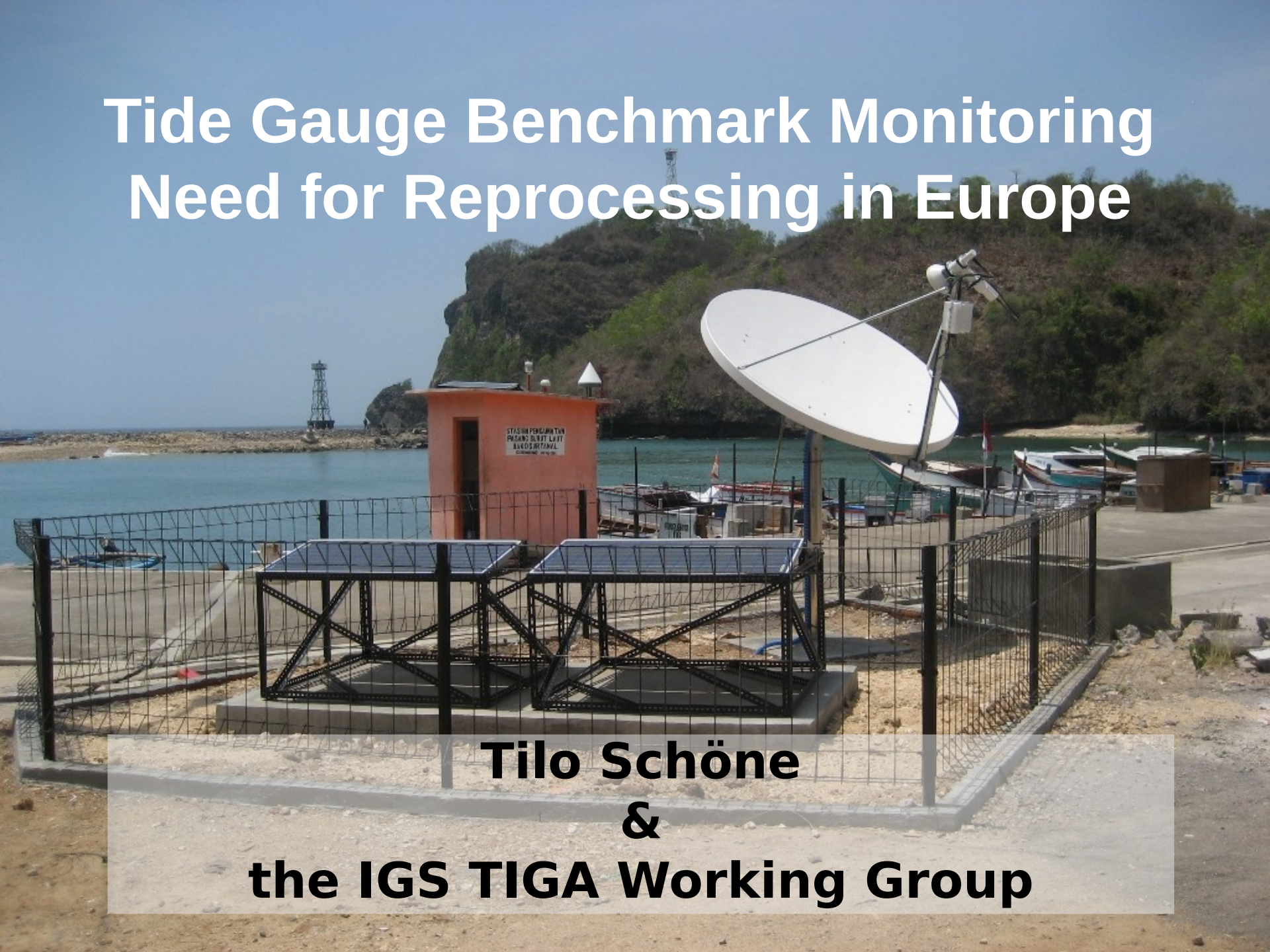
Tide Gauge Benchmark Monitoring
Need for Reprocessing in Europe



