



Climate, Weather and Natural Risks

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Leading researcher

Research area "Earth and related environmental sciences"

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Physics Faculty, Sofia University "St. Kliment Ohridski"

"2023 European science night",
29 September 2023 Sofia Bulgaria

Why

Storm
Demo

Design

GNSS

WRF

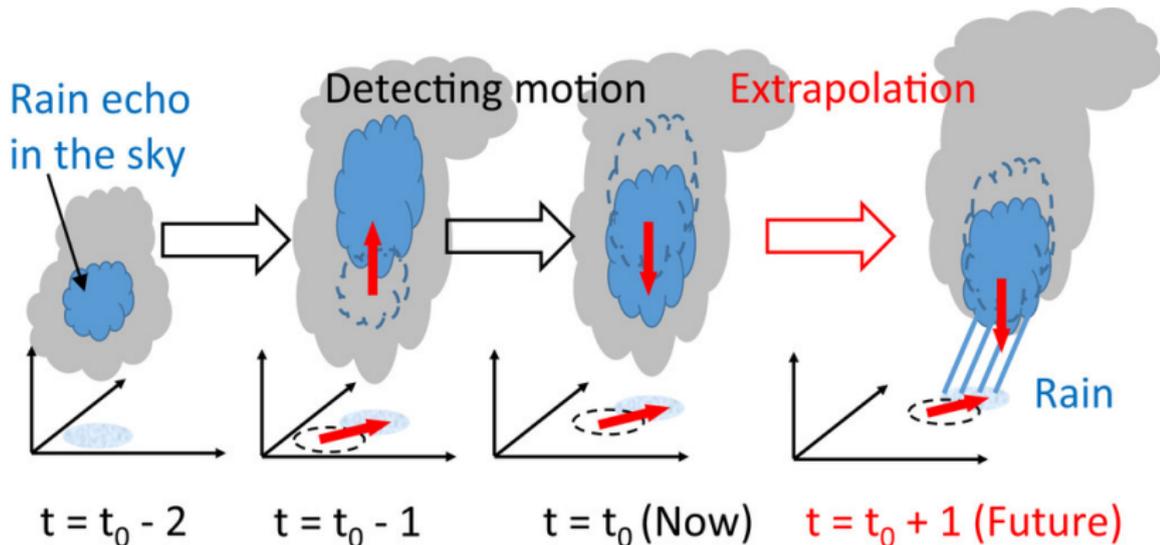
Web portal

End

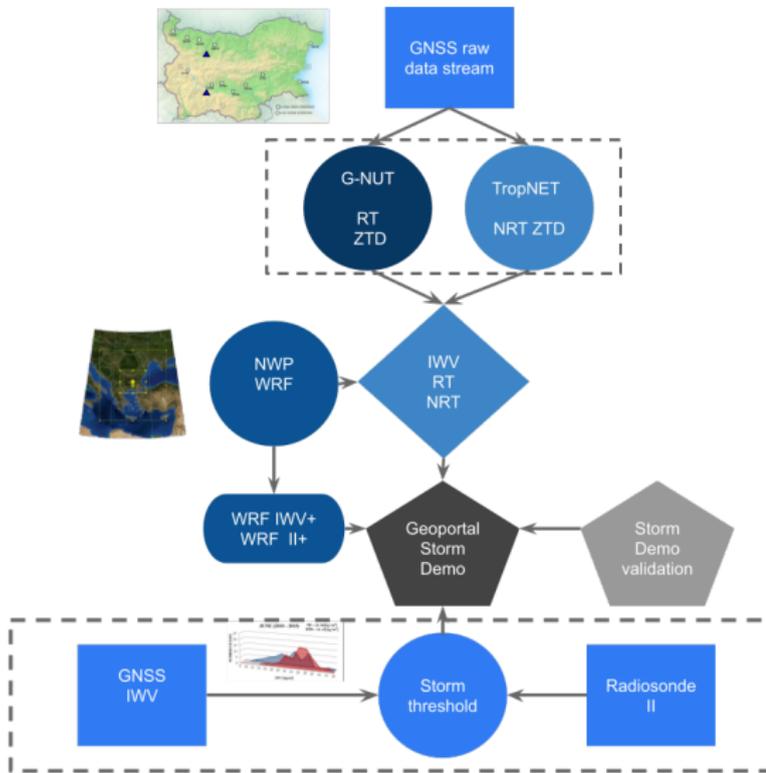
- WMO nowcasting "detailed description of current weather and forecasts 0 to +6 h"
- phenomena: 1) convective storms 2) mesoscale events associated with extra-tropical & tropical storms 3) fog & low clouds 4) locally forced precipitation events 5) sand & dust storms 6) snow, ice, glazed frost, blizzards, avalanches 7) wildfires 8) air pollution
- benefits: 1) fatalities & injuries reduction 2) private, public, industrial property damage reduction 3) savings for industry, transportation, agriculture



- weather radar data extrapolation
- "blending" 1) in-situ and remote sensing observation, 2) Numerical Weather Prediction (NWP), 3) model output statistic data, 4) high resolution topography, 5) heuristic rules



*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.



