Comparison of weekly and daily IGS reference frames: the first year

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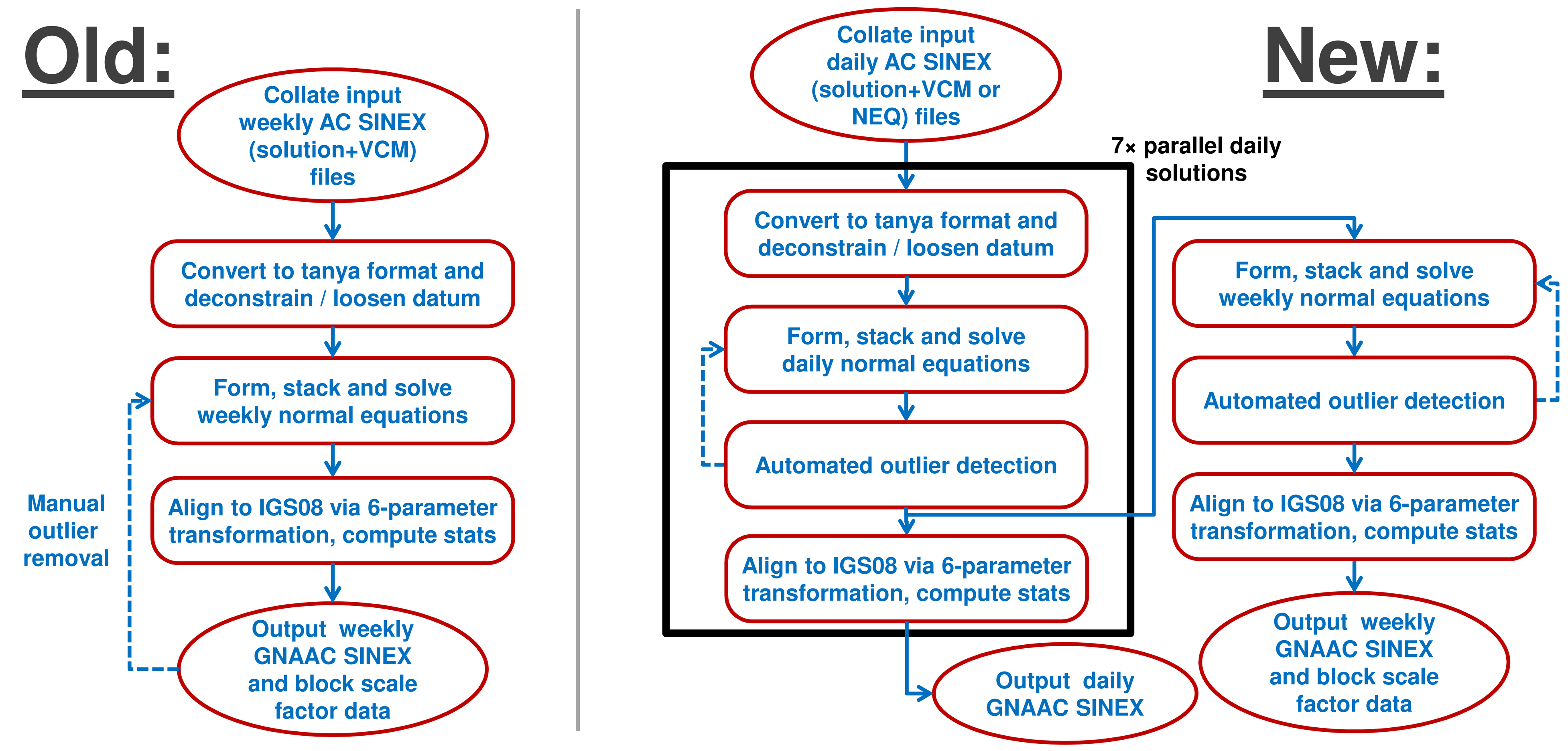
1. Introduction

From GPS week 1702 (19 Aug 2012), the International GNSS Service adopted daily analyses of the terrestrial reference frame (TRF). Analysis Centers (ACs) should now provide independent 24-hour batch solutions for each day's data, with the mildest possible constraints from one day to the next. Amongst other benefits, in due course this will allow more detailed analysis of sub-seasonal errors in GNSS (*e.g.* Ray *et al.*, in press). Previously, ACs provided weekly TRFs based on data arcs with different lengths and constraints.

