January 18, 2017

ILRS Quality Control Board (QCB)
Telecon
January 17, 2017
Draft

Participants: Horst Mueller, Matt Wilkinson, Erricos Pavlis, Sean Bruimsma, Alexandre Couhert, Carey Noll, and Mike Pearlman

Data Bias Pilot Project (Erricos)

The ASC continues on the Station Systematics Pilot Project: each participating AC is computing station biases from loosely constrained weekly orbits for L1, L2, and L1 +L2 over a 4-year period to characterize the long-term biases of each station. The first combination by JCET was presented at the workshop in Potsdam. The good stations had biases at the few mm level; poorer stations had significant biases. ASI is working on the next combination for presentation at the ASC meeting in Vienna. It is anticipated that this PP should evolve into the routine production of weekly station biases as an ILRS data product that can be displayed in different ways that can reveal key dependencies and performance issues. Practitioners and analysts are encouraged to suggest displays and screens that could 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 are 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.

Unfortunately, not all of the AC’s were able to participate, bringing up the question of whether participation in this activity will be required for AC status.

Web Based Station Performance Tool (Erricos)

Five ACs currently provide station performance parameters on a pass-by-pass basis on LAGEOS-1 and -2 for consolidation into the ILRS report cards compiled by Mark

Torrence. JCET has been developing an on-line tool to digest the pass-by-pass inputs from the AC's and display them in different modes (plots, fits, moving averages, etc.). This tool will provide users with a method for detailed examination of the data and a basis for standardized reports that can be interpreted by station personnel and be augmented with highlights and recommended actions. Erricos expects the beta version of the web tool will be ready for testing mid-year.

Additional tools for examining systems biases

We also discussed the possibility of using existing orbital analyses on altimeter satellites (with co-located GNSS and DORIS) as another tool to look at the system biases. These orbits are computed by analysts working with the altimetry data and might help provide some additional insight since some of these long-term orbits have a sub-cm precision. This activity would be separate from the geodetic pilot project. We asked Sean and Alexandre to discuss this idea with Frank L. to see what might be done. In the very least we should be cognizant of their results and see if these is any correspondence with ours.

Data Processing

Cinzia has asked if we can provide an automated screening tool that would highlight pass discontinuities in the time series and permit automated exclusion of data according to some set of criteria. We need to determine what would be meaningful and how we ascribe a confidence level to those criteria. This idea will require examination of data histories and some testing. The on-line tool should be useful, but some examination now might help formulate some constraints and bounds. If this tool is to be used for historical data, most of the discontinuities will have already been discovered. If it is be used on incoming data there will not be much leverage. This idea needs to be discussed further with Cinzia.

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 and Mike have followed up and clarified inconsistencies in site ties and eccentricities in the site logs.

Range Dependent Errors

Some of the engineering studies have asked if we could display system biases as a function of range using the geodetic satellites. Horst is analyzing computation of these biases for the geodetic satellites from LEO to Etalon using data from all of the network stations over a period of several years. He expects to have some plots ready at the next meeting.

Displaying System Performance

It has been noted that we tend to display data quantity charts, but less often, data quality (short and long term stability) charts that would be useful to our users. The web-based performance tool above will give us many options to display this information. Attached is a chart (using Toshi's Report Card information) presented by Jose Rodrigues at the OSTST 2016 meeting. In addition, we will have the results from the Pilot Project to provide station systems biases.

Is it worth trying to do any more to the report card at the moment?

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.

Low Elevation Data Modeling

There is still interest in low elevation tracking as a tool for checking our models (refraction, orbits, etc.). However, 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 that we examine existing low elevation data on geodetic satellites 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.

ACTION Horst: Decide if this is worth pursuing.

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. In response to our inquiry, they have said that they are reviewing their operational procedures and will try to expand LAGOES coverage. Let's see what happens.

