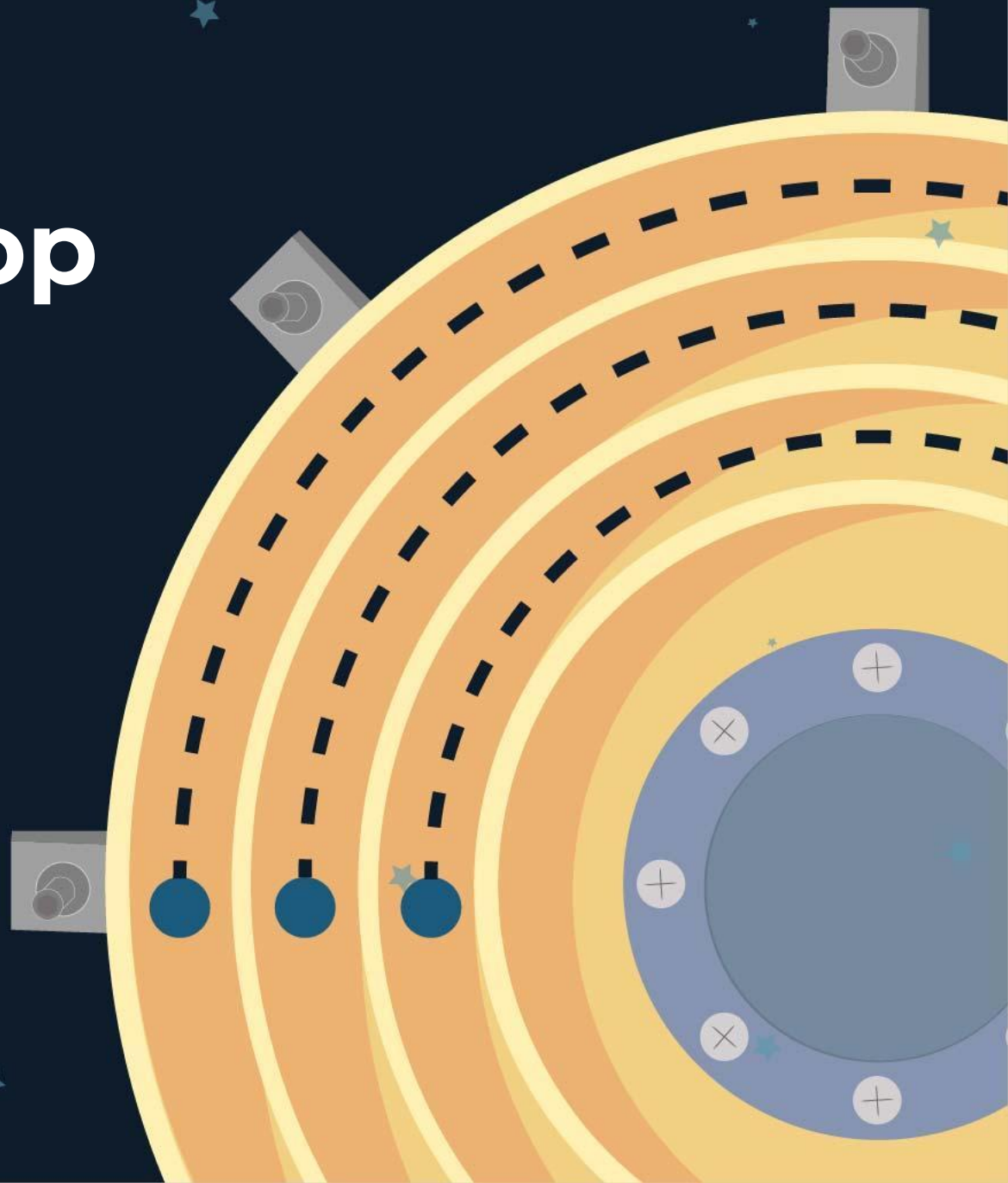
Welcome to the Tour de l'IGS 5th Stop

GNSS for Natural Hazards in the South Pacific

Léo Martire[1, 2] ***et al.***
[1] Jet Propulsion Laboratory, California Institute of Technology
[2] International GNSS Service



IGS INTERNATIONAL GNSS SERVICE

Tour de l'IGS
Mini Workshop Series

Outline

- Disaster Risk Reduction
- GNSS Techniques
- GNSS-TEC Examples
  - 2022 Tonga Volcanic Eruption
  - 2023 Turkey Earthquakes
- ICG Task Force
- Workshop Guidelines
- Agenda

