



Application of the UN-IGIF to the Sendai Framework for Disaster Risk Reduction

Discussion Paper

Prepare for the 14th Session of the UN-GGIM

This Discussion Paper has been developed as a Background Document to Agenda item #14 Geospatial information for climate and resilience, fourteenth session of the UN-GGIM Committee of Experts. The document has been developed as a task within the Working Group on Geospatial Information and Services for Disasters.

Lead author: Alan Mills, MapAction

Other authors, Indigo Brownhall , Ian Coady, Claudia Offner (MapAction).

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Executive Summary

The Sendai Framework for Disaster Risk Reduction is the global agreement for UN Member States to ensure the “The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.” It gives guiding principles, sets out priorities for action at national, local, global and regional levels, and identifies key stakeholders at those scales that will lead to improved resilience against disasters and give a more stable foundation to achieve wider sustainable development goals. It encompasses total disaster risk management across the cycle of prevention and mitigation, early warning and anticipatory action, preparedness and response, and early recovery to build back better, and speaks to the humanitarian aims of giving life sustaining resources and services to the most vulnerable across sectors such as food and nutrition, health, shelter, protection and education.

The Sendai Framework explicitly mentions geospatial data and services (including earth observation) in only seven paragraphs across 37 pages. Building on the priorities laid out in the **Strategic Framework for Geospatial Information and Services for Disaster** (SF-GISD), this document specifically maps the text of the Sendai Framework against the strategic pathways of UN-GGIM’s **Integrated Geospatial Information Framework** (IGIF), and geospatial provision to support the disaster management cycle and key humanitarian sectors. It identifies that geospatial data and services directly or indirectly support almost every single paragraph in the Sendai Framework. It also shows how key governance, policy and legislation, standards, capacity building and communication needed to build the framework for disaster risk reduction matches the aspiration of the corresponding strategic pathways for the implementation of IGIF. Thus, there are multiple opportunities for harmonisation of approaches, alignment of the UN-IGIF aims to disaster risk reduction (DRR) governance, and possible synergies from collaboration between the two communities to target political awareness and financial support.

In particular, the building of strong, effective partnerships and communicating targeted messages and value statements is at the heart of both frameworks, but delivery of an improved geospatial offer to the disaster management sector could benefit from a more outward facing focused partnership building, a stronger understanding of the disaster management sector, and raising its geographical and geospatial literacy levels so the disasters domain can better see where geospatial can provide crucial support.

Key to identifying clear pathways to greater encompassment of geospatial technology to support the Sendai Framework’s vision is to identify tangible benefits from investment in geospatial directly for resilience building, however, case studies are sparse. More case studies and a global overview of these are urgently required to state the case within the timeframe to implement the framework by 2030.

There is also an implicit understanding in the Sendai Framework that the geospatial community provides authoritative, accurate and timely information, and trusts that the geospatial community provides its own quality assurance around technical matters such as standards, robust geodetic frameworks and application of appropriate technology and innovation to often difficult environments without question. Implementation of the UN-IGIF across all its strategic pathways will deliver that trusted foundation to good services to the disaster sector.

The text of the Sendai framework provides challenges to the UN-IGIF that the geospatial community should meet. Given that the most vulnerable in society often have the least heard voices or are slow to access new technology, special attention is needed, not only to bridge the spatial divide across national authorities, but also to civil society generally and the most vulnerable, poor or hungry, young or old, women, and persons with disabilities in particular. Also primary humanitarian principles are to preserve the dignity, safety and security of those vulnerable to disasters and there is space to debate how the geospatial community shows humanity when dealing with issues such as data custodianship or increasingly automated technologies. It also needs to deal with the threat that as well as “data for good”

there is the challenge of combatting “data for bad”, a principle heightened in the challenging conditions of disasters.

Finally, the connection between the geospatial community and the disaster management sector needs to be flexible to meet the flux of three dimensions - future geospatial trends identified in UN-GGIM (e.g. use of AI, digital twins, greater availability of geospatial technology through mobile apps), evolving disaster management and humanitarian thinking (including the growth in anticipatory action before a disaster hits, and being accountable to affected populations), as well as the evolving nature and impact of disasters. Not only the enhanced effect from climate change, but also growing intensities of disasters leading to shorter recovery times and the increased exposure magnitudes of populations and infrastructure as we pass 8 billion inhabitants on earth. This document explains the demands on the geospatial community as laid down in the Sendai Framework and hopes to encourage more informed communication and partnership between the two communities and leverage better funding and governance to support UN-IGIF implementation and serve a key global challenge to reduce risks to our planet.

The Sendai Framework runs till 2030 and it should be expected that discussions to formulate a new framework from that date will start soon. There is an opportunity for UN-GGIM to have a greater role in promoting logical arguments to demonstrate how UN-IGIF and the application of geospatial data and services across the whole disaster management cycle and all its components can be embedded more fully in any new framework.

Acronyms and Abbreviations

| | | | | | |
|--------|---|-----------|--|------------------|--|
| AA | Anticipatory Action | IAEG-SDGS | Inter-Agency and Expert Group on the Sustainable Development Goal Indicators | Sendai Framework | Sendai Framework for Disaster Risk Reduction |
| ASEAN | Association of Southeast Asian Nations | | | SF-GISD | Strategic Framework for Geospatial Information and Services for Disaster |
| CDEMA | Caribbean Disaster and Emergency Management Agency | IFRC | International Federation of Red Cross and Red Crescent Societies | | |
| CESDRR | Center for Emergency Situations and Disaster Risk Reduction | UN-IGIF | Integrated Geospatial Information Framework | SWOT | Strengths, Weaknesses, Opportunities, Threats |
| CRED | Centre for Research on the Epidemiology of Disasters | IM | Information Management | UN OCHA | United Nations Office for the Coordination of Humanitarian Affairs |
| DRM | Disaster Risk Management | IMWG | Information Management Working Group | UN SPIDER | United Nations Platform for Space-based Information for Disaster Management and Emergency Response |
| DRR | Disaster Risk Reduction | INGO | International Non-Governmental Organisations | | |
| EM_DAT | Emergency Events Database | M&E | Monitoring and Evaluation | UNDP | United Nations Development Programme |
| EO | Earth Observation | OCHA | Office for Coordination of Humanitarian Affairs | UNDRR | United Nations Office for Disaster Risk Reduction |
| GEO | Group on Earth Observations | ODA | Official Development Assistance | UNSD | United Nations Statistics Division |
| GI | Geospatial Information | OGC | Open Geospatial Consortium | WCDRR | World Conference on Disaster Risk Reduction |
| GPDR | Global Platform for Disaster Risk Reduction | ROI | Return on Investment | | |
| GSGF | Global Statistical Geospatial Framework | SADC | Southern Africa Development Community | WFP | World Food Programme |
| HDX | Humanitarian Data Exchange | SDG | Sustainable Development Goals | WG-GSD | Working Group - Geospatial Information and Services for Disasters |
| | | SDI | Spatial Data Infrastructure | | |

Introduction

The primary (and only) purpose of national governments in any country is to provide protection for the lives, liberties and possessions of the people. Right to life is universal and we should all take steps to protect life, whether it be our family, household, community, state or globally. Humans all individually manage risk in their lives but when shocks or long-term stress hit our health and wellbeing, livelihoods and assets, wider cooperation to put in place special measures are essential to build up resilience against them.

The United Nations Office for Disaster Risk Reduction (UNDRR) defines DRR as a process “aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development” ([UNDRR 2015](#)). As such it sits at the heart of many Sustainable Development Goals (SDG) targets to be completed by 2030. As examples, targets related to promoting education for sustainable development under SDG 4, such as building and upgrading education facilities and ensuring healthy lives, as well as targets under SDG 11 (cities) and under SDG 9 (building resilient infrastructure) reaffirm the interrelationship between disaster risk reduction and sustainable development.

Risk is usually defined as the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time ([UNDRR](#)). It is determined probabilistically as a function of four elements:

1. **Hazard** - a phenomenon or human activity that may cause loss of life, injury of other health impacts, property damage, social and economic disruption or environmental degradation. They come in a wide range of forms (see box below)
2. **Exposure** - This is how those hazards impact on people, their housing and other infrastructure, production capacities and cultural assets.
3. **Vulnerability** - These are the conditions determined by social, economic, environmental and physical parameters that increase the susceptibility of individuals, communities or systems.
4. **Capacity** - a combination of factors for how a community or society is able to cope with disaster, whether these be related to knowledge, institutions or physical infrastructure. A better coping capacity leads to better resilience against these threats.

Typology of hazards ([UNDRR](#))

Natural **hydrometeorological** effects such as tropical cyclones (also called typhoons or hurricanes), flash floods, droughts, cold spells and heatwaves, often causing other hazards such as landslides, avalanches, wildfire or insect infestations.

Geological or geophysical hazards such as earthquakes, volcanic activity, landslides and mudslides. Tsunamis are a consequence of geological movement.

Environmental Hazards - such as air, soil or water pollution, often a consequence of soil erosion, deforestation, biodiversity loss, salinization and sea level rise.

Biological Hazards - viruses, parasites and bacteria that cause human epidemic but also plant and animal diseases affecting our food production.

Technological Hazards coming from e.g. industrial accidents, dam failures, transport incidents and spills.

Complex - Beyond the scope of this paper, heightened risk can be induced by political protest, conflict and enforced migration. The United Nations has other mechanisms around its peacekeeping operations for helping countries navigate the difficult path from conflict to peace. The Sendai Framework tends to avoid reference to the direct risk management around conflict. However the indirect impacts of conflict cannot be ignored within the context of Sendai - geospatial information and

services should be provided to support the increasing vulnerabilities put on populations in situ, those migrating and the host populations of migrants, and the environmental, social and economic impacts that result.

Every human being has a responsibility to manage risk, and supporting that are a wide range of actors, including community-based groups and other civil society organisations, local, national and regional governmental organisations and many international organisations. Private sector organisations and the business community generally, and academia provide essential thinking and services towards risk management. Risk reduction should be mainstreamed through society and its governance, but when an event is overwhelming, there are a large body of equally diverse humanitarian actors who give life saving support to deal with the residual risk.

All four risk elements listed above can be described according to location. Geospatial data and services not only can fundamentally help illustrate each of these components, but the power of overlay, proximity and other spatial analysis makes it a supremely important tool to holistically and specifically understand and manage risk at all scales.

Sendai Framework for Disaster Risk Reduction

The UN General Assembly endorsed the Sendai Framework for Disaster Risk Reduction 2015-2030 (hereafter referred to as the Sendai Framework), following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR). The Sendai Framework advocates for:

“The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.”

The Sendai Framework, signed by 187 member states, works hand in hand with the other 2030 Agenda agreements, including The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals.

It recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and civil society.

In 37 pages, there are only a few places within the Sendai Framework where GIS and mapping are explicitly mentioned, all within the Priorities for Action section:

Paragraph IV.24(c) To develop, periodically update and disseminate, as appropriate, location-based disaster risk information, including risk maps, to decision makers, the general public and communities at risk of exposure to disaster in an appropriate format by using, as applicable, geospatial information technology

IV24.(f) To promote real time access to reliable data, make use of space and in situ information, including geographic information systems (GIS), and use information and communications technology innovations to enhance measurement tools and the collection, analysis and dissemination of data;

IV.25 (a) To enhance the development and dissemination of science-based methodologies and tools to record and share disaster losses and relevant disaggregated data and statistics, as well as to strengthen disaster risk modelling, assessment, mapping, monitoring and multihazard early warning systems;

IV.25 (b) To promote the conduct of comprehensive surveys on multi-hazard disaster risks and the development of regional disaster risk assessments and maps, including climate change scenarios;

IV.25 (c) To promote and enhance, through international cooperation, including technology transfer, access to and the sharing and use of non-sensitive data and information, as appropriate, communications and geospatial and space-based technologies and related services; maintain and strengthen in situ and remotely-sensed earth and climate observations; and strengthen the utilization of media, including social media, traditional media, big data and mobile phone networks, to support national measures for successful disaster risk communication, as appropriate and in accordance with national laws;

IV.25 (g) To enhance the scientific and technical work on disaster risk reduction and its mobilization through the coordination of existing networks and scientific research institutions at all levels and in all regions, with the support of the United Nations Office for Disaster Risk Reduction Scientific and Technical Advisory Group, in order to strengthen the evidence base in support of the implementation of the present Framework; promote scientific research on disaster risk patterns, causes and effects; disseminate risk information with the best use of geospatial information technology; provide guidance on methodologies and standards for risk assessments, disaster risk modelling and the use of data; identify research and technology gaps and set recommendations for research priority areas in disaster risk reduction; promote and support the availability and application of science and technology to decision-making; contribute to the update of the publication entitled “2009 UNISDR Terminology on Disaster Risk Reduction”; use post-disaster reviews as opportunities to enhance learning and public policy; and disseminate studies;

IV 30 (g) To promote the mainstreaming of disaster risk assessment, mapping and management into rural development planning and management of, inter alia, mountains, rivers, coastal flood plain areas, drylands, wetlands and all other areas prone to droughts and flooding, including through the identification of areas that are safe for human settlement, and at the same time preserving ecosystem functions that help to reduce risks;

Additionally, some sections refer to the use of remotely sensed earth and climate observations and other forms of information management. Implicitly, however, the application of geospatial data, information and services runs through the vision, principles, actions and recommendations of the framework.