Tilo Schöne
&
the IGS TIGA Working Group

Vertical Tide Gauge Control

- Long-term stable and consistent frame to relate globally distributed tide gauge (sea level) measurements
- Connecting national and local height systems to the shore-side sea level
- Point-wise constraints for, e.g. GIA
- Short-term control in earthquake-prone areas
- Other scientific studies

WMO/GCOS

Action O9 *[IP-04 O11]*

Action: Implement the GLOSS Core Network of about **300 tide gauges**, with **geocentrically-located** high-accuracy gauges; ensure continuous acquisition, real-time exchange and archiving of high-frequency data; put all regional and local tide gauge measurements within the same **global geodetic reference system**; ensure historical sea-level records are recovered and exchanged; include sea-level objectives in the capacity-building programmes of GOOS, JCOMM, WMO, other related bodies, and the GCOS system improvement programme

Vertical Reference Frames
Report for the Period 2003 – 2007, Ihde et al.

GGOS/IAG

A global unified vertical reference system for an International Vertical Reference System (IVRS) can be realized by:

- A global network of stations with coordinates in ITRF and geopotential numbers referred to a conventional global reference level. **This network should include collocation of permanent GNSS, tide gauges, permanent (SG) and periodical (AG) gravity stations.**
- ...

Objectives of the TIGA-WG

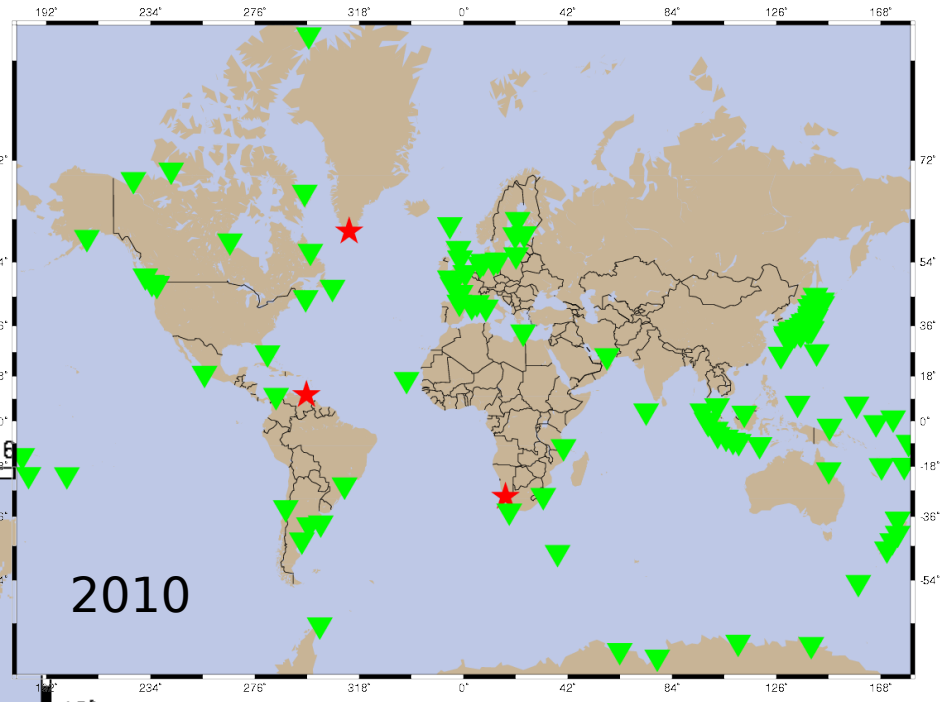
- Provide a dedicated GNSS product (coordinates, time series of coordinates, vertical rates) for sea level research of any kind (and other applications)
- Interact with GLOSS, GCOS, IAG/GGOS, WCRP, etc.
- Interact and align with GLOSS
  - defines the scope of TIGA
  - Main users of TIGA results
- Promote the establishment of links to other geodetic techniques (DORIS, AG, SLR, *VLBI*)

