IERS Working Group on HF-EOP

John Gipson, Chair
NVI,Inc/NASA GSFC

2018 Fall AGU
Washington, DC

Issues & Recent Results

Current IERS model of HF-EOP is ~ 20 years old and based on tidal models.

- Madzak (2016) derived a model based on satellite altimetry data and showed it was better for VLBI
- Desai and Sibois (2016) derived a model based TPX0.8 and showed that it worked better in GNSS
- Springer (2017) used an empirical model provided by Gipson derived from VLBI data. This reduced GNSS residuals.

All this suggests the IERS model is no longer adequate and needs to be updated.

Formation & Goals of Working Group

An ad hoc Working Group on ‘Diurnal and semi-diurnal Earth orientation variation’ was established as an outgrowth of the 2017 JULY GGOS/IERS UAW in Paris.

At the 2017 IERS Directing Board meeting the working group was put under the auspices of the IERS.

This working group includes representatives of all space geodetic techniques.

The WG will evaluate a suite of models and make recommendations to the IERS.

Working Group Webpage

https://ivscc.gsfc.nasa.gov/hfeop_wg

IERS Working Group on Diurnal and Semi-diurnal EOP Variations

This page is meant to faciliate communication among the members of the IERS Working Group on Diurnal and Subdiurnal Earth Orientation Variation. It is maintained by John Gipson, chair of this Working Group, and IVS Analysis Coordinator. This has the following subdirectories:

- Models of diurnal and sub-diurnal EOP variation in IERS format.
- Software and output used to generate HFEOP from different models.
- Memos written by members of the working group.
- Presentations related to our work
- Papers related to our work
- Archived WG mail. Must be a WG member to access.

The position of the IVS Analysis Coordinator is currently supported by NASA GSFC.

+ Privacy Policy and Important Notices

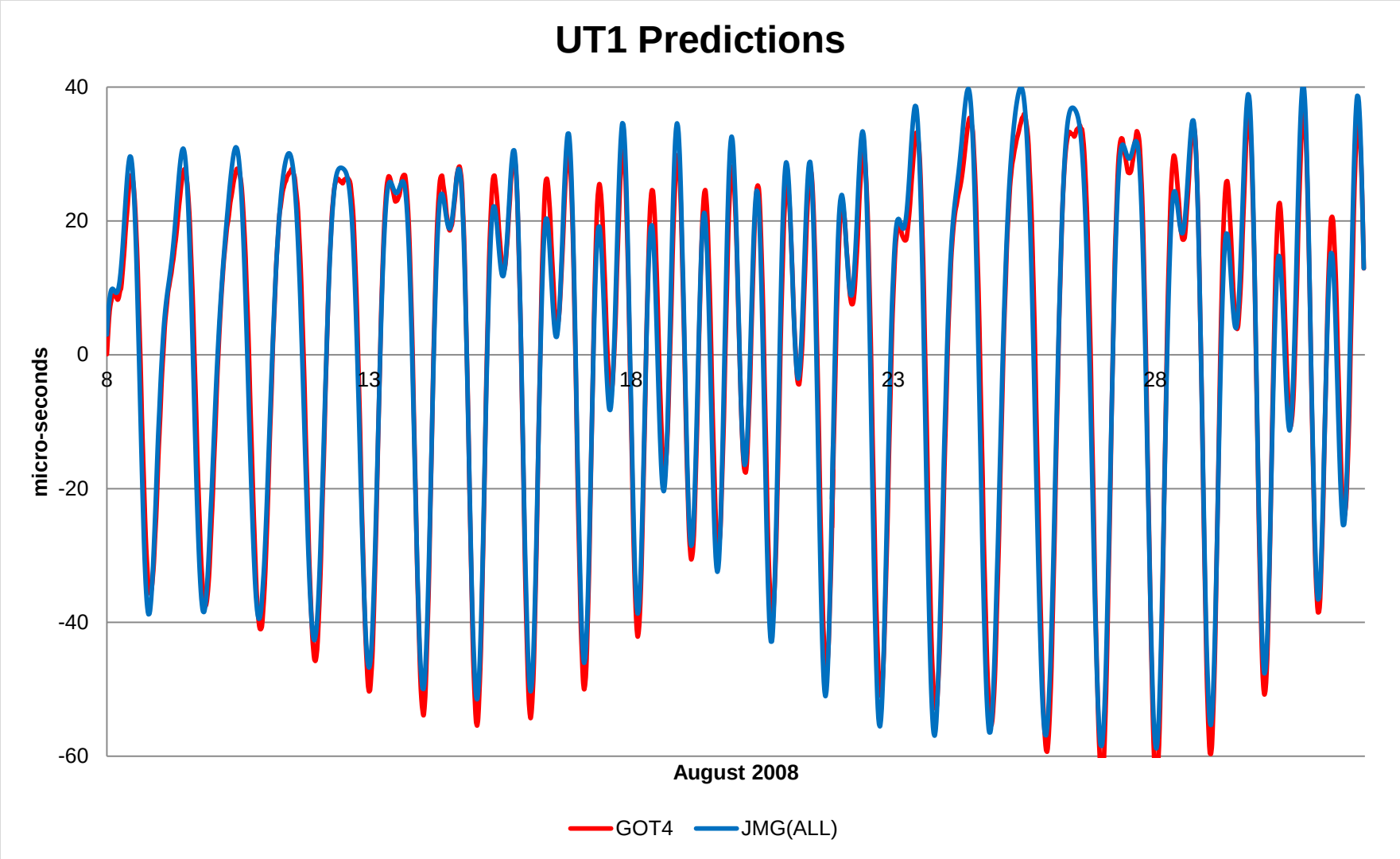
Curator: John Gipson
Web administrator: Ross Asato
NASA official: Stephen Merkowitz
Last updated: 11/07/2018

