Towards better GNSS Observations at the new IGS Reference Station BRUX

Multi Path Mitigation and Individual Antenna Calibration

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Outline

From Site Log

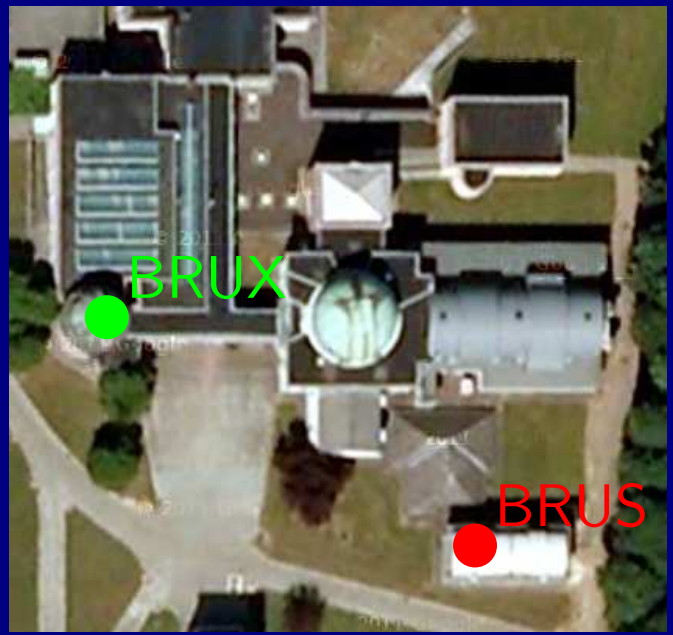
	BRUS	BRUX
Site Name	Brussels	Brussels
Domes Number	13101M004	13101M010
Networks	IGS+EPN	IGS+EPN
Date Installed	1993-10-20	2006-07-07
Date Removed	2012-02-14	–
Receiver	ASHTECH Z-XII3T	SEPT POLARX4TR
Antenna	ASH701945B_M	JAVRINGANT_DM

BRUS was removed due to construction works (asbestos removal)

Marker Name	City	Country	Lat.	Long.	H.	DQ (%)		Availability (%)					Latency			Receiver			Networks			Remarks
						0°	15°	Daily BKG	Daily OLG	Hourly BKG	Hourly OLG	RT	Hourly(%) BKG	Hourly(%) OLG	RT (s)	Sat. System G	Sat. System R	Sat. System E	IGS	TOS	ECGN	
BRST	Brest	France	48.38	-4.50	65.8	84	97	100	100	100	100	98	98	31	0.6	✔	✔	✔	✔	✔	✔	
~~BRUS~~	~~Brussels~~	~~Belgium~~	~~50.80~~	~~4.36~~	~~149.7~~											✔	_	_	✔	_	_	*Former*
BRUX	Brussels	Belgium	50.80	4.36	158.3	94	99	100	100	100	100	99	99	96	0.6	✔	✔	✔	✔	_	_	
BSCN	Besançon	France	47.25	5.99	359.5	79	96	100	100	100	100	98	96	31	1.2	✔	✔	✔	_	_	_	