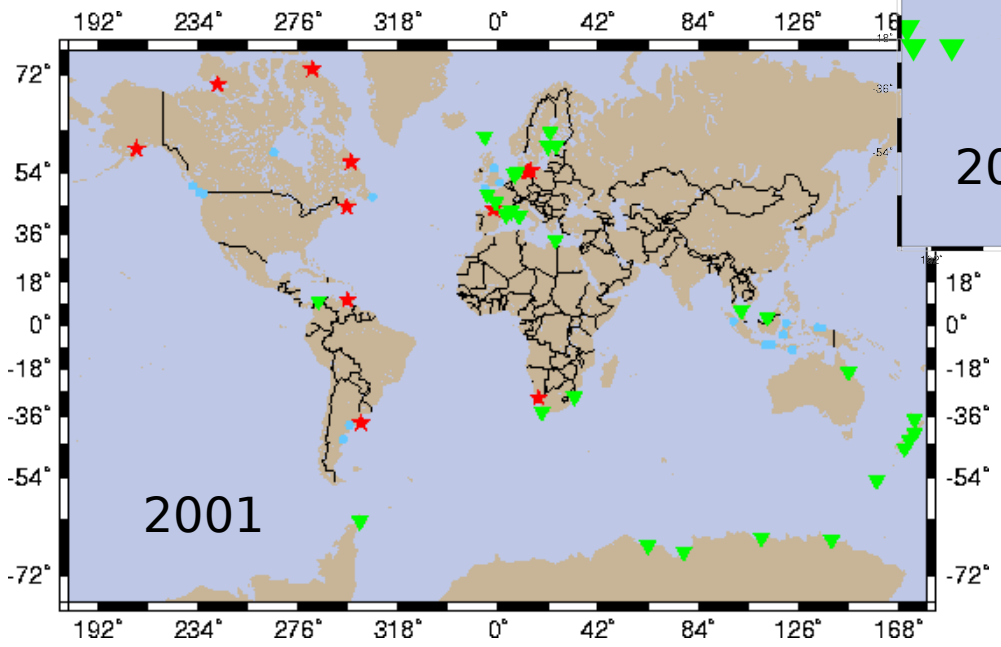
Components of the TIGA WG

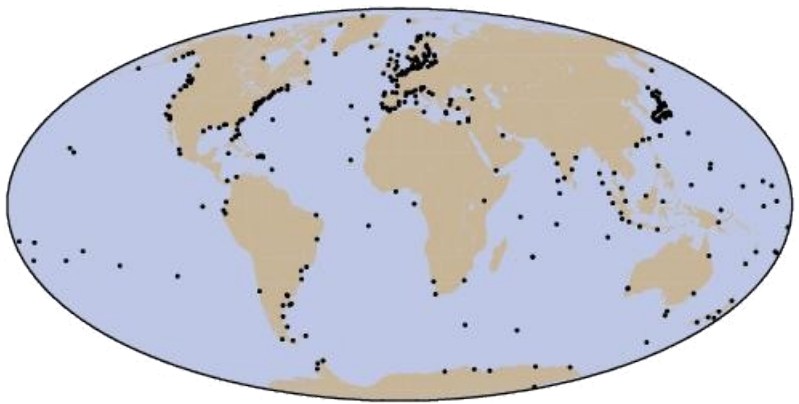
- TIGA Data Center
  - SONEL/Univ. La Rochelle (ULR), CDDIS
- TIGA Network Coordinator
  - ULR
- TIGA Analysis Centers
  - BIGF/UoL, DGFI, EUREF, GA, GFZ, ULR
- TIGA Combination Centers
  - UoBern, UoLuxembourg

