TECHNISCHE UNIVERSITÄT WIEN
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High frequency EOP estimated from the CONT campaigns

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VieVS User Workshop

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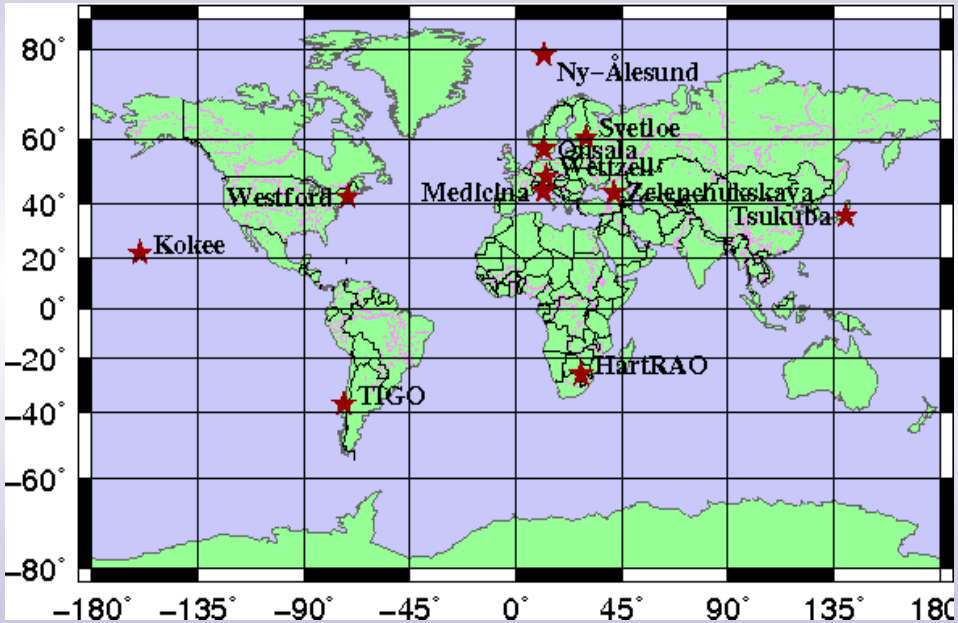
Vienna

The CONT campaigns

- The CONT campaigns:
  - Continuous VLBI observations over 15 days
  - CONT02:
    - October 2002
    - 8 stations
  - CONT05:
    - September 2005
    - 11 stations
  - CONT08:
    - August 2008
    - 11 stations



The CONT08 Network

High frequency EOP from CONT campaigns

- One of the main purposes of the CONT campaigns was to obtain high frequency EOP (sub-diurnal resolution)
- VieVS was used to estimate hourly EOP's from CONT02, CONT05 and CONT08
- Issues that need consideration:
  - Each CONT campaign consist of 15 individual sessions. Needs to be combined in order to avoid jumps between sessions
  - Separation of polar motion and nutation when having sub-diurnal resolution

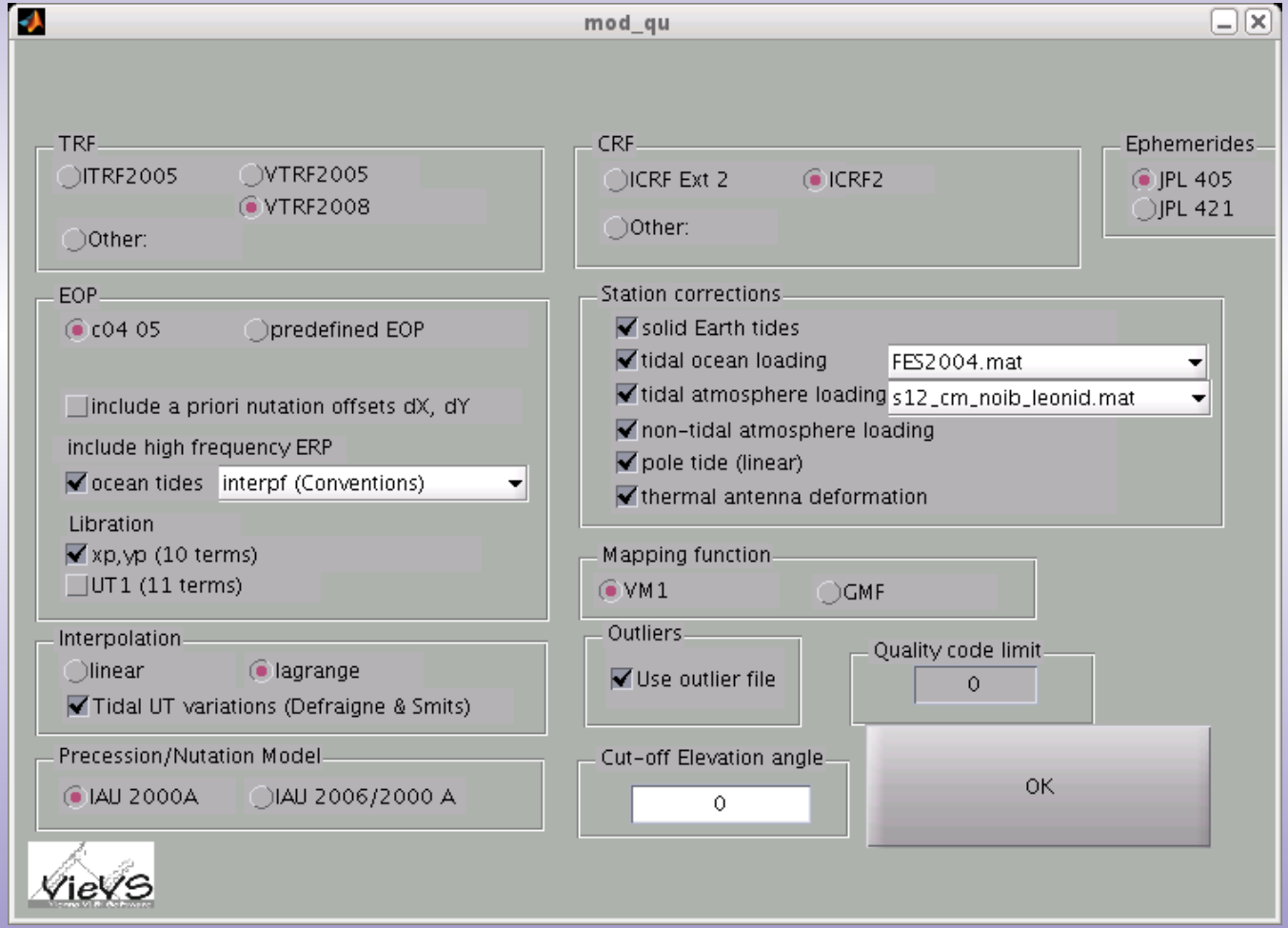
High frequency EOP from CONT campaigns (II)

