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Towards common data exchange formats for seafloor geodesy



Recent development of the *GNSS-A Data Standardization Task Force*

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AGU23
San Francisco, CA & Online Everywhere
11-15 December 2023

1 : Institut de physique du globe de Paris, Paris, France

3 : LIENSs, CNRS/ La Rochelle University, France,

5 : Ocean Networks Canada, Vancouver, Canada

8 : Nagoya University, Earthquake and Volcano Research Center, Nagoya, Japan

2 : University of Washington, Earth and Space Sciences, Seattle, USA

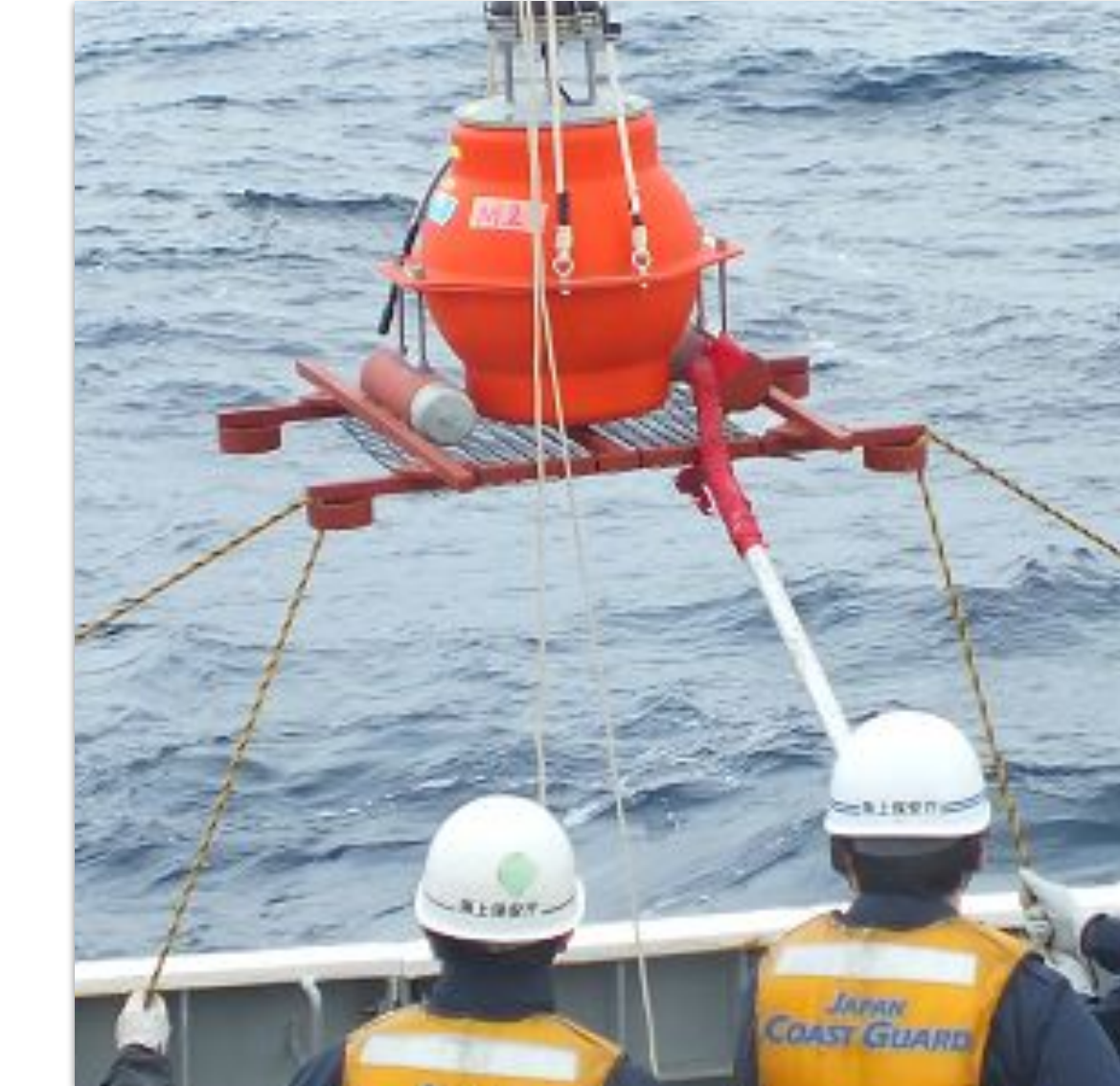
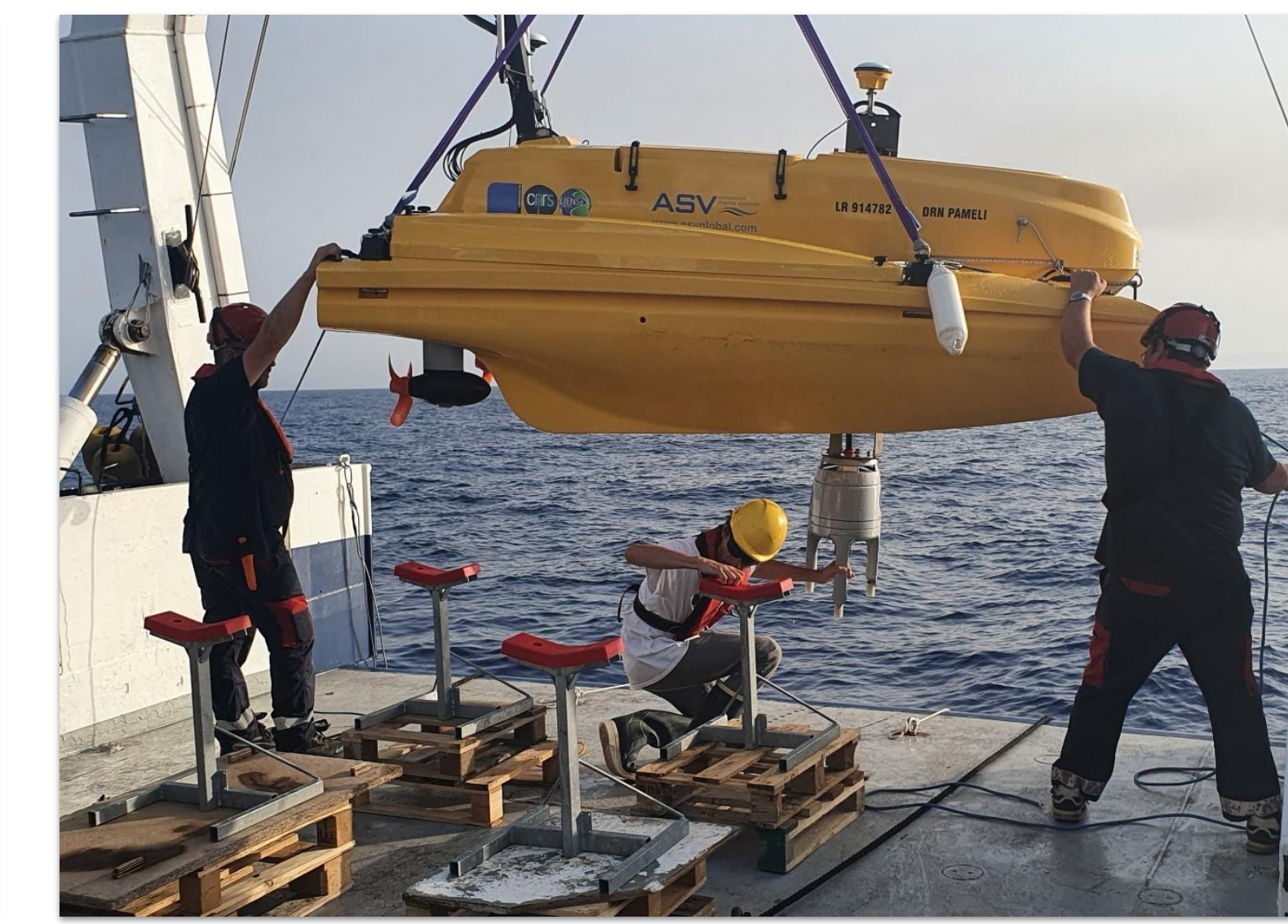
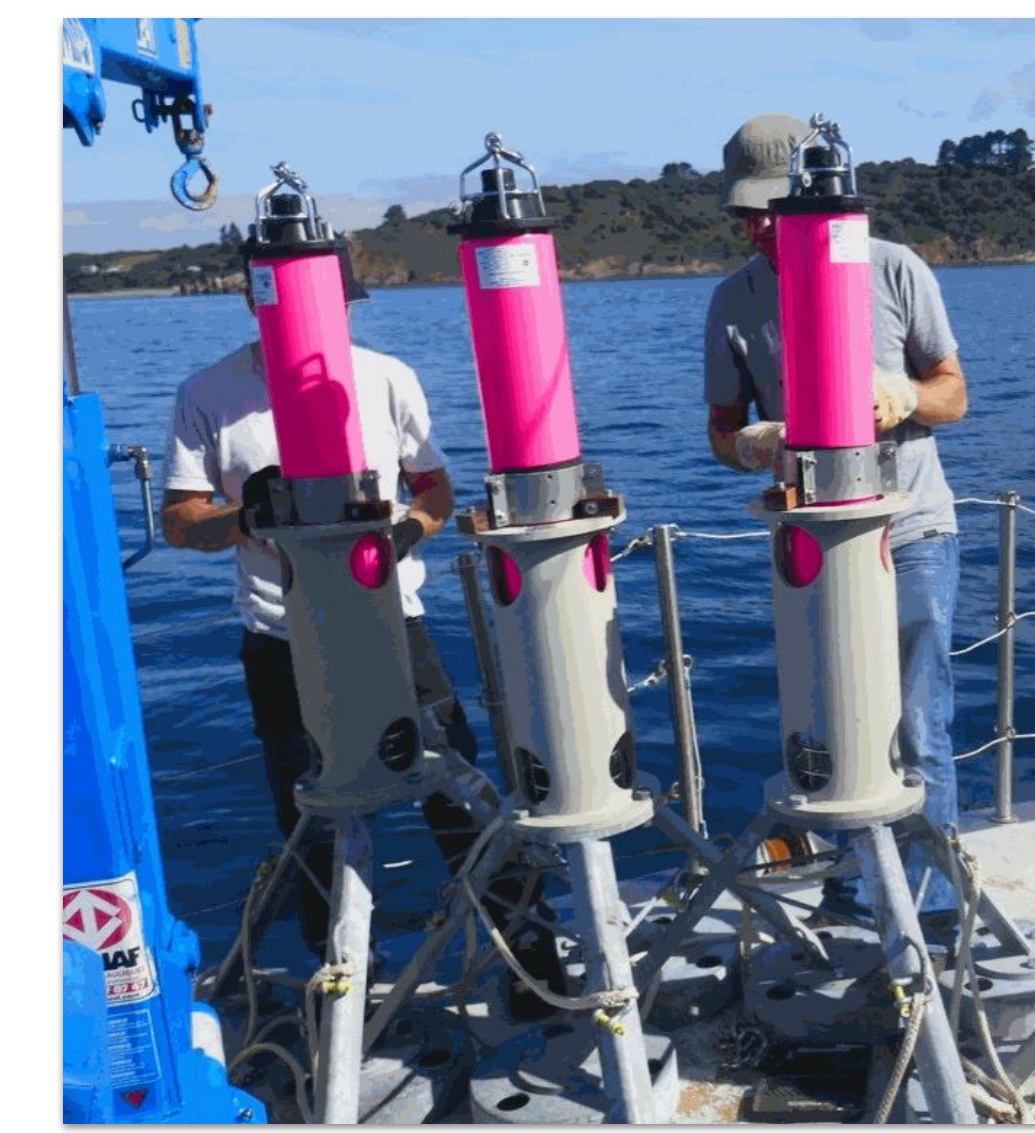
4 : China University of Petroleum (East China), Qingdao, China

