Progress Report on the GNSS at Tide Gauge Data Assembly Center: SONEL Data Holdings & Tools to access the data

(Status report as of April 9th, 2019)

Prepared by G. Wöppelmann, M. Gravelle, M. Guichard, E. Prouteau

Foreword

In 2009, the GLOSS program convened a workshop on "*Precision Observations of Vertical Land Motion at Tide Gauges*" before its XIth Group of Experts meeting. The main objective was to review the geodetic methods that could provide a means to accurately express the tide gauge data in the same geocentric reference frame as the satellite altimetry data, and to monitor the vertical land movements that are recorded by the tide gauges at the sub-millimeter per year precision level, hence enabling their separation from the climatic signals. One of the main conclusions of the workshop was that the Global Positioning System (GPS) had reached the maturity to address these issues, provided continuous GPS observations were carried out at the tide gauge and were made available to any group that has the knowledge and experience to analyze the data using the state-of-the art data analysis strategies, models and corrections. Most of these groups are committed to the International GNSS service (IGS) working group named TIGA. (Note that GPS was the first operational system of the several Global Navigation Satellite Systems (GNSS) available today). In the following, we will use the general term of GNSS, instead of GPS.

Another important conclusion from the mentioned workshop was that the GLOSS program should designate a dedicated "GNSS at tide gauge" data assembly center. To further examine this issue of a dedicated data center, a follow up meeting was organized at the University of Hawaii Sea Level Center (UHSLC) in 2010. The proposal of the SONEL data center, which has been acting as primary data center for the TIGA since 2001 was retained, and finally adopted at the XIIth GLOSS Group of Experts meeting in 2011. The GLOSS Implementation Plan released in 2012 recognizes that data center as an associated infrastructure, along with the other dedicated data centers of the program such as the UHSLC or the PSMSL (IOC, 2012).

Consistently, **the GLOSS implementation plan calls for the important upgrade of its core network sea level stations with continuous GNSS stations**, and that their observations be provided to its dedicated data assembly center (SONEL), so that **the observations and generated products be public and free to anyone** in line with the IOC/UNESCO Oceanographic Data Exchange Policy.

This report is the fourth status report of the SONEL GNSS at tide gauges data center since its inception in GLOSS. Most of the illustrations herein are extracted from the Internet portal of SONEL, and continuously updated versions can be viewed at www.sonel.org.

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Wake Is. (GLOSS 105)

Palau Is. (GLOSS 120)

Examples of GLOSS Core Network stations equiped with continuous GNSS since 2017

I- GNSS data holdings at SONEL

1. Global status overview

SONEL has currently identified 895 tide gauges for which a GNSS station is nearby (within ~15km), or from the other point of view 1109 GNSS stations that are nearby a tide gauge site (Figure 1). Among these GNSS stations **559 are active at 542 tide gauges** (a data file was successfully retrieved within the last 30 days, in green on Figure 1), 227 are dormant (no data for the last 30 days, in orange on Figure 1), and 166 are decommissioned (in red on Figure 1). It should be noted that 157 GNSS stations have no data available in SONEL (in blue on Figure 1), mostly because of commercial restrictions. Note that all the values in this report correspond to the status as of April 5th, 2019. As of April 2019, the SONEL data assembly center contains more than 4,780,000 daily station files of GNSS measurements in RINEX format, **contributed by nearly 190 different organizations.**

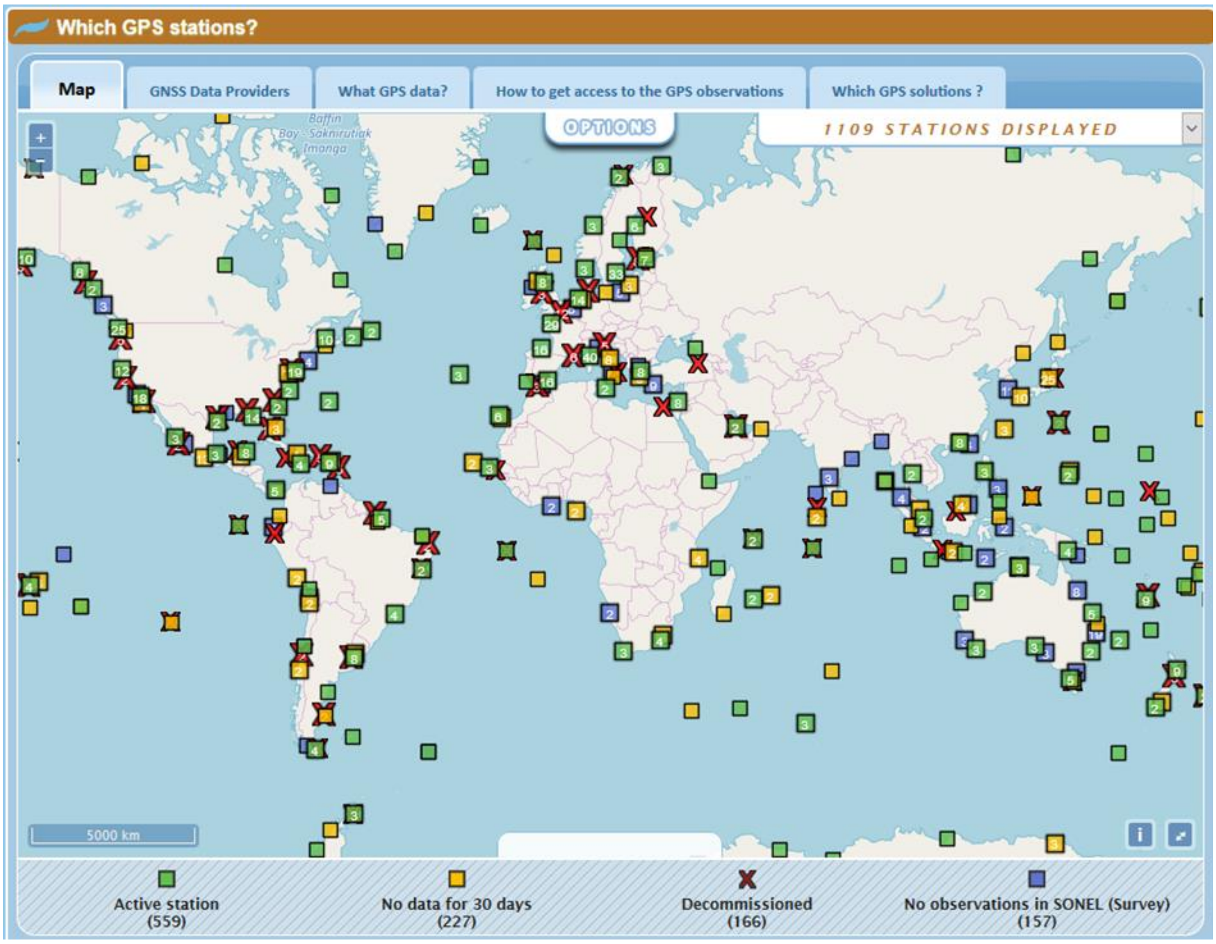

Figure 1: Status of the GNSS@TG data available on SONEL (April 2019). The numbers within the symbols indicate the number of GNSS stations grouped at that location/symbol for visualization purposes. The online version of this map enables to zoom out, and separate the locations of each GNSS. Online version at: **http://www.sonel.org/-GPS-.html**

Since the 15th session of the GLOSS Group of Experts meeting in July 2017, 11 new GNSS stations nearby a GLOSS Core Network tide gauge have been identified and their data collected into SONEL. Among these, two are replacing a decommissioned GNSS station (at Palau, GLOSS 120, and at Cilacap, GLOSS 291). Thus, 9 GLOSS Core Network tide gauges out of the above 11 did not have any

GNSS in 2017. It should also be noted that data are available in SONEL for only 5 of the 11 new GNSS stations at GLOSS sites. (Note that by GNSS it is meant a continuous GNSS station).

Figure 2 shows the evolution of the number of daily GNSS data files, which informs on the number of GNSS stations actually operational. As many as 720 stations are reported ("Total" curve, in blue), which includes both the GNSS at tide gauges and the reference frame stations. The latter reference frame stations are essential in the GNSS data analysis to ensure the realization of a stable geocentric reference frame over the entire data span.

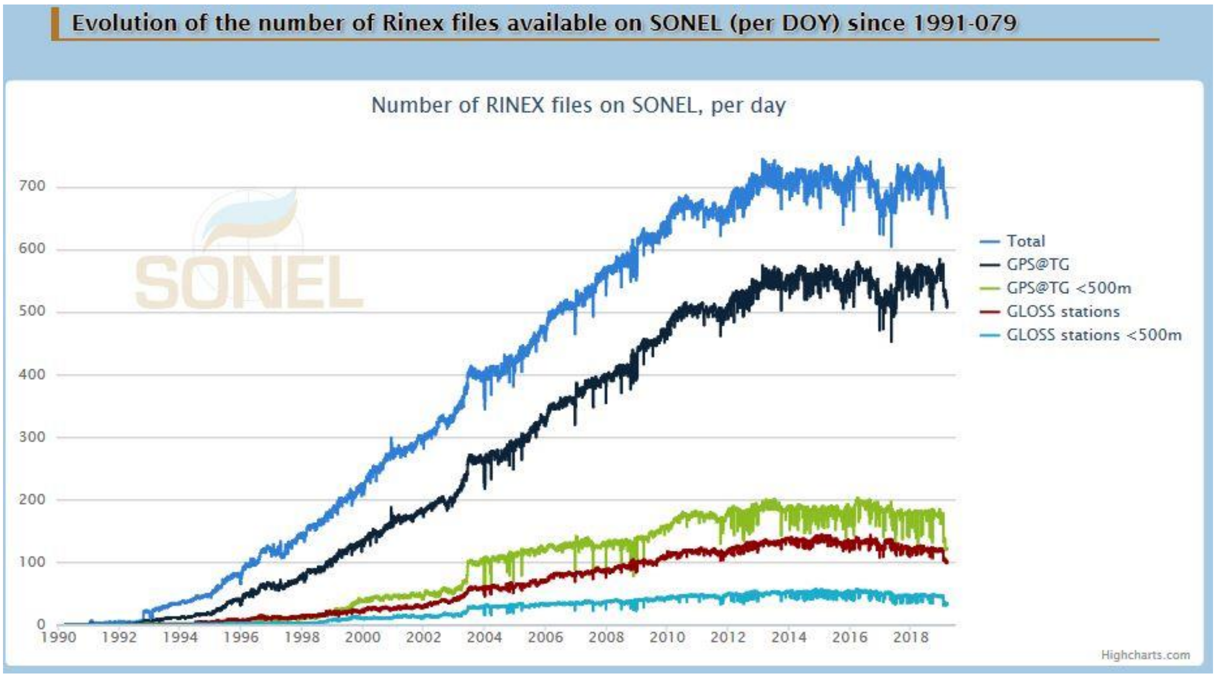

Figure 2: Evolution of the number of daily observation files (active GNSS stations).
Online version at: http://www.sonel.org/-GPS-.html

2. GLOSS Core Network status overview

According to the latest version of the GLOSS station handbook (https://www.gloss-sealevel.org/gloss-station-handbook), the GLOSS core network comprises 290 tide gauge sites. Figure 3 shows that **219 of these stations are nearby one or more GNSS stations**. The 71 tide gauges for which no GNSS station has been found in the vicinity are in white on Figure 3. For 21 stations, a GNSS station has been identified but the data are not available (in blue on Figure 3, see also Table 1) in SONEL yet. This situation is primarily due to the restricted data policy of the station owner.