TIGA Network Development

Increasing network coverage
- more valuable
- more attractive





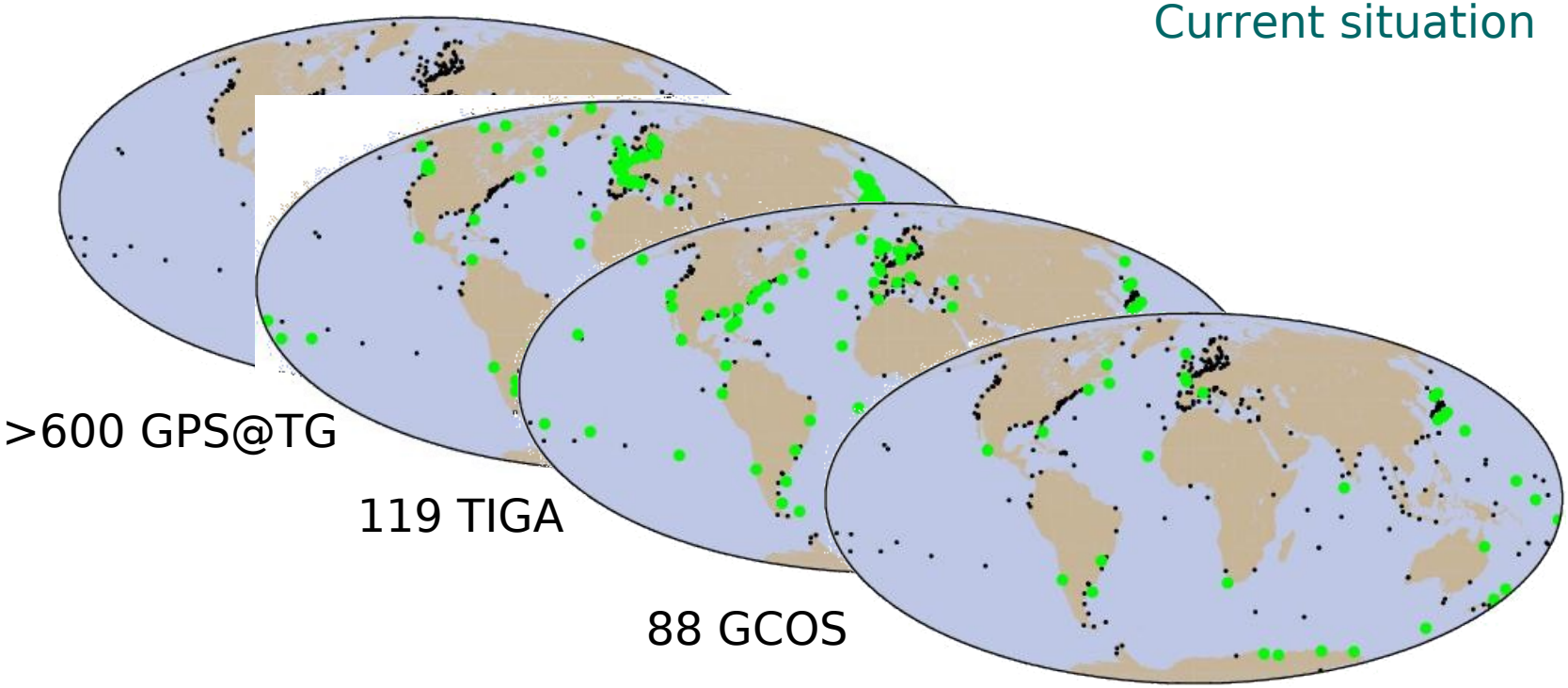


Results from the IGS TIGA

- Reprocessing of a large data set of GPS@TGs previously not know to IGS
- Many scientific applications supported
  - Altimetry calibration
  - Sea level reconstruction
  - Sea level change analyses
  - Height system support

