

Investigation of the accuracy of "Košava" wind forecasting using different ECMWF products



**STRONG "KOŠAVA" WITH VIOLENT STORM AND HURRICANE FORCE
WIND GUSTS IN NORTH AND NORTH-EAST PARTS OF SERBIA
FEBRUARY 2014.**

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About "Košava"

"Košava" is strong south-east wind:

- average wind speed is 5 to 10 m/s (18- 36 km/h)
- usually lasts two or three days.
- area of "Košava" includes north (N) and north-east (NE) parts of Serbia
- the strongest wind gusts are in southern Banat region (Vršac).

Wind gusts are:

Usually: ≥ 17 m/s (60 do 85km/h)

yellow warning/ potentially dangerous

Occasionally: 17- 24m/s (85- 100 km/h)

orange warning/ dangerous

Rarely: ≥ 24 m/s (≥ 100 km/h)

red warning/ very dangerous

Strong "Košava" can be hazardous for human lives, it can cause significant damage of assets, traffic and construction problems as well.

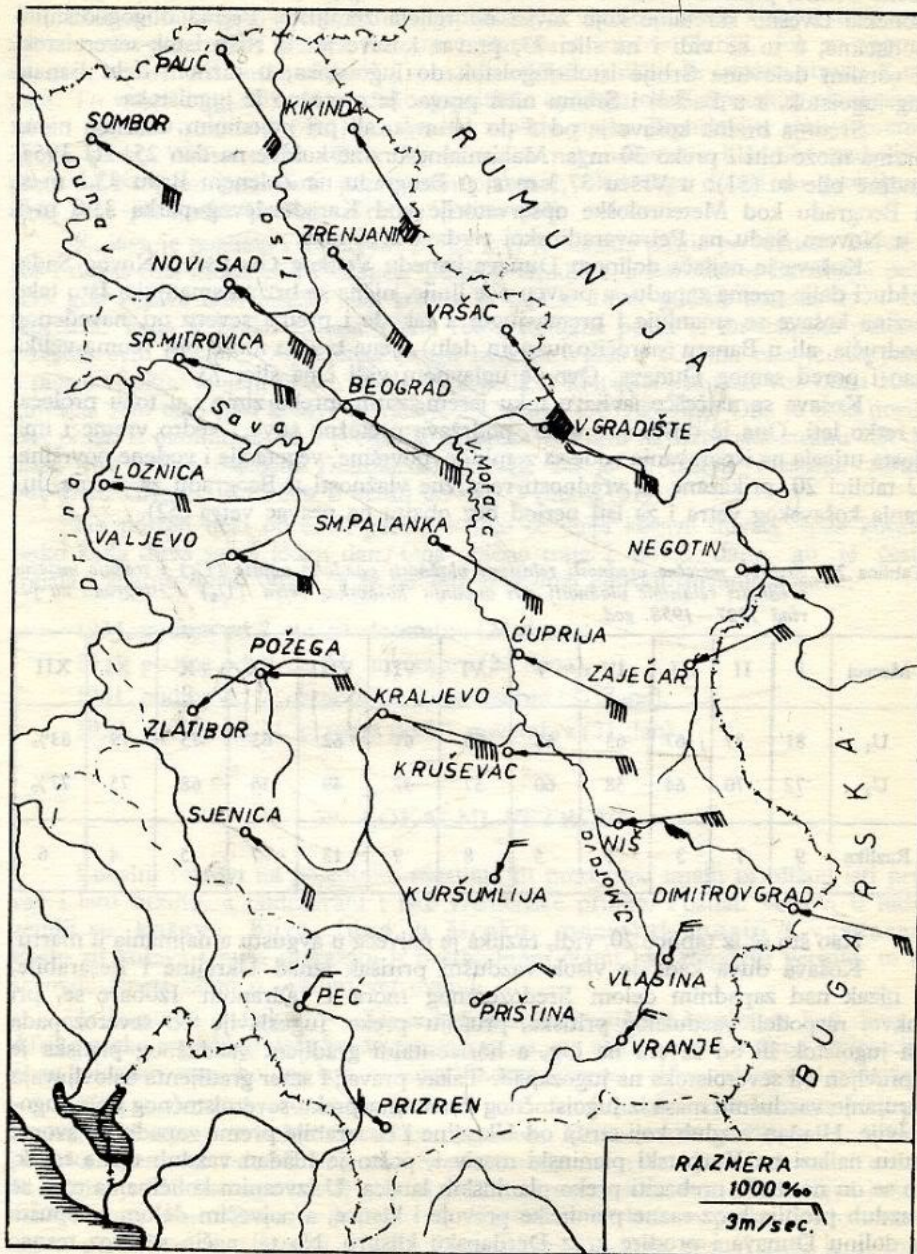
From 30.01 until 04.02.2014.

strong "Košava" was affected Serbia with violent storm and hurricane force wind gusts.

The strongest gusts were recorded

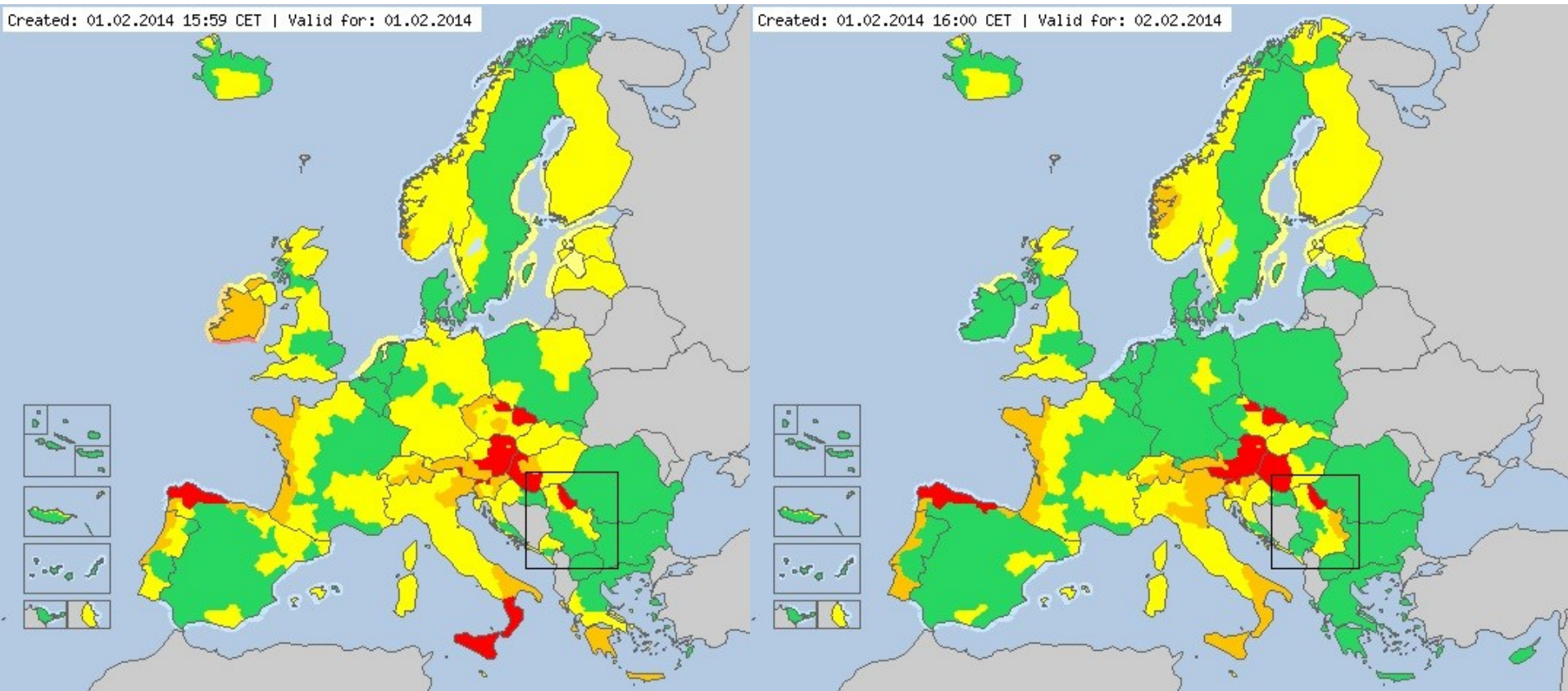
1.02 – 170 km/h in Vršac, which is a **second** strong wind gust **ever recorded** in Serbia.

– 104 km/h in Belgrade



Slika 73. Rezultante pravca košavskog vetra i srednja brzina vetra u m/s u Srbiji i Vojvodini u vremenu od 25. do 29. marta 1957. godine.

