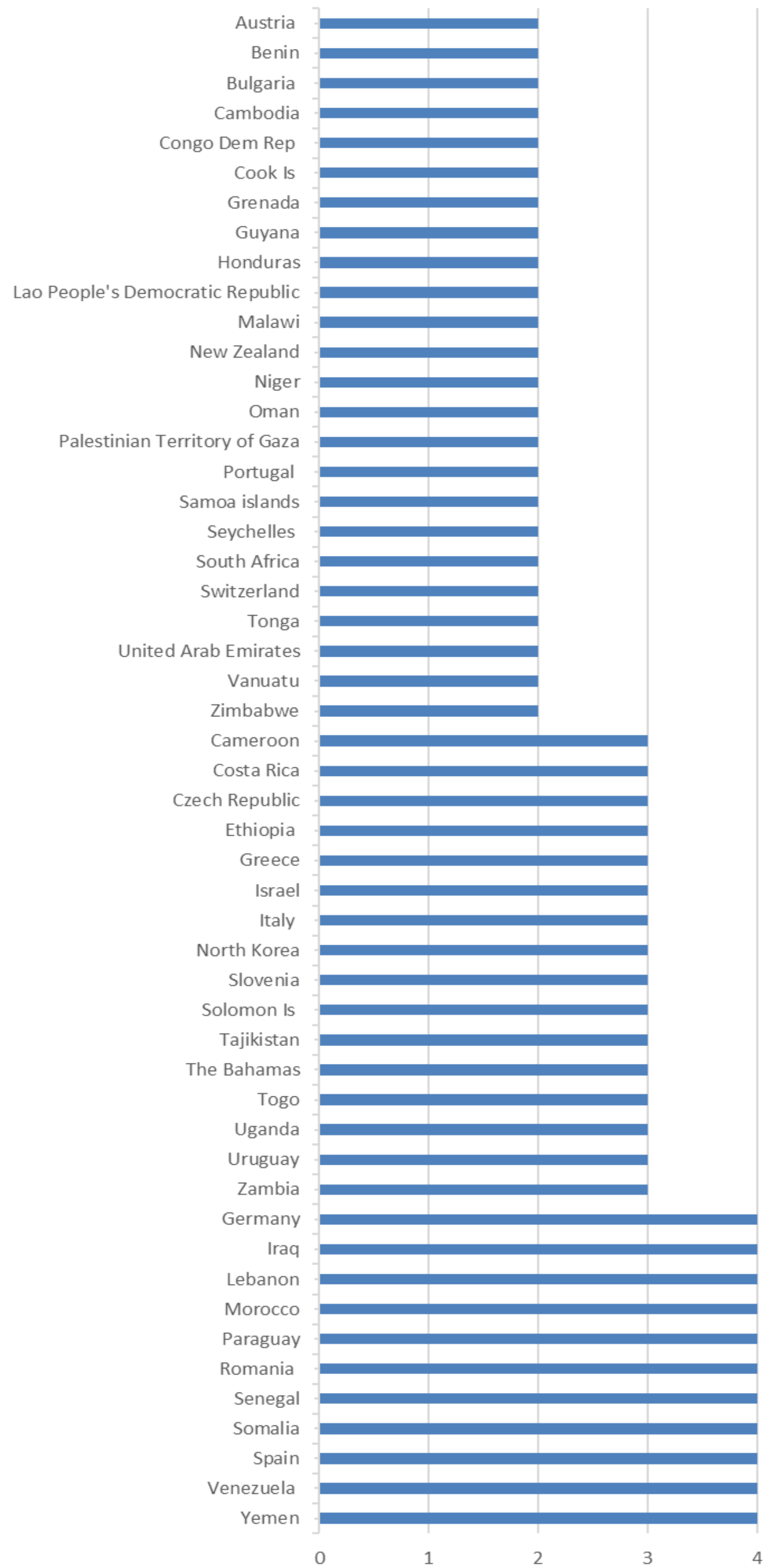


Figure 5. 2000-2021 breakdown of Charter activations by Beneficiary country (countries with 2 to 4 disasters covered by the Charter)

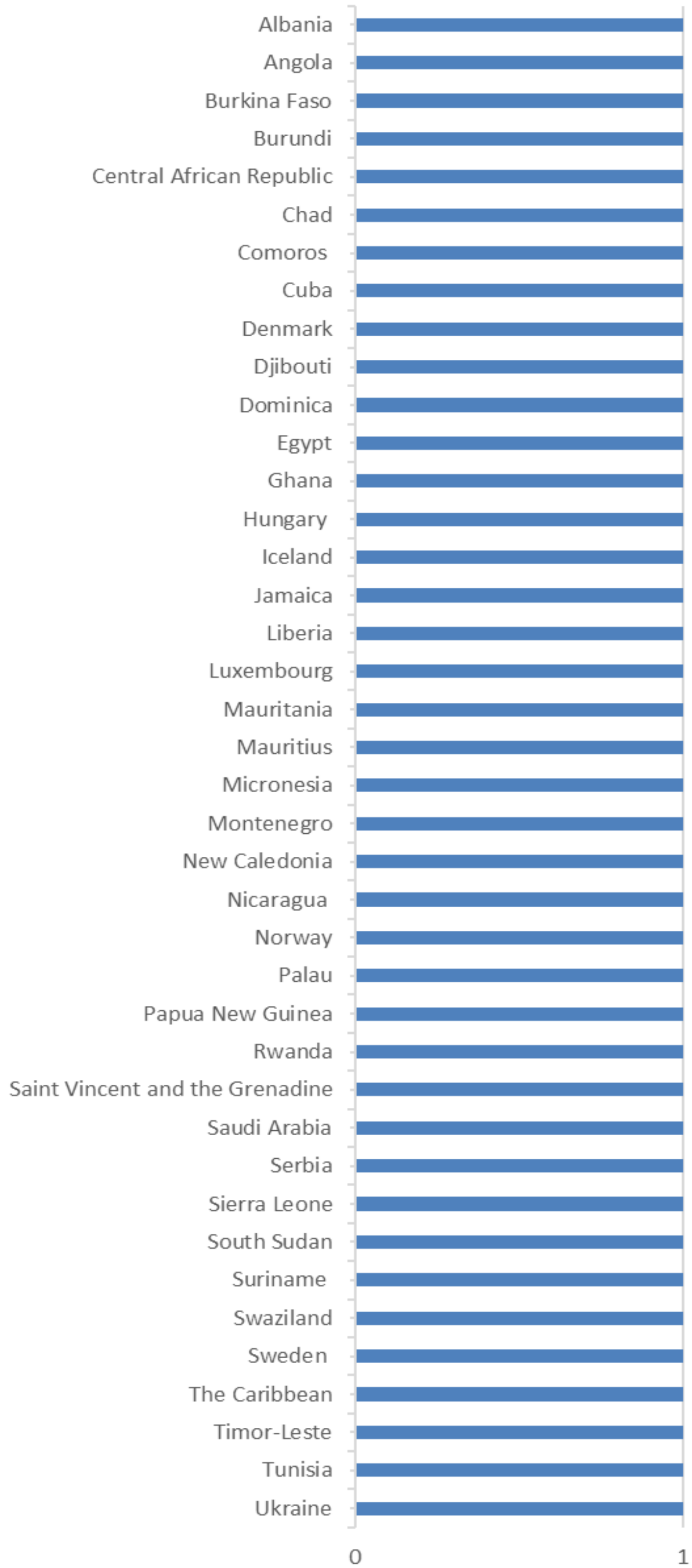


Figure 6. 2000-2021 breakdown of Charter activations by Beneficiary country (countries with one disaster covered by the Charter)

Since 2000, 130 Countries worldwide have benefited from the International Disasters Charter.

The USA, China, India, Indonesia, Russia, Chile, Philippines, Argentina, Vietnam, France, Pakistan, the UK, Colombia, Canada, Bangladesh, Brazil, Bolivia, Sri Lanka, Sudan, Haiti, and Japan are the hazard affected countries for which the Charter was activated most often (>10 times) to cover major disaster events during these 21 years, the remaining 68% of countries using the Charter requested it less often (1 to 4 activations in 20 years).

All 2021 activations are listed in Table 2. The Call-ID is the unique number assigned by the Charter's COS-2 software to any User Request Form (URF) received. The number of the activation ('Activation ID') differs from the Call-ID, as some Calls are not processed (rejection mechanism) and others are merged.

In total, 58 requests were received in 2021. In four cases, calls were merged into one activation, as these requests had been made for the same disaster events:

- Calls 798 and 799 were requested for an earthquake in Indonesia by ADRC on behalf of the Disaster Management Agency of Indonesia and by LAPAN-SPIDER.
- Calls 807 and 808 were requested for Flood, storm, Hurricane in Timor-Leste by UNITAR/UNOSAT and by ADRC.
- Calls 806 and 812 were requested for Flood, storm, Hurricane, landslide in Indonesia by ADRC on behalf of LAPAN and by UNITAR/UNOCHA
- Calls 836, 837, and 839 were requested for an earthquake in Haiti by UNITAR/UNOSAT, CENAPRED and by Direction de la Protection Civile on behalf of UNOCC.

Call 845 for a flash flood in Mexico was rejected.

Calls 805 and 838 for a Flood in Belarus and an earthquake in Haiti were withdrawn.

Table 2. List of 2021 Activations

Act. No	Type of disaster	Country	Charter activation date
693	Flood	Bolivia	05/01/2021
694	Flood	Morocco	12/01/2021
695	Earthquake	Indonesia	15/01/2021
696	Flood, storm, Hurricane	Mozambique	22/01/2021
697	Flood, storm, Hurricane, landslide	Swaziland	27/01/2021
698	Flood and landslide	Chile	07/02/2021
699	Flood	India	07/02/2021
700	Flood, storm, Hurricane, landslide	Philippines	22/02/2021
702	Flood, storm, Hurricane, landslide	Indonesia	06/04/2021
701	Flood, storm, Hurricane	Timor-Leste	07/04/2021
703	Volcano	Saint Vincent and the Grenadine	09/04/2021
704	Flood	Russia	12/04/2021

705	Flood	Russia	14/04/2021
706	Flood	Somalia	03/05/2021
707	Flood	Russia	07/05/2021
712	Flood	Russia	12/05/2021
709	Storm and hurricane	India	16/05/2021
710	Flood	Russia	21/05/2021
711	Earthquake	China P Rep	22/05/2021
712	Earthquake	China P Rep	22/05/2021
713	Volcano	Congo Dem Rep	23/05/2021
714	Storm and hurricane	India	25/05/2021
715	Oil Spill	Sri Lanka	04/06/2021
716	Flood	Sri Lanka	05/06/2021
717	Flood	Guyana	07/06/2021
718	Flood	Russia	21/06/2021
719	industrial accident	Thailand	06/07/2021
720	Flood	Luxembourg	15/07/2021
721	Flood	Switzerland	15/07/2021
722	Wildfire	Russia	20/07/2021
723	Flood and landslide	India	26/07/2021
724	Wildfire	Tunisia	28/07/2021
725	Flood	Russia	04/08/2021
726	Flood	Russia	13/08/2021
727	Flood and landslide	Japan	14/08/2021
728	Wildfire	Russia	14/08/2021
729	Earthquake	Haiti	15/08/2021
730	Flood	Haiti	17/08/2021
731	Flood	Togo	06/09/2021
732	Flood	Sudan	09/09/2021
733	Earthquake	China P Rep	16/09/2021
734	Flood	Thailand	28/09/2021
735	Storm and hurricane	United Arab Emirates	02/10/2021
736	Storm and hurricane	Oman	03/10/2021
737	Flood and landslide	Sri Lanka	12/11/2021
738	Volcanic debris after submarine volcano eruption	Philippines	24/11/2021
739	Volcano	Indonesia	07/12/2021
740	Flood	Micronesia	09/12/2021
741	Ocean storm and flood	Philippines	16/12/2021
742	Flood	Brazil	31/12/2021

3.1.1 Monthly activations

During 2021, the monthly average of activations was 4.2, lower than in 2020 but significantly higher than average over the last decade (the average was 3.3 activations for the period 2011-2020). Figure 7 shows the monthly distribution of activations throughout 2021. The number of activations is distributed throughout the year in a less uniform way than in previous years. No activations occurred in March and the highest number was in June. The period May to August corresponds to 50% of the total number of activations (i.e., about half of the year’s activations were concentrated in this 4-month period).

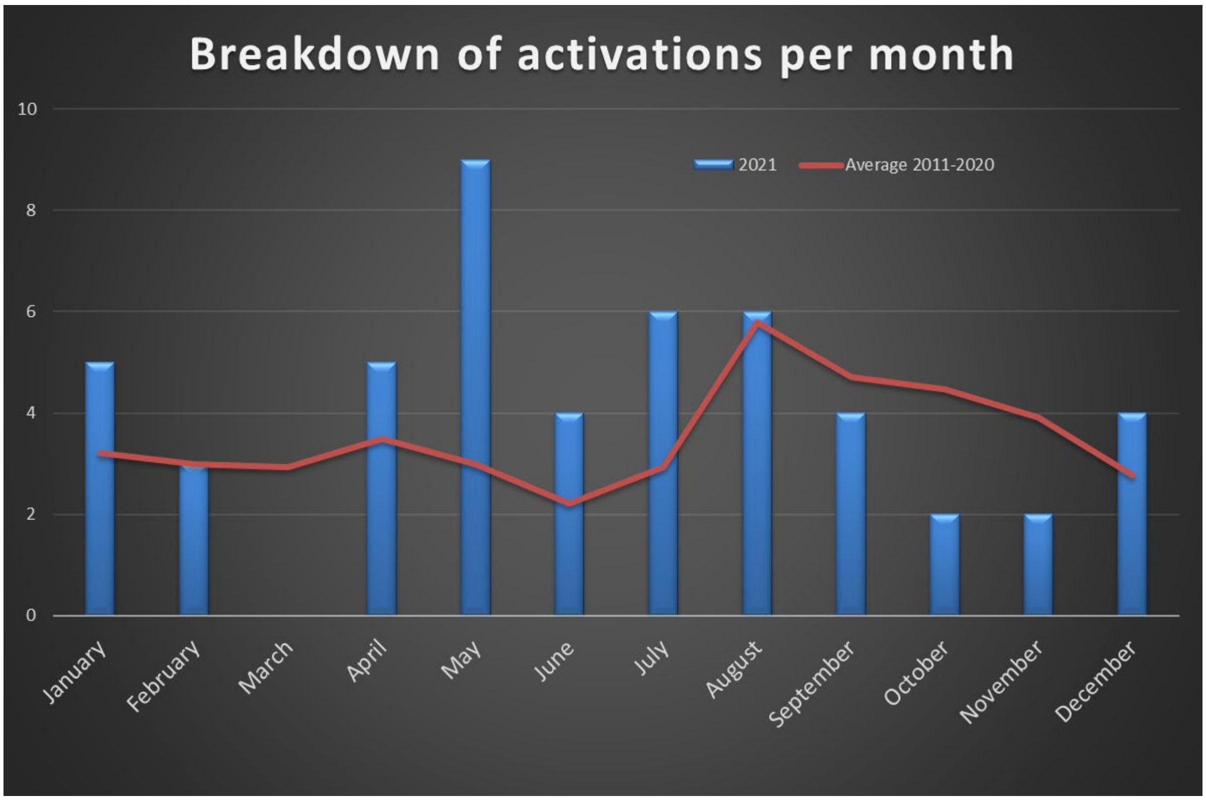


Figure 7. Distribution of the Charter activations by month in 2021 and the monthly average number of activations for 2007-2020

Peaks in activations at the end of summer (northern hemisphere) have occurred regularly since 2007 (Figure 7). Natural disasters occurring throughout that period of the year are mainly attributable to meteorological events (80%) (intense rains; ensuing floods; tropical storms; wildfires) in Asia (5), Africa (2) and Caribbean (1). The spike in May 2021 activations was mainly due to floods, Storms, or hurricanes in Asia.

This figure also shows the overall trend through the years, with the monthly average number of activations for the period 2007-2020. The diagram clearly shows the peak of activations at the end of summer. The 2021 diagram shows few agreements with the average during most months, with large increases in activations for May and July but fewer activations in October and November and none in March.

3.1.2 Geographical distribution

In 2021, the activation breakdown per region was as follows: 33 activations in Asia (i.e., 66% of 2021 activations); 8 activations in Africa; 4 activations in South America; 3 activations in Central America; and 2 activations in Europe (Figure 8 and Figure 9).

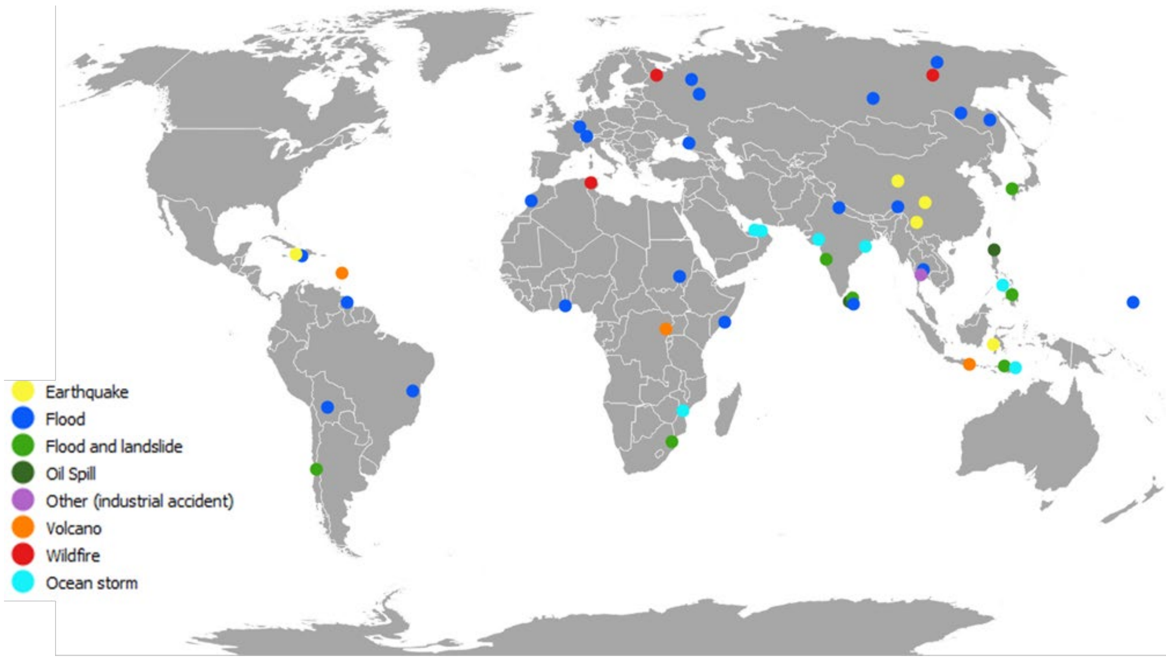


Figure 8. Location of the 2021 activations (by hazard type)

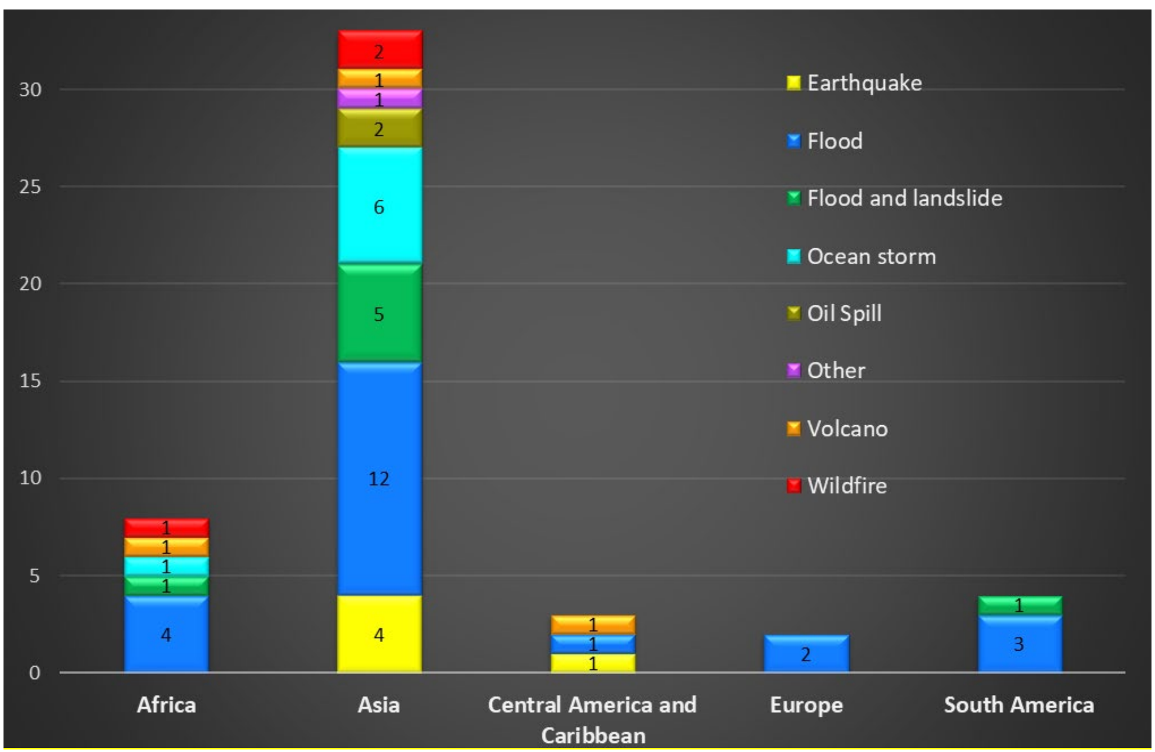


Figure 9. 2021 - Number of activations by continent/subcontinent and hazard type

The most frequent hazard types being floods (44%), floods and landslides (14%) and ocean storms (14%) while wildfires and volcanoes represented 6 % each, oil spills (4%), earthquakes (10%) and other types of hazards 2% (Figure 10).

However, it should be noted that it is not always a straightforward process to classify Charter activations by disaster type. Activations are often multi-hazard events, such as floods causing landslides, earthquakes causing landslides or tropical/ocean storms resulting in direct damages as wells as floods and landslides, etc.

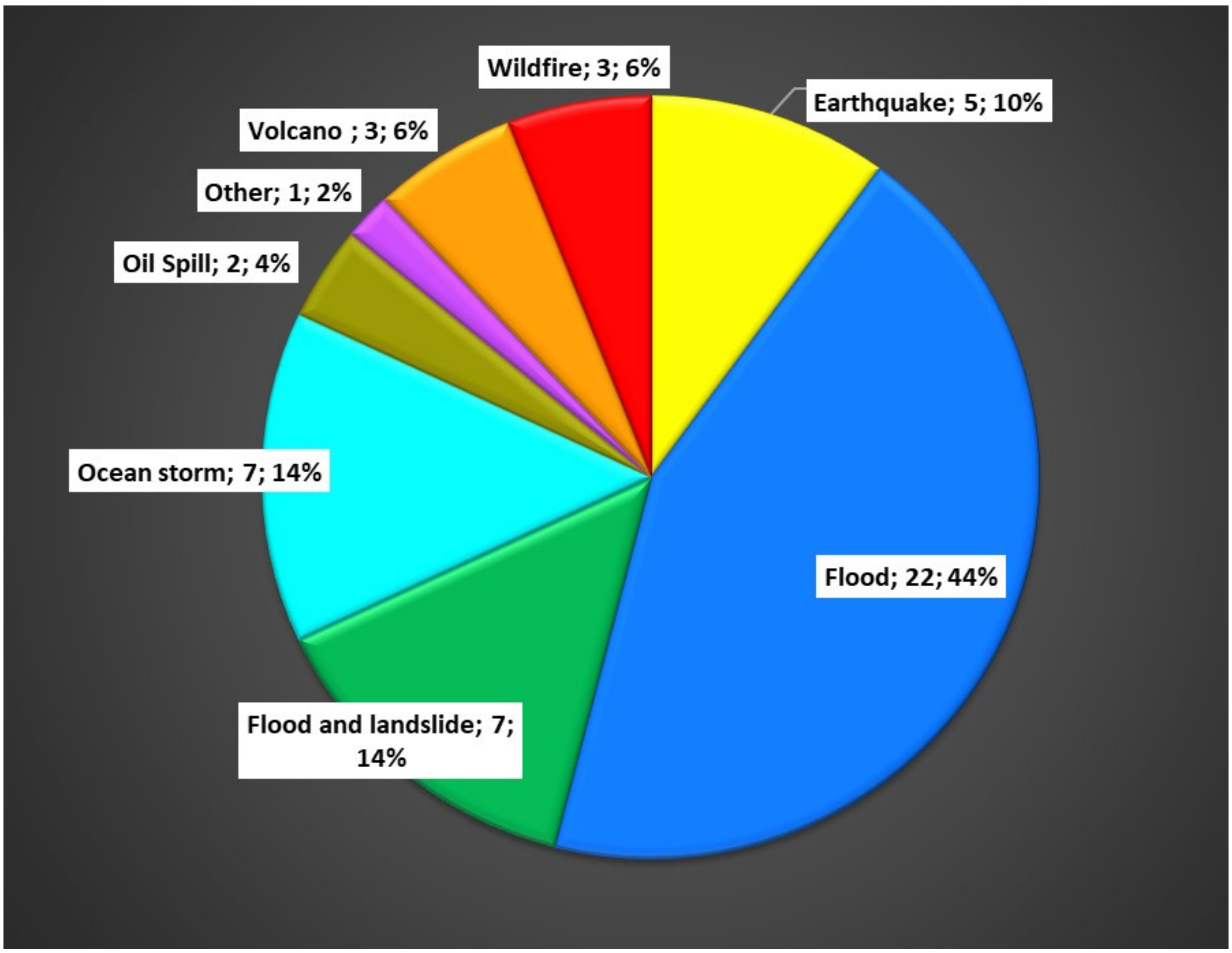


Figure 10. 2021 Number of activations by hazard type

As shown below (Figure 11), since 2000 the Charter has been frequently activated for weather-related disasters such as floods, ocean and wind storms, and landslides triggered by heavy rainfall or floods, wildfires, ice/snow hazards – representing 79% of all Charter activations - while solid earth-related hazards (e.g. earthquakes, volcanic eruptions) represent 16% of all Charter activations.

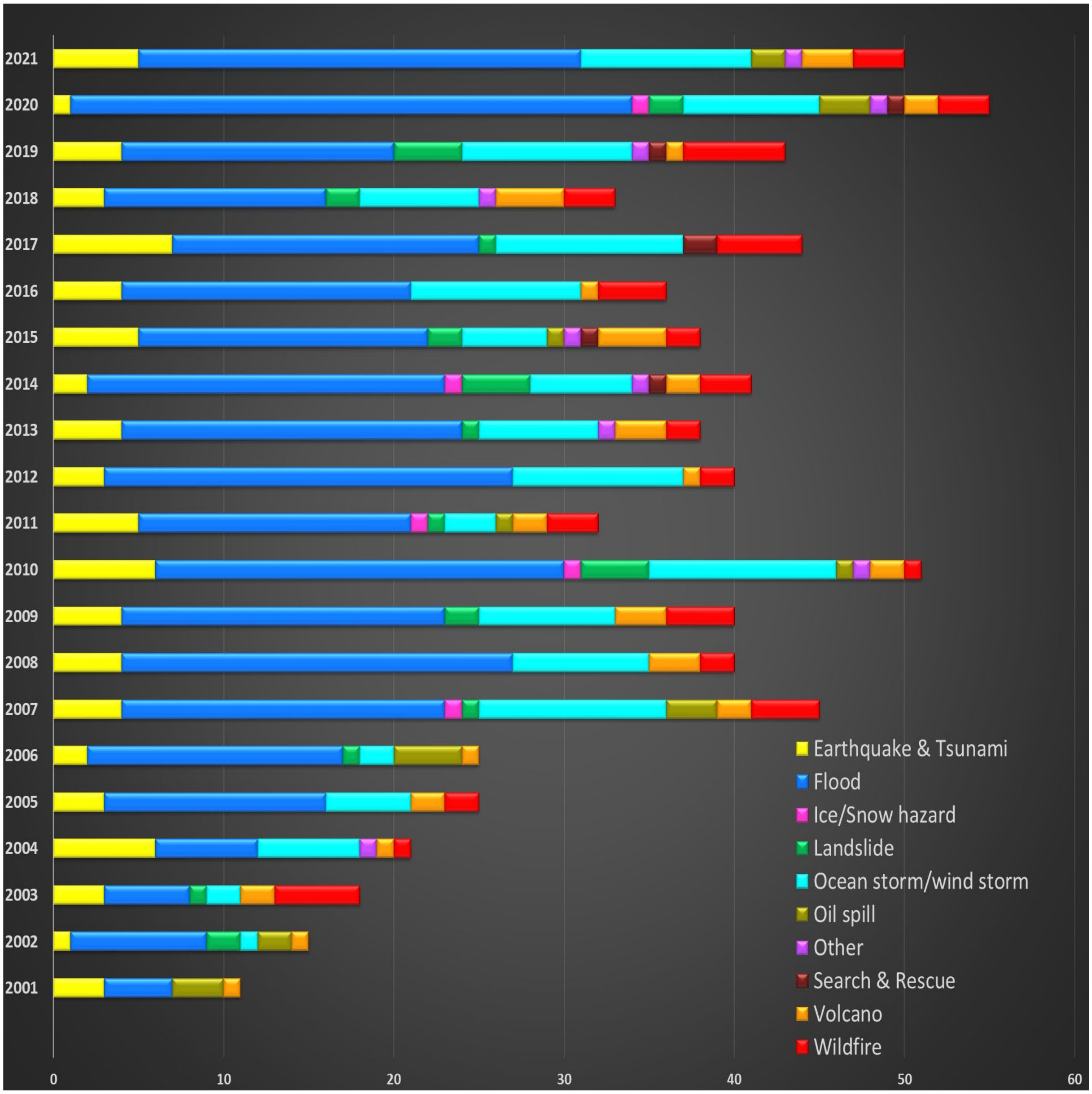


Figure 11. 2000-2020 Distribution of activations by hazard type

Activations for oil spills, search and rescue of aircrafts and industrial accidents are marginal. See also the Figure 12 and Figure 13 showing the geographical distribution of Charter activations by weather-related hazards and solid earth-related hazards for the 2000-2021 period.

