Real time GNSS storm nowcasting demonstrator for Bulgaria

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G-Nut Software s.r.o.

IGS, Bern Switzerland
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Motivation: Storm nowcasting*

- WMO nowcasting ”detailed description of current weather and forecasts 0 to +6 h”
- phenomena: 1) convective storms 2) extra-tropical & tropical storms 3) fog & low clouds 4) locally forced precipitation
- 1) fatalities & injuries reduction 2) savings for industry, transportation, agriculture
- ”blending” 1) in-situ and remote sensing observations, 2) Numerical Weather Prediction (NWP), 3) model output statistic data, 4) high resolution topography

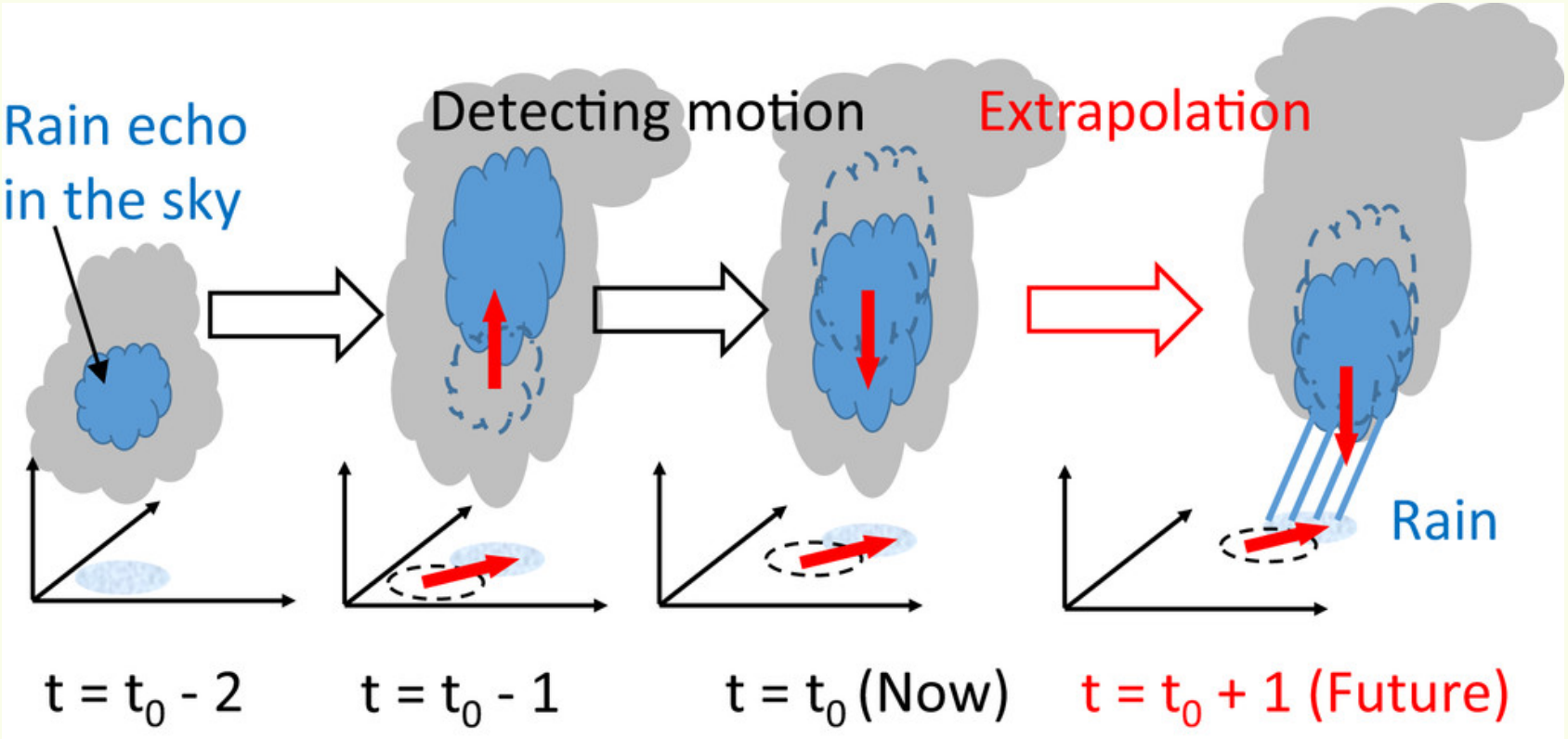
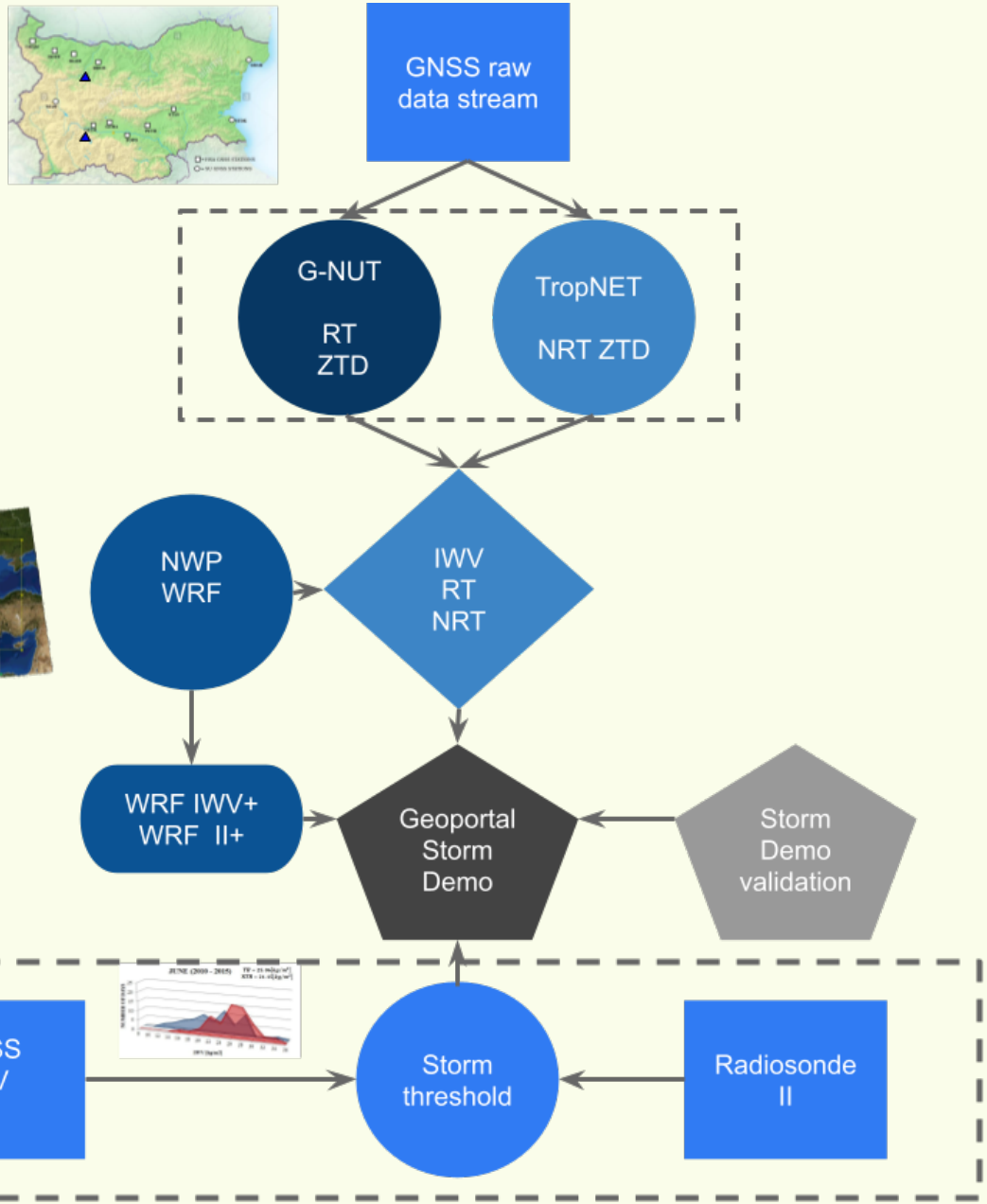