Following the procedure of the European Meteoalarm system, national service of Serbia (RHMZS) issued the highest degree (red) warning for strong SE winds, in N and NE parts of the country, which was valid for 1st and 2nd of February this year



Warning was issued on 1st of Feb at 16UTC(17:00 local time)

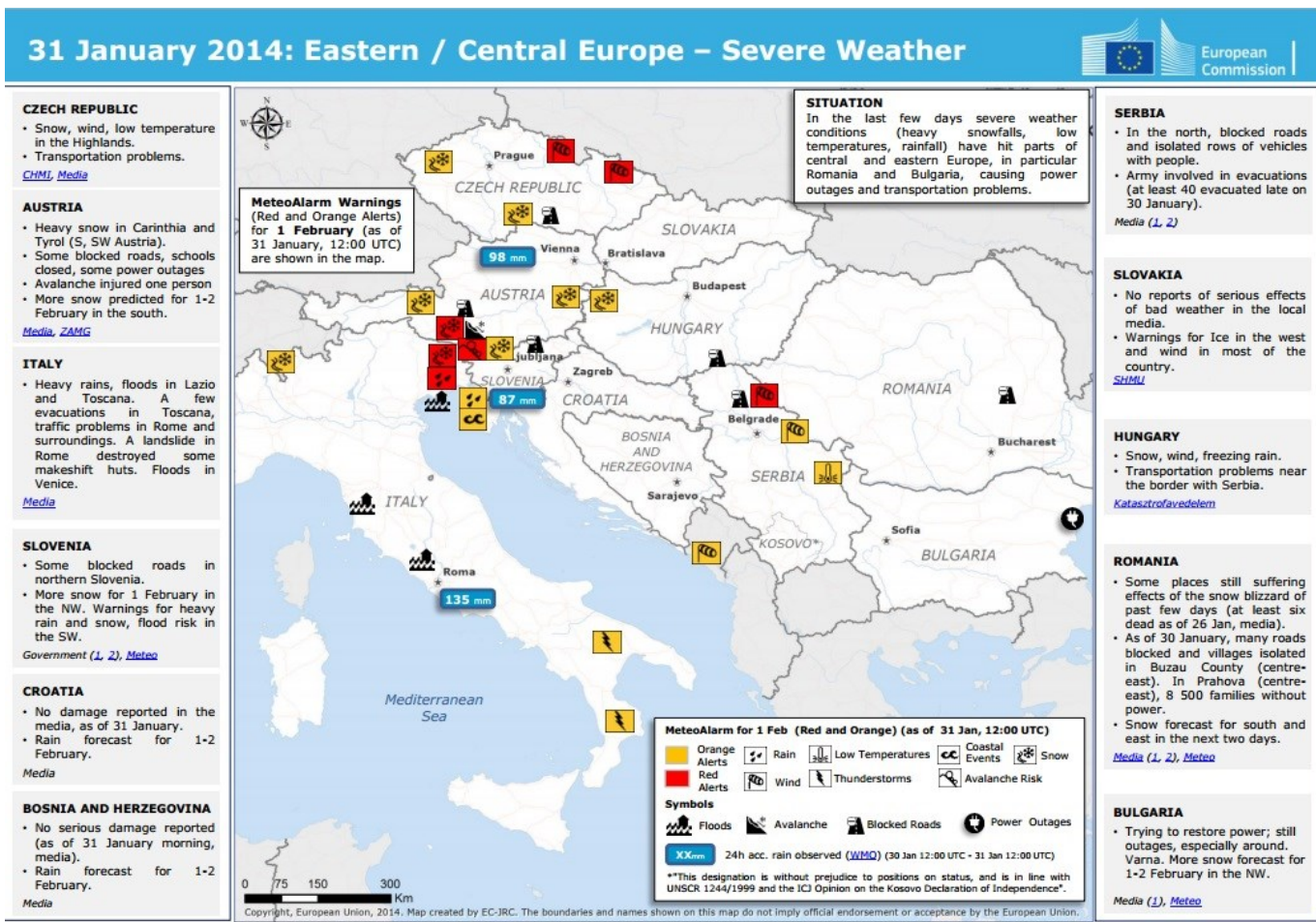
Red - the weather is very dangerous: wind gust > 100km/h

Orange - the weather is dangerous: 85 km/h < wind gust < 100 km/h

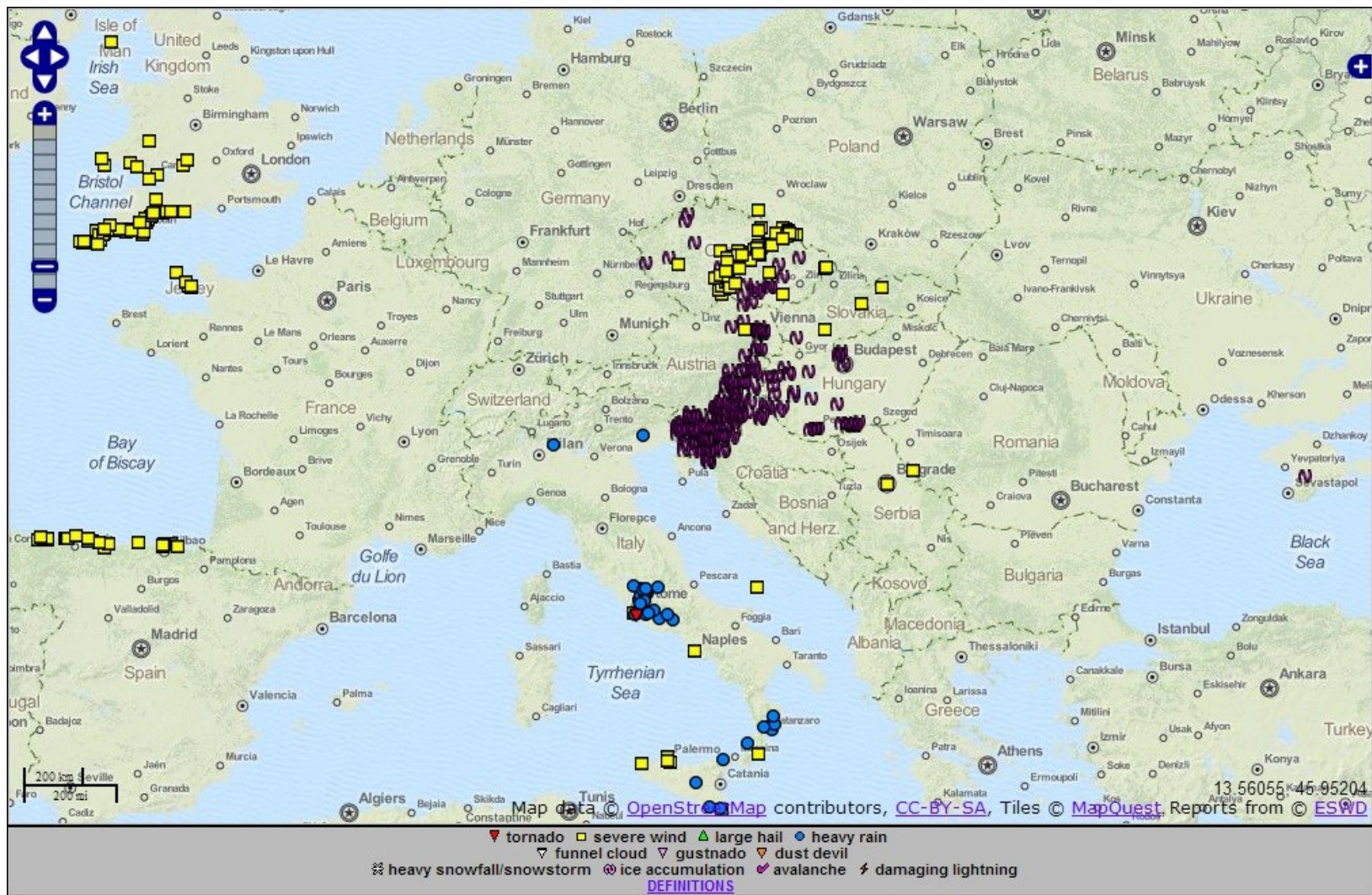
Yellow - the weather is potentially dangerous: 60 km/h < wind gust < 85 km/h