Models to be tested

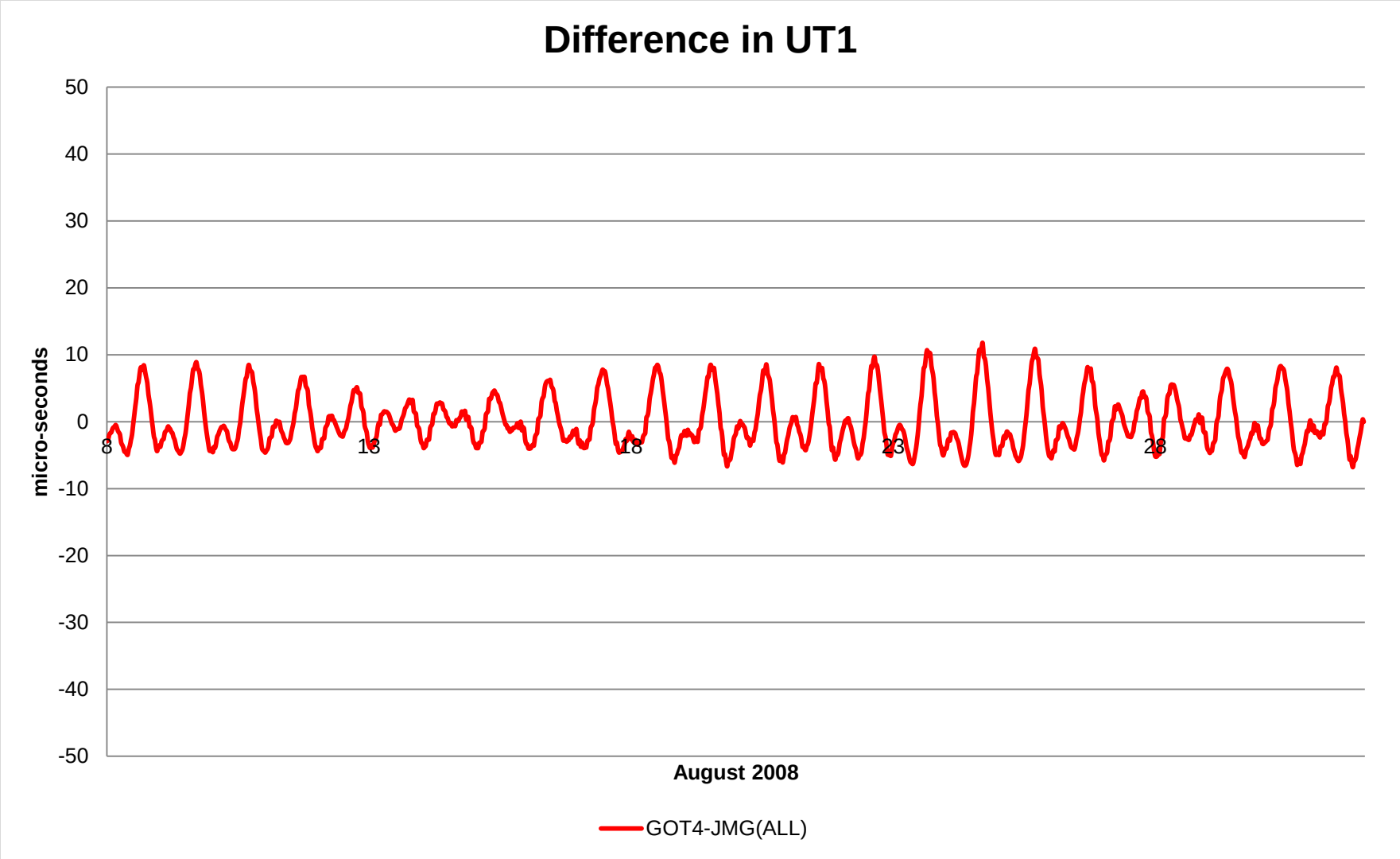
Tidal Models		
IERS Conventions	Based on TPX 0.4	Current
Desai and Sibois	Based on TPX 0.8.	Better on GNSS
Madzak et al	Tidal model	Better on VLBI
Ray	Based on TPX 0.9	Newer tide model
Lyard	FES2014	Newer tide model
Empirical Models		
Gipson	Derived from VLBI data	Fit using VLBI, better on GNSS
Artz et al	Derived from VLBI and GNSS	Untested on other techniques