GNSS-controlled tide gauges

Current situation



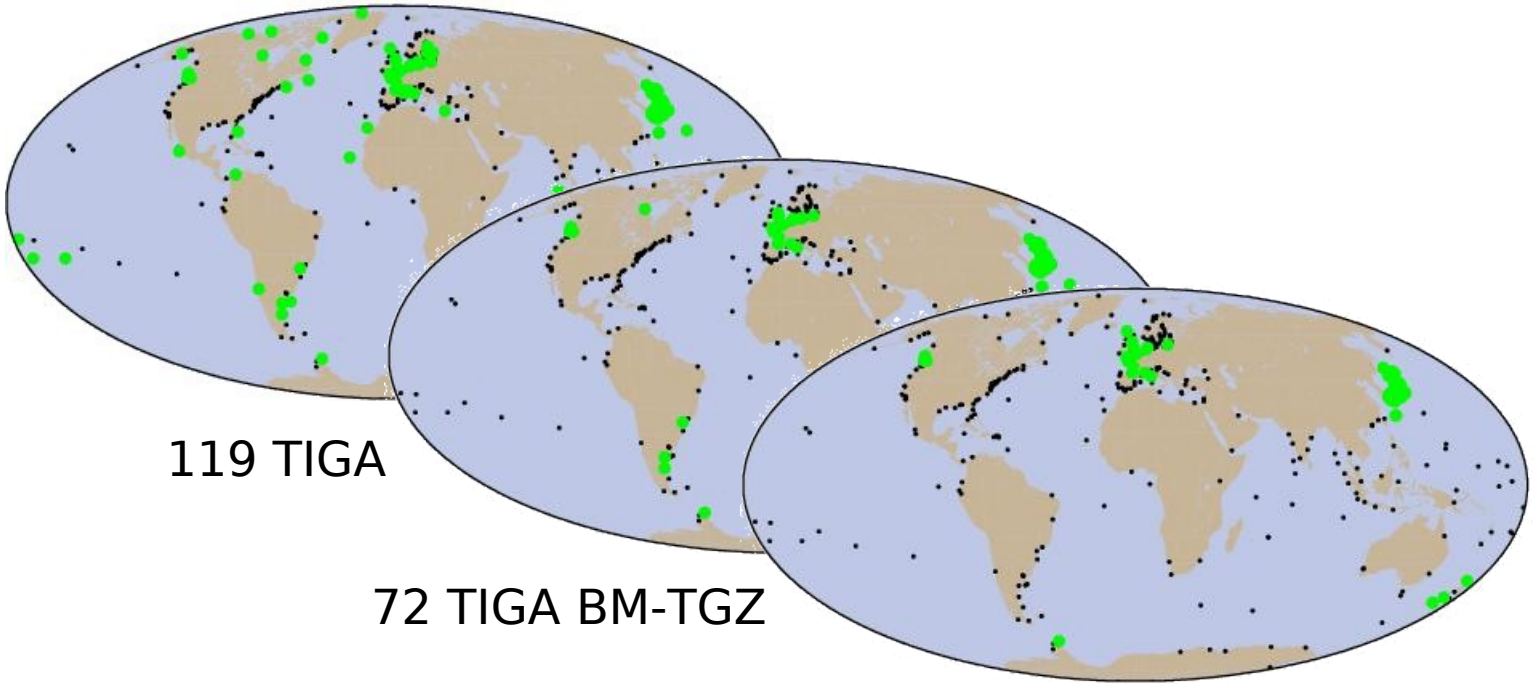
>600 GPS@TG

119 TIGA

88 GCOS

32 are TIGA & GCOS stations

Contribution to the Unification of WHS



