# SUGAC: Sofia University GNSS Analysis Center

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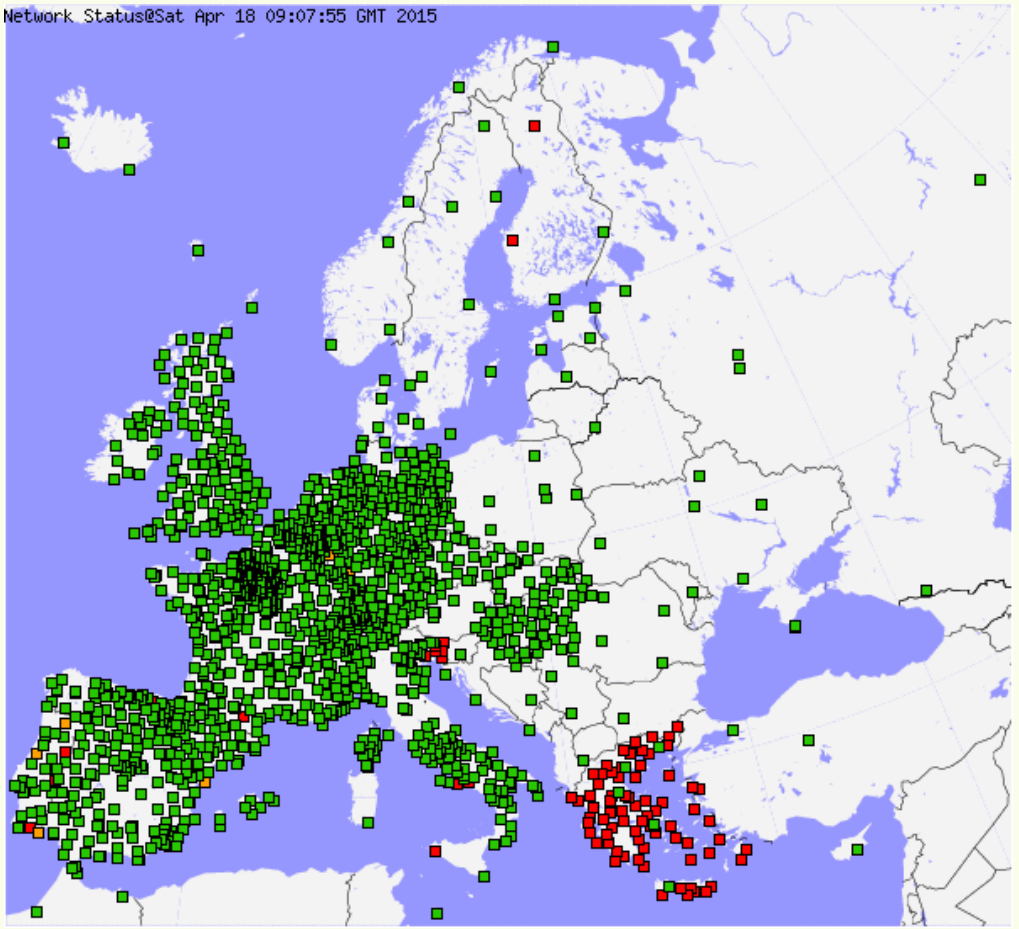
# Motivation

