Assessing the quality of WVR data from Onsala during the CONT11 geodetic VLBI campaign

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[1]WVR data analysis, [2]VLBI data analysis (data bases from the VLBI group in Leipzig), [3]GPS data analysis [4]Coordination/presentation

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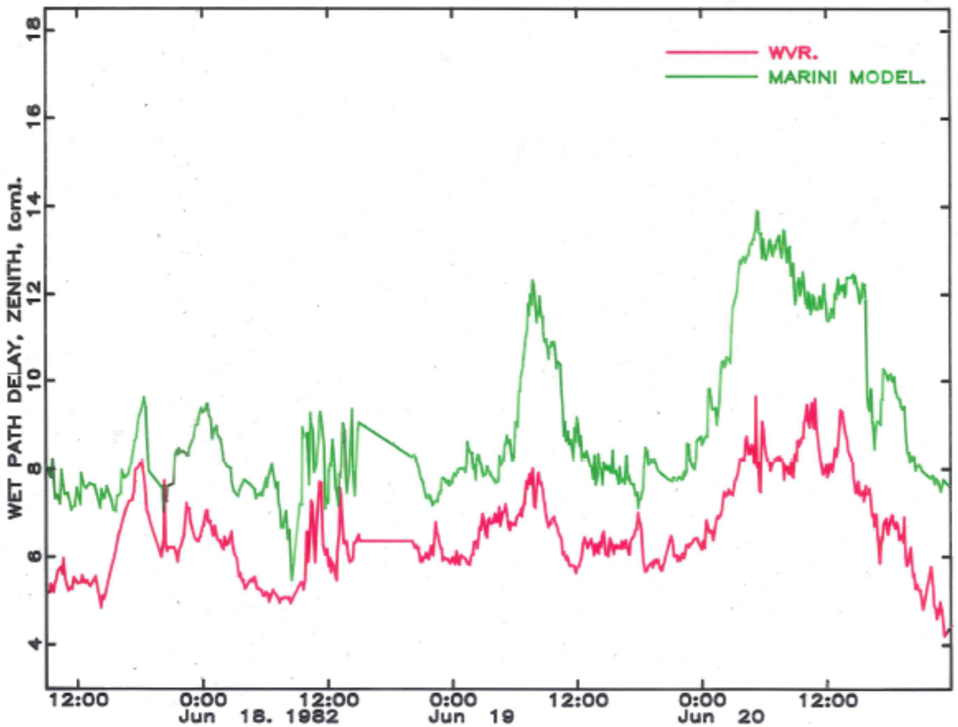
Structure of presentation

- Background: the role of Water Vapour Radiometers (WVRs) in geodetic VLBI
- Instrumentation used during CONT11
- Preliminary results of comparisons for selected time periods
- Conclusions and outlook

During the 80:ies we had the goal to use WVRs as independent calibrators

Example of a WVR–Marini/Saastamionen model comparison from a geodetic VLBI experiment in 1982



The Marini/Saastamoinen model uses ground meteorology data only.

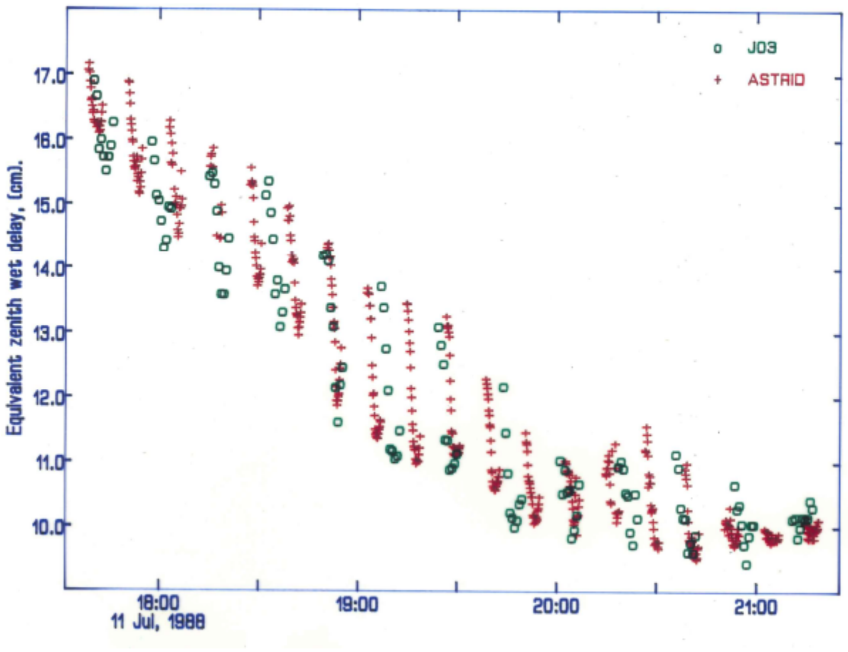
When using the model one or a few atmospheric parameters where estimated per station for a 24 h long experiment.

