Attempts to implement the elevation-dependant DORIS station antenna phase correction

Based on the document CO-SP-DO-OP-2460-CN, available on the IDS web site:

Reference	: CO-SP-D0-OP-2460-CN
Issue	: 16.2
Date	: **22/04/2008**
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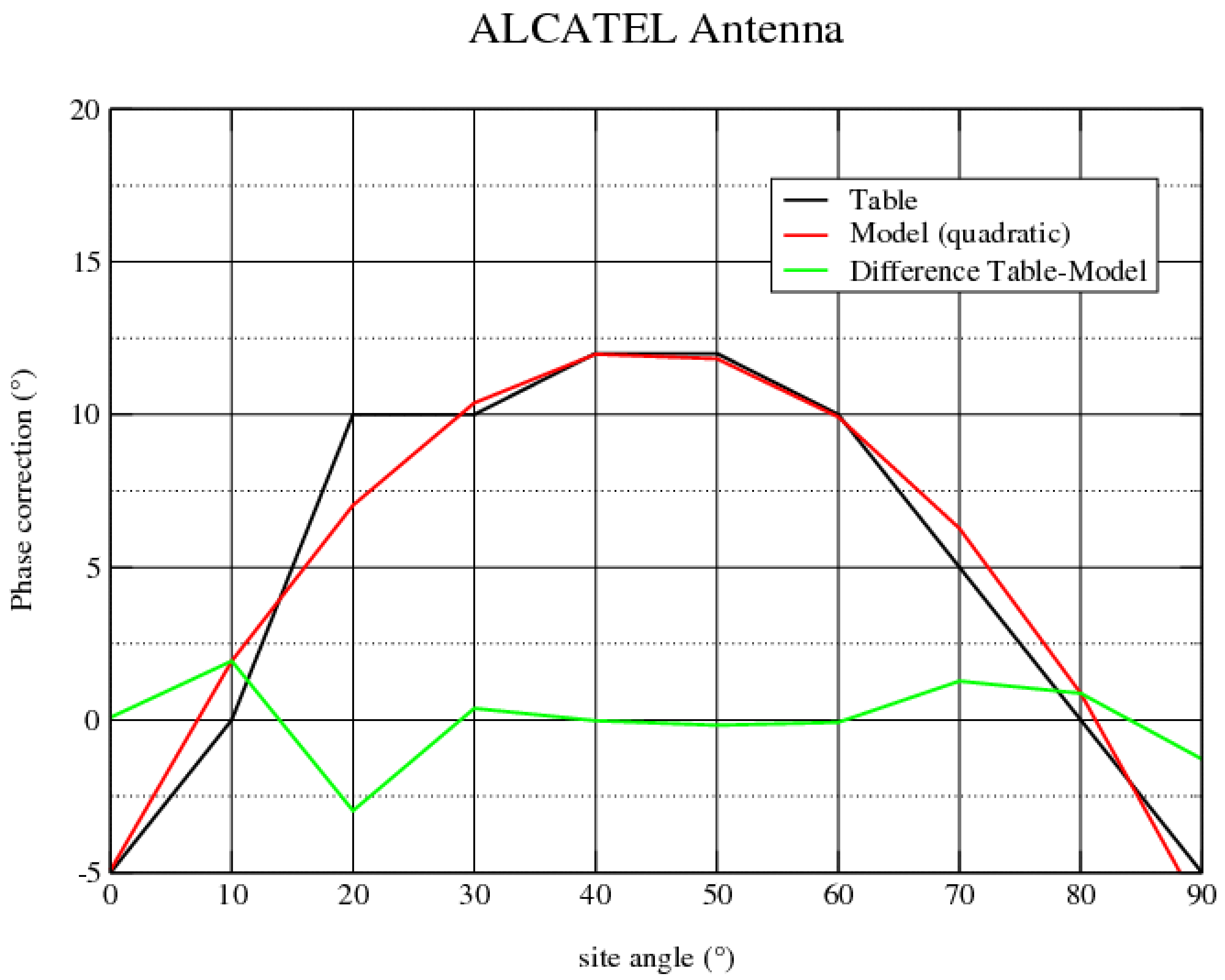
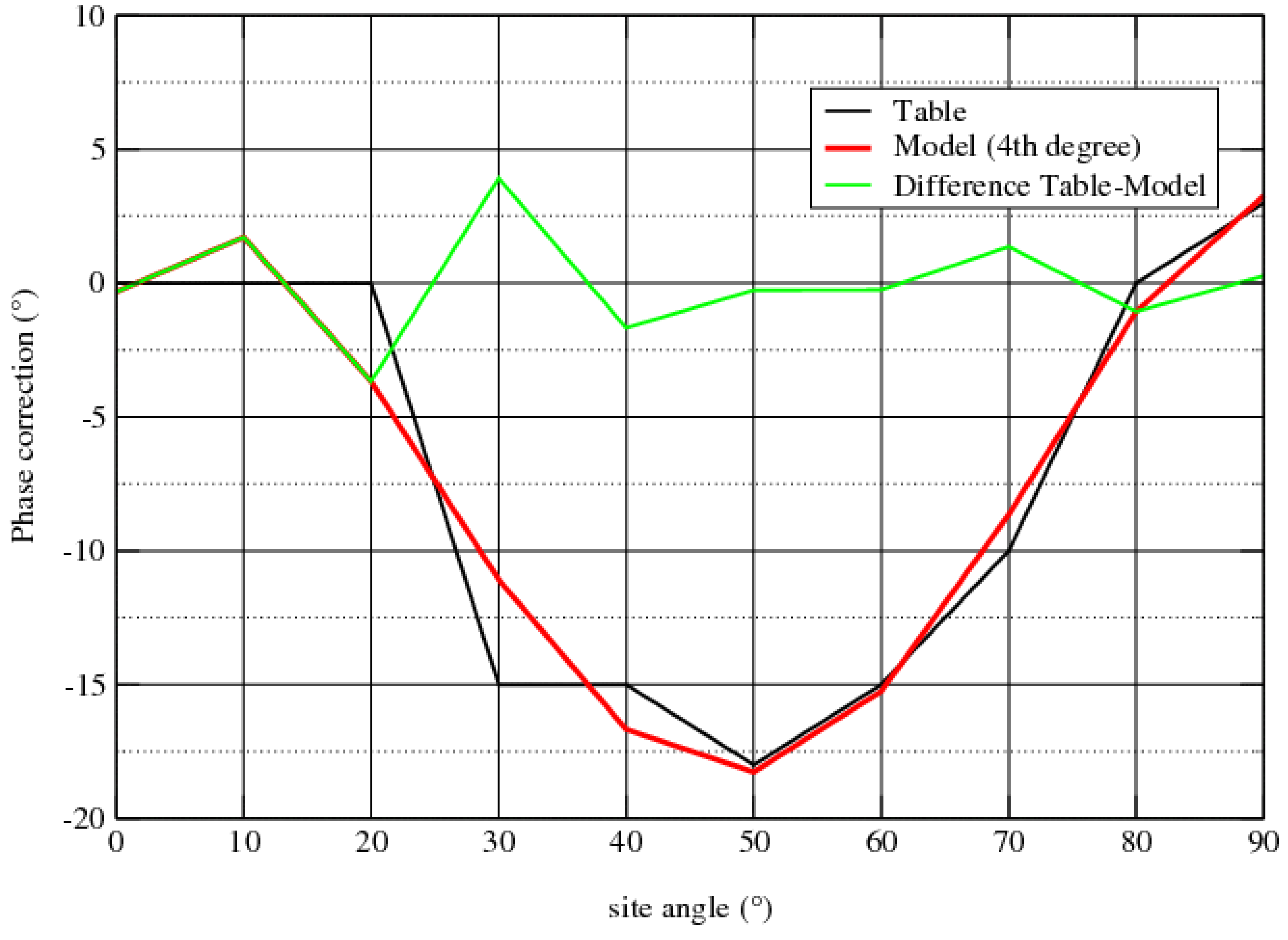
Title : Modelling of DORIS instruments