The following map (Figure 12) shows by country the number of Charter activations caused by hydro-meteorological related events for the period 2000-2021 (587 activations out of 742 activations in total = 79.1%).

In total, 130 countries have benefited from the Charter service for hydrometeorological disasters since 2000. USA, India, Argentina, China, Russia, France, Philippines, Bolivia and Vietnam used the service most frequently.

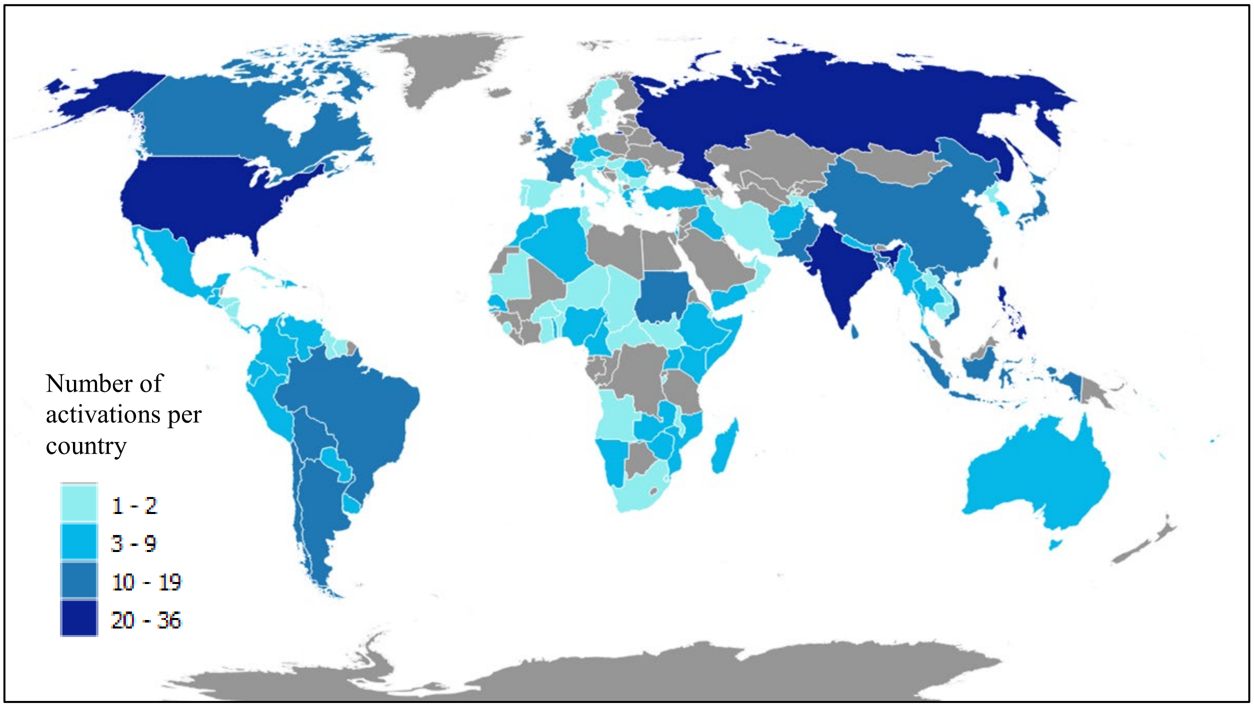


Figure 12. Figure 12. 2000-2021 Number and geographical distribution of Charter activations due to hydrometeorological events (floods, ocean storms, windstorms, landslides caused by heavy rains, wildfires, snowfall and ice jam)

The following map (Figure 13) shows the number of Charter activations by country (120 activations out of 742 activations in total = 16.2%) caused by solid earth-related events for the period 2000-2021.

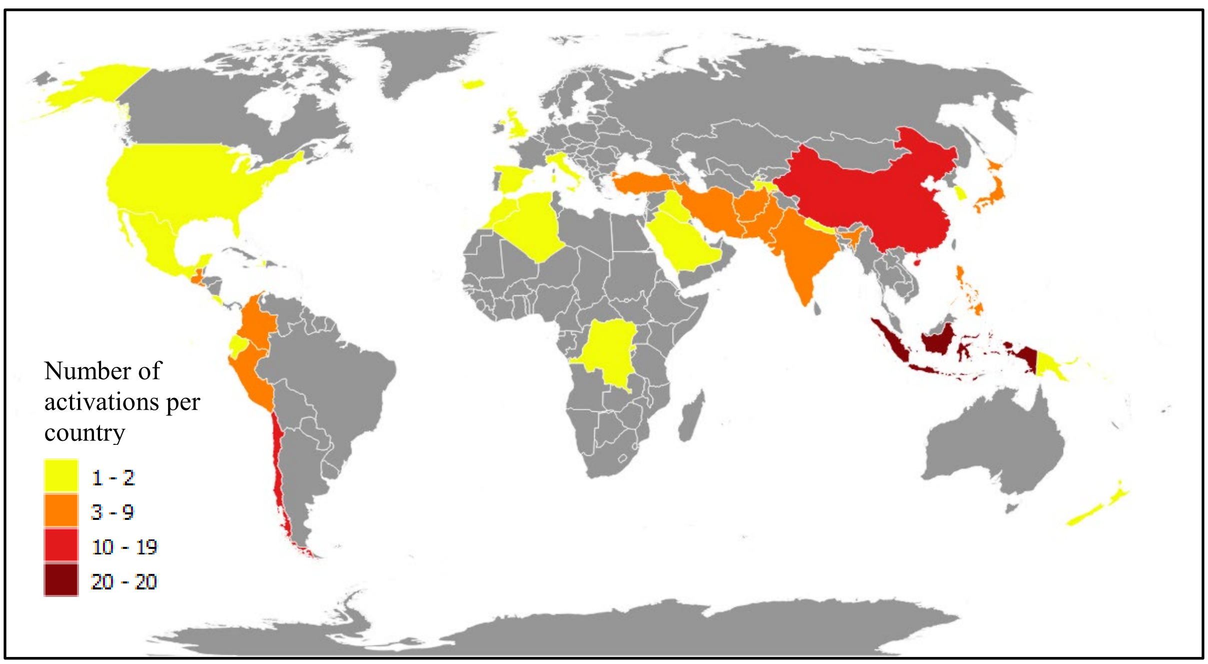


Figure 13. 2000-2021 Number and geographical distribution of Charter activations due to solid earth-related events (earthquakes, tsunamis, volcanic eruptions, landslides caused by earthquake)

In total, 38 countries have benefited from the Charter service for solid-earth events since 2000. Indonesia, Chile and China are countries for which the Charter was activated the most frequently (13-20 activations) and they are located along important active seismic faults.

Figure 14 shows the geographic distribution of activations by access mode. Since 2010, there are 4 access modes that have been used:

- Mode 1: direct activation by an Authorized User (AU) for a disaster occurring in their country.
- Mode 2: activation by an Authorized User on behalf of a user from another country.
- Mode 3: activation by UNOOSA or UNITAR/UNOSAT for UN users.
- Mode 4: activation for national users from the Asia-Pacific region via Sentinel Asia's partner, the Asian Disaster Reduction Center.

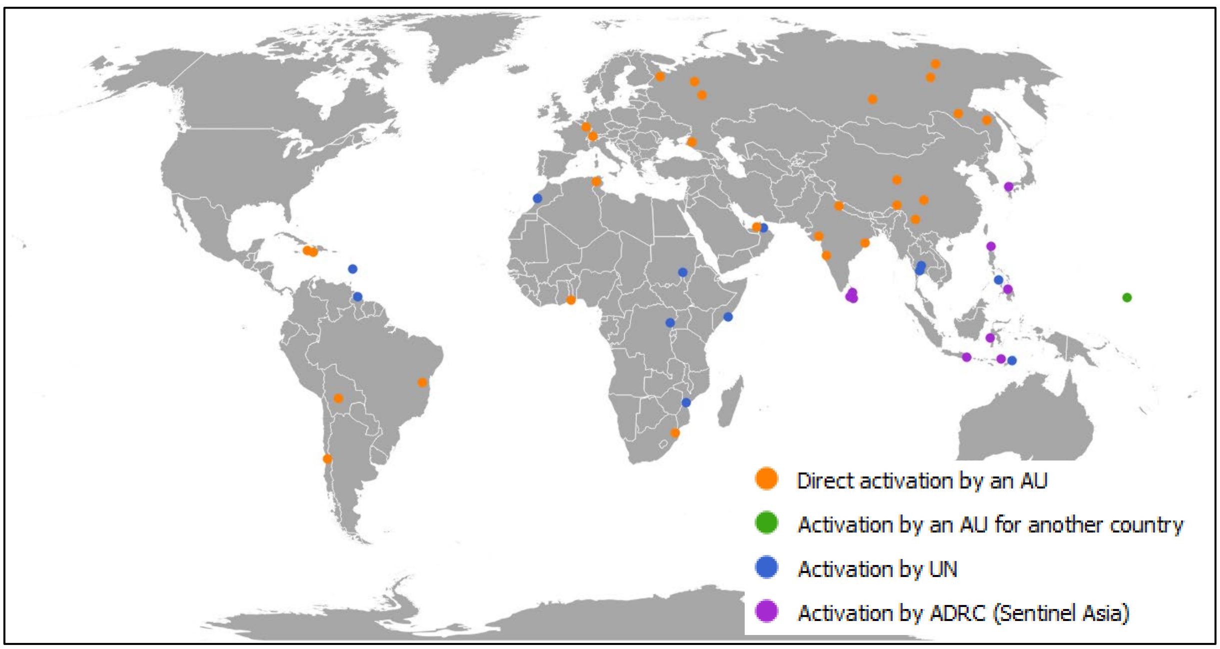


Figure 14. Location of the 2021 activations (per Mode)

In 2021, Mode 1 was mainly used for disasters in "Continental" Asia, Europe and South America, and partially in Africa and The Caribbean; Mode 2 was only used one time for a disaster in Micronesia; Mode 3 was used for disasters in Africa, South America, The Caribbean, and Asia. By definition, Mode 4 was used in Asia and mostly in Southeast Asia (Figure 14). Bolivia, Swaziland, Madagascar, Chile, Tunisia, Haiti and Togo have activated the Charter in 2021, thanks to their AU status achieved through the Charter's Universal Access initiative.

In 2021, activations by an AU (Modes 1 & 2) were the main access modes (summing up to 58% in total). However, activations by an AU on behalf of another country in 2021 were only 2% of the activations that took place in 2021.

In 2021, the Charter received the highest number of activations by an AU (Mode 1) and the highest number of SA Activations (Mode 4) compared to all previous years (i.e., 9 activations).

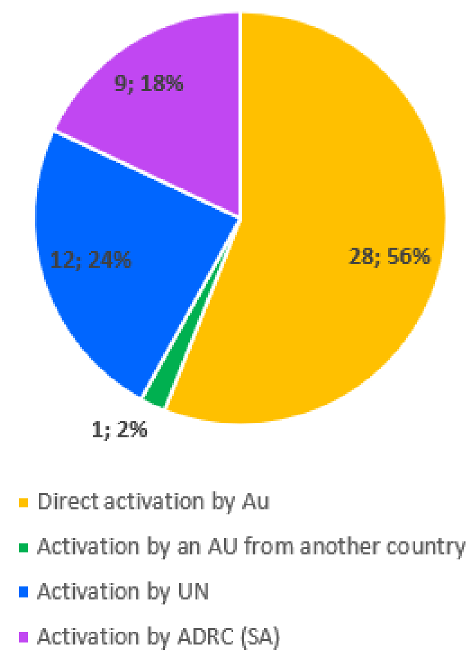
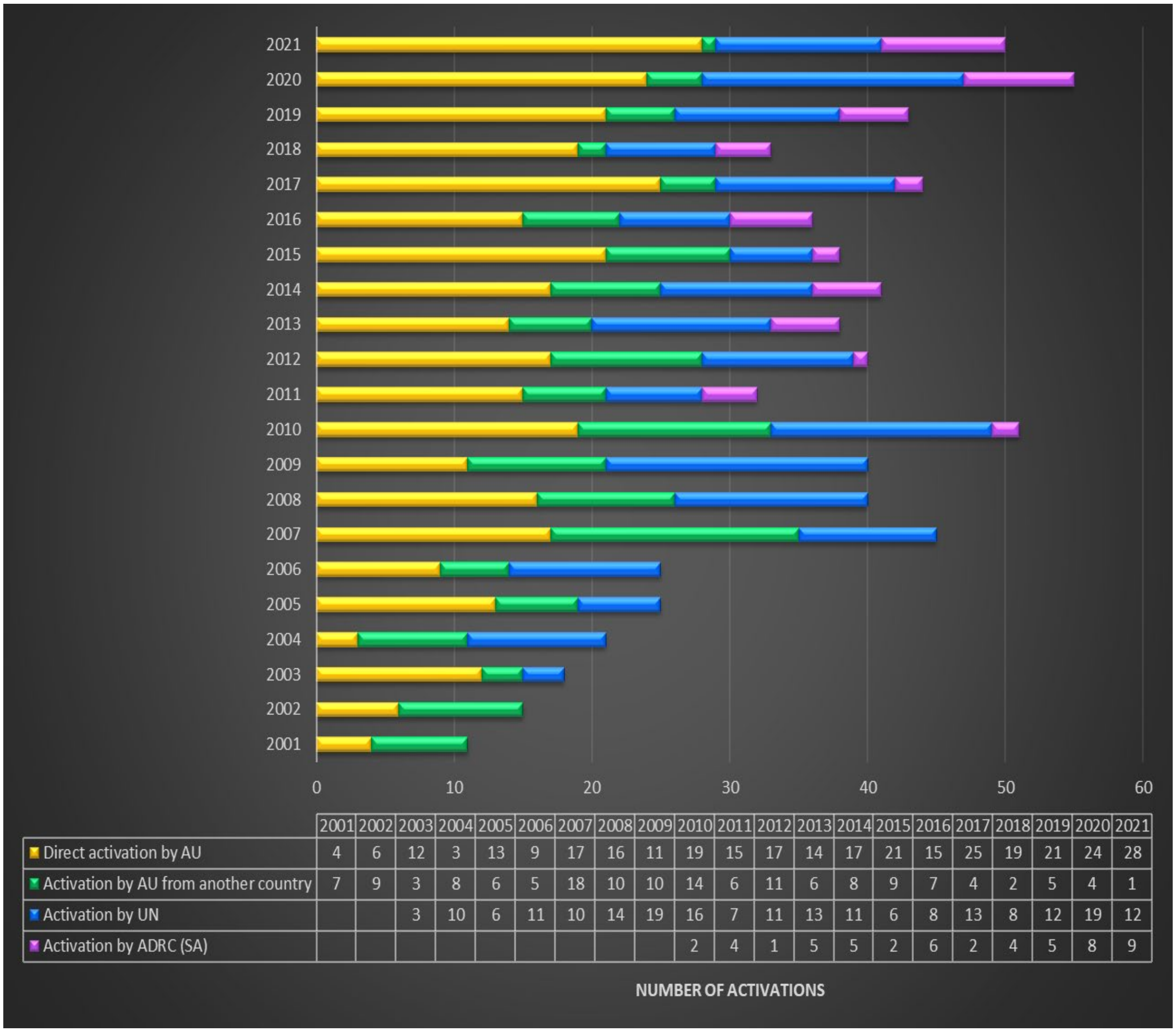


Figure 15. 2021 breakdown of Charter activations per mode

The diagram in Figure 16 compares the relative weight of the different access mechanisms adopted from 2001 to 2020, to request the International Charter service. Since its inception, 101 countries without AUs have benefited from the Charter and 56% of the activations were requests on behalf of a user (AUs for another country, UN or Sentinel Asia) in countries without an AU.

The International Charter continues to support users worldwide, including countries without direct access. At the same time, the number of AUs is increasing thanks to the Universal Access initiative, which changed the relative weight between the activation modes. By the end of 2021, mandated organisations of 36 countries prone to natural disasters have become AUs after a registration and training process under the Charter's Universal Access initiative (see chapter 5.2).



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Direct activation by AU	4	6	12	3	13	9	17	16	11	19	15	17	14	17	21	15	25	19	21	24	28
Activation by AU from another country	7	9	3	8	6	5	18	10	10	14	6	11	6	8	9	7	4	2	5	4	1
Activation by UN			3	10	6	11	10	14	19	16	7	11	13	11	6	8	13	8	12	19	12
Activation by ADRC (SA)										2	4	1	5	5	2	6	2	4	5	8	9

Figure 16. 2001-2021 number of Charter activations per mode

3.2 Resource report

3.2.1 EO data delivered in 2021

- General information

In 2021, a total of 6,435 images were provided as shown in Table 3.

In 2021, a total of 5,346 optical and radar post-crisis images for 55 activations (2020: 5,877 for 55 activations; 2019: 3,969 for 43 activations; 2018: 3,527 for 33 activations, 2017: 3,628 for 44 activations) were provided by the Charter members (Figure 17 & Figure 18, Table 3 & Table 4) with 3,489 optical images (3,547 in 2020; 2,776 in 2019) and 1,857 SAR images (1,330 in 2020; 1,193 in 2019). These figures are stable.

Regarding archive images (pre-event), 879 optical images (1,042 in 2020; 822 in 2019) and 210 SAR images (646 in 2020; 395 in 2019) were also provided (Total of 1,089).

Table 3. Statistics for 2021 for EO Charter sensors (without U.S. satellites)

	Optical data	Radar data	Total
Archive (pre-event)	879	210	1089
Programmed (post-event)	3489	1857	5346
Total	4368	2067	6435

This is complemented by 4,558 images (1,830 post-crisis and 2,728 pre-crisis images) of U.S. VHR (GeoEye, WorldView1, 2 and 3) and HR (Planet) optical satellite images that were supplied (Table 4, Figure 23 and Table 9) (2020: 2,980; 2019: 15,031; 2018: 18,293; 2017: 13,920).

Table 4. Statistics for 2021 for U.S. Commercial satellites

	VHR sat.	HR sat.	Total
Archive (pre-event)	2586	142	2728
Programmed (post-event)	1172	658	1830
Total	3758	800	4558

For Chinese satellites FY-3C/3D/2H/4A, 6,798 programmed images and no archived images were provided to the Charter in 2021 (these figures were processed out of the general statistics table as the huge difference between the number of products provided prevented from accessing details).

Figure 17 and Figure 18 show the total number of EO data from the Charter virtual Earth Observation constellation and the U.S. and Chinese optical data provided in 2021 by disaster type.

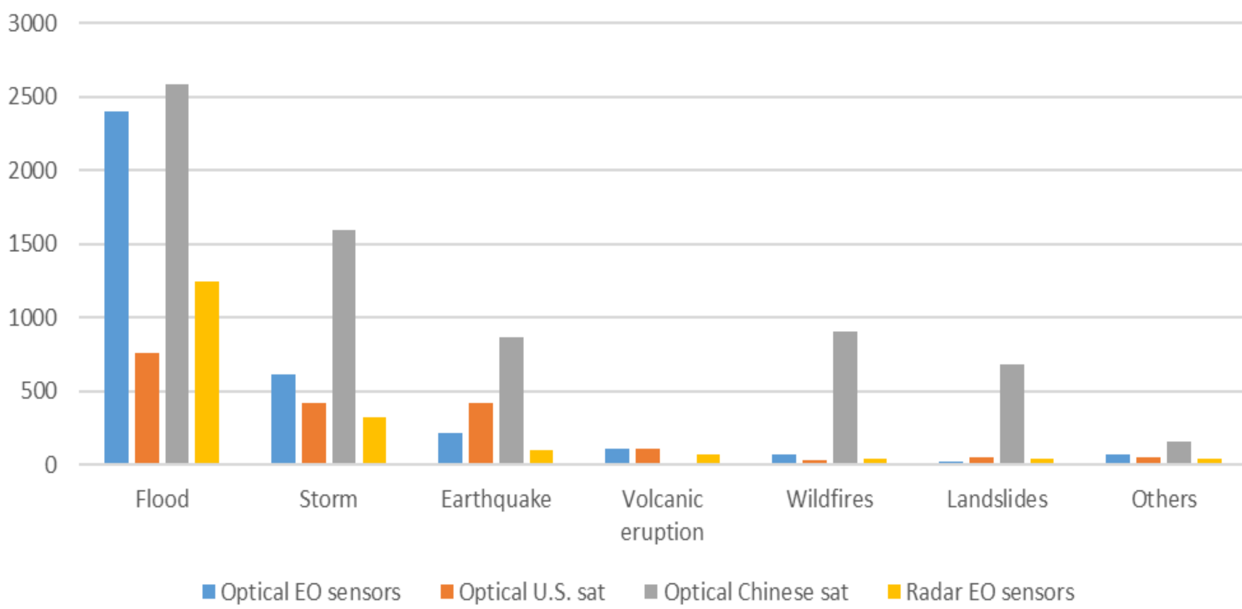


Figure 17. 2021 EO post-crisis data of the Charter EO constellation, U.S. optical data and Chinese optical data grouped by disaster type

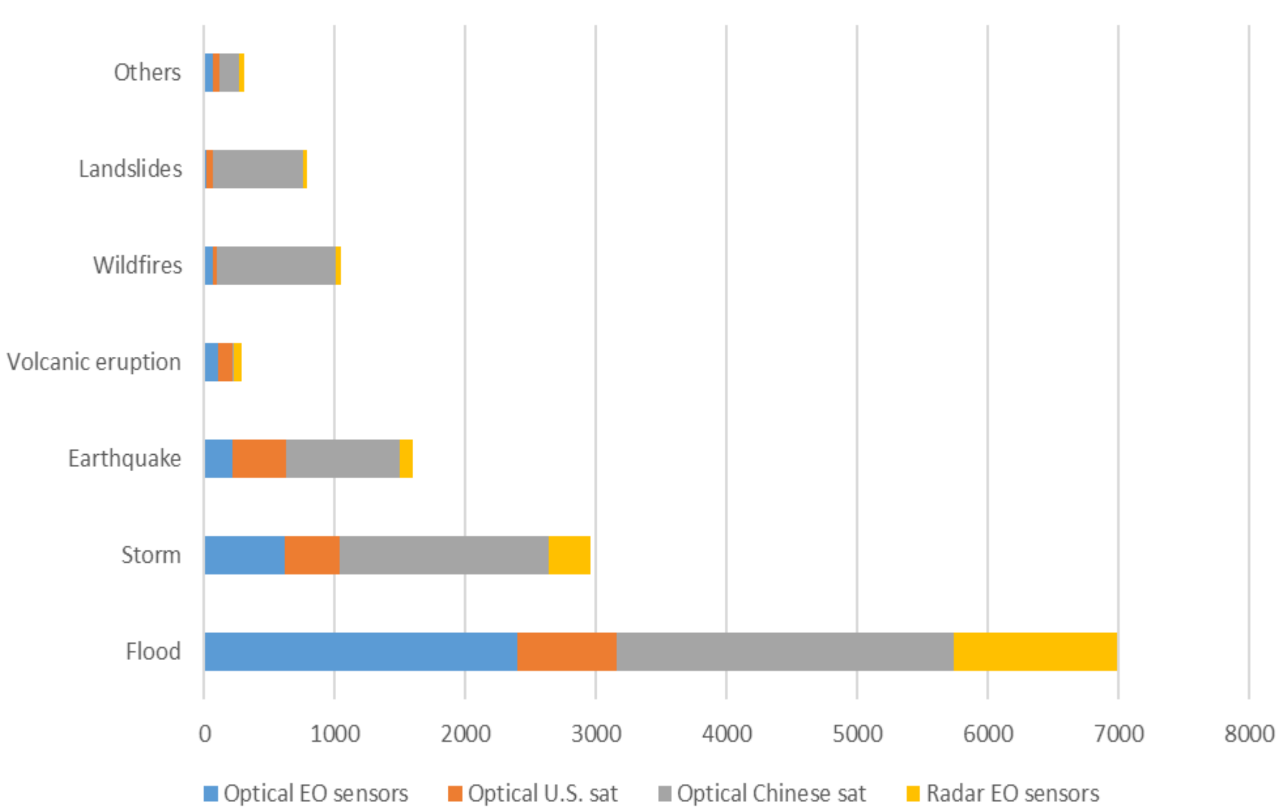


Figure 18. Another representation of 2021 EO post-crisis data of the Charter EO constellation, U.S. optical data and Chinese optical data grouped by disaster type

Table 5. Number of images (Optical EO sensors, U.S. optical sensors, Chinese optical sensors and radar sensors) provided per disaster type

	Optical EO sensors	Optical U.S. sat	Optical Chinese sat	Radar EO sensors
Flood	2400	757	2581	1248
Storm	613	423	1598	325
Earthquake	214	416	862	103
Volcanic eruption	109	109	6	67
Wildfires	69	28	910	36
Landslides	17	50	685	38
Others	67	47	156	40

The amount of EO data delivered by the agencies each year is linked to the annual number of activations, the type of disasters, the sizes of the AOIs (Areas Of Interest), the size of the image tiles, the duration and severity of certain disasters, and the change in the virtual Charter constellation (decommissioning of satellites and new satellites entering the constellation). It should be noted that due to different characteristics of EO systems - such as spatial and temporal resolution, cloud screening procedures, etc. – the total number of images of the different satellites alone does not adequately express the relative importance and contribution of a system to the overall capacity provided by the Charter.

Table 6 tries to show if the distribution of Charter activations and the provision of Charter data are consistent per disaster type. It really depends on sensors. Floods are the major disasters covered by all sensors then storms and earthquakes that is in line with activations repartition but in different proportions.

Table 6. Percentage of 2021 Charter activations and Charter data (Optical EO sensors, U.S. optical sensors, Chinese optical sensors and radar sensors) provided per disaster type

	Earthquake	Storm	Flood	Wildfire	Landslide	Volcano	Others
Charter Activations	10 %	16 %	58 %	4 %	2 %	6 %	4 %
Optical EO sensors	6.1%	17.6%	68.8 %	2 %	0.5 %	3.1 %	1.9 %
Optical U.S. VHR and HR sensors	22.7 %	23.1%	41.4 %	1.5 %	2.7 %	6 %	2.6 %
Optical Chinese sensors	12.7%	23.5%	38%	13.4%	10.1%	0.1%	2.3%
Radar EO sensors	5.5%	17.5%	67.2%	1.9%	2%	3.6%	2.2%

It is important to remember that all provided images are not systematically used, and therefore the image count is not related to the quantity of images used for generating value-adding products.

- Optical resources consumption (excluding U.S. VHR and HR data and Chinese data)

Figure 19 and Table 7 describe the optical data resources consumption for 2021. A total of 4,368 optical images were provided by the Charter members.

879 archived optical images were provided by the Charter members, which is a slighty less than 2020 (2020: 1,042; 2019: 882 images).

3,489 programmed optical images were provided by the Charter members, which is stable compared to 2020 (2020: 3,547; 2019: 2,776 images).

Among the 17 satellite constellations, around 63,4% of the total number of optical images (archived and programmed) was provided by Sentinel-2 (34,2%), Pleiades (14,8%) and Landsat 7/8 (14,4%).

Most of programmed optical images are provided by Sentinel-2 (32%), Kanopus-V (18,6%) and Pleiades (16,9%).

Most archive optical images are provided by Sentinel-2 (43,5%) and Landsat 7/8 (36,2%).

