

# Advocacy and Accomplishments in support of GNSS Enhanced Tsunami Early Warning Systems



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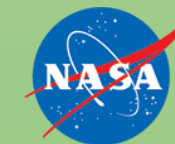
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Report to the United Nations International Committee on GNSS

December 2019 – Bangalore, India



**Jet Propulsion Laboratory**  
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# How do International Geodesy Organizations contribute to United Nations Initiatives?



IUGG



Global Geodetic  
Observing System



IGS



UN-GGIM

UNITED NATIONS  
COMMITTEE OF EXPERTS ON  
GLOBAL GEOSPATIAL  
INFORMATION MANAGEMENT



International Union of Geodesy and Geophysics (IUGG)\*

International Association of Geodesy (IAG)\*

Global Geodetic Observing System (GGOS)

+ International GNSS Service

# Global Geodetic Observing System Geohazards

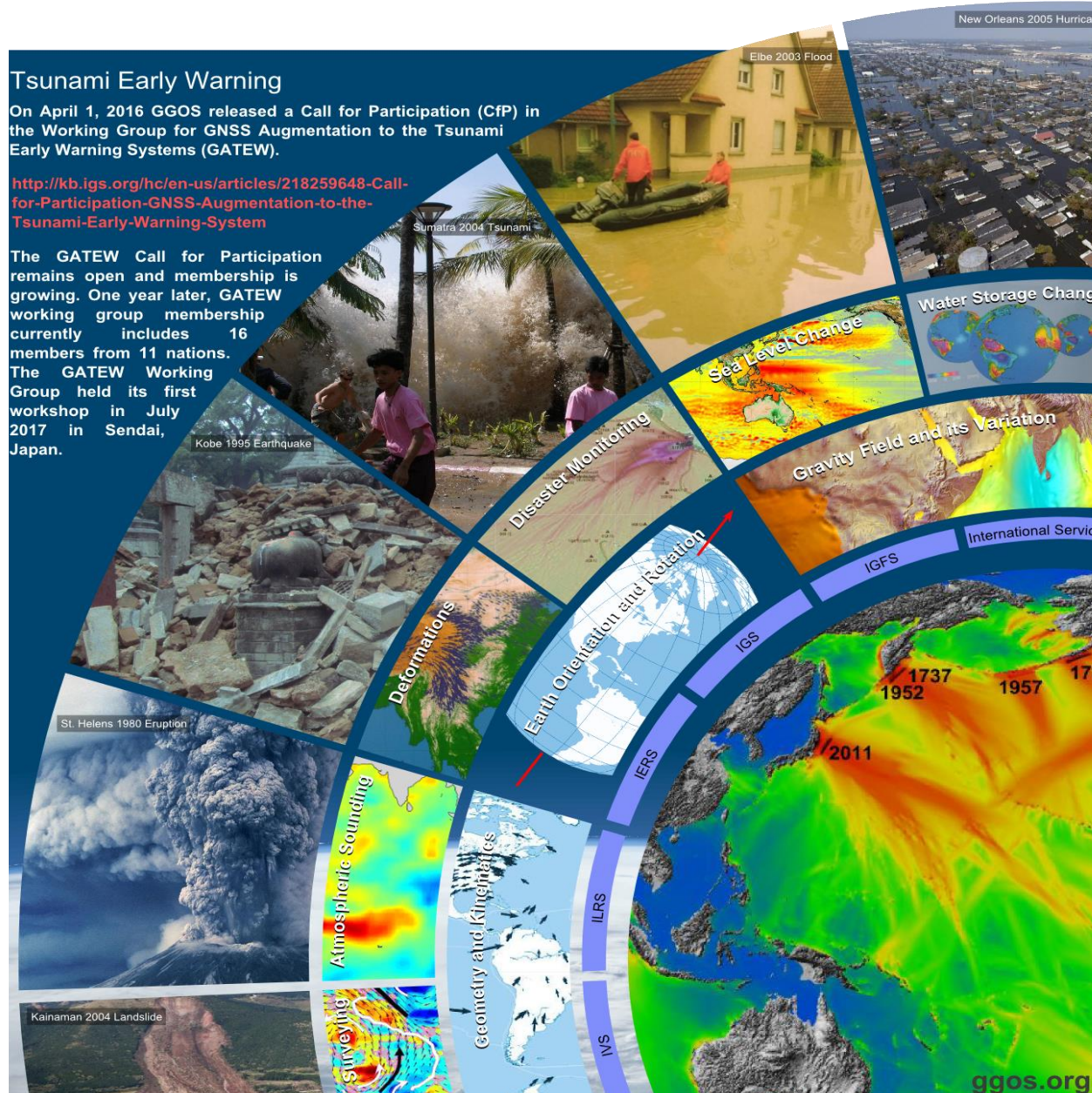
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## Tsunami Early Warning