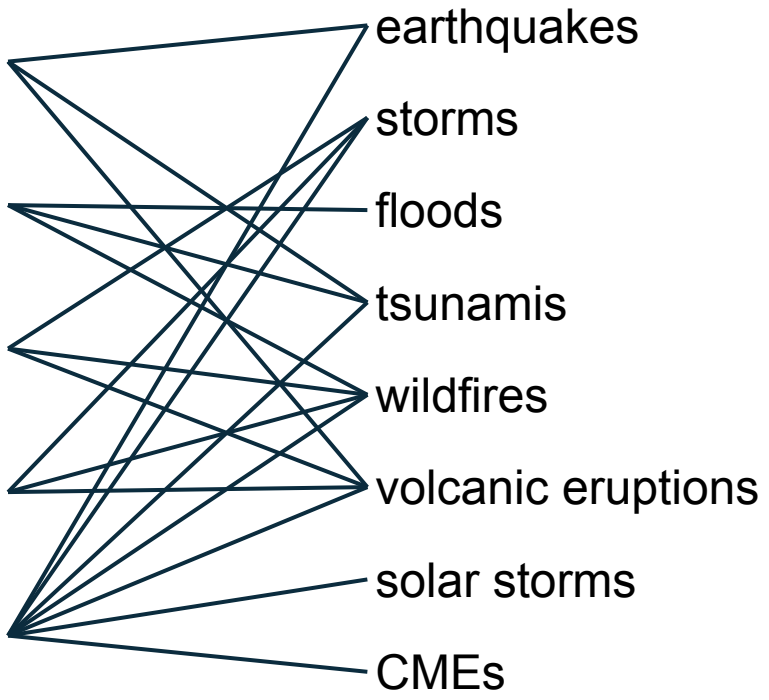
Disaster Risk Reduction

Disaster	Risk	Reduction
	UN Office for DRR: "preventing new and reducing existing disaster risk and managing residual risk".	
earthquakes storms floods tsunamis wildfires volcanic eruptions solar storms coronal mass ejections ...	<u>human casualties</u> community health concerns infrastructure damage power grid damage positioning systems disruptions economic losses	prevention *(do not create risk)* prediction capabilities early warning systems rapid response techniques

GNSS Techniques

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)	