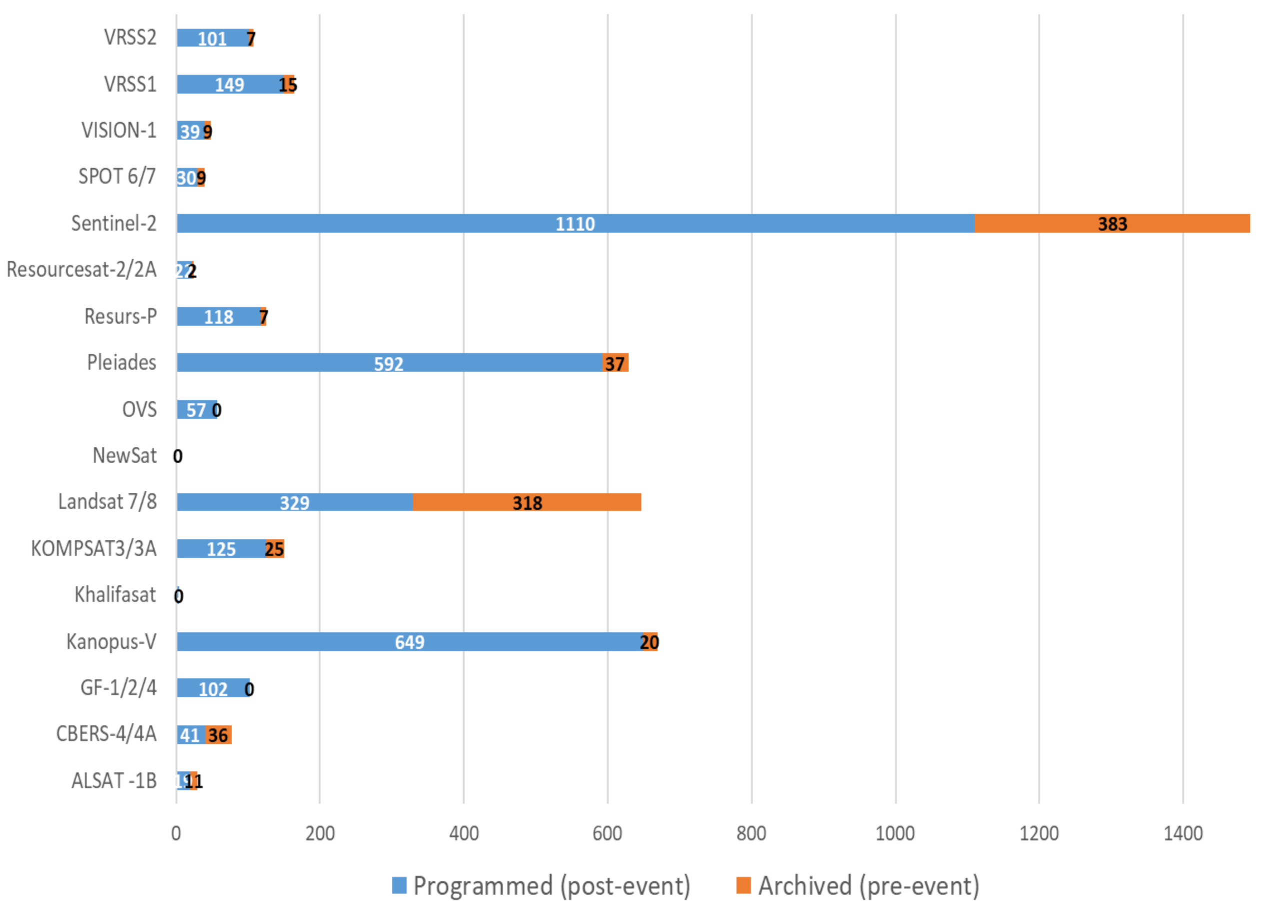


Figure 19. 2021 optical data delivered

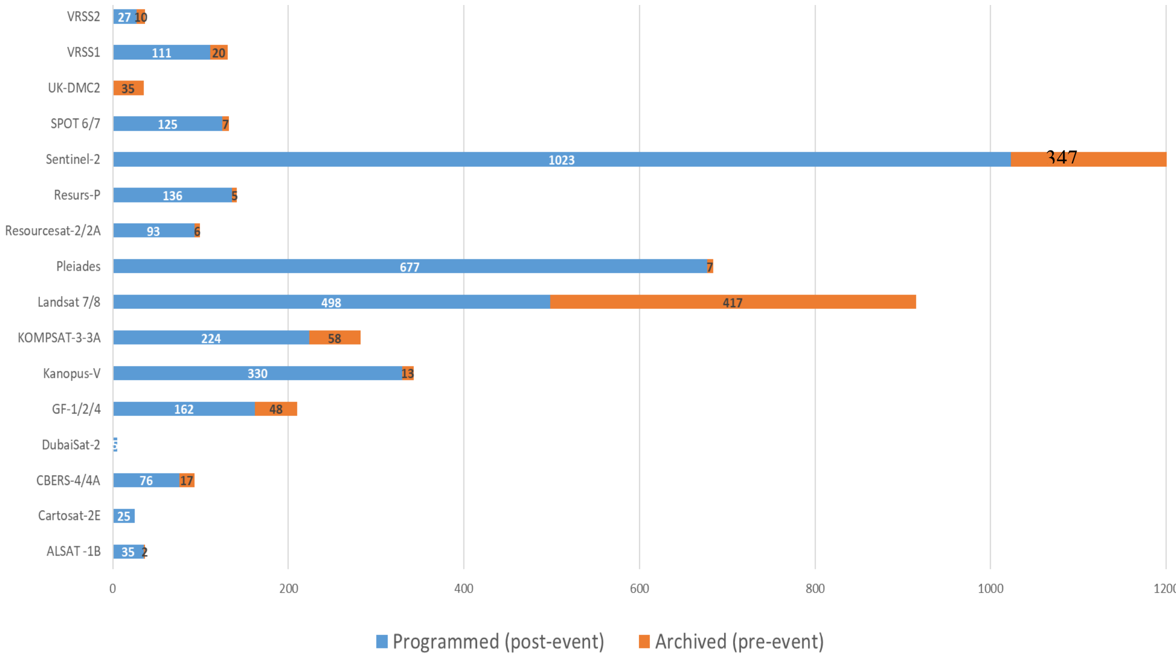


Figure 20. 2020 optical data delivered

Table 7. 2021 Statistics for Optical sensors

Resource	ALSAT -1B	CBERS-4/4A	GF-1/2/4	Kanopus-V	Khalifasat	KOMPSAT3/3A	Landsat 7/8	NewSat	OVS	Pleiades	Resurs-P	Resourcesat-2/2A	Sentinel-2	SPOT 6/7	VISION-1	VRSS1	VRSS2
Number of archived (pre-event) images provided	11	36	0	20	0	25	318	0	0	37	7	2	383	9	9	15	7
Number of activations with archived images provided	4	10	0	7	0	11	44	0	0	13	3	1	43	2	6	2	3
Number of programmed (post-event) images provided	19	41	102	649	4	125	329	2	57	592	118	22	1110	30	39	149	101
Number of activations with programmed images provided	8	20	22	40	4	25	41	1	2	30	18	9	35	3	13	13	14
Total number of images provided	30	77	102	669	4	150	647	2	57	629	125	24	1493	39	48	164	108

The provision of meteorological satellites (METOP, METEOSAT, METEOR-M, SUOMI-MPP) has not been detailed but they supported several events, such as storm activations, and were very useful for the value adders.

- Radar resources consumption

Figure 21 and Table 8 describe the radar data resources consumption for 2021.

The total number of newly acquired images (2,067) provided by the Charter members is quite stable compared to 2020 (2,330). The Figure 22 details 2020 statistics for radar sensors.

The number of Sentinel-1 images has slowly decreased compared to 2020 mainly due to the decrease of provision of archived data.

A total of 210 archived images were provided by the Charter members, which is considerably less than last year (646 images in 2020).

The contribution of KOMPSAT-5 data was less in 2021 (227) by a factor 3 compared to 2020 (681).

The number of GF-3 images has greatly decreased (14 in 2021 compared to 118 in 2020).

For ALOS-2, the number of scenes provided is stable (30 in 2021, 29 in 2020).

The number of RADARSAT-2 images provided has really decreased (5 in 2021 compared to 39 in 2020). This is explained by the introduction of the RCM satellites in the CSA constellation (255 newly images available in 2020).

66 percent of radar data (1,371 out of 2,067) were used to monitor 29 flood events. In the cases of flood disasters, radar satellite imagery often brings the most benefit to emergency response, because radar systems are able to monitor the extent of flooded areas independent of the weather conditions.

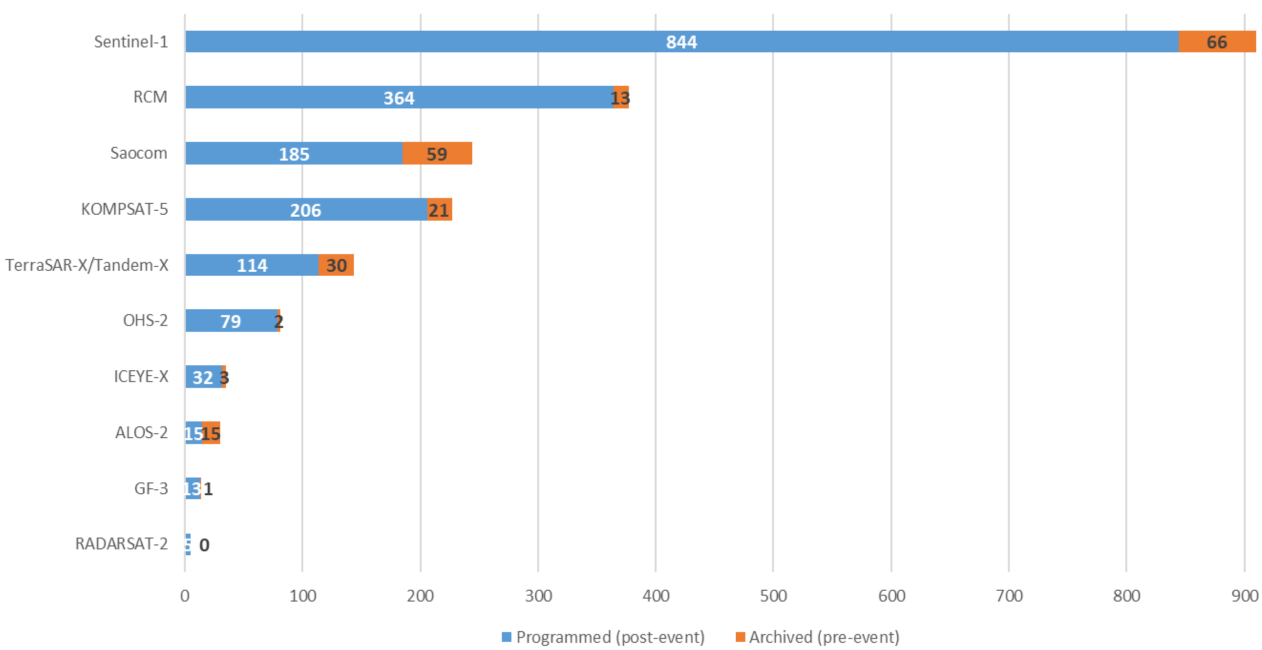


Figure 21. 2021 delivered data (number of archive images (pre-event) is in orange and number of programmed newly acquired images (post-event) is in blue) - Radar sensors

Table 8. 2021 Statistics for Radar sensors

Resource	ALOS-2	GF-3	ICEYE-X	RADARSAT-2	KOMPSAT-5	OHS-2	RCM	Saocom	Sentinel-1	TerraSAR-X /Tandem-X
Archived (pre-event)	15	1	3	0	21	2	13	59	66	30
Programmed (post-event)	15	13	32	5	206	79	364	185	844	114
Number of activations with archived images provided	7	1	3	0	11	1	6	22	24	16
Number of activations with programmed images provided	7	2	14	2	28	4	44	31	46	39
Total number of images provided	30	14	35	5	227	81	377	244	910	144

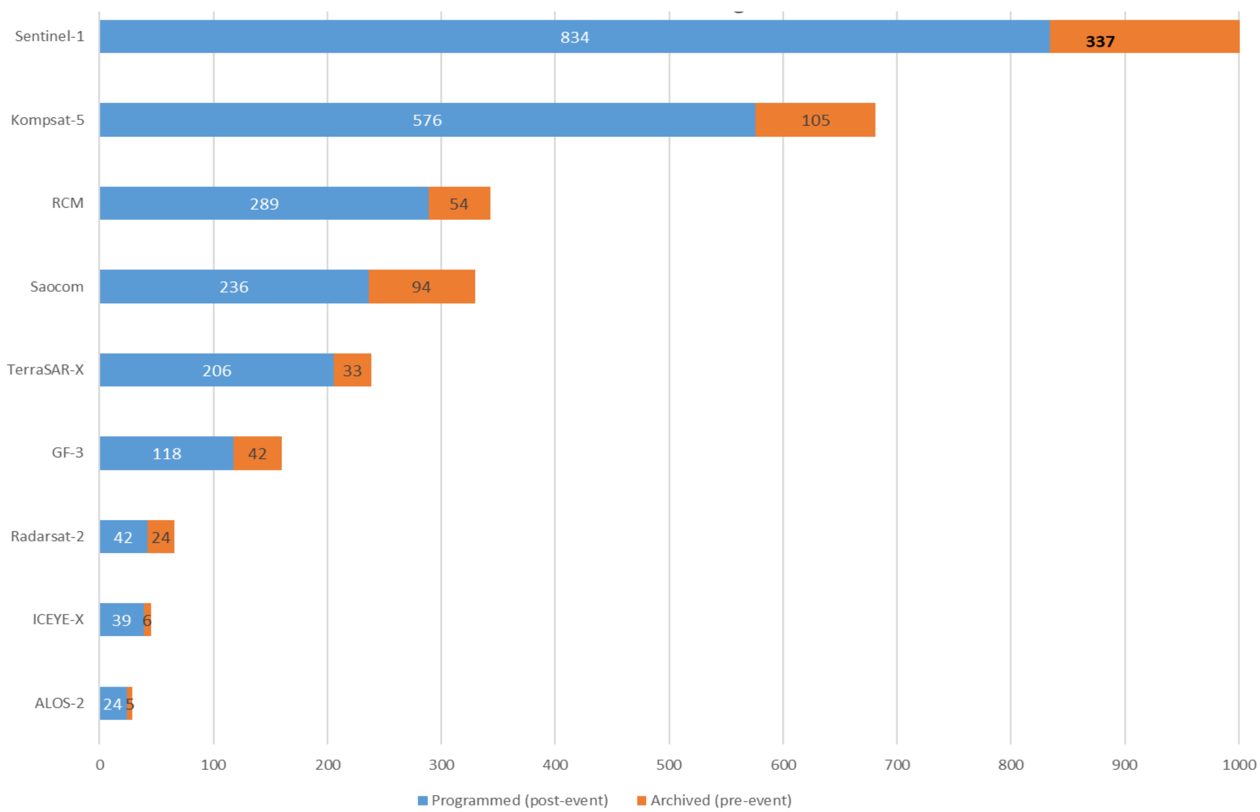


Figure 22. 2020 delivered data (number of archive images (pre-event) is in orange and number of programmed newly acquired images (post-event) is in blue) - Radar sensors

- U.S. VHR and HR data delivered

Table 9. 2020 and 2021 statistics concerning U.S. commercial optical satellites

Resources	GeoEye (2020/2021)	Planetscope (2020/2021)	Worldview (2020/2021)
Archived (pre-event)	1428 / 600	581 / 142	2944 / 1986
Programmed (post-event)	346 / 114	1089 / 658	1545 / 1058
Total number of data delivered	1774 / 714	1670 / 800	4489 / 3044

U.S. VHR provided 1,172 newly acquired images (GeoEye-1 – 114 images, WorldView-1, 2 and 3 – 1,058 images) and HR (Planet) – 658 images - optical satellites in 2021, less than half in 2020.

U.S. VHR provided 2,586 archived images (GeoEye-1 - 600 images, WorldView-1, 2 and 3 – 1,986 images) and HR (Planet) – 182 images - optical satellites in 2021, also less than in 2020.

In total, 3,758 images of U.S. VHR optical satellites (GeoEye-1, WorldView-1, 2 and 3) and 800 images of U.S. HR optical satellites (Planet) were supplied in 2021 (Figure 23).

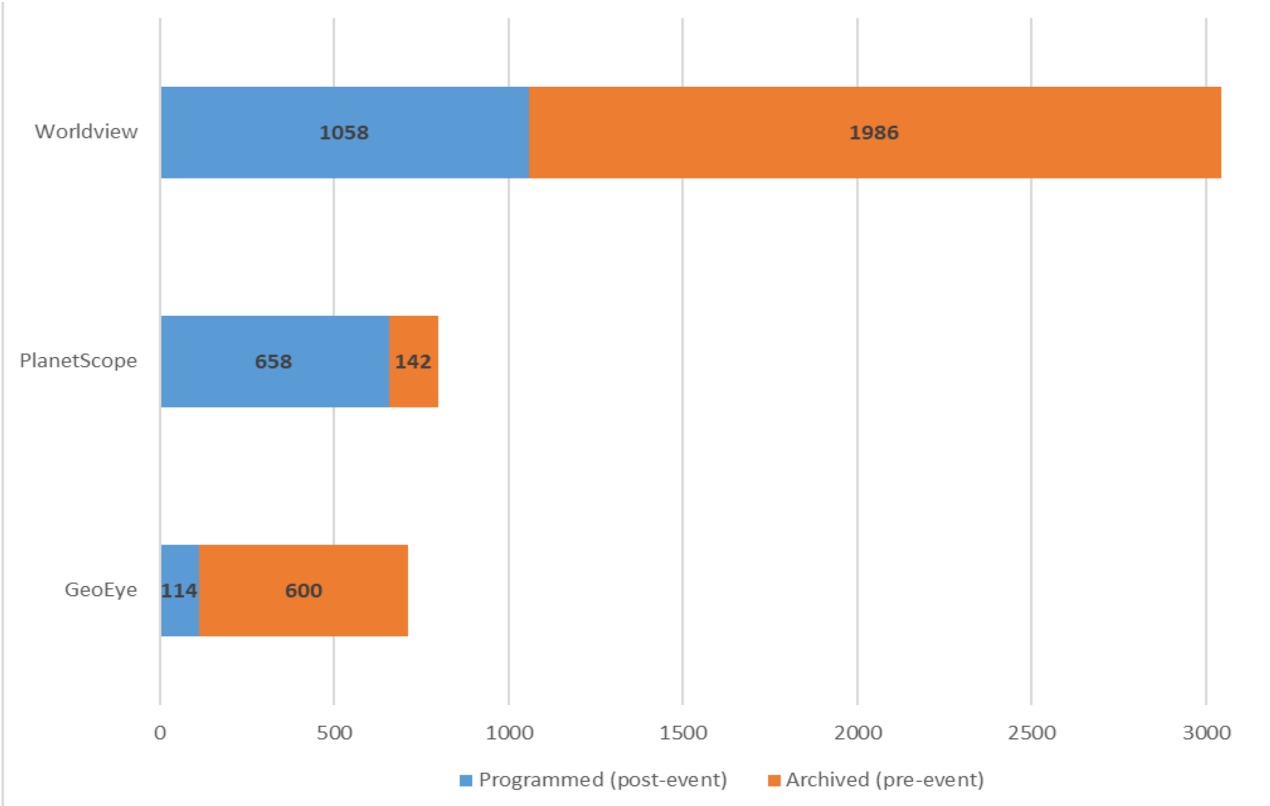


Figure 23. 2021 Data Consumption – U.S. Commercial optical satellites (number of archive images (pre-event) is in orange and number of programmed images (post-event) is in blue)

U.S. VHR optical WorldView-1, 2 and 3 contributions (3,044 images) were lower (33% less) than in 2020 (4,489 in 2020; 9,560 in 2019 and 16,969 in 2018). This difference comes from the decrease of the programmed and archived contributions.

Similar reductions were evident for the programmed Planet contributions (658 in 2021 compared to 1,089 in 2020).

And finally, the number of GeoEye data delivered is also less compared to 2020 (-60%).

- Overview of data consumption per activation

Figure 24 and Figure 25 respectively depict the number of programmed (post-event) and archived (pre-crisis) data for EO Charter sensors (except U.S. VHR and HR data) by activation.

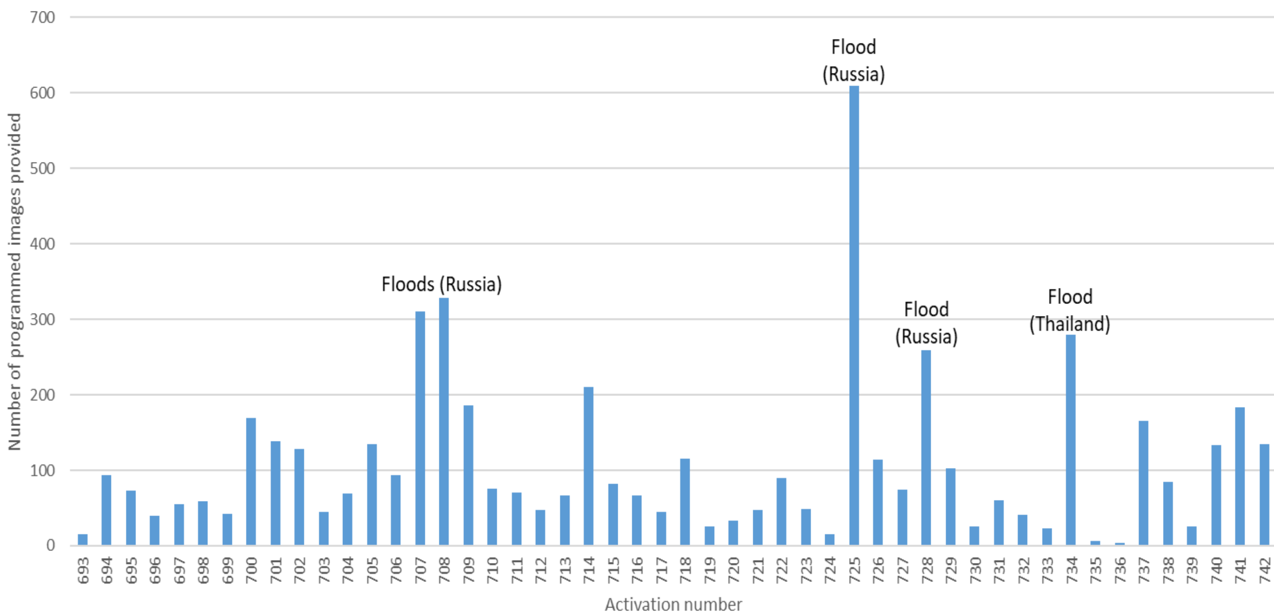


Figure 24. Number of delivered programmed images post-event (radar and optical) by activation in 2021

The average number of programmed images provided by activation in 2021 is 107 (compared to 102 in 2020, 92 in 2019, 72 in 2018).

The activations with the highest numbers of programmed data which were provided (Optical & radar sensors) are:

- **Act 707,** Flood in Russian Federation, 311 images
- **Act 708**, Flood in Russian Federation, 328 images
- **Act 725,** Flood in Russian Federation, 609 images
- **Act 728**, Flood in Russian Federation, 259 images
- **Act 734,** Flood in Thailand, 280 images

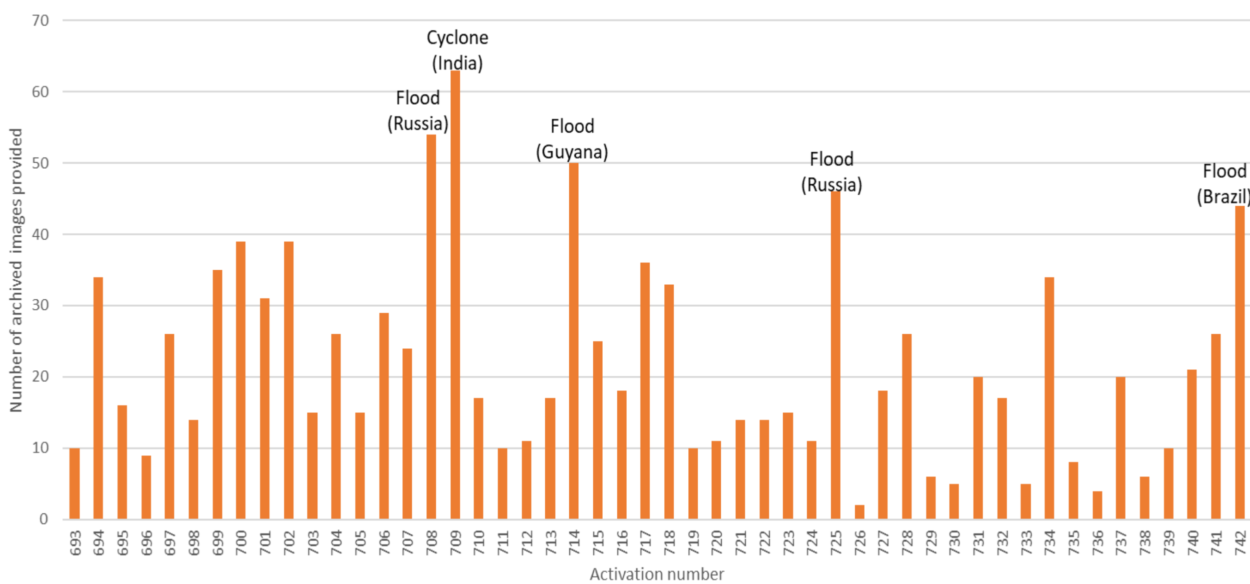


Figure 25. Number of delivered archived images pre-event (radar and optical) by activation in 2021

The average number of archived images provided by activation in 2021 is 22 (31 in 2020, 28 in 2019, 24 in 2018). The activations with the highest numbers of archived data which were provided (Optical & radar sensors) are:

- **Act 708,** Flood in Russian Federation, 54 images
- **Act 709,** Cyclone in India, 63 images
- **Act 725,** Flood in Russian Federation, 46 images
- **Act 742,** Flood in Brazil, 44 images

Figure 26 and Figure 27 respectively depict the number of optical and radar data for EO Charter sensors (except U.S. VHR and HR data) by activation, and Figure 28 shows the number of U.S. VHR and HR programmed images by activation.

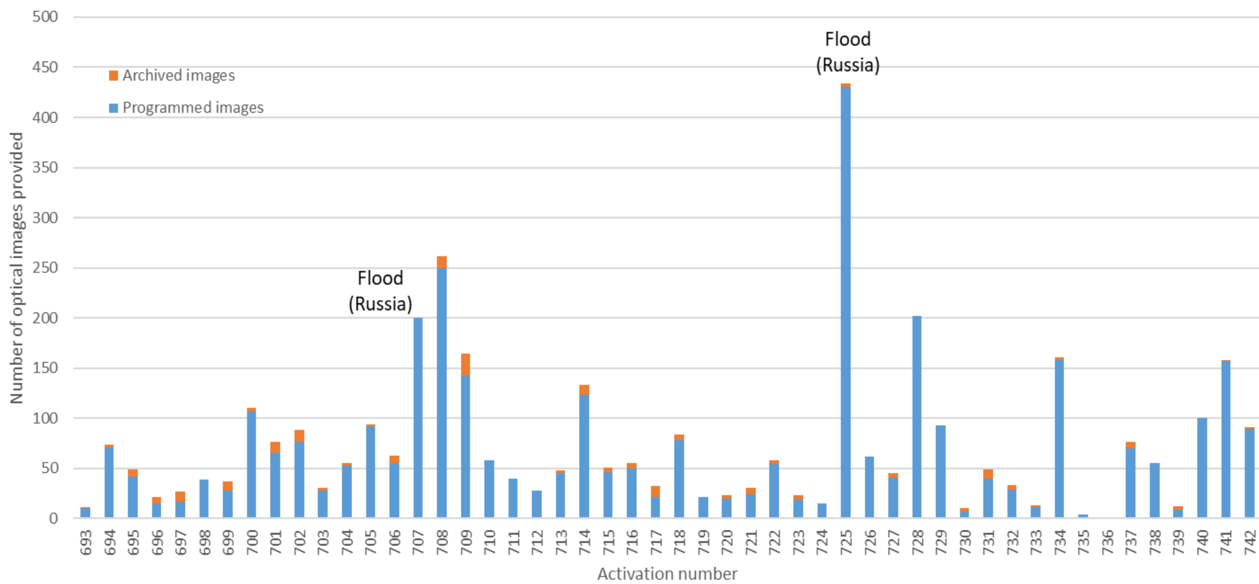


Figure 26. Number of delivered optical images (archived and programmed) per activation in 2021

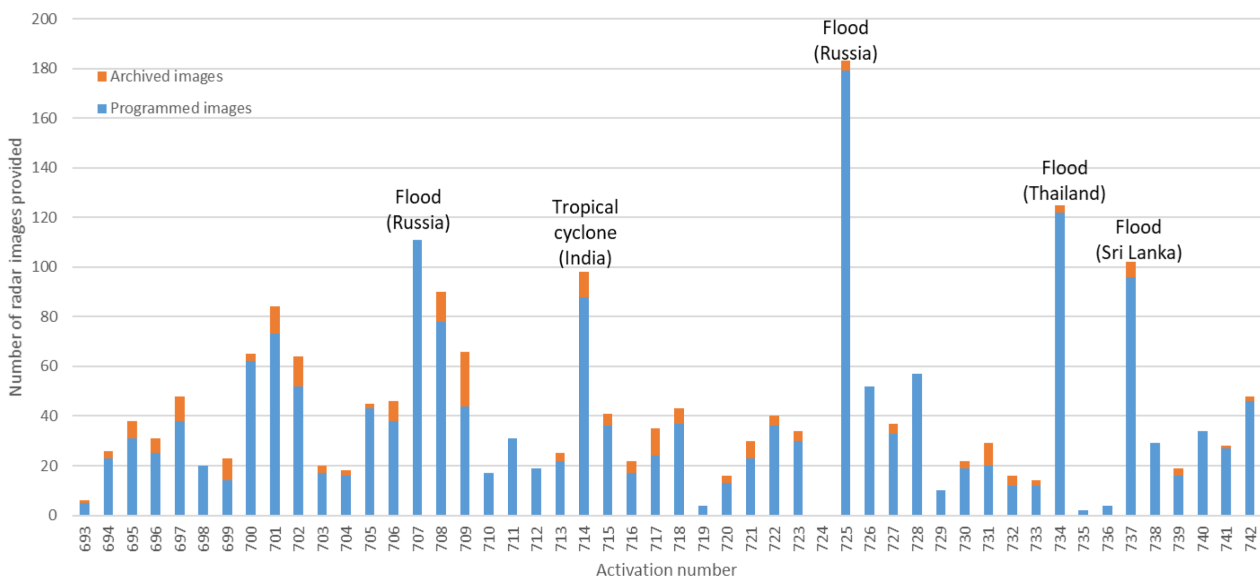


Figure 27. Number of delivered radar images (archived and programmed) per activation in 2021

In total, 42 activations out of 50 have benefited from U.S. VHR and HR data. The four cases with the highest number of U.S. VHR and HR newly acquired data provided are:

- **Act 708,** Flood in Russian Federation, 359 images
- **Act 709**, Cyclone in India, 315 images
- **Act 717,** Flood in Guyana, 290 images
- **Act 729**, Earthquake in Haïti, 505 images

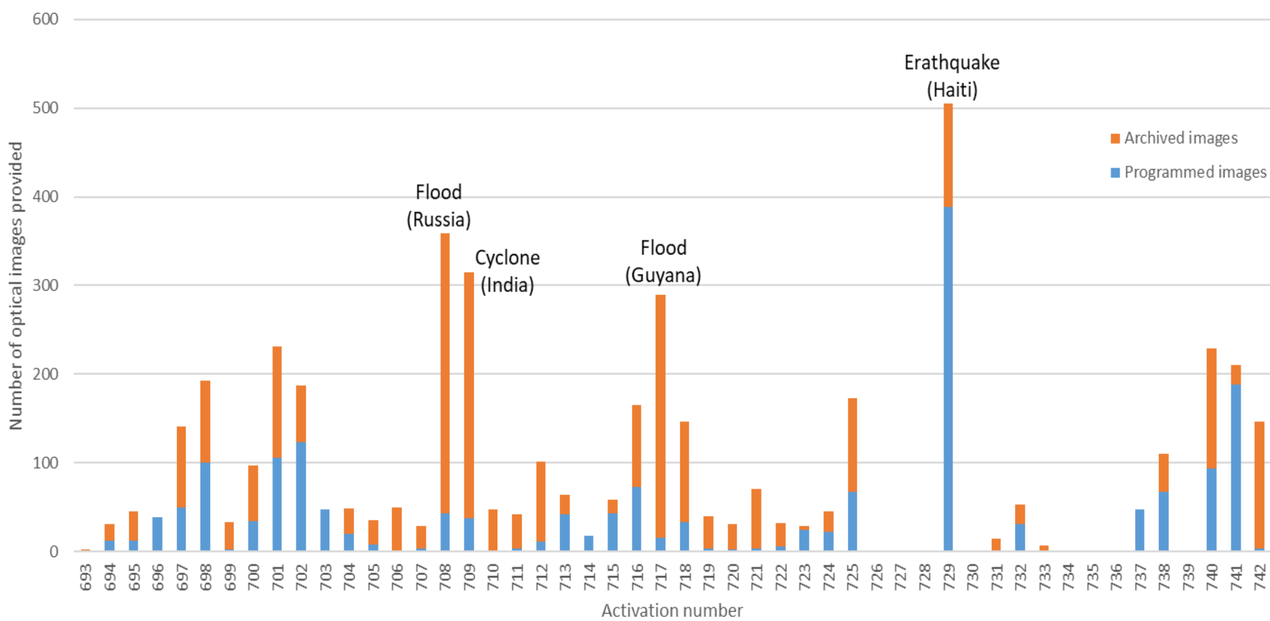


Figure 28. Number of delivered archived / programmed images per activation in 2021 for U.S VHR & HR commercial satellites.