Green - no risk

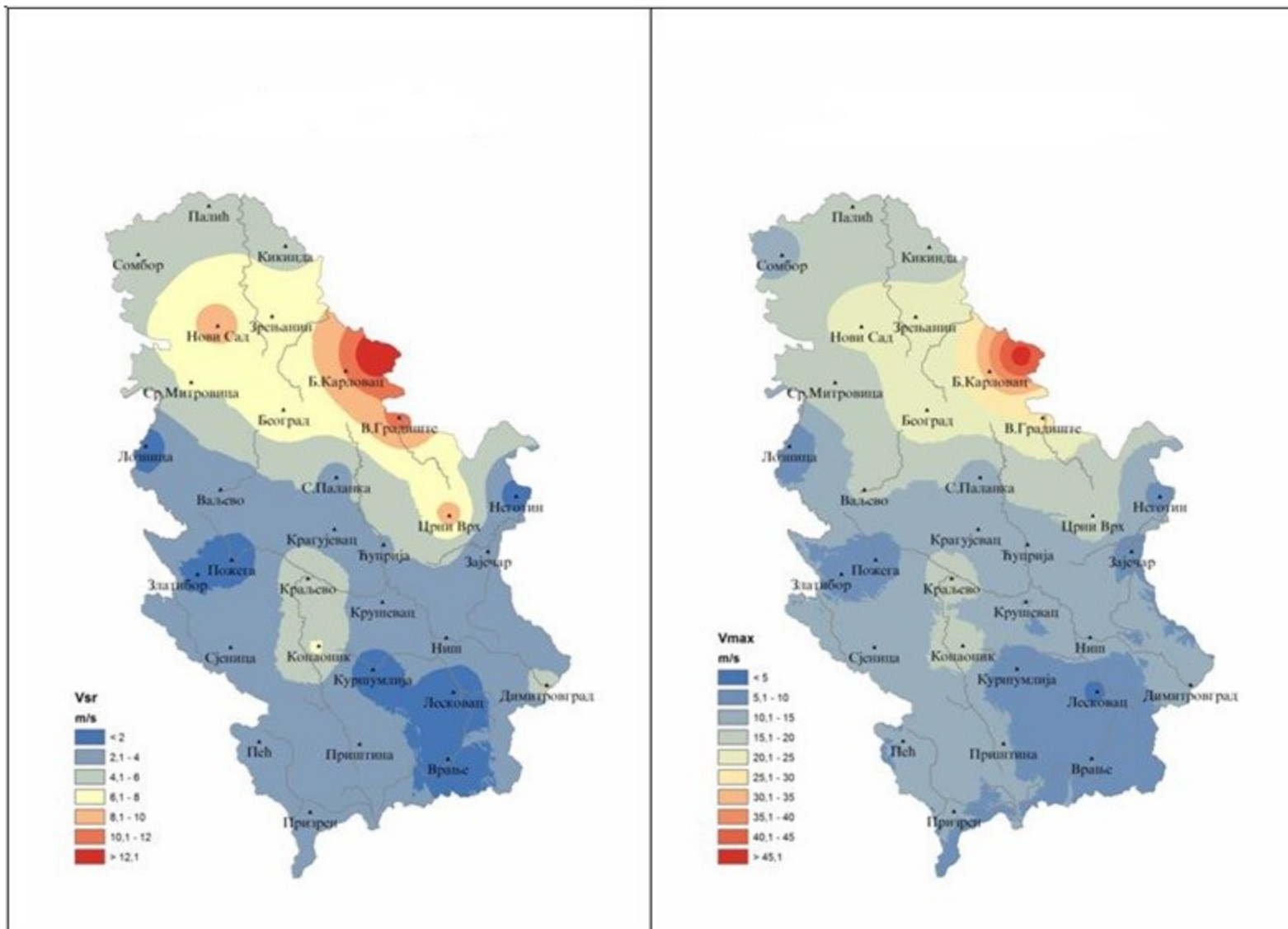
Web portal of the European Commission broadcasted this warning of dangerous meteorological phenomena based on metealarm.eu



European Severe Weather Database between 30.01.2014. 00UTC and 04.02.2014. 24UTC



Average wind speed (left) and strongest wind gusts (right) from 29.01 to 04.02.2014



The strongest wind gusts were on 1st/2nd of February

01.02.2014

In south Banat (Vrsac), wind gust of **170 km/h** was recorded, which is the **second strongest wind gust ever recorded in Serbia!**

In Belgrade, wind gust of **104,4 km/h was recorded**, which is the **9th** strongest wind gust ever recorded in capital city

Aiport Vrsac station, LYVR (13183)

Datum	Udari
11. 01. 1987.	173km/h
01.02.2014 , 24.02.1988.	170km/h
15. 01. 1987, 25. i 27. 11. 1987.	166 km/h
17.02.1979, 24.10.1987, 25.02.1988.	158 km/h

Belgrade station (13274)

Datum	Udari
17.10.1976.	130 km/h
17.02.1979.	121 km/h
16.02.1979.	114 km/h
18.01.1972.	112 km/h
16.10.1976., 17.01.1978.	110 km/h
26.02.1984.	108 km/h
16.01.1973.	107 km/h
15.03.1980.	106 km/h
01.02.1014.	104, 4 km/h

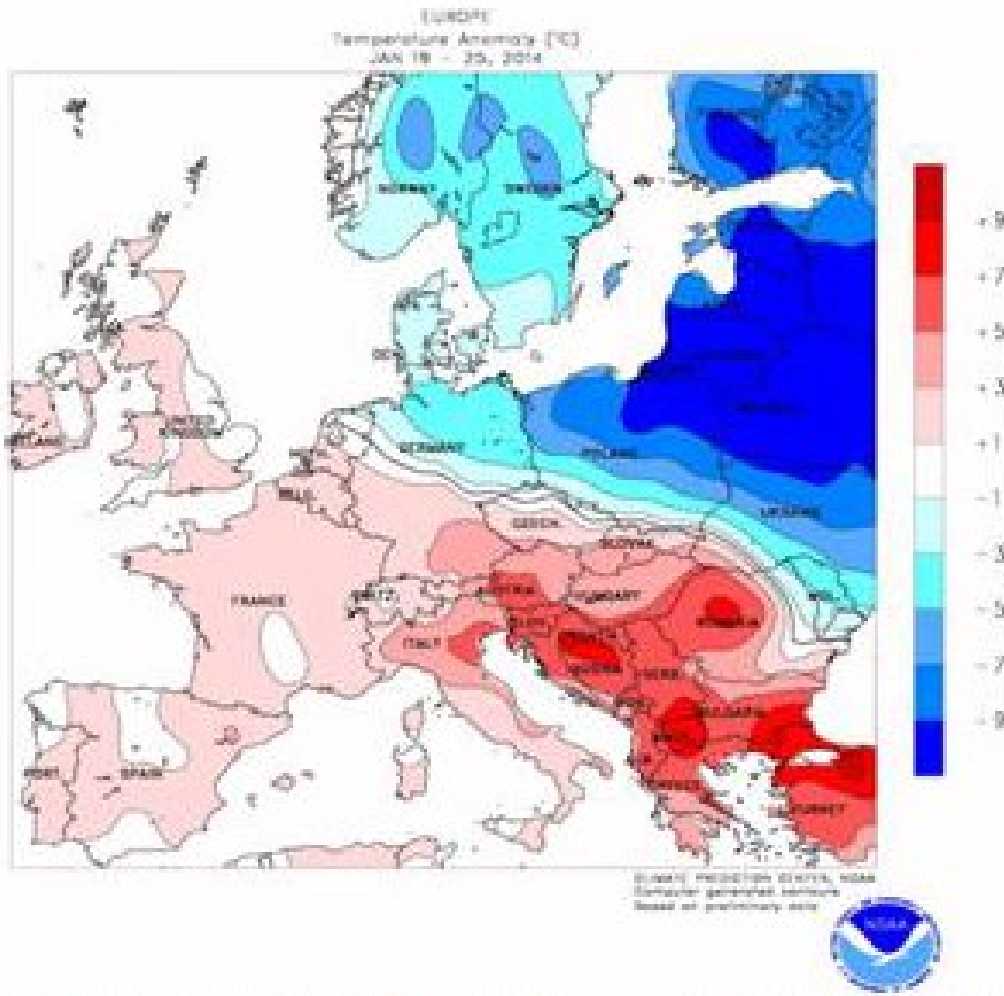
02.02.2014. Gusts were slightly weaker:

Vrsac 151 km/h,

Belgrade still about 104 km/h.

Going to the north and west, wind gusts were slightly weaker.

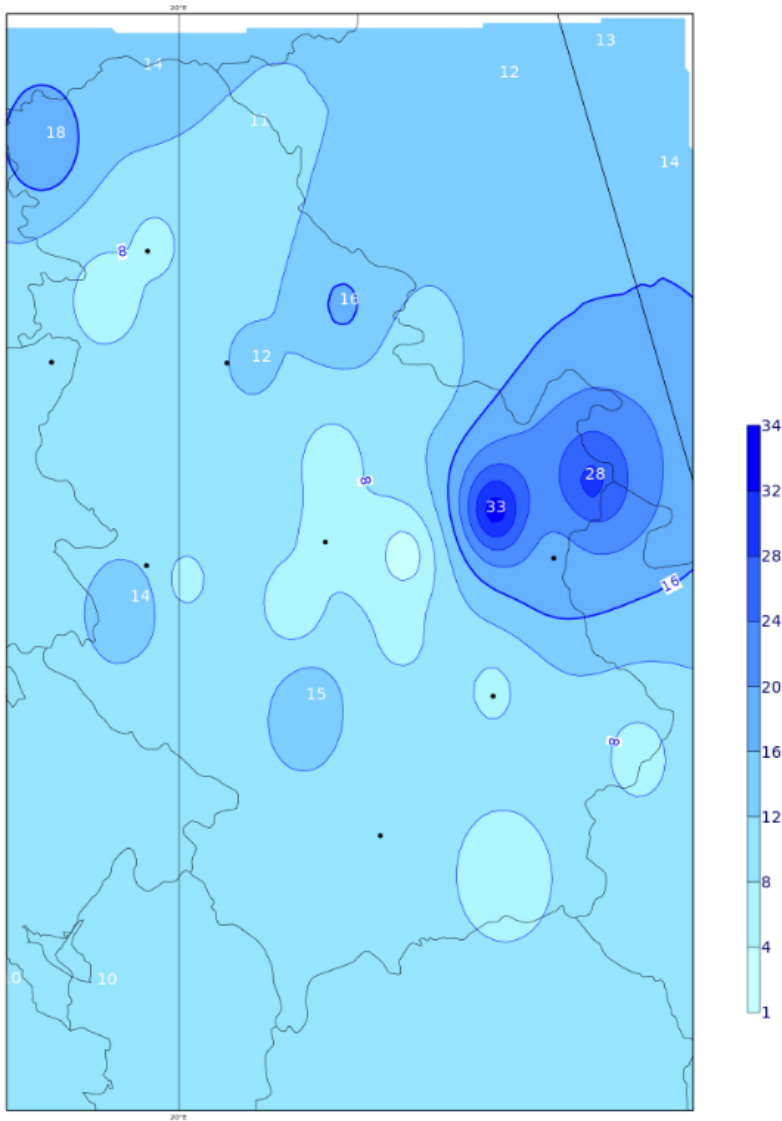
Details about weather situation which preceded this extreme wind event: 19th to 24th of Jan



- January of 2014. was warmer than average
- on the Balkan Peninsula from 19th to 24th of Jan according to the analysis of the U.S. NOAA, the mean monthly temperature was 3° to 7°C higher than average and that was the period without precipitation as well.

