

2020-2022 GEO Work Programme
Global Flood Risk Monitoring Community Activity
Implementation Plan

1. Executive Summary

The Group on Earth Observations (GEO) Global Flood Risk Monitoring (GFRM) - Community Activity (CA) integrates information from multiple Earth observation systems to derive and deliver environmental intelligence characterizing intensive flood risk for the benefit of decision makers [UNISDR- UNGA 2017, NIST/SDR 2019]. This includes the coordination and analysis of timely, reliable and suitable observations with earth system modeling and geospatial data management. To be more resilient to flood perils, GFRM enhances the ability to prepare for the anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions.

Elements of the GFRM-CA implementation include

- A Community of Practice (CoP) able to collect, process, and analyze changes due to complex and rapid flood stresses. Through early and ongoing stakeholder engagement, the CA will assess impacts and apply knowledge to fill gaps with trusted data to yield scientifically-defensible guidance supporting timely, reliable and suitable decisions.
- Pilot projects to increase access of diverse data sets, models and visualization products while testing the ability to provide efficient and actionable information.
- Demonstration projects to extend global reach of applications to ensure consistent intelligence products for risk-sensitive assessments and planning.
- Integration projects to bring together tool sets and capacity building to develop and maintain resilience and risk reduction efforts.
- End-to-end integration of research and application within an earth system framework to prevent new, reduce existing, and manage residual flood risk through increased analysis of exposure, vulnerability and coping capacity.

As a CA, the GFRM is an inherently collaborative and transdisciplinary capability, which creates key partnerships and maintains engagement among diverse stakeholders and actors. Contributors promote shared access and use of open data for research, development and operations. Routine and timely coordination and cooperation through projects, workshops and capacity development drives the pace of innovation, improves modeling and mapping skills, spreads learning and advances readiness of research results for application. This in turn builds trust and modifies local behavior through greater certainty, learning, and awareness of flood perils and security measures.

To realize these goals, the GFRM CA initiates a formalized CoP, creating a space where new and existing data/product providers and consumers, researchers and operators, and other stakeholders can work together. This CoP incentivizes partnerships to demonstrate the viability of flood risk monitoring on a global level informed by Earth observations in concert with meteorological and hydrological modeling, creating new connections that increase the use of flood risk information in decision-making. The CA Steering Committee requests the support of the GEO Secretariat to leverage the GEO network, and initially identify GEO Country Principals and subsequently more appropriate contacts in this specific flood risk areas of interest.

2. Purpose

GEO for GFRM-CA provides an organizational means for the comprehensive integration of Earth observation systems to assist national societal interests and commitments associated with flood risk and resilience. This includes enabling scientifically-defensible practices and reporting of nations implementing the Sendai Framework for Disaster Risk Reduction, the United Nations Sustainable Development Goals and the Paris Agreement on Climate Change.

The community approach includes attention to uptake of results and mainstreaming new practices through a distributed network of knowledge brokers and actors at the GEO regional and national scales. The stakeholders and users include sectors impacted such as water/energy/food system security, resource and emergency management, reinsurance and finance, as well as humanitarian assistance and disaster relief. Indicators of progress include maintaining and improving efficiency in the use of catastrophe models and resilience maps, shared services for effective stress testing and planning, and increased capacity for flood management incorporating Earth observations, as well as measureable advances in social and economic development.

The GFRM-CA provides a means to not only promote and organize data access, but also to fill gaps in understanding by combining a variety of data sources, assessing trends in science and technology, and the infusion of new capabilities. Integrated observations necessitates the inclusion of relevant measurements from networks of satellite, airborne, in situ and socio-economic surveillance systems. Pilot projects can address the integration of specific ground truth data for benchmarking, crowd sourcing and citizen science for validation. Implementation work of the GFRM-CA maintains agility through projects that accommodate frontier IT and communication solutions for scalable geospatial analysis and dissemination of catastrophe and resilience modelling and mapping results. Implementation plans include nascent capabilities in big data management and assimilation; numerical modeling (including hydrological models driven by growing deterministic and ensemble global meteorological modeling); artificial intelligence and automation, and visualization technologies to support large-scale and regional risk predictions and mobile and accessible applications for decision-making [UNISDR GRAF, 2018].