This study is aimed at identifying those implications where geospatial can be supporting the detail of the framework - whether they be in supplying critical information, or in aligning the principles of the UN-IGIF to better serve one of the four most important ratified charters for sustainable life on this planet.

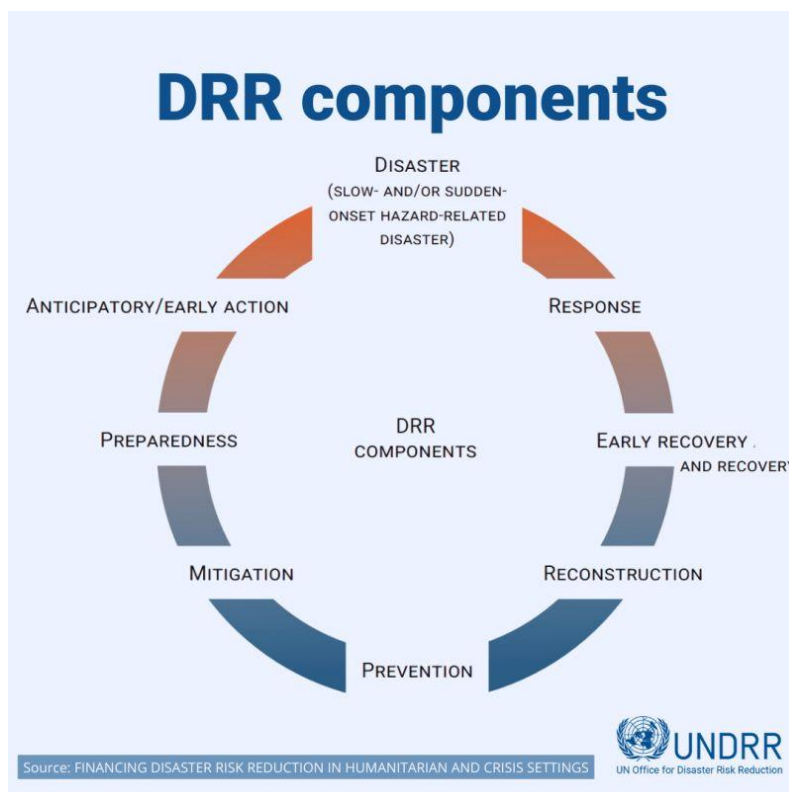
Disaster management and humanitarian considerations

To set the context for the combined review of the Sendai Framework against the UN-IGIF and SF-GISD, it is useful to briefly explain the dimensions of disaster risk management and how the DRR and humanitarian communities organise themselves to implement policy and activity.

Disaster management cycle

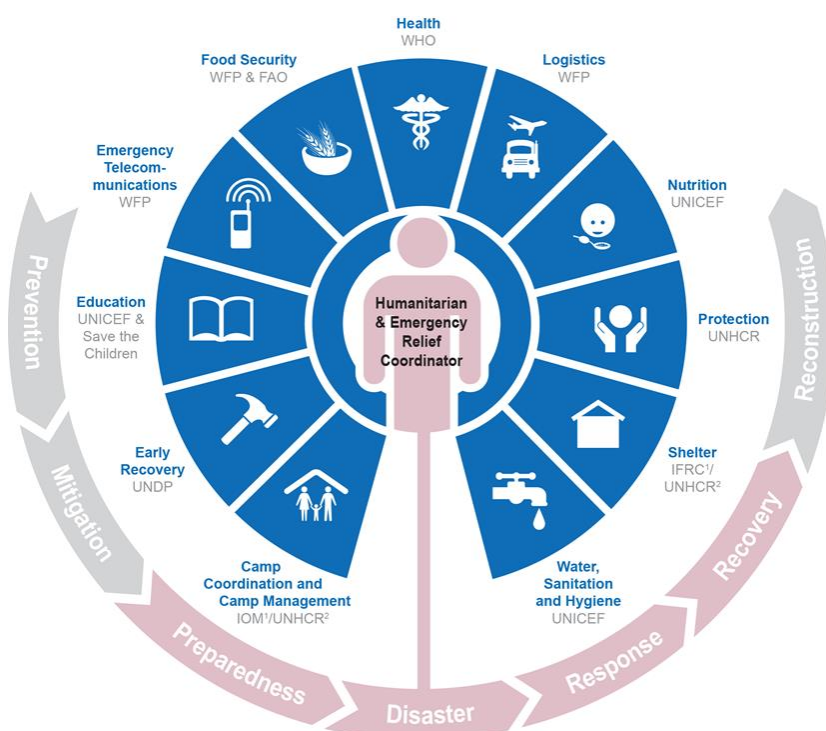
It is common to describe management of disasters in a positive feedback cycle (e.g. [Elhra](#)). If one can **prevent** a disaster from happening or at least mitigate its effects by having good infrastructure, maintenance, and robust communities with sustainable livelihoods, then they are more resilient to dealing with shock events. However, DRR is also essential if those **mitigations** cannot prevent an emergency happening. In that case the best measure is to give people early **warning** indicating the timing, scale and potential impact of an event, **prepare** for what to do during the emergency and immediate aftermath, and if possible take **anticipatory action** to put in place support for those most vulnerable. Once an event has

occurred, there will be some residual risk which could not be mitigated against; this is where disaster **response** and in particular humanitarian actors come in to provide life supporting systems and protection while the ordinary systems of government, community and business are being repaired. After the event, assessment of both damage and long term needs identifies the amount of extra investment and resources required to both quickly **recover** from the disaster and put in place long term strategic planning to **reconstruct** and “**build back better**” and feed back into the pre-disaster mitigation strategy.



National Governments implement disaster management acts and policy across their

agencies that respond to the guidance in the Sendai Framework and develop action plans that mandate certain authorities' responsibility for areas of concern, and coordination mechanisms, monitoring and evaluation tools and communication strategies. Local and Regional authorities develop similar instruments. A key outcome for DRR strategy is to mainstream its principles across all actors and sectors, ensuring that disaster risk management aligns with other national and global priorities such as climate resilience programming, sustainable development and environmental and biodiversity health management.



Clusters/ key humanitarians need

Part of national disaster action plans deal with preparedness to respond to events and give support to the affected population in the event of impacts on life sustaining resources and key services. In some instances, national government mechanisms can be overwhelmed by an emergency and there are humanitarian mechanisms to allow for international agencies either working in

host countries or incoming international actors to provide surge support on request. At the behest of national government, UN and non-UN Humanitarian actors, can organise themselves around 15 technical areas of humanitarian action, with the aim of coordinating preparedness and response activities, called Clusters. Used many times, they often align closely with national government coordination sectors. Key UN and INGO agencies coordinate local and international humanitarians and their action around key lifesaving and protection topics. (<https://reliefweb.int/topics/cluster-coordination>) .

Additionally, there are other supporting international emergency response mechanisms, such as Urban Search and Rescue, which have their own standards and organisations.

Principles of Humanitarian Action

Humanitarian action, as with good DRR practice more generally, respect principles of humanity, impartiality, neutrality and independence to ensure fair delivery of life saving aid to those in need without any adverse distinction; and important principles exist to allow humanitarians to do their work and leave no-one behind. These are set out in the International Red Cross and Red Crescent Movement's Code of Conduct as summarised below.

- The humanitarian imperative comes first.
- Aid is given regardless of the race, creed or nationality of the recipients and without adverse distinction of any kind.
- Aid priorities are calculated on the basis of need alone.
- Aid will not be used to further a particular political or religious standpoint. We shall endeavour not to act as instruments of government foreign policy.
- We shall respect culture and custom.
- We shall attempt to build disaster response on local capacities.
- Ways shall be found to involve programme beneficiaries in the management of relief aid.
- Relief aid must strive to reduce future vulnerabilities to disaster as well as meeting basic needs.
- We hold ourselves accountable to both those we seek to assist and to those from whom we accept resources.
- In our information, publicity and advertizing activities, we shall recognize disaster victims as dignified human beings, not hopeless objects.

Even before this document examines the detailed correspondence between the UN-IGIF and SF-GISD , it should be clear that the provision of geospatial data and services for disaster management needs to understand, respect and support the principles behind DRR and in particular humanitarianism, given that when risk mitigation fails systems need to support the most vulnerable and possibly severely traumatised in our societies.

UN-GGIM Strategic Framework on Geospatial Information and Services for Disasters

The United Nations Committee of Experts of Global Geospatial Information Management (UN-GGIM) established the Working Group on Geospatial Information Services to Disasters (WG-GISD) in 2015. Its mandate to develop and implement a strategic framework that brings all stakeholders and partners involved in Disaster Risk Reduction and/or Emergency Management together to ensure that quality geospatial information and services are available and accessible in a timely and coordinated way to support decision-making and operations within and across all sectors and phases of disaster risk management. The resulting [Strategic Framework on Geospatial Information and Services for Disasters](#) (SF-GISD) aimed that “The human, socioeconomic and environmental risks and impacts of disasters are prevented or reduced through the use of geospatial information and services.”

Through five priorities at national/local and global/regional level the SF-GISD seeks to strengthen geospatial data and services to disasters through 1. better governance and policies, 2. raising awareness

and capacity building, 3. data management, 4. common infrastructure and services and 5. resource mobilisation.

The SF-GISD was completed before the finalisation of the Integrated Geospatial Information Framework (UN-IGIF) but a WG-GISD review in 2020 concluded that the UN-IGIF is supportive of and mutually compatible with the SF-GISD, the UN-IGIF should be the primary tool to develop implementable and detailed actions plans to improve use of geospatial data and services for disaster risk management, and the SF-GISD remained highly relevant as a resource to develop such action plans. It was recommended that the UN-IGIF needs to make clear reference to the SF-GISD to ensure accountability of action plan development. It also suggested that this SF-GISD be reviewed in three to five years.

IGIF - Solving the Puzzle - Benefits:

The following is the IGIF statement regarding how geospatial data and services benefits the disaster management domain

*- **Disaster Response:** Planning, mitigating, responding to, and recovering from natural disasters, is crucial to providing safe and secure communities. Geospatial information is critical in these processes. In terms of mitigation, geospatial information contributes to the placement of early warning systems as a preventative measure prior to a pending disaster event. Knowing where vulnerable populations and critical infrastructure are located in preparation for impending natural events allows for more informed preventative actions. Improved information sharing technologies will provide a common operating picture and up-to-date information that can be shared across the spectrum of agencies that are managing the environment and dealing with emergency situations. In emergency management terms, being able to share integrated geospatial information in real-time means the 'same Information will be delivered to all agencies at the same time'. Geospatial information is also critical in responding to the aftermath of disasters. What happens next and where actions are needed are made possible by up-to-date geospatial information.*

In its summary the 2020 review stated “Using Disaster Risk Reduction and Management (DRM) as a focus for the development (or supporting the development) of a National SDI is recognised by both frameworks. Countries (or other organisations) looking to establish improved DRM practice through the greater use of geospatial information and services could reference both frameworks as guiding documents; the SF-GISD for a view of what success could look like and what actions should be considered, and the UN-IGIF as a means to develop a viable and specific action plan for implementation.”

While the SF-GISD identifies that it was a timely document to support the Sendai Framework for Disaster Risk Reduction it does not explicitly relate to the text of the Sendai agreement and the aims, guiding principles and actions recommended within that. Indeed, the SF-GISD is specifically targeted towards the geospatial community in how it should organise itself to facilitate DRR. The Sendai Framework, a document fashioned through a collaboration of policy makers, advisors and others from multiple, sometimes competing, disciplines, has no room to elaborate on linkages which illuminate how geospatial data and services could be integral in disaster risk management. The SF-GISD was not designed to communicate directly between geospatial practitioners and policy makers to comprehend the detailed priorities of Sendai Framework policy on which the widest range of geospatial support can be provided. The underlying principle of this current work and this document is to help the geospatial community have more structured arguments related specifically to the global disaster risk management policy document, the Sendai Framework, to communicate geospatial benefits to disaster managers and policy makers more clearly at local, national, regional and global levels.

The SF-GISD was created in 2017 as the implementation of the Sendai Framework was being established. This document comes soon after the mid-way point to the 2030 targets and is a chance to reflect on not just the original arguments for geospatial adoption within DRR, but also consider how changes in the geospatial disaster risk management and humanitarian environments are evolving, the new technologies which are emerging, wider issues such as poor data usage, the evolving nature of disasters given climate change and increased food insecurity and political unease, and the evolving humanitarian and DRR

philosophies - with a focus on early warning for all, greater attention on taking measures before a forecast disaster occurs (anticipatory action) and the localisation agenda where more coordination, assets and focus is given to achieving better resilience at the local level.

