Sharing Space-based Information:

Procedural Guidelines for Disaster Emergency Response in ASEAN Countries

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The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional hub promoting cooperation among countries to achieve inclusive and sustainable development. The largest regional intergovernmental platform with 53 Member States and 9 associate members, ESCAP has emerged as a strong regional think-tank offering countries sound analytical products that shed insight into the evolving economic, social and environmental dynamics of the region. The Commission's strategic focus is to deliver on the 2030 Agenda for Sustainable Development, which is reinforced and deepened by promoting regional cooperation and integration to advance responses to shared vulnerabilities, connectivity, financial cooperation and market integration. ESCAP's research and analysis coupled with its policy advisory services, capacity building and technical assistance to governments aims to support countries' sustainable and inclusive development ambitions.

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United Nations publication

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Preface

This handbook forms part of a series of knowledge products developed in collaboration with Association of Southeast Asian Nations (ASEAN) institutions and ASEAN member countries. The series is designed to increase capacity and skills as well as promote institutional development for countries wishing to embrace innovative space-based information in disaster risk management. The series also supports the development of standard operating procedures and information sharing policies for the utilisation of space-based information in relevant countries.

This handbook provides procedural guidelines for sharing space-based information during emergency response. While satellite-derived and geospatial information is often used for increasing situational awareness in the aftermath of disasters, many disaster managers are unfamiliar with the systematic approach necessary for properly utilising such innovative applications. There is a lack of standard processes and procedures across agencies, making it difficult to coordinate national activities as well as regional cooperation and support during emergencies. Free satellite-data for emergency response is increasingly becoming available and accessible, but end-users are often unaware of such global and regional initiatives. Furthermore, the procedures for requesting space-based information from the growing number of data providers can vary, with no consolidated set of instructions, as there are multiple platforms for sharing information at national, regional and international levels, which can often create confusion.

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), in collaboration with the Operational Satellite Applications Programme (UNOSAT) of the United Nations Institute for Training and Research, and the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) of the United Nations Office for Outer Space Affairs (UNOOSA), the ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management, space agencies and national disaster management authorities in ASEAN countries, has compiled this set of procedural guidelines to provide structure to and define processes for accessing and sharing space-based information during emergency response. The guidelines have been developed in close collaboration with operational staff and are based on the best practices in the region. Extensive consultations led to the identification of operational needs during a series of workshops held over the course of 2015 and 2016. The guidelines have been field tested in various settings with some countries adopting these guidelines as standard practice and many others expressing their desire to adopt similar practices.

It is our hope that this handbook with its practical procedural guidelines for the use of space-based information will significantly contribute to strengthening the disaster risk resilience of countries in the ASEAN region.

With input from national disaster management authorities, space agencies and scientific institutions in ASEAN countries

	Cambodia	National Committee for Disaster Management
LAPAN National Institute of Aeronautics and Space (LAPAN)	**Indonesia**	BNPB National Disaster Management Authority
Ministry of Science and Technology Ministry of National Resources and Environment	**Lao People's Democratic Republic**	National Disaster Management Office
ANGKASA MALAYSIA National Space Agency	**Malaysia**	National Disaster Management Agency

Department of Meteorology and Hydrology	**Myanmar**	Relief and Resettlement Department
Philippine Council for Industry, Energy and Emerging Technology Research and Development	**The Philippines**	National Disaster Risk Reduction and Management Council
Centre for Remote Imaging, Sensing and Processing	**Singapore**	Civil Defence Force
Geo-Informatics and Space Technology Development Agency (GISTDA)	**Thailand**	Department of Disaster Prevention and Mitigation
Space Technology Institute, Viet Nam Academy of Science and Technology	**Viet Nam**	Disaster Management Centre, Directorate of Water Resources, Ministry of Agriculture and Rural Development

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The guidelines also benefited from review by national focal points of the ESCAP Regional Space Applications Programme for Sustainable Development (RESAP). Feedback from Waraporn Pichetshote on the design of infographics is appreciated. ESCAP acknowledges the joint efforts of ESCAP, UN-SPIDER and AHA Centre in conceptualising this initiative to support ASEAN countries, through a series of workshops conducted with ASEAN countries over the course of 2015 and 2016.

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Acronyms and abbreviations

AHA Centre	ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management
AOI	Area of Interest
ASEAN	Association of Southeast Asian Nations
EO	Earth Observation
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ETC	Estimated Time to Completion
GDACS	Global Disaster Alert and Coordination System
GIS	Geographic Information System
GISTDA	Geo-Informatics and Space Technology Development Agency (Thailand)
HDDS	Hazards Data Distribution System
IWG-SEM	International Working Group on Satellite-Based Emergency Mapping
KML	Keyhole Markup Language
KMZ	Keyhole Markup Language Zipped
LAPAN	National Institute of Aeronautics and Space (Indonesia)
NDMAs	National Disaster Management Authorities
RESAP	Regional Space Applications Programme for Sustainable Development
RSS	Really Simple Syndication
SEM	Satellite-based Emergency Mapping
SOP	Standard Operating Procedure
UNITAR	United Nations Institute for Training and Research
UNOOSA	United Nations Office for Outer Space Affairs
UNOSAT	United Nations Operational Satellite Applications Programme
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response

Overview

Background

The Sendai Framework for Disaster Reduction: 2015–2030 recognized the critical role of space-based technologies in disaster risk reduction that fits into its Priorities 1 and 4. The momentum generated by this recognition resulted in initiatives to strengthen cooperation and capacity-building in the use of space-based technologies in disaster response for ASEAN, which would be a significant contribution to Priority 4 of the Sendai Framework.

Among these is a joint initiative started by ESCAP, UN-SPIDER and the AHA Centre with support from UNOSAT as well as the national space agencies of Indonesia (LAPAN) and Thailand (GISTDA), and other NDMAs, space agencies and relevant regional and national institutions. The initiative aimed at providing procedural guidelines for sharing space-based information during emergency response.

Objectives

The prime objective of the Procedural Guidelines is to leverage EO products and services to support emergency response activities by delivering the right information to the right people at the right time. For complex emergencies, governments usually have their own standard operating procedures (SOPs) and national mechanisms in which a specific organization leads emergency response coordination. There are also regional and international mechanisms for sharing space-based information for emergency response. Both country and regional/international mechanisms are expected to integrate seamlessly and complement one another. However, there are no consolidated procedures

in place for making the best use of these available resources and no comprehensive guidelines listing the options that are accessible and applicable to different scenarios. These Procedural Guidelines set out to address both of these issues.

In most emergencies, an NDMA coordinates the emergency response. Therefore, the target audience for these Procedural Guidelines is NDMAs or any other relevant authority responsible for emergency response coordination at the national level.

Seven steps have been identified in the workflow and decision-making process for sharing space-based information during emergency response. These have been compiled through extensive consultation with national disaster management authorities (NDMAs) and space agencies in ASEAN countries. Figure 1 provides an overview of the steps and their additional functions presented in use case form.

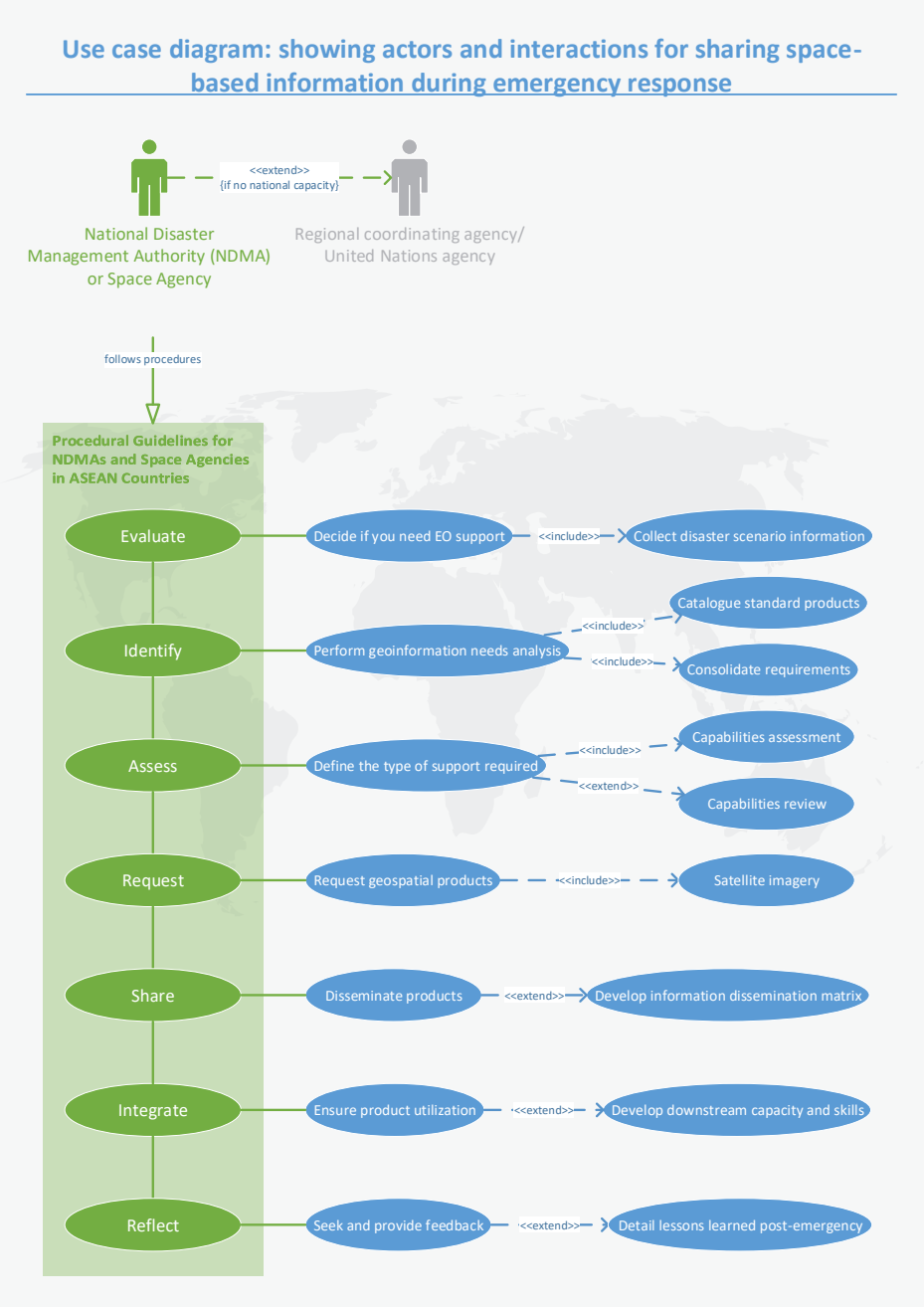


Figure 1: Use case diagram of the seven-step Procedural Guidelines

In pursuit of these objectives, Through extensive consultation with experts and the NDMAs and space agencies of ASEAN Member States, this set of Procedural Guidelines was developed during the course of several workshops conducted since 2014:

1. 1st ASEAN workshop on 'Development of mechanisms for acquisition and utilization of space-based information during emergency response', organized by UN-SPIDER, ESCAP and LAPAN, held in April 2014 in Yogyakarta, Indonesia. The workshop focused on how to identify effective use of space-based information in decision-making during emergencies to save lives and minimize economic losses.
2. 2nd ASEAN workshop on 'Development of mechanisms for acquisition and utilization of space-based information during emergency response', held in June 2015 in Hangzhou, China.
3. 3rd ASEAN 'Workshop on procedural guidelines for sharing space-based information during emergency response in ASEAN', held in December 2015 in Siracha, Thailand.
4. 4th ASEAN workshop on 'Simulation exercise on the procedural guidelines for sharing space-based information during emergency response' – in Bogor, Indonesia, April 2016. The workshop evaluated the draft Procedural Guidelines; conducted exercises and drills based on them; and decided how to proceed to adopt them for the ASEAN region.

Free and commercial support

Led by a decision flow diagram, the Procedural Guidelines will help users decide what to seek and when during an emergency situation, including the use of a range of satellite-derived products with differing formats and applicability to the situation on the ground. As well as providing the above-mentioned Quick Guide, the Procedural Guidelines set out the combination of free and commercial providers that can provide emergency geospatial products, in some cases raw imagery, and where the gaps or legal or commercial restrictions are. Such gaps and restrictions can be broadly divided into two categories: free or commercial data.

Free: The largest source of free satellite imagery in the context of a major disaster is the International Charter on Space and Major Disasters (Disaster Charter). All the images received by the authorized users of the Charter can be used for emergency situations only and cannot be shared or used for other purposes. Sentinel Asia is another regional mechanism through which Joint Project Team members can access free imagery. There are also different bilateral and ad hoc mechanisms to address imagery needs. However, the images received from these tend to be provided in high volumes, which can be difficult to sort and process. There can also be a lot of images that are not particularly useful, though what remains is often vital.

This is where the value added resellers in Disaster Charter or Sentinel Asia's Data Analysis Node play an important role. UNOSAT acts as an operational entity for interaction between United Nations beneficiaries and the Disaster Charter. UNOSAT coordinates, manages and provides timely, reliable EO-based maps and geodata based on user needs in digital format with a small file size. This improves the whole work chain by removing the need for the user to download and analyse the data. These products and services can then be used by the relevant agencies to address their specific needs.

Commercial: The advantage of commercial image provision over free is that it is much faster because it does not come with some of the administrative and political obstacles that can slow down the provision of promised free imagery. Additionally, through existing bilateral agreements with commercial vendors, and if budget is available, UNOSAT can order and purchase imagery rapidly and provide satellite imagery analysis. For trained beneficiaries, UNOSAT provides access to commercial satellite imagery as part of technical backstopping.

Existing mechanisms

The Procedural Guidelines take stock of the existing Standard Operating Procedures (SOP), instructions and protocols that are being used by different agencies at national, regional and international levels to access and apply space-based information in emergency response situations. Currently there are a number of mechanisms at these three levels at the disposal of any country during emergencies. Those which are used by ASEAN countries and mentioned during consultations have been listed below.

International services

The International Charter on Space and Major Disasters

The Disaster Charter is an international collaboration between the owners and operators of EO missions to provide rapid access to satellite data to assist rescue authorities in the event of a natural or man-made disaster. Although its mandate only requires the provision of satellite data quickly and at no cost, Charter members often collaborate with other value adding agencies for data analysis and interpretation. Each agency member has committed resources to support the provisions of the Charter and thus is helping to mitigate the effects of disasters on human life and property. Services include:

- Supplying data providing a basis for critical information for the anticipation and management of potential crises to States or communities whose population, activities or property are exposed to an imminent risk, or are already victims, of natural or technological disasters;
- Participating, by means of this data and of the information and services resulting from the exploitation of space facilities, in the organization of emergency assistance or reconstruction and subsequent operations. [1]

UNOSAT Rapid Mapping Services

UNOSAT is the UNITAR Operational Satellite Applications Programme. The UNOSAT mission is to leverage satellite technology to produce geospatial information and create integrated solutions for human security, peace and socioeconomic development in line with the mandate entrusted to UNITAR by the United Nations General Assembly since 1963.

UNOSAT is a technology-intensive programme delivering imagery analysis and satellite solutions to relief and development organizations within and outside the United Nations system to help make a difference in critical areas such as humanitarian relief, human security and strategic territorial and development planning. UNOSAT develops applied research solutions, keeping in sight the needs of beneficiaries at the end of the process.

UNOSAT is the main implementing agency within the United Nations for the Disaster Charter. UNOSAT is mandated by the United Nations to provide satellite imagery products and services in support of international humanitarian operations (United Nations, Inter-Agency Standing Committee, NGOs and other humanitarian agencies). The service is free of charge for United Nations Member States, sister agencies and humanitarian entities operating in line with United Nations policies. Output products include maps, geographic information system (GIS)-ready data (for example, flood extents, damage assessments), statistics and reports. Some features of UNOSAT Rapid Mapping services include:

- In the context of emergency response mapping, UNOSAT is able to request Disaster Charter activation on behalf of users from the United Nations. UNOSAT is also able to provide direct support to the Charter by acting as Project Manager and value added reseller during activations of the Charter made in response to United Nations humanitarian agencies' needs, which ensures no waste of time since the Project Manager function and value adding work are co-located.

1 https://www.disasterscharter.org/.