On April 1, 2016 GGOS released a Call for Participation (CfP) in the Working Group for GNSS Augmentation to the Tsunami Early Warning Systems (GATEW).

<http://kb.igs.org/hc/en-us/articles/218259648-Call-for-Participation-GNSS-Augmentation-to-the-Tsunami-Early-Warning-System>

The GATEW Call for Participation remains open and membership is growing. One year later, GATEW working group membership currently includes 16 members from 11 nations. The GATEW Working Group held its first workshop in July 2017 in Sendai, Japan.



***On April 1, 2016, the GGOS released the GATEW Call for Participation (CfP) in support of the IUGG- 2015 ([https://www.dropbox.com/s/yb9zqyz46loa769/GGOS\\_GATEW%20Call%20for%20Participation.pdf?dl=0](https://www.dropbox.com/s/yb9zqyz46loa769/GGOS_GATEW%20Call%20for%20Participation.pdf?dl=0) ).***

***The GATEW CfP called upon the community of agencies and institutions to join the GATEW working group to support and promote GNSS Augmentation to Tsunami Early Warning system as recommended by IUGG 2015 Resolution 4. (<http://www.iugg.org/resolutions/IUGGResolutions2015.pdf> ).***

***The GATEW Working group now numbers 17 member agencies and institutions from 11 countries. The GATEW working group held its first meeting GTEWS 2017 in Sendai, Japan on July 25-27, 2017.***

# GGOS Geohazards: Status and Progress

- **The first meeting of the GATEW Working Group included other representatives from Indo-Pacific Region at GTEWS 2017 in Sendai, Japan- July 25-27, 2017.**
  - **42 Participants reviewed the status and made recommendations on the development of a GNSS enhanced Tsunami Early Warning System as recommended by Resolution #4 of the IUGG 2015 General Assembly.**
  - **The GTEWS 2017 was cosponsored by NASA, GGOS, APRU, and Tohoku University.**
  - **GATEW working group members contributed a majority of the GTEWS 2017 presentations.**
  - **The GTEWS 2017 program of video and power point presentations is available at:**  
<https://www.dropbox.com/s/s0c03xv34zfv7y4/2017%20GTEWS%20Program.pdf?dl=0>
  - **Report of the GTEWS 2017 meeting with findings and recommendations is being finalized for publication in Fall, 2018.**

