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The International Legal Framework on the Utilization of Remote Sensing Satellites in the Event of a Disaster: Analysis of the Copernicus Emergency Management Service and its Contribution in the Response to the Wildfire in Chile

Elisa Leoni
CASD/SSU

Carlo Bongioanni
CASD/SSU

THE INTERNATIONAL LEGAL FRAMEWORK ON THE UTILIZATION OF REMOTE SENSING SATELLITES IN THE EVENT OF A DISASTER: ANALYSIS OF THE COPERNICUS EMERGENCY MANAGEMENT SERVICE AND ITS CONTRIBUTION IN THE RESPONSE TO THE WILDFIRE IN CHILE

Elisa Leoni and Carlo Bongioanni***

ABSTRACT

The aim of this contribution is to stress the importance of the use of remote sensing satellites within the framework of regional and international cooperation to improve responses to natural and human-made disasters. Starting from a comprehensive review of the international legislation underlying the satellite remote sensing activities, which has promoted the use of these technologies in emergency scenarios, the article will proceed, analyzing a practical case, with a technical explanation of how these satellites have actually been used to assist operators engaged in the disaster response to the emergency in question.

I. INTRODUCTION

The severity and frequency of natural and human-made disasters occurring around the world is constantly increasing.[1] States,

* Ph.D. Candidate at the School of Advanced Defence Studies (CASD/SSU), in Defence & Security Studies, curriculum: Legal studies for innovation, elisa.leoni@unito.it or elisa.leoni@stud.unicasd.it.

** Assistant Professor at the School of Advanced Defence Studies (CASD/SSU), Defence Research and Analysis Institute (IRAD), carlo.bongioanni@unicasd.it

1 As affirmed by the Joint Research Center (JRC) of the European Union (EU), natural and human-made disasters include "...droughts, desertification, floods, landslides,

international organizations and private actors must be prepared to respond to such disasters in an effective and timely manner to minimize damage and loss of life. To this end, a crucial contribution in disaster response activities is provided by remote sensing satellites which, through the addition of mapping capacity, help to illustrate the severity and scope of the damage caused by disasters, and consequently, guide operators to adopt the correct operational decisions.

The aim of the present article is to make readers aware of the relevance of using these kinds of technologies in disaster response activities, stressing the importance of utilizing these tools within international or regional mechanisms, like the Charter on Space and Major Disaster or Copernicus Emergency Management Service (CEMS).[2]

To achieve this goal, the article is divided into three main sections. The first section offers a comprehensive analysis of the international legal framework ruling remote sensing activities, with a focus on United Nations (UN) Resolution 41/65, commonly known as the Principles Relating to Remote Sensing of the Earth from Space[3] (Principles). Within this section, particular attention is given to Article XI of the Principles, which is widely recognized as the catalyst for key initiatives promoting the use of remote sensing satellites in disaster prevention and response.[4]

In the subsequent section, the discussion shifts to a detailed examination of a fundamental international mechanism in this field: the Charter on Cooperation to Achieve Coordinated Use of Space Structures in the Event of Natural or Technological

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wildfires, earthquakes, tsunamis or cyclones" and may also be considered to include "[t]he dispersion of radioactive gases in the atmosphere, or technological accidents - like oil plants or gas pipelines damaged by a natural hazard and releasing hazardous materials or gases…" *See Natural and Man-Made Hazards*, EUR. COMM. JOINT RSCH. CENTRE, https://joint-research-centre.ec.europa.eu/projects-and-activities/natural-and-man-made-hazards_en (last visited Dec. 18, 2024).

[2] *See generally Copernicus Emergency Management Service (CEMS)*, U.N. OFF. FOR OUTER SPACE AFFS., https://www.un-spider.org/copernicus-emergency-management-service-ems (last visited Dec. 6, 2024).

[3] *See generally* G.A. Res. 41/65, Principles Relating to Remote Sensing of the Earth from Outer Space (Dec. 3, 1986) [hereinafter Remote Sensing Principles].

[4] *See id.* at art. XI.

Disasters[5] (Charter). This section provides both legal and non-legal analyses of the Charter's significance and its activities.

The third section delves into the Copernicus Emergency Management Service[6] (CEMS), exploring its evolution and role in disaster response activities. Within this section, emphasis is placed on the importance of cooperation between CEMS and the Charter, clarifying, by means of a case study, how and in what circumstances this cooperation is carried out.

Lastly, in recognition of the vital role that remote sensing satellites play in emergency response, subsections IV.B and IV.C offer technical explanations of how CEMS has significantly contributed to Chile's disaster response efforts. These subsections also shed light on the practical implementation of this cooperation, providing insights into the operational aspects of utilizing remote sensing satellites for disaster management.

II. THE INTERNATIONAL LEGISLATION ON REMOTE SENSING SATELLITES: PRINCIPLES RELATING TO REMOTE SENSING OF THE EARTH FROM OUTER SPACE AND THEIR LEGAL VALUE

A. Development

In order to understand the importance of remote sensing in the event of a disaster, it is essential to analyze and understand the international legal framework associated with such activities, established by UN General Assembly Resolution 41/65.[7] The Principles were adopted by the UN without a vote on December 3, 1986.[8] Per Principle I of the Remote Sensing Principles, "remote sensing" means "the sensing of the Earth's surface from space by making use of properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural

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[5] *See generally* Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters, Rev.3 (25/4/2000).2, https://disasterscharter.org/text-of-the-charter (last visited Dec. 6, 2024) [hereinafter Disaster Charter].

[6] COPERNICUS EMERGENCY MANAGEMENT SERVICE, https://emergency.copernicus.eu/ (last visited Dec. 15, 2024).

[7] *See* Remote Sensing Principles, *supra* note 3.

[8] See *Res 41/65,* U.N. OFF. FOR OUTER SPACE AFFS., https://www.unoosa.org/oosa/oosadoc/data/resolutions/1986/general_assembly_41st_session/res_4165.html (accessed Dec. 18, 2024).

resources management, land use and the protection of the environment."[9] To briefly explain, remote sensing entails transferring information related to the Earth, using space techniques and human skills.[10] This information can be used for several purposes: e.g., mapping forests and urban areas, monitoring nuclear activities, supporting humanitarian relief operations, and also for troop control.

The first proposal for a non-binding document regulating remote sensing activities in space was submitted to the UN Committee on Peaceful Uses of Space (COPUOS)[11] in 1970.[12] Four years later, the former Soviet Union and France presented a joint working paper on new agenda item, called "Legal Implication of Remote Sensing Application from Space."[13] The main topic discussed during multiple COPUOS debates was how to strike a balance between protection of national sovereignty of the sensed State and the freedom of remote sensing.[14] An interesting aspect of this debate was that the problem discussed was already settled by a well define

[9] *See* Remote Sensing Principles, *supra* note 3, Principle I.

[10] *See* Diego Zannoni, *Disaster Management and International Space Law, in* STUDIES IN SPACE L.15, 148 (2019).

[11] The Committee on the Peaceful Uses of Outer Space (COPUOS) was set up by the General Assembly in 1959 to govern the exploration and use of space for the benefit of all humanity: for peace, security and development. The Committee contributed to the drafting and the adoption of the five treaties and five principles of outer space. The Committee has two subsidiary bodies: the Scientific and Technical Subcommittee, and the Legal Subcommittee, both established in 1961. The Committee reports to the Fourth Committee of the General Assembly, which adopts an annual resolution on international cooperation in the peaceful uses of outer space. *See* COPUOS, *Committee on the Peaceful Use of Outer Space,* U.N. OFF. FOR OUTER SPACE AFFS., https://www.unoosa.org/oosa/en/ourwork/copuos/index.html (last visited Jan. 6, 2025).

[12] *See* SERGIO MARCHISIO, THE LAW OF OUTER SPACE ACTIVITIES (2022).

[13] See U.N. Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., Draft Principles Governing the Activities of States in the Field of Remote Sensing of Earth Resources by Means of Space Technology, U.N. Doc. A/AC.105/C.2/L.99 (May 27, 1974); Yearbook of the United Nations 1974 168, U.N. Sales No. E.75.I.1 (1975); Building on this initiative, the United States presented its own working paper in 1975, focusing on the development of additional guidelines See Comm. on Peaceful Uses of Outer Space, Legal Implications of Remote Sensing of the Earth from Space: Remote Sensing of the Natural Environment of the Earth from Outer Space: Working Paper on the Development of Additional Guidelines, U.N. Doc. A/AC. 105/C.2/L.103 (1975), https://digitallibrary.un.org/record/3976044?v=pdf (last visited Jan. 6, 2025).

[14] D.M. Polter, *Remote Sensing and State Sovereignty*, 4 J. Space L. 99, 100, 104–07 (1976).

practice.[15] Indeed, for years, States, international and regional organizations and non-governmental entities had carried out remote sensing activities without the consent of the sensed States and without any protest or compliance.[16] While, at the time of the debates in COPUOS, this practice was still controversial, its subsequent consolidation and eventual enshrinement in 1989 Principles, has contributed to the recognition of a customary rule[17] affirming the freedom to collect satellites data without prior consent.[18] Today, this freedom is widely regarded as a cornerstone of the international legal regime for remote sensing.[19]

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15 MARCHISIO, *supra* note 12, at 318.

16 Remote sensing activities were carried out well before the adoption of the 1986 UN Remote Sensing Principles: early meteorological satellites such as TIROS (1960) and the Landsat program (from 1972) routinely collected and disseminated Earth observation data across borders without prior consent from the sensed States. *See* NASA, *History Landsat Science,* https://science.nasa.gov/mission/landsat/outreach/landsats-enduring-legacy, (last visited Aug. 20, 2024); NASA, *Launch of TIROS-1, World's 1st Weather Satellite/,* https://www.nasa.gov/history/launch-of-tiros-1-worlds-1st-weather-satellite-this-week-in-goddard-history-march-31-april-6/ (last visited Aug. 20, 2025).