- UNOSAT has bilateral agreements with space companies like Airbus, Digital Globe and Radarsat to procure commercial images quickly. In special cases, it is also able to request reprogramming of satellites to make the process even quicker.
- UNOSAT has a 24/7 emergency hotline and therefore requires partners that provide imagery to also operate 24 hours, seven days a week, in order to be able to order and/or access imagery as quickly as possible when needed.
- UNOSAT has its own crowdsource application – UN-ASIGN – which allows communities to collect geotagged photos and information to validate the EO-based assessment. This robustly increases the reliability of such analysis and makes it easier to integrate into decision-making.
- UNOSAT is also able to provide an accelerated 'rapid mapping service', re-tasking satellite images for emergency situations that require such a service.
- UNOSAT maintains the Global Disaster Alert and Coordination System (GDACS) Satellite Mapping Coordination System to avoid duplication of mapping efforts and maximize the area of coverage. Additionally, all the analysis from different mapping agencies is available through GDACS Live Map, making it a one-stop shop for beneficiaries to get all the information they need.
- To ensure maximum use of the geodata and EO-based information products, UNOSAT offers capacity development activities to end users in Member States as well as international humanitarian actors.

United Nations Platform for Space-based Information for Disaster Management and Emergency Response

In its resolution 61/110 of 14 December 2006, the United Nations General Assembly agreed to establish UN-SPIDER as a new United Nations programme, with the following mission statement: 'Ensure that all countries and international and regional organizations have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle'.

UN-SPIDER, implemented by UNOOSA, aims to provide universal access to all types of space-based information and services relevant to disaster management by being a gateway to such information for disaster management support; serving as a bridge to connect the disaster management and space communities; and being a facilitator of capacity-building and institutional strengthening. [2]

UN-SPIDER is able to provide satellite images during emergency and non-emergency situations through its cooperation with national space agencies in Asia and with leading satellite data providers, such as DigitalGlobe. UN-SPIDER has developed a formal network of Regional Support Offices. These are either national space agencies or national or intergovernmental organizations that possess expertise to provide and analyse EO data. This network is readily available to Member States to provide a wide range of services involving applications of EO data in all stages of disaster management. UN-SPIDER also contributes to IWG-SEM. The latest version of the IWG-SEM Emergency Mapping Guidelines is available from the UN-SPIDER knowledge portal. [3]

International Working Group on Satellite-based Emergency Mapping

IWG-SEM is a voluntary group of organizations involved in satellite-based emergency mapping. It was founded in 2011 because a lack of common procedures in communication and information exchange was identified as one of the major problems in using EO data and information for disaster response. The objective of IWG-SEM is to improve cooperation, communication and professional standards among the global network of satellite-based emergency mapping providers. It consists of experts representing a wide spectrum of SEM capabilities and making satellite imagery data more accessible. [4]

SEM is defined as the creation of maps, geo-information products and spatial analyses dedicated to providing situational awareness for both emergency management and immediate crisis information

2 www.un-spider.org.
3 http://www.un-spider.org/sites/default/files/IWG_SEM_EmergencyMappingGuidelines_v1_Final.pdf.
4 https://www.IWG-SEM.org.

for response by extracting reference (pre-event) and crisis (post-event) geographic information/ data from satellite or aerial imagery. The three fundamental principles of SEM include:

1. Cooperation – active and constructive engagement to find solutions to problems.
2. Openness – meaning sharing information.
3. Ethics and Integrity – since SEM entities must acknowledge the work and results achieved by others (copyrights and citations are used every time the work of some other entity is reported or quoted).

IWG-SEM has developed Emergency Mapping Guidelines for providers of satellite data and geospatial products and services. These guidelines complement this set of Procedural Guidelines by providing the supply-side perspective on EO data and products, and have been taken into consideration when developing these guidelines and appropriately referenced where applicable. The main objectives of the IWG-SEM Emergency Mapping Guidelines are to:

1. Ensure and improve the general level of quality of emergency mapping products.
2. Easily and quickly enable all participants to judge the capacity and qualification level of the other involved parties to adequately dispatch the workload in joint SEM activities.
3. Provide the users of SEM products with an objective tool to assess the capacity and qualification of a SEM organization and respective emergency mapping products by visualization of the IWG-SEM logo in combination with a respective qualification status of the value-added provider.

Within the Procedural Guidelines, for every step, there is a dedicated section where we briefly outline what IWG-SEM has explained in detail in their Emergency Mapping Guidelines, and the way both sides' perspectives and work are complementary in emergency response is illustrated.

Regional services

Sentinel Asia

Sentinel Asia is a voluntary initiative of the Asia-Pacific Regional Space Agency Forum (APRSAF) to support disaster management activity in the Asia-Pacific region through applying Web GIS technology and space-based technology for disaster management. Led by the Japan Aerospace Exploration Agency (JAXA), Sentinel Asia shares information collected from EO satellites and other space technology tools via Internet. The initiative brings together regional space agencies and disaster risk management authorities for humanitarian purposes. The aim is to mitigate and prevent damage caused by natural disasters including typhoons, floods, earthquakes, tsunamis, volcano eruptions and wildfires. [5]

The main activities of Sentinel Asia are:

- Emergency utilization of EO satellites in case of major disasters;
- Acceptance of satellite data requests from countries in the Asia-Pacific region;
- Wildfire monitoring, flood monitoring and glacial lake outburst flood monitoring;
- Satellite image and data utilization capacity-building programmes for disaster management.

Regional Space Applications Program for Sustainable Development

ESCAP's Regional Space Application Programme (RESAP) was launched in 1994 at the first Ministerial Conference on Space Applications for Development in Asia and the Pacific. Its goal is to enhance regional coordination and cooperation through the promotion of effective applications of space technology for sustainable development in the Asia-Pacific region. The programme aims to assist developing countries and other members to integrate space technology applications into sustainable development planning.

5 *Source: https://sentinel.tksc.jaxa.jp/sentinel2/MB_HTML/About/About.htm.*

The mandate of RESAP includes the following:

- Promote and coordinate regional space cooperation for development;
- Organize and implement space application projects of regional interest;
- Provide policies, models, techniques, information and analysis;
- Conduct studies related to various issues on space applications;
- Establish regional networks comprising national focal points and working groups in major space technology application fields;
- Promote national capacity-building for space applications.

National/bilateral services

Some countries have bilateral agreements for space resource sharing with other countries or commercial providers which allow the country without space technology infrastructure to access satellite imagery during an emergency. The operational specifications – such as cost, licence level, mode of delivery, data formats etc. – are specified in advance through this agreement. Such agreements allow data to be made available in emergency situations without delay.

NDMAs need to be aware of the existing bilateral agreements in place and any considerations and exceptions for emergency support. For example, Thailand has an agreement with Canada which allows GISTDA access to imagery from the Canadian remote sensing EO satellite programme.

Challenges to existing mechanisms

Despite the current mechanisms in place for sharing space-based information during emergency response, there are still challenges and gaps. Some of these have been identified by participating experts during consultations when taking stock of the existing mechanisms. These challenges and gaps are not only related to the use of these mechanisms but also to the understanding of the role, value and limitations of each mechanism; the interaction with all the relevant actors involved; and the understanding of key considerations for decision-making in order to coordinate the sharing of space-based information during emergency response. The following challenges and gaps were identified by ASEAN experts and are addressed in these Procedural Guidelines:

- There is no decision-making framework for evaluating initial needs based on disaster scenarios.
- There are a variety of satellite-derived products based on time frame and applicability which end users may not be aware of.
- There is varying capacity for processing raw satellite images to derive meaningful information. In cases where there is capacity, there may be no operational experience to deliver such products under pressure and to a tight deadline.
- The process for requesting space-based information is different for different providers and mechanisms and there are no consolidated instructions.
- There are multiple actors and platforms for sharing information at national, regional and international levels, which can create confusion and potentially lead to duplication of efforts.
- Capacity may not exist for effectively using satellite-derived products; for example, maps and other geospatial information.
- Feedback lacks intensity and enthusiasm as it is often not integrated into normal operating workflows.

There are a multitude of actors, interactions and procedures needed for the efficient sharing of space-based information during emergency response. Figure 2 represents this complex environment to some degree and demonstrates the structure and control which these Procedural Guidelines will provide. This complex environment was identified and communicated during meetings with experts and was also captured through questionnaires collected from workshop participants. It shows that NDMAs often face difficulties with regard to acquiring, sharing and using geospatial information and other space-based products; there are often no set procedures in place; and there is potential overlap or disconnect with existing national and international mechanisms.

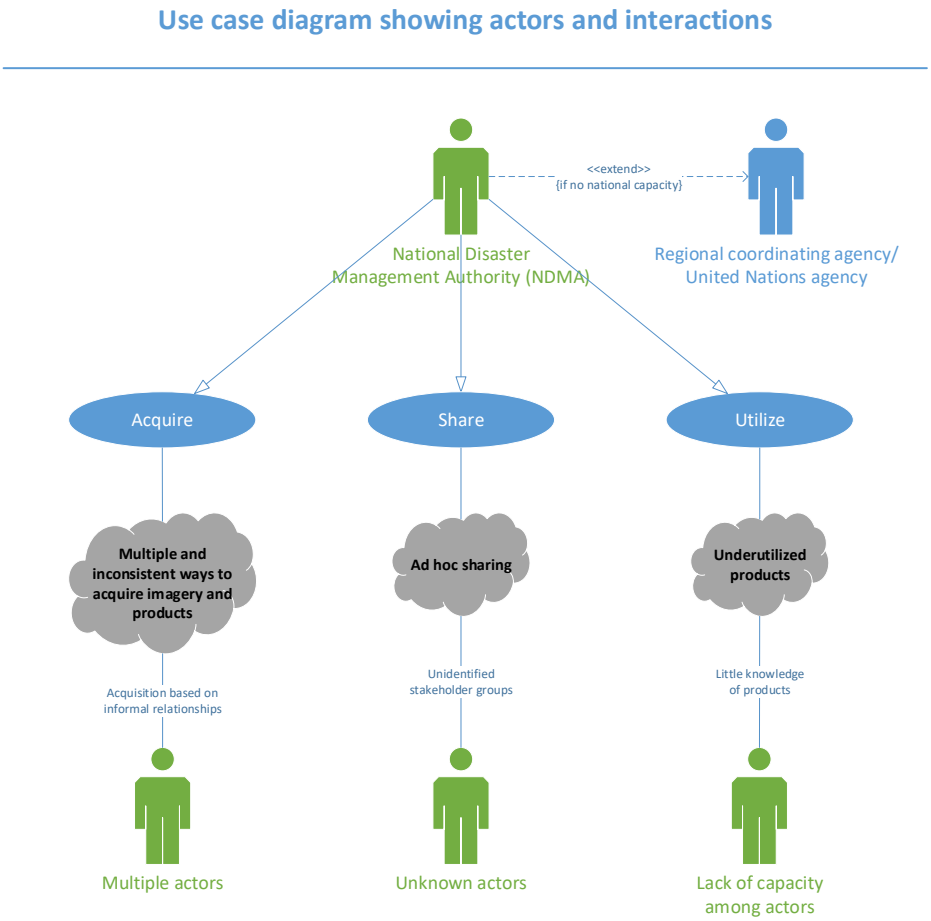


Figure 2: Use case diagram showing identified challenges for coordinating space-based information

Structure of the Procedural Guidelines

The Procedural Guidelines are structured in seven steps. Each step outlines the procedural considerations for evaluating the need for space-based information support, acquiring and sharing satellite-derived imagery and products, and using specific products. Additionally, each step includes a decision flow diagram that guides the user through the process. The steps include:

- Step 1: EVALUATE – Decide if you need EO support;
- Step 2: IDENTIFY – Identification of geospatial information needs;
- Step 3: ASSESS – Assess your operational capabilities;
- Step 4: REQUEST – Make your request;
- Step 5: SHARE – Disseminate to relevant authorities;
- Step 6: INTEGRATE – Use geospatial products for decision support;
- Step 7: REFLECT – Provide feedback.

SEM creates mapping products that are useful in decision-making and that can be potentially used as input to other phases of the disaster cycle as well, such as the early recovery and the prevention phases. The following steps take note of the IWG-SEM Emergency Mapping Guidelines and make reference to them where appropriate in order to give the end user an idea of what considerations may need to be made or what procedures need to be in place from the data providers' perspective. A corresponding appendix provides additional information; this will be indicated within the text where applicable. These Procedural Guidelines are also available in a Quick Guide for easy reference.

An Estimated Time to Completion (ETC) has been identified for each step of the Procedural Guidelines in order to provide end users with a reference point for how long respective activities should normally take. This has been indicated at the beginning of each step.

Step 1: EVALUATE

Decide if you need earth observation support

In response to early warnings or during and immediately after a disaster event a decision needs to be made about whether EO-based products and services are required. This decision will largely depend on a series of questions. Additionally, if international support has already been requested and/or the event has been declared as a national disaster, this will play a major role in the decision-making process. A country may also be required to follow their own national directives or executive order(s), if they exist.

This decision can also follow a procedural flow in order to make sure that all factors are considered in an appropriate sequence and logic. The flow diagram in figure 3 provides the recommended procedures to follow based on good practice. However, these will vary depending on the country context or disaster scenario. It is estimated that this step may take 30 minutes to 2 hours.

Aggregate disaster information

Immediately before or once a disaster strikes, initial disaster information may be available from a variety of sources. These include (but are not limited to):

- Disaster alerts from national, regional and international early warning systems;
- Local and international news;
- Directives and requests from government departments and other institutions.

This information must then be aggregated, collated and categorized in order to support situational awareness development.

Develop situational awareness

Once information is available, developing awareness of the situation is necessary. This requires multiple dimensions of historical, current and potential information in order to determine what is happening with regard to the disaster and what may happen in the future as the disaster evolves. Elements of situational awareness include:

- The scale and urgency of the disaster;
- Hazard type and characteristics;
- Any baseline or archived data available;
- Whether the disaster can be detected by EO and if so what aspects of it;
- The geographic bounds of the disaster or affected area;
- Existing or additional risk that may overlap;
- Which actors are already on the ground, if any.

Decide if EO support is required

Once situational awareness is developed, a decision can be made on whether EO support is required for this particular disaster, based on the available information.

Preparedness activities

In order for this procedure to operate efficiently, steps need to be taken beforehand to prepare for a live disaster situation. These can include setting up early warning systems, having a dedicated situation analysis team in place and establishing an emergency operations centre.

From the data providers' perspective

According to the IWG-SEM guidelines, the initial phase occurs immediately after the need for emergency mapping. This includes defining the Area of Interest (AOI) and takes into account end user inputs regarding the desired mapping products. Information includes the location of the disaster as well as type of the disaster, the date and time. If the end user is an 'Authorized User' of the Disaster Charter, mapping requirements will also include information regarding who is responsible for triggering the SEM mechanism or who could potentially be the 'Project Manager' for the mapping initiative under the Disaster Charter.

IWG-SEM identifies the most appropriate tool for sharing information quickly as simple GeoRSS feeds (or similar agreed standards that can be easily opened in web browsers), which should be released as soon as the SEM mechanism is activated. This includes links to open standards such as Keyhole Markup Language (KML) or Keyhole Markup Language Zipped (KMZ) files or the link to a map layer in Google Maps. It is recommended that information from the initial phase be shared with all the interested actors. Disasters may be officially labelled using a Global Identifier (GLIDE) number, if this already exists. A Global Identifier number is often assigned by Sentinel Asia and defines the type of disaster, location and year of the occurrence. It is a unique identifier referring to a specific disaster.