NOAA: Temperature deviations from average for this period

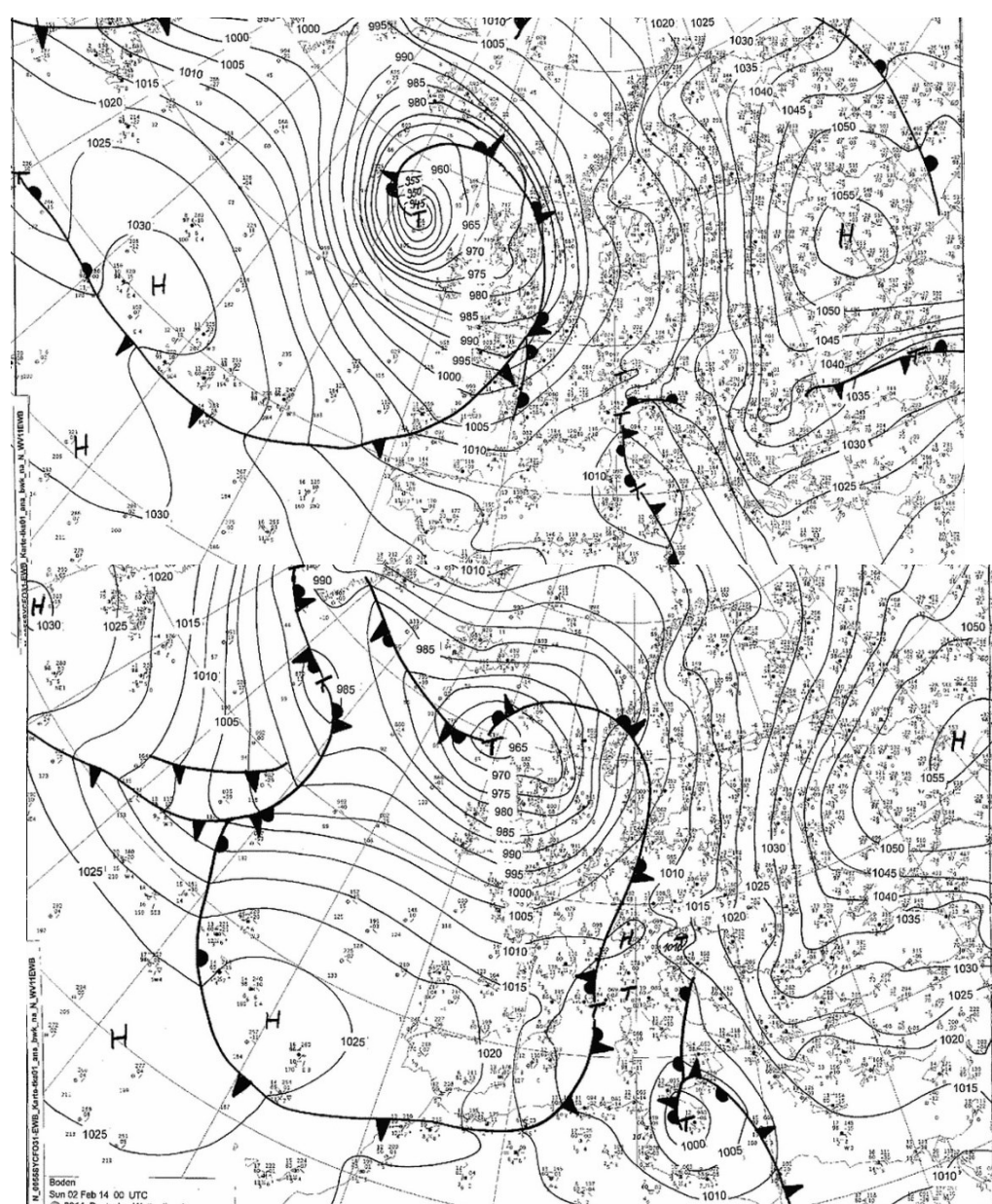
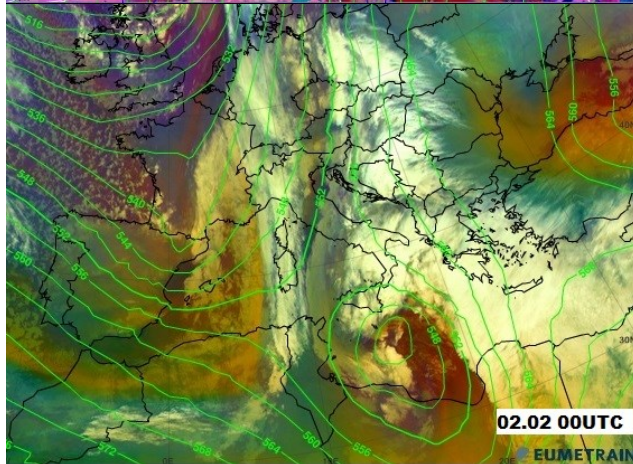
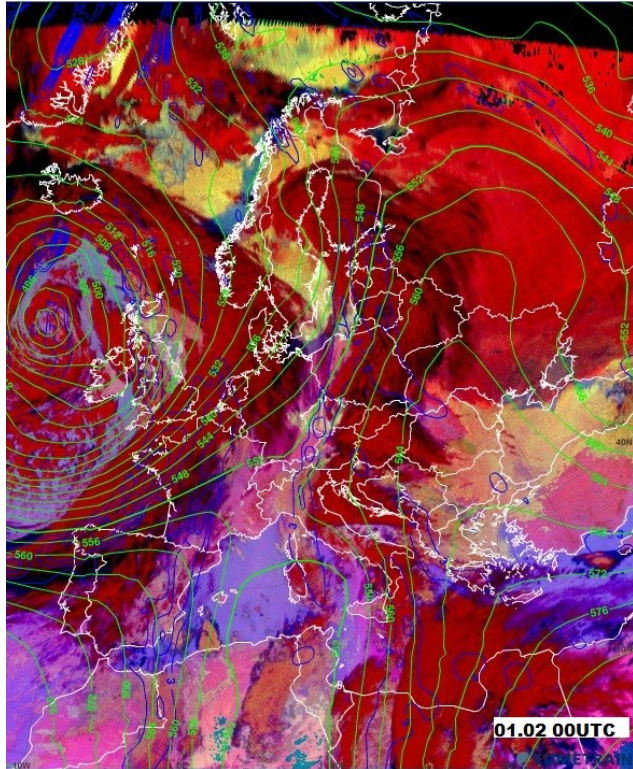
Weather situations from 24th to 29th of Jan