17 International custom, recognized in Article 38(1)(b) of the ICJ Statute, is composed of two elements: *state practice* and *opinio juris*. State practice must be sufficiently general and consistent, although absolute uniformity is not required, and must be carried out with a sense of legal obligation rather than mere convenience. Evidence of state practice and opinio juris may be found in government statements, legal memoranda, digests of international law, and the work of the International Law Commission. In space law, the *travaux préparatoires* of the treaties are an additional relevant source, and treaty provisions may serve either as evidence of emerging custom or as codifications of pre-existing rules. For custom to form, practice must be continuous and relatively stable, even if perfect consistency is unnecessary. As affirmed by the ICJ in *Nicaragua v. United States*, inconsistent conduct is generally treated as a breach of the rule, rather than evidence of a new one. No specific timeframe is required for a norm to crystallize into customary international law. See Statute of the International Court of Justice art. 38(1)(b), June 26, 1945, 59 Stat. 1055, 33 U.N.T.S. 993; Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.), Merits, Judgment, 1986 I.C.J. Rep. 14, ¶ 186; Memorandum by the Secretariat, Identification of Customary International Law, Int'l Law Comm'n, U.N. Doc. A/CN.4/691 (2016); M.O. Hudson, *International Legislation* vol. I, at 1–17 (Carnegie Endowment for Int'l Peace 1931); A. PERREAU-SAUSSINE & J.B. MURPHY EDS., THE NATURE OF CUSTOMARY LAW 149–335 (2007).

18 Zannoni, *supra* note 10, at 168.

19 MARCHISIO, *supra* note 12, at 323.

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B. Status

The Principles themselves are not legally binding and belong to the category of "soft law acts."[20] Despite their non-mandatory character, soft law acts (and in this regard UN resolutions) have more than a mere political and moral value. Indeed, they express the legal opinion of States, influencing their behavior and, some argue, directly contributing to the progressive consolidation of custom.[21] A resolution adopted without dissension by the UN General Assembly indicates that no UN member States disagreed with the text of the resolution, and demonstrate a willingness to put the

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[20] Notwithstanding that the international community does not have to reach a unique definition of what effectively constitutes "soft law acts," soft law is generally defined as a *variegate corpus* of non-legally binding instruments (e.g., resolutions, declarations, recommendations, guidelines, codes of conduct). Their non-binding nature is the parameter that is normally used to distinguish them from the so called "hard law," consisting of instruments that are always legally binding. Typical examples of relevant soft law acts are the Stockholm Declaration and the Rio Declaration. These non-binding "soft law" environmental instruments have laid the groundwork for the subsequent development of hard law principles, as they provide guidelines or standards of conduct that may often influence the actions of States in relation to environmental protection, but they do not, in and of themselves, have the legal "force" of binding treaties. Rather, it is only the subsequent reflection in treaties and customary law of the relevant concepts contained in these instruments that gives rise to binding international legal obligations. It is paramount to bear in mind that soft law acts cannot be seen as sources of international law. *See* Fabio Tronchetti, *Soft Law, in* OUTER SPACE IN SOCIETY, POLITICS, AND LAW 619-32 (11 ed. Christian Brünner & Alexander Soucek, *in* STUDIES IN SPACE POLICY 8, 2011); *see also* Nathan Clark, *Gauging the Effectiveness of Soft Law in Theory and Practice: A Case Study of the International Charter on Space and Major Disasters*, 43 AIR SPACE L. 77-111 (2018); *see also* Setsuko Aoki, *The Function of 'Soft Law' in the Development of International Space Law, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 57-86 (Irmgard Marboe ed. 2012); *see also* Steven Freeland, *The Role of 'Soft Law' in Public International Law and Its Relevance to the International Legal Regulation of Outer Space, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 9-30 (Irmgard Marboe ed. 2012).

[21] *See generally* Fabio Tronchetti, *Soft Law, in* OUTER SPACE IN SOCIETY, POLITICS, AND LAW 619-32 (11 ed. Christian Brünner & Alexander Soucek, *in* STUDIES IN SPACE POLICY 8, 2011); *see also* Nathan Clark, *Gauging the Effectiveness of Soft Law in Theory and Practice: A Case Study of the International Charter on Space and Major Disasters*, 43 AIR SPACE L. 77-111 (2018); *see also* Setsuko Aoki, *The Function of 'Soft Law' in the Development of International Space Law, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 57-86 (Irmgard Marboe ed. 2012); *see also* Steven Freeland, *The Role of 'Soft Law' in Public International Law and Its Relevance to the International Legal Regulation of Outer Space, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 9-30 (Irmgard Marboe ed. 2012).

https://egrove.olemiss.edu/j_space_l/vol48/iss1/4
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terms into practice.[22] As asserted by many scholars, soft law provisions, to a certain extent, have legal value; indeed, they can be deemed to operate in a gray zone between binding norms of law and legally irrelevant political maxims.[23] According to the ruling of the International Court of Justice, a State's agreement with another entity can hold binding force, even if it is not in the form of a treaty.[24] The legal significance of provisions within soft law instruments is evidenced by their influence on the law-making process.[25] In this regard, it is worth underlining the several functions that soft law acts can provide: they can serve as evidence of existing legal norms;[26] they can contribute to the formation of *opinio juris* or State practice, thus leading to the creation of new customary rules;[27] they can initiate the process that ultimately results in the formation of a treaty;[28] they can undergo changes and shed their non-binding nature as States starts to comply with them.[29] It is important to note that soft law does not inherently constitute law itself, but it can certainly have a significant impact on the development of legal norms in certain circumstances.[30] As far as the Principles are

[22] *See generally* Fabio Tronchetti, *Soft Law, in* OUTER SPACE IN SOCIETY, POLITICS, AND LAW 619-32 (11 ed. Christian Brünner & Alexander Soucek, *in* STUDIES IN SPACE POLICY 8, 2011); *see also* Nathan Clark, *Gauging the Effectiveness of Soft Law in Theory and Practice: A Case Study of the International Charter on Space and Major Disasters*, 43 AIR SPACE L. 77-111 (2018); *see also* Setsuko Aoki, *The Function of 'Soft Law' in the Development of International Space Law, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 57-86 (Irmgard Marboe ed. 2012); *see also* Steven Freeland, *The Role of 'Soft Law' in Public International Law and Its Relevance to the International Legal Regulation of Outer Space, in* SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW 9-30 (Irmgard Marboe ed. 2012).

[23] Kenneth Abbot & Duncan Snidal, *Hard and Soft Law in International Legal Governance*, 54(3) INT'L ORG. 421, 421-56 (2000).

[24] Anglo-Iranian Oil Co. Case (U. K. V. Iran), Preliminary Objections, 1952 I.C.J. 93 (July 22). *See* Tronchetti, *supra* note 20, at 619-632.

[25] Pierre-Marie Dupuy, *Soft Law and the International Law of the Environment*, 12 MICH. J. INT'L L. 420, 424–28, 431–32 (1991). *See* Tronchetti, *supra* note 20, at 619-632.

[26] Bin Cheng, *United Nations Resolutions on Outer Space: "Instant" International Customary Law?, in* BIN CHENG, STUDIES IN INTERNATIONAL SPACE LAW 135, 140–42 (1997).

[27] Dupuy, *supra* note 25, at 332-333. *See* Tronchetti, *supra* note 20, at 619-632.

[28] Alan Boyle, *Some Reflections on the Relationship of Treaties and Soft Law*, 48 INT'L & COMP. L.Q. 901, 904–06 (1999).

[29] Christine M. Chinkin, T*he Challenge of Soft Law: Development and Change in International Law*, 38 INT'L & COMP. L.Q. 850, 856–59 (1989).

[30] See Tronchetti, *supra* note 20, at 619-632.

specifically concerned, one can observe that some of them have acquired the status of customary law.[31]

C. The Principles

The first of the Principles provides several definitions.[32] Remote sensing is narrowly defined as "the sensing of the Earth's surface from space by making use of the properties of electromagnetic waves, emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resources management, land use and the protection of the environment."[33] "Primary data" is defined as the "raw data that are acquired by remote sensors borne by a space object.[34] "Processed data," refers to "the products resulting from the processing of the primary data" which makes such data usable.[35] Finally, "analyzed information," is defined as "the information resulting from the interpretation of processed data, inputs of data and knowledge from other sources."[36]

Another definition included in Principle I that is worth mentioning regards the term of "remote sensing activities."[37] According to Principle I(e), this term encompasses not only the operation of remote sensing satellites in orbit but also the functioning of primary data collection and storage stations, as well as the processing, interpretation, and dissemination of the resulting data. According to Professor Sergio Marchisio, this broad definition mirrors the rationale of Principle XIV, which sets out a dual system of international responsibility encompassing both States and private actors.[38] Remote sensing activities as defined by the Principles, are generally carried out on Earth and are thus subject to the ordinary regime of international responsibility,[39] while States operating remote sensing satellites bear international responsibility as

[31] *See generally id.*
[32] *See generally* Principles Relating to Remote Sensing, *supra* note 3, Principle I.
[33] *Id.* Principle I(a).
[34] *Id.* Principle I(b).
[35] *Id.* Principle I(c).
[36] *Id.* Principle I(d).
[37] *Id.* Principle I(e).
[38] *See* MARCHISIO, *supra* note 12.
[39] *See* MARCHISIO, *supra* note 12 at 317-326; *See generally* Int'l L. Comm'n, Draft Articles on Responsibility of States for Internationally Wrongful Acts, with Commentaries, Fifty-Third Session, U.N. Doc. A/56/10 (2001) [hereinafter Draft Articles on Responsibility]

affirmed in article VI of Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty or OST).[40] Under this approach, Principle XIV embodies a dual track of international responsibility: satellite operations in orbit fall under Article VI OST, whereas the Earth-based activities enumerated in Principle I(e) remain governed by the ordinary rules of State responsibility.

Principles II and III provide for the sharing of the benefits of remote sensing among States.[41] This is in keeping with, and reiterates Article I of the OST which states that in relevant part that "the exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries."[42] Many scholars argue that this concept can be considered customary international law.[43] Principle IV fully incorporates Article I of the OST into the Principles, repeating that remote sensing activities shall be conducted for the benefit of all countries and reaffirming the freedom of exploration and use of outer space.[44] While recognizing these freedoms in space, Principle IV also confirms the right of full and permanent sovereignty of all States "over their own wealth and natural resources.[45]

The need to promote international cooperation is recognized in Principles V through VIII.[46] The push for international cooperation in remote sensing and related activities may be attributed to the understanding that these types of endeavors become more efficient and beneficial when shared and promoted to support all countries.

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[40] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. VI, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty] (stating that "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the [M]oon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities[...] The activities of non-governmental entities [...] shall require authorization and continuing supervision by the appropriate State Party to the Treaty. [...]").

[41] *See* Principles Relating to Remote Sensing, *supra* note 3, Principles II & III.

[42] Outer Space Treaty, *supra* note 40, art. I.

[43] Ram S. Jakhu & Steven Freeland, *The Relationship Between the Outer Space Treaty and Customary International Law*, 59 PROC. INT'L INST. SPACE L. 183, 185–87 (2016).

[44] Principles Relating to Remote Sensing, *supra* note 3, Principle IV.

[45] *Id.*

[46] *Id.* Principles V-VIII.

