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The Oso Landslide: Disaster Management Law in the Space Age

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THE OSO LANDSLIDE: DISASTER MANAGEMENT LAW IN THE SPACE AGE

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INTRODUCTION

Climate change entails prospective increase in natural disasters.[1] Such disasters often take governments and their people by surprise. Governments fail to anticipate and to mitigate, in spite of inherent vulnerability.[2] When disasters unexpectedly happen, governments tend to be badly prepared for the aftermath. To illustrate, this Paper describes two recent landslide disasters. One landslide is in a developed economy (the United States), the other landslide is in a developing economy (Sri Lanka). Although the country with the developed economy could be expected to have more resources to deal with a disastrous landslide, it appears that neither of these countries was effectively proactive, and neither was prepared for disaster relief after the events. In disasters, typically the burden falls mainly upon local authorities and the people affected, or who live nearby, despite significant national and international resources that could be used to prevent disasters and to provide relief after they happen. These observations apply not just to landslides, but to all types of disasters.

The prevailing disaster philosophy of the International Red Cross and Red Crescent is that international disaster assistance should become

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[1] *See* Nick Watts et al., *Health and Climate Change: Policy Responses to Protect Public Health*, THE LANCET (June 23, 2015), http://www.sciencedirect.com/science/article/pii/S014 0673615608546 [http://perma.cc/57Z3-DSDF] (stating that climate change will cause increase in disasters including storms, droughts, floods, and heat waves); *see also* Sabrina Tavernise, *More People Will be Exposed to Extreme Weather in Coming Decades, Report Says*, N.Y. TIMES, June 23, 2015, at A6.

[2] *See generally* JEFFREY R. KEATON ET AL., GEOTECHNICAL EXTREME EVENTS RECONNAISSANCE, THE 22 MARCH 2014 OSO LANDSLIDE, SNOHOMISH COUNTY, WASHINGTON 161–63 (2014) [hereinafter GEER Report] (stating that there was no public communication of the risks of a landslide in Oso, which could have helped mitigate the disaster).

available only when States are unable to cope with their local disasters.[3] Should that basic assumption apply in the space age, where satellite technology is available? Satellites can observe and locate developing disasters. Disaster risks can be assessed and possibly be prevented. The data they collect can be preserved in international data banks and made available to national authorities to improve their capacity to handle disasters. In the future, States may well have to resort to assistance from international sources on a continuing basis rather than wait until they become overwhelmed.

This Paper discusses how outer space resources such as remote sensing and Global Navigation Satellite Systems ("GNSS") can be activated for use at an early stage.[4] Existing international authorities, such as the Group on Earth Observations ("GEO"),[5] the UN Platform for Space-Based Information for Disaster Management and Emergency Response ("UN-SPIDER"),[6] and the International Telecommunication Union ("ITU")[7] as well as Non-Governmental Organizations ("NGOs")[8] can assist in disaster situations. Their effectiveness will be evaluated.

There is a fundamental humanitarian duty to assist in emergency situations.[9] That duty was expressed in United Nations General Assembly ("UNGA") Resolution 41/65 of 1986.[10] Principle X of the UNGA Resolution states that remote sensing shall be used to protect Earth's natural environment, so as to avoid harm, and concerned States shall be informed of dangers revealed through remote sensing.[11] Principle XI states: "Remote sensing shall promote the protection of mankind from natural disaster."[12] States in possession of information about impending natural

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[3] David Fisher, *Law and legal issues in international disaster response*, INT'L FED'N OF RED CROSS & RED CRESCENT SOC'YS 3, 24–25 (2007), http://www.ifrc.org/PageFiles/125639/113600-idrl-deskstudy-en.pdf [http://perma.cc/V7NX-EWJK] ("[D]isasters are sometimes so large that they overwhelm national coping capacities. In those cases, the assistance of foreign and international actors is critical to ensuring that humanitarian needs are promptly and adequately met").

[4] *See* discussion, *infra* Section II.C.

[5] *See* discussion, *infra* Section IV.C.

[6] *See* discussion, *infra* Section III.B.

[7] *About ITU*, INT'L TELECOMM. UNION, http://www.itu.int/en/about/Pages/default.aspx [http://perma.cc/QTU8-DL9L] (last visited Nov. 12, 2015).

[8] *See* discussion, *infra* Section V.B.

[9] FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE 432–36, (Ashgate 2009) [hereinafter Lyall & Larsen].

[10] G.A. Res. 41/65 (XI), U.N. Doc. A/RES/41/65 (Dec. 3, 1986).

[11] *Id.* at (X).

[12] *Id.* at (XI).

disasters "shall transmit such data and information to States concerned as promptly as possible."[13] Likewise, the Convention on International Liability for Damage Caused by Space Objects, Art. XXI, states that States, in particular launching States, "shall examine the possibility of rendering appropriate and rapid assistance to the State which has suffered the damage [from a space object], when it so requests."[14] The same humanitarian principle about helping affected States is expressed in the 1972 Stockholm Declaration, Principle 18.[15] It is expressed in Principles 18 and 19 of the 1992 Rio Declaration.[16] We may even ask "whether humanitarian assistance may be developing as a norm of customary law."[17]

I. COMPARISON OF TWO RECENT DISASTROUS LANDSLIDES

The concern of this Paper is with disasters in general. But it is useful to compare two actual, similar disasters. One is in the developed economy of the United States and one is in the developing economy of Sri Lanka.

A. Disaster in a Developed Economy: Washington, United States, Oso Landslide in 2014

The landslide in Oso, just North of Seattle, Washington, in the United States, occurred on March 22, 2014.[18] The event has now been thoroughly studied and analyzed and its causes and effects are well understood. Forty-three people perished.[19] The landslide demolished

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[13] *Id.*

[14] The Convention on International Liability for Damage Caused by Space Objects, MULTILATERAL, 961 UNTS 15 (1975) [hereinafter the Liability Convention], *available at* https://treaties.un.org/doc/Publication/UNTS/Volume%20961/volume-961-I-13810-English.pdf [https://perma.cc/6AFD-5K5M].

[15] Conference on Human Environment, June 5–16, 1972, Stockholm, Declaration of the United Nations Conference on Human Environment, 11 ILM 1416 (Nov. 1972).

[16] United Nations Conference on Environment and Development, *Rio Declaration on Environment and Development*, UN Doc. A/CONF.151/26/Rev. 1 (Vol. 1), annex I (Aug. 12, 1992). *See generally* Francis Lyall, *Protection of the Space Environment and Law*, 42 IISL PROC. 472 (1999).

[17] Lyall & Larsen, *supra* note 9, at 429–30.

[18] GEER Report, *supra* note 2, at 1.

[19] KATHY LOMBARDO ET AL., THE SR 530 LANDSLIDE COMMISSION FINAL REPORT 1 (Dec. 15, 2014) [hereinafter the Washington State Commission].

many buildings and caused great physical damage to roads, rivers, and to the environment.[20]

The area was prone to slides. The fragile hills were formed by retreating ice age glaciers about 20,000 years ago.[21] The sediments of the glaciers consist mostly of sand and gravel interspersed with clay and rocks. Steep hills are prone to slide when the level of ground water rises. There were sustained heavy rains prior to the landslide, as described in the 2014 GEER Report.[22] The report was sponsored by the United States National Science Foundation and was performed by members of the geo-engineering community.[23]

The area of the 2014 Oso slide has a long history of prior similar slides. "[T]he 2014 Oso Landslide was a reactivation of one of these ancient landslides."[24] At the time of the slide no earthquake activity was recorded on any seismic measuring instrument, thus excluding seismic activity as the cause of the slide. However, heavy rains, as much as thirty inches, or seventy-six centimeters, fell during the month prior to the slide.[25] Heavy logging of timber may have increased the lubricating effect of the groundwater.[26] Trees and plants help to hold hills from sliding.[27]

Lacking knowledge of the landslide history of the area, many people built houses in the dangerous slide-prone area. In fact, neither the U.S. government nor the State of Washington government have sufficient land-planning regulations or guidelines governing the risks of building and living in natural landslide-prone areas.[28] On the federal level of

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[20] GEER Report, *supra* note 2, at 90–91.
[21] *Id.* at 6–8.
[22] *Id.* at 28–32. *See generally Geotechnical Extreme Events Reconnaissance*, GEER ASSOC., http://www.geerassociation.org [http://perma.cc/KGH6-X8FS] (last visited Nov. 12, 2015) (stating the mission of the Geotechnical Extreme Events Reconnaissance). *See also* Sandi Daughton, *What Triggered Slide?*, SEATTLE TIMES, June 2, 2015, at A1.
[23] GEER Report, *supra* note 2, at 164.
[24] *Id.* at 159.
[25] *Id.* at 160.
[26] *Id.* at 161–62.
[27] *Killer Landslides* (NOVA Program, KCTS 9 television broadcast Nov. 19, 2014). *See also* Phuong Le, *State Reviews Logging Decisions Before Oso Slide*, ASSOC. PRESS, Dec. 10, 2014 (stating the Washington State Department of Natural Resources found that a lumber company had cut a wider area at the OSO landslide than permitted); *Forest Practices Board Gives State More Power to Examine Harvests in Unstable Areas*, THE CHRONICLE, Nov. 13, 2014 (stating that the Washington State Department of Natural Resources now wants to require logging companies to provide more technical information in slide-prone areas when planning to cut timber).
[28] GEER Report, *supra* note 2, at 162.

government the United States Federal Emergency Management Agency ("FEMA") is charged with federal management of disasters in the United States.[29] However, other government agencies also become involved in U.S. disaster management. No agency, including FEMA, keeps comprehensive records of disaster remedial efforts by agencies. Such lack of record-keeping undermines U.S. national preparedness for disaster. A report for the Government Accounting Office recently reported that "FEMA is not aware of the full range of information" possessed by other government agencies.[30]

The GEER Report on the Oso landslide was sponsored by the National Science Foundation.[31] This report is just a recommendation. The National Science Foundation is not a government regulatory agency. It has no enforcement authority. However, the federal government and the State of Washington are free to adopt and enforce these recommendations. The GEER Report studied the Oso landslide from a national perspective and recommended as follows:

1. That the geological history of landslide-prone areas be carefully considered by government authorities when planning human activities in those areas.
2. The risks of building in landslide areas must be effectively communicated to people wanting to build in those areas.
3. Slide-prone areas must be closely monitored, and for that purpose monitors must be built into the system.
4. Weather must be closely monitored by use of rain gauges and otherwise, and dangers must be communicated to people in slide-prone areas.
5. New ways to monitor earth slides must constantly be considered.

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[29] *About The Agency*, FEMA, http://www.fema.gov/about-agency [http://perma.cc/B68Z-DPGT] (last updated Jan. 31, 2015). *See also* Lewis Kamb & Jim Brunner, *Year After Slide Devastation*, SEATTLE TIMES, Mar. 22, 2015, at A1 (stating Snohomish County applied to FEMA for a grant to buy properties in the area of the landslide).

[30] Hope Yen, *US Not Fully Prepared for Nuclear Terrorist Attack*, ASSOC. PRESS, Dec.19, 2014.

[31] GEER Report, *supra* note 2, at 1. *See also* discussion of LIDAR and remote sensing, *infra* Section II.B.

6. Light Detection and Ranging ("LIDAR") and remote sensing imagery should be used to identify potential landslides.[32]

The governor of the State of Washington also appointed a commission to study the Oso landslide.[33] It viewed the Oso landslide from the local perspective. The commission made several useful recommendations to the Governor:

1. Using the latest technology such as LIDAR, the State should collect data on landslides for local land-use planning. The State should also establish a geological hazards resilience institute.
2. The State emergency management system is in need of improvement and should include proactive preparations for landslides and other disaster emergencies.
3. The State should standardize requests for tracking, mobilizing and demobilizing requests for disaster emergency resources.
4. The State should continue to investigate potential landslides in the area of the 2014 Oso landslide.
5. The State should prioritize requests for emergency assistance in order not to overwhelm emergency management.
6. The State should manage local volunteers for emergencies such as landslides.
7. The State should organize a more effective, unified communication system.
8. The State should establish guidelines for designating geological hazard areas and for making assistance available.[34]

The Governor is now acting on several of the Washington state commission's recommendations. Some of the recommendations require the State legislature to provide implementation money.[35]

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[32] GEER Report, *supra* note 2, at 162–63.
[33] Washington State Commission, *supra* note 19, at 1.
[34] *Id.* at 11–33.
[35] Phuong Le, *Panel: Oso Mudslide Offers Public Safety Lessons*, ASSOC. PRESS, Dec. 15, 2014.

B. Disaster in a Developing Economy: Badulla, Sri Lanka, Landslide in 2014[36]

In order to measure the abilities of the United States to access disaster assistance technology, it is useful to compare the Oso landslide with a recent landslide in Asia. Sri Lanka has its share of active landslides. The Sri Lankan government estimates that twenty percent of Sri Lanka, mostly on the inland tea plantations, is prone to landslides.[37] The Sri Lankan National Building Resources Organization ("NBRO")[38] has issued "active warnings for the districts of Kalutara, Nuwera Eliya, Badula, Kandy, Matale, Kegalle and Rathnapura which have a combined population of 5.3 million."[39] The emergency management problems regarding the 2014 landslide in Badulla, Sri Lanka, are not unlike the emergency management problems in the State of Washington. The Sri Lankan landslide occurred on October 29, 2014, on a tea plantation.[40] Initially several hundred people were feared killed.[41] However, the final death toll was reported to be thirty-eight people. Many people were left homeless.[42]

Like the Oso landslide, the Sri Lankan landslide was preceded by heavy rainfall, which caused the hillside to collapse and to bury the tea workers and their homes in a thick layer of mud. The Sri Lanka Disaster Management Center[43] had warned people about the danger of a slide and had conducted evacuation drills.[44] Because Sri Lanka suffered severely from the Indian Ocean tsunami in 2004, in which 31,000 people died, the government has been diligent about organizing exercises and drills about

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[36] *How Disaster Preparation Broke Down in Sri Lanka*, IRIN HUMANITARIAN NEWS & ANALYSIS, Nov. 4, 2014, http://www.irinnews.org/report/100794/how-disaster-preparation-broke-down-in-sri-lanka [http://perma.cc/RW68-NGNW] [hereinafter IRIN].