*Figure from: Otsuka et al. 2016. Precipitation Nowcasting with Three-Dimensional Space-Time Extrapolation of Dense and Frequent Phased-Array Weather Radar Observations, Weather and Forecasting, 31(1), 329-340.

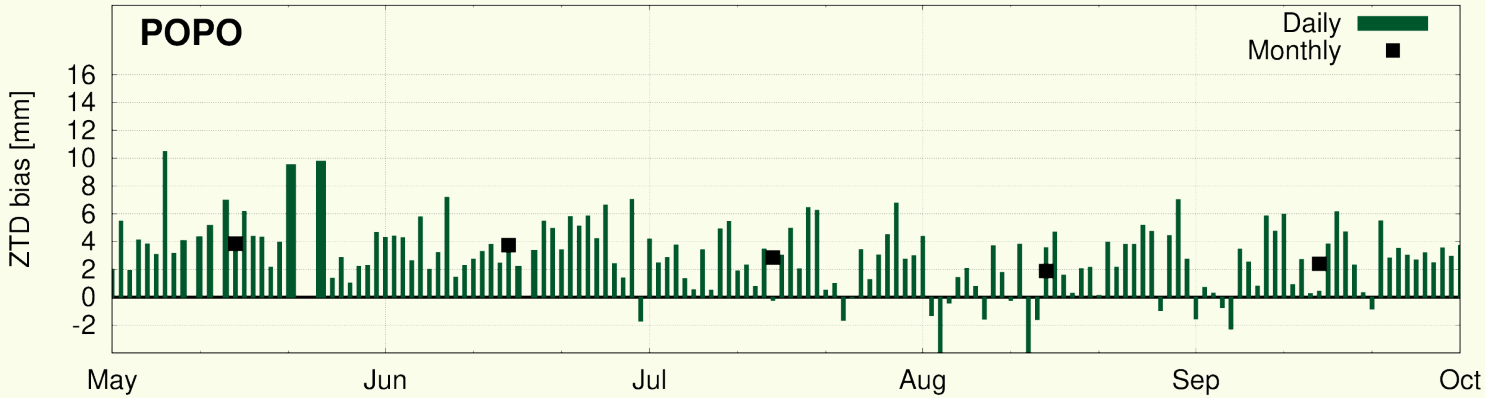
GNSS storm nowcasting demonstrator (Storm Demo)