Aims and Objectives

The aim of this document is to provide UN-GGIM and the geospatial community the arguments and understanding of how geospatial data and services could be more specifically applied to the aims, guiding principles and actions outlined in the Sendai Framework. This should leverage a more compelling communication to a key end user community of geospatial data and services, one which is a critical vanguard for worldwide usage of location based data and services.

Its target audience is primarily to allow the geospatial community to understand the underlying principles of the Sendai Framework - how measures before, during and after a disaster can be taken to reduce the risk to communities, assets and livelihoods, and help the disaster management domain understand better the richness, rigour and communication benefits of collecting data with location, and conducting geographical analysis and visualising information in map form.

This study takes a high level review of the Sendai Framework and identifies where the nine UN-IGIF pathways are relevant, and where humanitarian principles, clusters and phases of the disaster management cycle are most impacted. It also identifies wider considerations of how geospatial data and services, such as specific mapping types and products have specific utility to components of the DRR delivery.

This matrix of connections between the Sendai Framework and the UN-IGIF in particular helps to identify a number of issues:

- Where direct policy (and terminology) correspondence exists between Sendai and UN-IGIF (i.e. the same pathways regarding legal instruments, standards, communication strategy) are required and how they could be combined.
- Where could UN-IGIF and Sendai Framework implementations be completed in partnership and have possible synergies from a joint approach (e.g. to funding and capacity building).
- Beyond the few paragraphs in the Sendai Framework explicitly mentioning mapping and geospatial information, identify other priorities for action where advocacy, promotion of existing good practice and case studies could be used by the geospatial community in exposing the DRR community to greater application.
- Where are their unmet needs in the Sendai Framework that the geospatial community could address.
- Highlight principles and concerns in the Sendai Framework which have implications for UN-IGIF strategic pathways and UN-GGIM Expert Committee deliberations going forward, such as how this community manages respect for human dignity in use of digital data. It is appreciated that the Sendai Framework may in places set up challenges to the established orthodoxy of Geospatial science and application.

Methodology

By breaking down the Sendai Framework, into its component paragraphs, related specifically to guiding principles and priorities for action they can be compared with the nine strategic pathways of UN-GGIM's UN-IGIF (see below) and each pathway's four component elements. This has gone further than the strict language used in either the UN-IGIF or Sendai Framework, A series of humanitarian terminology has been used that helps pin down if there are specific types of disaster which Sendai Framework and UN-GGIM speak to, at what phase of the disaster management cycle the text refers to, which may require different

geospatial approaches and tools, and if it speaks to different cluster or elements of disaster management, in particular humanitarian action, such as health support or shelter. A small number of case studies show examples where existing geospatial data and services are answering the priorities for action detailed in the Sendai Framework.

Following a preamble (Section I) which has been removed from the analysis in this document as it deals primarily with the history of international disaster management agreements, the Sendai Framework is organised around expected **outcome and goal**, a series of **guiding principles** and then four **priorities for action**. These are:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction

The document concludes by laying out the role of stakeholders and the role of international cooperation and global partnership.

For each priority for action, sections deal with the priorities first for national and local stakeholders, and then for global and regional stakeholders. References to the document are given by Section/Paragraph and subparagraph (e.g. IV.1(g)). Before going into the detail of the findings it should be acknowledged that in so many instances, across the board holistic implementation of all nine UN-IGIF Strategic Pathways aid so many principles and actions within the Sendai Framework. This report highlights distinct issues or priority crossover between specific Strategic Pathways and Sendai text. A small number of boxes give exemplar case studies where geospatial has been applied to specific actions highlighted in the Sendai Framework.



A brief reverse analysis will look at each of the 9 UN-IGIF Strategic Pathways and pull together key cross cutting and recurrent themes across the text of the Sendai Framework.

Additionally a brief review of what literature exists on the benefits of geospatial in disaster management (and in support of SDGs) and return on investment (ROI) of geospatial services for disasters and how governments have integrated geospatial services into its national policy are provided.

The consolidation of these reviews will provide potential policy gaps and guidance which can be reviewed by the WG-GISD and shared with the wider Committee of Experts as formal recommendations.

It is hoped that this document helps the Committee of Experts to better understand the language, priorities and mechanisms of disaster risk management, identification of end use cases and application of innovative technology provides the basis for a dialogue with those communities about how best to engage, promote and enhance their activities with these services.

Findings

Sendai framework vs UN-IGIF and the Geospatial offer

Introduction

As mentioned, the Preamble (Section I) deals primarily with the history and purpose of international disaster management agreements.

Goals and outcomes (Section II)

The expected outcomes of the Sendai Framework is (II.16) “**The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.**” The goal of the framework is (II.17) “**Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience**”

The Framework then lists seven global targets (ii.18.a-g) each of which are establishing the need to have measurable indicators and targets. Underpinning these targets are the need for establishment of baseline indicators (*cf* the Indicators created for the SDGs) and monitoring of such. UNDRR maintains this M&E through the [Sendai Framework Monitor](#). Other agencies also have guidance on how to establish baselines and monitoring, for example the [Framework for Disaster Related Statistics](#) designed to provide data curated by National Statistics Bureaus for a key set of indicators at national level (which can be aggregated and compared at regional and global scales). Advisory on both tools promote the concept of locationally disaggregated data which could be advantageous at different scales for community and subnational governmental levels with the same potential for both better quality aggregation/detail for national summaries and for cross comparison between different communities and regions in terms of risk, coping capacity and actual events. UN-GGIM could be leading on the clear standardised demarcation of those sub national units of data collection and analysis, whether they be enumeration districts or other administrative jurisdiction and supporting both data collection and spatial analysis and rigour. And it would be useful to understand to what extent the Global Statistical Geospatial Framework (GSGF) can support the statistical needs of disaster risk management.

Consideration should be given to the impact of disasters not just on human populations but on the natural world; as such disaster management units should also extend beyond the land terrain and take into account marine boundaries and habitats as well as potentially for airspace.

Guiding Principles (Section III)

A series of thirteen guiding principles outline the approach for stakeholders in understanding and applying the Sendai Framework actions. The key issues relating to UN-IGIF are:

- **Governance and institutions -**
 - **Setting responsibilities for actions in DRR**, both in the supply and the governance of geospatial data and services for disaster (III.19 (a and b)). There needs to be identification of who is responsible within the geospatial community for all aspects of data and service provision to the disaster management sector. This can build upon the general UN-IGIF development but should explicitly state the functions of good geospatial data management to the disaster sector. The SF-GISD goes some way to outlining key functions but with the evolving of both the geospatial market and DRR environment there could be both new or changed priorities and modes of delivery (e.g. how much can be state managed and the degree to which much could be led by private or civil society sectors). The balance of these responsibilities and modes will vary in different member

states but needs to acknowledge a greater influence of global geospatial mechanisms and provision. In some cases, there needs to be a deconfliction of which agencies have jurisdiction over the management of key authoritative datasets in different thematic sectors.

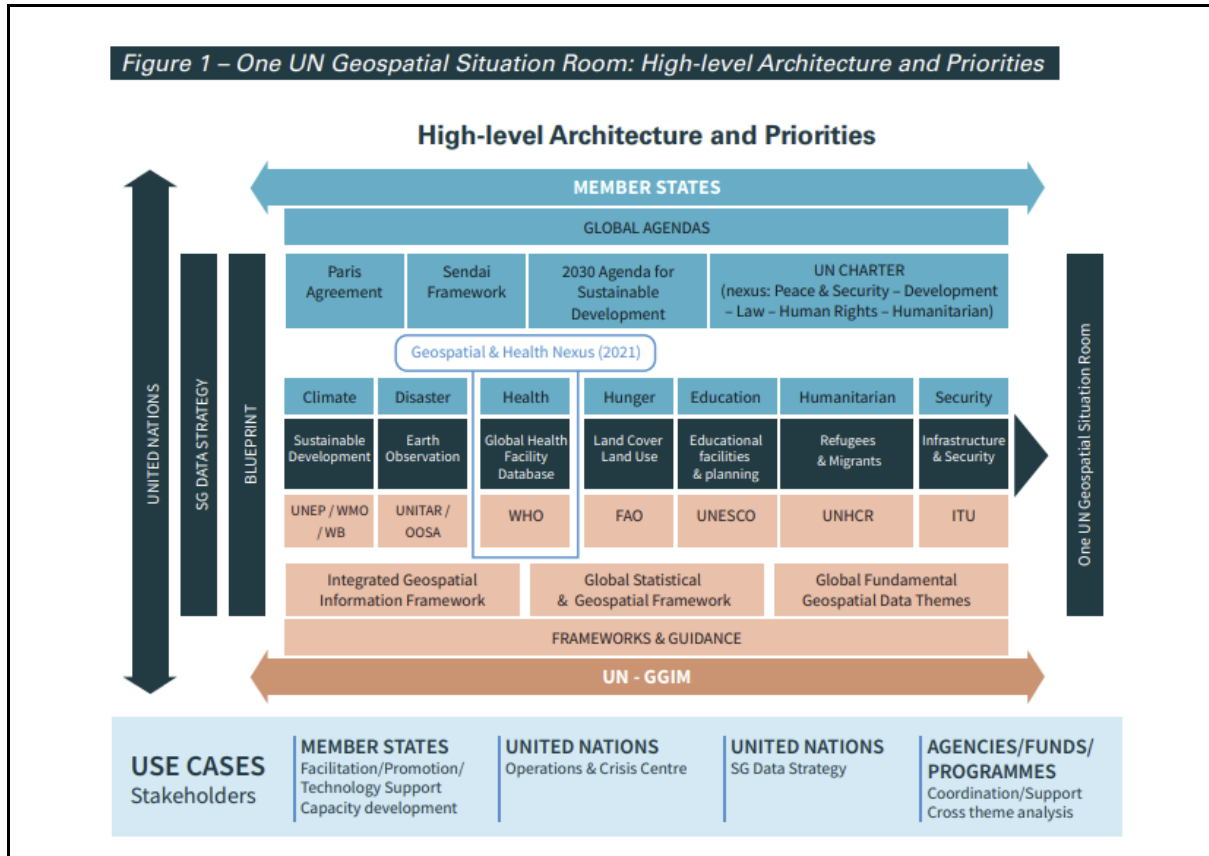
- Sendai states the need for clarity on **coordination** (III.19(e)) of DRR and visibility and availability of targeted geospatial data and services should complement this completely.
- **Policy and Legal -**
 - **Inclusivity** - Sendai Policies take note of all aspects of societies - in particular gender, disability, youth, age (III.19(g)). To what extent can geospatial data both describe societal makeup but also be sensitive in policy and action to all society's sectors and protective to those who are most vulnerable to disasters in society?
 - **Society Accountability** - Sendai's implementation depends upon accountability across all sectors and throughout society (III.19(e)) and UN-IGIF, particularly in its policy and legal deliberations, should identify what checks and balances exist ensure that the whole of society are captured by geospatial data and that they have equal access and reap the benefits of GIS, specifically in regard to reducing personal and community risk and especially important where the most vulnerable to disasters are often those whose voices are least heard, have limited access to technology, and may not be able to afford data and services that could protect them. One particular aspect for consideration is that traditional models of geoscience force the division of features into points, lines, polygons and pixels, and are biased towards measures that can be classified and quantified. The overlapping worlds (threats, needs, support, aid, connections) of vulnerable populations are not easily expressed in this fashion (See [Problems of common GIS structures](#)) and to better describe personal risk profiles alternative models need to be explored and adopted.
- **Data -**
 - Paragraph III 19(g) states "Disaster risk reduction requires a multi-hazard approach and inclusive risk-informed decision-making based on the open exchange and dissemination of **disaggregated data**, including by sex, age and disability, as well as on easily accessible, up-to-date, comprehensible, science-based, non-sensitive risk information, complemented by traditional knowledge". While this paragraph speaks of information generally UN-GGIM should be advocating that the vast majority of that information will have a geospatial component and the UN-IGIF infrastructure provides an optimum way of organising the disseminating such. Implicit to this is the application of sophisticated modelling and analysis, as well as the visualisation through various mapping and infographic options available.
- **Partnerships -**
 - **Acknowledging and leveraging all society** and in particular DRR stakeholders and agencies (both suppliers and consumers of geospatial data and services). While noting that States take the primary role, responsibilities need to be shared with other stakeholders (III.19(b)) and there needs to be all society accountability (III.19(d)) Although the SF-GISD recognise the need for all stakeholders to collaborate within government structures, it is not explicit in the way geospatial data and services have moved much beyond governmental, international or private sector, and that communities themselves and civil society are generating information, analysis and visualisation themselves, often using open source technologies or widely available platforms. Neither does it recognise existing international and regional GI systems for disaster management are outside ,although may complement, national geospatial responses and are sometimes the prime provider of geospatial services to disasters in some regions. More appreciation of those systems is needed while encouraging cooperation, standardisation and interoperability are needed going forward.

