Help from Above: The Role of International Law in Facilitating the Use of Outer Space for Disaster Management

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I. INTRODUCTION

Behind the tragedy of major natural disasters in the past decade lies a remarkable story of international cooperation. On hundreds of occasions since 2000, disaster-stricken States activated an international coordination mechanism to request data from Earth observation and meteorological satellites, leading participating space agencies to re-task satellites and follow carefully-coordinated procedures to get potentially life-saving information into the hands of rescue and relief operators, within hours.

Contemporary space systems have much to contribute to disaster management, from

* Office of the Legal Adviser, United States Department of State. The views expressed are personal and do not necessarily reflect those of the U.S. government. © Brian R. Israel 2012
monitoring changing conditions for long-term forecasting; to early warning of floods, volcanoes, and hurricanes; to imagery guiding relief efforts; as well as communications, navigation, and search-and-rescue support.

This chapter examines the role of international law in enabling the use of outer space for disaster management. It conceptualizes this overall project in three phases, each defined by distinct historical circumstances, both political and technological, collective action challenges corresponding to these circumstances, and varying roles for international law in facilitating international cooperation. The first phase is defined by the collective action problems inherent in utilizing outer space in general. In this phase the United Nations treaties on outer space were concluded, supplying a legal framework for the exploration and use of outer space by an ever-growing number of States and private actors.

The second phase begins with the advent of remote sensing—the space activities most relevant for disaster management—and the ensuing political divide between the few States possessing these capabilities and those concerned about being at an informational disadvantage about their territory. After a decade-long confrontation between the promise of this new capability and sovereignty, a path forward was illuminated in the General Assembly’s Remote Sensing Principles, particularly in the principle of non-discriminatory access. The Principles reflect an aspiration that “[r]emote sensing shall promote the protection of mankind from natural disasters,” and direct States that have identified relevant remote-sensing-derived information in their possession to promptly provide it to States threatened or stricken by a disaster. Although not itself a source of
international law, the Principles play an essential role in enabling the robust regime for remote sensing relied upon today for disaster management.

The third phase brings us into the present decade, and is defined by coordination challenges that, though less political, are daunting in their complexity. Disaster management applications of space systems often require: data from sensors of multiple satellites—owned by governmental and private operators in several States as well as international organizations—re-tasking of satellites; combination of the raw data with data from other systems and processing into a format useable by relief operators; and all this must happen within hours. In this present phase, the cooperative mechanisms employed by States are comparatively less formal, and non-legal. They include the International Charter on Space and Major Disasters, global and regional coordination groups, a UN program established by General Assembly resolution, and capacity building initiatives, among others.

This third and present phase is the focus of this chapter. It examines the nature of the challenges in effectively harnessing existing remote sensing systems for disaster management applications, and the mechanisms employed by States toward this end. The legally non-binding Disaster Charter, in particular, presents a remarkable case study in international cooperation because of the speed with which it progressed from a proposal by a handful of space agencies to a highly effective resource for disaster management. The Charter, however, was never intended to be a panacea for all disaster applications; by design, it is temporally constrained to the period immediately before, during, and immediately after a disaster, and does not encompass all humanitarian crises. For all the
success of the Charter and related mechanisms, there remains work to be done in realizing the full potential of remote sensing systems for disaster management.

The chapter explores the optimal role of international legal mechanisms in capturing this potential. For example, in retrospect, would a legally binding international agreement on remote sensing for disaster management have been superior to the non-binding Disaster Charter? Now, twelve years into the Charter’s operational life, is elaboration into a legally-binding agreement—such as the International COSPAS-SARSAT Programme Agreement for satellite-based search and rescue—an inevitable (or desirable) development? In so doing, it builds upon (and aims to make a modest contribution to) the rich body of interdisciplinary literature on the role international legal mechanisms versus so-called “soft law” mechanisms in international cooperation.

The challenges in this third phase most closely resemble coordination problems, a subset of collective action problems that has received comparatively little attention in the international cooperation literature, which tends to focus on collective action problems involving costly commitments and strong interests to defect, and the design of mechanisms to realign state interests in favor of compliance. By contrast, compliance considerations are not at the fore in this third phase. The challenge is not one of aligning state interests around a costly objective—like reducing emissions or armaments—but in coordinating efforts to overcome technical and logistical hurdles to create a valuable new application of existing resources.

The optimal role of international legal mechanisms in addressing such complex coordination challenges deserves greater attention. The swift success of the Charter serves as a compelling invitation to survey what global challenges might be addressed
through creative international coordination. Strapped national budgets and deadlocked formal lawmaking processes provide additional incentives to explore what might be achieved with existing resources through relatively informal international cooperation.

For the myriad examples of international cooperation in which considerations of *ex post* interstate compliance are not at the fore, I submit that a focus on the role of legal form in *ex ante* intrastate implementation is the key to ascertaining the optimal role of international legal mechanisms versus non-legal mechanisms in a given case. The ultimate success of an international cooperative arrangement depends on each participant taking the necessary actions at home to ensure its ability to fulfill its commitments. I propose a practical approach to identifying instances in which implementation would be enhanced by an international legal mechanism, as well as opportunities to achieve productive cooperative outcomes through relatively informal cooperation.

**A. The Potential of Space Systems For Disaster Management**

Existing remote sensing systems are capable of gathering data relevant to a wide range of natural and man-made crises, including: floods, droughts, earthquakes, ocean storms (cyclones and typhoons) mud and rock flows, landslides, volcanoes, forest fires, deforestation, desertification, oils spills, marine and water pollution, ice hazards, and nuclear disasters, among others.¹ The data derived from these systems has much to offer to all phases of the disaster cycle: long-range forecasting, early warning, response in the crisis phase, and post-crisis recovery. Long range forecasting involves monitoring and analyzing changing condition on Earth (e.g., soil conditions) and the atmosphere to

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predict the occurrence of natural disasters. It also involves analysis of space-derived data from prior disasters to improve prediction models, and inform land-use decisions. Early warning involves detection of an event from space—such as volcanic eruption—to provide advance warning on Earth.

At present, the most developed application of land remote sensing systems is during and immediately following the crisis. Space systems are capable of providing disaster management actors on the ground with a picture of the nature, extent, and location of damage. For example, knowledge of the location and severity of floods enables prioritization of resources, while information about the condition of roads aids route and evacuation planning. High-resolution imagery of areas affected by an Earthquake allows response actors—whether in the capital city or on another continent—to assess the damage to physical infrastructure and plan accordingly. And in the post-crisis rehabilitation phase, space-derived data can inform development planning, such as prioritizing the distribution of assistance to farmers based on analyses of damage to agricultural areas.²

Each type of disaster and phase of the disaster cycle has unique requirements for (1) satellites equipped with certain types of sensors; (2) breadth and depth of imagery (i.e., how “zoomed in” or “zoomed out” an image is, and its resolution); and (3) the window of time, in relation to the onset of the crisis, in which space-derived products are most useful, including how often they must be refreshed. For example, early warning for floods requires real-time data from meteorological satellites covering a vast area that

could include several states’ territories. During the crisis phase, optical imagery as well as radar imagery (which is capable of “seeing through” cloud cover) is useful to assessing the location and extent of floods—which requires a broader, lower-resolution picture—and the status of infrastructure, which necessitates a higher-resolution image. Such information is most useful within one to six hours of the disaster, and when refreshed within hours or days.