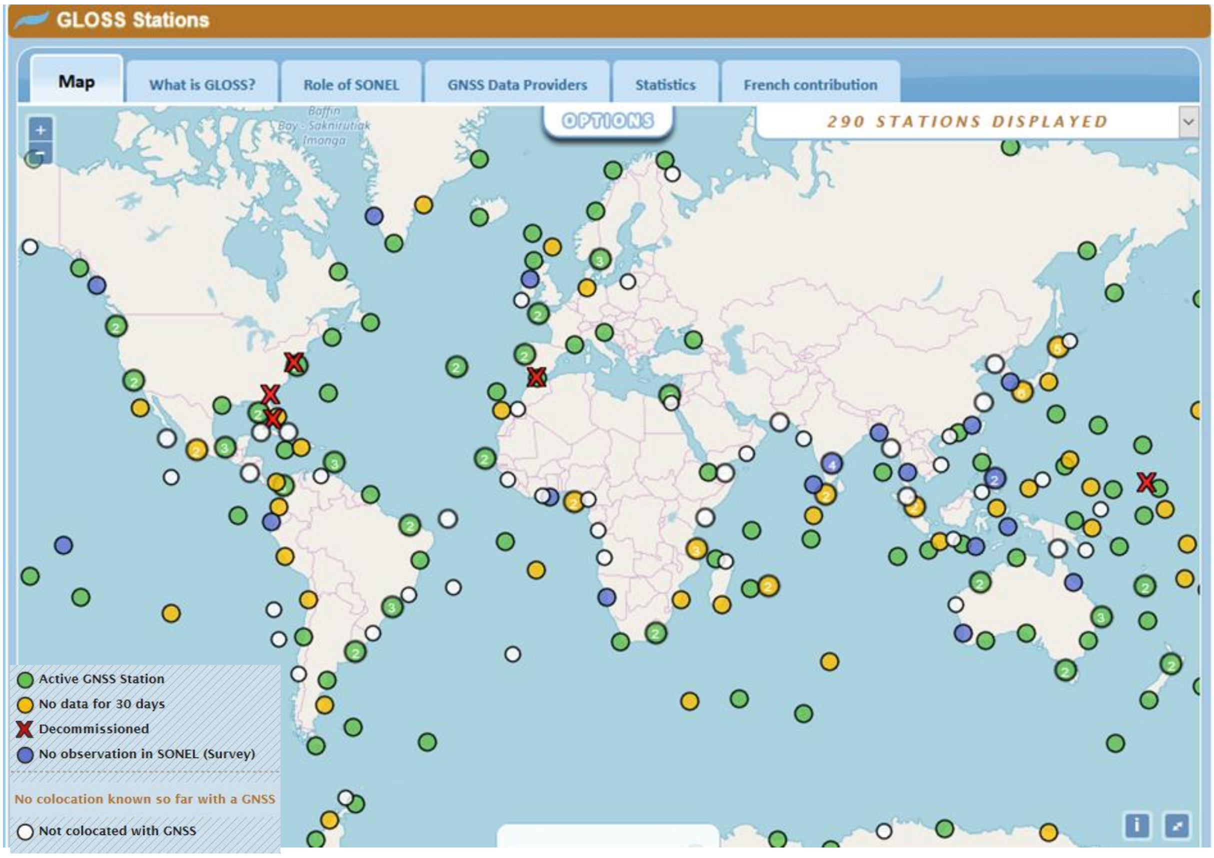

Figure 3: Status of the GLOSS tide gauge network with a GNSS station nearby.
Online version at: http://www.sonel.org/-GLOSS,81-.html

GLOSS tide gauge	Country	GNSS acronym
Fremantle	Australia	FMTL
Townsville	Australia	TCC1
Chittagong	Bangladesh	Unknown
Prince Rupert	Canada	BCPR
Xiamen	China	Unknown
Godthab	Denmark/Greenland	NUUK
La Libertad	Ecuador	SALN, SEEC
Nuku-Hiva	France (French Polynesia)	Unknown
Takoradi	Ghana	TKTG, TADI
Cochin	India	Unknown
Chennai / Madras	India	Unknown
Marmagao	India	Unknown
Minicoy	India	Unknown
Vishakhapatnam	India	VISA
Ambon	Indonesia	CAMB
Waikelo	Indonesia	WAIK
Malin head	Ireland	Unknown
Legaspi	Philippines	PLEG
Davao Gulf	Philippines	PDAV
Pusan	**Republic of Korea**	**PUSW**
Walvis Bay	Namibia	WBTA

Table 1: GLOSS stations (21) for which a continuous GNSS station has been identified nearby but its data are currently not available

It is worth reminding here that beyond the formal commitment to the GLOSS program (and hence the requirement for a free data policy of the tide gauge and GNSS data in line with the IOC/UNESCO Oceanographic Data Exchange Policy), there is a clear interest to distribute the GNSS measurements freely. Indeed, deriving geocentric vertical velocities from GNSS measurements at the sub-millimeter per year level over a decade remains a challenge in geodesy. Making the GNSS observations freely available will increase the chances of the data being processed, especially by the groups contributing to the IGS. This will then allow confrontation of the products (position time series and velocities) from different GNSS data analysis strategies, and hopefully will stimulate advances to obtain vertical velocities at tide gauges that are robust and reliable.

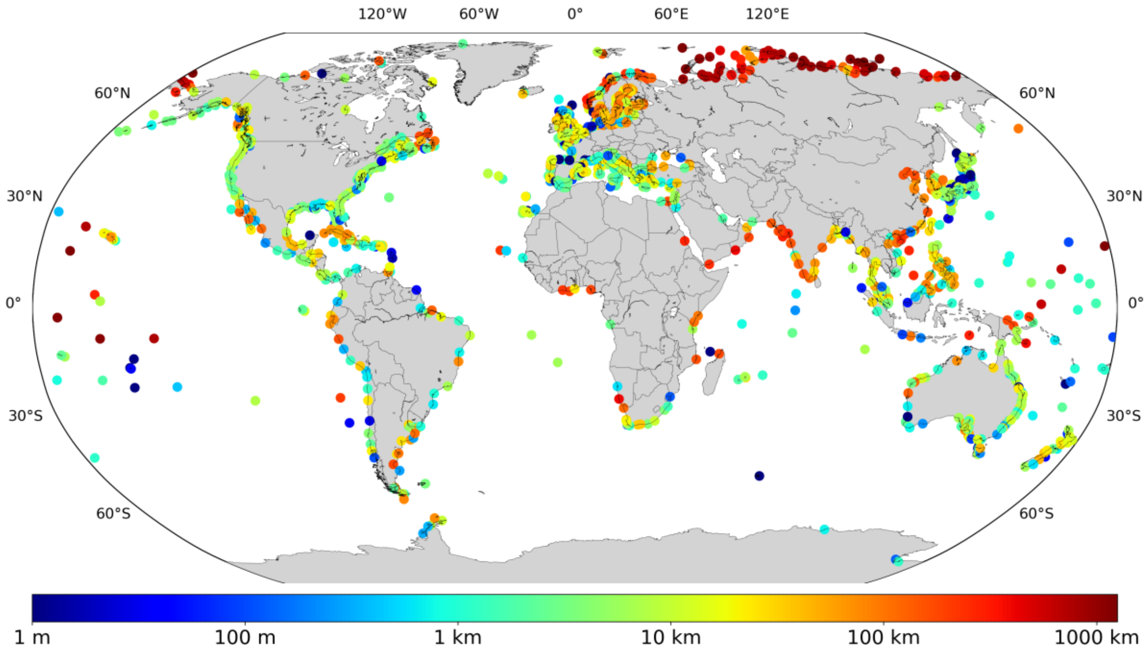

Figure 4: Distance of a tide gauge in the PSMSL (RLR category; https://www.psmsl.org/data/obtaining/) to the nearest GNSS antenna known at the Nevada Geodetic Laboratory (http://geodesy.unr.edu/NGLStationPages/GlobalStationList).

Figure 4 and Figure 5 highlight the information on distance between the tide gauge and the closest GNSS antenna. This information is important as the likelihood of leveling decreases with distance (resources, expertise…), and thus raises the question of usefulness of a distant GNSS antenna to monitor the actual vertical land movement at the tide gauge. This issue was first discussed by Bevis *et al*. (2002), and most recently by Gill *et al*. (2015). As highlighted by Gill *et al*. (2015), **the leveling error can potentially become a significant part of the total error budget at distances longer than 1000 m**. Thus, stations distant more than one kilometer should not be considered as "co-located" in the practical sense, unless there is evidence of local relative stability. For the **130** GLOSS tide gauges with a GNSS antenna less than 1000 m distance, **69** are within 100 m.

Appendix 1 provides a list of the GLOSS Core Network sites with some relevant information on the data availability related to the GNSS stations nearby, and the leveling connections of the GNSS antenna and tide gauge benchmarks. Section 3.1 provides further details on the leveling connections.

