



POSITIONING AND APPLICATIONS

4.0	ANNOUNCEMENT		RINEX VERSION / TYPE
POSITIONING AND APPLICATION SYMPOSIUM		IAG COM. 4	EVENT NAME / AGENCY
WUELS	WROCLAW	POLAND	LOCATION / CITY / COUNTRY
2016 09 04	2016 09 07		TIME START / END
51.11283 17.063761 3835751.626	1177249.744	4941605.054	APPROX POSITION B / L / XYS
1 Emerging Positioning Technologies			SESSION NO / TOPIC
2 Geospatial Mapping and Engineering Applications			SESSION NO / TOPIC
3 Atmosphere Remote Sensing			SESSION NO / TOPIC
4 Multi-Constellation GNSS			SESSION NO / TOPIC



GNSS-derived IWV using G-Nut/Tefnut vs. radiometer data: a case study

Pawel GOLASZEWSKI*, Pawel WIELGOSZ, Katarzyna STEPNIAK

University of Warmia and Mazury in Olsztyn

**Corresponding author's e-mail: pawel.golaszewski@uwm.edu.pl*

MOTIVATION

- COST ES1206 Benchmark Campaign dataset.
- Validation of GNSS derived ZTD and IWV by comparing it to the microwave radiometer data.
- Testing the software capabilities for future research and applications.

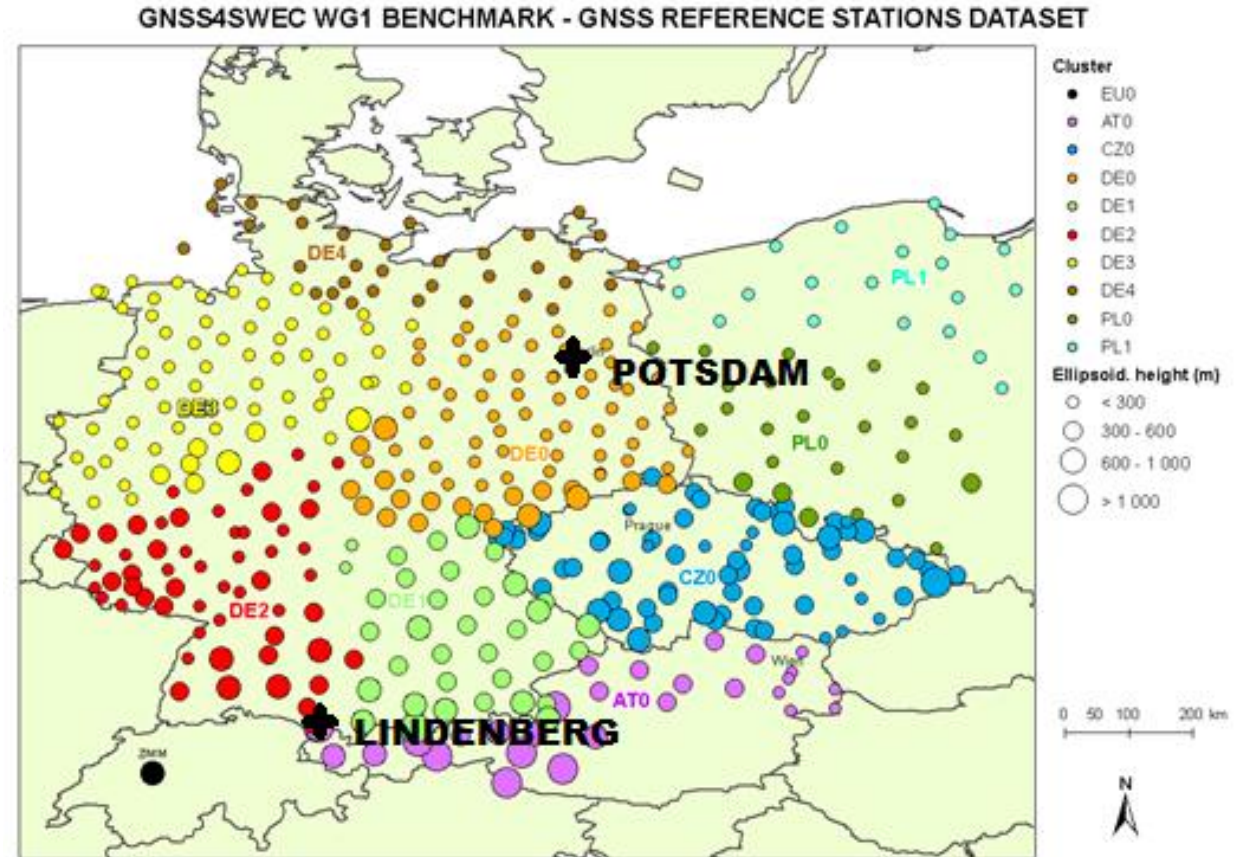
Microwave radiometer

- Two microwave radiometers are located in POTSDAM and LINDENBERG.
- High quality IWV data.
- Benchmark for the GNSS-derived ZTD/ZWD estimates.