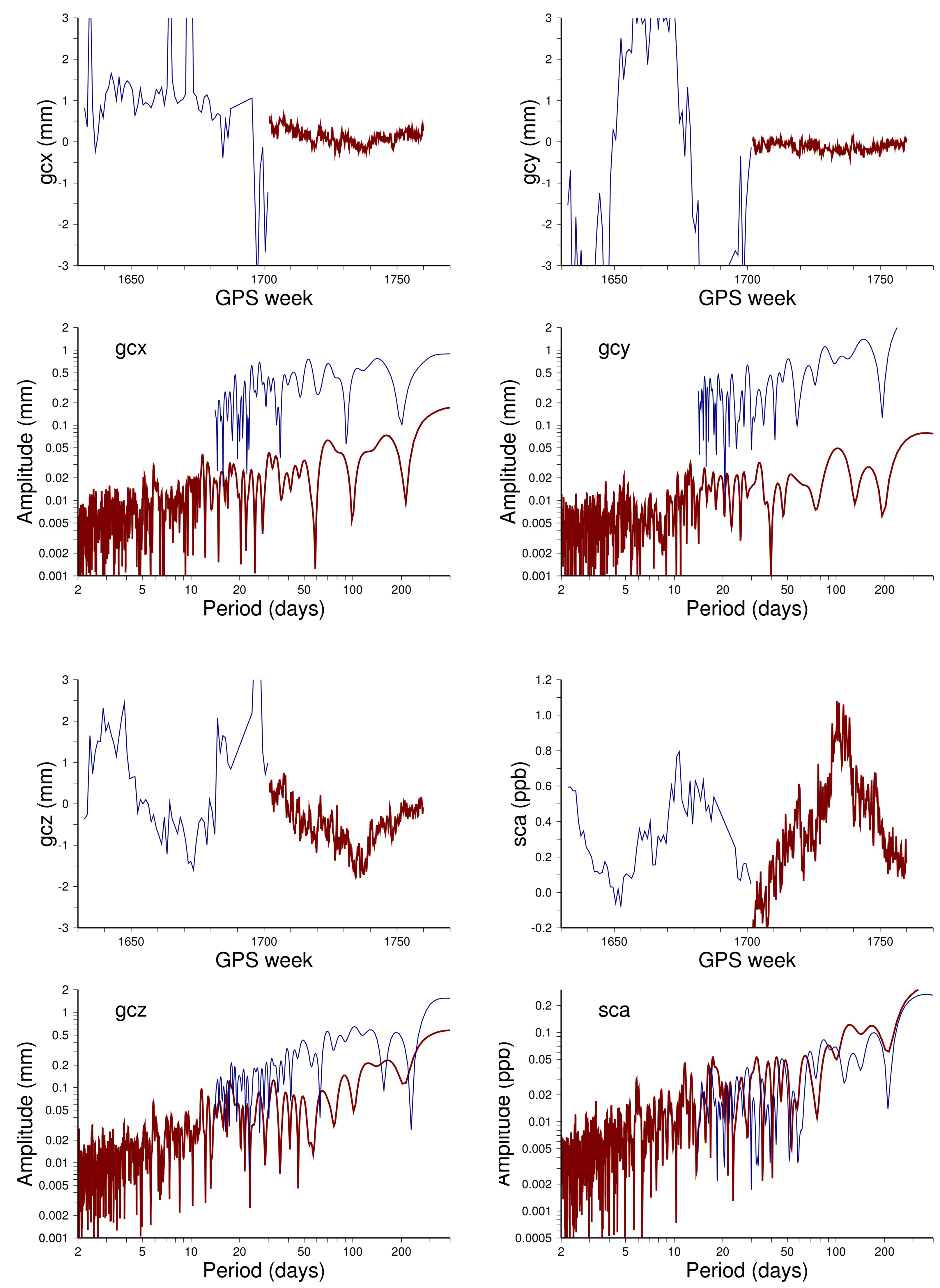
In the official (IGN) and associate (MIT-GNAAC and NCL-GNAAC) IGS combinations, TRFs including Earth Rotation Parameters (ERPs) produced by each AC are combined and quality-checked to yield separate daily and weekly products. Here, I report on recent changes in the NCL-GNAAC 'Tanya' software, and offer a preliminary comparison of data quality before and after week 1702.