(a) EPNCB Station List

(b) BRUX



(c) On Google Maps

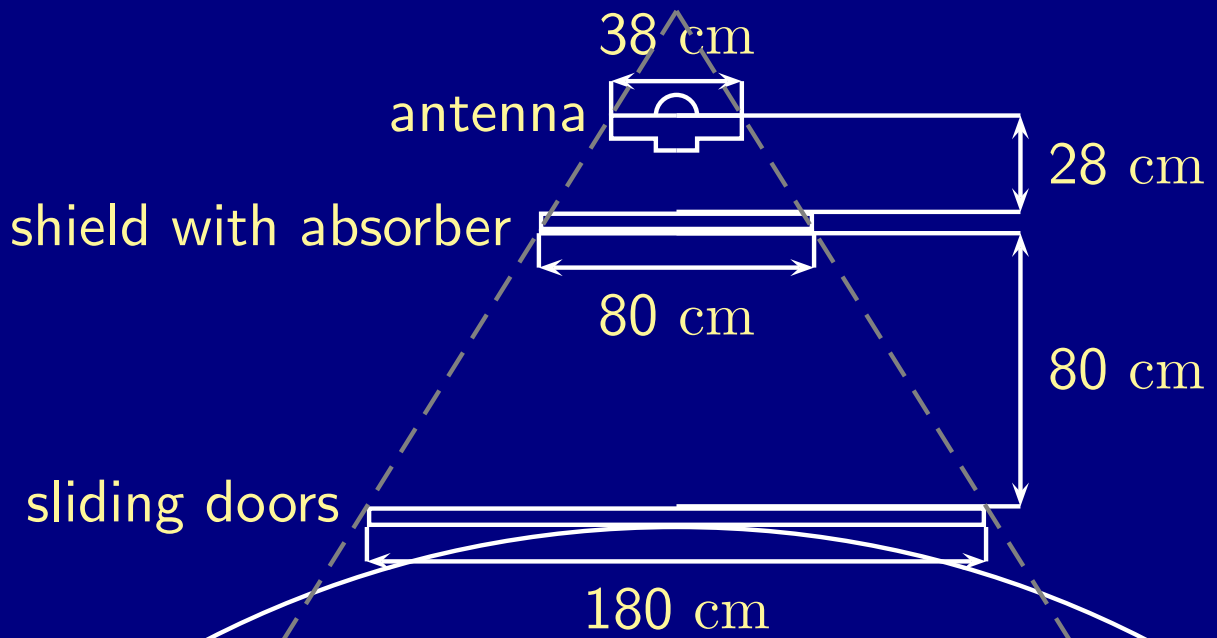
(d) BRUS

Outline

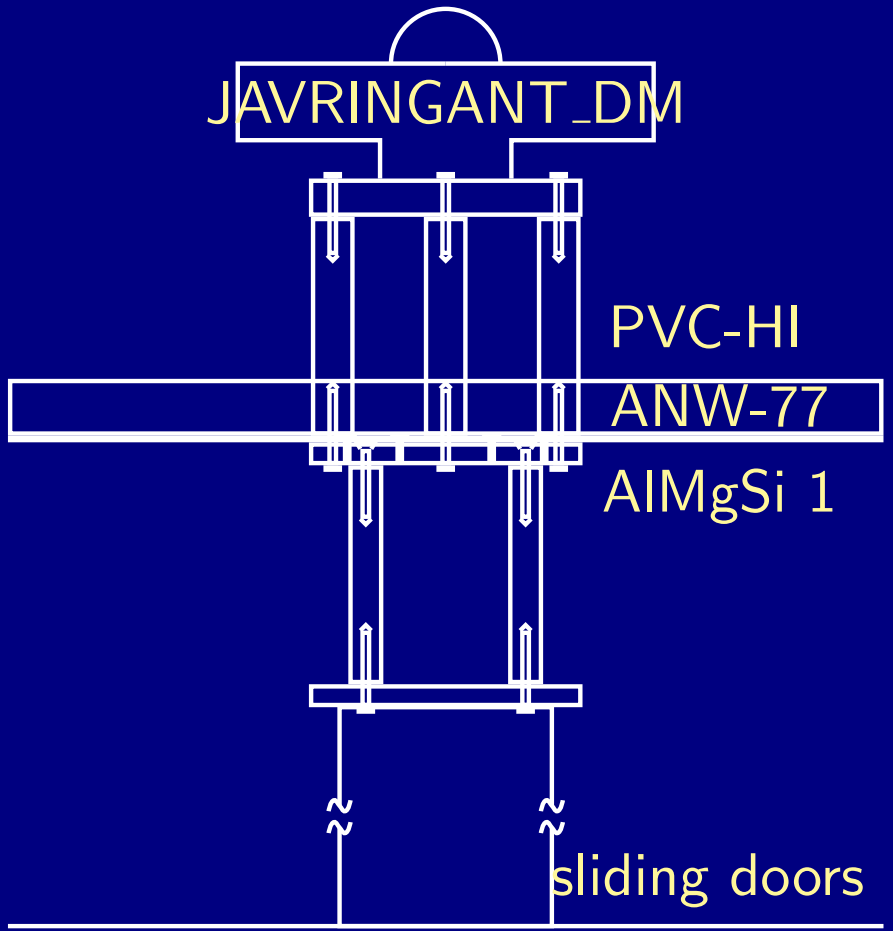
Constraints

- Cost of RF absorbing material
- Limit shield weight and dimensions
- Minimum antenna to absorber spacing
- Limit horizontal and vertical displacement of antenna