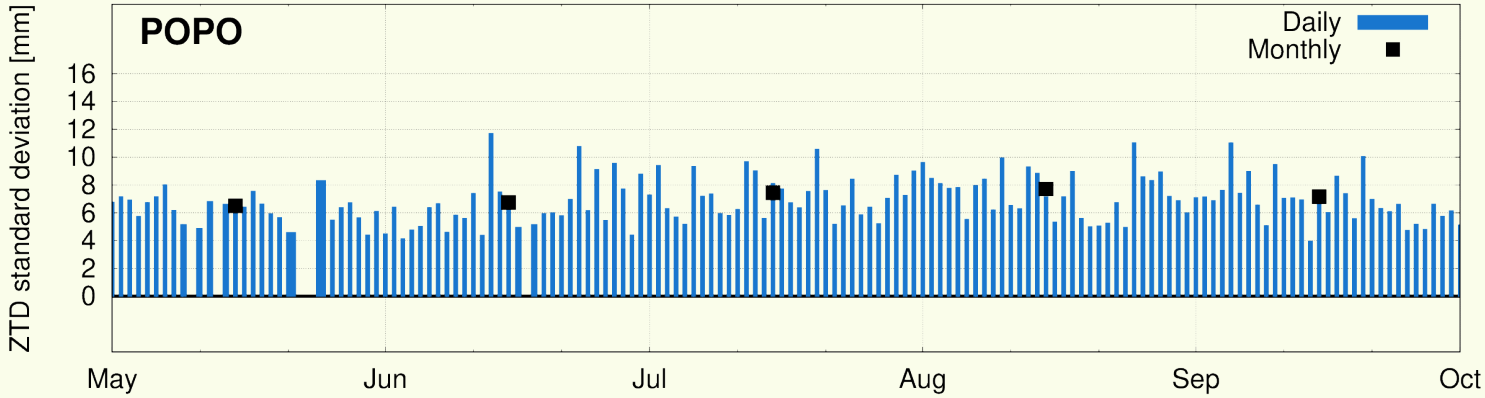
GNSS RT vs Post-processed May-September 2021*

ZTD bias/std = 3.85 ±6.51 mm

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

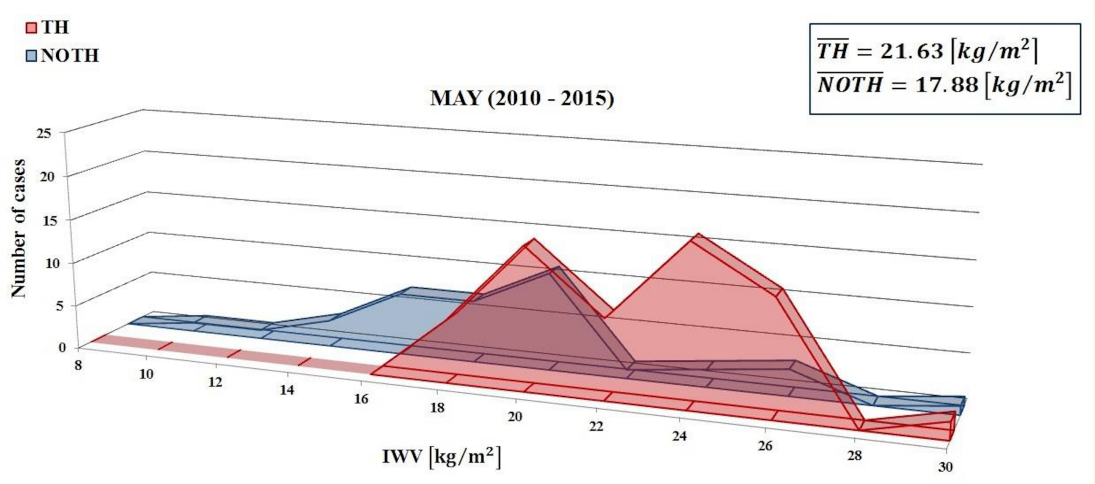


Daily/monthly statistics: real-time vs. post-processing [RT1-PP]

