TIGA WG Splinter Meeting

IGS Workshop Wuhan

31. October 2018

IGS INTERNATIONAL GNSS SERVICE

TIGA

aims to deliver the expertise of the IGS to the sea level community.

IGS works with UNESCO/IOC The Global Ocean Observing System

is recognized by both organizations

TIGA Objectives

- Maintain a global virtual GNSS @ TG network
  - Select a set of tide gauges equipped with GNSS, with a long and reliable history, useful for sea level studies.
  - IGS network operation standards should be applied.
  - 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 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. Provide a combined solution as the TIGA official product.
- Provide training to tide gauge operators through workshops, encourage station operators to provide necessary metadata. Through GLOSS advice station operators about the operation of GNSS @ TG stations.

Report TNC & TDC

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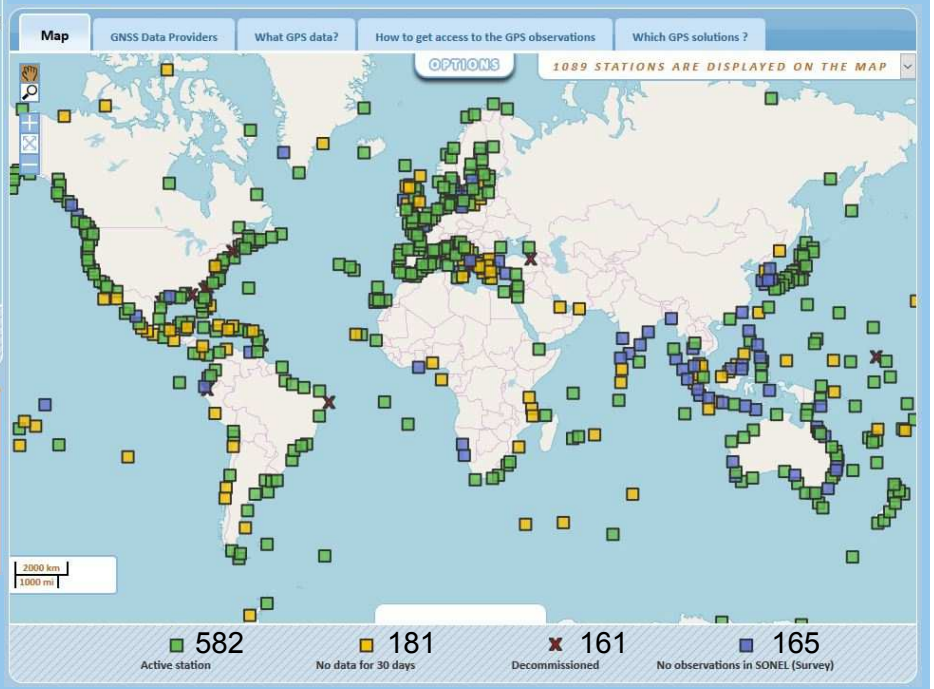
TIGA network status