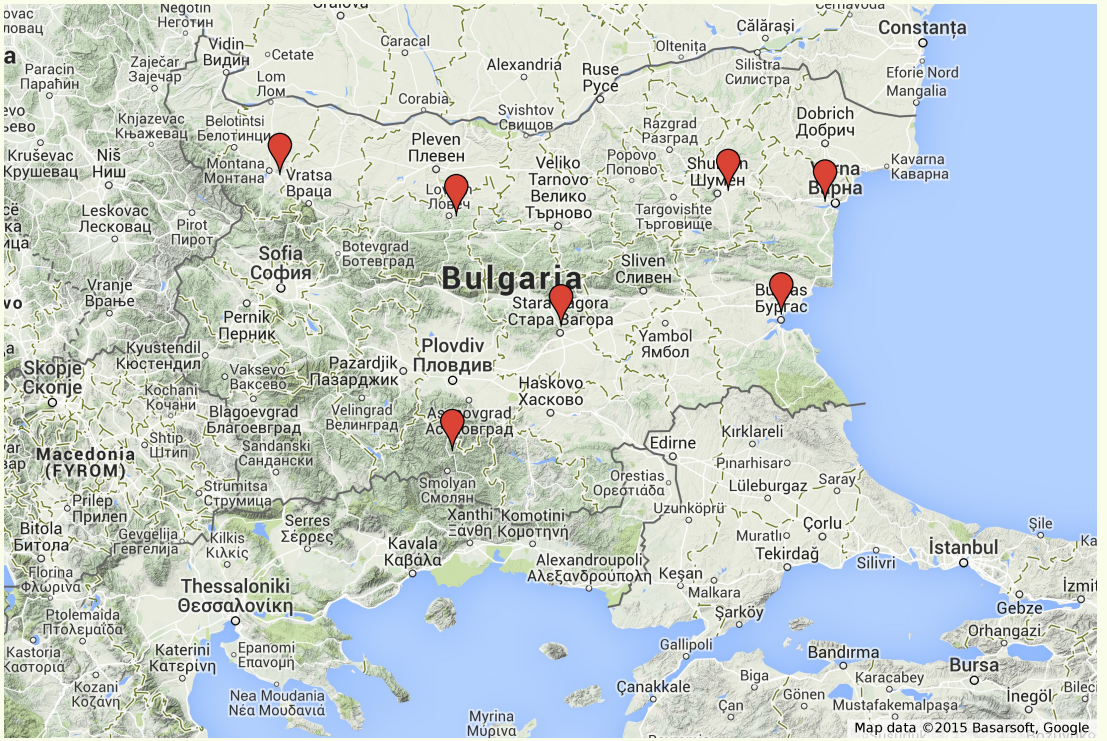
- SUGAC: established in 2013 by the GNSS Meteorology group at Sofia University
- First processing campaign: in collaboration with BuliPOS GNSS network and Prof. N. Teferle, University of Luxembourg
- Long term objective: deliver GNSS tropospheric products in real time for E-GVAP service




*Source: E-GVAP real time processing network (http://egvap.dmi.dk).*

# SUGAC processing campaign: 2013

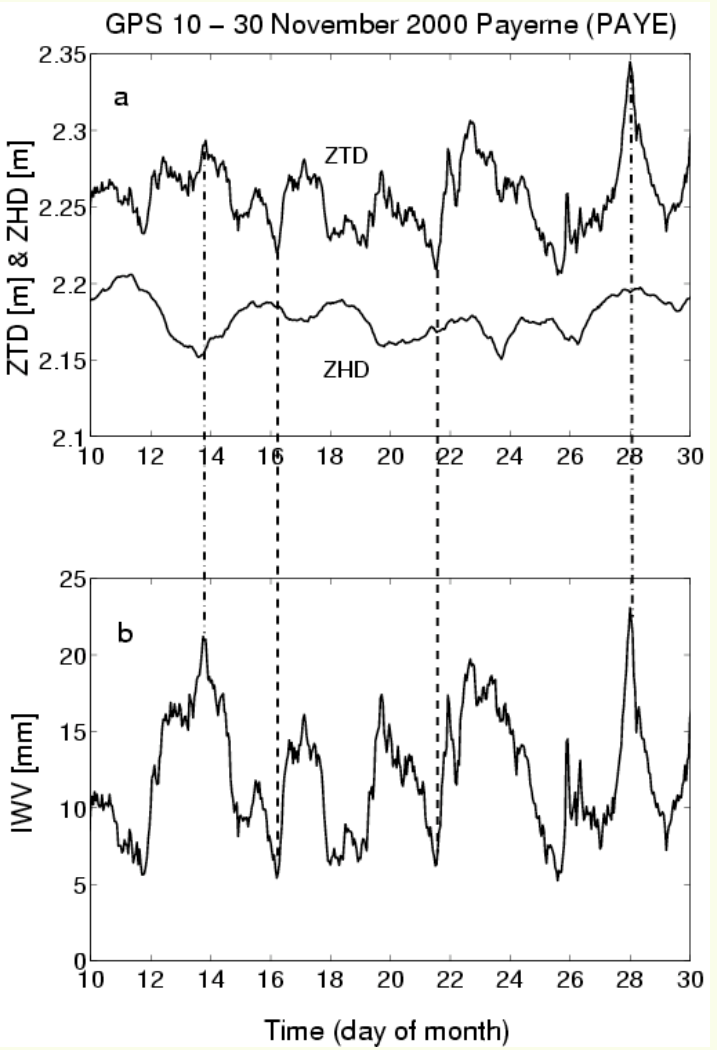
- NAPEOS - GNSS processing software developed by ESA
- Precise Point Positioning (PPP) processing with IGS orbits and clocks
- Global Mapping Function (GMF, Boehm et al., 2006)
- elevation cut-off angle 10°
- Zenith Total Delay (ZTD) temporal resolution 5 minutes