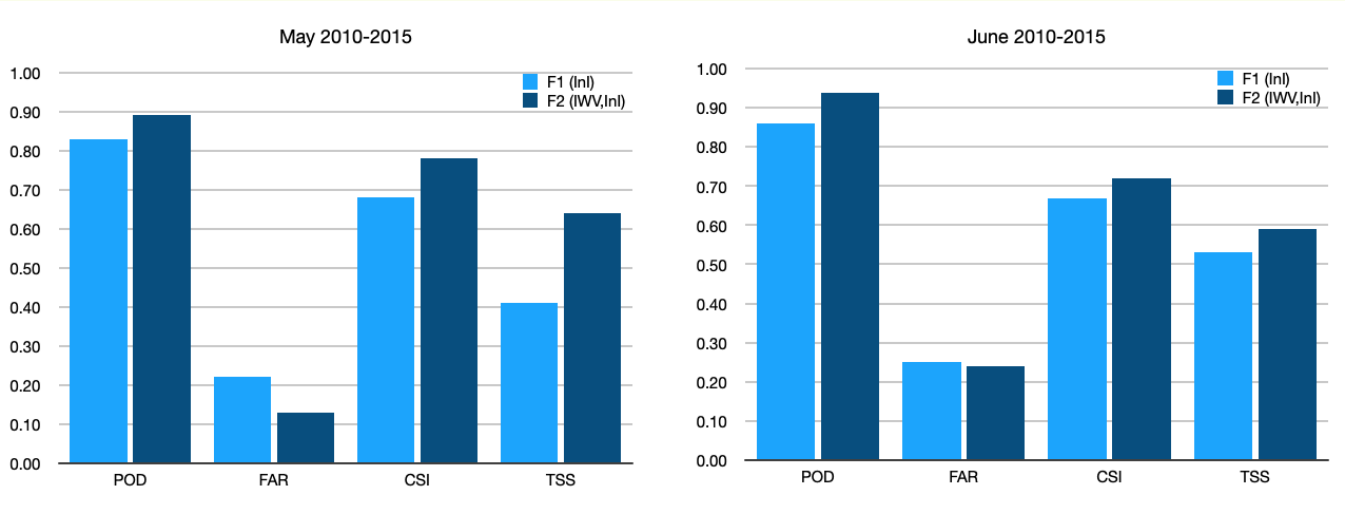


*Guerova et al. 2022. GNSS storm nowcasting demonstrator for Bulgaria, Remote sens., 14/15, 3746.

IWV and Instability Indices: May-June 2010-2015*

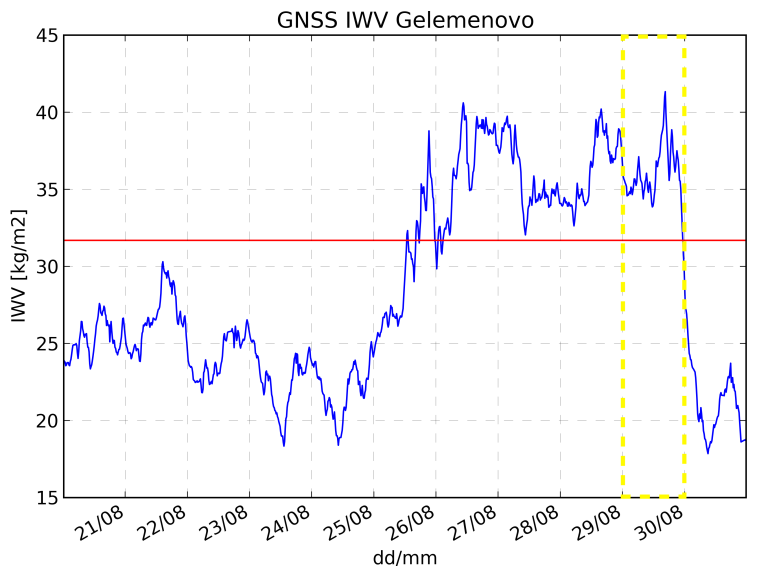


- May F1 (InI) = 0,15*K + 0,32*LI + 0,01*SWEAT - 5,355
- May F2 (IWV,InI) = 0,54*IWV - 1,36*SHI + 0,74*TT + 0,07*K - 51,16