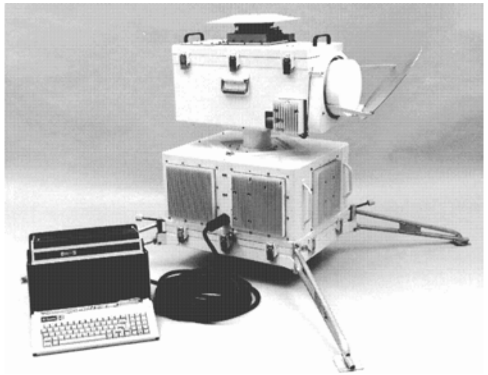
WVR impact on VLBI results:
Elgered et al. 1991, J. Geophys. Res.
Kuehn et al. 1991, Radio Science

During the 90:ies the comparison methods were refined to include horizontal gradients

NASAs WVR J03 visited Onsala in the summer 1988:

systematic azimuthal dependence was observed





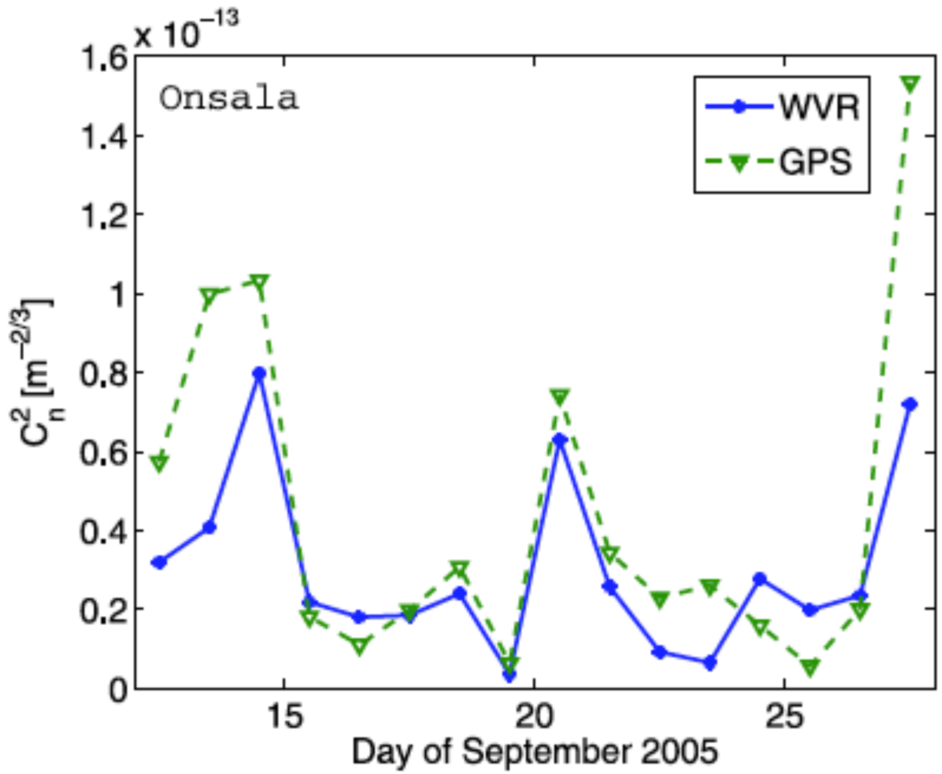
Description of model:

Davis et al. 1993, Radio Science

Impact on VLBI data analysis:

MacMillan 1995, Geophys. Res. Lett.