Case study

- Data was collected from COST ES1206 Benchmark Campaign repository.
- Two radiometers from benchmark: POTSDAM and LINDENBERG.
- 26 days: 29.05 – 23.06.2013
- Period includes the occurrence of severe weather events.



Data and software configuration

G-Nut/Tefnut processing:

- GNSS data processed in PPP mode.
- IGS final orbit and clock corrections.
- Troposphere a priori model – GPT.
- Time interval – 5 min.

IWV conversion:

$$\bullet \text{ IWV} = \frac{ZWD}{10^{-8} \left(k_2' + \frac{k_3}{T_m} \right) R_w}$$

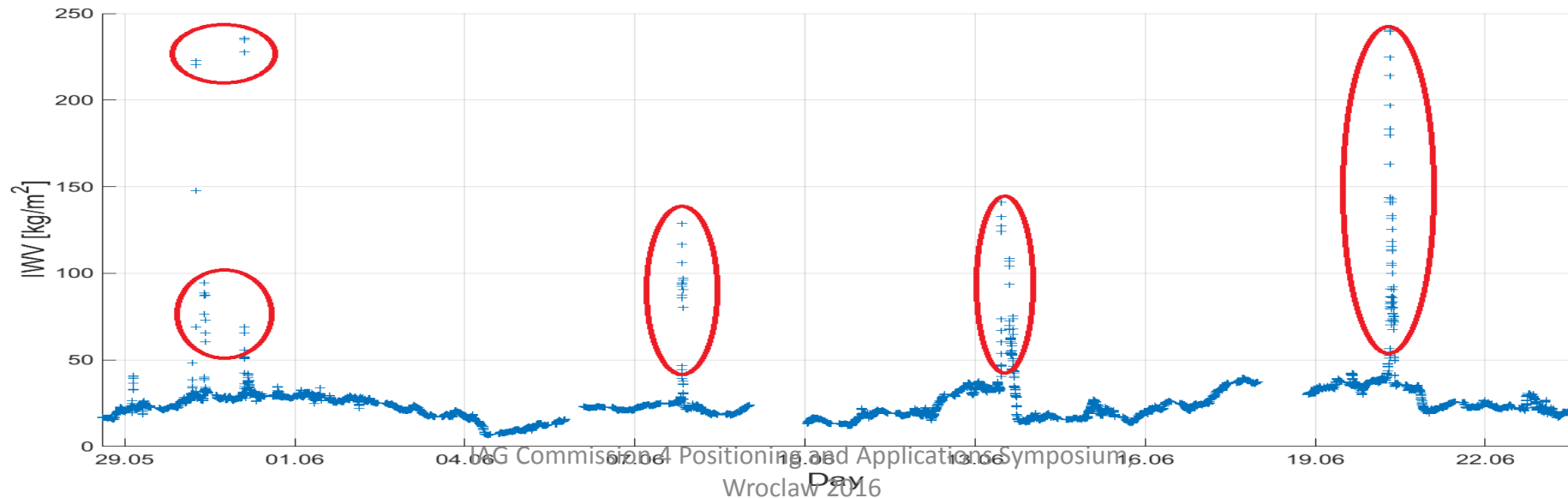
- Refraction index from Bevis et al.(1992)

Reference data:

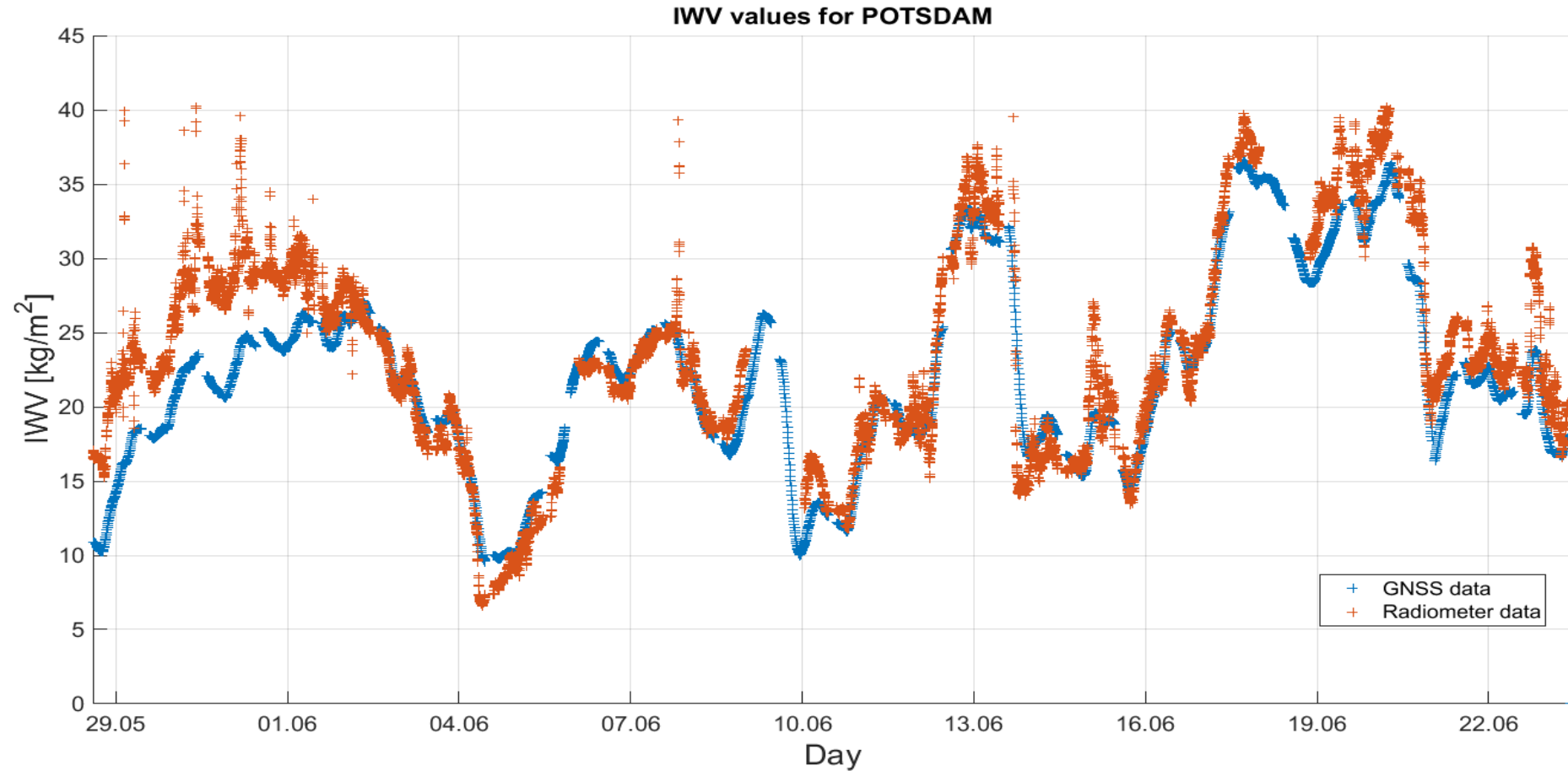
- Potsdam time interval – 5 min
- Lindenberg time interval – 10 min

Radiometer data screening

- IWV values for Potsdam and Lindenberg exceeded respectively 200 kg/m² and 300 kg/m².
- Range check – deleting values exceeding 50 kg/m².
- Outliers check – deleting values exceeding (median + 2.5*std).



