

From Relative to Absolute Phase Center Calibration: The effect on the SINEX Products

Rémi Ferland

Martin Bourassa

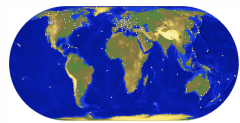
Geodetic Survey Division



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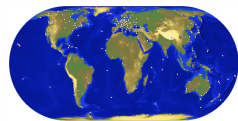
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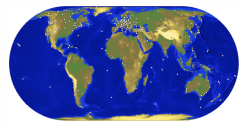
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1. Objectives

- Replace Relative with Absolute Phase Center Calibration
- Relative Calibration (w.r.t. AOAD/M_T=0.0)
 - Deficient for long baselines
 - Only elevation dependant effects
 - Satellite “Absolute” Phase Center cannot be properly accounted for
 - Introduces a scale bias
- Absolute Phase Center Calibration
 - Anechoic chamber
 - In the field using Robots (Geo++)
 - From relative calibrations.
 - Elevation and Azimuth dependent
 - Include Satellites (Estimated)





2. Contributions

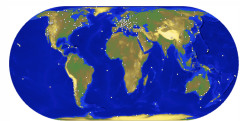
- Parallel runs
 - Ideally identical to the official solutions except for the phase center models (IGS_01 -> IGS_T05) (XXX -> XX2) e.g.: (cod -> co2)
- cod - emr - gfz - MIT - ngs - sio
- Phase 1 (1325 – 1340) (Testing - Fixing Bugs)
- Phase 2 (1341 – 1364) (Analysis)



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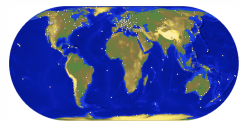
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3. Analysis Strategies

- 1) Align (Txyz & Rxyz) the “XX2” to the “XXX” solutions and compare the differences
- 2) Use IGS weekly combination procedure for the comparison
 - a) $T_{xyz} + R_{xyz} + S_{cl}$
 - b) $T_{xyz} + R_{xyz}$

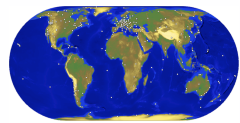




(XXX-XX2) Δ H Consistency

AC	Wks 1325 - 1364		Wks 1341 - 1364		Diff.	
	Strategy 1)	# Obs	Avg. (mm)	# Obs		Avg. (mm)
COD		6185	-13.3	3561	-13.9	0.6
EMR		1716	-17.8	1035	-18.0	0.2
GFZ		5890	-10.8	4371	-10.4	-0.4
MIT		5569	-10.9	3354	-11.1	0.2
NGS		5645	-30.9	3359	-26.5	-4.4
SIO		5699	16.8	3085	15.4	1.4





4. Analysis with IGB00

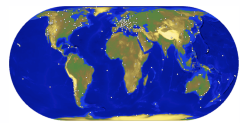
- One example (ALGO)
- AOAD/M_T
- All Antennas
- TRM29659.00
- Effect on transformation (T_{xyz} , R_{xyz} , $Scl.$)



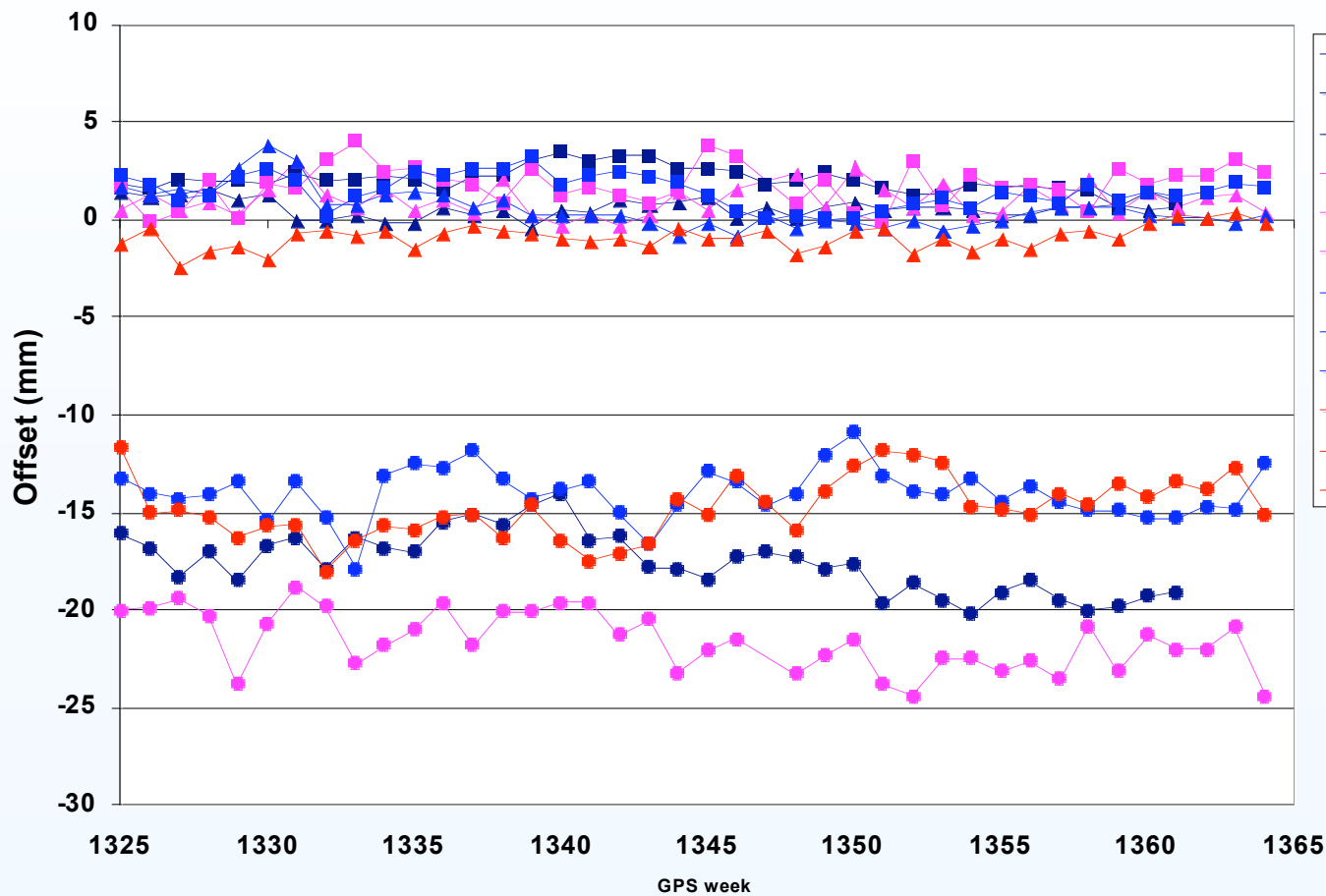
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(XXX-XX2) $\Delta N / \Delta E / \Delta H$ at ALGO