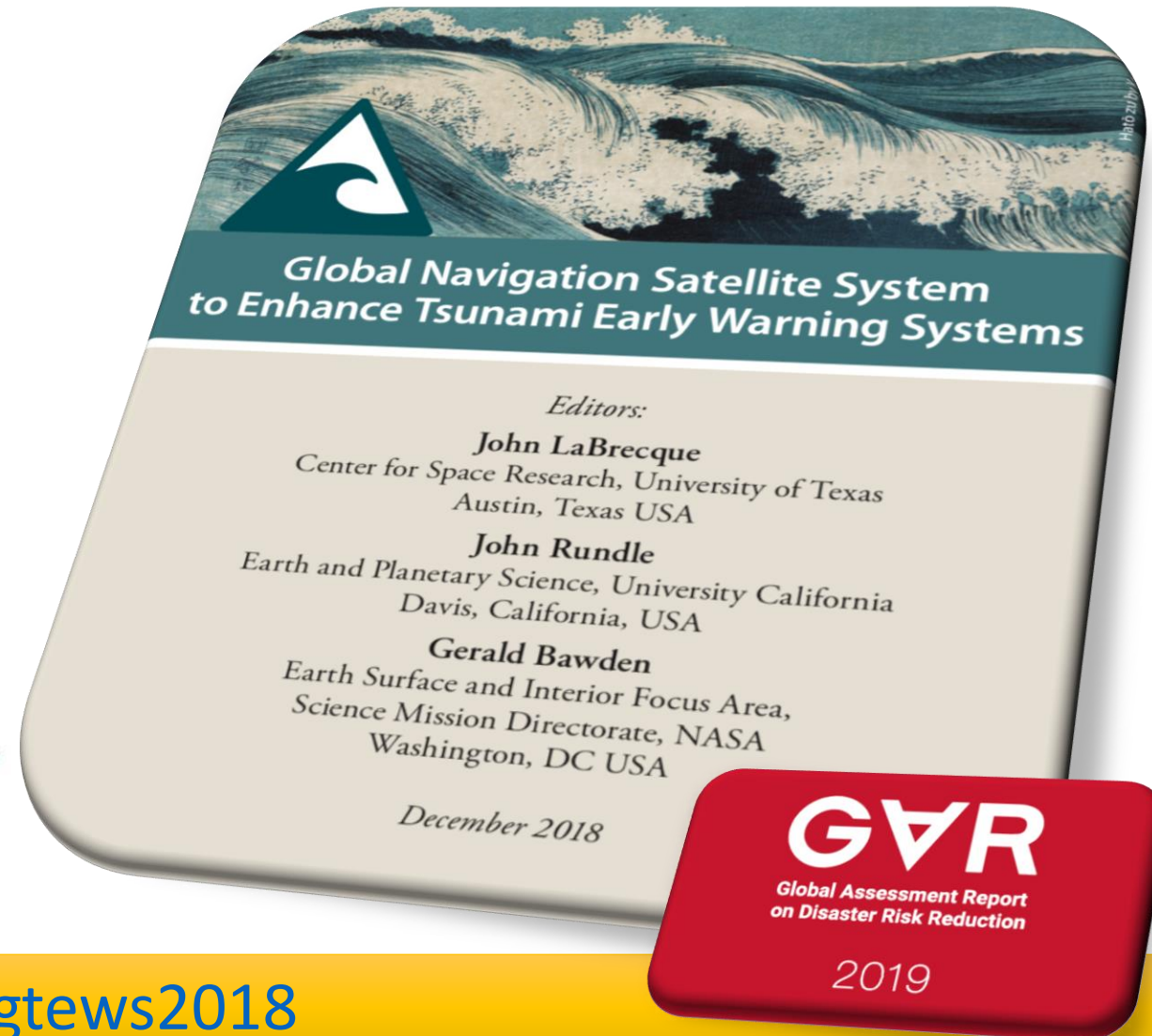
# GGOS Geohazards: Planned Actions and Milestones

- **The Geohazards Focus Area is working with the IUGG GeoRisk Commission and the AGU to develop a series of two inter-related workshops at the AGU 2018 and IUGG 2019 centennial meetings.**
  - **AGU 2018 Fall Meeting: December 10-14, 2018**
  - **IUGG 2019 General Assembly: Montreal, Canada July 8-17, 2019.**
  - **The workshops will focus on the implementation of Disaster Science challenges, strategies, and opportunities with presentations and panel discussions by scientists, engineers, policy experts, and funding institutions.**
  - **The GGOS FA and the IUGG GeoRisk Commission will also propose a special symposium on the implementation of the IUGG Resolution #4 on the fourth anniversary of Resolution #4.**

# Connecting Geodesy with United Nations Initiatives : GNSS Enhanced Tsunami Early Warning Systems

Geodetic observations have a clear role in helping to reduce the risk of disasters, as well as contribute to disaster preparedness with better mitigation and response.

GGOS-Geohazards Working Group contributed content for the 2019 UN Global Assessment Report on Disaster Risk Reduction (GAR19), which is a major UN report addressing disaster risk reduction that contributes to regional and global platforms for disaster risk reduction, as well as the high-level political forum on sustainable development



Download GTEWS report: <http://bit.ly/gtews2018>

*How do we support*  
***GNSS Enhanced Tsunami Early Warning Systems and  
other Geodetic Contributions to  
Disaster Risk Reduction + Resilience?***



***Geodesy for the Sendai Framework***  
**Community Activity**

- **Supporting geodetic development and capacity building for disaster risk reduction and resilience**
- **Identifies existing resources and stakeholder communities, and makes connections**
- **Identifies geodetic elements of targets and indicators of the Sendai Framework for Disaster Risk Reduction**
- **Provides opportunity for other GEO efforts to interact with geodesy community**
- **Integration with UN Sustainable Development Goals and UN-GGIM World Bank Integrated Geospatial Information Framework**

**... and more...**

# Supporting the UN Sendai Framework for Disaster Risk Reduction

Coordinating Earth Observations for Disasters

GEO supports implementation of Sendai Framework targets E,F and G through engagement with UNISDR.