In many instances, creating space-derived products that are useful in disaster management requires combining data from the sensors of multiple satellites, as well as air and ground-based systems. For example, detecting, analyzing and monitoring an oil spill frequently requires data from multiple types of space-based sensors (including synthetic aperture radar and multi-spectral imagers) in combination with ground data, such as bathymetry (i.e., depths). Of course, the raw data “seen” by sensors aboard satellites is not immediately useful to disaster management actors; it must be processed, analyzed, and combined with other data to produce useful products such as maps overlain with information about the nature and extent of damage. These are generally known as value-added products, and can require significant human analysis on the ground.

B. The Role of International Law In Capturing This Potential: Three Phases

An examination of the role of international law in facilitating disaster applications of space systems would be incomplete without accounting for its role in enabling the existence and uses of these systems that give them their great potential for disaster management. Using satellites in outer space to aid disaster management on Earth would

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3 See id.
4 See id.; Action Team Report, supra note 1 ¶17.
5 See Action Team Report, supra note 1 ¶17.
6 See id. ¶ 41.
be little more than science fiction without the existence of satellites in orbit carrying sensors and other payloads valuable for disaster management, among other applications. Such satellites, of course, are enormously expensive, and launching and operating them in an increasingly congested space presents considerable risk. Without a regime to manage this risk and provide the legal certainty to facilitate investment in these space systems by governments and private entities, it is unlikely they would exist. And it is doubtful these systems would be of much use for disaster management if outer space were treated as an extension of national territory or air space.

The overall challenge of utilizing outer space to aid disaster management divides naturally into three phases. Disaster management uses are specific applications of a broader activity—remote sensing—that is itself a subset of a larger class of activities involving the use of outer space. Although each phase coincides with distinct historical circumstances, they are also unique in the nature of the collective action challenges they present. They form a spectrum from the highly political—how will an entirely new activity of inherently global concern be conducted, and how will the risks and benefits be distributed—to increasingly technical, detail-intensive coordination challenges. Common to all phases is the necessity of international cooperation. The role of international legal mechanisms—versus other mechanisms for international cooperation—in each phase is largely a function of the nature of the collective action challenges each phase presents.

II. Phase 1: Using Outer Space

As space flight became a reality with the launch of the first satellite into orbit in 1957, so too was the need for an international regime for the use and exploration of outer
space. Demand for such a regime was not limited to the two superpowers capable of accessing space. The vast majority of states without a near-term prospect of accessing space shared an interest in managing the long-term military and economic advantage that might accrue to the first space-faring states. Potential military applications of space loomed large in the minds of elites throughout the world. And there was concern that the first to reach space—or celestial bodies, like the Moon—not appropriate territory or resources for themselves. More immediately, the dangers inherent in launching objects into outer space—and their eventual return—were of concern to all on Earth. A degree of unpredictability attends launches and reentry, and there was a shared concern in clarifying responsibility for damage caused on Earth.

The few space-faring states at the time had their own interests in an international regime to facilitate their immediate and future plans for space exploration, including human space flight. High among them was the rescue of astronauts and the return of space objects, wherever they may land on Earth, notwithstanding the relations between the countries concerned or sovereign rights over air space and territory. And they shared an interest in rules to facilitate the seemingly endless uses of space by a growing array of actors, without collision or interference. In a remarkably prescient account of the collective action challenges inherent to the use of space, Professors McDougal and Lipson, writing in 1958, observed: “Space can be used for the simultaneous flight of

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7 See Hobe, Schmidt-Tedd, Schrogl & Goh, Cologne Commentary on Space Law, 3 vols. (Cologne: Carl Heymanns Verlag, 2010), vol. I ¶ 11.
8 See Herbert Reis, ‘Some Reflections on the Liability Convention for Outer Space’ (1978) 6 Journal of Space Law 125 (reflecting on the concern about international liability from the very outset of space exploration).
more than one craft, for instance, though in time some rules of the road will of course be needed.”

Consonant with the global interest in space, the negotiation of the initial “rules of the road” did not occur bilaterally, between the United States and Soviet Union, but multilaterally, under the auspices of the United Nations. Discussion of outer space was taken up in the General Assembly in November 1957, within a month of the launch of the first satellite into orbit. Through its Resolution 1348 (XIII) in December 1958, the General Assembly established an *ad hoc* Committee on the Peaceful Uses of Outer Space, comprising 18 Members, and with a mandate that included reporting on “[t]he nature of legal problems which may arise in the carrying out of programmes to explore outer space.” A year later, acting on the recommendation of the *ad hoc* Committee, the General Assembly established a permanent Committee on the Peaceful Uses of Outer Space (COPUOS). COPUOS established a Scientific and Technical Subcommittee and a Legal Subcommittee, which continue today as important mechanisms for facilitating international cooperation in the use and exploration of outer space.

By December 1961, four years after the orbit of the first satellite, the General Assembly “Commend[ed] to States for their guidance in the exploration and use of outer space the following principles:”

(a) International law, including the Charter of the United Nations, applies to outer space and celestial bodies;

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10 See Hobe, Schmidt-Tedd, Schrogel & Goh, *supra* note 7 ¶ 11.
11 See *id.* ¶ 12.
13 See *id.* ¶ 13; G.A. Res. 1472A IXIV) ¶ 1 (Dec. 12, 1959).
(b) Outer space and celestial bodies are free for exploration and use by all States in conformity with international law and are not subject to national appropriation.\textsuperscript{14}

At the same time, the General Assembly established a registration regime, calling upon States to provide to the Secretary General information about the launch of objects into outer space, and for the Secretary General to establish a public registry of such information.\textsuperscript{15}

\textbf{A. Declaration of Legal Principles}

The 1963 Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space ("Declaration")\textsuperscript{16} represented the first major attempt to elaborate an international regime for the use and exploration of space. In its Resolution 1962 (XVIII), the General Assembly unanimously, and "solemnly declare[d] that in the exploration and use of outer space States should be guided by [nine] principles." Whereas the first four Principles largely echoed Resolution 1721 A (XVI) of 1961, reflecting the interests "of all mankind" in space, Principles 5 through 9 broke new ground in prescribing "rules of the road" for the shared use of space.\textsuperscript{17} Among them, state responsibility for national activities in space (Principle 5); avoidance of harmful interference to other states or space activities (Principle 6); registration, ownership, and jurisdiction and control over objects launched into outer space (Principle 7); launching


state liability for damage caused on earth, in air, or space (Principle 8); and assistance to astronauts as “envoys of mankind” (Principle 9).

The statements of many delegations expressing their governments’ intent to abide by these principles—and in some cases suggesting the Declaration reflected or would over time precipitate customary international law—drew much attention to the legal status of the 1963 Declaration. Eminent jurists such as Judge Manfred Lachs and Professor Bin Cheng have explored whether the rapid development of space exploration condensed state practice sufficient to support rules of customary international law into a short period of time—or whether the 1963 Declaration and accompanying statements amounted to expressions of opinio juris that obviated any requirement of state practice. Whatever the state of customary international law at the time or the role of the Declaration in developing it, the unequivocal statements by the space-faring states that they would conduct their space activities in accordance with the principles suggest the Declaration was the foundation of an international regime for the exploration and use of outer space. In any event, the question of the Declaration’s legal status soon became primarily of academic concern, with the conclusion of the Outer Space Treaty less than four years later.