- Each session was first processed individually using VieVS. Normal equations were saved.
- The normal equations of each CONT campaign were than stacked using a MATLAB script.
- Polar motion and nutation were represented in the frequency domain. Make it easy to block certain frequencies
- Inversion of the stacked normal equations gives EOP time series with hourly resolution.

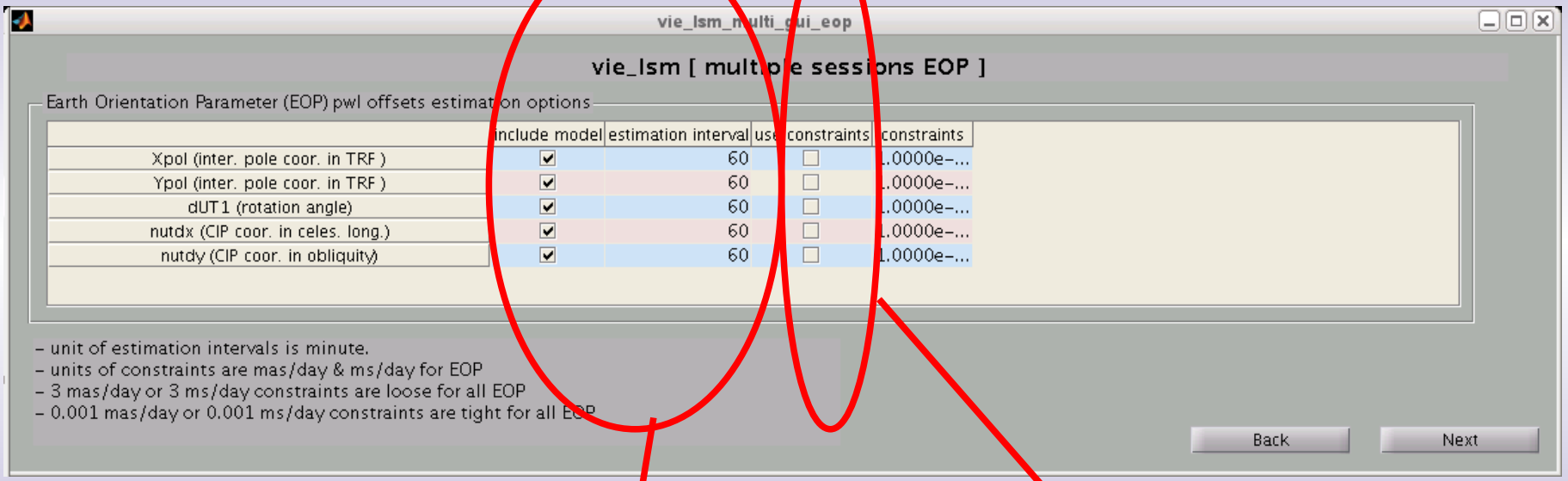
Setup in VieVS

- VIE_MOD: follow IERS conventions
- Clocks: 1 hour resolution
- ZWD: 30 minutes resolution
- Gradients: 2 hour resolution
- Station coordinates: estimated, constant offset for each CONT, NNT/NNR to VTRF2008
- Source coordinates: fixed to ICRF2
- EOP's: 1 hour resolution

Setup in VieVS (II)