*Source: BuliPOS GNSS network used in SUGAC processing (http://www.bulipos.eu/).*

# GNSS tropospheric products: ZTD, ZHD, IWV

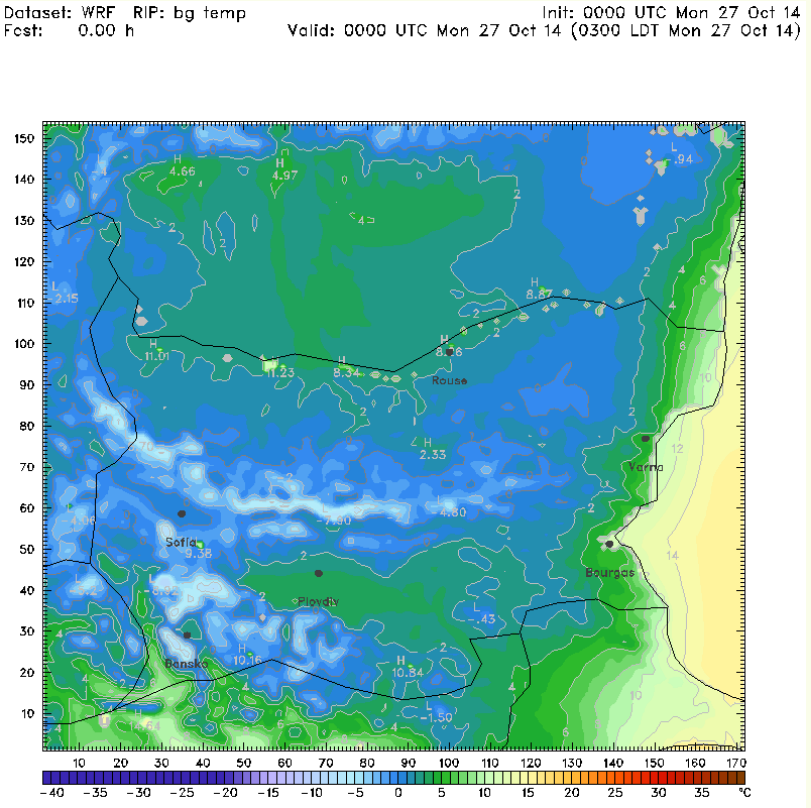
- ZHD and IWV computed from ZTD with surface pressure and temperature from the WRF model
- GNSS Meteorology explained: https://www.youtube.com/watch?v=t1inZaRdWY4

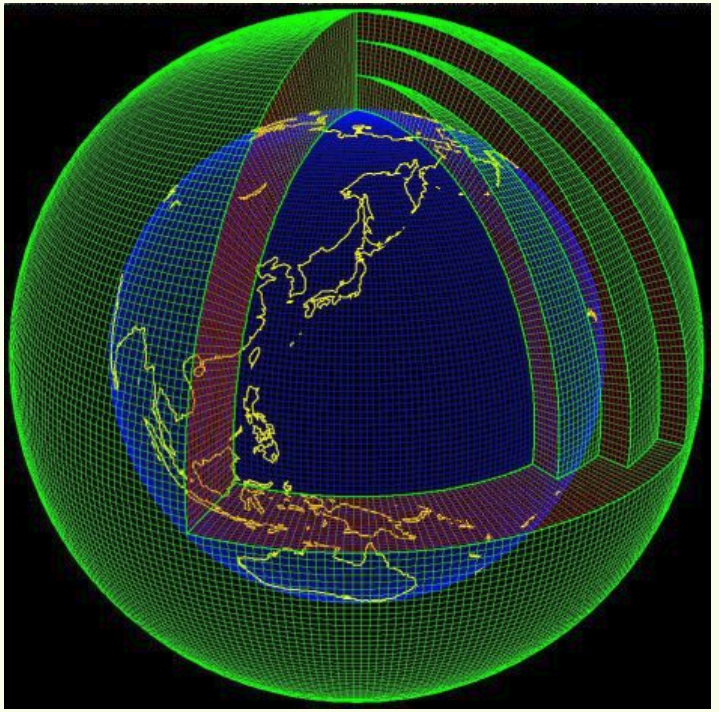



*Source: Guerova et al., 2003. Validation of NWP mesoscale models with Swiss GPS Network AGNES. Journal Applied Meteorology, 42, 1, 141-150 .*