19 See Lachs, id. at pp135-138.
20 See Cheng, supra note 18.
21 Excerpts from several statements are reproduced in Professor Cheng’s account, supra note 18. See also Paul G. Dembling and Daniel M. Arons, ‘The Evolution of the Outer Space Treaty’ (1967) 33 Journal of Air Law and Commerce 419 at 422.
22 See Setsuko Aaoki, ‘The Function of ‘Soft Law’ in the Development of International Space Law’, in Irmgard Marboe (ed.) Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law (Vienna: Böhlau, 2012) p. 67 (distinguishing the elements of customary international law from those of an “international regime,” defined as “a set of implicit or explicit principles, norms, rules and decision-making procedures around which actors’ expectations converge in a given area of international relations.”).
B. United Nations Treaties on Outer Space

Propelled by a sense of urgency among the major space powers, the principles set out in the 1963 Declaration were soon enshrined and elaborated in a series of treaties negotiated in the COPUOS Legal Subcommittee. On December 19, 1966, the General Assembly reported-out the 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”), which was opened for signature a month later and entered into force on October 10, 1967. The Outer Space Treaty lays down the foundational elements of an international regime for the exploration and use of outer space. For example, Article II confirms:

Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

The Treaty addresses certain fundamental principles—such as the international liability of the launching state for damage caused on Earth, in air, or in space (Article VII), and concepts of registration and jurisdiction and control over space objects—in general terms, anticipating their detailed elaboration in subsequent agreements.

The Outer Space Treaty is forward-looking in its anticipation of a future in which use of space is not the exclusive preserve of superpowers—or even governments. Article VI establishes the “international responsibility of State Parties for national activities in outer space,” “whether such activities are carried on by governmental agencies or non-governmental entities.” It assigns responsibility for assuring all national activities

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23 See Dembling and Arons, supra note 21 at 425-426.
25 See General Assembly Resolution 2222 (XXII).
conform to the terms of the Treaty, and further requires that non-governmental activities in space be authorized and supervised “by the appropriate State Party to the Treaty.” This is the mechanism through which rules of international space law are made applicable to non-governmental activities in space, generally through national legislation and licensing regimes.

A year later, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (“Rescue and Return Agreement”), was concluded and entered into force in 1968. Next came the Convention on International Liability for Damage Caused by Space Objects (“The Liability Convention”) in 1972. That Convention elaborated on the principles of liability announced in the 1963 Declaration and Outer Space Treaty by defining “launching state,” establishing a regime of strict liability for damage caused on Earth or to an aircraft in flight (Article II), and an expedited process for the presentation of claims on behalf of injured nationals, carving out the local remedies rule (Articles VIII-XI). Last among the core space treaties was the Convention on Registration of Objects Launched into Outer Space (“Registration Convention”), which elaborated the duties of launching states to register objects launched into outer space through the UN Secretary General.

These four agreements enjoy broad membership. At time of writing, the Outer Space Treaty has 103 parties, and 25 signatories. The Rescue and Return Agreement has 91 parties, and 24 signatories. The Liability Convention has 88 parties, and 23

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signatories. The Registration Convention has 54 parties, and 4 signatories. A fifth treaty negotiated under the auspices of the UN—the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (“Moon Agreement”)—never gained similar acceptance, with only 13 parties and 4 signatories, a membership that does not include the most active space-faring states. Given their broad membership and fundamental importance to the most prevalent uses of outer space, the first four agreements are sometimes referred to as “the four core treaties” on outer space.

III. PHASE 2: A GLOBAL REGIME FOR REMOTE SENSING

In the decade following the conclusion of the four “core” United Nations space treaties, global concern about the use of outer space shifted to the observation of Earth from space, and analysis and dissemination of space-derived information on Earth. By the mid-1980s, the United States’ Landsat remote sensing program had been in operation for a decade, bringing into focus the tremendous potential of remote sensing for understanding and managing natural resources on Earth. France’s SPOT remote sensing satellite would soon come online. As the United States, France, and a handful of other states invested heavily in laying the groundwork for commercial remote sensing, they shared a keen interest in developing a global market for remote sensing products. U.S. policymakers believed that remote sensing presented significant economic opportunities

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29 The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature on December 18, 1979, entered into force July 11, 1984.
for American companies. It was more broadly believed that commercializing remote sensing would expand the breadth of available products. Notwithstanding the demonstrated potential of Earth-applications of remote sensing information—or perhaps because of this potential—the prospect of commercial remote sensing was greeted with suspicion, even hostility, by a broad swath of the world. Many developing countries feared that the concentration of remote sensing capabilities would put “sensed” states at an informational disadvantage about their own territories—and resources within—vis-à-vis the most economically powerful states and their companies. Many feared that such an informational advantage would amount to a significant bargaining advantage for companies in possession of remote sensing data in negotiations over the exploitation of a state’s natural resources.

**A. Addressing Sovereignty**

These very practical concerns of a number of countries were expressed in terms of sovereignty — over territory, and natural resources. The Outer Space Treaty had established that outer space cannot be an extension of a state’s territory. Thus, unlike airspace, the mere presence of satellites in outer space above a state’s territory does not

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31 See id.
33 See Foreign Relations of the United States, 1969-76, Volume E-3, Document 106: Action Memorandum from the Deputy Assistant Secretary for International Organization Affairs (Buffum), the Legal Adviser (Leigh), and the Assistant Secretary of States for Oceans and International Environmental and Scientific Affairs, (Ray) to the Deputy Secretary of State (Ingersoll), Washington, April 3, 1975 (hereinafter “April 3, 1975 Action Memo”), available http://history.state.gov/historicaldocuments/frus1969-76ve03/d106.
implicate sovereignty. But a number of states espoused the position that “sensing” a state’s territory from space—and disseminating this information without its consent—may nevertheless undermine the sovereign prerogatives of the sensed state. At the heart of these concerns was the prospect of being at an informational disadvantage or losing control over information about conditions within a state’s territory.

These sovereignty concerns found expression in the most contentious element of a proposal by Brazil and Argentina and supported by much of the developing world: a prior consent regime in which a state’s territory could not be sensed without its consent. Such a regime would have been practically unworkable. Earth observation satellites do not “see” national borders. Moreover, some of the most promising remote sensing applications envisioned at the time, such as addressing desertification, involve observation of transboundary phenomena, which could not be accomplished if sensing were made to stop at national borders, even if technologically feasible.

The Soviet Union did not favor a prior consent regime for remote sensing itself, but sought to extend state sovereignty over territory and natural resources to control over the dissemination of information about them. That is, it favored a prior consent regime for data dissemination. This too would have frustrated many disaster applications, as well as many of the other promising applications of remote sensing. Apart from limiting or delaying the observation of transboundary phenomena, constraining access to data would in turn limit the understanding and predictive modeling of natural disasters that can be informed by remote sensing data.

