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Why

Storm
Demo
Design

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SW2022

Thanks

HPC application for severe weather monitoring in Bulgaria

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Motivation: Severe weather forecasting

- 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

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Storm nowcasting state-of-the-art:

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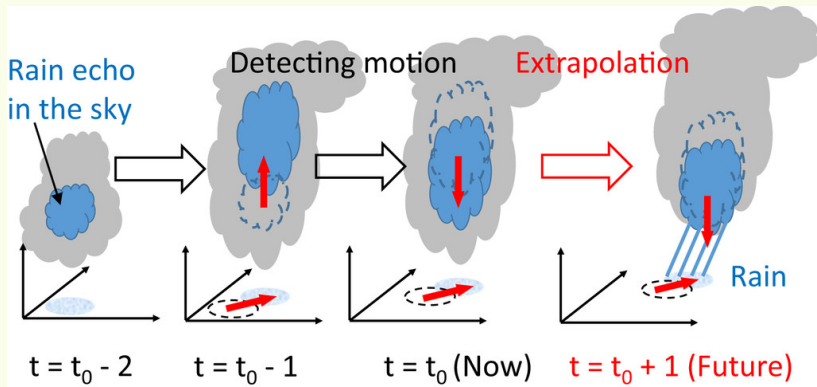
*Figure from: Otsuka et al. 2016. Precipitation Nowcasting with Three-Dimensional Space-Time Extrapolation of Dense and Frequent Phased-Array Weather Radar Observations, Weather and Forecasting, 31(1), 329-340.

GNSS storm nowcasting demonstrator (Storm Demo)

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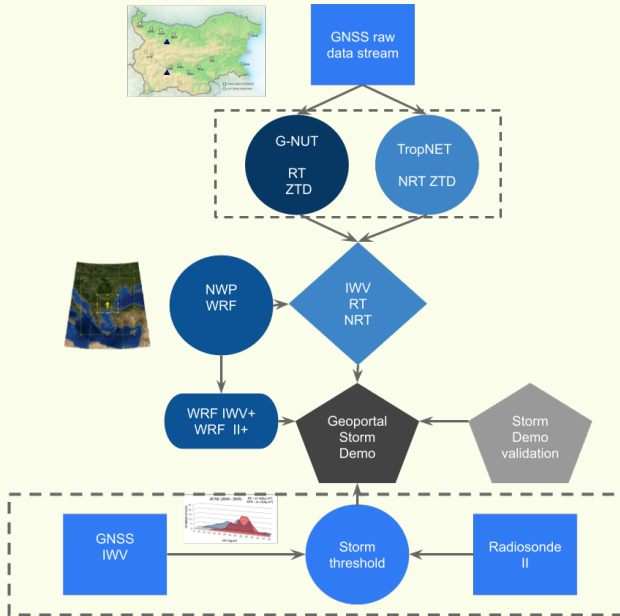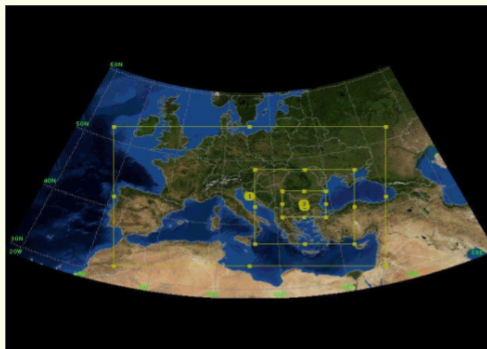PhysOn
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PHYSON: University of Sofia Parallel Computer Center

- 2005 - National Scientific Research Fund
- 256 core high performance Linux cluster
- http://physon.phys.uni-sofia.bg/about-physon-en

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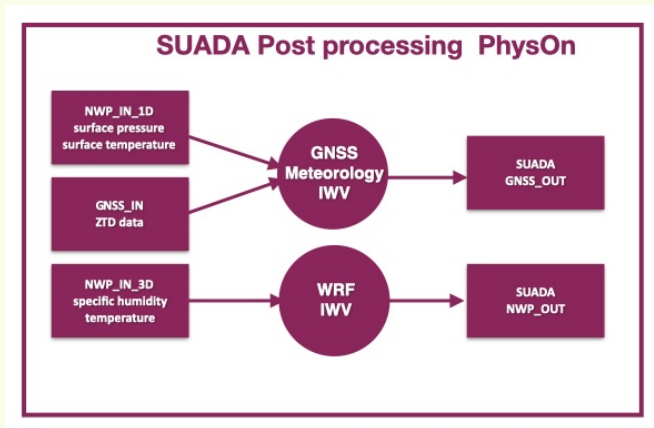G.Guerova