The GFRM-CA delivers a multi-hazard earth system approach consistent with the Sendai Framework and GEO, relevant to risks from coastal, river, and flash flood type events and includes cascading changes such as landslides and erosion. Parameters of interest include greater characterization of flood depth and extent, capturing the spread of floods across river networks, the occurrence of flash floods, and the longer historic trends before events and projections of future scenarios. The transition from hazard to systemic risk necessitates understanding and describing the vulnerability and exposure of populations, economies and infrastructure. Specifically, the GFRM-CA includes extent of *past* events as a period of record and changes in severity of flood risk over time with other changes including climate and social dynamics.

3. Background and Previous Achievements

There are many programs, projects and activities as well as research and operational practitioners engaged in aspects of flood observation, but not necessarily monitoring the risk. The applications include routine and event monitoring by public and private sector organizations on a wide range of geographical and temporal scales. Similarly, GEO has been a valuable mechanism to identify sector-specific observing needs and promote flood hazard partnerships for increased access and use of existing

data and motivate collaborative efforts to design, build deploy or advance networks of observations, sensors and platforms to fill observational gaps. To a limited extent, there has not been a consensus on the attributes of observation to better define and act specifically on flood risk by a community monitoring variables associated with vulnerability, exposure and coping capacity. The work plan and achievements to date have targeted resources toward community building and an initial set of multiyear application projects:

Community Building and Engagement:

- *2018 International Flood Risk Workshop, Boulder Colorado 1-3 October, 2018*
 - Activity scoping the community activity goals and documenting solutions:
 - A representative community assembled from flood and stakeholder communities as well as associated GEO communities and participating organizations.
 - A report, concept note and whitepaper were prepared that examine the GFRM issues and solutions in depth, and present findings toward initial community tasks to monitor and estimate flood risk on both short and climate time scales.
 - Targeted engagements included professional societies, re-insurance, hydro-meteorological, geoscience, food system and banking sectors.

Founding projects:

The GFRM-CA, directly supported by NASA Research Opportunities in Earth and Space Science (ROSES) grants, address various aspects of global flood risk, and were included in the 2017-2019 GEO Work Programme. The 2018 and 2019 activities include targeted opportunities and ad hoc instances to invite and organize community contributions of data and data products, geospatial analytics, and services in support of real world flood events or related long-term studies. In some instances these were significant large-scale or extended regional events related to tropical storms or seasonal variability.

Ongoing efforts in 2019 include expanding the community contributions to build a sustainable data sharing architecture and knowledge platform to transform actionable information. The Committee on Earth Observation Satellites and the Coordination Group for Meteorological Satellites are the primary satellite contributors to the GFRM. Public, private and civil society groups are also playing an active role.

Current Projects:

- *Towards a Global Flood and Flash Flood Early Warning Early Action System driven by NASA Earth Observations and Hydrologic Models*
 - Activity: Pilot project to enhance analysis and decision making of localized flash floods with globally consistent user methodologies and open data sets, including development of a historical flash flood dataset, an inter-comparison of forecasts, and a prototype early warning framework. Demonstration of forecast-based financing mechanisms in target GEO countries.
 - Collaborators/contributions: Columbia University/International Research Institute for Climate; Red Cross Climate Center (Netherlands); University of Chicago; NASA Goddard Space Flight Center; NOAA National Weather Service/National Water Center; University of Oklahoma; University of Chicago;
 - Users and stakeholders: Concern World/Humanitarian; Red Cross Climate Center; International Federation of Red Cross Red Crescent; Peru Red Cross; Bangladesh Red Cross; European Centre For Medium Range Weatherforecast/GLoFas : UN World Food Programme;
- *Global Rapid Flood Mapping System with Space borne Synthetic Aperture Radar (SAR) Data*