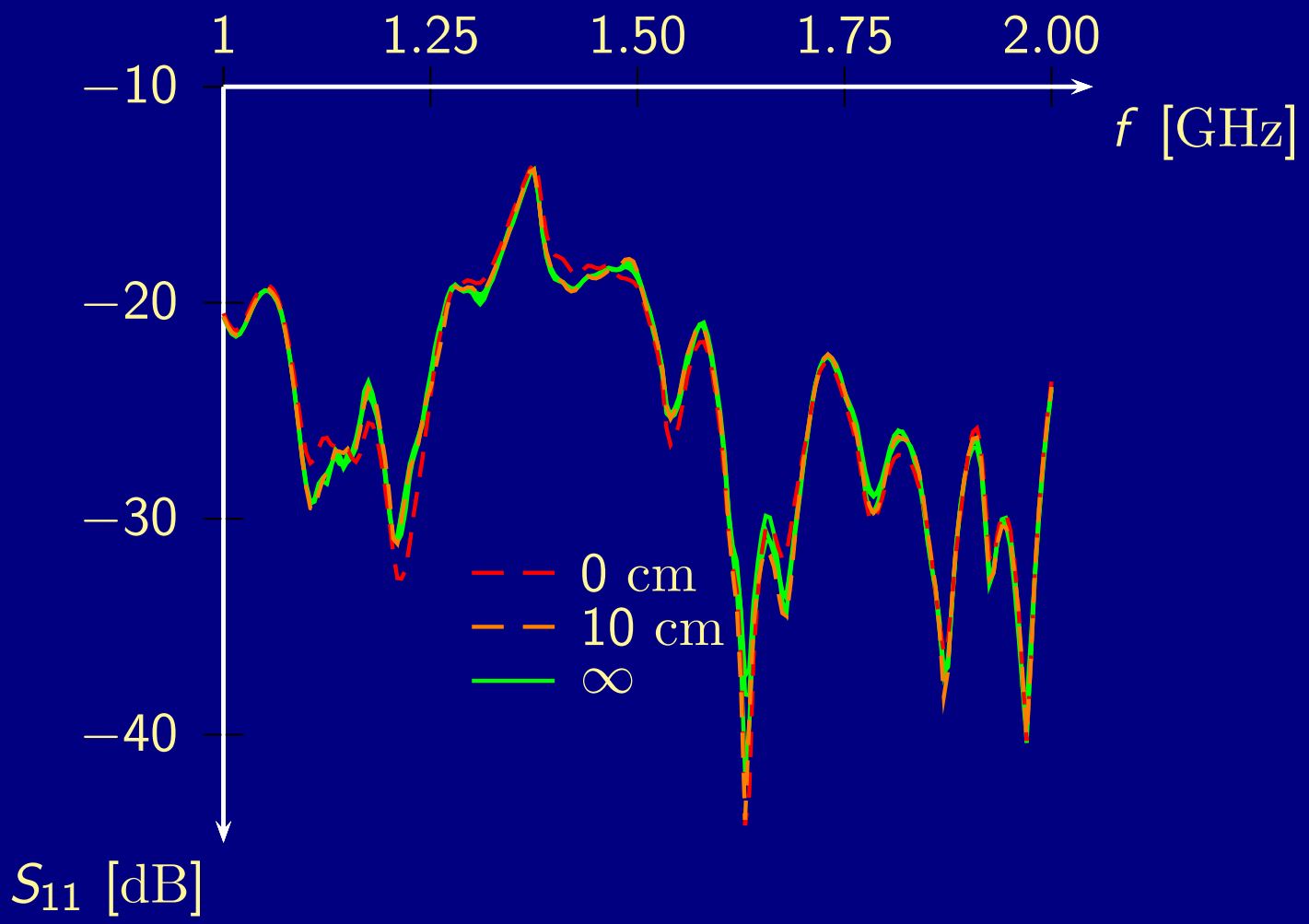
Shielding the Telescope Dome Doors



Antenna Support



Minimum Antenna to Absorber Spacing

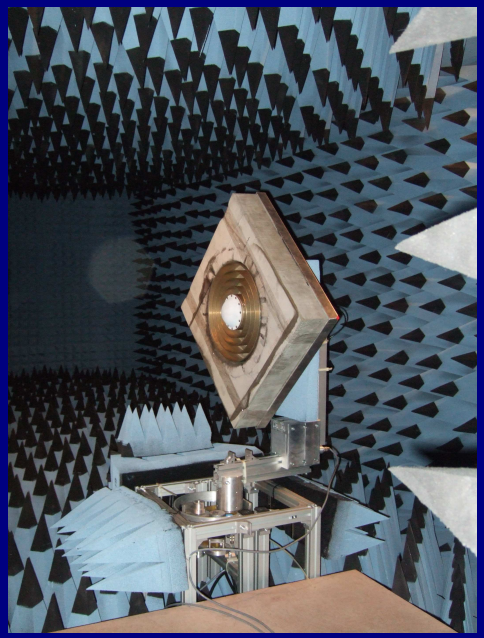


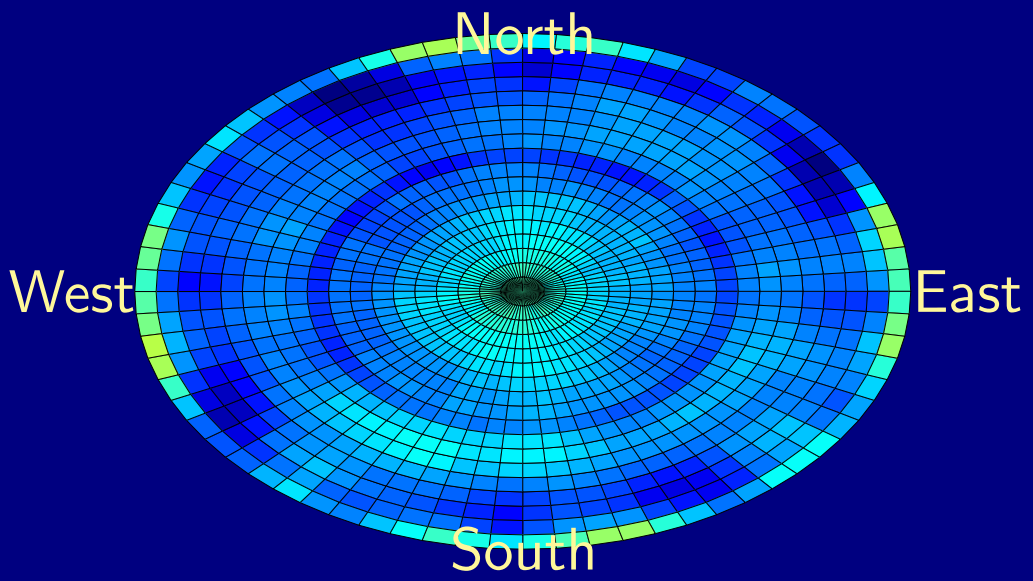
Some Other Examples

ONSA setup (left) from T. Ning (et al) "The impact of microwave absorber and radome geometries on GNSS measurements of station coordinates and atmospheric water vapour" (2011)
Bird Nest (right) from A. Kerkhoff (et al) "Modifications to GPS Reference Station Antennas to Reduce Multipath" (2010)

Effect of Absorbers in Line Of Sight (LOS)

Material adds delay (2 mm for ASH701945C_M in ANW-79 on GPS L1)