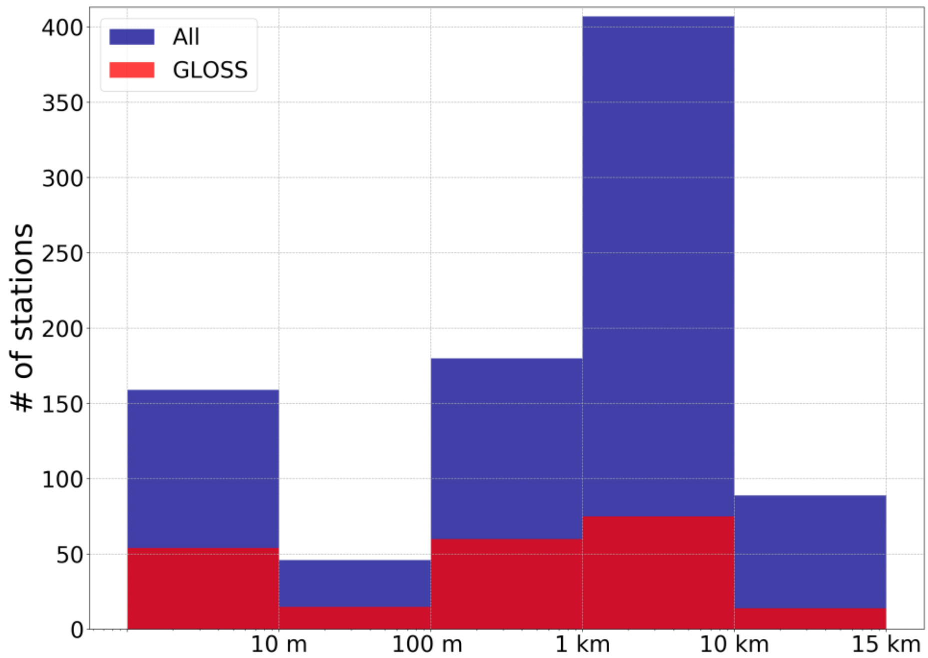

Figure 5: GNSS antenna distance from the tide gauge (April 2019).

The distribution of the number of GNSS stations against their record length or against a minimum record length are shown in Figure 6 and Figure 7, respectively. The record length is calculated as the difference between the last and the first data file available, ignoring gaps. The information on large data gaps is stored and available on the SONEL website. The GNSS record length is a critical factor in order to derive an accurate vertical velocity. According to Santamaría-Gómez and Mémin (2015) **a minimum record length of a decade** (without gaps) is required in certain tropical areas to mitigate the impact of interannual land deformation in the secular vertical velocity estimates. As an obvious consequence, it is highly recommended **to install a permanent GNSS station at the tide gauge as soon as possible**, and **to change the GNSS equipment only when it is strictly necessary** (to avoid interruption and offsets in the time series that can bias the velocity estimate).

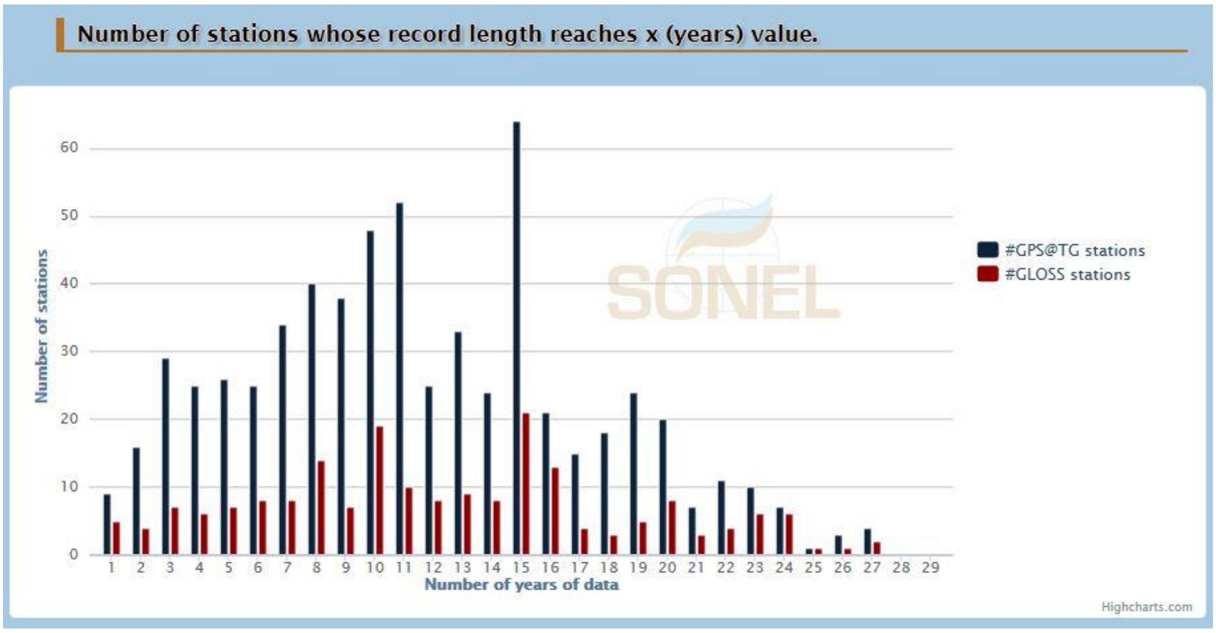

Figure 6: Number of stations whose record length reaches a given number X of years (April 2019).

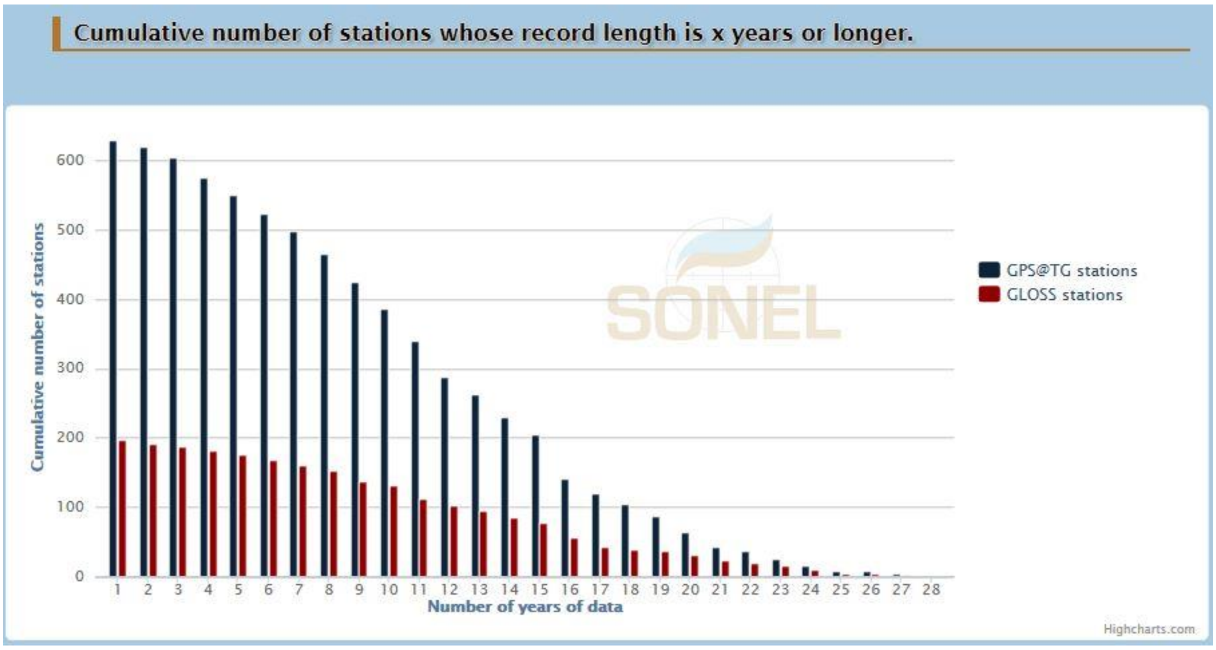

Figure 7: Cumulative number of stations whose record length is X years or longer (April 2019).

II- Data access tools and products

1. General

SONEL strives to provide user-friendly access to its data holdings by developing web-based interfaces such as clickable maps (e.g., Figure 1). For the last couple of years, the maps have given information on which GNSS stations are near a tide gauge, its activity status, and data availability. Some display options on the subset of stations can be chosen on the panel just below the map (checkboxes). For instance, what data is retrieved from a specific data center, or whether the station belongs to a particular network or program? The selection options could be further developed upon request, if the users express a particular interest.

The station symbols on the maps are usually clickable to show basic details such as name, latitude, longitude, and a link that leads the user to a full page of station details. For each station, one can learn whether SONEL has collected data files of observations, what is the first and latest observation available on SONEL, but also one can display a detailed calendar table to see and retrieve the daily file of observations in RINEX format by simply clicking on a specific day on the calendar table. The user can also find what tide gauge is nearby, and if there are other tide gauges nearby or GNSS stations, in which case a link is available to access the co-located station information web-page. If leveling data are available between the GNSS antenna and the tide gauge, a link to that information is available as well.

In addition, if the observations of that station were processed by at least one analysis center contributing a *'GNSS solution'* to SONEL, the GNSS position time series can be viewed and downloaded as an ASCII file to facilitate users studies. The SONEL team has also been working on extending the web-based clickable maps to enable a comprehensive view and a simple access to some relevant products such as the GNSS vertical velocities. More interestingly, SONEL also proposes demonstrative products to illustrate some applications of its data such as: (i) the combined linear trends from the GNSS and the tide gauge records (relative *versus* geocentric sea level trends), (ii) the combined linear trends from the tide gauge and satellite altimetry data (an unorthodox method of estimating vertical land motion). Both demonstrative products were achieved through stimulating and productive cooperation between the SONEL and the PSMSL teams or between the SONEL and the University of Balearic Islands, respectively. The SONEL report of 2015 to the GLOSS group of experts described the first product, whereas the second was described in the 2017 report.

2. GNSS solutions

To start with, it may be helpful to clarify what is meant here by a *'GNSS solution'*. A GNSS solution consists of the average station position and velocity for each of the stations analyzed. Note that the station average position and velocity are valid primarily over the input observation time span of the station. The GNSS solution also comprises the 'residual' position time series, typically at weekly or daily time sampling since the last IGS reprocessing campaign. The term 'residual' refers to the difference between the daily station positions and the predictions from the adjusted linear model. This model may include parameters such as offsets, in which case their values are estimated in the same adjustment run. Each GNSS solution is expressed in a specific geocentric reference frame (the most precise and stable at the moment of the solution release).