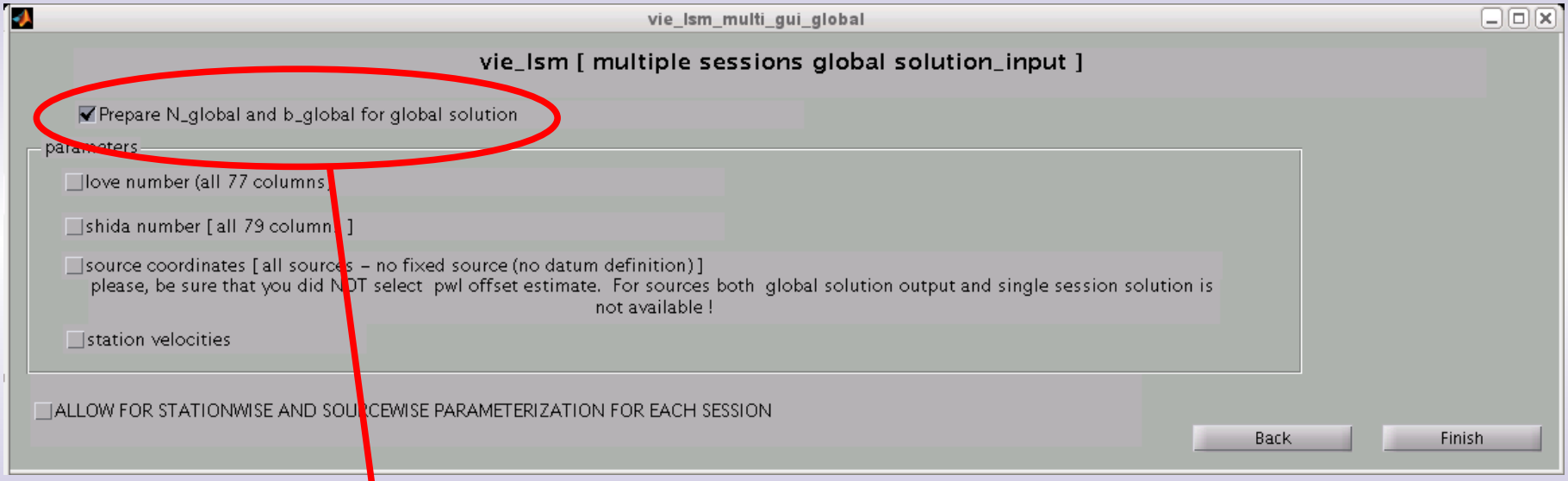
Setup in VieVS (III)



All EOP's estimated with hourly resolution

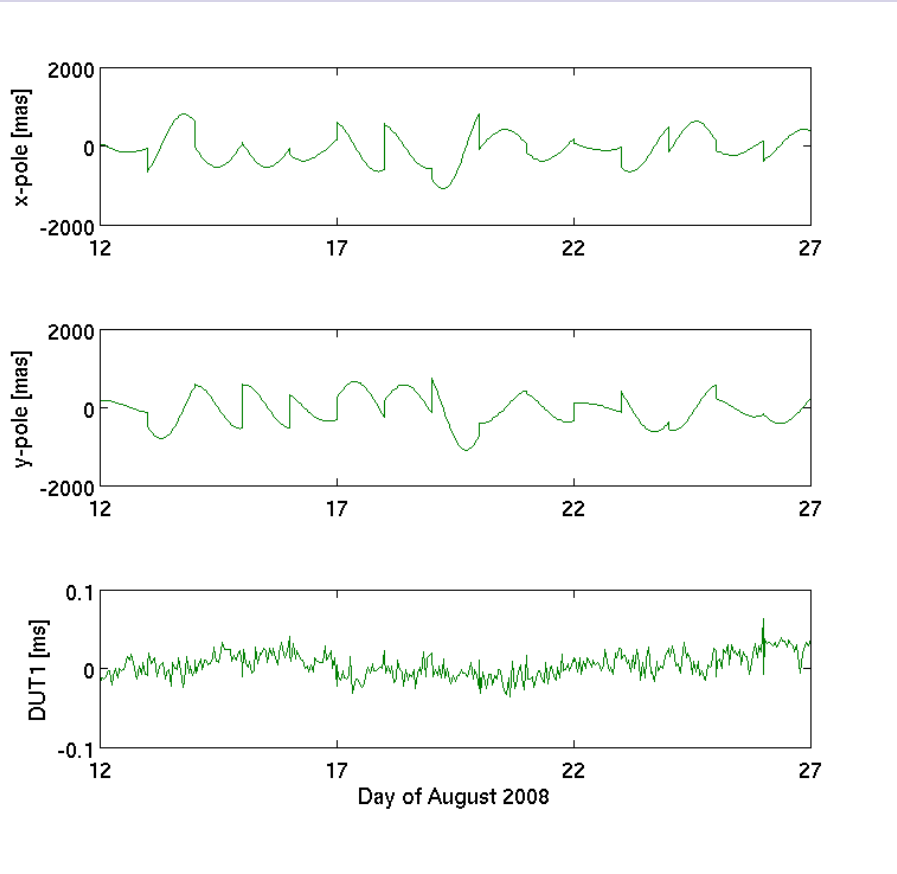
No constraints applied
Done later when stacking the normal equations

Setup in VieVS (IV)



Save the normal equation matrices

EOP from single session analysis



- CONT08
- Estimates relative to the a priori values
- Polar motion estimates really bad. Reason: problem badly posed, polar motion and nutation cannot be separated
- DUT1 ok

Stacking of normal equations

- Use the data saved in **DATA/LEVEL2/**
  - 08AUG*DD*_N004_Nb_glob: N and b matrices
  - 08AUG*DD*_N004_par_glob: x_ and opt_ structure arrays (x_ needed for bookkeeping, which variable is in which column)
  - 08AUG*DD*_N004_an_glob: station positions
- Stack EOP's, ZWD, and gradients at the session boundaries. Stack station coordinates
- Add constraints for the EOP's (relative constraints, 2 mas/day)