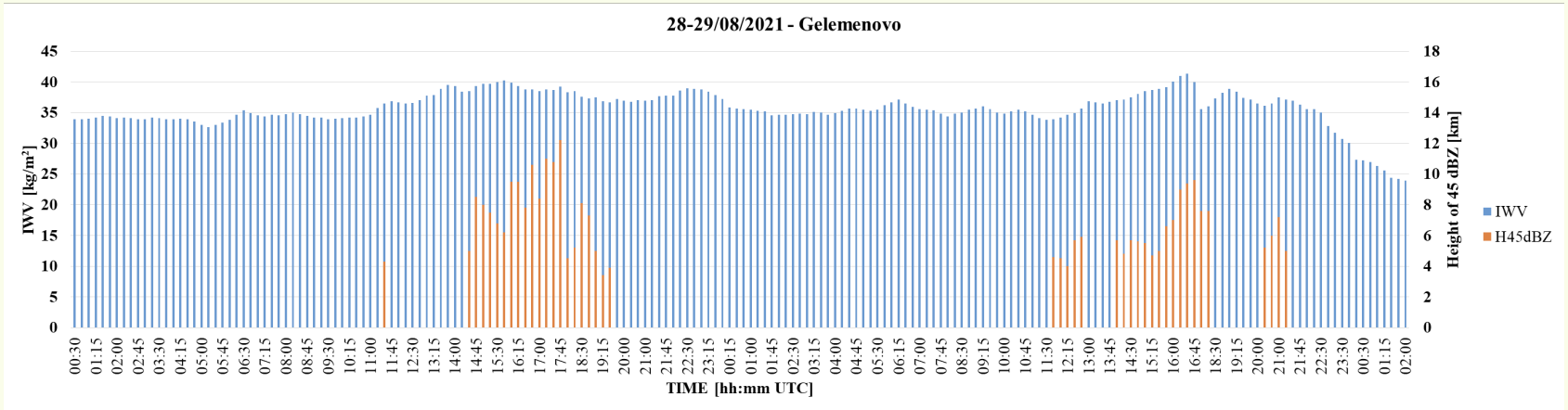


*Guerova et al. 2019. Thunderstorm Classification Functions Based on Instability Indices and GNSS IWV for the Sofia Plain, Remote sens., 11(24).

Hail storm 28-29 August 2021: IWV & altitude 45 dBZ*

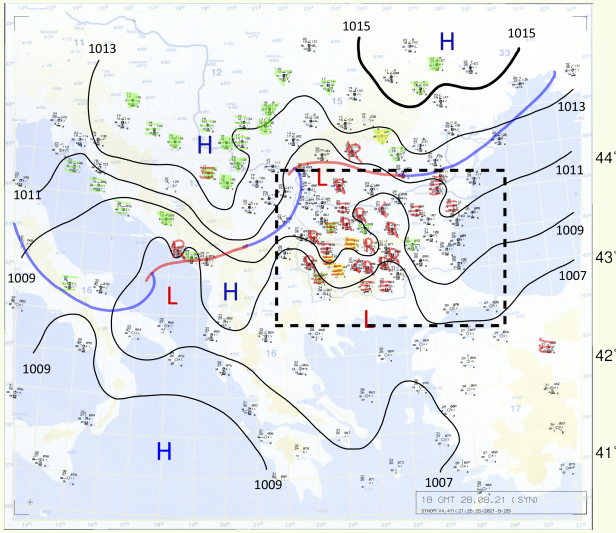


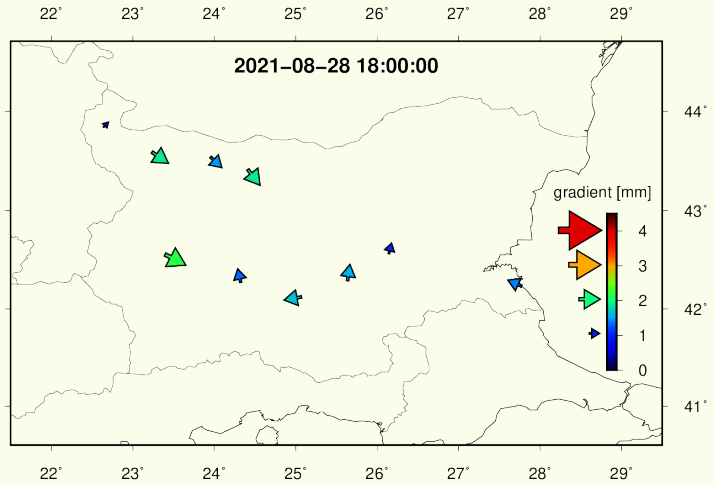
- dIWV/dt (6-16 UTC, Gelemenovo) 0.62 (28.08) & 0.34 (29.08)
- 45 dBZ altitude (Gelemenovo) 14 km (28.08) & 8 km (29.08)

