G53B-0905: Quantifying load model errors by comparison to a global GPS time series solution

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Introduction

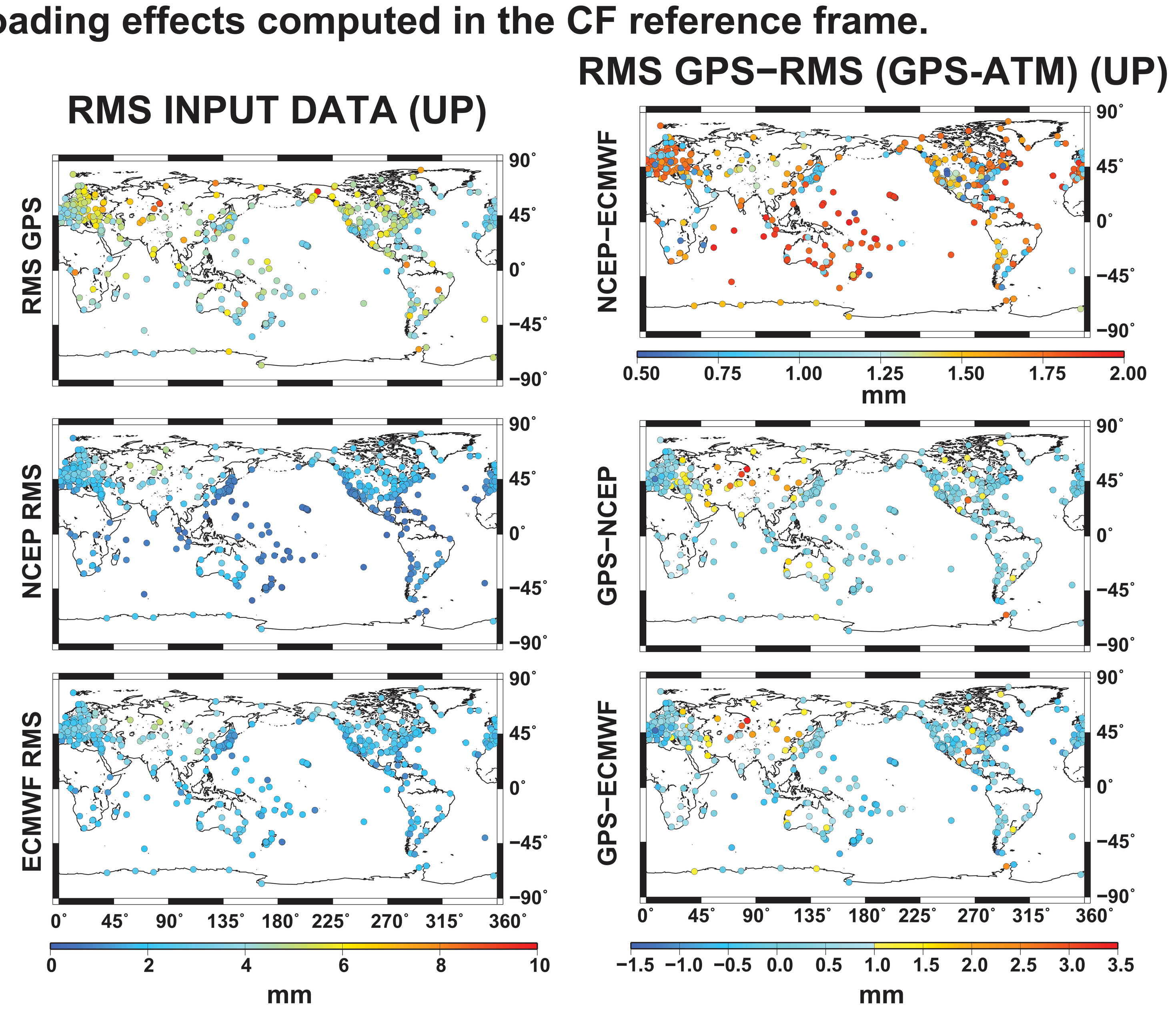
Geodetic data observe suface displacements associated with surface mass redistributions. Historically these effect have been modeled using surface mass models (NCEP, ECMWF, ECCO, OMCT,GLDAS, etc). In this poster, we turn things around. Instead of using the models to estimate loading effects, we use a precise GPSsolution to establish the precision of the loading models themselves.

Our geodetic solution is the most current reprocessed station time series from the International GNSS Service (IGS) for a global set of between 500 and 700 stations, each having more than 100 weekly observations. The long-term stacking of the weekly frame solutions has taken the utmost care to minimize aliasing of local load signals into the frame parameters to ensure reliable time series of individual station motions.

Atmospheric Analysis: NCEP and ECMWF (2005-2010)

NCEP Reanalysis: 2.5 x 2.5 deg global coverage; 6 hourly; ECMWF Interim analysis: 1.5 x 1.5 deg global coverage; 6 hourly decimted to 2.5 x 2.5; IB applied in both cases; data averaged to weekly centered on GPS week then interpolated to the time of the GPS observations.