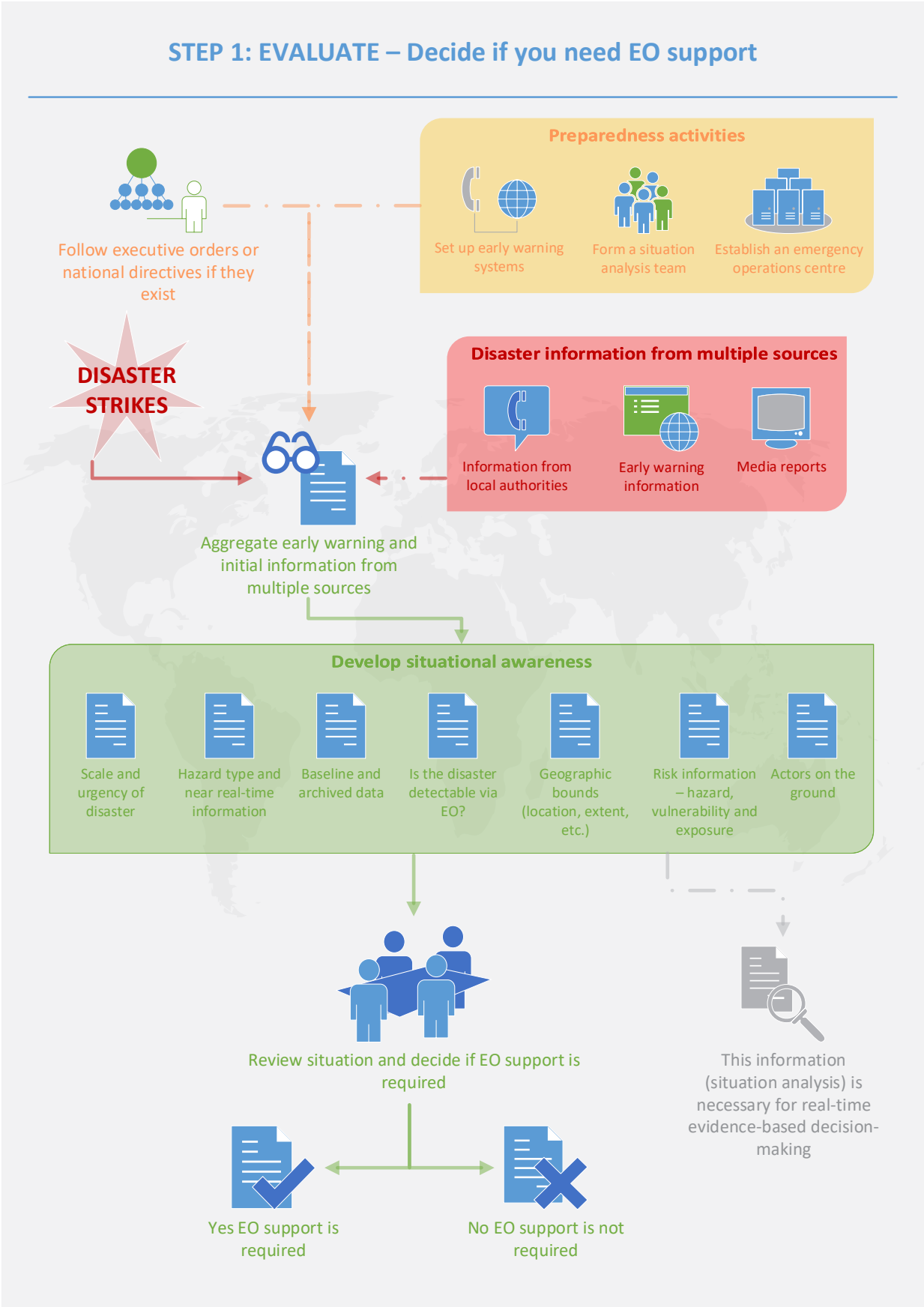


Figure 3: How to evaluate the need for EO support during emergency response

UN Photo/Eskinder Debebe

Step 2: IDENTIFY

Identification of geospatial information needs

During and after a disaster situation information needs are very dynamic. Information which is useful in one stage may not be suitable for another stage. Figure 4 provides an illustration of how to perform geospatial information needs assessment by taking into account information requirements and information availability at different moments before and after a disaster. It is estimated that this step may take 15 minutes to 1 hour to perform.

Performing needs analysis

During disaster response, and after step 1 in these procedures, a needs analysis is necessary in order to ascertain the geospatial information needs for the specific disaster. This will use information developed during the situation analysis performed in step 1 plus additional information based on the time frame after the disaster and the EO data available during that time.

Recommended phases for the time frame include phase 0 (-72 to 0 hours before a disaster), phase 1 (0 to 24 hours after a disaster), phase 2 (24–72 hours after a disaster) and phase 3 (72 hours to three weeks after a disaster).[6] Each phase has its own limitations in terms of what can most likely be observed via EO or what data is available at that time, with differing scales of definition. Based on these available data, certain geospatial products can be developed for the relevant phases. Box 1 provides some example product categories based on the operational experience of UNOSAT.

6 Derived from the United Nations Office for the Coordination of Humanitarian Affairs Multi-Cluster/Sector Initial Rapid Assessment framework and UNOSAT product timeline.

Box 1: Example of geospatial product categories used by UNOSAT

Based on 13 years of operational experience and user needs assessments, UNOSAT has come up with different standard satellite-derived products which fit into international humanitarian response time frames. For example, during the initial phases, in the time frame of 0–24 hours, it is of essence to create situational awareness, and this purpose can be served by location and situation maps developed using existing baselines and real-time satellite imagery. From 24–72 hours, impact and preliminary damage analysis can be performed; while from 72 hours to several weeks or months, detailed building infrastructure damage assessment can be developed using satellite imagery to address the specific need of that phase. The examples below are the generic satellite-derived products defined by UNOSAT as relevant for the specific phases of emergency response.

Location maps/preliminary situation maps

Purpose: Provides preliminary nature, extent and severity of the probable impact.

- Locations/situation maps are overviews of potentially affected regions (generally realized using the most recent available pre-disaster satellite images).
- Variable map scale ranging from 1:50,000 to 1:1,500,000.
- Includes baseline information: administrative boundaries, topography, major communication networks, major cities and towns, population density/distribution and other relevant available information.
- First available (almost real time) hazard-related information such as: rainfall accumulation, cyclone tracks or wind speed, extent and variation of ground shaking, etc. Overall view of affected areas for planning and coordination of response activities.

Situation update/impact and preliminary damage assessment

Purpose: Define the nature, extent and severity of the impact; location and estimates of the number of people likely to be affected; identify key priorities; locate access constraints.

- Satellite-derived analysis using both optical and radar imagery (e.g. flood extraction and preliminary impact and damage analysis).
- Preliminary damage analysis is performed using change detection methods for feature extraction and overlay analysis using GIS.

Detailed building/infrastructure damage assessment

Purpose: Refine the definition of the nature, extent and severity of the impact; define focus for follow-up in-depth assessment; identify information gaps and needs; integrate into detailed damage and loss assessment; expedite a strategic response plan.

- Detailed building/infrastructure damage assessment is performed through change detection methods using visual interpretation of pre- and post-disaster high resolution satellite imagery.

Information requirements should be defined for each phase of the disaster, taking into account the situational awareness (from step 1), as well as general information needs and availability for each phase of a disaster. This can facilitate planning and tasking of satellites and other information capturing resources.

Preparedness activities

As part of preparedness, any existing scenario or prediction models that are currently available can be run in order to establish whether all necessary information requirements are properly captured within a controlled or simulated environment. In some cases, needs analysis for a live disaster situation can begin during the preparedness phase once an early warning has been received, as in the case of cyclones that have an estimated track including other parameters such as wind speed, etc.

From the data providers' perspective

When deciding what information is needed, it is helpful to know what kind of information is normally included from data and information providers. This can help in requesting information that would normally be available at different phases of a disaster response timeline. For example, based on the IWG-SEM guidelines, the in-production phase would most appropriately describe what information can be provided. This includes information about the mapping products such as the exact coverage, the intended content (e.g. map layers, detailed AOIs, satellite spatial resolution category, satellite sensor type, type of analysis), as well as the metadata about the satellite data/images being used.

This information set is more advanced and may be limited to those SEM organizations that are involved in the same emergency mapping activation because it might be difficult to share this information in a timely fashion. The means of communication for such information can be KML files, Google Map links or telephone calls and emails. Box 2 provides more detailed information on what type of information may be contained within different mapping products as outlined by IWG-SEM.

The main type of information provided by emergency mapping will allow:

- End users to be aware of what types of information they can expect to obtain from the different emergency mapping products;
- Authorized Users' (possibly of the Disaster Charter) or other value added providers or end users to request the most suitable mapping products.

Box 2: Mapping products and information content

Reference/pre-event maps provide knowledge and overview on the territory and assets prior to the emergency. Information includes topographic features of the area affected by the disaster. A reference map is based on available reference data and the pre-event (archived) satellite images where available.

Impact/delineation/grading/damage level/post-event maps provide an assessment of the event impact and extent. Delineation maps are directly derived from satellite images acquired immediately after the emergency event and they may be combined with digital elevation modelling and compared with archived information and data of similar event occurrences. Damage level maps can provide an assessment of the damage and can include the extent, type and damage from a specific disaster. These maps can be further updated to provide an assessment of the evolution of the impact and extent of the disaster.

A map template structure should provide information regarding the items that should always be present in an emergency mapping map product (such as map legend, event description, data sources, grid/graticules, etc.) related to both the map (geographic) frame(s) and to the marginalia section. Maps produced through SEM efforts should always have at least two main elements: map frame and map marginalia. They should consistently complement each other. The map (geographic) frame(s) contains the geographical representation of the map contents (e.g. crisis information, general information, topographic features etc.), compliant with product typology, legend items and possible detailed user requests. The symbology used in a map frame always depends on the needs. The sources should always be credited (copyright). Information reported can include:

- Crisis information
- Settlements, utilities and transportation
- AOIs
- Other legend items
- Graticule and tick marks
- Background image.

The map marginalia contains the metadata of the map, allowing interpretation of the map frame contents. The key elements are the title/identifier, the cartographic information and the map legend. The representation of the different thematic layers can include:

- Background information (a satellite image backdrop or a topographic map)
- Damage/impact layer

- Infrastructure
- Critical infrastructure.

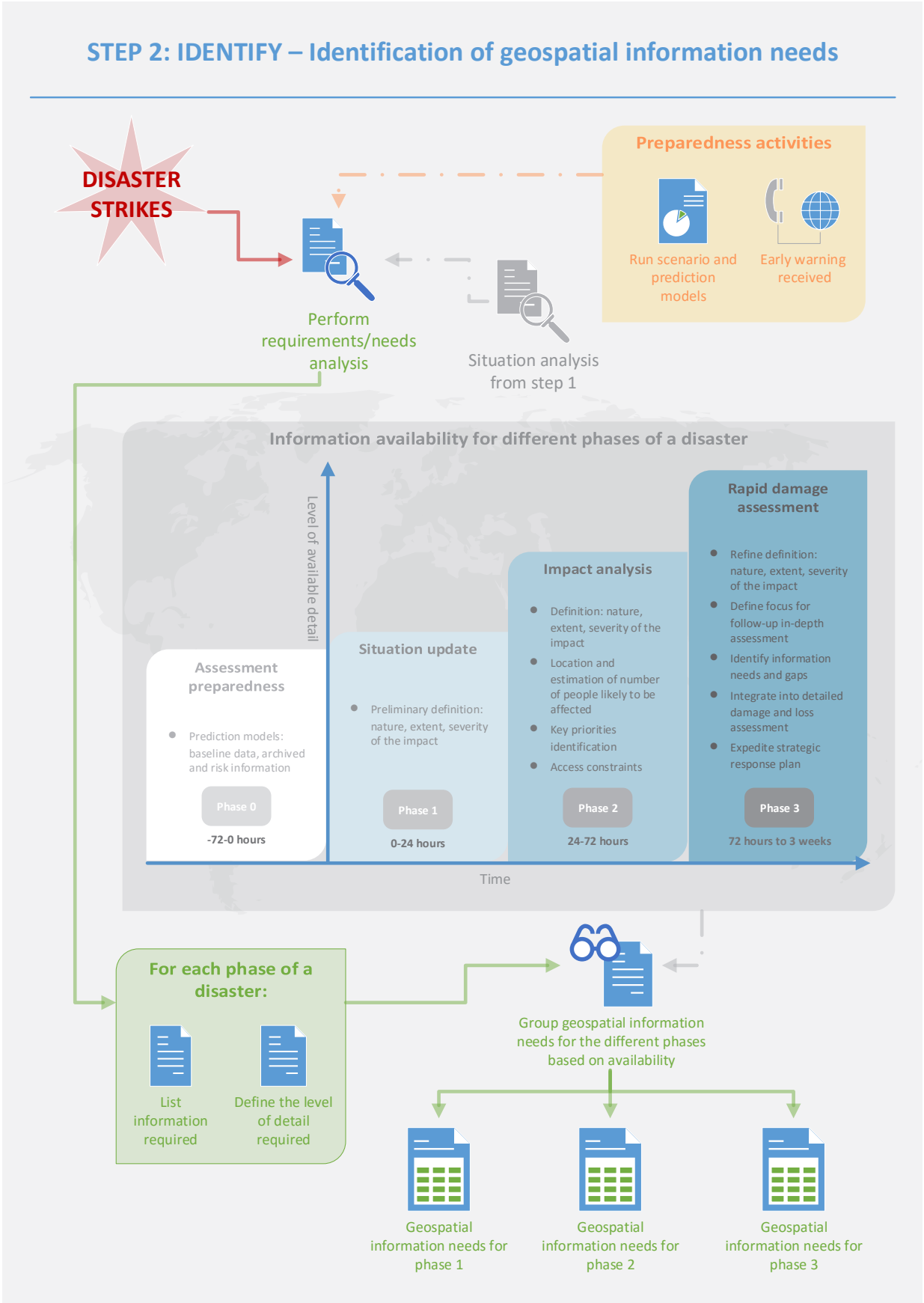


Figure 4: Identification of geospatial information needs for the different phases of a disaster

Step 3: ASSESS

Assess your operational capabilities

Developing the products mentioned in the previous section requires adequate infrastructure and the necessary skills for acquiring, processing and analysing EO data and imagery. However, this capacity is variable and can change before and during the disaster. Both before and immediately after the disaster, a full assessment of the capabilities for downloading, processing, developing and analysing products to assist emergency response activities is required. Figure 5 provides an example of some key considerations when making a capabilities assessment before and during a disaster. It is estimated that this step may take 20 minutes to 1 hour to perform.

Review current capacity against baseline capacity

Once a disaster strikes it is necessary to review the current capacity of an organization. This review should be carried out against any existing baseline capacity that has previously been identified, to determine whether an organization can still operate as it would have done before the disaster.

During disasters, however, established infrastructure and acquired skills are pushed to the limit. The added stress and strain can not only affect normal functioning but can even lead to a complete collapse of infrastructure or breakdown of skills. In some cases, any infrastructure which remains may end up taking on additional loads where redundant or alternate infrastructure has failed; and any existing skills, while adequate under normal operating procedures, may not be sufficient when operating under emergency situations. Therefore, current capacity must be reviewed taking all these additional factors into account.

Perform gap analysis of operational capacity to deliver the desired products

Once the current capacity has been determined in a disaster situation, the geospatial information needs (identified in step 2) must also be factored in to perform a gap analysis. This process will determine whether the organization has the capacity to deliver the desired geospatial information products and can lead to several outcomes. If an organization has the capacity to confidently deliver the required geospatial products then it may only require raw satellite imagery or data; if an organization has no capacity to deliver the required geospatial products then it may require satellite-derived geospatial products from others; and if the organization has some limited capacity to deliver only some of the required geospatial products then it may require a combination of both raw satellite imagery and data and satellite-derived geospatial products from others.

Even if the capacities exist during all the phases of disaster, in most cases it is important to use all the resources available – which include international resources – in order to produce timely, reliable and verifiable information. In cases where multiple stakeholders are participating in the emergency response mapping, it is also necessary to coordinate efforts using platforms such as the Global Disaster Alert and Coordination System (GDACS) Satellite Mapping Coordination System to avoid duplication and cover all the AOIs in the shortest possible time.

Preparedness activities

A baseline assessment of capabilities is part of preparedness. This means that an institution needs to know what kind of operational skills, experience and resources it has in normal times. An assessment can include, for example, if and how the institution would normally access satellite imagery; its ability to develop geospatial products; the number of staff and their skill sets; the resources available on standby and in reserve; and any other factors which may impede their capacity, such as the available functioning infrastructure. Additional factors are important to consider during any capabilities assessment; at a minimum these are:

- **For acquiring EO data in a timely manner:**
    - Fast to very fast broadband Internet connection for downloading the data;
    - Large data storage facilities for storing and backing up the data, as EO data is very large;
    - Skilled information and communications technology personnel to manage and maintain the infrastructure.

- **For processing and analysing EO data in an accurate and reliable manner:**
    - Experienced remote sensing and GIS analysts;
    - Remote sensing and GIS software;
    - High-powered computers capable of processing large amounts of data.

Analysis of objects and the methods and techniques used for processing geospatial data are very subjective and based on preferences or experience. For example, the satellite-derived products of one institution may differ from those of other institutions. It is also necessary to outline the methodologies used in geospatial analysis so that others may reproduce the results, if necessary, or obtain comparable results when applying the same methodologies to different AOIs.