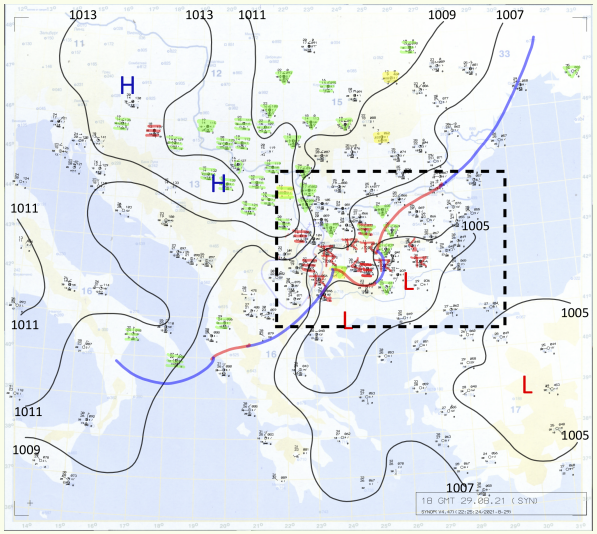


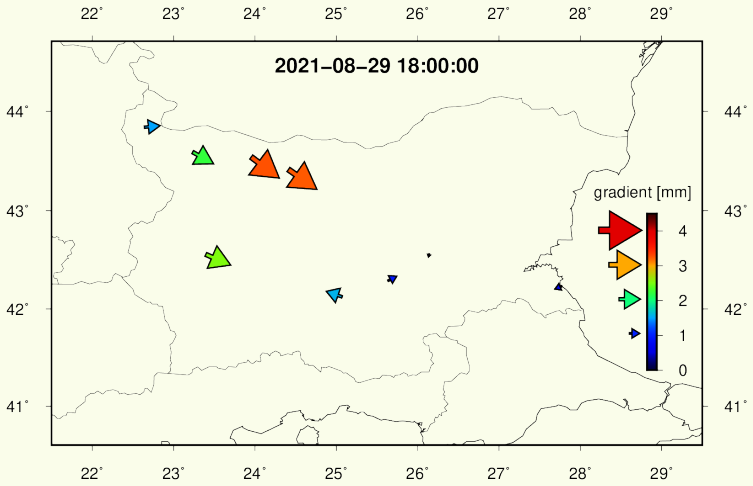
*Guerova et al. 2022. GNSS storm nowcasting demonstrator for Bulgaria, Remote sens., 14/15, 3746.