In simpler terms, if a disaster strikes a developing country without satellite technology access, providing remote sensing technology becomes crucial for aiding relief efforts by assessing the damage.[47]

Principles X and XI are closely linked to disaster management activities, yet they operate on different planes and impose distinct obligations depending on the event concerned.[48] Principle X requires States to disclose information regarding phenomena that may cause harm to the Earth's natural environment; in this sense, the obligation is triggered by the mere foreseeability of environmental harm and is directed at ensuring transparency about potential risks.[49] By contrast, Principle XI focuses on natural disasters and obliges States to transmit processed data and analysed information in their possession that could be of assistance to other States affected by ongoing or imminent disasters.[50] The Principles thus articulate a dual regime: environmental harm gives rise to an obligation of disclosure, whereas natural disasters entail an obligation of transmission of data products. In both cases, the mere possession of relevant information is sufficient to activate the duty.[51] It is important to note that the Principles themselves do not impose an obligation to transmit data to the United Nations or to other international organizations. In this regard, as Professor Marchisio has pointed out, the involvement of competent authorities should be interpreted in light of the general objective of the legal framework for environmental information, namely the prevention of natural and technological disasters and the mitigation of their impacts.[52] However, in practice, certain international initiatives have filled this gap, by involving such bodies in disaster response mechanism. For example, the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), operated by the UN Office for Outer Space Affairs (UNOOSA),

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[47] *See infra,* Sections IV.B and IV.C.

[48] Principles Relating to Remote Sensing, *supra* note 3, Principles X & XI ("Remote sensing shall promote the protection of the Earth's natural environment. [...] States [...] that have identified information in their possession that is capable of averting any phenomenon harmful to the Earth's natural environment shall disclose such information to States concerned.").

[49] *Id.* Principle X.

[50] *Id.* Principle XI.

[51] *Id.* Principles X & XI.

[52] *See* MARCHISIO, *supra* note 12, at 325-26.

facilitates the use of space-based information for disaster management, while the International Charter on Space and Major Disasters allows UNOOSA to act as an Authorized User[53] on behalf of requesting States. Similarly, the United Nation Satellites Center (UNOSAT), as part of the United Nations Institute for Training and Research (UNITAR), provides satellite imagery analysis in support of humanitarian and emergency operations.[54] In conclusion, it is possible to assert that Principle XI is the provision which has inspired and sponsored the development of the most relevant initiatives, at an international and regional level, that promote the use of remote sensing satellites in the prevention and response of a natural or human-made disaster.

The heart of the legal regime regulating remote sensing is Principle XII, which reads as follows:

> As soon as the primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a non-discriminatory basis and on reasonable cost terms. The sensed State shall also have access to the available analyzed information concerning the territory under its jurisdiction in the possession of any State participating in remote sensing activities on the same basis

[53] Authorized Users (AUs) are the entities entitled to request the activation of the International Charter on Space and Major Disasters. Originally, AUs were limited to disaster management authorities of States whose space agencies were Charter members. Following the adoption of the "Universal Access" principle in 2012, however, any national disaster management authority may apply to become an AU by registering with the Charter's Executive Secretariat. Once registered, AUs can request activation both for emergencies occurring within their own country and, in cooperation, for those affecting other States. United Nations entities, through UNOOSA and UNITAR/UNOSAT, may also request activation on behalf of affected States. *See* United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), https://www.un-spider.org/ (last visited Aug. 5, 2024); International Charter "Space and Major Disasters, https://disasterscharter.org/ (last visited Aug. 20, 2024).

[54] The United Nations Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER), established by G.A. Res. 61/110 (Dec. 14, 2006), provides universal access to satellite-based data and services for disaster management, with a mandate to support developing countries in particular. The United Nations Institute for Training and Research (UNITAR) operates the United Nations Satellite Centre (UNOSAT), which delivers satellite imagery analysis, training, and capacity development to United Nations entities and Member States for humanitarian and disaster relief. For a detailed analysis of the International Charter on Space and Major Disasters, see infra paragraph III- letter (a).

> and terms, taking particularly into account the needs and interests of the developing countries.[55]

This provision has been written to reconcile the no-prior consent Principle with the concerns shared by many States, especially developing countries, of an informational disadvantage compared to remote sensing operators.[56]

Looking at the content of the provision, it is possible to affirm that the sensed State has the right to access "primary data" and "processed data" as soon as those are produced. "Analyzed information," must be accessible as soon as it becomes available.[57] While the process of analysis inevitably requires time, the obligation under the Principles implies that, as soon as the information exists in an analysed form, States should ensure its dissemination without further delay. This approach avoids the risk of prolonging access beyond what is necessary, which could jeopardize effective disaster response, where minutes and hours may be decisive.

Principle XII establishes that the sensing State must offer access to the data to all relevant States on a non-discriminatory basis.[58] Concerning the term "non-discriminatory basis," some academics affirmed that these provisions expand the principle of non-discrimination of Article I of the OST.[59] Indeed, article I(2) of the OST, seeks to ensure that outer space remains open for exploration and utilization by all countries without any form of discrimination.[60] Thus, Principle XII can be interpreted to mean that data must be shared equally, without showing preference to any particular State.

The respect of this principle is guaranteed by some State practice. The Indian Remote Sensing Data Policy stands as an

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[55] *See* Principles Relating to Remote Sensing, *supra* note 3, Principle XII.

[56] U.N. Comm. on the Peaceful Uses of Outer Space, Working Group on Remote Sensing of the Earth by Satellites, Report of the Working Group on Remote Sensing of the Earth by Satellites on the Work of its 3rd Session, U.N. Doc. A/AC.105/125 (Mar. 13, 1974). *See* MARCHISIO, *supra* note 12, at 317-326; Brian R. Israel, *Help from Above: The Role of International Law in Facilitating the Use of Outer Space for Disaster Management*, *in* THE INTERNATIONAL LAW OF DISASTER RELIEF 217, 218 (David D. Caron, Michael J. Kelly & Anastasia Telesetsky eds. 2014).

[57] Zannoni, *supra* note 10, at 183.

[58] Principles Relating to Remote Sensing, *supra* note 3, Principle XII.

[59] Zannoni, *supra* note 10, at 282-285; *See* Outer Space Treaty, *supra* note 40, art. I.

[60] *Id.*, art. I (2).

interesting example.[61] Similarly, United States (US) legislation supports the application of this provision. Indeed, the principle of "non-discriminatory basis" has been incorporated in the Commercial Space Act of 1998[62] and the Earth Remote Sensing Act of 1992,[63] which also promotes an open access, often free of charge data distribution policy. At a regional level, examples of incorporation of the aforementioned principle come from the policy of the European Space Agency (ESA) on the distribution of European Remote Sensing Satellites (ERS) and ENVISAT (Environmental Satellites) data,[64] as well as the European Meteorological Satellite (EUMETSAT) data policy.[65]

On the other hand, a potential limitation to the right of access to data by the sensed State may exist. According to some sensing States, the access to such data is ultimately subject to political, strategic, and military considerations. In the United States, national security safeguards are explicitly embedded in the licensing framework governing remote sensing activities.[66] Under 15 C.F.R. § 960.8, licensed systems must be operated in a manner that preserves the national security, foreign policy, and international

[61] In 2011, the Indian Parliament approved and adopted a Comprehensive Remote Sensing Data Policy (RSDP). Under the RSDP, satellite data and imagery are regarded as a "public good" intended to support commerce, knowledge and national development. All data up to 5.8 meters are available on a non-discriminatory basis. *See generally* REMOTE SENSING DATA POLICY (2011), https://lib.icimod.org/records/q0par-4b692. As noted by Professor Frans von der Dunk, the Radarsat document mentions UN Resolution 41/65 as well as the "open non-discriminatory basis" required under Resolution 41/65 for access to its data. In addition, the Committee on Earth Observation Satellites (a consortium of 61 agencies operating 172 satellites worldwide working together to ensure international coordination of civil, space-based, Earth observation programs for the benefit of all) drafted its own Satellite Data Exchange Principles in Support of Global Change Research in 1991 which explicitly refers to the principle of "non-discriminatory access to data," albeit without explicit reference to Resolution 41/65. *See* Frans von der Dunk, *Non-Discriminatory Data Dissemination in Practice*, 18 SPACE, CYBER, AND TELECOMM. L. PROG.: FAC. PUBS. 41, 41-50 (2002).

[62] *See generally* Commercial Space Act of 1998, 42 U.S.C. § 14701 (1998).

[63] *See generally* Earth Remote Sensing Act of 1992, 15 U.S.C. § 5601 (1992).

[64] *See generally* EUROPEAN SPACE AGENCY, ESA DATA POLICY FOR ERS, ENVISAT, AND EARTH EXPLORER MISSIONS (2012), https://earth.esa.int/eogateway/documents/20142/1564626/ESA-Data-Policy-ESA-PB-EO-2010-54.pdf.

[65] *See generally* EUMETSAT Data Policy, EUMETSAT, https://www.eumetsat.int/data-policy/eumetsat-data-policy.pdf (last amended Jan. 1, 2025).

[66] *See* Aniel Caro De Beer, *The Refusal of Access to Remote Sensing Data for Reasons of National Security: A (New) Rule of Customary International Law?*, UNIVERSITY OF PRETORIA, THESES AND DISSERTATIONS 1, 30 (Mini Dissertation, 2015).

obligations of the United States.[67] The regulations further establish a tiered system of licensing: while systems categorized as Tier 1 are generally subject to minimal restrictions, Tier 2 and Tier 3 systems may be required to comply with additional conditions, including limitations on data dissemination, in order to address national security concerns.[68] Not only did the US adopt this approach, but Canadian legislation is also oriented in the same direction.[69] Similarly, the Indian Government reserves the right to impose control over imaging tasks and distribution of data from Indian remote sensing satellite for reasons of national security, to comply with international obligations, or to pursue foreign policy objectives.[70] Those practices are not sufficient to confirm the existence of a rule of customary international law establishing the right to refuse access to high-resolution remote sensing data for national security reasons, but a trend toward this conclusion is evident.[71]

Three principles remain. Principle XIII refers to the promotion of international cooperation particularly with developing countries.[72] Principle XIV, already mentioned, describes the international responsibility regime applicable to "remote sensing" and "remote sensing activities."[73] And Principle XV promotes the peaceful settlement of disputes.[74]

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[67] Licensing of Private Remote Sensing Space Systems, 15 C.F.R. § 960.8, (last visited Aug. 19, 2024).

[68] Licensing of Private Remote Sensing Space Systems, 15 C.F.R. §§ 960.6, 960.9, 960.10(b) (last visited Aug. 19, 2024). Tier 2 systems may be subject to additional standard conditions under § 960.9; Tier 3 systems may be subject to additional standard and temporary conditions, including limitations on data dissemination, as authorized in § 960.10(b).

