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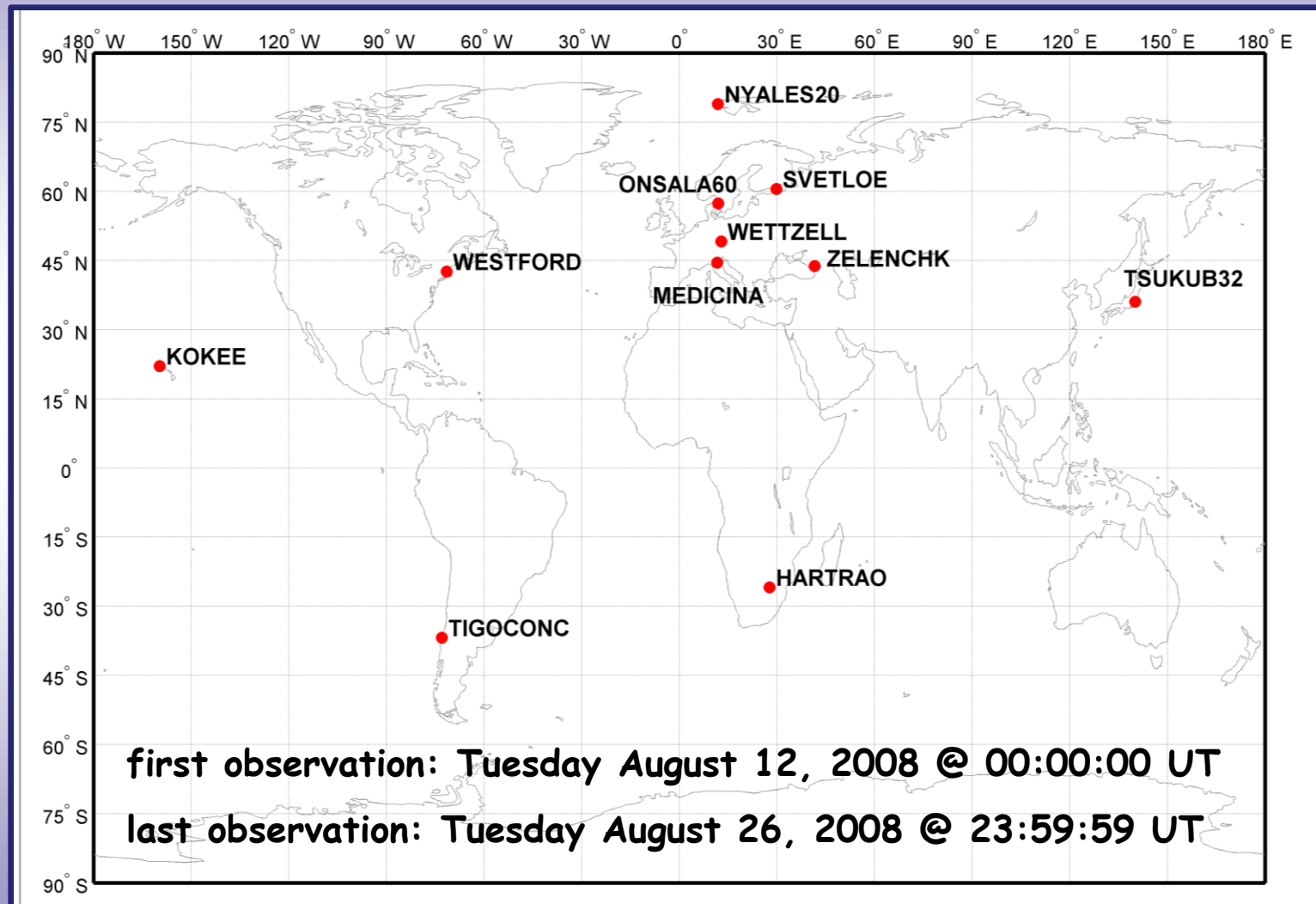
Troposphere Zenith Total Delays (ZTDs) from IVS-CONT08 Sessions