**E:** Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;

**F:** *Substantially enhance international cooperation to developing countries* through adequate and sustainable support to complement their national actions for implementation of the present framework by 2030;

**G:** Substantially increase the **availability of and access to multi-hazard early warning systems** and disaster risk information and assessments to people by 2030.



# GVR

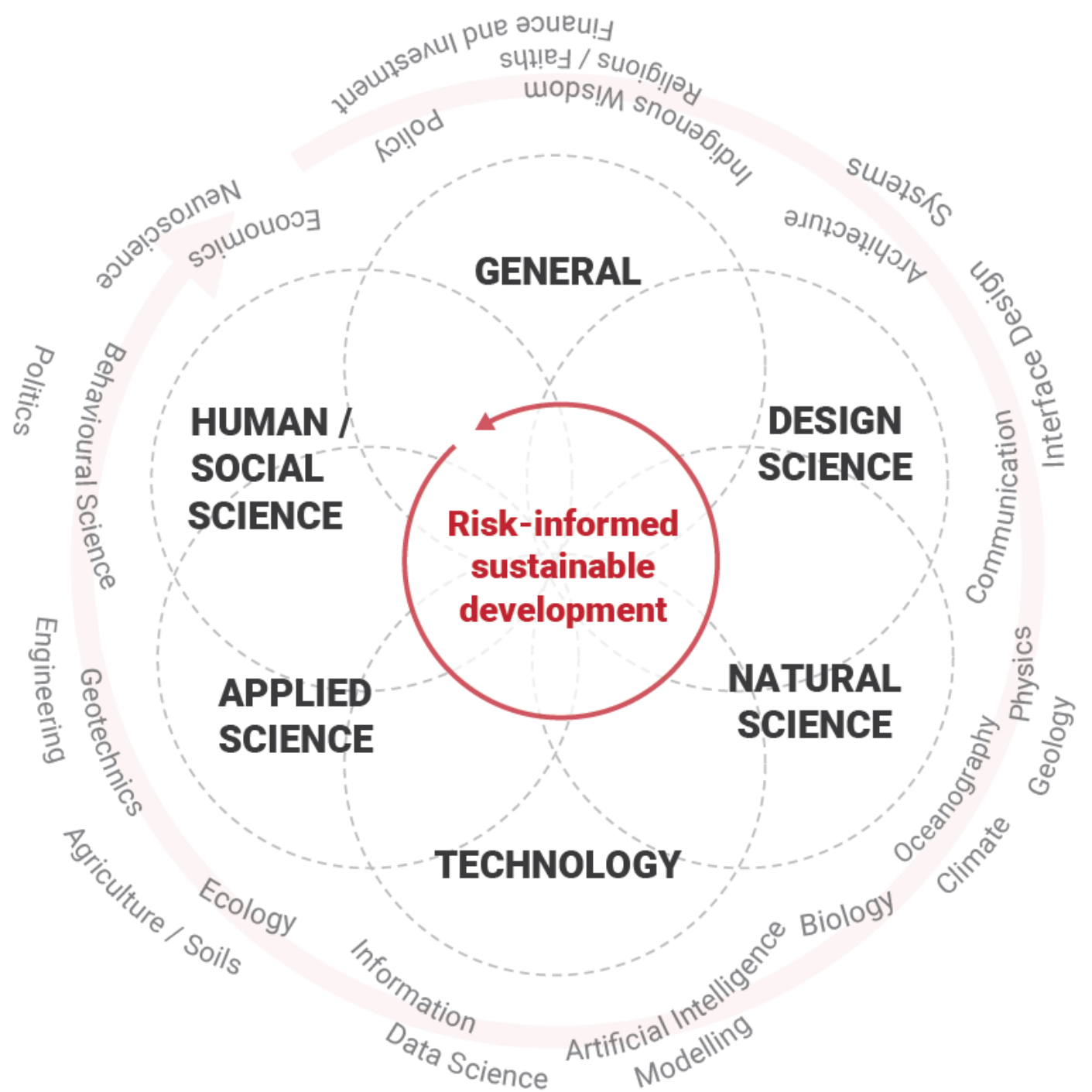
Global Assessment Report  
on Disaster Risk Reduction

2019

*The Global Assessment Report on DRR is a biennial snapshot contextualising progress in realising the global targets of the Sendai Framework, and contributes to the High Level Political Forum on Sustainable Development.*



United Nations



## 2.2.2

### Feedback loops of asynchronous operations of system components

An adverse event affecting the functioning of an individual system component can cause reverberations or ripples within the larger system and lead to a breakdown of related system components and potentially the complete system.