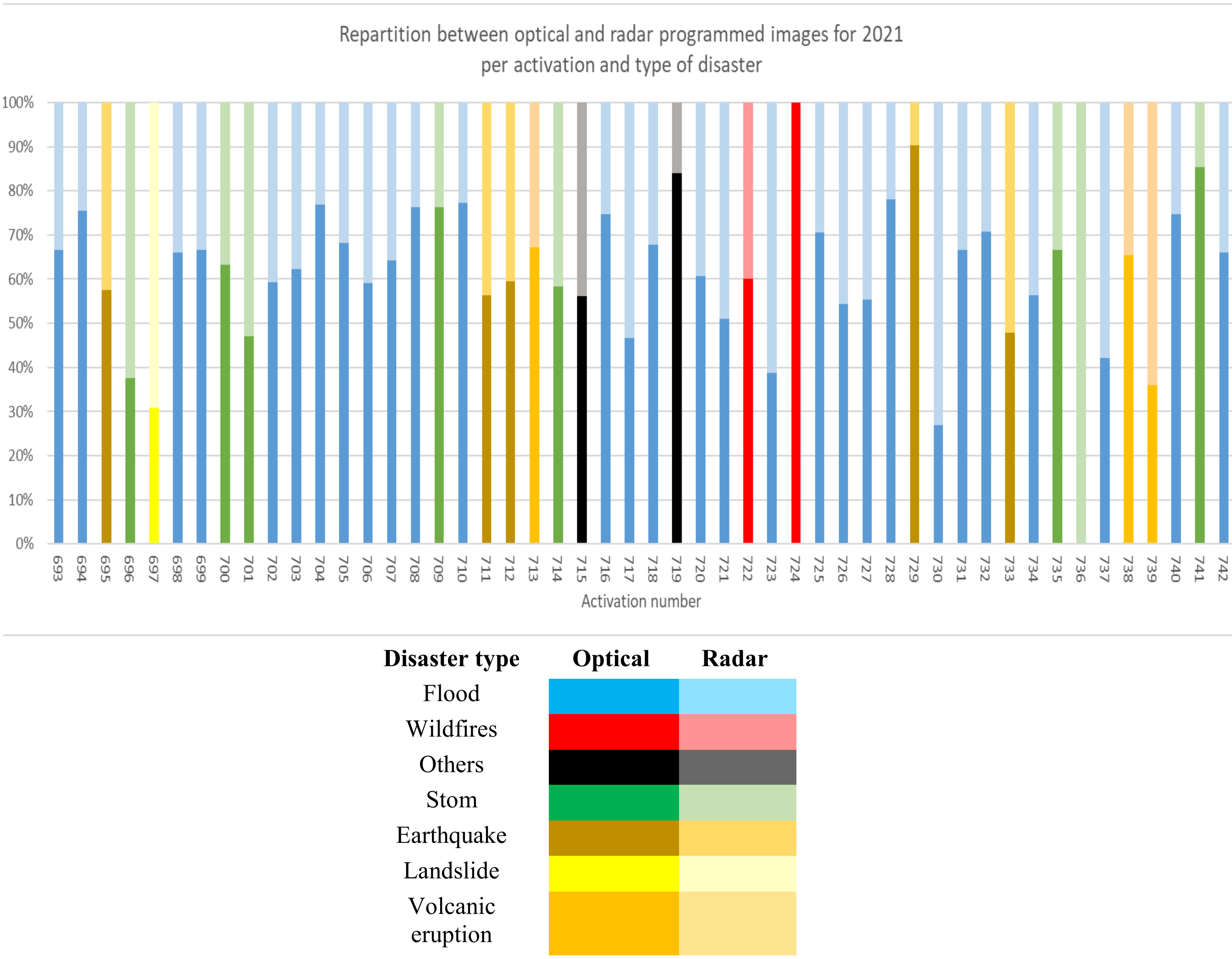


Figure 29. Repartition (in percentage) between optical and radar programmed images for 2021 per activation and disaster type

Figure 29 describes the radar/optical repartition of newly acquired images by activation. This shows that radar and optical images are provided for all types of events, but more optical data than radar data are provided for earthquakes, landslides, wildfires and to some extent ocean storms events. Radar images are mainly provided for the flood events compared to optical data.

3.2.2 Human resource contribution (ECO and PM) in 2021

3.2.2.1 ECO resources

The Emergency On-Call Officer (ECO) services were provided on a weekly rotational basis by 10 Charter members agencies: CNES, CNSA, CONAE, CSA, DLR, UKSA/DMCII, ESA, ISRO, NRSC, and ROSCOSMOS as shown in Figure 30.

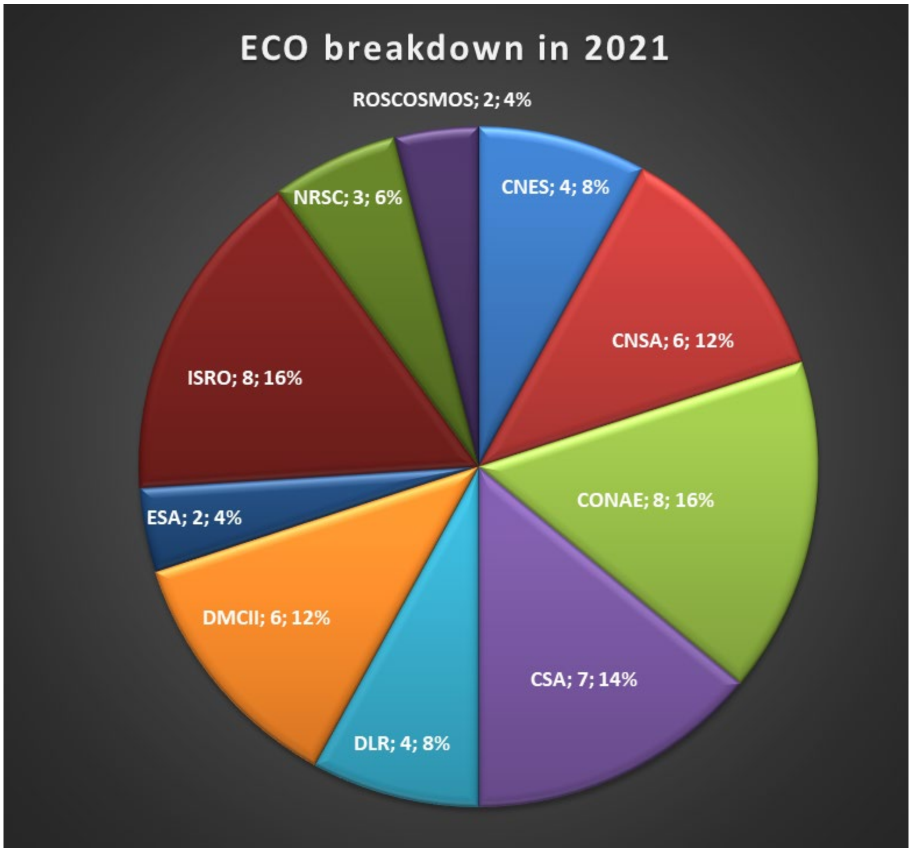


Figure 30. Distribution of Charter Parties responsible for the ECO services in 2021

The random nature of calls resulted in an uneven workload distribution for the members, with ISRO, CONAE and CSA handling between 7 and 8 calls each, i.e. about 46% of all the calls were handled by three agencies. To compare, in 2020, ESA, CSA and UKSA/DMC handled nine calls each (44%).

3.2.2.2 Distribution of Charter members responsible for the PM services delivered in 2021

For each activation, a Project Manager (PM) is needed, i.e., in 2021 Charter members nominated 50 PMs. As shown in Figure 31, JAXA, ISRO and INPE, as agencies that have acted as Charter lead during 2021, have been responsible for 14, 10 and 2 PM nominations, respectively. In total, these three agencies covered 52% of activations. Eight other Charter member agencies also took responsibility for PMs in 2021.

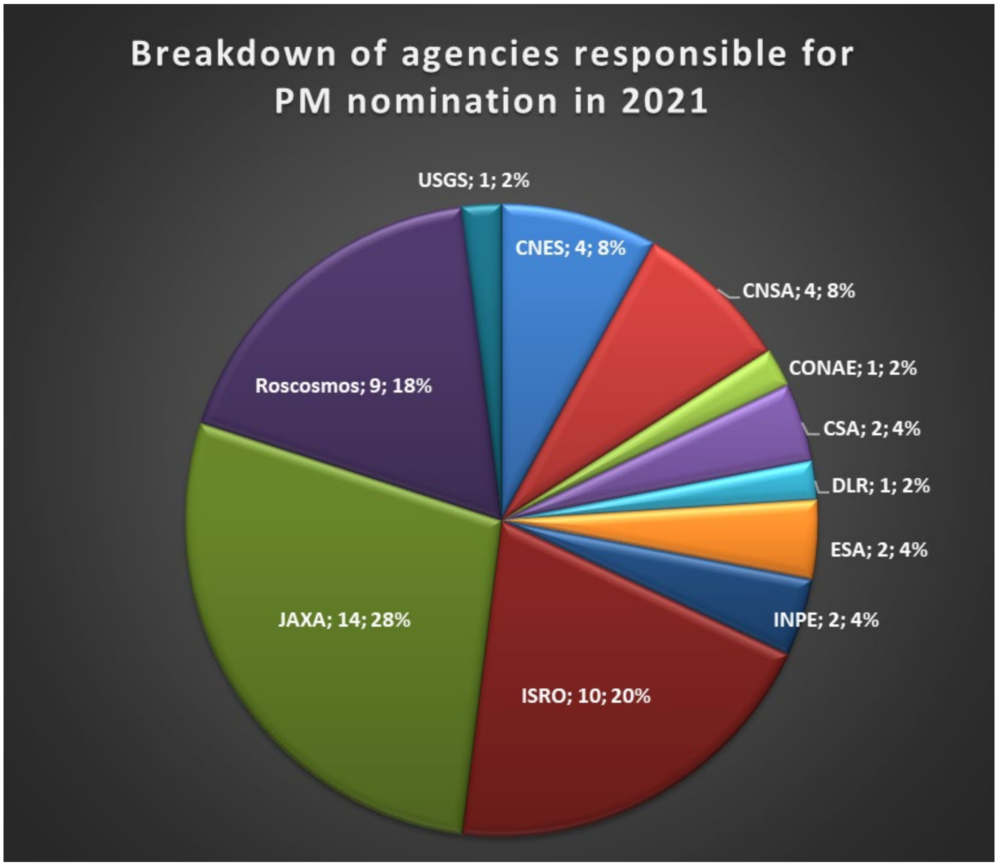


Figure 31. Distribution of Charter Parties responsible for the PM services in 2021

3.2.2.3 Distribution of organizations providing PM resources in 2021

PMs may be sourced from a Charter member agency or an external entity. Figure 32 shows the breakdown of all organizations that have contributed to Charter activations by assuming the PM role in 2021. In the case of external organizations, it is required that a Charter member nominates them and takes the responsibility for the service they provide. During this reporting period, 23 different organizations contributed their PM services to Charter activations.

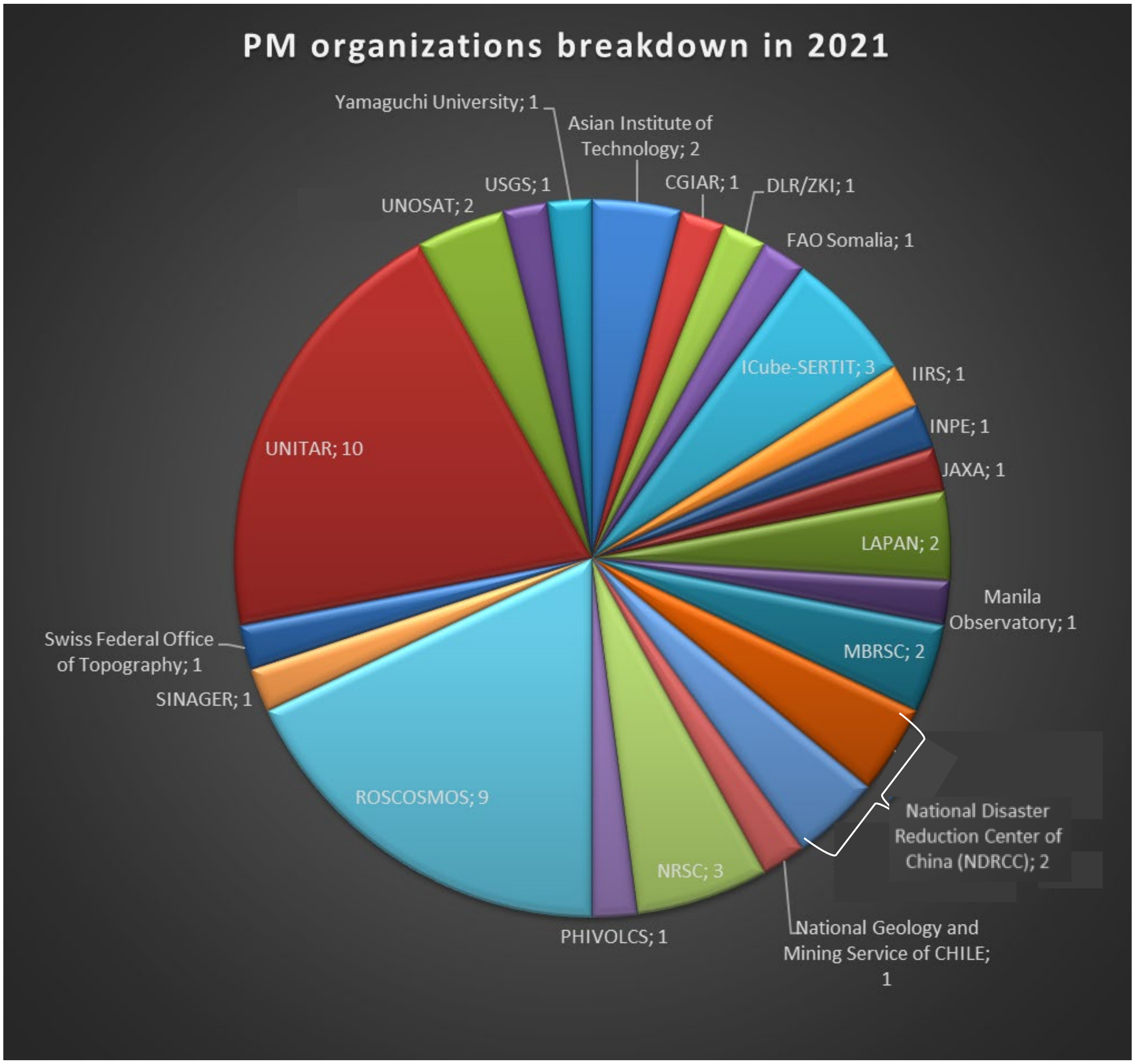


Figure 32. PM Organizations breakdown in 2021

3.3 Charter Training

3.3.1 Authorized User Training

The Authorized User training aims at training the future Authorized Users and the current AUs in order to train them how and when to activate the Charter.

All nine AU trainings were carried out online in 2021:

- In February 2021: 4 on-line AU training were organized by ESA (50 participants).
- In July 2021: AU training for Republic of Armenia by CSA.
- In Aug 2021: AU on-line training organised by ESA for Belarus.
- In September 2021: AU training of Gambia by INPE.
- In October 2021: AU training for Mongolia by UKSA and UAESA.
- In November 2021: 1 AU training for South Africa was organised by ESA.

3.3.2 Emergency on-Call Officer Training

The Emergency On-Call Officer (ECO) function is of utmost importance for the Charter operations, because the ECO is the person who orders appropriate data from the Charter members within a few hours after an activation request is received.

- In March 2021: 2 sessions of ECO on-line training organised by ESA, CNES, CSA, DLR and JAXA.
- In Aug 2021: ECO on-line training organised by ESA for Belarus.

3.3.3 SARE exercises

Because some ECO staff might not face “real activations” frequently, two so-called “Semi-Annual Refresher Exercises” are performed every year with all of the ECOs.

In 2021, there was only one exercise:

- SARE 25: held in November 2021, led by ROSCOSMOS and ISRO.

3.3.4 Project Manager Training

The PM training is aimed at strengthening the network of Charter PMs by providing refresher sessions for current PMs and training sessions for new PMs. Eight PM training sessions were carried out in 2021.

- In February 2021: 4 online PM training was organized by ESA (42 participants).
- In July 2021: PM training of British Geological Survey (BGS) by UKSA.
- In Aug 2021: PM on-line training organised by ESA for Belarus.
- In September 2021: PM training for Ordnance Survey of Northern Ireland (OSNI) by UKSA.
- In October 2021: PM training of Scottish Environment Protection Agency (SEPA) by UKSA.

3.3.5 Joint training

In June 2021, a 2-day training for AU, ECO, ES and PM was organised with Belarus in the frame of their integration as new charter member.

3.4 Sentinel Asia training

As to the PM trainings for Sentinel Asia members, Jaxa usually has once a year in Sentinel Asia member countries. Nevertheless, this training had to be cancelled for 2021 because of COVID.

3.5 The Charter Operational System (COS)

ESA has developed, operates, and continues to improve the web-based Charter Operations System second generation “COS-2”, linked to the Charter Geobrowser, to manage Charter operations in one web-based platform and facilitate the work of the different Charter operational staff (AUs, CBs, ODO, ECOs, PMs and VAs). Several Charter member agencies support the COS-2 development as part of the “COS-2 Evolution Team”.

COS-2 is operational since the beginning of March 2015. Almost all Charter members have their EO metadata fetching executed on COS-2, allowing automated and on-line cataloguing of Charter acquisitions.

The COS-2 development contract has been enlarged in scope introducing a helpdesk in order to support all the Charter users for COS-2, the portal, the Charter Geobrowser and the processing environments. No service degradation has been observed during the phase-in of the new contract.

A new COS-2 version has been released in June adding a machine-to-machine interface with USGS's HDDS system, allowing automatic retrieval of U.S. VHR data. In addition, the visualisation of browses has been improved and the handling of Sentinel-1 new data repository (https) has been implemented. An update, in July, added a machine-to-machine interface with CNES/Airbus system, allowing automatic retrieval of Spot and Pleiades data.

In addition, COS-2 now handles the End User License Agreement (EULA) for the Charter members requesting the PM and VA to accept a licence to access the data (currently CNES, CSA, CONAE, DLR and USGS/Planet). This simplified the access to the data by PM and VAs.

Larger effort was used to interface the ESA Processing Environment, now called Charter Mapper, with COS-2. COS-2 acts as identity management for the Processing Environments, as a security measure. The data uploaded in COS-2 (physically or via link) are passed to the Charter Mapper that imports, calibrate them and displays in full resolution (see next section). Also the information about the EULA is transferred in order to grant access to the data.

During 2021 no issues blocking the regular flow of the activations had been detected in COS-2. All Activations were handled by COS-2.

All Charter Activation from 2015 had been imported in COS-2 (the data from the first releases were not compatible with the versions from 2018). A background job is ongoing to import all activations in COS-2.

3.4 The Charter Processing Environment

While COS-2 is focused on the operational steps of the Charter activation workflow, it does not have workflow specifically addressing the generation of geospatial data.

In the frame of the Strategic Plan 2017-2027 discussions led by the Board identified the need to develop an interface/platform for easy data access and tools and methods for PM/VA and users. Two Charter members (ESA and ISRO) decided to respond to this request and started the development of on-line Processing Environments, to support full-resolution visualization, data screening and basic data manipulation (data comparison, band combinations, etc.). Looking at the longer term, the Board is pursuing a reflection on the benefit of expanding on-line platform capabilities with a Value Adding capability for rapid end-to-end information extraction.

The processing Environment shall be seen as an extension of the COS-2 system, dedicated primarily to PM and VAs.

The ESA Processing Environment, now called **Charter Mapper**, approved by the Board in July, was operationally released in September 2021. The release of the platform, initially foreseen by end July has been delayed due to the unforeseen handling of data user licences (EULAs), in order to grant that only users accepting an EULA will be able to handle and download the EO data of the involved agency. This granted VHR data availability of CNES, DLR and USGS in the Charter Mapper.

The Charter Mapper has been fed with all the data of the Charter activations from August (more than 2000 images handled in 2021, coming from ABAE, CONAE, CNES, CNSA, CSA, DLR, JAXA, KARI, PLANET, ROSCOSMOS, UKSA and USGS).

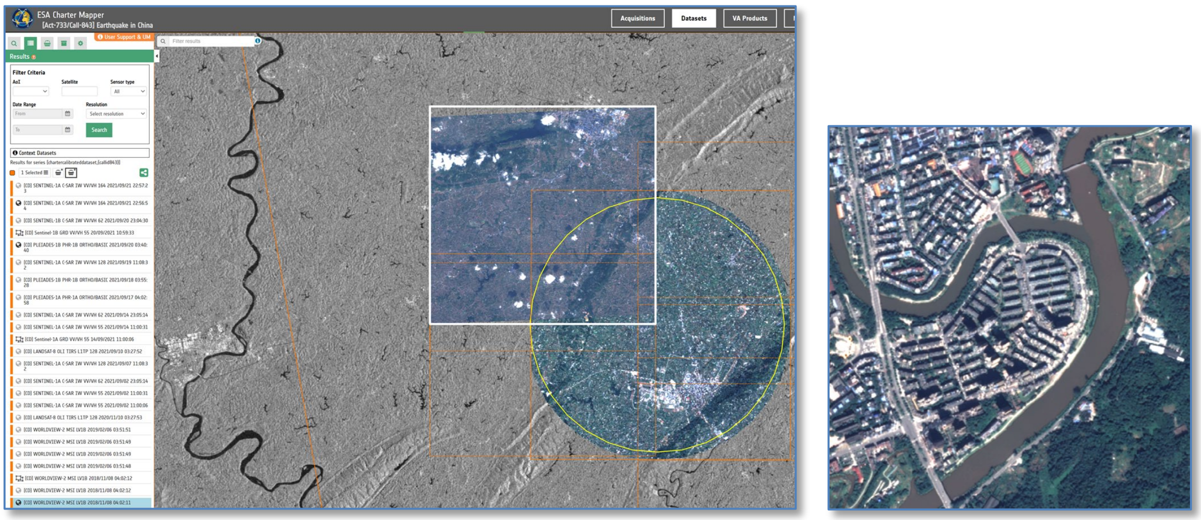


Figure 33. WorldView-2 (front), Pleiades and Sentinel-1 (back) images over China earthquake September 2021

Imagery received from COS-2 is ingested and transformed automatically in full resolution, irrespective of the original format, so as the user logs in, all available EO data can be viewed online. This will allow PM/VAs not familiar with some data formats to see the data without specific SW to handle them.

The PM/VA can browse imagery online, select the EO data of interest, analyse and process them online with EO services and toolboxes to generate geo-information products.

The Charter Mapper presents Activation Workspaces for each Activation. The workspace allows the PM/VA to:

- **Browse** full-resolution satellite data as raster on the map (for some data, the PM/VA shall accept the EULA – the system automatically redirects them)
- **Search and filter** among the available data
- **Upload** external satellite data outside COS-2 from local workstation or free EO Data catalogues;
- Submit **processing jobs** using satellite imagery processors; view the results as part of the Activation Analysis and download the results.
- **Store & share** satellite data and Value-Added Products with other partners involved (e.g., a PM or VA provider with credentials for the same activation)

The PM/VA can access a specific widget that allows to visualize & combine the assets (bands and overviews) derived by the Charter Mapper from the satellite data product:

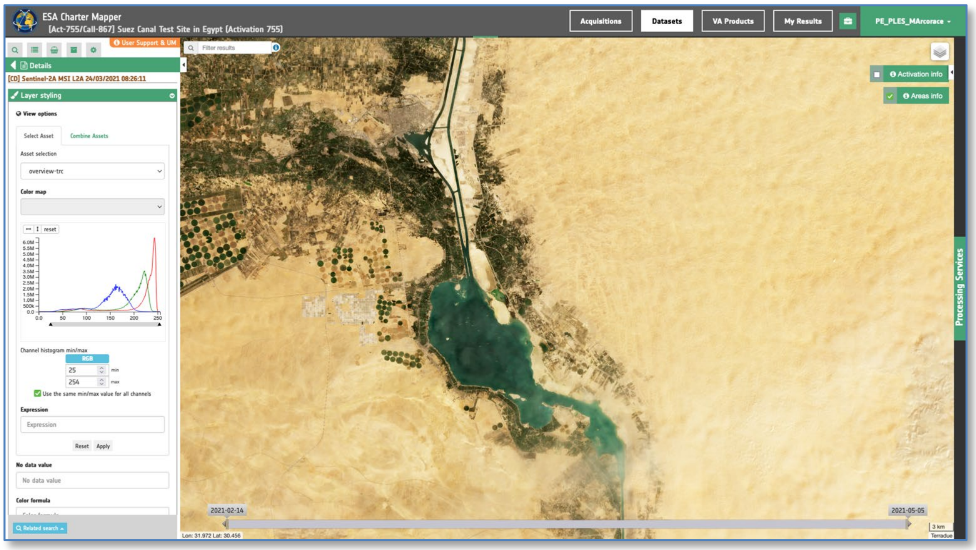


Figure 34. Visualize and combine function

Among the features, it is possible to compare visually two images quickly through a slider:

Figure 35. Slider function

The version released in September allows PMs and VAs to see the data in full resolution and to perform some basic processing. The processing services will be gradually released as fully validated, improving the usefulness of the platform. At the end of 2021 the following services were available:

Table 10. Charter Mapper processing services in December 2021

- **COMBI**: Multi-sensor band composite
- **Optical Index**: Spectral index
- **Stack**: co-located Stacking (requires that the images are already georeferenced)
- **SAR-Change**: SAR Amplitude Change (Creates an RGB composite showing changes of backscatter values using a pair of SAR images)
- **Hotspot** Detection
- **BAS**: Burned Area Severity

Currently the Charter Mapper can support the following Charter satellites:

- ALOS-2
- ALSAT-1B
- CARTOSAT-2
- GeoEye-1
- GF-1, 2, 3
- ICEYE-X constellation
- KANOPUS-V, V-IK
- KOMPSAT-3, 3A
- KOMPSAT-5
- LANDSAT-8, 9
- PlanetScope constellation
- Pleiades-1A, 1B
- RCM
- RESOURCESAT-2, 2A
- SAOCOM-1A, 1B
- SENTINEL-1A, 1B
- SENTINEL-2A, 2B
- SPOT-6 & 7
- TanDEM-X
- TerraSAR-X
- UK-DMC-2
- Vision-1
- VRSS-1, 2
- WORLDVIEW-1, 2, 3

The remaining missions will be handled as the complete information for their handling will be provided.

