

GNSS storm nowcasting demonstrator for Bulgaria

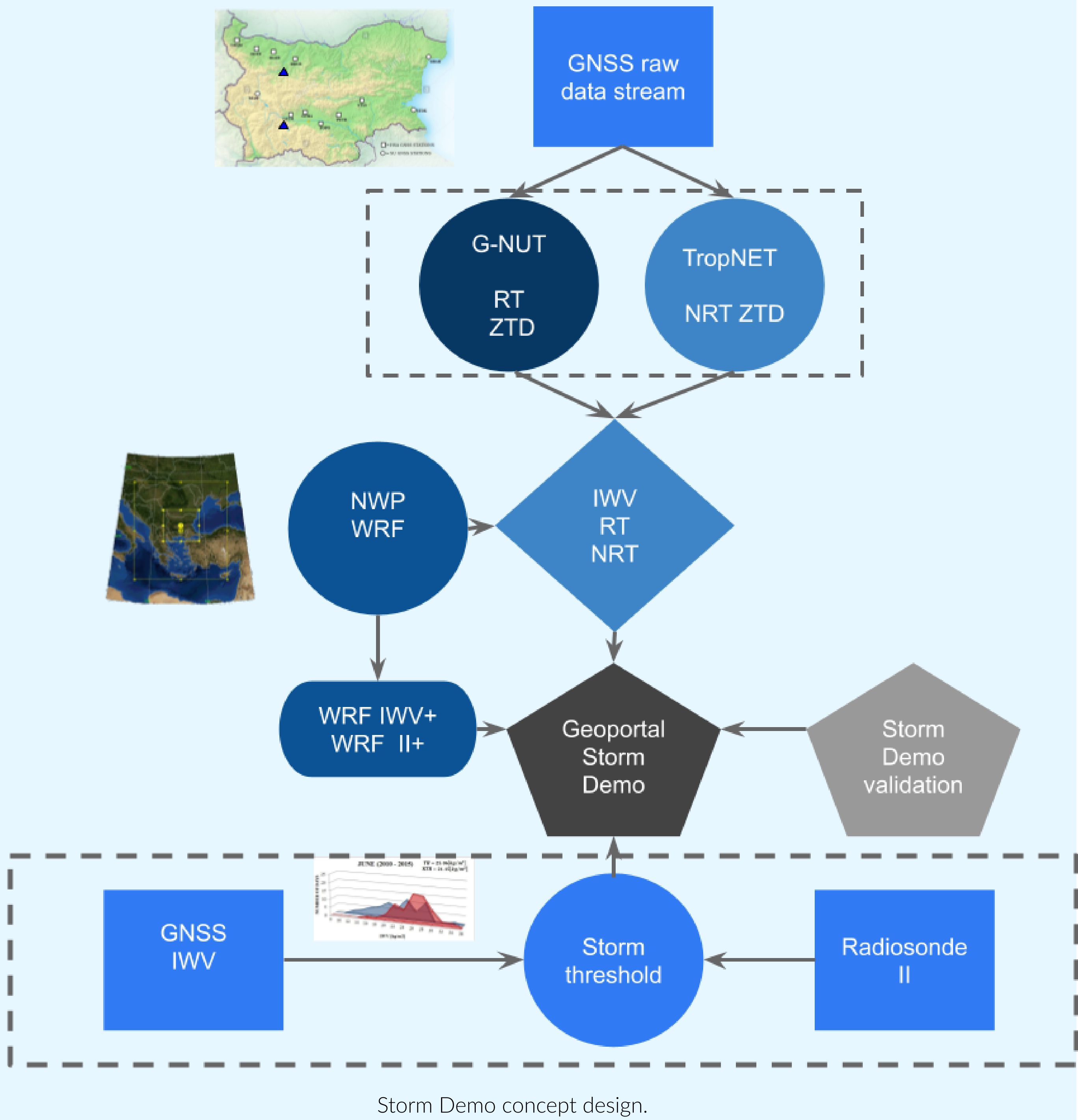
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Introduction

A convective Storm Demonstrator (Storm Demo) is build using real-time GNSS tropospheric products and Instability Indices to derive site specific threshold values in support of public weather and hail suppression services. The Storm Demo targets development of service featuring GNSS products for two regions with hail suppression operations in Bulgaria where thunderstorms and hail events occur between May and September with a peak in July.



