



The New IGS Tropospheric Delay Production

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Point Positioning Approach



- Fixed orbits and clocks: **IGS Final Combined**
- Earth orientation: **IGS Final Combined**
- Transmit antenna phase center map: **IGS Standards**
- Receiver antenna phase center map: **IGS Standards**
- Elevation angle cutoff: **7 degrees**
- Mapping function (hydrostatic and wet): **Niell**
- A priori delay (m): **hyd** = $1.013 * 2.27 * e^{-0.000116 * ht}$ **wet** = 0.1
- Data arc: **24 hours**
- Data rate : **5 minutes**
- Estimated parameters: **clock** (white noise), **site position**, **wet zenith delay** (3 cm/hour random walk), **delay gradients** (0.3 cm/hour random walk), **phase biases** (white noise)
- Temporal resolution: **5 minutes**

Primary Product: Total Zenith Delay



Production Stats



- (new) Trop products spans 2000 - present (~8.5 years)
- Solutions for all sites for which RINEX files are available at one of three Data Centers (~300 sites daily)
- Temporal resolution of 5 minutes
- Comparison products with all submissions, currently from:
COD, EMR, EUR, GFZ, JPL, NGS
 - Comparison products span 2005 - present (~3 years)
- ~One week latency
- Products available from CDDIS and JPL

of CDDIS hits:

Jan - May 2008: ~1.6M

Jun - Nov 2007: ~6.4M

2006: ~2.7M

- TROP **new**
 - One file per day per station: `ssssddd0.yyzpd`
- TROP **cmp**
 - Individual AC's submitted solution is compared with the new ZPD product
 - One file per day for all stations: `TROPddd0.yycmp`
- TROP **rpt**
 - Summary comparison report and plots
 - One file per week: `TROPwwwx.rpt`, `TROPwwwx.eps`



TROP1461x.rpt



+Center	COD				EMR				ESA				GFZ				JPL				NGS			
	bias	max	sdev	npt	bias	max	sdev	npt	bias	max	sdev	npt	bias	max	sdev	npt	bias	max	sdev	npt	bias	max	sdev	npt
.TOTAL	-0.9	-20.1	3.7	1677	-0.5	25.5	4.3	1316	-2.0	-22.7	5.4	667	-0.9	26.8	4.1	3610	-0.9	17.8	3.6	21989	-1.3	-30.9	4.4	3931
albh A	-3.5	-10.0	4.4	12	-	-	-	-	-	-	-	-	-0.4	-7.6	2.8	24	-	-	-	-	-0.7	-8.2	3.5	24
algo A	0.7	3.5	1.3	12	0.8	3.6	1.7	24	3.3	6.2	3.6	12	0.0	2.9	1.2	24	-	-	-	-	0.4	-5.4	2.3	24
alic A	1.5	4.6	2.8	12	2.6	7.1	3.3	24	-2.3	-5.9	3.2	12	2.0	5.4	2.6	24	-	-	-	-	1.7	6.5	2.8	24
amc2 A	-0.1	-2.8	1.6	10	9.1	11.6	9.2	21	3.4	7.3	4.2	10	1.3	3.7	2.0	21	-	-	-	-	-	-	-	-
areq A	0.5	4.6	2.2	12	-3.5	-8.4	4.2	24	-4.7	-11.4	5.4	12	2.3	5.9	2.8	24	-3.6	-8.1	4.1	286	1.4	6.8	3.2	24
artu A	-0.5	-1.8	1.1	12	-0.2	-3.4	1.3	24	2.9	5.3	3.1	12	-1.5	-4.8	2.2	24	-3.0	-9.3	3.3	286	1.5	4.4	1.9	24
aspa A	4.8	13.4	6.0	12	7.0	25.5	8.9	24	-	-	-	-	0.7	-8.3	3.9	24	6.6	17.8	7.4	286	1.5	-15.6	6.0	24
auck A	-1.1	-3.2	1.8	12	-	-	-	-	-	-	-	-	-1.4	-6.9	2.3	24	-	-	-	-	-1.9	-11.8	5.6	24
bahr A	0.3	2.0	1.3	12	1.1	3.3	1.6	24	-	-	-	-	-0.5	-2.5	1.3	24	-2.4	-5.5	2.8	286	0.2	4.4	1.8	24
ban2 A	-	-	-	-	-	-	-	-	-	-	-	-	-2.1	-10.8	4.2	24	-	-	-	-	-6.9	-24.0	8.9	24
bdos A	0.5	8.1	3.7	12	-	-	-	-	-	-	-	-	-1.8	16.1	7.2	24	-	-	-	-	-4.3	12.6	6.7	24
bili A	-2.1	-7.0	2.8	12	-	-	-	-	5.2	7.5	5.4	12	-1.8	-5.9	2.3	24	-2.0	-8.1	2.6	285	-1.3	-5.6	1.9	24
bjfs A	-1.6	-4.5	2.6	12	-	-	-	-	-	-	-	-	-2.1	-5.8	2.6	24	3.0	7.8	3.5	285	-4.6	-7.7	4.9	24
bogt A	-	-	-	-	-	-	-	-	-	-	-	-	-4.4	-7.8	4.8	24	-1.7	-4.7	2.1	286	-3.1	-12.0	4.5	24
bor1 A	0.0	2.0	1.2	12	-	-	-	-	-	-	-	-	-1.0	-2.5	1.4	24	-	-	-	-	0.4	2.8	1.1	24
braz A	1.5	10.1	4.7	12	-	-	-	-	-	-	-	-	1.2	9.1	3.7	24	-	-	-	-	0.5	-16.2	5.5	24
brew A	-	-	-	-	-	-	-	-	0.6	3.1	1.7	12	-	-	-	-	-	-	-	-	-	-	-	-
brnu A	2.5	15.7	7.1	12	-	-	-	-	-	-	-	-	4.4	18.0	7.1	24	-	-	-	-	1.8	20.0	5.4	24
brst A	2.3	4.7	2.7	12	-	-	-	-	-	-	-	-	-	-	-	-	-0.2	3.2	1.2	286	-	-	-	-
brus A	3.0	5.3	3.1	12	0.4	3.2	1.3	24	0.5	-3.4	1.5	12	1.7	3.7	2.0	24	-	-	-	-	1.8	5.5	2.6	24
cagl A	-	-	-	-	-	-	-	-	-	-	-	-	0.3	3.7	2.0	24	-1.5	-8.0	2.4	286	-1.7	-5.6	2.7	21
cagz A	-1.8	-3.9	2.2	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-3.2	-8.7	3.8	21
ccjm A	0.5	11.5	4.1	12	-	-	-	-	-	-	-	-	2.5	11.9	4.1	24	-	-	-	-	-0.6	-7.4	3.4	24
cedu A	1.0	4.2	1.8	12	3.2	11.3	3.8	24	-	-	-	-	1.5	7.2	2.5	24	2.7	10.4	3.2	286	2.2	9.6	3.8	24

