WG-D and WG-B's Task Force on **Applications of GNSS for Disaster Risk Reduction**

Report to ICG-17

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Outline

- Scope Reminder
  - Context within ICG
  - GNSS Techniques and Natural Hazards
- Goals: Reminder and Completion
- Attendance and Membership
- Joining the DRR Task Force
- GNSS-Based Tools for DRR
- Suggested Recomendations

Scope Reminder - Context within ICG

This Task Force was created at ICG-16 in October 2022,
following **WG-D**'s Recommendation #26 and in tandem with **WG-B**.

Rationale: Apparent lack of international coordination on topics at the intersection of **GNSS applications** and **disaster risk reduction**.

Focus: GNSS-based **monitoring** and **remote sensing**, not transmission of alerts, not replacement of existing EWS.

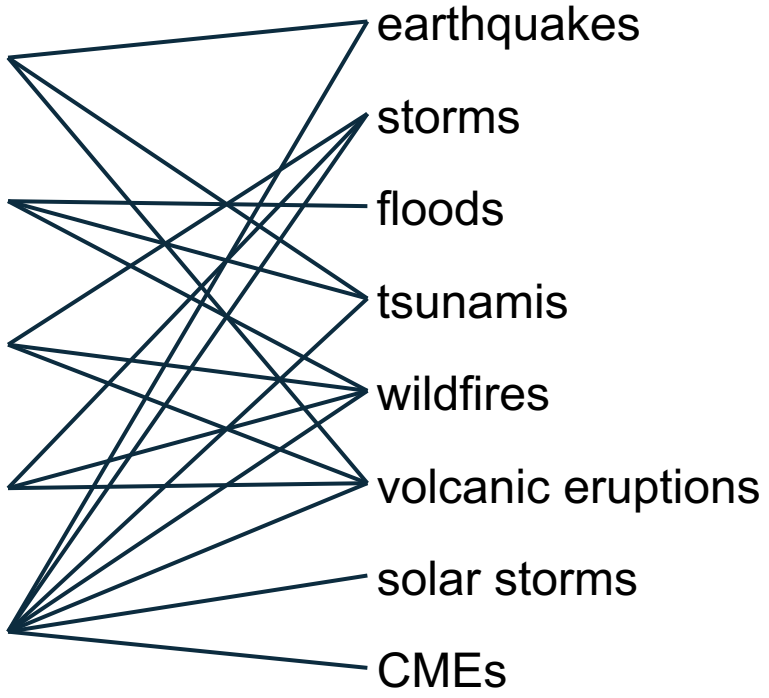
Task Force Co-Chairs:

IGS (Léo Martire, WG-D),
China (Jun Shen, WG-B),
Japan (Naofumi Takamatsu).

Scope Reminder - GNSS Techniques *vs.* Hazards

GNSS-based techniques enable the (remote) sensing of the whole surface-atmosphere system.
Objective: use GNSS to **augment early warning systems** for natural hazards.

technique	probing region	relevant to
GNSS Precise Point Positioning (GNSS-PPP)	ground displacements (3D position of the receiver)	
GNSS Reflectometry (GNSS-R)	surface conditions (*e.g.*, soil moisture, ice thickness)	
GNSS Radio Occultation (GNSS-RO)	surface to mid-stratosphere (40 km) (temperature + moisture)	
GNSS Polarimetric RO (GNSS-PRO)	surface to mid-stratosphere (40 km) (temperature + moisture + heavy precipitation)	
GNSS Ground-Based Ionospheric TEC (GNSS-TEC)	ionosphere (100-1500 km) (Total Electron Content - TEC)	



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Goals: Reminder and Completion

1. Assemble a *diverse group of members* representative of the GNSS community.

Diversity: **19 countries** represented by at least 1 member (12 USA, 8 China, 5 Japan, 4 Fiji).

Natural hazards: **at least 2 experts** on each type.

GNSS expertise: PPP, TEC, administration, and source determination are well-represented; other fields of expertise are still slightly lacking.

2. Discuss *recommendations* for the next steps in using GNSS for natural hazards; present those at the yearly meeting of the International Committee on GNSS (ICG).

⇒ Today's discussion.