θ (°) \ X(θ) (°)	Ground antennas			
	Alcatel Type*		Starec Type*	
	2 GHz	400 MHz	2 GHz	400 MHz
0	- 5	0	0	0
10	0	0	0	0
20	10	0	0	0
30	10	0	- 15	0
40	12	0	- 15	0
50	12	0	- 18	0
60	10	0	- 15	0
70	5	0	- 10	0
80	0	0	0	0
90	- 5	0	+ 3	0
ε (°)	2	4	2	4

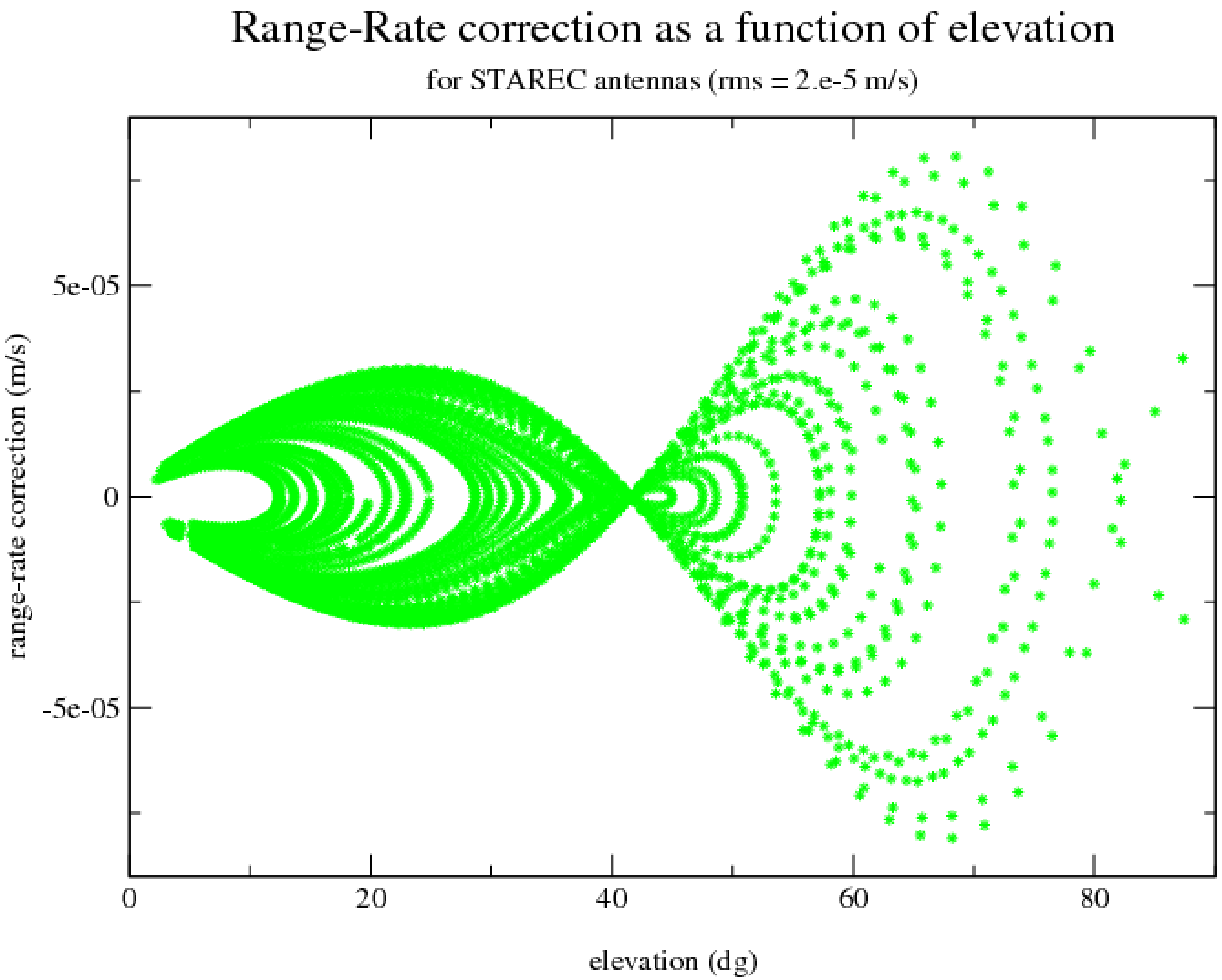


ALCATEL Antenna
Table
Model (quadratic)
Difference Table-Model
Phase correction (°)
site angle (°)
20
15
10
5
0
-5
0
10
20
30
40
50
60
70
80
90