[37] *Id.*

[38] *National Building Research Organization*, NBRO, http://www.nbro.gov.lk/web/index.php?land=en [http://perma.cc/SM32-DS9Z] (last updated Aug. 27, 2015) (stating the NBRO's mission is to promote and sustain research and development and provide technical services for disaster risk reduction and safer environment).

[39] IRIN, *supra* note 36.

[40] *Sri Lanka Landslide: 38 Feared Dead as Death Toll Revised Down*, BBC (Nov. 1, 2014), http://www.bbc.com/news/world-asia-29863805 [http://perma.cc/KC5R-ZHN5].

[41] *Id.*

[42] *Id.*

[43] The purpose of the Sri Lanka Disaster Management Center is to protect human life and property of the people and the environment of Sri Lanka from the consequences of disasters taking place in the national territory by effectively dealing with them from a national perspective. *Id.*

[44] IRIN, *supra* note 36.

escaping from natural disasters.[45] The Sri Lanka Disaster Management Center selects locations that are most likely to experience disasters. The Badulla disaster location had a simulated disaster exercise one year prior to the 2014 landslide. However, the tea plantation workers are very poor and do not have alternative places to live, so they tend to remain where they grew up.[46]

After surveying the Badula landslide area the NBRO proposed that the entire settlement be relocated elsewhere. The Sri Lankan government's Disaster Management Center has included that relocation in its long-term plan. In consequence of the Badula landslide, Sri Lanka is preparing to focus more of its emergency preparedness on landslides.[47]

C. Evaluation

Failure of disaster management in the United States and Sri Lanka resulted in significant loss of lives and property damage. In some ways Sri Lanka was better prepared than the United States for landslides, having identified vulnerable sites and having marked the site which did slide. But that knowledge did not translate into relocation of the people affected by the landslide. So whether the landslides in both countries were surprises or not, the outcome was the same. Both relied primarily on local resources for prevention and for emergency assistance. Neither of the two countries significantly used international proactive nor post-disaster management assistance. Several important international tools that can benefit individual countries will be discussed in the following sections.

II. INTERNATIONAL DISASTER TOOLS

A. Weather Forecasting: World Meteorological Organization ("WMO")

Excessive rainfall is a basic ingredient of the Earth liquefaction process that causes landslides.[48] Therefore, advance information about approaching rains is important in predicting landslides. Storms and hurricanes are also causes of disasters for which advance warnings are essential. Warnings are available through highly developed weather prediction. Meteorological satellites observe and report on developing

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[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] GEER Report, *supra* note 2, at 160–61.

weather patterns. Countries exchange meteorological information within the framework of the WMO.[49] The Global Climate Observation System ("GCOS") was established in 1992 at the Second World Climate Conference to organize fair and even distribution of climate information to all interested parties.[50] GCOS is cosponsored by the WMO, the Intergovernmental Oceanographic Commission of the UN Educational, Scientific and Cultural Organization, the UN Environmental Program and the International Council of Science.[51] For the purpose of reporting, GCOS sets essential climate variables. GCOS receives climate reports from 1000 surface stations around the Earth and from 150 upper reporting stations.[52]

It is now reliably known when it is going to rain three days before that happens.[53] If available meteorological data is used skillfully, governments can put effective disaster management into effect before the event occurs.[54] Economically developed countries are rich sources of weather information. Both the United States and Sri Lanka receive weather information under the frameworks of the WMO and the GCOS.

B. Tracking Disasters: Remote Sensing, Including LIDAR, Synthetic-Aperture Radar ("SAR"), and Geographical Information System ("GIS")

Monitoring potential landslides is an important first step in avoiding the disastrous consequences of a slide. Monitoring of the Earth from

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[49] In the United States, the National Oceanic and Atmospheric Administration ("NOAA") provides the weather information. *About NOAA*, NOAA, http://www.noaa.gov/about-noaa.html [http://perma.cc/ZS72-L2BZ] (last visited Nov. 12, 2015). In Europe, weather information is generated under the Convention for the Establishment of European Organization for the Exploitation of Meteorological Satellites ("EUMETSAT"). *See* Convention for the Establishment of European Organization for the Exploitation of Meteorological Satellites, May 5, 1983, 1434 U.N.T.S. 3.

[50] *Ensuring the Availability of Global Observations for Climate*, GLOBAL CLIMATE OBSERVING SYS., http://www.wmo.int/pages/prog/gcos/Publications/GCOS_brochure2010.pdf [http://perma.cc/2CMF-TRQA] (last visited Nov. 12, 2015).

[51] *Id.*

[52] *Status Report on the Key Climate Variables*, GLOBAL CLIMATE OBSERVING SYS. at 10, 22, 26 (Sept. 10, 2003), http://www.wmo.int/pages/prog/gcos/Publications/gcos-82_2AR_TechnicalSupp_DraftSep03.doc.

[53] Mike Hammer, *How Accurate is the Weather Forecast?*, WORLD SCI. FESTIVAL (Feb. 24, 2014), http://www.worldsciencefestival.com/2014/02/how_accurate_is_the_weather_forecast [http://perma.cc/W5JJ-6DUF].

[54] *See generally Guidelines on the Role, Operations and Management of the National Meteorological or Hydrometeorological Services*, WORLD METEOROLOGICAL ORG., https://www.wmo.int/pages/prog/dra/eguides/index.php/en/5-functions/5-12-disaster-risk-reduction [https://perma.cc/2K4F-WZK7] (last visited Nov. 12, 2015).

satellites is increasingly possible. New remote sensing technology makes it possible to make "high-resolution hazard maps" for the entire United States at a cost less than the annual cost of landslides in the United States.[55] Such maps are available in Italy and Switzerland and were recommended for the United States by the National Research Council, but failed to be funded.[56]

The European Space Agency ("ESA") established the European Earth Observation and Monitoring Program called Copernicus.[57] Copernicus is a remote sensing service.[58] It collects information from sensors established on the Earth's surface.[59] Thus it is able to track surface changes and to transmit the information to decision-makers. For example, Copernicus can identify subtle changes in land surface and the density of water in the surface that may lead to landslides. The Copernicus emergency management program is currently operational. At this moment, Copernicus is focused on Europe, but the ESA and the Asian Development Bank have agreed to extend its Earth observation program into Asia to facilitate international development and disaster and risk analysis. According to this agreement, a fleet of Earth observation satellites "will provide satellite data at unprecedented resolution and frequency for years to come."[60]

NASA's Earth Sciences Program is actively involved in Earth observation. Its Soil Moisture Active Passive ("SMAP") satellite observes the surface of the Earth.[61] NASA uses radar and radiometer signals to

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[55] David R. Montgomery & Joseph Wartman, Op-Ed., *How to Make Landslides Less Deadly*, N.Y. TIMES (Mar. 20, 2015), http://nyti.ms/1CEofYY [http://perma.cc/2PU2-CQFE].

[56] *See id.* The State of Washington has adopted a law requiring detailed mapping of potential landslides in the state. *See* ASSOC. PRESS, *Governor Signs Bill to Boost Mapping of Geologic Hazards,* SEATTLE TIMES (Apr. 18, 2015, 9:29 AM), http://www.seattletimes.com/seattle-news/governor-signs-bill-to-boost-mapping-of-geologic-hazards [http://perma.cc/AS45-TTJZ].

[57] *Leaflet of Global Land Service Monitoring of Earth Surfaces*, COPERNICUS, http://land.copernicus.eu/global/sites/default/files/service/COPERNICUS_Leaflet_FINAL.pdf [http://perma.cc/79QG-XHVN] (last visited Nov. 12, 2015).

[58] *Overview: Observing the Earth*, EUR. SPACE AGENCY, http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Overview3 [http://perma.cc/D7SW-UNG9] (last visited Nov. 12, 2015).

[59] *Id.*

[60] *Tapping into Earth Observation Data for International Development*, EUR. SPACE AGENCY (Dec. 11, 2014), http://www.esa.int/Our_Activities/Observing_the_Earth/Tapping_into_Earth_observation_data_for_international_development.C104 [http://perma.cc/LF9L-RNPW].

[61] *NASA Soil Moisture Radar Ends Operation, Mission Science Continues*, NASA (Sept. 2,

get highly accurate data on soil moisture.[62] Such information can be important for detecting impending landslides caused by heavy rains.[63] NASA has a fleet of satellites which observes Earth's natural events and systems and compares its observations with past accumulated data collection to detect possible changes. NASA shares this information with interested persons and institutions within the United States and abroad to enhance understanding and protect planet Earth from disasters.[64]

LIDAR uses laser beams combined with remote sensing.[65] It measures distance very accurately. LIDAR is commonly used in geology and seismology. Both the GEER Report and the report of the Washington state commission that studied the Oso landslide strongly recommend using remote sensing to detect very small earth movements in order to alert government authorities and people to potentially dangerous earth movement that may lead to landslides.[66] LIDAR uses light beams to image materials such as rock and rain. It can even image single molecules. LIDAR can produce three-dimensional images of the ground. Satellite-based and aircraft-based LIDAR use Earth-based Global Navigation Satellite System ("GNSS") receivers to establish absolute position and orientation. LIDAR can quickly establish a high resolution database at low cost. It can penetrate forest canopy to detect the material consistence of the ground, which is a major advantage for examination of earth that is ready to slide.[67]

2015), https://www.nasa.gov/press-release/nasa-soil-moisture-radar-ends-operations-mission-science-continues [https://perma.cc/NVJ3-8XE5].

[62] *Id.*

[63] *See* Frank Morring, Jr., *Water World*, 177 AVIATION WEEK & SPACE TECH. 21, 21 (2015). For more information about SMAP, *see Soil Moisture Active Passive*, NASA, http://www.nasa.gov/smap [http://perma.cc/NJJ2-BZUV] (last visited Nov. 12, 2015).

[64] *See Overview: Earth Right Now*, NASA, http://www.nasa.gov/topics/earth/overview/index.html [http://perma.cc/UWU4-4D5C] (last visited Nov. 12, 2015).

[65] *See* Lyall & Larsen, *supra* note 9, at 414. "LIDAR, which stands for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth." *What is LIDAR?*, NOAA, http://oceanservice.noaa.gov/facts/lidar.html [http://perma.cc/YRQ5-8TCU] (last visited Nov. 12, 2015).

[66] GEER Report, *supra* note 2, at 160–61.

[67] *See* Michael A. Lefsky et al., *Lidar Remote Sensing for Ecosystem Studies*, 52 BIOSCI. 19, 19 (2002). The use of LIDAR improves the accuracy of maps and enables public officials to make more informed choices. *See* Kamb & Brunner, *supra* note 29. Note that satellite-based radar and GNSS are used to monitor gasses and other indicators of earth movements of volcanos. *See* Henry Fountain, *Pressure, and Mystery, on the Rise*, N.Y. TIMES (Jan. 5, 2015), http://www.nytimes.com/2015/01/06/science/predicting-what-a-volcano-may-or-may-not-do-is-as-tricky-as-it-is-crucial-as-iceland-well-knows.html [http://perma.cc/SW9Y-Y5WD]. It is used to measure earthquake activity in Nepal. *Nepal Earthquake on the Radar*,

SAR is used to create images of land surfaces.[68] SAR uses the motion of the SAR antenna over a target to provide "finer spatial resolution than is possible with conventional beam-scanning radar."[69] SAR may be attached to a satellite or an aircraft.[70] SAR is used for remote sensing in order to map the Earth's surface to obtain high resolution images.[71] It is also used to measure earth movements, to test the stability of slopes, and to measure landslides and glaciers.[72]

Land surveys using radar are currently done by Earth observation satellites deployed by ERS-1/2, JERS-1, Envisat ASAR and Radarsat-1.[73] TerraSar-X and TanDEM-X are earth observation satellites with SAR antennas.[74] They were launched jointly by the German Aerospace Center ("DLR") and European Aeronautic Defence and Space Company Astrium.[75] They orbit close together, in tandem, and record data synchronously.[76] They are thus able to observe with great accuracy. They are placed in low earth orbit.[77] Because of their frequent revisit capability, they are particularly valuable for observing developing disaster situations.[78]

GIS provides another remote sensing capability which can help select and preserve valuable information about potential changes in the

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SPACE NEWSFEED (Apr. 29, 2015), http://www.spacenewsfeed .com/index.php/news/3647-nepal-earthquake-on-the-radar [http://perma.cc/47L3-9L3G].

[68] *See* Y. K. Chan & V. C. Koo*, An Introduction to Synthetic Aperture Radar (SAR)*, 2 PROG. IN ELECTROMAGNETICS RES. 27, 28 (2008).

[69] Pavan Kumar et al., *An Overview of Synthetic Aperture Radar and Its Applications*, 4 NY SCI. J. 6, 6 (2011).

[70] Chan & Koo, *supra* note 68, at 8.

[71] *Id.*

[72] *Id.* at 7.

[73] *See What is ERS?*, EUR. SPACE AGENCY, https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/ers [https://perma.cc/GCR7-QDSN] (last visited Nov. 12, 2015); *Third Party Missions*, EUR. SPACE AGENCY, http://www.esa.int/Our_Activities/Observing_the_Earth/Third_Party_Missions_overview [http://perma.cc/H8Z7-RBS6] (last visited Nov. 12, 2015).