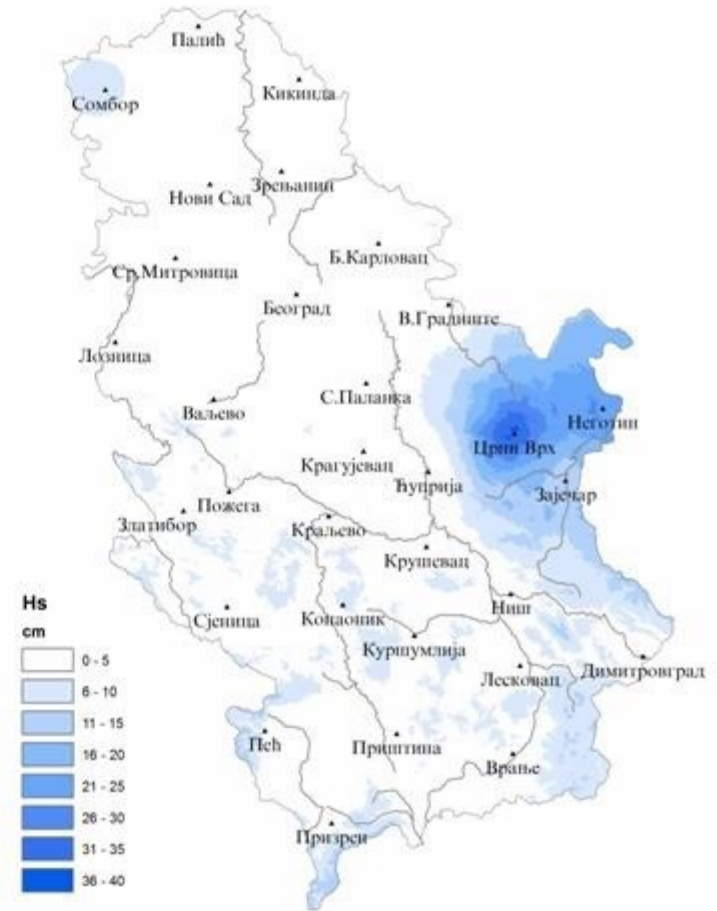
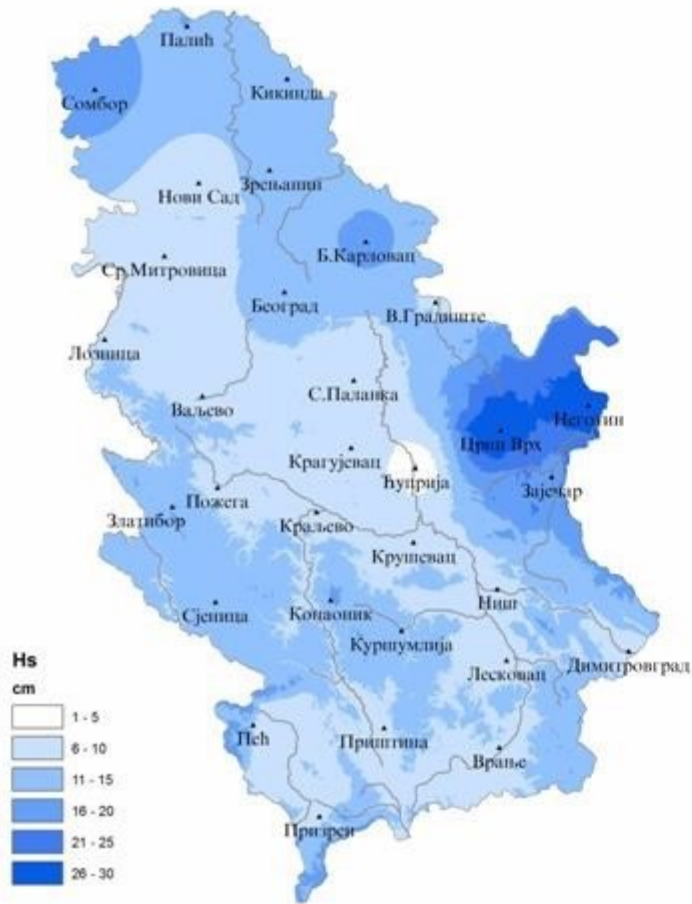
January 29th : snow depth

- On 24th of Jan significant change occurred:
cold front passed,
surface temperature dropped,
this front produced some precipitation:
at first rain, then freezing rain and at the end snow
- from 25th until 29th of Jan
it was snowing,
the largest amounts of new snow were measured
in east Serbia about 30 cm,
in northeast parts from 10 to 20cm
in the rest of the country, new snow amounts were below these values

Synoptic situations from 1st and 2nd of February (h500 and mslp, night microphysics / airmass RGB)



Snow depth before (left) and after (right) the strong "Košava " event



The main issue besides strong winds were snowdrifts in northern Serbia, reaching 2m in height and caused the condition

of natural disasters (severe weather)

* flat terrain in N Serbia contributed to this extreme event



Due to the declaration of emergency the Serbian army, police and a number of utilities were involved





The Automobile and Motorcycle Association of Serbia (AMSS): traffic report for 1st of Feb at 12h

* traffic closure in both directions,

*highway E-75 is important for traffic between Hungary and Serbia



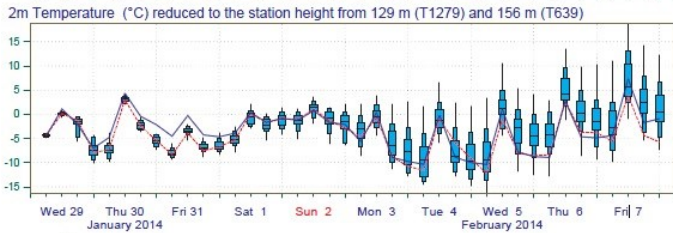
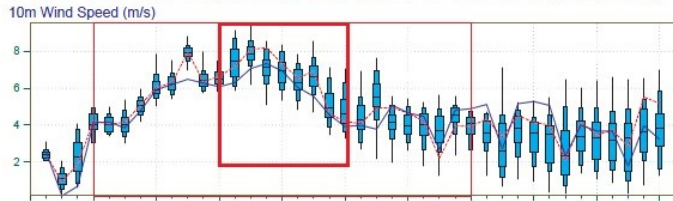
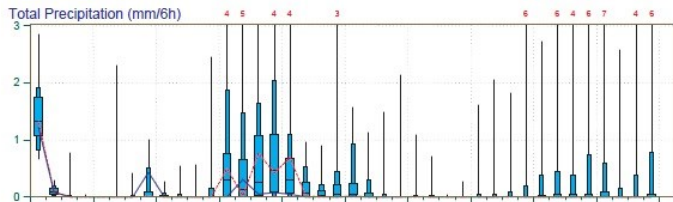
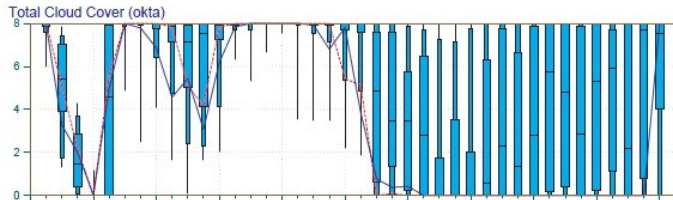
For forecasting strong "Košava", with violent storm or hurricane force wind gusts, besides basic products of deterministic model ECMWF, next few products we found very useful:

extreme forecast index EFI for wind gust, wind speed, EFI distribution, ENS meteograms, probabilities: 24h maximum of 10m wind gust.

The main goal of this analysis is to determine how these parameters can affect forecasting of strong "Košava" winds in Belgrade and southern Banat area. SYNOP data for Belgrade station (13274) and Airport Vršac, LYVR (13183) were used in this analysis.

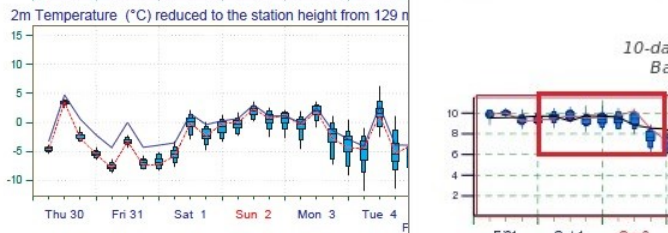
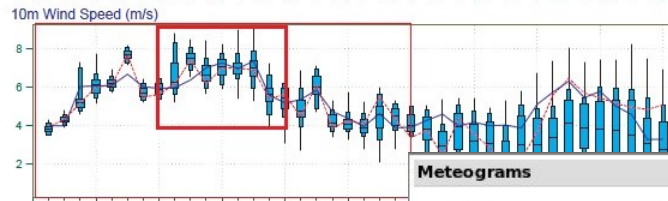
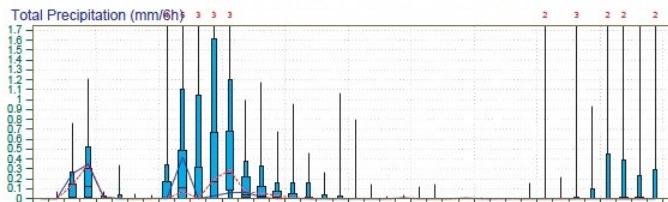
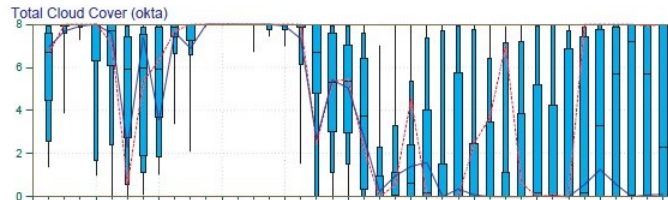
Eps Meteogram for Belgrade, model run 29.01, 30.01, 31.01 at 00UTC

EPS Meteogram
44.54°N 20.25°E (EPS land point) 129 m (T1279)
Deterministic Forecast and EPS Distribution Wednesday 29 January 2014 00 UTC



max
90%
75%
median
25%
10%
min
EPS Control(31 km) High Resolution Deterministic(10 km)

EPS Meteogram
44.54°N 20.25°E (EPS land point) 129 m (T1279)
Deterministic Forecast and EPS Distribution Thursday 30 January 2014 00 UTC

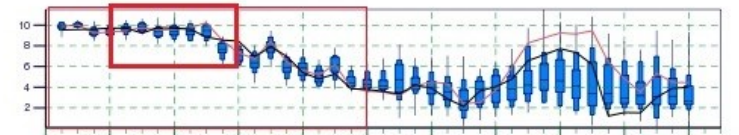


max
90%
75%
median
25%
10%
min
EPS Control(31 km) High Resolution Deterministic(10 km)