GNSS@TG stations committed to TIGA

SONEL GNSS@TG network

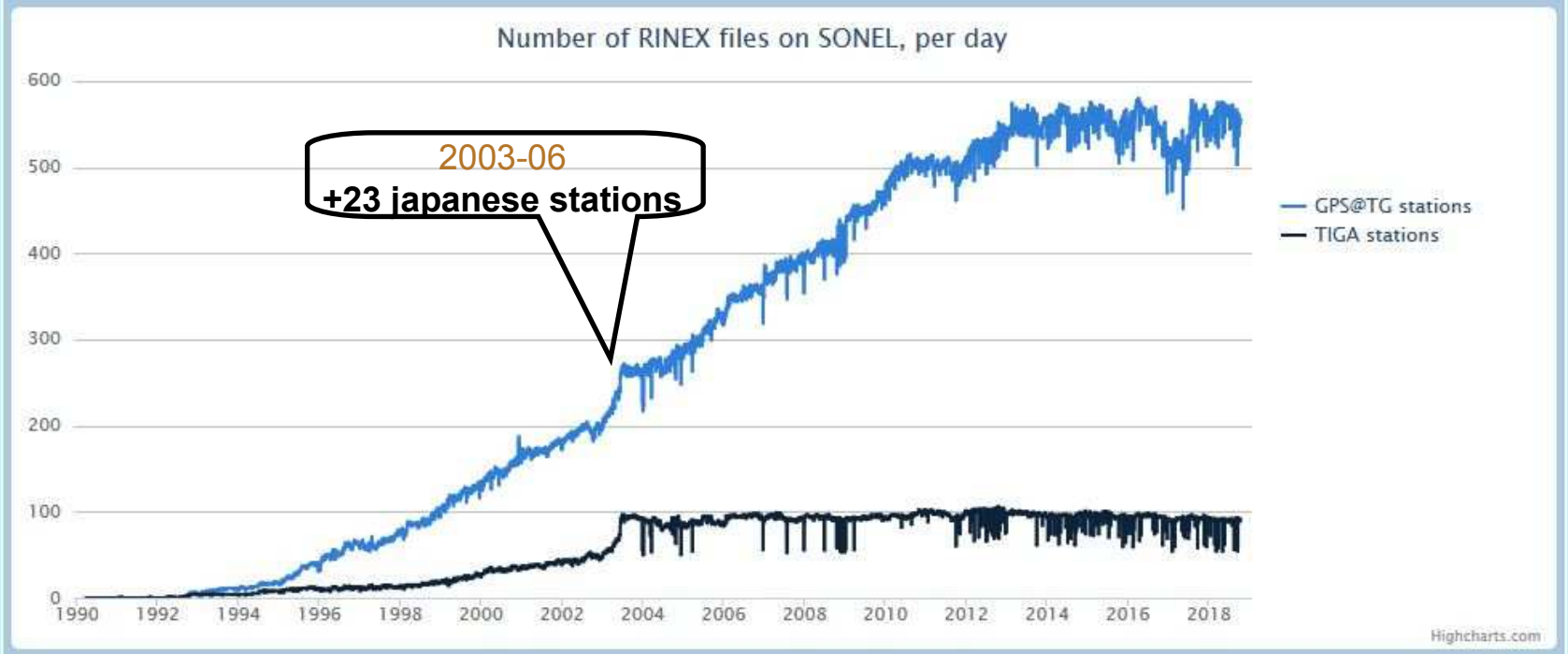


TIGA network status

Number of RINEX files for TIGA and GNSS@TG stations

Number of RINEX files

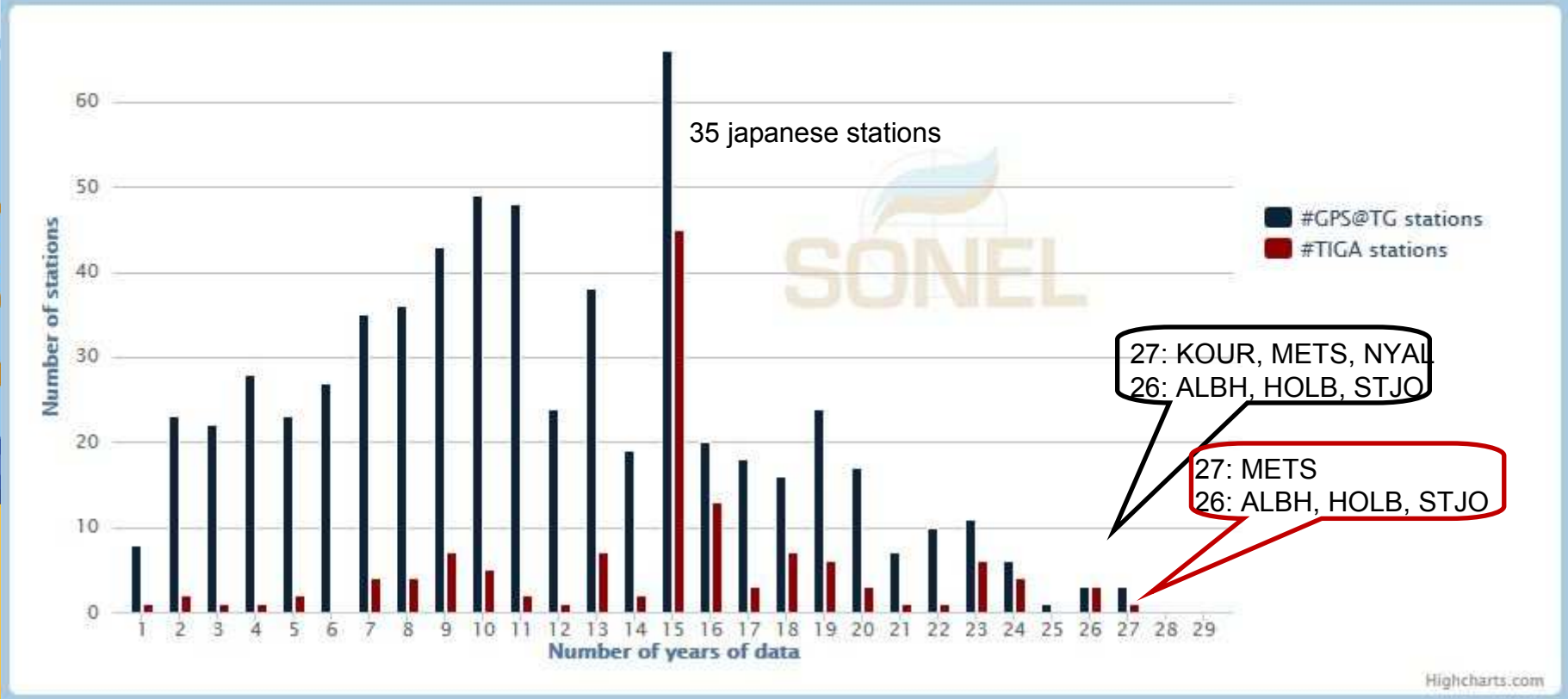
This graph shows the evolution of the number of Rinex files available on SONEL (per DOY) since 1990-079 for GPS@TG and TIGA stations