1. We welcome other promising candidates.
2. All of the models are fairly similar.
3. *We need your help to test!*

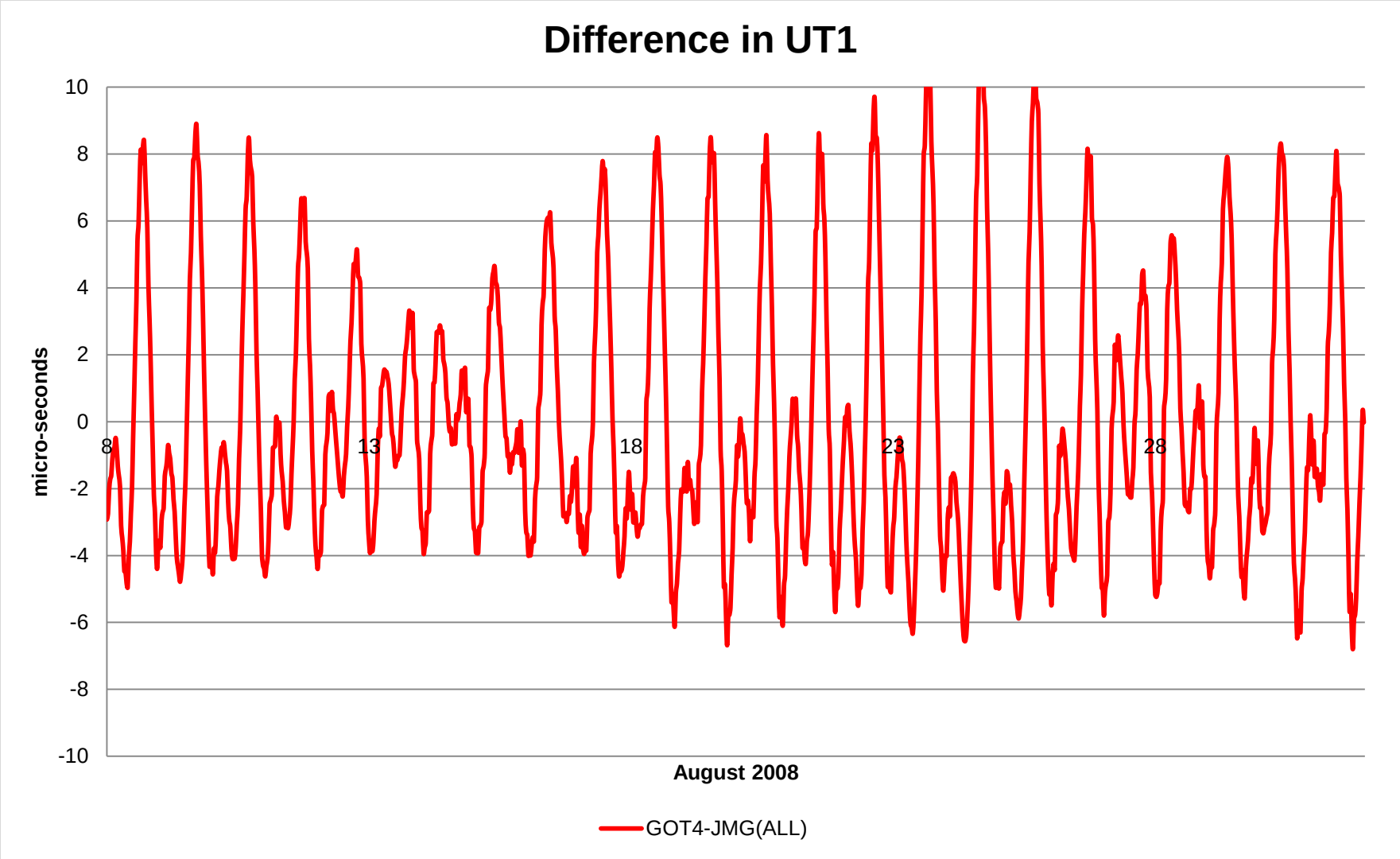
Comparison of Two Models



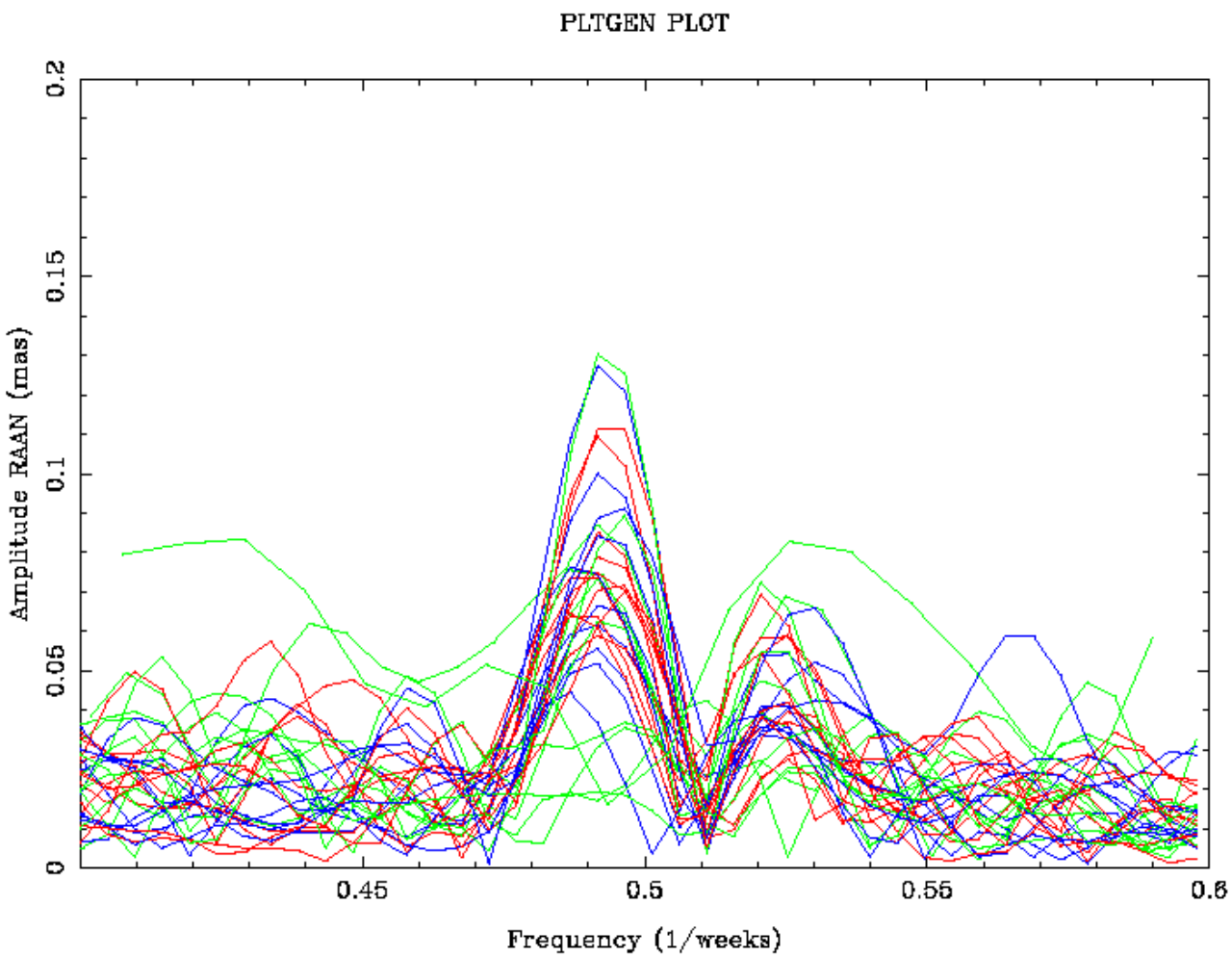
Comparison of Two Models



Comparison of Two Models



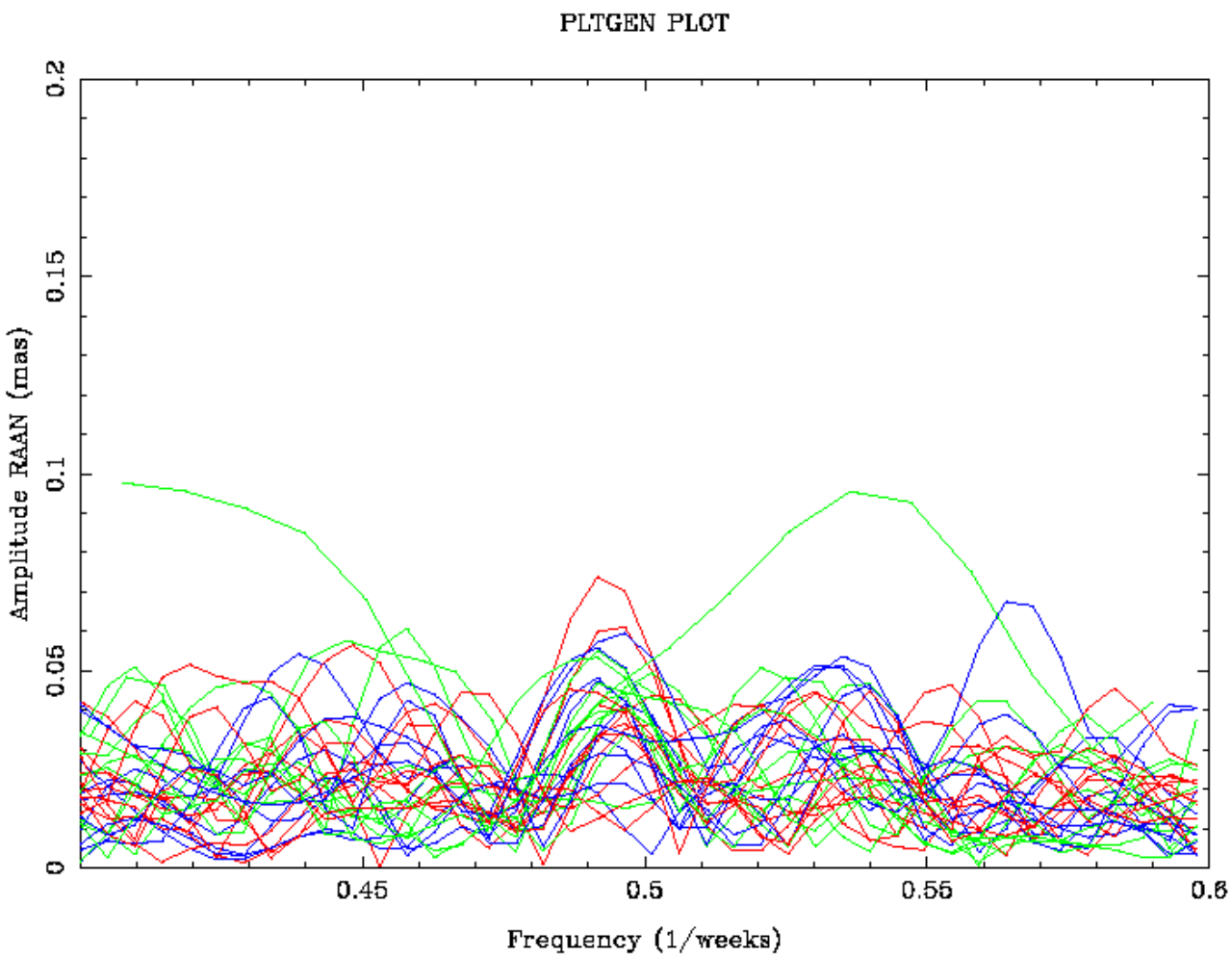
Some GPS Results



IERS model

Courtesy Tim Springer

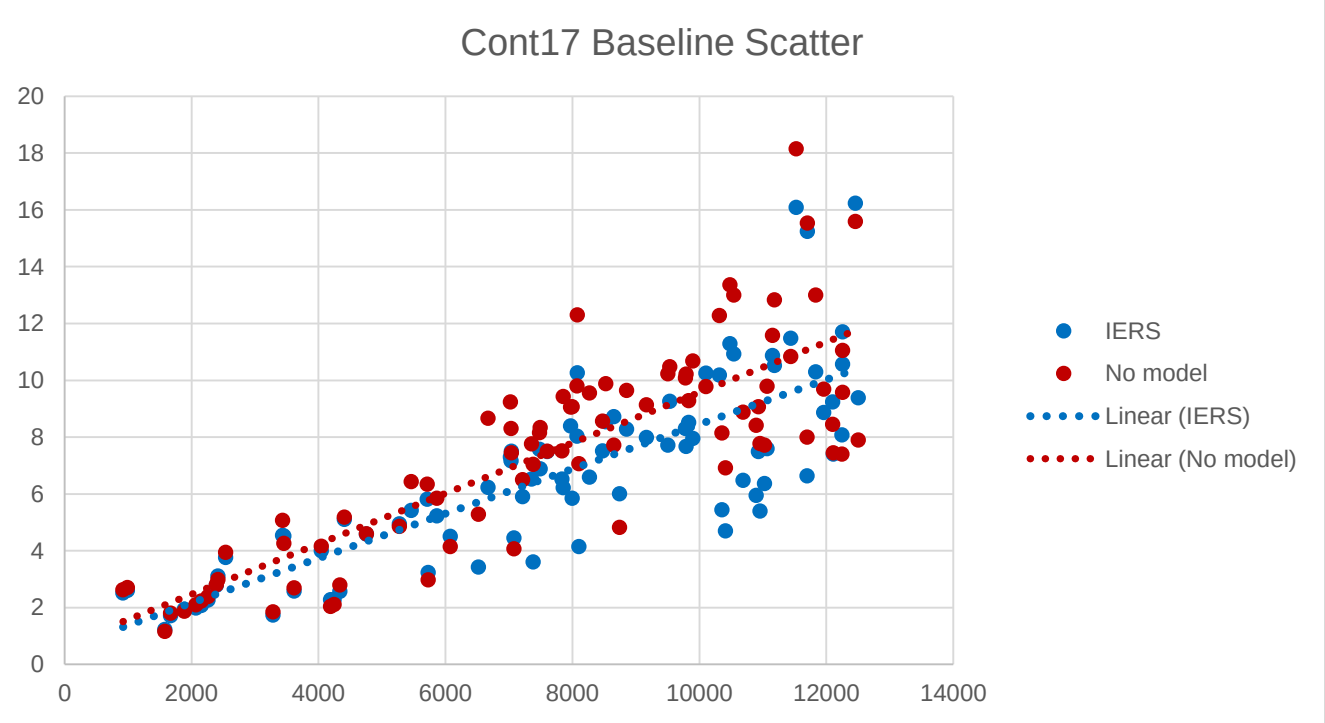
Some GPS Results



Gipson 2010
VLBI model

Courtesy
Tim Springer

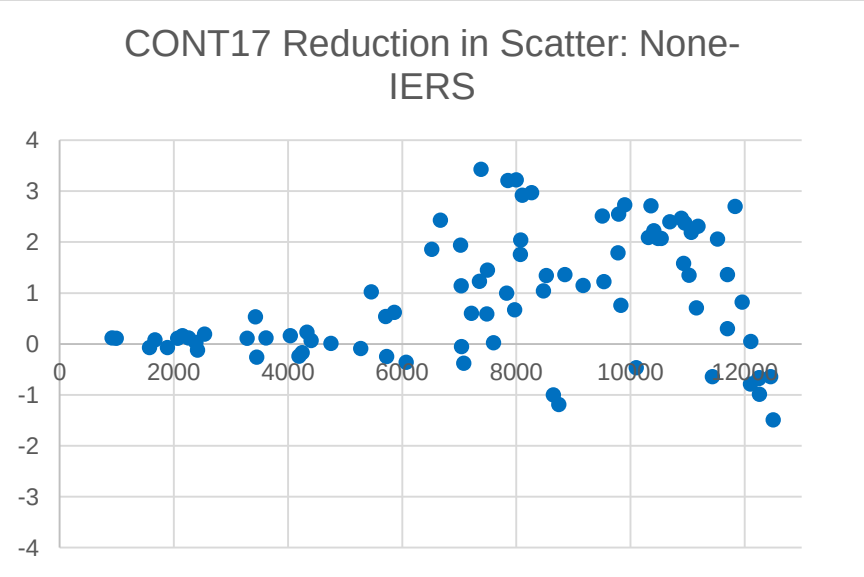
Some VLBI Tests



Applying IERS model reduces baseline scatter.