Example Cases - 2022 Tonga Volcanic Eruption

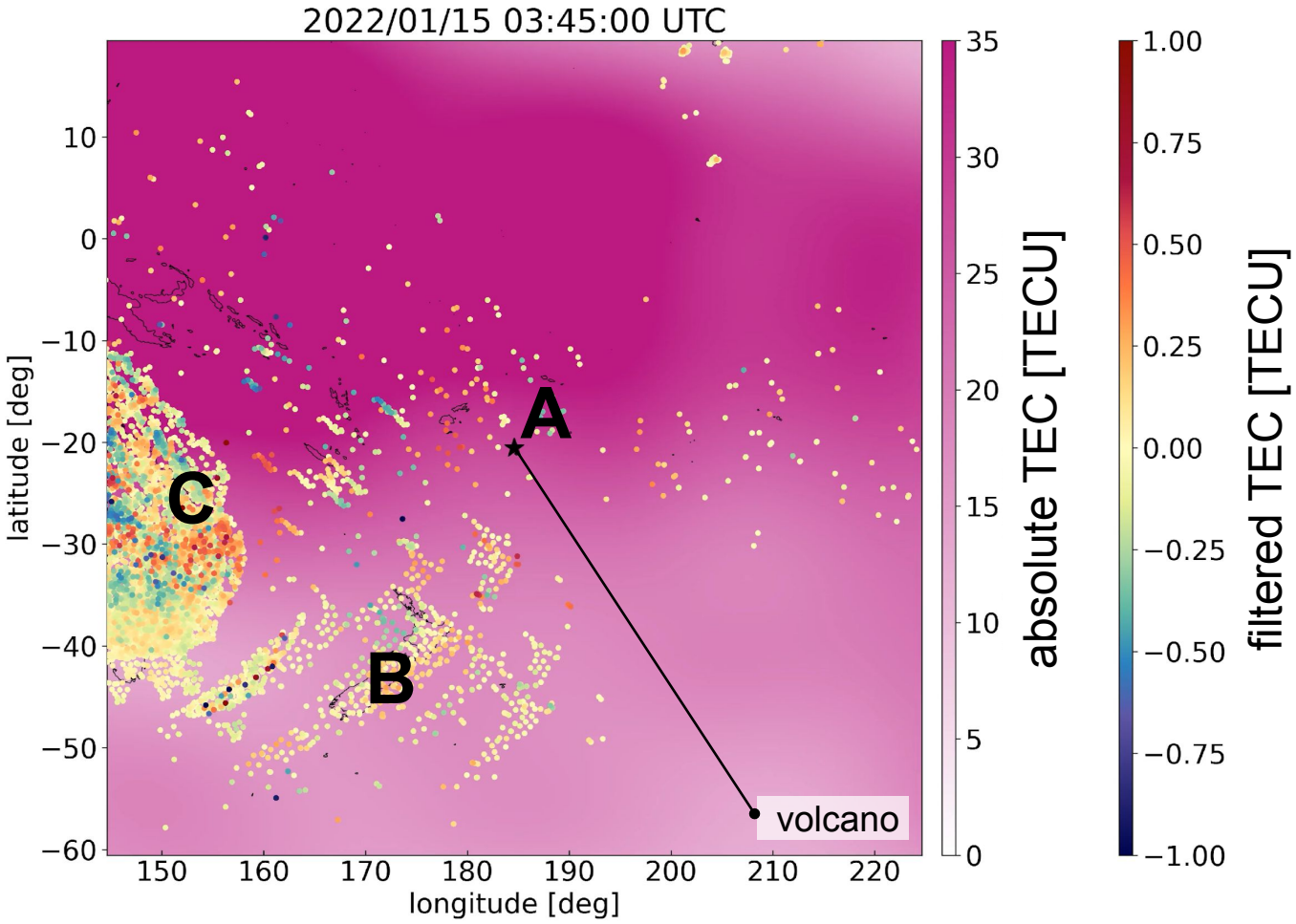
Ionospheric signals appear as soon as ~15 minutes after the onset of the event.

Background: Total Electron Content map
(2-min. resolution, 1000 sites worldwide).

Foreground: Filtered TEC
(individual links, periods < 60 min.).

Ionospheric signals:

A. strong depletion,
B. shock wave, and
C. enhanced ionospheric activity
(depletion recovery + gravity waves).



Example Cases - 2023 Turkey Earthquakes

GNSS-based monitoring (TEC and Precise Point Positioning) **captured signals in (near-)real-time.**