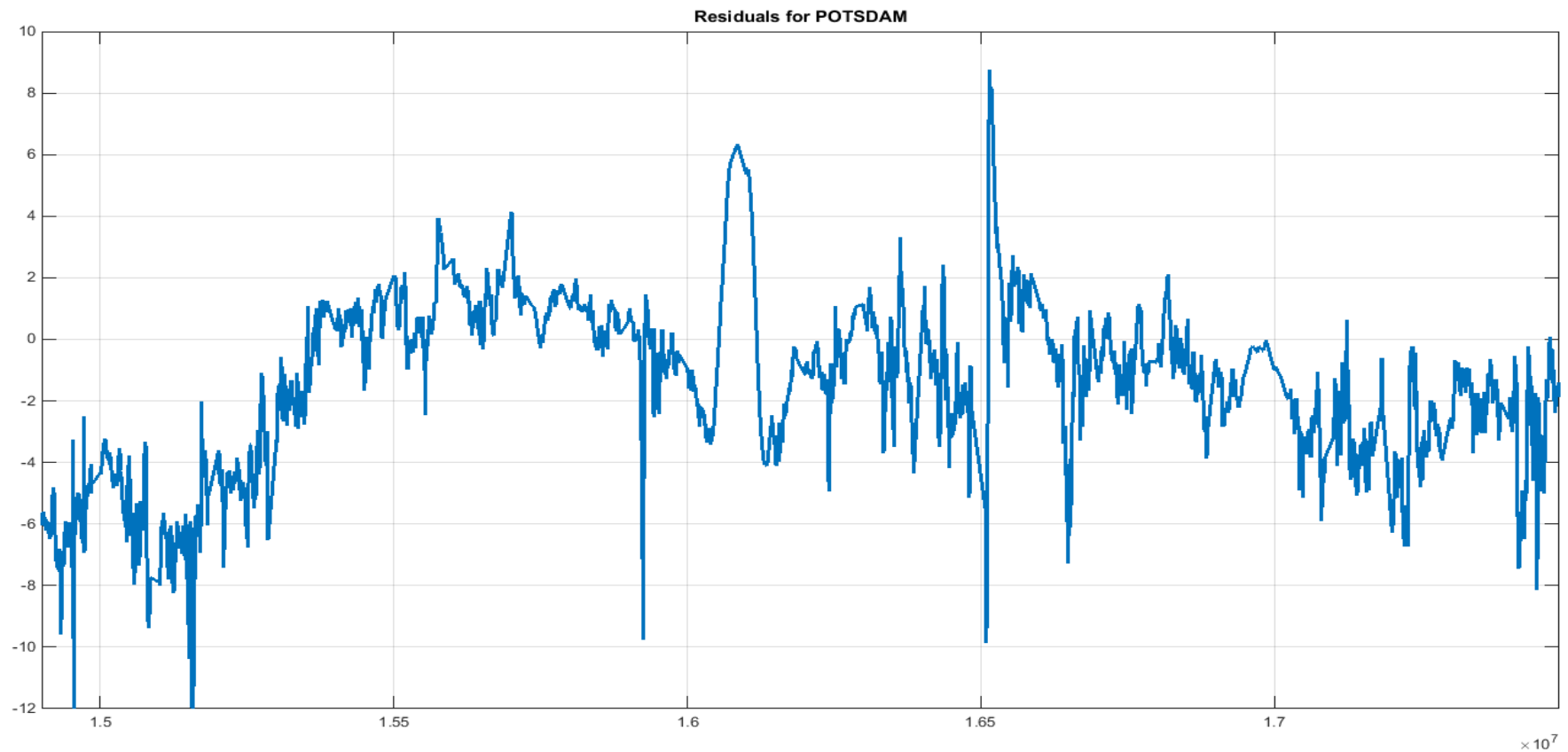
IWV at POTSDAM



Correlation = 92.27%

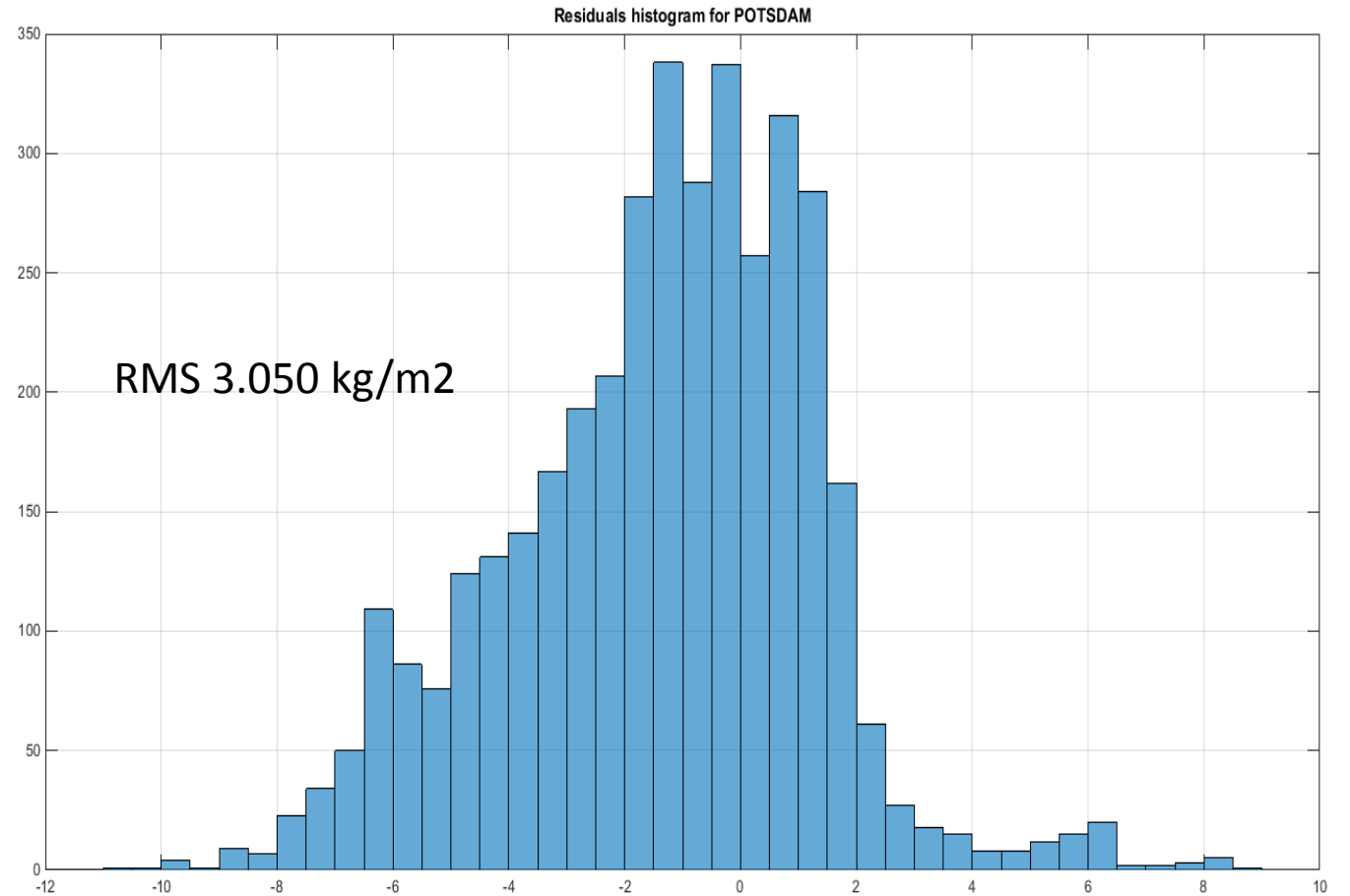
IAG Commission 4 Positioning and Applications Symposium,
Wroclaw 2016

