GPS Slant Delay Retrievals

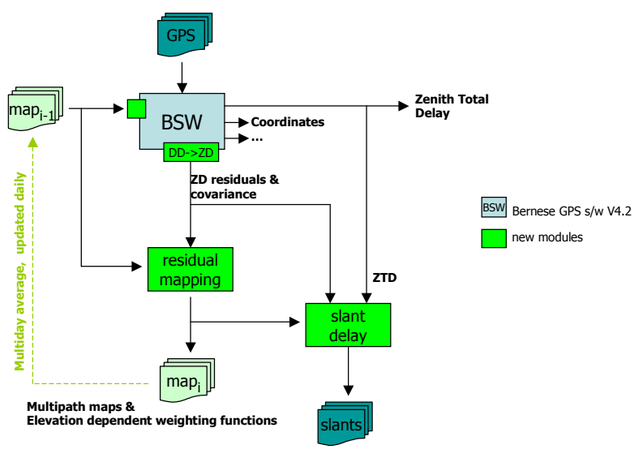
H. van der Marel, TU Delft, DEOS/MGP

Within TOUGH the use of GPS Slant delays for meteorology is investigated.

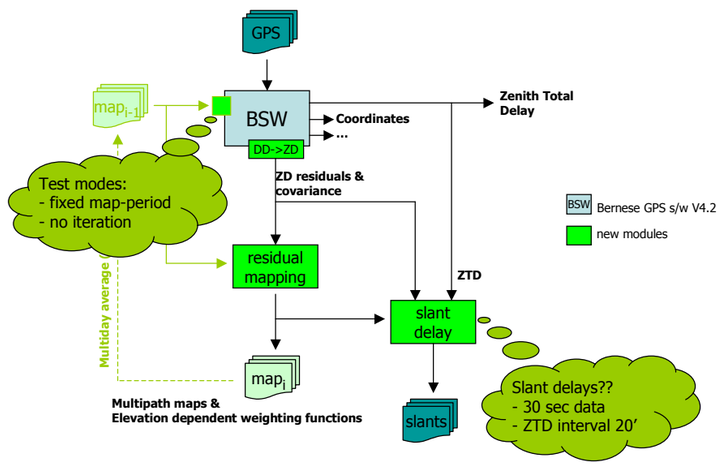
The TU Delft is responsible for:

1. Computing undifferenced residuals and (co-) variance matrix from Bernese s/w
2. Residual stacking to estimate site dependent multipath and antenna phase center variations
3. Slant Delays retrievals using multipath corrected residuals

GPS Processing (Operational mode)



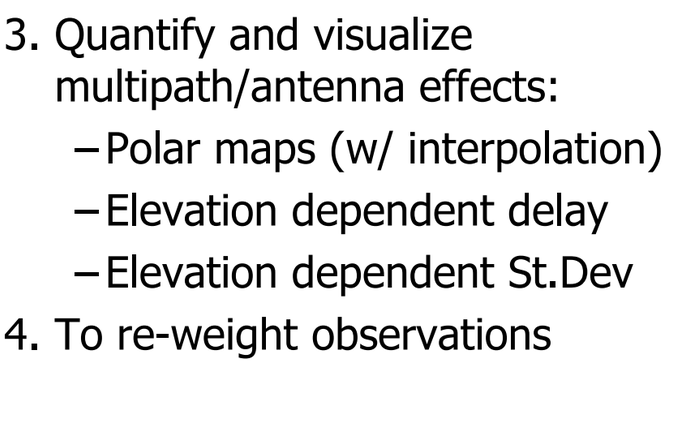
GPS Processing (Test modes)



GPS Processing (GIPSY/OASIS)

Residual Stacking:

(i) Daily binned maps, in equal area projection, of mean residual, sum of squares, and number of residuals