[69] Remote Sensing Space Systems Act, S.C. 2005, c. 45, §§ 10–16 (Can.). Providing that the Minister may amend, suspend, or cancel licences, order interruptions of service, grant priority access, or restrict transfers of control of satellites, where continuation of operations would be injurious to national security, the defence of Canada, the safety of Canadian Forces, or Canada's conduct of international relations.

[70] REMOTE SENSING DATA POLICY (2011), at 2, https://sarinlaw.com/wp-content/uploads/2020/10/Remote-Sensing-Data-Policy.pdf, (last visited Aug. 20, 2024). Providing that remote sensing data up to 1 meter resolution shall be made publicly accessible, while higher-resolution data are to be screened and distributed by the Government in order to protect national security.

[71] To understand how Customary International Law is formed, *see supra* note 17.

[72] Principles Relating to Remote Sensing, *supra* note 3, Principle XIII.

[73] *Id.* Principle XIV.

[74] *Id.* Principle XV.

In conclusion, although the Principles are a non-legally binding instrument, they play a crucial role in regulating remote sensing activities. Moreover, many of the Principles have become customary international law, as evidenced by the practices of relevant States.[75] The failure to convert the resolution into a treaty has not diminished its effectiveness. Instead, it has spurred States and organizations to establish programs aimed at sharing remote sensing satellite technologies during disaster situations. The International Charter on Space and Major Disasters serves as a prime example.

III. THE INTERNATIONAL CHARTER ON SPACE AND MAJOR DISASTER: LEGAL RELEVANCE AND ACTIVATION MECHANISM

A. The Charter: Development and Provisions

Fifteen years after the adoption of the Principles, the international community became fully aware of the importance of the mutual exchange of remote sensing technology and data in the event of a disaster. Indeed, the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in July 1999, focused on the application of space systems for the benefit of the environment, human security, development, and welfare.[76] This relevance was also stressed in the Vienna Declaration drafted during the Conference, where the main challenge was not creating incentives for advanced spacefaring States to contribute data for disaster application, but managing the complexity that comes with the diversity of space systems and actors involved in disaster management activities.[77]

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[75] *See* generally, Zannoni, *supra* note 10.

[76] *See* Brian Israel, *Help from Above: The Role of International Law in Facilitating the Use of Outer Space for Disaster Management*, *in* THE INTERNATIONAL LAW OF DISASTER RELIEF 217, 217-44 (David Caron et al. eds. 2014).

[77] *See* Preparations for the 3rd U.N. Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) by the Preparatory Comm., U.N. Doc. A/CONF.184/PC/CRP.7/Rev.1 (1998) [hereinafter Vienna Declaration on Space and Human Development].

In this international context, in 1999 ESA[78] and the Centre National d'Études Spatiales (CNES)[79] proposed at the UNISPACE III Conference the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disaster.[80] They were joined in 2000 by the Canadian Space Agency (CSA).[81] Thanks to the combination of the three space agency resources, the Charter started its operations in November 2000.[82] Concerning its characteristics, it is possible to assert that the Charter is a cooperative mechanism through which satellite operators, government agencies, intergovernmental organizations provide satellites delivered data and information in support of

[78] The European Space Agency (ESA) is an intergovernmental organization, created in 1975, with the mission to shape the development of Europe's space capability and ensure that investment in space delivers benefits to the citizens of Europe and the world. ESA has 22 Member States: Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom. Slovenia is an Associate Member. ESA has established formal cooperation with six Member States of the European Union (EU). Canada takes part in some ESA programs under a Cooperation Agreement. *See European Space Agency,* ENCYCLOPAEDIA BRITANNICA, https://www.britannica.com/science/optical-telescope (last updated May 1, 2025).

[79] The Centre National d'Études Spatiales (CNES) is the French government's space agency (administratively, a "public administration with industrial and commercial purpose."). Established under President Charles de Gaulle in 1961, its headquarters are in central Paris, and it is under the supervision of the French Ministries of Defense and Research. It operates out of the Toulouse Space Center and Guiana Space Centre, but also has payloads launched from space centers operated by other countries. CNES formerly was responsible for the training of French astronauts, but the last active CNES astronauts transferred to the European Space Agency in 2001. CNES is a member of Institut au Service du Spatial, de ses Applications et Technologies. *See Le CNES en Bref,* CENTRE NATIONAL D'ÉTUDE SPATIALES, https://cnes.fr/en-bref (last visited Apr. 7, 2025).

[80] *Charter History,* DISASTER CHARTER, https://disasterscharter.org/membership-history (last visited Dec. 15, 2024).

[81] *Charter History,* DISASTER CHARTER, https://disasterscharter.org/membership-history (last visited Dec. 15, 2024). The Canadian Space Agency (CSA) is the national space agency of Canada, established in 1990 by the Canadian Space Agency Act. The president is Lisa Campbell, who took the position on September 3, 2020. The agency is responsible to the minister of innovation, science and industry. The CSA's headquarters is the John H. Chapman Space Centre in Longueuil, Quebec. The agency also has offices in Ottawa, Ontario, and small liaison offices in Houston, Washington, and Paris. *See History of Canda in Space,* GOVERNMENT OF CANADA, https://www.asc-csa.gc.ca/eng/history-of-canada-in-space.asp (last visited Apr. 7, 2025).

[82] *About,* DISASTER CHARTER https://disasterscharter.org/about-the-charter (last visited Dec. 15, 2024).

disaster prevention and response.[83] This mechanism facilitates the rapid provision of space-derived information, free of charge, to rescue and relief operators.[84]

Evaluating its legal value, the Charter, like the Principles, is a non-legally binding agreement, identifiable as a "soft law act." Its non-legally binding nature does not negatively affect its relevance and effectiveness; indeed, nowadays the Charter consists of 17 members, 270 contributing satellites, and 134 countries.[85]

Interpreting the Charter in comparison with the Principles, it is possible to assert that the Charter is an evolution and implementation of Principle XI. Moreover, the Charter's preamble includes a direct reference to the Principles, with the implication that it has to be observed in the activities under the Charter.[86] The objective of Principle XI ("Remote sensing shall promote the protection of mankind from natural disasters…") is echoed in the purpose of the Charter as expressed in its article II:

> … [T]he Charter seeks to pursue the following objectives:
>
> - supply during periods of crisis, to States or communities whose population, activities or property are exposed to an imminent risk, or are already victims, of natural or technological disasters, data providing a basis for critical information for the anticipation and management of potential crises;
>
> - participation, by means of this data and of the information and services resulting from the exploitation of space facilities, in the organisation of emergency assistance or reconstruction and subsequent operations.[87]

As indicated in the text, the Charter's scope is temporally limited to the most acute period of disaster management; in fact, the

[83] *Id.*

[84] *See* Atsuyo Ito, *Issues in the Implementation of the International Charter on Space and Major Disasters*, 21(2) SPACE POL'Y 141, 141-49 (2015).

[85] *Charter History,* DISASTER CHARTER, https://disasterscharter.org/membership-history (last visited Dec. 15, 2024).

[86] Disaster Charter, *supra* note 5, at Preamble. *See also* Jean-François Pekel et al., *A Decade of the Copernicus Emergency Management Service,* JOINT RSCH. CENTRE, EUR. COMM. (2022), https://publications.jrc.ec.europa.eu/repository/handle/JRC130970 (last visited Apr. 7, 2025).

[87] Disaster Charter, *supra* note 5, art. II.

term "crisis" refers to the time immediately before, during, or after a disaster.[88]

In continuing the comparison between the two soft law instruments, it is important to note that while the Principles deal only with the imaging of the Earth's surface from space, the Charter extends to all "space facilities" of cooperating parties, promoting the use of various space technologies in the event of a disaster.[89] It is possible to affirm that the Charter goes beyond the framework and requirement of the Principles in the promotion of international cooperation and non-discrimination. Indeed, it provides the sensed States with data completely free of charge. By use of the term "contribution," Article II of the Charter suggests that no funds will be exchanged between members in return for services provided through the Charter and that operational costs are covered by member space agencies.[90] Thus, the Charter embodies a solidarity-based model of cooperation, whereby members share resources without financial compensation, ensuring that operational costs are collectively borne by the participating space agencies, thereby enhancing its effectiveness as a non-commercial mechanism of mutual assistance in times of crisis.

As regard Article V, it seeks to assure that no legal action will be undertaken against Parties in cases of injury, damage, or financial losses.[91] This provision has raised academic concerns about the liability regime applicable to remote sensing.[92] In the present circumstance, it is not opportune to delve into this matter extensively, however, it may be appropriate to explore it further in a subsequent article.

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88 *See* Israel, *supra* note 60, at 217-44.

89 Disaster Charter, *supra* note 5, art. I.

90 *Id.*, art. II.

91 Disaster Charter, *supra* note 5, art. V.

92 *See* Ito, *supra* note 84, at 141-49. ("If misinterpreted data are delivered to end users and the decision making on crisis management based on it generates greater damage: who is going to be liable?").

B. The Charter: How it Works

Following a natural or technological disaster,[93] the affected State first contacts the designated Authorized Users (AU)[94] who may log in to the Charter's Operational System and submit a request to mobilize the space and associated ground resources to obtain data and information on a major disaster.[95] AUs are the only bodies allowed to directly request an activation of the Charter. They may also request support on behalf of another user with whom they cooperate for relief purposes.[96] In addition to AU, Cooperating Bodies such as UNOOSA, the United Nations Institute for Training and Research, UNOSAT and Sentinel Asia may submit requests on behalf of users from the United Nations and 31 Asian-Pacific Countries.[97] The request is received by a 24-hour On-Duty Operator who checks the identity of the requestor and verifies that the User Request Form is correctly completed.[98] The operator forwards the information to an Emergency On-Call Officer (ECO) who then evaluates the request and the extent of the disaster.[99] Subsequently, the ECO devises a plan for data acquisition and archiving utilizing available satellite resources, determining the most suitable satellites to fulfil the AU's requirements.[100] This plan is then presented to the relevant space agency.[101] Data acquisition and delivery occur on an urgent basis.[102] A Project Manager (PM), possessing expertise in data procurement, handling and utilization, is appointed by the

[93] Article I of the Charter provide a clear definition of the term "natural or technological disaster, which means "a situation of great distress involving loss of human life or large-scale damage to property, caused by a natural phenomenon, such as a cyclone, tornado, earthquake, volcanic eruption, flood or forest fire, or by a technological accident, such as pollution by hydrocarbons, toxic or radioactive substances." This definition does not consider conflict as natural or technological disaster; thus, in those situations the Charter cannot be activated. Disaster Charter, *supra* note 5, art. I.