TIGA network status

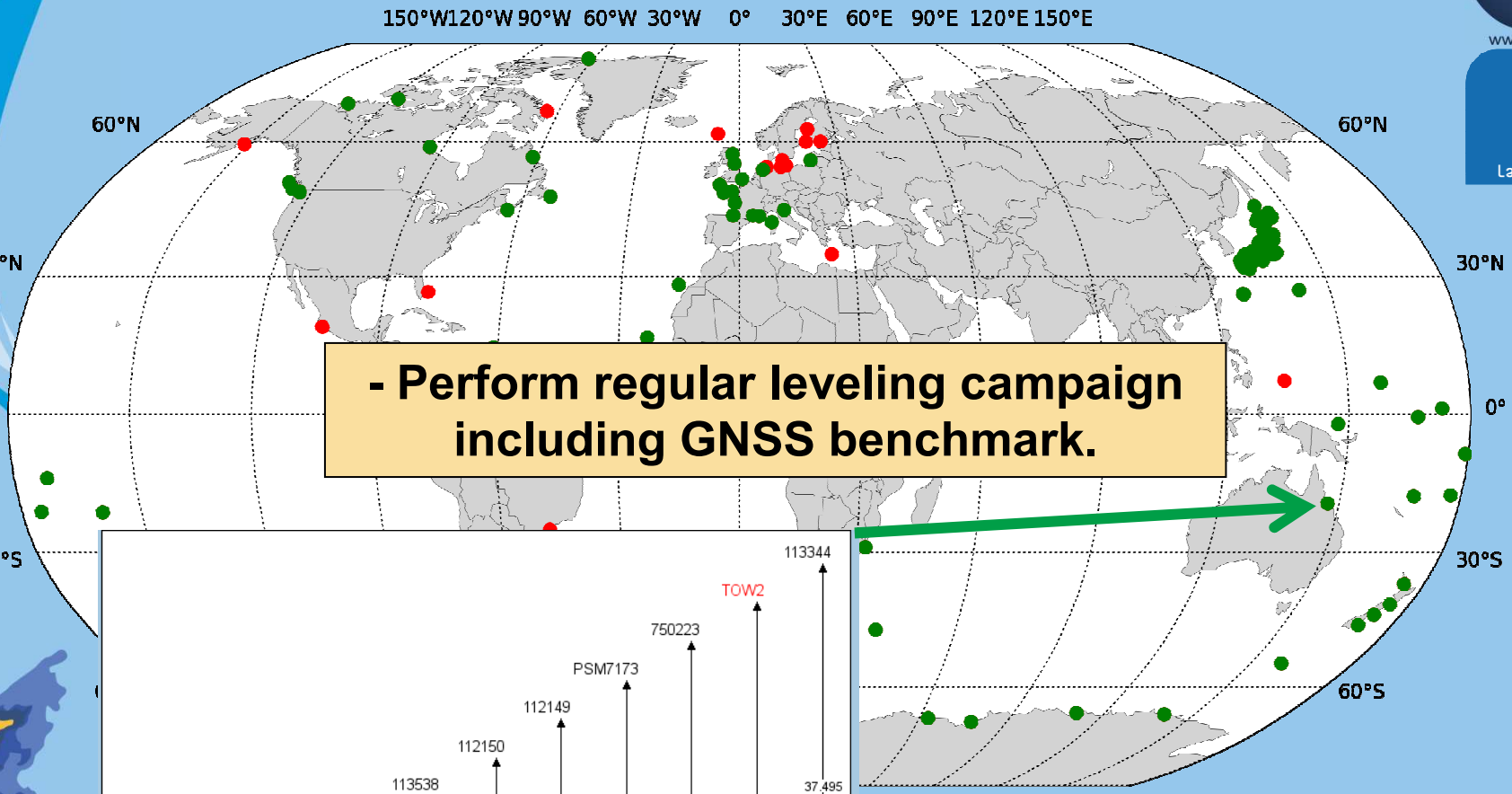
Time series lengths for TIGA and GNSS@TG stations

Number of stations whose record length reaches x (years) value.



TIGA network status

Leveling status for TIGA stations



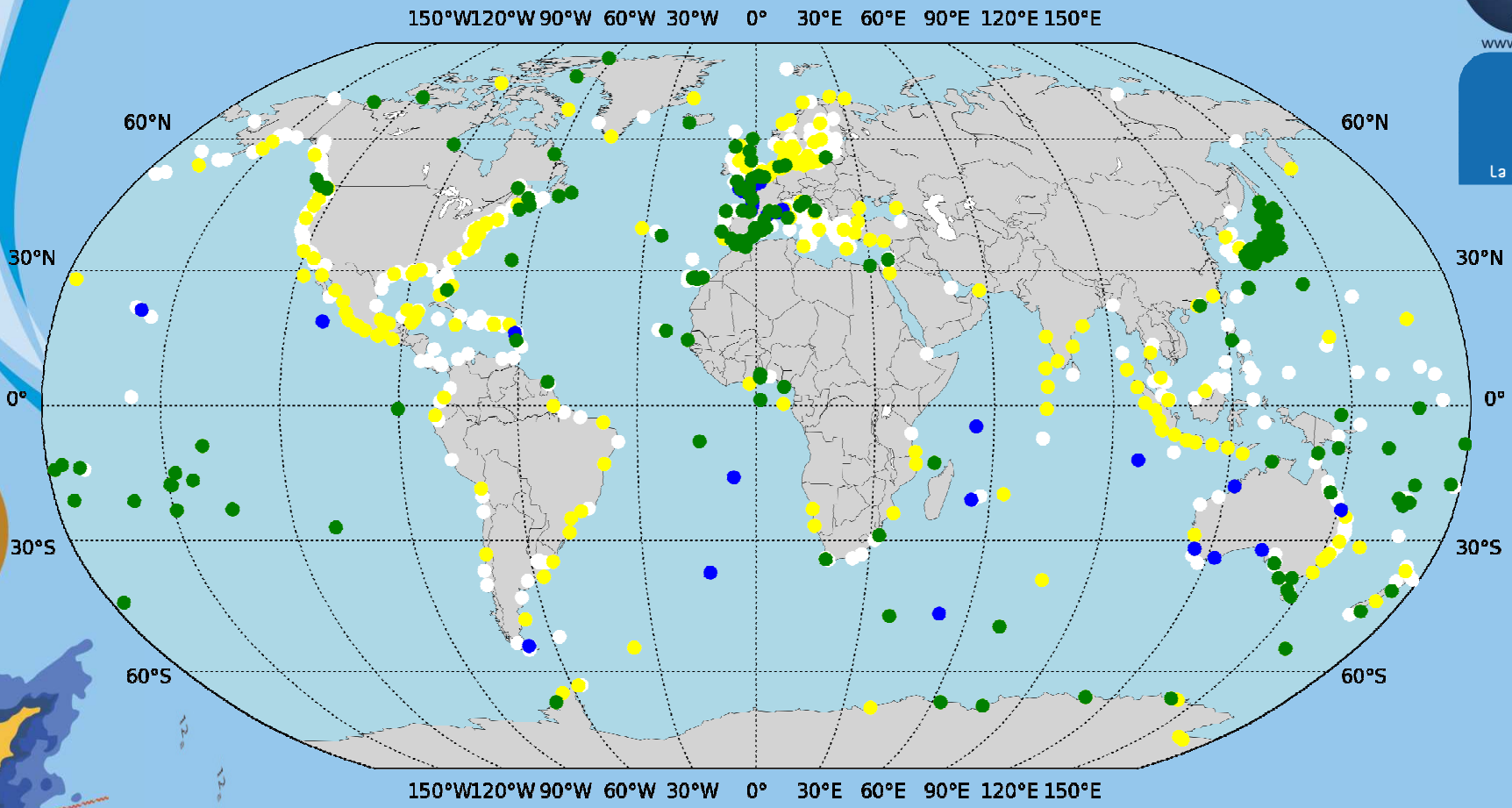
- Perform regular leveling campaign including GNSS benchmark.