Residuals chart at POTSDAM

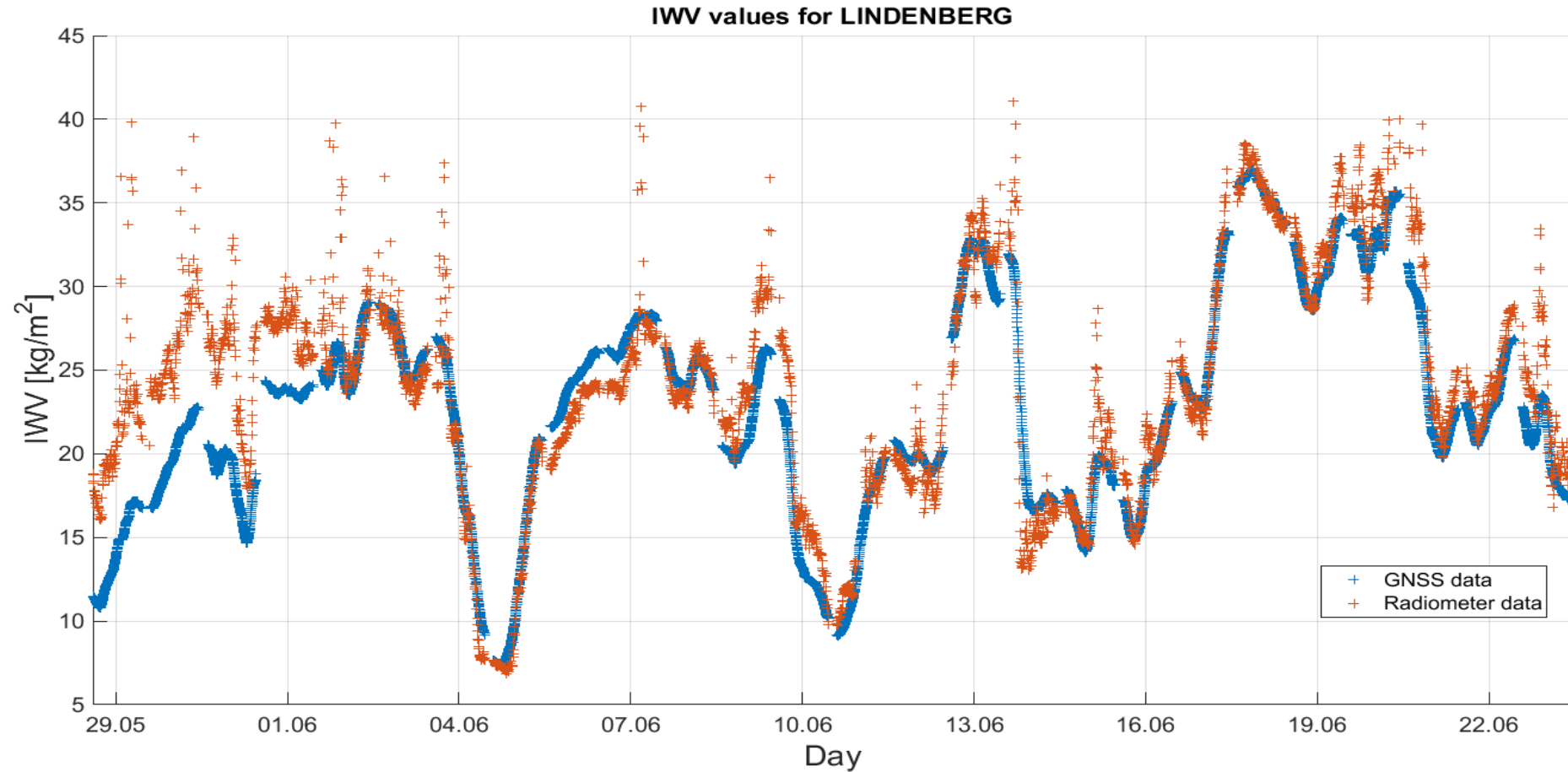


Data statistics at POTSDAM

[kg/m ²]	std	max	min	mean	median
GNSS	6.201	36.595	9.583	21.961	21.799
Radiometer	6.999	39.835	6.650	23.359	22.577
Residuals	2.710	8.759	-23.410	-1.399	-1.089