Turbulence parameters can be estimated from WVR (and GPS) observations and included in the VLBI analysis as constraining parameters



WVR and GPS data were used during the CONT05 experiment to estimate the strength parameter for atmospheric turbulence C_n^2

Details in: Nilsson and Haas, 2010, J. Geophys. Res.

Additional instrumentation for assessment of the wet delay at Onsala from VLBI during CONT11

Astrid

21.0 and 31.4 GHz

~ 6° beam widths

Accuracy ~ 1 K

Konrad

20.65 and 31.6 GHz

~ 3° beam widths

Accuracy ~ 1 K

ONSA (IGS site)

IGS site ONSA

GIPSY PPP

10° elevation cutoff

Antenna PCV corrections

Pros and cons of methods for validation of VLBI atmosphere results

WVR:

+ Measurement in any specific AZ and EL angle (EL > 18°)

– Inaccurate (to useless) when raining or large drops of water in the antenna beam

GPS:

+ Almost insensitive to liquid water drops (and rain)

– Smoothing process applied in the estimation of the Zenith Total Delay (ZTD) — limits the temporal and angular resolution

Rain measuring devices used

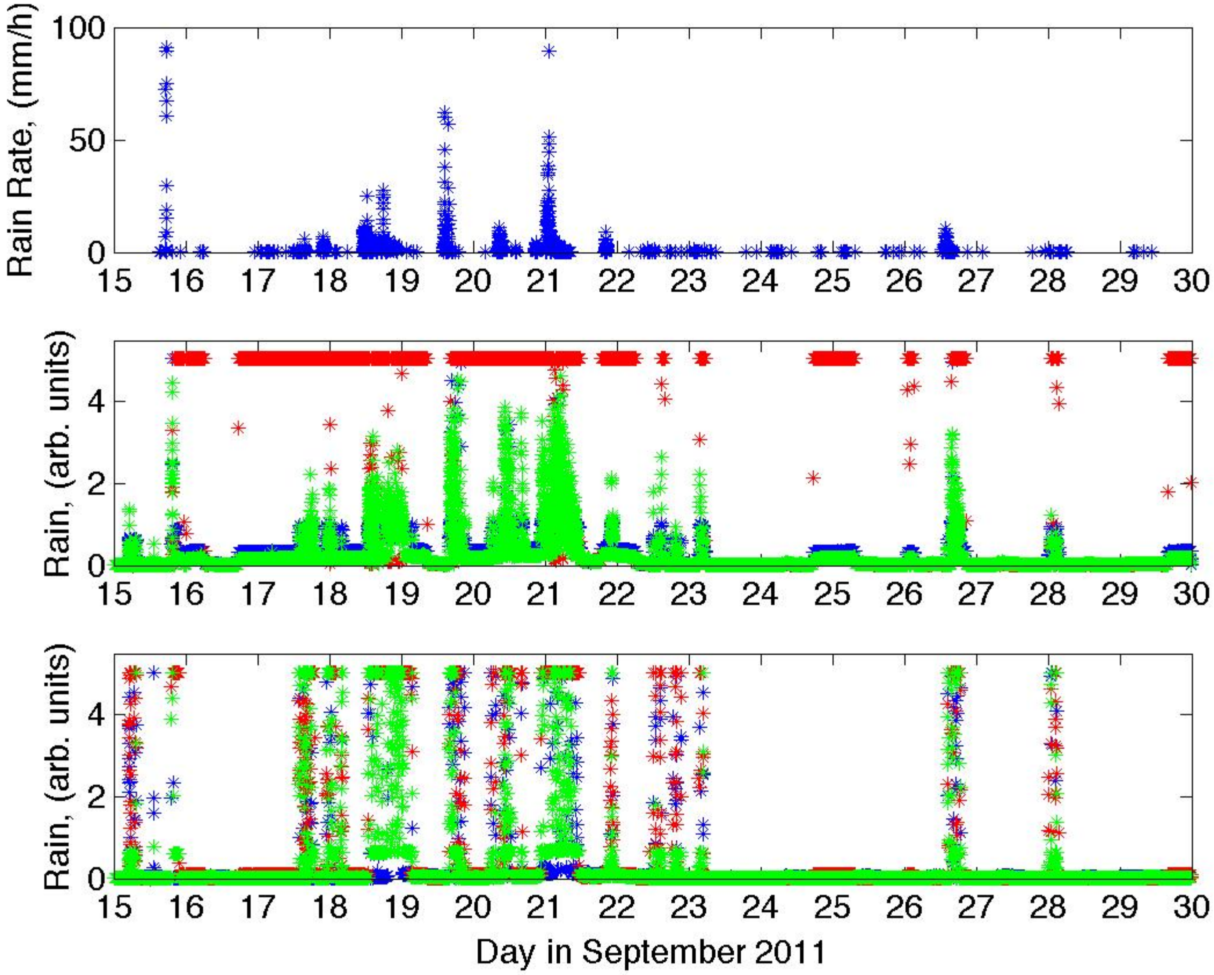
Three capacitive liquid drop detectors

Three infrared liquid drop detectors

Rain radar: zenith looking continuous Doppler (Metek)

When did it rain?