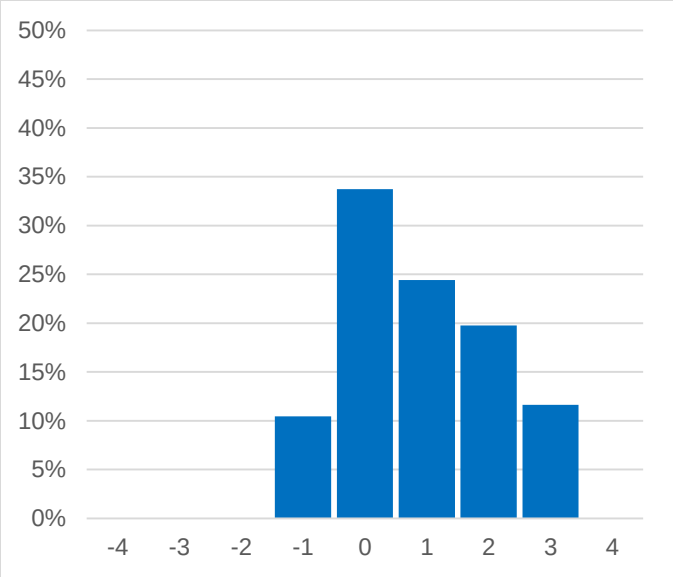
All following tests use CONT17 data set.

Difference in Baseline Scatter



IERS
is better

'None'
is better



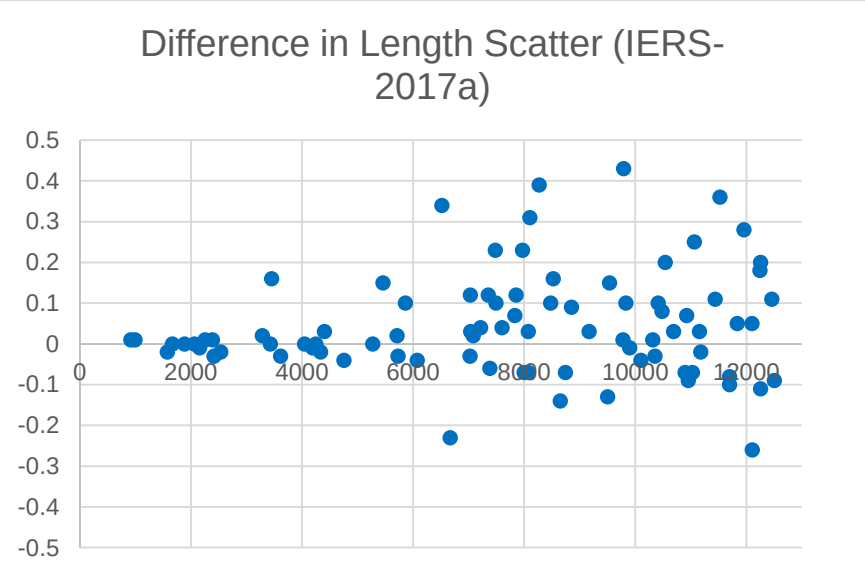
Each point is the difference in baseline scatter between 'None'-IERS.
If a point is above the axis, then IERS is better.
Below, then 'None' Is better.

Reduction in scatter for 65/86 baselines.
Average reduction is 0.94 mm

IERS Model is better than no model.

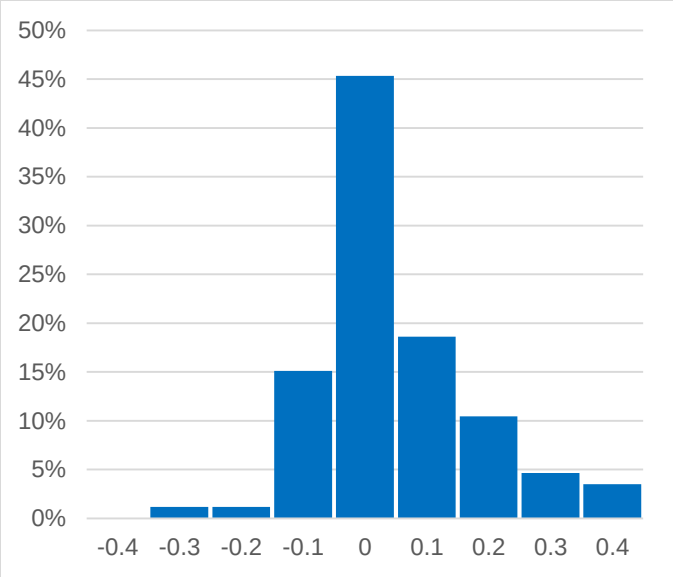
John Gipson NVI, Inc./NASA GSFC

IERS vs Gipson (VLBI)



