Tide Gauge Benchmark Monitoring

IGS Workshop 2022 (28.06.2022, ZOOM)
Agenda

- Tilo Schöne: Introduction to the session
- Gary Mitchum: A brief history of the GLOSS, TIGA partnership
- Guy Wöppelmann: Estimates of vertical land motion at tide gauges from multiple solutions (IGS-repro3 and others)
- Benjamin Männel: Results of the GFZ's TIGA repro3 contribution
- Status of the TIGA Network and status of SONEL (prepared by Elizabeth Prouteau)
- ALL: Open discussion along the key technical questions

https://igs.org/igs-ws-2022/#day-2
Applications of GNSS@TG

- Sea Level Research – Tide Gauges have century time series
- Altimetry calibration and stability monitoring
- World Height System Unification
  - GNSS@TideGauges are the contact between the physical (geoid/MSL) and geometrical reference (ITRF) frames
- ITRF densification
- Reference for InSAR coastal/subsidence mapping
  - Coastal hazard assessment
- Near-coastal wet tropo- and ionospheric product for altimetry
NEED of GNSS@TG

- Tide Gauges measure against their TGZ (which may change over time)
- Two close gauges may give opposite signals due to local effects
- Tide gauges might be moved (e.g., harbour constructions)
- GNSS provide the connection to the geometrically stable reference frame and other techniques (e.g., InSAR)
Tide Gauges – Where Sea Level Rise matters!

Geocentric SLR is only part of the problem! Several coastal cities have a higher hazard potential due to subsidence. GNSS-controlled tide gauges and InSAR services are indispensable. The relative SL matters too!
We aiming on providing the best possible GNSS solution for sea level research

bringing the GNSS, tide gauge and sea level community together

- Maintain a global virtual GNSS @ TG network
  - Promote the establishment of local ties (leveling) between GNSS and TGBMs.
  - Promote the establishment of more continuous operating GNSS stations, in particular in the southern hemisphere.
  - Provide meta information, e.g. on leveling between benchmarks or open data access
- Compute precise coordinates and velocities of GNSS stations at or near tide gauges with a significant delay to allow as many as possible stations to participate (e.g., IGS repro campaigns).
- Provide training to tide gauge operators through workshop. Through UNESCO/GLOSS advice station operators about the operation of GNSS @ TG stations.
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Progress (from AM Meeting 12/2021)

- Contributions by ULR and GFZ with dedicated repro3 solutions, UoL in 2022
- www.SONEL.org:
  - Integration of new levelling data (TGZ to ARP)
  - Integration of **RINEX3** files. Now collecting **RINEX3** data for **566** (out of 900) stations.
  - « Last data events » tool: a table is automatically updated when:
    - a new station is added to SONEL database
    - a new sitelog has been recovered
    - a large amount of data has been downloaded out of the daily process
- Corona affected your work
  - important outreach activities are missing
  - Missing input about new stations and GNSS@TG from this community
Ways have been establish for seamless integration of collocated tide gauges information between IGS (www.igs.org), SONEL (www.sonel.org) and PSMSL.
Key technical items to be discussed by WG

• Review the status (coverage) of repro3 contribution, requirements of the Sea Level community on the IGS-TIGA products

• TIGA-repro3
  • GFZ-TIGA-repro3 is not included in the official release of IGS (only the AC version)
  • Setup a combination product after UoL is ready with repro3

• Discuss ways to improve the situation with leveling TGBM/ARP

• Impact of multi-GNSS combinations on long-term homogeneity of the vertical of GPS-only time series (req. sub-mm/a) at tide gauges

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Relevant pre-reading for TIGA

- IGS CORS Guidelines
- IGS Data Center Guidelines
- Review the Service of (the TIGA Data Center) [www.sonel.org](http://www.sonel.org)
  - GNSS@TG network: [https://www.sonel.org/-GPS-.html?lang=en](https://www.sonel.org/-GPS-.html?lang=en)
  - Access to time series: (e.g.) [https://www.sonel.org/spip.php?page=gps&idStation=639](https://www.sonel.org/spip.php?page=gps&idStation=639)
- Review the usefulness of the tide gauge related information at [https://igs.org/network/](https://igs.org/network/) (e.g., [https://igs.org/imaps/station.php?id=COCO00AUS](https://igs.org/imaps/station.php?id=COCO00AUS))
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TIGA repro3 contribution

Network of 601 stations over the period [2000-2020],
554 « robust » velocities (468 GNSS@TG velocities)

- do we have sufficient network coverage
- can we increase the number of contributing stations (and how)
- are there any other AC/AAC/groups which may contribute
- how can we come to a combined products of all (non)repro3 solutions
- Multi-GNSS ; RINEX2/3
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TIGA - SONEL Levelling

Finn Bo Madsen/DTU
Levelling info for Greenland 😊
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Digital Object Identifiers (DOIs) for Geodetic Data Sets

- GGOS Working Group Digital Object Identifiers (DOIs) for Geodetic Data Sets
  - https://ggos.org/about/org/co/dois-geodetic-data-sets/
- Also of value for TIGA solutions, e.g., https://doi.org/10.5880/GFZ.1.1.2022.001

Should we consider also to apply DOI(s) for the Time Series available through SONEL.
TIGA-WG plan@2022

- Integration of GFT & ULR solution in SONEL
- UoL repro3 solution based on CODE orbits & integration into SONEL
- Time Series Analysis at tide gauges
- Outreach to GLOSS-GE and sea level community
- Work towards more levelling ties

- Most GNSS@TG are legacy receiver of the TG community delivering GPS signals only
Special thanks to UNAVCO for the help in the session
## Working Group Members Review

<table>
<thead>
<tr>
<th>Name</th>
<th>Entity</th>
<th>Host Institution</th>
<th>Country</th>
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