# Numerical Weather Prediction (NWP) model: WRF

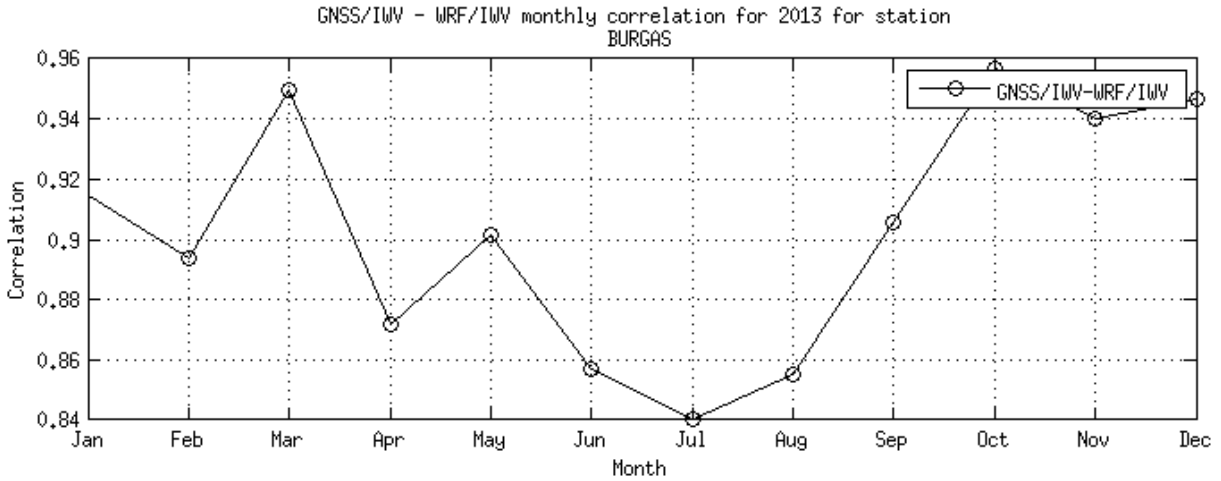
- Weather Research and Forecasting (WRF) model simulations for Bulgaria
- horizontal resolution 9 km, 44 vertical levels
- temporal resolution 30 min.

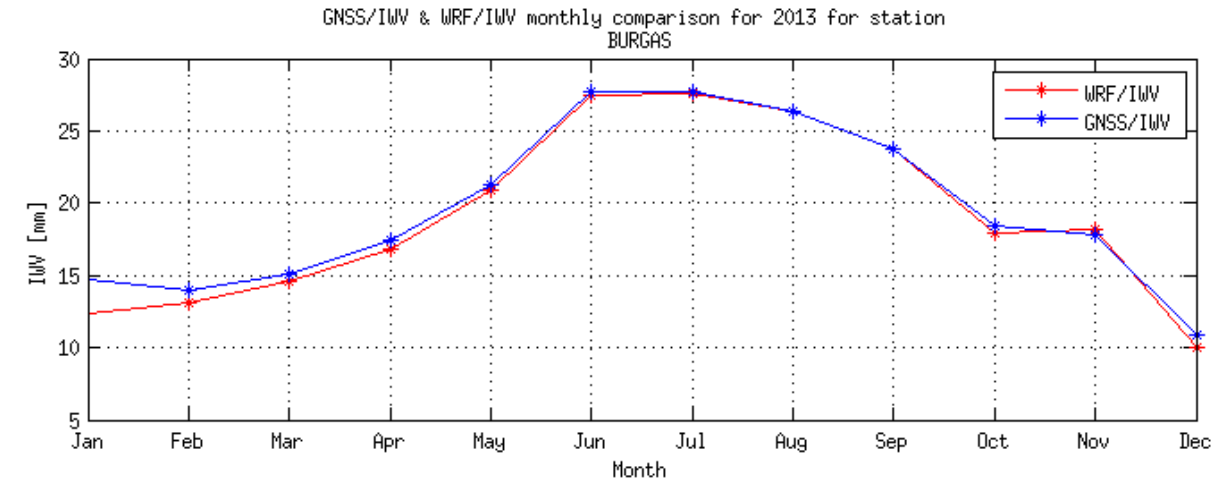


# IWV comparison GNSS and WRF: monthly mean station Burgas

- very good agreement between GNSS and WRF for the monthly mean IWV
- correlation 0.84 in July, 0.96 in October