- Activity: Pilot and demonstration project to streamline a SAR-based end-to-end automated flood response process, making available flood extent mapping products to select users. The demonstration outcome is an optimal SAR framework for future near real time flood responses to augment modeling methods and flood risk analysis in 10 GEO member countries.
 - Collaborators/contributions: NASA Jet Propulsion Laboratory/SAR Damage Proxy and Flood Extent Maps; NASA Goddard Space Flight Center/Global Precipitation and Global Landslide maps University of Maryland/GFMS; NOAA/National Geodetic Survey; NOAA National Water Center; US Federal Emergency Management Agency; US Geologic Survey/Hydrology models/
 - Users and stakeholders include: The World Bank/International Bank for Reconstruction and Development ; Spanish Red Cross/Disaster Management; Ecuador Escuela Superior Politécnica del Litoral; South Korea Ewha Womans University; Singapore Nanyang Technological University; S Korea Water Resources Corp.; Japan ICHARM-UNESCO; Netherlands Red Cross;
- *Integrating Global Remote Sensing and Modeling Systems for Local Flood Prediction and Impact Assessment*
 - Activity: Integration project linking globally scoped flood prediction, monitoring and impact-assessment capabilities including risk evaluations and automating data dissemination.
 - Collaborators/contributions include: University of Colorado/Dartmouth Flood Observatory River Watch; University of Maryland/Global Flood Monitoring System; Remote Sensing Solutions/Modeling and mapping; NASA Goddard Space Flight Center /automated MODIS flood product; SAR-based flood mapping; Luxembourg Institute of Science and Technology/modeling and mapping; Global Flood Partnership a GEO Participating Organization and its international members/cooperation framework for flood prediction and mapping.
 - Users and stakeholders include: the World Food Program, the World Bank, the International Red Cross/Red Crescent, the European Commission’s Global Disaster Alert and Coordination System, the GeoSUR project (for Latin America).

The CA will continue to support and manage outreach efforts to expand participation in the CoP, welcoming additional pilot, demonstration and integration projects.

4. Key Activities

The GFRM Community Activity will work to ensure all associated projects and outreach efforts support the Sendai Framework and the associated Seven Global Targets through the following broad applications for disaster-related Earth observations data:

- As countries move towards the implementation of their national and local strategies for disaster risk reduction, EO can be used to map past events in the historical record, their changes over time, and immediate risk associated with future floods that lengthen the period of record. In collaboration with team members, GFRM efforts will identify the most pressing priorities (Priority Area 1: Understanding Disaster Risk).
- Earth observations can assist countries and the international community in monitoring national implementation of the Sendai Framework, of the SDGs, and of the Paris Agreement in a coherent manner, and for taking corrective action where implementation is lagging. EO data can help fill gaps in the frequency of recurrence, extent, and extremes of precipitation and flood events where information is absent.
- UNISDR is building a Global Risk Assessment Framework to provide to decision makers at all levels a tool for understanding risk and to make risk-informed decisions – Earth observation data is an

integral aspect of this effort, along with standards to improve sharing of information and appropriate training to ensure correct interpretations and adoption.

More specifically, there is an identified need to understand availability and interoperability of data and tools to mitigate flood risk. Addressing this need will facilitate a global methodological comparison between various Earth-observing data sets, models, and maps while ensuring a focus on local flood risk. This widespread need will guide specific GFRM Community Activity objectives:

- Work with GEO Principles to identify national and local strategies for flood risk reduction, and identify complementary indicators for applying Earth observation data, products and tools.
- Identify which flood risk indicators and priorities the GEO Work Plan is actively contributing to, and which gaps remain, identifying solutions when able.
- Promote interoperability of flood risk products through well-established standards (Example, Open Geospatial Consortium), appropriate training, and acquire feedback from end users to adopt improvements and encourage broader usage
- Communication of methods and models to encourage transparency and accelerate scientific advances of the community by building upon existing knowledge.
- Uncertainty estimation for flood risk mapping and modeling products to better ensure informed decisions by flood risk management.
- Pursue opportunities for early prediction and characterization of flood inundation in near real time through incorporation of meteorological and hydrological models.
- Support developing nations' efforts to directly identify hazardous land areas.
- Broaden the network of practitioners and data providers, to improve the ability of end users to give feedback to providers.

5. Relationship to GEO Engagement Priorities and to other Work Programme Activities

Through the societal benefit areas of GEO, this Activity seeks to support established efforts to explore opportunities in the use of Earth observations systems for the benefit of humankind, in alignment with the Sendai Framework. With this in mind, the Activity will address the need for credible data and derived products that correctly assess flood risk, and support the ability to make risk-informed decisions. Earth-observing systems have enormous potential to put risk into a systems context and assist the global community in making a strong case for disaster risk reduction.