Separating polar motion and nutation

- According to the definition of the Celestial Intermediate Pole, there are no nutations with periods <48 hours. Consequently, polar motion with period between -48 and -16 hours are considered as nutation
- We express polar motion and nutation by their Fourier series:

$$x_p(t) = \sum_{k=0}^{N-1} \left[a_k \cos(\omega_k t) + b_k \sin(\omega_k t) \right],$$

$$y_p(t) = \sum_{k=0}^{N-1} \left[-a_k \sin(\omega_k t) + b_k \cos(\omega_k t) \right],$$

$$dX(t) = \sum_{k=0}^{N-1} \left[c_k \cos(\omega_k t) - d_k \sin(\omega_k t) \right],$$

$$dY(t) = \sum_{k=0}^{N-1} \left[c_k \sin(\omega_k t) + d_k \cos(\omega_k t) \right].$$

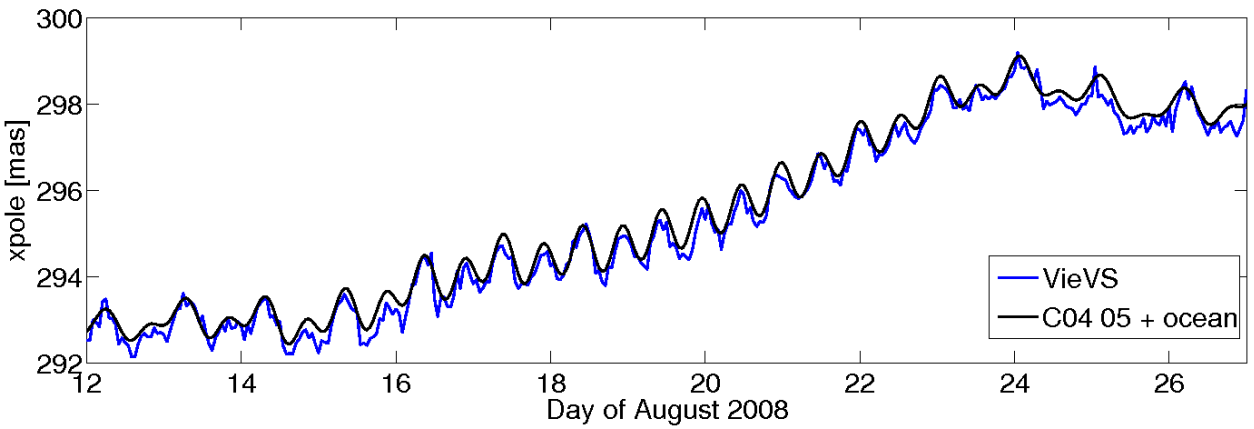
Separating polar motion and nutation (II)

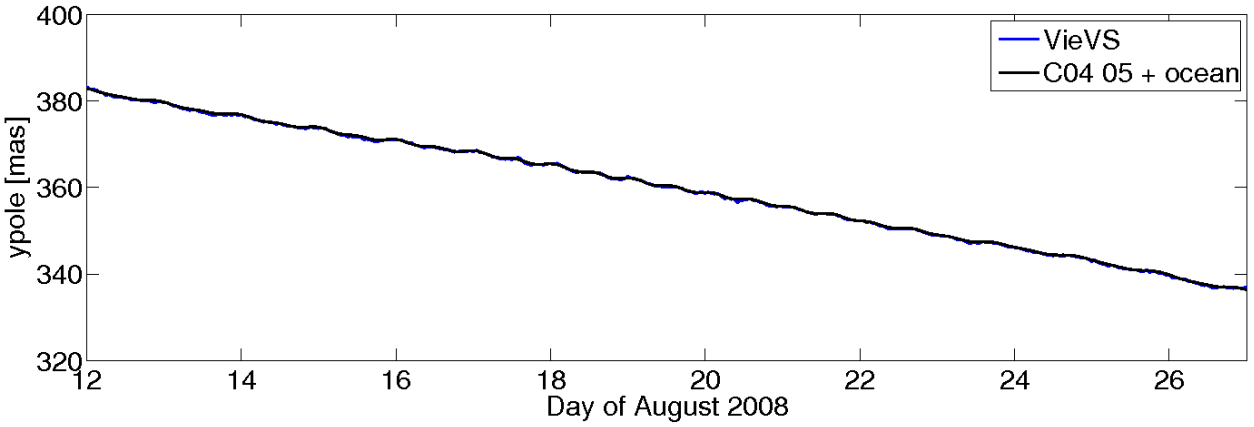
- A change of variables is made. Instead of estimating polar motion and nutation series, the Fourier coefficients a_k, b_k, c_k, and d_k are estimated.