¹ funded by ESA AO/1-10327/2020/NL/CBi Invitation to Tender for the Sixth Call for Outline Proposals under the Plan for European Cooperating States (PECS) in Bulgaria

Why

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Demo

Design

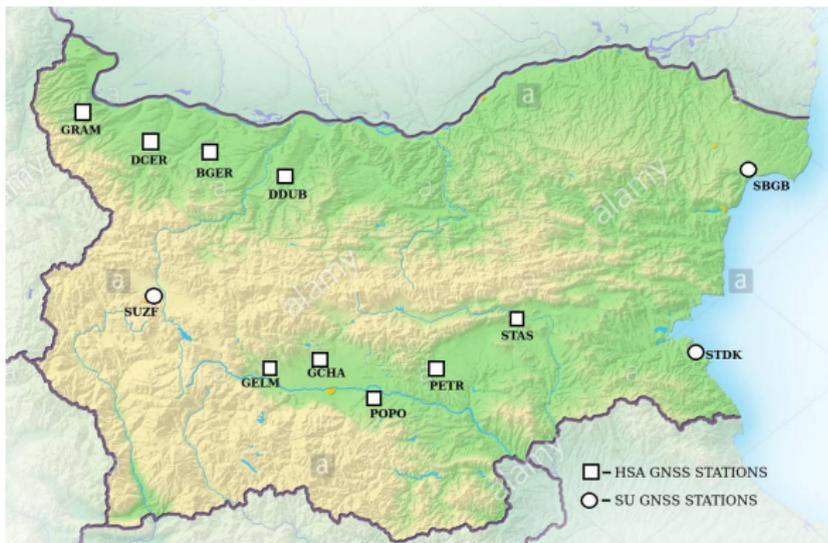
GNSS

WRF

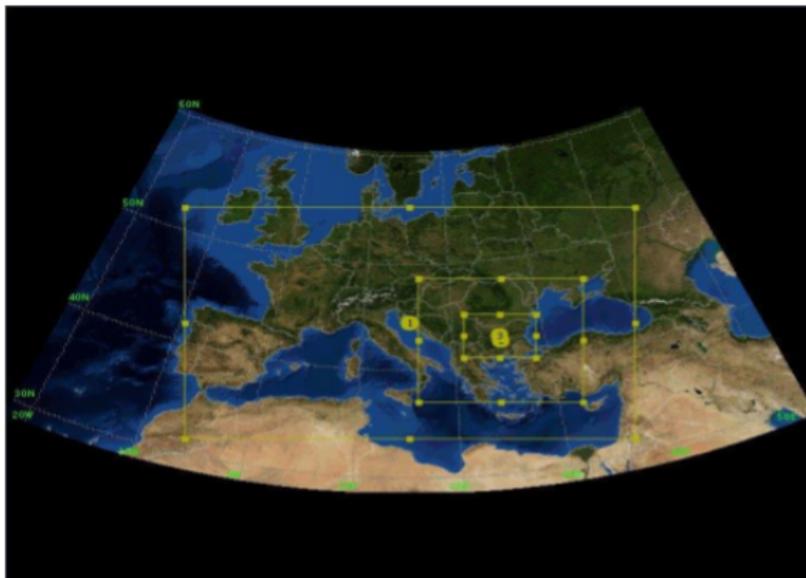
Web portal

End

- operated by Hail Suppression Agency (HSA) since 2018
- collocated with weather radar observations
- hail suppression for agriculture protection
- hail storm season May-September



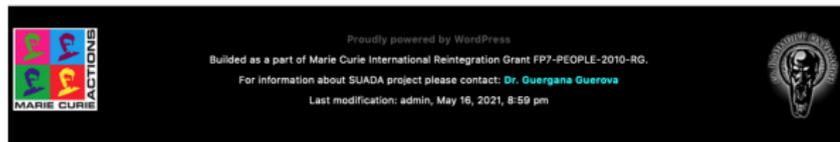
- 2 daily forecasts for 48 hours
- horizontal resolution 2 km over Bulgaria
- vertical levels 45
- surface pressure and temperature – > GNSS IWV
- profiles temperature and humidity – > WRF IWV



- hosted by Sofia University Atmospheric Data Archive
- public access with real-time and near-real time IWV update for operational use