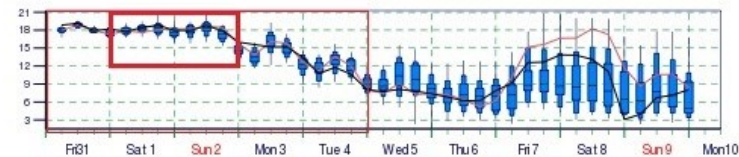
01.02.1014:
104, 4 km/h (29m/s)

Meteograms + More ... + Load

10-day epsgram 10m wind speed (m/s)
Base date: Friday 31 Jan, 00 UTC

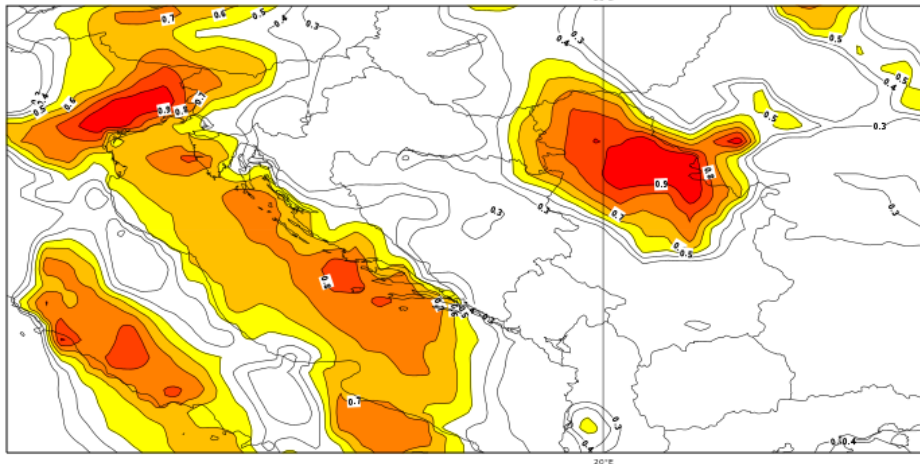


10-day epsgram 10m wind gust (m/s)
Base date: Friday 31 Jan, 00 UTC

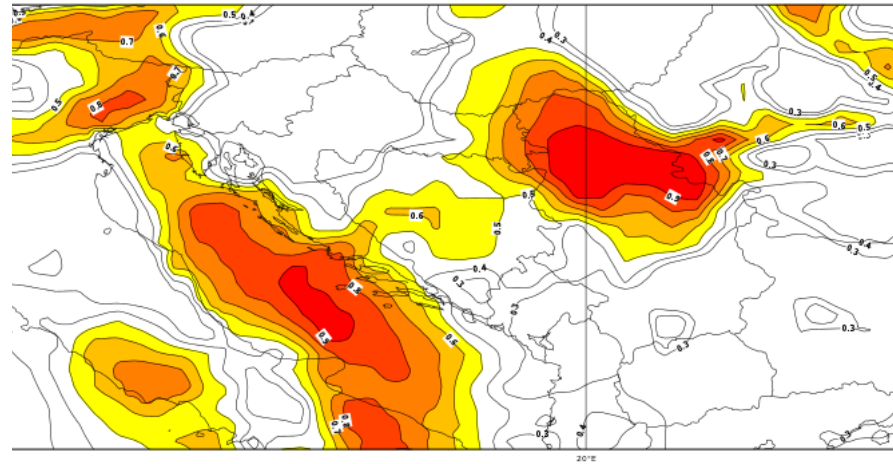


model run 31.01 at 00UTC: EFI wind gust for 01, 02, 03, 04 and 05.02

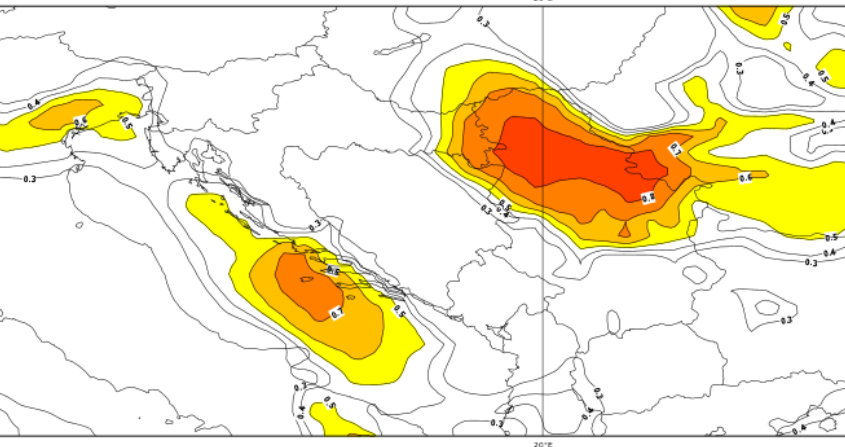
EFI 10 metre wind gust index
ST: Friday 31 January 2014 at 00 UTC VT: Saturday 01 February 2014 at 00 UTC STEP: 0-24



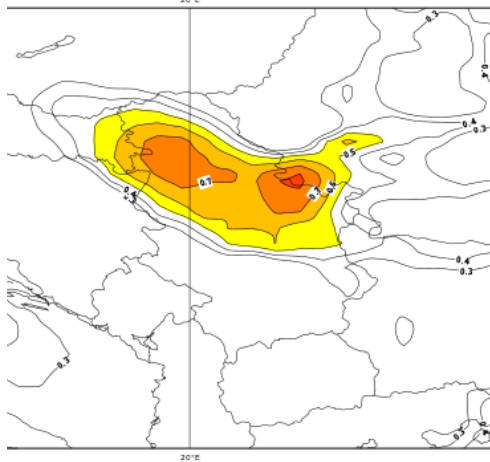
EFI 10 metre wind gust index
ST: Friday 31 January 2014 at 00 UTC VT: Sunday 02 February 2014 at 00 UTC STEP: 24-48



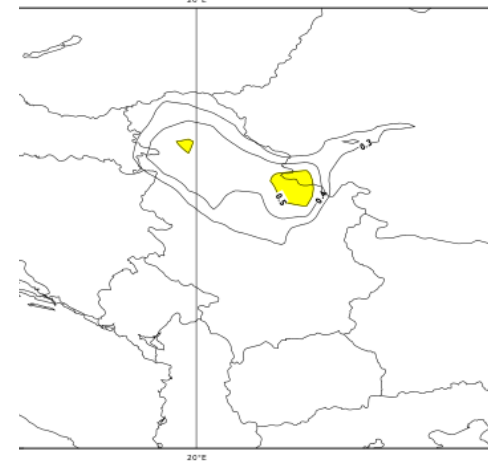
EFI 10 metre wind gust index
ST: Friday 31 January 2014 at 00 UTC VT: Monday 03 February 2014 at 00 UTC STEP: 48-72