VLBI better

IERS better

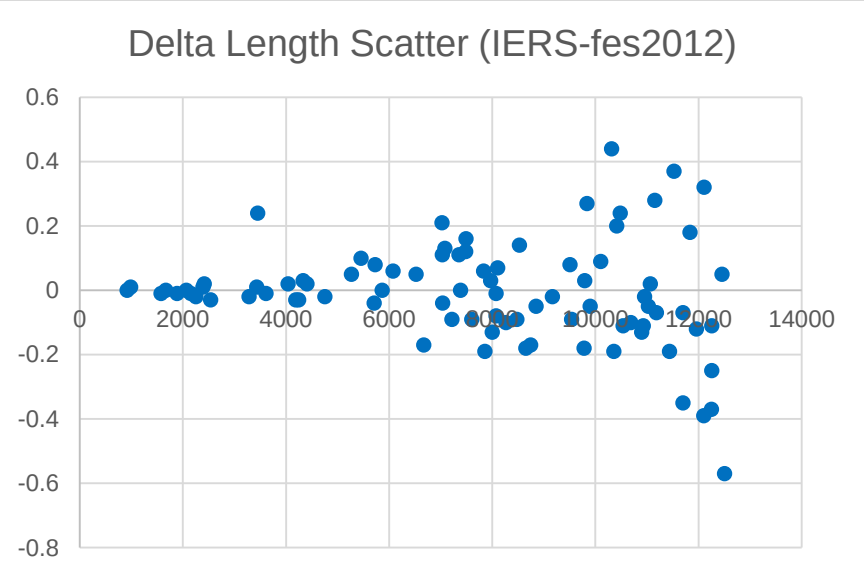


Each point is the difference in baseline scatter between IERS – VLBI model.

Reduction in scatter for 49/86 baselines using Gipson.
Average reduction is 0.05 mm

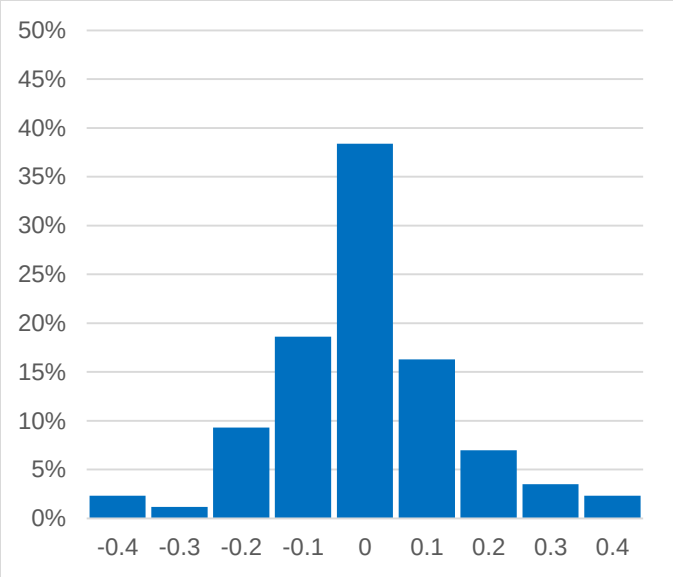
Gipson is better

IERS vs FES2012 model



FES2012 better

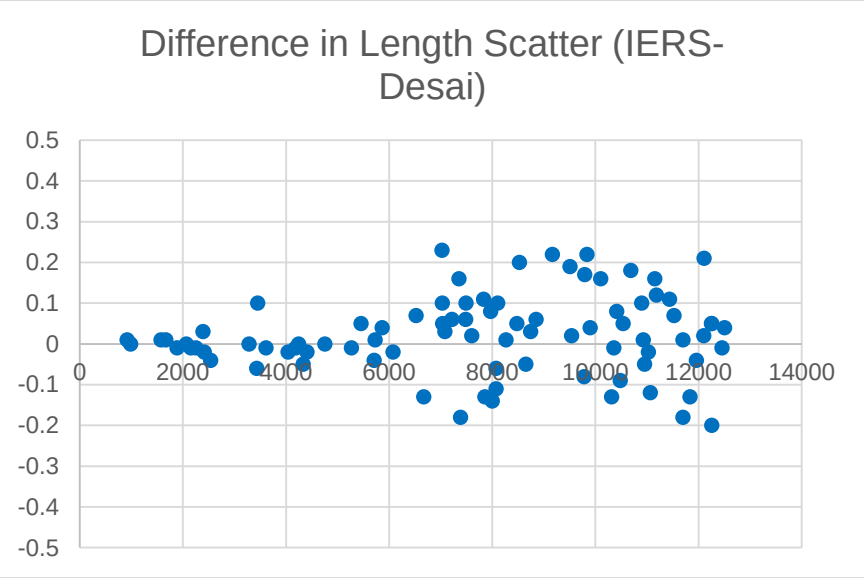
IERS better



Reduction in scatter for 36/86 baselines with FES.
Average reduction is -0.01 mm

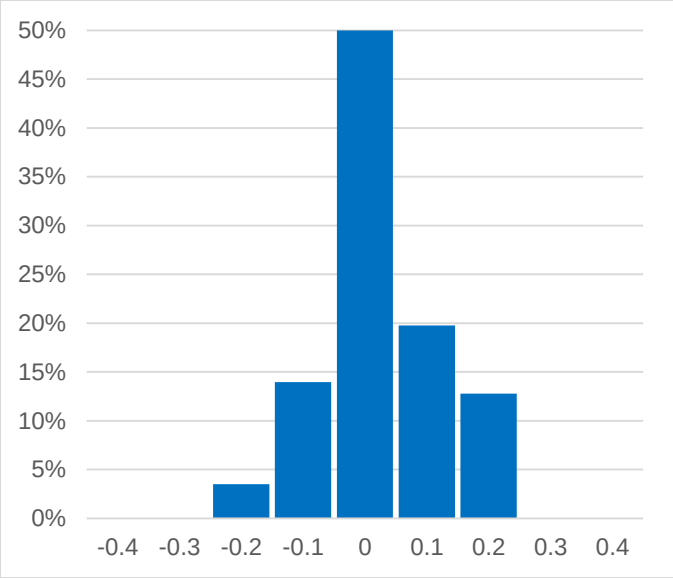
IERS is better…
But really not much difference

IERS vs Desai&Sibois



Desai& Sibois better

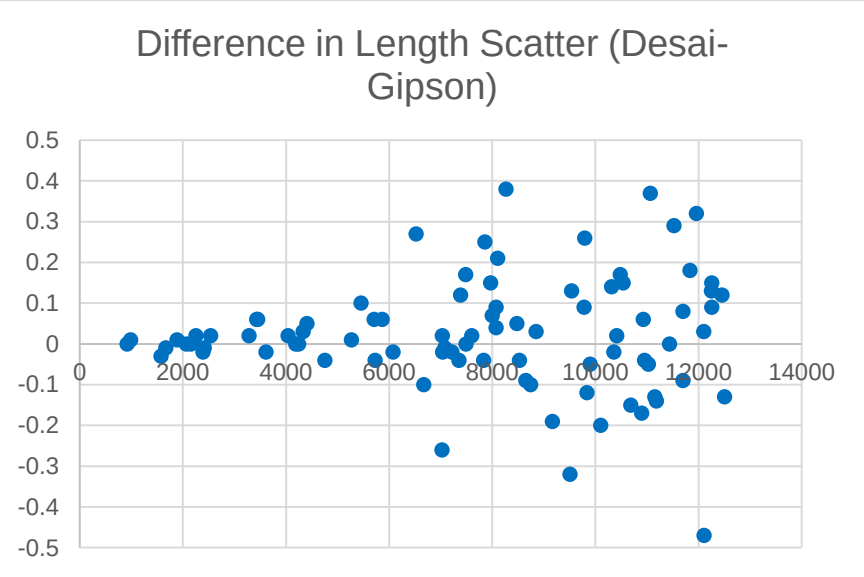
IERS better



Reduction in scatter for 48/86 baselines with Desai & Sibois.
Average reduction is 0.02 mm

