

December 7, 2016

**ILRS Quality Control Board (QCB)**  
**Telecon**  
**December 7, 2016**  
**Draft**

Participants: Toshi Otsubo, Horst Mueller, Matt Wilkinson, Carey Noll, and Mike Pearlman

**Data Bias Pilot Project (not updated)**

The ASC has a pilot project underway to harmonize the results from all of the QC sources and develop a routine data product on an accessible URL that will give clear and useful information on the systematic biases for each station. The output needs to display key dependencies that can reveal performance issues. The web-based product will provide a tool for detailed examination of the data and a basis for standardized reports that can be interpreted by station personnel people and be augmented with highlights and recommended actions. Erricos expects the beta version of the web tool will be ready for testing in the second quarter of 2017.

Practitioners are encouraged to suggest additional displays and screens to aid in diagnostics. Two requests so far are:

- (1) Range bias verses range for geodetic satellites (Starlette/Stella, LARES, LAGEOS, etc.) for each station for a standardized time interval (months to a year) to reveal any range dependent biases; Etalon would be a good altitude to include, but data is sparse and the C/M is not well known;
- (2) Long-term plots of system biases on LAGEOS by station, averaged in some standardized intervals (moving window) so we can look at historical trends.

The web-tool should help us decide the proper standardized intervals for each application. Although the tool itself offers great flexibility for “discovery”, the stations need a set of consistent displays with standardized conditions to provide a unified framework for their understanding and our use as a means of conveying advice. We need to keep it as simple as we can to convey the message.

**Data Processing**

At the last meeting Cinzia asked if we provide an automated screening tool that would highlight pass discontinuities in the time series and permits automated exclusion if data according to some set of criteria (perhaps based on 5 sigma, perhaps minimum of 4

passes, etc.). We need to determine what would be meaningful and how we ascribe a confidence level to those criteria. This will require examination of data histories and some testing. The in-line tool should be useful, but some examination now might help formulate some constraints and bounds.

**ACTION Mike:** Ask Cinzia if this is for post processing historical data using ITRF 2014 or scrutinizing incoming data. If it is historical data, most of the discontinuities will have already been discovered. If it is on incoming data there will not be much leverage. Ask Cinzia to clarify the application and suggest a set of criteria based on her analysis experience

### **Site Logs**

Site Logs are being examined to see if station information is current and if the stations are using the most current satellites C/M models; Tom Varghese is checking on the NASA Sites. Erricos has begun an examination and follow up on the site ties and eccentricities in the site logs.

### **Range Dependent Errors**

Horst is analyzing system biases as a function of range using the geodetic satellites from LEO to Etalon using data from all of the network stations. He expects to have a plot at the next meeting.

### **OST Notes from Jose Rodriguez**

Jose participated in the OSTST meeting in La Rochelle in November. His notes are attached. The main points from that community are; SLR is necessary for altimetry, the quality of the data is not homogeneous, and top quality data is space. The data issues are discussed in his notes. This is a very important customer and we need to pay heed, not only in addressing the shortcomings, but also providing a user-friendly evaluation of our data by station; whom can they rely on and whom can they not.

We will probably want to work with the OD people in the satellite altimetry community to combine our efforts.

### **Displaying System Biases**

The SLR Quarterly Reports tabulate data quantity by station and long and short term biases in the data calculated by each of five analysis centers. We have data quantity in graphs, but not data quality graphs by station, which would be of interest to our users. Attached are charts made by Jose Rodrigues using the Report Card tabulated results for from Toshi's analysis. In general the results look as we would expect.

The question is how should we aggregate the station data biases over all the Analysis Centers into one product. Also it also is not clear how Mark Torrence formulates the stations values from the weekly and daily reports from the Analysis Centers.

We also have the problem of corruption of the bias results due to errors in the stations positions for new sites (SOS-W, Brasilia, etc.).

If we use charts like those produced Jose with the currently tabulated bias results we will need some explanation on these caveats.

Is it worth trying to do any more before we have updated station position with ITRF 2014?

Horst has updated the station positions (through 2016) including the new stations using DGF (see his poster at AGU): he should have new station bias values available by early 2017.

ACTION Horst: Speak with Erricos on how we should proceed and whether we should wait until new aggregated stations positions and bias values are available before doing much on the website;

ACTION Matt: speak with Jose to get some feeling on what the customers want.

ACTION Mike: Ask Mark T how he determines the data biases from the individual Analysis Centers results.