92
33

more than in 2017)
EL

SONEL network status

Leveling status for GNSS@TG stations on SONEL

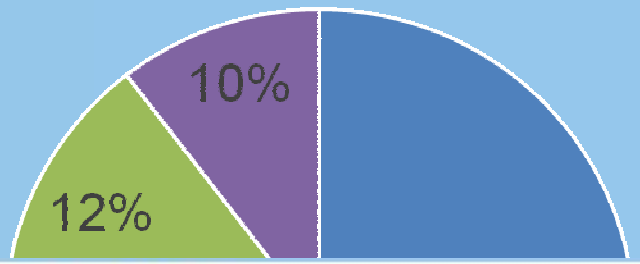


175 GNSS@TG stations with leveling information in SONEL (= 15 more than in 2017)
296 Tide gauges without any known geodetic connection (GNSS-TG ≤ 1000 m)
31 Tide Gauges with leveling information in SONEL but no link to the GNSS stations collocated
914 GNSS@TG stations without any leveling information in SONEL

TIGA network status

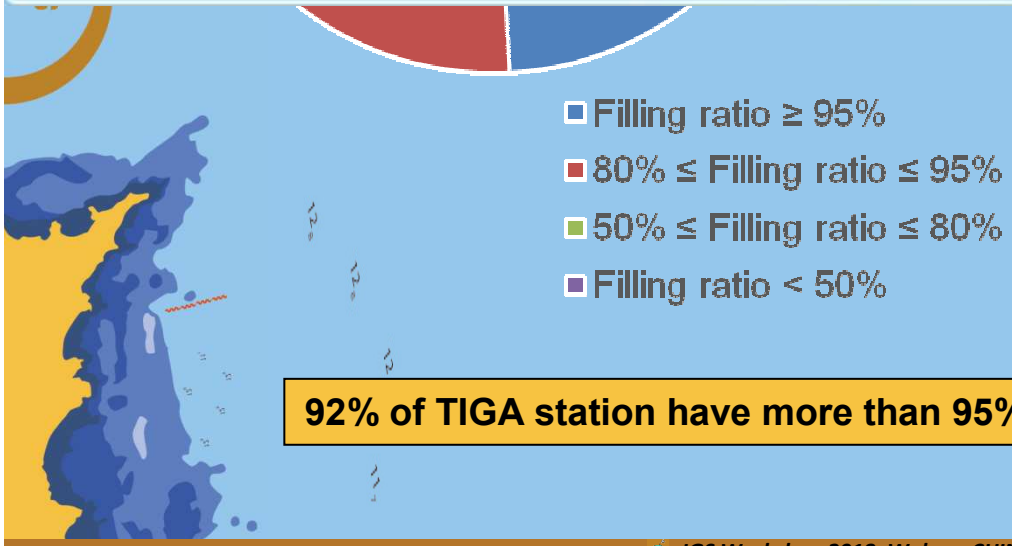
Time series filling ratio for TIGA and GNSS@TG stations

TIGA stations



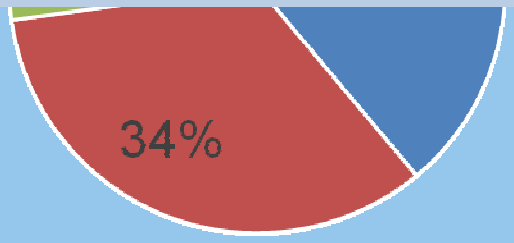
49% of the TIGA stations have a filling ratio of the observations completeness ≥ 95%.

39% for GPS@TG stations on SONEL.



BUDP@KOBENHAVN:

- Filling ratio = 99,79%
- % good data = 99,99%



92% of TIGA station have more than 95% of good data.

TIGA network status

Identified problems with TIGA stations:
stations with filling ratio < 80%

ACRONYM	Filling ratio	Start date	Date of last data	Comments
FREE	9%	07/06/1999	21/10/2001	BHMA nearby, but few data
TGCV	16%	29/04/2000	02/12/2014	CPVG-> TG=5km, green (TGCV->TG=5m)
MNZO	21%	04/11/2001	12/02/2014	MZNC-TG=1,9km, green
SIMO	32%	01/01/2001	19/04/2016	
KLPD	32%	07/12/2004	04/11/2012	
CART	36%	03/02/2000	…	
PLUZ	42%	06/04/2004	17/08/2013	
GETI	45%	01/01/1999	30/11/2015	GET1 announced, no news
PALA	47%	02/08/1996	24/04/2017	
RBAY	53%	03/10/2000	…	
BIN1	54%	19/09/2007	25/03/2017	BINT: 12% decommissioned
MALD	67%	12/08/1999	11/06/2006	HULE nearby, but few data
MARN	67%	31/07/2006	06/06/2018	
FFT2	68%	03/12/2015	12/12/2017	FFTG: 27% decommissioned, FFT2 good (but temporally out of order
DUM1	72%	30/01/1995	20/03/2017	
RWSN	75%	26/01/2000	…	
DUNT	77%	30/09/1999	12/10/2018	
LYTT	77%	15/11/1999	…	
SHEE	79%	26/03/1997	…	

No data for more than 30 days

Continued RINEX data delivery

Decommissioned station

10% of TIGA stations have less than 50% of data, with no other GNSS station nearby: CART, FREE, GETI, KLPD, PALA, PLUZ, SIMO.