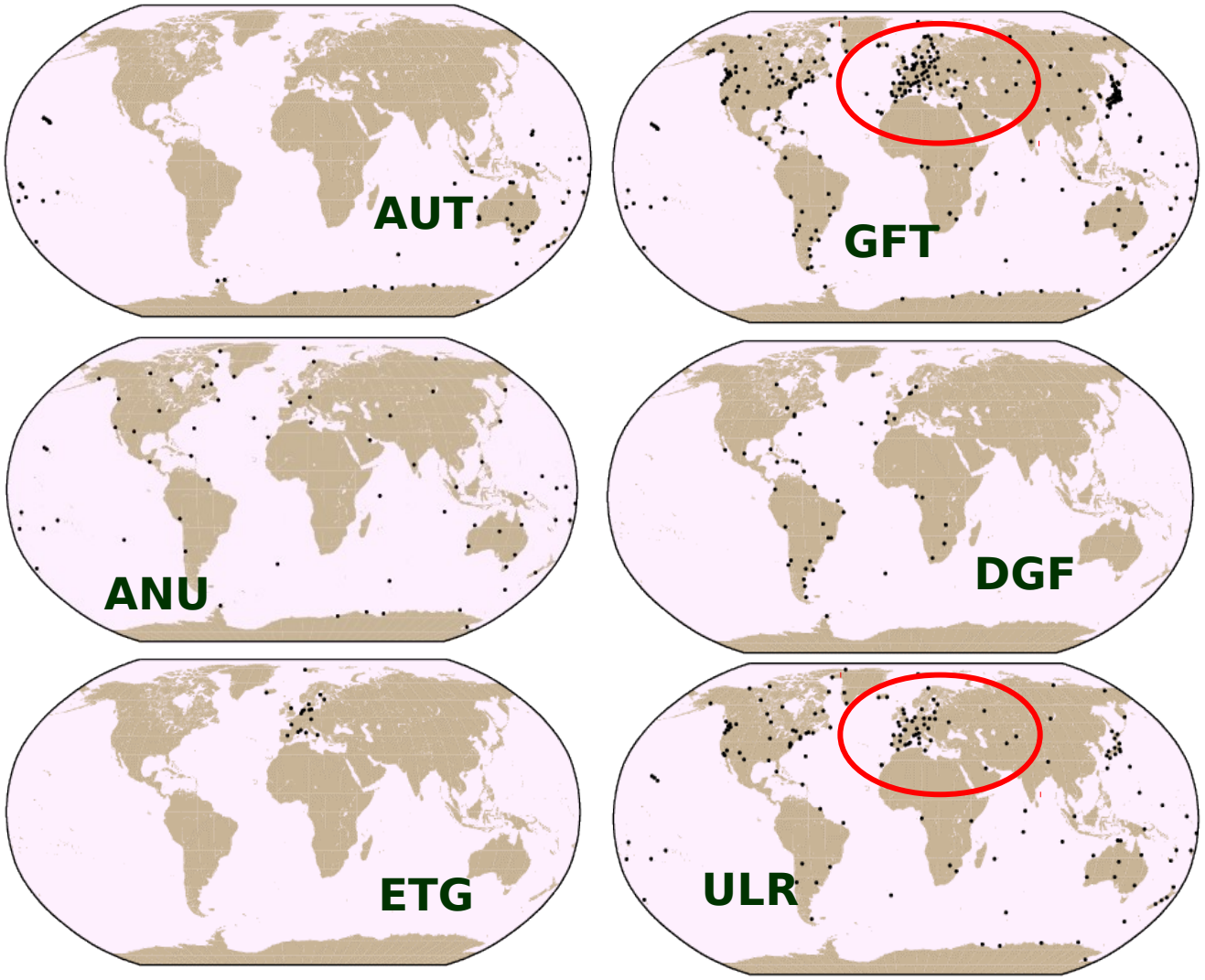
119 TIGA

72 TIGA BM-TGZ

56 TIGA stations provide
GNSS-TGZ ties

Survey on ties to national height systems still missing
But likely, the number goes down further

TIGA-repro1 coverage (2008)