Hail storm 28-29 August 2021: GNSS gradients*





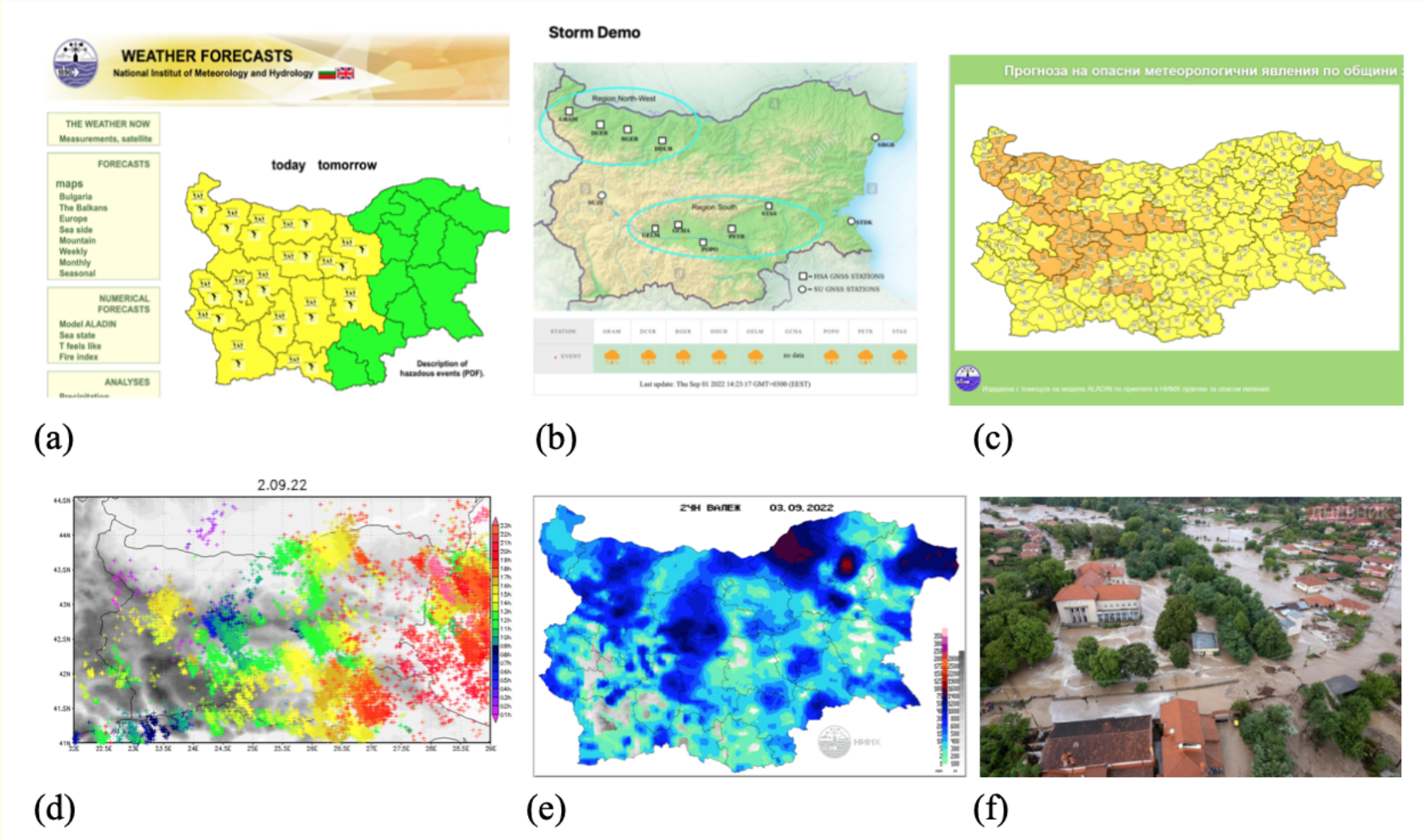




*Guerova et al. 2022. GNSS storm nowcasting demonstrator for Bulgaria, Remote sens., 14/15, 3746.

Severe weather & flood 1-2 September 2022*

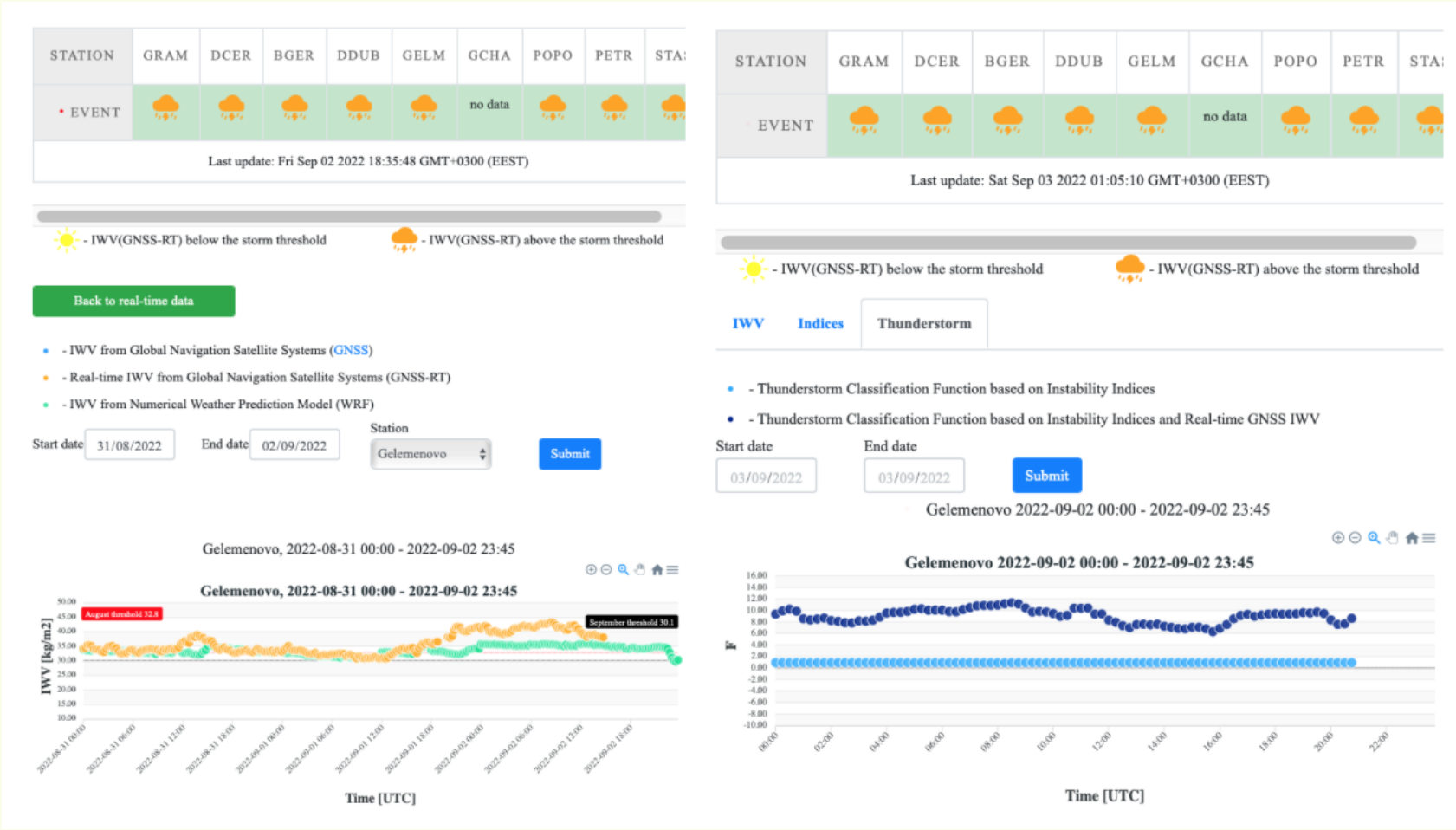
- Meteoalarm - yellow code (1 September), orange code (2 September)
- Intense precipitation - localised to 100 mm/day
- Widely spread thunderstorm