Additionally, Sendai makes reference to the **local and specific nature** (iii 19(i)) of disaster risk (which chimes with the humanitarian focus currently on **localisation**). The principle of “**subsidiarity**” needs to be addressed - a principle of social organisation that holds that social and political issues should be dealt with at the most immediate or local level that is consistent with their resolution. With disaster risk reduction the principle holds that response and resilience is conducted and coordinated at the lowest level where it can be successfully resolved. Hence a small flood in a Barangay in Manila can be tackled by its own council, air pollution across the whole of Manila is for the oversight of the Metro Mayor, and a strong typhoon crossing Luzon needs a national or even international response. However, this should not mean that the upper levels of government leave local agencies stranded and can supply resources and services if requested. In fact subsidiarity is less about an agency being left responsible for all actions, more it is coordinating and leading the response and can request outside help. The same principle needs to be applied to the provision of geospatial information in a DRR context. Geospatial technology and data can be created, curated and utilised at the community level, but it needs the support of local, national and international geospatial agencies (for extra data and capacity) to allow decision making, action and monitoring at the appropriate level. To do this there is the need to empower more widely not just consumers of geospatial services but those who want to leverage geospatial technology. For UN-GGIM the implementation of UN-IGIF principles and tools made applicable to local authorities and to community groups is essential, without overwhelming them with bureaucracy that stifle its use in risk reduction. It also depends on the transfer and adaptation (the spillover) of existing methods and potential innovations for simpler and more effective adoption by communities.

Sendai’s guiding principles also stress a **holistic approach** to DRR(III.19(h))“ The development, strengthening and implementation of relevant policies, plans, practices and mechanisms need to aim at coherence, as appropriate, across sustainable development and growth, food security, health and safety, climate change and variability, environmental management and disaster risk reduction agendas. Disaster risk reduction is essential to achieve sustainable development”. That DRR needs to be applied across all aspects of human life and the planet’s environment speaks well to how UN-GGIM’s UN-IGIF is to establish effective geospatial platforms to serve humanity, addressing SDG, the impacts of climate change, and is related to land and marine environments, but better synergies between these different thematic strands are necessary. Sendai Framework speaks to mainstreaming the mindset of DRR across all these aspects so integrated, multi-thematic analysis and frameworks should be the response of the geospatial community. This holistic approach underpins vanguard initiatives such as the One UN Geospatial Situation Room, tying in DRR and humanitarian information sharing initiatives to breaking down those siloes.

CASE STUDY - [ONE UN GEOSPATIAL SITUATION ROOM](#)

“Timely and high-quality data are more essential than ever. Indeed, data are being widely recognized as strategic assets in building back better and accelerating the implementation of the SDGs. What is needed now are new investments in data and information infrastructure, as well as human capacity to get ahead of the crisis and trigger earlier responses, anticipate future needs and design the urgent actions needed to realize the 2030 Agenda for Sustainable Development.”



Integrated geospatial data and services can demonstrate cost saving efficiencies in sharing data from all domains; these return-on-investment arguments can be provided to government and other DRR agencies. The primary argument is that data created once for a specific purpose has multiple usages across so many sectors, as long as it is of good quality and well described (has strong metadata). Ensuring that data and services are fit for multiple purposes and can serve multiple sectors does need more research, not just for DRR but to the benefit of all end-users.

Priorities for Action (Section IV)

Priority 1 Understanding Risk

The Sendai Framework’s fundamental foundation is that if you understand the potential components, nature, magnitude, frequency, impacts and consequences of risk, you can better develop policy, resources and activities to manage it. That much of those parameters can be described with reference to spatial information makes this the most obvious target for UN-IGIF and implementation of the SF-GISD. Indeed this is the section of the framework which makes most direct reference to the use of GIS, mapping and earth observation.

National and Local Priorities

- **Governance and Institutions -**
 - **Leadership** - the major national and local priorities here depend upon good political leadership and championing of the cause of DRR in government and across its stakeholders. Across every action in this area a similar (or the same) champion is required to show leadership in leveraging appropriate geospatial technology and systems.
- **Data**
 - **Promote good quality information management** (IV.24 (a)) is the first action in this section; not just to collect, analyse and manage relevant data but ensure its

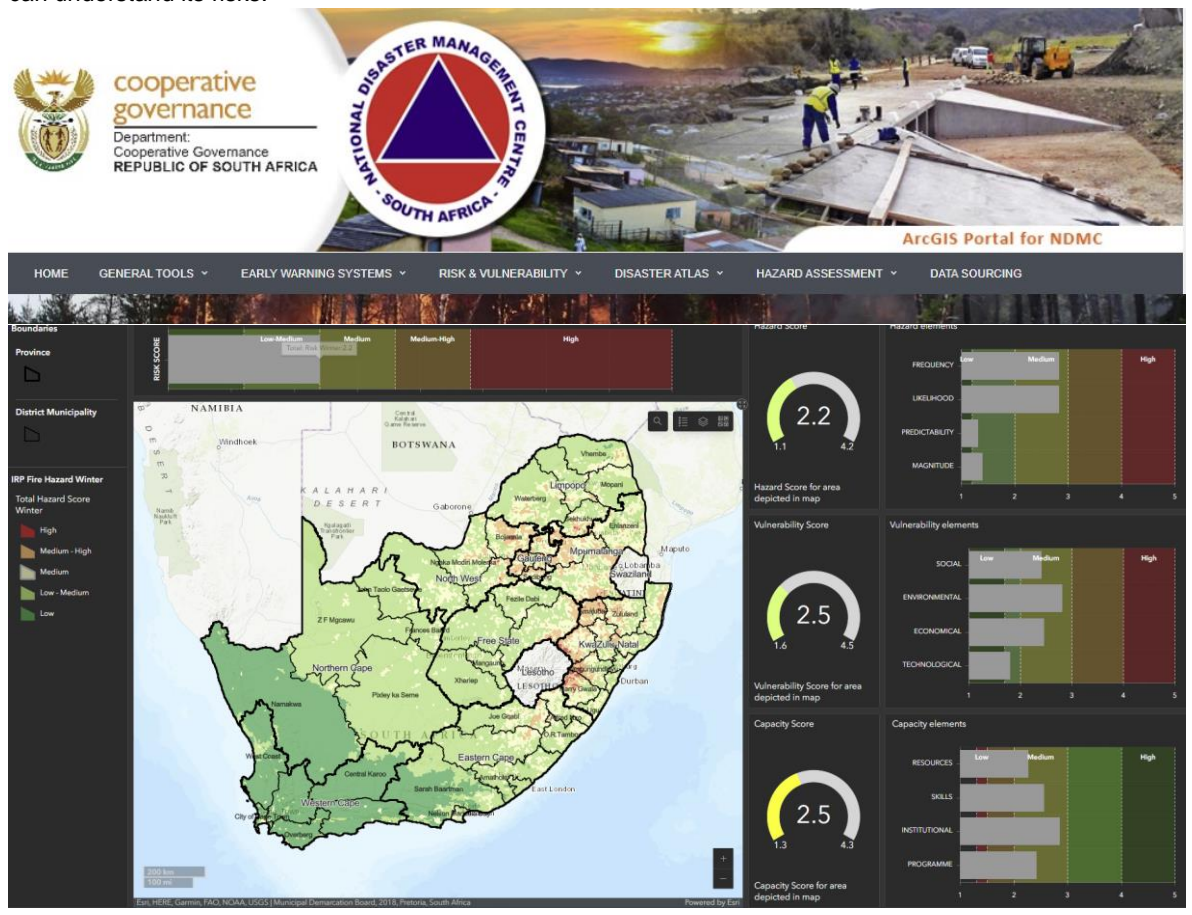
dissemination, taking into account the needs of different categories of users, as appropriate.

- **Baseline information** - (IV.24 (b)) which echoes one of the key guiding principles, is to ensure countries have a strong baseline on which to monitor progress and “assess disaster risks, vulnerability, capacity, exposure, hazard characteristics and their possible sequential effects at the relevant social and spatial scale on ecosystems”
- **Location based disaster information** - IV.24(c) mentions Geospatial Information Technology explicitly - “To develop, periodically update and disseminate, as appropriate, location-based disaster risk information, including risk maps, to decision makers, the general public and communities at risk of exposure to disaster in an appropriate format by using, as applicable, geospatial information technology”
- **Disaster Loss Data** - recording actual data loss (e.g. in post disaster needs assessment) is a requirement for national agencies (IV.24(d) often is aggregated to the scale of the disaster affected area but geospatial can play a much larger role in disaggregated datasets and establishing the geographical units for description, assessment and analysis. Indeed what is often missing from the Sendai Framework text is to link the aspiration of application of risk policy to having sufficiently disaggregated data in defined spatial units to make local analysis pertinent.

**CASE STUDY - Promoting good quality information management
NATIONAL DISASTER MANAGEMENT CENTRE (NDMC) , SOUTH AFRICA**

<http://gismap.ndmc.gov.za/>

NDMC have a series of interactive webmaps of all their key risks (including fire, storm, drought, snow and wind) openly available and supported that demonstrate to the public and decision makers how South Africa can understand its risks.



- **Policy and Legal**
 - **Data protection licensing and sharing** - IV.24 (e) says “make non-sensitive hazard-exposure, vulnerability, risk, disaster and loss-disaggregated information freely available and accessible, as appropriate”. The balance between data sharing and protection of vulnerable populations and national security runs through the Sendai Framework and speaks directly to this Strategic Pathway’s deliberations and advisory, especially on the role of open data standards.
- **Technology and Innovation**
 - The Sendai Framework stresses the need for **real time access to EO and GIS outputs** and to integrate new technologies (IV.24(f)) . The challenge comes in taking global technical advances and innovation and making them accessible and appropriate to national and local scales and a non-geospatial technical audience. Once unlocked the range of datasets and mapping possibilities can cover a wide multitude of hazards and risk management activities.
- **Communication and Engagement**
 - IV.24(h) is concerned with the **dialogue** between the scientific and technical community and DRR practitioners (both policymakers and operational personnel). A two way challenge exists in the geospatial community being better conversant with the challenges of DRR (as this document attempts to expand on) while the DRR community needs to have heightened geographical literacy, not just awareness of the potential and success stories of the geospatial community but understanding how understanding geographical principles and processes will give a holistic systems approach to risk management at all scales.
 - IV.24(o) to involve the community in disaster risk information dissemination calls on action to develop the best **communication and visualisation conduits** and turn attention more to the trends in information consumption by the public including use of social media and SMS as well as traditional formal media and sharing platforms.
- **Partnerships -**
 - **Indigenous knowledge capture** (IV.24(i)) and integration with scientific data is important in risk reduction and greater attention to community participation and use of technology appropriate to local data capture (mobile apps, UAV) and approaches (citizen science, participatory mapping) is needed.
- **Training and Capacity Building**
 - IV.24(g) looks at **cross stakeholder learning** especially through use of existing training mechanisms. The extension of integrating better experience sharing, lesson learned, good practice dissemination and specific training of geospatial techniques for DRR should be an easy synergy with those training structures. Better to integrate geospatial learning within wider learning mechanisms than just within the geospatial community.
 - IV.24(j) recommends the **strengthening of technical and scientific capacity** to model, analyse and assess disaster risk. National disaster research and technology institutions need to be closely aligned or even have geospatial expertise within national geospatial institutions.
 - IV.24(l) promotes formal **disaster management education** and encouragement for geospatial modules within education syllabus is essential alongside those in formal and non formal geospatial learning mechanisms to be exposed to the needs of disaster risk management.
- **Financial -**
 - IV.24 (k) - to what extent geospatial **research and innovation**, technical advance, are being coordinated and given the long term vision and investment to support the major issues of risk reduction - multi hazard, long term solution driven research is needed, and the emphasis here for the Sendai agreement is ensuring that finance is available for national innovation hubs, entrepreneurs and other research institutions.

- IV.24(n) speaks to the **application of risk information to policy making**. While this has governance issues in that national geospatial capacity should be more closely aligned to disaster management bodies (as the UN-GGIM WG-GSD is actively working towards), the realization of the benefits from using geospatial data and services to advocate for pre-disaster resilience measures being more cost effective than response and recovery expenditure is the primary focus for this paragraph. Multiple examples of data, services, modelling, analysis and mapping outcomes can be used as useful case studies to promote this activity.

Global and Regional Priorities

The global roles in understanding risk are to support the capacity development at national level across people, institutions, data, financing and infrastructure. This can be achieved through direct assistance to nations or by spreading good practice, international collaborations and brokering partnerships.