BIN1, FFT2, VALN have been added to TIGA

TIGA network status

Identified problems with TIGA stations:
Stopped or no data

Problems with data:

- PLUZ -> no data since 2013-229
- GETI -> no data since 2015-334
- KLPD -> no data since 2012-309 (a storm destroyed the station, and nothing has been restored).
- FREE -> no data since 2001-294

Information since last IGS workshop 2017

- DEGE (on the TG) is decommissioned, with 96% data, 11 years data, replaced by FINS, with 99,8% data, 4 years data since 2014 (but 32km from TG)
- TUKT and SIMO have been decommissioned from IGS resp. 29/08/2017 and 04/10/2018*

No information & no data:

- GVD0

Consider better stations?

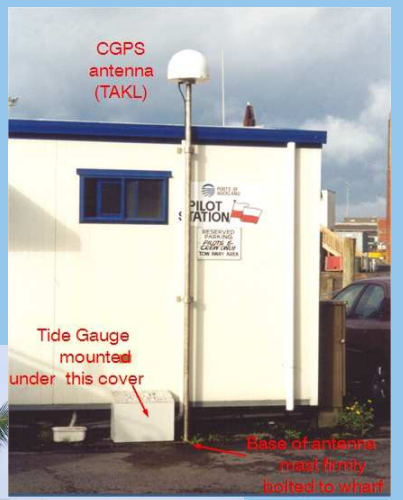
- TGCV -> no data since 2014-336 – Consider CPVG GNSS station? 5km from TG but delivering daily RINEX, IGS station.
- MNZO -> no data since 2014-043 – Consider MZNC GNSS station? 1,9km from TG but delivering daily RINEX

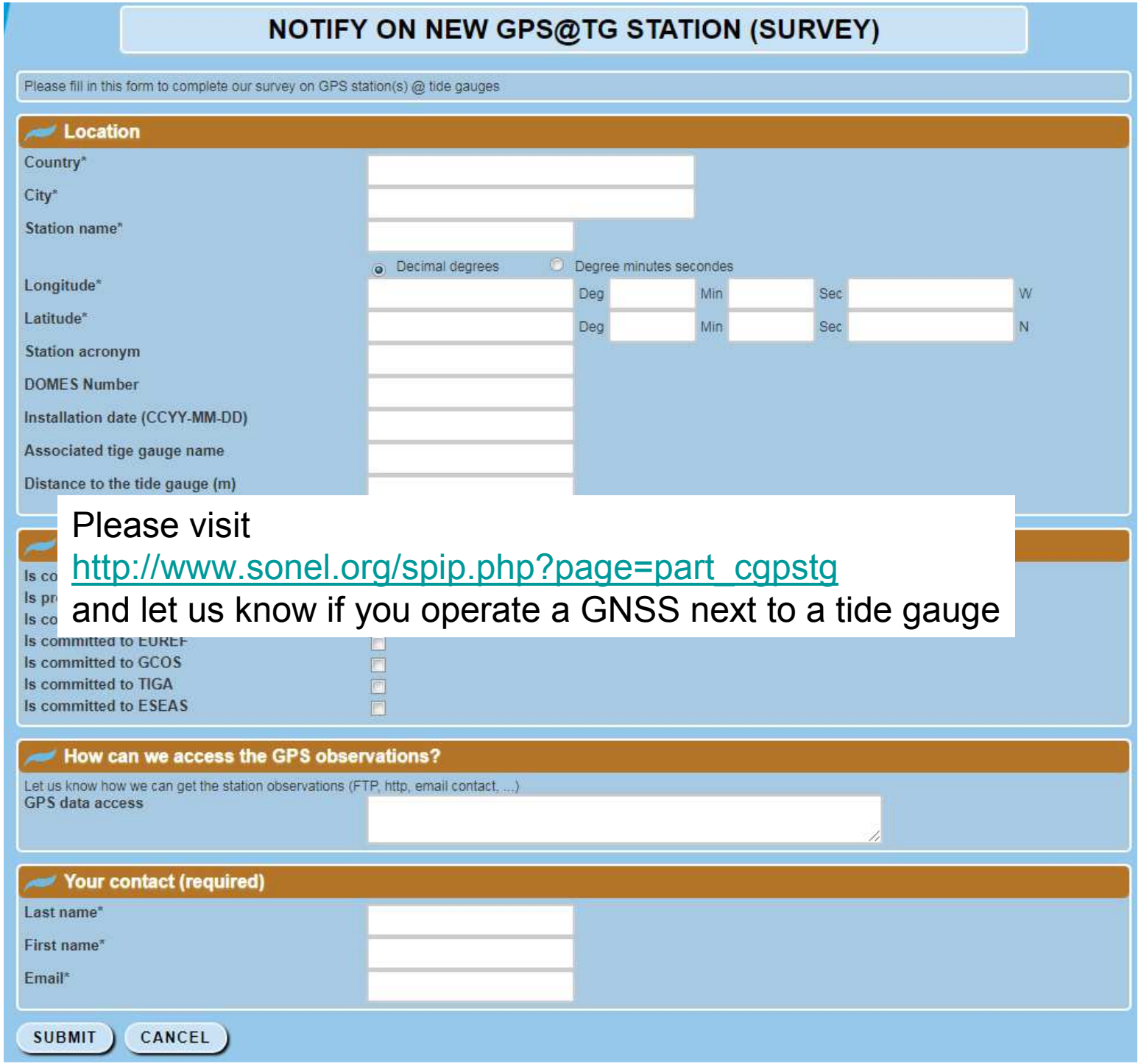
TIGA network status

Remind:

Requirements to become a TIGA station:

i. Availability of GNSS data & sitelog at the TDCs
ii. Tide gauge data being sent to the PSMSL or UHSLC
iii. Provision of the TOS (TIGA Observing Station) form
iv. Regular connections TG-Benchmark->TG_Zero and TG-Benchmark-ARP
v. Regular leveling of the benchmarks of the GNSS-marker