- cod - N
- ▲ cod - E
- cod - H
- emr - N
- ▲ emr - E
- emr - H
- gfz - N
- ▲ gfz - E
- gfz - H
- mit - N
- ▲ mit - E
- mit - H

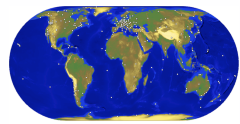
	ΔN (mm)	ΔE (mm)	ΔH (mm)
cod	2.0 ± 0.6	0.6 ±0.5	-17.6 ±1.6
emr	1.7 ±1.1	1.0 ±0.8	-21.0 ±3.7
gfz	1.5 ±0.8	0.6 ±1.0	-17.0 ±1.3
MIT	1.1 ±0.6	-0.9 ±0.6	-14.8 ±1.7



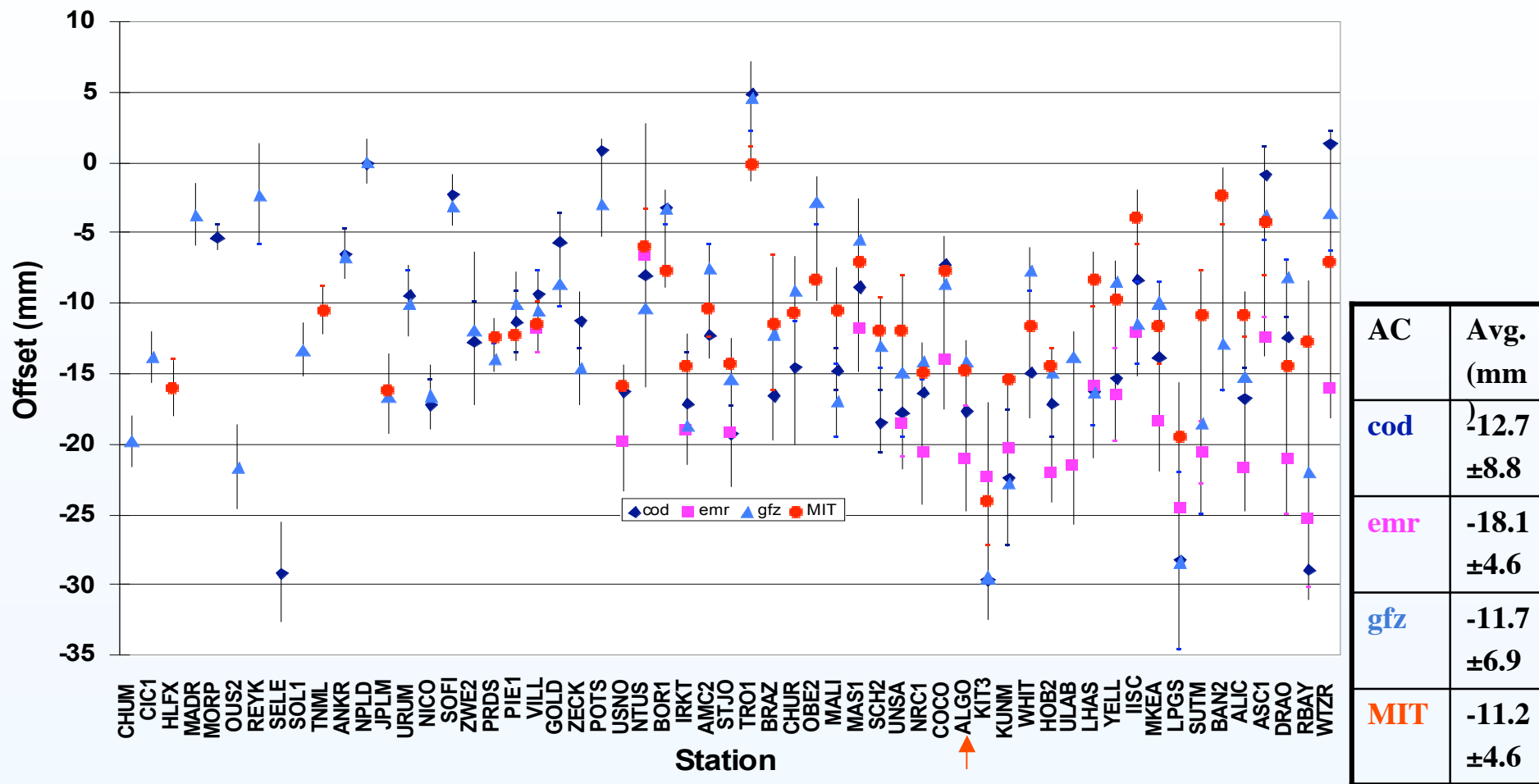
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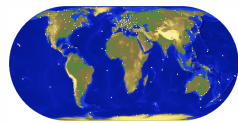
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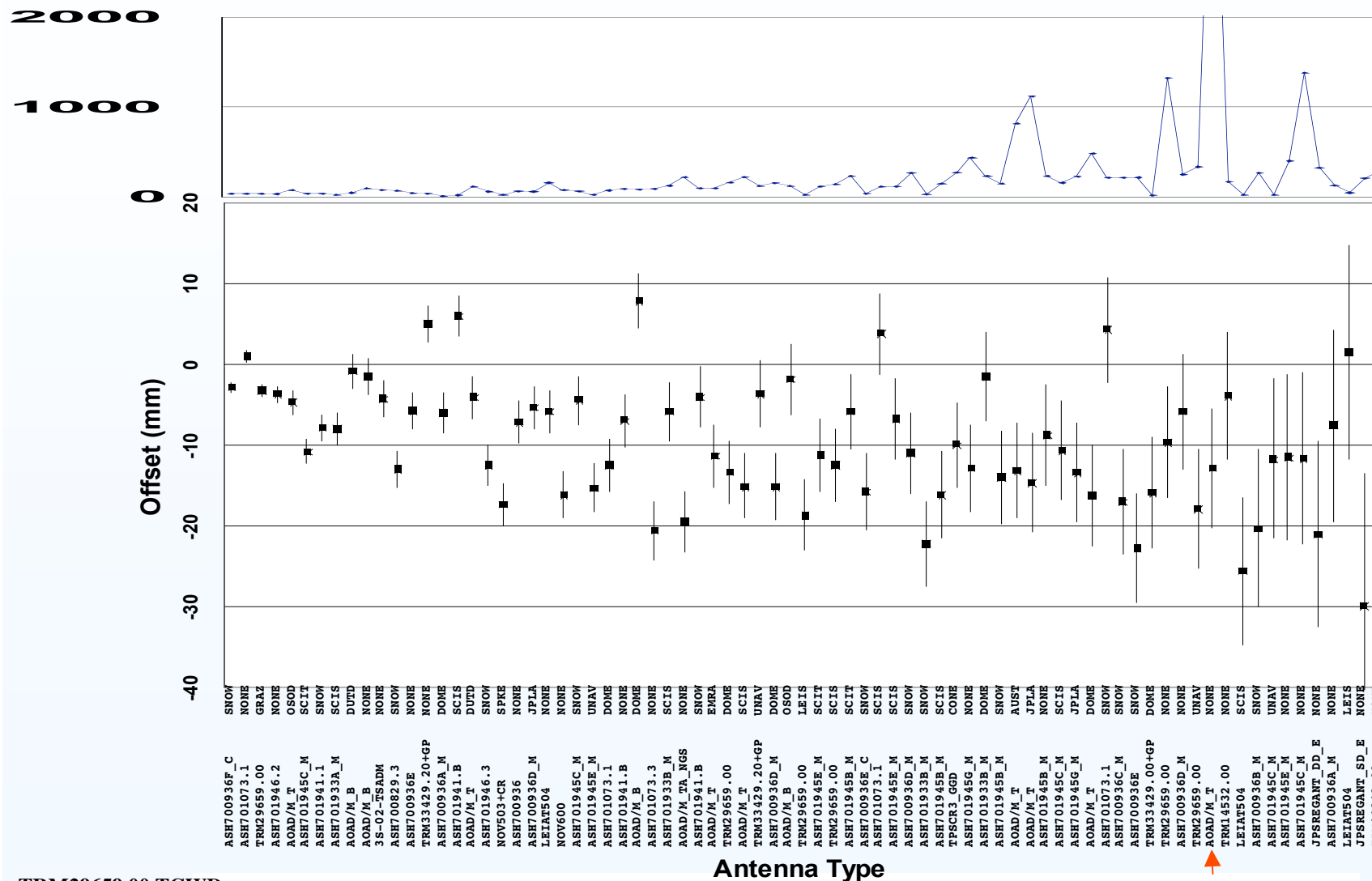


