COST-STSM-ES0701-5895 Scientific Report

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STSM Topic: Mitigating the effect of GPS systematic error propagation through geometry stabilisations

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1. Introduction

The STSM was aimed at reducing the effects of unmodelled (systematic) errors on long GPS coordinate time series. Such effects inflate time series noise, lengthen the timespan required to reach a certain precision, and may also bias site velocities. In order, therefore, to constrain GIA models, these need to be minimised.

2. Work carried out

The work was carried out as proposed, focusing on two areas related to carrier phase multipath. The work builds on simulations in King and Watson (JGR, 2010) but using real data.

   a. Forward modelling of multipath

   We adopted a modified version of the Herring (pers. comm., 2009) multipath model as used in King and Watson (2010). In this instance we focused on the KERG IGS site, and used the local site geometry (e.g., the distance to concrete pad below the antenna) to construct a model of multipath. Since not all values are perfectly known, we searched around the parameter space for the model parameter settings which reduced the carrier phase residuals most effectively. We then tested the model on the KERG time series from 2000-2008 using GIPSY and modelling the multipath as an additional component to the site's antenna phase centre variation file (antex file).

   Figure 1 demonstrates the effect of the model on the carrier phase residuals.

Top Panel:	Standard antenna, no multipath model.
Middle Panel:	Best fit model using sumsq of the 1° binned running average residual. In this solution, the near field ht changes have less impact (i.e. elevs 20-40)
Lower Panel:	Best fit model using sumsq of all residuals. This seems slightly better at ~23 degrees as more weight is given the region where there are more observations., 10-20° still looks good.

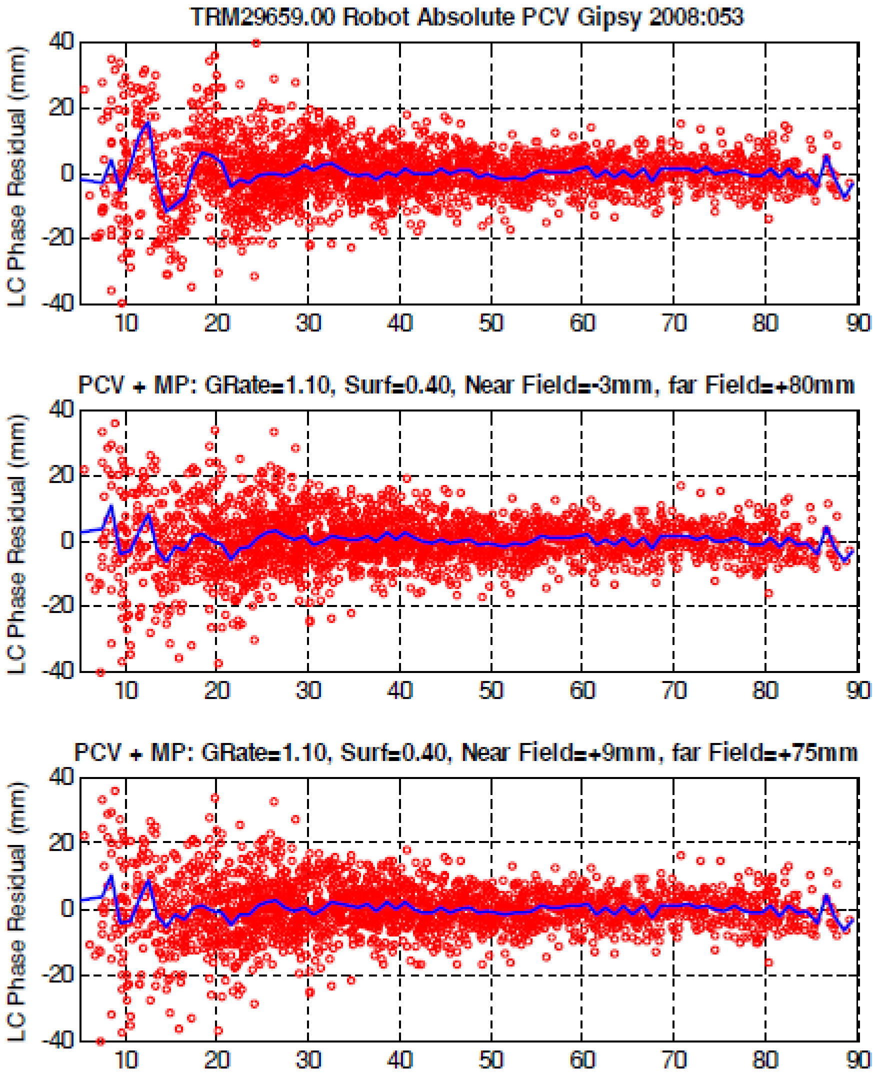

Figure 1: effect of applying the model to post-fit carrier phase residuals in GIPSY. Note the differences at low elevation.