From December 2021, the Charter Mapper was enriched by a reporting system allowing an analysis of the data received and processed. In December 2021 the Charter Mapper received 801 satellite data notifications from COS-2. Of these 732 were successfully imported (most of the not imported were related to quicklooks and metadata only, no products found or broken links). Of these, 98% were successfully calibrated and available to PMs and VAs.

The failure information is very important because, except the data types not yet handled, it is due to issues in the data (lack of metadata, data corruption, not recognised formats), which means that also the PM/VA will not be able to read them.

It is also interesting to see the Charter Mapper load due to the ingestion of the data. The picture below (Figure 36) shows for the month of December the load, where peaks are clearly visible, corresponding to the first phase of the activations.

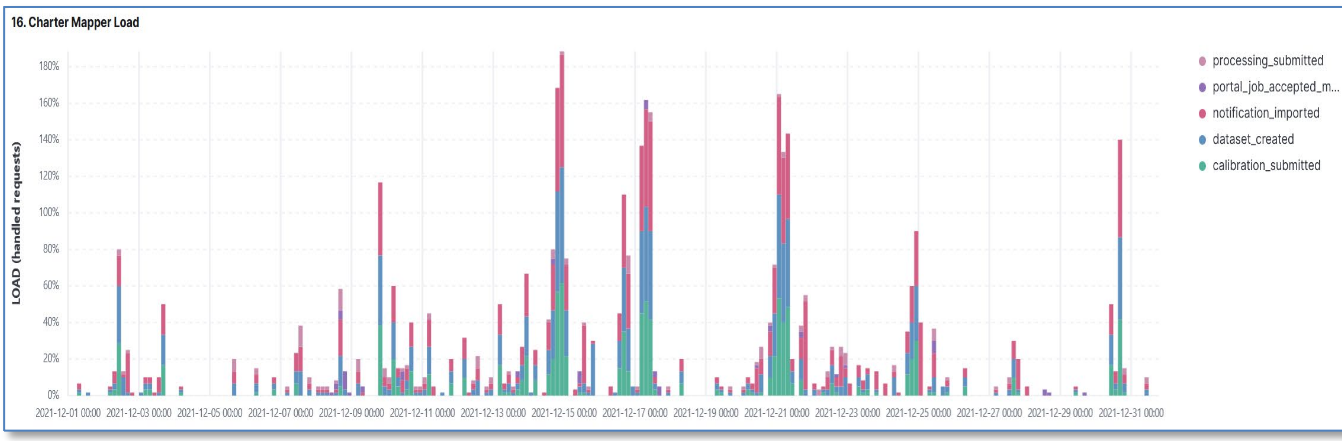


Figure 36. Charter Mapper Load

4. Assessment of the Charter operations

This chapter provides a synopsis of the overall assessment, including recommendations to be taken into consideration for improving Charter operations.

Statistics on the 2021 activations were compared with EM-DAT data to evaluate the overall impact of the Charter as a service to support disaster response – EM-DAT: The Emergency Events Database - Université Catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium.

The reports issued by the Project Managers of Charter activations and the various performance metrics recorded by COS-2 are the main sources of information for assessing the performance and quality of service provided by the Charter during 2021.

4.1 Overall impact

In 2021, despite of the Covid pandemic that continues to affect and kill people, the two most catastrophic events were the earthquake in Haiti that killed 2,575 people, injured 12,763 and affected 702,763 people, and floods in India that killed 1,282 people and affected 375,000.

The EM-DAT database (managed by the Centre for Research on the Epidemiology of Disasters (CRED) (http://emdat.be/disaster_list/)) inventoried 411 natural events in 2021 that killed a total of 9,450 people. The database excludes droughts and extreme temperature events, while includes earthquakes and tsunamis, floods, landslides, storms, volcanic eruptions, and wildfires. The Charter covered 32 of the 411 total events in 2021 (7.8%). If we consider the 51 most severe disasters in the EM-DAT database (86% of fatalities), the Charter covered 13 of them, accounting for 4,065 fatalities (43%).

In comparison, in 2020, the Charter covered 35 of the 377 events registered in the EM-DAT database (9.3%). These 35 events accounted for 4,306 fatalities (49%), 1,377 injuries and approximately 39,697,530 people affected. It can be seen from the previous 2 years of data that the Charter accounts for a much higher percentage of overall fatalities than overall events, meaning that the charter is often activated for the most severe events only.

Figure 37 shows that 13 of the 51 most severe events recorded in EM-DAT in 2021 were covered by Charter activations. In 2021, the number of Charter activations (50) was lower than in 2020 (55). However this still falls in the high range of annual activations in recent years, as the number of Charter activations has fluctuated between 32 and 55 per year since 2007. Such fluctuations can be explained in part by several factors such as: the variability in the total number of natural disasters occurring during a given year, the occurrence of disasters covering more than one country (e.g., hurricanes), and by the existence of national and regional EO-based emergency response services (e.g., Copernicus EMS, Sentinel Asia). Figure 38 shows that since 2007, the curve of the Charter activations follows, more or less, the trend of events recorded by EM-DAT.

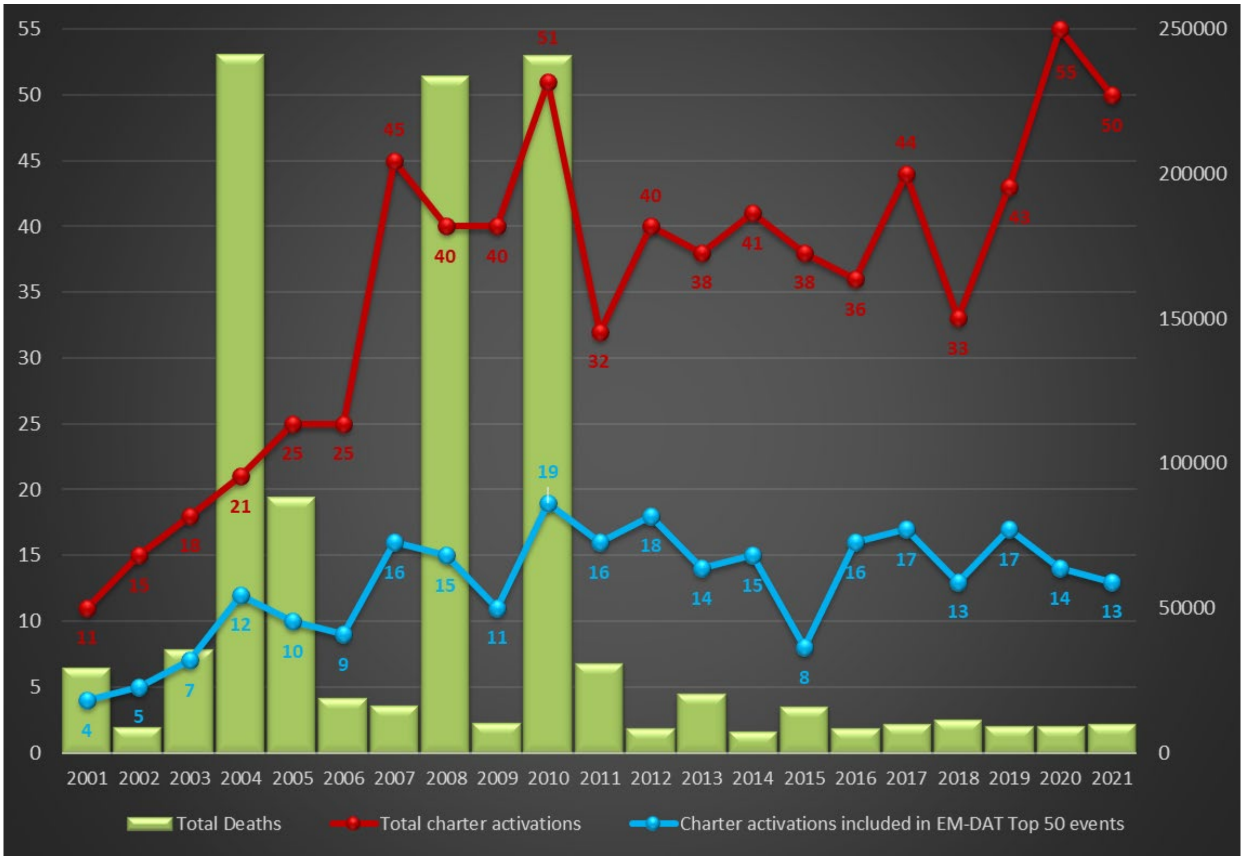


Figure 37. Number of Charter activations from 2001-2021, linked with the number of fatalities from all recorded natural disasters. Represented in blue are the number of Charter events per year that are included within the 50 most severe disasters (by fatalities)

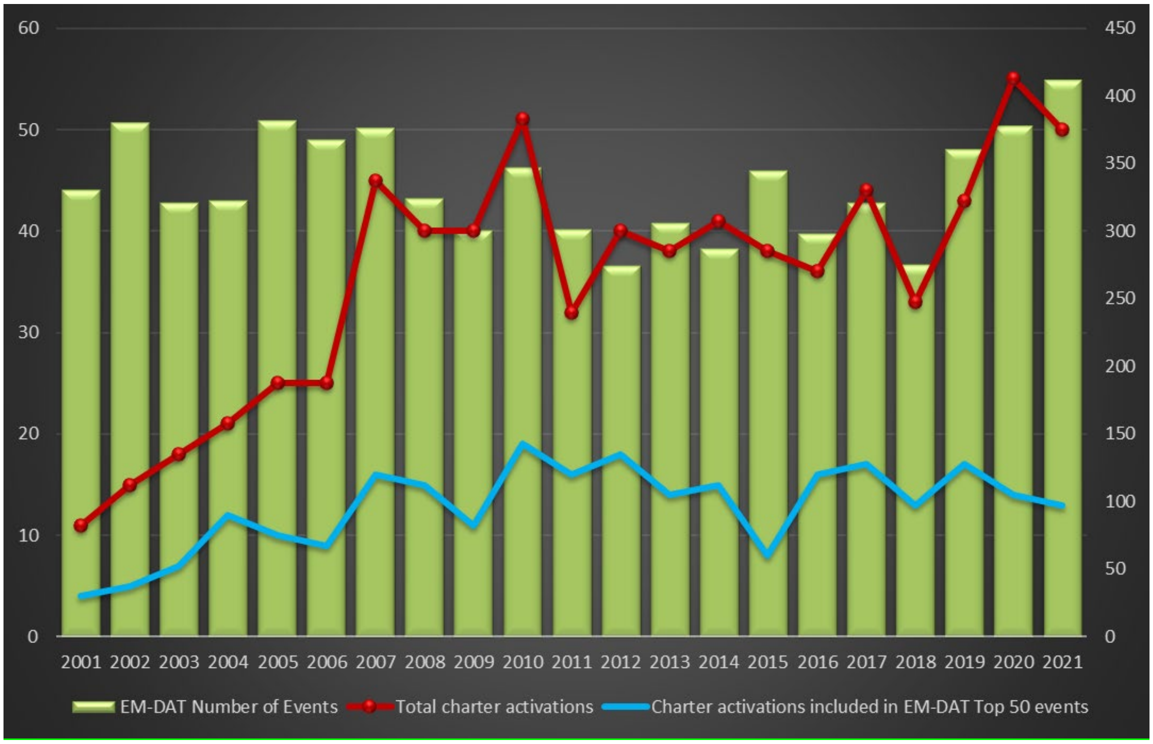


Figure 38. Number of Charter activations from 2001-2021, linked with the total number of natural disasters recorded by the EM-DAT

In 2021, the Charter covered 5 of the 10 most severe disasters by fatalities (see Table 11). Over the last thirteen years (2009-2021), the Charter was triggered for 17 of the 18 most severe natural disasters by fatalities, as reported by EM-DAT (see Table 12 and Table 11).

Table 11. The ten most severe natural disasters by number of fatalities in 2021 (events covered by Charter activations are indicated in bold and italics). (Source: EM-DAT: The Emergency Events Database - Université Catholique de Louvain (UCL) - CRED, D. Guha-Sap

Top 10 Disasters – Number Killed – 2021 *The text in italic indicates that the Charter was activated*			
Country	**Disaster type**	**Date**	**Fatalities**
Haiti	***Earthquake***	***14/08/2021***	***2575***
India	Flood	June-Sept 2021	1282
Philippines (the)	***Storm***	***16/12/2021***	***457***
China	Flood	June-August 2021	352
Afghanistan	Flood	28/07/2021	260
United States of America (the)	Storm	10/02/2021	235
India	***Flood***	***7/02/2021***	***234***
Indonesia	***Storm***	***2/04/2021***	***226***
India	***Storm***	***14/05/2021***	***198***
Germany	Flood	12/07/2021	197

Table 12. Eighteen most severe disasters by number of fatalities (2009-2021) (events covered by Charter)

Top 18 Natural Disasters: 2009-2021 *Text in italics indicates that the Charter was activated* **Text in Red indicates occurrence in 2021**				
Date	***Country/District***	***Type***	***Fatalities***	***Affected people***
12/01/2010	***Haiti***	***Earthquake***	***222,570***	***3,700,000***
11/03/2011	***Japan***	***Earthquake and tsunami***	***19,848***	***368,820***
25/4/2015	***Nepal***	***Earthquake***	***8,831***	***5,639,722***
8/11/2013	***Philippines***	***Tropical cyclone***	***7,354***	***16,106,807***
12-27/06/2013	***India***	***Flood***	***6,054***	***504,473***
28/09/2018	***Indonesia***	***Earthquake***	***4,929***	***769,109***
14/04/2010	***China P Rep***	***Earthquake***	***2,968***	***112,000***
14/08/2021	***Haiti***	***Earthquake***	***2,575***	***702,763***
28/07/2010	***Pakistan***	***Flash flood***	***1,985***	***2,0359,496***
15/06/2020	***India***	***Flood***	***1,922***	***1,300,000***
14/07/2019	***India***	***Flood***	***1,900***	***3,000,000***
4-5/12/2012	***Philippines***	***Tropical cyclone***	***1,900***	***6,246,664***
07/08/2010	***China P Rep***	***Landslide***	***1,765***	***4,7200***
29/05/2010	***China P Rep***	***General flood***	***1,691***	***134,000,000***
15/12/2011	***Philippines***	***Tropical cyclone***	***1,439***	***1,150,300***
1/06-30/9/2021	India	Flood	1,282	375,000
30/09/2009	***Indonesia***	***Earthquake***	***1,177***	***679,402***

Table 13 lists the 51 most severe natural disasters by number of fatalities recorded by EM-DAT in 2021.

Note: EM-DAT events were filtered according to the type of natural disasters covered by the Charter.

Table 13. Fifty-one most severe disasters by number of fatalities in 2021 (Source: EM-DAT: The Emergency Events Database - Université Catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium, filtered according to the type of disasters

Country	Disaster Type	Start Date	Long event (> 1 month)	Total Deaths	Charter Activation Number
Haiti	Earthquake	14/08/2021		2575	729
India	Flood	01/06/2021	x	1282	
Philippines (the)	Storm	16/12/2021		457	741
China	Flood	1/06/2021	x	352	
Afghanistan	Flood	06/10/2020		260	
United States of America (the)	Storm	10/02/2021		235	
India	Glacial lake outburst (Flood)	7/02/2021		234	698
Indonesia	Storm	2/04/2021		226	702
India	Storm	14/05/2021		198	709
Germany	Flood	12/07/2021		197	
Pakistan	Flood	1/07/2021	x	194	
Nepal	Flood	16/10/2021		118	
Afghanistan	Flood	2/05/2021		116	
Indonesia	Earthquake	15/01/2021		110	695
United States of America (the)	Storm	28/08/2021		96	
United States of America (the)	Storm	10/12/2021		93	
Algeria	Wildfire	9/08/2021		90	
Nepal	Flood	1/07/2021		74	
Turkey	Flood	10/08/2021		70	
India	Flood	18/11/2021		62	
Niger (the)	Flood	15/06/2021	x	62	
India	Flood	1/06/2021		59	
Philippines (the)	Storm	11/10/2021		59	
India	Flood	18/10/2021		57	
Malaysia	Flood	17/12/2021		56	
Brazil	Flood	15/11/2021	x	52	
Indonesia	Volcanic activity	4/12/2021		52	739
Sudan (the)	Flood	20/07/2021	x	52	732
Nepal	Flood	16/06/2021		46	
Venezuela (Bolivarian Republic of)	Flood	23/08/2021		46	
Belgium	Flood	14/07/2021		43	
Timor-Leste	Storm	5/04/2021		41	701
India	Flood	11/10/2021		39	
India	Flood	28/07/2021		37	723

India	Landslide	11/08/2021		35	
India	Landslide	17/07/2021		33	
Chad	Flood	26/06/2021	x	32	
Congo (the Democratic Republic of the)	Volcanic activity	22/05/2021		32	713
South Africa	Flood	1/02/2021		31	
Japan	Landslide	3/07/2021		26	
Sri Lanka	Flood	6/11/2021		26	737
Somalia	Flood	1/05/2021		25	706
Congo (the)	Flood	29/11/2021		24	
Morocco	Flood	1/02/2021		24	
Japan	Storm	7/01/2012		23	
United States of America (the)	Flood	21/08/2021		22	
Bangladesh	Flood	27/07/2021		21	
China	Storm	22/05/2021		21	
China	Flood	12/08/2021		21	
Indonesia	Flood	15/01/2021		21	
Pakistan	Earthquake	7/10/2021		21	

The Charter covered 13 of the 51 most severe natural disasters in terms of fatalities recorded by EM-DAT in 2021, excluding droughts and extreme temperature events (Figures 4-1, 4-2, and 4-3).

For these 13 disasters, activation requests were made by:

- Charter Authorised Users (AUs) for disasters in their home countries: One activation for an earthquake in Haiti (several calls) was requested by “Direction de la Protection Civile”; three activations for floods/storms in India were requested by ISRO.
- Activations from Charter Cooperating Bodies: One for a Flood in The Philippines, one for a flood in Somalia, one for a flood in Sudan, and one for volcanic eruption in The Democratic Republic of the Congo were requested by UNITAR/UNOSAT, three activations for floods in Indonesia, Sri Lanka, and Timor-Leste, and one for a volcanic eruption as well as one for an earthquake in Indonesia were requested by Sentinel Asia (ADRC).

The Charter continues to make progress with its Universal Access (UA) initiative by granting charter access to new countries globally each year (refer to chapter 5.2).

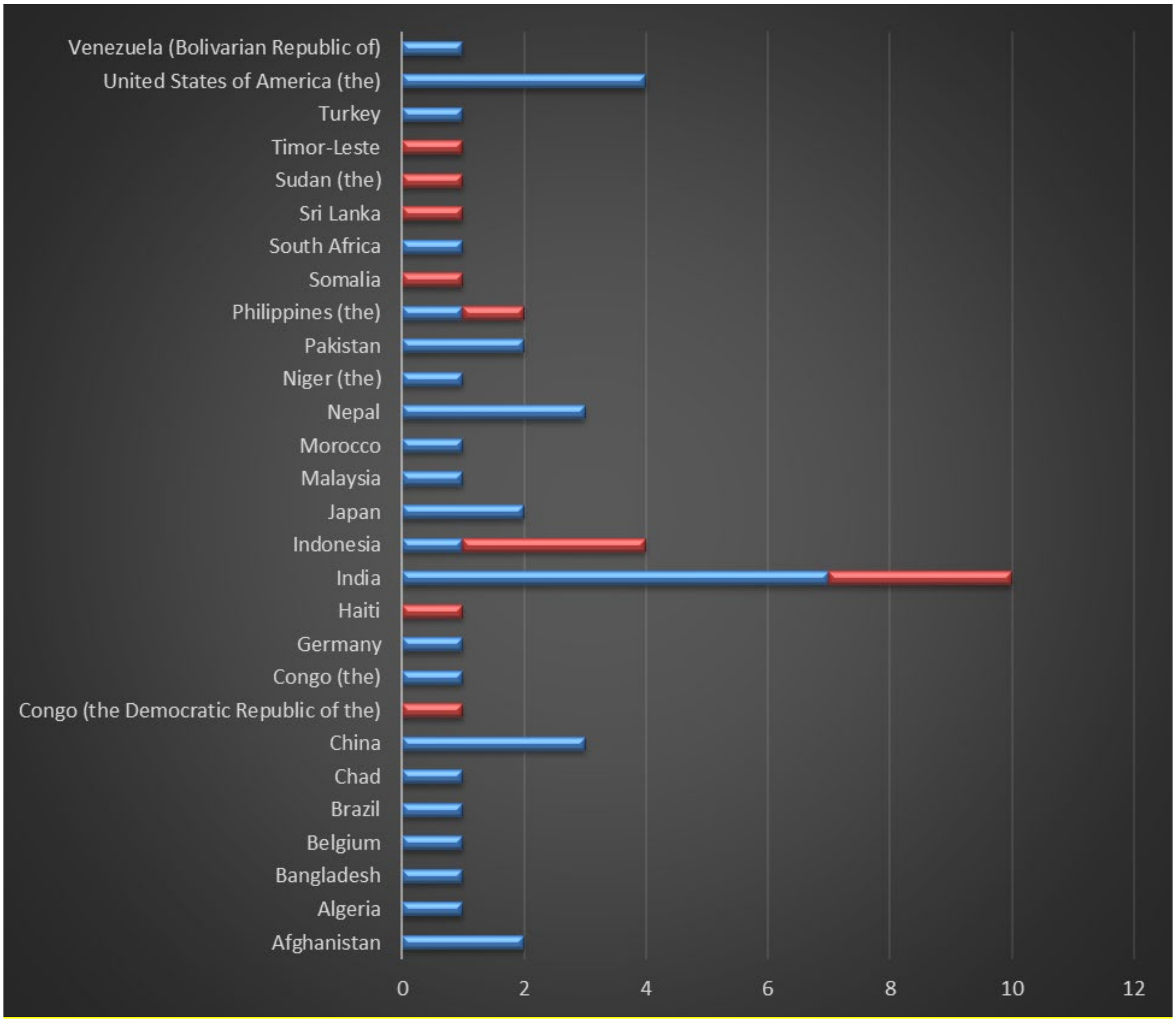


Figure 39. 2021 Breakdown by country of the 51 most severe natural disasters (by fatalities) recorded by EM-DAT. Disasters covered by the Charter are shown in red (13 out of 51 disasters).

4.1 System Performances Assessment

Up to 2016, system performance statistics were gathered and calculated manually. Also, all metrics were calculated with an accuracy of days instead of hours, which sometimes generated huge error margins.

The COS-2 operational system, implemented in March 2015, helps to improve the speed and visibility to all Charter members of some operations and exchanges amongst the different operational staff involved during the activation. Since September 2017, COS-2 systematically monitors the Charter workflow and most of Charter performance parameters will be generated automatically.

Since 2018, Charter operations have an automated monitoring system and all system performances can be calculated with a higher accuracy (hours and minutes). The automated monitoring system is operational with more than thirty statistic parameters being generated automatically.

4.1.1 Delivery of the first image

The two plots below (Figure 40 and Figure 41) show the performance in the delivery of the first image (split by pre-crisis – blue – and crisis).

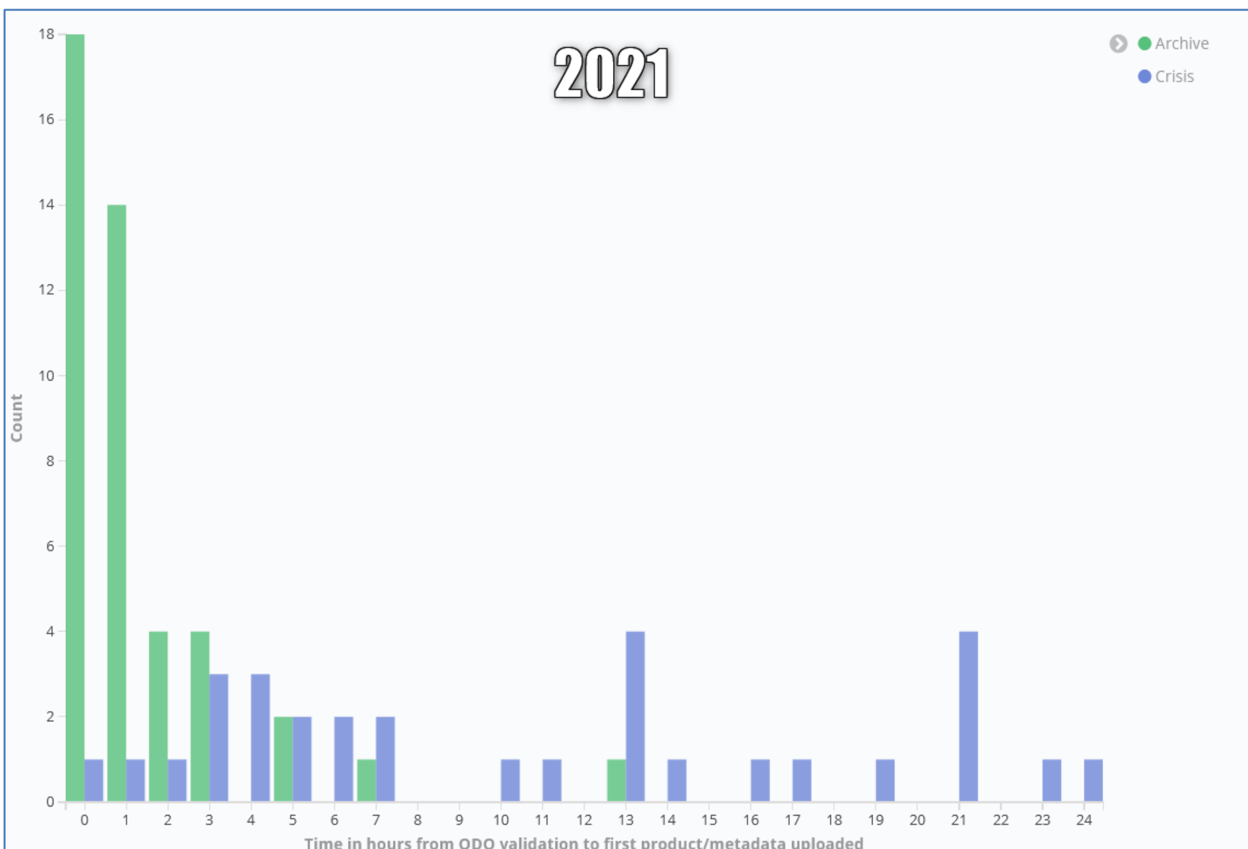


Figure 40. 2021 Delivery time of first image

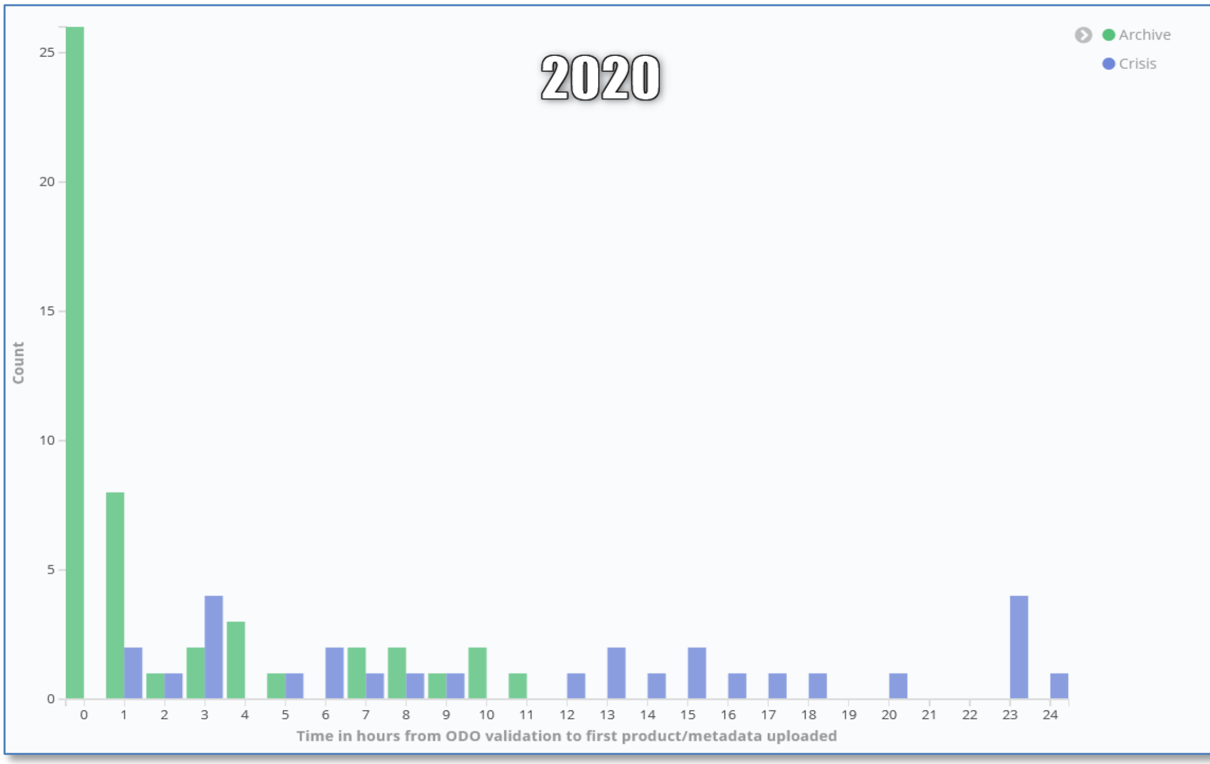


Figure 41. 2020 Delivery time of first image

Most of the calls have a relatively high performance for the delivery of the first archive image, as shown on Figure 40 and we see an improvement vs. the 2020 (Figure 41), with an archived image provided within 1 hour for 32 activations.