(XXX-XX2) ΔH for AOAD/M_T (Without Radome)





(XXX-XX2) ΔH by Antenna Type



Obs.

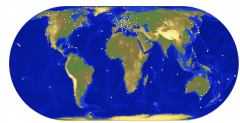
TRM29659.00 TCWD
Excluded
See other slide



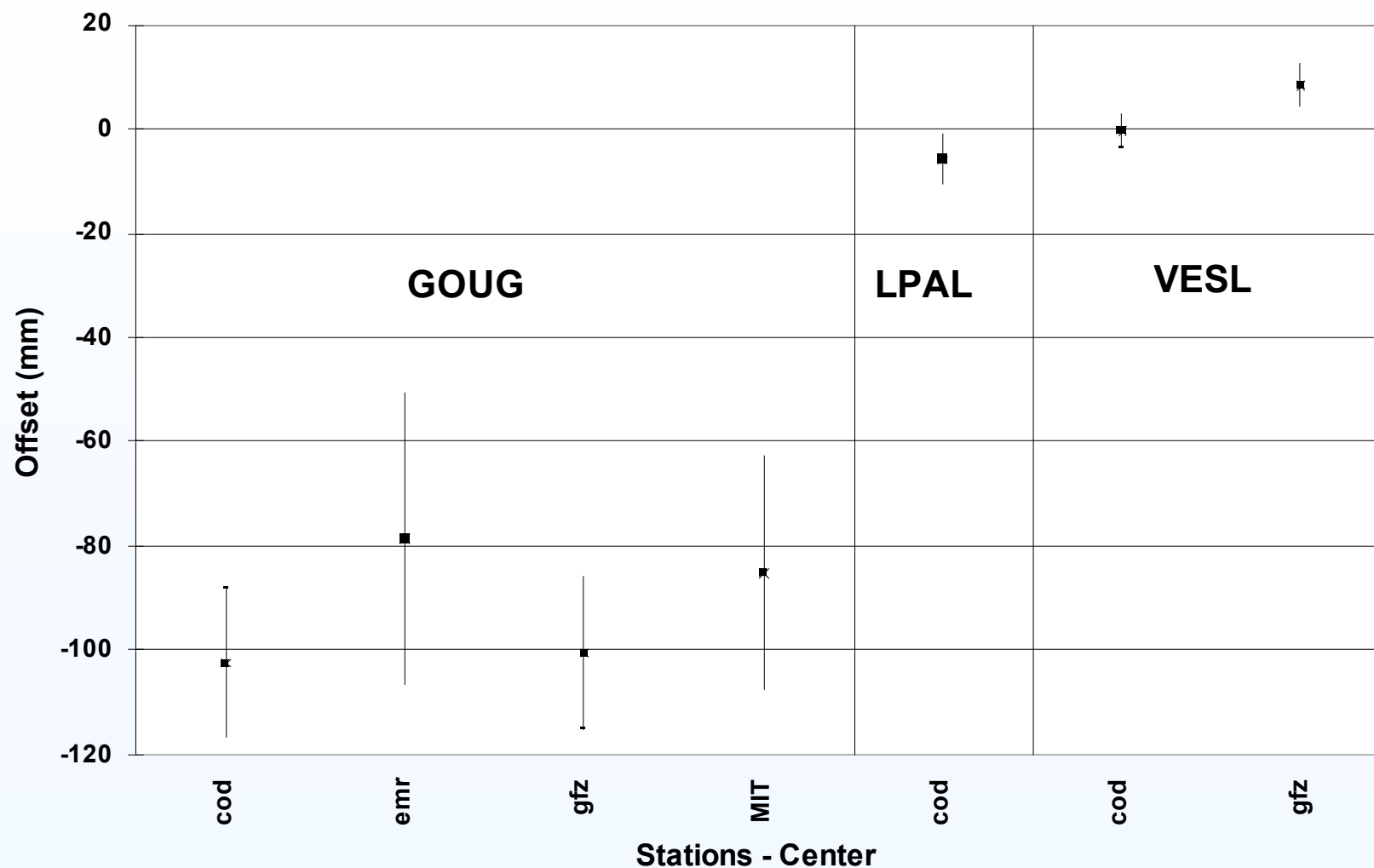
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(XXX-XX2) ΔH for TRM29659.00 – TCWD