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CONT08 VLBI NETWORK



Troposphere Delay

$$\Delta L = 10^{-6} \int_0^{H_{trop}} [N_h(s) + N_w(s)] ds$$

$$\Delta L(\alpha, \varepsilon) = ZHD m_h(\varepsilon) + ZWD m_w(\varepsilon) + m_{h,w}(\varepsilon) \cot(\varepsilon) [G_n \cos(\alpha) + G_e \sin(\alpha)]$$

Davis et al., 1993; Chen and Herring, 1997

$$m_{h,w}(\varepsilon) = \frac{1 + \frac{a_i}{1 + \frac{b_i}{1 + \frac{c_i}{1 + \dots}}}}{\sin(\varepsilon) + \frac{a_i}{\sin(\varepsilon) + \frac{b_i}{\sin(\varepsilon) + \frac{c_i}{\sin(\varepsilon) + \dots}}}}$$

VMF1, is the state-of-the-art MF that is currently available. VieVS uses this MF for both reducing hydrostatic delay from observations and estimating ZWDs. VMF1 hydrostatic and wet a_i coefficients are computed from the profiles of NWM, ECMWF with a time resolution of 6 hours.

Marini, 1972; Niell, 1996; Böhm et al., 2006

CONT08 Analysis of VieVS (parameterization)

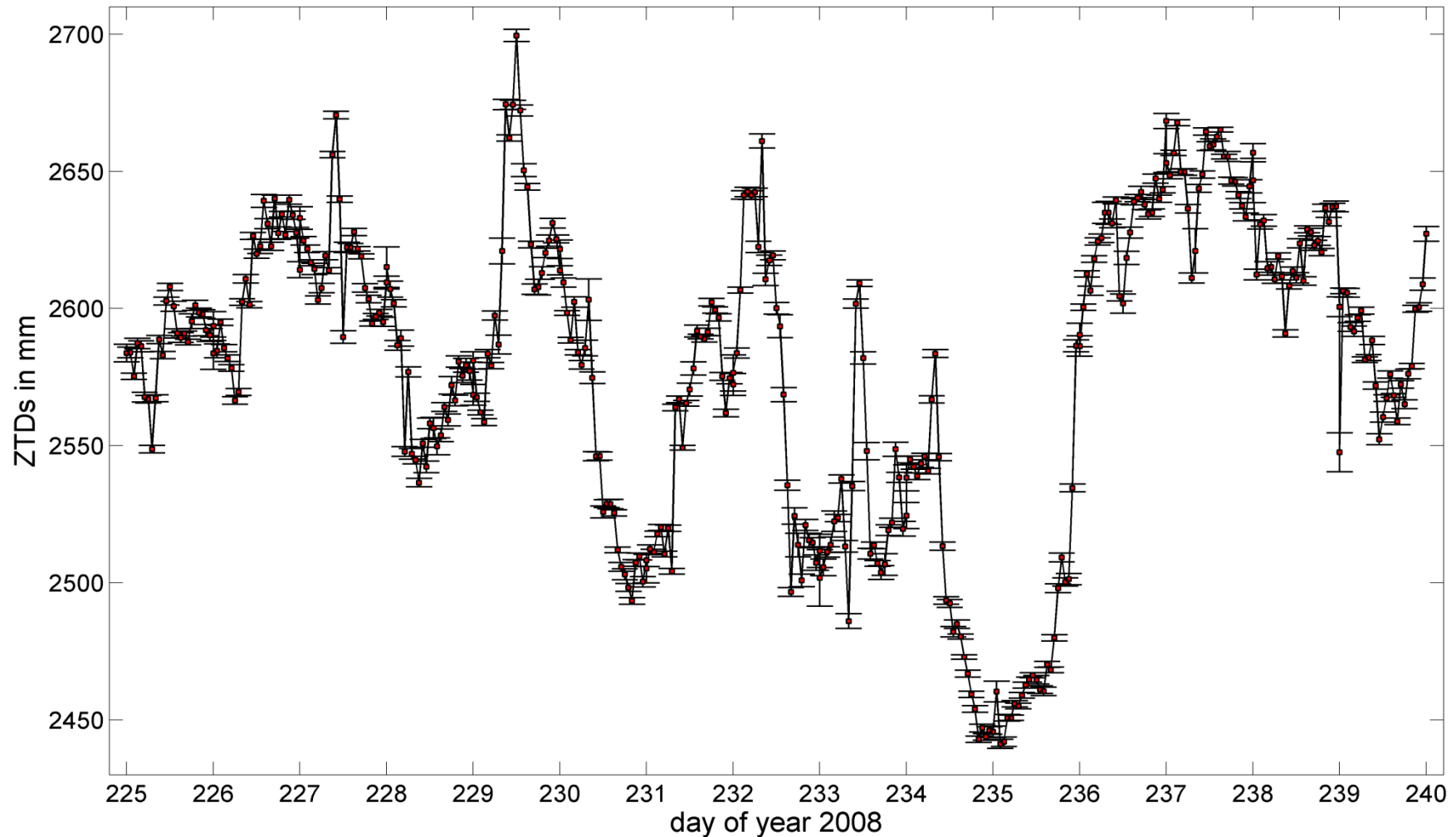
- ▶ **Wettzell clock was fixed** for all 15 sessions of CONT08. Other relative clock errors w.r.t. Wettzell clock were estimated as **pwl offsets at UTC integer hours** in addition to **a rate** and **a quadratic** term. **Relatively loose constraints** ($0.5 \text{ psc}^2/\text{sc}$) were introduced on the estimated pwl clock offsets.