  $x_{new}=Mx_{old}$, $N_{new}=M^TN_{old}M$, $b_{new}=M^Tb_{old}$

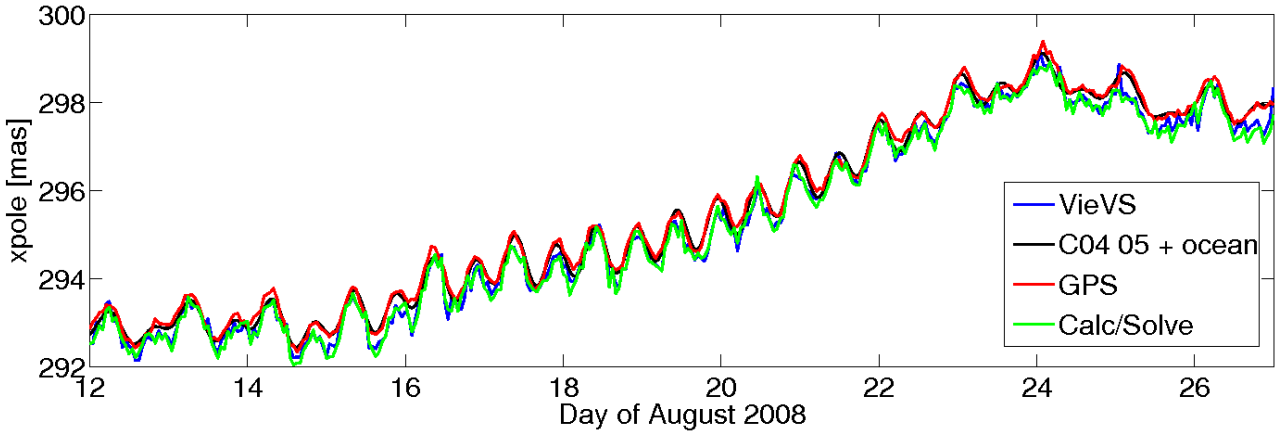
- Set the coefficients a_k, b_k to zero for frequencies between -1.5 and 0.5 cycles per day. Set c_k, and d_k to zero for frequencies higher than 0.5 cycles per day.
- The normal equation matrix is now regular. A solution can be obtained.