STAREC Antenna



• Range-rate correction:



- Impact of the correction in terms of:
- Residuals
- Measurement zenithal tropospheric bias (MZB)
- Station heights

Remarks:

- mean residuals are 0.327 mm/s rms
- Correction rms is 0.02 mm/s

→ **In all cases, we observe an increase of the residuals !**

	Without solving for station heights			Solving for station heights		
	Additional noise (mm/s)	ΔMZB (mm)	ΔH station (mm)	Additional noise (mm/s)	ΔMZB (mm)	ΔH station (mm)
Negative correction	+0.015	+1.64	0	+0.019	+1.9	-2.35
Positive correction	+0.021	-1.61	0	+0.015	-1.9	+2.24

CONCLUSION:

- Correction (or implementation) is not convincing in its present state ;
- Need to redo the study with the new phase laws established by the CNES “Antenna Laboratory” ;
- Implementation of full phase wind up (according to the azimuth) should be tested.

Implementation of the azimuth-dependant DORIS Phase Wind Up

Theory, from →

A GUIDE TO USING INTERNATIONAL GNSS SERVICE (IGS) PRODUCTS

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The phase wind-up correction (in radians) can be evaluated from dot (·) and vector (×) products according to (Wu at al., 1993) as follows:

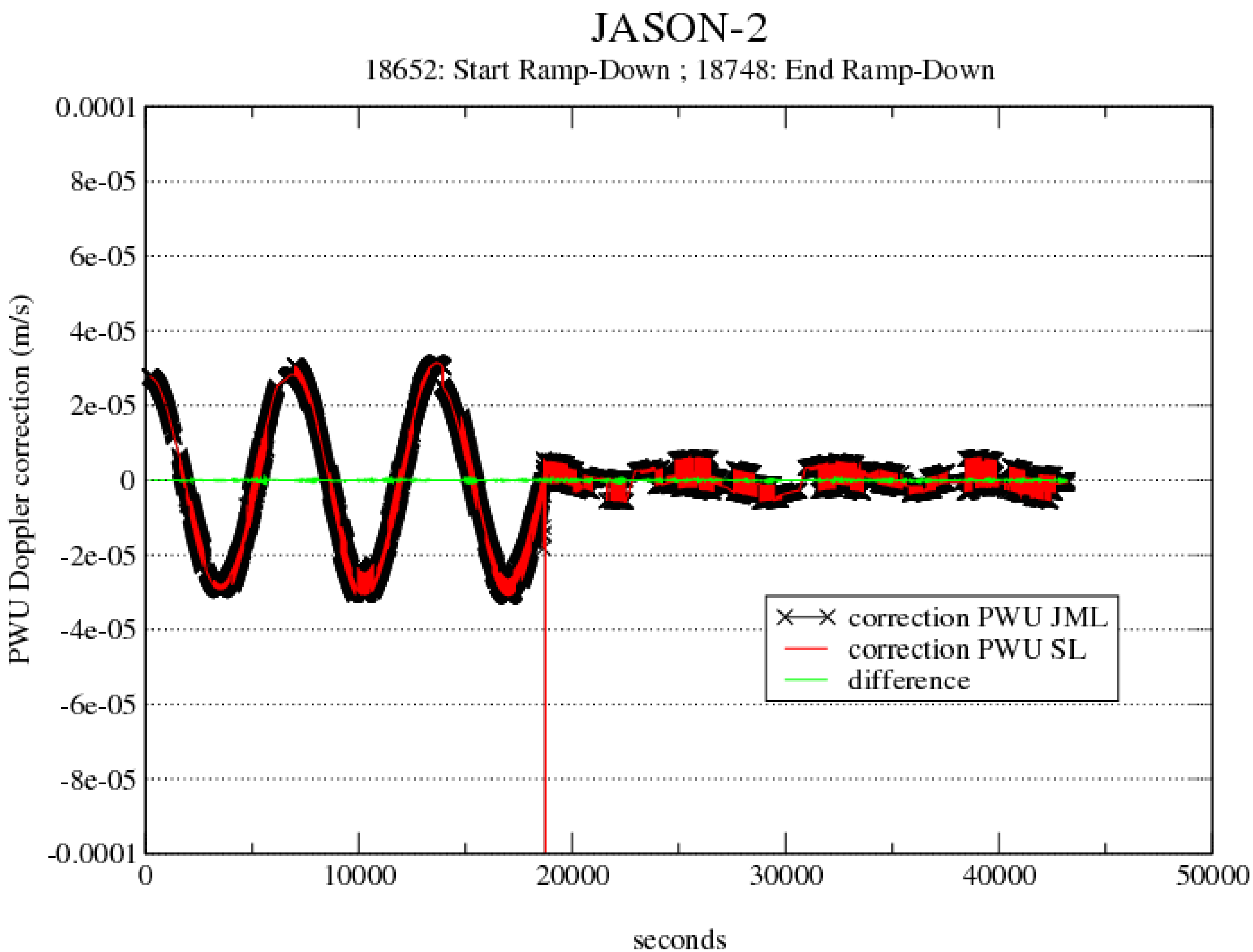
$$\Delta\phi = sign(\zeta)\ \cos^{-1}(\vec{D}'\cdot\vec{D} / |\vec{D}'||\vec{D}|)\ , \qquad (20)$$