All loading effects computed in the CF reference frame.

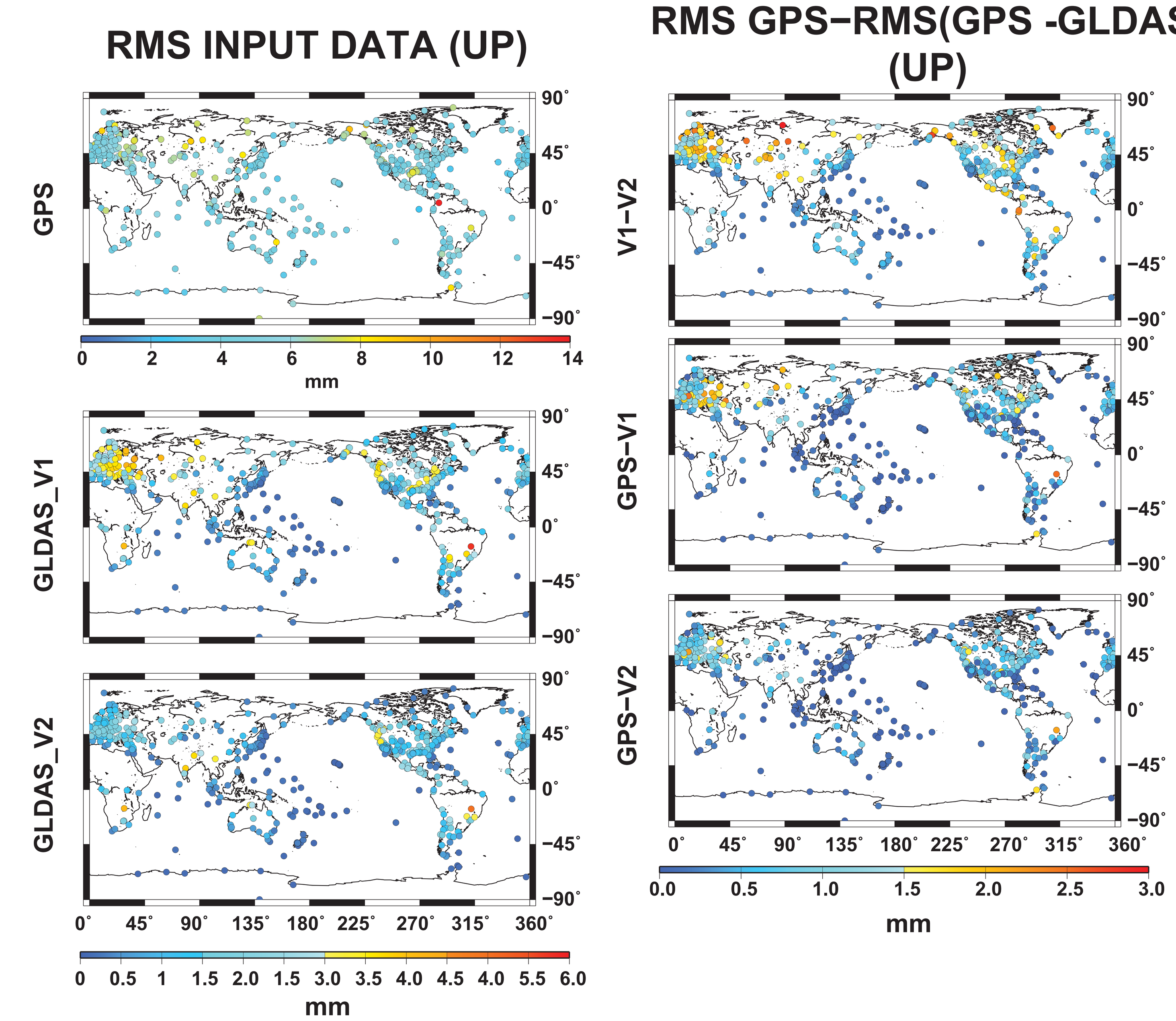


Of the 514 stations with more than 100 weeks of observations:
GPS - NCEP: 406 of 514 station RMS improved; GPS - ECMWF: 282 of 514 station RMS improved
Results appear to indicate that NCEP fits the GPS residualsbetter than the ECMWF

Continental Water Storage Analysis: GLDAS V1; V2 (1993-2007)

Version 1 and 2 of GLDAS: monthly 1x 1 deg over the continents; soil moisture and snow; snow removed from the arctic; monthly data interpolated to gps weekly epochs

Version 2 uses more climatologically consistent data sets i.e. the Princeton forcing data sets extending from 1948. In Version 1, forcing sources switched several times throughout the record from 1979 to present, which introduced unnatural trends and exhibited highly uncertain forcing fields in 1995-1997 (Rui, 2011).



V1 is more variable over Europe than V2. V1 does better at removing signal over Europe and North America as compared to V2.

Overall, both models very comparable and reduce the RMS on the same number of GPS stations (548 of 631) albeit different stations.