Regarding the crisis image, also there we can note an improvement in the timeliness, with 12 activations where the data was provided within 6 hours.

4.1.2 First image provided vs. used

The first image provided is Sentinel-2, as for 2020. But this depends on by the fact that COS-2 is automatically searching in the Copernicus catalogue for archived scenes over the area of interest. In the plots below, thus we have removed Sentinel 2 has been removed from the provided satellites. It is very interesting to note that the distribution between 1st image provided and the 1st image used is very different.

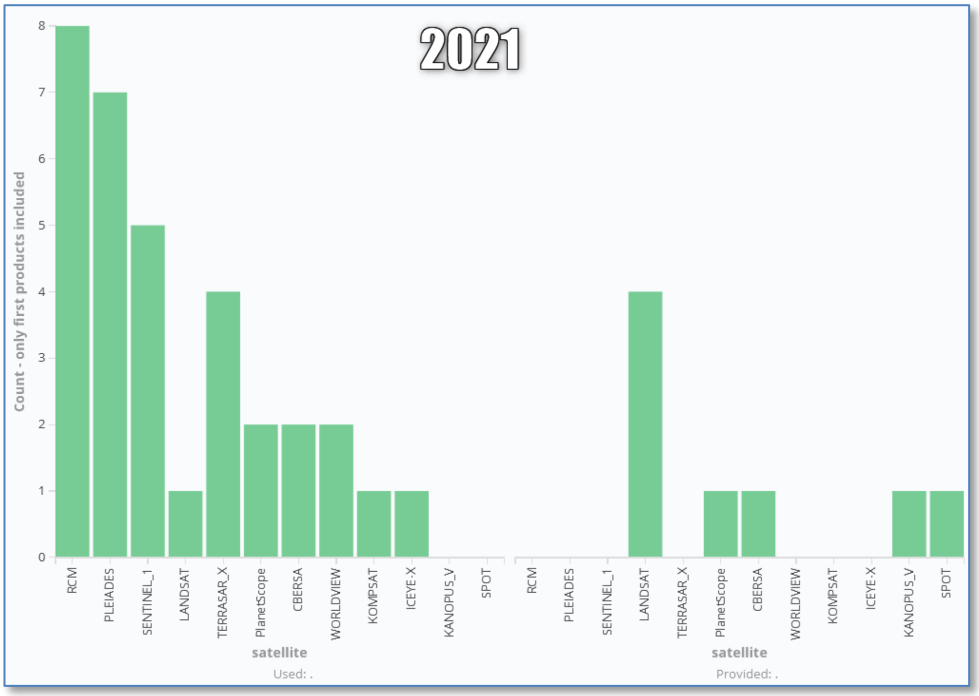


Figure 42. 2021 First image provided vs. used

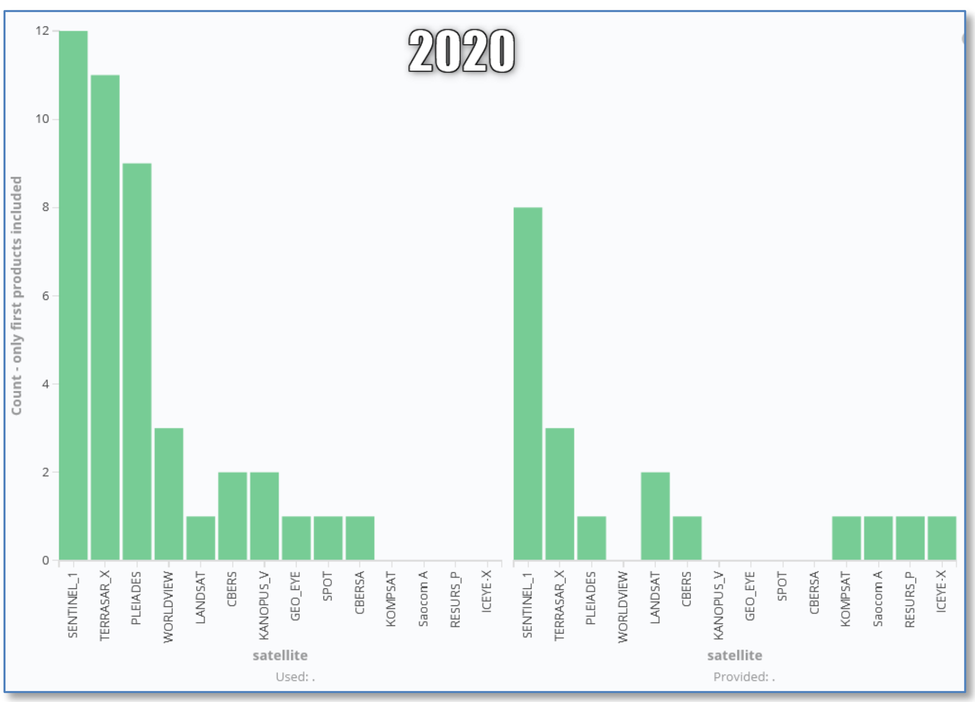


Figure 43. 2020 First image provided vs. used

Radar satellites, also this year, are favourites with 18 first-image activations vs. 16 for the optical (last year 31 vs. 20) as used data. Regarding the provided data, the 2021 has been heavily affected by the quick delivery of a Sentinel-2, so very few satellites were able to provide a “first image”.

4.1.3 ECO performances

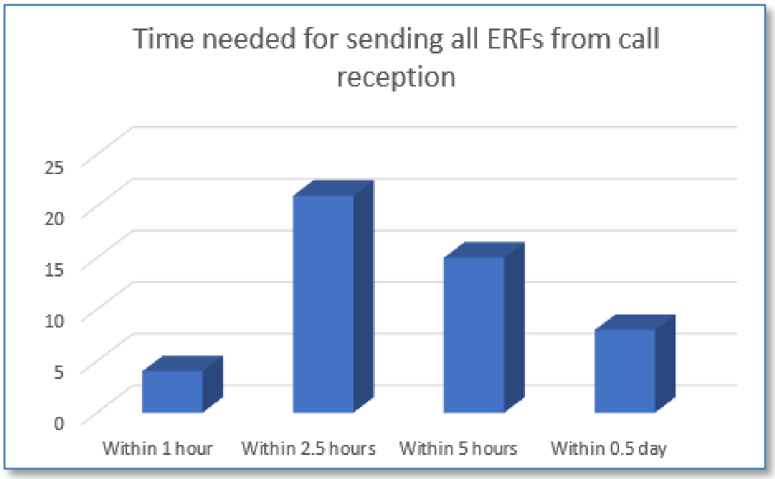


Figure 44. ECO performance: time needed for sending all ERFs from call reception

The ECO completed its work within half a day for all the 2021 activations, normally within 2.5 hours (see Figure 44). Quite similar profile to 2020. Events in anticipation are removed from this stat because there could be the decision to not task immediately the satellites.

In the worst case, the ECO acknowledge the call reception after 3.2 hours, best in 5 minutes.

4.1.4 PM/VA performances

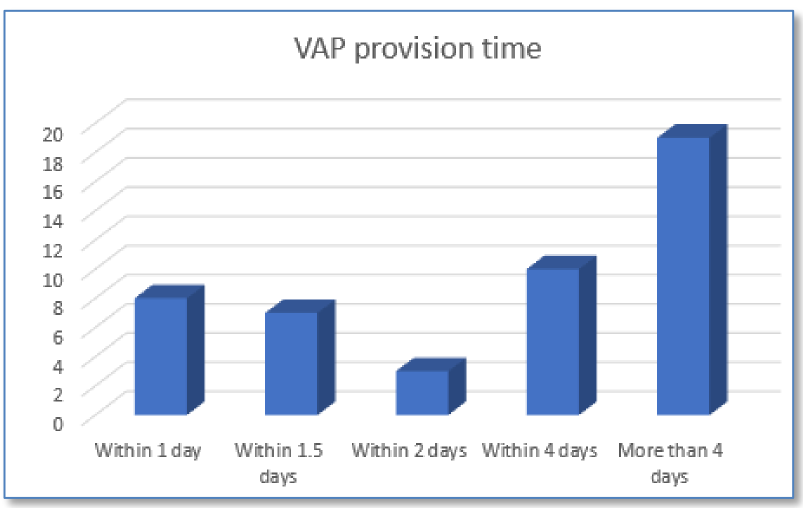


Figure 45. Value-Added Product delivery

The first Value-Added Product was provided within in 1 day for 9 activations , even if the most recurrent case is within more than 4 days. These values are taken from the PM Reports where the PM reports when the VAP has been really sent to the End User, but very often the time of the upload in COS-2 is left blanck and which could be longer). Very similar to 2020.

4.2 Assessment of products & services

The members of the Charter make a constant effort to ensure that all relevant staff (ODO, ECOs, the member agencies' order desks, the PMs and the Executive Secretariat members) are well trained, and that Charter operations are running smoothly in every circumstance:

The different Charter scenarios describing the most appropriate response for the different disaster types, such as flooding, ocean storms, earthquakes, volcanic eruptions, etc. and definition of new scenarios (e.g., tsunami scenario) are regularly reviewed by the Charter's Executive Secretariat, taking into account every modification in the Charter satellite constellation, as well as recommendations by the ECOs and PMs. The objective is to offer optimal background procedures and to make the work of the ECOs and the PMs as efficient and easy as possible.

In addition to the systematic review of the PM training material, an online PM refresher training course is available to keep PMs up to date on the new members, additional satellites, and updated Charter processes.

Although the Charter's mandate is limited to supplying satellite data quickly and at no cost, Charter members invest a significant amount of effort and resources in providing crisis mapping and damage assessment for most of the Charter activations.

5 Collaborations and External relations

5.1 New members accession

The Charter is a group of 17 members since 2018. No new members have been integrated in 2019, 2020 and 2021.

5.2 Universal Access

In order to improve Charter access globally, the Charter launched its Universal Access (UA) initiative in 2012. UA allows any national disaster management authority to become a Charter Authorized User (AU) and to submit requests to the Charter for support in the case of a major emergency. Some basic conditions have to be met to become a Charter AU, and a procedure has to be followed which includes a training. The UA process is designed to achieve greater impact in the disaster management worldwide, and is being implemented gradually. See https://disasterscharter.org/web/guest/how-to-register-as-a-user for more information.

Figure 46. Map showing all countries (in dark blue) with direct access to the Charter as of Feb. 2022 (Honduras, South Africa and Nicaragua were added in 2022)

Today, there are 95 Authorized Users in 78 different countries. Universal Access is progressing, with the result that more and more national disaster management users are being granted AU status (38 AU at the end of 2021):

- Australia in 2013,
- Malawi and Pakistan in 2014,
- Bolivia, Chile, Colombia, and the Dominican Republic in 2015,
- Belarus, El Salvador, Guatemala, Iraq, and Uruguay in 2016,

- Ecuador, Myanmar, New Caledonia, and Sri Lanka in 2017,
- Madagascar, Paraguay, Peru, and Sudan in 2018,
- Eswatini, Ghana, and Tunisia in 2019,
- Cayman Islands, Costa Rica, Ethiopia, Haiti, Tanzania, Togo, Trinidad & Tobago in 2020,
- Uganda, Armenia, Cameroon, Gambia, Mexico, Mongolia in 2021.

By the time of publishing this report, additional nationally mandated disaster management organizations have become able to directly activate the Charter in case of a major disaster in their country due to their newly achieved status.

The Charter continues its efforts for promoting the Universal Access policy. Moreover, the Charter frequently offers refresher trainings for Authorized Users with the main focus on activating the Charter via the web-based operational system of the Charter (COS-2).

5.3 Cooperating Bodies

5.3.1 Cooperation with UNOOSA

Active cooperation with UNOOSA has been continuing for many years. In a report in 2020 UNOOSA described its activities to support the Charter, mainly through its programme UN-SPIDER. It was reported that the UNOOSA raised awareness about the Charter in several conferences or events addressing disaster managers and Earth observation experts in Africa, Asia, Europe, Latin America and the Caribbean, as well as within the UN-SPIDER communication channels (Knowledge Portal, monthly UN-SPIDER Updates, etc.).

In particular, the Charter's Universal Access (UA) initiative has been promoted. Disaster management authorities from several countries have been engaged to get in touch with the Charter. Others are in the process that includes a training that helps understand which sorts of emergencies are covered by the Charter, how an activation is triggered, and what information is crucial for the Charter to be able to support its users in the case of a major emergency caused by a disaster.

In 2021, country missions for Technical Advisory Support and/or Institutional Strengthening, as well as international conferences, could not be carried out as usual by UN-SPIDER due to the ongoing COVID-19 pandemic and virtual formats had to be used to stay in touch with the international Disaster Risk Management community, e.g. at the following events:

- To continue efforts to promote the use of space technologies in disaster risk management, emergency response and recovery efforts, UN-SPIDER and the Centre for Remote Sensing of Land Surfaces of the University of Bonn (ZFL) joined forces to organize the UN-SPIDER / ZFL Regional Virtual Expert Meeting for Southern Africa "Space-based Solutions for Disaster Risk Management and Emergency Response" from 13 to 15 July 2021.
- On 11 and 12 August 2021, UN-SPIDER and the National Directorate of Civil Protection of Niger (DNPC) carried out a virtual training course on the use of UN-SPIDER´s Recommended Practice for Rapid Flood Mapping. The virtual training course, carried out at the request of the DNPC, targeted nearly 45 staff of the Directorate, institutional liaisons of the Operational Centre for Crisis Monitoring and Management (COVACC), and participants from the Civil Protection Academy.

- On November 16 to 18 2021 The UN-SPIDER programme of the United Nations Office for Outer Space Affairs (UNOOSA) and the Center for Remote Sensing of Land Surfaces (ZFL) of the University of Bonn successfully concluded the UN-SPIDER Bonn International Conference: “Space-based Solutions for Disaster Management in Africa: Networks and Information Technologies in times of crisis”.
- UN-SPIDER and the Central American Coordination Centre for Natural Disaster Prevention successfully concluded the UN-SPIDER / CEPREDENAC Regional Expert Meeting for Latin America: Space-based solutions for disaster risk reduction and response. The virtual expert meeting was carried out between 23 and 25 November 2021 and was attended by nearly 150 participants from many countries in Latin America, the United States and Europe.

One Charter activation was triggered by UNOOSA on behalf of national disaster management authorities under the “Universal Access Trial” agreement (see below) between the Charter and UNOOSA.

- In January 2021, the Disaster Management Agency of Indonesia (BNPB) was supported by UNOOSA (through LAPAN) in triggering the Charter for Earthquake in Indonesia. At least 42 people died with hundreds more injured after a 6.2-magnitude earthquake hit Indonesia's Sulawesi Island.

In most of these cases, UNOOSA also assisted the Charter in finding a Project Manager with the help of the network of Regional Support Offices of UNOOSA’s UN-SPIDER program.

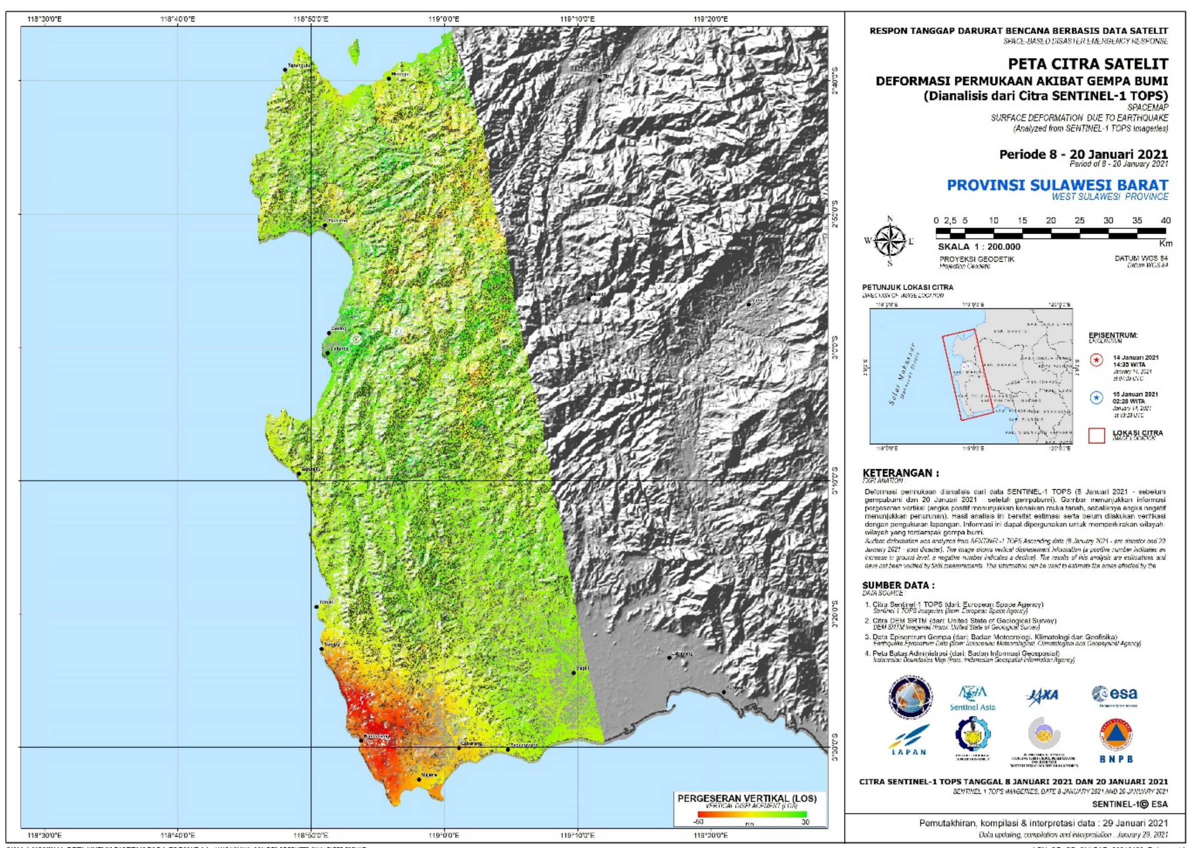


Figure 47. Example of a map produced by LAPAN: Surface Deformation due to a 6.2-magnitude earthquake that hit Indonesia’s Sulawesi Island on 15 January 2021

In early 2018, a "Universal Access Trial" mechanism was agreed between the Charter and UNOOSA, allowing UNOOSA to elevate requests for activation of the Charter on behalf of disaster management authorities in countries that are not yet Charter Authorized Users (AUs), and using these activations as an opportunity to encourage these authorities to become Charter AUs following the emergency.

5.3.2 Cooperation with UNITAR/UNOSAT

Active cooperation with UNITAR/UNOSAT has been continuing for many years. UNOSAT has continued to raise awareness about the Charter among its user community and other relevant stakeholders. The operational rapid mapping service is one of UNOSAT's key activities and creates added value to information for actors in the field and at headquarters. Since late 2019, UNOSAT has experienced an increase in the number of requests to trigger the Charter.

Thirteen Charter activations were triggered by UNITAR/UNOSAT which comprises a significant portion of the overall Charter activations in 2021:

- In January 2021, an activation was triggered on behalf of UNDP due to flooding in Morocco.
- In January 2021, an activation was triggered on behalf of UNOCHA/Regional Office for Southern & Eastern Africa due to Tropical Cyclone Eloise in Mozambique.
- In April 2021, an activation was triggered on behalf of UN Resident Coordinator Office - Timor-Leste/ADRC due to Tropical Cyclone Seroja in Timor-Leste.
- In April 2021, an activation was triggered on behalf of WFP due to La Soufrière Volcano eruption in Saint Vincent and the Grenadines.
- In May 2021, an activation was triggered on behalf of FAO Somalia due to flooding in Somalia.
- In May 2021, an activation was triggered on behalf of UNOCHA due to the Nyiragongo Volcano in the Democratic Republic of the Congo.
- In June 2021, an activation was triggered on behalf of WFP due to flooding in Guyana.
- In July 2021, an activation was triggered on behalf UNOCCHA due to a Chemical factory explosion in Thailand.
- In August 2021, an activation was triggered on behalf of Direction de la Protection Civile de Haiti and UNOCC UNOCHA due to Earthquake in Haiti.
- In September 2021, an activation was triggered on behalf of UNHCR due to flooding in Sudan.
- In September 2021, an activation was triggered on behalf of UNOCHA due to flooding in Thailand.
- In December 2021, an activation was triggered on behalf of UNOCHA and its Regional Office for Asia and the Pacific due to Typhoon Rai in the Philippines.

UNOSAT staff members strongly supported the Charter by providing value-added products based on the satellite images made available by the Charter for all the activations listed above.

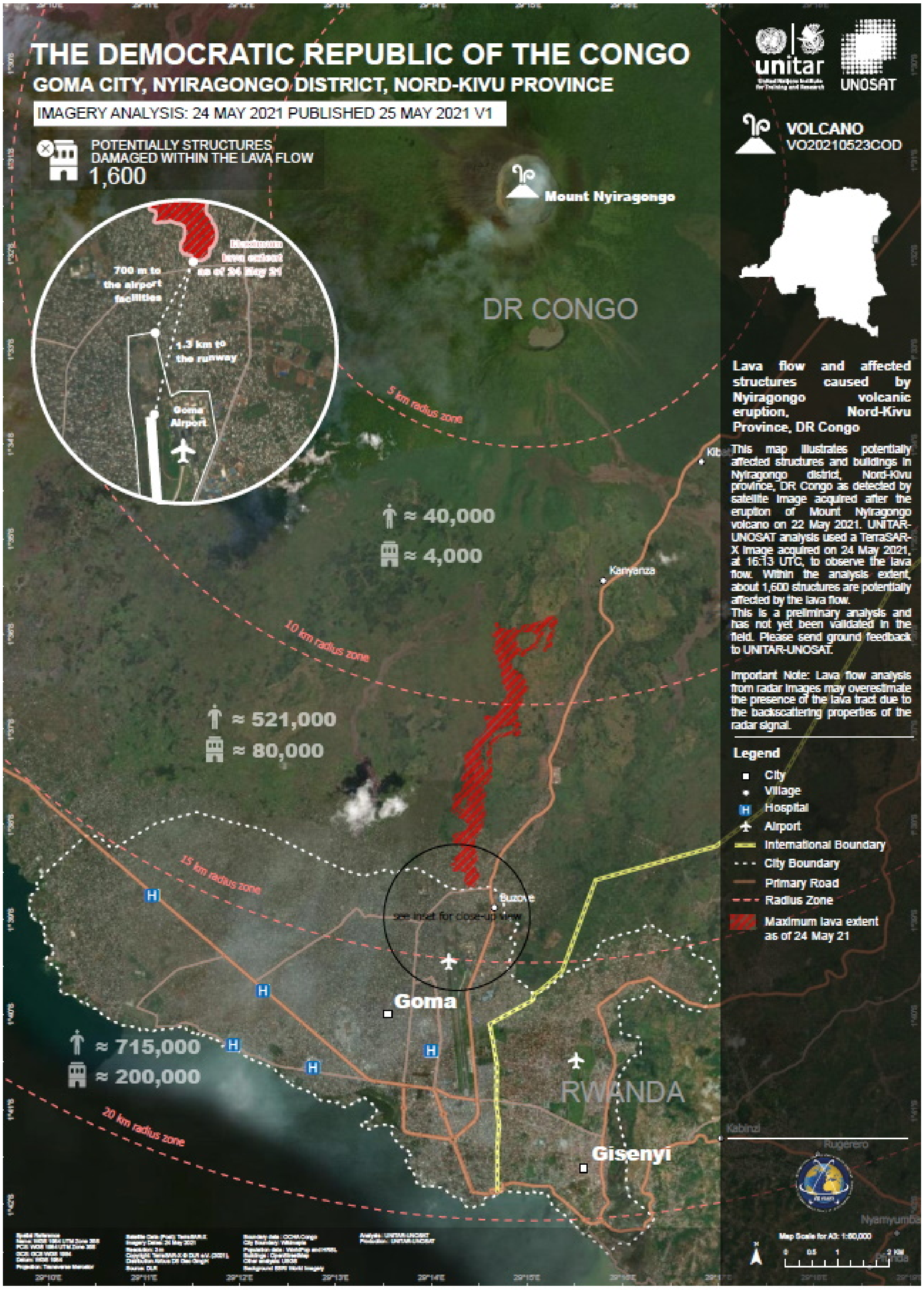


Figure 48. Example of a map of Lava flow and affected structures on 24 May 2021 delivered by UNOSAT in support of the Charter activation after Nyiragongo volcanic eruption in the Nord-Kivu Province of the Democratic Republic of Congo on 22 May 2021

5.3.3 Cooperation with Sentinel Asia

The Asian Disaster Reduction Center (ADRC) has the status of a Charter Cooperating Body to be able to trigger the Charter in support of requests from national members of Sentinel Asia (SA) and ADRC. By the end of 2021, SA was comprised of 94 organizations from 28 countries and regions and 17 international organizations.

JAXA provides the Charter with monthly activation status reports as well as two biannual reviews presenting SA's emergency response and promotional/awareness activities. At the 44th online Charter Board meeting, ADRC reported on their activities including coordinating escalations of SA activations to the Charter and expressed their intent to continue contributing as a hub facility bridging space agencies and disaster management organizations. In 2021, 33 activations were handled by SA. Among these, the escalation mechanism to the Charter was used in response to 10 events:

- Earthquake in Indonesia in January 2021
- Flooding in Philippines in February 2021
- Flooding and Landslide in Indonesia in April 2021
- Flooding and Landslides in Timor-Leste in April 2021
- Oil Spill in Sri Lanka in June 2021
- Flooding in Sri Lanka in June 2021
- Flooding and Landslides in Japan in August 2021
- Flooding in Sri Lanka in November 2021
- Floating volcanic debris in Philippines from the Fukutoku-Okanoba Submarine Volcano eruption in November 2021
- Eruption of Mount Semeru volcano in Indonesia in December 2021

Despite the fact that several SA member countries have become Charter Authorized Users to be entitled to trigger the Charter activations directly, Sentinel Asia's escalation mechanism is still beneficial in that satellite sources of Sentinel Asia and the Charter are different and the Sentinel Asia community provide PM and VA in case of Sentinel Asia's escalation.

JAXA, as the executive secretariat of SA, continued to promote the Charter, explaining the escalation mechanism to activate the Charter and the Charter's Universal Access policy at several occasions. In addition, JAXA has contributed to increasing Project Manager (PM) resources and to maintaining PM skills, especially for the purpose of making escalations from SA to the Charter effective and beneficial to the SA member countries and regions where disasters occur. Another goal of these efforts is to have trained PMs in SA member countries with a Charter Authorized User for coordinated response within the country in case of a Charter activation.