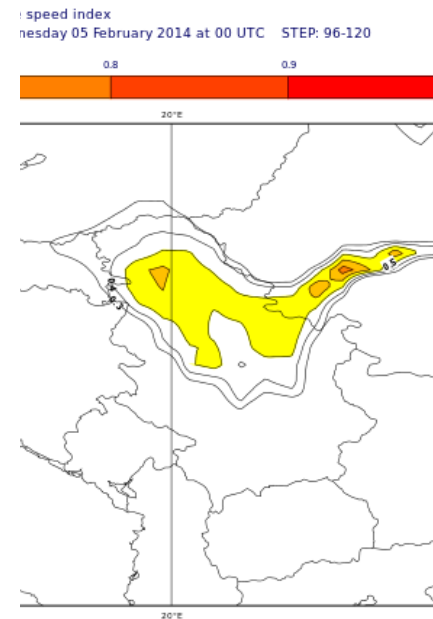
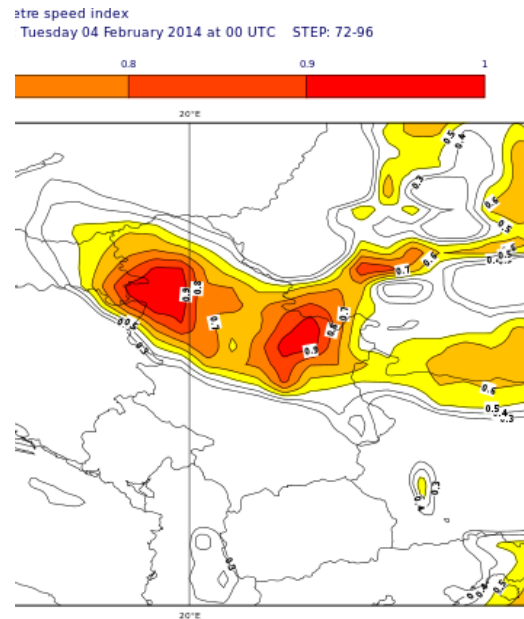
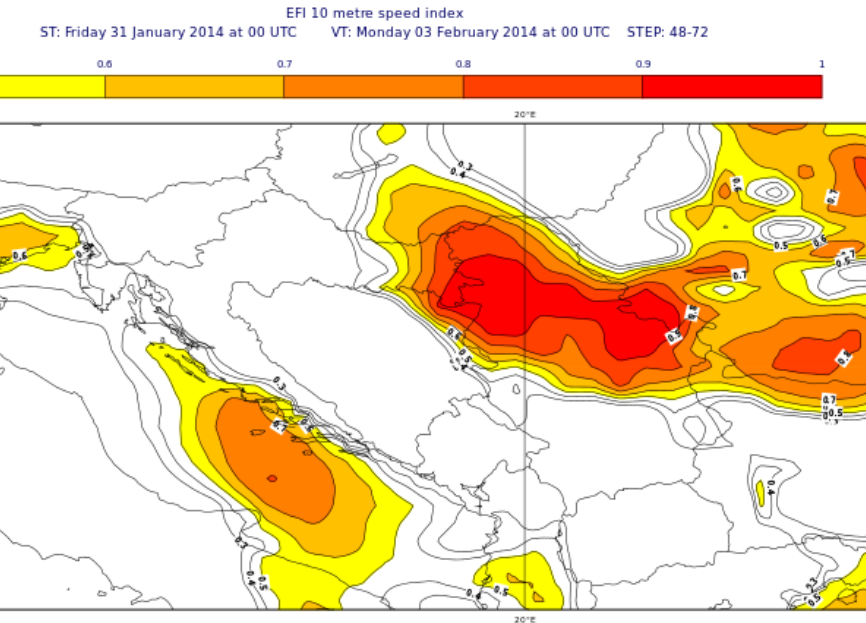
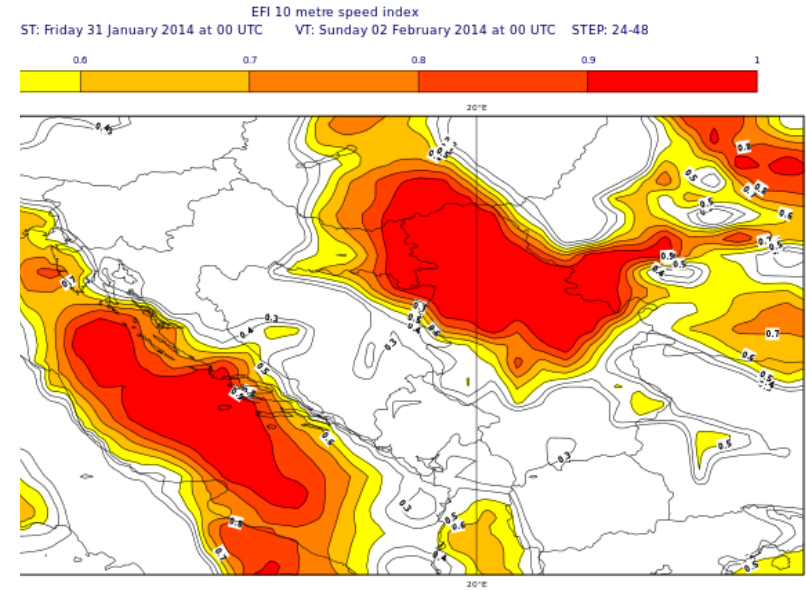
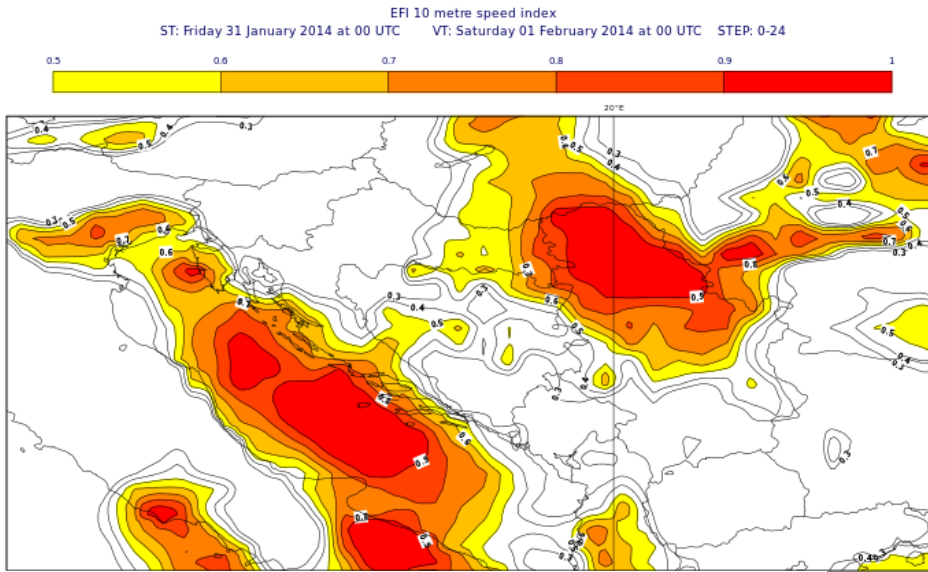
EFI 10 metre wind gust index
VT: Tuesday 04 February 2014 at 00 UTC STEP: 72-96



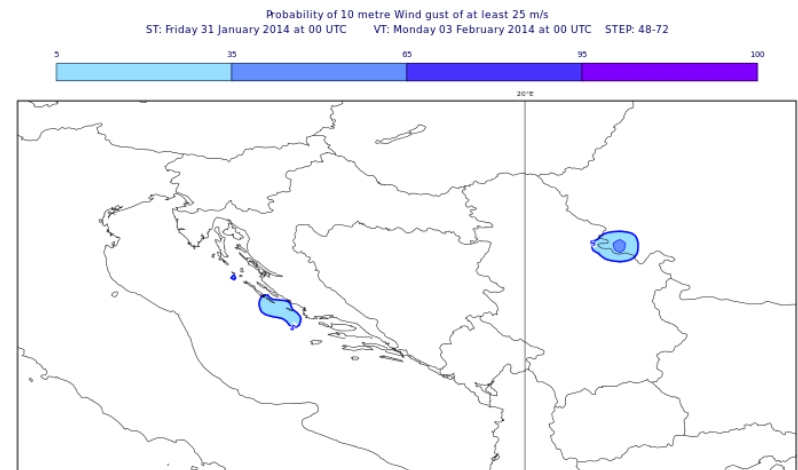
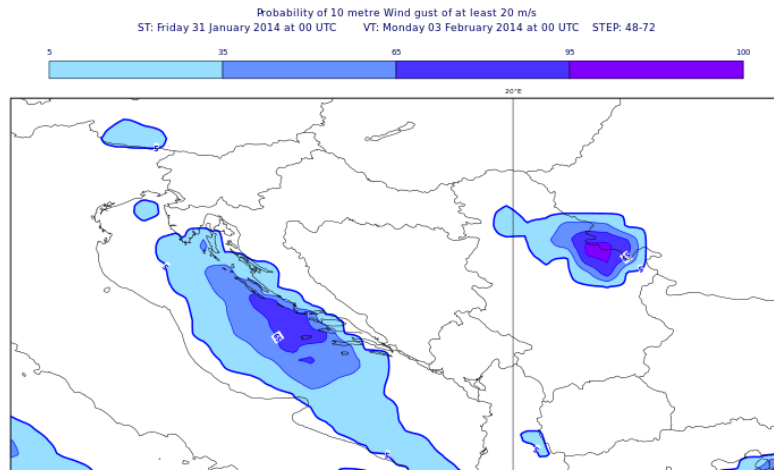
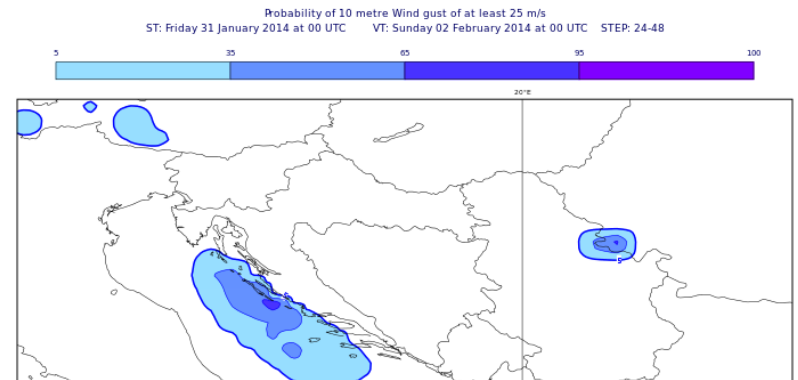
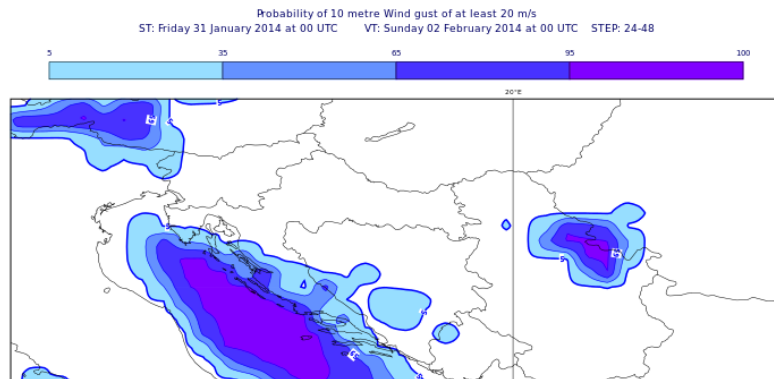
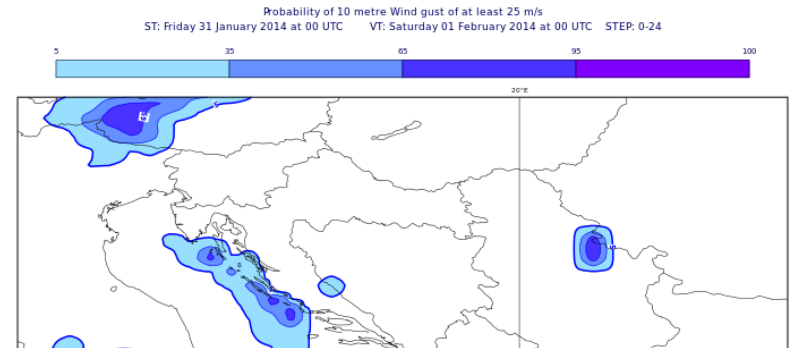
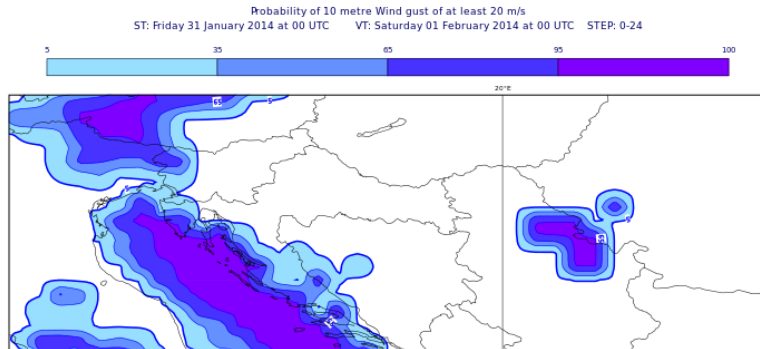
EFI 10 metre wind gust index
VT: Wednesday 05 February 2014 at 00 UTC STEP: 96-120