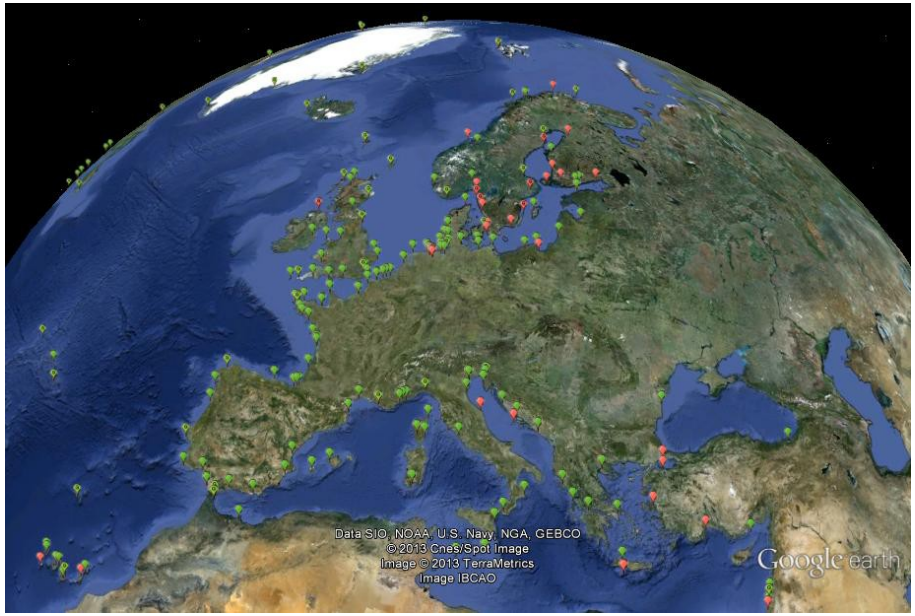


In Europe only 2 global solutions, weakly coverage and weakly constrained

TIGA Network Europe

Europe was covered by the ESEAS (European Sea Level Service) GNSS groups, but is not longer working

Traditionally TIGA had only very limited coverage,
⇒ Improvement/Densification needed



Possible EUREF Contributions

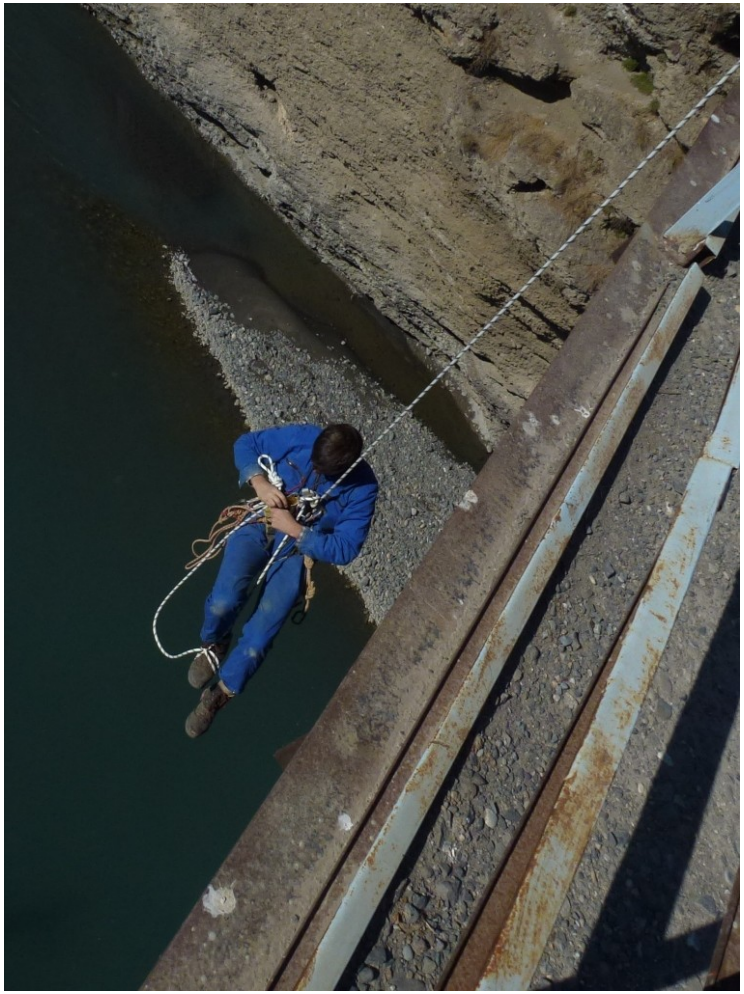
- **Take a key role to attract other national/regional networks**
- **Network Densification in Europe**
- **Provide European Expertise and Perspective**
- **Establishing leveling ties between GNSS (benchmarks), tide gauge benchmarks and national leveling networks**

TIGA reprocessing frame

- Reprocessing for 1995-2012
- Using IGS08b as common reference
- Follow IGS-repro2 standards to a large extend
- Weekly SINEX solutions (7 day combinations) and single-day SINEX
- Preferable exchange of Normal Equations
- Submissions for 1st TIGA repro October 2013

Many thanks …

- to the GNSS and tide gauge operators,
- the IGS, IOC/GLOSS,
- the TIGA members
- and the GNSS, TIGA and sea level community support



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Sorry for not being here, I hang around somewhere