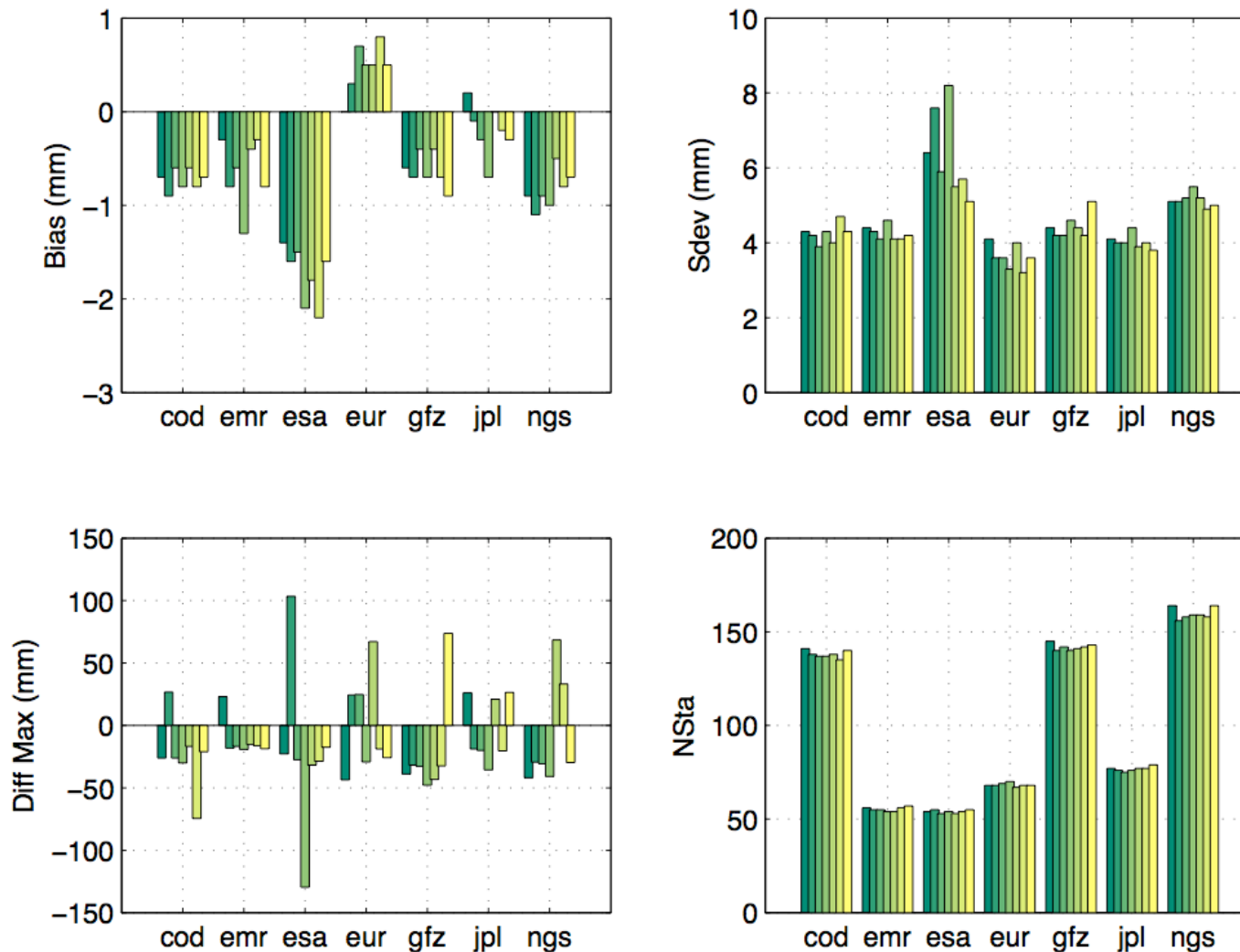


TROP1461x.rpt



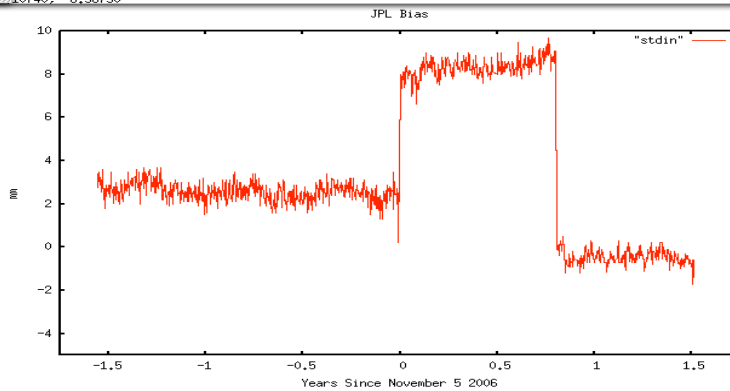
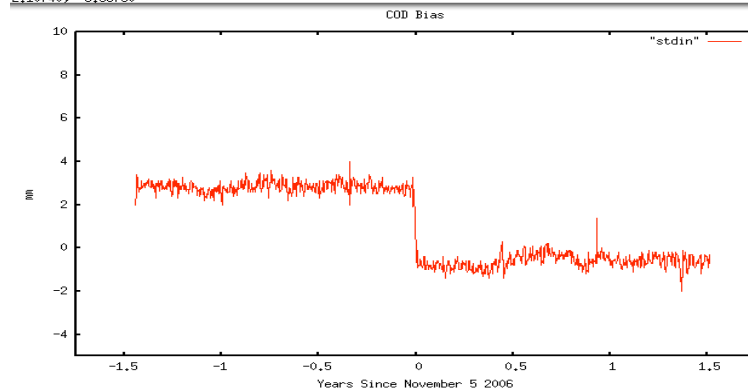
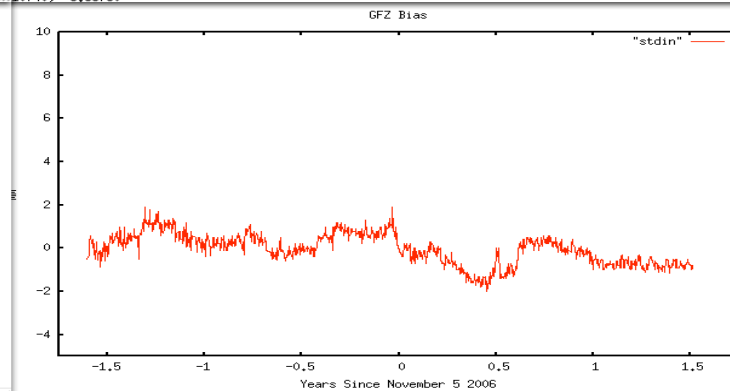
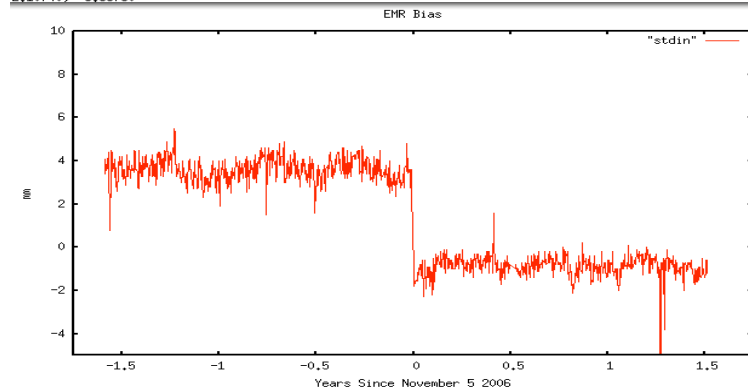
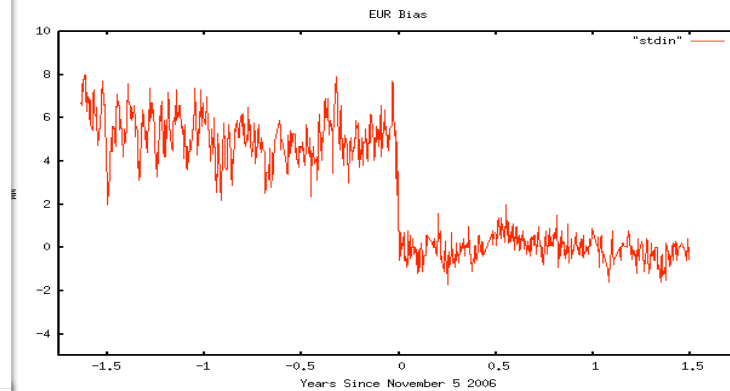
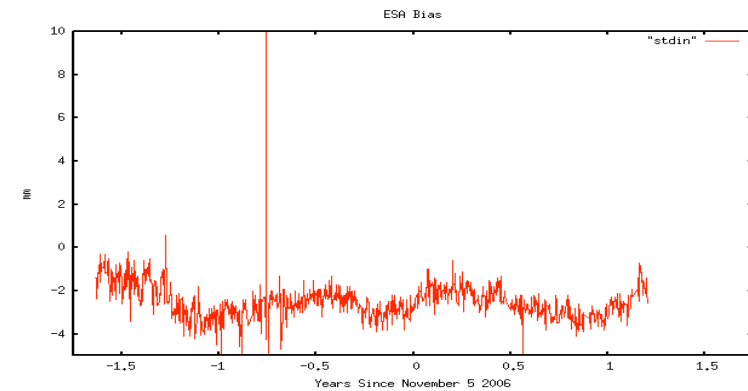
#gpswk	AC	bias	bimax	sta	sdev	sdmax	sta	dfmax	sta	nsta	npts
14610	cod	-0.7	-12.5	zeck	4.3	14.5	zeck	-26.2	zeck	141	1675
14610	emr	-0.3	-14.1	mcm4	4.4	14.2	mcm4	23.0	amc2	56	1344