Should there be a minimum number of NP's for a pass to be acceptable? It may depend on the altitude. Should we weigh or exclude outlier NP's by the number of contained FR points? This may be a topic for Riga. Maybe we need a study group to come up with some recommendations?

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 within the Networks and Engineering Standing Committee; input from the stations on practices that they use might be useful.

Other items (not discussed)

In our 1 mm long-term interest, it probably is a good idea to do a rigorous component-by-component examination of the SLR systems, trying to understand all sources of error sources in measurements. We should discuss this with Ivan Prochazka.

Carey is working on clarifying the proper point of contact and interface for each of the stations. Have we covered all stations?

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

ACTION Carey: Send a reminder message to the stations to keep their site logs up to date.

Matt has established the on-line forum tool. Some messages have already been posted. Take a look.

Next meeting: February 16 at 14:00 UTC; 09:00 in Eastern US, 14:00 in UK; 15:00 in Central Europe.

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Passcode: 317382

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France (toll free)	0 805 101 207
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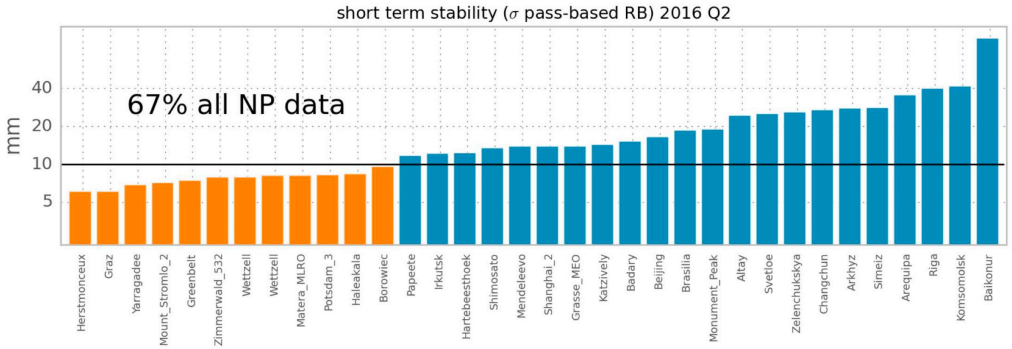
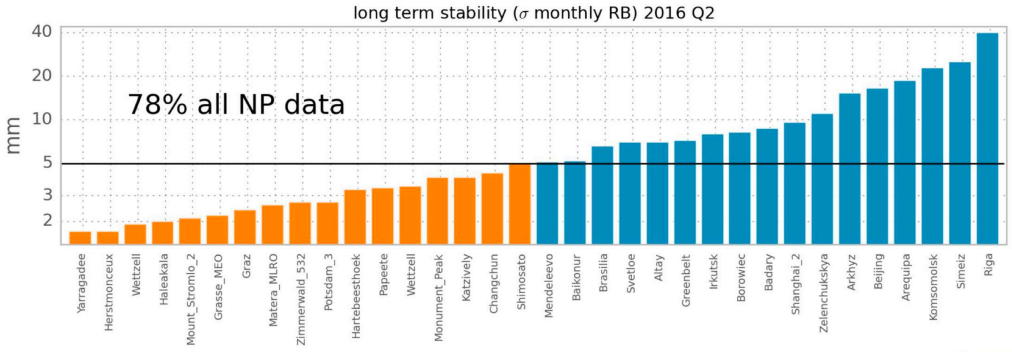
Stability: short- and long-term (Hitotsubashi University analysis 2016 Q2)





Almost 50% stations (¾ + all data) achieve long-term stability < 5 mm

OSTST 2016 notes

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/2013/oral/OSTST_2013_Meeting_Report.pdf
http://www.aviso.altimetry.fr/fileadmin/documents/OSTST/2014/OSTST_2014_Meeting_Report.pdf
http://www.aviso.altimetry.fr/fileadmin/documents/OSTST/OSTST_2015_Meeting_Report.pdf

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