[94] For a discussion of Authorized Uses *see supra* note 53. These can be (e.g.) rescue and civil protection organizations and the defense and security bodies of a country.

[95] *See Charter Activation Process*, DISASTER CHARTER, https://disastercharter.org/web/guest/how-the-charter-works (last visited Dec. 8, 2024).

[96] *See id.*

[97] *Id.*

[98] *Id.*

[99] *Id.*

[100] *Id.*

[101] *See Charter Activation Process*, DISASTER CHARTER, https://disastercharter.org/web/guest/how-the-charter-works (last visited Dec. 8, 2024).

[102] *Id.*

Executive Secretariat to support the AU throughout the process.[103] The PM receives a dossier prepared by the ECO detailing the disaster and the actions taken prior to the PM's appointment.[104] In addition, the PM oversees the distribution of maps from the Value Added Providers (VAP)[105] to the end-user and collaborating organizations.[106] The VAPs analyze the data provided by member agencies, interpreting satellite imagery and compiling it into value-added products, such as maps and ground verification reports.[107] Upon closure of the activation, typically within a few weeks depending on the disaster's magnitude, the PM compiles a comprehensive report detailing the activities undertaken, including feedback from end-users.[108] These reports are utilized by the Executive Secretariat to facilitate the ongoing development of the Charter.[109]

Notwithstanding numerous shortcomings that have been highlighted thanks to the annual reports,[110] the mechanism from November 2000 to February 2024 has been activated more than 800 times.[111] All of this evidence highlights the Charter's efficacy in response and relief activities, as well as its role in fostering the development of extensive cooperative mechanisms that promote the use of satellite technologies, particularly remote sensing satellites, in disaster response, fully implementing Principle XI of Principles.

IV. THE EVOLUTION OF THE COPERNICUS EMERGENCY MANAGEMENT SERVICE

At a regional level, a mechanism worth discussing is the Copernicus Emergency Management Service, aimed at supporting all

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103 *See id.*
104 *Id.*
105 *Id.* An example of an organization that provides value-adding services for the Charter by producing maps based on satellite data for use in interpreting and assessing disaster situations is the National Space Research and Development Agency (NASRDA).
106 *See Charter Activation Process*, DISASTER CHARTER, https://disastercharter.org/web/guest/how-the-charter-works (last visited Dec. 8, 2024).
107 *Id.*
108 *Id.*
109 *Id.*
110 These concern issues such as slow response time, late data delivery, and the usefulness of some data because of limited visibility. *See* Ito, *supra* note 84, at 141-49.
111 *See About the Charter*, DISASTER CHARTER, About the Charter - International Disasters Charter (last visited Feb. 28, 2024).

actors involved in the management of natural or human-made disasters by providing geospatial information to decision makers.[112]

CEMS is part of the Copernicus Program, which is the European method for monitoring the Earth composed of a set of systems that collect data from multiple sources, such as remote sensing satellites and *in situ* sensors (ground station, airborne and sea-borne sensors).[113] The idea to develop such system dates back to 1979, when the European Parliament adopted a resolution stressing the importance of creating a European Earth Observation (EO) system to support key community policies.[114] However, a concrete step toward the creation of an European EO constellation was not achieved until almost twenty years later when, in May 1998, all key European actors met in Baveno, Italy, and produced a Manifesto calling for an initiative on global monitoring for environmental security, aimed at supporting the commitments made under the Kyoto Protocol adopted a year before.[115] The manifesto represented the cornerstone on which the Copernicus Program was established.[116] In fact, in June 2001 the European Commission and the

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[112] *See About Us*, COPERNICUS EMERGENCY MANAGEMENT SYSTEM, https://emergency.copernicus.eu/about/ (last visited Dec. 8, 2024).

[113] *See* Gil Dennis et al., *The Evolution of Earth Observation Satellites in Europe and Its Impact on the Performance of Emergency Response Services*, 127 ACTA ASTRONAUTICA 619, 619-33 (2016).

[114] *See Minutes of Proceedings of the Sitting of Wednesday, 25 April 1979*, OFFICIAL J. EUR. COMMUNITIES, Doc. No. C 127/24, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.1979.127.01.0024.01.ENG&toc=OJ:C:1979:127:TOC (last visited Apr. 8, 2025).

[115] The Kyoto Protocol was adopted on December 11, 1997. Due to a complex ratification process, it entered into force on February 16, 2005. Currently, there are 192 Parties to the Kyoto Protocol. In short, the Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gas (GHG) emissions in accordance with agreed individual targets. The Convention itself only requires those countries to adopt mitigation policies and measures and to report periodically. The Kyoto Protocol is based on the principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries, placing a heavier burden on them under the principle of "common but differentiated responsibility and respective capabilities", recognizing that they are largely responsible for the current high levels of GHG emissions in the atmosphere. *See What Is the Kyoto Protocol?*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, https://unfccc.int/kyoto_protocol (last visited Dec. 8, 2024).

[116] *See A Short History of the Copernicus In Situ Component since the Baveno Manifesto*, COPERNICUS IN SITU NEWSLETTER, https://insitu.copernicus.eu/news/the-copernicus-in-situ-component-since-the-baveno-manifesto (last visited Dec. 8, 2024).

ESA presented a joint document describing a European approach for a Global Monitoring for Environment and Security (GEMS).[117] To clarify, GEMS corresponds to the precursor program of Copernicus.

Concerning the satellite constellations that provided those services, the idea to build GEMS dedicated space components, known as Sentinels, was expressed by the ESA Council in December 2005, with the goal of launching the first Sentinels satellite in 2014 (Sentinel 1-A).[118] Another relevant step forward the creation of Copernicus Program, was made in 2012 when the Commission decided to rename GEMS to Copernicus.[119] Two years later, the European Parliament and the Council adopted a regulation officially establishing the program; this regulation confirms that the Commission is the owner of all tangible and intangible assets created or developed under Copernicus and has overall responsibility over the program.[120] The Commission has adopted a free, full and open data policy to all users via a simple pre-registration.[121] Nowadays, the program faces six thematic areas: land, marine, atmosphere, climate change, security and emergency management. The area of interest for the present article is emergency management and it will be addressed in the following part.

CEMS provides maps and analysis based mainly on satellites imagery collected before, during and after a disaster, as well as early warning services for flood, fire, and drought risks.[122] All of those services are essential to support crisis managers, civil protection authorities, humanitarian aid actors and those involved in

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[117] Global Monitoring for Environment and Security, THE EUROPEAN SPACE AGENCY, https://www.esa.int/About_Us/Ministerial_Council_2012/Global_Monitoring_for_Environment_and_Security_GMES.

[118] European Space Agency, *Resolutions Adopted at the ESA Council Meeting at Ministerial Level, Berlin, 5–6 Dec. 2005*, ESA Bulletin No. 125, at 131 (Feb. 2006).

[119] European Commission, Copernicus is the new name of the European Commission's Earth Observation Programme, previously known as GMES, Press Release (Brussels, Dec. 11, 2012) (IP 12 1345), *available at* ec.europa.eu/commission/presscorner/detail/en/ip_12_1345 (last visited Aug. 19, 2024).

[120] Council Regulation (EU) No. 377/2014, of 3 April 2014, 2014 O.J. (L 122/44).

[121] General Secretariat of the Council of the European Union, *Council Conclusions on "Towards a Space Strategy for the European Union That Benefits Its Citizens,"* COUNCIL OF THE EUROPEAN UNION (May 31, 2011), https://data.consilium.europa.eu/doc/document/ST%2010901%202011%20INIT/EN/pdf.

[122] *See About Us*, COPERNICUS EMERGENCY MANAGEMENT SYSTEM, https://emergency.copernicus.eu/about/ (last visited Dec. 8, 2024).

disaster risk reduction, preparedness and recovery. Moreover, the access to the data is granted also to private citizens, oil and gas companies, insurance companies and agriculture stakeholders.[123]

The peculiar aspect of CEMS is that its scope is not limited to the category of natural or technological disasters; rather, it also considers humanitarian crises provoked by conflict situations extending beyond the contributions of the Charter and Resolution 41/65.[124]

Looking at some technical characteristics, CEMS consist of two components: a mapping component and an early warning component.[125] The mapping component offers global coverage and furnishes civil protection authorities and humanitarian aid agencies with maps derived from satellite imagery.[126] This service has been fully operational since April 1, 2012, and it is implemented by the European Commission DG Joint Research Centre (JRC).[127] On the other hand, the early warning component consists of three different systems: the European Flood Awareness System (EFAS), which provides overviews on ongoing and forecasted floods in Europe up to 10 days in advance; the European Forest Fire Information System (EFFIS), which provides near real-time and historical information on forest fires and forest fire regimes in the European, Middle Eastern and North African regions; and the European Drought Observatory (EDO), which provides drought-relevant information and early-warnings for Europe.[128] In addition, the Global Flood Awareness System (GloFAS), the Global Wildfire Information System (GWIS) and the Global Drought Observatory (GDO) complete the three systems mentioned above at global level.[129] The service is accessible at no-cost to all users operating in either rush mode for urgent emergency management tasks demanding immediate attention, or non-rush mode for aiding emergency disaster management

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[123] *Access to Data,* THE EUROPEAN SPACE AGENCY, https://emergency.copernicus.eu/data/ (last visited Dec. 8, 2024).

[124] U. Donezar-Hoyos et al., *The Copernicus EMS Validation Service as a Vector for Improving the Emergency Mapping Based on Sentinel Data,* 56 REVISTA DE TELEDETECCIÓN 23, 23-24 (2020).

[125] *See Emergency,* COPERNICUS EMERGENCY MANAGEMENT SYSTEM, ¶ 2, https://www.copernicus.eu/en/copernicus-services/emergency (last visited Dec. 8, 2024).

[126] *See id.* ¶ 3.

[127] *Id.*

[128] *Id.* ¶ 6.

[129] *Id.* ¶ 7.

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activities that don't require immediate response.[130] It is important to bear in mind that the activation of this specific service is limited to designated Authorized Users.[131]

The analysis conducted so far, which initially reviewed the soft-law legal framework underlying remote sensing satellite activities and subsequently introduced two examples of mechanisms that have implemented Principle XI: the Charter and CMES, facilitates understanding of the importance of international cooperation in remote sensing activities to improve disaster management. To thoroughly comprehend this message, it is useful present a practical case concerning the recent wildfire that occurred in Chile.