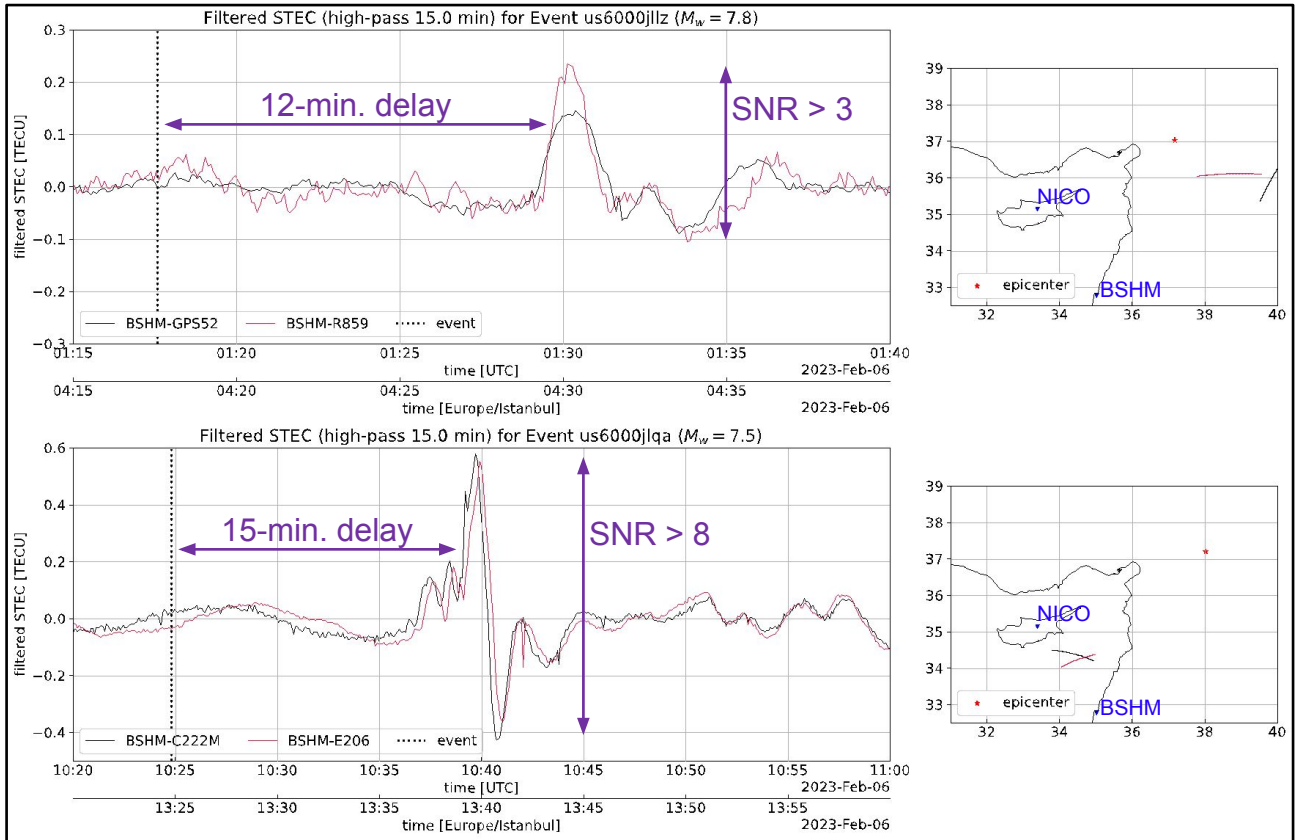


Figure: ionospheric TEC time series captured in near-real-time (< 10 min. latency) by JPL's GUARDIAN system (Martire *et al.*, 2023, 10.1007/s10291-022-01365-6).