Research objectives and Method

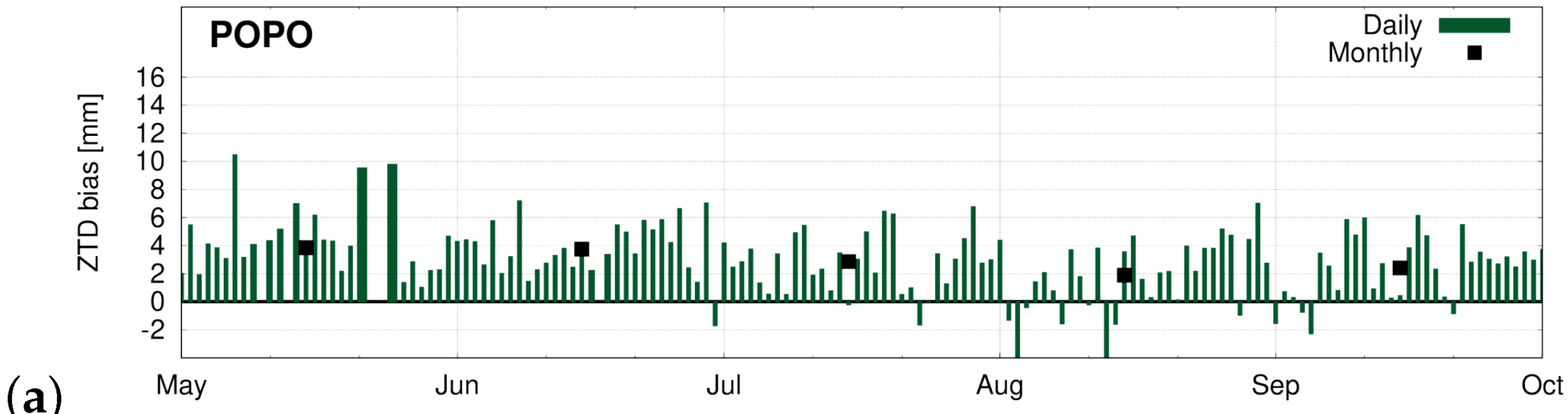
The aim of this work is to present Storm Demo design and validation.

- Datasets
 - Radar reflectivity height of 45 dBZ (H45)
 - WRF horizontal resolution 2 km vertical levels 45 – surface pressure and temperature
- Method
 - Real time GNSS data processing – Precise Point Positioning with G-Nut software
 - Zenith Total Delay – temporal resolution 15 minutes
 - GNSS Meteorology 12 ground-based stations in Bulgaria - IWV, GE and GN

Real time processing evaluation: May-September 2021

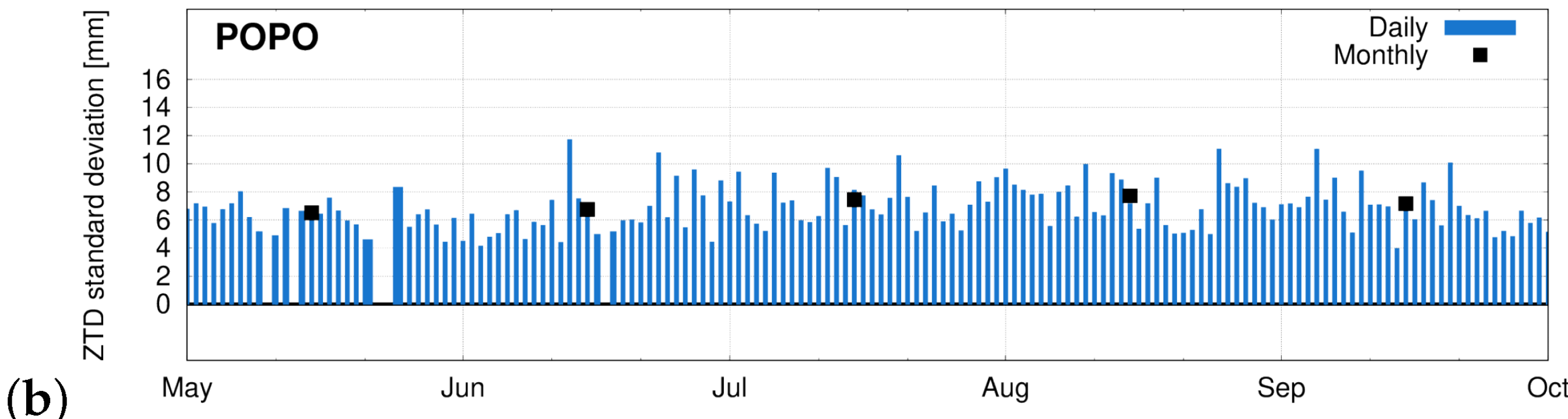
All long-term ZTD biases are below 5 mm but may still vary up to a 10 mm in a short-term evaluation daily. An overall precision is below 9 mm for all the stations with almost an identical performance on a monthly or daily basis. As the evaluation concerns the summer season, a similar or better performance is expected in winter too, when considering that water vapour content and its variations in the atmosphere is significantly lower. The ZTDs estimated in real time are within the WMO requirements for nowcasting (below 15 mm).