In addition, correlations to the other global mandate policies that guide GEO including the 2030 Agenda for Sustainable Development Goals (SDGs), the Paris Climate Agreement and the New Urban Agenda will be identified where applicable and exploited. This Community Activity will welcome and encourage all flood risk-related efforts that apply, test, demonstrate and enable sustained uses of Earth observation derived data and integrated data on flood risk and impacts to population and human settlements to support one or more of the SDGs and the associated Targets and Indicators. Particular effort will be directed towards engaging and integrating GFRM activities, projects and derived flood risk data products with national statistical offices, line ministries, or other appropriate entities in the respective countries where flood risk work is focused. The primary objectives should be to enable sustained use of these data in measuring and reporting on the SDGs, tracking progress, supporting risk informed planning efforts and informing policy and management decisions that contribute towards achieving SDGs associated with flood risk.

2017-2019 GEO Work Programme Elements Relevant to GFRM

- **AmeriGEO**
The GFRM Community Activity will continue to foster a close partnership with AmeriGEO. Partnership efforts will include data integration solutions and common data product standards, with the end goal of community activity project teams producing flood risk data which may automatically integrate with the AmeriGEOSS Data Hub. End user identification and outreach in the Americas will also be an objective of this partnership. Similar partnerships with the additional Regional GEOs will also be encouraged when able, supported by GEO Secretariat outreach efforts.
- **Global Flood Awareness System (GloFAS) Community Activity**
Partnership opportunities will be explored with GloFAS, in regards to integrating risk elements into ongoing global flood awareness efforts.
- **Data Access for Risk Management (GEO-DARMA) Initiative**
GFRM intends to support and integrate with ongoing GEO-DARMA activities and successes, adding global flood risk data and products where appropriate.

In addition to GEO Work Programme relationships, the GFRM community activity will work closely with the Committee on Earth Observing Satellites (CEOS) Working Group on Disasters (WGDisasters). The overarching goal of the WG Disasters is to increase and strengthen the contributions of satellite Earth observations to the various disaster risk management phases, and to inform politicians, decision-makers, and major stakeholders of the benefits of using satellite Earth observations in each of those phases. WGDisasters recently initiated a review activity with a view to taking stock of what has been achieved in recent pilots and demonstrators and reviewing the long-term strategy of the WG towards achieving the goal described above. This GEO GFRM will actively engage with WGDisasters to accomplish shared goals and objectives related to global flood risk.

The United Nations Economic and Social Council (ECOSOC) adopted draft resolution E/2018/L.15, Strategic Framework on Geospatial Information and Services for Disasters on 2 July 2018. Likewise, the GFRM Community Activity will be committed to the implementation of the priorities for action outlined in this resolution (governance and policies, awareness-raising and capacity-building, data management, common infrastructure and services and resource mobilization). Geospatial information and services contribute vastly to the overarching effort of preventing or reducing the social, economic and environmental impacts of disasters. Therefore, the GFRM Community activity will adopt international best practices whenever possible that support the Sendai Framework and will augment existing capacities in using geospatial information and services across all phases of disaster risk management related to flood risk.

6. Governance

Community Activity Lead: David Green

Community Activity Steering Committee: David Green, David Borges, Tim Stough, John Murray, Shanna McClain

Community Activity Advisory Committee: Steering Committee, Andrew Kruczkiewicz, Robert Brakenridge, Sang-Ho Yun, Albert Kettner, Guy Schumann, and Beth Tellman

Community Activity Current Roster: See attached GRM Participants Table

The Community Activity Steering Committee, led by David Green, will lead regularly scheduled meetings and manage general participation in the Community Activity. The Steering Committee will also lead integration efforts associated with Community of Practice development efforts. Interaction with the GEO Secretariat and subsequent outreach to GEO Country Principles and relevant flood risk end users will be the responsibility of the Steering Committee.

The Community Activity Advisory Committee will be made up of the Steering Committee as well as relevant Community Activity Project leads. The Advisory Committee will lead the scientific and technical efforts required to achieve the objectives laid out previously in this document. These efforts will include developing next generation flood risk data and products, working collaboratively between the activity partners to adopt common data standards, means of communicating uncertainty, and training, while interacting with target end users, identified by the Steering Committee.

7. Data Policy

The GFRM Community Activity will promote the discovery, open access and usability of flood risk data, tools, services and resources for analysis, understanding and decision making. Recognizing that the societal benefits arising from Earth observations can only be fully achieved through the sharing of data, information, knowledge, products and services. GEO has therefore promoted fundamental principles for data sharing, expanding the trend towards open data worldwide. The GFRM Community Activity and associated Community of Practice will follow established GEO data sharing principles.