SONEL database was designed to handle several types of GNSS solutions. Firstly, it can cope with solutions from different analysis centers. This is an interesting feature which enables the user to appraise the level of agreement in the vertical velocities from the various analysis centers at a given station. It provides some additional reliability, beyond the formal uncertainties from an individual analysis center solution. Secondly, SONEL can also handle multiple solutions from a single analysis center. For instance, it may be interesting to update a solution by incorporating new data or new models and corrections (reprocessing), as long as these comply with the IGS-agreed international standards (see http://acc.igs.org/reprocess.html).

a) Global comprehensive view

Figure 8: GNSS vertical velocities from the ULR6 GNSS solution, displayed on a web-based clickable map.
Online version at: http://www.sonel.org/-Vertical-land-movement-estimate-.html

Figure 8 shows the GNSS solution webpage: http://www.sonel.org/-Vertical-land-movement-estimate-.html, which displays a clickable map with the GNSS vertical velocities of a given *'GNSS solution'* (here, as an example, it displays the ULR6 solution). The upward arrows indicate land uplift, whereas the downward arrows indicate subsidence. Double-end arrows indicate velocities within -0.5 to +0.5 mm/year. The arrows are clickable to obtain a small popup window with the station name, its vertical velocity, the associated time span, data completeness, and a link to the station web-page with full information on the station and its 'GNSS solutions' (see next section).

The detailed description of a given 'GNSS solution' is split into "tabs" to reduce the amount of information displayed in a single web-page. The default-selected tab corresponds to the vertical velocity map of the network of stations processed for which a robust vertical velocity has been estimated. The tab called "About" gives technical details on how the solution was processed (main features of the analysis strategy) and in which geocentric reference frame the solution is expressed. Another tab called "Statistics" provides common statistics and graphs for the solution. Finally, the tab called **"Download" gives comprehensive access to download the GNSS solution files** (table of all the vertical velocities that were estimated, station position time series files assembled in a .zip file, global solution file in SINEX format, table of estimated discontinuities, etc.).

As mentioned previously, SONEL database was devised to handle other GNSS analysis center solutions than the ULR ones, including also DORIS solutions, provided the groups are making them available to SONEL (Section III.1).

b) Local specific view (concerning a particular station)

The 'GNSS solution' for a specific station can be accessed either through the aforementioned 'GNSS solution' map (Figure 8) by clicking on an arrow symbol, or through the GNSS general information map presented in Section II.1, which describes what stations are available in SONEL (e.g., Figure 1). Note that a GNSS station webpage can also be accessed directly by using the GNSS acronym in the "Search" facility on the left-hand panel that is available from any page on the SONEL website.

Whenever a 'GNSS solution' is available for a given station, the individual station webpage will show a "GPS position time series" block of information that otherwise will not appear. This block displays the (residual) position time series, but it has been improved to provide web-based tools that support the analysis of the results (Figure 9). Firstly, the general information was completed by adding the reference frame, ellipsoid, average station position and velocity (left-hand side; Figure 9). Secondly, the graphs are dynamic, which means that the vertical scale can be adjusted (+/- buttons) and the information on a point of the curve under the cursor (residual, epoch) can be displayed.

In addition, the trend was added back to the residual position time series (default display). However, the user can choose to remove this trend through a checkbox. The annual signal and the estimated position offsets can be added back for an overall analysis, for instance, to assess the linearity or the quality of the results. The horizontal components of the positioning are also available. They can provide information on problems that have occurred at the station. The vertical dashed bars on the graphs point to the epochs when a position or velocity discontinuity was identified, and estimated. These discontinuities are detailed on the left-hand side of the graph. Finally, the "Download" button below the graph allows downloading the (residual) position time series corresponding to the user's view of the graph (default, or de-trended or whatever choices were selected).

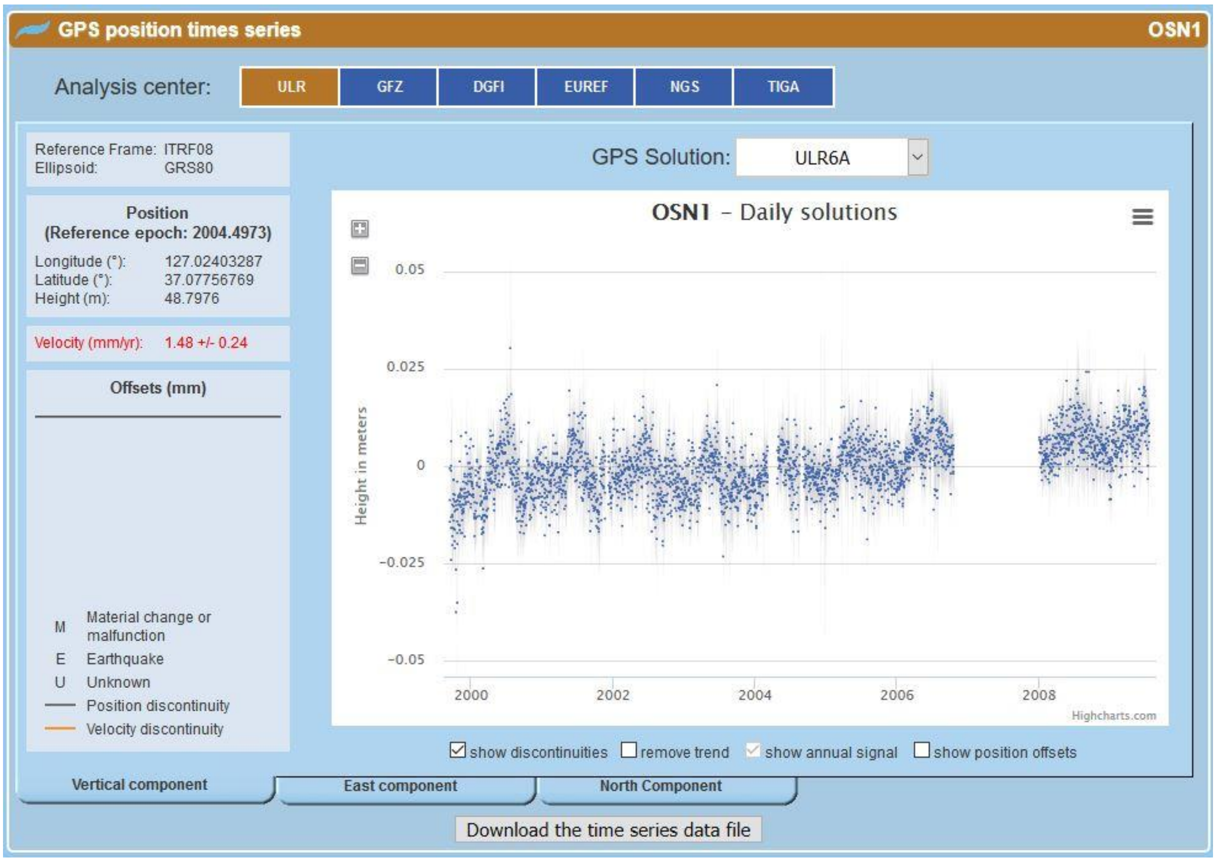

Figure 9: An example of 'GNSS solution' (ULR6A solution) for the OSN1 station (Osan, Republic of Korea). Online version at: https://www.sonel.org/spip.php?page=gps&idStation=2490

III-Work in progress and perspectives

1. Other vertical velocity solutions (TIGA, IGS, DORIS…)

SONEL has been developing its infrastructure **to cope with different GNSS solutions**, that is, updated solutions from a given analysis center, but also solutions from other groups within the GNSS area or from other data analysis strategies. That said, only state-of-the art solutions at the time of submission will be considered; the minimum standard being the adoption of the latest IGS-agreed models and corrections (http://acc.igs.org/reprocess.html). Figure 9 illustrates how the user may choose a particular solution (the analysis centers displayed on the top panel as tabs are tentative, and only serve as an example at this stage). This perspective has progressed since the last report, and should soon be active with solutions from the Nevada Geodetic Laboratory (contact with G. Blewitt and C. Kreemer) and the French geographic institute (contact with B. Garayt and S. Nahmani).

DORIS solutions are still envisaged from a first contact in 2016 with the CLS group at the OSTST meeting. However, that group needs still to fix the issue of reference frame alignment.

Regarding the approach of combining tide gauge and satellite altimetry data (Gravelle *et al*. 2017; Wöppelmann & Marcos 2016), it is not clear yet whether the users find the demonstration product really useful, for instance, to supplement estimates of vertical land motion where there are still no GNSS stations and solutions, or to check the level of agreement between this approach and the GNSS solutions. If it proves useful, SONEL will consider updating the product on a yearly basis to extend the time series. Satellite altimeter products from other groups than AVISO will then be explored.

2. Tide gauge to GNSS antenna local connections (leveling data)

For applications such as worldwide vertical datum unification in hydrography or geodesy, or studies of the mean dynamics topography, the geodetic connection between the GNSS antenna reference point and the tide gauge benchmark is crucial (Woodworth *et al.* 2015; 2017). Of course, this connection is also important for studies of long term trends in sea levels, even though one can make the (questionable) assumption of local stability when the data (connection) is missing. In any of the above case studies, the leveling data between the tide gauge datum and the GNSS antenna reference point appears crucial, and making this leveling data available is an important requirement for GLOSS Core Network stations (IOC, 2012).