- **Governance and Institutions**

- **International Arrangements and Liaison**. UN-GGIM can work more closely through the UN Geospatial Network and applying the Global Statistical Geospatial Framework (GSG) to look at global initiatives and mechanisms. These speak directly to sharing improved methodologies for risk information (IV.25(a)) by working closely with UNDRR, OCHA, UNDP and global IM DRR support such as the Centre for Research on the Epidemiology of Disasters (CRED) and their Emergency Events Database (EM-DAT) in systematically recording disaster events and losses, and UNSTATS on the Framework for Disaster Related Statistics. For connecting geospatial innovation to DRR research (IV.25(g)), liaison with the UNDRR Scientific and Technical Advisory Group would be advantageous. As the WG-GSD already achieves, connections both with thematic and regional networks can help awareness of global initiatives, national needs and assist with regional cooperation. Connecting geospatial stakeholders at the national, regional and global levels with the increasingly influential regional disaster agencies (e.g. the Caribbean Disaster and Emergency Management Agency (CDEMA), The Centre for Emergency Situations and Disaster Risk Reduction (CESDRR) in Central Asia, The ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre) in SE Asia or the SADC Humanitarian Operations Centre (SHOC) in Southern Africa) . The UN-IGIF Strategic Pathways on Partnership and Communications and Engagement also have an important role here.
- **Liaison with other global initiatives** is specifically given attention in IV.25(f), mentioning the “One million safe schools and hospitals” initiative; the “Making Cities Resilient: My city is getting ready” campaign; the “United Nations Sasakawa Award for Disaster Risk Reduction”; and the annual “United Nations International Day for Disaster Reduction”, and more recently “Early Warning for All”. Collaborations between UN-GGIM and SDG, land and marine applications, and regional initiatives can all help to make the correct linkages to these initiatives and develop synergies.

- **Standards and Interoperability**

- **Terminology and definitions** - IV.25(g) refers to contributions to [2009 UNISDR Terminology on Disaster Risk Reduction](#) and UN-GGIM are both placed to contribute to that terminology to assist defining the geospatial terminology more clearly, but also disseminate the terminology and definition of disaster related statistics to be gathered as part of global monitoring. OGCs work on geosemantics can make a vital contribution here.
- Underpinning the **sharing of risk information** (IV.25(a)) will be issues related to standards, especially around open data, metadata and for recording disaster related statistics. Ensuring easy interoperability between different organisations, scales of operations and

thematic areas will require greater thought. The work of [OGC in this area](#) to help decision support gives useful arguments.

- **Sharing of copyright and patented material** (IV.25(h)) can be facilitated by the guiding principles of this strategic pathway, particularly in the procurement of standards based data and technologies. Especially in disaster response, where information access has to be fast, Georights management by OGC can focus on rapid release and minimise discussions over ownership and access rights.

CASE STUDY - HUMANITARIAN DATA PORTAL - HDX

The Humanitarian Data Exchange (HDX) is an open platform for sharing data across crises and organisations. Launched in July 2014, the goal of HDX is to make humanitarian data easy to find and use for analysis. Its growing collection of datasets has been accessed by users in over 250 countries and territories.

HDX is managed by OCHA's Centre for Humanitarian Data, located in The Hague, the Netherlands. OCHA is part of the United Nations Secretariat and is responsible for bringing together humanitarian actors to ensure a coherent response to emergencies.

While many of the datasets have been created by agencies globally, national verification and cooperation by national mapping agencies is common and OCHA strive to agree to share the most authoritative datasets available.

The screenshot shows the HDX website interface for the Vanuatu dataset page. At the top, there is a navigation bar with the HDX logo, search bar, and links for DATA, LOCATIONS, ORGANISATIONS, and PRODUCTS. Below this, the page title 'Vanuatu' is displayed with statistics: 114 Datasets, 6 Followers, and 34 Organisations. A 'Key Figures' section provides data on Population, total (326.7k), Population density (26.2), GDP per capita, PPP (current international \$) (3.3k), and Land area (12.2k). Below this, there is a search bar and a 'SHOW FILTER' button. The main content area lists several datasets, including 'Vanuatu - Subnational Administrative Boundaries', 'Vanuatu Buildings (OpenStreetMap Export)', and 'Vanuatu Financial Services (OpenStreetMap Export)'. Each dataset entry includes a description, download count, and update frequency. A sidebar on the left offers filters for 'FEATURED' and 'DATA SERIES'.

- **Communication and Engagement -**

- **Promoting information and technology sharing**, to the public (IV.25(c)), amongst the scientific and technical communities (IV.25(d)) and supporting knowledge sharing platforms (IV.25(e)) are at the core of global contributions to understanding risk. In particular the paragraph which refers to “local, national, regional and global user-friendly systems and services for the exchange of information on good practices, cost-effective and easy-to-use disaster risk reduction technologies and lessons learned on policies, plans and measures for disaster risk reduction” raise the issue to what extent does UN-GGIM use existing DRR platforms (UN SPIDER, Prevention Web, ReliefWeb), promote existing geospatial portals and ensure visibility between the sectors, or seek to develop new platforms and the implications of financing, curating, promoting and sustaining such mechanisms.
- **Communication strategies** should make the distinction between knowledge and data portals, as the integrative platform geospatial software provides means data sharing platforms have a significantly different structure and need for more sophisticated governance, management, policy and standards than a file or general knowledge repository.

CASE STUDY _ KNOWLEDGE SHARING PORTALS - UN-SPIDER

<https://www.un-spider.org/>

Since 2006 the Office for Outer Space affairs has managed the UN platform for Space-based information for disaster management and emergency response and an exploration can show how knowledge portals speak to a wide audience, both technical and non-technical and provide information, news, ,advisory support and a one-stop shop to link to the plethora of other resources. Only a careful focus on the portal's mission and long term curation of the resources keep these platforms current and relevant.

- **Innovation and Technology -**

- IV.25(i) is in regard to **leveraging innovation and technology**, not just applying existing technology to national situations but in encompassing the future proofing of how new IT and geospatial innovations could be adapted, adopted and applied to DRR situations. Both in developing communities of interest across national boundaries, knowledge

sharing and capacity building, global support can be given to seeding innovation and entrepreneurship in those countries currently on the wrong side of the digital divide.

Priority 2: Strengthening disaster risk governance to manage disaster risk

“Disaster risk governance at the national, regional and global levels is of great importance for an effective and efficient management of disaster risk. Clear vision, plans, competence, guidance and coordination within and across sectors, as well as participation of relevant stakeholders, are needed. Strengthening disaster risk governance for prevention, mitigation, preparedness, response, recovery and rehabilitation is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development.”

The role of geospatial data and services and implementation of the UN-IGIF has less direct and universal application in this priority than others. However, if the value statements of UN-IGIF and the benefits in geospatial investment across governments and elsewhere are to be realised, as well as ensuring the culture of geospatial application is to be embedded across all DRR actors, the contribution to DRR governance has to be addressed. There are two major strands of thinking here; the provision of data feeds and robust analysis, modelling and scenario building will inform the formulation of DRR governance and also the specific governance of geospatial information for DRR should also be an integral and embedded component of DRR governance in itself.

National and Local Priorities

● **Governance and Institutions**

- **Mainstreaming DRR in law, institutions and coordinating DRR across all sectors** - (IV.27(a)) has implications for UN-GGIM and national geospatial actors that not only should geospatial directly address the DRR domain but its work across other important domains (marine, land, sustainable development to name a few) will need aligning with DRR strategy. This also impacts on the Policy and Legal Strategic Pathway to align geospatial law and policy with DRR law and mainstreaming issues at the national level.
- **Implementing DRR strategies and plans** (IV.27(b)) at national and local levels will require value propositions to ensure that information management is not seen as a separate issue or an afterthought to DRR strategy but interwoven between every aspect and level of risk planning and that the Legal and Policy implications regarding geospatial needs for those plans are considered.
- **Parliamentary and public scrutiny** (IV.27(e)) highlights that progress reports to inform debate on progress on national and local plans are essential. Not only is geographical evidence useful in creating the overall statistics but both the public and elected representatives will be interested in geographical variation in implementation and impacts. Communication and Engagement advice will be essential in framing that information in acceptable formats.
- **Parliamentary advocacy** to enable DRR mechanisms (IV.27(i)) to be implemented and create new or amend existing DRR legislation and budget allocation provides opportunities for the geospatial agencies to make their case for value statements of the benefits, synergies and ROI of investing in supporting UN-IGIF and DRR specific geospatial services.

● **Financial**

- The governance issues highlighted above all speak to arguments which need to be made to invest long term in national geospatial capacity. In particular, IV.27(h) speaks to local regulatory power and financing, and to ensure those local coordination mechanisms are able to work with local stakeholders to gather, assimilate, analyse and distribute information that needs sustained funding from national or local recurrent streams.

- **Data**
 - Before **implementing the disaster action plans** (IV.27(b)), their formulation should rely on accurate, scientific and indigenous geographical knowledge to craft robust policy.
 - **House zoning** is developed as a major national intervention (IV.27(j)) given its importance for avoiding or reducing development in disaster risk prone areas. Evidence based geospatial outputs need to be at the centre of this application but also the voices of those living in those zones (often with no alternative accommodation) can be expressed through maps and analysis.
- **Legal and Policy**
 - For assessing DRM capacity (IV.27(c)) complementary SWOT analyses of the geospatial landscape should be conducted including using more general geomaturity studies and status of base data.
 - **Law compliance with DRM principles** (IV.27(d)) should include a closer examination of how geospatial policy is tested within the DRM realm and can facilitate better use of information in disasters. Indeed the Working Group on Policy and Legal Frameworks for Geospatial Information Management have made inroads into this subject. In 2023 they [published a paper](#) “Authoritative Data in an Evolving Geospatial Landscape: An Exploration of Policy and Legal Challenges” which touches on some of the special cases to be considered when the imperative is on life saving activities in a rapidly evolving situation.
 - **Strengthening of DRR forums** (IV.27(h)), especially the linkage between local and national levels, requires good access to data and sharing agreements so that these forums are properly informed.
- **Standards**
 - **DRM quality assurance methods** (IV.27(j)) should run in parallel with efforts to have compliance with geospatial standards (e.g. for data, metadata, open data).

Global and Regional Priorities

- **Governance and Institutions**
 - **Creating common information systems** (IV.28 (a)), supporting this aim so that global support to national and regional governance has access to the best quality DRR information and analysis, this also impacts in sound sharing and data protection policies.
 - **Collaboration and coherence with other global priorities** related to climate change, biodiversity and sustainable development (IV.24(b)) speaks again to the holistic approach needed in the guiding principles.
 - **Engage with the Global Platform for Disaster Risk Reduction (GPDR) and other platforms** (IV.24(c)). Geospatial leaders need to keep informed about disaster risk reduction and humanitarian current thinking, trends, and be able to converse with end users with their terminology and explain geospatial solutions more clearly. An assessment of the degree of geographical literacy/ geomaturity within the delegates at [recent Global Platforms](#) could inform where to engage and at what level.
- **Partnerships**
 - **Leveraging geospatial partnerships** across UN-GGIM’s Thematic Networks would allow coordinated delegations to put forward coherent value propositions at conferences such as GDPR (IV.24(c)) and other disaster forums would be advantageous (e.g. the UN’s Humanitarian Networks and Partnerships’ Week)..
- **Policy and Legal**
 - IV.28(d) looks to **promote transboundary cooperation** especially in coastal and watershed environments. Policies which allow both transboundary information and knowledge sharing and regional governance of geospatial information and services would support this and promotion of Standards and Interoperability also play a large role in that harmonisation of transboundary geospatial data supply.
- **Data**

- **Monitoring and assessing disaster risks** (IV.28(f)) needs the geospatial community supplying risk information to move from ad hoc, single hazard studies to an integrated, repeatable and standard methodology to cover multi hazard risk monitoring. This is especially important as the impacts of climate change continue to evolve the form, frequency and intensity of many hazards. Innovations in remote surface, UAV or satellite based observation systems are key here. Global monitoring by EU Copernicus, NASA and others are developing trusted analysis in some areas but are often not suitable for local scale risk management.
- **Capacity and Education**
 - **Promoting learning and exchange of good practice** (IV.28(e)) for DRR ties closely with the UN-IGIF priority for increasing geospatial learning and synergies could be found by prompting either parallel or integrated learning platforms, peer reviews and platforms.

Additionally, IV.28(d) pays special attention to **epidemics** (remembering the Sendai Framework was ratified before the Covid Pandemic) highlighting that disaster and relief is often needed for events which have no respect for national borders. In particular it refers to those displaced by disaster that may result in refugees.

Priority 3: Investing in disaster risk reduction for resilience

This priority is directly influenced least by the application of geospatial data and services given that it is to put in place the financial mechanisms, both capital and recurrent funding, that can support administration, development and the implementation of disaster risk strategies. However, like Priority 2 covering governance, this aim in itself requires both significant investment in good geospatial data and analysis to support the allocation of funding and can be synchronised with the investment in sustainable geospatial financing as good value propositions to support vital resilience building measures.