NOTIFY ON NEW GPS@TG STATION (SURVEY)
Please fill in this form to complete our survey on GPS station(s) @ tide gauges
Location
Country*
City*
Station name*
Decimal degrees
Degree minutes secondes
Longitude*
Deg
Min
Sec
W
Latitude*
Deg
Min
Sec
N
Station acronym
DOMES Number
Installation date (CCYY-MM-DD)
Associated tige gauge name
Distance to the tide gauge (m)
Please visit
http://www.sonel.org/spip.php?page=part_cgpstg
and let us know if you operate a GNSS next to a tide gauge
Is committed to EUREF
Is committed to GCOS
Is committed to TIGA
Is committed to ESEAS
How can we access the GPS observations?
Let us know how we can get the station observations (FTP, http, email contact, ...)
GPS data access
Your contact (required)
Last name*
First name*
Email*
SUBMIT
CANCEL

Report TCC

Felix Norman TEFERLE

Norman.Teferle@uni.lu

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Current TIGA Analysis Centres (TAC)

TAC	Host Institutions	Software package	Contributors
AUT	GeoScience Australia, Canberra, Australia	Bernese GNSS Software V5.2	M. Moore, M. Jia
BLT	British Isles continuous GNSS Facility and University of Luxembourg TAC (BLT), UK and Luxembourg	Bernese GNSS Software V5.2	F. N. Teferle R. M. Bingley
DGF	The Deutsches Geodätisches, Forschungsinstitut, Germany	Bernese GNSS Software V5.2	L. Sanchez
GFZ	GeoForschungsZentrum (GFZ), Potsdam, Germany	EPOS P8	T. Schöne Z. Deng
ULR	Centre Littoral de Geophysique, University of La Rochelle (ULR), France	GAMIT V10.5	G. Wöppelmann A. Gómez-A. Santamaría M. Gravelle

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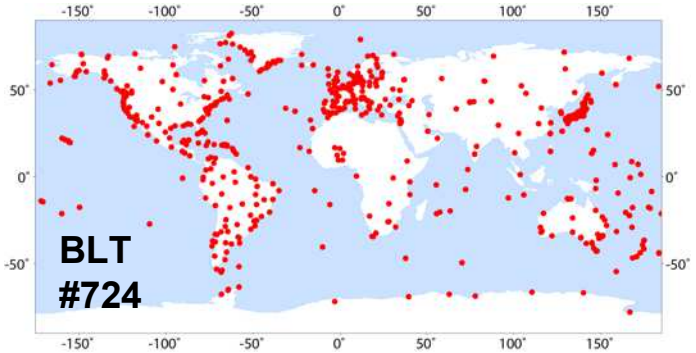
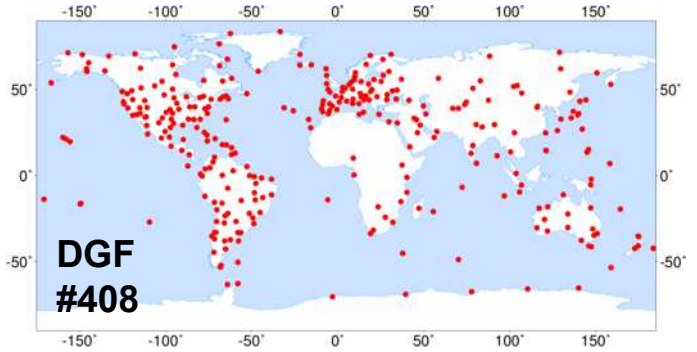
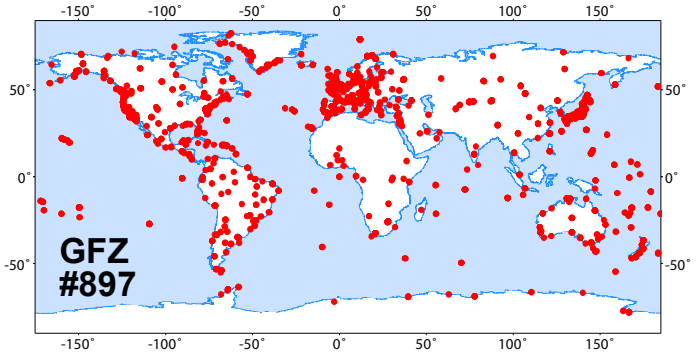
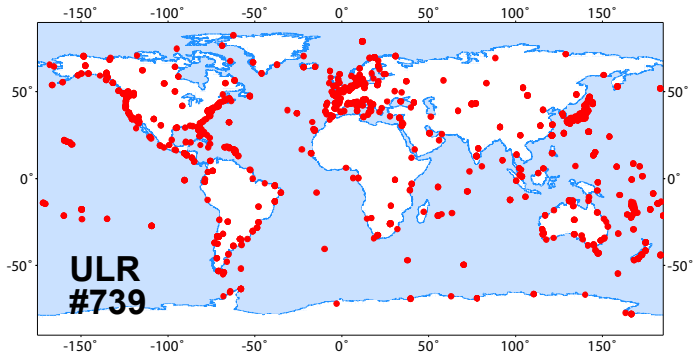
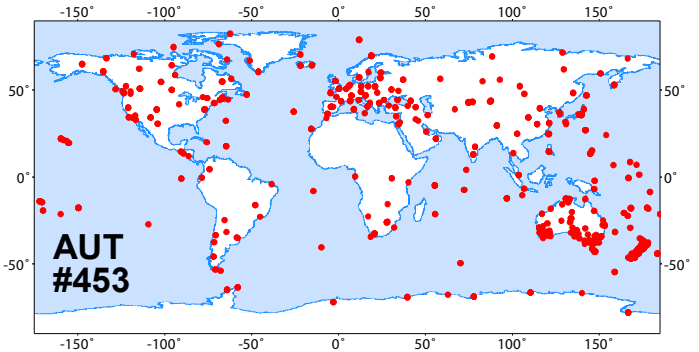
TAC Global Networks