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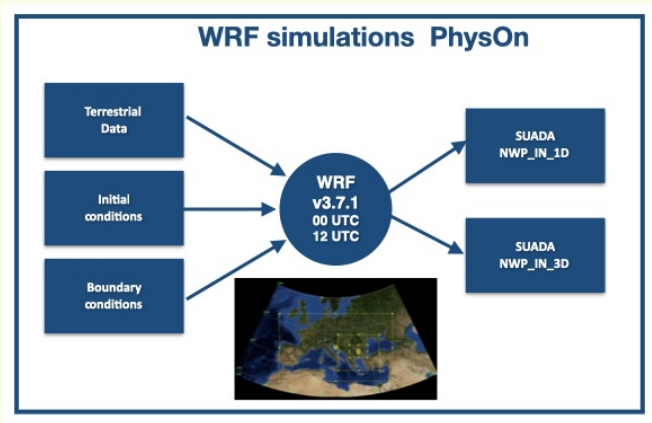
Weather Research and Forecasting (WRF) model: set-up

- 2 daily forecasts5
- 2 km horizontal resolution
- 45 vertical levels

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PHYSON: Sofia University Atmospheric Data Archive (SUADA)

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PHYSON: StormDemo Geoportal*

- hosted by Sofia University Atmospheric Data Archive
- public access with real-time and near-real time IWV update for operational use
- http://suada.phys.uni-sofia.bg/?page_id=4838
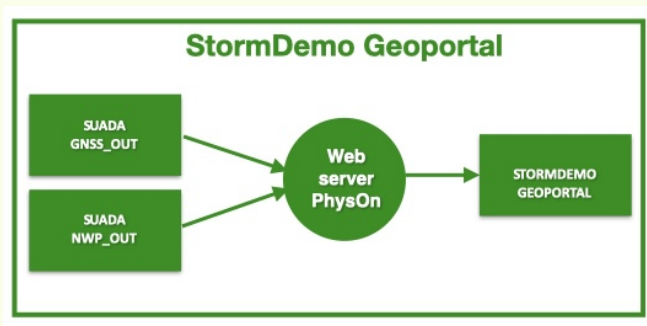
*Guerova et al. 2022. GNSS storm nowcasting demonstrator for Bulgaria, Remote sensing, 14/15, 3746. doi:10.3390/rs14153746

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Severe weather in Bulgaria: 1-3 September 2022

- National Institute of Meteorology & Hydrology - yellow and orange code
- record daily precipitation registered - 200 mm/day
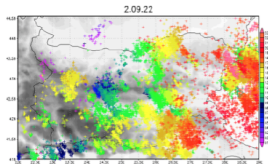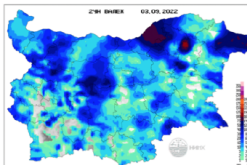- intense thunder storm activity
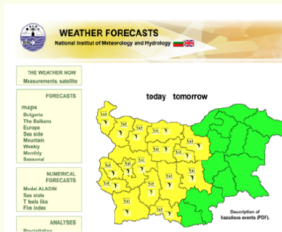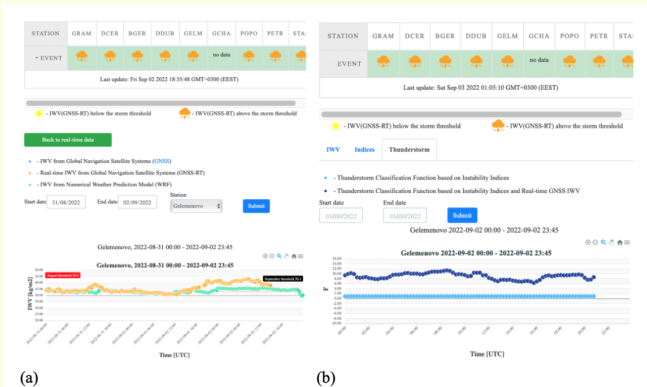

(a) (b) (c)

(d) (e) (f)

Severe weather in Bulgaria: 2 September 2022

- observed humidity above the monthly threshold
- WRF model underestimates the humidity during severe weather
- exceptionally high values for classification function including humidity observations

(a)   (b)

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Severe weather in Bulgaria: 3 September 2022

- StormDemo clear sky from west to east
- drop in humidity below the monthly threshold
- technical problems at one station close to the region of the flooding

(c)   (d)   (e)

- PhysOn - critical infrastructure for Storm Demonstrator
- HPC computation + SQL database + Web server
- First Storm Demonstrator for Bulgaria in real time
- High temporal resolution of humidity information comparable with weather radar data
- Geoportal with public access and timely update of observations and Numerical Weather Prediction Model

THANK YOU!