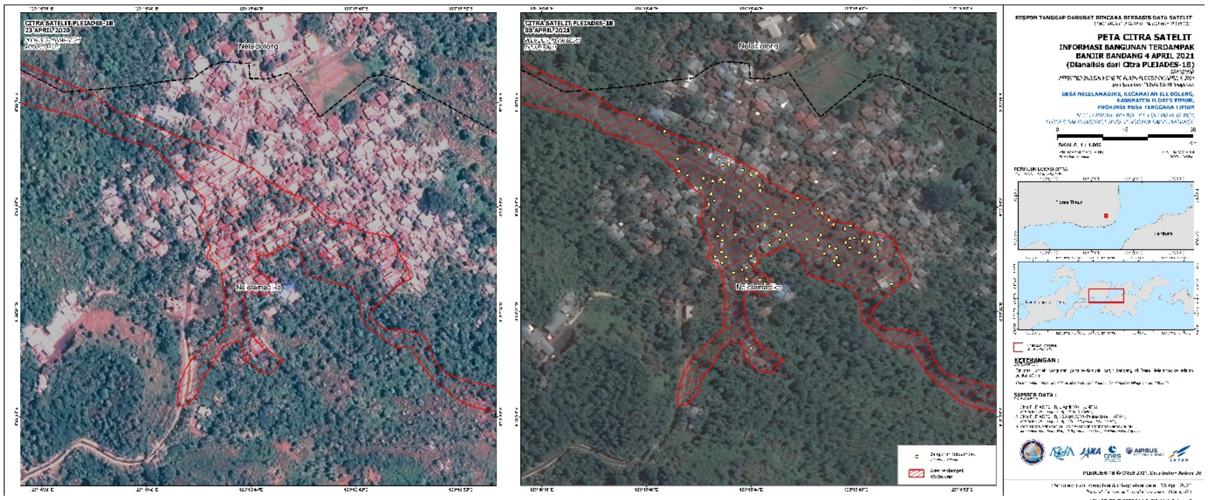


Figure 49. Example of a map produced by LAPAN, showing buildings affected by flash floods after Cyclone Seroja at Nelelamadike Village, Ile Boleng Regency, Flores Timur District, Nusa Tenggara Timur Province after in April 2021

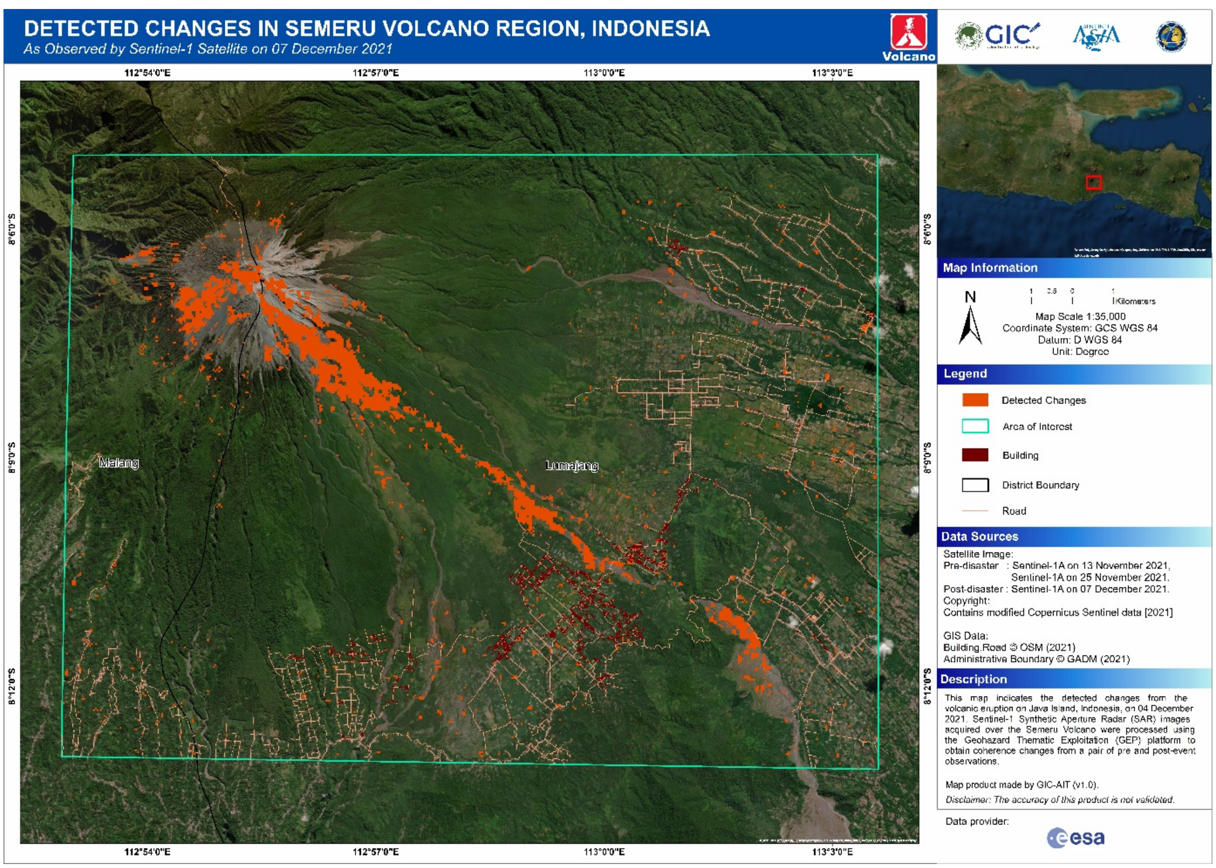


Figure 50. Example of a map produced byGIC-AIT of detected changes after the eruption of Semeru Volcano on Java Island on 4 December 2021

5.4 Cooperation with other programs and initiatives

5.4.1 Cooperation with the Copernicus Emergency Management Service of the European Union

The Charter and the Copernicus Emergency Management Service (CEMS) are complementary with slightly different scope: the Charter is strictly focused on the response phase during a major emergency caused by a natural or technical disaster, while the CEMS is intended to provide support also for other phases of the emergency management cycle in and outside of Europe. However, significant overlap exists between the Charter and the CEMS Rapid Mapping Service. Therefore, collaboration is mutually beneficial and has taken place in numerous cases in the past.

In April 2018, the Charter and the CEMS finalised and agreed on procedures for collaboration, not only to avoid duplications, where possible, but also to leverage synergies. Since then, the Charter could substantially benefit from the mapping capacity of the CEMS on a case-by-case basis, and the CEMS could, especially in cases of large-scale disasters, benefit from satellite data provided by the Charter. Collaboration can be triggered based on these procedures by either the CEMS or the Charter, with the goal to collaborate efficiently.

In 2021, the new procedures were used for a few successful collaboration cases. CEMS was granted access to the data of ongoing Charter activations in the following cases:

- Earthquake in Indonesia in January 2021
- Nyiragongo Volcano in the Democratic Republic of the Congo in May 2021
- Flood in Guyana in June 2021
- Earthquake in Haiti in August 2021

In 2021, the Charter did not have the opportunity to invite Copernicus to contribute to Charter activations with maps produced by the CEMS.

In 2021, the CEMS Rapid Mapping Service was activated 58 times. Thirty-four of these activations were due to wildfires, the majority of which took place in European countries. Another 18 activations covered flood events, all of which were in Europe. Volcanic activities and Storms each had 3 activations. In the same time period there were 11 Charter activations for disasters in Europe. It can be concluded that demands in Europe are very successfully covered by the CEMS.

Figure 51. Example of a map produced by CEMS showing a damage assessment after an earthquake of 7.2 M hit the south of Haiti on 14 August 2021

5.4.2 Collaboration with CEOS Working Group on disasters

The Committee on Earth Observation Satellites (CEOS) Working Group on Disasters aims at increasing and strengthening satellite Earth observation contributions to the various Disaster Risk Management (DRM) phases in different domains, such as earthquakes, volcanoes, and landslides (http://ceos.org/ourwork/workinggroups/disasters/). A number of thematic demonstrators intend to showcase:

- the added value and uniqueness of increased CEOS coordination in these thematic areas;
- the benefits of closer ties to users (decision makers, disaster management stakeholders, and politicians) and ease of access to data;
- the potential for the increased roles of space-based Earth observation under the Sendai Framework for Disaster Risk Reduction 2015-2030 of the United Nations.

In addition to demonstrator projects focusing on certain natural hazards, there is also a "Recovery Observatory" demonstrator focusing on the southwest of Haiti that was devastated by Hurricane "Matthew" in October 2016. The project demonstrated the potential and increased the contribution of satellite-based information to the recovery phase in the years after extreme catastrophic events.

Following an agreement established in 2015, once the peak of a Charter activation is passed, and access to Charter data is required from one of the CEOS demonstrators, Charter agencies may share the data collections acquired during an activation taking into account the respective data licenses. A procedure for requesting such collaboration was established. It was used several times since then by the CEOS group in order to be able to access data acquired by the Charter, e.g., for the area focused by the Haiti Recovery Observatory. More recently, observer access to COS-2 has been granted to lead scientists involved in the above-mentioned demonstrators, so they can more easily follow the status of activations of the Charter.

6 Communication

6.1 Web site

The Charter website is available in English and some pages are available in Spanish, French and Russian; other languages versions are also expected. The website design is being continuously improved to facilitate the user navigation and information search.

https://www.disasterscharter.org/web/guest/home

The Charter website allows direct access to COS-2 for authorized Charter members' personnel and provides information on how the Charter can be activated by Authorized Users through the Universal Access initiative.

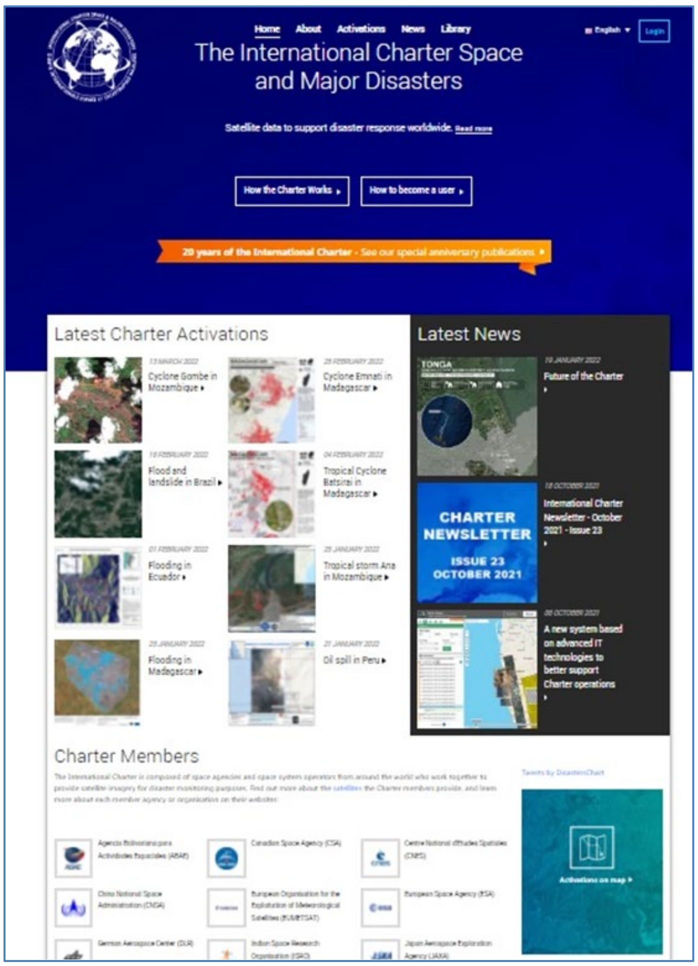


Figure 52. Charter website homepage

According to the Charter Website statistics in 2021 there were totally 823,142 page views, and 216,258 views were unique (indicating many returning visitors). The most viewed pages (more than 10,000 views and unique views) were the home page, disaster types page and activations page. Average time spent on a page comprised approximately 1 minute. Average bounce rate was 61% and average exit percentage comprised 66%.

Table 14. Charter website main pages views (January-December 2021)

Page	Page Views	Unique Page Views	Avg. Time on Page	Bounce Rate	Exit Rate
https://disasterscharter.org/web/guest/home	45,424	32,552	1 minute	42%	52%
https://disasterscharter.org/web/guest/disaster-types/-/article/fires	18,429	15,292	1 minute	83%	96%
https://disasterscharter.org/web/guest/charter-activations	17,241	10,240	52 seconds	59%	50%
https://disasterscharter.org/web/guest/disaster-types/-/article/landslides	5,643	4,707	1 minute 7 seconds	82%	92%
https://disasterscharter.org/web/guest/disaster-types/-/article/cyclones	5,393	4,545	1 minute 7 seconds	83%	92%
https://disasterscharter.org/web/guest/about-the-charter	5,250	4,059	1 minute 31 seconds	71%	56%
https://disasterscharter.org/web/guest/about-the-charter	2,680	1,983	1 minute 35 seconds	83%	64%
https://disasterscharter.org/web/guest/how-the-charter-works	2,530	2,074	1 minute 50 seconds	65%	48%
https://disasterscharter.org/web/guest/disaster-types/-/article/earthquakes	2,173	1,864	1 minute 14 seconds	84%	84%
https://disasterscharter.org/web/guest/disaster-types/-/article/ice	1,958	1,696	39 seconds	85%	91%
https://disasterscharter.org/web/guest/disaster-types/-/article/volcanoes	1,910	1,662	1 minute 11 seconds	84%	86%
https://disasterscharter.org/web/guest/disaster-types/-/article/oil-spills	1,658	1,428	1 minute 1 second	83%	86%
https://disasterscharter.org/web/guest/disaster-types/-/article/floods	1,582	1,353	1 minute 15 seconds	81%	65%
https://disasterscharter.org/web/guest/how-to-register-as-a-user	1,538	1,277	1 minute 40 seconds	63%	42%
https://disasterscharter.org/web/guest/disaster-types/-/article/ocean-wave	1,394	1,199	44 seconds	84%	88%
https://disasterscharter.org/web/guest/news	1,303	978	50 seconds	32%	22%
https://disasterscharter.org/web/guest/disaster-types/-/article/other	590	508	1 minute 14 seconds	76%	53%
https://disasterscharter.org/web/guest/text-of-the-charter	468	400	2 minutes 1 second	69%	50%
https://disasterscharter.org/web/guest/20th-anniversary	402	334	56 seconds	65%	38%
https://disasterscharter.org/web/guest/history	322	285	1 minute 52 seconds	48%	39%

https://disasterscharter.org/web/guest/newsletter	193	176	2 minutes 11 seconds	49%	64%
https://disasterscharter.org/web/guest/contact-us	131	113	1 minute 29 seconds	24%	27%
https://disasterscharter.org/web/guest/universal-access	128	119	1 minute 11 seconds	85%	50%

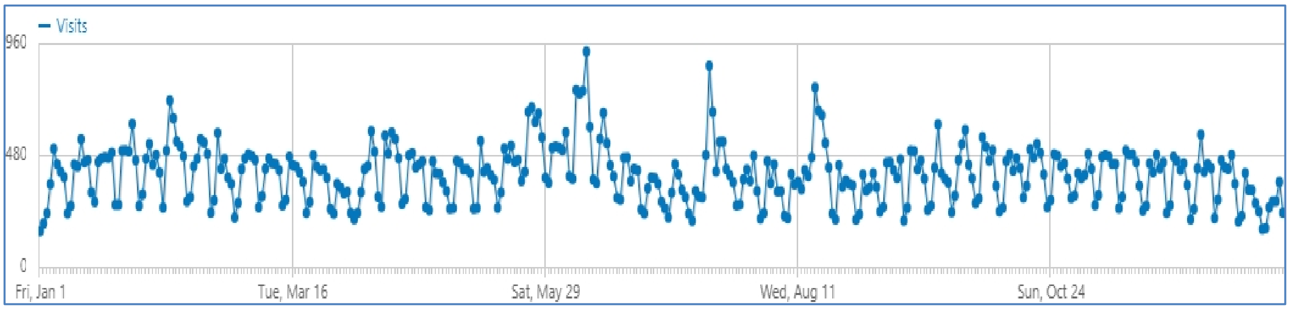


Figure 53. Charter website visits (January-December 2021)

The Figure 53 shows a clear increase in visits to the Charter website as there were 145 170 visits in 2021 with three peaks in activity, occurring in June, July and August. These all happened on the day or day after the following activations:

- Flood and oil spill activations in Sri Lanka – June
- Floods in Switzerland and Luxembourg – July
- Earthquake in Haiti – August

The statistics show that the activations still generally remain the most visited part of the website, but the Disaster Types pages (which are SEO-friendly), followed by the Library and general pages about how to activate the Charter or register as an AU also attract a lot of visitors.

Table 15. Top 10 countries that visited the website (January-December 2021)

Country	Visits
U.S.	82,795
UK	14,882
France	5,453
Spain	5,273
Japan	5,052
Russia	4,595
India	3,998
China	2,569
Germany	2,309

In 2021, there was an increased growth of the visits from United Kingdom as well as visits from the United States, which are still far more than from the other countries, as shown in Table 15.

2021 also shows an overall increase in the number of visitors to the activations pages. The main Charter Activations page received more than 30 000 views compared to almost 18,000 page views in 2020.

The activations list shows that the top 3 activations which received the most interest in 2021 were the oil spill in Sri Lanka, the Nyiragongo Volcano eruption in the Democratic Republic of the Congo (DRC) as well as the flood in India. All the three were featured widely in the media.

Table 16. Number of Charter activations pages views (January-December 2021)

Page	Page Views	Unique Page Views	Avg. Time on Page (seconds)	Entrances	Bounce Rate	Exit Rate
https://disasterscharter.org/web/guest/activations/-/article/oil-spill-in-sri-lanka-activation-715-	1,519	1,282	113	849	65%	77%
https://disasterscharter.org/web/guest/activations/-/article/volcano-in-congo-the-democratic-republic-of-the-activation-713-	1,409	1,241	116	783	72%	80%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-india-activation-698-	1,407	1,220	121	599	62%	66%
https://disasterscharter.org/web/guest/activations/-/article/volcano-in-saint-vincent-and-the-grenadines-activation-703-	1,401	1,254	117	888	68%	80%
https://disasterscharter.org/web/guest/activations/-/article/earthquake-in-haiti-activation-729-	1,388	1,175	117	630	63%	71%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-luxembourg-activation-721-	1,225	1,085	70	794	70%	80%
https://disasterscharter.org/web/guest/activations/-/article/earthquake-in-indonesia-activation-695-	1,113	1,028	67	654	89%	71%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-timor-leste-activation-701-	1,095	1,026	71	766	85%	83%
https://disasterscharter.org/web/guest/activations/-/article/landslide-in-eswatini-activation-697-	994	929	63	551	95%	73%

https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-thailand-activation-734-	910	780	116	316	65%	62%
https://disasterscharter.org/web/guest/activations/-/article/storm-hurricane-urban-in-fiji-activation-691-	895	876	24	696	98%	84%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-bolivia-plurinational-state-of-activation-693-	877	833	60	559	91%	73%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-switzerland-activation-720-	823	706	82	350	60%	66%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-haiti-activation-730-	813	708	89	350	65%	57%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-russian-federation-activation-704-	774	754	16	560	97%	81%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-indonesia-activation-702-	773	711	63	468	86%	74%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-morocco-activation-694-	771	717	82	353	85%	65%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-chile-activation-699-	758	682	71	361	81%	60%
https://disasterscharter.org/web/guest/activations/-/article/storm-hurricane-urban-in-india-activation-709-	736	691	37	493	94%	80%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-mozambique-activation-696-	712	651	90	342	77%	65%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-philippines-activation-700-	669	608	55	320	85%	66%
https://disasterscharter.org/web/guest/activations/-/article/storm-hurricane-rural-in-india-activation-714-	558	491	119	234	70%	61%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-guyana-activation-717-	541	475	124	217	58%	63%

https://disasterscharter.org/web/guest/activations/-/article/volcano-in-indonesia-activation-739-	517	446	111	222	62%	74%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-sudan-activation-732-	488	426	99	141	69%	53%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-sri-lanka-activation-716-	485	438	109	180	65%	56%
https://disasterscharter.org/web/guest/activations/-/article/flood-flash-in-japan-activation-727-	467	392	112	122	56%	42%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-sri-lanka-activation-737-	460	373	105	127	72%	59%
https://disasterscharter.org/web/guest/activations/-/article/fire-in-tunisia-activation-724-	437	388	74	151	65%	52%
https://disasterscharter.org/web/guest/activations/-/article/fire-in-thailand-activation-719-	403	357	86	121	75%	56%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-somalia-activation-706-	398	356	85	162	78%	61%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-togo-activation-731-	390	333	111	119	66%	58%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-india-activation-723-	358	305	107	102	58%	53%
https://disasterscharter.org/web/guest/activations/-/article/landslide-in-swaziland-activation-697-	351	246	72	133	46%	50%
https://disasterscharter.org/web/guest/activations/-/article/earthquake-in-china-activation-733-	346	309	78	39	46%	38%
https://disasterscharter.org/web/guest/activations/-/article/fire-in-russian-federation-activation-722-	338	299	56	121	64%	50%
https://disasterscharter.org/web/guest/activations/-/article/oil-spill-in-philippines-activation-738-	315	281	76	115	74%	68%
https://disasterscharter.org/web/guest/activations/-/article/flood-large-in-micronesia-federated-states-of-activation-740-	296	244	71	102	75%	70%
https://disasterscharter.org/web/guest/activations/-/article/fire-in-russian-federation-activation-728-	294	258	84	38	66%	36%

https://disastercharter.org/web/guest/activations/-/article/flood-large-in-russian-federation-activation-725-	288	243	92	82	60%	47%
https://disastercharter.org/web/guest/activations/-/article/storm-hurricane-rural-in-philippines-activation-741-	270	220	118	84	56%	69%
https://disastercharter.org/web/guest/activations/-/article/flood-flash-in-russian-federation-activation-718-	263	236	75	71	65%	53%
https://disastercharter.org/web/guest/activations/-/article/earthquake-in-china-activation-712-	251	232	73	51	53%	43%
https://disastercharter.org/web/guest/activations/-/article/flood-large-in-russian-federation-activation-705-	245	220	66	41	61%	37%
https://disastercharter.org/web/guest/activations/-/article/flood-large-in-russian-federation-activation-707-	195	181	42	85	75%	59%
https://disastercharter.org/web/guest/activations/-/article/flood-large-in-russian-federation-activation-726-	177	157	56	30	57%	27%
https://disastercharter.org/web/guest/activations/-/article/earthquake-in-china-activation-711-	168	143	95	27	52%	30%
https://disastercharter.org/web/guest/activations/-/article/flood-large-in-russian-federation-activation-708-	153	140	55	36	72%	50%
https://disastercharter.org/web/guest/activations/-/article/flood-flash-in-russian-federation-activation-710-	96	87	84	19	68%	34%

Charter visibility is also ensured through other social media outlets, such as Twitter, which gained approximately 500 new followers in 2021 and had around 8,810 followers on the account by the end of the year. This trend shows that the Charter audience continues to increase compared to 2013 (880), 2014 (1,840), 2015 (3,160), 2016 (4,000), 2017 (5,000), 2018 (6,000), 2019 (7,300), and 2020 (8,310).

The number of impressions of Charter's followers in January-December 2021 comprised 501,279, the following figure shows the tweets published in 2021.

The spreadsheet is organised by the Tweets that received the most re-Tweets. Taking this and likes into account, the most popular Tweets were all related to new maps for the following activations:

- La Soufriere volcano in Saint Vincent and Grenadines
- Nyiragongo volcano in DRC
- Earthquake in Haiti
- Floods in Thailand
- Floods and landslides in Timor-Leste

This is common activity for the account, as the products are always the most popular, and even more so when the scope of the disaster is big, or it is a disaster that's widely covered in the media.

Table 17. Disasters Charter Twitter statistics for 2021

Tweet permalink	Tweet text	Date and time	Impressions	Engagements	Retweets
https://twitter.com/DisastersChart/status/1381967104262344705	We have our first maps of the #LaSoufriere volcanic eruption in #SaintVincent and the Grenadines: https://t.co/QsB82oyAlQ The maps provide preliminary analysis of the situation after the eruption, and estimate the potentially affected area. https://t.co/9EeMuPMepu	13.04.2021 13:46	22,993	1,528	47
https://twitter.com/DisastersChart/status/1400020866898055171	We have a series of maps available analysing the #NyiragongoEruption in the #Congo: https://t.co/971KFpjX0i #DRCongo The maps use #Sentinel1, #Pleiades, #TerraSARX and #WV2 data to estimate the extent of the lava flow. https://t.co/yfnrM4ARZn	02.06.2021 9:26	26,377	1,279	44
https://twitter.com/DisastersChart/status/1400738577881907204	This map uses #Sentinel1, #Sentinel2 and #Pleiades data to estimate the lava flow extent from the #NyiragongoEruption in NordKivu Province: https://t.co/971KFpjX0i #DRCongo https://t.co/GtqmJ8FDgs	04.06.2021 8:57	12,661	507	29
https://twitter.com/DisastersChart/sta	Our latest map of the #earthquake in #Haiti uses #Pleiades imagery to estimate damage to buildings	18.08.2021	10,205	359	23

tus/142792940744068710 4	and infrastructure in Les Cayes: https://t.co/bznyQ2LnNm #Haitiearthquake2021 https://t.co/Jv8hzJ2G5y	9:44			
https://twitter.com/DisastersChart/status/14460960711392092 18	We have a series of maps available of the #floods in #Thailand: https://t.co/FeLamOEdLL These maps all use #Sentinel1 data to estimate the extent of the flooding. https://t.co/B6URTLEKpL	07.10.2021 12:52	3,928	381	20
https://twitter.com/DisastersChart/status/13800946186966261 77	The Charter has been activated to provide satellite imagery of #CycloneSeroja's impact to #TimorLeste: https://t.co/rWulom3bXN #EastTimor Our first map of the disaster uses #Sentinel1 data to provide a preliminary analysis of Baucau department. https://t.co/YOHOGZkDFQ	08.04.2021 9:46	8,999	263	19
https://twitter.com/DisastersChart/status/13844835359148892 16	These maps use optical imagery from the #Pleiades, and #Vision1 satellites to provide preliminary analysis of the #floods and #landslides affecting #TimorLeste: https://t.co/w5yjoGRhVT #EastTimor https://t.co/fHy1bzmDw6	20.04.2021 12:26	24,714	1,274	19
https://twitter.com/DisastersChart/status/13595396818185338 90	Our latest maps of #India use #Pleiades, Kanopus-V, #Sentinel2, and KOMPSAT imagery to estimate damage to the Tapovan Power Plant and estimate where the avalanche occurred: https://t.co/bfA0XDK830 https://t.co/kuHqtxcAP2	10.02.2021 16:28	16,174	812	17
https://twitter.com/DisastersChart/status/14461222076508569 62	.@UNOSAT have produced a series of reports on the #floods in #Thailand, using imagery and data from #Pleiades, Kanopus-V and @NOAA: https://t.co/FeLamOmCnb The images (such as these examples) provide a clear indication of the level of flooding	07.10.2021 14:36	7,926	472	17

	these regions have experienced. https://t.co/FyVKuCuc0I				
https://twitter.com/DisastersChart/status/14025647824699228 20	This map uses data from the #RCMsatellites to estimate the #flood extent at Kwakwani in #Guyana as of 7 June: https://t.co/gkWAMuSxdl https://t.co/HYiukiXjnS	09.06.2021 9:54	28,930	331	16
https://twitter.com/DisastersChart/status/14710304006046883 85	We have a series of maps of the #MountSemeru volcanic eruption in #Indonesia: https://t.co/aF0teOVp0N The maps use data from multiple satellites to estimate the impact of the eruption and extent of the lava flow. https://t.co/rhh3JRbBMJ	15.12.2021 8:12	6,537	310	15
https://twitter.com/DisastersChart/status/13830295112273715 26	These maps use SAOCOM-1A and #Sentinel2 imagery to provide a preliminary outline of the pyroclastic flow and ash outline of the #LaSoufriere volcanic eruption: https://t.co/QsB82oQbKq #SaintVincent https://t.co/9gpgAeGIPV	16.04.2021 12:08	5,419	223	14
https://twitter.com/DisastersChart/status/14019093355848171 56	These maps use data from the #ICEYE and #SAOCOM missions to detect potential oil spills from the #XPressPearl ship wreck off the coast of #SriLanka: https://t.co/jdLuuRzAPR https://t.co/pQQAVBZh8E	07.06.2021 14:30	3,480	253	14
https://twitter.com/DisastersChart/status/14022197398128599 07	The Charter has been activated to provide satellite data over #floods in #Guyana: https://t.co/NHNjYR4YJe We already have our first map of the disaster, which uses NOAA satellite data to estimate the flood extent. https://t.co/DSbwO38Fzx	08.06.2021 11:03	4,029	135	14
https://twitter.com/DisastersChart/status/1435911	Our first map for the flooding in Togo uses data from the #RCMSatellites to estimate flood areas along the Mono River:	09.09.2021 10:23	22,579	411	13

685576007685	https://t.co/gYnwOsBaiz https://t.co/w7SrA1J85v				
https://twitter.com/DisastersChart/status/13667234423478231117	We have now provided satellite data in response to requests for 700 disasters since 2000. Our last activation, for Tropical Storm Auring (Dujuan) marked the 700th activation of the Charter: https://t.co/wT9U5OCiug	02.03.2021 12:13	4,707	85	12
https://twitter.com/DisastersChart/status/1384090412889956355	Our latest maps of #LaSoufriere volcano use data from the #RCMsatellites to look at changes to the crater on 16 and 17 April: https://t.co/QsB82oyAlQ #SaintVincent https://t.co/JHN2OrLg1M	19.04.2021 10:24	4,067	195	12

5.1 Charter Newsletters

Charter Newsletters #22 and 23 were issued in April 2021 and October 2021 respectively. The newsletters represent an additional means of informing users, stakeholders and the public on recent Charter activations, news, events and related activities.

The 22nd issue is available on the link below and reported on the following matters:
https://disasterscharter.org/web/guest/-/international-charter-newsletter-april-2021-issue-22

- JAXA lead the Charter for the last six months;
- Three new satellites joined the Charter (virtual) constellation;
- Canada's recent contributions to the Disasters Charter.