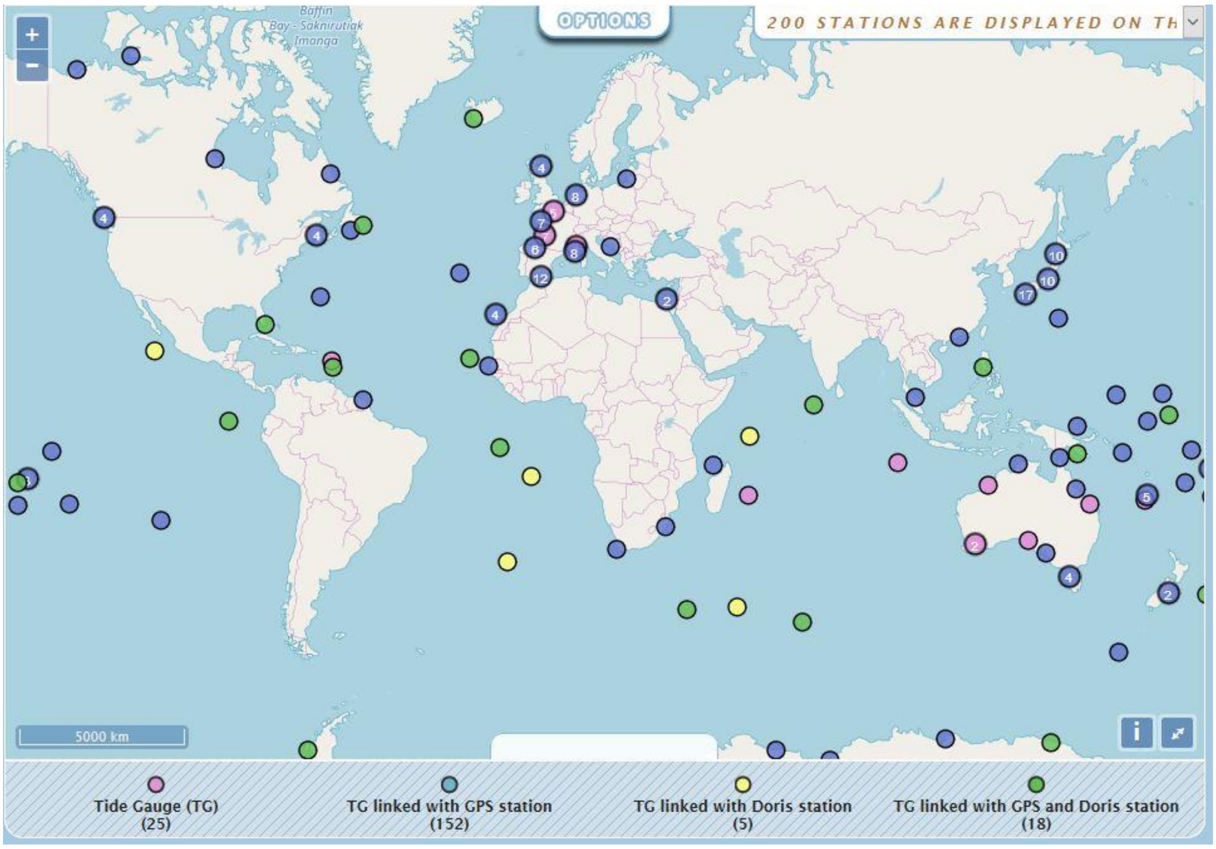

Figure 10: Status of the leveling data at tide gauges stored in SONEL.
Online version at: http://www.sonel.org/-Stability-of-the-datums-.html

In this context, SONEL attempts to gather all the available geodetic connections (mostly leveling results) for the tide gauges and integrate those into its database (Figure 10). A major issue associated with this activity is the access and analysis of reports from leveling campaigns, focused on linking the tide gauge data reference level (for instance the RLR when the data are retrieved from the PSMSL) and the GNSS antenna reference point. Many of these reports are observing tide gauge benchmarks that are not reported in the PSMSL diagrams showing where the tide gauge reference level or RLR is, or their identification (name) is not the same, making it difficult or impossible to guess if they are actually the same. The activity includes the connections with GNSS antennas but also with nearby DORIS stations (about 30 DORIS stations are nearby a tide gauge; details can be obtained at: https://www.sonel.org/-Doris-.html).

Figure 10 shows that as many as (or as few as) 152 tide gauges have a geodetic link to a GNSS station on SONEL, and 23 tide gauges with a DORIS station. A status of these geodetic connections between tide gauges and GNSS stations available in SONEL was published by Woodworth *et al.* (2017), highlighting the varied issues associated with this activity.

Among the 170 (152+18 in Figure 10) tide gauges with a geodetic connection to a permanent GNSS station, 73 belong to the GLOSS Core Network. These connections are thus currently available at SONEL for only 25% of the GLOSS tide gauges.

Figure 11 shows that at present the geodetic connection is unknown in SONEL for 77 GLOSS Core Network tide gauges that lie within 1 km distance from a GNSS station. A 1 km distance is a reasonable distance for a leveling campaign, meaning that the potential for a substantial improvement is within reach if tide gauge operators consider including the leveling of the GNSS antenna in their next (annual) leveling control.

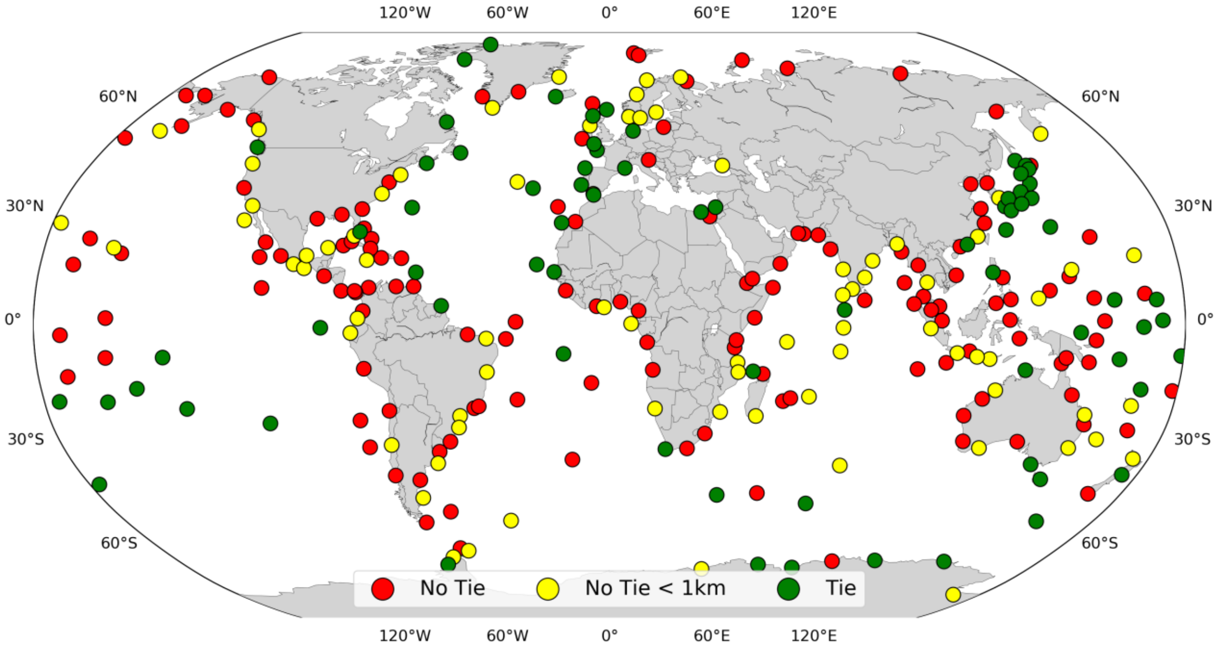

Figure 11: Geodetic connections available in SONEL for the GLOSS Core Network. In yellow are highlighted those for which this is missing, **but** the tide gauge is within 1 km from the nearest GNSS station; thus, the potential for a substantial improvement is within reach if tide gauge operators include the GNSS antenna in their next leveling control.

3. Summary of major limitations today

The major limitation for the applications aimed at in GLOSS is certainly the availability of continuous GNSS station at tide gauges (long term trends in sea levels, confrontation with satellite altimetry, vertical datum unification). Only 24% (69 out of 290) are co-located at a GLOSS station (at or within 100 m). Progress is still needed in this respect to fulfill the GLOSS Implementation Plan (IOC, 2012) requirements for a core network station.

Another important issue is the free and open access to the GNSS observations following the international guidelines of the IGS, that is, daily files in RINEX format with a 30s sampling.

Equally important is the need for updating on any equipment changes or any change of its immediate environment (metadata) as soon as possible by updating the GNSS station log-sheet, which should follow the IGS standards, and to inform the SONEL network station manager, Ing. Elizabeth Prouteau (elizabeth.prouteau@univ-lr.fr).

Last but not least, whenever the GNSS station is not directly installed on the same ground or structure (roof) as the tide gauge, it is important to undertake repeated leveling connections for at least five years to assess that the GNSS antenna and the tide gauge are not experiencing differential land motions at 0.1-0.2 millimeter per year level. In any case, the availability of the initial leveling connection is critical for satellite altimetry comparisons or calibrations, and vertical reference unifications on land (height systems) and sea (chart datums).

IV- Users statistics and feedbacks

Accurate usage statistics of the SONEL data service are extremely difficult to establish, in particular for the FTP anonymous servers, which is the case for most data in SONEL. A rough idea can be obtained, however, from the number of files downloaded in March 2019: as many as 326,000 files were downloaded from the SONEL FTP server. Another idea of the importance of the service can be appraised from the number of visits of the SONEL website per month (Figure 13). Figure 13 shows a steady and significant increase of this number of visits until 2016, then the number stabilizes at about 2800 visits per month.

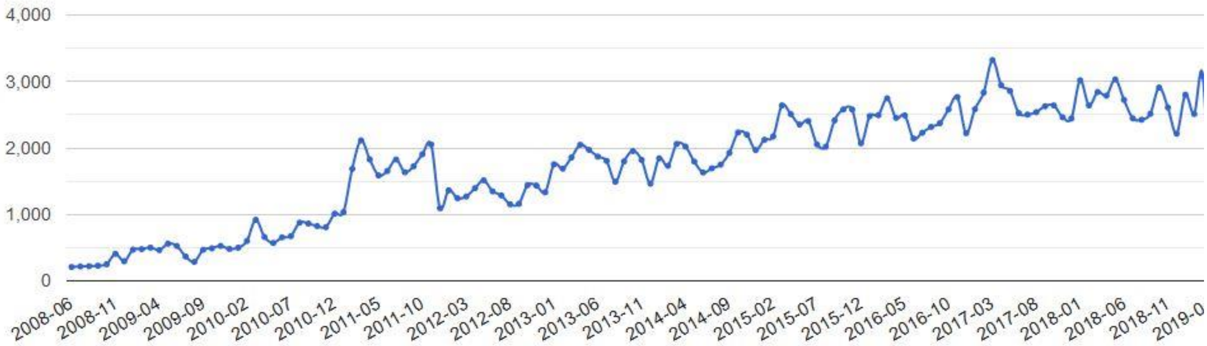

Figure 13: Number of monthly visits of SONEL website (April 2019).
Online version at: http://www.sonel.org/-Statistics-.html

It is even more difficult to appraise the number of scientific studies that use data from SONEL. The number of articles published in peer review journals that explicitly acknowledge SONEL data center (as far as the SONEL team was informed) is shown in Figure 14. It certainly represents the tip of the iceberg. From the titles of the articles (See also: http://www.sonel.org/-Users-feedback-.html), it appears that in addition to sea level, the areas of tectonics, atmosphere, physics and geodesy also benefit from SONEL service.