*Storm Demo public portal http://suada.phys.uni-sofia.bg/?page_id=4838

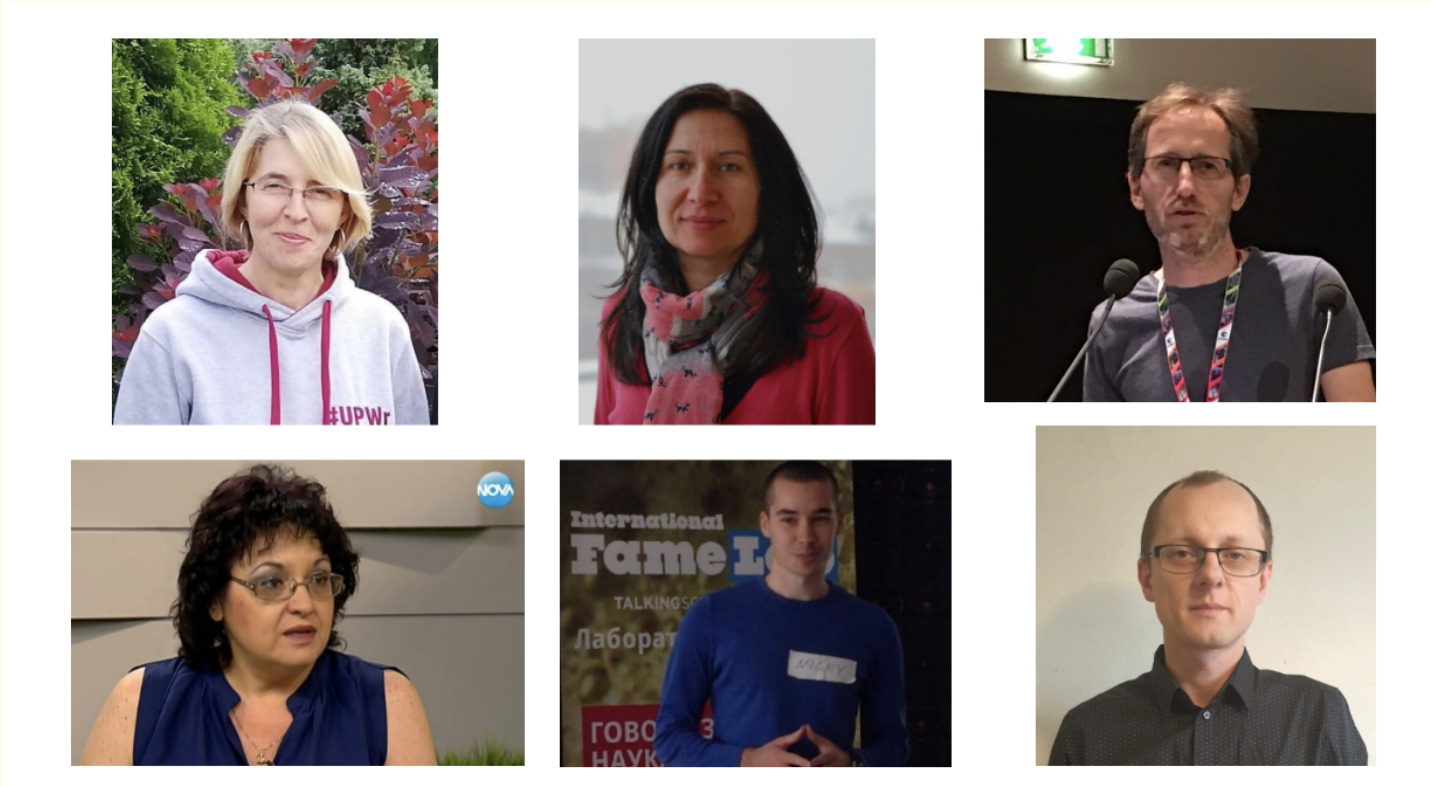
Severe weather & flood 1-2 September 2022

- IWV above the monthly threshold for August
- IWV&InI classification function with large positive values



Conclusions

- GNSS Storm nowcasting demonstrator (2021)
- IWV temporal resolution comparable to weather radar data 15
- Monthly threshold criteria IWV & Instability Indices
- Hail storm environment highly dependent on IWV increase
- Web portal with public access and timely IWV update



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THANK YOU!