35 See, e.g., Meyers, supra note 34.
36 See April 3, 1975 Action Memo, supra note 33.
37 See Hodgkins oral history, supra note 30.
38 See id.
39 See Parminter, supra note 34; April 3, 1975 Action Memo, supra note 33.
B. The Mechanism: Principles Adopted by the UN General Assembly

Efforts to reach a global consensus on the modalities of remote sensing spanned more than a decade. In 1974, the UN General Assembly recommended in Resolution 3234 that the COPUOS Legal Subcommittee consider the “legal implications of remote sensing from space, taking into account the various views of States expressed on the subject, including proposals for draft international instruments,” and noted that Argentina and Brazil had submitted draft articles for “a treaty on remote sensing of natural resources by means of space technology” for the consideration of the Legal Subcommittee. The remote sensing debate in the United Nations persisted until December 1986 when the UN General Assembly adopted the Principles Relating to Remote Sensing of the Earth from Outer Space (“Remote Sensing Principles” or “Principles) by consensus. The definition of “remote sensing” in Principle I(a) reveals the relatively limited scope of the debate and the Principles’ applicability to remote sensing activities:

The term “remote sensing” means 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. Not encompassed by this definition are remote sensing activities for national security or military purposes. What the principles do address are the remote sensing activities most relevant to disaster management applications.

40 G.A. Res. 3234 (XXIX) (1974) ¶ 6(c)
41 Id. ¶ 7.
42 The Principles were adopted by the General Assembly in Resolution 41/65 (1986), to which the principles are annexed.
43 Emphasis added.
44 See Hodgkins oral history, supra note 30.
At the heart of the Principles is the principle of non-discriminatory access in Principle XII that “the sensed State shall have access to [data] on a non-discriminatory basis and on reasonable cost terms.” Principle XII addresses the concerns shared by many states about being at an informational disadvantage vis-à-vis the sensing state, a private company, or neighboring states about its territory and natural resources. This principle is found in the national laws of several states governing commercial and governmental remote sensing activities encompassed by the Principles.\(^{45}\) United States law, for example, mandates that licenses to operate private remote sensing systems obligate the operator to “make available to the government of any country (including the United States) unenhanced data collected by the system concerning the territory under the jurisdiction of such government as soon as such data are available and on reasonable terms and conditions.”\(^{46}\) Significantly for disaster applications, the U.S. regulations implementing this statutory section interpret “nondiscriminatory” and “reasonable” to permit the provision of data at reduced or no cost for certain types of “public benefit users.”\(^{47}\)

Of special relevance to disaster management applications is Principle XI:

Remote sensing shall promote the protection of mankind from natural disasters. To this end, States participating in remote sensing activities that have identified processed data and analyzed information in their possession that may be useful to States affected by natural disasters, or likely to be affected by impending natural disasters, shall transmit such data and information to States concerned as promptly as possible.

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\(^{46}\) 51 U.S.C. § 60122(b)(2).

\(^{47}\) See 15 CFR Part 960.
Upon detailed examination, Principle XI is more limited than it may at first appear. As the United States explained in its Explanation of Vote, the Principle “does not contemplate that states will screen all data for those purposes, but rather that states will alert other states when they have identified information that would assist those states in preventing or dealing with emergencies.”

Given that remote sensing was in infancy at the time the General Assembly adopted the principles, and the absence of the practical arrangements necessary to effectively utilize remote sensing for disaster management, Principle XI represented more of an aspiration than a practical directive to states.

Why principles adopted by the General Assembly instead of an international agreement on remote sensing? As noted above, Brazil and Argentina had proposed a draft early on. From the perspective of the developing countries interested in establishing a prior consent regime for remote sensing and extending sovereignty over resources to information about those resources, an international agreement would have placed these ideals on the strongest footing, provided that the states conducting or developing remote sensing activities signed up. But there was little prospect of the United States, France, or the Soviet Union agreeing to such an arrangement. From the perspective of the states seeking broad, international acceptance of remote sensing—to facilitate a global market for remote sensing products—principles adopted by consensus in the General Assembly had the benefit of instant, global consensus, compared to the piecemeal acceptance by a small number of states over time that comes with a treaty.

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49 See Hodgkins oral history, supra note 30 at 150.
50 See Traummüller, supra note 17 at 153(quoting an April 17, 1963 statement by the UK Representative to the COPUOS Legal Subcommittee).

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The Principles are recommendatory; they do not, in and of themselves, possess legal force under international law. Their importance lies in their statement of a consensus of the international community on the conduct of remote sensing activities, following more than a decade of intense debate. Perhaps most importantly for present purposes, they helped pave the way for the robust array remote sensing systems in operation today, many of which are operated by private commercial entities. And the Principles precipitated an international regime for remote sensing in which data can be gathered and disseminated rapidly, which is essential to disaster management applications.

IV. PHASE 3: DISASTER MANAGEMENT APPLICATIONS

In the decade following the adoption of the Principles by the General Assembly, a significant item on the multilateral space agenda was applications of space systems for the benefit of the environment, human security, development and welfare. Such was the focus of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in July 1999. The resulting Vienna Declaration on Space and Human Development set forth a “strategy to address global challenges in the future,” including:

To implement an integrated, global system, especially through international cooperation, to manage natural disaster mitigation, relief and

51 See Lowell statement, supra n 48 (“…under the Charter of the United Nations, these Principles can only be recommendatory in character; they cannot, in and of themselves, possess legal force…. Nevertheless, these Principles constitute a significant statement of the views of the international community on a matter of importance to the future of the peaceful use and exploration of outer space.”).
52 See id.
53 See Setsuko Aaoki, supra note 22 at 66-68 (suggesting that “the 1986 Remote Sensing Principles may have developed or are developing into “an international regime.”).
54 See, e.g., The Space Millenium: Vienna Declaration on Space and Human Development (July 30, 1999) (hereinafter “Vienna Declaration”).
prevention efforts, especially of an international nature, through Earth observation, communications and other space-based services, making maximum use of existing capabilities and filling gaps in worldwide satellite coverage.55

The principal challenge in realizing the disaster management aspiration expressed in the Vienna Declaration was one of coordination. Effective use of space systems in disaster situations requires a lot of moving parts to work in concert, and quickly. A given disaster application will often require data from the sensors of multiple satellites, which are operated by a diverse array of agencies, private commercial entities, and intergovernmental organizations. Satellites with the right sensors and orbital characteristics must be tasked to acquire data about the affected areas. Raw data from the sensors of these satellites must be processed, analyzed, and combined with data from ground systems to produce value-added products directly useful to disaster management actors. And all this must happen within a matter of hours.

Of course, advanced space-borne sensors and sophisticated value-added products are of little use in a disaster scenario if the local disaster response authorities are not aware of these space-derived products and do not request them in time, or if they do not have the proficiency to take full advantage of them. Thus, building capacity throughout the world—especially in less-developed, disaster-prone regions—is a significant piece of the overall challenge.56

In sum, disaster applications of space systems could only be achieved through international cooperation, as any given disaster requires the assets of multiple states or intergovernmental organizations. No state is immune from disasters, and even for the

55 See id. ¶ (b)(ii).
56 See Action Team Report supra note 1 ¶ 49(f); Zeil, supra note 2 at 57.
states with the most advanced and extensive space systems, the value of an international mechanism to coordinate these systems exceeded the relatively low cost of contributing data, whether from their own systems or under volume contracts with commercial satellite operators. The challenge lay not in creating incentives for advanced space-faring states to contribute data for disaster applications, but in managing the complexity that comes with the diversity of systems and actors relevant to success.