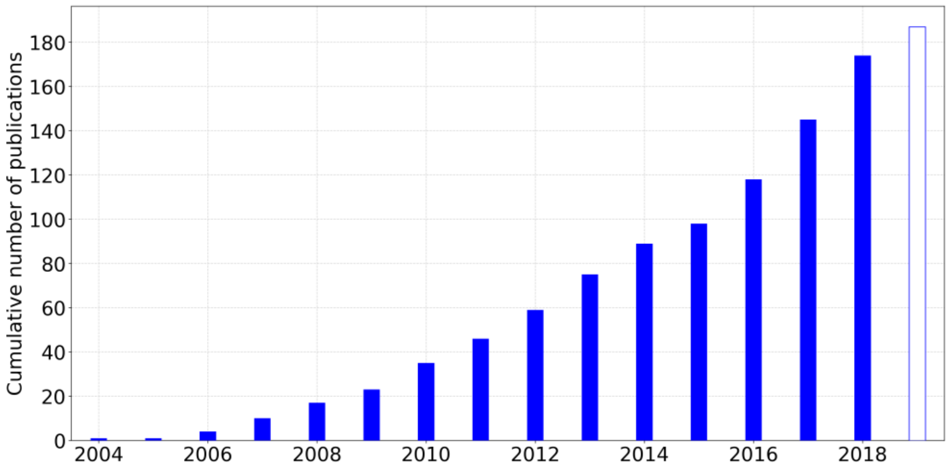

Figure 14: Cumulative number of scientific publications using SONEL data as far as the SONEL team knows (April 2019).

Acknowledgements

SONEL is funded by the University of La Rochelle, the INSU/CNRS (SNO program) and the French research ministry (IR infrastructures). The service is based on the many institutions worldwide making GNSS data and products public and freely available. SONEL strives to acknowledge these contributions by including the names of these institutions and their contacts at the individual station web-pages on SONEL portal. In addition, there is a **dedicated webpage on the GNSS data providers** at: http://www.sonel.org/-Data-providers-125-.html. Don't hesitate to contact us to complete our database in this respect (Email: sonel@sonel.org).

References

Bevis M., Scherer W., Merrifield M. (2002). Technical issues and recommendations related to the installation of continuous GPS stations at tide gauges. *Marine Geodesy, 25*, 87-99.

Gill S., Weston N., Smith D. (2015). NOAA Guidance Document for Determination of Vertical Land Motion at Water Level Stations Using GPS Technology. NOAA Technical Report NOS 139, NOAA National Ocean Service, Silver Spring, MD, August 2015, 18pp.

Gravelle M., Prouteau E., Wöppelmann G. (2017). Third progress Report on the GNSS at Tide Gauge Activities: SONEL Data Holdings & Tools to access the data, presented at the XVth GLOSS group of experts meeting, University of Columbia, New York (USA), 8-9 July 2017. Online version available at: https://www.sonel.org/IMG/pdf/ge15_gnssattg_activities_sonel_report.pdf

IOC (2012) The Global Sea Level Observing System Implementation Plan 2012, Intergovernmental Oceanographic Commission Technical Series, Vol. 100.

Santamaría-Gómez A., Mémin A. (2015). Geodetic secular velocity errors due to interannual surface loading deformation. *Geophysical Journal International, 202*, 763-767.

Woodworth P. L., Gravelle M., Marcos M., Wöppelmann G. (2015). The status of measurement of the Mediterranean mean dynamic topography by geodetic techniques. Journal of Geodesy, 89, 811-827.

Woodworth P. L., Wöppelmann G., Marcos M., Gravelle M., Bingley R. M. (2017). Why we must tie satellite positioning to tide gauge data. *Eos, 98*, doi:10.1029/2017EO064037.

Wöppelmann G., and Marcos M. (2016). Vertical land motion as a key to understanding sea level change and variability. *Reviews of Geophysics, 54*, 64-92.

APPENDIX 1

GLOSS ID	Tide gauge name	Country	Distance TG-GNSS (m)	GNSS acronym	GNSS data	Leveling
262	Lobito	Angola	/	/	/	/
192	Mar del Plata	Argentina	7	MPLA	Y	N
	Mar del Plata	Argentina	5	MPL2	Y	N
191	Puerto Madryn	Argentina	59983	RWSN	Y	N
190	Puerto Deseado	Argentina	14	PDES	Y	N
	Puerto Deseado	Argentina	1189	PDE2	Y	N
	Puerto Deseado	Argentina	1191	PDE3	Y	N
185	Bahia Esperanza	Argentina	2	SPRZ	Y	N
181	Ushuaia	Argentina	3986	AUTF	Y	N
308	Thevenard	Australia	35161	CEDU	Y	N
278	Casey	Australia	2	CAS1	Y	Y
277	Davis	Australia	440	DAV1	Y	N
148	Lord Howe Is.	Australia	519	LORD	Y	N
	Lord Howe Is.	Australia	2758	LDHI	Y	N
130	Macquarie Is.	Australia	470	MAC1	Y	Y
124	Norfolk Is.	Australia	2195	NORF	Y	N
62	Darwin	Australia	7266	DARM	Y	N
	Darwin	Australia	636	00NA	Y	N
	Darwin	Australia	2955	LKYA	Y	Y
	Darwin	Australia	12369	DWMI	Y	N
	Darwin	Australia	13493	02NA	Y	N
61	Booby Is.	Australia	/	/	/	/
60	Townsville	Australia	23390	TOW2	Y	N
	Townsville	Australia	6824	TCC1	N	N
59	Burnett Heads (Bundaberg)	Australia	16893	BNDY	Y	N
58	Brisbane (West Inner Bar)	Australia	20050	CLEV	Y	N
	Brisbane (West Inner Bar)	Australia	18490	WOOL	Y	N
57	Sydney, Fort Denison	Australia	10775	SYDN	Y	N
	Sydney, Fort Denison	Australia	66	FTDN	N	N
	Sydney, Fort Denison	Australia	4245	CHIP	N	N
	Sydney, Fort Denison	Australia	7036	UNSW	N	N
56	Spring Bay	Australia	432	SPBY	Y	Y
55	Portland	Australia	2	PTLD	Y	Y
54	Esperance	Australia	374	ESPA	Y	Y
53	Fremantle	Australia	32018	PERT	Y	N
	Fremantle	Australia	1653	FMTL	N	N
52	Carnarvon	Australia	/	/	/	/
51	Port Hedland	Australia	26952	PTHL	Y	N
47	Christmas Is.	Australia	3430	XMIS	Y	N
46	Cocos Is. (Keeling)	Australia	10172	COCO	Y	N
40	Broome	Australia	950	BRO1	Y	N
22	Mawson	Australia	560	MAW1	Y	Y
211	Settlement Point	Bahamas	5	FREE	Y	N
	Settlement Point	Bahamas	3411	BHMA	Y	N
12	Exuma	Bahamas	/	/	/	/
36	Chittagong	Bangladesh		???	N	N
120	Malakal	Belau	3076	PALA	Y	N
	Malakal	Belau	7	PALR	Y	N
352	Porto De Macaé	Brazil	/	/	/	/
351	Porto De Imbituba	Brazil	670	IMBT	Y	N
336	Fortaleza	Brazil	19006	FORT	Y	N
	Fortaleza	Brazil	19009	BRFT	Y	N
	Fortaleza	Brazil	597	CEFT	Y	N
334	Salvador	Brazil	157	SSA1	Y	N
	Salvador	Brazil	9994	SAVO	Y	N
	Salvador	Brazil	3902	SALV	Y	N
265	Trindade Is.	Brazil	/	/	/	/
200	Ponta da Madeira	Brazil	18523	SALU	Y	N
199	St Peter & St Paul Rocks	Brazil	/	/	/	/
198	Fernando de Noronha	Brazil	/	/	/	/
195	Rio de Janeiro - I.Fiscal	Brazil	5993	ONRJ	Y	N
194	Cananeia	Brazil	10	NEIA	Y	N
193	Porto de Rio Grande	Brazil	/	/	/	/
350	Port Sonara	Cameroon	/	/	/	/
333	Alert	Canada	450	ALRT	Y	Y
224	Nain	Canada	730	NAIN	Y	Y
223	St John's, Newfoundland	Canada	4988	STJO	Y	Y
	St John's, Newfoundland	Canada	4990	STJ3	Y	N
222	Halifax	Canada	3100	HLFX	Y	N
156	Tofino	Canada	37005	UCLU	Y	Y
	Tofino	Canada	343	TFNO	Y	Y
155	Prince Rupert	Canada	9000	BCPR	N	N
329	Palmeira	Cape Verde Islands	5	TGCV	Y	Y
	Palmeira	Cape Verde Islands	5753	CPVG	Y	N
189	Captain Prat Base (Antarctica)	Chile	/	/	/	/
178	Puerto Montt	Chile	/	/	/	/
177	San Felix	Chile	/	/	/	/
176	Juan Fernandez Island	Chile	/	/	/	/
175	Valparaiso	Chile	910	VALP	Y	N
	Valparaiso	Chile	617	VALN	Y	N
	Valparaiso	Chile	1429	BN05	N	N
174	Antofagasta	Chile	3038	UCNF	Y	N
137	Pascua (Easter) Is.	Chile	10863	ISPA	Y	N

GNSS decommissioned
No GNSS data for a long time (> 8 years)
GNSS exists (identified) but no data on SONEL
No GNSS identified near this tide gauge
No leveling in SONEL, but TG-GNSS distance < 1000 m