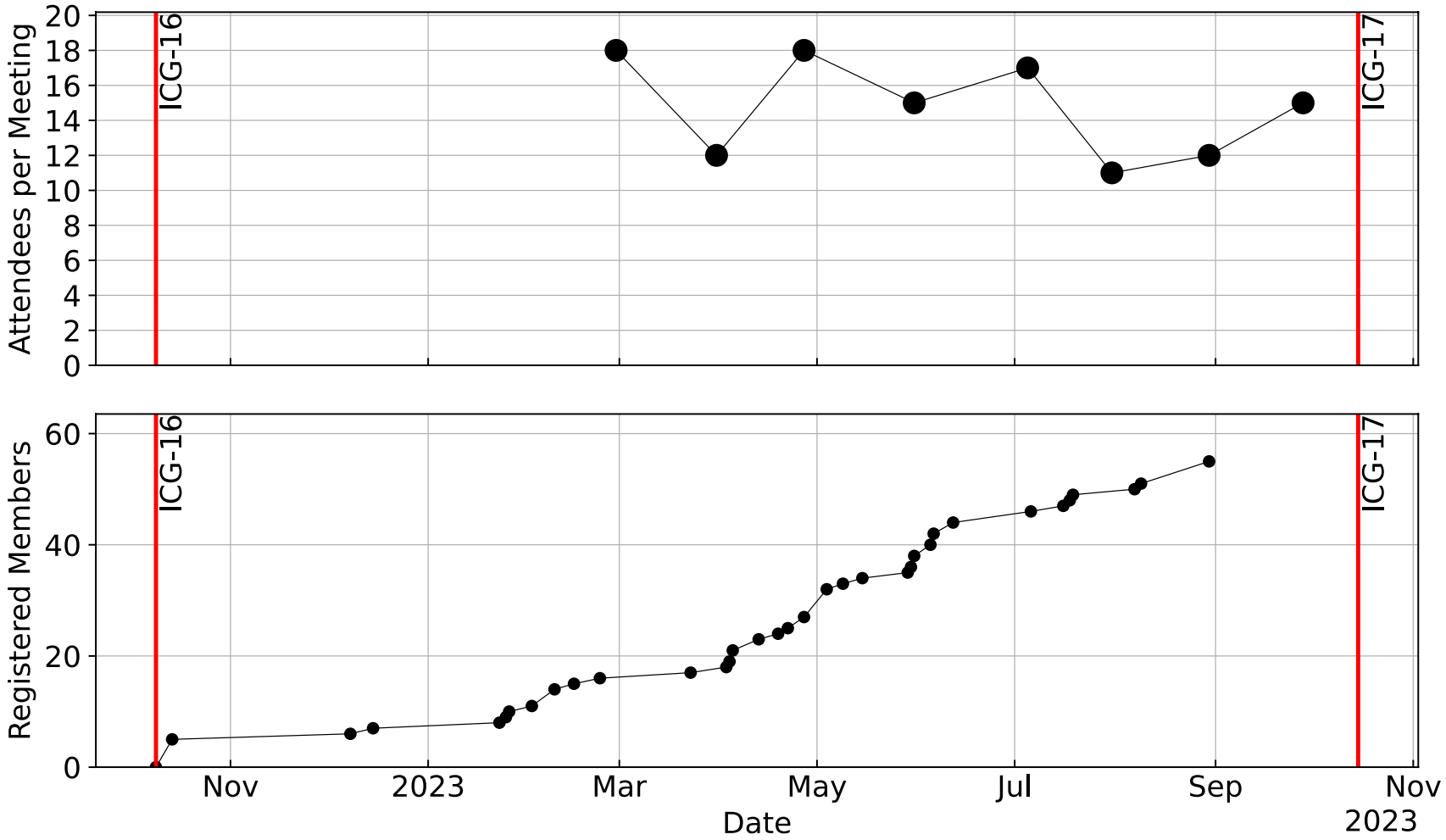
3. Develop science connections to the strategic plans of the relevant agencies.

No significant progress.

4. Develop *operational tools* that would benefit natural hazards early warning systems.

12 expert presentations given and **10 tools catalogued** and over the course of the FY.

Attendance and Membership during FY23



Joining the DRR Task Force

Please fill the following form:
https://forms.gle/vJRt1TwaT6eRDoB39.

Please forward it to any and all colleagues
who might be interested in contributing.

If there are any issues with Google Forms,
please contact us directly (leo.martire@igs.org).

GNSS-Based Tools for Disaster Risk Reduction

operational | semi-operational | experimental

Name	Point(s) of Contact	Technique	Natural Hazards (main focus, secondary focus)
ShakeAlert[1]	USGS, USA	PPP	earthquakes
REGARD[2]	GSI, Japan	PPP	tsunamis, earthquakes
G-FAST[3]	Crowell (UW, USA), Melgar Moctezuma (UO, USA)	PPP	tsunamis, earthquakes
R-CET GNSS[4]	d'Anastasio (GNS Science, New Zealand) *Geng (WU, China), McClusky (GA, Australia)*	PPP	earthquakes, tsunamis
<?>	Koshimura (Tōhoku University, Japan)	PPP	tsunami (inundation maps)
VARION[5]	Ravanelli (IPGP, France)	PPP + TEC	tsunamis, volcanic eruptions, space weather
GUARDIAN[6]	Martire, Krishnamoorthy, Komjáthy (JPL, USA)	TEC	tsunamis, volcanic eruptions, space weather
IPS[7]	Sgammini (JRC, Italy)	TEC	space weather
<?>	Han (University of Newcastle, Australia)	RO	tsunamis, volcanic eruptions
gnssrefl[8]	Larson (University of Bonn, Germany)	R	sea level, drought, floods

[1] https://www.shakealert.org/. Focus is the USA.
[2] Originally called RAPiD (https://doi.org/10.1029/2011JB008750). Focus is Japan.
[3] Is currently in trial use by tsunami warning centres both in the US and other Pacific countries.
[4] R-CET is a 5 year project looking into a variety of tools for rapid modelling of earthquakes and tsunamis; a specific GNSS branch exists.
[5] Was used in the exploratory stages of the GUARDIAN development.
[6] Near-real-time data is public and free: 10.1007/s10291-022-01365-6, guardian.jpl.nasa.gov/, cddis.nasa.gov/archive/gnss/products/realtime/jpl_ionosphere/.
[7] Requirement is to provide space weather warnings 24 hours in advance. Uses machine learning. Is funded by the European Commission.
[8] https://github.com/kristinemlarson/gnssrefl.

Suggested Recommendation

DRAFT Recommendation, hosted in WG-D:

- Demonstrate the deployment for a multi-technique GNSS station in an area of sparse coverage.
  A single ground station is sufficient for PPP, TEC, and interferometric R.
  Define and answer the important questions, provide a guide for future installations.
  Location? Land authorisations? Equipment? Connectivity? Operations? *Etc.*.

- Foster open+free+accessible software+data. In particular:
  - Encourage open-source, free, readily- and easily-usable software.
  - Encourage open-access, real-time, high-rate, precise GNSS products.

- Pursue the development of data assimilation, data fusion for various types of datasets, and crowd-sourcing GNSS data. *E.g.*:
  - USGS' ShakeMap,
  - ESA's Camaliot project.