- ▶ Zenith wet delays (ZWDs) were estimated as **pwl offsets at UTC integer hours**. **Relatively loose constraints** were introduced ($0.7 \text{ pcs}^2/\text{sc}$). Zenith hydrostatic delays were computed (Saastamoinen, 1972) and reduced from observations a priori to the adjustment.
- ▶ Troposphere north and east gradients were estimated **at every 3 UTC integer hours**. **Relatively loose constraints** were introduced (2 mm/day).
- ▶ Nutation offsets in celestial longitude and in obliquity were **fixed** to their a priori values (IAU2000A precession-nutation model + IERS 05 C04 combined EOP series).
- ▶ ERPs were estimated as **pwl offsets at every UTC integer hours** in addition to IERS 05 C04 combined EOP series + short period (high frequency) tidal variations. **Relatively loose constraints** (30 mas/day for polar motion, 2 ms/day for UT1-UTC) were introduced.
- ▶ All source CRF coordinates were fixed to ICRF2.
- ▶ All antenna TRF coordinates were **fixed to VTRF2008** (including Zelenchukskaya) but **only Wettzell** coordinates were estimated as **pwl offsets at every UTC integer hours**. **Relatively loose constraints** were applied (150 mm after one day) on the Wettzell pwl coordinate offsets.