[74] *See TanDEM-X-A New High Resolution Interferometric SAR Mission*, DLR, http://www.dlr.de/hr/en/desktopdefault.aspx/tabid-2317/3669_read-5488 [http://perma.cc/NXU4-KPU8] (last visited Nov. 12, 2015) [hereinafter TanDEM-X].

[75] *Id.*

[76] TanDEM-X, *supra* note 74.

[77] *See TerraSar-X-Germany's radar eye in space*, DLR, http://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10377/565_read-436/#/gallery/350 [http://perma.cc/DLS7-KDJW] (last visited Nov. 12, 2015).

[78] *See* Timo Batz et al., *The Sichuan Earthquake (1)*, GIM INT'L (Sept. 23, 2008), http://www.gim-international.com/content/article/the-sichuan-earthquake-1 [http://perma.cc/CF34-6K87].

environment.[79] GIS data may be collected by remote sensing from sensors on the surface. Those sensors may include LIDAR described above. Data of whatever kind can be introduced into the GIS and be shown in two or three-dimensional displays. It is also possible to add a time dimension into a GIS display showing, for example, varying amounts of rainfall in different locations. Remote sensing surface sensors can indicate gradual increase in water in a hillside and thus show whether it is likely to slide; furthermore, introduction of NASA earth satellite data can measure soil moisture, thus forecasting which land is sufficiently wet so as to slide.[80] It is possible to coordinate several GISs using the Open Geospatial Consortium ("OGS"), which can give an extensive picture of the slide-prone areas.[81]

A variety of remote sensing services are available. Some of them, including Copernicus, SMAP and Landsat, are publicly owned and their data are thus easily available. Remote sensing is now offered by commercial operators such as GeoEye-1, RapidEye, WorldView and QuickBird.[82] The remote sensing technology is increasingly capable of detailed observation based on the resolution of images. Needless to say, remote sensing of potential and developing landslides requires high resolution. High resolution earth observation data are most valuable because they show greatest detail. Medium and low resolution data provide information about large areas, which is sometime what is needed. Landsat historically has provided high resolution data and it is free.[83]

Each provider country maintains its own data collection; they are expected to make them publicly available. Under the UNGA Principles Relating to Remote Sensing of the Earth from Outer Space, Principle XI:

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[79] *GIS, Encyclopedic Entry*, NAT'L GEO., http://education.nationalgeographic.com/encyclopedia/geographic-information-system-gis [http://perma.cc/6Q33-FTNK] (last visited Nov. 12, 2015).

[80] Soil emits microwave radiation, and the amount of water changes how much of this energy is emitted. Radiometers measure the radiation and scientists use the data to calculate water content. *Radiometer tunes in to soil's frequency*, SPACE NEWSFEED, http://www.spacenewsfeed.com/index.php/news/2881-radiometer-tunes-in-to-soil-s-frequency [http://perma.cc/ZN3K-ZQET] (last visited Nov. 12, 2015).

[81] *See OGC's Role in the Spacial Standards World*, OPEN GIS CONSORTIUM, http://portal.opengeospatial.org/files/?artifact_id=6207&version=1&format=pdf [http://perma.cc/C7VA-ZNJY] (last visited Nov. 12, 2015).

[82] *See Remote Sensors*, NASA, https://earthdata.nasa.gov/user-resources/remote-sensors [https://perma.cc/TCR2-76AA] (last visited Nov. 12, 2015).

[83] *See* Simonetta Di Pippo, *The Future Key Role of Earth Observations in Disaster Risk Reduction*, UN OFF. FOR OUTER SPACE AFF., Mar. 2015, at 6, http://www.un-spider.org/sites/default/files/March2015_Newsletter_DRR_online.pdf [http://perma.cc/QDV4-R5CV].

> 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.[84]

The UNGA Resolution pertains only to outer space remote sensing; it does not have the binding effect of a treaty and sharing data is thus by voluntary act. Remote sensing providers may charge for their services. Principle XII of the UNGA Resolution states that sensed States shall give access to data collected in the sensed States "on a non-discriminatory basis and on reasonable cost terms."[85] The amount of money that a victim State can afford to pay for remotely sensed data is supposed to be considered in determining reasonable cost terms.

It is a problem that remotely sensed data may disclose military installations and may thus have national security value that States do not want to share. Remote sensing and sharing may therefore be restricted by national laws. Yet another obstacle to sharing is the large volume of sensed data. That may make it difficult to sort out data relevant to a particular natural disaster.[86]

Monitoring and collecting Earth information is important for avoidance and mitigation of landslides. As illustrated by both the Oso and the Sri Lankan landslides, a major problem is in selecting relevant disaster information. Secondly, there is often a gap between collection of information and its dissemination down to the grassroots community level. For example, in Sri Lanka the disastrous slide area had been identified as dangerous, but the affected people had not been relocated from that area. In the Oso landslide relevant geological data had not been made known at the local level.

In summary, a lot of remote sensing data about potential landslides is available. Even more sophisticated space technology is developing. The main problem is for the data to be collected, coordinated, analyzed, and then submitted to government decision-makers who are supposed to transmit it down to the low government level at the location

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[84] G.A. Res. 41/65, *supra* note 10.
[85] *Id.*
[86] *See generally* Lyall & Larsen, *supra* note 9, at 418–30 (discussing remote sensing from space).

of potential disaster areas. The Oso landslide reports indicated both ineffective data collection and failure of the high and low level government to act despite known dangers.[87] Finally, the people who live in landslide-prone locations may refuse to move because of poverty as happened on the Badulla tea plantation in Sri Lanka.

C. Tracking Disasters: Global Navigation Satellite System

GNSS satellites provide positioning, timing, and navigation services all around the globe. There are four GNSS services in existence: The U.S. Global Positioning System ("GPS"), the Russian Global Navigation Satellite System ("GLONASS"), the European GALILEO, and the Chinese BeiDou, in addition to several GNSS augmentation systems.[88] GLONASS faltered financially during the 1990s but is now reestablished. However, during that period most of the world became dependent on GPS. GPS and GLONASS are globally available. European GALILEO and Chinese BeiDou are available in limited areas. They are in the process of becoming globally available.[89] GNSS can identify and track Earth movements and can track the dynamics and energy of hills likely to slide. Atomic clocks on board each GNSS satellite measure time and movement precisely. Receivers on the ground receive timing signals from several satellites. The receivers on the ground are programmed to compare timing signals and to establish location. Thus receivers planted on the Earth's surface will be able to identify Earth movements at landslide areas.[90]

The Pacific Northwest area is already covered by a large network of GNSS sensors planted on the ground to measure earthquakes. It is called the Pacific Northwest Geodetic Array ("PANGA").[91] It is quickly

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[87] *See* Washington State Commission, *supra* note 19; GEER Report, *supra* note 2, at 129–30, 161–62.

[88] *See, e.g.*, Xingxing Li et al., *Precise Positioning with Current Multiconstellation Global Navigation Satellite Systems: GPS, GLONASS, Galileo and BeiDou*, 5 SCI. REPORTS 1, 1 (2015).

[89] All four systems are able to measure Earth movements. They and their augmentations are referred to as Global Navigation Satellite Systems ("GNSS") in this discussion. *See, e.g.*, *id.*

[90] Note the description of interaction between LIDAR sensors and Global Navigation Satellite Systems above.

[91] Sandi Doughton, *GPS Network May Give Us a Jump on Trouble Underfoot*, SEATTLE TIMES (June 3, 2011), http://www.seattletimes.com/seattle-news/gps-network-may-give-us-jump-on-trouble-underfoot/ [http://perma.cc/5JBQ-4Q7E].

and accurately able to pinpoint movements of the surface of the Earth.[92] 450 GPS sensors were known to be located in the Northwest in 2002 and many more have been added since that time.[93] They report readings every second.[94] PANGA can track ground motions as tiny as one-tenth of a millimeter.[95]

Early warnings of approaching Earth movements can give affected people time to react, even if the warnings are only seconds before disaster strikes. The University of California, Berkeley, and Deutsche Telecom Innovation Laboratories are developing a smartphone app, *myshake,* to send out alerts of Earth movements to cellphone users.[96] The service is mainly focused on earthquakes, but other Earth movements, such as landslides, could also be reported. The University of California has plans to use cellphones as sensors. The app would collect data on movement of the cellphone and compare it with the shaking of other cellphones in the area to establish the magnitude of the shaking.[97] The American Red Cross Earthquake app for iPhones and Android phones can provide excellent warnings of natural disasters. The Red Cross will issue a warning by cellphone as soon as the Federal Geological Survey sends a notification.[98] The warning is sent directly to the cellphone of individual users. Anyone can arrange to be notified. The app can even provide for the users to report that they are safe. Facebook provides a separate service called Safety Check whereby individuals, who are in a natural disaster, can report to relatives and friends that they are safe.[99] Furthermore, if Facebook senses that persons are located in or at a disaster, it can send a message to such persons asking them whether they are safe and enabling them to respond by pressing a button.[100]

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[92] *Id.*
[93] *Id.*
[94] *Id.*
[95] *Id.* Use of GNSS to detect earthquake differs from use of GNSS to detect slowly developing landslides, however. *See* Doug Esser, *Washington state quake shows early warning system is slow*, WASH. TIMES (Feb. 18, 2015), http://www.washingtontimes.com/news /2015 /feb/18/moderate-earthquake-strikes-in-central-washington [http://perma.cc/E5MQ-2A4R].
[96] Roxie Hammill & Mike Hendricks, *A Quake, Before It Strikes*, N.Y. TIMES (Nov. 12, 2014), http://www.nytimes.com/2014/11/13/technology/personaltech/an-earthquake-warning-system-in-your-pocket.html?_r=0 [http://perma.cc/TE8U-3QY3].
[97] *Id.*
[98] *Id.*
[99] *Id.*
[100] *Id.*

D. Tracking Disasters: Telecommunication

Emergency telecommunication provides important support during disasters. A disaster requires instant decision-making by a coordinator of resources that includes assessment of dangers, knowledge of whether people are trapped, and deployment of rescue workers and their equipment. Communication is needed not only to locate victims at the site of the disaster but also to inform the outside world and government authorities of the magnitude of the disaster so that more resources can be delivered. These are basic lessons learned from past disasters such as the Oso landslide, the Sri Lankan landslide, as well as the 2004 Indian Ocean tsunami and the 2010 Haitian earthquake.

Effective communication links require cleared interference-free radio frequency channels. Radio spectrum must be reserved both at the host State and the receiving State. Satellites require radio spectrum for their guidance and cannot interact with surface stations without a cleared radio spectrum.[101] Communication satellites require spectrum both for communication and for guidance.

The 2010 earthquake in Chile is a good example of the importance of space-based communication equipment.[102] This earthquake destroyed all Earth-based communication equipment.[103] The United States quickly sent satellite telephones, thus enabling the rescue workers to organize disaster relief.

Telecommunication oversight is the responsibility of the International Telecommunication Union ("ITU").[104] Several ITU resolutions have affirmed the duty of ITU members to participate in disaster relief and mitigation. The 1990 ITU Conference on Disaster Communication agreed

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[101] ITU allocates radio frequencies to member States. *Radio Navigation Satellite Service*, UNOOSA, http://www.unoosa.org/pdf/icg/2012/idm2012/2.pdf [http://perma.cc/E7AW-CDN6]. The Federal Communication Commission ("FCC") further distributes the frequencies to users. The proposal of the FCC that foreign GNSS operators, such as GLONASS, should need FCC authorization for their use into the United States would undermine public safety and disaster assistance during disasters in the United States. *See* Dee Ann Divis, *FCC Raises Questions about U.S. Access for Non-GPS GNSS*, http://www.insidegnss.com/node/4369 [http://perma.cc/WWE8-LYVA].

[102] *Emergency Telecommunications Saving Lives*, INT'L TELECOMM. UNION, at 7 (2012), https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Documents/SavingLivesBrochure/BD__emergencybrochure_E.pdf [https://perma.cc/UMA2-ACQW].

[103] *Id.*

[104] *About*, INT'L TELECOMM. UNION, http://www.itu.int/en/about [http://perma.cc/3E7A-GEMH] (last visited Nov. 12, 2015).

to provide telecommunication services in disasters for recovery and response.[105] Resolution 36 of the ITU Plenipotentiary Conference in Kyoto in 1994 urged States to facilitate rapid deployment of telecommunication equipment in disaster situations and for States to remove regulatory obstacles to deployment.[106] These recommendations were ultimately adopted as international law in the 1998 Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations ("the Tampere Convention").[107]

E. Review of Resources and Tools for Disaster Assistance[108]

GNSS, remote sensing, GIS, LIDAR, SAR, and emergency telecommunication can and do provide great support in disaster situations such as landslides. Assistance must be prompt. At its best it results in effective coordination, rapid decision-making, assessments of needs, and effective operations in the field. The following benefits exist:

1. Mitigation of Disasters: Effective use of satellite imagery can predict natural hazards and disasters so that authorities can take preemptive measures. Remote sensing technology can identify potential natural disasters.
2. Preparedness for disasters: GIS, remote sensing, LIDAR, and SAR provide geographical knowledge of at-risk areas. An established geo-database greatly improves understanding of vulnerable specific locations. Remote sensing can establish early warning systems and is used to predict natural hazards and disasters.
3. Quick emergency response: Remote sensing, GIS, LIDAR, and SAR identify the geographical scope of disaster areas and identify best responses. Furthermore, they can be used to monitor the vulnerable areas for subsequent disasters such as landslides.

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[105] Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations, Jan. 8, 2005, 2296 U.N.T.S. 5 [hereinafter Tampere Convention].
[106] *Id.*
[107] *See* discussion on Tampere Convention *infra* Section IV.B.
[108] *See generally* Tampere Convention, *supra* note 105.