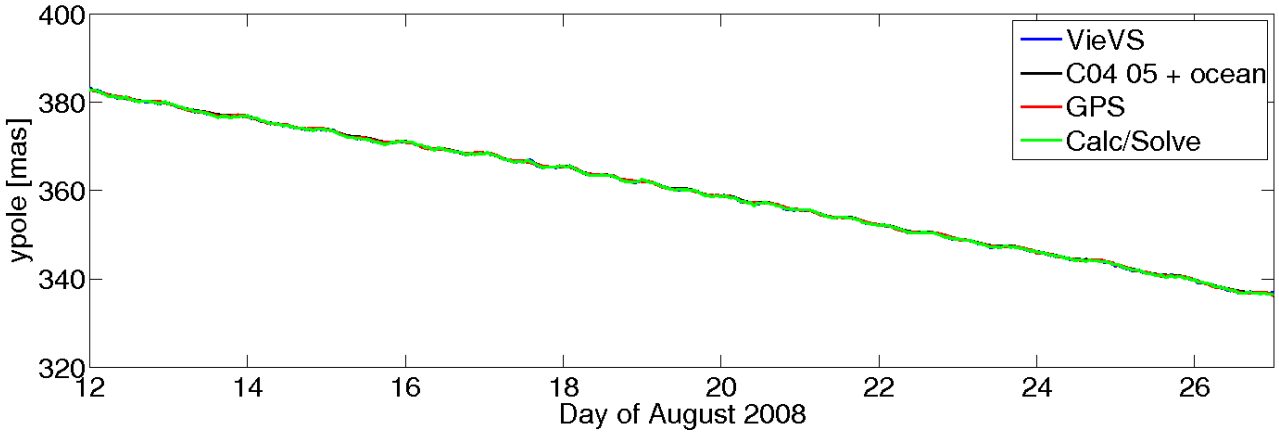
Polar motion from CONT08



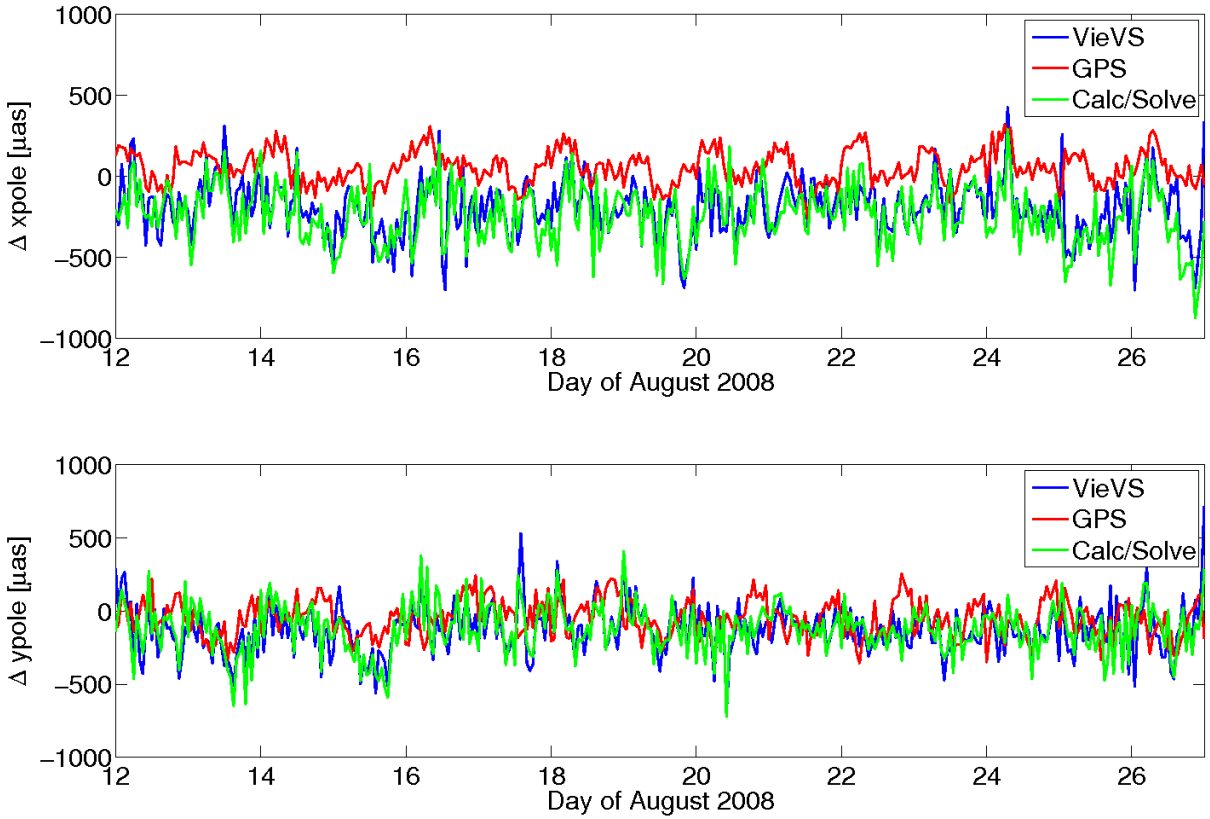


Polar motion from CONT08 (II)



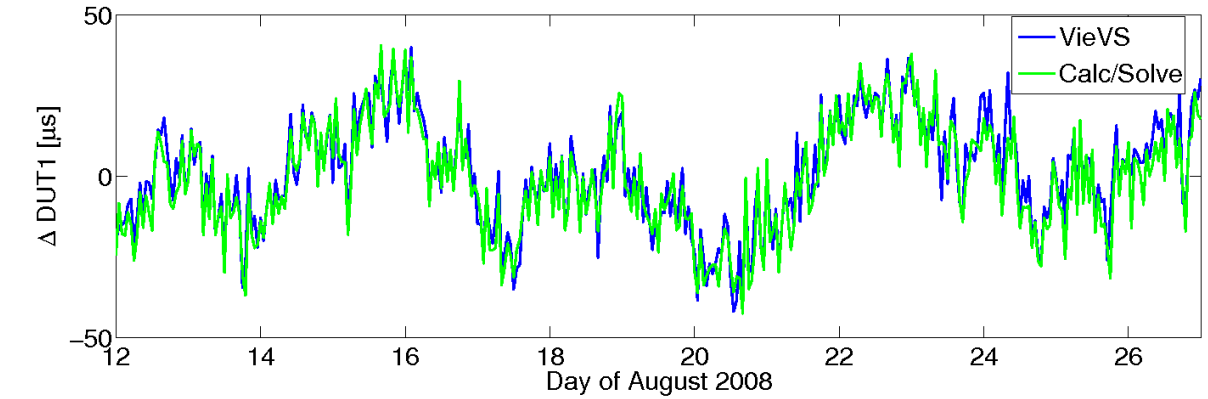


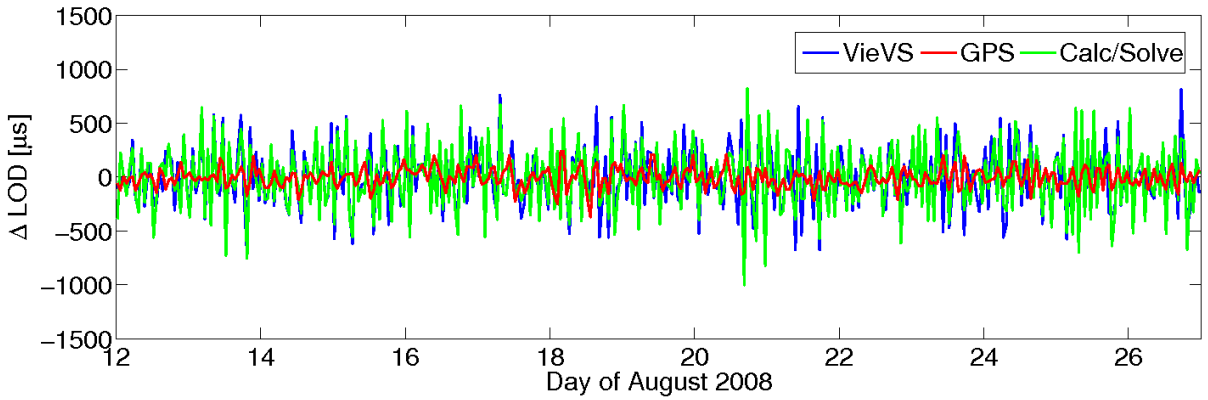
Polar motion from CONT08 (III)