An overall impression from all rain sensors during CONT11

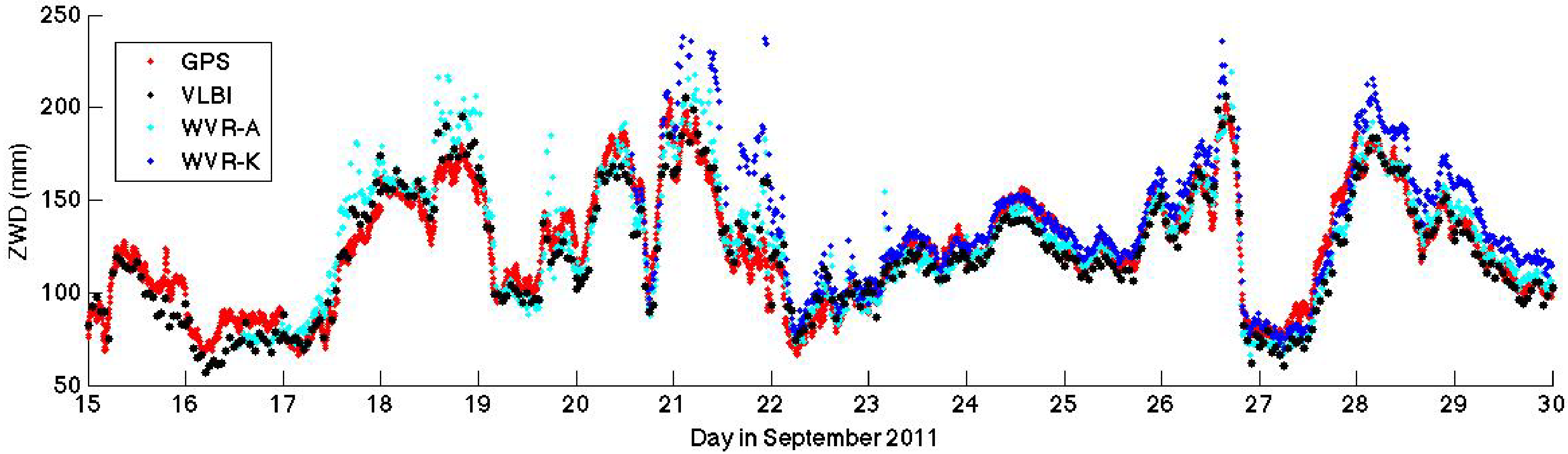


Rain radar

IR-sensors
Red – condensation
Green – rain rate