Daily/monthly statistics: real-time vs. post-processing [RT1-PP]



(a)

Daily/monthly statistics: real-time vs. post-processing [RT1-PP]



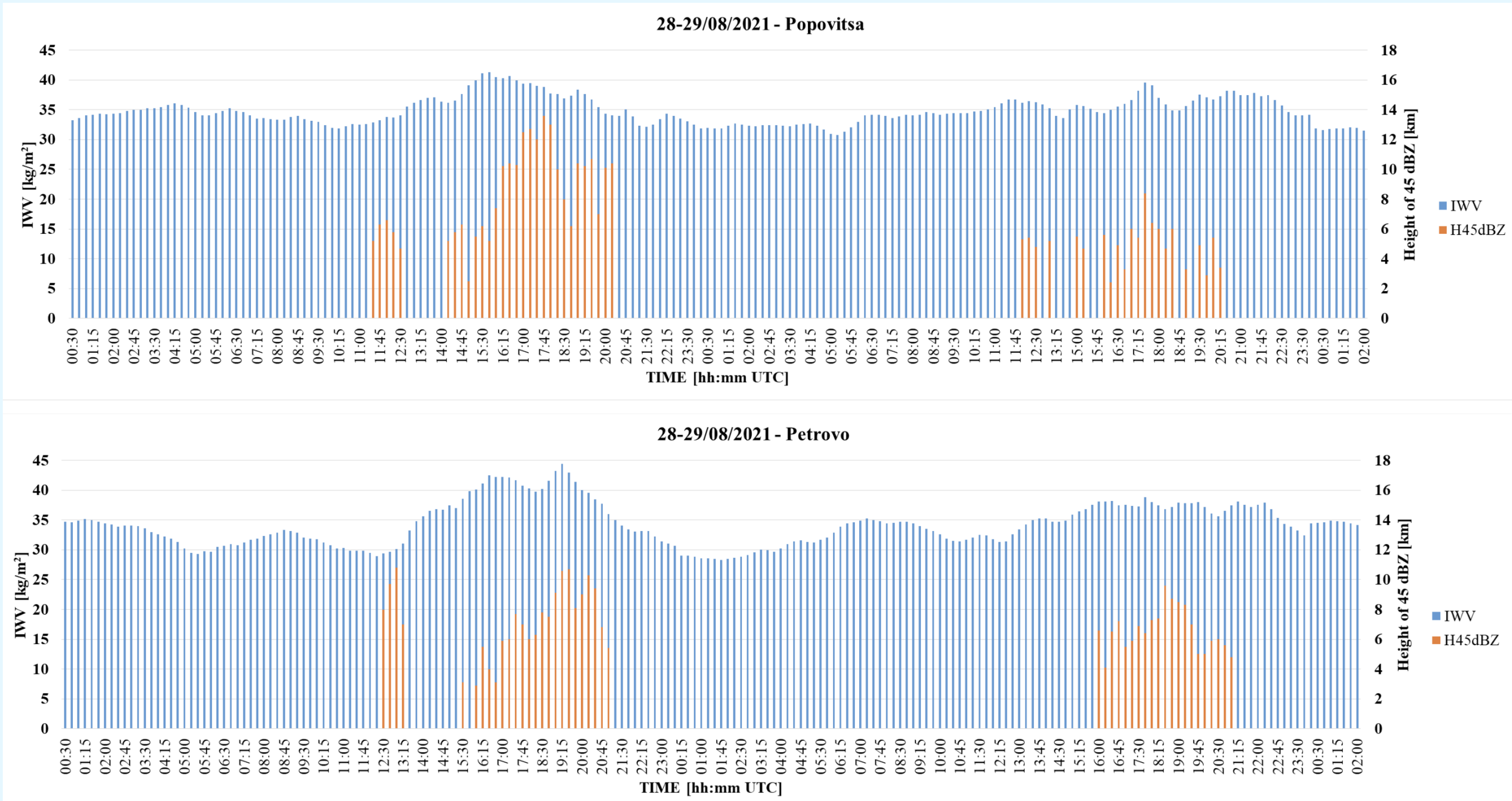
(b)