Creating SINEX Troposphere output files

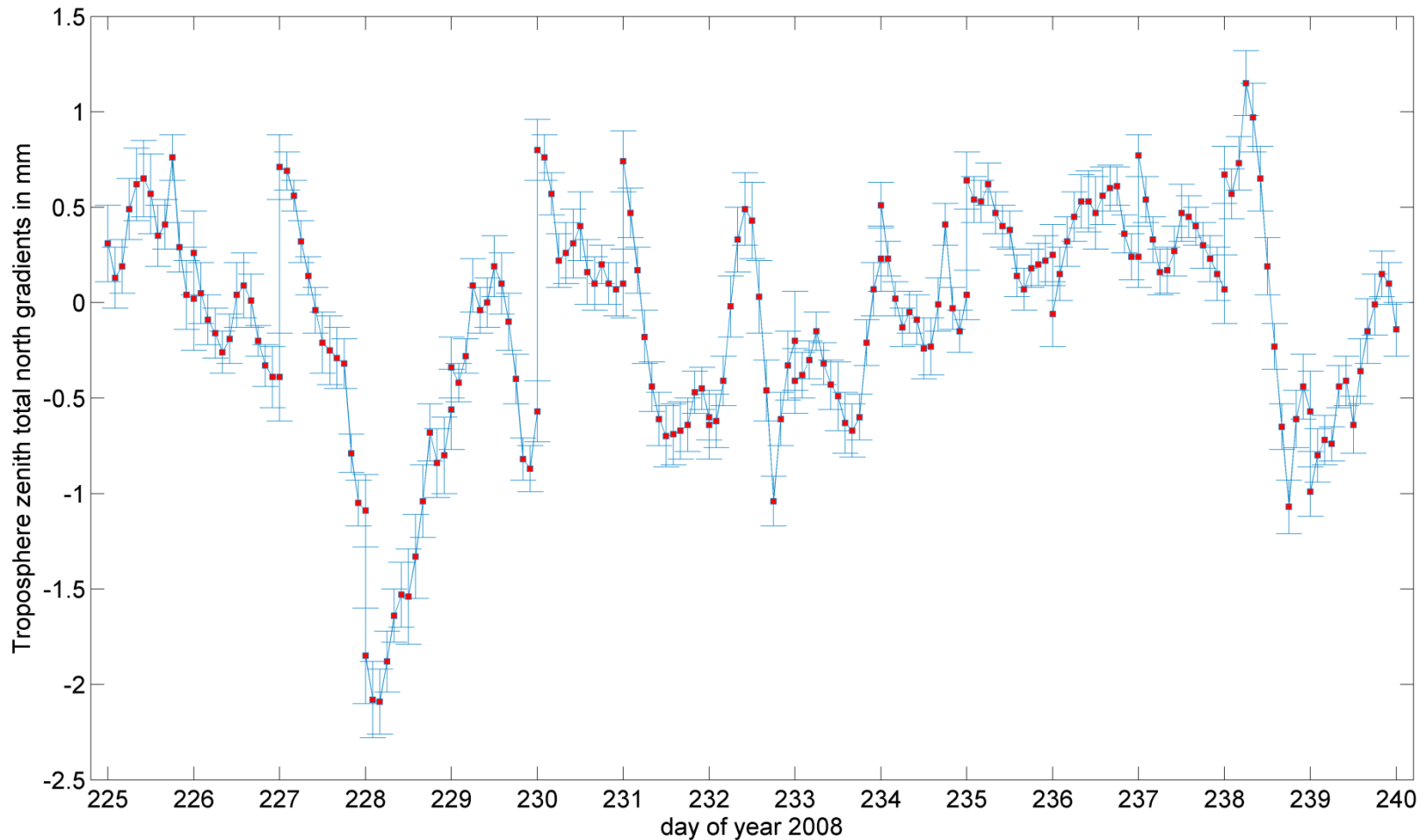
- ▶ **/VieVS/OUT/tropo_sinex.m** (1)
- ▶ update (1) via ftp
- ▶ run (1) just after processing CONT08 sessions. Consider, (1) reads
 - **'VieVS/WORK/runp.mat'** (the name of the output directory in **/LEVELX** created by the user before processing VieVS)
 - and
 - **'VieVS/WORK/process_list.mat'** (the last list of the session names that were processed with VieVS).
- ▶ For each session separate ASCII files are created (**session_name.tropo**) in the same directory (**/VieVS/OUT**). ZTDs, ZWDs, troposphere east and north gradients are written.
- ▶ The functions of (1) file are
 - **tropo_header.m**
 - **tropo_solution_block.m**

or directly parameter vector can be loaded from:
'/VieVS/DATA/LEVEL3/USER_DIR/x_fname.mat'.

