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The evolution of Earth Observation satellites in Europe and its impact on the performance of emergency response services

Gil Denis [a,*], Hélène de Boissezon [b], Steven Hosford [b], Xavier Pasco [c], Bruno Montfort [a], Franck Ranera [a]

[a] Airbus Defence and Space, France
[b] Centre National d'Etudes Spatiales, France
[c] Fondation pour la Recherche Stratégique, France

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ABSTRACT

The paper reviews the evolution of Earth Observation systems in Europe and Worldwide and analyses the potential impact of their performance in support of emergency response services. Earth Observation satellites play already a significant role in supporting the action of first responders in case of major disasters. The main principle is the coordinated use of satellites in order to ensure a rapid response and the timely delivery of images and geospatial information of the area affected by the event.

The first part of the paper reviews the main instruments and evaluates their current performance. The International Charter "Space and Major Disasters", signed in October 2000, was the first international initiative aimed at establishing a unified system for the acquisition of space data. The charter is a co-operation agreement between space agencies and operators of space systems. At regional level, a similar instrument exists in Asia: Sentinel-Asia. In the frame of the European programme Copernicus, the emergency management service was launched in 2009. Geo-information products derived from space imagery are delivered during all phases of the emergency management cycle, in either rush or non-rush mode, free of charge for the users. In both cases, the capacities were historically drawn from national missions, funded with public money and directly operated by the space agencies or by national operators.

The paper focuses on the performance of the space infrastructure (satellites and ground segments). Several trends may have a significant impact on the current performance:

- The increasing number of space systems which are privately-owned and managed by commercial operators.
- The emergence in Europe of shared-ownership or community-owned systems. Copernicus Sentinel missions (Copernicus) or Eumetsat satellites are two typical examples.
- The development of dual-use capacities and the sovereignty dimension of these systems.
- The development of unmanned airborne vehicles (UAVs) for civil applications.
- The development of social media and crowd-based initiatives for humanitarian aid and emergency response.
- Possible disruptions, such as large LEO constellations or GEO infrastructures enabling persistent observation.

A common feature is the increased number of information sources and the higher real time dimension.

Abbreviations: ADRC, Asian Disaster Reduction Center; AOI, Area of Interest; ASEAN, Association of Southeast Asian Nations; AU, Authorised User; CCM, Copernicus Contributing Mission; CDS, Coordinated Data Access System; CSC-DA, Copernicus Space Component Data Access; CNES, Centre National d'Etudes Spatiales; DAP, Data Access Portfolio; DEM, Digital elevation Model; DG, Directorate General; DPN, Data Provider Node; DWH, Data Warehouse; EC, European Commission; EFAS, European Flood Awareness System; EMS, Emergency Mapping Service; EO, Earth Observation; ESA, European Space Agency; EU, European Union; FS, Feasibility study; GAFA, Google Apple Facebook Amazon; GEO, Group on Earth Observation; GIO, GMES/Copernicus Initial Operations; GMES, Global Monitoring for Environment and Security (former name of Copernicus); HAPS, High Altitude Pseudo-Satellite; HR, High Resolution; IDP, Internally Displaced Persons; JPT, Joint Project Team; PM, Project Manager; PPP, Public Private Partnership; NGA, National Geospatial-Intelligence Agency; NRT, Near Real-Time; SA, Sentinel Asia; SAARC, South Asian Association for Regional Cooperation; SAFER, Services and Applications for Emergency Response; SAR, Synthetic Aperture Radar; UAV, Unmanned Aerial Vehicle; UN, United Nations; UNOOSA, UN Office for Outer Space Affairs; VA, Value-adder; VHR, Very High Resolution

* Corresponding author.
E-mail addresses: gil.denis@airbus.com (G. Denis), helene.deboissezon@cnes.fr (H. de Boissezon), steven.hosford@cnes.fr (S. Hosford), x.pasco@frstrategie.org (X. Pasco), bruno.montfort@astrium.eads.net (B. Montfort), franck.ranera@astrium.eads.net (F. Ranera).

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Typical scenarios for the future are described and their likelihood is discussed, including political acceptance and the international dimension. Aside from rapid technological evolutions, two main driving factors are the capacity of national and international stakeholders to agree on governance and the sustainability of the economic models.