- Data, metadata and products will be shared as Open Data by default.
- Where international instruments, national policies or legislation preclude the sharing of data as Open Data, data should be made available with minimal restrictions on use.
- All shared data, products and metadata will be made available with minimum time delay.

GFRM will also promote the advancement of technology solutions that will accelerate the ability of a wide spectrum of end users to discover, view and download flood risk datasets in a variety of common, international formats including KML, shapefile, OGC WMS, OGC WFS, GeoJSON and via GeoServices API. Progress towards these goals will ensure flood risk datasets are exposed in a wide variety of formats, and in line with GEO data management principles.

- Ensuring data are properly managed (including data citation), accessible, archived and long term preserved (when appropriate);
- Ensuring data are properly documented (metadata), quality controlled and quality assessed, delivered, and updated in ways to facilitate access and re-use of information made available through the GEOSS Common Infrastructure (GCI);
- Facilitating the link between user needs and data availability, especially with regard to the needs of users from developing countries (e.g. by identifying existing sources of requirements already approved by the relevant user community);
- Facilitating interoperability of GEOSS data resources by promoting a progressive harmonization/standardization of content (data models, thesauri, coding list) and dissemination and usage rights in order to facilitate their re-use at global or regional scales.

Tables

- A. Individual Participants [See Excel Spreadsheet]
- B. Confirmed Contributions [See Excel Spreadsheet]

C. Annexes

I. Leadership

David S. Green, PhD

David is the NASA Earth Science Disasters Program Manager. David joined NASA after 11 years as a program manager and scientist at NOAA where he worked in eco-forecasting, health, energy and coastal hazards and served as the Tsunami Program Manager for nearly four years. Prior to joining NOAA, he was a Research Fellow at the National Institution of Science and Technology and worked in the private sector as well. David is a member of the American Meteorological Society (AMS) Board on Enterprise Planning and the Forecast Improvement Group, and serves on the American Geophysical Union (AGU) Natural Hazards Committee. David received his Ph.D. in Physical Chemistry from the University of Toronto and holds two masters degrees – one from the University of Pennsylvania in Chemical Physics and one from the University of Maryland in International Management – Science, Technology and Commerce. He received his bachelor's degree in Chemical Physics from the University of Toronto.

II. GFRM Terms of Reference

**2020-2022 GEO Work Programme
Global Flood Risk Monitoring Community Activity
Terms of Reference (ToR)**

Purpose

Through the societal benefit areas of the Group on Earth Observations (GEO), there is an established effort to explore opportunities in the use of Earth observations systems for the benefit of humankind, in alignment with the Sendai Framework for Disaster Risk Reduction 2015-2030. The Group on Earth Observations (GEO) Global Flood Risk Monitoring (GFRM) Community Activity will support and integrate efforts that leverage Earth observations to improve the ability to assess flood risk on a global scale and translate risk information to impacts at the community, national and regional level by supporting risk-informed decision making.

Objectives

- To promote the use of Earth observations in the flood risk community, and advocate for improved decision making based on greater access to flood risk information.
- To identify, gather, and seek agreement on global flood risk needs, best practices, gaps and requirements.
- To promote the interoperability of flood risk products through the implementation of well-established standards.
- Communication of methods and models to encourage transparency and ultimately accelerate scientific advances of the community by building upon knowledge.
- Provide a forum for cooperation of activities which add value to existing global flood risk initiatives, to identify linkages and opportunities for collaborative strategic and technical projects and to coordinate the delivery of global flood risk data, products and information to end users to enable the realization of GEO societal benefits.

Membership

This Community Activity will include representatives from GEO member states, participating international organizations and any other stakeholders/organizations that have similar interests, goals, and or objectives, working closely together to create a forum for efficient and effective communication of flood risk data, products and information.

Governance

This Community Activity will be led by Steering Committee. The Steering Committee will lead regular meetings where activities will be coordinated towards the realization of the stated Objectives. The Steering Committee will work with the GEO Secretariat to promote the integration of data providers and data consumers in the thematic flood risk arena, and actively work grow the community where needed and integrate with existing flood risk efforts when able.