Accuracy and Stability Assessment of the ILRS Stations Over Two Decades

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Abstract

The development of the ITRF depends on the quality of the contributions from the four geometric techniques. With the GOOS requirements for ITRF accuracy and stability becoming exceedingly stringent, ITRS requests that each technique generate and deliver an assessment of the performance of each station over time, covering as much of the period spanned by their contribution as possible. Since the ITRF relies on the consensus of the techniques at the collocated sites, this information can be used to sort out cases where a discrepancy is observed between the techniques and the local survey information, isolating the most likely culprit and taking appropriate steps to avoid distorting the final result. In response to an ITRS request we have developed a historical qualification index based on the long-term and short-term performance information available to ILRS, a consistently derived set of systematic error estimates from the analysis of LAGEOS and LAGEOS 2 SLR data and all the engineering information reported to ILRS by the stations. We propose to establish and maintain this index to serve as input to ITRS for the ITRF2013 development as well as for the future realizations.

ILRS NETWORK QUALITY CONTROL RESOURCES

ILRS since more than two decades has monitored the performance of individual stations through a Quality Control (QC) process. QC is based on the standardized analysis of the collected data by a dedicated group of Analysis Centers (AC). The results have been tabulated in what is known as the “Global Report Card”, originally released every three months, and now on a monthly basis.

Monitoring the statistics of each station’s calibration stability provides a metric for the quality of the collected NPs and their noise content. Fitting the data from the entire network in orbital arcs may further reveal systematic errors which sometimes arise from several sources, some of which cannot be detected through engineering QC procedures, such as those routinely performed on site, but only through a precise data analysis with the rest of the network data.

Tracking the system performance over the past three months gives a sense of the trends in systematics, by way of averaging over longer periods, such as the past year, characterizes the “long-term performance” of the system. Every AC uses a different piece of s/w and analysis approach, resulting in different pieces of the RMS error for the same data batches. Lack of a higher standard of absolute comparison is overcome by forming the average of the performance indices estimated by each AC and computing the standard deviation of these estimates about the mean. This metric is one of the elements used to characterize a systems’ stability and the lack or presence of systematics over time.

OUR APPROACH FOR SYSTEM PERFORMANCE CHARACTERIZATION

The ILRS AWG has long adopted a policy in estimating systematic measurement errors for the tracking sites, separating the network in “Core” and “Associate” sites, and in general avoiding estimation for the core sites, unless a real problem is detected through the daily QC process or reported directly by the station crew.

The QC process qualifies the data and the system performance on the basis of the currently available best set of station positions and velocities (usually the ITRFxxxx models), which however do suffer from errors themselves, thus biasing our results to some extent. Model deficiencies will further bias our analysis, however, these would affect all stations at a similar level, although errors for some models do have a geographically correlated nature. It is thus clear that the “long-term performance” index as it is represented by the quarterly or monthly Global Report Cards, should be taken with more than a grain of salt, and it should stand for the estimated systematic errors (e.g. measurement or timing biases, etc.) and good understanding of the quality of the underlying (fixed) position of each site.

ILRS AWG LIST OF DATA DELETIONS*

The development of the ITRF2008 (which SLR2008 is based on). Recent improvements in SLR2008 will soon be implemented and a revised version of the data base will provide a more realistic picture of the errors for all ILRS systems, throughout the period covered by this data base: 1993 to present.

During the development of the previous ITRF model, the AWG compiled a detailed list of documented measurement errors at each tracking site and adopted a standard way of addressing these in the analysis. Some of the information was derived from station logs, some from station emails, others from communications with the station crew. All that information has been logged in a database which is maintained by DFGF and accessible through their web site.

Additionally, the AWG determined through analysis a number of systematic errors that were found present in the data and for most of which the stations could not identify a reason for their existence. All of this information is still valid and will be used as input for the characterization of the relative stability and fidelity of each site over time, with respect to the rest of the network. The end product of this process will only be available after we have agreed on the revised SLR2008 release, the reassessment of the measurement errors obtained from a reanalysis of the data for the affected stations (mostly those entering the network in 2009 and later), and it will have the form of a relative weight for each site versus the entire network over the time span 1993 to present.

LONG-TERM RMS AVERAGE VALUES (TOP CHARTS) AND THEIR STANDARD DEVIATIONS (BOTTOM CHARTS) BY REGION COLOR LINES ARE FOR INDIVIDUAL STATIONS – BLACK LINE IS THE AVERAGE OVER ALL STATIONS

SYSTEMATIC ERRORS CAN AFFECT EVEN THE BEST STATIONS – CASE STUDY: YARRAGADEE

Averaging over long periods of time can easily mask short-term deviations which sometimes even the local crew cannot explain. Note the large and significant error from Oct.2010 to March 2011: 15.4 ± 2.7 mm

*All data adopted prior to the development of the ITRF2008 product