	Pascua (Easter) Is.	Chile	6627	EISL	Y	N
283	Lusi	China, People's Rep.	/	/	/	/
247	Xiamen	China, People's Rep.	280	???	N	N
94	Kanmen	China, People's Rep.	/	/	/	/
79	Laohutan (Dalian)	China, People's Rep.	/	/	/	/
78	Zhapo	China, People's Rep.	/	/	/	/
207	Cartagena	Colombia	1439	CART	Y	N
171	Tumaco	Colombia	316	TUMA	Y	N
170	Buenaventura	Colombia	7854	BUEN	Y	N
261	Pointe-Noire	Congo	/	/	/	/
143	Penrhyn	Cook Islands	/	/	/	/
139	Rarotonga	Cook Islands	3483	CKIS	Y	Y
167	Quepos	Costa Rica	/	/	/	/
257	Abidjan	Cote d'Ivoire	/	/	/	/
276	Gibara	Cuba	/	/	/	/
215	Siboney	Cuba	/	/	/	/
214	Cabo San Antonio	Cuba	/	/	/	/
237	Torshavn, Faroe Islands.	Denmark	1453	ARGI	Y	N
	Torshavn, Faroe Islands.	Denmark	1714	TORS	Y	N
228	Ammassalik, Greenland	Denmark	22193	KULU	Y	N
225	Godthaab/Nuuk, Greenland	Denmark	1422	NUUK	N	N
2	Djibouti	Djibouti	/	/	/	/
172	La Libertad	Ecuador	342	SEEC	N	N
	La Libertad	Ecuador	10009	SALN	N	N
169	Baltra, Galapagos Is.	Ecuador	1661	GALA	Y	N
	Baltra, Galapagos Is.	Ecuador	1661	GLPS	Y	Y
349	Alexandria	Egypt	3126	ALEX	Y	Y
	Alexandria	Egypt	3126	ALX2	Y	N
1	Suez (Port Taufig)	Egypt	/	/	/	/
182	Acajutla	El Salvador	/	/	/	/
119	Yap, Caroline Is.	Fed. Micronesia	/	/	/	/
117	Kapingamarangi, Caroline Is.	Fed. Micronesia	/	/	/	/
116	Chuuk Atoll, Caroline Is.	Fed. Micronesia	5119	TRUK	Y	N
115	Pohnpei, Caroline Is.	Fed. Micronesia	2534	POHN	Y	Y
122	Suva	Fiji	1166	SUVA	Y	N
338	Fort-de-France	France	7246	LMMF	Y	N
	Fort-de-France	France	2	FFTG	Y	Y
	Fort-de-France	France	1	FFT2	Y	Y
242	Brest	France	292	BRST	Y	Y
	Brest	France	9196	GUIP	Y	N
	Brest	France	10928	BGBC	Y	N
205	Marseille	France	2	MARS	Y	Y
	Marseille	France	1541	PRIE	Y	N
165	Clipperton Is.	France	/	/	/	/
142	Nuku Hiva, Marquesas Is.	France	1	NHTG	N	Y
131	Dumont d'Urville	France	2	DUM1	Y	Y
	Dumont d'Urville	France	2	DUMG	Y	Y
123	Noumea, New Caledonia	France	7223	NRMG	Y	N
	Noumea, New Caledonia	France	7223	NRMD	Y	N
	Noumea, New Caledonia	France	3159	NOUM	Y	N
	Noumea, New Caledonia	France	10	NBTG	Y	Y
96	Dzaoudzi (Mayotte)	France	2	MAYG	Y	Y
24	Saint Paul Island	France	2	SPTG	Y	N
23	Kerguelen Island	France	77	KETG	Y	Y
	Kerguelen Island	France	2643	KRGG	Y	N
	Kerguelen Island	France	2643	KERG	Y	Y
21	Crozet Is.	France	1737	CZTG	Y	N
17	Pte des Galets, Reunion Is	France	3282	LEPO	Y	N
202	Cayenne	French Guiana	2	IRYL	Y	Y
	Cayenne	French Guiana	24526	KOUR	Y	N
	Cayenne	French Guiana	11237	CAYN	Y	N
140	Papeete, Tahiti	French Polynesia	2	PAPE	Y	Y
	Papeete, Tahiti	French Polynesia	6011	THTI	Y	N
	Papeete, Tahiti	French Polynesia	6053	THTG	Y	N
	Papeete, Tahiti	French Polynesia	5607	FAA1	Y	N
	Papeete, Tahiti	French Polynesia	6035	TAH1	Y	N
	Papeete, Tahiti	French Polynesia	6035	TAH2	Y	N
138	Rikitea, Gambier	French Polynesia	915	GAMB	Y	N
	Rikitea, Gambier	French Polynesia	2	RKTG	Y	Y
284	Cuxhaven, Steubenhoft	Germany	2	TGCU	Y	Y
335	Takoradi	Ghana	42	TKTG	N	N
	Takoradi	Ghana	1606	TADI	N	N
344	Qaqortoq	Greenland	745	QAQ1	Y	N
343	Pituffik/Thule	Greenland	1359	THU1	Y	N
	Pituffik/Thule	Greenland	402	THU2	Y	N
	Pituffik/Thule	Greenland	402	THU3	Y	Y
315	Ittoqqortoormiit/Scoresbysund	Greenland	465	SCOR	Y	N
255	Conakry	Guinea	/	/	/	/
209	Port-au-Prince/Les Cayes	Haiti	6069	VOIL	Y	N
77	Quarry Bay	Hong Kong	6528	HKSC	Y	N
	Quarry Bay	Hong Kong	2	HKQT	N	N
229	Reykjavik	Iceland	1645	REYK	Y	Y
281	Marmagao	India	2	???	N	N

38	Port Blair, Andaman Is.	India	7800	PBRI	Y	N
	Port Blair, Andaman Is.	India	7789	PBR2	Y	N
	Port Blair, Andaman Is.	India	9237	CARI	Y	N
35	Vishakhapatnam	India	2	VISA	N	N
34	Chennai/Madras	India	/	/	/	/
32	Cochin	India	/	/	/	/
31	Veraval	India	/	/	/	/
29	Minicoy, Laccadive Is.	India	/	/	/	/
347	Sabang	Indonesia	/	/	/	/
346	Waikelo	Indonesia	2	WAIK	N	N
292	Surabaya	Indonesia	/	/	/	/
291	Cilacap	Indonesia	61	CLCP	Y	N
	Cilacap	Indonesia	2918	CILI	Y	N
69	Manado (Bitung)	Indonesia	1231	BTNG	Y	N
	Manado (Bitung)	Indonesia	1942	CBIT	N	N
68	Ambon	Indonesia	5261	CAMB	N	N
49	Benoa	Indonesia	235	BNOA	Y	N
45	Padang (Telu Bayuk)	Indonesia	730	IPA0	Y	N
	Padang (Telu Bayuk)	Indonesia	2	PADA	N	N
	Padang (Telu Bayuk)	Indonesia	19467	PSKI	Y	N
337	Chabahar	Iran	/	/	/	/
330	Castletownbere	Ireland	/	/	/	/
239	Malin Head	Ireland		???	N	N
80	Hadera	Israel	3139	CSAR	Y	Y
340	Trieste	Italy	6695	TRIE	Y	N
210	Port Royal, Kingston	Jamaica	7335	JAMA	Y	N
	Port Royal, Kingston	Jamaica	13280	CN12	Y	N
327	Abashiri	Japan	16	P202	Y	Y
326	Hamada	Japan	306	P209	Y	Y
325	Toyama	Japan	890	P207	Y	Y
324	Wakkanai	Japan	880	P201	Y	Y
104	Minami-tori-shima	Japan	1631	MARC	Y	N
	Minami-tori-shima	Japan	1644	MCIL	Y	N
103	Chichijima	Japan	1696	P213	Y	Y
	Chichijima	Japan	1407	CCJM	Y	N
	Chichijima	Japan	2094	CCJ2	Y	Y
95	Syowa	Japan	543	SYOG	Y	N
89	Kushiro	Japan	2	P203	Y	Y
88	Hakodate	Japan	2	P204	Y	Y
87	Ofunato	Japan	405	P205	Y	Y
86	Mera	Japan	2	P206	Y	Y
85	Kushimoto	Japan	2	P208	Y	Y
83	Nagasaki	Japan	251	P210	Y	Y
82	Aburatsu	Japan	29	P211	Y	Y
81	Naha	Japan	456	P212	Y	Y
8	Mombasa	Kenya	/	/	/	/
146	Christmas Is., Line Is.	Kiribati	/	/	/	/
145	Kanton Is., Phoenix Is.	Kiribati	/	/	/	/
113	Tarawa, Gilbert Is.	Kiribati	1605	KIRI	Y	Y
307	Won San	Korea, PDR	/	/	/	/
84	Pusan	Korea, Republic of	343	PUSW	N	N
271	Fort Dauphin (Taolanaro)	Madagascar	/	/	/	/
15	Nosy-Be	Madagascar	/	/	/	/
293	Chendering/Kuala Terengganu	Malaysia	8070	KUAL	Y	N
43	Pengkalan TLDM Lumut	Malaysia	/	/	/	/
28	Male	Maldives	1190	HULE	Y	N
	Male	Maldives	5	MALD	Y	Y
27	Gan	Maldives	465	ADDU	Y	N
112	Majuro	Marshall Is.	1716	MAJU	Y	Y
111	Kwajalein	Marshall Is.	1172	KWJ1	Y	N
19	Rodrigues, Port Mathurin	Mauritius	553	RDRG	Y	N
18	Port Louis Harbour	Mauritius	15609	VACS	Y	N
267	Acapulco, Gro.	Mexico	2	ACYA	Y	N
213	Progreso, Yuc.	Mexico	2	PROX	Y	N
	Progreso, Yuc.	Mexico	36222	MERI	Y	N
212	Veracruz, Ver.	Mexico	2	VRCX	Y	N
164	Puerto Angel	Mexico	891	OXUM	Y	N
163	Manzanillo, Col.	Mexico	2	MANZ	Y	N
	Manzanillo, Col.	Mexico	3	MNZO	Y	N
	Manzanillo, Col.	Mexico	11607	UCOM	Y	N
	Manzanillo, Col.	Mexico	11574	TNMZ	Y	N
	Manzanillo, Col.	Mexico	1884	MZNC	Y	N
162	Socorro Is.	Mexico	/	/	/	/
161	Cabo San Lucas	Mexico	/	/	/	/
160	Isla Guadalupe	Mexico	241	GUAX	Y	N
282	Tan Tan	Morocco	/	/	/	/
11	Pemba	Mozambique	415	PMBA	Y	N
10	Inhambane	Mozambique	734	INHB	Y	N
141	Moulmein (Mawlamyine)	Myanmar	/	/	/	/
37	Akyab (Sittwe)	Myanmar	/	/	/	/
314	Walvis Bay	Namibia	/	/	/	/
114	Nauru, Gilbert Is.	Nauru	3017	NAUR	Y	Y
134	Scott Base	New Zealand	2626	MCM4	Y	N
129	Bluff	New Zealand	4284	BLUF	Y	N