National and Local Priorities

- **Governance and Institutions/Partnerships**
 - National Geospatial Agencies need to lobby for better use of geospatial in DRR needs good return on investment arguments and clear benefits of investing in geospatial over other technologies. Using DRR as a vanguard application of UN-IGIF would be promoting arguments for wider investment in national geospatial frameworks supporting multiple important national and international priorities. Specifically for IV.30(a) in allocating resources, geospatial insights will help institutions allocate *where* those investments go and look at the locational interrelationships between the complexity of disaster risk reduction factors and actors.
 - IV.30 (b) specifically looks to supporting the **insurance and reinsurance industry**, which already make extensive use of geospatial modelling in their risk management strategies. Close collaboration could open up new markets for geospatial data and help harmonise and improve data and service quality, in particular the granularity of their analysis.
 - Similarly, the investment in **resilient critical infrastructure**, IV .30 (c), **support for protection of cultural assets**, IV .30 (d), **and DRM in planning, particularly urban planning**, IV .30 (f), but also **rural/watersheds and coastal zones** (IV .30 (g)) requires articulation of the benefits of geospatial technology to enhance and streamline planning processes. The natural focus would be for local authorities and their planning departments to be provided with good geospatial information, but would also reach out to the private sector (e.g. for developers and surveyors) and allow consideration that communities themselves and civil society need data for their own resilience building and advocacy, particularly since the most vulnerable people to disasters are often those who do not have a voice or access to all the technology to state their cases.
 - IV.30(n), which relates to implementation of DRR in regard to **sustainable ecosystem management**, is a good example of the value proposition that using geospatial reference frameworks allows holistic multi factor analysis and breaks down silos between specialist interests. Key to this is advocacy that integrated GI for environmental and DRR

is cost effective and has synergies - can be used with regards to so many other key GI applications - land management, land tenure, marine management. This approach has potential to open up more funding sources and showing the synergies is advantageous to donors, government finance, ministries, philanthropies, banks and other funding mechanisms.

A number of the paragraphs in this priority focus on specific support in key disaster sectors (or clusters) and targeted vulnerable communities that would benefit from a full implementation of UN-IGIF strategic pathways.

- **Health and social services-** IV.30(i) makes special reference to financing **resilient health systems**, a target that has been put into sharp focus by the Covid Pandemic. Health is a particular focus for national and international disaster response and the role of geospatial data and services from identifying adequate health provision across a country and its population, resilient premises, and systems in place to monitor spread of disease, to modelling the effectiveness of prevention measures or environmental factors can be better promoted. Similarly, the provision of financing for DRM in **health and social safety net mechanisms** (IV.30(j)) and **chronic disease** (IV.30(k)) speak to those national and international agencies focused on food and nutrition, food security, protection, child specific services, reproductive health. Greater access to spatially referenced indicator data for these services and the wider food, physical aid items and services to these demonstrate to authorities how finances can be better targeted and more efficiently used.
- IV 30(l) specifies policies and programmes for **disaster induced displacement** and how to support migrants and host communities. Not only can geospatial data and services monitor movements and bottlenecks but also help match need for support with impact on local services and the need to bolster aid supplies. **Logistics** - IV.30(o) focuses on supply chain resilience to ensure continuity of commodities and services during emergency periods; the application of well-regarded geospatial innovation and technology for private and government agencies is a growth area, and innovation (e.g. application of big data and AI) continue to bring efficiencies in supply systems. Support to governments to model and predict how those chains can be impacted by disaster scenarios and track actual disruption and resilience in those chains can help more coordinated and equitable continuity.
- **Agriculture Sector** - IV.30(p) - similarly there is much potential in integrating sophisticated geospatial modelling and monitoring, including from EO and remote logging, with building impact scenarios of multi hazard threats to the agricultural domain.
- **Tourism Sector** - IV.30(q). Sendai makes special mention of disaster management approaches as tourism is a key economic driver in many vulnerable states, particularly small island developing states. Logging tourism assets and spatial contribution to economies plus risk modelling should be standard tools in these countries.

The challenge for providing good geospatial services to cover these humanitarian issues and key economic sectors comes from having appropriate and affordable solutions that bridge the geospatial divide, given that the most vulnerable countries are often those without a mature innovation and private sector uptake of new geospatial technologies in these sectors.

Global and Regional Priorities

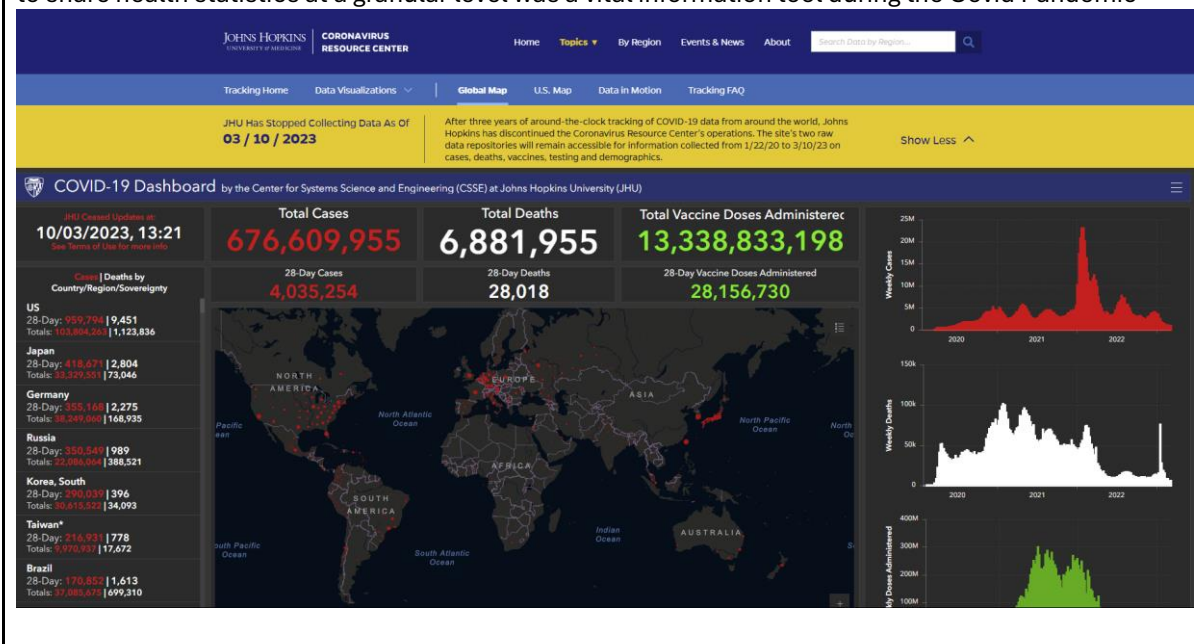
- **Governance and Institutions**
 - The first paragraph of this section speaks to **coherence across systems** (IV.31A), in particular in relation to the sustainable development goals. Greater awareness of the Sendai Framework by groups such as the Inter-Agency and Expert Group on the Sustainable Development Goal Indicators (IAEG-SDGS) can ensure the alignment between geospatial services supporting measurement and monitoring of SDG indicators and targets within the Sendai Framework and greater awareness amongst international agencies and platforms related to SDG.
- **Partnerships**

- Similarly greater reach out by UN-GGIM components to the DRR community will support the **promotion of DRM partnerships** (IV.31(b)) and connectivity between the Academic, Professional Associations, UN Geospatial and Private Sector Thematic Networks to similar networks related specifically to DRR to promote **appropriate technologies and innovation** (IV.31(c)) are essential. This dialogue supports the embracing of new technology and innovation to support real world sustainable solutions to attract and manage financing streams.

As with National priorities, the Global and Regional Priorities pay consideration to collaboration in embedding **DRR action within a range of specific sectors**, i.e. the economic and financial industry (IV.31(d)) including the insurance, parametric insurance and reinsurance sectors, health systems (IV.31(e)), agriculture (iv.31(f)), social safety nets (IV.31(g)) and business (IV.31(i)). Dynamic geospatial innovation and technological application has become commonplace in the public’s minds (e.g. see the John Hopkins University covid dashboard below) that often the geospatial foundation to those dashboards and platforms is not realised.

CASE STUDY - [John Hopkins](#) University Coronavirus Resource Centre and other dashboards

The application of the International Health Regulations as signed up by 196 member states. The ability to share health statistics at a granular level was a vital information tool during the Covid Pandemic



Additionally, this section focuses on the target to **eradicate hunger and poverty** through DRR (IV.31(h)). Regional, national, local and household food security all depend on so many factors, not just climate and hydrometeorological factors but soil health, access to inputs, pest monitoring, post-harvest, employment, markets, government regulations which vary by location. The World Food Programme’s Hunger Map shows how many of these factors can be visualised and interrelated with clarity for public awareness and to support decision making and strategic planning.

CASE STUDY - [WFP Hunger map](#) is a major example of how global mapping supports awareness raising and specific issues from a wide set of data, as well as being routinely updated to provide up to date analysis and trend monitoring.



Priority 4 : Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction

This priority speaks to how when the risk to disaster has been minimised through prevention and mitigation, agencies and communities deal with the risk that is left, the residual risk, from shock events. This is achieved by preparing better, anticipating the shock and implementing actions ahead of time, responding once the event has occurred and allowing a faster and better recovery from those events that improves prevention and mitigation in future.

National and Local Priorities

The priorities for action here speak mainly to operational mechanisms and actions that need to be in place rather than finance, governance, partnership and capacity building issues. While again a strong UN-IGIF implementation across all the strategic pathways will be essential, these speak more to how data and technological innovation can provide geospatial solutions for these DRR actions.

● **Governance and Institutions**

- IV.33(a) does however provide an umbrella action that needs high level governance action. In this paragraph the target is to ensure **disaster risk management plans are updated** and kept relevant, especially considering climate change scenarios. Integrating the geospatial mandate, responsibilities and instruments to support DRM within those plans is essential which impacts on the development of policy, and building cross sectoral partnerships to ensure data and service provision and consumption are optimised.

● **Legal and Policy**

- The liaison between national and international aid support is vital when national systems are overwhelmed but international law needs applying at national level. Sendai requires national and local agencies to review and strengthen, as appropriate, national laws and procedures on international cooperation, based on the Guidelines for the Domestic Facilitation and Regulation of International Disaster Relief and Initial Recovery Assistance (IV.33(p)). Support between international geospatial data and service providers and local actors needs similar due attention. The SF-GISD states that nations are responsible to

have “Policies on collaboration, coordination and sharing, established, issued and implemented;” and “The implementation of the framework shall encourage data sharing, interoperability and harmonisation among neighbour countries in order to respond efficiently to cross border disasters”; UN-GGIM can make extra advice to help nations formulate policies whereby when international geospatial assistance is provided that data sharing can be extended under humanitarian terms to trusted international and civil society geospatial partners and secondary distribution and acceptable sharing formats, respecting the need to protect (vulnerable) individuals who may be identified by the data. This will fulfil the SF-GISD statement that “*Geospatial data and information generated and maintained by Member States and the international community shall be openly accessible to the DRM community, as appropriate*”.

- **Data**

- Sendai identifies the high priority for **Early Warning Systems** (IV.33(b) which has translated into the [Early Warning for All](#) initiative (for the period 2023-7) to fast track development. Often meteorological offices lead this work but seismological and other early warning system types exist. Geospatial should be at the heart of these as the hazard area and intensity should be geographically described, and exposure to populations and infrastructure spatially variable. Financial support is needed long term, the key arguments for investment being that good dissemination of early warning builds resilience for all in particular the communication of warnings to private sector, utility companies, transport bodies, government agencies and the public generally spreads risk management which also spreads the financial costs of being resilient.
- Several national and local priorities here cover key **disaster preparedness activities** - operational readiness of critical facilities infrastructure (IV.33(c) including health, water, transportation, education and telecommunications; community hubs including shelters and logistical stockpiles (IV.33(d)); and relief funding mechanisms (IV.33(e)); morbidity case registers (IV.33(n); mental health and psychosocial support (IV.33(o)); and evacuation capacity and planning (IV.33(m)) . UN-IGIF implementation should encompass all these data themes in the design of national and local data repositories and services. Indeed, geospatial agencies can help take the lead to define what constitutes critical infrastructure and maintain comprehensive and standardised location based inventories.
- IV.33(i) - Reconstruction calls for consultation on the often-controversial **resighting of infrastructure** including housing and workplaces after disaster and disseminating **learning lessons** (IV.33(j)). Participatory mapping and collaborative platforms using a map as a base for identifying underlying factors, options, conflicts and resolutions of the issues surrounding planning would be a solution to advocate. The use of geospatial services both in highlighting suitable sites and as a consultation platform can be promoted.

- **Training and Capacity Building**

- Continual **training in disaster response** (IV.33(f) and (h)) particularly to be able to deliver under difficult conditions, is essential and both awareness raising of geospatial support to planning, assessing, aid delivery and monitoring and how geospatial expertise can be integrated within operational and coordination mechanisms should be embedded within national training programmes and simulation exercises.

Underpinning much of the provision of the data themes highlighted above is the essential need to keep base mapping, inventories, registers **up to date and accurate**, and repeating analysis regularly as rapidly evolving landscapes will keep changing the levels of risk and resilience at community, national and global levels.