#### Box 2.4. Systems reverberations – global navigation satellite system

In supply chains and traffic systems, applications using global navigation satellite systems – notably the global positioning system (GPS) – have been expanding exponentially, delivering innovative and efficiency-enhancing capabilities, revolutionizing the operations across entire supply chains. Efficiency gains through just-in-time delivery systems have been

remarkable in the logistics sector and also in related sectors such as financial services (e.g. settlement systems), food systems and health (e.g. manufacturing).<sup>\*</sup> A failure in a GPS will cause deliveries to be delayed. Order and delivery jams could cause, through positive feedback loops, the simultaneous failure of many services that are likely otherwise assumed

to be independent of each other. It is entirely plausible that the malfunctioning of a relatively small service delivery system, originally designed to assure the synchronization of

business operations reaping efficiency gains, could cause large-scale breakdown of food and health systems at local or even national or global scale.

<sup>\*</sup> Beneficial efficiency gains must be measured against new risks posed; for example, the potential deleterious effect of just-in-time food delivery programmes on the resilience of communities.

## Global navigation satellite system enhancement for tsunami early warning systems

SOURCE(S): [UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION \(UNDRR\)](#)

The demonstrated early warning capability of Global Navigation Satellite Systems (GNSS) to accurately, rapidly, and cost effectively measure deformation of the Earth's surface and the response of the ionosphere to this deformation was the factual basis for the GNSS Tsunami Early Warning Systems Workshop (GTEWS) and this report. GTEWS 2017 was held in Sendai, Japan to review the principles of GNSS positioning, the geophysics of mega-thrust earthquakes, and GTEWS techniques in utilizing GNSS displacement and ionospheric imaging to advance global tsunami warning. This report explores the development history of GNSS Tsunami Early Warning Systems, their tsunami early warning technology and requirements, prototype networks, and the workshop findings and recommendations.

*This paper is a contribution to the 2019 edition of the Global Assessment Report on Disaster Risk Reduction (GAR 2019).*

### To cite this paper:

LaBrecque, J.; Rundle, J. et al. Global navigation satellite system enhancement for tsunami early warning systems. Contributing Paper to GAR 2019