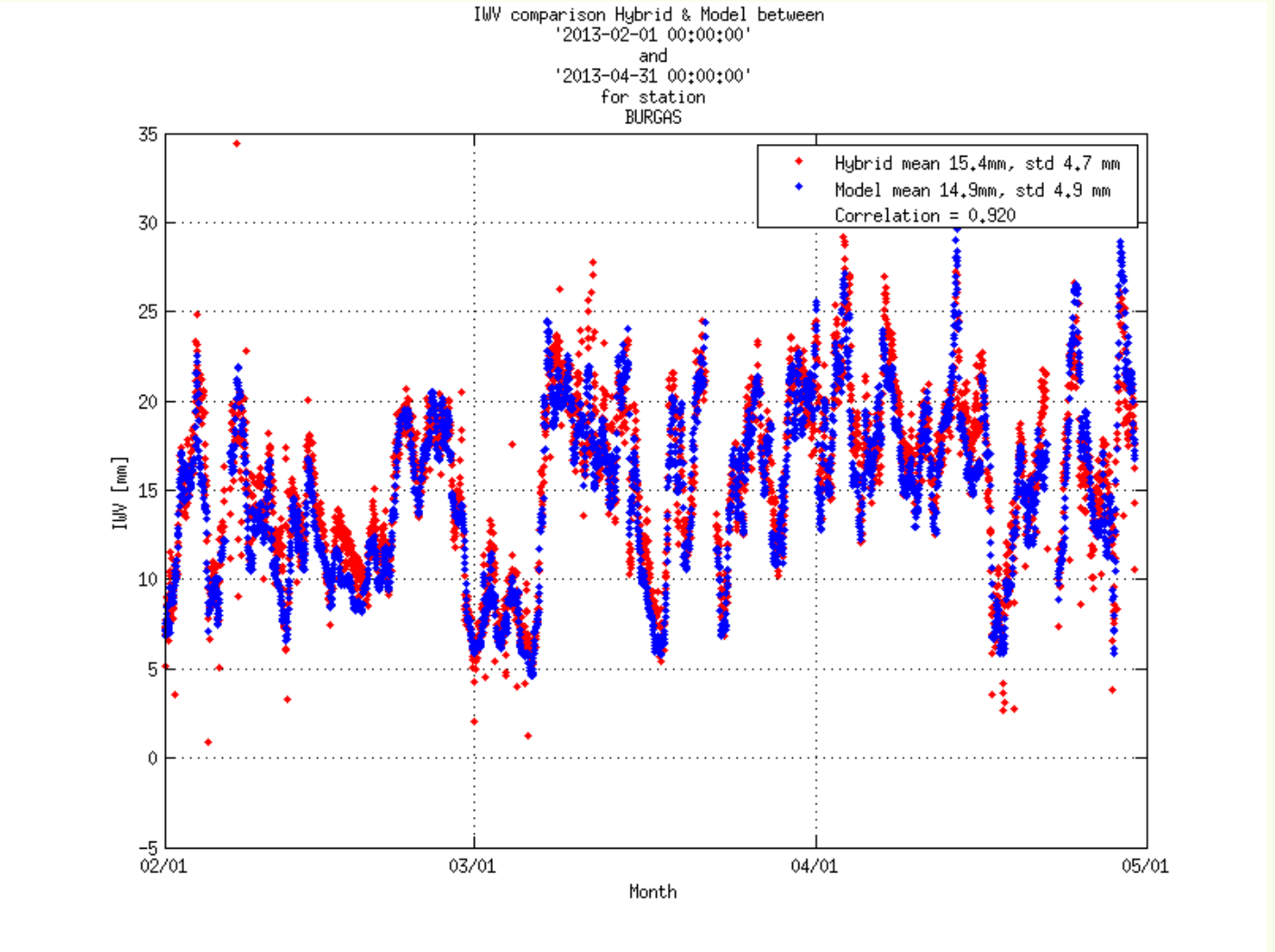


# IWV comparison GNSS and WRF

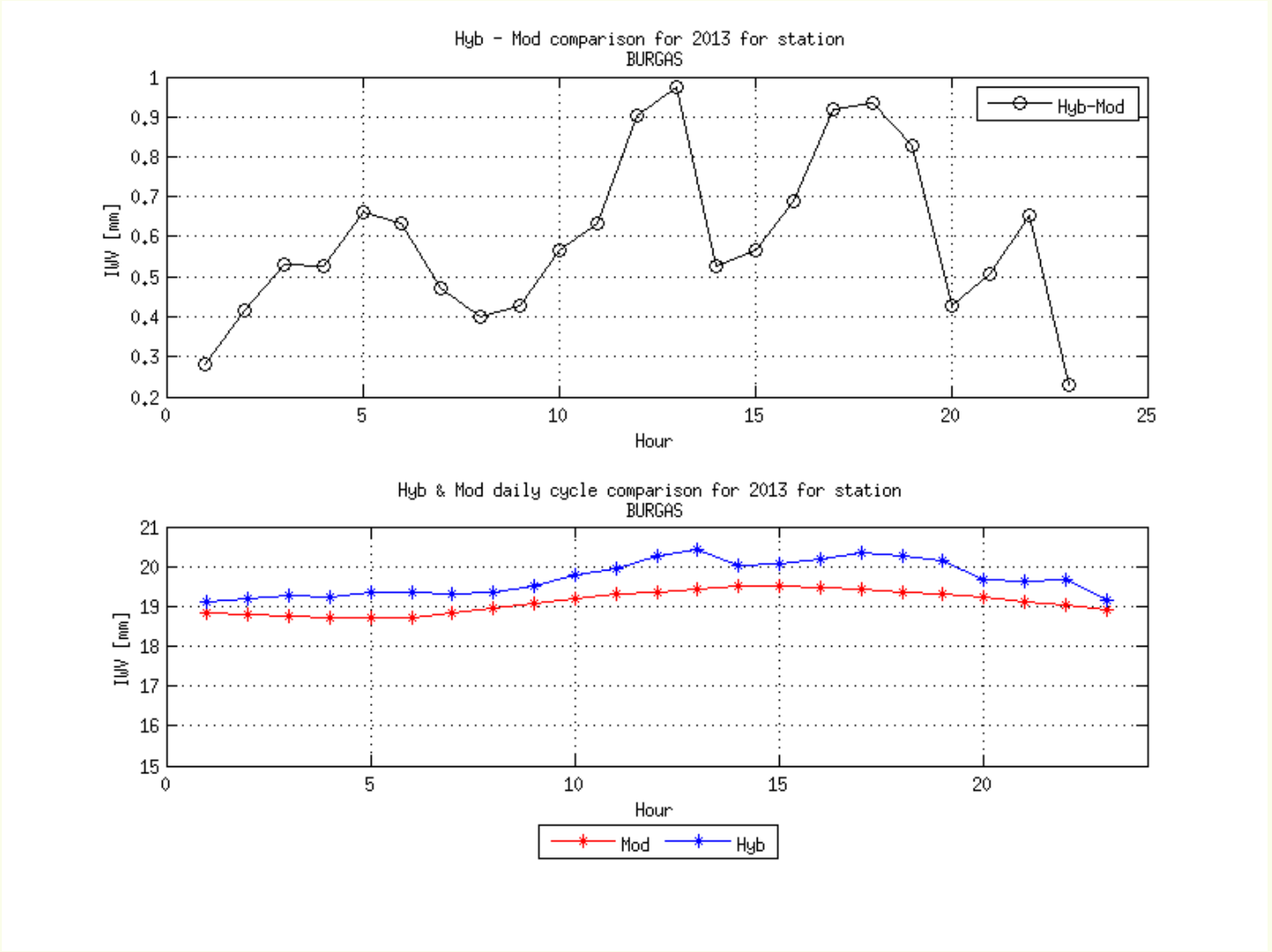


- IWV from GNSS (red) and WRF (blue) February to April 2013 station Burgas

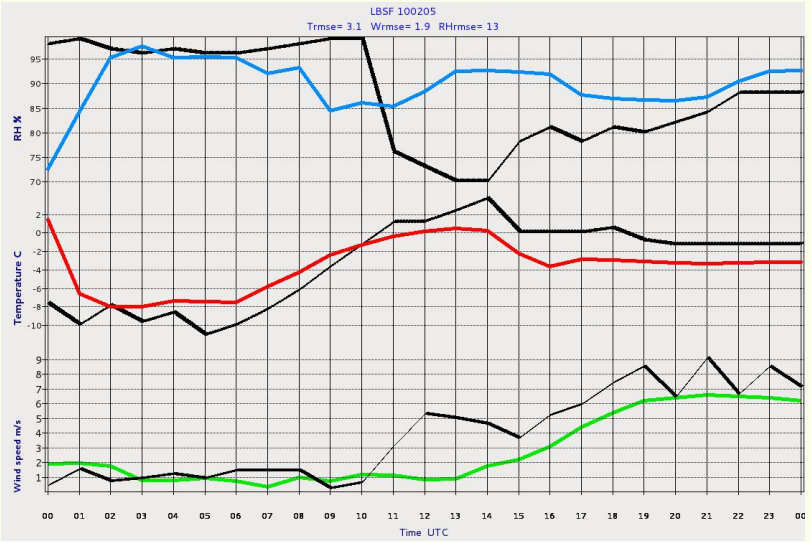


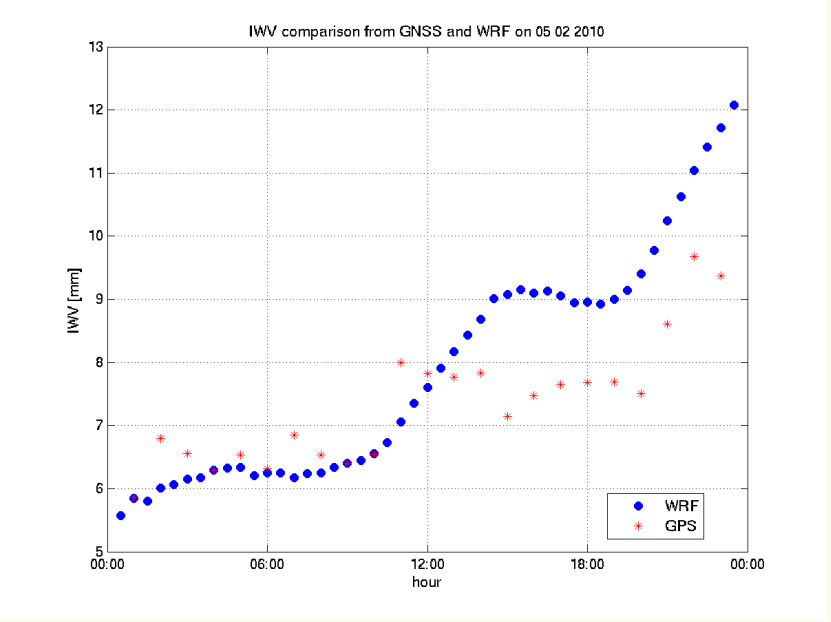
# IWV comparison GNSS and WRF: diurnal cycle

- the model tends to underestimate IWV by about 0.6 mm



# Case study: radiation fog on 5 February 2010 Sofia, Bulgaria




- from 00 to 10 UTC - relative humidity (RH) above 95 % - fog
- 11 UTC - RH drop to 75 %
- from 00 to 10 UTC - Integrated Water Vapour (IWV) 6 to 7 mm
- 11 UTC - increase of IWV to 8 mm
- IWV increase is due to transition from liquid water to water vapour and this is clear indication that the fog is dispersing
- very good timing between RH and IWV

# Conclusion

- Successfully completed the first GNSS tropospheric processing campaign of SUGAC for 2013
- Processed 7 Bulgarian GNSS station with NAPEOS software in PPP mode
- Comparison of IWV from GNSS and WRF model shows very good agreement
- GNSS-WRF IWV correlation low (0.8) in summer high (0.9-0.95) in winter
- the WRF model tends to underestimate the IWV on avereged by 0.6 mm
- case studies of radiation fog show potential for application of GNSS IWV for monitoring the fog dynamics and dispersion

**THANK YOU!**