TIGA Data Centre:
University of La Rochelle (ULR):
www.sonel.org

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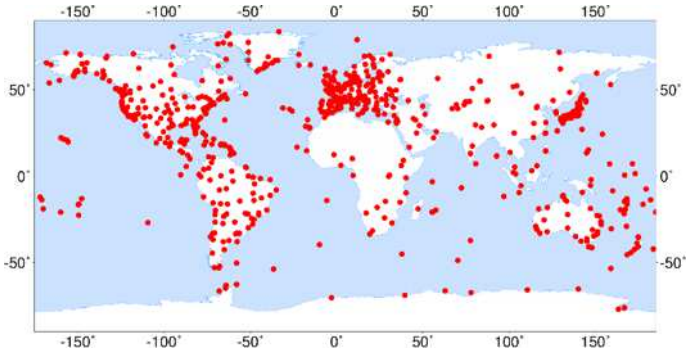
TIGA Combination (Release 0.99)

- Presented at IGS WS 2017
- It should have been Release 1.0, so why Release 0.99?
- AUT and DGF solutions were not included
- Reasons
  - Incompleteness of solution set at cut-off date (AUT)
  - Seemingly unresolvable issues (DGF) that lead to failure in computing combined solutions



All tracking stations in the combined solution

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Towards TIGA Combination (Release 1.0)

- Progress:
  - Participated in CATREF training in April 2018 and obtained latest CATREF release.
  - Obtained complete set of SNX files from AUT
  - Investigated (with P Rebischung) problems of adding DGF SNX files to solution
    - Works ok for large time spans but not for complete span
    - CATREF routines normally applied to Bernese GNSS Software solutions do not fully resolve DGF solution issues
    - Suspicion that problem is related to tight constraints applied in the DGF solution
- Outlook:
  - Attempt to provide Release 1.0 first half of 2019

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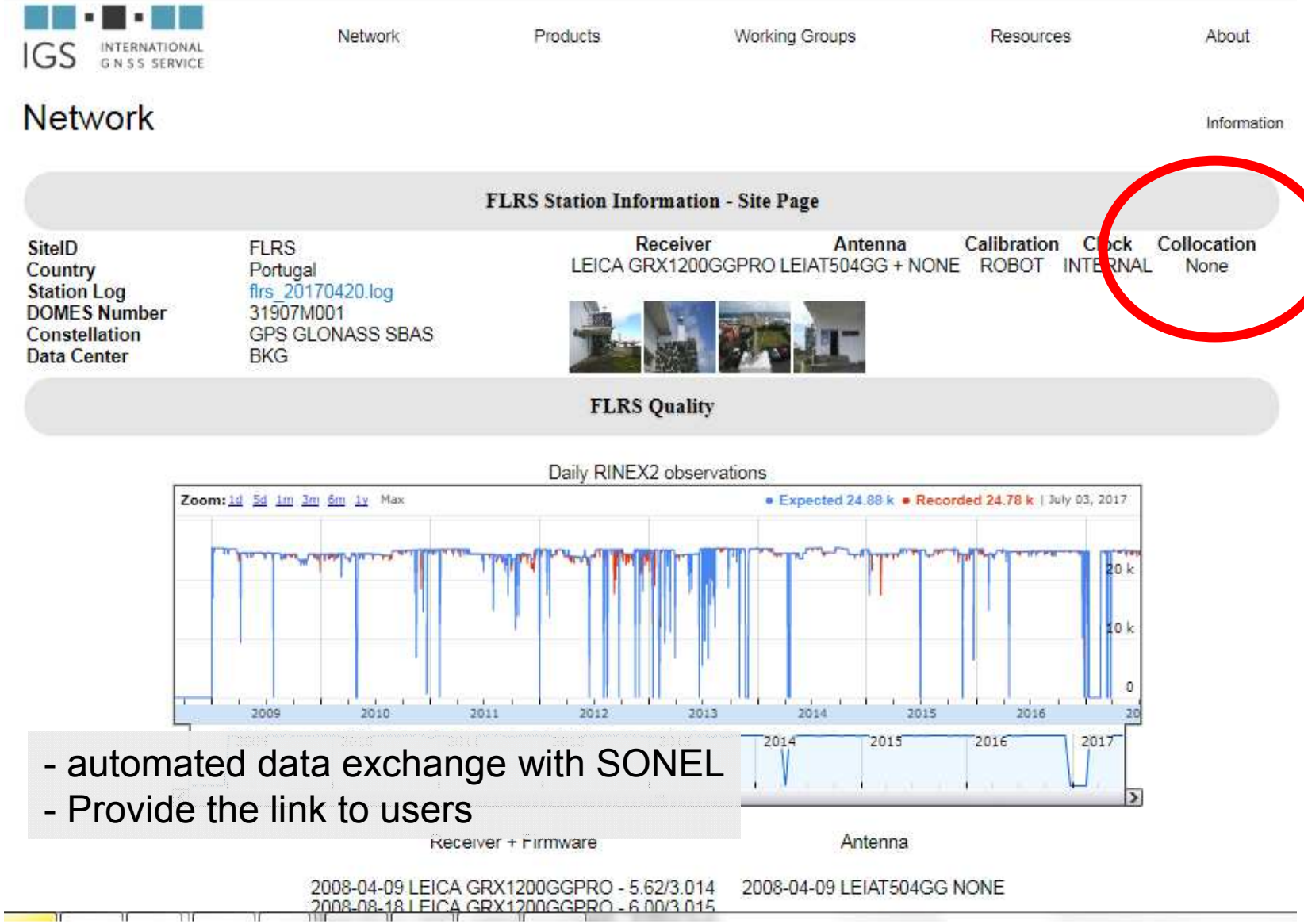
Interfacing with Infrastructure Committee

- Nacho, Médéric, David, Tilo, Elizabeth

Advancing the Interface to IGS



- automated data exchange with SONEL
- Provide the link to users

TIGA Analysis Center repro3

TIGA Analysis Center (TAC)	TIGA	Submit to IGS
BLT (University of Nottingham , University of Luxembourg)	yes	Yes
DG3 (DGFI/TUM Germany)	pending	Pending
GT3 (GFZ Potsdam TIGA Solution)	pending	pending
UL3 (University La Rochelle)	Yes	yes

Feedback pending, or under discussion

GA will provide consistent time series based on repro3 results (orbits/clocks)

TIGA Analysis Center repro3

- Sea Level community has specific requirements (especially loading)
  - necessary to keep atmospheric loading out of observation level
- Any other specific issue on this or for repro3?
- How a multi-GNSS repro affects the long-term stability of (TIGA) GPS-only stations?