4. Rapid recovery requires extensive knowledge of the disaster areas prior to their occurrence. A standardized, digitalized Geo-database must first be established in order to store, share, and disseminate all relevant information.[109]

Lack of coordination of all these benefits may defeat their value.

III. UNITED NATIONS INTERNATIONAL DISASTER OBSERVATION AND MANAGEMENT

A. UN Disaster Coordination and the UN Hyoga and Sendai Frameworks

The UN Office for the Coordination of Humanitarian Affairs ("OCHA") was created to be the centralized coordinator for disaster assistance.[110] However the coordination functions of OCHA are carried out by a number of other UN-related bodies: There is an Emergency Relief Coordinator ("ERC") who chairs the Interagency Standing Committee ("IASC").[111] The non-governmental assistance groups participate in the IASC. The ERC must coordinate with individual country humanitarian coordinators who in turn represent the assistance team of that country.[112] Coordination with other UN offices is also necessary, including the UN Disaster Assessment and Coordination team, the International Search and Rescue Advisory Group ("INSARAG"), the UN Commissioner for Refugees ("UNHCR"), the World Health Organization ,and the UN Children's Fund.

A special representative of the UN Secretary General for disaster risk reduction leads the UN efforts to deduce risks of disasters. This special UN representative directs the UN Office for Disaster Risk Reduction ("UNISDR"). She chairs the Senior Management Group and oversees the Inter-Agency on Disaster Risk Reduction.[113] UNISDR was established by UNGA Resolution 56/195 "to serve as the focal point in the UN System

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[109] *Who We Are*, UNOCHA, http://www.unocha.org/about-us/who-we-are [http://perma.cc/4QTE-M6NP] (last visited Nov. 12, 2015).
[110] *Head of OCHA*, UNOCHA, http://www.unocha.org/about-us/headofOCHA [http://perma.cc/5C5C-HBHQ] (last visited Nov. 12, 2015).
[111] *Id.*
[112] *Coordination*, UNOCHA, http://www.unocha.org/what-we-do/coordination/overview [http://perma.cc/MKT8-QA4X] (last visited Nov. 12, 2015).
[113] *UNISDR in the UN System*, UNISDR, http://www.unisdr.org/who-we-are/unisdr-in-un [http://perma.cc/2W2Z-Q5UK] (last visited Nov. 12, 2015).

for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the UN System and regional organizations and activities in socio-economic and humanitarian fields."[114] UNISDR is primarily responsible for implementation of the Hyoga Framework for Acton and for the 2015 Sendai Framework for Disaster Risk Reduction, which established seven targets and four priorities for action.[115] The responsibilities of these UN offices tend to overlap with each other, which is a source of confusion and delay.[116]

Shortly after the 2004 Indian Ocean tsunami, the 2005 UN World Conference on Disaster Reduction ("WCDR") in Hyogo, Japan, established the important International Strategy for Disaster Risk Reduction.[117] The objective of the Conference was to create a strategic and systematic approach to reducing vulnerabilities to hazards.[118] The UN Conference took place immediately after the 2004 Indian Ocean tsunami disaster. The resulting disaster risk reduction strategy applies to all disasters including earthquakes and tsunamis, as well as landslides such as those described in this Paper.[119]

The UN Hyoga Framework for Action 2005–2015 ("HFA") addressed the question whether and to what extent disaster risk assessment and preparedness should be differentiated from disaster relief.[120] It recognizes that disaster risk reduction is a special problem that needs individual attention. The HFA was particularly important for locating and mitigating the risks of disasters. Under the HFA framework, the States assumed primary responsibility for disaster risk reduction.

The HFA established the following five priorities to be acted upon during 2005–2015:

> 1. Ensure that disaster risk reduction is a rational and local priority with strong institutional basis for implementation. States should designate responsibilities

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[114] G.A. Res. 56/195, U.N. Doc. A/RES/47/1 (Jan. 21, 2002).
[115] World Conference on Disaster Reduction, *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*, U.N. Doc. A/CONF.206/6, py. IV (Jan. 22, 2005) [hereinafter Hyoga Framework]; Third UN World Conference, *The Sendai Framework for Disaster Risk Reduction 2015–2030*, U.N. Doc. A/CONF.224/CRP.1, pt. II [hereinafter Sendai Framework].
[116] Fisher, *supra* note 3, at 14.
[117] Int'l Strategy for Disaster Reduction, G.A. Res. 60/195, U.N. Doc. A/RES/60/195 (Mar. 2, 2006).
[118] Hyoga Framework, *supra* note 115, at 1.
[119] *Id.* at 15.
[120] *Id.* at 4–5.

internally, decentralize responsibilities and resources, and encourage community participation.

2. Identify, assess and monitor disaster risks, and enhance early warning. States should make risk assessments, identify vulnerabilities, observe disaster dangers from satellites, and issue early warnings.
3. Use knowledge, innovation, and education to build a culture of safety and reliance at all levels. States should freely share information; they should educate people about disasters and create a general awareness and expectation of possible disasters.
4. Reduce the underlying risk factors. States should actively engage in land-use planning, protection of the environment, anticipation of changes in the climate, and insure availability of food.
5. Strengthen disaster preparedness for effective response at all levels. States should establish disaster policies and plans, set aside contingency funds for disaster situations, and invite volunteers to train and participate.[121]

The HFA priorities are now ten years old and were expected to be reached in 2015. The disasters in Oso and in Sri Lanka show how far countries are from reaching the objectives to which they committed in Hyoga in 2005. If the United States and Sri Lanka had accomplished their committed tasks, the two disasters could have been avoided or significantly reduced. At least the loss of lives could have been greatly minimized. The two disasters show how much remained to be done at the end of ten years. That led to Hyoga's successor, the Sendai Framework for Disaster Risk Reduction 2015–2030.[122]

The Third World Conference on Disaster Risk Reduction held in Sendai, Japan, in 2015 adopted the new disaster risk reduction framework.[123] The conference examined progress made during the time of the Hyoga Framework and concluded that much yet had to be done to reduce the risk of major disasters. Continuing in the spirit of the Hyoga Framework, the Sendai conference adopted the following global targets for the next fifteen years:

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[121] *Id.* at 5–6.
[122] Sendai Framework, *supra* note 115, at 5–6.
[123] *Id.* at 3.

1. Substantially reduce global disaster mortality by 2030, aiming to lower the average global figure per 100,000 between 2020–2030 compared with 2005–2015.
2. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020–2030 compared to 2005–2015.
3. Reduce direct disaster economic loss in relation to global gross domestic product ("GDP") by 2030.
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2030.
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.[124]

The Sendai conference agreed that the overall responsibility for disaster risk reduction continues to rest on the States with the assistance of non-governmental entities such as businesses and voluntary and community-based organizations. The Sendai conference established four priorities for all participants to:

1. [Understand] disaster risks at the national and local levels;
2. Strengthen disaster risk governance to manage disaster risks;
3. Invest in disaster risk reduction for resilience;

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[124] *Id.* at 7–8.

> 4. [Enhance] disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.[125]

The Sendai conference tasked UNISDR with the overall support and oversight of the Sendai targets and priorities. UN-SPIDER, as detailed below, provides the portal for disaster management and emergency response. Clearly the Hyoga and later the Sendai frameworks present powerful visions for action on disaster risks. The problem remains with the implementation of their visions. Neither Hyoga or Sendai are binding treaties. They are voluntary actions and States have many competing priorities besides disaster risk reduction.

B. United Nations Platform for Space-Based Information for Disaster Management and Emergency Response ("UN-SPIDER") in the UN Office of Outer Space Affairs ("UNOOSA")

UNGA Resolution 61/110 of December 14, 2006, established UN-SPIDER.[126] Its satellite capabilities have developed significantly since 2006. This Resolution gives UN-SPIDER a significant mandate to engage in space-based disaster risk reduction:

> [T]o provide universal access to all countries and all relevant international and regional organizations to all types of space-based information and services relevant to disaster management to support the full disaster management circle by being a gateway to space information for disaster management support, serving as a bridge to connect the disaster management and the space communities and being a facilitator of capacity-building and institutional strengthening in particular for developing countries.[127]

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[125] *See generally id.* at 9.

[126] United Nations Platform for Space-based Information for Disaster Management and Emergency Response, G.A. Res. 61/110, U.N. Doc. A/RES/61/110 (Jan. 15, 2007) [hereinafter Disaster Management and Emergency Response]. *See also* United Nations Office for Outer Space Affairs, *United Nations Platform for Space-based Information for Disaster Management and Emergency Response UN-SPIDER*, http://www.unoosa.org/pdf/publications/st_space_65E.pdf [http://perma.cc/WFT9-LLBT] (last visited Nov. 12, 2015); *What is UN-SPIDER?*, UNOOSA, http://www.un-spider.org/about/what-is-un-spider [http://perma.cc/96RK-RGQ4] (last visited Nov. 12, 2015).

[127] Disaster Management and Emergency Response, *supra* note 126.

UN-SPIDER is administered by the UNOOSA, which is responsible for all aspects of outer space.[128] UNOOSA administers GNSS coordination and has a mandate to concern itself with remote sensing satellites both of which are essential tools in disaster management.[129] UN-SPIDER seeks particularly to make satellite technology available to developing countries for disaster preparedness, prevention, and post disaster assistance.[130]

With few resources UN-SPIDER conducts an impressive program to educate governments, organizations, and individuals about disaster resources. When a disaster occurs, one call to UN-SPIDER results in contacts with the countries that can provide assistance. That call triggers the International Charter on Space and Major Disasters ("Disaster Charter"), the Tampere Convention,[131] and related UN aid programs offering rescue, food, refugee, and other assistance. UN-SPIDER can analyze the particular situation of individual countries and can, for example, make recommendations that respond to the needs of a country like Nepal, suffering uniquely from a magnitude of landslides.[132]

UN-SPIDER has constructed a knowledge portal that is central to its disaster activities. The portal is a computer search engine that can be accessed on the Internet.[133] In this search engine anyone can access disaster assistance, and read recorded information and descriptions of experiences with disasters.[134] The website can be accessed in many languages. The search engine contains more than 200 scientific papers and case studies, as well as references to other specific sources. Relevant information is divided according to the category of disaster (fire, tsunami, volcano, mass movement, insects, epidemics, temperature, drought, flood, earthquake, severe storms).[135] The search engine exceeds space-based information and includes other kinds of helpful information.[136]

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[128] *Id.*
[129] *Mandate of the United Nations Programme on Space Applications*, UNOOSA, http://www.unoosa.org/oosa/en/ourwork/psa/mandate.html [http://perma.cc/Y77Z-R6GA] (last visited Nov. 12, 2015).
[130] *What is UN-SPIDER?*, *supra* note 126.
[131] *See supra* Section I.
[132] *See Killer Landslides*, *supra* note 27; *see also Nepal one month on: UN calls for more aid*, BBC NEWS (May 25, 2015), http://www.bbc.com/news/world-asia-32874952 [http://perma.cc/MJ4G-U2HC].
[133] *What is UN-SPIDER?*, *supra* note 126.
[134] *Id.*
[135] *Data Sources*, UNOOSA, http://www.un-spider.org/links-and-resources/data-sources [http://perma.cc/HD9G-J2D6] (last visited Nov. 12, 2015).
[136] *Id.*

The search for information may encounter obstacles. Some countries have not institutionalized disaster information. It may exist, but it may not be shared, or it may not be available in the form of national emergency plans. Local officials may not be aware of or have ready knowledge about how to access the centralized information. That appears to have been the case with the Oso landslide in the United States.

UN-SPIDER headquarters is located in Vienna, Austria, and in Bonn, Germany.[137] There are sixteen regional offices with expertise in disaster management.[138] Pursuant to its UN mandate, UN-SPIDER focuses more on disasters in developing countries than on developed countries on the theory that developing countries have fewer resources.

UN-SPIDER is part of the United Nations but has a mandate to act independently. That mandate is limited by the UNGA resolution to space-based resources.[139] Its lack of a broad emergency management mandate and its lack of budget resources are significant limitations on the excellent disaster-related activities of UN-SPIDER. Disasters require both space-based management and assistance as well as Earth-based management and assistance. A standing international organization that could become a data bank and a clearing-house for Earth observation data would be even more effective.[140] Analogy and example can be drawn from recent UNOOSA coordination activity involving GNSS global satellites. Related to UNOOSA, the UNGA has authorized not only UN-SPIDER, but also the International Committee on GNSS ("ICG").[141] Within the ICG, a global voluntary monitoring group has been formed, headed by the NASA Jet Propulsion Laboratories ("JPL").[142] This tracking scheme consists of 200 institutions around the globe, which are all capable of collecting data from and about GNSS satellites.[143] These monitoring data

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[137] *What is UN-SPIDER?*, *supra* note 126.

[138] *Regional Support Offices*, UNOOSA, http://www.un-spider.org/network/regional-support-offices [http://perma.cc/BB7E-2KDK] (last visited Nov. 12, 2015).

[139] *Disaster Management and Emergency Response*, *supra* note 126.

[140] An adequate budget to perform these duties would be needed. Such an international organization could link up with individual national governments in the affected countries.

[141] *International Committee on Global Navigation Satellite Systems (ICG)*, UNOOSA, http://www.unoosa.org/oosa/en/ourwork/icg/icg.html [http://perma.cc/7XNJ-CQWW] (last visited Nov. 12, 2015).

[142] *See Cutting Edge GPS Science Applications*, NASA, http://www.unoosa.org/pdf/icg/2008/icg3/22.pdf [http://perma.cc/UCU8-3XYC] (last visited Nov. 12, 2015).