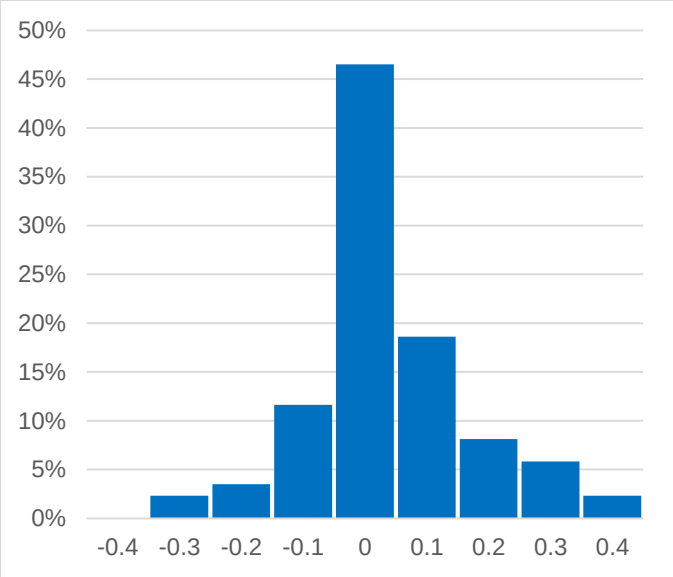
Desai&Sibois is better

Desai&Sibois vs Gipson



Gipson better

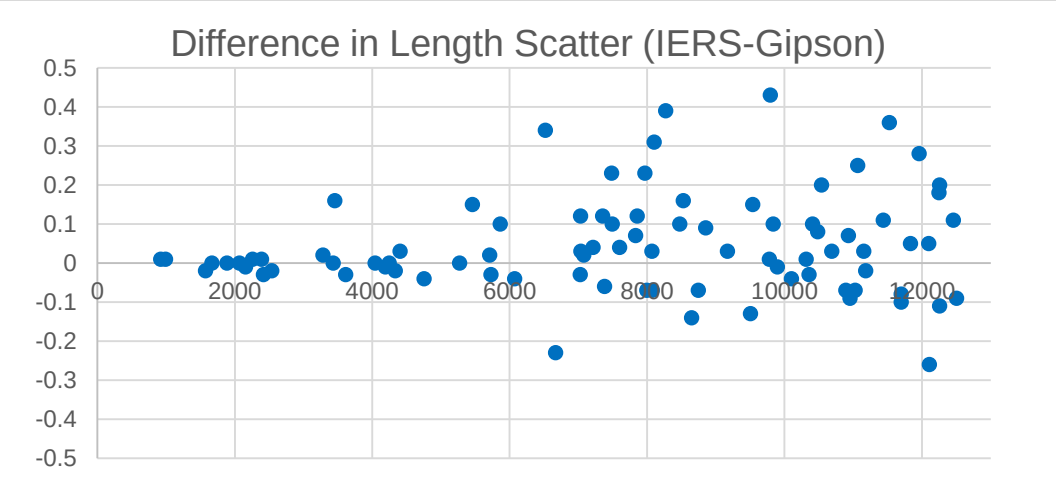
Desai &Sibois better



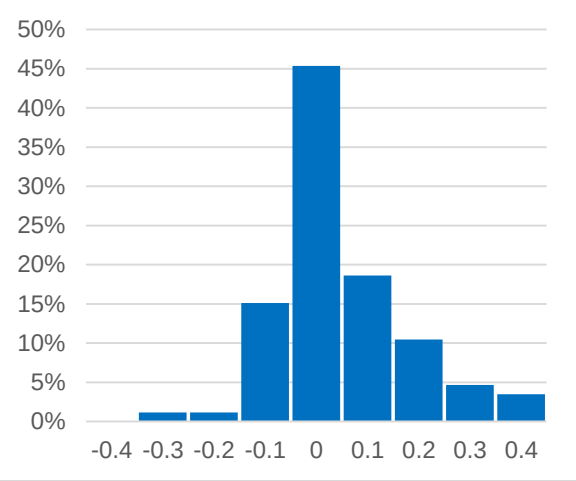
Reduction in scatter for 46/86 baselines with Gipson.
Average reduction is 0.03 mm

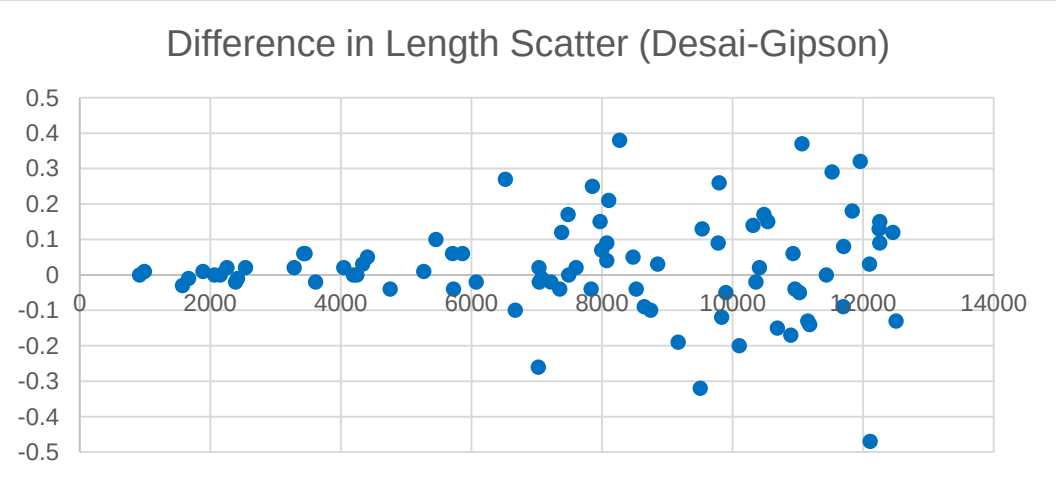
Gipson is better

IERS-Gipson and Desai-Gipson

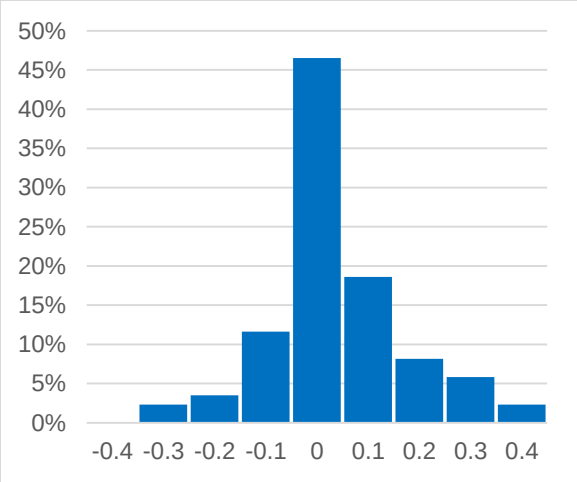


IERS





Desai & Sibois



For VLBI analysis, Desai&Sibois better than current IERS.