A. Cooperation Between Copernicus Emergency Management Service and the Charter on Space and Major Disaster: The Chilean Wildfire Case Study

In some extreme disaster events, international and regional mechanisms that make their satellites and space technologies available for disaster management activities often cooperate to enhance the effectiveness of their services in responding to disasters. An apt example is the active collaboration between the Charter mechanism and CEMS in response to the wildfire which occurred in Chile in February of 2024. Before examining the disaster, it is necessary to understand the type of the agreement and collaboration laid down by the parties.

In April 2018, CEMS and the Charter signed an agreement on collaboration procedures during the 39th Charter Executive

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[130] *See id.* ¶ 8.

[131] There are three distinct user categories. 1) Authorized Users may trigger the service by sending a Service Request Form (SRF) directly to the European Response Coordination Centre (ERCC). Authorized Users include National Focal Points (NFPs) in EU Member States and in countries participating in the European Civil Protection Mechanism, as well as EC Services (DGs), the Situation Room of the EEAS and the EU delegations. 2) Associated Users must coordinate with and go through the Authorized Users in order to trigger the service. Associated Users include local, regional and other public entities; International Governmental Organisations (e.g. UN agencies, World Bank), and National & International Non-Governmental Organizations; the INTCEN, the EU Satellite Centre. 3) General Public Users are not authorized to trigger the service but can be informed of an activation request through the web portal. Activations, for which sensitivity restrictions apply, are excluded. *See Who Can Use the Service*, COPERNICUS EMERGENCY MANAGEMENT SYSTEM - MAPPING, https://emergency.copernicus.eu/mapping/ems/who-can-use-service (last visited Apr. 8, 2025).

https://egrove.olemiss.edu/j_space_l/vol48/iss1/4
DOI: 10.56702/PJKX6569/jspalaw_4801.4

Secretariat and Board Meeting (Darmstadt), thereby ratifying existing links between the two organizations.[132] Thanks to this agreement, the Charter can benefit from the mapping capacity of CEMS on a case-by-case basis; on the other hand, CEMS can benefit from data provided by the Charter's hundreds of available satellites. In the context of collaboration between the two mechanisms, CEMS plays the role of a Value Added Provider (VAP) of the Charter. Indeed, it re-elaborates satellite imagery, transforming it into maps which contain detailed information about the damage provoked by the disaster.[133] The main advantage contributed by CEMS is its rapid mapping service that provides an on-demand and fast provision (hours-days) of geospatial information in support of emergency management activities, immediately following a disaster. The service is based on the acquisition, processing and analysis, in rapid mode, of satellite imagery and other geospatial raster and vector data sources (including social media[134] when relevant).[135] According to information directly provided by employees of the Emergency Response Coordination Centre (ERCC), between 2023 and 2024 CEMS made available its mapping capacity to the Charter in five disaster events.[136]

Wildfires have intensified around the globe, providing a stark reminder of how the climate crisis is upending lives and inflicting billions of dollars a year in damage. … [t]he UN Environment Program suggests it's time we "learn to live with fire" and adapt to the uptick in the frequency and severity of wildfires that will inevitably put more lives and economies in harm's way.[137]

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[132] *See Co-Operation Between the Charter and Copernicus EMS*, DISASTERS CHARTER (Apr. 24, 2018), https://disasterscharter.org/web/guest/-/co-operation-between-the-charter-and-copernicus-ems (last visited Dec. 8, 2025).

[133] *See* Res 41/65, *supra* note 8, §§ 3.2, 3.3.

[134] Interpreting social media data to understand a disaster situation can help improve response efforts. Citizen generated social media activity offers 24/7/365 real time information across the globe. *See* Pekel, *supra* note 86.

[135] *See Rapid Mapping*, COPERNICUS EMERGENCY MANAGEMENT SYSTEM - MAPPING, https://emergency.copernicus.eu/mapping/ems/rapid-mapping-portfolio (last visited Apr. 8, 2025).

[136] Author's interview with staff members of the Emergency Response Coordination Centre (ERCC), Apr. 11, 2024 (notes on file with the author).

[137] Rachel Ramirez, *Wildfires Are Getting More Extreme and Burning More Land. The UN Says it's Time to 'Learn to Live With Fire'*, CNN (Feb. 23, 2022), https://www.cnn.com/2022/02/23/world/wildfire-increase-climate-change-unep-report/index.html (last visited Dec. 8, 2024).

Starting in January 29, 2024, an unusual atmospheric event called "El Niño," consisting of a strong and warm wind, struck six regions of Chile (Coquimbo, Valparaíso, Metropolitan Region, O'Higgins, Maule, and Ñuble), rendering the climate particularly prone to extensive and damaging wildfires.[138] Due to the dry and drought climate conditions, strong attention was placed on the wildfires that were spreading around Valparaíso and on the night of February 2, the President of the Republic of Chile declared a Constitutional State of Emergency in the provinces of Valparaíso and Marga Marga, Valparaíso Region.[139]

Considering the severity of the situation, on February 3 at 11:05 a.m., the Servicio Nacional de Prevención y Respuesta ante Desastres (SENAPRED) officially requested the activation of the Charter mechanism, which promptly engaged in collaboration with CEMS for managing the activation.[140] In addition, CEMS provided further support through its value-added service by developing maps based on satellite data for interpreting and assessing wildfire disasters. The last report drafted on February 26 by the UN Resident Coordinator in Chile estimated that there had been 132 casualties and that more than 15,000 hectares had been destroyed.[141] To

[138] The cyclical warming phenomenon known as El Niño has a multifaceted impact on the temperature and wildfire risk in Central Chile. While coastal regions experience elevated precipitation, the Andean foothills often encounter paradoxical warming, leading to drier conditions and heightened fire susceptibility. This complex interplay poses significant challenges, as the initial moisture increase stimulates vegetation growth, which ultimately serves as fuel for more intense wildfires when El Niño's influence wanes and aridity returns. United Nations Office for the Coordination of Humanitarian Affairs, *ACAPS Briefing Note - Chile: Wildfires in the Central Region (12 February 2024)*, RELIEFWEB.INT (Feb. 13, 2024), https://reliefweb.int/report/chile/acaps-briefing-note-chile-wildfires-central-region-12-february-2024 (last visited Apr. 8, 2025).

[139] The declaration of a State of Emergency empowers authorities to limit freedom of movement and assembly, requisition of goods, impose restrictions on property rights, and implement any essential extraordinary administrative measures to restore normalcy. United Nations Resident Coordinator of Chile, *Chile: Incendios Forestales, 2024 Sistema de Naciones Unidas, Reporte de Situación No. 1*, RELIEFWEB.INT (Feb. 5, 2024), https://reliefweb.int/report/chile/chile-incendios-forestales-2024-sistema-de-naciones-unidas-reporte-de-situacion-no-1 (last visited Dec. 8, 2024).

[140] *Wildfire in Chile*, DISASTER CHARTER, https://disasterscharter.org/activations/fire-in-chile-activation-859- (last visited Dec. 8, 2024).

[141] United Nations Resident Coordinator of Chile, *Chile: Incendios Forestales, 2024 Sistema de Naciones Unidas, Reporte de Situación No. 3*, RELIEFWEB.INT (Feb. 17, 2024), https://reliefweb.int/report/chile/chile-incendios-forestales-2024-sistema-de-naciones-unidas-reporte-de-situacion-no-3 (last visited Apr. 8, 2025).

conclude the disaster examination, it is interesting to take a look at other information about the disaster response emphasized by the Assessment Capacities Project[142] (ACAPS). By February 5, approximately 1,400 firefighters and 1,300 military personnel, along with 31 firefighting helicopters and airplanes, had been mobilized to combat fires.[143]

Having become aware of the severity of the disaster and its resulting consequences, and notably, having observed that Chile utilized the Charter mechanism in close collaboration with CEMS in its response to the wildfire, we now explore, particularly from a technical point of view, the tangible contributions made by the Copernicus satellite constellation in Chile's disaster response efforts.

B. Technical Features of Sentinel Satellites

i. The Sentinels

Before describing the technical details of the specific contribution provided by the Sentinel satellites in the management of the wildfire in Chile and in the post-wildfire damage assessment, it is useful to provide a brief description of the main technical features of Sentinel satellites.

ESA has been developing a new family of missions called Sentinels specifically for the operational needs of Copernicus. The following technical analysis of the Copernicus constellation will focus on the Sentinel-2 and Sentinel-3, as they have been involved in managing the emergency in Chile.

Sentinel-1 provides all-weather day and night radar imagery for land and ocean services. The twin satellites Sentinel-1A and Sentinel-1B were respectively launched on April 3, 2014 and on April 25, 2016. The mission ended for Sentinel-1B in 2022, and plans are in force to launch Sentinel-1C as soon as possible[144].

Sentinel-2 provides high-resolution optical imagery for land services. It provides, for example, imagery of vegetation, soil and

[142] ACAPS is an independent information provider in humanitarian needs analysis and assessment. ACAPS, https://www.acaps.org/en/ (last visited Dec. 8, 2024).

[143] ACAPS, *ACAPS Briefing Note - Chile: Wildfires in the Central Region (12 February 2024)*, RELIEFWEB.INT (Feb. 13, 2024), https://reliefweb.int/report/chile/acaps-briefing-note-chile-wildfires-central-region-12-february-2024 (last visited Apr. 8, 2025).

144 https://www.copernicus.eu/en/about-copernicus/infrastructure-overview/discover-our-satellites (last visited Aug. 21, 2024)

water cover, inland waterways and coastal areas. Sentinel-2 also delivers information for emergency services. The twin satellites Sentinel-2A and Sentinel-2B were respectively launched on June 23, 2015 and on March 7, 2017. The two polar-orbiting satellites are placed in the same sun-synchronous orbit,[145] separated by 180°, at a mean altitude of 786 km; the orbit inclination is 98.62°.[146] A dual-frequency Global Navigation Satellite System (GNSS) receiver measures the position of each Sentinel-2 satellite in its orbit. Orbital accuracy is maintained by a dedicated propulsion system. The surface area measured on the ground and represented by an individual pixel, is termed as the spatial resolution. For Sentinel-2, there are three possible spatial resolutions: 10, 20 and 60 m.[147] Temporal resolution is the amount of time, expressed in days, that elapses before a satellite revisits a particular point on the Earth's surface: the satellites in the Sentinel-2 constellation will provide a revisit time of 10 days at the equator with one satellite, and 5 days with 2 satellites under cloud-free conditions[148]. The swath width of Sentinel-2 is 290 km.[149]

Sentinel-3 provides high-accuracy optical, radar and altimetry data for marine and land services. The twin satellites Sentinel-3A and Sentinel-3B were respectively launched on February 16, 2016 and on April 25, 2018. EUMETSAT operates the satellites and

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[145] A sun-synchronous orbit (SSO) is a particular kind of polar orbit. Satellites in polar orbits usually travel past Earth from north to south rather than from west to east, passing roughly over Earth's poles. Satellites in SSO, travelling over the polar regions, are synchronous with the Sun, meaning that the satellite always visits the same spot at the same local time. This means that the satellite will always observe a point on the Earth as if constantly at the same time of the day, which serves a number of applications, including emergency monitoring. *See* European Space Agency, *Types of Orbits*, ESA.INT (Mar. 30, 2020), https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits (last visited Apr. 8, 2025).