[143] See author's article on the formation of GNSS soft law in the United Nations, to be published in 80 J. AIR. L. & COM, NO. 2. There are four separate Global Navigation Satellite Systems: USGPS, Russian GLONASS, Chinese BeiDou, and European Galileo. Interestingly, the main operators of remote sensing satellites are also the United States,

are submitted to UNOOSA which in turn makes them available to the individual GNSS providers; the transfer is transparent so that anyone has access to the data. The process is apolitical. It is voluntary but necessary for accurate and efficient GNSS operation. Establishing a clearing-house for disaster-related data would not be an unusual activity for UN-SPIDER because UN-SPIDER functions within UNOOSA, which already collects space-related data.[144]

IV. BEYOND THE UNITED NATIONS: THE DISASTER CHARTER AND TAMPERE CONVENTION

A. The Disaster Charter

The Disaster Charter[145] stems from a recommendation of the 1999 UNISPACE III conference. The Charter is not a treaty. It is an interagency agreement among outer space-related agencies in several countries including the United States, Russia, China, ESA, and Canada.[146] All the parties participate in the governing board.[147] It is a voluntary organization. Each participant contributes its own resources (remote sensing, meteorological information, geological information, etc).[148] They do not contribute money.[149] The governing board has adopted a policy of universal

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Russia, China, and Europe. Thus, the four space powers are familiar with the satellite data collection though UNOOSA.

[144] *See* Convention on Registration of Objects Launched into Outer Space, Sept. 9, 1976, 1023 U.N.T.S. 15. Under the UN Convention on the Registration of Objects Launched into Outer Space, satellites are required to register their location in outer space. That information is deposited and readily available to the world in UNOOSA.

[145] *International Charter Space and Major Disasters*, UNOOSA, http://www.un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters [http://perma.cc/QZX9-TD9N] (last visited Nov. 12, 2015). *See also* Lyall & Larsen, *supra* note 9, at 432–36.

[146] The U.S. Geological Survey ("USGS") and the U.S. National Oceanic Research administration ("NOAA") participate for the United States. Barbara J. Ryan, *International Charter, Space and Major Disasters, International Symposium on Remote Sensing Applications to Natural Hazards*, GWU (Sept. 12, 2007), https://www.gwu.edu/~spi/assets/docs/Ryan%20-%20International%20Charter%20Space%20and%20Major%20Disasters.pdf [https://perma.cc/C6GQ-49LM].

[147] *International Charter Space and Major Disasters*, UN-SPIDER, http://www.un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters [http://perma.cc/5GPR-R7YL] (last visited Nov. 12, 2015).

[148] *Id.*

[149] *Frequently Asked Questions*, DISASTER CHARTER, https://www.disasterscharter.org/web/guest/faq [https://perma.cc/HW8W-2NXU] (last visited Nov. 12, 2015).

access to disaster assistance.[150] All countries, whether members of the Charter or not, have the right to obtain assistance from Charter members.[151] The Disaster Charter has been activated hundreds of times, including in several landslide disasters.[152] One single communication to UN-SPIDER or to the Executive Secretariat of the Charter will activate all the resources committed under the Charter, thus providing an efficient delivery of help.[153] The assistance is free to the recipients. However, the assistance is limited to the period immediately after the occurrence of the disaster.[154] That includes evacuation and saving people, immediate assistance, and damage assessment.[155] Preparedness, mitigation, and risk assessments before the event are outside the scope of the Charter.[156] Furthermore, ongoing assistance, reconstruction, and redevelopment activities after the disaster are also outside the scope of the Charter.[157] The Charter must be activated within ten days of the occurrence of the disaster and is limited to fifteen days after the occurrence.[158] Countries may assist individually outside the scope of the Charter.

Assistance, from resources identified and dedicated as standing disaster resources, under the Charter is provided as soon as an emergency is

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[150] *Activating the Charter*, DISASTER CHARTER, https://www.disasterscharter.org/web/guest/activating-the-charter [https://perma.cc/VZG2-MFP5] (last visited Nov. 12, 2015).

[151] *Id.* According to Article 1 of the Charter, it may be activated by a situation of great distress involving loss of human life or large-scale 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, forest fire, or by a technological accident, such as pollution by hydrocarbon, toxic, or radioactive substances. *Id.*

[152] *Latest Activation, Landslide in Sri Lanka*, DISASTER CHARTER, https://www.disasterscharter.org/web/guest/activations/-/article/landslide-in-sri-lanka [https://perma.cc/PE9K-ZECJ] (last visited Nov. 12, 2015).

[153] *Activating the Charter*, *supra* note 150.

[154] *International Charter Space and Major Disasters*, UN-SPIDER, http://www.un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters [http://perma.cc/AU8T-HAQC] (last visited Nov. 12, 2015).

[155] *Emergency and Disaster Management*, UN-SPIDER, http://www.un-spider.org/risks-and-disasters/emergency-and-disaster-management [http://perma.cc/98NQ-5HCZ] (last visited Nov. 12, 2015).

[156] *Text of the Charter*, DISASTER CHARTER, https://www.disasterscharter.org/web/guest/text-of-the-charter [https://perma.cc/E76Q-AHKH] (last visited Nov. 12, 2015).

[157] *Id.*

[158] Richard J. Kotapish, *International Charter Space and Major Disasters*, http://www.oregon.gov/DAS/CIO/GEO/fit/preparedness/docs/intcharter_final.pdf [http://perma.cc/2V9V-5ARG] (last visited Nov. 12, 2015). "Empowering rescue and civil defense bodies, the Charter offers the best up-to-date satellite resources available by delivering fast, reliable and clear information on disasters—anywhere in the world." *Id.*

communicated.[159] Central and unified data collected by a multitude of satellites are applied in the emergency.[160] Satellites can provide low resolution pictures of entire disaster areas or high resolution detailed images, thus enabling assistance on the ground to manage rescue and relief tasks.[161] Priorities will be established when a multitude of tasks exist and the available resources are scarce.[162]

Evaluation of the effectiveness of the Disaster Charter includes its established successes since the beginning of the Charter in 2000.[163] It provides disaster stricken countries satellite images of disasters immediately after their occurrence, thus reducing confusion, and aids planning and establishment of priorities.[164] The need for these kinds of management tools was apparent in the confusion after the Indian Ocean tsunami and the Oso and the Sri Lankan landslides. There is also need for assistance during the period of reconstruction and economic recovery. However, the Disaster Charter is another example of how fragmented disaster relief is. The Charter may efficiently perform its limited tasks, but it is not a comprehensive program.

B. Tampere Convention

Several UNGA Resolutions have recommended sharing telecommunication resources. The ITU Constitution Article 46 requires ITU Member States to accept and communicate emergency distress signals, giving such signals due priority.[165] States are also required to investigate false distress signals within their individual jurisdictions.[166]

The Tampere Convention facilitates and expedites communication during disasters.[167] The convention was adopted in Tampere, Finland, in

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[159] *Implementing Universal Access*, DISASTER CHARTER, https://www.disasterscharter.org/documents/10180/187832/CHARTER_UA_ENG.pdf [https://perma.cc/VGT8-BKNC] (last visited Nov. 12, 2015).
[160] *Id.*
[161] Jens Danzeglocke, *International Charter Space and Major Disasters*, UN-SPIDER, http://www.un-spider.org/sites/default/files/EO2015_Danzeglocke.pdf [http://perma.cc/PPJ4-9KLL] (last visited Nov. 12, 2015).
[162] *International Charter*, *supra* note 147.
[163] *Activating the Charter*, *supra* note 150.
[164] *Id.*
[165] *Constitution and Convention of the International Telecommunication Union,* UNITU, at art. 46, http://www.itu.int/dms_pub/itu-s/oth/02/09/S020900000C5201PDFE.PDF [http://perma.cc/5R6Q-FV6L] (last visited Nov. 12, 2015).
[166] *Id.* at art. 47.
[167] *See* Allison Rahrig, *Love Thy Neighbor: The Tampere Convention as Global Legislation*, 17 IND. J. GLOBAL LEGAL STUD. 273, 273 (2010).

1998, and entered into force in 2005.[168] The parties are bound by the terms of this treaty to share telecommunication services with countries suffering from disasters.[169] The treaty is a recognition that in the space age, disasters are not only local events, but they affect communication with other countries.[170] Communication satellites can play a vital part in disasters.[171] The experience in many natural disasters has been that local land-based communication systems have been destroyed and that the management of the emergency urgently requires replacement communication systems.[172] Frequently satellite communication becomes the main medium of communication.[173] Many countries do not have large scale access to telecommunication.[174] Thus, countries in possession of satellite technology must provide it.

Like the Disaster Charter, the Tampere Convention also establishes one central point of contact for telecommunication assistance from all countries.[175] Article 2 of the Tampere Convention makes the UN emergency relief coordinator the one contact for activation of emergency assistance under the convention.[176] The appointment of a UN official by a treaty that is essentially an ITU instrument is remarkable.[177] Thus, the Tampere Convention attempts to concentrate coordination in the most central UN office that is concerned with overall relief coordination.[178] ITU will assist the relief coordinator in performing the coordination tasks.[179] The UN Coordinator's activities are limited to international coordination.[180] The

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[168] *Tampere Convention, supra* note 105. The Convention entered into force when ratified by 30 States. The treaty defines "Disaster" as follows:

> "Disaster" means a serious disruption of the functioning of society, posing a significant, widespread threat to human life, health, property or the environment, whether caused by accident, nature or human activity, and whether developing suddenly or as the result of complex, long-term processes. Landslides fit within this definition.

[169] *Id.*
[170] *Id.* at art. 3.
[171] *See* Rahrig, *supra* 167, at 273.
[172] *Id.* at 276.
[173] *Country Rankings*, ITU (Apr. 2010), https://www.itu.int/net/itunews/issues/2010/03/26.aspx [https://perma.cc/5YK7-8QFR].
[174] *See generally ITU releases annual global ICT data and ICT Development Index country rankings*, ITU, http://www.itu.int/net/pressoffice/press_releases/2014/68.aspx#.VhKsWhyIvmw [http://perma.cc/4Y3C-Q6ZQ] (last visited Nov. 12, 2015).
[175] Rahrig, *supra* note 167, at 275, 279.
[176] *Id.* at 279, 282.
[177] *Tampere Convention, supra* note 105, at art. 2.
[178] *Id.*
[179] *Id.*
[180] *Id.* at art. 2, 3.

coordinator will not get involved with domestic telecommunication resources.[181] It is the duty of the State seeking assistance to coordinate with its own terrestrial and satellite telecommunication services (Article 3).[182] No telecommunication assistance may be provided without the consent of the requesting State, which may refuse assistance (Article 4).[183] The relief coordinator and coordinator's staff will be entitled to immunities and privileges necessary for performing their tasks.[184] Indeed, Article 5 of the Tampere Convention will also grant NGO representatives these privileges.[185] Of course, the host State can avoid the grant of privileges and immunities by refusing admission to the NGO organization.

Prior to occurrence of disasters, each participating country will make an inventory of telecommunications resources that it is willing to contribute to disaster assistance, as well as for deployment of those resources (Article 8).[186] The States providing relief assistance under the convention may demand compensation for their assistance, but the provider States shall take into consideration the special financial situation of developing countries.[187] The requesting State may at any time terminate disaster assistance (Article 6).[188] No assistance will be provided other than as agreed (Article 7).[189] The provider countries agree to exempt their assistance from regulatory barriers (customs restrictions, restrictions on use of equipment and radio spectrum, movement of personnel, restrictions on transit of equipment, and other regulatory burdens).[190] Often States require special permission for out-of-State communication equipment to use local radio spectrum, but Article 9 removes this regulatory barrier.[191]

Forty-eight States have ratified the Tampere Convention.[192] The countries receiving assistance in disasters are clearly interested in being parties to the convention.[193] Evaluation of the benefits from the Tampere

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[181] Isabelle Reinecke, *International Disaster Response Law and the Coordination of International Organizations*, ANU UNDERGRADUATE RESEARCH J. 143, 157–58 (2010).
[182] *Tampere Convention, supra* note 105, at art. 3.
[183] *Id.* at art. 4.
[184] *Id.* at art. 5.
[185] *Id.*
[186] *Id.* at art. 8.
[187] *Id.* at art. 7.
[188] *Tampere Convention, supra* note 105, at art. 6.
[189] *Id.* at art. 7.
[190] *Id.* at art. 9.
[191] *Id.*
[192] *Id.*
[193] Rahrig, *supra* note 167, at 279, 282–85.

Convention triggers the question why major space technology States like the United States, Russia, and China have not ratified the Tampere Convention. There are a number of reasons. Ratification may not be in the interest of some space powers for reasons of national security. Space technology has significant national security value, and transparency may not be in country's interest. The United States may rationalize that it has all the space telecommunication technology necessary to take care of its own natural disasters. However, as the Oso landslide shows, technology is not readily available.

