Refined GPS Analysis Strategies for EUREF Tested by CODE

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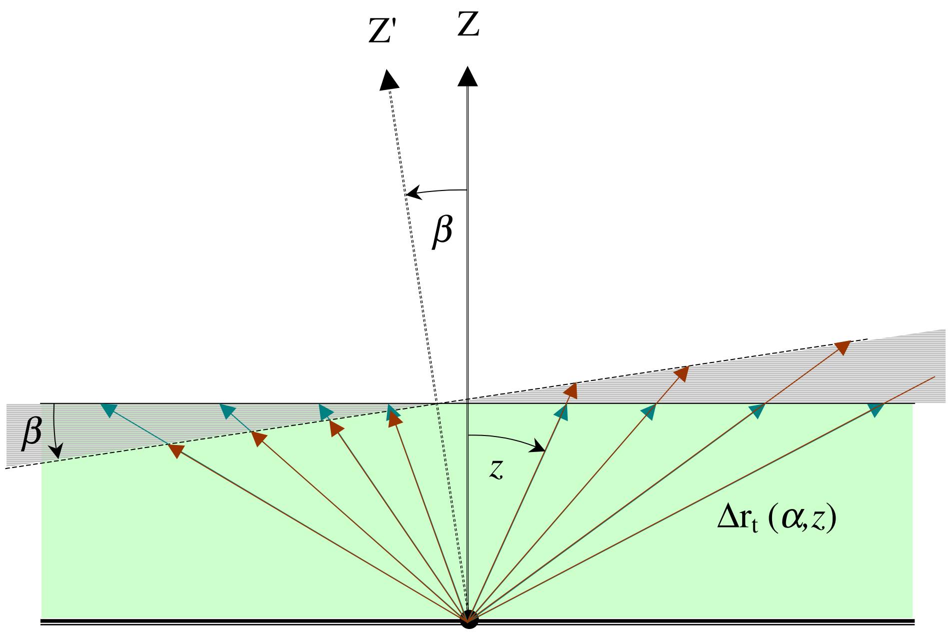
Characteristics of CODE EUROCLUS Solutions in Overview

ID	Amb res	Min el	ED obs wgt	Trop mod	Grad est	# trop par
EG_	No	15	No	Saas	No	12
EQB*	Yes	15	No	Saas	No	24
NMF	Yes	15	No	Niell	No	24
NMW	Yes	15	Yes	Niell	No	24
EQ_	Yes	10	Yes	Niell	No	24
ET_	Yes	10	Yes	Niell/intro	No	24/12
NM5	Yes	5	Yes	Niell	No	24
NMG	Yes	5	Yes	Niell	Yes	24

*Official COE solution

Troposphere Gradient Estimation

Tilting of the “tropospheric” zenith by the angle β:



Why Considering Low-Elevation Data?

The inclusion of low-elevation data has two major advantages:

- The number of observations increases by about 13 percent when going from 15 to 5 degrees. This number is valid for actual data from the EPN GPS network. When looking at simulated data (full tracking down to 5 degrees), the increase would be almost 28 percent.
- A better decorrelation of the estimated height and the tropospheric delay parameters of the same station is achievable.

ONSA Daily Station Coordinate Reproducibility

North/East/Up standard deviations given in units of mm:

ID	Amb res	Min el	ED obs wgt	Trop mod	Grad est	N	E	U
EG_	No	15	No	Saas	No	1.7	1.9	4.2
EQB*	Yes	15	No	Saas	No	1.7	1.6	4.3
NMF	Yes	15	No	Niell	No	1.7	1.6	4.4
NMW	Yes	15	Yes	Niell	No	1.4	1.3	4.0
EQ_	Yes	10	Yes	Niell	No	1.5	1.4	3.6
ET_	Yes	10	Yes	Niell/intro	No	1.6	1.4	3.1
NM5	Yes	5	Yes	Niell	No	1.6	1.4	3.6
NMG	Yes	5	Yes	Niell	Yes	0.9	1.0	3.4

*Official COE solution

Conclusions

- The change of the mapping function (from Saastamoinen to Niell) did not change the daily repeatability.
- The biggest improvement in height results from the elevation-dependent weighting of the observations and from the inclusion of low-elevation data.
- A small improvement in the horizontal position is obtained by weighting the observations.
- The estimation of troposphere gradients has definitely the largest impact on the results by improving the horizontal positions by a factor of almost two (from approximately 2 to 1 mm) compared to the “standard” solution `EQB`.
- The consideration of “global” troposphere delay estimates as part a regional—or local—GPS data analysis may lead to considerably improved station height results.

Outlook—Ideas for Future Test Solutions

- Troposphere parameterization without discontinuities, eventually also over day boundaries
- Minimal elevation angle of 3 (or even 0) degrees
- Slightly modified elevation-dependent observation weighting functions
- Other tropospheric mapping functions
- “Tropospheric” zenith perpendicular to global geoid
- Atmospheric loading
- Satellite-specific observation weighting scheme (using SP3 accuracy code information)
- Station-specific observation weighting scheme
- Multipath reducing models