[146] Orbit inclination is the angular distance of the orbital plane from the equator. *See* COSMOS – The SAO Encyclopedia of Astronomy, *Orbital Inclination*, ASTRONOMY.SWIN.EDU.AU, https://astronomy.swin.edu.au/cosmos/O/orbital+inclination (last visited Dec. 8, 2024).

[147] Spatial resolution is the linear dimension on the ground represented by each pixel of the images captured by a sensor. *See* Maxar, *Spatial Resolution: Distance and Detail,* EXPLORE.MAXAR.COM, https://explore.maxar.com/Imagery-Leadership-Spatial-Resolution (last visited Dec. 8, 2024).

[148] https://sentiwiki.copernicus.eu/web/s2-mission (last visited Aug. 21, 2025)

[149] Swath width refers to the horizontal distance covered by a satellite sensor as it captures images of the Earth's surface. *See Swath Width*, LOCATIONIQ.COM, https://locationiq.com/glossary/swath-width (last visited Dec. 8, 2024).

delivers the marine mission, while ESA delivers the land mission. Sentinel-3 is a multi-instrument mission, providing different services such as measuring sea-surface topography, sea-surface height and significant wave height, measuring ocean and land-surface temperature and color, monitoring sea and land ice topography, sea-water quality and pollution monitoring, inland water monitoring, including rivers and lakes, aid ocean forecasts with acquired data, aid ocean forecasts with acquired data, climate monitoring and modelling, land-use change monitoring, forest cover mapping, fire detection, weather forecasting, and measuring Earth's thermal radiation for atmospheric applications. The two near-polar orbiting satellites are placed in the same sun-synchronous orbit, separated by 140°, with a reference altitude of 814.5 km, and inclination of 98.65°. Sentinel-3 constellation provides a nominal revisit time of 27 days. The two in-orbit Sentinel-3 satellites enable a short revisit time up to less than one day for specific applications, like ocean and land-surface temperature and color monitoring[150].

Other missions are Sentinel-4, Sentinel-5 and Sentinel-6. Sentinel-4 and Sentinel-5 will provide data for atmospheric composition monitoring. Sentinel-6 was launched in 2020 and provides high accuracy altimetry for measuring global sea-surface height, primarily for operational oceanography and for climate studies.[151] It is a cooperative mission developed in partnership between Europe (EU, ESA and EUMETSAT) and the US (National Oceanic and Atmospheric Administration, NOAA, and National Aeronautics and Space Administration, NASA).

ii. Ground Segments

The ground segment is composed of the Core Ground Segment, the Collaborative Ground Segment, and the Copernicus contributing missions' ground segments.[152] The Core Ground Segment

150 https://www.eumetsat.int/sentinel-3 (last visited Aug. 21, 2025)

[151] A Sentinel-5 Precursor also exists, a satellite mission launched on October 13, 2017, acting a gap filler mission aiming to provide data continuity until the launch of Sentinel-5, the dedicated atmospheric Copernicus mission. *See* European Space Agency, *Sentinel-5P*, ESA.INT, https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P (last visited Dec. 8, 2024).

[152] European Space Agency, *Gound Segment Overview,* https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Ground_Segment_overview (last visited Aug. 21, 2024).

monitors and controls the Sentinel spacecraft. It also ensures the measurement data acquisition, processing, archiving and dissemination to the final users. In addition, it is responsible for performing conflict-free mission planning according to a pre-defined operational scenario and ensuring the quality of data products and performance of the space-borne sensors by continuous monitoring, calibration and validation activities, guaranteeing the overall performance of the mission.

The Collaborative Ground Segment was introduced with the aim of exploiting the Sentinel missions further. This entails additional elements for specialized solutions in different technological areas such as data acquisition, complementary production and dissemination, innovative tools and applications, and complementary support for calibration and validation activities.

The Copernicus contributing mission ground segments, with their own specific control functions, data reception, data processing, data dissemination and data archiving facilities, deliver essential data complementing the Sentinel missions.

C. Technical Analysis of the Contribution Provided by Sentinel Satellites in the Management of the Wildfire in Chile

As already mentioned in sub-section IV.A, on February 2, 2024, a wildfire affected the Valparaíso Region of Chile. Given the seriousness of the event, the Copernicus EMS Rapid Mapping service (EMSR715) and the International Charter Space and Major Disasters (Charter ID859) were activated to provide wildfire extent emergency mapping.[153] The Copernicus EMS Risk and Recovery service was then requested to provide information about human settlement structures in the area of interest (AOI, representing the geographical area to be analyzsed and mapped), a detailed damage assessment and impact analyses.[154]

[153] Rapid Mapping provides geospatial information within hours or days of a service request to support emergency management activities in the immediate aftermath of a disaster. *See A Decade of the Copernicus Emergency Management Service*, *supra* note 86.

[154] Full details about the post-wildfire damage assessment in Valparaíso region, Chile, are available at the following link: https://riskandrecovery.emergency.copernicus.eu/EMSN188/. Rapid mapping products for this event can be viewed (and downloaded) at the following link: https://rapidmapping.emergency.copernicus.eu/EMSR715/download.

Three different AOI were identified in this event: Valparaíso (AOI01), Santa Cruz (AOI02) and Malalcahuello (AOI03). For each area, according to the rapid mapping service, different products can be provided:

- **First estimate product (FEP)** is an early information product which aims at providing an extremely fast (yet rough) assessment of most affected locations within the area of interest. Such information will be derived from the earliest suitable available post-event image and can be of different resolution and sensor type than the image used for producing delineation and grading products. FEP can be used to: highlight possibly affected areas; review the initial product specifications (product type, areas of interest); decide on cancellation of initially requested delineation or grading products.

- **Delineation product** provides an assessment of the event impact and extent and, if requested, an update of the situation (monitoring).

- **Grading product** provides information about the damage grade, its spatial distribution and extent. An update (monitoring) can be requested. The grading product is a superset of the delineation product as it contains the event type, impact extent (delineation) and the damage grading. [155]

Delineation and grading products are also derived from images acquired as soon as possible after the emergency event.

For each AOI, (*Tab. 1*) summarizes the information about satellites, dates and image resolutions for the different images used as pre-event and post-event datasets to provide the 8 Copernicus EMS products for this wildfire.

[155] European Union, *Rapid Mapping for Emergency Response Portfolio,* https://mapping.emergency.copernicus.eu/about/rapid-mapping-portfolio/ (last visited Aug. 21, 2024).

AOI01 - Valparaiso	**First Estimate**	**Delineation**	**Grading**
Pre-event	ESRI World Imagery (2023)	Sentinel-2A/B (2024)	Sentinel-2A/B (2024)
Acquired on	04/04/2023	08/01/2024, 14:37 UTC	08/01/2024, 14:37 UTC
Resolution [m]	0.31	10	10
Post-event	Sentinel-3A/B (2023)	Worldview-2[156] © Maxar Technologies, Inc. (2024)	Worldview-2 © Maxar Technologies, Inc. (2024)
Acquired on	03/02/2024, 14:20 UTC	05/02/2024, 14:50 UTC	05/02/2024, 14:50 UTC
Resolution [m]	300	2 (This image is used as background image)	2 (This image is used as background image)
AOI02 – Santa Cruz	**First Estimate**	**Delineation**	**Grading**
Pre-event	Sentinel-2A/B (2023)	Sentinel-2A/B (2023)	Sentinel-2A/B (2023)
Acquired on	09/12/2023, 14:37 UTC		
Resolution [m]	10		
Post-event	Sentinel-3A/B (2024)	SPOT6/7[157] (Airbus DS, 2024)	Sentinel-2A/B (2024)
Acquired on	04/02/2024,13:57 UTC	06/02/2024, 14:28 UTC	07/02/2024, 14:37 UTC
Resolution [m]	300	5 (This image is used as background image)	10 (This image is used as background image)
AOI03 – Malalcahuello	**First Estimate**		**Grading**
Pre-event	Sentinel-2A/B (2024)		Sentinel-2A/B (2024)

[156] WorldView-2 is an imaging and environment-monitoring satellite from Maxar of the United States, launched on October 8, 2009 (sun-synchronous orbit, altitude 770 km, revisit time up to 1.1 days). *See* European Space Agency, *WorldView-2*, EARTH.ESA.INT, https://earth.esa.int/eogateway/missions/worldview-2 (last visited Apr. 8, 2025).

[157] SPOT-6 (*Satellite pour l'Observation de la Terre*) is a commercial Earth-imaging satellite owned and operated by Airbus Defence and Space, launched on September 9, 2012 (sun-synchronous orbit, altitude 694 km, revisit time 1 day when operating simultaneously with SPOT-7, between 1 and 3 days with only one satellite). European Space Agency, *SPOT-6*, EARTH.ESTA.INT, https://earth.esa.int/eogateway/missions/spot-6 (last visited Apr. 8, 2025).

Acquired on	18/01/2024, 14:37 UTC		18/01/2024, 14:37 UTC
Resolution [m]	10		10
Post-event	Sentinel-2A/B (2024)		Sentinel-2A/B (2024)
Acquired on	04/02/2024, 14:27 UTC		07/02/2024, 14:37 UTC
Resolution [m]	10 (This image is used as background image)		10 (This image is used as background image)

Table 1 – Summary of datasets used for Copernicus EMS products.

As an example, Figure 1 shows the map representing the grading product for the AOI01 (Valparaíso). Since the image is difficult to read as it is related to a rather large area (more than 8.700 ha for this AOI), a zoom related to a specific area of the overall map is shown in (Fig. 2), together with the map legend.

Fig. 1 – Grading map for AOI01 (Valparaíso), from Copernicus EMS Rapid Mapping service (EMSR715 - Wildfire in Valparaíso region, Chile[158]).

158 *See WorldView-2, supra* note 156.