Blue – heavy rain

Capacitive sensors
Detects water on
the sensor surface

Zenith Wet Delay during CONT11



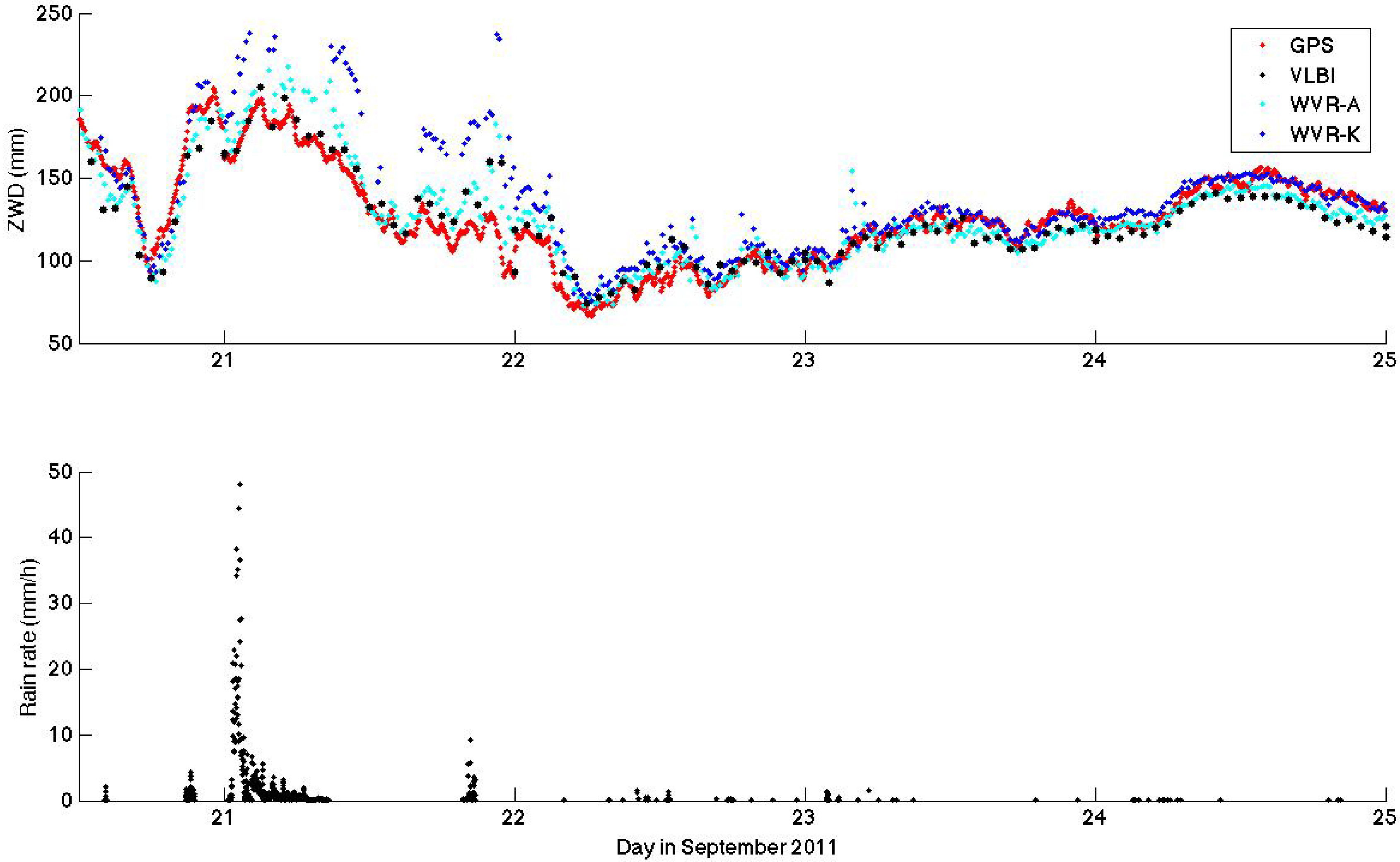