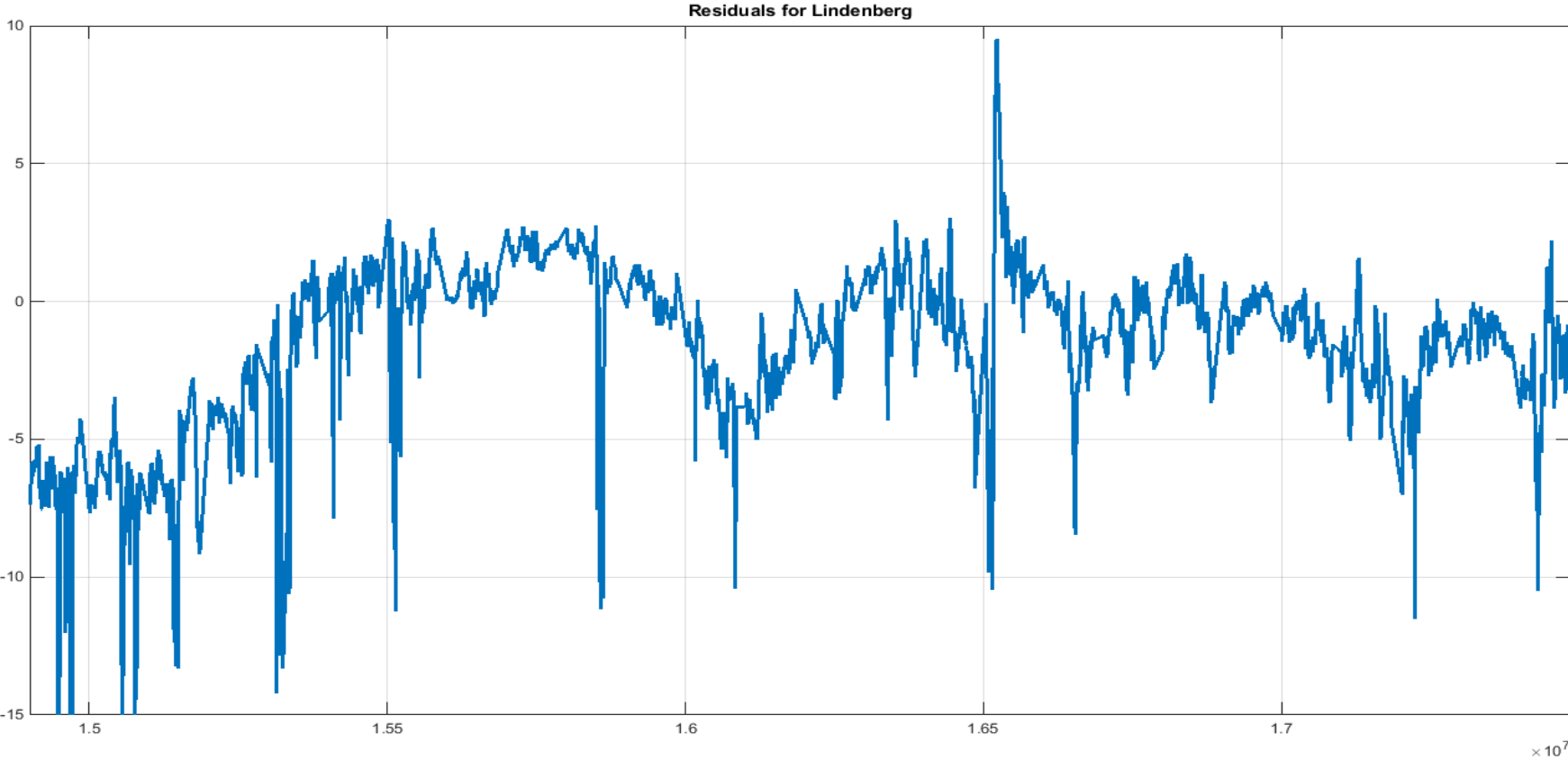


IWV at LINDENBERG



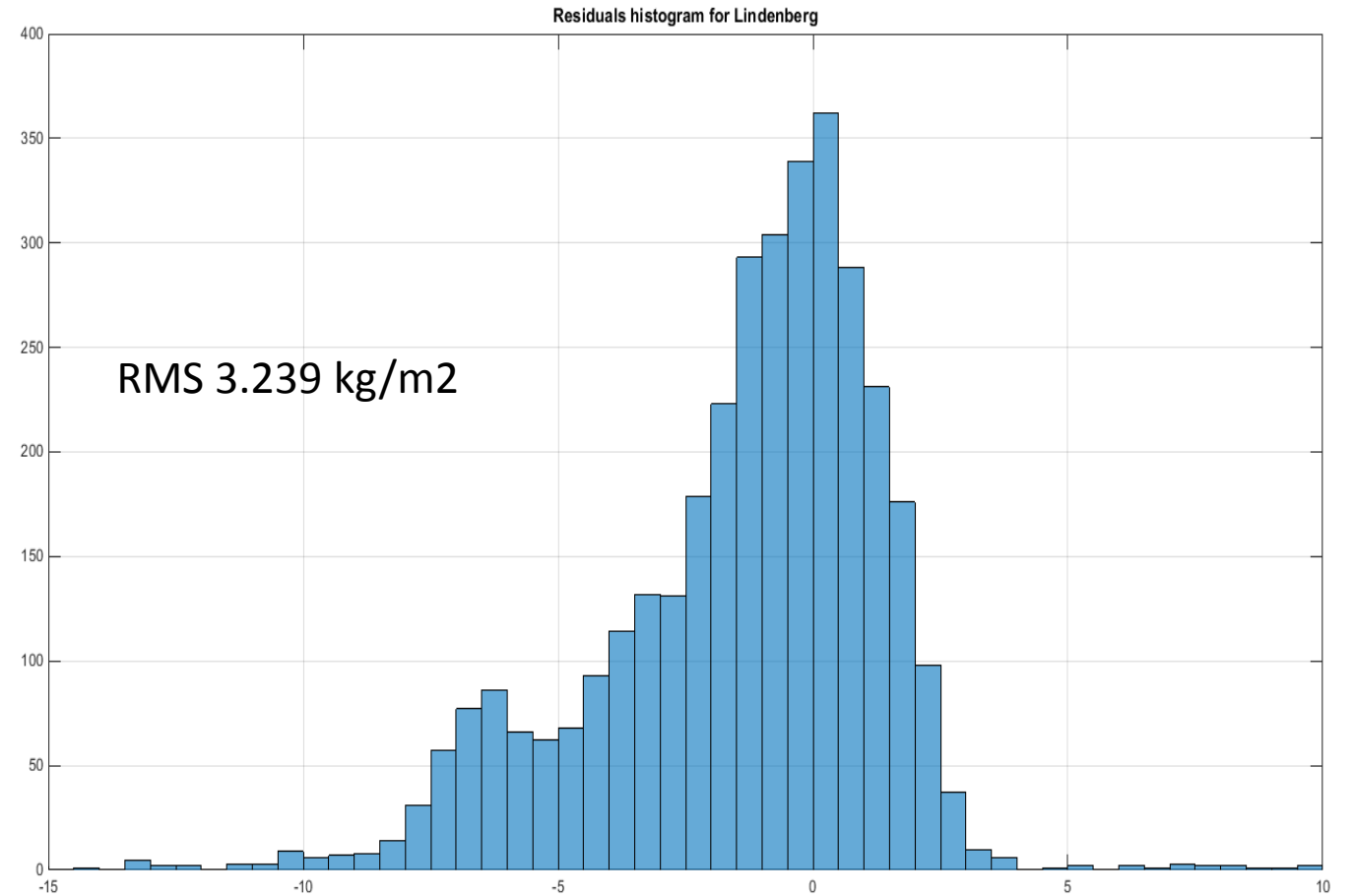
Correlation = 90.36%

Residuals chart at LINDENBERG



Data statistics at LINDENBERG

[kg/m ²]	std	max	min	mean	median
GNSS	6.423	37.073	7.342	22.573	22.671
Radiometer	6.699	41.060	6.860	24.030	23.940
Residuals	2.893	9.516	-22.776	-1.457	-0.845