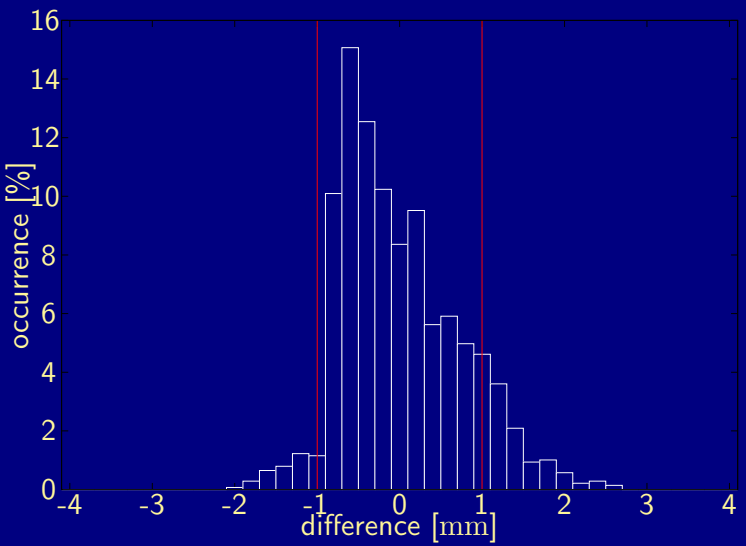


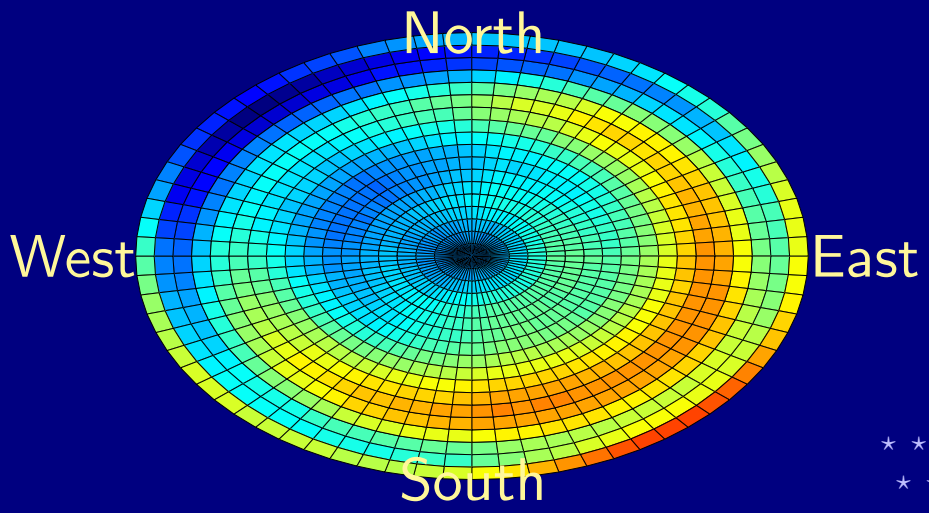


Type versus Individual Calibration

Type from igs08.atx versus Individual from UniBonn:

frequency	ΔPCO North	ΔPCO East	ΔPCO Up	% within ± 1 mm
GPS L1	-0.62 mm	0.70 mm	10.09 mm	85%
GPS L2	-1.22 mm	0.44 mm	5.33 mm	82%
GPS L3	0.31 mm	1.10 mm	17.45 mm	78%