From the data providers' perspective

It is essential to communicate your level of capacity to data providers as this will help to determine which type of data or products you receive from data providers. For example, if you have the capacity to perform geospatial analysis but your analysts are busy working on other AOIs, that may result in a shortage of human resources or time to perform analysis in order to meet decision-making deadlines. This can significantly affect your organization's capacity to respond in a timely manner with an adequate degree of accuracy. Cooperating mechanisms can supplement your capacity but these need to be established beforehand, including defining the level of interaction required for different crisis levels so that partners may remain on standby and ready to act if necessary. IWG-SEM provides an indication of the readiness in capabilities necessary for different crisis levels. These also depend on the nature of an event:

- **Non-crisis situation**
  - Level 0 – inactive/unavailable.
  - Level 1 – monitoring/on-call – SEM organizations may have a list of 'Authorized Users' who can trigger the Emergency Mapping Activation.

- **Crisis situation**
  - Level 2 – self-organization (small-scale to medium-scale crisis).
  - Level 3 – cooperation of multiple providers (medium to large-scale crisis).

UN Photo/Sylvain Liechti

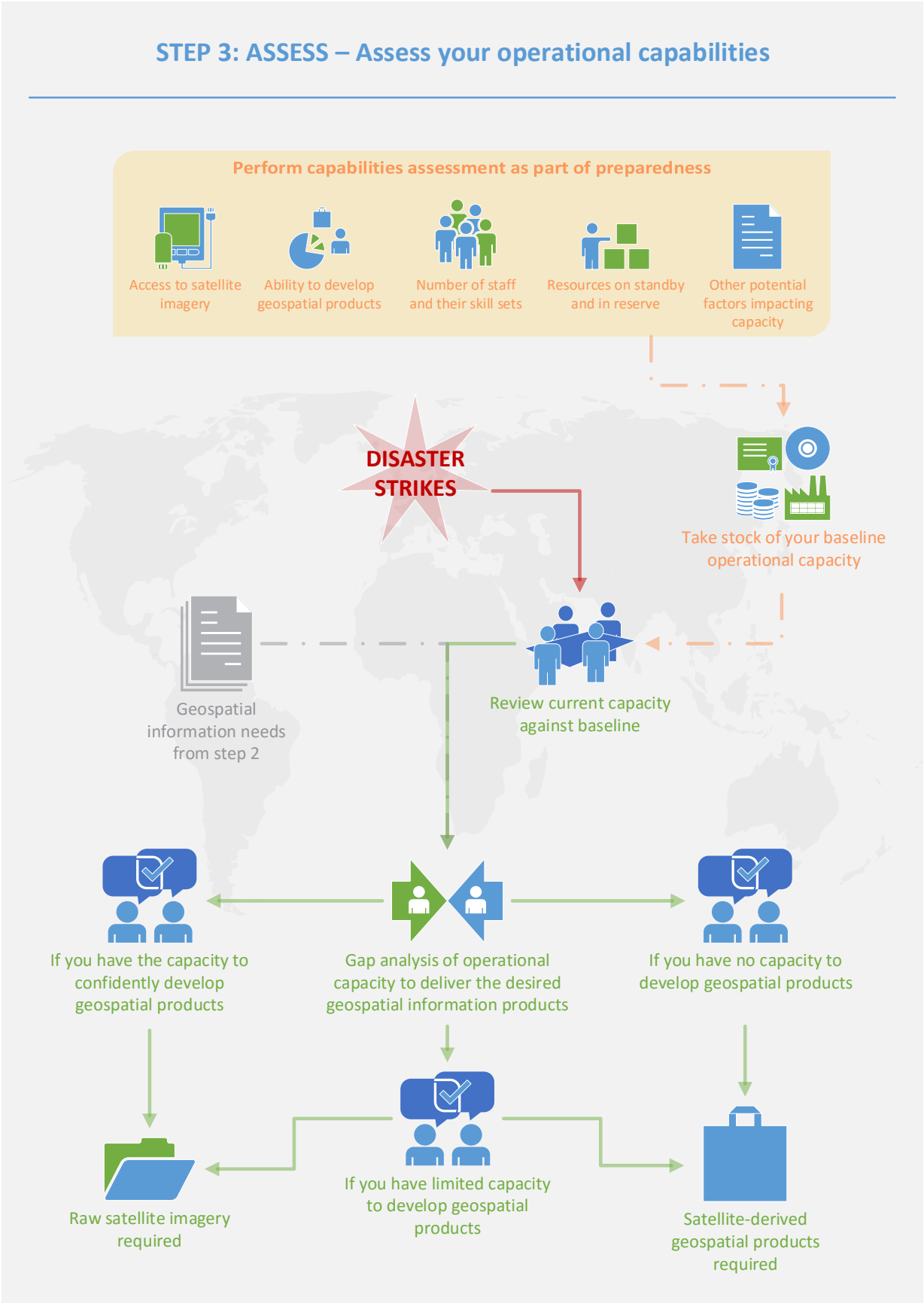


Figure 5: Flow diagram showing how to assess operational capabilities

Step 4: REQUEST

Make your request

Action can now be taken in the form of making a request for either obtaining satellite imagery and raw data or geospatial products. This decision is based on steps 1, 2 and 3 : situational analysis, geospatial information needs, and requirements and gaps in capabilities. Figure 6 provides a flow diagram of the considerations when making a request. A repository of geospatial service and satellite data providers should be maintained in order to determine who to make such requests to. Commonly used mechanisms and initiatives for obtaining raw satellite imagery or satellite-derived geospatial products have also been highlighted in figure 6. There are essentially two types of requests to be made: 1) a request for raw satellite imagery; or 2) a request for satellite-derived geospatial products. A third option is to request both imagery and products. It is estimated that this step may take 5 to 30 minutes to perform.

Option 1 – How to obtain satellite imagery and raw data: if you have the capacity to process it

This step will provide users with different international, regional and bilateral options for obtaining free or commercial satellite images given that the users have the capacity to download, analyse and process the raw satellite images into meaningful information in a timely manner.

For a list of satellite imagery and raw data providers, including instructions for requesting, please see appendix 1.

Option 2 – How to obtain geospatial products: if you do not have the capacity to develop them

If the capacity does not exist for downloading, processing and analysing satellite imagery rapidly, it is necessary to request services from international

and regional specialized centres. For example, even if the capacity exists during disaster situations, local specialized centres can be seriously shorthanded due to fluctuations in communication networks and various priority tasks set by government line ministries. International and regional centres can work alongside local specialized centres to fill data and information gaps.

For a list of geospatial information service providers, including instructions for requesting, please see appendix 2.

Preparedness activities

In order to make both the request process and receiving data, services and products more seamless, the right infrastructure to request and receive such products and services must be set up. This can be in the form of receiving base stations. Registering beforehand with some service providers is also necessary, as well as bilateral agreements between countries and with satellite data providers, so that when requests are made there is already an established protocol in place.

From the data providers' perspective

Data providers need to coordinate data collection and monitoring activities in order to cover all AOIs and avoid duplication of activities in the same areas between different organizations. This can help to manage resources and time more efficiently. There are two noteworthy mechanisms which can support coordination by data providers and organizations working in emergency mapping.

1. **VirtualOSOCC:** The real-time coordination platform 'VirtualOSOCC' [7] gives disaster managers around the world the ability to view existing satellite data acquisition in order to better coordinate their own efforts. It is part of the GDACS platform. GDACS is a cooperation framework under the United Nations umbrella. It includes disaster managers and disaster information systems worldwide and aims to fill the information and coordination gaps in the first phase after major disasters. It provides real-time access to web-based disaster information systems and related coordination tools, and provides standards and guidelines for international information exchange during disasters. [8]

Through the GDACS Satellite Mapping Coordination System website it is possible to visualize existing mapping initiatives, to see where the available layers are: a) Only archived; b) Only active; and c) Show both. For every AOI there is a detailed report showing the Global Identifier number of the event, date, description, source and possible external links to other organizations working on a disaster. [9]

Through UNOSAT's GIS platform, it is possible to see which areas are currently being mapped and which agencies are operating in a certain territory; and it is possible to visualize three types of AOI layer for each event: a) Completed; b) In Progress; and c) Planned. [10]

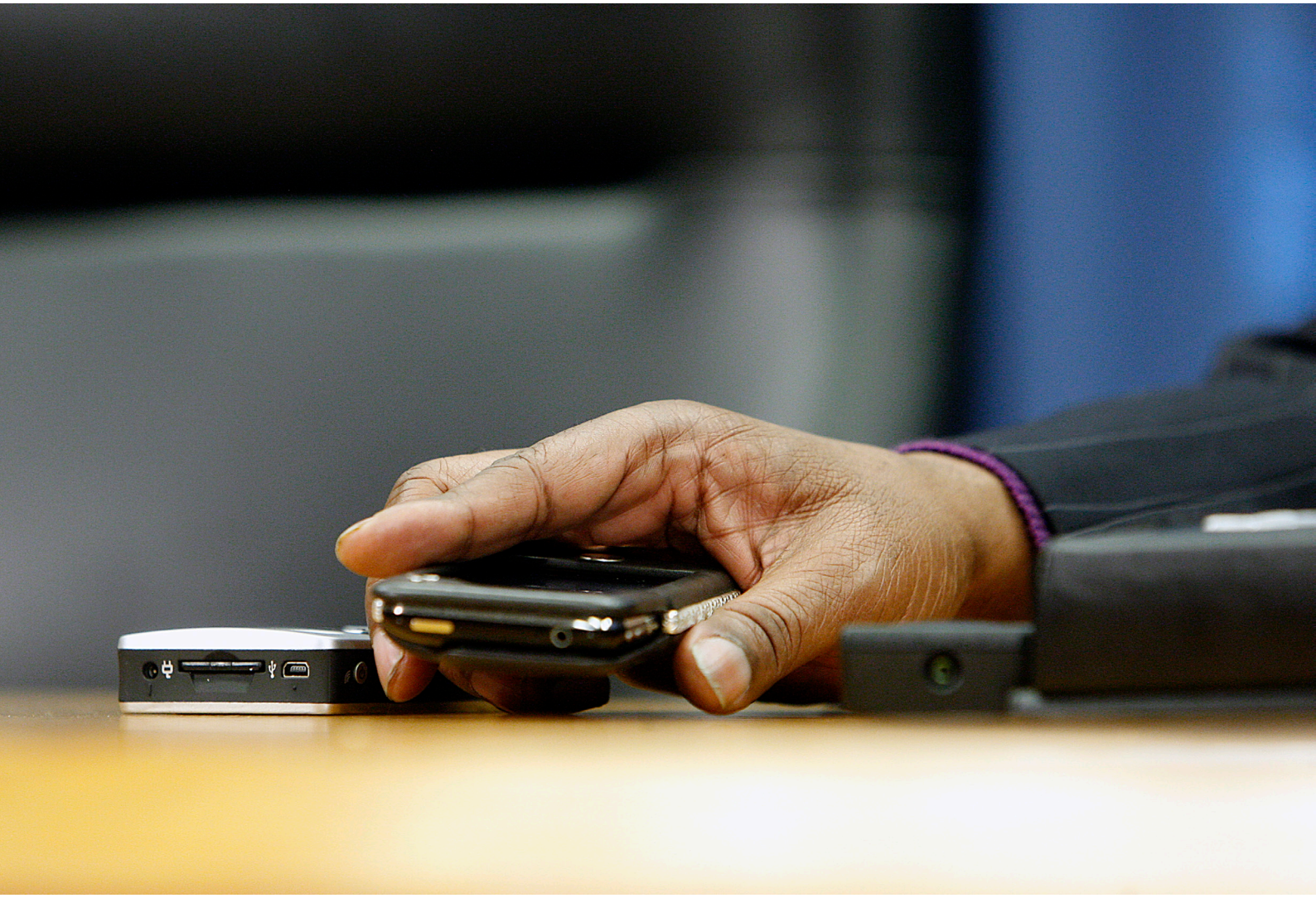
2. **IWG-SEM** is a voluntary group of organizations involved in SEM. It was founded to improve cooperation, communication and professional standards among the global network of SEM providers. The portal used by IWG-SEM (http://www.un-spider.org/network/iwg-sem) displays locations and descriptions of activations of several emergency mapping organizations which publish GeoRSS feeds compliant with the IWG-SEM recommended

7 http://vosocc.unocha.org
8 http://portal.gdacs.org/
9 https://gdacs-smcs.unosat.org/
10 https://unosat.maps.arcgis.com/

technical specification for emergency activations metadata exchange.
Really Simple Syndication (RSS) is a format for delivering regularly changing web content and enables other websites to automatically consolidate news and information from different sources. For example, ArcGIS online allows users to ingest RSS feeds. The map is updated autonomously by means of GeoRSS feed aggregation, and it shows several emergency mapping entities sending GeoRSS feeds with basic and initial information on their current emergency mapping activation. GeoRSS feeds used in the IWG-SEM map include:

- Copernicus Emergency Mapping Services – Rapid Mapping Activations;
- Copernicus Emergency Mapping Services – Risk and Recovery Mapping Activations;
- International Charter on Space and Major Disasters;
- Service Régional de Traitement d'Image et de Télédétection (Regional Service for Image Treatment and Remote Sensing).

By clicking on an icon for a single AOI, it is possible to view more details; each icon represents the agency that reported the feedback; an additional link opens a more detailed map for the relevant event. The link also takes the user to the portal of the organization that provided the GeoRSS feed.



UN Photo/Mark Garten

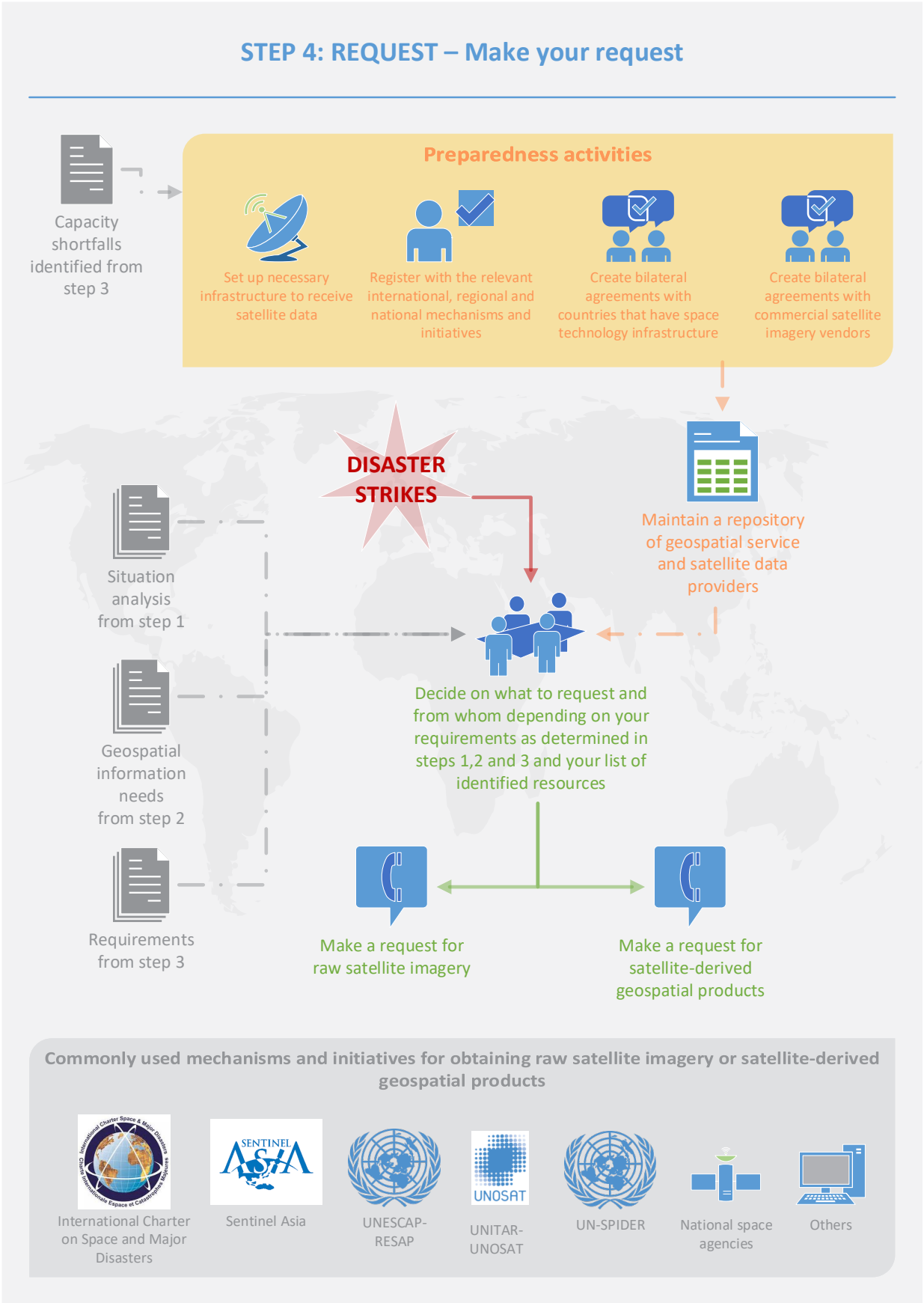


Figure 6: How to make a request for support

Step 5: SHARE

Disseminate to relevant authorities

It is very likely that the department or team receiving the satellite imagery and raw data or satellite-derived geospatial products requested in step 4 is not the only one that will benefit from this information. All stakeholders will require different forms of information to suit their levels of involvement and responsibility in emergency response. Additionally, there are multiple platforms where EO data and related emergency response information may be shared, different times when they will be needed and standardized formats that they will be required in. Therefore, disseminating information to the relevant authorities requires extensive planning to ensure seamless sharing during an actual disaster. In terms of timeframe, this step is ongoing with periodic updates expected as and when products become available.