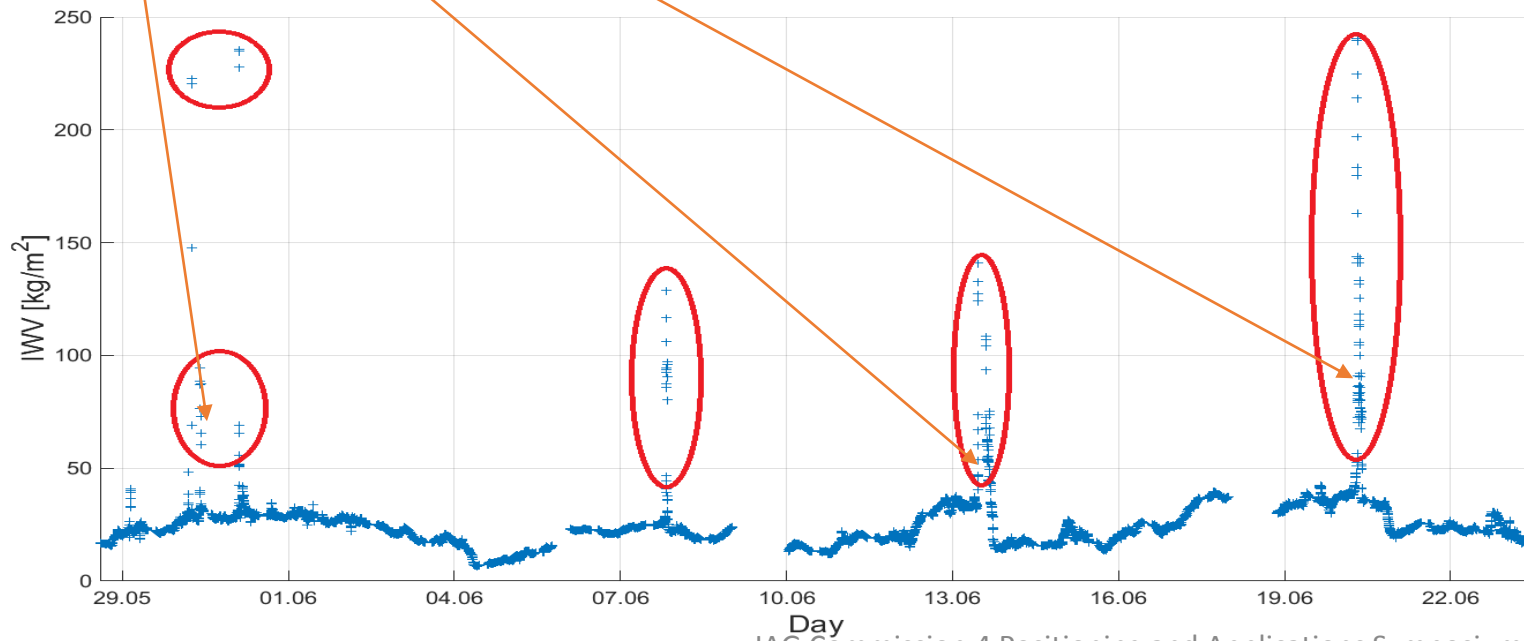


Sensitivity of radiometer

According to historical weather data, the storm events occurred in Berlin i.a.:

- 30.05.2013
- 14-15.06.2013
- 20-21.06.2013

Mostly, these events are correlated with the extremely high values of IWV measured with the radiometer located in Potsdam.



Example link:
https://www.wunderground.com/history/airport/EDDT/2013/6/20/WeeklyHistory.html?req_city=Poczdham&req_state=&req_state_name=Germany&reqdb.zip=00000&reqdb.magic=1&reqdb.wmo=10379

Summary

Conclusions:

- GNSS-derived IWV is highly correlated with the radiometer data, mean residuals do not exceed 8-10%.
- G-Nut/Tefnut software is sufficiently accurate with the ZTD/ZWD estimation for IWV conversion.
- Radiometers have their disadvantages

Plans for future:

- Perspectives for real-time solutions.
- IWV estimates from near real-time PPP solution for Polish network.
- Testing various forecasting methods.

Thank You!

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