A. Disaster Charter

The Charter on Cooperation to Achieve The Coordinated Use of Space Facilities In The Event of Natural Or Technological Disasters ("Disaster Charter” or “Charter")\(^{57}\) is a cooperative mechanism through which satellite operators—government agencies, as well as intergovernmental organizations—provide satellite-derived data and information in support of disaster prevention and response. The Charter is a legally non-binding arrangement. It was proposed by the European Space Agency (ESA) and the French space agency (Centre National d’Etudes Spatiales, or “CNES”) at the UNISPACE III conference in July 1999, and was joined shortly thereafter by the Canadian Space Agency (CSA) in October 2000.\(^{58}\) With the combined resources of the three space agencies, and following some logistics planning and testing, the Charter was declared operational on November 1, 2000. Within a matter of weeks, the Charter was activated for the first time in response to severe mudslides in Slovenia.\(^{59}\)

In essence, the Disaster Charter is a coordination mechanism that facilitates the rapid provision of space-derived information (e.g., maps showing the location or extent


\(^{58}\) A/AC.105/C.1/L.285.

of damage), free of charge, to rescue and relief operators in response to a “natural or technological disaster.” The Charter is open to participation by national space agencies and other space system operators. At the time of writing, government agencies of 11 States, as well as intergovernmental organizations such as ESA and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), participate directly in the Charter. These participants are responsible for governance through the Board. Charter Parties commit, on a “voluntary,” “best endeavors” basis to (1) collaborate to develop scenarios for streamlining the provision of space-derived information for disaster applications, and (2) upon activation of the Charter in the event of a “natural or technological disaster,” to task satellites they control, or to which they have access, to gather data requested by an authorized user.

The Charter’s scope is temporally limited to the most acute period of the disaster management cycle: Article I defines “crisis” to mean “the period immediately before, during or immediately after a natural or technological disaster, in the course of which warning, emergency or rescue operations take place.” Until recently, the Charter was additionally limited in who may activate it. For its first twelve years, only Charter Parties (including the member states of international organization Parties) were able to directly request services under the Charter. Over time, access to the Charter’s resources

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60 Id. The Disaster Charter defines “natural or technological disaster” as “a situation of great distress involving the 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.”
61 Id. at Article 1 (defining of “parties”).
62 Id. at Article 3.3.
63 Id. at Articles 3.1; 4.
64 Id. at Article 1.
65 See Disaster Charter, supra note 57 at Articles 1, 3.4, 3.5, and 5.
was expanded through arrangements with the United Nations\textsuperscript{66} and regional organizations.\textsuperscript{67} Parties may additionally activate the Charter on behalf of non-parties. For example, the Argentine space agency (Comisión Nacional de Actividades Especiales, or CONAE), a Charter Party, has activated the Charter on behalf of Latin American users on a number of occasions. For the period between 2007 and 2009, Charter activations divided equally among each of these paths to Charter services—direct activation by Charter parties, by Parties on behalf of a non-party, and through the UN. In September 2012, Charter Parties adopted a principle of Universal Access, expanding direct access to the disaster management authorities of all states.\textsuperscript{68}

Charter Parties share responsibility for maintaining 24/7 operational capabilities, assuming responsibility for receiving requests, liaising with other participating agencies, and assigning tasks for data acquisition and value-added processing on a rotating basis. Operation of the Charter additionally relies on an array of non-governmental actors. For example, several of the high resolution imaging systems employed by Charter participants are owned and operated by private commercial entities.\textsuperscript{69} Many of the value-added services—turning raw data into products useful for disaster management—are also performed by non-governmental entities. The Charter leaves to each participant how to structure its participation. Thus, some participants rely on extensive in-house value

\begin{itemize}
\item \textsuperscript{66} Through arrangements with the UN Office of Outer Space Affairs (OOSA) and the UN Organization Satellite (UNOSAT), these entities may activate the Charter on behalf of UN users. See \url{http://www.un-spider.org/mechanisms-guides/international-charter-space-and-major-disasters}.
\item \textsuperscript{67} The Asia Pacific Disaster Reduction Centre is authorized to request data through the Charter on behalf of 31 states in the Asia-Pacific region. See id.
\item \textsuperscript{68} See Universal Access brochure, available \url{http://www.disasterscharter.org/c/document_library/get_file?uuid=23109&groupId=127346&name=DLF_E-4304.pdf}.
\item \textsuperscript{69} It is United States policy to promote the development and growth of a commercial remote sensing industry by “rely[ing] to the maximum practical extent on U.S. commercial remote sensing space capabilities for filling imagery and geospatial needs for military, intelligence, foreign policy, homeland security, and civil users.” Fact Sheet: U.S. Commercial Remote Sensing Space Policy (May 13, 2003), available at \url{http://georgewbush-whitehouse.archives.gov/news/releases/2003/05/20030513-8.html}.
\end{itemize}
added capabilities, such as the Center for Satellite Based Crisis Information of the German Aerospace Center, while others rely on relationships with private commercial entities and academic institutions. Some participants have budgets to pay for data or value-added services, others have reached arrangements to provide some—or all—free of charge for humanitarian applications, and some rely on arrangements other parts of the government have with commercial entities. This flexibility the Charter affords each participant to contribute in its own way is often cited by participating agencies as an important factor in the Charter’s success.

At time of writing, the Charter has been activated more than 300 times to provide space-derived information in support of disaster management efforts. And its value to the disaster management community is growing, with the steady growth of its membership—and resources—and its efforts to expand access worldwide.70

B. **The Growth of a Disaster Management Ecosystem**

The past five years have witnessed a proliferation of initiatives aimed at harnessing space systems to address different phases of the disaster management cycle (e.g., long-term forecasting or early warning) and aspects of the overall challenge (e.g., communications infrastructure and capacity building), as well as broader environmental and humanitarian ends. The development of these initiatives could be characterized as *outside-in*: in contrast to a centralized initiative expanding outward to address broader parts of the disaster management cycle (i.e., inside-out), these initiatives have developed

independently, in parallel, in diverse fora including the United Nations, as well as less-
formal and regional coordinating groups, and are increasingly linking together with
varying degrees of formality. Together these initiatives comprise what could be called a
space-disaster management ecosystem.

Whereas the Charter is the leading mechanism for coordinating the rapid tasking
of satellites during a crisis, other initiatives aim to address phases of the disaster cycle or
services not encompassed by the Charter. For example, proactive, long-term monitoring
of Earth and climate conditions to aid disaster prediction and early warning is a
significant item on the international disaster management and sustainable development
agendas, highlighted as a priority in the Hyogo Framework Plan of Action\(^\text{71}\) as well as the
Rio+20 Outcome Document.\(^\text{72}\) Among the initiatives to further prediction, risk-
assessment and early warning of natural disasters through coordination among space
system operators is the Global Earth Observation System of Systems (GEOSS). GEOSS
is an initiative of the Group on Earth Observations (GEO), a voluntary group facilitating
coordination of Earth observation activities carried out by governments and
intergovernmental organizations. GEOSS is proceeding according to a 10-year
Implementation Plan (2005-2015), which embraces land, air, and sea-based Earth
observation activities as well as space, and aims to serve broader sustainable
development objectives in addition to disaster mitigation. Longer-term monitoring of the
Earth environment is also among the aims of the Global Monitoring for Environment and
Security (GMES) initiative of the European Commission. In support of this initiative,

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\(^{71}\) Hyogo Framework Plan of Action ¶ 17(k)
\(^{72}\) Rio+20 Outcome Document ¶ 187.
ESA and EUMETSAT are developing and will operate five new Earth observation satellite missions over the next decade.