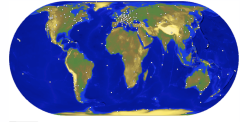


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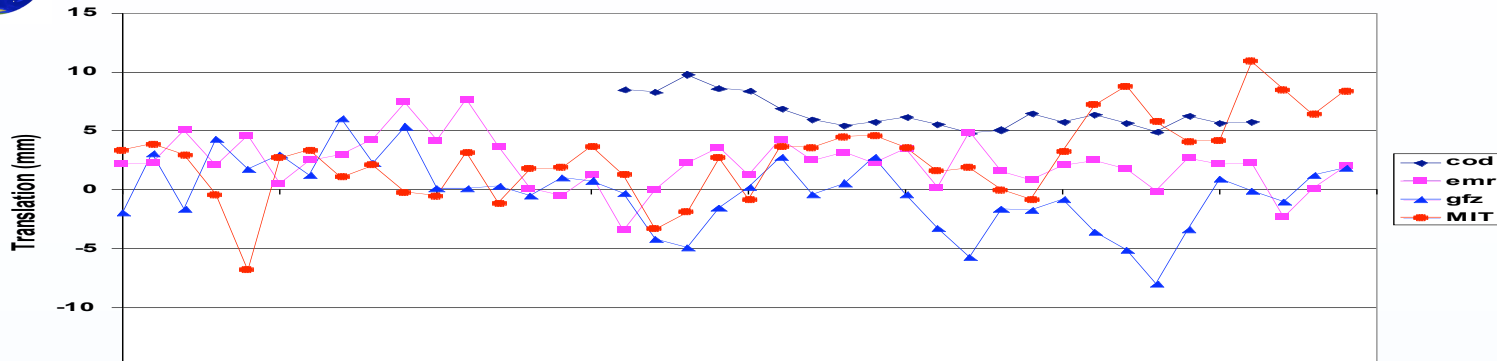
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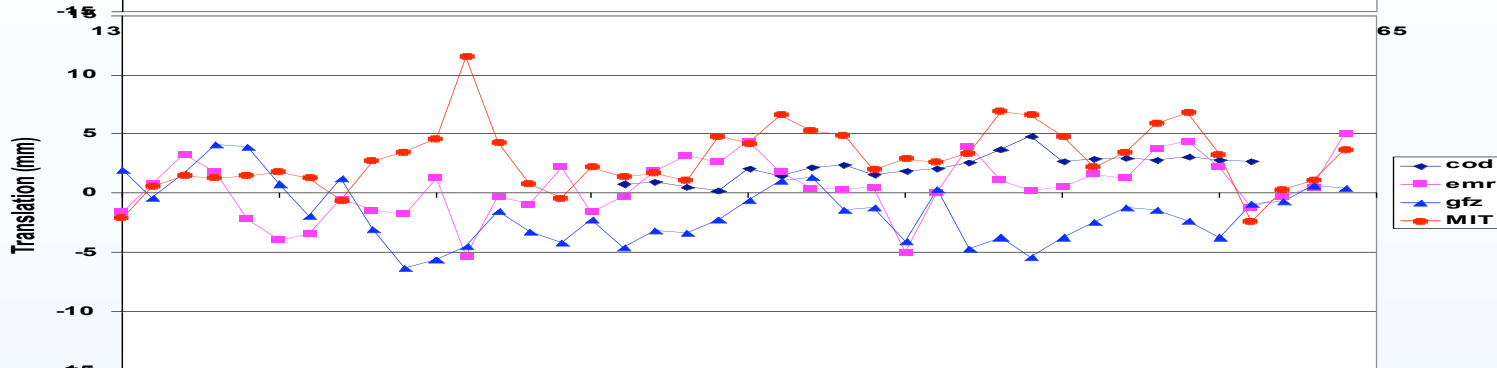
$(XX2 \rightarrow XXX) \Delta T_{xyz}$



