Recommendation for Committee Decision

Prepared by: Working Group D

Date of Submission: 19 October 2023

Issue Title: Development of GNSS-based techniques for applications related to disaster risk reduction and natural hazards monitoring.

Background/Brief Description of the Issue:

The "Applications of GNSS for Disaster Risk Reduction" Task Force (hereafter DRR TF), operates under the umbrella of Working Groups (WGs) D and B. Its mission is to explore how GNSS technology can enhance disaster risk reduction (DRR) strategies and bolster natural hazard early warning systems (NHEWS). At the heart of this endeavour is the concept that GNSS-based techniques provide a cost-effective means to comprehensively monitor the surface-atmosphere system, offering a novel approach to tracking natural hazards. Currently, the TF's focuses primarily on four GNSS-based techniques: Precise Point Positioning (GNSS-PPP), Reflectometry (GNSS-R), Radio Occultation (GNSS-RO), and ground-based Total Electron Content (GNSS-TEC). These techniques have broad applications, spanning for instance earthquakes, tsunamis, floods, and solar storms. Established at ICG-16 in October 2022 following WG-D Recommendation #26, the DRR TF has dedicated a full year to gathering and organising expertise in the field up to the time of this recommendation.

Discussion/Analyses:

The DRR TF has explored the GNSS-based techniques and their potential and current applications to DRR and NHEWS. Over the past year, the TF has convened seven times, gathering diverse worldwide expertise from Australia, Chile, China, France, Germany, Italy, Japan, New Zealand, Spain, and the United States of America. The DRR TF has found the following points to be relevant to the discussion.

- A single ground GNSS station is sufficient to obtain GNSS-PPP, GNSS-TEC, and interferometric GNSS-R data which would be critically useful to DRR and NHEWS.
- GNSS-PPP remains the conventional approach for early warning systems, with ongoing efforts to strengthen it and explore innovative methods.
- GNSS-TEC is a relatively new development from the past two decades but shows promising results (*e.g.*, the GUARDIAN system developed by JPL; Martire *et al.*, 2023).
- GNSS-R and GNSS-RO represent cutting-edge research areas, holding significant potential but requiring further development for operational use (*e.g.*, the gnssrefl software by Larson *et al.*).
- Earthquakes remain the primary and most-developed target for GNSS-based NHEWS, followed closely by tsunamis.
- Efforts are underway to study space weather effects, such as solar storms, mainly motivated by the desire to monitor the perturbations such effects induce on positioning and navigation (such as the European JRC's Ionospheric Prediction Service).
- There are ongoing but more limited, non-operational research studies on using GNSS to monitor volcanic eruptions, wildfires, floods, storms, and sea-level rise.

- The topics of data assimilation, data fusion for various types of datasets (*e.g.*, seismo-geodetic enhancements; Golriz *et al.*, 2023), and crowd-sourcing GNSS data (*e.g.*, cellphones) were deemed to be particularly valuable in the short-term.

Not related to GNSS, satellite imagery was found important to assess Disaster Risk Reduction potential, especially by and for island nations in the Pacific.

Recommendation of Committee Action:

It was recommended by ICG that:

1. *The DRR TF should (a) demonstrate the deployment of a multi- GNSS station in an area of sparse coverage; and (b) define a step-by-step guide for future such deployments, including critical details such as (but not limited to) the administrative and technical requirements, the cost and timing estimates, and the potential sources of funding to which one could apply.*

2. *The ICG should encourage the development of open-source, freely available, and readily- and easily-usable software. In addition, the ICG should encourage the publication of open-access, real-time, high-rate, accurate, and precise multi-GNSS data and products.*

3. *The science community should pursue the development of data assimilation, data fusion for various types of datasets, and crowd-sourcing GNSS data to their full, synergistic potential.*

Members Consensus Reached_____X___; **No Consensus Reached**_____

Chairperson Signature: _____**Date:** ____19/10/2023_____