John Gipson NVI, Inc./NASA GSFC

Anastasiia Girdiuk et al. (VLBI)

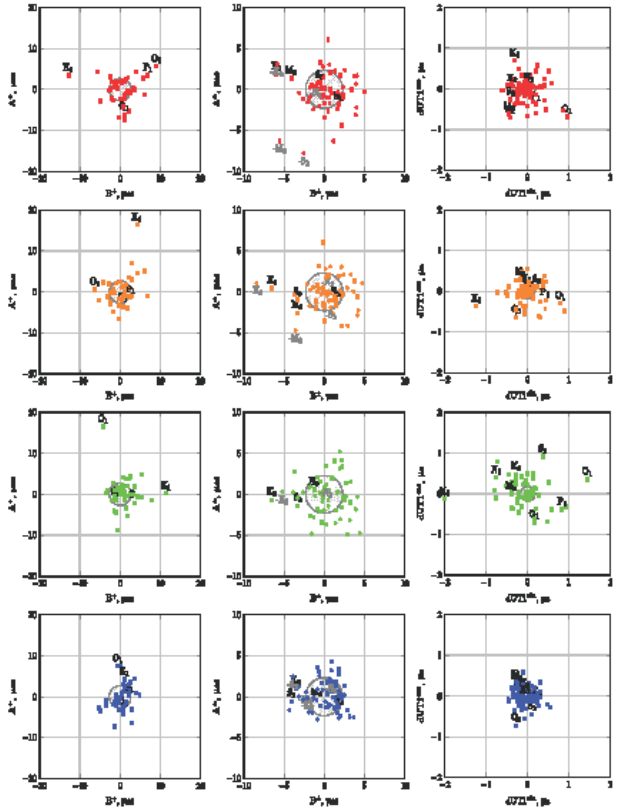


Figure 1: The obtained residuals per tide term for each model. Columns show the estimated amplitude differences for prograde diurnal polar motion, prograde (squares) and retrograde (circles) semi-diurnal polar motion, and dUT1 (from left to right). Annotations mark prograde terms (above the data) and retrograde terms (below the data, in gray). Panels from top to bottom illustrate the results for the Conventional model, Desai and Sibois (2016), Madzak et al. (2016), and John Gipson (2017a). Threefold σ-levels are marked by the gray hatched circle.

2

IERS

Desai & Sibois

Madzak et al.

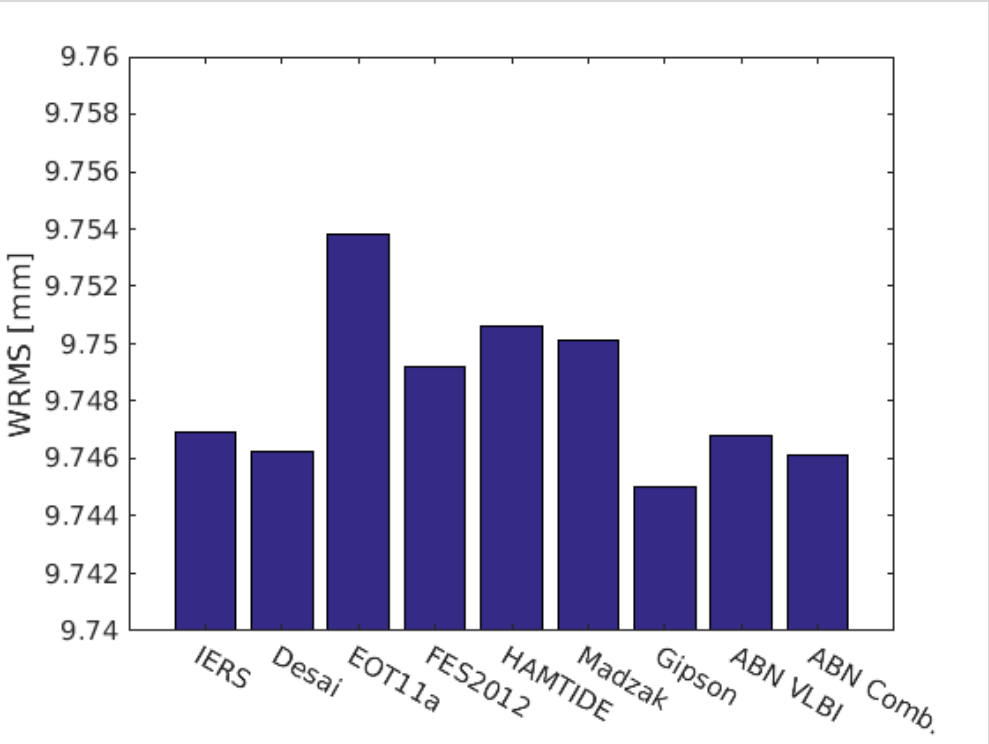
Gipson

Take model as a priori, and then estimate residual tidal terms.

This was done using VieVs.

Best agreement is with Gipson… not too surprising, since this was derived from VLBI data.

Tobias Nilsson WRMS (VLBI)

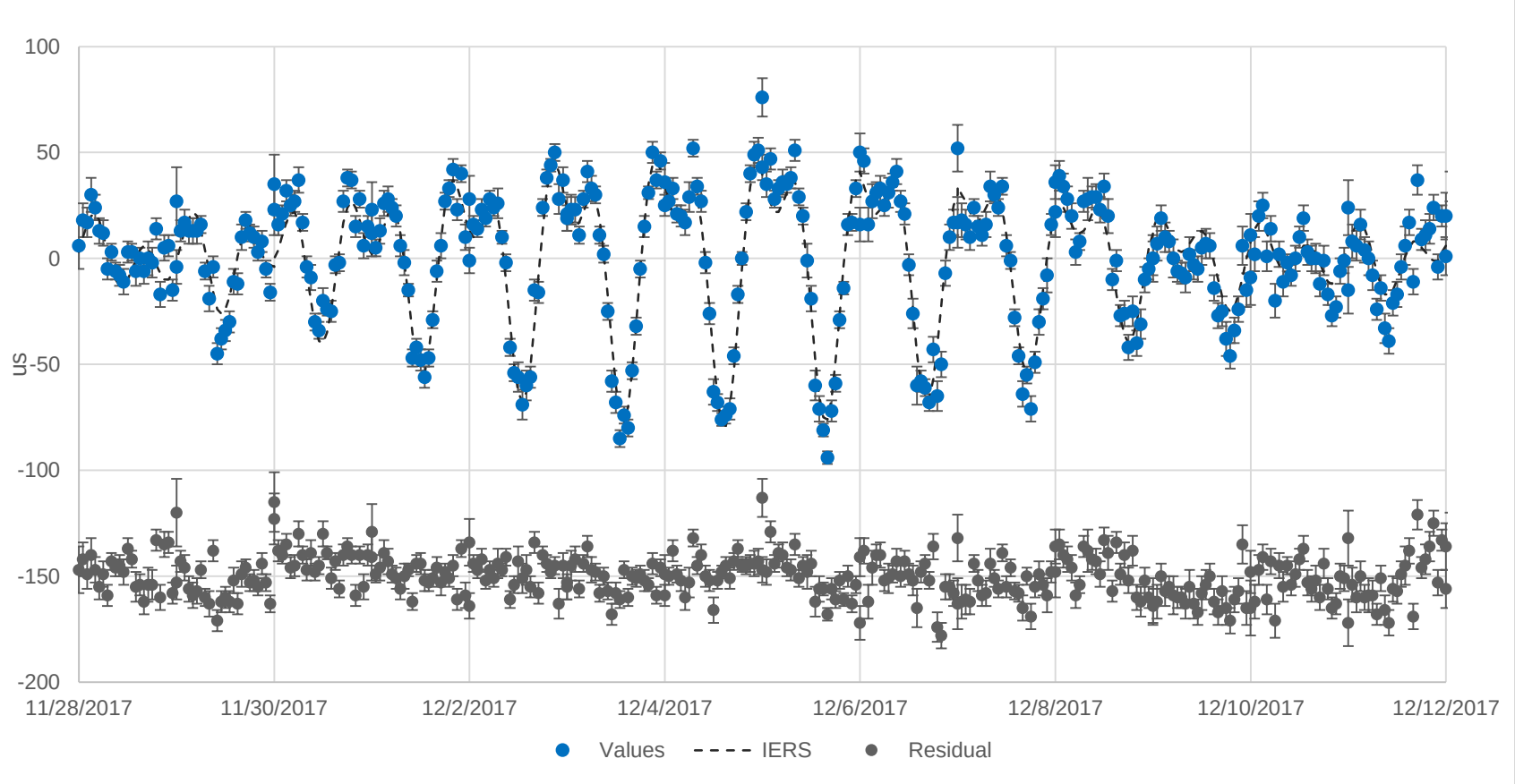


WRMS of residuals from 1072 R1, R4 and CONT sessions from 2007-2016.

Gipson is best of empirical techniques. Desai & Sibois best of tidal models.