VLBI, one data gap (1.5 h) on Sep. 25

GPS, continuous time series

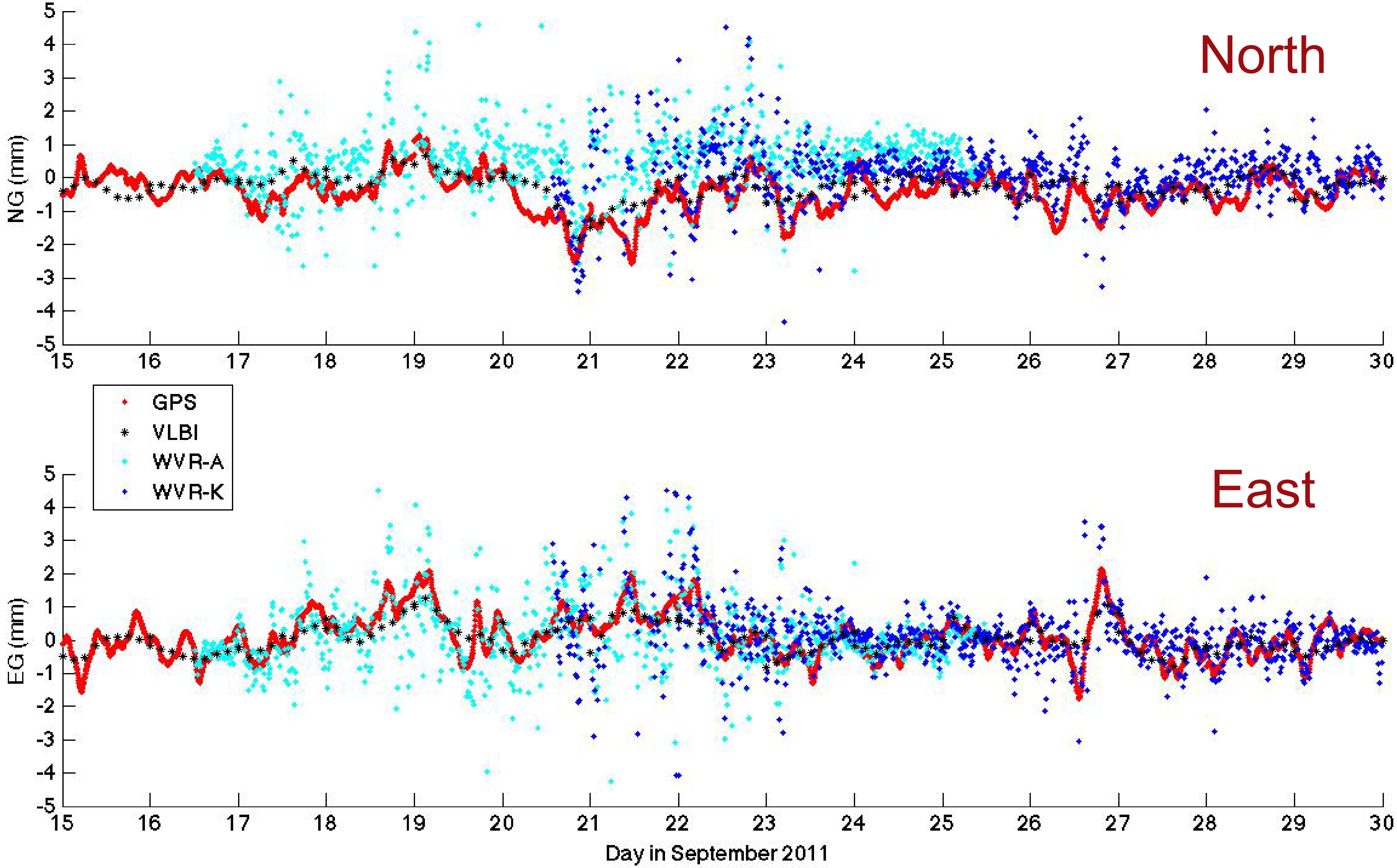
WVR–Astrid, full sky coverage | EL scans only