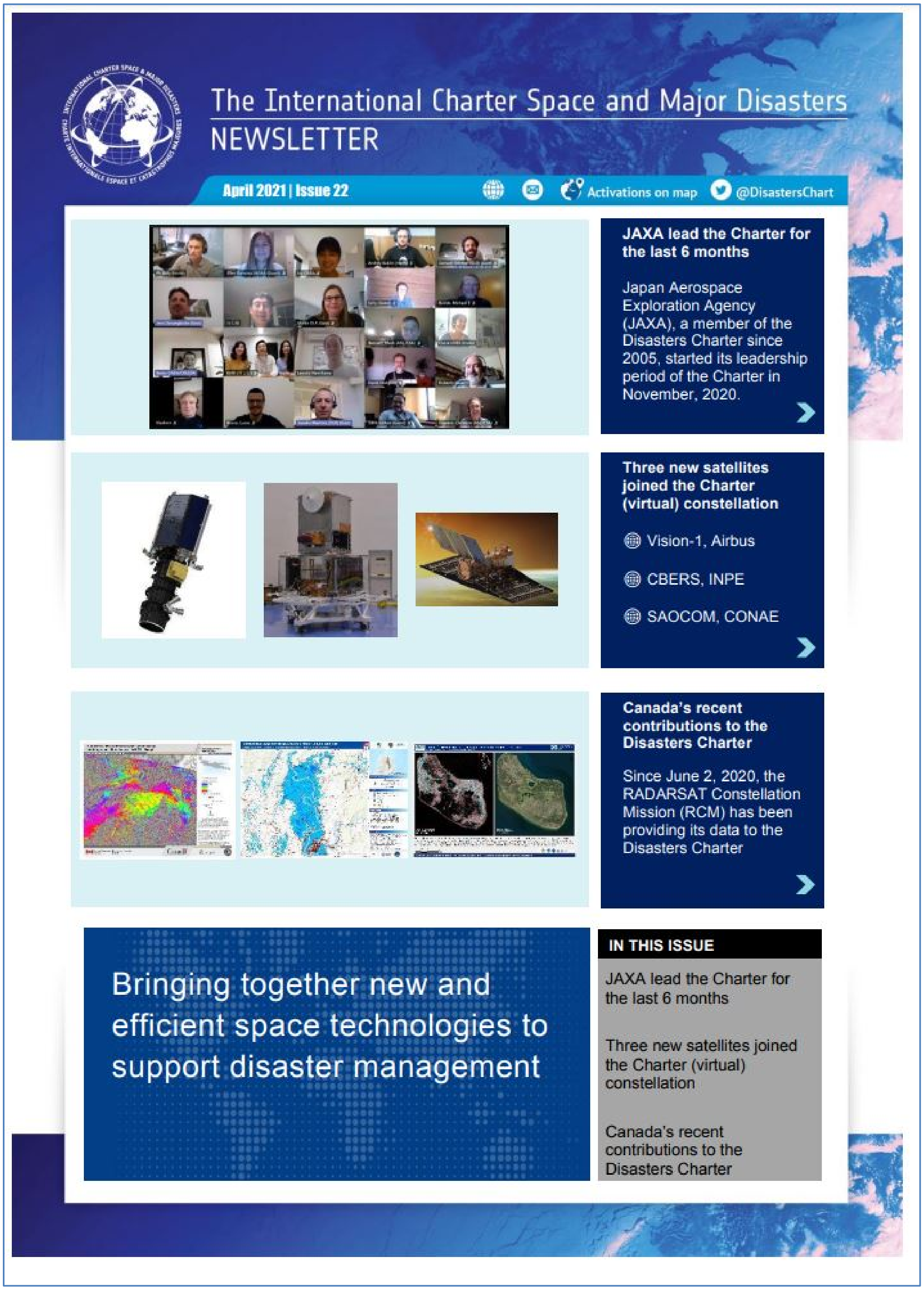
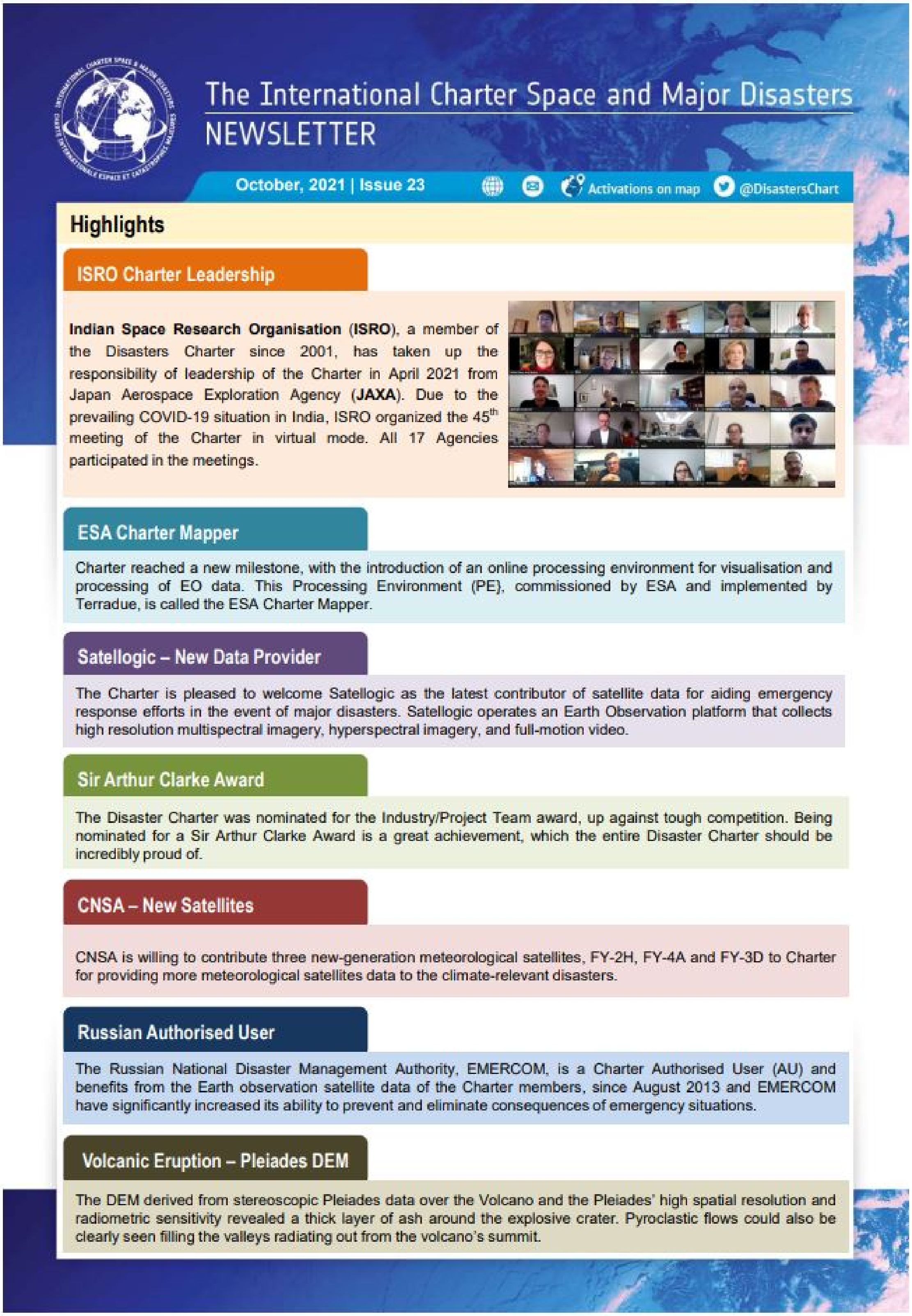


Figure 54. Charter Newsletter issue 22



The International Charter Space and Major Disasters
NEWSLETTER

October, 2021 | Issue 23 Activations on map @DisastersChart

Highlights

ISRO Charter Leadership

Indian Space Research Organisation (**ISRO**), a member of the Disasters Charter since 2001, has taken up the responsibility of leadership of the Charter in April 2021 from Japan Aerospace Exploration Agency (**JAXA**). Due to the prevailing COVID-19 situation in India, ISRO organized the 45th meeting of the Charter in virtual mode. All 17 Agencies participated in the meetings.

ESA Charter Mapper

Charter reached a new milestone, with the introduction of an online processing environment for visualisation and processing of EO data. This Processing Environment (PE), commissioned by ESA and implemented by Terradue, is called the ESA Charter Mapper.

Satellogic – New Data Provider

The Charter is pleased to welcome Satellogic as the latest contributor of satellite data for aiding emergency response efforts in the event of major disasters. Satellogic operates an Earth Observation platform that collects high resolution multispectral imagery, hyperspectral imagery, and full-motion video.

Sir Arthur Clarke Award

The Disaster Charter was nominated for the Industry/Project Team award, up against tough competition. Being nominated for a Sir Arthur Clarke Award is a great achievement, which the entire Disaster Charter should be incredibly proud of.

CNSA – New Satellites

CNSA is willing to contribute three new-generation meteorological satellites, FY-2H, FY-4A and FY-3D to Charter for providing more meteorological satellites data to the climate-relevant disasters.

Russian Authorised User

The Russian National Disaster Management Authority, EMERCOM, is a Charter Authorised User (AU) and benefits from the Earth observation satellite data of the Charter members, since August 2013 and EMERCOM have significantly increased its ability to prevent and eliminate consequences of emergency situations.

Volcanic Eruption – Pleiades DEM

The DEM derived from stereoscopic Pleiades data over the Volcano and the Pleiades' high spatial resolution and radiometric sensitivity revealed a thick layer of ash around the explosive crater. Pyroclastic flows could also be clearly seen filling the valleys radiating out from the volcano's summit.

Figure 55. Charter Newsletter issue 23

The 23rd issue is available on the link below and reported on the following matters:
https://disasterscharter.org/web/guest/-/international-charter-newsletter-october-2021-issue-23

- ISRO lead the Charter for the last six months;
- The new online processing environment Charter Mapper was introduced by ESA;
- New data provider Satellogic has joined the Charter;
- The Charter was nominated for a Sir Arthur Clarke Award;
- CNSA contributed 3 new meteorological satellites to the Charter;
- Russian EMERCOM is a part of the Charter Authorised Users community;
- Pleiades DEM contributed to analyse a volcanic eruption.

The dissemination of the newsletters is organised through the Charter website and by e-mail. Each agency deals with its own distribution list.

5.2 Conferences and presentations

The following table provides details of the 2021 events or conferences where the Charter was represented. On such occasions, presentations were given covering the Charter's role in the acquisitions and production of satellite imagery for disaster response together with the Universal Access initiative.

Table 12. List of conferences/workshops/presentations with Charter presence

Event	Venue	Date	Speakers
IAC 2021 - Highlight Lecture "20 Years of Saving Lives from Space".	UAE	27 Oct 2021	CNES
French statement during the **64th and 65th sessions of COPUOS.**	Vienna	25 Aug – 3 Sep & Nov 2021	
Exhibition « Space for our Planet » : 28 testimonials in favor of the space solutions for a sustainable world, a response to the Unites Nation's 2030 Agenda and the 17 Sustainable Development Goals (SDGs). **https://www.space4ourplanet.org/about/ ; https://www.space4ourplanet.org/story/space-imagery-provides-us-with-essential-data-for-sending-rescue-teams-where-they-are-needed/**	Dubai	2021	
CNES presented the Charter to the students of the Institut des Hautes Etudes de Défense Nationale -IHEDN- https://ihedn.fr/ and to the young researchers (doctoral and post	CNES	Feb & Mar 2021	

doctoral students) of the CNES, https://cnes-jc1.fr/ .			
Online Translation Training	CNSA	19 Aug 2021	CNSA
Online COS-2 Data Upload Training		26 Aug 2021	
IAC Charter special sessions: **-** Heads of Agencies allocution; - Twenty years of saving lives from Space : How space agencies are contributing to relief efforts through the 'International Charter Space and Major Disasters' - The International Charter: A Canadian Perspective. Interview with Claire Malcolm ahead of IAC - How space agencies help to save lives (dwtc.com)	Dubai World Trade Centre	Oct 2021	CSA
UN-SPIDER / ZFL Regional Virtual Expert Meeting for Southern Africa "Space-based Solutions for Disaster Risk Management and Emergency Response"	UN-SPIDER (virtual)	Jul 2021	DLR
UN-SPIDER Bonn International Conference- The Charter was presented.	UN-SPIDER (virtual)	Nov 2021	INPE
USGS presented Charter during a **Hurricane Data Mining Workshop** (an annual event that prepares for the hurricane season and involves several regional emergency response agencies).	virtual	8-10 Jun 2021	USGS
USGS co-authored a poster that was presented by Gigi Pavur, University of Virginia, at the Fall 2021 American Geophysical Union (AGU) Meeting**. The poster, titled "A Meta-Analysis of Best Practices and Lesson Learned from 20 Years of the International Charter 'Space and Major Disasters' Flood Activations", was presented as part of a session called Knowledge Transitions for a Disaster-Resilient Society.**	New Orleans, Louisiana, USA	13 Dec 2021	
IAC 2021 : • Lecture "Roscosmos and the Charter Cooperation".	UAE	29 Oct 2021	Roscosmos

• Two decades of the Disaster Charter: Reflecting on relevant legal issues and policies for the future -Ms. Dimitra Stefoudi - Leiden University - The Netherlands • The Utility of Satellite Imagery During the 2010 Deepwater Horizon Oil Spill - Mr. Albert DeGarmo -NOAA - United States • Activation of the international charter for major disasters through the universal access - Mr. Pierric Ferrier - CNES - France • UNOOSA/UN-SPIDER: Facilitating the link between the Charter and the Disaster Management Community - Dr. Juan Carlos VILLAGRAN DE LEON – UNOOSA - Germany • Charter tools to support call management and information delivery - Dr. Robert Biasutti - ESA - Italy • Roscosmos and the Charter Cooperation - Mr. Andrey Kuklin - Federal Space Agency (ROSCOSMOS) - Russian Federation • International Charter: A Canadian Perspective - Mr. Luc Brûlé - Canadian Space Agency - Canada • KEYNOTE: Canada’s emergency geomatics for disaster response: use case of the 2019 floods - Mr. Vincent Decker - Canada Center for Mapping and Earth Observation - Canada			

UNOOSA and UNITAR/UNOSAT also contributed towards increasing Charter awareness through presentations to a wider public audience, ranging from Ministers and Heads of Agencies to operational entities within the UN system.

5.3 Press releases and articles

The following table summarises the main press releases, web and paper articles issued by the member agencies or others in 2021.

Table 18. List of articles and press releases

Issuing agency	Date	Title
CNES	2021	Press release regarding India/Chamoli - activation 698: https://charte.cnes.fr/fr/pleiades-revele-les-causes-dune-crue-devastatrice-au-pied-de-lhimalaya https://www.esa.int/Applications/Observing_the_Earth/Satellites_reveal_cause_of_Chamoli_disaster https://theprint.in/science/satellite-images-reveal-550m-scar-left-by-uttarakhand-landslide-in-nanda-ghunti-glacier/603123/
	Aug 2021	Press release regarding HAITI - activations 729 and 730 regarding the e arthquake and the tropical storm Grace in Haiti mid-August, were widely reported in the media in France: press releases (CNES and AFP), French national and regional newspapers, TV news reports (BFM TV, TF1), social media, etc. Claire Tinel from CNES and SERTIT were required to answer to the media. They shared their concrete work and extensive interactions with the Authorities (Civil Protection) in the field, to support the disaster assessment by providing maps of the damages observed. https://presse.cnes.fr/fr/seisme-et-depression-tropicale-en-haiti-le-cnes-active-les-satellites-pleiades-pour-organiser-laide GEO : https://www.geo.fr/environnement/des-incendies-du-var-au-seisme-a-haiti-les-cartographes-de-lurgence-205985 CAPITAL : https://www.capital.fr/economie-politique/incendies-seismes-inondations-des-cartographes-de-lurgence-viennent-en-aide-aux-secours-1412416 NICE MATIN : https://www.nicematin.com/faits-de-societe/des-incendies-du-var-au-seisme-a-haiti-des-cartographes-repertorient-les-catastrophes-dans-le-monde-709471 VAR MATIN : https://www.varmatin.com/faits-de-societe/des-incendies-du-var-au-seisme-a-haiti-des-cartographes-repertorient-les-catastrophes-dans-le-monde-709471 SCIENCES ET AVENIR : https://www.sciencesetavenir.fr/espace/systeme-solaire/des-incendies-du-var-au-seisme-a-haiti-les-cartographes-de-l-urgence_156748 LES NOUVELLES CALEDONIENNES : https://www.lnc.nc/article/france/monde/sciences/des-incendies-du-var-au-seisme-a-haiti-les-cartographes-de-l-urgence LA CROIX : https://www.la-croix.com/incendies-Var-seisme-Haiti-cartographes-urgence-2021-08-21-1301171682

		LE TELEGRAMME : https://www.letelegramme.fr/france/incendies-du-var-seisme-en-haiti-inondations-en-allemagne-les-cartographes-de-l-urgence-22-08-2021-12811077.php La Dépêche in French Guyana and in Toulouse https://www.franceguyane.fr/actualite/societe-social-emploi/seisme-en-haiti-les-satellites-pleiades-appuient-les-operations-de-recherche-488365.php https://www.ladepeche.fr/2021/08/23/seisme-a-haiti-le-centre-spatial-de-toulouse-accompagne-les-secours-grace-aux-images-satellite-9746973.php CNES Social Media : Haïti : https://playplay.com/app/share/cnes/bigvsltlofdbdlct
CNSA	19 Oct 2021	CRESDA：Multi Measures to Forge Capabilities for Disaster Prevention and Mitigation
	1 Nov 2021	The 11th Asia Oceania Meteorological Satellite User Conference and 2021 International User Conference on Feng Yun Meteorological Satellite
	Nov 2021	International Symposium on Peaceful Uses of Space Technology
	30 Dec 2021	Our Answer Sheets in 2021
CSA	21 Aug 2021	Earth in Focus exhibition (has a section on the Charter), opened at the Canada Science and Technology Museum in Ottawa (more than 25 000 visitors at the Museum).
	19 Jul 2021	Media interview: SpaceQ, Guy Aubé: How satellites are providing information to national, provincial and local authorities about disasters like heat waves and wildfires.
	20 Oct 2021	Media interview: Dubai World Trade Centre, Guennadi Kroupnik: Interview ahead of IAC - Dubai World Trade Centre - How space agencies help to save lives (dwtc.com)
	27 Oct 2021	Highlight of the Charter anniversary on social media.
DLR	Jan 2021	DLR Countdown Article "20 years of satellite observation for disaster relief"
JAXA	12 Mar 2021	12th March, 2021: Satellite Data Application for the Disaster Monitoring (including the Charter's contribution to the Earthquake and Tsunami in Japan in 2011) https://www.eorc.jaxa.jp/earthview/2021/tp210312.html
	4 Jun 2021	4th June, 2021: Contribution by ALOS-2 to the volcanic eruption in Congo in 2021 https://www.eorc.jaxa.jp/earthview/2021/tp210604.html
	2021	Space Application for Disaster Monitoring, Case Study of ALOS-2 2014-2019

		https://earth.jaxa.jp/files/application/disaster/space_application_for_disaster_monitoring.pdf
Roscosmos	2021	News publications related to the ongoing disasters monitoring activities and data provision in support to the various Charter activations: http://en.roscosmos.ru/21966/, http://en.roscosmos.ru/21951/, http://en.roscosmos.ru/21937/, http://en.roscosmos.ru/21916/, http://en.roscosmos.ru/21904/, http://en.roscosmos.ru/21894/, http://en.roscosmos.ru/21882/, http://en.roscosmos.ru/21872/, http://en.roscosmos.ru/21866/

4.3 Users' appraisal

To understand the value the Charter brings in supporting disaster management teams and, to identify possible improvements to the Charter service, we gather feedback after each activation. This feedback which comes primarily from End Users, the recipients of our value-added products, and from Project Managers, the individuals who coordinate each activation. During an ongoing disaster, the Charter products support disaster situation awareness, after the event, they support post-event analysis and training exercises. Figure 56 indicates how the value-added products are used.

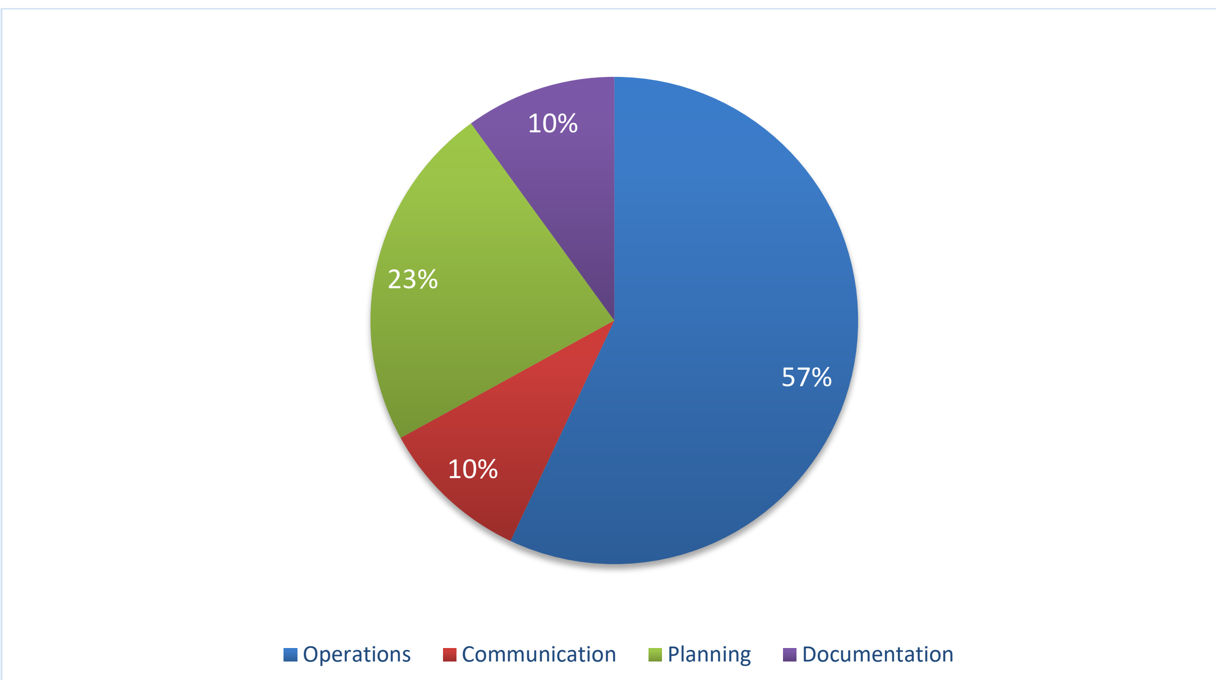


Figure 56. Breakdown of use of Charter value-added products in 2021

The feedback received in 2021 indicates that, end users are in general very satisfied with the Charter's service. Figure 57 indicates the level of satisfaction based on feedback from end users when asked to rate the contribution made by the Charter service to the emergency events affecting them in 2021.

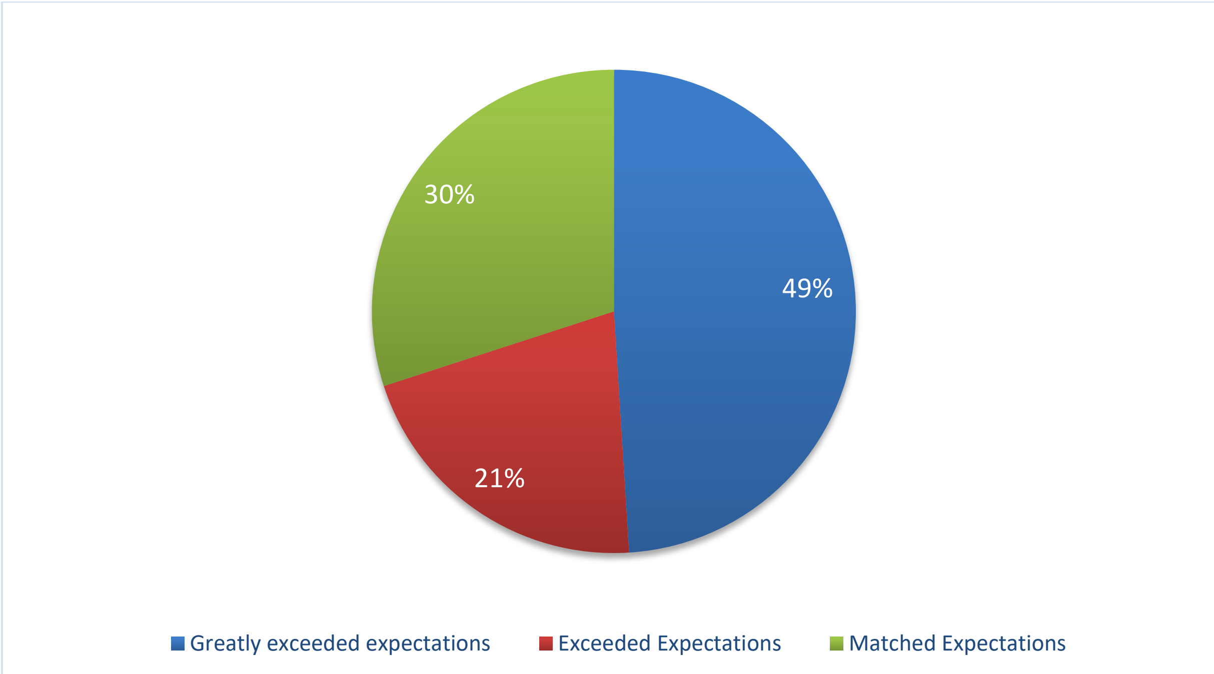


Figure 57. The contribution made by the Charter to emergencies in 2021

Occasionally, it is not possible to satisfy user needs for correct type of satellite data, for example due to the size of the damaged region, or due to cloud cover. Here is a selection of feedbacks, including some suggestions for improvement, received from Project Managers and End-Users:

- "Keep increasing the range of satellites to support future disaster, which will definitely be more and more complicated."
- "A web map with daily analysis could have helped to see the evolution of the wildfire."
- "The value-added products can be improved to make them more useful for the end-user by placing them on the webGIS-based platform or mobile-based platform."
- "Encourage the use of Web Map Services more often. So that the end users can easily access value added products in a more interactive manner."
- "Always try to provide georeferenced images and include documentation regarding processing levels of data."

4.4 Communication assessment

The improved version of the website facilitates the user navigation and information search.

Several channels were used to ensure more comprehensive communication to Charter users, stakeholders and the general public:

- The publication and distribution of newsletters.
- The Charter website, still well visited.
- The Charter Twitter account. All Charter activations and news are distributed via tweets. Around 9,000 followers were counted by the end of 2021 (700 followers were gained in 2021, many more will actually be reached due to retweets of Charter messages, e.g., through Charter agency twitter accounts).

- The Charter videos available in the “Library” Section of the Charter Website as well as on YouTube.
- Participation in international/regional events all over the world to promote the Charter and the Universal Access (UA) initiative.
- Press releases and articles mainly via the web and in particular, the Charter website, Charter members’ websites and UN-SPIDER communication channels.

The Charter flyer and brochure in English and French are distributed and used regularly at conferences and workshops both nationally and internationally.

7 Conclusions

In 2021, the following agencies took the lead function which rotates among Charter members on a six-month basis: the Japan Aerospace Exploration Agency, JAXA (November 2020 – April 2021), ISRO (April 2021 – October 2021), INPE (October 2021 – May 2022). Due to sanitary conditions still in place at the beginning of the leadership periods, the members of the Charter Board and the Executive Secretariat met online for their biannual meetings hosted by ISRO in April 2021 and by INPE in October 2021.

In total, the Charter has been triggered for 742 disasters in 130 countries between its inception in the year 2000 and the end of 2020. Throughout 2021 alone, there were 50 activations in 28 countries, a figure far above the yearly average between 2007 and 2019. The number of activations is distributed throughout the year in a less uniform way than in previous years. No activation occurred in March and the highest number was in June. The period May to August corresponds to 50% of the total number of activations (i.e., about half of the year's activations were concentrated in this 4-month period). Natural disasters occurring throughout that period of the year are mainly attributable to meteorological events (80%) (intense rains; ensuing floods; tropical storms; wildfires) in Asia (5), Africa (2) and Caribbean (1). The spike in May 2021 activations was mainly due to floods, Storms, or hurricanes in Asia.

In 2021, the Charter was triggered two times for man-made disasters (one oil spill Sri Lanka, one was an industrial accident (chemical explosion and wildfire) in Thailand).

Thirteen Charter activations were among the 51 most severe disasters in 2021 as registered by CRED's EM-DAT. Moreover, excepting the COVID pandemic that continues to affect and kill people, the two most catastrophic events were the earthquake in Haiti that killed 2,575 people, injured 12,763 and affected 702,763 people, and floods in India that killed 1,282 people and affected 375,000.

Earth Observation data provided in 2021 represent a total of 6,435 images (1/3 radar images; 2/3 optical images). Among them, 1,089 images are archives (pre-event) and 5,346 images are programmed (post-event).

Nine Authorized Users, 3 Emergency on-Call Officer and 8 Project Manager online training sessions were organized to strengthen the network of the Charter operation loop. On-line refresher training courses are also available. One SARE exercise was organized by ROSCOMOS.

Universal Access (UA) is still continually progressing. UA allows disaster risk management organizations worldwide to be granted Authorized User (AU) status. Uganda, Armenia, Cameroon, Gambia, Mexico, Mongolia became Authorized Users in 2021. Other candidates are under assessment or training. Charter members have continued to promote UA and the Charter as a whole through their participation in different international (online) events held in 2021.

The Charter website is available in English and some pages are available in French, Chinese, Japanese and Spanish. It allows Charter staff and Authorized Users to directly access to COS-2. The 22nd and 23rd Charter newsletters were issued in 2021. In addition, Twitter is frequently used as a tool to increase visibility of the Charter activations and other relevant news and raising public awareness on the Charter.

Successes of the International Charter Space and Major Disasters in 2021, such as improving our operational environment, welcoming additional authorized users, effectively communicating our mission and most importantly, responding to disasters as requested will continue going forward.

The Members of the International Charter “Space & Major Disasters” remain dedicated to assisting emergency response efforts and providing improved access and benefit from satellite resources.

In conclusion, though the whole world was affected by the COVID-19 pandemic crisis, its impact on the operations of the Charter has been kept to a minimum and more satellite Earth observation data have been provided to support disaster response worldwide than ever!