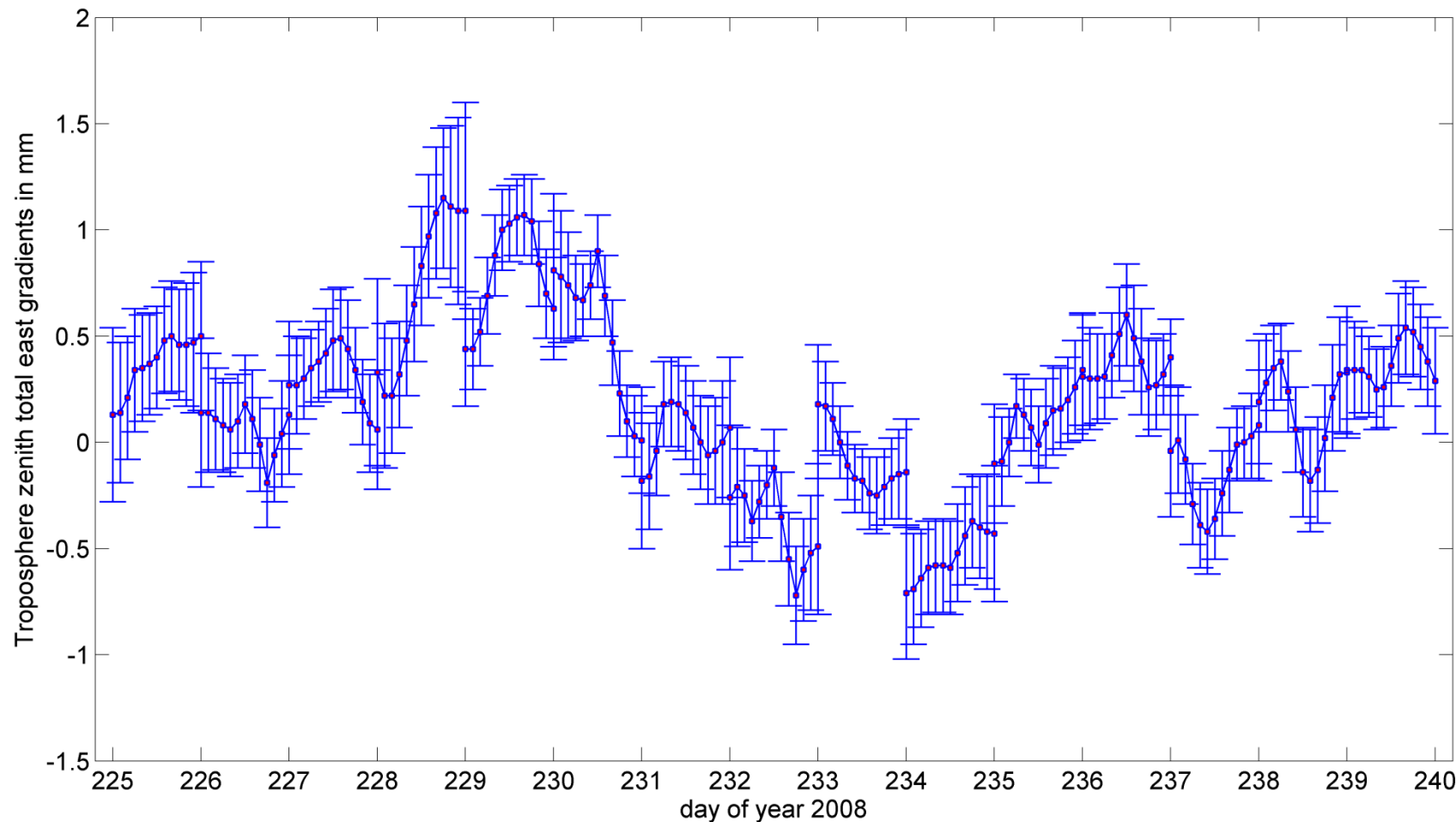
VieVS **ZTDs** and **formal errors** at Tsukub32 (Japan) during CONT08