***GGOS Contributing Paper to the GAR is available for viewing and download***



PUBLICATION DATE  
2019

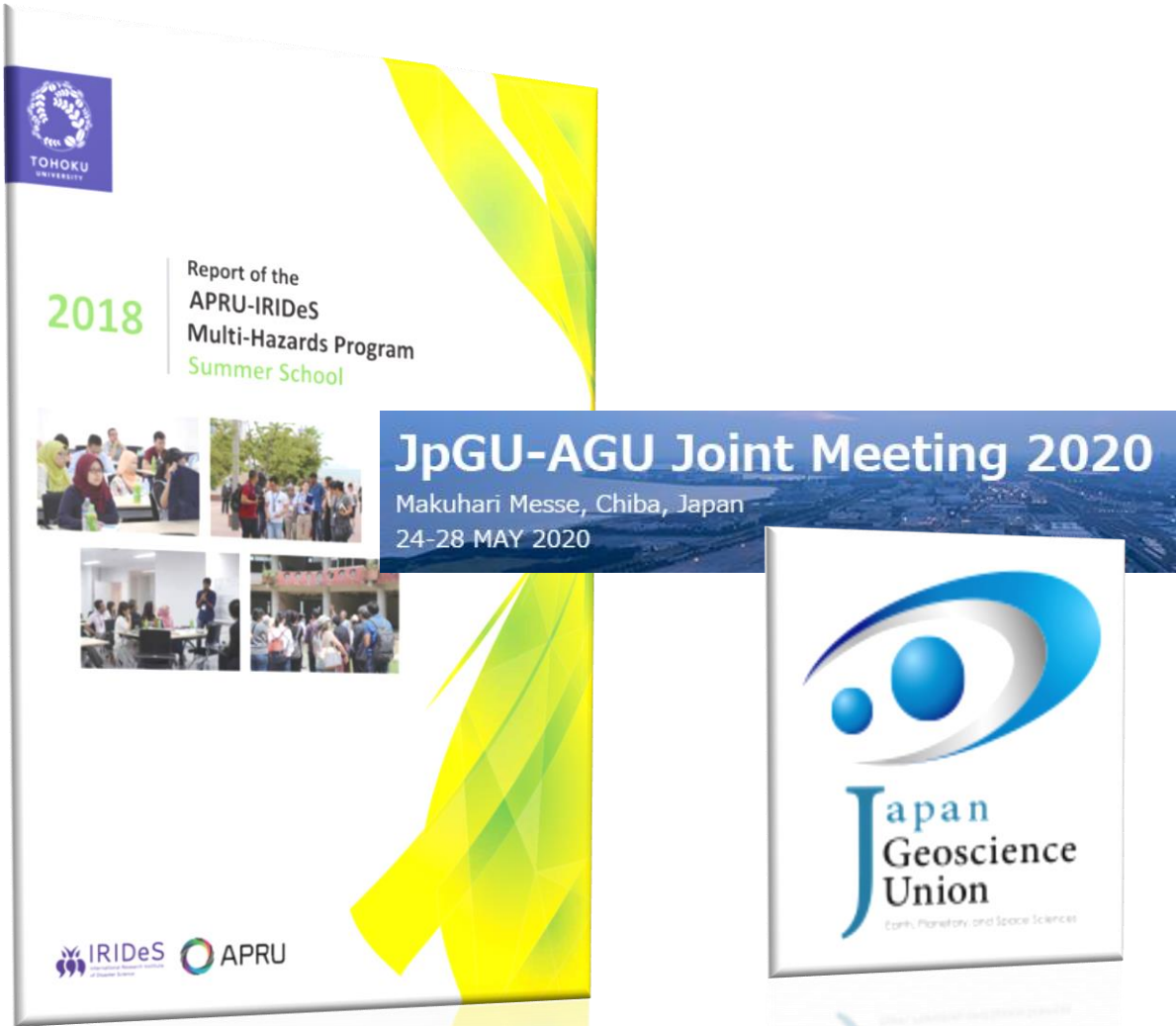
AUTHOR(S)  
LaBrecque, John; Rundle, John; Bawden, Gerald (eds.)

NUMBER OF PAGES  
37 p.

# 2017 Sendai Workshop Recommendations

1. The GGOS/IUGG, Association of Pacific Rim Universities (APRU) and the UN-GGIM are encouraged **coordinate efforts** to develop a GNSS Shield Consortium for the Indo-Pacific.
2. The GNSS Shield Consortium should work to **encourage software, data exchange, and continued improvement of network design and performance.**
3. **Strengthen broadband communication to underserved regions of the GNSS Shield.**
4. Work with national organizations including those mandated for natural hazards mitigation to develop **agreements for [openly sharing] GNSS receivers** within the GNSS Shield.
5. Design an optimal GNSS Shield network for both **crustal displacement and high resolution TEC monitoring.**
6. Understand the operational requirements of existing tsunami warning systems and determine the steps required to **interface with existing tsunami warning systems.**

# GTEWS/geodesy4sendai Workshop 2020



- Next GTEWS workshop, now organized as a project of the GEO Community Activity “geodesy4sendai” is in development, and scheduled to take place **June 1-5, 2020 in Sendai.**
- Organized to complement relevant sessions at JpGU-AGU 2020 (to be held one week before the workshop in Chiba, Japan)
- Followed by APRU-IRIDeS Multi-Hazards Summer School (held one week before and after the GTEWS Workshop at Tohoku University)

# ***geodesy4sendai Next Steps***

- **What does the Geodesy community need from this GEO Community Activity?**
- **What does the Disaster Risk Reduction + Resilience community need from geodesy?**
- **How can geodesists better engage with the broader Earth observation and disasters community?**
- **What resources already exist, and how can we better identify and discover them?**
- **Where are the gaps in our resources, communications, and capacities?**



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