Global and Regional Priorities

- **Governance and Institutions**

- Matching a similar national priority (IV.33(p)), Sendai calls for **response operation and coordination mechanisms** to be strengthened (iv.34(a)). Global disaster response information management mechanisms have long gone hand in hand with overall coordination and regional disaster management agencies are building similar capacities but still much more could be done to ensure interoperability and greater cooperation between national geospatial and disaster management agencies and international geospatial support during responses.
- **Standards and interoperability**
 - IV.34(b) promotes the further **development and dissemination of instruments**, such as standards, codes, operational guides and other guidance instruments, to support coordinated action in disaster preparedness and response and facilitate information sharing on lessons learned and best practices for policy practice and post-disaster reconstruction programmes. There is scope for geospatial research to look across various codes of practice and operational guides which have been developed in the humanitarian and DRR sectors, in particular the [Core Humanitarian Standards](#) and the [SPHERE standards](#) for minimum humanitarian assistance. This could include matching DRR codes with the principles behind geospatial codes (e.g. [EthicalGeo's Locus charter](#)).
- **Partnerships**
 - Sendai makes special reference to the use of **global hydrometeorological expertise** (IV.34(e)) but there is no equivalent mention of geospatial expertise, only use of geospatial services and earth observation. It demonstrates the need for much more advocacy and engagement with the disaster risk management community to promote the benefits of the sector.
 - IV.34 (g) regards **regional resource sharing** and there are a number of elements which should be maintained with locational reference. "Who What Where" databases logging response capacity and mapping in preparedness for events and during response and recovery efforts, including monitoring of fund allocation and number of beneficiaries reached, is vital M&E for a relief effort and useful in planning. Building that around a specific geographic framework (lowest level of administration with unique codes (OCHA advocates for use of a system termed PCodes but national systems exist). Similarly mapped capacity of shelters and other logistics and critical facilities are at the heart of being prepared to implement response plans.
- **Training and Capacity Building**
 - Regional preparedness through better **coordination and simulation exercises** (IV.34(g)) is very important both for awareness raising and capacity building. Examples exist at the international level within the UN system, with the Red Cross/Red Crescent Movement and with NGO and other partners (e.g the Geospatial Sub Committee of the UN Information Management (IM) Working Group, and mapping components within UN and International Humanitarian Partnership (Triplex) simulation exercises). Some implementation at regional level is happening, but more could be done to give geospatial support to existing simulations or bring together IM and data providers at a regional level to support data preparedness, response services and capacity building programmes. For example, in the Caribbean, CDEMA did launch their own IM working group in late 2023.
 - IV.34(h) - methods for **continuing capacity development** of geospatial DRR actors will be essential, not just widening the pool of practitioners at entry level but ensuring career development and skill enhancement to counter turnover of specialists. This will ensure a larger pool of actors who not only have the geospatial skills but also understand the context of disaster related mapping and are sensitive to the principles of DRR and humanitarian action.

Stakeholders (Section V) and International Cooperation and Global Partnership (Section VI)

National Stakeholders - Section V (V.36 a,b,c) is devoted to describing the range of stakeholder groups that play a part in complete disaster risk management. There are ones which overlap strongly UN-GGIM's own recognised range of stakeholders (Academia, Business, Professional associations, Private Sector) but the Sendai Framework also pays special attention to the Media and to components of Civil Society (not just organised groups but also women, children and youth, persons with disabilities, older persons, indigenous peoples and migrants). As the review of the priorities for action has shown, there are geospatial stakeholders represented in UN-GGIM from the academic, private sector, government and international community, but the role of civil society - both as a provider and consumer of geospatial services has been undervalued within many UN-GGIM fora despite its particular importance for resilience building and sustainable development. Given open access of mobile technology, greater use of citizen science and community involvement to gather data and embed knowledge in future could vastly expand the pool of geospatial practitioners combating disasters.

More thinking around how the role of geospatial for civil society and civil society's contribution to geospatial data and services is needed as it impacts a number of key UN-GGIM topics. These include:

- **Authoritative data** - can a balance be found between having recognised, broadly consensus information curated by nationally recognised institutions, and the need for more local level, community data, different voices and approaches to data; ones which may challenge received wisdom but give insights into both vulnerability and resilience.
- **Indigenous knowledge and systems** - what more can be achieved to provide geospatial models and tools which better capture cultural, social, historical (and potentially non-scientific) knowledge to support resilience building.
- More attention to **geospatial research and private development entrepreneurship** to both less developed countries and community based DRR activity. Research continues to be highly skewed towards more developed countries and large organisations which widens the digital divide, not where most vulnerability to disasters occurs. This should not only be around research topics which are focused on those countries, but also producing technical solutions and innovations which are appropriate to their technology levels and supporting technological platforms.

Role of international cooperation - Section VI (VI.48(a-i)) list UN entities, UNDRR, International Finance institutions and banks, other international organisations including the Conference of the parties of the United Nations Framework Convention on Climate Change, the International Red Cross and Red Crescent Movement, UN support for developing countries, the Inter Parliamentary Union and United Cities and Local Government Organisation. Speaking mainly to the UN-IGIF Partnership Strategic Pathway, the listing of both international and local stakeholders in DRR helps to frame where effective relationships between the geospatial and disaster management communities can be strengthened.

Policy and Return on Investment

The Sendai Framework includes a number of references to the importance of information management in developing early warning systems, identifying vulnerable populations and responding effectively to disasters. Despite this call to action, the integration of information management into disaster risk reduction and response has been limited, and this is reflected in the availability of literature, particularly on the benefits of investment in geospatial data for disasters.

Whilst not specific to disaster response, there is literature available on the benefits of investment in data systems to support the broader sustainable development agenda. It is possible to then transpose this existing benefits analysis onto both geospatial data and humanitarian systems to identify four distinct categories of benefit: the economic benefits that create value and unlock cost efficiencies within humanitarian systems; the societal benefits that enhance the quality and equity of living standards through more efficient and effective humanitarian programming; environmental benefits where geospatial data

can deliver better understanding of the drivers of **environmental issues** that lead to humanitarian crises; and, **institutional benefits** where geospatial data can increase data based decision-making and improve the strength and credibility of humanitarian and government agencies.

As part of its [investment case on multiplying progress through data ecosystems](#), the Global Partnership for Sustainable Development Data highlights a number of case studies where the use of geospatial is implicit in the delivery of humanitarian benefits but without the geospatial components being referenced. These include the development of flood early warning systems in Bangladesh that allowed delivery of aid to 220,000 people in advance of flooding, and the analysis of local travel patterns on COVID-19 disease transmission to assess the effectiveness of Government policy on the pandemic.

As the Sendai Framework has not been fully implemented in most countries, the evidence to support greater use of information management in disaster response is limited, however there is considerably more data available on the benefits of implementing its predecessor, the Hyogo Framework. The [UN Office for Disaster Risk Reduction](#) and [UN Economic Commission for Asia-Pacific](#) both completed analysis of the implementation of the Hyogo framework that may be beneficial to future analysis of Sendai.

These include estimates of the impact and cost of disasters over the decade that the Hyogo Framework was available (2005-2015). During this time the analysis indicates 500,000 people lost their lives as a result of disaster events, with 1.6bn people affected, and at a cost of \$705bn in damages. The reporting also breaks these figures down by disaster type in a way that could be integrated into a more detailed economic analysis of the benefits of geospatial data for disasters.

Whilst many countries recognise the challenges of extreme weather, infectious disease and urban growth as driving exposure to disaster risk, the integration of the Sendai framework into national and regional policy is limited.

The overarching UN-IGIF acknowledges the importance of geospatial data for disaster response and cites some of the benefits of its use in decision-making such as placement of early warning systems, identification of vulnerable populations and common operational overviews of response. The UN-IGIF also notes the existing policy and technical capacity gaps on geospatial data for decision-making and calls for greater alignment between the two, particularly within developing countries. It does not provide guidance however, on how these applications should be addressed within policy and legislation to ensure that geospatial data is used effectively within all stages of the disaster cycle.

The UN Office for Disaster Risk Reduction provides a [catalogue of national focal points and data platforms](#) for the implementation of the Sendai Framework, however most of the entries for countries remain incomplete. There are however some exceptions such as the development of a national platform in Benin for the integration of risk prevention and disaster management into national policy and South Africa where a [National Disaster Management Framework](#) has been established through the [2002 Disaster Management Act 57](#).

The only national legislation to include specific reference to the role of geospatial data is the 2010 Philippine Disaster Risk Reduction and Management Act which includes references to the allocation of funding for communities to assess disaster risk, and multi-stakeholder engagement on information sharing and GIS-based risk mapping (section 6d).

Discussion

This review of the Sendai Framework mapping the relation of the UN-IGIF and the SF-GISD identifies that the text, while having some direct references to the use of geospatial technology, earth observation and mapping, fails to capture the breadth and depth of data and services that the Geospatial community does and could supply to disaster risk management at all scales. This mapping exercise shows that locationally referenced data and spatial analysis supports across the four priorities, namely understanding disaster

risk, strengthening governance, investment and enhancing disaster preparedness for response and recovery. Indeed a clear message is that the role of geospatial should not be restricted in providing outputs to support operational DRR - risk mapping, mitigation strategies, response and recovery activities. Geospatial can support at a much more strategic level of DRR governance and laws, ensuring that policy, strategies and plans are formulated both with good spatial information to support fundamental thinking, and embed the process of using geospatial throughout DRM activity - planning, assessment, warning, delivery, monitoring and evaluation, lessons learnt and ultimately revision of strategies. As an aside, the framework makes only occasional reference to the use of earth observation and in particular the potential of UAV and other remote sensing platforms. Working closely with GEO and using references such as the 2022 [Beyond Borders](#) report for the UK Humanitarian Innovation Hub, a much wider geospatial offer to the disaster management and humanitarian domains can be demonstrated.

The text of the Sendai Framework was set and ratified in 2015, but the document and the DRR specialists who were its composers should not be dictating or restricting where geospatial data and services should be provided. The Expert Committee should be thought leaders to ensure that the geospatial community advocates the value of our services in the disaster management domain, which means better communication strategies of the benefits and potential of geospatial to the disaster management and humanitarian communities are necessary to change their perceptions. The report highlights how a lack of geographical and geospatial literacy amongst the disaster management community at best sees geospatial as an add on to other disaster management functions, at worst seen as esoteric and can be completely ignored. Showing both how geospatial data and services should be an integral part of the whole disaster management process and be used not just to create visualisations but also allow debate, planning, scenario building, strategy and indeed governance of DRM mechanisms is a key priority now. Additionally, the existence of a robust model for geospatial management - the implementation of the UN-IGIF - can be used to show how application of geospatial science is not a costly add on to disaster risk management but provides multipurpose services in a cost efficient manner and can build trust at all scales that geospatial information management is providing coherent and quality assured solutions. But the brief review of policy shows tangible case studies are few and far between in the disaster management domain and more cost benefit and return on investment studies are required.

The lobbying of the disaster management domain will not exist in a vacuum; use cases and solutions need to be demonstrated in terms of their superiority to other techniques (e.g. data science solutions or AI). The unique selling point of providing both locational information ("Everything happens somewhere") and spatial analytics provide, more detailed, better targeted, richer, insightful outputs into disaster risk management.

Conversely, the review shows that an increased understanding of the principles, operations and governance of the disaster management community - at all scales - would benefit geospatial practitioners when needing to engage in a systematic fashion. This review has revealed how the humanitarian aspects of disaster risk management, especially during emergency response, is underplayed in the text of the Sendai Framework, and there are both applications of geospatial and specific considerations about how data and mapping impacts the dignity and humanity of those affected by disasters.

Beyond the data and services, the text of the Sendai Framework demonstrates how UN-IGIF implementation by national mapping and geospatial agencies and the geospatial ecosystem could be better coordinated with the policies and legal frameworks of domains such as disaster management. There needs to be more encouragement to those drafting disaster management policy and laws to consider hard coding geospatial requirements into that legislation. In terms of financing of geospatial for DRR, and the wider UN-IGIF financing approach needed to underpin disaster management mapping, it is acknowledged that the complexity of funding for DRR is on a par with that for geospatial, relying on a range of mechanisms from proprietorial, personal investment, government funding, public/private partnerships, trusts, remittances, donor and philanthropic funding. It has been beyond the scope of this study to analyse this mix across all member states, but funding arguments for disaster resilience should go beyond traditional government funding support or grant or loan aid. Similarly the geospatial framework needed for

DRR demands flexible financing not just from proprietorial solutions but also innovative mechanisms such as the [PLACE](#) initiative. This must be achieved both to secure sustainable funding streams and be more cost effective.