Other initiatives address different aspects of the overall challenge of getting relevant space-derived information into the hands of disaster response actors during a crisis. One challenge is the transmission of information—particularly high-resolution space-derived products—to regions lacking sufficient communications bandwidth or where communications infrastructure has been crippled by a disaster. GEONETCast, a part of the GEOSS strategy, is a system for disseminating critical information from satellites to receiving stations that can be constructed from widely available, relatively inexpensive (i.e., $2,000-3000) components. The infrastructure for GEONETCast is provided by the U.S. National Oceanic and Atmospheric Administration (NOAA) for the Americas region, by the intergovernmental organization EUMETSAT for Europe and Africa, and by the Chinese Meteorological Administration (CMA) for the Asia-Pacific region.

The United Nations Organization Satellite (UNOSAT), established in 2003, processes and analyzes remote sensing data to generate value-added products (e.g., a map showing the nature and location of damage) in support of UN emergency relief agencies. The scope of UNOSAT’s services is broader than “natural or technological disastro[s],” supporting the work to the UN refugee and human rights agencies, and also includes initiatives to build capacity in the use of satellite-derived products.

Sentinel Asia is a regional, voluntary initiative led by the Asia-Pacific Regional Space Agency Forum (APRSAF) that aims to combine many of the above-described

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73 http://www.geonetcastamericas.noaa.gov/
74 Id.
elements to provide comprehensive disaster management services in the Asia-Pacific region. For example, high-bandwidth satellite-based communications are among the planned elements of the initiative. In addition to the satellites operated by APRSAF members, APRSAF is authorized to activate (i.e., request data from) the Disaster Charter on behalf of 31 states in the Asia-Pacific region.

Last and certainly not least among the initiatives comprising the space-disaster management ecosystem is the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UNSPIDER). Following the UNISPACE III conference, the General Assembly tasked COPUOS to study “the possibility of creating an international entity to provide for coordination and the means of realistically optimizing the effectiveness of space-based services for use in disaster management….” An ad hoc expert group surveyed potential applications of space systems for disaster management, the needs of user communities, existing mechanisms, and possible roles for the United Nations, reporting its findings to COPUOS in 2006. Through its Resolution 61/110, the General Assembly decided to establish UNSPIDER to “provide universal access” to “all types of space-based information and services relevant to disaster management, and to support the full disaster management cycle” by “serving as a bridge to connect the disaster management and space communities and being a facilitator of capacity-building and institutional strengthening, in particular for developing countries.”

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76 A/AC.105/C.1/L.285
V. EXPLORING THE OPTIMAL ROLE OF INTERNATIONAL LAW IN PHASE 3

Whereas international legal mechanisms were the tool of choice in addressing the collective action problems inherent in utilizing outer space—and play an essential role in the international cooperation to field the relevant space systems—they are not in the foreground of the third and present phase. Although this phase coincides temporally with what many have argued is a broader trend in space governance away from international legal mechanisms, I submit that the relatively informal, non-legal nature of the space-disaster management ecosystem is not simply a sign of the times. Rather, it is a function of the specific characteristics of this challenge.

The central focus of this chapter is the optimal role for international legal mechanisms in this third phase. I use optimal here to represent a balance of what I call agility and efficacy. Efficacy, unsurprisingly, concerns whether a mechanism is successful in achieving the desired cooperative outcome. Agility is the measure of time and resources necessary to get an efficacious mechanism up and running, and its flexibility to adapt once operational. Efficacy is a more holistic measure than compliance; it is oriented toward an end result dependent on actors beyond the parties to a given arrangement.

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79 My approach is in line with Richard Bilder’s suggestion that studies of international legal v. non-legal mechanisms “not be limited to compliance alone,” but also include “a comprehensive explanation of the development, interaction, and relative advantages and disadvantages of different kinds of international normative techniques, particularly legally-binding and non-binding norms, and how they can be used, alone or in combination, to achieve higher, more useful, and more stable levels of cooperation.” Richard B. Bilder, ‘Beyond Compliance: Helping Nations Cooperate’, in Dinah Shelton (ed.) Commitment and Compliance: The Role of Non-Binding Norms in the International Legal System (Oxford: Oxford University Press, 2000) p. 73.
The first task in this inquiry is backward-looking. Should the space agencies that founded the Charter have pursued an international agreement on remote sensing for disaster applications? Would an international legal mechanism have been optimal? If you have read this far, this may seem a disingenuous question. In retrospect, the Charter is a stunning example of both agility and efficacy. Declared formally operational within a month of signature by the three founding space agencies, the Charter was activated for the first time only a few weeks later, in response to severe mudslides in Slovenia. In a very short span of time, it has proven itself a valuable resource for disaster management, having been activated to provide satellite-derived data and information to the disaster response community more than 300 times.

However clear the optimality of the legally non-binding Charter appears through the lens of hindsight, what methodology could the participants at the negotiating table in 1999 have used to evaluate the merits of an international legal mechanism versus a non-legal mechanism? And by extension, how should states approach this question of institutional design in their efforts to address analogous coordination challenges?

A. Refocusing on Implementation for Complex Coordination Problems

The international relations literature seeking to explain when and why states favor legally non-binding—or “soft law”—mechanisms in place of international legal mechanisms offers a number of useful insights, but it is ultimately calibrated for a different class of problems. This literature has tended to focus on high-stakes collective action problems for which cooperative solutions involve costly commitments like reducing emissions or armaments. Functionalist analyses of the role of international legal mechanisms are oriented toward the international plane, with the success of cooperative
mechanisms measured primarily in their capacity to alter states’ behavior vis-a-vis one another— to promote compliance. Explanations grounded in liberal theory account for how the demands of domestic political constituencies may influence the choice of legal form, which, of course, presupposes domestic visibility and active, organized constituencies.

The challenge of harnessing existing space systems for disaster management applications through international cooperation falls through the cracks of these explanations. The low cost of participation relative to the value of direct access to the pooled resources of Charter participants presents little incentive to defect. This is not to suggest that the enterprise is entirely free of incentives to free ride; only that compliance considerations are not at the fore.