2. Changes in combination procedure



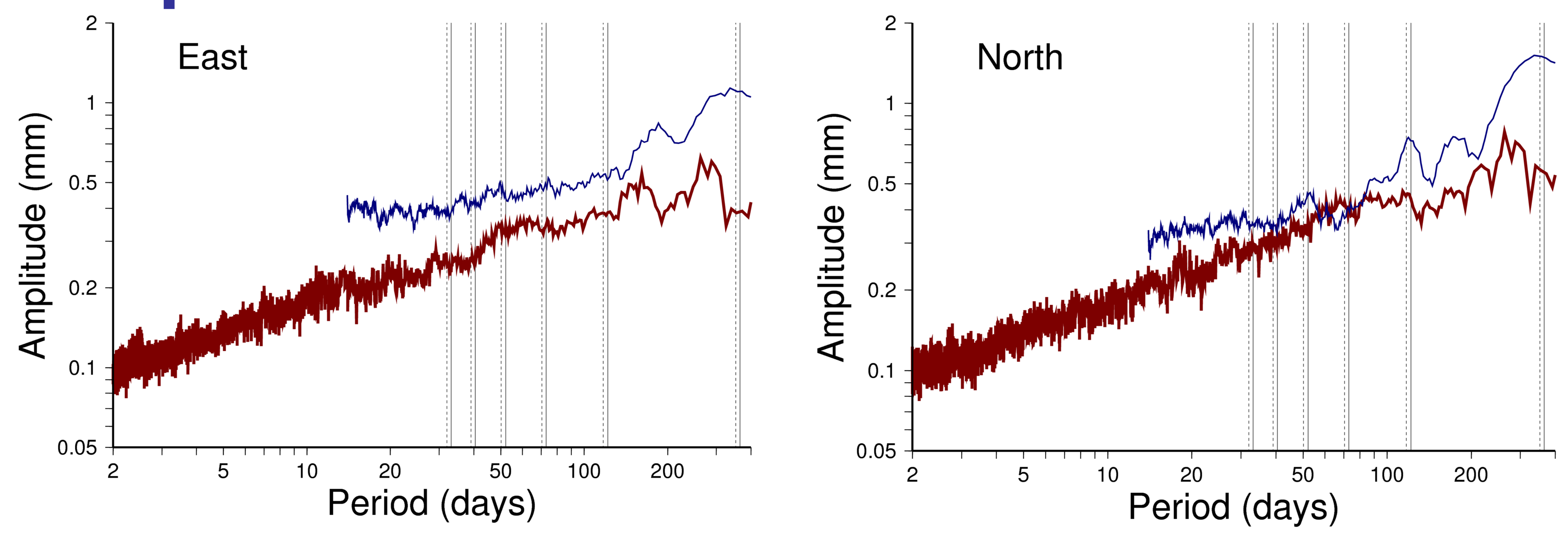
The approximately eightfold increase in computation required by the adoption of daily solutions has led to the replacement of the old processing strategy (left) with one based on distributed processing (right). Automatic outlier detection has also been improved: individual station coordinate-triplet outliers are now removed iteratively using Baarda's *w*-statistic, and ERP outliers using a threshold for the weighted residual that decreases at each iteration.