Nilsson used VieVs@GFZ

CONT17 Hourly EOP



RMS Signal	~30 µs
RMS Residuals	~10 µs
Formal errors	~ 6 µs

Can use the residual as a measure of the goodness of the model.

John Gipson NVI, Inc./NASA GSFC

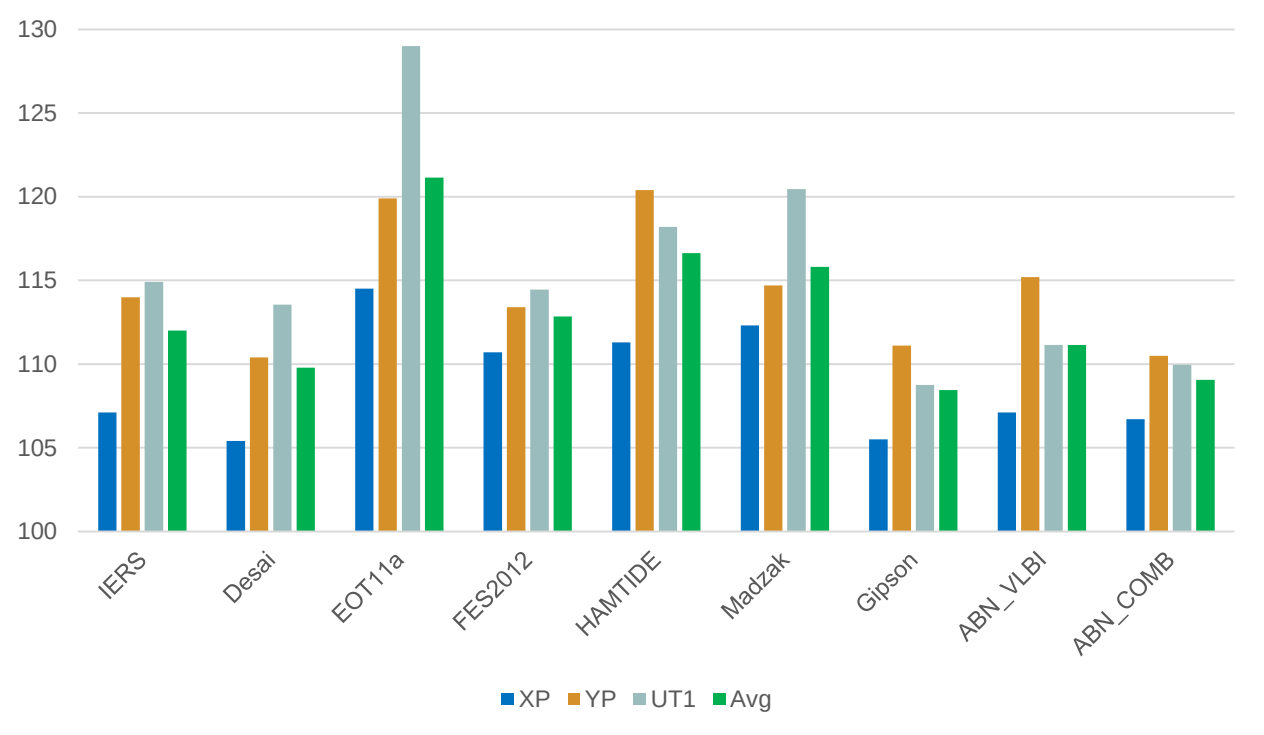
Residual Hourly EOP over all CONTS

	X-pole	Y-pole	Total PM	UT1	Total EOP
Model	µas	µas	µas	µs	µas
IERS	107.1	114.0	110.4	7.66	111.90
Desai&Sibois	**105.4**	**110.4**	**107.8**	7.57	109.80
EOT11a	114.5	119.9	117.1	**8.60**	**121.20**
FES2012	110.7	113.4	112.0	7.63	112.80
HAMTIDE	111.3	**120.4**	**115.7**	7.88	116.60
Madzak	112.3	114.7	113.5	8.03	115.90
Gipson	105.5	111.1	108.2	**7.25**	**108.40**
ABN_VLBI	107.1	115.2	111.0	7.41	111.10
ABN_COMB	106.7	110.5	108.5	7.33	109.00

Best and worst results.

Work done by Tobias Nilsson

Residual Hourly EOP over all CONTS



Notice: Starts at 100

As a result of this and several other tests, Nilsson's general conclusion is that the **Desai&Sibois and Gipson** models were best.

Conclusions/Next Steps

Testing of different models by VLBI groups is well underway and we have some preliminary results.

→Desai is better than current IERS.

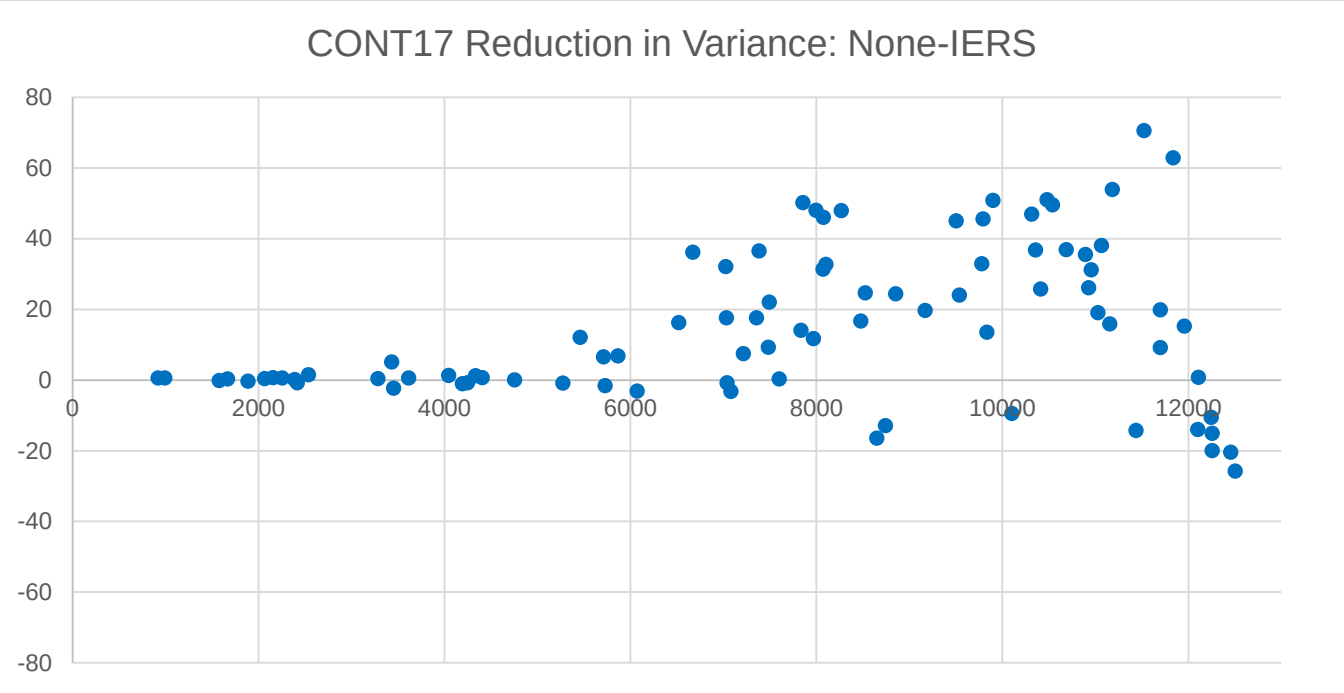
→Not as good as Gipson.

Waiting for feedback from other VLBI and **non-VLBI groups.**

We need to agree on a model prior to ITRF2020—and IGS plans on beginning reprocessing in June 2019.

Won't you please help!

Difference in Baseline Variance



IERS model is better

No model is better

Each point is the difference in baseline variance between None-IERS.

Reduction in variance for 65/86 baselines.
Average reduction is 15 mm^2

IERS Model is better than no model.