As explained above, the principal challenge in this third phase is coordination. It is a complex variant of a “coordination problem,” in which “incentives to violate commitments—once agreed upon—are quite low.” The international relations literature addresses coordination problems only in passing, as they are understandably “least interesting from a compliance perspective.” It does suggest that states can be expected to address coordination problems, as a category, through non-legal mechanisms, on

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80 Kenneth W. Abbott and Duncan Snidal, ‘Pathways to international cooperation’, in Eyal Benvenisti and Moshe Hirsch (eds.) The Impact of International Law on International Cooperation (Cambridge: Cambridge University Press, 2004) p. 50 (arguing that “an international agreement is only effective when it alters the behavior of participant states in ways that affect outcomes. This requires [inter alia, that] the participating states feel compelled to change some aspect of their behavior because of the agreement.”).
81 See Kal Raustiala, ‘Form and Substance in International Agreements’ (2005) 99 American Journal of International Law 581, 595-597.
82 The Charter is not simply a gift from the most technologically advanced states to the least developed. Even the states with the most advanced remote sensing capabilities stood to benefit from the rapid, streamlined access to data from multiple systems afforded the Charter. Indeed, Charter participants have activated the Charter on a number of occasions in response to crises within their borders. See Charter activation statistics, available http://www.disasterscharter.org/web/charter/activations.
83 Raustiala, supra note 81 at 591.
account of the minimal incentives to defect, and relative ease of conclusion,85 but does not explain why states nevertheless address many such problems through international legal mechanisms. Acknowledging the diminished explanatory power of compliance in such cases, Guzman and Meyer perfectly frame the question I take up: “if expected levels of compliance are equal across forms of agreements, how do states make the choice between a soft or hard law agreement?”86

I submit that answering this question in a given case necessitates a shift in focus away from compliance—and inter-state relations—and an examination of the roles of international legal mechanisms in intra-state implementation. The efficacy of an international cooperative arrangement—whether legal or non-legal—depends on each participant taking the necessary actions at home to fulfill its commitments under the arrangement. This may require new authorities, funds, or personnel; the requirements for implementation for a given state can vary according to its constitutional arrangements, political realities, and the existing authorities and resources of the agencies responsible for fulfilling its commitments under the arrangement. Beyond the domestic actions each cooperating state must take to enable it to fulfill its commitments, the efficacy of international cooperative arrangements sometimes depends on the conduct of outside actors—states not party to the arrangement or non-governmental entities. The legal form of the arrangement is relevant to the success for both types of implementation challenges.

The case of the Cospas-Sarsat system for satellite-based search and rescue illustrates the relevance of legal form to the varied challenges of implementing an international cooperative arrangement. Consisting of satellites carrying search and rescue

85 Guzman and Meyer, id. at 188-192; Raustiala, supra note 81 at 593, 600.
86 Guzman and Meyer, supra note 84 at 190.
(SAR) payloads, ground stations around the world, and compatible distress beacons carried by ships, airplanes, and individuals, the system alerts nearby SAR authorities when a distress beacon is activated, and is now capable of pinpointing the location of the vessel or person in distress. It has thus been described as “taking the ‘search’ out of search and rescue.”

The efficacy of the system depends on vessels carrying compatible beacons. Early in the life of the system, the cooperating states determined that widespread adoption of distress beacons operating at a frequency better suited for Earth-space communication was essential to the system’s success. This would entail some cost to vessel operators, and thus require coordinated regulatory action — not merely in participating states, but throughout the world, spurred by actions in international maritime and civil aviation organizations to promote the standard. Worldwide adoption of the standard required global confidence in the continuity of the system, and the participating agencies believed that elevating their cooperation from a series of agency-level MOUs to an intergovernmental agreement would signal a credible commitment to the system. But here the rationale for signaling was not about compliance; the audience was not parties to the agreement, but non-party states and international organizations whose coordinated regulatory action was essential to promoting the standard.

It is worth noting here that the choice of legal form rarely rests on a single factor, and in many instances of international cooperation, including Cospas-Sarsat case, an

88 See id. at 264-66.
89 See id.
international legal mechanism is necessary for reasons ancillary to the overall objective. For example, apportionment liability or intellectual property rights arising from the cooperative activities can only be accomplished by legal agreement. The 1988 Cospas-Sarsat Programme Agreement and each of the agency-level MOUs that preceded it were necessarily legally-binding as they included cross-waivers of liability. Through the 1988 agreement the parties demonstrated their commitment to the system not by upgrading the legal form of their cooperation, but by moving from agency-level to a government-level agreement.

The implementation-advantages of an international legal mechanism are greatest where successful implementation requires governmental action beyond the agency at the negotiating table. In the Cospas-Sarsat case, the National Oceanic and Atmospheric Administration (NOAA) led the U.S. involvement, but implementation required action by senior executive branch officials to incorporate funding requests for the search and rescue payloads, and the weather satellites that carry them, into the President’s budget, as well as rulemaking by the Federal Communications Commission to promote the adoption of compatible distress beacons.\(^\text{91}\) In many states, including the United States, negotiating and concluding a legally-binding international agreement triggers a more comprehensive internal review process than non-binding arrangements. This internal coordination, in parallel with negotiations on the international plane, serves to ensure the government as a whole will be able to perform its commitments.\(^\text{92}\) It facilitates \textit{ex ante} buy-in by the

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\(^{91}\) See 47 CFR 80.1061.

\(^{92}\) Abbott and Snidal address a potential role for international legal mechanisms in domestic implementation, arguing that “executive officials should look to hard international law to commit other domestic agencies (especially legislatures) or political groups when those officials are able to make international agreements without interference or control, and when their preferences differ significantly from those of competing power centers.” Abbott and Snidal, \textit{supra} note 90 at 430. While acknowledgement of the influence of implementation needs on legal form is an important insight, I
governmental actors essential to the success of the cooperative arrangement, which might not have been aware of it if concluded through less-formal means.

In sum, where compliance considerations are not at the fore, and where apportionment of rights or liability is not essential, implementation is the key to understanding the choice between legal and non-legal mechanisms. In many cases, the choice will come down to whether successful implementation would be served by the internal coordination processes triggered by international legal mechanisms. To a certain extent, these processes are enemies of agility; non-binding arrangements, in general, require less coordination and authorization, and thus less time to conclude. But agility matters only if the arrangement is efficacious, if each participant implements its commitments. I propose a practical approach to assessing when an international legal mechanism would be advantageous for implementation.

B. An Operational Level Approach

I propose what I call an operational level approach to ascertaining the optimal role for international legal mechanisms in addressing complex coordination problems. An operational level approach begins by identifying the actors essential to success in each participating state, and then considers their level within or relationship to the state. To use the Disaster Charter as an example: whose action is necessary to task satellites and provide data free of charge to foreign entities in response to a disaster? Are the relevant satellites owned and operated by governments or private entities? Do the governments have value-added processing capabilities, or do they rely on the private

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disagree with the suggestion (at least in the United States) that the function of an international agreement is “commit” a legislature. Rather, the internal coordination processes are useful in securing ex ante buy-in by actors essential to implementation.
sector? Within each government, which agencies must act? At what level of each agency would the necessary actions occur? Do the relevant agencies have existing authority to do this, or is legislative action or intra-executive delegation necessary? Are new budgetary appropriations necessary to add personnel or buy data?

Identifying the operational level brings into focus any implementation challenges that may favor an international legal mechanism. For example, in the Cospas-Sarsat case, the level of operations was relatively high and distributed across executive and legislative functions. Fielding the space segment of the system required new funds, and promoting the standard required regulatory action in each participating state. Where the operational level is high and distributed within cooperating governments, the implementation-advantages of an international legal mechanism are greatest.