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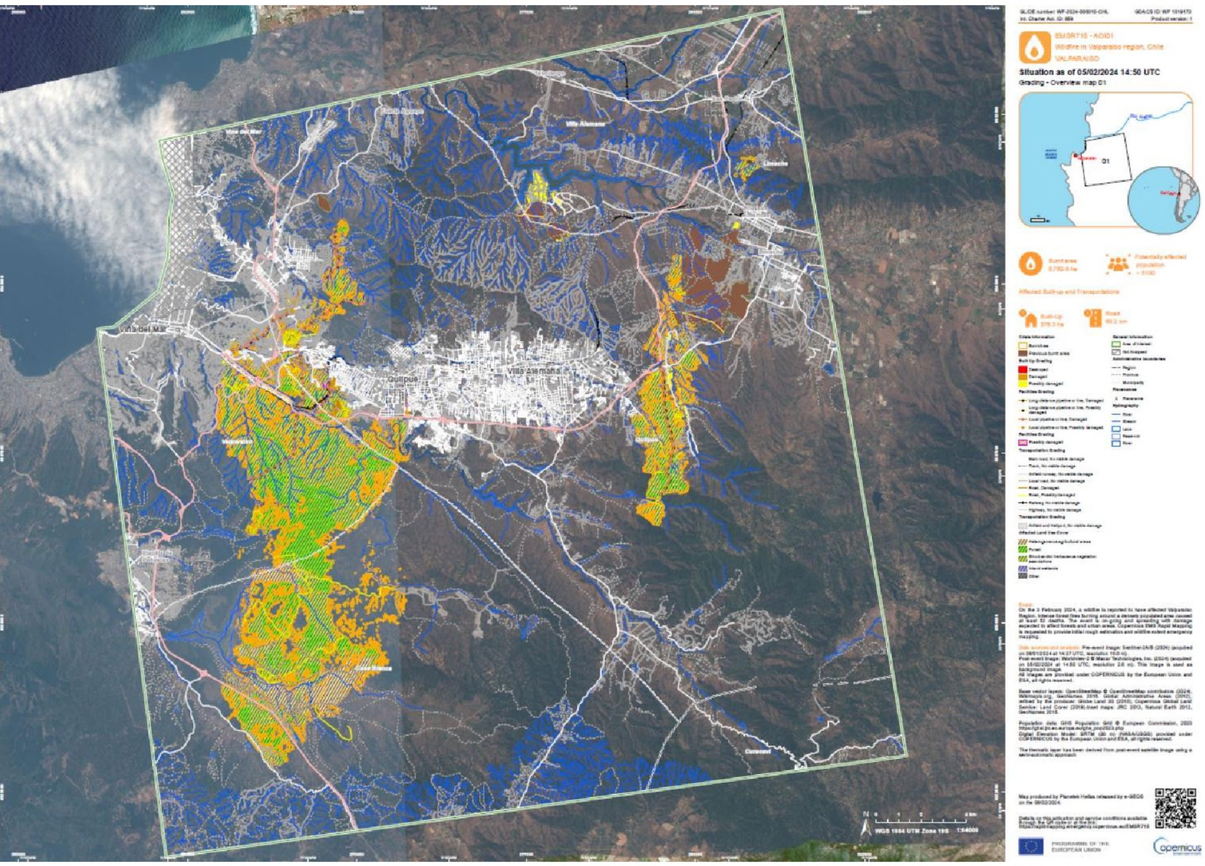
As is apparent, the added value provided by CEMS is represented by the different information included in the map (technically referred to as layers): inside the area of interest, highlighted by the green contour, different colors and symbols are used to highlight



the burnt area, the destroyed, damaged or possibly damaged built up areas, damage or possible damage grading for facilities and transportation assets, classification of use-cover for affected areas, e.g. agricultural areas or forests, and much more information.

According to the situational reporting, based on the data provided by the rapid mapping service products and on the analysis performed by CEMS, exposure within the three AOI concerned 3.643.000 population, 71241.4 built-up ha, 44308.8 km roads. Detailed exposure data are summarized in Table 2.

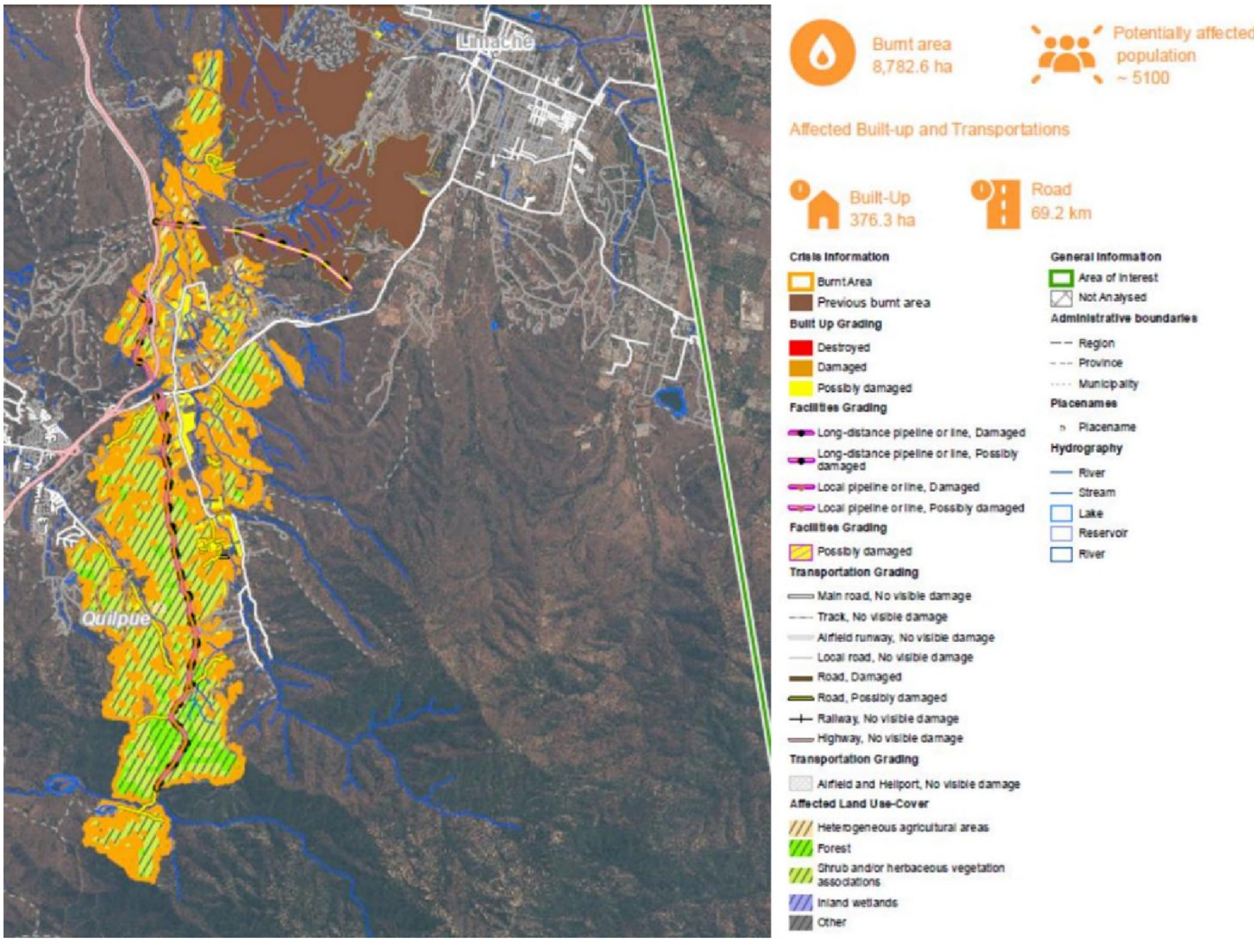


Fig. 2 – Grading map for AOI01 (Valparaíso), from Copernicus EMS Rapid Mapping service (zoom of a specific portion from Fig.1).

Area of Interest (AOI)		Exposure				
ID	Name	Built-up [ha]	Facilities [ha]	Facilities [km]	Roads [km]	Population [No.]

AOI01	Valparaíso	15.001,4	810,0	519,3	8.387,8	1.200.000
AOI02	Santa Cruz	56.240,0	4815,3	1.301,3	32.385,7	2.400.000
AOI03	Malalcahuello	-	-	-	3.535,7	43.000
	Total	71.241,4	5.625,3	1.820,6	44.308,8	3.643.000

Table 2 – Detailed exposure table after situational reporting.

Damage assessment indicated an event extent equal to 23.611,6 ha, with 495,9 built-up ha, 175 km roads and about 5.400 population potentially affected. Detailed damage assessment is summarized in (*Tab. 3*).

Area of Interest (AOI)		**Observed Event**		**Affected or potentially affected**		
ID	**Name**	**Latest observations [ha]**	**Max. extent [ha]**	**Built-up [ha]**	**Roads [km]**	**Population [No.]**
AOI01	Valparaiso	8.782,6	8.782,6	376,3	69,2	5.100,0
AOI02	Santa Cruz	12.921,3	12.921,3	119,6	105,8	300,0
AOI03	Malalcahuello	1.907,7	1.907,7	-	-	
	Total	23.611,6	23.611,6	495,9	175,0	5.400,0

Table 3 – Detailed damage assessment.

V. Conclusion

While the international legal framework for remote sensing activities is non-legally binding, it has effectively encouraged the development of regional and international mechanisms to promote the use of remote sensing satellites in disaster management. However, as discussed in the first section, certain State practices that restrict data transmission for national security reasons could undermine its effectiveness. Fortunately, these practices have not yet been sufficiently consolidated to have significant consequences under international law. On the contrary, to better prevent and respond to disasters, it is important to promote policies that encourage collaborative information exchange between sensing and sensed States. To achieve this objective, it is crucial to clarify and harmonize State policies on remote sensing data policy at an international level.

Despite their non-binding nature and some interpretative uncertainties, both the Principles and the Charter have received significant international support. Far from undermining their role, these characteristics have facilitated broader acceptance and demonstrated their utility as practical tools for cooperation in disaster management. At the regional level, it is relevant to implement more mechanisms similar to CEMS, thereby making their tools available to all operators working in the field of emergency management. In conclusion, it can be affirmed that collaboration and technology exchange among space agencies, international organizations, and States can significantly support disaster preparedness and response initiatives.

It is important to bear in mind that: the better the prevention and response to disasters, the fewer the victims and the less the economic, social, and material damages.[159]

[159] We would like to extend our gratitude to the Emergency Response Coordination Centre for providing additional information on the dynamics of cooperation between the Charter mechanism and CEMS, and to Major Francesca Citossi for her assistance in facilitating contact with the ERCC. Finally, we are deeply grateful to Associate Professor of International Law Nicola Colacino of the School of Advanced Defence Studies for overseeing the development of the entire article.