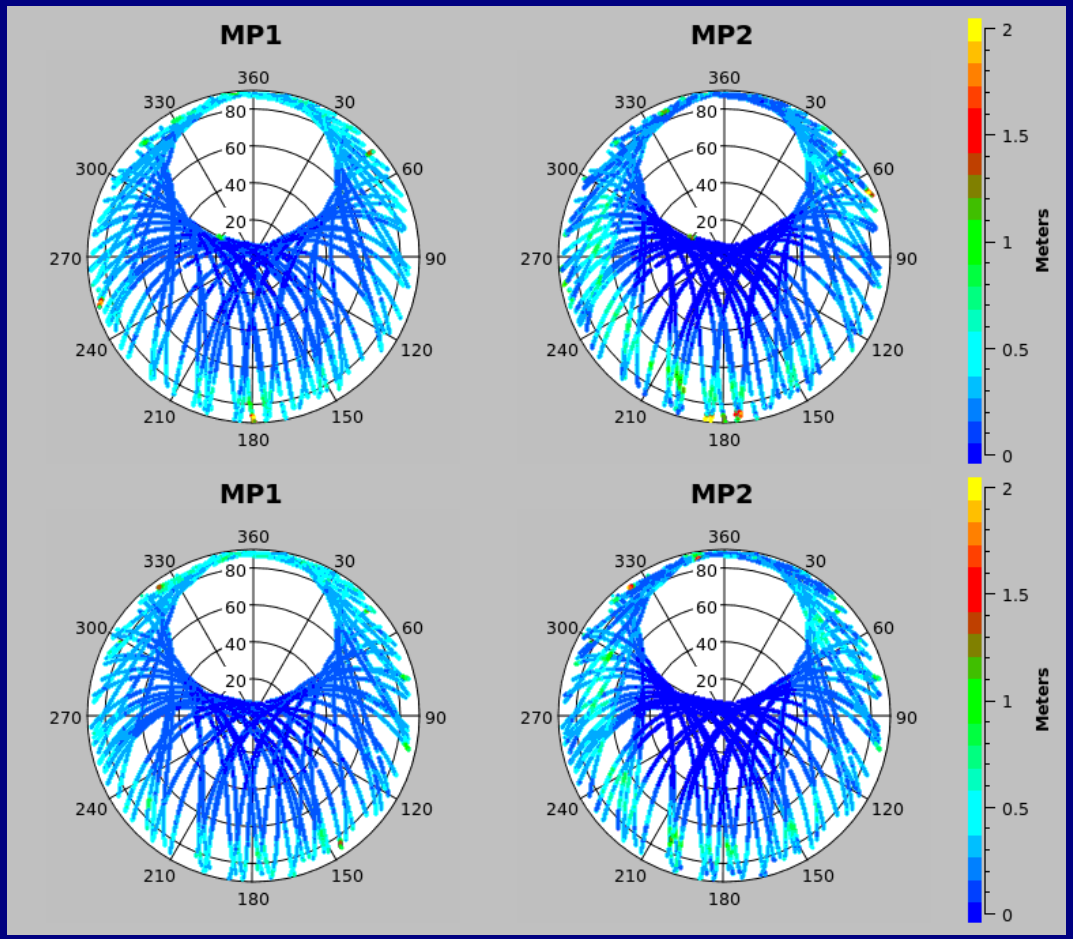




Outline

Multi Path Sky Plots (Preliminary Results)

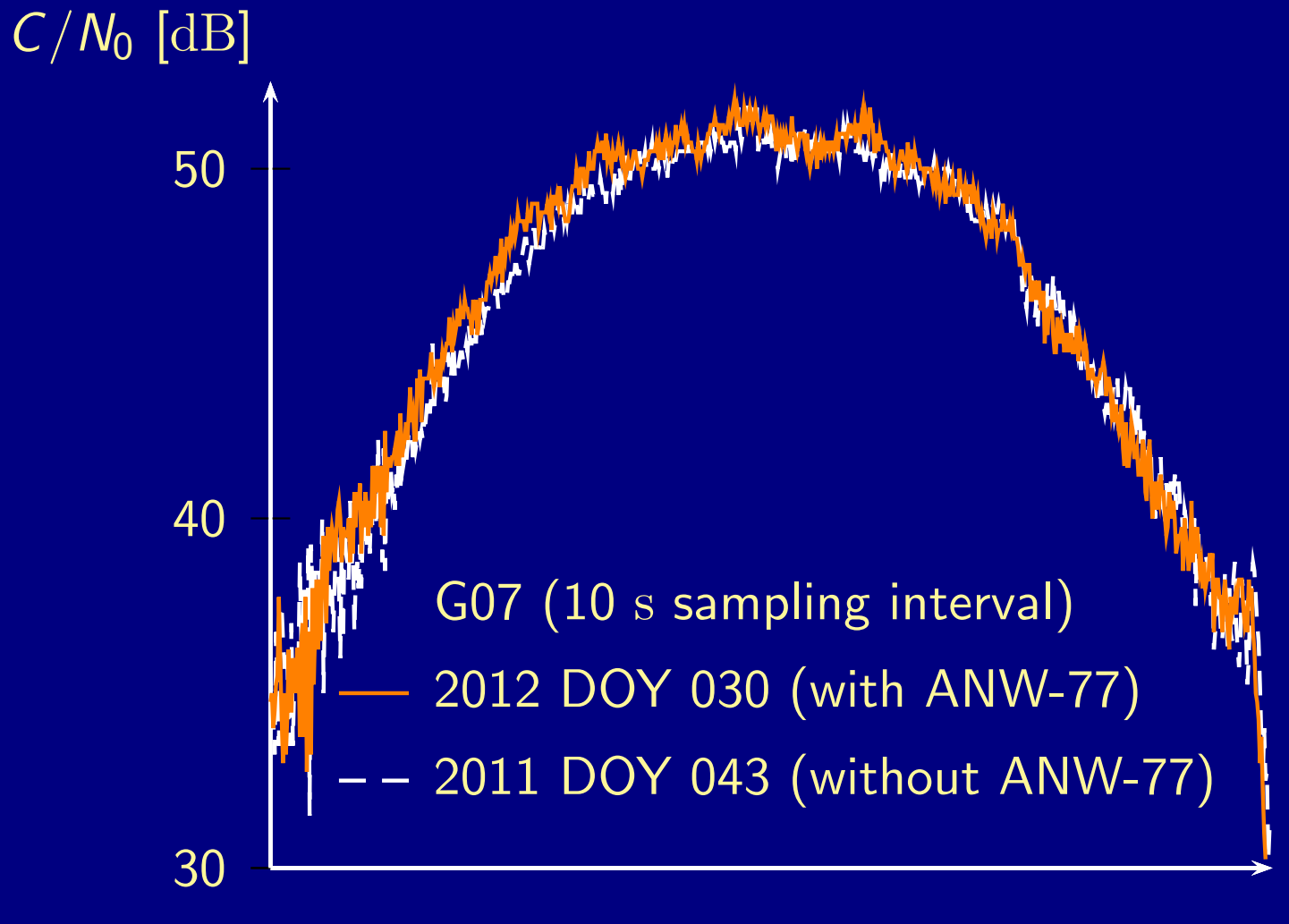
MP1 and MP2 rms values from BNC:



BRUX 2011–043
(without ANW-77)

BRUX 2012–030
(with ANW-77)

C/N_0 Curves (Preliminary Results)



Day Boundary Clock Jumps (Preliminary Results)

Consecutive days calculated with Atomium (PPP)

year	# days	minimum	maximum	stdev
2010	10	-205 ps	171 ps	127 ps
2012	8	-100 ps	152 ps	86 ps

2010 setup: MJD 55234–55244 (DOY 025–035)
ASHTECH Z-XII3T connected to CH1-75A maser
ASH701945C_M without ANW-77

2012 setup: MJD 55965–55973 (DOY 039–047)
SEPT POLARX4TR connected to CH1-75A maser
JAVRINGANT_DM with ANW-77

BRUS–BRUX Local Tie

method	ΔX	ΔY	ΔZ	ΔR
terrestrial	-12.1690	-47.3262	23.7428	54.3284
GPS L3 type/indiv	-12.1640	-47.3295	23.7428	54.3302
(diff to terr)	-0.0050	0.0033	0.0000	-0.0018
GPS L3 type/type	-12.1640	-47.3283	23.7430	54.3292
(diff to terr)	-0.0050	0.0021	-0.0002	-0.0008
method	Δ N	Δ E	Δ U	ΔR
terrestrial	27.1967	-46.2645	8.4563	54.3284
GPS L3 type/indiv	27.1931	-46.2682	8.4593	54.3302
(diff to terr)	0.0036	0.0037	-0.0030	-0.0018
GPS L3 type/type	27.1931	-46.2670	8.4595	54.3292
(diff to terr)	0.0036	0.0025	-0.0032	-0.0008

NOTE: individual calibration of BRUS antenna is planned

Conclusion

- BRUS was shut down, BRUX replaced BRUS in EPN and IGS
- To improve quality of observations at BRUX
  - the dome was shielded
    to avoid reflections reaching the antenna
  - the antenna was individually calibrated
    at the anechoic chamber of uniBonn
- The terrestrial BRUS-BRUX survey showed good agreement with the distance as obtained from GPS L3 calculations

Acknowledgments

- Solar Terrestrial Network of Excellence (STCE)
- Andria Bilich, Jim Ray, Guy Vandenbosch, Philipp Zeimetz, . . .