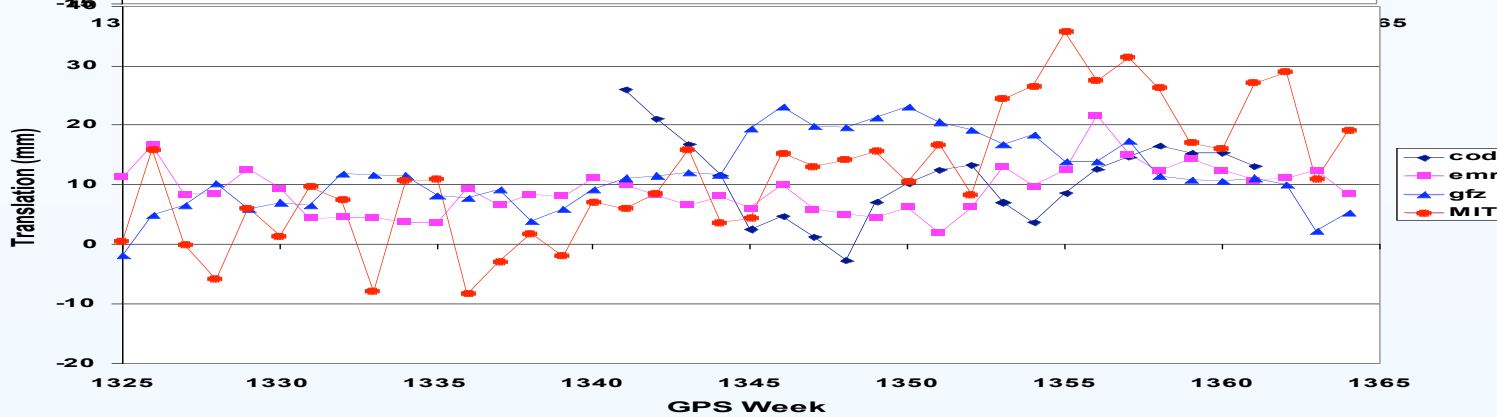
TX
Range
30mm



TY
Range
30mm



TZ
Range
60mm

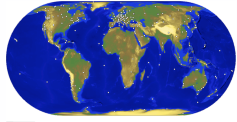


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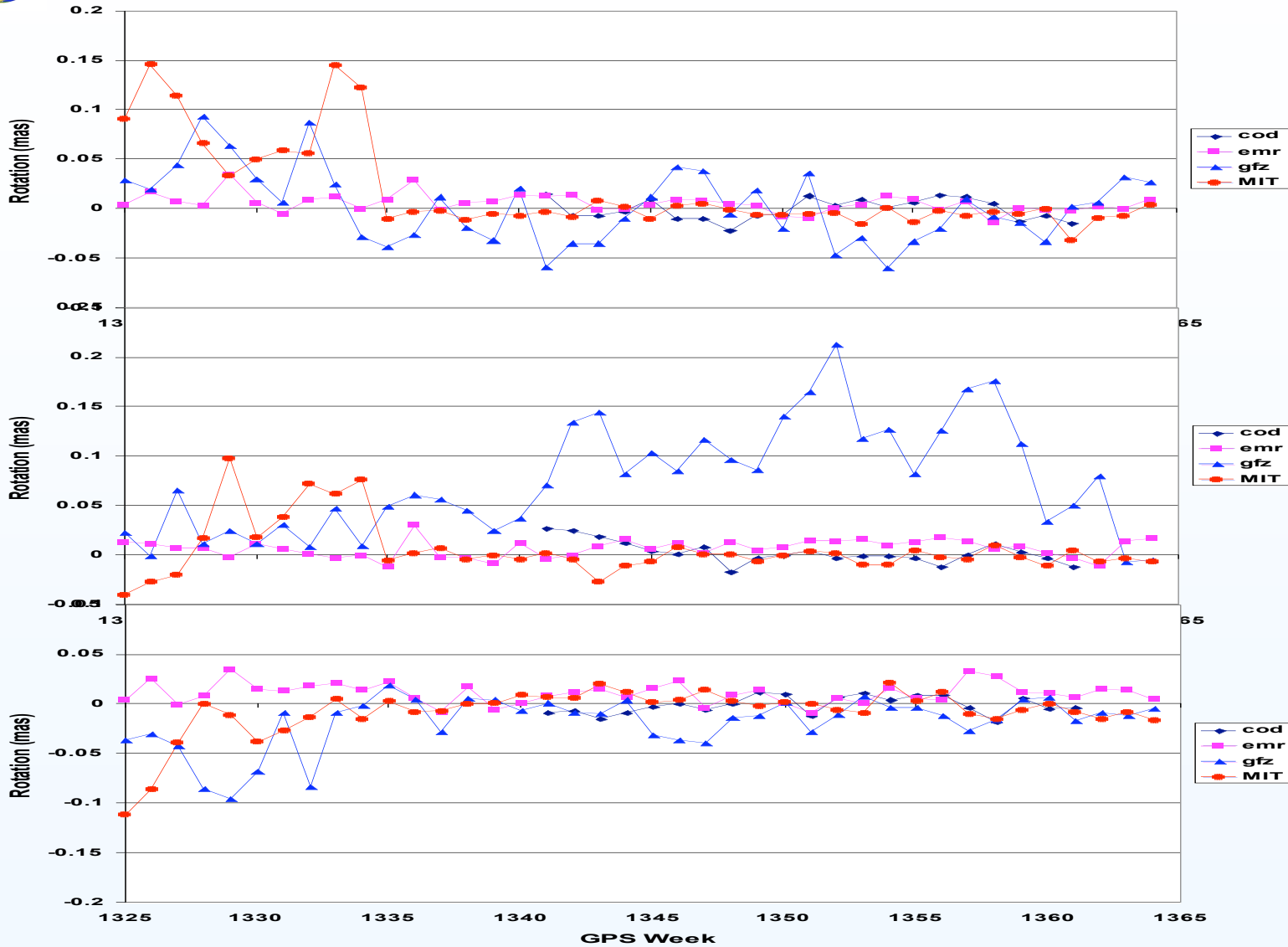
(XX2->XXX) ΔR_{xyz}



RX
Range
0.3mas

RY
Range
0.3mas

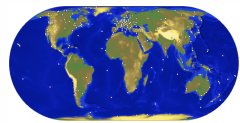
RZ
Range
0.3mas



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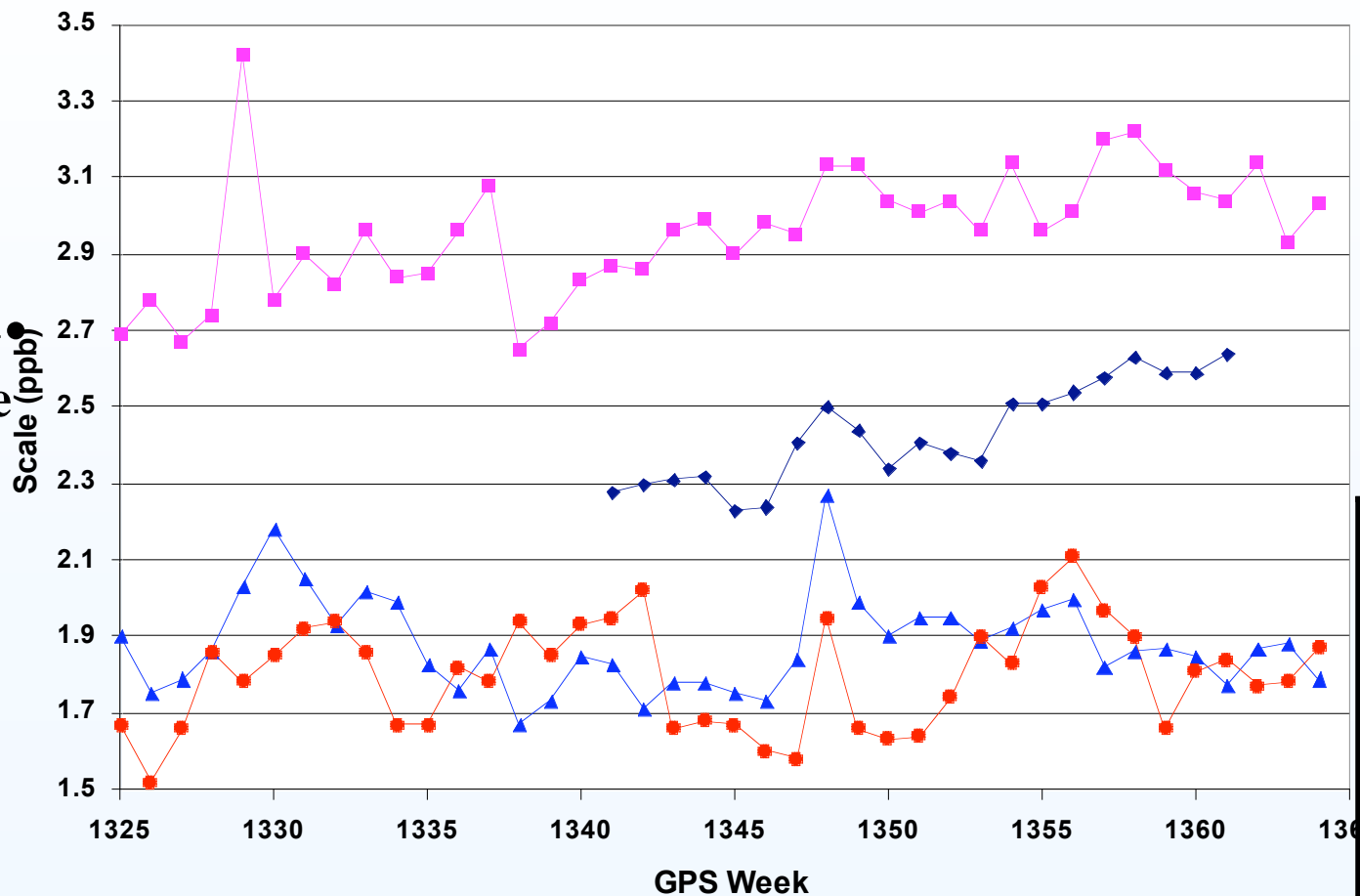
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(XX2-> XXX) ΔScl