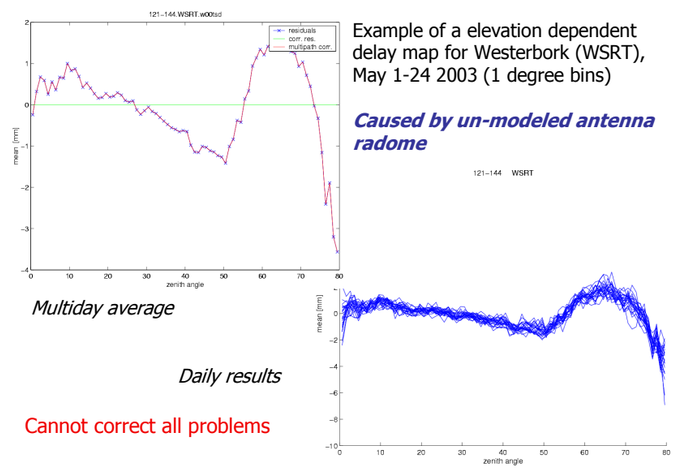
(ii) Multi-day running average

Applications of residual stacking:

1. Correct slants for multipath
2. Correct GPS observations for multipath (affects all parameters, including slants)
3. Quantify and visualize multipath/antenna effects:
   - Polar maps (w/ interpolation)
   - Elevation dependent delay
   - Elevation dependent St.Dev
4. To re-weight observations

Example of a multipath map for Apeldoorn, May 1-24 2003 (1x1 degree bins in an equal area projection)

Elevation dependent phase delay

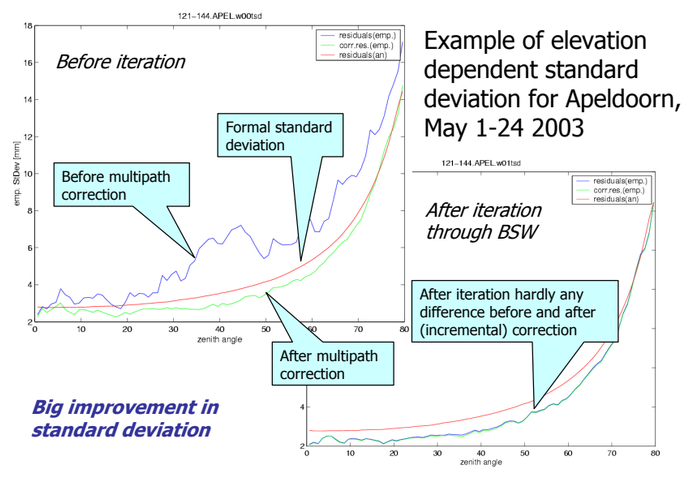


Example of a elevation dependent delay map for Westerbork (WSRT), May 1-24 2003 (1 degree bins)

Caused by un-modeled antenna radome

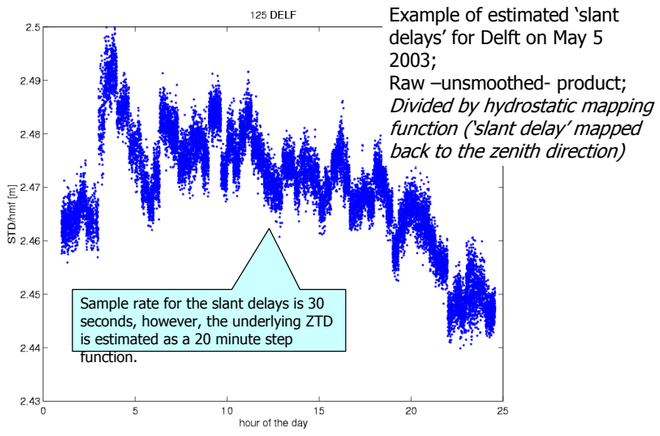
Cannot correct all problems

Elevation dependent error modeling



Example of elevation dependent standard deviation for Apeldoorn, May 1-24 2003

Example of 'Slant Delays'



Example of estimated 'slant delays' for Delft on May 5 2003;
Raw –unsmoothed- product;
Divided by hydrostatic mapping function ('slant delay' mapped back to the zenith direction)

Compared to ZTD, with slants delays

- it is known which part of the atmosphere is sampled (the sky is not sampled homogeneously)
- information on non-isotropic delays and gradients in the atmosphere become available
- there are simply more observations and they are much 'closer' to the raw GPS data
- could include more low elevation observations
- data can be (re-)processed more intelligently down the line