6 : IRIDeS, Tohoku University, Sendai, Japan

9 : University of Houston, Dept of Civil and Environmental Engineering, Houston, USA

7 : Japan Coast Guard, Hydrographic and Oceanographic Dept, Tokyo, Japan

10 : Institute of Industrial Science, University of Tokyo, Tokyo, Japan



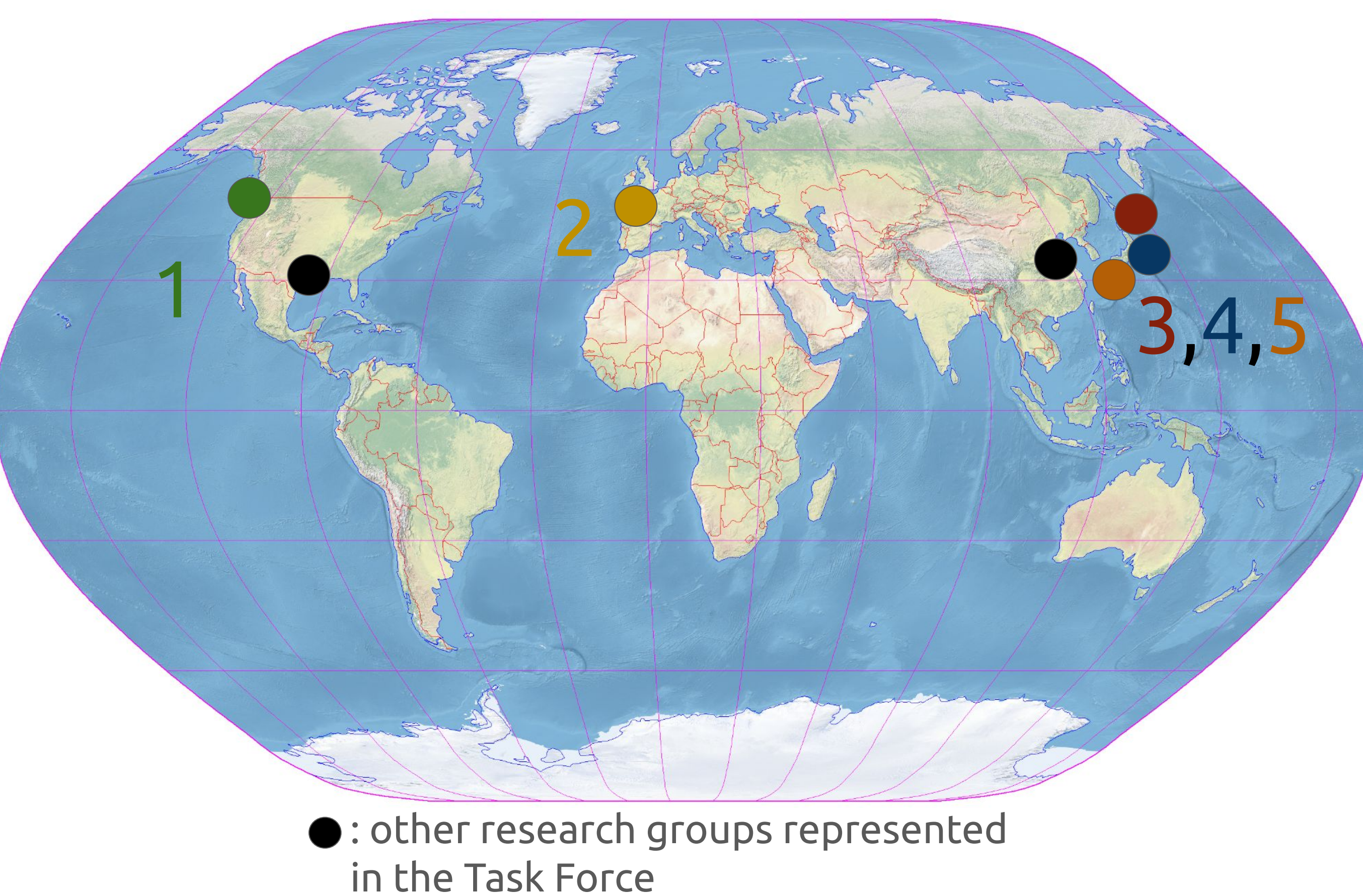
1) Scripps, Univ. of Washington & Ocean Network Canada (source: D. Schmidt & M. Heeseemann)

2) IUEM Brest & LIENSs La Rochelle (source: J.-Y. Royer & P. Sakic)

3) Tohoku University (source: M. Kido)

4) Japan Coast Guards (source: S. Watanabe)

5) Nagoya University (source: K. Tadokoro)



● : other research groups represented in the Task Force

Goals

The goals of the task force were defined as follows:

- Enable the **shareability** of the seafloor geodesy data collected by the different research groups around the world.
- Give **better visibility** to seafloor geodetic data.
- Respect the **FAIR data principles** (Findable, Accessible, Interoperable, Reusable).
- A special emphasis has to be given to the **interoperability** of seafloor geodetic data, i.e., the possibility to easily use data of one research group with the software of another one.
- Identify how data can be **easily stored in existing** repositories or establish expectations for new repositories.
- Establish **community-supported data standards** that can be **adopted by the repositories/data centers**.

Initially, the task force attempted an exhaustive inventory of all the seafloor geodetic techniques. Given the main interest in **GNSS-Acoustic** for the initial participants during the first meeting, it was agreed to **start discussions with this technique**. Nevertheless, the task force is interested in a **wide range of techniques** and will likely **revisit them in the future** e.g. acoustic ranging, ocean bottom pressure sensors (OBP), tiltmeters...

How to federate the international seafloor geodesy community while making GNSS-A data acquired around the World interoperable?

Main points discussed within the Task Force so far

Should we continue with ASCII/CSV style for GNSS-A data?

⇒ **Yes**

- Such a data representation style is more or less “universal” since all the members of the Task Force currently use it.
- “such representation format must remain community-driven”.

The necessity to explicitly include both the send and receive ping epochs? If not, which one is the best?

⇒ **We include both**

What data level (raw versus initially processed) is appropriate for broad dissemination of GNSS-A data, and ingestion by processing codes?