Workshop Recommendations

- TIGA-WG should be included in any discussion regarding repro3 & will contribute
- Encourage IGS community
  - to explore possibilities to establish new GNSS stations at or near tide gauges
  - to provide resources for establishing ties between GNSS-ARP and TG-TGZ/TGBM
- Ask IGS-AC's to include as many as possible GNSS@TG stations for repro3
- Ask the IGS-AC to study the impact of multi-GNSS combinations on long-term homogeneity of GPS-only time series (req. sub-mm/a)

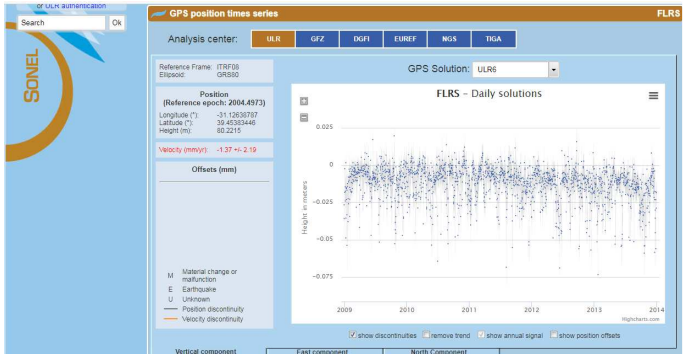
Membership

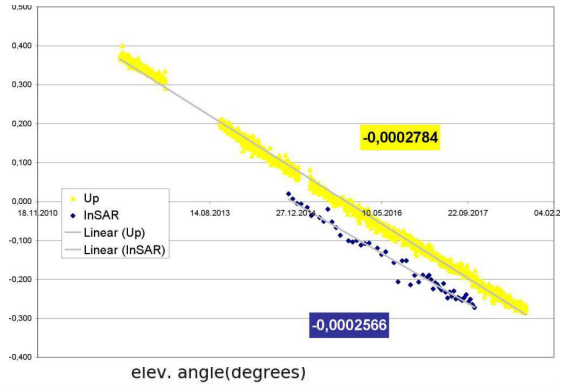
Name	Entity	Host Institution	Country
Guy Wöppelmann	TAC, TNC, TDC	University La Rochelle	France
Laura Sánchez	TAC	DGFI Munich	Germany
Minghai Jia	TAC	GeoScience Australia	Australia
Zhiguo Deng / Benjamin Männel	TAC	GFZ Potsdam	Germany
Elizabeth Prouteau	TNC	University La Rochelle	France
Norman Teferle	TAC/Combination	University of Luxembourg	Luxembourg
Richard Bingley	TAC	University of Nottingham	UK
Allison Craddock	IGS Central Bureau	ex officio	USA
Tom Herring / Michael Moore	IGS AC coordinator(s)	ex officio	USA / Australia
Carey Noll	TDC	CDDIS, NASA	USA
Tilo Schöne	Chair TIGA-WG	GFZ Potsdam	Germany
Simon Williams	PSMSL	PSMSL, NOC Liverpool	UK
Gary Mitchum	GLOSS GE (chair)	University of South Florida	USA
Matt King		University of Tasmania	Australia

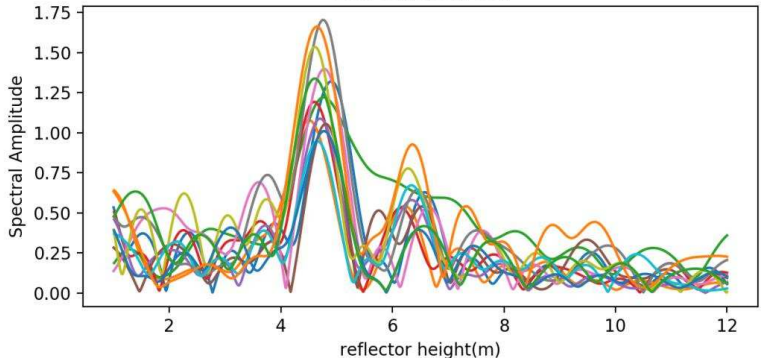
+ observers

To do List

- Integration of TAC solutions into SONEL
- InSAR/PSI stability test for long-distance ties
- Evaluating GNSS as tide gauges







To do List

- Action items from IGS-GB
  - Infrastructure Committee to work with TIGA for linking tide gauges to infrastructure
    - Meeting after the splinter
  - Find a way to identify and/or integrate TIGA stations in the Reference Frame by working toward a set of recommendations for identifying those sites that do or do not have IGS site guideline monuments, as well as identification and treatment of non-stable monuments through removal or flagging.
    - Today's discussion with RF coordinator

Next dates

- 2018 AGU Session
  - Integration of GNSS into Water Level Observation Networks: Priorities, Technologies, and Benefits (deadline passed)
- **GLOSS Group of Expert Meeting**
  - Korea Hydrographic and Oceanographic Agency, Busan, Republic of Korea (11-13 April 2019)
- EGU 2019 (7.-12.4.2019)
  - High-precision GNSS: methods, open problems and Geoscience applications (deadline 10 January 2019)