where $\zeta = \hat{k}\cdot(\vec{D}'\times\vec{D})$, $\hat{k}$ is the satellite to receiver unit vector and $\vec{D}'$, $\vec{D}$ are the effective dipole vectors of the satellite and receiver computed from the current satellite body coordinate unit vectors ($\hat{x}'$, $\hat{y}'$, $\hat{z}'$) and the local receiver unit vectors (i.e. north, east, up) denoted by ($\hat{x}$, $\hat{y}$, $\hat{z}$):

$$\vec{D}' = \hat{x}' - \hat{k}(\hat{k}\cdot\hat{x}') - \hat{k}\times\hat{y}'\ ,$$

$$\vec{D} = \hat{x} - \hat{k}(\hat{k}\cdot\hat{x}) + \hat{k}\times\hat{y}\ .$$

Continuity between consecutive phase observation segments must be ensured by adding full cycle terms of $\pm 2\pi$ to the correction (20).


JASON-2
18652: Start Ramp-Down ; 18748: End Ramp-Down
PWU Doppler correction (m/s)
0.0001
8e-05
6e-05
4e-05
2e-05
0
-2e-05
-4e-05
-6e-05
-8e-05
-0.0001
0
10000
20000
30000
40000
50000
seconds
correction PWU JML
correction PWU SL
difference

- Results of the correction on Jason-2:

The RMS of the PWU correction on this half day is 1.61e-5 m/s (0.0161 mm/s)

	Laser residuals (192 meas.)	DORIS residuals (7695 meas.)	Noise removed / introduced
No PWU correction	4.0828 cm	0.301323 mm/s	
+ PWU correction	4.0804 cm	0.301016 mm/s	- 0.0136 mm/s
- PWU correction	4.0853 cm	0.301911 mm/s	+ 0.0188 mm/s

CONCLUSION:

- Everything OK for Jason-2

- Results of the correction on TOPEX:

The RMS of the PWU correction on this day is 0.90e-5 m/s (0.0090 mm/s)

	Laser residuals (287 meas.)	DORIS residuals (5297 meas.)	Noise removed / introduced
No PWU correction	0.9525 cm	0.439979 mm/s	
+ PWU correction	0.9528 cm	0.439983 mm/s	+ 0.0013 mm/s
- PWU correction	0.9523 cm	0.439977 mm/s	- 0.0018 mm/s

CONCLUSION:

- No reaction of TOPEX residuals…???????????