Review information dissemination strategy and identify reporting needs

When a disaster strikes, after completing steps 1–4 of these guidelines, a review is required of the information dissemination strategy and identification of reporting needs, whether they are regular or ad hoc. In order to review the strategy, input is required. This will be geospatial products received from making a request in step 4 or value-added information and additional analysis performed after receiving satellite imagery data from step 4. This input needs to be assessed in relation to an existing dissemination strategy, developed as part of preparedness, so that the final geospatial products can be disseminated appropriately as either:

1. Ad hoc information products as and when required, i.e. press releases, situation reports, breaking news, etc. These can be in the form of social media, web-based or other quick-response tools and new media; or
2. Information products within regular reporting i.e. bulletins, newsletters, situation updates, etc. These can be in the form of social, web-based or print media or other traditional media platforms.

Any integration of geospatial products into regular reporting channels should feed back into the overall information dissemination strategy.

Preparedness activities

This step requires significant preparation before a disaster. Good practice mainly consists of three distinct stages which must then be merged into the overall existing communications plan. The first stage is performing stakeholder analysis. This means identifying all information stakeholders and organizing them into groups based on their interest, influence, capacity, or other categories. This will allow targeted communications based on the individual needs of different groups.

The second stage is mapping products to stakeholder information needs. This means listing all standard and common geospatial and information products and then assigning them to the groups identified in the previous stage. This mapping of information products to information groups helps to identify which information products certain groups are most likely to require and subsequently benefit from.

The third stage is defining the best way to deliver geospatial information to the different stakeholder groups. After identifying the different information groups in the first stage and the information products they require in the second stage, it next needs to be understood how the products will be delivered to these groups. This involves identifying all communication platforms at your disposal, agreeing on the format and timing of geospatial information products, sharing standard products via relevant platforms and remaining on standby to share new products as the situation progresses. It is essential to merge this with an existing communications plan in order to remain consistent in communications and ensure synergy with already established communications methods and procedures. Finally, if a national spatial data infrastructure exists, all of this information must be integrated into it so that all communications use a standardized geospatial element, through the infrastructure's existing information and data sharing policies and standards.

From the data providers' perspective

The IWG-SEM guidelines highlight that there should be common dissemination formats for emergency mapping products in terms of both raster and vector data sets as well as other web services. The delivery and dissemination of (geo-) information or map products should be done via web portals of SEM organizations. File naming conventions should be available and easily accessible to users, to allow accurate and timely interpretation of file names. Information sharing and distribution should not be static: the use of web services is recommended for this reason.

Metadata should reflect international standards such as those developed within ISO/TC211. Commonly adopted raster data formats should be used for the raster map product dissemination, while vector data should be disseminated using standard (or de facto standard) formats, preferably developed in the context of ISO/TC211 or Open Geospatial Consortium, to allow high levels of interoperability: e.g. Esri shapefiles with corresponding projection files (.prj), Google Earth KML (or KMZ) formats.

Furthermore, analysis layers should also be shared as this allows:

1. More aggregated products – layers from different SEM organizations combined in one product;
2. Better quality – exchange layers of low quality with layers of high quality derived from more optimal data; and
3. Cross-checking of layers among SEM organizations – more reliable ad hoc products and enabling of offline validation.

The contents of layers could include hydrology, place names and administrative boundaries, physiography, settlements, transportation, industry and utilities, and other information .

UN Photo/Eskinder Debebe

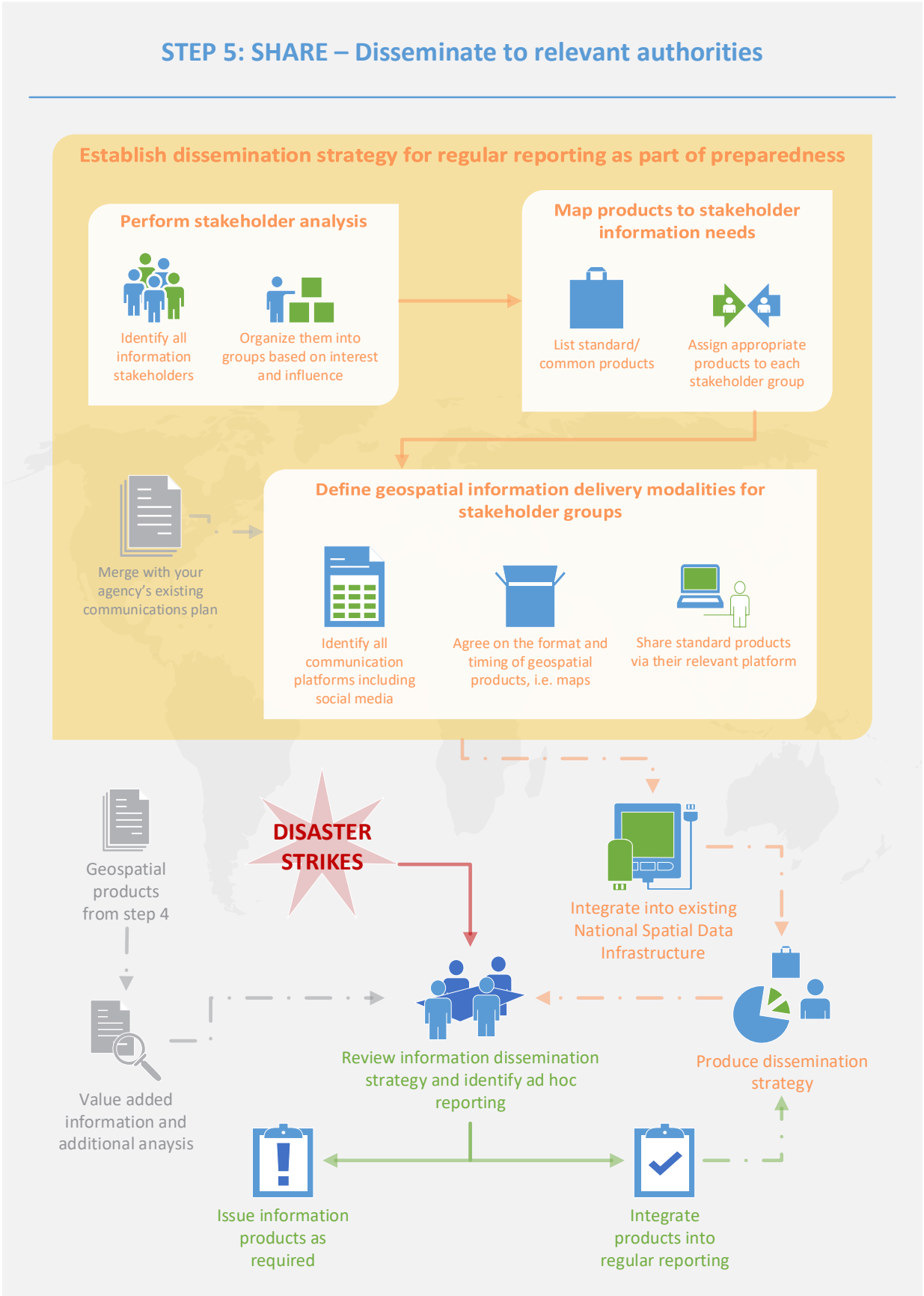


Figure 7: How to share geospatial information with relevant authorities

Step 6: INTEGRATE

Use of geospatial products for decision support

The use of geospatial products for decision support was recognized as an area where key improvement is required. Often products are not properly understood or not used in the correct manner to support decision-making. In order to address this, countries identified better integration of geospatial services and products to support decision-making, particularly during disaster situations as well as for preparedness. It is estimated that this step should begin within 24 to 48 hours of a disaster. To use products most effectively, the relevant authorities need to:

- Have a basic understanding of different maps and geospatial products;
- Be aware of the trade-offs in analysis regarding accuracy and subjectivity arising from the lack of scope and time for validation or verification;
- Know how to interpret the information presented in the map for effective decision-making;
- Be both aware of and willing to use satellite-derived analysis, especially for disaster response scenarios.

Both during disaster situations and in preparedness for such scenarios, integration of geospatial services is necessary in four main areas:

- Geoportals
- Customizable geo-data
- GIS experts
- Geospatial information dashboards.

During disasters

During disasters geoportals can be updated to support public information services and information provided to emergency and crisis operations centres: customizable geo-data should be provided to these centres. GIS experts should be deployed to both emergency and crisis operations centres that often coordinate at national or regional levels, and situation and crisis rooms specifically set up for the current disaster. Geospatial information should also be presented in the form of dashboards which can be customized for situation and crisis rooms.

Preparedness activities

As part of preparedness activities, geoportals should be better understood by relevant agencies in terms of their use and administration. Geo-data should also be better understood by relevant agencies in terms of how it can be customized and applied to the different areas of work. Field staff should have an understanding of how to analyse geospatial data with the help of GIS experts. Decision makers should be familiar with the interpretation of geospatial information that can be presented in the form of information dashboards.

For good practices in satellite mapping, please see appendix 4.

From the data providers' perspective

According to the IWG-SEM guidelines, in order to ensure that space-based data and mapping products are fully utilized, data providers should honour the needs of end users and those needs should not be negatively influenced by any sharing which has already occurred among SEM organizations. Furthermore, data and products are more likely to be used if they include official authoritative reference data to produce post-event analysis and maps. This allows end users to confidently integrate results into their own operational frameworks and products.

In order to make mapping products more accurate, reliable and appealing, the SEM community should consider using well-known and already validated open data sources, both in vector and raster form. These can include:

- Geospatial information from OpenStreetMap for baseline data, or Google Mapmaker data (if openly distributed for non-profit usage), WorldPop, Landscan or Gridded Population of the World data;
- Freely accessible satellite imagery such as Landsat, China–Brazil Earth Resources Satellite, Sentinel, the OrbView-3 collection, archived Spot Image data (older than five years that might be released with a non-restricted licence);
- Elevation data models such as the recently-released Shuttle Radar Topography Mission v2 30m resolution global data set (and its planned improved versions) or the Shuttle Radar Topography Mission 90m and GTOPO30 1km data sets.

Users are encouraged to use the highest quality and resolution data sets where possible. Licensing policy should always be taken into account, according to the SEM fundamental principles. Licensing should always be respected, especially when sharing satellite imagery data.
Work allocation on the data providers' side depends on the number of users requesting information, the different languages in which the products need to be delivered, the number of AOIs and the availability of resources at SEM organizations. Possible approaches to the division of responsibilities or labour can be by:

1. AOIs;
2. Analysis layers;
3. Processing steps;
4. Time of availability of the SEM organization;
5. End user group (e.g. using the targeted language).

UN Photo/Eskinder Debebe

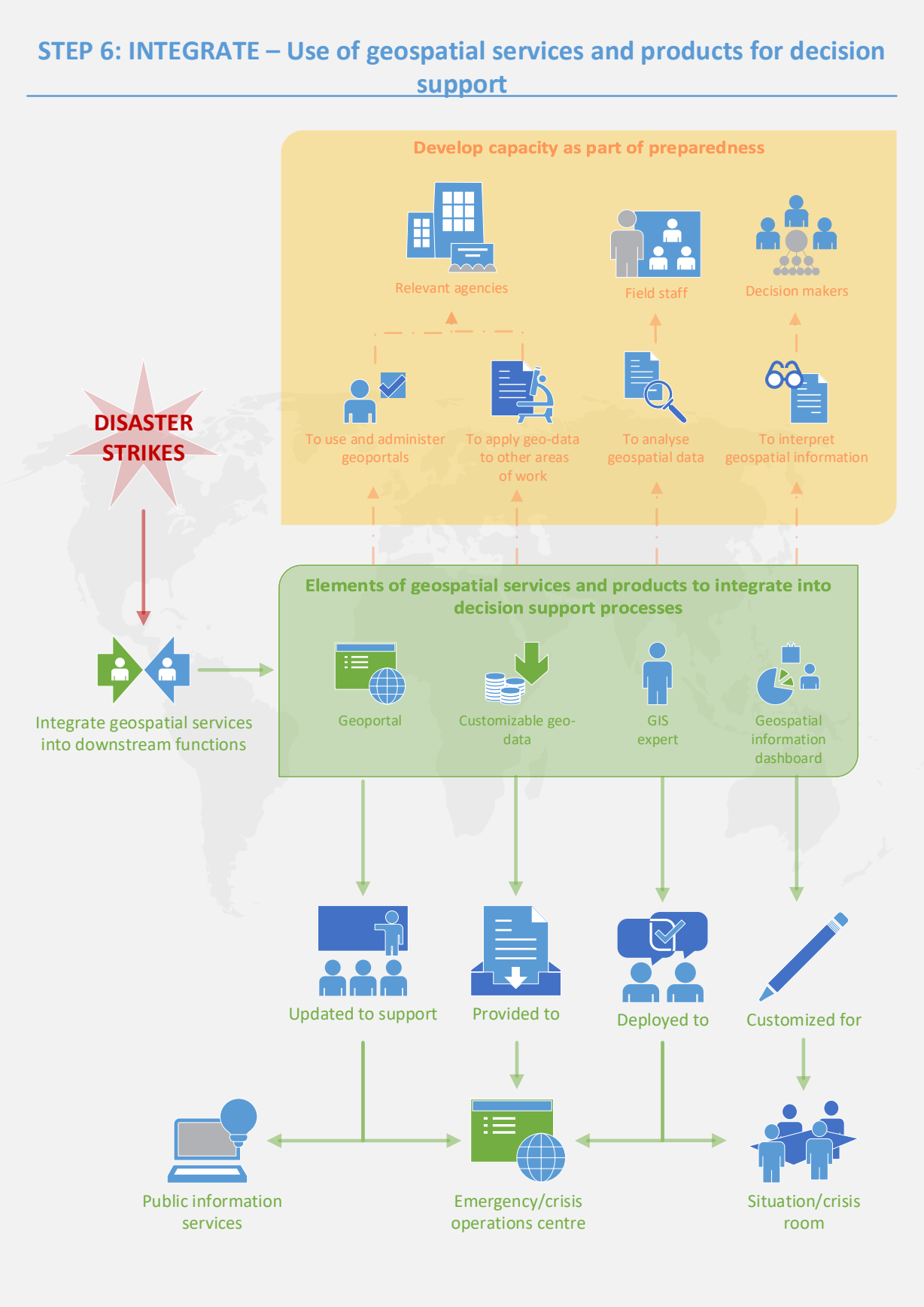


Figure 8: How to integrate geospatial services to ensure their use in decision-making processes

Step 7: REFLECT

Provide feedback

One of the most important but also most underestimated steps in coordinating satellite imagery or satellite-derived geospatial products is to provide feedback during and after the disaster. Feedback has the potential to significantly improve the process of sharing space-based information during emergency response – including the analysis contained within geospatial products – and can address potential challenges by implementing improvements to the workflow for future disasters. Ideally, this feedback process can be divided into two different segments: real-time feedback and post-event debriefs. It is estimated that this step should begin within 24 hours of a disaster and remain an ongoing task for each product that has been developed or shared.