### **Low Elevation Data Modeling**

There is still interest in low elevation tracking as a tool for checking our models (refraction, orbits, etc.). Extending passes to low elevations will cut into tracking time for other satellites, so there is a trade off. Some stations also have minimum elevation restrictions. It was suggested the we could try some simulations to estimate the advantage of the lower elevations data (10 – 20 deg), but we opted instead to examine existing low elevation data from MOBLAS 5 and 7, and any other stations with low elevation data to see if we can reach a conclusion on the value of the low elevation data. We should stick with geodetic satellites from LEO out to LAGEOS. Very few stations have low elevation data, so the sample is very small.

ACTION Horst: Decide if this is worth pursuing with simulations.

### **Data Population on LAGEOS Passes**

We still have stations that are taking too small a NP sample on passes; in particular the Changchun station is tracking many satellites but has a very sparse sampling on the LAGEOS passes. Mike has asked the Changchun Station if they can take more data on LAGEOS. Await a response.

Should there be a minimum number of NP's for a pass to be acceptable? Should we weigh or exclude outlier NP's by the number of contained FR points? This maybe a topic for Riga

### **Station Tools**

We need to define tools/procedures/suggestions to help the stations detect system problems on-site, and to address issues when diagnostics are received from the QC process.

Matt has started discussion on this at the Networks and Engineering Standing Committee; input from the stations on practices that they use might be useful.

### **Other items (not discussed)**

Maybe Ivan Prochazka would be willing to lead an activity on a rigorous component-by-component approach to trying to understand all sources of error in the SLR measurements.

Carey is working on clarifying the proper point of contact and interface for each of the stations.

A list of the Site Log updates and configuration change notifications has been provided by Erricos. Have all stations provided recent update?

Matt has established the on-line forum tool. He will vet it through the N&E SC and then the Board and the CB. Some messages have already been posted. Take a look.

Next Meeting: January 17 at 14:00 UT; 9:00 Eastern US, 14:00 in UK; 15:00 in Central Europe

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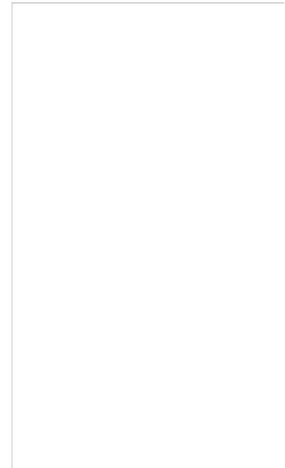
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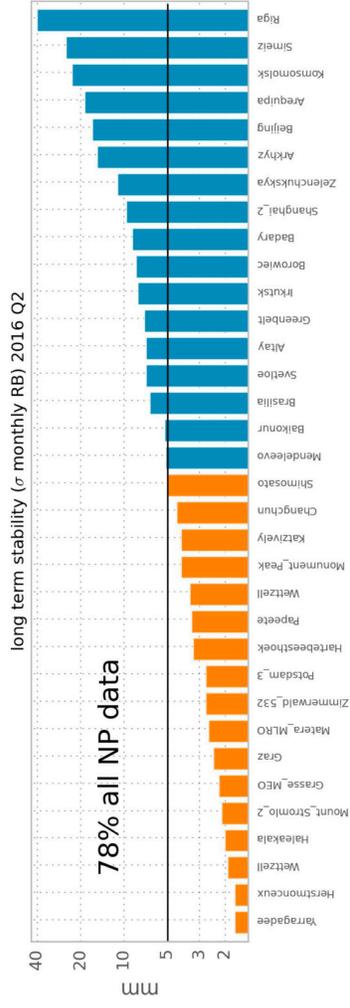
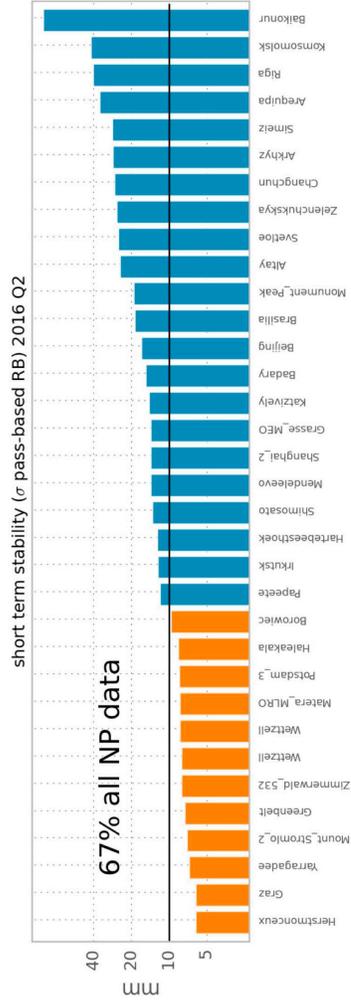
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**Stability: short- and long-term** (Hitotsubashi University analysis 2016 Q2)