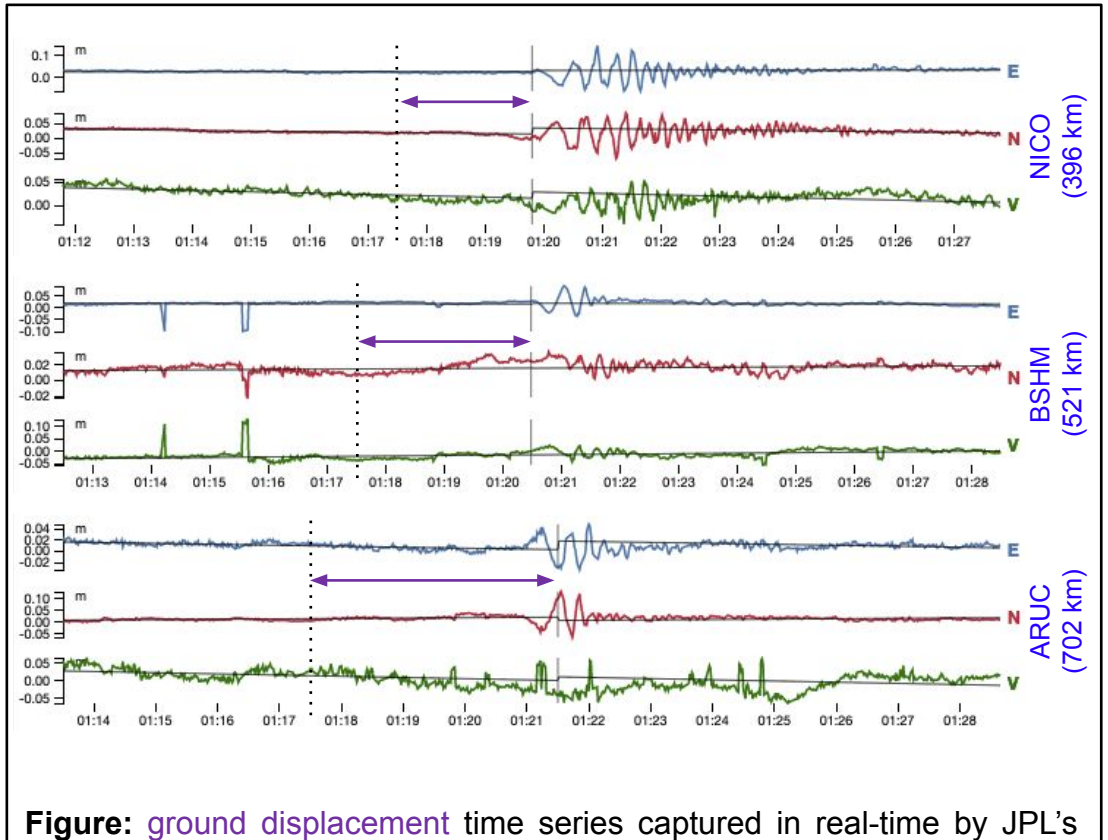


Figure: ground displacement time series captured in real-time by JPL's GREAT Alert System (*credit: GREAT Alert team*), for event us6000jllz (M_w = 7.8). Delays (2 min, 2.5 min, 3.5 min) = seismic wave propagation.

Note that no technique can provide an early enough warning for epicentral effects. GNSS-based techniques are valuable for far-field hazards and applications.

ICG Task Force:

Applications of GNSS for Disaster Risk Reduction

Created in October 2022 by the International Committee on GNSS, based on **a lack of international coordination** on topics at the intersection of **GNSS applications** and **disaster risk reduction**.

Chairs: IGS + China + Japan.

Goals: develop international **collaborations, recommendations, and policies**;
establish **science connections** to the relevant strategic plans; and
facilitate the development of **GNSS-based operational tools for early warning systems**.

Kick-Off Meeting: February 28th, 2300-0000 UTC.

If interested, please contact us at **leo.martire@igs.org** and/or **craddock@igs.org**.

Workshop Guidelines

Please make sure you are using a first and last name,
turn off your camera and microphone,
use the “Raise Hand” feature or the chat to ask questions, and
follow the IGS Code of Conduct (see reminder email and next slide).

Note that this meeting is recorded and will be made available on the International GNSS Service’s YouTube Channel (https://www.youtube.com/user/igsorg).

An online “**group picture**” will be taken just before the break.

Code of Conduct

Expected Behavior

- All participants are treated with respect and consideration, valuing a diversity of views and opinions.
- Act demonstrably in the best interest of the whole of the IGS and its strategic objectives and values.
- All participants should consult the pre-meeting reading prior to joining the meeting.
- Be considerate, respectful, and collaborative. Do not speak over others, and avoid monopolizing the discussion.
- Communicate openly with respect for others, critiquing ideas rather than individuals, organizations or countries/regions.
- Participants should feel able to ask questions without being discouraged, as well as respectfully and constructively challenge discussion points.
- Avoid personal attacks directed toward other participants.

- Anyone requested to stop unacceptable behavior is expected to comply immediately. Staff may take any action deemed necessary and appropriate, including immediate removal from the meeting without warning or refund.

Unacceptable Behavior

- Harassment, intimidation, or discrimination in any form will not be tolerated.
- Abuse of any participant. Examples of unacceptable behavior include, but are not limited to, purposely disrupting discussions and/or talks, verbal comments related to gender, sexual orientation, disability, physical appearance, body size, race, religion, national origin, geopolitical ideals, inappropriate use of nudity and/or sexual images in public spaces or in presentations, or threatening or stalking any participant.
- Disruptive behavior and/or interruption of discussions, presentations, sessions, or events.
- Any retaliation for reporting harassment or reporting an incident in bad faith.

Reporting Unacceptable Behavior

- If you are the subject of unacceptable behavior or have witnessed any such behavior, please immediately notify the IGS Central Bureau and the workshop organizers.
- Notification should be done by contacting a staff person on site or by emailing your concern to cb@igs.org and workshop@igs.org

Tour de l'IGS 5th Stop Agenda

(All times are UTC.)