Funding

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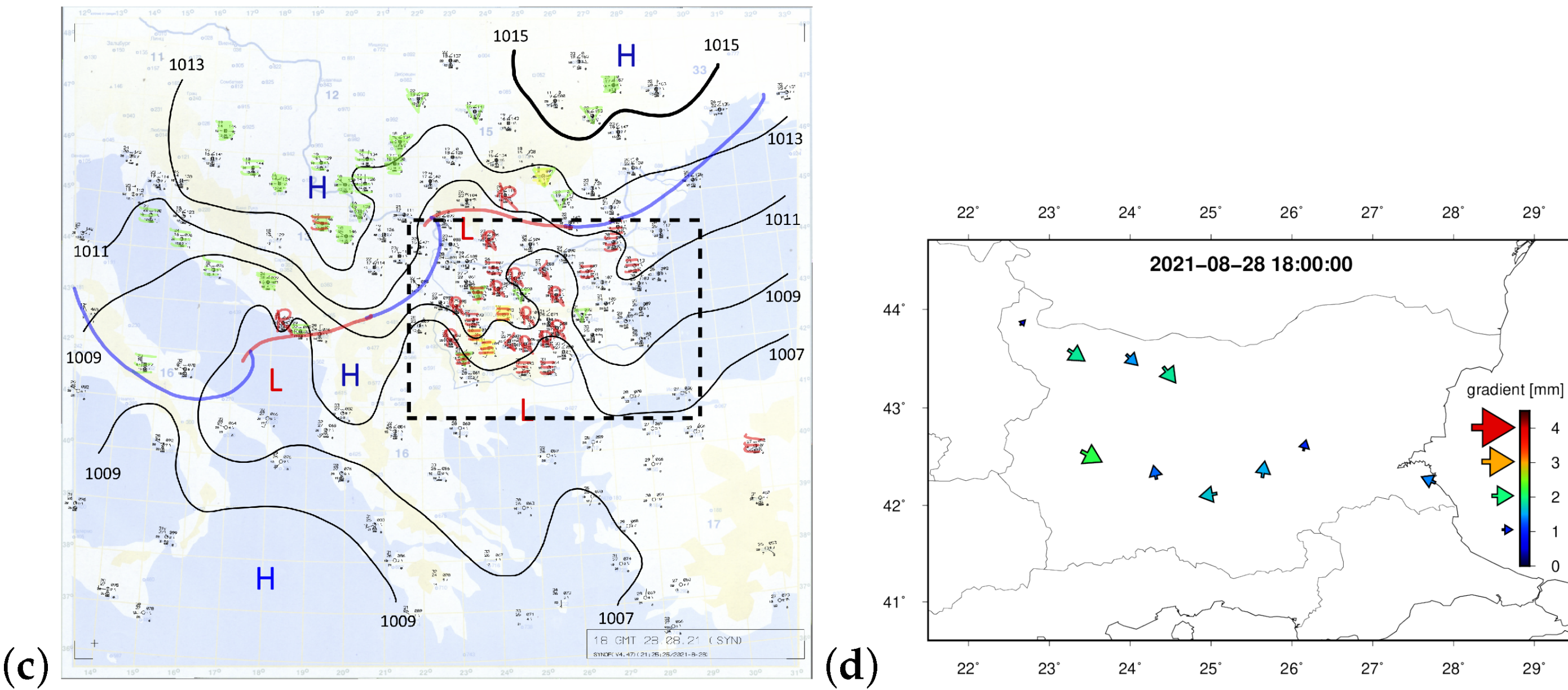
Hail storm 28-29 August 2021: IWV and H45

The hourly rate of IWV increase between 6 and 16 UTC on 28 August for Popovitsa is 0.56 and H45 is about 9 km. On 29 August IWV rate is 0.14 and corresponding H45 is 5 km.



ZTD gradients: 28 August 2021

Surface weather charts for the Balkan peninsula and 18 UTC on 28 August (c) and corresponding ZTD gradients over Bulgaria(d).