14610	esa	-1.4	-13.9	ispa	6.4	14.5	ispa	-22.8	reun	54	648
14610	eur	0.0	-15.2	zeck	4.1	17.8	zeck	-43.6	zeck	68	1632
14610	gfz	-0.6	-12.1	mcm4	4.4	13.9	zeck	-38.9	zeck	145	3473
14610	jpl	0.2	11.7	amc2	4.1	12.1	amc2	26.1	lpgs	77	22003
14610	ngs	-0.9	-12.2	mcm4	5.1	13.8	zeck	-41.9	tidb	164	3930
14611	cod	-0.9	-11.2	dav1	4.2	11.4	dav1	26.8	opmt	138	1637
14611	emr	-0.8	-14.6	mcm4	4.3	14.7	mcm4	-18.1	mcm4	55	1317
14611	esa	-1.6	-19.0	ispa	7.6	31.9	mate	103.5	mate	55	659
14611	eur	0.3	7.1	not1	3.6	8.8	kely	24.5	kely	68	1614
14611	gfz	-0.7	-13.2	mcm4	4.2	13.3	mcm4	-31.7	ous2	140	3344
14611	jpl	-0.1	-10.0	harv	4.0	10.1	harv	-18.9	khaj	76	21721
14611	ngs	-1.1	-14.4	mcm4	5.1	14.6	mcm4	-29.4	pimo	156	3736
14612	cod	-0.6	-11.8	dav1	3.9	12.0	dav1	-26.2	petp	137	1625
14612	emr	-0.6	-12.5	mcm4	4.1	12.6	mcm4	-16.8	guam	55	1319
14612	esa	-1.5	-10.9	ispa	5.9	12.0	reun	-27.4	chat	53	634
14612	eur	0.7	6.6	cagl	3.6	8.1	kely	24.7	kely	69	1645
14612	gfz	-0.4	-11.2	mcm4	4.2	11.3	mana	-32.8	petp	142	3395