Technology and innovation is a major driver to the evolution of how geospatial meets global challenges such as risk management. At both global level and with many national efforts, the support of increasingly sophisticated approaches (targeted use of AI, digital twins) are enriching the way geospatial services support livelihoods, social and economic activity around the world. But given the most vulnerable often have least access to either the hardware or bandwidth to be able to utilise these game changers, every innovation for DRR should be put through the test of being appropriate to the communities they should serve, and special attention and additional help given to those countries, institutions and individuals which may not have access to the optimum technical environment.

There is a wider need to bridge that digital divide to harmonise application of geospatial data and services around the world and ensure no-one is left behind when they need humanitarian assistance. There are several bridges to cross; not just to reach out to the formal institutions of governments in less developed countries and the special cases for microstates, often small island developing states and landlocked countries, but also the digital divide between private sector, international or government agencies and communities and civil society organisations and those living in rural environments as well as those in informal urban settings. This is not necessarily a blocker to technological application, as some new technology is unlocking the potential to democratise geospatial usage, provide platforms, data and services, including the spaces for individuals to create their own solutions and geographical narratives (the likes of Github, Web 2.0 applications, Open GeoSMS) to make accessible appropriate technology to those communities.

A major finding of this review has been to describe the interconnectedness needed to build effective resilient communities. This manifests itself in many ways. One is the need for partnerships - a sentiment which runs both through the Sendai Framework and the UN-IGIF. There also needs to be interoperability of systems - data, reporting mechanisms, transboundary harmonisation, knowledge sharing platforms and breaking down domain siloes so that DRR is mainstreamed across sustainable development, industry, environment, health systems and other areas. The danger is that to just highlight the need for wide partnership is easy, but care needs to be taken that busy disaster managers are not overwhelmed by constant cross checking. Too many webinars, communities of interest and portals can be as confusing as none at all. More focused connections across partnerships, knowledge sharing and domains, such as promoting trusted one-stop-shops for particular knowledge or data and having focused communities of practice that target their actions towards solving particular niches of geospatial /DRR focus, should be a priority.

There are multiple synergies that can be gained by coordinating the UN-IGIF strategic pathways around capacity and education and communication and engagement with similar aspirations within the Sendai Framework. More work is needed to ensure that the learning in both disciplines overlaps and synergises - that geospatial professional development is sensitive to the needs and conditions of disaster risk reduction activity, and that a geospatial component is embedded across any DRR capacity building programme. These need to be tailored for different audiences - for example, awareness raising and helping managers/decision makers to effectively use the outputs from geospatial data, maps and services as well as levels of technical training for in house geospatial capacity building. And as well as communicating better DRR and Geospatial literacy between both sectors, joint communication strategies to politicians, decision makers, DRR and humanitarian agencies, the environmental, marine, land management and other domains, and the wider public can express the relevance of investment in geospatial technology to real world risk management issues.

Ultimately, the DRR domain needs to trust the geospatial community to deliver timely, authoritative, detailed and accurate solutions. Thus, while the Sendai Framework and humanitarian actors have their own sets of standards, disaster managers assume the geospatial community are keeping their own and will not want to be involved in any technical detail. For example, a geodetic framework is not explicitly

stated as a requirement anywhere in the text of the Sendai Framework, but by demanding accurate risk and mapping information, it is essential geodetic frameworks are designed, implemented and maintained, and in themselves resilient when impacted by disaster. Communicating that the UN-IGIF is a comprehensive set of guidelines and good practice for geospatial information provision should be the primary messaging to the DRR community to build that trust.

Understanding the domain

The Sendai Framework and in particular the humanitarian codes of conduct have messages for the geospatial community, revealing that while the UN-IGIF has strong guidelines on the institutional and technological aspects of geospatial, and does mention its role in giving geospatial benefits for socially inclusive development, less is said about geospatial's position within wider societal and cultural aspects. In DRR in particular humanitarians sign up to codes of conduct which respect principles of neutrality, impartiality and above all the dignity of human beings, i.e. treating those adversely affected by disaster as individuals and not numbers. A key number of texts, in particular standards have been identified, which not only have considerations which the geospatial community need to take on board (e.g. the Core Humanitarian Standards and the IFRC principles of humanitarian action) but also where geospatial data and services could play a much bigger role (e.g. the implementation of SPHERE standards around issues such as temporary shelter occupancy, basic life sustaining requirement logistics, and feedback mechanisms). The UN Geospatial Network's paper on [Geospatial for Humanity](#) identified when the Covid Pandemic was at its height how UN agencies are applying geospatial for peacekeeping and humanitarian needs and since increasing the resilience of the most vulnerable in our communities is a primary focus for the Sendai Framework, reflection across UN-IGIF implementation and debate should ensure that human dignity and humanity should be front and centre of those discussions. However, there is scope for UN-GGIM to consider the impact UN-IGIF implementation has on particularly vulnerable individuals, households and communities particularly protecting them against further harm. Special attention needs to be made to provide geospatial data and services to displaced or informally settled people, especially in growing urban areas, often overlooked by formal national mapping and documentation schemes.

Future Trends

The delivery of the UN-IGIF has a strong generic composition which make it a long-lasting blueprint for national geospatial development. Even so, UN-GGIM has reflected since UN-IGIF's roll out on the rapidly evolving technological and socio-cultural impacts of geospatial. Similarly, since the Sendai Framework was ratified the evolution of thinking in the humanitarian and disaster management communities continues and to evolve just how resilience building can continue to be relevant to changing dynamics of disasters.

On the technological side, UN-GGIM's [Future trends in geospatial information management: the five to ten year vision](#) (August 2020) document identified many of the key evolutions occurring in geospatial information management, including the increasing levels of automation and rise of digital twins, and their everyday usage particularly through mobile devices and Web 2.0 applications. This has the potential to democratise geospatial technology - and for disaster management allow communities and individuals to create their own solutions and data sets that give them a voice and tell their own narratives.

The social impacts of changing geospatial science means that greater access to data and platforms could also be used adversely. The Sendai Framework does not tackle the proliferation of fake news around climate change, disaster management and humanitarian support and that when data are open, they can be interpreted and promoted by groups with many different viewpoints. Especially sensitive during conflicts and migration crises, but also open for misuse in sudden onset or climate crises (or of course in the Covid Pandemic) where the competition to obtain scarce aid can be overwhelming, the spreading of bad data or misrepresentation of geospatial outputs is a growing concern, made more pressing by technological advances in AI and big data usage. UN-GGIM has a role to play in helping DRR actors to

manage through authoritative data sources, triangulation, verification techniques, legal and policy instruments,

Even in the nine short years since the Sendai agreement was ratified, several modifications to the disaster risk reduction landscape have happened. Following soon after the Sendai Framework the [Grand Bargain](#) was a commitment by large donors and agencies to put money and resources in the hands of those most affected by disasters, and out of that comes the localisation agenda and the need to implement the principle of subsidiarity where possible. The Sendai Framework focuses mainly on national and local government infrastructures with other stakeholders supporting, but while command and control systems are still strong for immediate emergency response, the localisation agenda is making resilience building action less rigid or hierarchical, instead structured as a more collaborative network. The geospatial community needs to recognise the greater role of non-governmental stakeholders as both providers and consumers of geospatial services.

Additionally the Sendai framework does not make explicit reference to Anticipatory Action (AA) as it has only matured as a concept since 2019, but the geospatial contribution in understanding risk, being able to predict the timing and extent of disaster events and conduct impact based forecasting, make AA an important new area for DRR/geospatial linkages. Research, knowledge and experience of the impacts of climate effects on environments, populations and infrastructure and increased frequency and intensity of hydrometeorological disasters are also influencing how disaster risk reduction can be achieved'

The conclusion to draw from all these evolving trends is that while UN-IGIF needs to have structure and regulation, and the application of its implementation to the DRR domain needs to reflect that structure, that framework needs to be built to be adaptable to absorbing new thinking, technology and other trends.

Recommendations

This paper is intended to open the discussion on how better and more focused connection of the provision of geospatial data and services to the disaster management domain could be achieved by speaking directly to the text of the Sendai Framework. As such, there is no recommended roadmap for action within this document. However, some opportunities have become apparent through conducting this review and the authors put forward the following suggestions for consideration by the Committee of Experts.

- **Monitor the application of geospatial in national and local DRR strategies and actions plans** - UN-GGIM should recommend that national governments monitoring the national and local disaster risk reduction strategies pay due attention to the potential, actuality and gaps to be filled around a firm geospatial strategy that complements the need for disaster management strategies. UN-GGIM could consider identifying the “minimum standards for geospatial maturity in disaster management support” ensuring linkage with UN-IGIF implementation and monitoring the extent of implementation of geospatial data and services across the range of disaster management and humanitarian stakeholders, the phases of disaster risk management, the sectors and themes covered by DRR and humanitarian policy, based around the priority actions set out in the Sendai Framework.
- **Get Geospatial into the next DRR framework** - The Sendai Framework is to be implemented by 2030. Disaster risk management will continue beyond then and it will be expected that a revised framework and strategy will be written to cover 2030-2045. The preliminary work for this will likely begin in the next couple of years. The geospatial community, through the UN-GGIM, should be advocating and communicating with the disaster management domain much more strongly to ensure that in the next iteration, logical arguments making clear the efficiencies and improvements to understanding risk and disaster risk management gained by using geospatial science will come through more explicitly in the text of the next framework.
- **Outreach to increase the geospatial literacy of the DRR community** - both the Sendai Framework and UN-IGIF recognise the benefits of partnerships; but both frameworks are inward looking in those partnerships and are not explicit how connections across the communities should be formulated and managed. UN-GGIM and the WG-GISD have a strong role to cross that

divide and integrate within each other's fora and platforms to understand how best to leverage geospatial technology within resilience building. A first step for this is to greatly increase the geospatial literacy of the DRR community, in some cases re-educating people about how modern geospatial solutions can support their work.

- **Embrace the geospatial community within the DRR sector** - The evolution of disaster management and humanitarian agencies means that many at local, national, regional and international scale, and governmental, private sector, academic and civil society, already have significant geospatial capacity and are best placed to guide both mapping agencies and the general geospatial world, and the disaster management community in particular, in how to articulate the benefits of adopting the technology, and the implications in investment, resource management and sustainability and UN-GGIM should reach out to their expertise more directly.
- **Understand how well geospatial data and services are meeting the needs of the disaster management domain.** - By reviewing the text of the Sendai Framework, the range of stakeholders at different scales have been identified, the phases of disaster management, the thematic sectors of support, and in particular the priorities for action across the four pillars. This document has identified mainly potential areas for consideration. An assessment of the degree to which geospatial data and services are covering these dimensions of support to the disaster management domain would serve as a useful understanding of where gaps and opportunities exist for application of innovation and technology, more strategic implementation of UN-IGIF actions. The supposition is that solutions are too often technology driven and a lack of investment has been given to some of the more complex disaster management challenges where geospatial could make a real difference, or is ignoring stakeholders who could build substantial resilience from low cost, low technology solutions.

Conclusions

The work done for this report has repercussions across the UN-GGIM thematic areas. While UN-IGIF focuses on good practice for geospatial policy and organisation internally, leveraging the benefits and return on investment of geospatial depends on a deeper understanding of the visions, priorities, actions and challenges of the domains geospatial should be serving, and disaster risk reduction, like sustainable development, climate change, environment and land rights are essential global issues with which UN-GGIM need to continue to grapple.

The review does demonstrate that the priorities laid down in the SF-GISD are robust and identify good guidance for the geospatial community when implementing UN-IGIF to develop action plans that speak to the disaster management domain. Indeed, the five priorities of 1. governance and policies, 2. awareness raising and capacity building, 3. data management and in particular mapping and analytical solutions, 4. common infrastructure and 5. resource mobilisation chimes well with the priorities of the Sendai Framework. However, this review makes stronger and more specific links to the actions of that domain, using their language and framework to provide arguments and evidence for geospatial practitioners when needing to advocate, engage and work with disaster management clients in building robust solutions. The review has also shown that issues both in the disaster management domain and geospatial world are evolving very fast and the adaptation of any guidelines needs to be flexible to these changing situations.

The multidimensional nature of applying risk management across all human action and to protect our environment is a daunting prospect. But this is where UN-IGIF is so ripe for application; since UN-IGIF integrates all spatial information across all domains in the earth already, geospatial for DRR should be a natural application of that framework, both to curate the necessary information required and create cross disciplinary analysis to inform decision makers, communities and business.

Above all the study has identified that for effective application of geospatial data and services for disaster risk management, a greater degree of understanding of each other's disciplines is needed. A greater geographical literacy by disaster management practitioners and a deeper understanding of the breadth,

depth and connectivity of the priority actions within the Sendai Framework by the geospatial community is essential. This will deliver authoritative standards, legislation, governance and data and be the bedrock for much more technical innovation, capacity building and communication across the globe so that resilient communities, not just for climate impacted hydrometeorological risks but seismological, technical and complex emergencies can reduce their vulnerability and ensure equitable sustainable development is achievable. It is hoped this document strengthens the geospatial community's understanding of disaster risk reduction and UN-GGIM and the working group on geospatial data and services for disaster can fine tune its work programme to deliver on these aims.