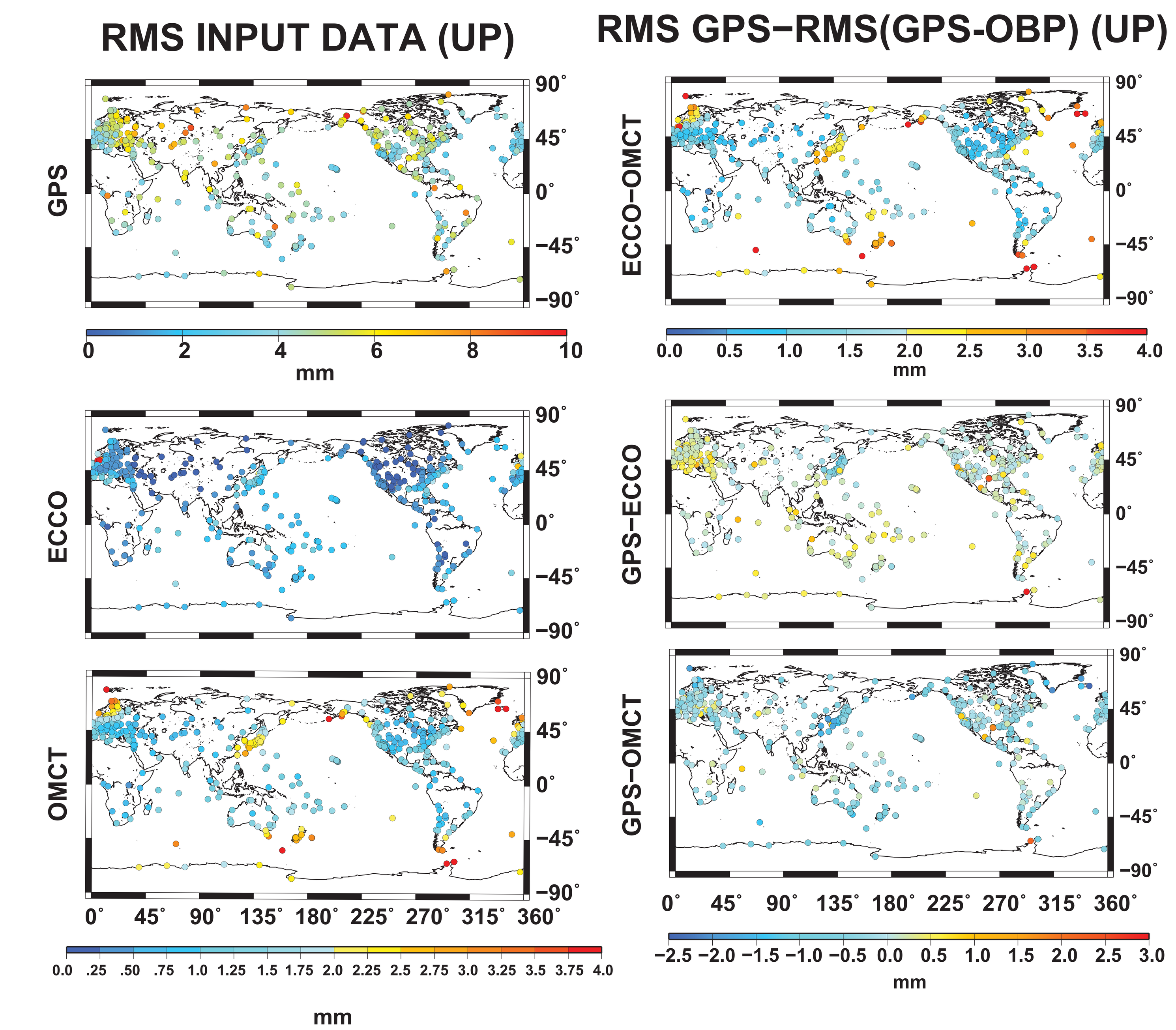
References:

Rui, H., README Document for Global Land Data Assimilation System Version 2 (GLDAS-2) Products, GES DISC Last revised, November 21, 2011.

Quinn, K. and R. Ponte, Estimating High Frequency Ocean Bottom Pressure Variability, GRL, 38, 2011.

Ocean Bottom Pressure Analysis: ECCO OMCT (2005-2010)

ECCO: 1 x 1 over the ocean; 12 hourly OMCT: Stokes Coefficient; l=100; 6 hourly Averaged to weekly centered on GPS week. Trend removed.



Of the 514 stations in this data set, ECCO reduces the RMS on 407 while OMCT reduces the RMS on only 85. These results indicate that the ECCO model is more valid at longer wavelengths and at periods > weekly as compared to OMCT.

Differences in the loading effects conistent with the reslts of Quinn and Ponte (2011), who demonstrated1) that the OMCT has higher variability than ECCO and 2) that ECCO is more consistent with OBP sensors.

Conclusion

These results indicate that these reprocessed GPS station height coordinates can be used to estimate the reliabiltyand precison of environmental data sets at wavelenths > 500 km and periods > weekly.

Future research will include a comparison of the GPS horizontal residuals with the model predictions as well.