Scl.
Range
2ppb

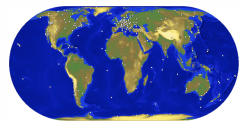


AC	Δscl (ppb)
cod	2.3 ± 0.1
emr	2.9 ± 0.2
gfz	1.9 ± 0.1
MIT	1.8 ± 0.1



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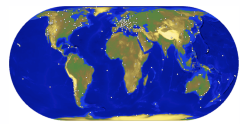
(XXX – XX2) Transformation

Statistics

Avg.	RX (mas)	RY (mas)	RZ (mas)	TX (mm)	TY (mm)	TZ (mm)	Scl (ppb)
cod	0.00	0.01	0.00	5.9	0.6	13.8	2.27
emr	0.01	0.01	0.01	2.3	0.5	9.1	2.96
gfz	0.00	0.08	-0.02	-0.2	-1.6	11.9	1.88
MIT	0.02	0.01	-0.01	2.7	3.0	11.7	1.80

Std.	RX (mas)	RY (mas)	RZ (mas)	TX (mm)	TY (mm)	TZ (mm)	Scl (ppb)
cod	0.01	0.01	0.01	1.4	1.1	6.9	0.13
emr	0.01	0.01	0.01	2.2	2.5	4.0	0.16
gfz	0.04	0.06	0.03	3.0	2.5	6.0	0.12
MIT	0.05	0.03	0.02	3.4	2.7	11.0	0.14





5. With Proposed “IGS05” (1350 – 1359)

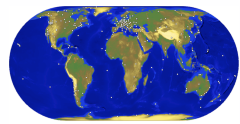
- Proposed Realization
- Pole Shift
- Apparent Geocenter Shift
- Scale Bias
- Coordinates



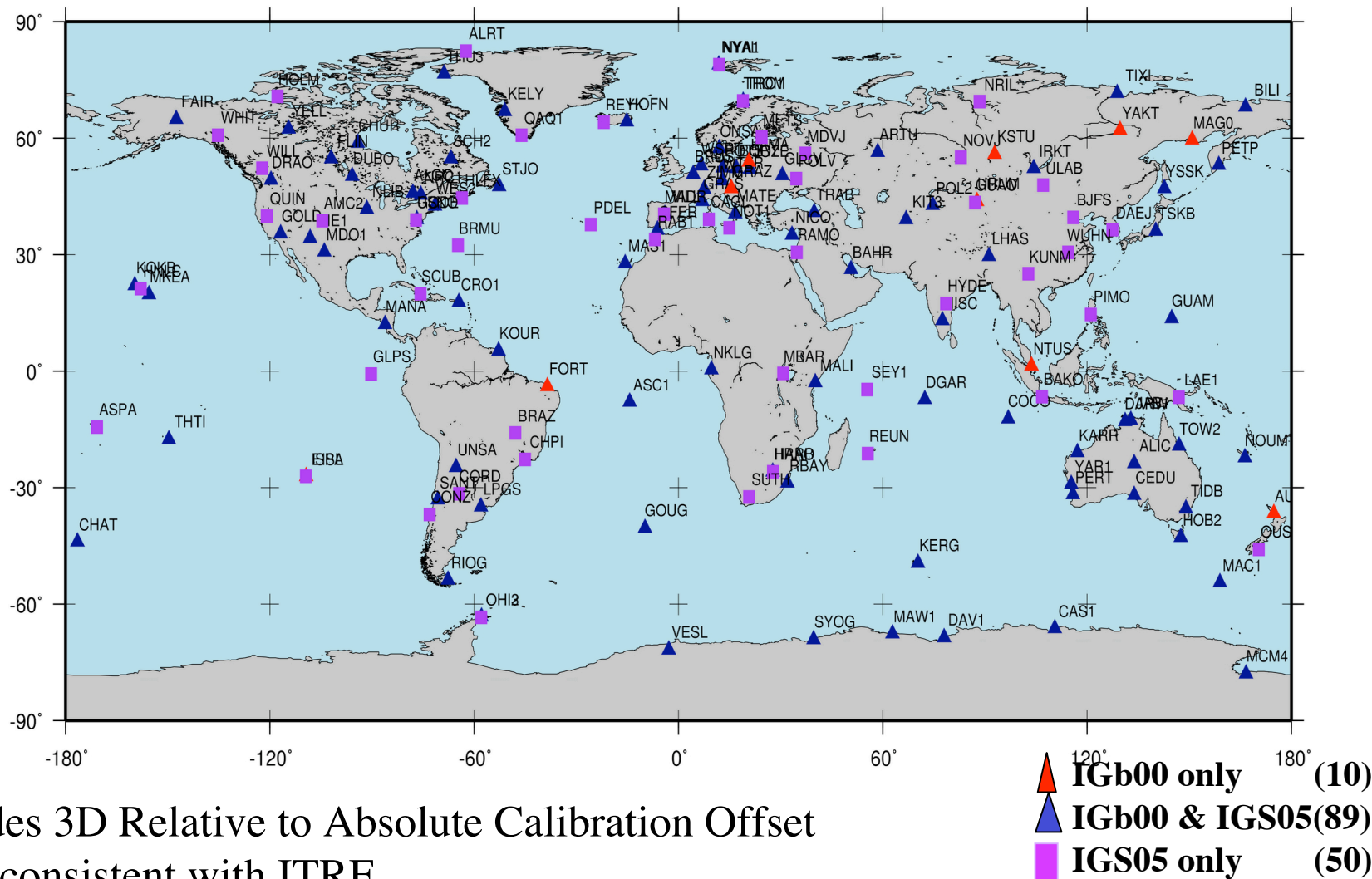
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IGb00 to IGS05 Proposed Realization



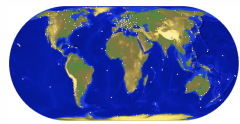
Includes 3D Relative to Absolute Calibration Offset
Scale consistent with ITRF