WVR: Konrad, full sky coverage

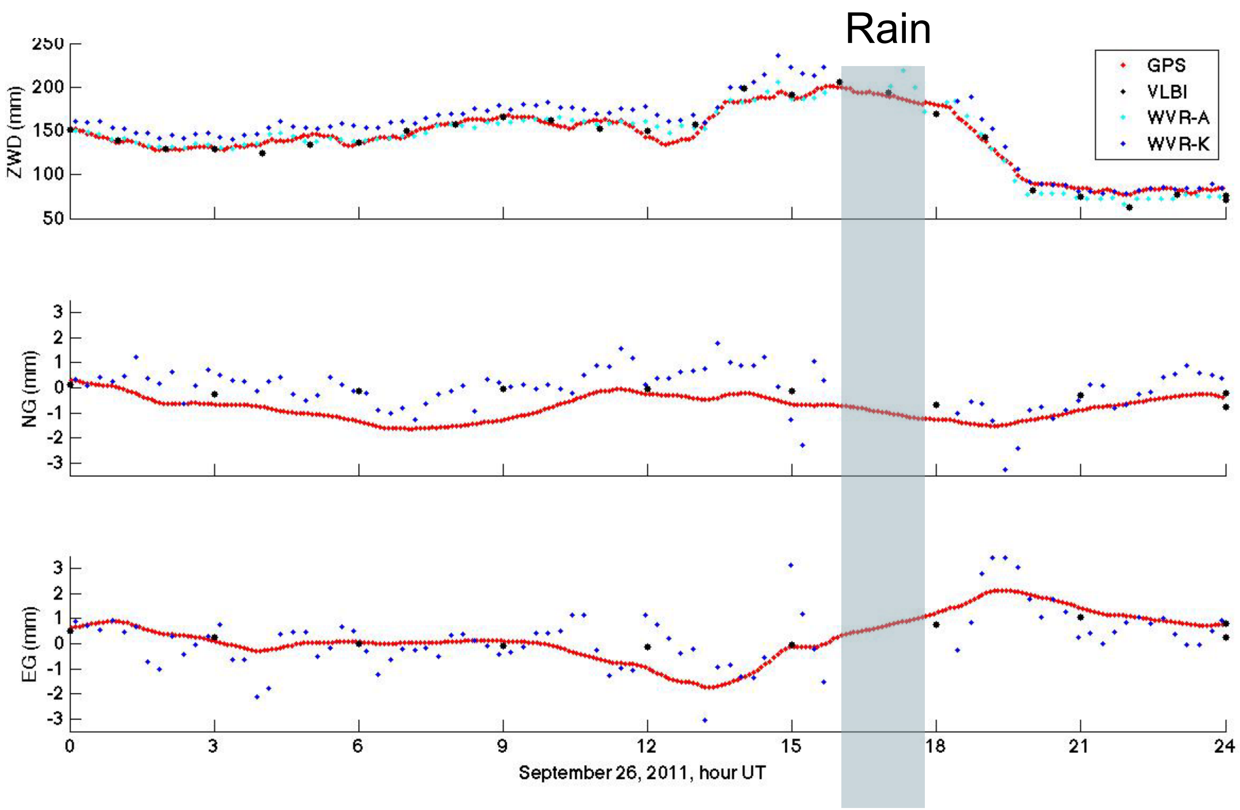
Zoom in on days when all sensors are active

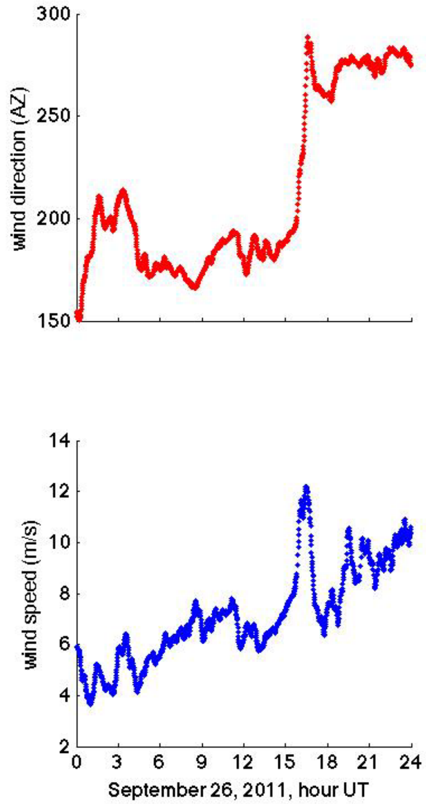


Estimated linear horizontal gradientes



Zoom in on large decrease in ZWD (Sep. 26)





Conclusions and outlook

The atmosphere at Onsala during CONT11 was (as usual) influenced by moving air masses with different moisture contents.

Careful assessment and editing of WVR data using independent rain information remains.

In order to study short term and small scale atmospheric variations the WVR beam widths must be considered.

A new WVR for Onsala is under consideration.