G4N



²http://suada.phys.uni-sofia.bg/?page_id=4838



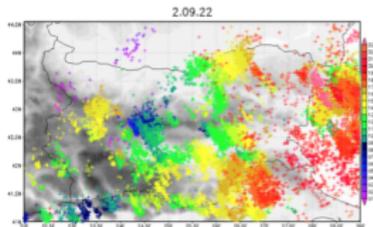
(a)



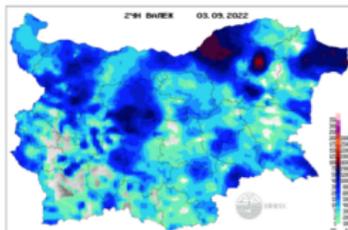
(b)



(c)



(d)



(e)



(f)

STATION	GRAM	DCER	BGER	DDUB	GELM	GCHA	POPO	PETR	STA:
EVENT						no data			

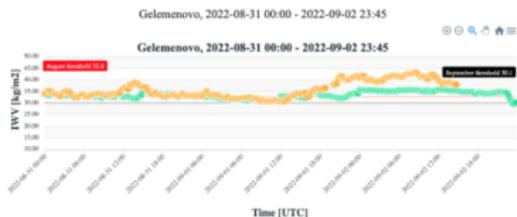
Last update: Fri Sep 02 2022 18:35:48 GMT+0300 (EEST)

- IWV(GNSS-RT) below the storm threshold - IWV(GNSS-RT) above the storm threshold

[Back to real-time data](#)

- - IWV from Global Navigation Satellite Systems (GNSS)
- - Real-time IWV from Global Navigation Satellite Systems (GNSS-RT)
- - IWV from Numerical Weather Prediction Model (WRF)

Start date: End date: Station:



STATION	GRAM	DCER	BGER	DDUB	GELM	GCHA	POPO	PETR	STA:
EVENT						no data			

Last update: Sat Sep 03 2022 01:05:10 GMT+0300 (EEST)

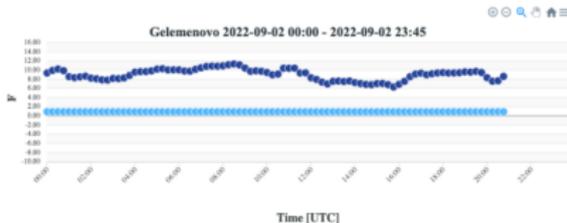
- IWV(GNSS-RT) below the storm threshold - IWV(GNSS-RT) above the storm threshold

[IWV](#) [Indices](#) [Thunderstorm](#)

- - Thunderstorm Classification Function based on Instability Indices
- - Thunderstorm Classification Function based on Instability Indices and Real-time GNSS IWV

Start date: End date:

Gelemenovo 2022-09-02 00:00 - 2022-09-02 23:45





- IWV(GNSS-RT) below the storm threshold - IWV(GNSS-RT) above the storm threshold

IWV Indices Thresholds

- Thunderstorm Classification Function based on Instability Indices
- Thunderstorm Classification Function based on Instability Indices and Real-time GNSS IWV

Start date

End date

02/09/2022

03/09/2022

Submit

- Gelesmevo 2022-09-03 00:00 - 2022-09-03 23:45



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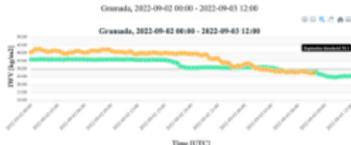
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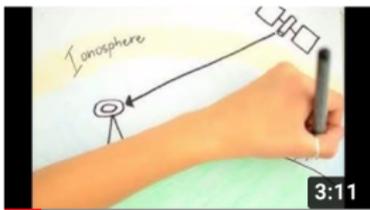
02/09/2022

03/09/2022

Submit



- 3 Youtube animations: over 36,000 views, awarded by MSCA, EMS, EGU and AGU
- GNSS Meteorology: Explained (<https://www.youtube.com/watch?v=t1inZaRdWY4&t=7s>)
- The Ionosphere and GNSS: Explained (https://www.youtube.com/watch?v=w-5HI2b_wKE&t=5s)
- Soil moisture and GNSS: Explained (<https://www.youtube.com/watch?v=xWNBIheRrtE&t=2s>)



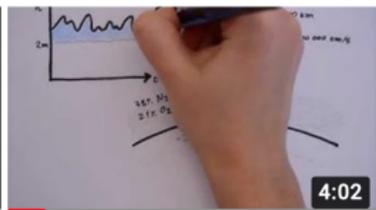
Soil moisture and GNSS: Explained

1.9K views • 6 years ago



The Ionosphere and GNSS: Explained

25K views • 7 years ago



GNSS Meteorology: Explained

6.1K views • 8 years ago

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NextGenerationEU

Национален план за
възстановяване и устойчивост



НА РЕПУБЛИКА БЪЛГАРИЯ