128	Chatham Is.	New Zealand	649	CHAT	Y	Y
	Chatham Is.	New Zealand	24183	CHTI	Y	N
	Chatham Is.	New Zealand	17932	OWNG	Y	N
	Chatham Is.	New Zealand	17900	OWMG	Y	N
127	Auckland-Waitemata Hbr.	New Zealand	49	AUKT	Y	N
	Auckland-Waitemata Hbr.	New Zealand	27363	AUCK	Y	N
	Auckland-Waitemata Hbr.	New Zealand	5	TAKL	Y	N
101	Wellington	New Zealand	1248	WEL1	Y	N
	Wellington	New Zealand	1248	WEL2	Y	N
	Wellington	New Zealand	634	WGTT	Y	Y
	Wellington	New Zealand	4814	WGTN	Y	N
259	Lagos	Nigeria	10800	ULAG	Y	N
118	Saipan	North Mariana Is.	827	CNMR	Y	N
345	Ny Alesund	Norway	1747	NYA1	Y	N
	Ny Alesund	Norway	1552	NYAL	Y	N
	Ny Alesund	Norway	1747	NYAC	Y	N
	Ny Alesund	Norway	1700	NYA2	Y	N
323	Vardo	Norway	5079	VARS	Y	N
	Vardo	Norway	2	VAR1	Y	N
322	Andenes	Norway	46	AND1	Y	N
321	Tregde	Norway	2	TGDE	Y	N
234	Rorvik	Norway	802	VIKC	Y	N
4	Salalah	Oman	/	/	/	/
295	Gwader	Pakistan	/	/	/	/
30	Karachi, Manoro Island	Pakistan	/	/	/	/
208	Coco Solo	Panama	6734	ACP1	Y	N
168	Balboa	Panama	4639	IGN1	Y	N
331	Lombrum (Manus)	Papua New Guinea	873	PNGM	Y	Y
272	Daru	Papua New Guinea	/	/	/	/
65	Rabaul	Papua New Guinea	1415	RVO_	Y	N
63	Alotau	Papua New Guinea	/	/	/	/
173	Callao (La Punta)	Peru	1432	CALL	Y	N
73	Manila, South Harbor	Philippines	1769	MANL	Y	Y
	Manila, South Harbor	Philippines	12543	PIMO	Y	Y
	Manila, South Harbor	Philippines	9568	PTAG	Y	N
	Manila, South Harbor	Philippines	9615	PTGG	Y	N
72	Legaspi, Albay	Philippines	3495	PLEG	N	N
71	Davao, Davao Gulf	Philippines	4923	PDAV	N	N
70	Jolo, Sulu	Philippines	/	/	/	/
250	Funchal (Madeira)	Portugal	880	FUNC	Y	N
246	Cascais	Portugal	273	CASC	Y	Y
245	Ponta Delgado, Azores	Portugal	1636	PDEL	Y	Y
244	Santa Cruz del Flores (Azores)	Portugal	158	FLRS	Y	N
313	Tiksi	Russia	5949	TIXI	Y	N
312	Dikson	Russia	/	/	/	/
309	Providenya	Russia	/	/	/	/
274	Murmansk	Russia	/	/	/	/
231	Barentsburg (Spitsbergen)	Russia	/	/	/	/
99	Russkaya Gavan	Russia	/	/	/	/
98	Port Tuapse, Black Sea	Russia	95	TUAP	Y	N
97	Kaliningrad	Russia	/	/	/	/
93	Petropavlovsk-Kamchatsky	Russia	737	PETS	Y	N
93	Petropavlovsk-Kamchatsky	Russia	6258	PETP	Y	N
92	Nagaevo Bay	Russia	4151	MAG0	Y	N
90	Yuzhno Kurilsk	Russia	/	/	/	/
25	Mirny (Antarctica)	Russia	/	/	/	/
260	Sao Tome	Sao Tome & Principe	441	STMP	Y	N
253	Dakar	Senegal	3765	DAKA	Y	Y
	Dakar	Senegal	4885	DAKR	Y	N
339	Pointe La Rue	Seychelles	287	SEYG	Y	N
	Pointe La Rue	Seychelles	5548	SEY1	Y	N
44	Keppel Harbour	Singapore	5114	NTUS	Y	N
66	Honiara	Solomon Is.	507	SOLO	Y	Y
7	Mogadishu	Somalia	/	/	/	/
6	Hafun (Dante)	Somalia	/	/	/	/
268	Simonstown	South Africa	2	SIMO	Y	Y
76	Port Elizabeth	South Africa	2859	PELB	Y	N
	Port Elizabeth	South Africa	2875	PLBA	Y	N
20	Marion Is.	South Africa	10	MARN	Y	Y
13	Durban	South Africa	12330	DRBN	Y	N
	Durban	South Africa	3697	DRBA	Y	N
251	Las Palmas, Canary Is.	Spain	1	PLUZ	Y	Y
249	Ceuta (Spanish N. Africa)	Spain	560	CEUT	Y	Y
	Ceuta (Spanish N. Africa)	Spain	840	CEU1	Y	N
243	La Coruna	Spain	478	ACOR	Y	Y
33	Colombo	Sri Lanka	5303	SGOC	Y	N
341	Stockholm	Sweden	373	0MOS	Y	N
233	Goteborg-Torshamnen	Sweden	7522	0BIS	Y	N
297	Zanzibar	Tanzania	7337	ZNZB	Y	N
9	Mtwara	Tanzania	93	MTWA	Y	N
	Mtwara	Tanzania	3922	MTVE	Y	N
42	Ko Taphao Noi	Thailand	/	/	/	/
39	Ko Lak	Thailand		???	N	N

125	Tongatapu	Tonga	777	TONG	Y	Y
203	Port of Spain	Trinidad and Tobago	12902	TTUW	Y	N
121	Funafuti, Ellice Is.	Tuvalu	2540	TUVA	Y	Y
305	Stanley, Falklands/Malvinas	U.K.	4106	FALK	Y	N
266	Edinburgh, Tristan da Cunha	U.K.	/	/	/	/
264	St. Helena	U.K.	6003	STHL	Y	N
263	Ascension	U.K.	3872	ASC1	Y	Y
	Ascension	U.K.	9266	ASCG	Y	Y
248	Gibraltar	U.K.	5	GIBR	Y	N
241	Newlyn	U.K.	5	NEWL	Y	Y
238	Stornoway	U.K.	2	SWTG	Y	Y
236	Lerwick	U.K.	2	LWTG	Y	Y
221	Bermuda, St. Georges Is.	U.K.	684	BRMU	Y	Y
	Bermuda, St. Georges Is.	U.K.	706	BRSG	Y	Y
188	Faraday, Argentine Islands	U.K.	731	VNAD	Y	N
187	South Georgia	U.K.	1927	KEPA	Y	N
26	Diego Garcia Is.	U.K.	3402	DGAV	Y	N
	Diego Garcia Is.	U.K.	65	DGAR	Y	N
342	Rothera	U.K.	118	ROTH	Y	Y
302	Adak, Aleutian Is.	U.S.A.	2030	AB21	Y	Y
149	Apra Hbr, Guam, Marianas	U.S.A.	19495	GUAM	Y	N
	Apra Hbr, Guam, Marianas	U.S.A.	871	GUUG	Y	N
220	Atlantic City, NJ	U.S.A.	16313	NJGT	Y	N
	Duck, N.C.	U.S.A.	400	DUCK	Y	N
219	Duck, N.C.	U.S.A.	189	NCDU	Y	N
289	Fort Pulaski, GA	U.S.A.	12447	GASK	Y	N
107	French Frigate Shoals, H	U.S.A.	/	/	/	/
217	Galveston (Pier 21), TX	U.S.A.	5928	GAL1	Y	N
	Galveston (Pier 21), TX	U.S.A.	2851	TXGA	Y	N
	Galveston (Pier 21), TX	U.S.A.	1	TXGV	Y	N
287	Hilo, Hawaiian Is.	U.S.A.	2120	HILO	Y	N
	Hilo, Hawaiian Is.	U.S.A.	2524	HILR	Y	N
	Honolulu, Hawaiian Is.	U.S.A.	2	HNLC	Y	Y
108	Honolulu, Hawaiian Is.	U.S.A.	5924	ZHN1	Y	N
109	Johnston Is., Hawaiian Is.	U.S.A.	/	/	/	/
	Key West, FL	U.S.A.	595	CHIN	Y	N
216	Key West, FL	U.S.A.	5414	KWST	Y	N
	Key West, FL	U.S.A.	15917	KYW1	Y	N
	Key West, FL	U.S.A.	15917	KYW5	Y	N
159	La Jolla (Scripps Pier) CA	U.S.A.	670	SIO3	Y	N
	La Jolla (Scripps Pier) CA	U.S.A.	3064	SIO5	Y	N
	La Jolla (Scripps Pier) CA	U.S.A.	3	SPW2	Y	N
106	Midway Is, Hawaiian Is.	U.S.A.	10	WQSI	Y	N
290	Newport, RI	U.S.A.	500	NPRI	Y	N
74	Nome	U.S.A.	8302	AB11	Y	N
144	Pago Pago, American Samoa	U.S.A.	7069	ASPA	Y	N
288	Pensacola, FL	U.S.A.	7547	PCLA	Y	N
	Prudhoe Bay, AK	U.S.A.	7670	DSL1	Y	N
151	Prudhoe Bay, AK	U.S.A.	17495	PBOC	Y	N
158	San Francisco, CA	U.S.A.	6641	PBL1	Y	N
	San Francisco, CA	U.S.A.	14170	SBRB	Y	N
	San Francisco, CA	U.S.A.	14210	SBRN	Y	N
	San Francisco, CA	U.S.A.	9534	TIBB	Y	N
	San Francisco, CA	U.S.A.	4864	UCSF	Y	N
	San Juan, Puerto Rico	U.S.A.	9455	BYSP	Y	N
	San Juan, Puerto Rico	U.S.A.	9661	ZSU1	Y	N
206	San Juan, Puerto Rico	U.S.A.	9661	ZSU4	Y	N
100	Sand Point, AK	U.S.A.	2579	AB07	Y	N
150	Seward, AK	U.S.A.	/	/	/	/
154	Sitka, AK	U.S.A.	24878	BIS1	Y	N
	Sitka, AK	U.S.A.	24878	BIS5	Y	N
	Sitka, AK	U.S.A.	24948	BIS6	Y	N
157	South Beach, OR	U.S.A.	4628	NEWP	Y	N
	South Beach, OR	U.S.A.	462	ORSB	Y	N
102	Unalaska, Aleutian Is. AK	U.S.A.	431	AV09	Y	N
332	Virginia Keys	U.S.A.	476	AOML	Y	Y
	Virginia Keys	U.S.A.	653	MIA3	Y	Y
	Virginia Keys	U.S.A.	387	SA20	Y	N
105	Wake Is., Marshall Is.	U.S.A.	32	WQSL	Y	N
300	Montevideo	Uruguay	1698	UYMO	Y	N
348	Vanuatu	Vanuatu	1488	VANU	Y	Y
	Vanuatu	Vanuatu	1015	PTVL	Y	N
328	La Guaira	Venezuela	/	/	/	/
75	Qui Nhon	Viet Nam	/	/	/	/
3	Aden	Yemen, P.D.R.	/	/	/	/