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1. Introduction

Earth Observation (EO) satellites play a significant role in supporting the action of first responders in case of major disasters. The coordinated use of EO satellites ensures a rapid response and the timely delivery of images and geospatial information of the area affected by the event to the first responders.

This paper reviews the future evolutions of Earth Observation systems and analyses the potential impact on the emergency response services. The main focus is the reactive image acquisition and the support to the immediate response during the crisis.

The objective is to evaluate the trends that may have a significant impact on the current situation. These trends are diverse, from the increasing number of EO satellites owned by developing countries, the development of commercial and private initiatives and possible disruptive technologies. There are also new non-space solutions, such as the unmanned airborne vehicles (UAVs) for civil applications or the social media and crowd-sourcing initiatives in the domain of humanitarian aid and emergency response.

Based on the European experience, the potential impact of these evolutions is evaluated from three perspectives (operational performance, governance and economic models).

From a prospective point of view, the paper identifies and articulates possible scenarios and derives a balanced vision based on a hybrid architecture of components owned by Member States, private operators and communities of States.

Section 2 introduces the role of Earth Observation satellites in support of emergency response operation. Section 3 describes three of the main current initiatives in Europe and Worldwide: the International Charter “Space and Major Disasters”, The Emergency management service implemented in the frame of the Copernicus programme and Sentinel Asia.

Based on statistics and operational figures recorded since 2000, Section 4 analyses the current use and value of Earth Observation capacities in support of crisis management. The trends and their possible impact on the emergency response operations and future scenarios a represented in Section 6. Section 7 provides a political perspective. The last part of the paper is a critical discussion of the possible scenarios and provides outlooks for the future.

2. The role of Earth Observation satellites in support of emergency response operation

2.1. How Earth observation satellites support emergency response efforts

Earth Observation satellites play a significant role in supporting the action of first responders in case of major disasters [1]. The main principle is the coordinated use of satellites in order to ensure a rapid response and the timely delivery of images and geospatial information of the area affected by the event (Fig. 1).

In case of a major disaster affecting a population, decision makers and in field actors need to get a rapid assessment of the affected area in which the event has occurred, together with an indication of the impact on people and goods.

To contribute efficiently and effectively to the management of operations, information derived from satellite imagery shall be:

- Provided in the shortest delay (24-h delivery after the event is a standard time requirement)
- Relevant and understandable for operations management (decision makers, in-field rescue team).
- Easily pluggable in the management process of the national authority.

2.2. Type of products and information content

To meet these objectives, specific satellite images have to be acquired very quickly during or immediately after the disaster. The efficient coordination of the Space data procurement and the reactive capacities of the current satellites, are a key asset to guarantee that any relevant satellite passing over the affected area will be programed (tasked) and that no opportunities will be missed. It is also crucial that the information content provided by the value added product responds to actors expectations. EO based Emergency Response services create two main types of products:

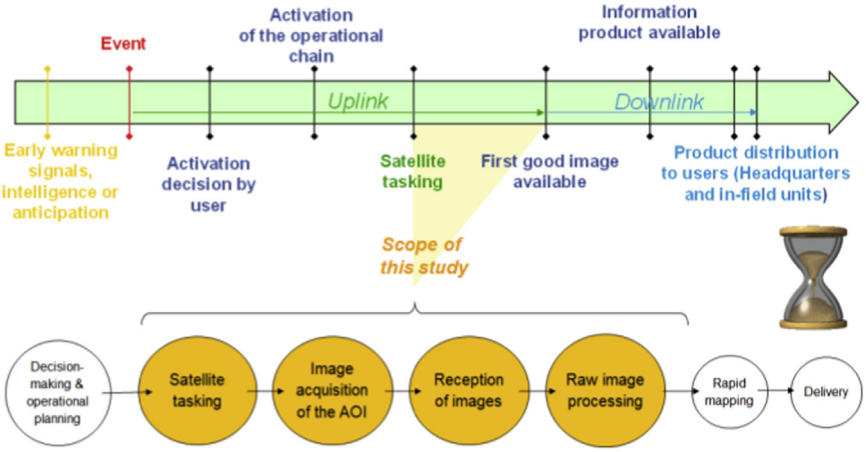

Fig. 1. scope of the study – Reactive imagery.

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