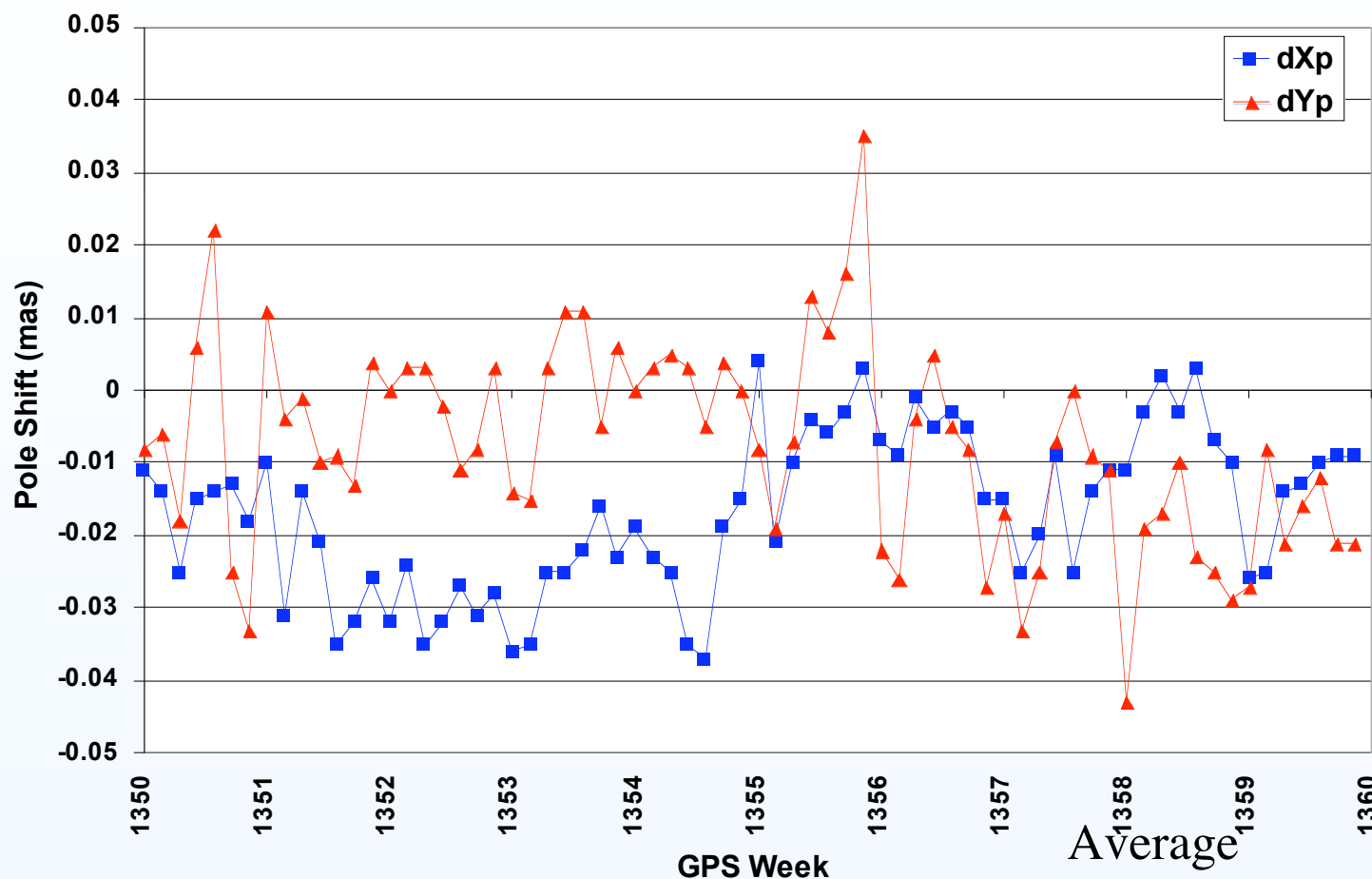
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Pole Shift (IGb00-IGS05)



IGb00 : cod emr esa gfz jpl MIT ngs sio

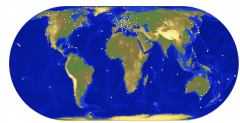
IGS05 : co2 em2 gf2 MI2

Average
 $dXp = -0.017 \pm 0.011$ mas
 $dYp = -0.008 \pm 0.014$ mas

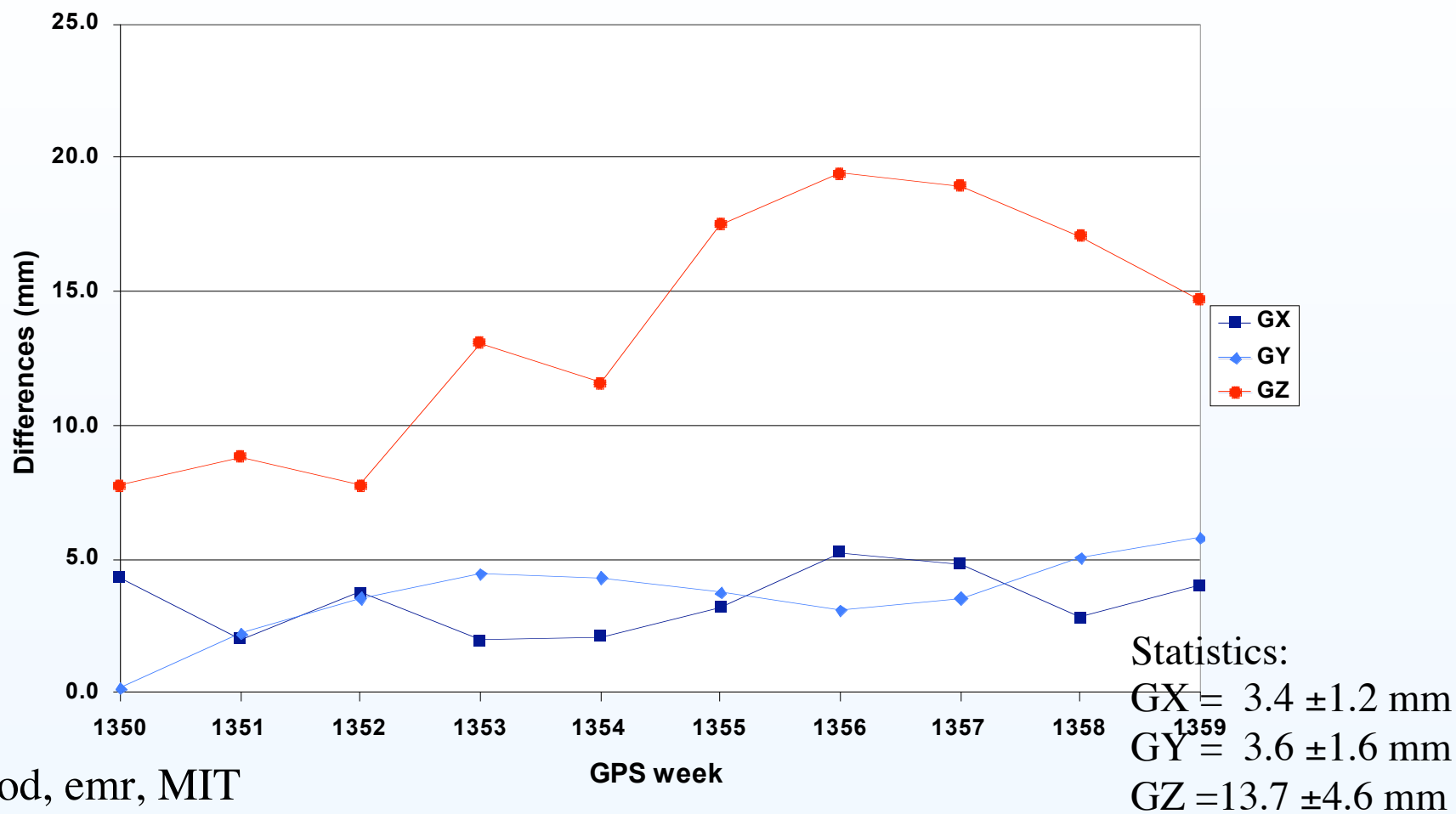


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Apparent Geocenter Shift (IGb00-IGS05)