Almost 50% stations (3/4 + all data) achieve long-term stability < 5 mm



# OSTST 2016 notes

Inbox x



**Jose Rodriguez** Nov 23

to me, giuseppe.bianco, Erricos, Luceri, horst.mueller, Toshimichi, Graham, Matthew

Dear all,

At the last OSTST (Ocean Surface Topography Science Team) altimetry meeting in November 2016 in La Rochelle, we were invited to give a presentation in the Precise Orbit Determination session about systematic errors and data quality in SLR (attached). There was a considerable amount of interest on this

topic. In fact, during their POD round table discussion a resolution was adopted to contact the ILRS officially to express their concerns and needs, and I was asked to report in some form these issues. This email summarises my own impressions from the meeting and the messages I heard from this key set of users of our data.

In the briefest terms (and unsurprisingly):

- 1) SLR is necessary for altimetry,
- 2) but quality is heterogenous,
- 3) and top quality data scarce

As you know, the unique contribution of SLR data for the altimetry community is that it allows the absolute validation of the radial accuracy of their orbits. Although this is not the only use, as some groups include laser data for dynamic orbit determination and others do so for selected missions (e.g. those not carrying GPS onboard). The issues noted regarding the quality of SLR data are well known to us: a small group of "core" stations dominates both in quality and quantity, something which in turn aggravates the problem of having a poorly geographically distributed network.

Most presentations/posters in the POD session included a section about the validation of the results with SLR residuals. Invariably it would be mentioned that the validation was performed with a small subset of "trusted" stations. This subset can be as small as 6 stations, and in no case bigger than 13 stations (more on this below). Apparently, for validation purposes the ideal requirement is 1 cm RMS short-term stability, with long-term stability well below 1 mm/year. For some purposes (e.g. identifying geographically correlated orbit errors at inter-annual and decadal time scales), if these requirements are not met the data is simply not good enough. So contrary to the situation where laser data is included in the dynamic orbit determination (e.g. Cryosat,

Envisat), where most of it is used (with appropriate weighting), in the case of validation the requirements are more strict and absolute. That "we are no longer in the era of TOPEX/Poseidon"---as someone remarked---captures well the message the altimetry community wanted to convey. Radial orbit accuracies for the best performing missions (Jason-2, Cryosat-2) nowadays approaches 7 mm RMS; SLR errors should ideally be consistently smaller to reveal orbit errors at that level.

Although already informed about it, they were pleased to hear about the recent progress regarding the estimation of systematic errors and the eventual release of an ILRS official product based on this. It is hoped that the corrections will improve the quality of the SLR data they depend on, both in the short- and long-term time scales.

After the meeting I contacted several groups asking which stations they normally employ for their validation work. I have answers from AIUB, CNES, DLR, ESOC, GSFC, GMV and JPL, although not always for the same mission or time periods. Without going into any detail, the number of stations used is between 6-7 (two groups) and 12-13 (three groups), with others using a different number or doing something slightly different (e.g. using all data and comparing the results with those from a very selective subset of 5 stations). Of course, the overlap between stations employed is large, and matches well with what ourselves know about the quality of the network.

To conclude, I note that this is not fresh news really, our altimetry colleagues have been worrying about the quality of the SLR data for some time now. Annual OSTST meetings reports can be found here:

[http://www.aviso.altimetry.fr/fileadmin/documents/OSTST/2012/OSTST\\_2012\\_Meeting\\_Report.pdf](http://www.aviso.altimetry.fr/fileadmin/documents/OSTST/2012/OSTST_2012_Meeting_Report.pdf)  
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Comments about the performance of the SLR network from their point of view can be read in the POD sections, where issues such as sudden increases in RMS, unannounced operational changes affecting the results, and presence of long-term drifts are noted.

I hope these observations are found to have some informative value.

All the best,

Jose