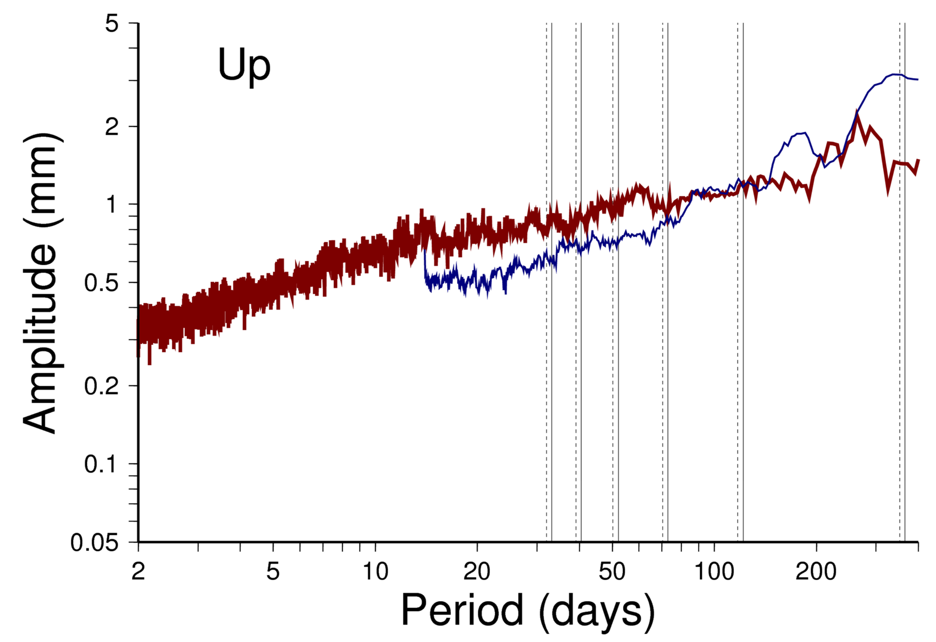
3. Geocentre and scale



Helmert parameters estimated between the loose GNAAC epoch solution and the propagated IGS08_1632 reference solution are shown above. Results are compared for the 70 weekly solutions from the adoption of the IGS08_1632 TRF (thin blue lines) to week 1701, and the 66 weeks of daily solutions since week 1702 (thick red lines). The increase in number of input solutions, and enhancements in outlier detection and AC solution quality, result in clear improvements in the time series. However, first indications are that the spectral content of each time series (slope of periodogram) is largely unchanged, and is similar at the shorter periods now observable.

4. Spectra of coordinate residuals





Similar to panel 3, but showing median values of stacked periodograms based on detrended coordinate time series. Solid and dashed vertical lines indicate odd harmonics 1-11 of the solar (365 d) and GPS-draconitic (351.4 d) years respectively. In the daily analysis, the peaks aligned with the 3rd and 7th harmonics in the North residuals seem to have disappeared. Some reddening of the spectra is apparent at shorter periods, and whitening at longer ones.

5. Conclusions

The switch to daily IGS analysis, and associated improvements in Tanya, have led to an improvement in TRF quality. Further improvements may become evident as the time series extends onwards, and backwards via the second IGS reprocessing campaign.

Initial results, based on a similar time span before and after the switch, suggest that TRF alignment is now less noisy. Site coordinate noise does not whiten at short periods. GPS draconitic errors seem to be mitigated slightly: given that there has been no change in satellite force models, this may mean that these errors are being absorbed into other estimated parameters.

Reference

Ray, J., J. Griffiths, X. Collilieux & P. Rebischung (in press). Subseasonal GNSS positioning errors. *Geophys. Res. Lett.*, published online 26 Nov 2013 (doi:10.1002/2013GL058160).

Acknowledgements

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