⇒ **Level 1:** raw observation i.e. RINEXs, lever arms, waveforms...
⇒ **Level 2:** a “master configuration + main data” file with preprocessed data

Which time scale/representation should we adopt for the recorded epochs?

⇒ **UTC scale**, a reference epoch in the header, and the seconds w.r.t. the reference for each event

What should be the standardized reference frame for the position of the surface platform?

⇒ **ECEF representation**. A sufficient level of detail must be provided regarding the reference frame in the metadata/header

Since the 19th of October 2022, representatives of the seafloor geodesy community have met on a regular basis within an *ad hoc* working group called the **GNSS-Acoustics Data Standardization Task Force (GADSTF)**. This task force has been placed **under the umbrella of the International Association of Geodesy’s Inter-Commission Committee on Marine Geodesy (ICCM)**.

Prototype for a future common exchange format

Draft of GNSS-A data format standardization

Version 0.231129 before discussion of the standardization
Taskforce meeting of the 29th November 2023

Definitions of column in GNSS-A standard CSV format

Table 1. Definitions of column in GNSS-A standard CSV format

Index	Necessity	Description
MT_ID	Essential	ID of mirror transponder
TravelTime	Essential	Observed travel time (net value) [sec.]
T_transmit	Essential	Transmission time of acoustic signal [sec. from origin]
X_transmit	Essential	Transducer position at T_transmit in ECEF [m]
Y_transmit	Essential	Transducer position at T_transmit in ECEF [m]
Z_transmit	Essential	Transducer position at T_transmit in ECEF [m]
T_receive	Essential	Reception time of acoustic signal [sec. from origin]
X_receive	Essential	Transducer position at T_receive in ECEF [m]
Y_receive	Essential	Transducer position at T_receive in ECEF [m]
Z_receive	Essential	Transducer position at T_receive in ECEF [m]
ant_X0	Optional	GNSS position at T_transmit in ECEF [m]
ant_Y0	Optional	GNSS position at T_transmit in ECEF [m]
ant_Z0	Optional	GNSS position at T_transmit in ECEF [m]
roll0	Optional	Roll at T_transmit (in degree) *rotation around “forward” axis in ATD offset
pitch0	Optional	Pitch at T_transmit (in degree) *rotation around “rightward” axis in ATD offset
heading0	Optional	Heading at T_transmit (in degree from north) *rotation around “downward” axis in ATD offset
ant_X1	Optional	GNSS position at T_receive in ECEF [m]
ant_Y1	Optional	GNSS position at T_receive in ECEF [m]
ant_Z1	Optional	GNSS position at T_receive in ECEF [m]
roll1	Optional	Roll at T_receive (in degree)
pitch1	Optional	Pitch at T_receive (in degree)
heading1	Optional	Heading at T_receive (in degree from north)
[other]	Optional	Any other optional indices * should be defined in the header or other documents

Definitions of site information file in GNSS-A standard format

- Current discussion in the Task Force intent to store these metadata either:
 - In the header of the data stored in a CSV as in the Table 1
 - In a separated dedicated file such as YAML

Variable	Format	Description
Site_name	character	GNSS-A site name or code
Campaign	character	Observation campaign name
TimeOrigin	YYYY-MM-DD hh:mm:ss.s	Origin of time used in the file [UTC]
RefFrame	character	Reference frame used in the file
MTlist	List of character	List of ID of mirror transponders
[*]_appPos	List of float	Approximate positions of transponder in ECEF [m] [*] should be replaced with MT’s ID.
ATDOffset (optional)	List of float	ATD offset (or local-tie/ lever-arm) defined as the vector of GNSS to transducer with [forward, rightward, downward] in [m]
[other] (optional)	N/A	Any other optional values * should be clearly defined in comments or other documents
Comments (optional)	character	Any other optional comments

Future topics of discussion

- Establish standards for low-level data to be included as Level 1 data (GNSS record as RINEX, raw waveform, etc.).
- Identify the best data quality indicators for GNSS/A data.
- How to improve metadata records.
- The appropriateness of archiving GNSS/A data in a binary format, such as NetCDF
- Define a naming convention for the data files, seafloor sites, and campaigns.
- Establish **new task forces** for other seafloor geodetic data types, **especially for ocean bottom pressure**.

We welcome new members to join the task force!
Help us to strengthen the international seafloor geodetic community!



register with the mailing list
<https://groupes.renater.fr/sympa/subscribe/seafloor-geodesy-data-standardization>



get the report the Task Force provided to the IAG for the IUGG'23
<https://hal.science/hal-04319233>

For more information about the task force, contact Pierre Sakic (sakic@ippg.fr)