Real-time feedback during the disaster

After a disaster strikes, and when geospatial information products or raw satellite imagery is received from data providers, it is essential that end users provide real-time feedback to the data providers. This can be done via quick-response tools such as phones calls, instant messages or e-mail. However, it is worth noting that such methods can introduce ambiguity as they are quick and not detailed. Feedback should indicate the timeliness, accuracy, reliability and appropriateness of the products or data received. This allows for a quick acknowledgement that the products have been received and an indication of whether or not they can be used effectively based on the end user's needs.

End users must also seek feedback from data providers so that they can better understand if their request was properly raised (i.e. if information was missing) and to identify efficiencies in the request process so that both agencies can work at optimum level. This feedback loop must then be reviewed

by the end user, with improvements prioritized based on feasibility. Any changes which are feasible or necessary within the response time frame should be implemented, with longer-term changes scheduled once the response phase has ended

Detailed feedback after the response phase has ended

Once the response phase has ended, end users and data providers should provide detailed feedback to each another. This can be in the form of comprehensive reports, face-to-face conversations or other unambiguous methods. End users should also organize a post-event debrief to discuss challenges and potential process improvements, and implement lessons learned for future disaster response activities.

Preparedness activities

As part of preparedness, it is important to implement lessons learned from previous disaster response situations. It is also essential to notify staff and relevant stakeholders of process improvements, especially if they will be affected by any future changes. Depending on the scale of changes, it may be necessary to incorporate good organizational change management practices because changes may often be related to working culture or other larger working practices, especially if organization-wide changes need to take place. This entire process forms a feedback and change loop in that feedback is sought during the disaster, while changes and improvements take place at the end of a disaster and in preparation for future disaster response activities.

From the data providers' perspective

IWG-SEM guidelines state that the post-delivery phase allows SEM organizations to collect feedback from users on the delivered mapping products. The recommended interaction tools for such feedback can include:

- GeoRSS feeds and KML files;
- E-mail exchanges;
- Teleconferences using normal phones and cell phones;
- Videoconferences using specialized teleconferencing equipment, such astele/videoconference rooms or online services such as Webex;
- Teleconferences and/or videoconferences over the Internet (e.g. Skype);
- Fax communication.

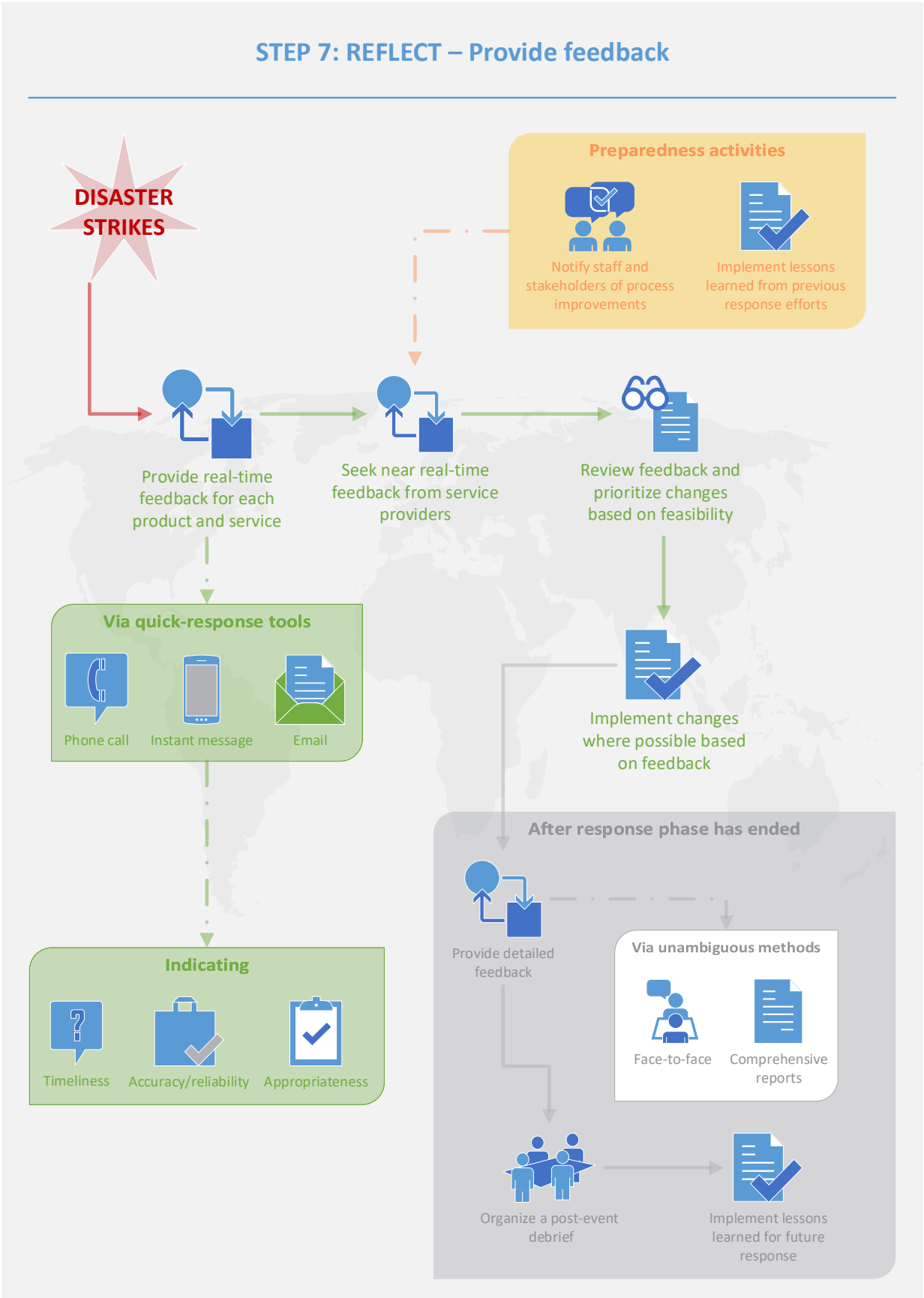


Figure 9: How to provide feedback during and after a disaster

The way forward

These Procedural Guidelines for sharing space-based information during emergency response provide a minimum set of operating guidelines for countries that do not have such mechanisms and procedures in place. They can be adapted to each country's needs and context and form the basis for implementing SOPs in sharing EO information for disaster emergency response. The guidelines are accompanied by a Quick Guide version that can be used as a user-friendly reference for each step, providing a visual representation of the procedures contained within. The Quick Guide has been designed so that it can be easily translated into other languages with the use of icons and other context-independent graphics.

The guidelines have been 'field-tested' in various UNESCAP-led workshops in collaboration with UNOSAT, UN-SPIDER and AHA Centre and are being promoted and disseminated by all relevant agencies as good practice from the Asia-Pacific region. The ASEAN subregion has helped to perfect the steps and procedures through multiple workshops and practical use of the guidelines during simulation training exercises and live disaster situations. Viet Nam has already developed their own SOPs based on the seven steps outlined in these guidelines. These have been endorsed at the ministerial level and are currently being implemented across relevant agencies at the national level. Cambodia and the Lao People's Democratic Republic have requested support to develop similar national SOPs.

The guidelines form a working document which needs to be continually updated as procedures change and in order to keep agencies prepared and on standby through simulation training, drills and related preparedness exercises.

Appendix 1: List of common satellite imagery and raw data providers

A brief summary of the different options, eligibility of users for accessing imagery, licence level and method of access is presented here.

International space resources – free/authorized access to satellite imagery

Name of source	Brief description	Access type	Access instruction	Steps to obtain satellite images
International Charter on Space and Major Disasters	The International Charter on Space and Major Disasters is a Charter which provides for the charitable and humanitarian retasked acquisition and transmission of space satellite data to relief organizations in the event of major disasters.	'Authorized Users' can request activation and access the satellite image, i.e. NDMAs	Registration required for NDMAs	• Activate the Charter: • www.disasterscharter.org/web/guest/activating-the-charter • Download the satellite image through provided links • Upload generated maps and information to the Charter
United States Geological Survey Emergency Response – Hazards Data Distribution System (HDDS)	United States Geological Survey Emergency Response strives to ensure that the disaster response community has rapid access to timely, accurate and relevant geospatial imagery, products and services before, during and after a disaster.	Immediate access to Landsat, Moderate Resolution Imaging Spectroradiometer and other freely available imagery on registration. For restricted access data, a request needs to be sent with the justification of use.	Register on Earth Explorer or HDDS Explorer: http://hddsexplorer.usgs.gov/documents/hddshelp.pdf	• One agency may submit the initial request for support but the imagery that becomes available on HDDS can be shared across the response community • Download free access data • Request for restricted access imagery via HDDS Explorer if required: • http://hdds.usgs.gov/hazards-data-distribution-system-hdds
UN-SPIDER	Ensures that all countries and international and regional organizations have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle.	UN-SPIDER can fill the gap left by the Disaster Charter or Sentinel Asia through its bilateral cooperation with national space agencies and providers such as Digital Globe.	The UN-SPIDER knowledge portal provides a comprehensive list of free or low-cost satellite images and geospatial tools through the following links: http://un-spider.org/links-and-resources/data-sources and http://un-spider.org/links-and-resources/gis-rs-software	The UN-SPIDER Beijing office can be contacted through e-mail to get support – un-spider@unoosa.org
Sentinels Scientific / Other Use Data Hub	The Sentinels Scientific Data Hub provides free and open access to a rolling repository of Sentinel-1 and Sentinel-2 user products, starting from the In-Orbit Commissioning Review.	Free to registered users for non-commercial use.	To access Sentinel data at the Sentinel Data Hub portal, individuals and entities need to register as a user and provide information to the European Space Agency. Through the registration, the user will be granted a password to access Sentinel data. https://scihub.copernicus.eu/twiki/do/view/SciHubWebPortal/TermsConditions	• Log in to the Sentinels Scientific Data Hub: • https://scihub.copernicus.eu/dhus/#/home • Search for AOI • Download radar or mulspectral data

Digital Globe Open Access Satellite Imagery	For some specific disasters Digital Globe opens its satellite imagery to all.	Open access	Can be downloaded using the link provided by Digital Globe. For every scenario the link can be different.	• Check the announcement on Digital Globe's disaster relief page • Follow the event-specific instructions to download the imagery: • www.digitalglobeblog.com/tag/disaster-relief/

International space resources – commercial satellite imagery

Name of source	Brief description	Access type	Access instructions	Steps to obtain satellite images
Digital Globe	Digital Globe is a American commercial company providing high resolution satellite images, aerial photos and geospatial content.	Commercial	Users can place orders and purchase imagery through the Digital Globe Image Finder web portal at http://explore.digitalglobe.com/Image-Finder-Request.html	• Define AOI • Search and select satellite sensor and imagery quality through Digital Globe Image Finder • Place an order inquiry using the following link: http://explore.digitalglobe.com/Image-Finder-Request.html • Place order from the information provided by the response to the inquiry • Download using the provided link
Airbus Defence and Space	Airbus Defence and Space is a division of Airbus Group responsible for defence and aerospace products and services.	Commercial	Customer membership is required at the GeoStore: www.geo-airbusds.com/en/4937-geostore	• Define AOI • Search, select the appropriate satellite imagery and order at www.geo-airbusds.com/en/4871-browse-and-order • Download using the provided link

Regional space resources – authorized access

Name of source	Brief description	Access type	Access instructions	Steps to obtain satellite images
RESAP	The RESAP network provides satellite images for free to be used by member countries for the purpose of disaster preparedness as well as emergency response.	RESAP National focal points or any UNESCAP Member States	To become a RESAP member: • Initially inform the UNESCAP Secretariat of your country's intention of becoming a member of the RESAP network • Write to the UNESCAP Executive Secretary requesting membership (recommended at the ministerial level) • Attend the subsequent annual Intergovernmental Consultative Committee session for RESAP in order to formalize membership.	Gather the following information: • Location name • Location coordinates • Type of hazard • Date of hazard event • Name(s) of person(s) to send imagery to • Contact telephone number • E-mail addresses to send imagery to • Additional notes • Name of your national RESAP focal point (if you have one and are requesting on their behalf). Contact the RESAP coordinator at UNESCAP: escap-sas@un.org
Sentinel Asia	Sentinel Asia is a voluntary initiative led by the Asia-Pacific Regional Space Agency Forum to support disaster management activity in the Asia-Pacific region by applying Web GIS technology and space-based technology such as EO satellite data.	Only a designated Data Analysis Node has access to the satellite imagery.	Sentinel Asia's 'data provider nodes', which consist of several regional space agencies and related institutions, provide satellite data for analysis and processing in the 'Data Analysis Nodes'.	Data Analysis Nodes request and access imagery through a specified mechanism.

Appendix 2: List of common geospatial information services providers

Here is a list of different specialized centres, the services they provide and the process to follow to access the data.

International service providers

Name of source	Brief description	Access information	Steps to obtain products and services
International Charter on Space and Major Disasters	The Disaster Charter provides for the charitable and humanitarian retasked acquisition and transmission of space satellite data to relief organizations in the event of major disasters.	The Disaster Charter provides geospatial products though specialized institutes such as UNOSAT, Service Régional de Traitement d'Image et de Télédétection, Asian Institute of Technology, the Indian Space Research Organisation, Copernicus, German Aerospace Centre, etc.	Registration is required for national authorities. **1. Direct activation:** A predefined list of appointed users, known as 'Authorized Users', can submit a request for a disaster occurring in their country. The only bodies authorized to directly request the Charter to be activated are the Authorized Users (typically civil protection agencies, governmental relief organizations or other authorities with a mandate related to disaster management). **2. Activation via an Authorized User on behalf of a user from a non-member country ('sponsor Authorized User'):** Authorized Users can access the Charter to request support for a disaster in a country with which they cooperate for relief purposes. **3. Activation via the United Nations for United Nations users:** The Charter has an agreement with the United Nations Office for Outer Space Affairs (Vienna) and UNITAR/UNOSAT (Geneva) to provide support to United Nations agencies. The United Nations Office for Outer Space Affairs and UNITAR/UNOSAT may submit requests on behalf of users from the United Nations. **4. Activation for Asia-Pacific users via Sentinel Asia's partner, the Asian Disaster Reduction Centre:** Since 2009 the Charter has granted the Asian Disaster Reduction Centre the right to submit activation requests on behalf of national users of Sentinel Asia.

UNOSAT Rapid Mapping	Operational since 2003, UNOSAT Rapid Mapping provides satellite image analysis during humanitarian emergencies, both natural disasters and conflict situations. With a 24/7, year-round availability to process requests, a team of experienced analysts ensures timely delivery of satellite imagery-derived maps, reports and data ready for direct inclusion in GIS according to needs. Typical situations for which UNOSAT Rapid Mapping is activated include floods, earthquakes, storms, landslides, volcanoes, oil spills, chemical waste spills, refugee and internally displaced person camp mapping, conflict damage assessment and situation analysis. UNOSAT benefits from a variety of sources for its satellite imagery: free and open source, commercial vendors, the Disaster Charter (natural and technological disasters only) and in-kind donations.	Who can request? • United Nations offices and agencies • Government agencies • Red Cross and Red Crescent Movement • International and regional organizations • Humanitarian NGOs	https://www.unitar.org/unosat/rapid-mapping Guidelines for Activating UNOSAT Rapid Mapping Services: 1. Identify: • Type (for example tropical storm, flood, earthquake, conflict) • Geographic area / location, ideally sent as KML files or latitude / longitude coordinates; however, place names are also acceptable. 2. Contact information UNOSAT can reach the requester at: name, function, e-mail, office phone and cell phone. 3. Submit requests via e-mail to emergencymapping@unosat.org, immediately followed by a phone call to the 24/7 hotline +41 76 487 4998 to confirm submission to the UNOSAT on-call officer. Requests can also be submitted to the 24/7 hotline directly if no Internet connection is available for e-mail. 4. UNOSAT will request satellite imagery programming for AOIs, inform the requester of the status of the request and produce relevant Rapid Mapping products available for digital download.
German Aerospace Centre–Centre for Satellite Based Crisis information	This Centre provides a 24/7 service for the rapid provision, processing and analysis of satellite imagery during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide.	www.zki.dlr.de/	Through activation of the Disaster Charter. www.zki.dlr.de/services/zki-de
Copernicus Emergency Mapping Services	This agency provides worldwide services and applications for emergency response. http://emergency.copernicus.eu/mapping/	http://emergency.copernicus.eu/mapping/ems/who-can-use-service	http://emergency.copernicus.eu/mapping/ems/how-use-service

International crowdsourced analysis

Name of source	Brief description	Access information	Steps to obtain products and services
Humanitarian Open Street Map Team	The Humanitarian Open Street Map Team applies the principles of open source and open data sharing for humanitarian response and economic development.	Free access to download digital products and register as volunteers to participate in image analysis through an online portal. Registration required in the community portal. https://hotosm.org/	Request activation of Open Street Maps services at http://hotosm.org/sites/default/files/HOTActivationProtocol.pdf Download data from crowdsourcing community portals
Tomnod	Tomnod is a team of volunteers who work together to identify important objects and interesting places in satellite images, which also extends to disasters.	Free access to download digital products and register as volunteers to participate in image analysis through an online portal. Registration required in the community portal. www.tomnod.com	Request and participate as a part of the crowdsourcing community.