Difference to 05 C04 + IERS HF ERP model

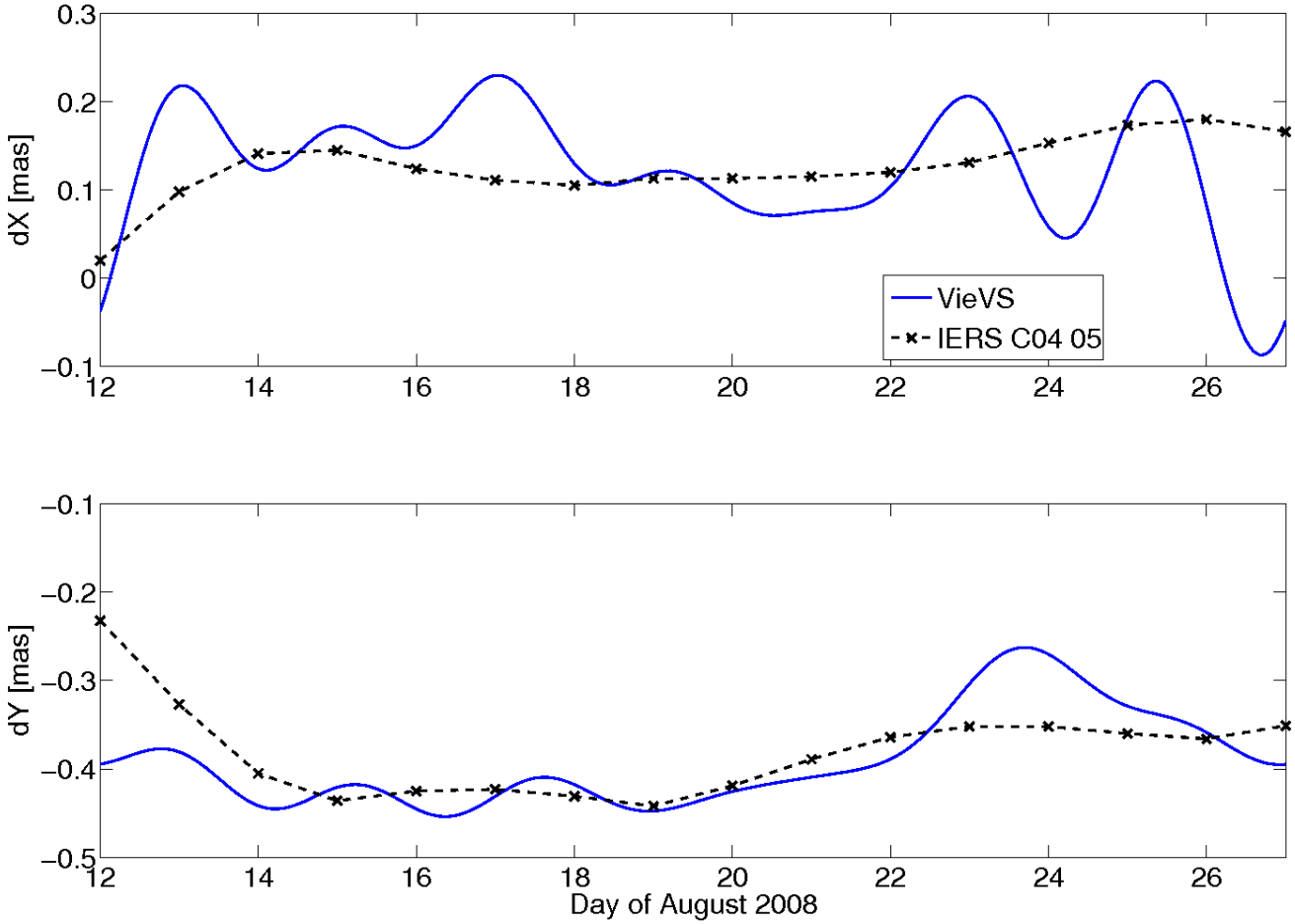
DUT1 and LOD from CONT08



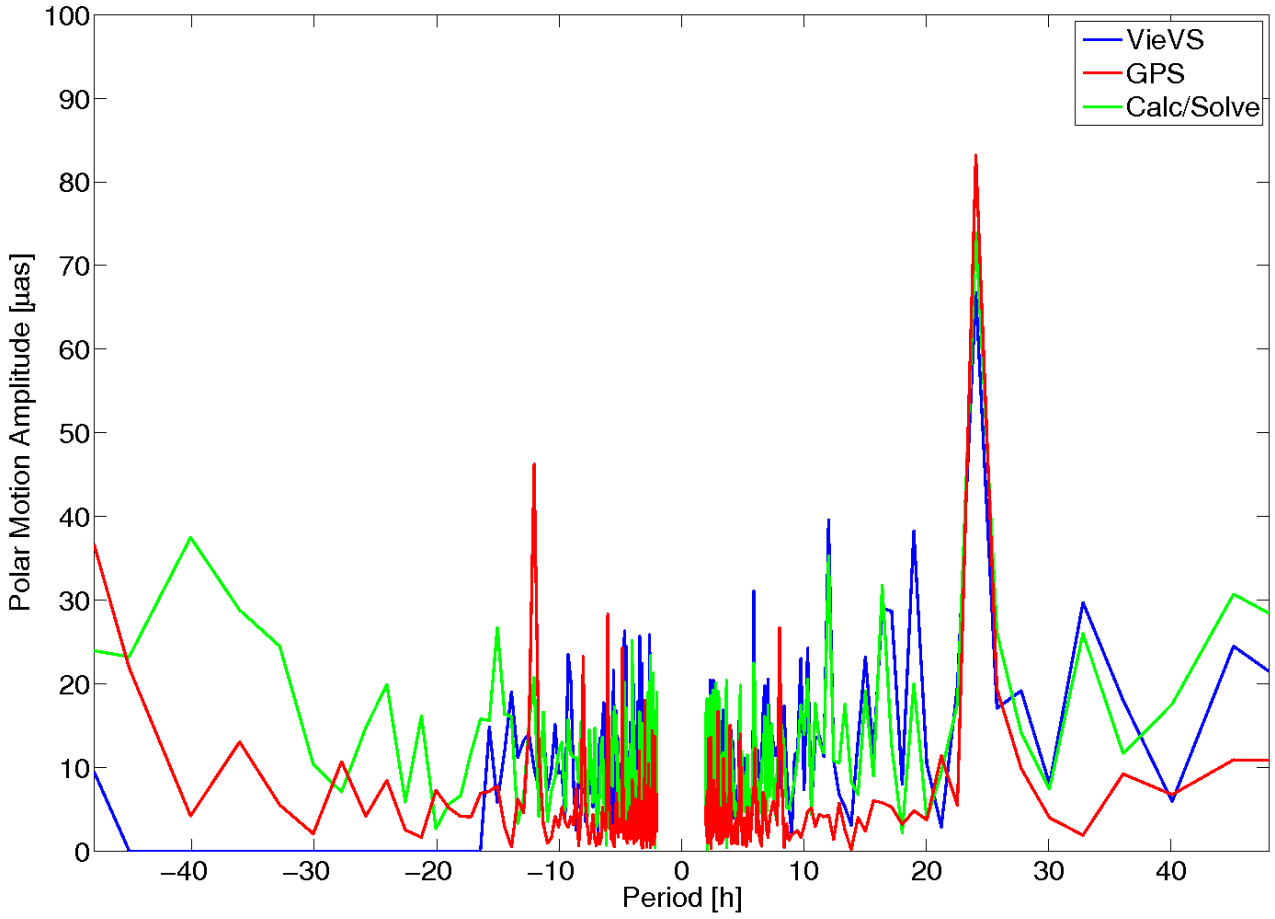


Difference to 05 C04 + IERS HF ERP model

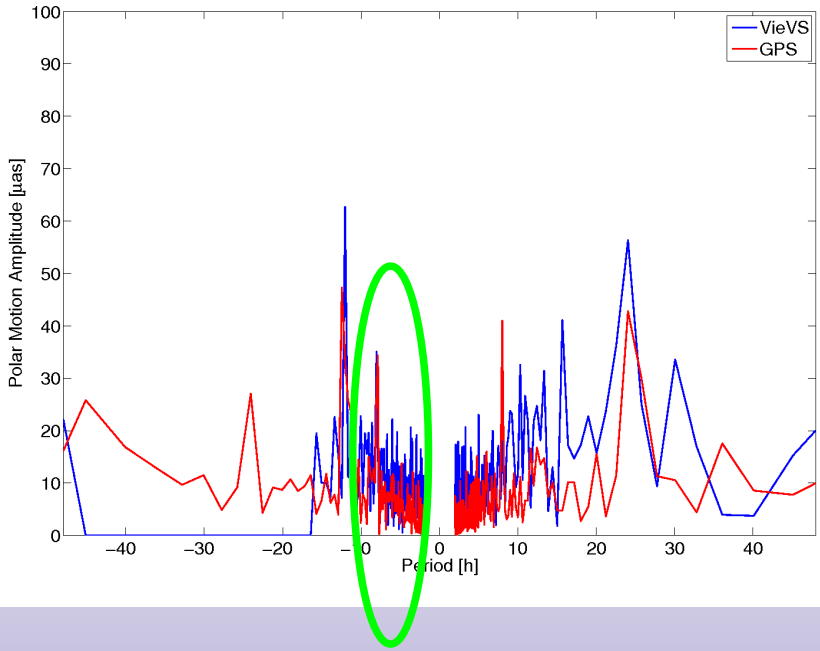
Nutation from CONT08



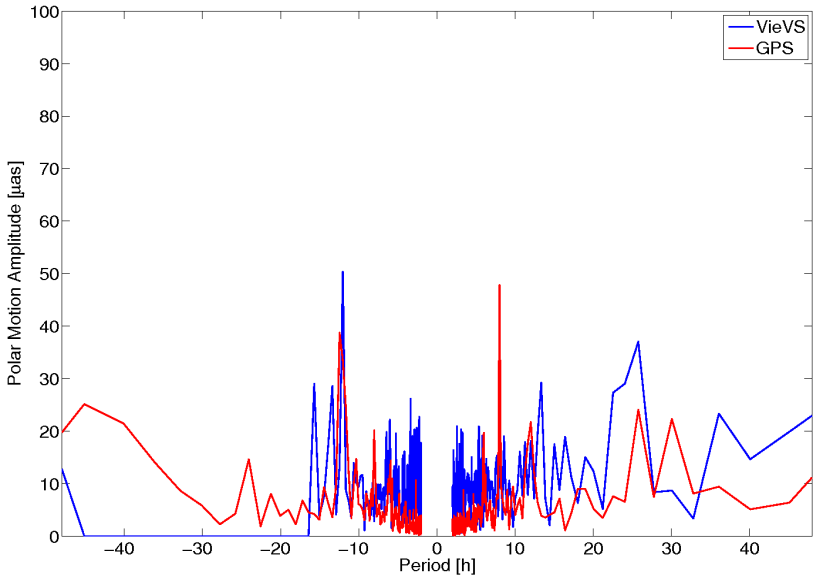
Polar motion residual spectrum, CONT08



Polar motion residual spectrum, CONT05 and CONT02



CONT02



CONT05

Conclusions

- VieVS have been used successfully for estimating high frequency EOP
- Results agree very well with Calc/Solve results and well with GPS results
- A special MATLAB script was used for the stacking of the normal equations. This could also have been done using VIE_GLOB