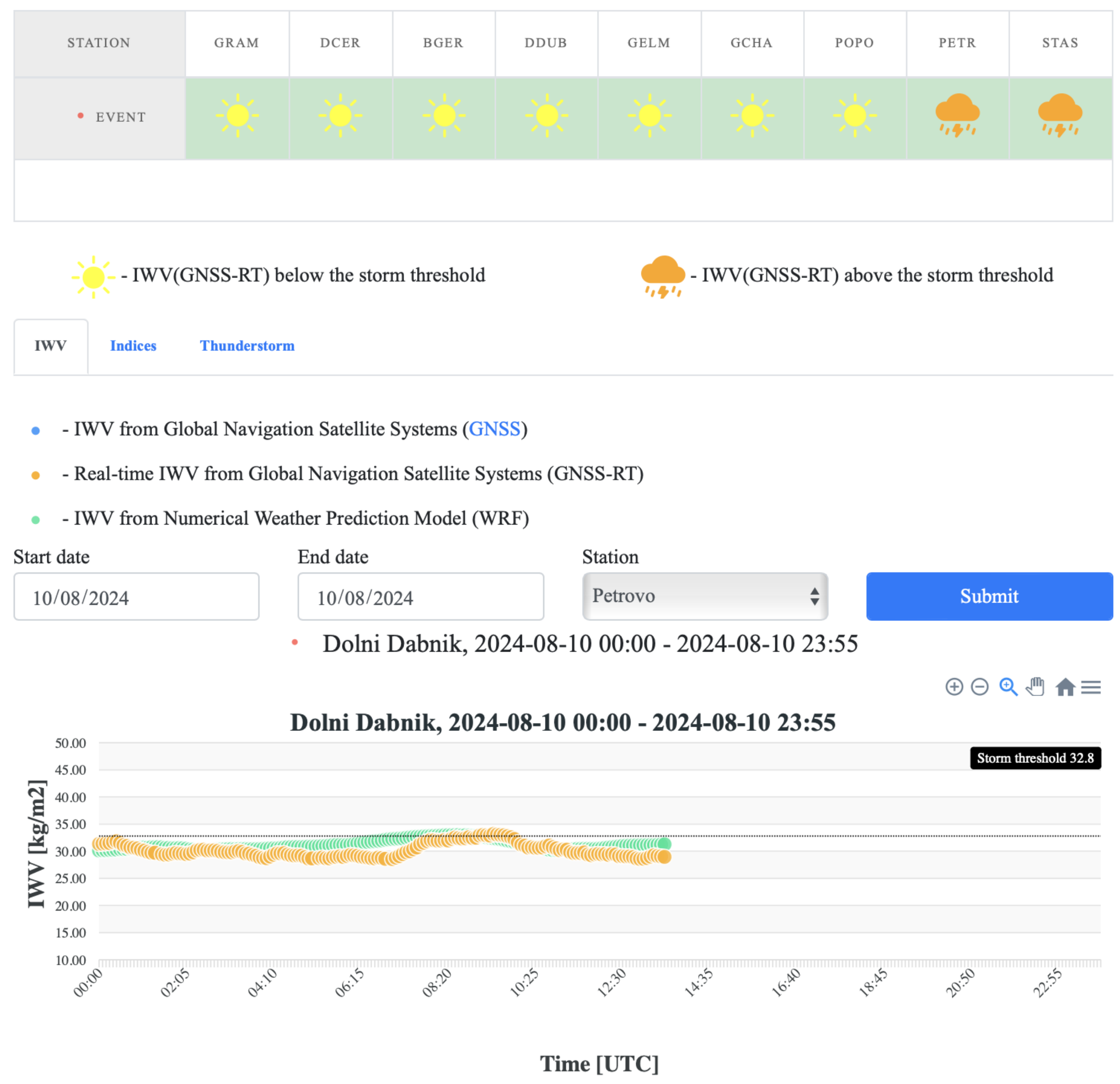


(c)

(d)

Web portal

Web portal realisation of real time IWV for Storm Demo on: http://suada.phys.uni-sofia.bg/?page_id=4838



Conclusions

Storm Demo is the first of its kind prototype based on real-time sub-hourly tropospheric products aimed at hail suppression service. Verification of real-time ZTD for the period May–September 2021 shows precision satisfying the WMO nowcasting requirements. During the severe hail storms on 28 and 29 August, the hourly rate of IWV increase between 6 and 16 UTC was found to be correlated with the weather radar reflectivity height of 45 dBZ. Storm Demo time series are publicly accessible from web portal with user-friendly visualisation and timely update in real-time.

More information: Guerova et al., 2022. GNSS storm nowcasting demonstrator for Bulgaria. Remote Sensing, doi:10.3390/rs14153746, 14/15, 3746.