The operational level in the Disaster Charter case is comparatively low and concentrated within the governments of participating states. The United States participates in the Charter through the United States Geological Survey (USGS), which operates the long-running LANDSAT remote sensing program and is charged with certain responsibilities in support of predicting and responding to natural hazards, and the National Oceanic and Atmospheric Administration (NOAA), which operates the nation’s weather and environmental satellites. Observation of Earth and its atmosphere from space were already important functions of the agencies. To carry out these missions for the United States they are equipped with expert personnel, as well as budgets and legal authorities to support these missions. Both operate remote sensing systems and have working relationships with other governmental operators—within and outside the U.S.—as well as with private commercial operators. To a significant extent, implementation of
the Charter could be accomplished by the lead agencies, within existing budgets and legal authorities, and by existing personnel.

Examination of the operational level reveals the limited value an international legal mechanism might add to the Charter’s implementation by each participant. Where an efficacious result can be achieved within existing resources and authorities—without action by the highest levels, or different branches of governments—the advantages of non-legal mechanisms in terms of agility will often predominate.

In cases where agility matters, keeping one eye on the operational level is a useful approach to identifying opportunities to scale an international cooperative arrangement under negotiation to lessen implementation challenges and delays. It is a methodical way for states to explore structuring their cooperation to maximize near-term results, even if only as an initial step in a longer-term, more ambitious plan for cooperation.  

C. Looking Ahead: Open Source Cooperation

Whether an international legal mechanism would be optimal now, twelve years into the operational life of the Disaster Charter, is a slightly different inquiry. The fully operational Charter frees us to consider the merits of elaborating the non-binding arrangement into a legally binding international agreement—or a broader agreement encompassing all phases of the disaster management cycle—with less concern for time.

In terms of value to end-users, there is little to be gained in the near term, and much to lose, by formalizing or centralizing the space-disaster management ecosystem, such upgrading the legally non-binding and expressly “voluntary,” “best endeavors”

93 Abbott and Snidal have demonstrated that a gradual deepening of cooperation over time by replacing non-legal mechanisms with international legal ones, or deepening the substance of international legal mechanisms, is a well-travelled pathway to international cooperation. Abbott and Snidal, supra note 80 at 59-60, 69-71. To their political uncertainty explanations of this common cooperative trajectory, I would add the implementation considerations discussed in this chapter.
commitments of Charter Parties to legally-binding, compulsory obligations. Any theoretic gains in the continuity of available resources must be weighed against the real possibility of declining participation if some current contributors are unable to undertake such a formal financial commitment.\textsuperscript{94}

For disaster management end users, the value of the Charter is growing. An expanding membership enhances the resources available through the Charter, and its recent shift to Universal Access dramatically expanded access. At the same time, elements of the space-disaster management ecosystem are linking together to create new disaster applications.\textsuperscript{95} Take for example recent initiatives to leverage GEONETCast’s global network of satellite communication systems to disseminate disaster management information—including through the Charter—when a disaster has crippled ground-based communications infrastructure.

The \textit{outside-in} trajectory of these mechanisms—developed independently, in separate fora, to address different aspects of a global problem, and reaching in and linking together over time—invites another comparison with the Cospas-Sarsat case. The development of the latter system was comparatively centralized. Interoperability between the satellites contributed by different partners, and compatibility with distress beacons, is absolutely essential to its success. The communication between a distress beacon and satellites, and the relay of the beacons’ distress signal to ground stations is automated; it does not work unless all components of the system talk to each other. The

\textsuperscript{94} The prospect that elaboration of a non-legal mechanism into an international agreement—or replacing an existing international agreement—will result in at least a temporary loss of some participants, gives successful international cooperative arrangements a certain inertia. This equilibrium in which the value of new international legal commitments to address relatively minor issues is exceeded by a loss in membership could be called \textit{treaty stasis}.

\textsuperscript{95} See Section IV.B \textit{supra}.
centrality of interoperability and compatibility to its operation favor what could be called a closed system.

By comparison, the space-disaster management ecosystem is an example of what might be called open source cooperation, as it is built upon varied contributions by a diverse range of actors. The effective use of satellites in outer space in disaster situations on Earth depends more on human intervention than hardware compatibility. In the first instance, someone—whether in the local disaster response authority or an agency or organization acting on its behalf—must understand what space systems can contribute to addressing a given disaster, and must request this assistance through the Charter or a related mechanism. Another person must then make a judgment call about which of the available satellites to task. Still others must process, analyze, and combine the raw data to generate value added maps for other people—sometimes half a world away in the disaster zone—to interpret and incorporate into response plans.

Some of these people making the Charter work day to day are employees of government space and science agencies. Some are at academic institutions, and others at private commercial entities. Some sell their data and services to Charter participants, others volunteer them. This open-ended architecture of the Charter and related mechanisms—inventing a diverse range of actors to contribute in their own way—significantly enhances the resources available to the disaster management community.

This relatively informal, open source approach seems to be headed in a productive direction, unlocking new opportunities to utilize existing space systems by accommodating the contributions of a diverse and growing range of actors. Challenges

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96 I borrow “open source” from the computer software realm, where it generally describes making the source code freely available so that the community of software developers may contribute improvements.
remain in realizing the full potential of space systems for disaster management, but at this early stage in the trajectory, solutions demand agility more than rigid commitments.

**VI. CONCLUSION**

International law plays an indispensable role in enabling the use of outer space for disaster management. It is essential to the use of space by a diverse array of state and non-state actors, and more particularly, to enabling the observation of Earth from outer space, on terms conducive to understanding, predicting, and responding to natural disasters. Another important role of international law is in facilitating international cooperation to field the individual space systems, which can be impracticable for a state acting alone. Many such systems are the result of a vast body of bilateral and trilateral international agreements fixing the contributions of multiple states to a given satellite—sensors, launch services, ground stations, technical know-how—and allocating risks, rights, and responsibilities among them. This is not addressed as separate a phase because it spans the entire history of space exploration.

To date, international legal mechanisms have not been favored in addressing the challenges presented by disaster applications in the third phase, and this is unlikely to change in the near term. But none of this suggests the role of existing international law is diminished in this third phase, or that it is declining over time. In fact, the opposite is true. The influence of the international law applicable to outer space continues to grow with the membership of the core instruments, and as a growing number of states enact national space laws, extending this body of international law to non-governmental
activities in space. The states seeking to harness space systems for disaster applications did not face a binary choice between international law and non-legal mechanisms. Rather, as in most areas of international cooperation, legal and non-legal mechanisms are layered, operating on different levels to address the aspects of an overall challenge for which they are best suited.

Phase 3 presents a qualitatively different set of challenges than Phases 1 or 2. Phase 3 does not require the ground-up establishment of a regime for an entirely new class of activities, with the attendant allocation of risks and rewards. It is an application of existing activities—and existing resources—and thus builds upon the shoulders of the international regimes for space and remote sensing, and the systems they enabled. For this specific challenge, international legal mechanisms are not optimal at this time: they do not offer significant advantages in terms of efficacy, and non-legal mechanisms afford greater agility. This is not necessarily true of all humanitarian applications of space systems or challenges falling under the umbrella of “coordination problems.” In general, a focus on implementation—and the operational level within each cooperating state—helps to illuminate the optimal role of international legal mechanisms in addressing global challenges of this kind.

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