A country's willingness to become a Party to the Tampere Convention is not necessarily indicative of a country's willingness to participate in humanitarian assistance after a natural disaster.[194] The United States lends huge assistance to victims of natural disasters.[195] Examples of U.S. massive assistance are the aid in the 2004 Indian Ocean tsunami disaster, the Haiti earthquake, and the recent tsunami in Japan.[196] Other technically and economically advanced countries likewise assisted both in their individual capacities and/or as part of a UN-sponsored common assistance program.[197]

Involvement of international organizations, and indeed other countries in disaster assistance, can be very sensitive. The host country has complete and absolute jurisdiction over the location of the disaster.[198] Outsiders including the United Nations can only enter and become involved with the permission of the affected country.[199] Even disaster assistance from satellites in outer space can raise objections.[200] Many countries, such as India and the United States, do not permit high resolution images to be made of their territories because of national security concerns. They exercise so-called 'shutter control.'[201]

Finally, the Tampere Convention is remarkable because it is the first and only treaty on civilian disaster assistance.[202] The treaty recognizes

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[194] *Id.*
[195] *Working in Crises and Conflict*, USAID, https://www.usaid.gov/what-we-do/working-crises-and-conflict [https://perma.cc/84VP-J52F] (last visited Nov. 12, 2015).
[196] *Id.*
[197] *Tampere Convention*, *supra* note 105, at art. 4.
[198] *Id.* at art. 11.
[199] *Id.*
[200] *Id.* at art. 12.
[201] James M. Smith & Jeffrey A. Larsen, *"All Our Tomorrows": A Long-Range Forecast of Global Trends Affecting Arms Control Technology*, INSS Occasional Paper 44 (June 2002), USAF INST. FOR NAT'L SEC. STUDIES USAF ACAD., http://www.usafa.edu/df/inss/OCP/OCP44.pdf [http://perma.cc/2TPV-6LSA].
[202] Rahrig, *supra* note 167, at 275, 282.

that major disasters can be global issues and that the space age is now available to deal with these issues. It is a precedent for further treaty regulation of disasters, and the possibility exists that the Tampere Convention could be expanded to regulate additional global disaster assistance.

C. The Group on Earth Observations ("GEO")[203]

It is plain to see that more centralized data collection and data management is necessary in order to examine past disasters, including landslides, and to apply that knowledge to future events.[204] Current collection, management, distribution, and application to actual disasters is inadequate.[205] It lacks coordination at the local, national, and international levels.[206] On the international level, much needs to be added to international disaster knowledge, remedies, and management to establish an effective disaster management system that monitors dangerous situations, makes risk assessments, issues early warnings, and reacts to dangers at the international, national, and local levels. Data collection and management regarding landslides require understanding of the hazards involved.[207] The weather, the land, its geodynamics, the resources, and the natural dangers present great challenges requiring experts.

The aim of the Group of Earth Observations ("GEO") is to fill the international gap in Earth observation and particularly in distribution of Earth observation data.[208] GEO is a voluntary international partnership of governments and scientific and technical organizations collaborating to develop a Global Earth Observation System of Systems ("GEOSS").[209] The ultimate vision is to create an informed overview of the entire panoply of Earth resources by a coordinated, comprehensive, and sustained Earth observation and information service.[210] GEO is independent of the United Nations, but membership of States is limited to UN members, including the European Union.[211]

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[203] *See* Global Earth Observation System of Systems 10 year Implementation Plan, adopted Feb. 6, 2005, [hereinafter "GEOSS"] *available at* https://www.earthobservations.org/documents/10-Year%20Implementation%20Plan.pdf [https://perma.cc/33DB-SC2X].
[204] Rahrig, *supra* note 167, at 278, 283, 286–88.
[205] *Id.*
[206] *Id.*
[207] *See* GEOSS, *supra* note 203.
[208] *Id.* at 6.1.
[209] *Id.*
[210] *Id.* at 3.3.
[211] *Id.*

GEO is actively arranging international coordination of Earth observation.[212] One of its main objectives is to create a clearing-house for sharing data observed about the Earth in the following nine areas:

1. Disasters: Reducing loss of life and property from natural and human-induced disasters.
2. Health: Understanding environmental factors affecting human health and well-being.
3. Energy: Improving management of energy resources.
4. Climate: Understanding, assessing, predicting, mitigating, and adapting to climate variability and change.
5. Water: Improving water resource management through better understanding of the water cycle.
6. Weather: Improving weather information, forecasting, and warning.
7. Ecosystems: Improving the management and protection of terrestrial, coastal, and marine resources.
8. Agriculture: Supporting sustainable agriculture and combating desertification.
9. Biodiversity: Understanding, monitoring, and conserving biodiversity.[213]

GEO is equally conducting international coordination of its earth observations affecting all the nine subject areas listed above. Its stated interest in the subject of disasters is to reduce loss of lives and property from a range of hazards such as landslides, avalanches, floods, earthquakes, tsunamis, and volcanic eruptions.[214] GEO is of the view that "GEOSS implementation will bring a more timely dissemination of information through better coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local, national, regional, and global levels."[215]

The GEOSS portal provides access to observed data from all over the Earth. The operating principle of GEOSS data sharing is:

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[212] *Id.*
[213] GEOSS, *supra* note 203, at 5.3.
[214] *Id.* at 3.1, 4.1.
[215] *Id.* at 4.1.1.

1. There will be full and open exchange of data, metadata, and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation.
2. All shared data, metadata, and products will be made available with minimum time delay and at minimum cost.
3. All shared data, metadata, and products being free of charge or no more than cost of reproduction will be encouraged for research and education.[216]

The continuing global information GEOSS system will improve the efficiency of Earth observation and monitoring, and advance understanding of the Earth's natural processes.[217] A good example is its assignment to the U.S. Geological Service to produce the 'Most Detailed Ecological Land Units Map in the World.'[218] This map was completed and published on December 9, 2014.[219] The app establishes the first Internet-based GIS-ready, global ecophysiograhic data product for land use planning.[220] It provides "a spatial accounting framework for assessments of ecosystem services, such as carbon storage and soil formation, as well as important risks such as environmental degradation."[221] Such a digital map functions like a portal to geological information around the entire Earth.

As a system of systems, GEOSS will not supplant existing systems.[222] It will coordinate them.[223] It will standardize analysis of data so that they may be compared with data in similar circumstances, thus enabling general conclusions and recommendations to be made. GEOSS will improve capacity building regarding Earth observations of natural disasters (such as landslides); it will build on the initiatives at the local

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[216] *Id.* at 5.4.
[217] *The Most Detailed Ecological Land Units Map in the World*, ESRI (Dec. 9, 2014), http://www.esri.com/esri-news/releases/14-4qtr/the-most-detailed-ecological-land-units-map-in-the-world [http://perma.cc/7VXB-GKZ7].
[218] *Id.*
[219] *Id.*
[220] *Id.*
[221] *Id.*
[222] *Id.*
[223] *Introducing the Global Ecological Land Units ArcGIS Online Services*, ESRI (Mar. 2015), http://www.esri.com/~/media/files/pdfs/library/whitepapers/pdfs/introducing-the-global-elu.pdf [http://perma.cc/C7A8-LHNH].

and national level.[224] GEOSS will be of particular benefit for countries of developing economies, such as Sri Lanka. Ultimately GEOSS will examine how well existing plans work and will make recommendations for improvements based on knowledge gained from other disasters.[225]

GEOSS was adopted in 2005 and was planned to be completed in ten years.[226] The original objectives have not been reached and, at a GEO ministerial meeting on January 7, 2014, the participating countries resolved to continue their efforts to achieve the original objectives of GEOSS.[227] The ministers renewed the GEO mandate through 2025. GEO is thus a standing organization.[228] The group has accurately defined the multifaceted problems of international disasters ranging from floods to earthquakes.[229] The GEO members pool their earth observation resources.[230] GEO international assistance consists of ad hoc arrangements based on availability of the resources of individual members.[231] GEO is limited by its mandate to make earth observation for multiple purposes.[232] It acts as a clearing-house of accumulated observed data.[233] Countries have open access to those data. Some of those data will be useful for and relevant to risks of disasters and assistance after disasters. However, its purpose and its contributions to disaster problem solving is limited; being independent, GEO is outside of the UN disaster assistance framework, and it is not concerned with disaster relief.

V. COORDINATION OF INTERNATIONAL DISASTER ASSISTANCE

There is no single core of multilateral law specifically on international disaster assistance. International disaster assistance stems from a

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[224] *Shuttle Radar Topography Mission (SRTM) Elevation Data for the Island Nation of Sri Lanka*, GEOSS, http://www.geoportal.org/web/guest/geo_resources_details?p_p_id=vrdPortlet_WAR_geoportal&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2&_vrdPortlet_WAR_geoportal_uuid=Tsunami_122604_SRTM&sourceType=USGSGN&navigation=metadata [http://perma.cc/K256-5VMW] (last visited Nov. 12, 2015).
[225] GEOSS, *supra* note 203, at 2, 3.1.
[226] *Id.*
[227] *Integrating Observations to Sustain Our Planet*, EARTH OBSERVATIONS, https://www.earthobservations.org/documents/ministerial/geneva/MS6_The_Geneva_Declaration.pdf [https://perma.cc/4WGC-YGXX] (last visited Nov. 12, 2015).
[228] *Id.*
[229] *Id.*
[230] *Id.*
[231] *Id.*
[232] *Id.*
[233] *Integrating Observations*, *supra* note 227.

mixture of international agreements, charters, UN Resolutions, State laws, special humanitarian impulses, and voluntary actions. The mixture of sources includes the Disaster Charter, the Tampere Convention, UN-SPIDER, GEO, and many UNGA resolutions as well as numerous NGOs such as the 2007 Code of Conduct of the International Red Cross and Red Crescent Federation, which will be described in further detail in section V.A.[234]

In practice, all of the public and private disaster assistance organizations have to deal with host governments' pride of sovereignty, as well as the needs of victims for relief and reconstruction. It is of major concern to all that the lack of overall organizational coordination leads to great confusion and waste.[235] Furthermore, host States are often in a state of confusion because of the disaster itself. Both developed and developing countries have severe internal management problems. For example, U.S. review of the assistance for the large flooding problem in New Orleans during the Katrina disaster found that half of foreign assistance in the amount of 126 million dollars had been left in a bank account and had not been distributed for intended purposes due to lack of coordination.[236] During the 2004 Indian Ocean tsunami hundreds of containers with essential supplies (tents, blankets, and body bags) were stopped by local customs regulations and were not released until long after the end of the emergency.[237] Consequently, after the 2004 Indian Ocean tsunami experience, the Red Cross and Red Crescent Federation adopted new Guidelines for the Domestic Facilitation and Regulation of International Disaster Relief and Initial Recovery Assistance.[238]

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[234] *The Code of Conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organisations (NGOs) in Disaster Relief*, INT'L FED'N OF RED CROSS & RED CRESCENT (1994), http://www.ifrc.org/Global/Publications/disasters/code-of-conduct/code-english.pdf [http://perma.cc/TAC6-BKP6]. It is sponsored by Caritas Internationalis, Catholic Relief Services, the International Federation of Red Cross and Red Crescent Societies, Save the Children Alliance, Lutheran World Federation, Oxfam, the World Council of Churches, and the International Committee of the Red Cross. *Id.*

[235] *Id.*; *see also* Fisher, *supra* note 3.

[236] *See* Fisher, *supra* note 3.

[237] *Id.* After the Haitian earthquake, The Economist reported that only 0.7% of more than $2 billion USAID assistance reached Haitian reconstruction businesses. Virtually all the money went to companies in Washington, D.C. for work in Haiti. *Haiti: Unhappy Anniversary*, ECONOMIST (Jan. 15, 2015), http://www.economist.com/news/americas/21639546-five-frustrating-years-later-earthquake-torn-nation-searches-stability-unhappy [http://perma.cc/HW8H-K6KE].

[238] *Guidelines for the Domestic Facilitation and Regulation of International Disaster Relief and Initial Recovery Assistance*, INT'L FED'N OF RED CROSS & RED CRESCENT (2010), http://scm.oas.org/pdfs/2010/CEPCD02642e.pdf [http://perma.cc/W7SW-WZ7R].

The obvious question is this: Is one single coordinator of disaster assistance possible? If not, then can an effective code of conduct, respected by all, be established? First, some background on the parties involved is necessary.

A. Lack of Coordination Among the International Governmental Organizations

A study of disaster law by the International Red Cross and Red Crescent describes International Disaster Response Law ("IDRL") as lacking an "overarching legal framework."[239] While the Tampere Convention made the UN Emergency Relief Coordinator the operational coordinator for this convention, the Disaster Charter has a different coordinator and the UN-SPIDER acts as an initial coordinator of requests for international space-based disaster assistance.[240] Lack of overall coordination leads one knowledgeable observer to conclude:

> The costs of coordination failures are serious. Uncoordinated responses lead to duplication, confusion, increased expenses, inefficient use of resources, inappropriate aid and sometimes fatally result in disaster affected persons "not receiving the right aid at the right time, delivered in the right way."[241]

Thus, lack of coordination is a great problem for international disaster assistance.[242] The law governing disasters, whether hard or soft law, needs to be clarified, made uniform, and needs to be extended to cover more than just the aftermath of disasters. It should be broadened to provide relevant risk management prior to disasters that may ultimately mitigate the effects of disasters such as landslides, earthquakes, and tsunamis. It should also cover coordination of more of the post-disaster recovery activities including assignment of personnel, allocation of supplies and equipment, and assistance to victims.

The UN Office for the Coordination of Humanitarian Affairs ("OCHA") was created to be the centralized coordinator for disaster

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[239] Fisher, *supra* note 3, at 15.
[240] *United Nations Platform for Space-based Information for Disaster Management and Emergency Response UN-SPIDER*, *supra* note 126, at 3.
[241] Reinecke, *supra* note 181, at 144 (quoting Fisher, *supra* note 3, at 8).
[242] *See id.*

assistance.[243] However, the coordination functions of OCHA are carried out by a number of other UN-related bodies; there is an Emergency Relief Coordinator ("ERC") who chairs the Interagency Standing Committee ("IASC").[244] The non-governmental assistance groups participate in IASC.[245] The ERC must coordinate with individual country humanitarian coordinators who in turn represent the assistance team of that country.[246] Coordination with other UN offices is also necessary. The responsibilities of these UN offices tend to overlap with each other, particularly during the reconstruction phase.[247] Thus, the UN bureaucracy itself can be an obstacle to coordination.[248]

The United Nations Economic and Special Council ("ECOSOC"), under Article 68 of the UN Charter, has authority to "set up commissions in economic and social fields and for the promotion of human rights and such other commissions as may be required."[249] Ideally, the UN could establish one single coordination commission of the interested parties in order to streamline disaster assistance in all its phases. Such a commission would be able to utilize the expertise of all parties. It could identify and resolve overlapping responsibilities and could at least unify UN decision-making into a single stream.[250] In practice, it may be difficult for such a UN commission to respond swiftly to disasters, which most often require immediate responses.