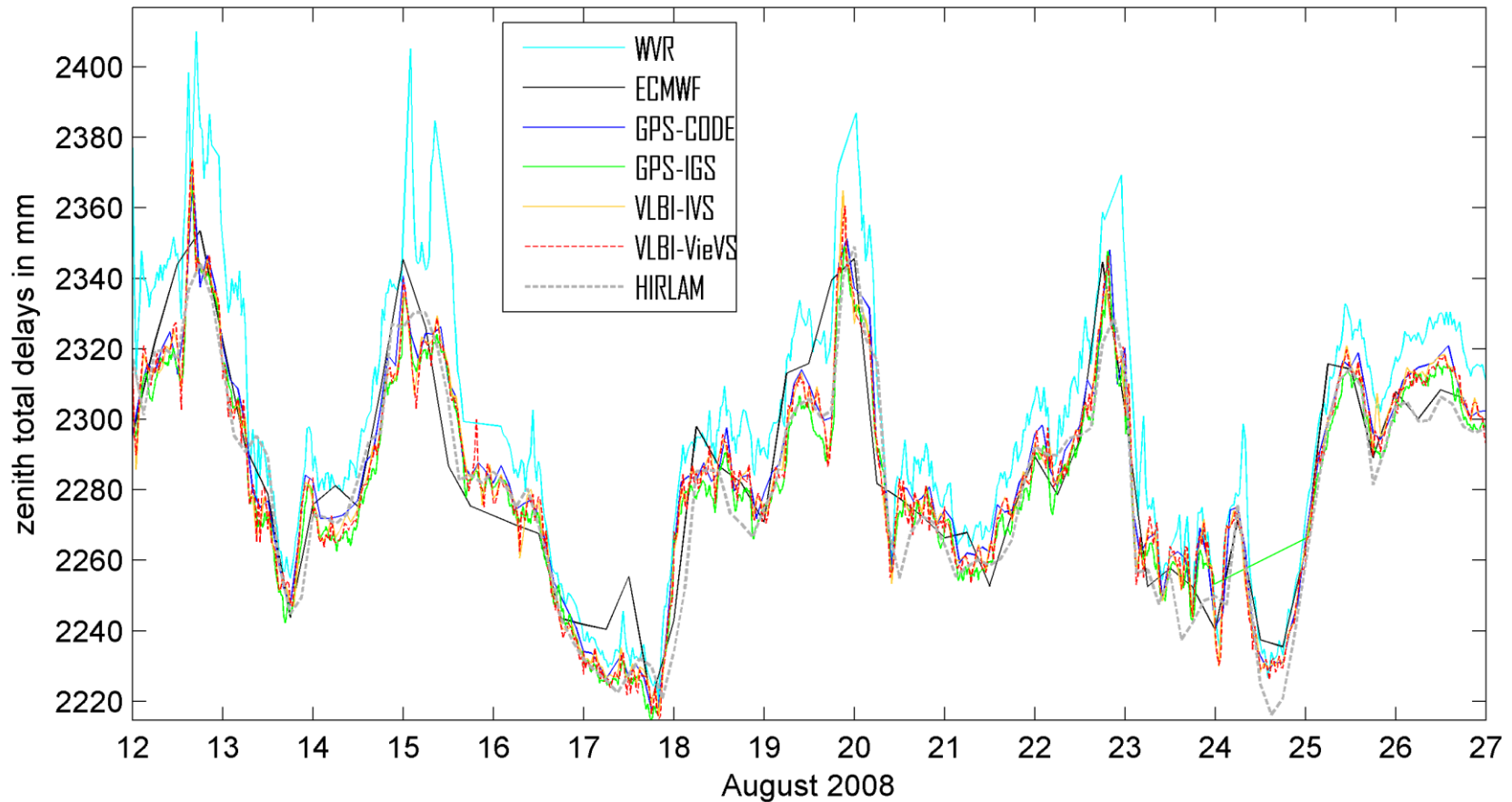
VieVS troposphere **north total gradients** and **formal errors** at Westford (USA) during CONT08