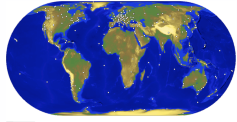
ACs = cod, emr, MIT



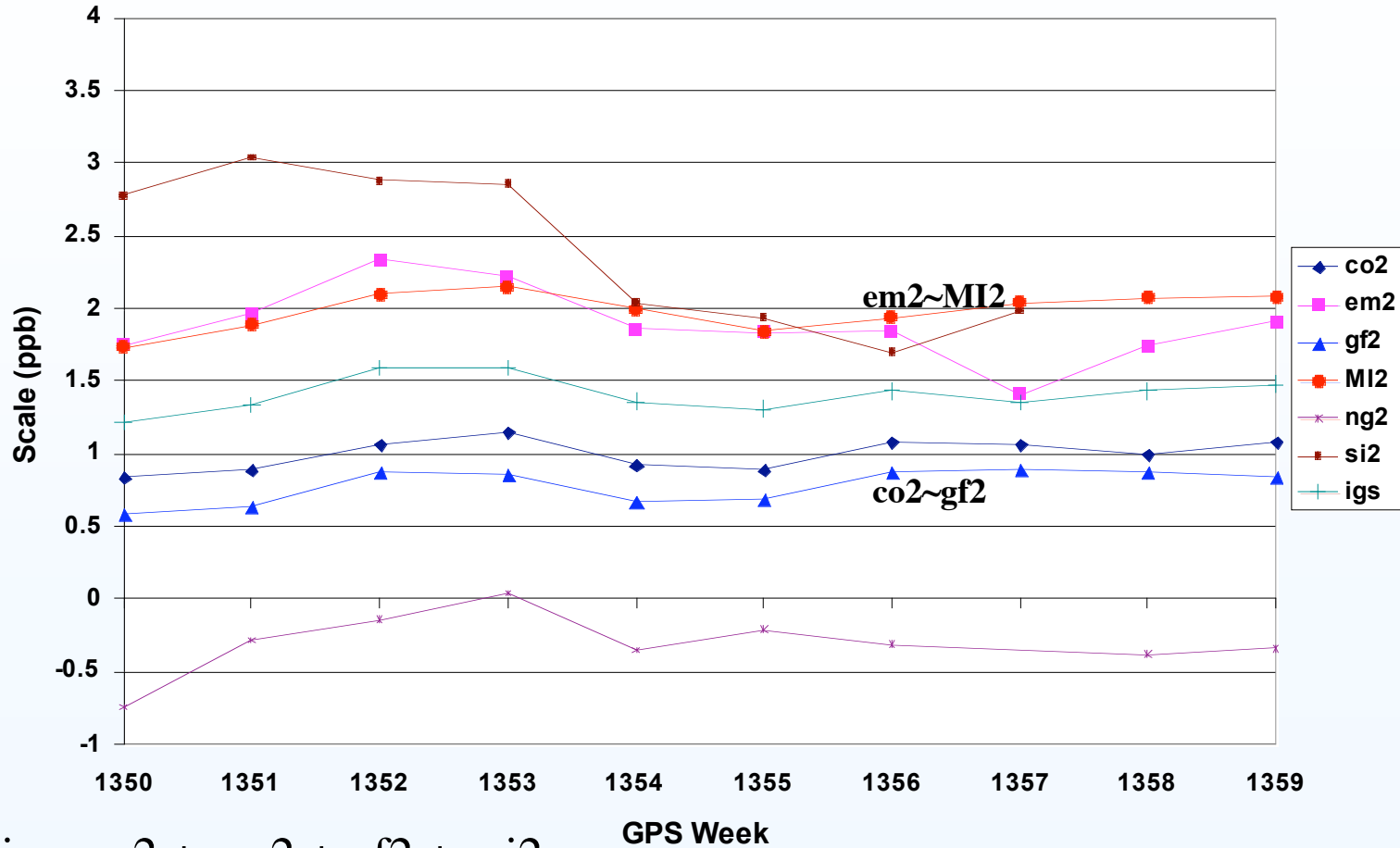
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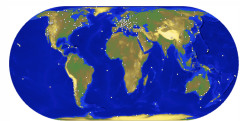


Scale Bias (IGS05)



AC	Avg (ppb)	Std (ppb)
co2	1.0	0.1
em2	1.9	0.3
gf2	0.8	0.1
MI2	2.0	0.1
igs	1.4	0.1
ng2	-0.3	0.2
si2	2.4	0.5

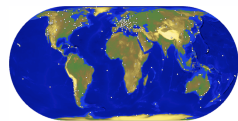
igs=co2 + em2 + gf2 + mi2
 ng2 & si2 for comparison only



Coordinates Residuals Noise Level (STD)

STD vs Realization	N (mm)	E (mm)	H (mm)
IGS05 (IGS_01)	2.0	1.9	5.8
IGS05 (IGS_T05)	2.3	2.0	6.8
IGS_01 to IGS_T05	1.1	0.6	3.5





5. *Summary (1/2)*

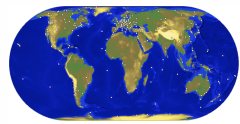
- Contribution
 - cod – emr – gfz – MIT – ngs - sio
- Used most consistent
 - cod – emr – gfz – MIT
 - Phase 1 (1325-1340) + Phase 2 (1341-1364)
- Offsets dependency:
 - Station / AC



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5. Summary (2/2)

- (IGS_01 to IGS_T05) on Transformations (IGb00)
 - Rotation $\sim 0.01-0.02\text{mas}$
 - Translation (TX/Y $\sim 2-3\text{mm}$; TZ $\sim 9-14\text{mm}$)
 - Scale ($\sim 1.8-3.0\text{ppb}$)
- With Proposed IGS05 (1350 – 1359)
 - Pole Shift $\sim 0.01-0.02\text{mas}$
 - Apparent Geocenter Shift (GX/Y $\sim 3-5\text{mm}$; GZ $\sim 7-20\text{mm}$)
 - Scale bias:
 - emr, mit, (sio) $\sim 2\text{ppb}$
 - cod, gfz $\sim 1\text{ppb}$
 - ngs $\sim -0.3\text{ppb}$