B. Lack of Coordination Among the NGOs

The 2004 Indian Ocean tsunami brought out a large number of additional nongovernmental assistance organizations.[251] The large number of NGOs results in greater diversity. They can act without coordination with each other or with the UN-directed assistance.[252] Significantly, the

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[243] *See History of OCHA*, UNOCHA, http://www.unocha.org/about-us/headofOCHA [http://perma.cc/GJ56-YCFJ] (last visited Nov. 12, 2015).
[244] *See* Reinecke, *supra* note 181, at 149.
[245] *See id.* at 153.
[246] *See History of OCHA*, *supra* note 243.
[247] *See* Reinecke, *supra* note 181, at 149.
[248] *See supra* Section III.A.
[249] U.N. Charter, art. 68.
[250] *See* Reinecke, *supra* note 181, at 151.
[251] The Indian Ocean Tsunami in 2004 involved 200 NGOs, and the number of NGOs involved in disaster relief is expected to increase. Several large corporations, such as IBM and Microsoft, now participate individually in disaster relief. *See* Fisher, *supra* note 3, at 30.
[252] *See* Reinecke, *supra* note 181, at 152.

NGOs tend to be better funded and equipped for disaster relief than the UN agencies.[253] On the other hand, some of the new NGOs, having been hastily formed, were ill-prepared for the disaster relief during the Indian Ocean tsunami.[254] Their multitude tended to increase disaster relief confusion. The NGOs competed and overlapped with each other. For example, in the Indian Ocean tsunami, one NGO was building houses in an area designated by another NGO for construction of a road.[255]

The NGOs have observer status in the IASC.[256] Coordination with and among the NGOs is desirable but has not been successful; although the new Red Cross and Red Crescent Code of Conduct has improved coordination.[257] However, each NGO decides for itself what it wants to do without required coordination with others.[258] Nevertheless, most NGOs recognize that they have to establish priorities among themselves and with the UN agencies in order to be more efficient and effective.[259]

Recognition of the need for greater coordination both among the NGOs and between the UN and the States that suffer disasters motivated the International Red Cross and Red Crescent in 2007 to address this as an urgent need.

> The International Federation [of the International Red Cross and Red Crescent] believes that improving the regular environment governing all international disaster response actors will increase the speed and effectiveness of both Red Cross and Red Crescent assistance and the overall response, saving more lives in disasters and public heath emergencies, and more completely addressing disaster impact. Sensibly balancing the interest in speed and efficiency of international assistance with the needs for coordination, quality control and complementarity will also help to check the erosion of the roles of local responders that has occurred in some major international operations and that has been regularly criticized in "lessons learned" evaluations.[260]

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[253] *See id.*
[254] *See id.* at 144.
[255] *See id.* at 154.
[256] *See supra* Section III.A.
[257] *See Red Cross Code of Conduct*, *supra* note 234.
[258] *See* Reinecke, *supra* note 181, at 153.
[259] *See id.*
[260] *Red Cross Code of Conduct*, *supra* note 234.

One observer comments that new coordination rules and regulations should require the NGOs to participate in an international coordination scheme.[261] The participants should have to agree on individual priorities and divisions of work. Toward that objective, IASC has tried to make divisions of work to get NGOs to focus on specific sectors of relief assistance, for example, water and sanitation, health, emergency shelter, logistics, telecommunication, immediate recovery, and nutrition.[262] This division has not been entirely successful and has in some cases caused additional coordination problems.[263]

C. Lack of Coordination in the Activities of Individual States

Individual States are involved in disaster relief both as donors and as recipients. Some donor States, such as the United States, send their military forces to assist in disasters. During the 2004 Indian Ocean tsunami disaster, thirty-four States sent their national military forces to assist in disaster relief.[264] Coordination of their activities with the overall disaster assistance objectives can be yet another coordination problem.

The host State is presented with many problems. The basic operating rule of disaster assistance is that individual States manage their own disasters unless they are too overwhelmed by the disaster.[265] At that point, international and foreign assistance can begin.[266] However, in a space age in which Earth observation satellites constantly gather data that may be vital towards risk analysis and disaster avoidance, basic operating rules of disaster assistance may no longer apply. In the space age, international satellite resources should probably be deployed at much earlier stages of disaster assistance.

Most individual States do not have protocols and laws that assure coordination of relief when a disaster strikes.[267] There are often few national government officials who can deal with disaster assistance from the United Nations and from NGOs.[268] These officials may have limited authority only in their area of responsibility.[269] Existing regulations and

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[261] Reinecke, *supra* note 181, at 153.
[262] *See id.*
[263] *Id.* at 150.
[264] *See, e.g.*, BIMAL KANTI PAUL, ENVIRONMENTAL HAZARDS AND DISASTERS: CONTEXTS, PERSPECTIVES, AND MANAGEMENT 247 (2011).
[265] *See generally* Fisher, *supra* note 3.
[266] *Id.*
[267] *See* Fisher, *supra* note 3, at 83.
[268] Reinecke, *supra* note 181, at 147.
[269] *Id.* at 148.

practices prove to be inadequate for these extraordinary situations.[270] Establishment of new regulations after the disaster is extremely difficult and often comes too late.[271] Some ministries are inflexible.[272] The result is tremendous confusion and consequent frustration of assistance personnel and waste of resources in spite of the very best intentions.[273] Two particularly difficult problems are obtaining entry visas for relief workers and customs entry clearances for relief shipments through local customs.[274]

Entry of disaster assistance personnel into individual States is most often frustrating.[275] Many countries require visas that are only issued after months of waiting time.[276] Visa requirements are particularly onerous for NGO relief workers, whereas UN personnel may be able to enter on diplomatic documents.[277] From the point of view of individual States, having a large number of foreigners, often undocumented and without visas, enter into a country that is not prepared for their entry, leads to delay until some *modus vivendi*[278] can be worked out.[279] Often the foreign relief workers simply enter on tourist visas.[280]

The Tampere Convention, Article 9, is a model for how to resolve the visa problem. It requires individual host States, "at the request of any other State Party, and to the extent permitted by its national law, [to] facilitate the transit into, out of and through its territory of personnel, equipment, material and information involved in the use of telecommunication resources for disaster mitigation and relief."[281]

In an emergency, States' relief supplies must be expedited. The Tampere Convention, Article 9, seeks to ease customs requirements. It provides that "when possible, and in conformity with their national law, States should reduce or remove regulatory barriers to the use of telecommunication resources for disaster mitigation and relief."[282]

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[270] *Id.* at 154
[271] *See* Fisher, *supra* note 3, at 90.
[272] *Id.* at 102.
[273] *See* Reinecke, *supra* note 181, at 154.
[274] *See id.*
[275] *See* Fisher, *supra* note 3, at 116.
[276] *See id.*
[277] *See id.* at 118.
[278] "An arrangement that helps people, groups, or countries work together peacefully even though they do not agree with each other." *Modus Vivendi Definition*, MERRIAM-WEBSTER .COM, http://www.merriam-webster.com/dictionary/modus%20vivendi [http://perma.cc /5WH8-6M5D] (last visited Nov. 12, 2015).
[279] *See* Fisher, *supra* note 3.
[280] *See id.* at 116–18 (discussing visas and work permits).
[281] *Tampere Convention*, *supra* note 105, at art. 9, ¶ 4.
[282] *Id.* at art. 9, ¶ 1.

How relevant were disaster assistance organizations in the American Oso and the Sri Lankan Badulla disasters?

1. U.S. Oso Landslide[283]

The landslide in Oso in the State of Washington was entirely a domestic affair.[284] It contrasts with the Katrina flood in New Orleans, which included significant foreign assistance.[285] In fact, the Oso landslide was primarily the responsibility of the State of Washington.[286] The State of Washington acted almost as an independent country protecting its integrity from outsiders.[287] However, the governor of the State did cause the President of the United States to declare it a federal disaster, the effect of which was to enable local Oso people to receive Federal emergency loans for reconstruction.[288] No international resources were solicited.[289] The Tampere Convention was not invoked because the United States is not a Party to this convention.[290] The Disaster Charter could have been triggered but was not activated.[291] No known request was sent to UN-SPIDER, nor to GEO.[292] Thus, the responsibility for disaster assistance and proactive activities to prevent and avoid further landslides in a landslide-prone area remained with the State of Washington. It is as if the State of Washington did not know about the availability of international resources.

2. Sri Lankan Badulla Landslide[293]

The outcome of the Sri Lankan landslide was disastrous,[294] just like the outcome of the Oso landslide. Prior to the landslide, Sri Lanka had identified the Badulla area as being disaster-prone.[295] The Sri Lanka Disaster Management Center had planned relocation, but the local tea

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[283] *See supra* Section I.A (discussing the Oso Landslide).
[284] *See generally* Washington State Commission, *supra* note 19.
[285] *See, e.g.*, *Foreign Aid to U.S. for Katrina Relief*, NBC NEWS, http://www.nbcnews.com/id/9282598/ns/us_news-katrina_the_long_road_back/t/foreign-aid-us-katrina-relief/#.VgLGt3snqnA [http://perma.cc/H9SB-U72S] (last visited Nov. 12, 2015).
[286] Washington State Commission, *supra* note 19.
[287] *See generally id.*
[288] *Id.* at 1.
[289] *See generally id.*
[290] *See, e.g.*, Rahrig, *supra* note 167, at 284.
[291] International Charter, *supra* note 147, at 2.
[292] *See generally* Washington State Commission, *supra* note 19.
[293] *See* discussion of the Badulla Landslide, *supra* Section I.B.
[294] *How Disaster Preparation Broke Down in Sri Lanka*, *supra* note 36.
[295] *See id.*

plantation workers had resisted.[296] Consequently, there had been insignificant proactive activity. The aftermath of the disaster became the responsibility of local authorities.[297] There was no reported significant involvement of international UN disaster assistance.

D. Current Efforts at Coordination, Including the 2007 Red Cross and Red Crescent Guidelines

The coordinated one-call activation of disaster assistance under the UN Disaster Charter has been remarkable. The Charter has been triggered hundreds of times since its initiation.[298] Similarly, the Tampere Convention is triggered by one-call activations directed to the ERC.[299]

OCHA has made valiant efforts to improve coordination, cooperation, and sharing of information among the main parties involved in disaster assistance; for example, OCHA has tried to get the NGOs to divide up the relief work with each group assuming responsibility for a specific sector such as food, sanitation, or housing.[300] The Red Cross and Red Crescent Federation has organized distribution of disaster activities internally among its members.[301] The NGOs have tried to streamline activities among themselves by creating networks such as the International Council of Voluntary Agencies, the Disaster Emergency Committee, the Steering Committee for Humanitarian Response, the Asian Disaster Reduction and Response Network, and the Voluntary Organization in Cooperation in Emergencies.[302] Finally, IASC has become established as a discussion forum for all participants. But these efforts have not succeeded in full coordination of differences, one reason being that the problems are increasing as the number of disasters increase.[303]

As a consequence of the Indian Ocean tsunami disaster, the Red Cross and Red Crescent Federation have issued their 2007 Guidelines for the Domestic Facilitation and Regulation of International Disaster Relief

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[296] *See id.*
[297] *See id.*
[298] *See* International Charter, *supra* note 147.
[299] Rahrig notes that the Tampere Convention facilitates telecommunication resources and is of significant benefit to its parties. Rahrig, *supra* note 167, at 284–86.
[300] *Strategic Plan*, OHCA, https://docs.unocha.org/sites/dms/Documents/OCHA%20SF%202014-2017%20Strategic%20Plan.pdf [https://perma.cc/9EGT-EQ7R] (last visited Nov. 12, 2015).
[301] Fisher, *supra* note 3, at 59.
[302] *Id.* at 33.
[303] *See id.* at 31.

and Initial Recovery Assistance.[304] It serves as a code of conduct for all parties. It is widely appreciated because all parties are concerned with wasted relief assistance due to lack of coordination. These are the guidelines:

1. The rules are voluntary recommendations. They do not have the binding effect of international law.
2. The guidelines apply to the United Nations as well as to NGO relief organizations.
3. Humanitarian assistance is recognized as a fundamental right of all people.
4. Assistance will not be given to further any political or religious objective.
5. Relief organizations will not act as political instruments of foreign governments.
6. Relief organizations must respect local culture and customs.
7. Relief organizations shall seek to use local sources to provide relief.
8. The beneficiaries of assistance should be involved in relief management.
9. Assistance shall be given with a view towards reduction of future dependence on assistance.
10. Relief organizations will hold themselves accountable both to people being assisted and to those people, organizations, or States providing relief resources.
11. Relief organizations will respect the human dignity of disaster victims.
12. Host governments should provide rapid access to the disaster victims. Host governments should facilitate entry of relief goods.
13. Governments should coordinate with and keep relief organizations informed about essential events.
14. Donor governments should respect the independence and impartiality of relief organizations.

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[304] IDRL Guidelines, INT'L FED'N OF RED CROSS & RED CRESCENT, https://www.ifrc.org/en/what-we-do/idrl/idrl-guidelines/ [http://perma.cc/9DZJ-L9QZ] (last visited Nov. 12, 2015).