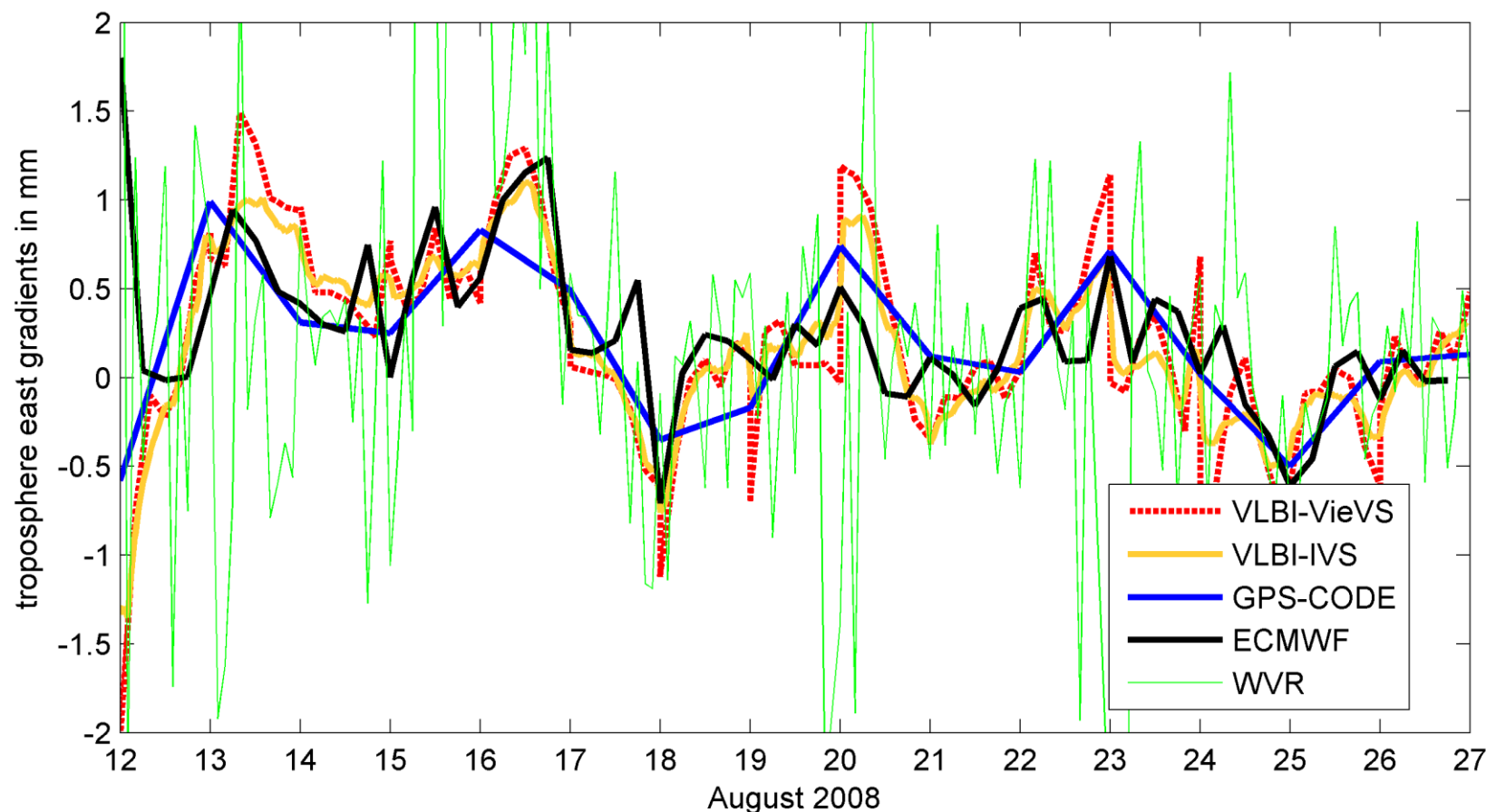
VieVS troposphere **east total gradients** and **formal errors** at Hartrao (South Africa) during CONT08



Comparison of **ZTDs** between different techniques at Wettzell (Germany) during CONT08 (IGS antenna: WTZR)



Comparison of troposphere east gradients between different techniques at Wettzell (Germany) during CONT08



Conclusions

-  The largest error exists in the observations of space geodetic techniques that can not be fully modeled is the troposphere delay. However, the most up-to-date models are used e.g. VMF1, pwl offset function in VieVS.
-  Several comparisons of VieVS troposphere results (ZWDs and troposphere gradients) show us a good agreement between the estimates of other techniques (GNSS, IVS-Combined, DORIS, WVR, NWMs: e.g. ECMWF, CreSS, HIRLAM, KARAT)
-  Formal errors of Wettzell hourly estimated ZWDs and antenna TRF coordinates at the same UTC epochs during CONT08 show us statistically significant strong positive correlations in radial and east directions whereas statistically significant weak correlations in north direction.

Thank you so much for your
attention !