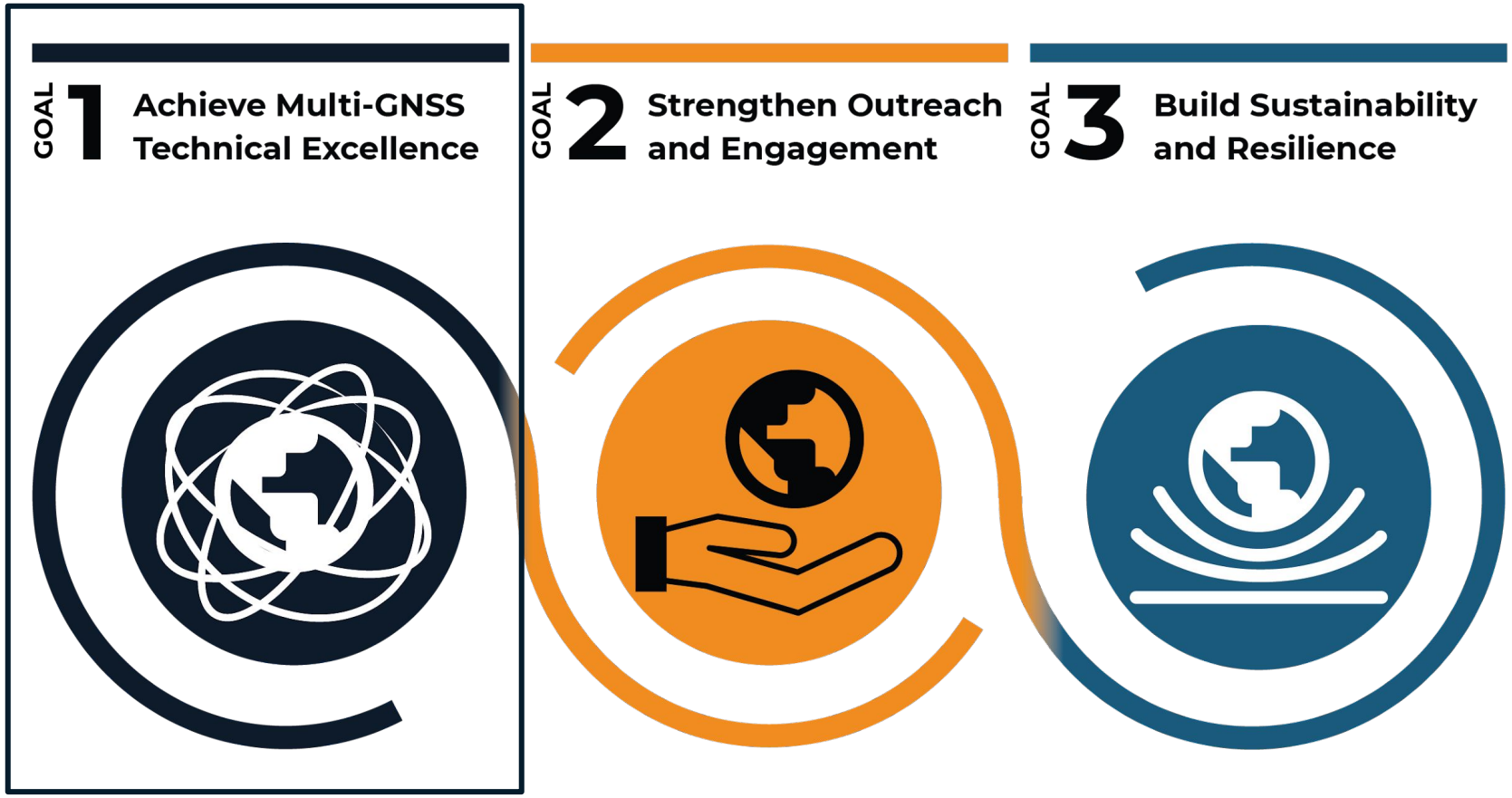
2140-2200	**John LaBrecque**	GNSS Tsunami Early Warning for the South Pacific
2200-2220	**Shunichi Koshimura**	A nation-wide tsunami inundation and damage forecast system in Japan
2220-2240	**Viliami Folau**	GNSS Infrastructure and Technologies to Support Tsunami Early Warning System
2240-2250	Break	A "group picture" will be taken right before the break.
2250-2310	**Simon McClusky *et al.***	Australian perspectives on the use of GNSS for Tsunami Warning
2310-2330	**Andrick Lal**	Pacific Sea Level and Geodetic Stations for Natural Hazards
2330-2350	**Elisabetta d'Anastasio *et al.***	GNSS for Natural Hazards in Aotearoa New Zealand
2350-0000	**Léo Martire**	Concluding Remarks, Further Discussion

Workshop will resume at 2300 UTC

Break

IGS Goals

Serving the community with facilitation, coordination, incubation, and advocacy in three strategic goals:



Example Cases - 2023 Turkey Earthquakes