15. Cooperation among inter-governmental organizations and relief organizations is essential.[305]

The Red Cross Code of Conduct is even-handed and is accorded general respect by all the parties involved in disaster assistance.[306] This positive response to the code of conduct may be a recognition that hard international disaster law is unlikely to be established and that 'soft' law may be what all the parties have to accept.[307] Whether the code will develop into the status of customary international law remains to be seen. International assistance to large disasters subsequent to publication of the Red Cross Code of Conduct has not been without coordination problems.[308] The 2010 earthquake disaster in Haiti is an example of continued need for greater coordination.[309] $10 billion relief was provided, but in 2015, 85,000 people still live in tents.[310] Aid was not adequately coordinated with the local government; further aid is dwindling, and the tourist industry has not returned.[311]

CONCLUSION

A. Recommendations: Greater Use of International Tools to Mitigate and Relieve Disasters in the United States such as the Oso Landslide

Receiving risk information before disasters strike is essential. Satellites are uniquely able to reduce the risk of disasters and to facilitate disaster assistance.[312] Satellites provide accurate and timely information

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[305] *Id.*
[306] The Red Cross was the first humanitarian organization, dating back to the first International Conference of the Red Cross in 1864. Its semi-official role has been confirmed in several subsequent international instruments. For a history of the Red Cross, *see* Fisher, *supra* note 3, at 19.
[307] *Id.* Professor David P. Fidler's article, *Disaster Relief and Governance After the Indian Ocean Tsunami: What role for International Law?*, 6 MELBOURNE J. INT. L. 458, 458 (2005), questions whether there is a need for international law on disaster assistance or whether responsibility of disaster assistance is now primarily with the donee State to arrange for the donor States and NGOs to facilitate assistance.
[308] *Haiti: Unhappy anniversary*, *supra* note 237, at 15.
[309] *Id.*
[310] *Id.*
[311] *Id.*
[312] iDIRECT, SATELLITE SOLUTIONS FOR EMERGENCY RELIEF AND DISASTER RECOVERY

about natural disasters around the world.[313] Satellites can provide communication in disaster situations.[314] Earth observation satellites locate and provide a clear picture of disasters such as earthquakes, tsunamis, landslides, fires, and floods.[315] They are cost effective.[316] Satellite resources should be used to their maximum extent for disaster risk prevention and for disaster relief to a greater degree than at the present time. It appears that both the State of Washington and the U.S. government could benefit from these recommendations:

1. Disaster Prevention

Prevention of disasters and relief after disasters are strikingly different. Relief after a disaster usually involves activity in the sovereign territory of the State in which the disaster happens; whereas disaster prevention involves monitoring within the location State and also substantial monitoring by satellites from outer space outside sovereign territory.[317] Only a few States have sophisticated satellite technology like weather, remote sensing, GNSS, and communication satellites.[318] Many States must obtain disaster monitoring and prevention assistance from those economically advanced States that have satellite Earth observation technology.[319] These satellites not only can monitor and warn of approaching dangers.[320] They can also store information in information banks so that developing dangers can be analyzed and communicated to States that are unaware of approaching dangers.[321] An increasing volume of data is being stored.[322] It is therefore strongly urged that accessible data banks be created and become like clearing-houses capable of being accessed by States experiencing approaching disasters.[323]

MANAGEMENT 4 (2009), *available at* http://www.idirect.net/~/media/Files/White%20Papers/WHITE_PAPER_iDirect_Disaster_Management.ashx [http://perma.cc/DHH2-ZLJ3].

[313] *Id.* at 4.

[314] *Id.*

[315] CEOS, THE EARTH OBSERVATION HANDBOOK, SPECIAL EDITION FOR THE 3RD UN WORLD CONFERENCE ON DISASTER RISK REDUCTION 39 (2015).

[316] *Id.* at 60.

[317] *See generally* IDIRECT, *supra* note 312.

[318] Country Rankings, *supra* note 173.

[319] Tampere Convention, *supra* note 105, at art. 4.

[320] *See generally id.*

[321] GEOSS, *supra* note 207, at 5.

[322] *Id.*

[323] *See infra* Section IV.B.1, recommending that UN-SPIDER become a data bank and clearing-house for disaster-related Earth observation data.

2. Weather Forecasting

The Oso disaster was mainly caused by excessive rain.[324] More attention to weather forecasts warning of approaching rains could have alerted the people in the landslide area to evacuate their homes.[325] Advanced warning could also have reduced the material damage.[326] Meteorological satellites significantly improve accuracy of weather forecasting.[327] Greater availability, distribution, and use of meteorological data from all sources, outer space as well as Earth-based, is therefore recommended.

3. Earth Tracking Observation by Remote Sensing, Including Augmentations

Both the GEER Report and the Washington state governor's landslide commission recommended use of remote sensing amplified by LIDAR to detect Earth movements leading to landslides.[328] Greater use of amplified remote sensing could lead to earlier risk detection and assessments. It could alert people to secure their property and leave dangerous areas before disasters happen.

Use of GIS analysis would permit risk analysis over extensive areas. Remote sensing from satellites is available from both U.S. sources such as Landsat and from foreign remote sensing satellites sharing their Earth observation data pursuant to the UNGA Resolution on remote sensing.[329] New Earth sensing technology such as NASA's SMAP and ESA's Copernicus constantly collect data that can be used to track developing disasters.

It is recommended that low, medium, and particularly high resolution disaster tracking data not only be collected in a central bank, but be analyzed continuously and be made freely available. This data will be used to issue advance warnings of possible disasters.[330]

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[324] Washington State Commission, *supra* note 19.
[325] *Id.*
[326] *Id.*
[327] Hyoga Framework, *supra* note 115.
[328] *See* discussion of the Oso Landslide, *supra* Section I.A.
[329] G.A. Res.41/65, *supra* note 10.
[330] ESA, *ESA-NASA Collaboration Fosters Comparable Land Imagery* (2013), *available at* http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/ESA_NASA_collaboration_fosters_comparable_land_imagery [http://perma.cc/YXX4-ZS5V].

4. Earth Tracking Observation Using GNSS Satellites

Several Global Navigation Satellite Systems, including GPS, GLONASS, Galileo, and BeiDou are available free of charge.[331] They are currently being used to monitor earthquakes because multiple sensors are already embedded in the ground in certain earthquake-prone regions such as the Pacific Northwest.[332] It is recommended that they be widely used, particularly in view of new developing GNSS technology such as GPS-3, including GNSS augmentations such as Earth-based sensors.[333] Furthermore, it is strongly suggested that the Federal Communication Commission's ("FCC") proposal[334] to require foreign GNSS providers to obtain FCC permission to beam into the United States should not be adopted as it would be contrary to public safety policy.

5. Telecommunication Satellites

The Washington state governor's Oso Landslide Commission recommended greater availability of communication equipment to reduce confusion in the wake of disasters such as landslides.[335] Disaster experience has proved that to be necessary. It is recommended that ready access to satellite communication be established and that satellite telephones be placed in stock ready for use in future disasters.

6. International Tools for Disaster Risk Assessment and Preparedness

The 2005 HFA established a five point set of priorities for reducing vulnerability to disasters such as landslides. In that document the United States and other States resolved to ensure disaster risk reduction as a national priority, identify disaster risks and enhance early warnings, educate and build a culture of safety, reduce underlying risk factors, and strengthen disaster preparedness.[336] The Sendai Framework for 2015–2030 continues and strengthens the international focus on disaster

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[331] *Multi-GNSS (Multi-frequency GNSS)*, FURNO (2014), http://www.furuno.com/en/gnss/technical/tec_multi [http://perma.cc/S8P8-3YPV].
[332] Tracy & Cozzens, *On the Edge: Tracking Slips and Creeps: Earthquake Monitoring* Gets *Substantial Boost from GPS*, SPIRENT (2011) (Federal Training Seminar).
[333] *See generally id.*
[334] Washington State Commission, *supra* note 19.
[335] *Hyoga Framework*, *supra* note 115.
[336] *Id.*

risk reduction.[337] The Oso disaster shows that the U.S. commitment to accomplish these goals fell vastly short. Other States appear also to have fallen short to varying degrees.[338] The goals were supposed to be reached by 2015.[339] States have now been given another fifteen years to reach completion.[340] It is strongly recommended that the United States put major effort into completing the objectives agreed upon in the HFA and in the Sendai Framework.

7. Tampere Convention

The Tampere Convention is the only treaty instrument on disaster assistance.[341] It has broken new ground in gaining access for disaster assistance to suffering countries. The treaty facilitates communication.[342] The United States is not yet a member of this treaty. The treaty could benefit the United States in the event of a major disaster affecting this country. Membership in the treaty would also facilitate U.S. satellite communication assistance to other countries. It is strongly recommended that the United States join the Tampere Convention.

B. Recommendation for Future Short-Term Strategy: Reorganization Within the International Organizations and Agencies (Including UN-SPIDER and UN Committees)

Article 1 of the UN Charter gives the United Nations the mandate to "achieve international co-operation in solving international problems of . . . humanitarian Character."[343] This gives the UN authority to coordinate international humanitarian assistance in disaster situations.[344]

Disaster assistance from satellites is new and different because satellites operate in outer space rather than in sovereign space.[345] Satellites observe and can gather data on dangerous conditions before and after disasters happen.[346] Disaster assistance in the space age differs

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[337] *Id.*
[338] *Id.*
[339] *Id.* at 1.
[340] *See Sendai Framework*, *supra* note 115.
[341] Tampere Convention, *supra* note 105.
[342] *Id.*
[343] U.N. Charter, *supra* note 249.
[344] *Id.*
[345] *See generally* G.A. Res. 41/65, *supra* note 10.
[346] *Id.* at XI.

from assistance practiced before the space age.[347] It is recommended that data from satellite Earth observation of disaster risks and relief be collected and made centrally available by UN-SPIDER, which operates within the scope of the United Nations.[348] Establishing a clearing-house of space-related data would not be an unusual activity for UN-SPIDER because UN-SPIDER functions within UNOOSA which already collects space-related data.[349]

C. Recommendation for Three Long-Term Strategies: Extensions of Tampere, World Trade Organization, and Customary International Law

Hard international law on disaster assistance is difficult to achieve. States are sensitive to possible encroachments on their sovereignty and independence. Several attempts have been made within and outside the United Nations for a new general treaty on non-military disaster assistance. The 1927 Convention and Statutes Establishing an International Relief Union was created within the framework of the League of Nations.[350] The main effort was to establish a centralized international agency to administer disaster assistance.[351] It failed for lack of adequate funding.[352] Similar attempts have been made within the United Nations.[353] But they have failed mainly due to concerns with national sovereignty. The increasing multitude of NGOs has made the issue of central coordination even more difficult.[354] A future hammer may be the increasing number of serious disasters caused by climate change.[355]

At the present time it seems that a new UN treaty on disaster assistance is impractical.[356] There are three existing legal regimes that could be extended to permit more effective disaster relief.[357]

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[347] *See generally id.*
[348] *See* UN-SPIDER, *supra* note 126.
[349] *Id.*; *see also* G.A. Res. 41/65, *supra* note 10 (requiring states to share data and information about possible natural disasters).
[350] Fisher, *supra* note 3, at 25.
[351] *Id.*
[352] *Id.*
[353] *Id.*
[354] Fisher, *supra* note 3, at 28.
[355] *Id.*
[356] Fidler, *supra* note 307.
[357] *Id.*

1. Extension of the Tampere Convention to Include Disaster Assistance Additional to Telecommunications

The scope of the Tampere Convention is limited to telecommunication assistance but the convention has succeeded in breaking new ground on the currently difficult issues of donor groups' (both international governmental organizations and NGOs) entry into those sovereign States experiencing the disaster.[358] While the convention respects the sovereignty of the donor State, it also places responsibility on the host State to arrange for entry of relief workers and relief goods.[359] The convention is moving in the direction of shifting the legal basis for international assistance from the rights of the donors to provide assistance, to placing the responsibility on the host State to arrange for aid and to facilitate the entry of the donors.[360]

The Tampere Convention is the only treaty instrument that deals specifically with disaster assistance. It is recommended that the Tampere Convention Article 9 provisions on host country duties to admit disaster assistance workers and to clear relief goods through customs be extended beyond telecommunications services to other relief workers and to other relief goods.

2. Extension of the World Trade Organization to Require Unhindered Importation of Relief Supplies

The World Trade Organization ("WTO") deals with international trade and trade restrictions among States.[361] The main objective of the WTO is not disaster relief.[362] Using the establishment of the Tampere Convention by the ITU as a precedent, WTO could be similarly urged to adopt a narrow disaster relief clause into the next WTO multilateral trade agreement because import and export through customs are aspects of international trade. It is recommended to attach a clause to the next WTO trade agreements permitting free imports of relief goods and services into countries experiencing severe disasters. That would resolve a limited but important problem of disaster relief.

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[358] Tampere Convention, *supra* note 105.
[359] *Id.*
[360] *Id.*
[361] Agreement Establishing the World Trade Organization, Apr. 15, 1994, 1867 U.N.T.S. 154.
[362] *Id.*

3. New Customary International Law Based on the Red Cross and Red Crescent Guidelines

The Red Cross and Red Crescent Code of Conduct[363] are *de minimus* guidelines for coordination of all disaster assistance among the NGOs and United Nations as well as for individual disaster assistance. It is in the interest of these parties to avoid waste. They have a self-interest in using these guidelines for coordination. The guidelines are considerate of the concerns of the host countries. They place responsibility on host States to facilitate the entry and use of the disaster assistance being offered to their countries. These guidelines are gaining in acceptance. In the short term, they operate as a code of conduct for everybody. They could and should eventually become generally accepted and thus develop into customary international law.[364]

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[363] Code of Conduct, *supra* note 234.

[364] *See* Lyall & Larsen, *supra* note 9, at 70–80, regarding development of customary international space law.