Regional service providers

Name of source	Brief description	Access information	Steps to obtain products and services
RESAP	The RESAP network provides geospatial information products for free to be used by member countries for the purpose of disaster preparedness as well as emergency response.	To become a RESAP member: • Initially inform the UNESCAP Secretariat of your country's intention of becoming a member of the RESAP network • Write to the UNESCAP Executive Secretary requesting membership (recommended at the ministerial level) • Attend the subsequent annual Intergovernmental Consultative Committee session for RESAP in order to formalize membership.	Gather the following information: • Location name • Location coordinates • Type of hazard • Date of hazard event • Name(s) of person(s) to send imagery to • Contact telephone number • E-mail addresses to send imagery to • Additional notes • Name of your national RESAP focal point (if you have one and are requesting on their behalf). Contact the RESAP coordinator at UNESCAP: escap-sas@un.org
Sentinel Asia	Sentinel Asia is a voluntary initiative led by the Asia-Pacific Regional Space Agency Forum to support disaster management activity in the Asia-Pacific region by applying Web GIS technology and space-based technology such as EO satellite data.	• Joint Project Team members can request activation. • Only a designated Data Analysis Node has access to the satellite imagery. https://sentinel.tksc.jaxa.jp/sentinel2/MB_HTML/JPTMember/JPTMember.htm	• Joint Project Team requests activation • Data Analysis Nodes provide satellite-derived products and information
UN-SPIDER	UN-SPIDER Regional Support Offices and partner organizations are able to provide mapping support during emergencies. In Asia, the Regional Support Offices are the International Centre for Integrated Mountain Development (www.icimod.org), the Iran Space Agency, the Space and Upper Atmosphere Research Commission of Pakistan and the International Water Management Institute (www.iwmi.cgiar.org). In addition, UN-SPIDER cooperates with partners such as the National Disaster Reduction Centre of China to provide emergency mapping support.	http://un-spider.org/network/regional-support-offices	

Appendix 3: List of common types of satellite applications which are available for each mechanism

A brief list of the satellites mentioned within these guidelines and their applications during an emergency response.

Name of the satellite	Applications	Activity	Commercial use	URL
Landsat	• Agriculture, forestry and range resources • Land-use and mapping • Geology • Hydrology • Coastal resources • Environmental monitoring	Active	Free	https://landsatlook.usgs.gov/viewer.html
China–Brazil Earth Resources Satellite	• Agriculture • Forestry • Water conservancy • Land-use • Geology and minerals • City planning • Environmental protection • Disaster monitoring • Mapping	Active	Free for Latin American Countries	http://www.dgi.inpe.br/CDSR/
Sentinel	• Land management • Marine environment • Atmosphere • Emergency response • Security • Climate change	Active	Free	https://sentinel.esa.int/web/sentinel/sentinel-data-access
OrbView-3	• Utilities • Telecommunications • Oil and gas • Mapping • Surveying • Agriculture • Forestry • National security	Not Active	Free	https://earthexplorer.usgs.gov/
Spot Image (SPOT 5, 6 and 7. Distribution rights on other satellites images)	• Civil and military mapping • Natural and man-made disaster management • Insurance • Natural resources exploration • Land planning • Agriculture • Civil engineering • Environmental protection • Maritime surveillance • GIS	Active	For Sale	http://www.intelligence-airbusds.com/geostore/

Appendix 4: Good practices in satellite mapping

A picture is worth a thousand words. It is the same for a crisis map. A typical crisis map – for example, a crisis map produced by UNITAR/UNOSAT – is usually self-evident and easy to read and understand. However, several points should be taken into consideration when reading a crisis map. The goal of this section is to share some fundamental understanding about typical crisis maps which may help readers interpret them more efficiently.

What is a crisis map?

A crisis map, or an emergency map, refers to a map that describes areas at risk of natural disasters, such as floods, cyclones, earthquakes, landslides, forest fires, volcanic eruptions. Crisis maps provide the reader with critical information to understand the crisis situation and to help deal with activities such as emergency response, recovery and reconstruction.

Basic types of crisis maps

According to Copernicus Emergency Management Service and IWG-SEM, there are essentially four types of crisis maps, including reference maps (or pre-event maps), delineation maps (or impact maps), grading maps (or damage level maps), and situation update maps. Each type of crisis map provides different information and hence plays a relatively specific role in the crisis event.

Reference maps

Reference maps, or pre-event maps, provide background knowledge and an overview of the situation of the affected territory prior to the disaster event. They usually include selected topographical features (such as administrative boundaries, settlements, transportation networks, utilities and hydrology) and other available geographic information about the area affected by a specific disaster event. They are normally based on a pre-event archived satellite image captured as close as possible to the time of the disaster event.

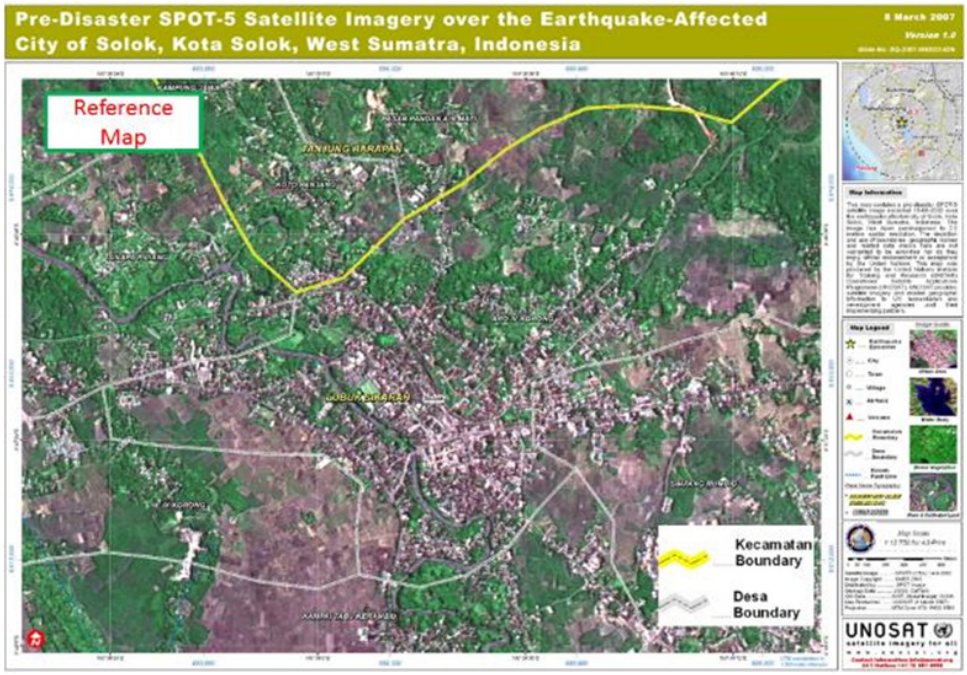


Figure 10: Reference map example

Source: UNITAR/UNOSAT, GLIDE: EQ-2007-000033-IDN

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 10 is an example of a reference map that contains a pre-disaster SPOT-5 satellite image (2.5m resolution) acquired close to the time of the earthquake, which shows the basic topographic features – such as administrative boundaries and labels – over the earthquake-affected city of Solok, Indonesia.

Delineation maps

Delineation maps, or impact maps, provide an assessment of the impact and extent of the disaster event. They are usually directly derived from post-event satellite images which are acquired immediately after the disaster event and they can be used to indicate flood extent, cyclone scope, burned area, etc. For example, for a flood event, delineation maps (or flood extent maps) can show flooded areas and can be compared with archived flood information if needed. Figure 11 is a sample of a delineation map for a flood.

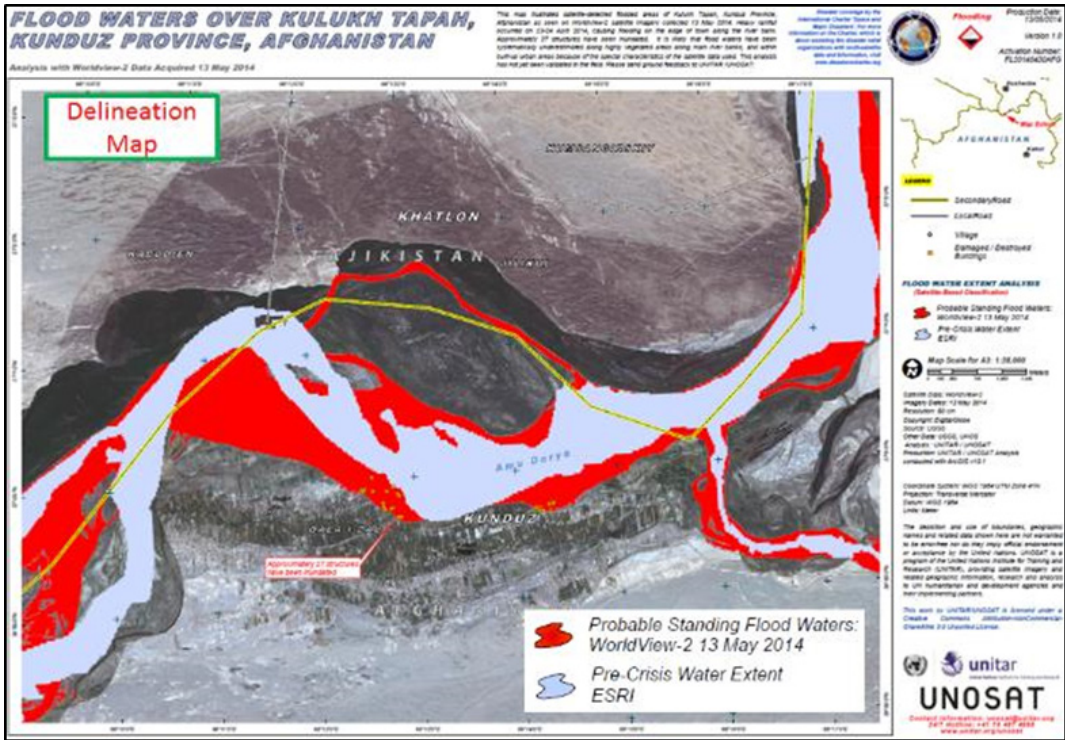


Figure 11: Delineation map example

Source: UNITAR/UNOSAT, GLIDE: FL20140430AFG
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 11 is a sample of the delineation map which contains a post-disaster Worldview-2 satellite image (0.5m resolution) acquired close to the time of the flood event. It shows the extent of the probable standing flood waters, which was detected by means of visual interpretation of the post-disaster satellite imagery. On the map, the red areas represent the probable standing flood waters and the light blue areas represent the pre-crisis water extent.

Grading maps

Grading maps, or damage level maps, provide an assessment of the damage caused by the disaster event. They are usually derived from post-event satellite images acquired after the disaster event and other available topographical information. They can include impact extent and type or magnitude of damage specific to the disaster. For example, with regard to cyclones, they can quantitatively indicate buildings damaged in the affected region. Figure 12 is an example of a grading map for a cyclone.

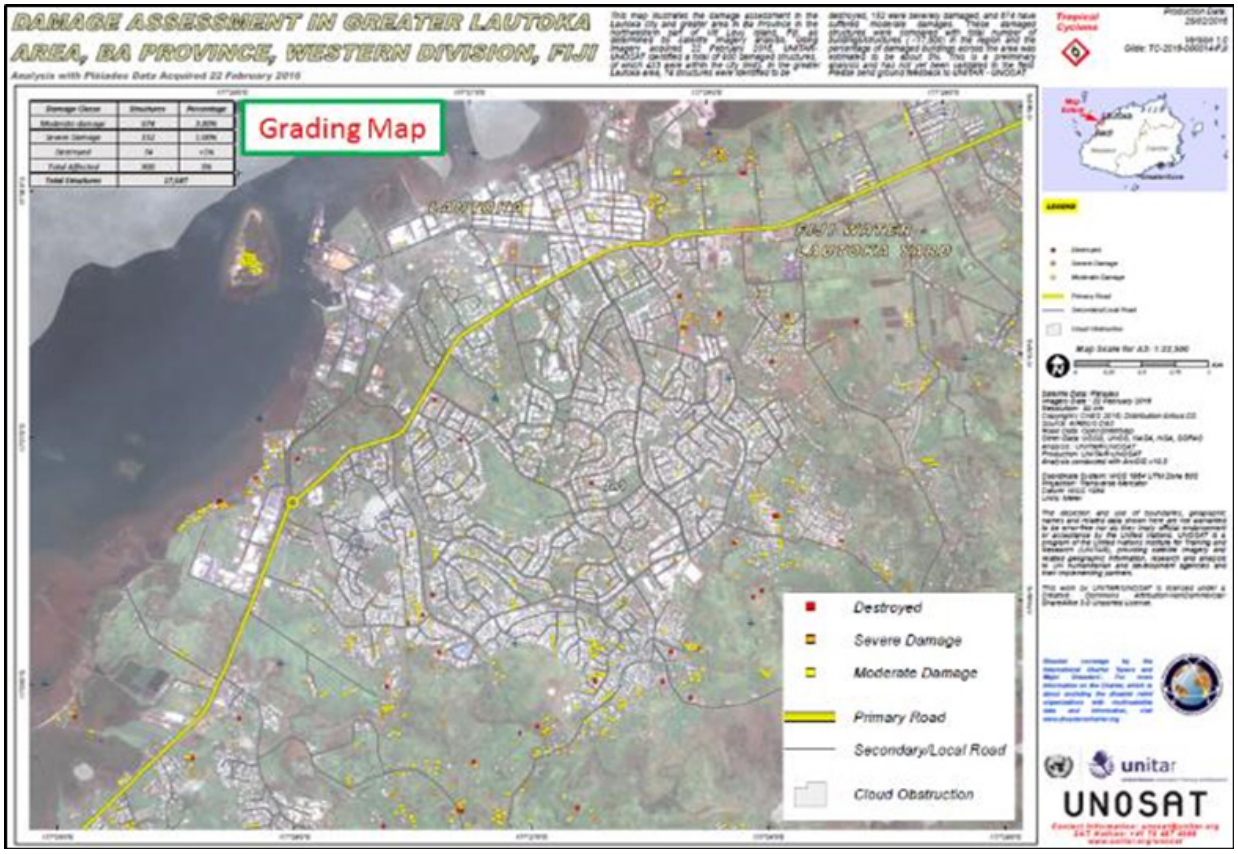


Figure 12: Grading map example

Source: UNITAR/UNOSAT, GLIDE: TC-2016-000014-FJ

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 12 is an example of a grading map which contains a post-disaster Pléiades satellite image (0.5m resolution). It illustrates the damage assessment (destroyed or damaged buildings) interpreted by satellite imagery analysis in the Lautoka area, Fiji. On this map, red markers represent destroyed buildings, while gold markers represent severely damaged buildings and yellow markers represent moderately damaged buildings.

Situation update maps

Situation update maps, or event monitoring maps, provide an assessment of the evolution of the event impact and extent. They are essentially the further updated delineation maps or grading maps of the disaster. This can also include monitoring of rainfall, vegetation, cyclone track, etc. Figure 13 is an example of a situation update map for a landslide.

Figure 13: Situation update map example

Source: UNITAR/UNOSAT, GLIDE: FL20140430AFG
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 13 is an example of a situation update map which contains a post-disaster WorldView-2 satellite image (0.5m resolution). It illustrates satellite-detected areas of landslide damage as well as areas of internally displaced persons, relief operations and water pooling due to the landslide in the village of Ab Barek, Badakshan, Afghanistan. On this map, the pinkish area represents the updated landslide area; the solid red area represents the updated flooded areas; the red markers represent damaged buildings; and the blue markers represent shelters for internally displaced persons.

Basic components of a crisis map

There are a number of basic components on a typical crisis map, such as map title, legend, scale, disaster information, topographical information, etc. However, from the viewpoint of the cartographer, these components fall into two main groups; one is the map frame and the other is the map marginalia, as shown in figure 14 below.