b. Geometry stabilisation

We adopted the "low elev" approach of King and Watson and created GIPSY routines that allow us to individually weight each observation such that it creates a geometry effectively constant from day to day. We refer to this as Stochastic Normalisation of Observation Geometry (SNOG). We have thus far tested it on a ~15 site network in Antarctica, including the problematic MCM4 site. The effect on time series appears to be both positive (in reducing systematic error) and powerful (in that the effect of the correction is large at some sites). For MCM4, we hope that this will allow us to recover a reliable GIA measurement at this site.

Figure 2 shows the effects at MCM4 of applying the SNOG approach

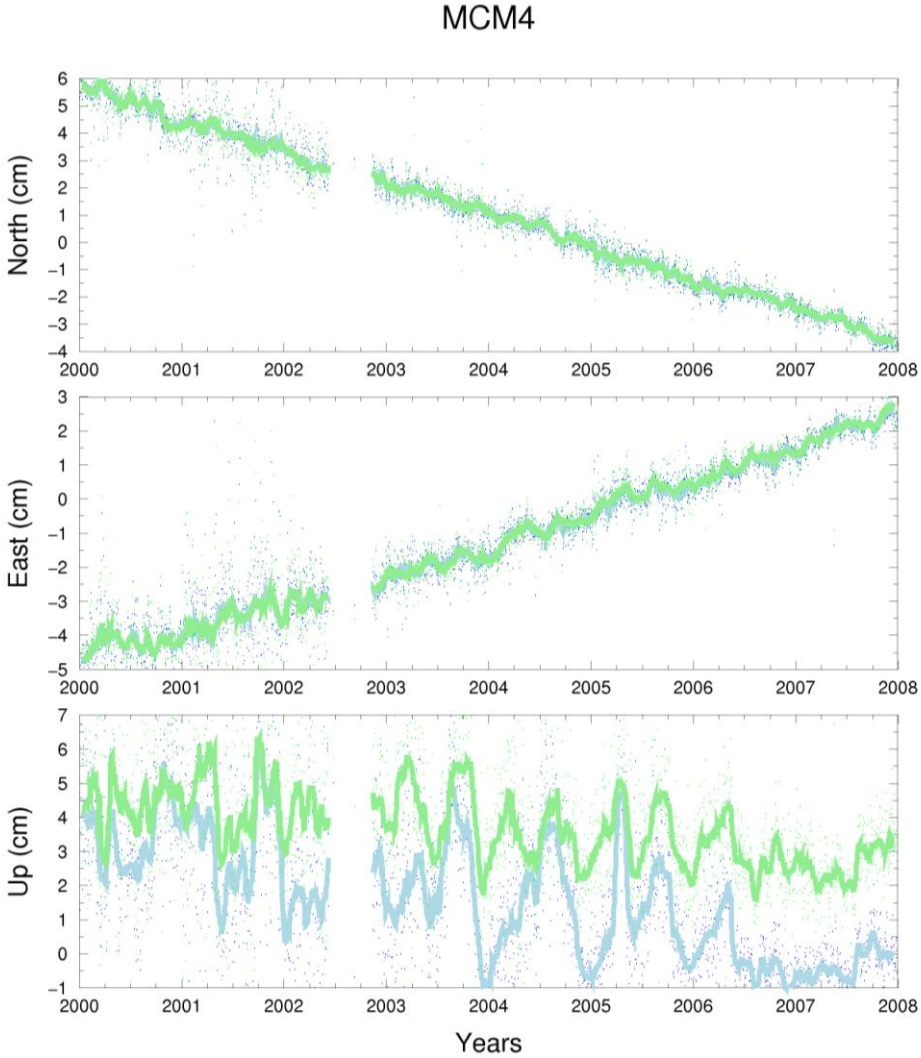

Figure 2: MCM4 time series using uniform (blue) and SNOG (green) weighting at MCM4

3. Outlook

We expect two publications to come out of this work – for example we plan to submit the SNOG work to Geophysical Research Letters. We are pursuing further refinements of the tests and additional sites. We also need to perform ambiguity fixing.

We note that this effort could not have occurred without the support of COST and the collaborative agreement that exists with Australia.

Matt King, May 2010.