AC – IGS ZPD Comparison for gpswd: 14610–14616

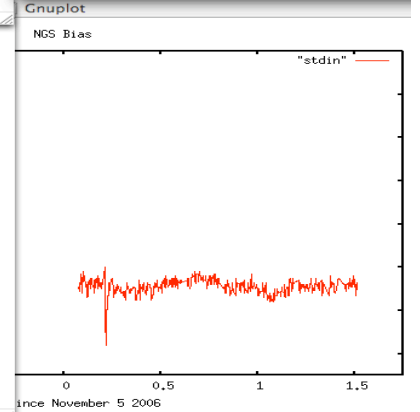




ACs Bias Relative to IGS



```
cobra86: zgrep ' esa ' y*/rpt.gz | c l 2 5 | gnup -
cobra87: pwd
/home/ftp/pub/igs_trop/trop_rpt
cobra88: gnup -h | less
cobra89: zgrep ' esa ' y*/rpt.gz | c l 'c2/10' 5 |
gnuplot> plot "Bias" with lines, "Week" with lines
can't read data file "Bias"
/tmp/gnup15636/gnup", line 6: util.c: No
cobra90: zgrep ' esa ' y*/rpt.gz | c l 'c2/10' 5 |
cobra91: gnup -h | less
cobra92: zgrep ' esa ' y*/rpt.gz | c l 'c2/10 - 14
cobra93: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
cobra94: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
cobra95: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
gnuplot> set xrange [-1:75;1:75]
"gnup", line 2: expecting ']'
cobra96: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
cobra97: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
cobra98: zgrep ' esa ' y*/rpt.gz | c l 'c2/10 - 14
cobra99: fg
zgrep gfz y*/rpt.gz | c l 2 5 | gnup -1
cobra100: fg
zgrep jpl y*/rpt.gz | c l 2 5 | gnup -1
cobra101: fg
zgrep cod y*/rpt.gz | c l 2 5 | gnup -1
cobra102: zgrep ' esa ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[1] 26242 26243 26244
cobra103: zgrep ' cod ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[2] 27428 27429 27430
cobra104: zgrep ' jpl ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[3] 28595 28596 28597
cobra105: zgrep ' gfz ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[4] 29769 29770 29771
cobra106: zgrep ' eur ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[5] 30946 30947 30948
cobra107: zgrep ' emr ' y*/rpt.gz | c l 'c2/10 - 14
Suspended
[6] 32116 32117 32118
cobra108: zgrep ' ngs ' y*/rpt.gz | c l 'c2/10 - 14
```



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- **Automated Long term comparisons for each AC**
 - Updated on a weekly basis

 - **Reprocessing with improved models:**
 - New mapping function (GMF)
 - A priori hydrostatic delay based on TBD (objective analysis fields/GPT)

-
- **Existential: should the IGS continue to produce trop products?**
 - Is it useful for the ACs?
 - Is it being used?
 - Is it unique?

 - **Reprocessing of orbit/clock is necessary to remove bias due to introduction of new standards in Nov 2006**
 - In progress; wait until completion (~end of 2008)
 - Followed by reprocessing of trop
 - ACs are asked to submit reprocessed trop for comparisons

- **Do we provide gradients**
 - Will likely be needed for GGOS cross-technique combination
 - Require modified file format for submissions
 - Are ACs ready to submit gradients for comparisons?
- **Do we provide Ultra Rapid trop product?**
 - Requires low latency (< 3 hours) to be useful
 - Poses significant operational responsibilities
 - Unlikely to be used by operational agencies