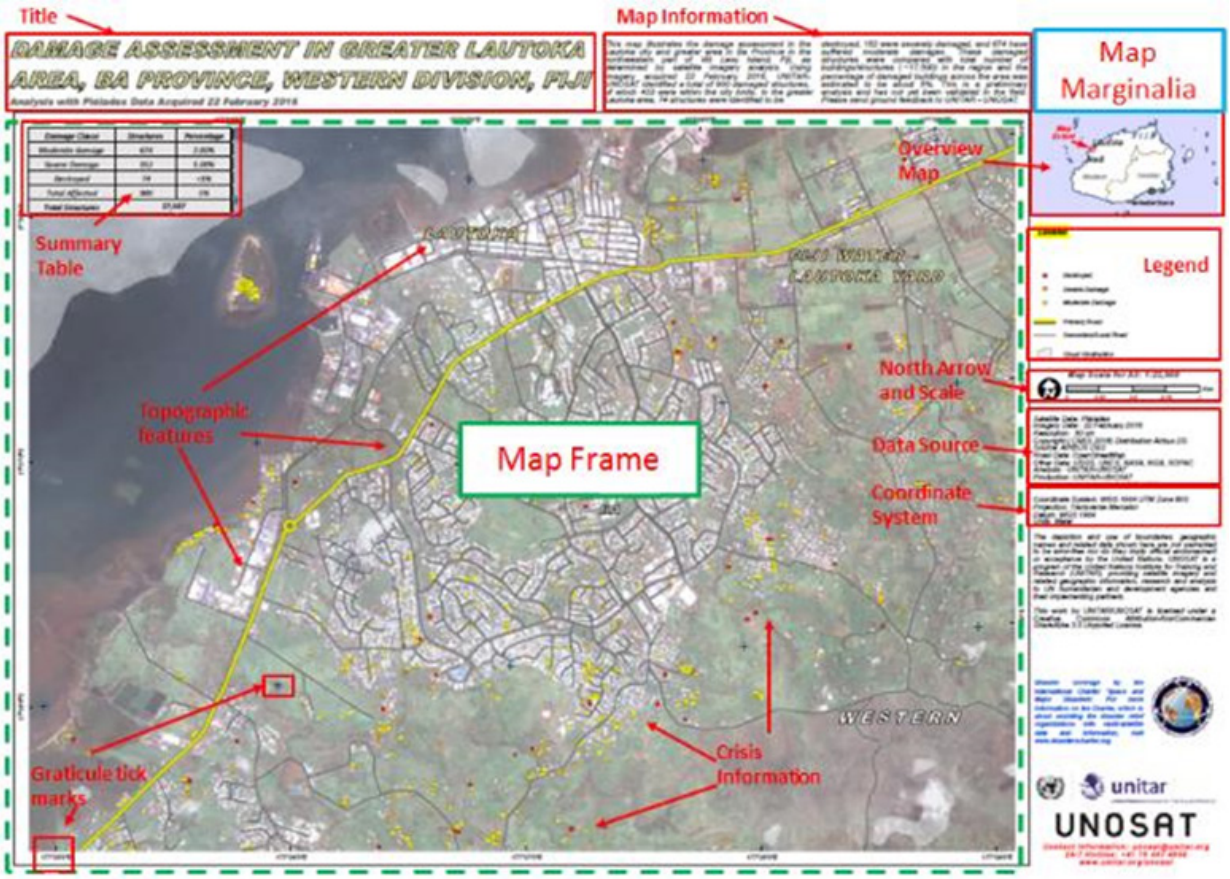


Figure 14: Basic components of a crisis map

Base map source: UNITAR/UNOSAT, Glide: TC-2016-000014-FJ

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Map frame

The map frame or primary map uses map symbols or satellite images to geographically represent the primary disaster information, essential topographic features and other general auxiliary information graphics in the mapped area.

- **Crisis information** (flooded area, damaged buildings, burned area, grading, etc.) is the most visible in the map frame. Examples of flood disaster and cyclone disaster information are shown in figure 15.

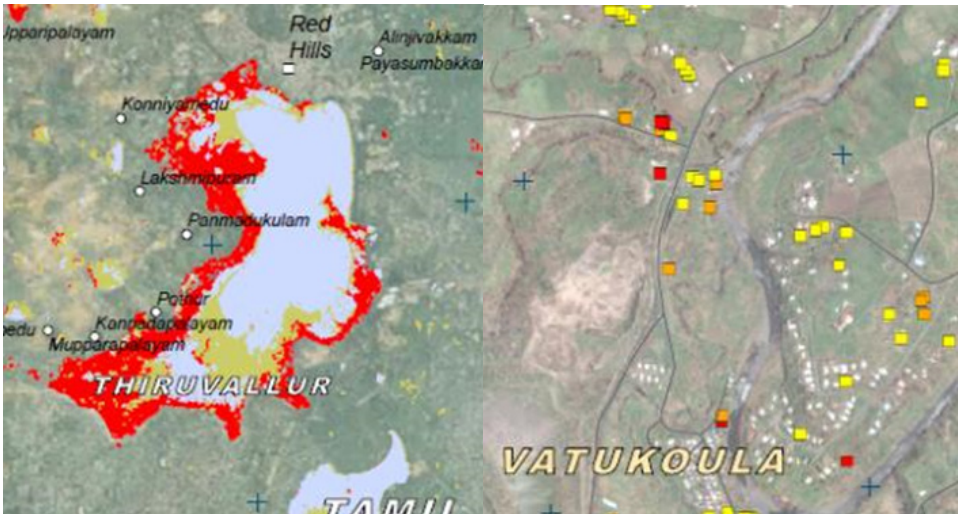


Figure 15: Crisis information examples (left, flood; right, cyclone)

Source: UNITAR/UNOSAT, Glide: FL20151123IND, TC-2016-000014-FJI
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

On the flood delineation map (left side), the red or olive areas (different colours mean different dates) represent probable standing flood waters, while the light blue areas represent the pre-crisis water extent. In the map on the right, a cyclone damage assessment map, the red markers represent destroyed buildings, while the gold markers represent severely damaged buildings and the yellow markers represent moderately damaged buildings.

- **Topographic features** include geographic features such as administrative boundaries and labels, settlements, hydrology, utilities, transportation networks, etc. Considering the subject and readability of the map, only the essential topographic features which are useful for the situation can be selected in the map. An example of topographic features with boundaries and labels, settlements, hydrology and transportation networks is shown in figure 16.

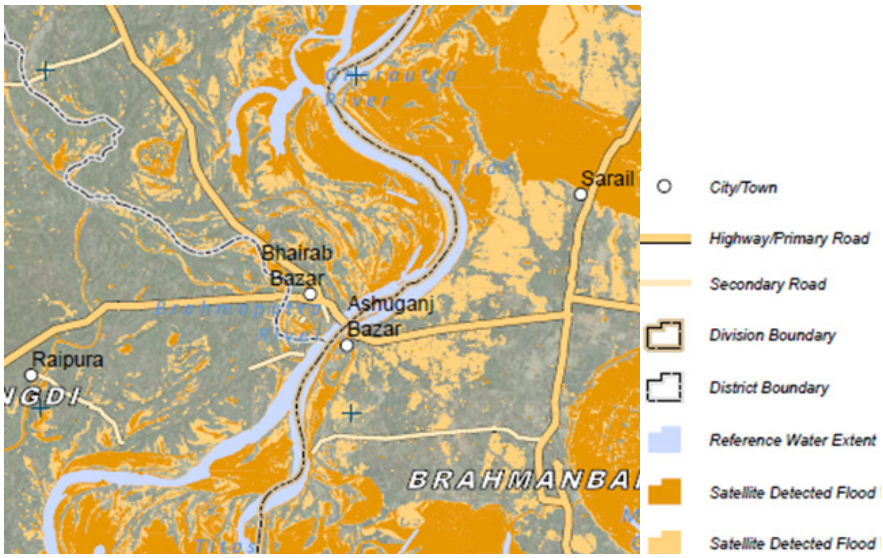


Figure 16: Example of topographic features

Source: UNITAR/UNOSAT, Glide: FL20160725BGD
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

- **General information**
  - Area of interest: A square or rectangle, together with labels and detail map, which shows the area of interest on the map. An example is provided in figure 17.

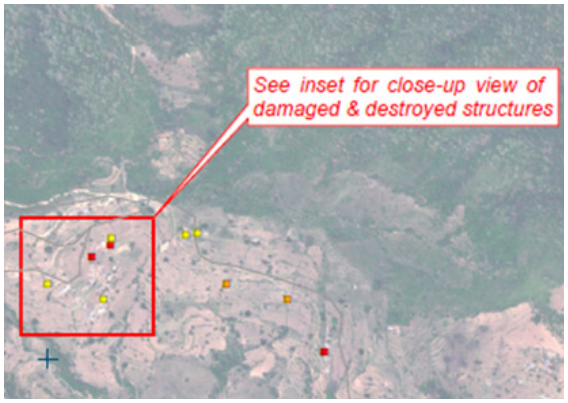


Figure 17: Area of interest example

Source: UNITAR/UNOSAT, Glide: FL20150425NPL
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

- Graticule tick marks: Related to the coordinate system used by the map and used to identify the absolute locations on the map. A sample with WGS84 geographical coordinate is shown in figure 18.

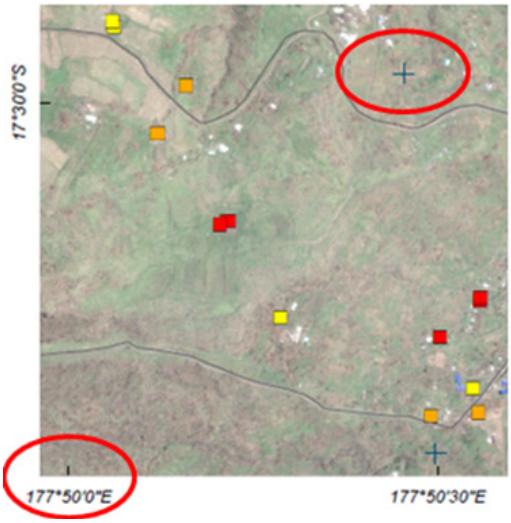


Figure 18: Graticule tick mark example

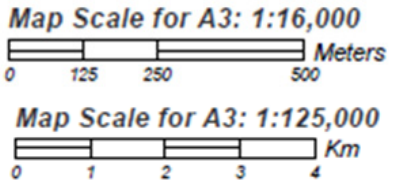
Source: UNITAR/UNOSAT, Glide: TC-2016-000014-FJ
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

- **Satellite images** such as those from Landsat, SPOT, the China–Brazil Earth Resources Satellite, Sentinels, Worldview, Pléiades, etc. are usually used as a backdrop on a crisis map. They provide valuable information about the disaster situation at a particular time.

Map marginalia

The map marginalia usually includes map title, map legend, cartographic information (scale bar, north arrow, map size, coordinate system, etc.), inset map, summary table and text information (data sources, copyrights and logos, etc.).

- **Map title** is used to focus the reader's attention on the primary content of the map and indicates the area (country and location) and the event and subject depicted on the map, e.g. 'Damage Assessment in Vatukoula area, Ba Province, Western Division, Fiji'.
- **Cartographic information** includes some essential cartographic features of the map (see the table below) which are independent of the map contents.

Map scale	A map scale represents the ratio of a distance on the map to the corresponding distance on the ground. In general, there are two ways to express map scale; one is scale ratio and the other is scale bar. The scale ratio is numerically expressed as a ratio or a fraction, e.g., 1:125,000 or 1/125,000. The scale bar is graphically expressed as a bar graph, e.g., metres or kilometres.	 Figure 19: Map scale examples
North arrow	This arrow helps to orient the map to north.	 Figure 20: North arrow examples
Map size	Paper size for printing and obtaining the declared cartographic scale, e.g. A1, A2, A3 etc.	
Coordinate system	Specifications of reference ellipsoid, reference datum and cartographic projection of the map. In general, the World Geodetic System 84 Universal Transverse Mercator coordinate system and the World Geodetic System 84 geographic coordinate system are two commonly used coordinate systems for crisis maps.	

- The **map legend** lists and describes all the symbols used on the map which are likely to be unknown to the reader. It should be completely consistent with the map frame content. Examples are shown in figure 21.

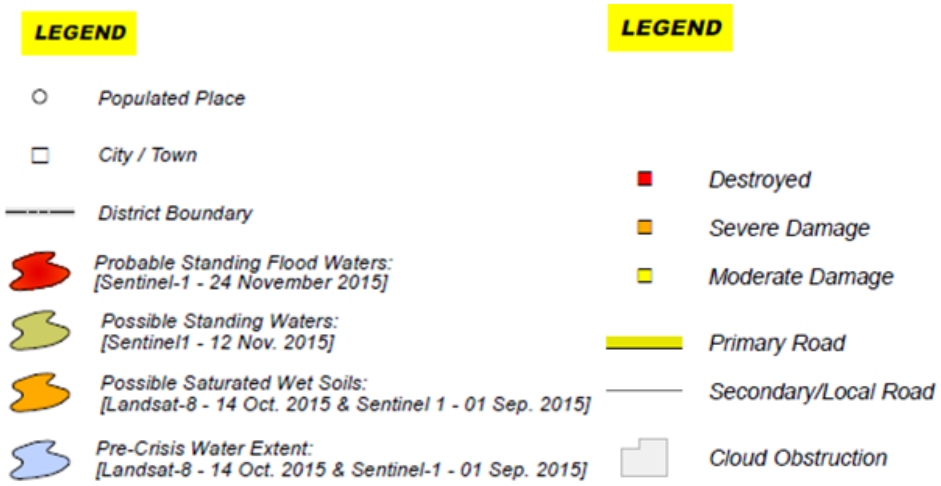


Figure 21: Map legend example

- An **inset map** is smaller than the primary map. In general, there are two basic types: one is an overview map and the other is a detail map. The overview map, also called location map, is used to locate the primary map at a small scale within the context of a large area. The detail map is used to show a detailed part of the primary map at a larger scale. Examples are shown in figure 22.

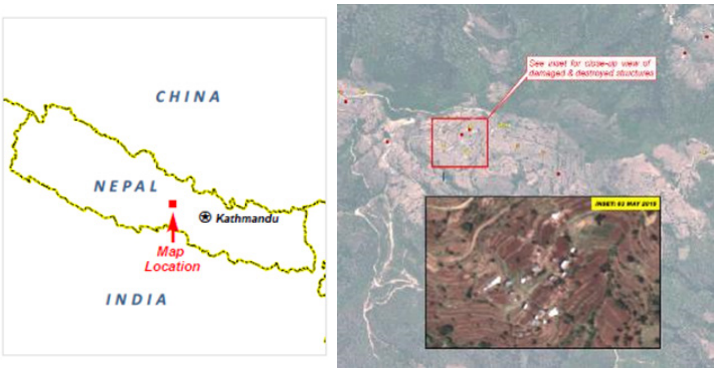


Figure 22: Inset map examples (left: overview map, right: detail map)

Source: UNITAR/UNOSAT, Glide: FL20150425NPL

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

- A **summary table** contains summary figures regarding the exposed or affected population, settlements, transportation networks, utilities, land use, etc. It is usually found on a grading map. An example is shown in figure 23.

Damage Classe	Structures	Percentage
Moderate damage	674	3.80%
Severe Damage	152	1.00%
Destroyed	74	<1%
Total Affected	900	5%
Total Structures	**17,587**	

Figure 23: Summary table example

- **Text information**
  - **Map information** describes some general information about the crisis and its consequences, including figures, e.g. the magnitude of the event, the number of affected municipalities and persons and the total affected area.
  - **Data sources** list data sources used on the map along with their information, e.g. date, accuracy, degree of completeness and reliability, copyright, etc. An example is shown in figure 24.
  - **Copyrights and logos**. An example is shown in figure 25.

Satellite Data: Pléiades
Imagery Date : 22 February 2016
Resolution: 50 cm
Copyright:(CNES 2016) Distribution Airbus DS
Source: AIRBUS D&S
Road Data: OpenStreetMap
Other Data: USGS, UNCS, NASA, NGA, SOPAC
Analysis : UNITAR-UNOSAT
Production: UNITAR-UNOSAT
Analysis conducted with ArcGIS v10.3

Figure 24: Data sources example

unitar
UNOSAT

Figure 25: Copyright and logo example

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facebook.com/UNOOSA
youtube.com/UNOfficeforOuterSpaceAffairs

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