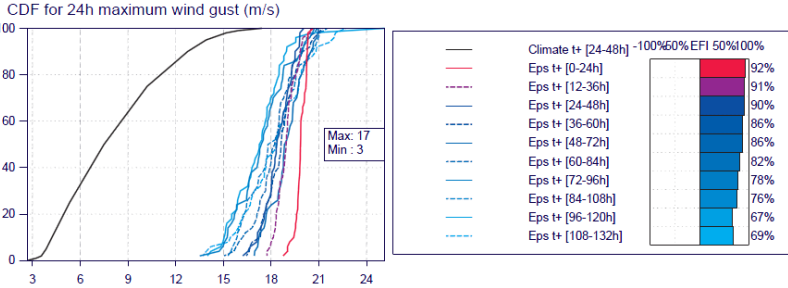
model run 31.01 at 00UTC: EFI wind speed for 01, 02, 03, 04 and 05.02



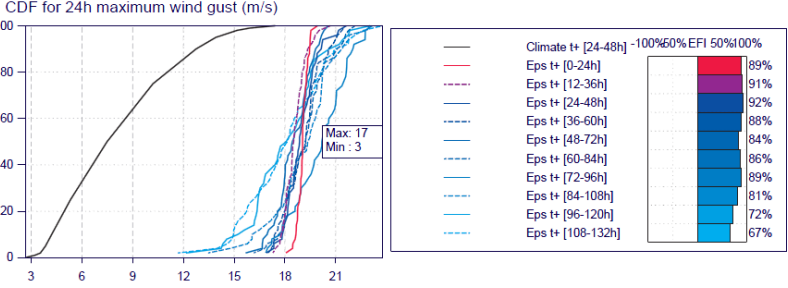
model run 31.01 at 00UTC: Probability of 10m wind gust $\geq 20, 25$ m/s for 01, 02, 03.02



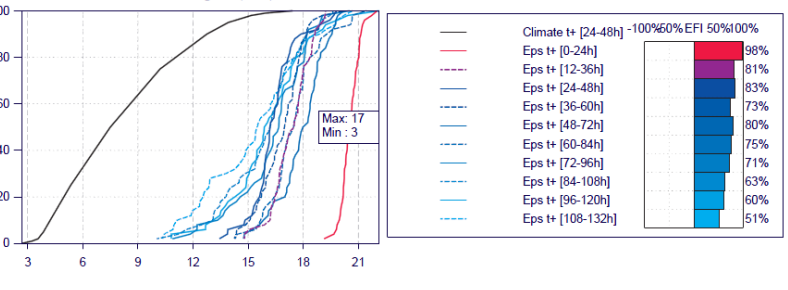
Forecast and M-Climate cumulative distribution functions with EFI values at 45.06°N/21.18°E valid for 24 hours from Friday 31 January 2014 00 UTC to Saturday 1 February 2014 00 UTC



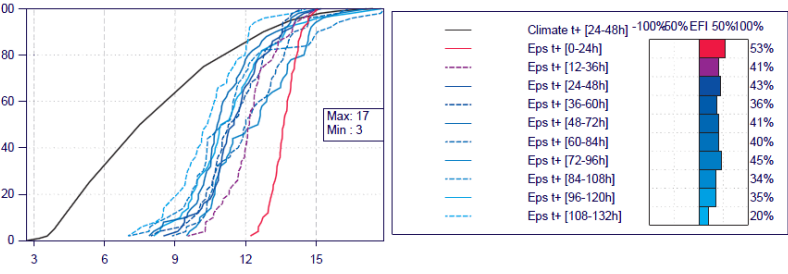
Forecast and M-Climate cumulative distribution functions with EFI values at 45.06°N/21.18°E valid for 24 hours from Saturday 1 February 2014 00 UTC to Sunday 2 February 2014 00 UTC



Forecast and M-Climate cumulative distribution functions with EFI values at 45.06°N/21.18°E valid for 24 hours from Sunday 2 February 2014 00 UTC to Monday 3 February 2014 00 UTC



Forecast and M-Climate cumulative distribution functions with EFI values at 45.06°N/21.18°E valid for 24 hours from Monday 3 February 2014 00 UTC to Tuesday 4 February 2014 00 UTC



CDF for wind gust (m/s) for Vršac * (Cumulative distribution function)

- black solid line is CDF of the M-Climate
- over 18 years, for ± 2 weeks relative to validity date
- the other color lines is CDF of the 50 ensemble members

• All forecasted curves are very steep, they are very distant and right from M-Climate

• Feb 1st and 2nd, when the strongest gusts were observed (2nd and 3rd graph):

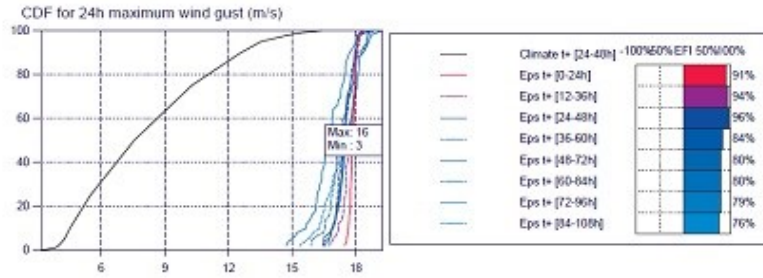
60, 70% members of the ensemble predicted 120h or 5 days in advance that the wind gusts will be significantly above maximum values of climatology model

percentage increased with each new start model,

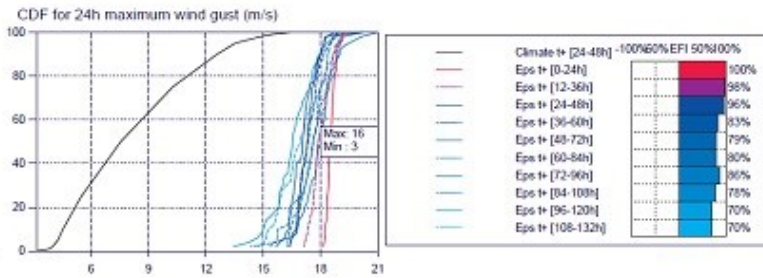
48h IN ADVANCE -OVER 80, EVEN 90% of the members ensemble predicted wind gusts significantly ABOVE of model CLIMATOLOGICAL VALUE!!

• Based on the last diagram, we can conclude that wind gust will begin to weakens

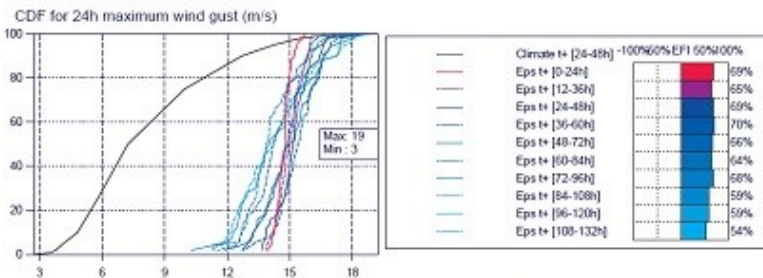
Forecast and M-Climate cumulative distribution functions with EFI values at 44.49°N/20.27°E valid for 24 hours from Friday 31 January 2014 00 UTC to Saturday 1 February 2014 00 UTC



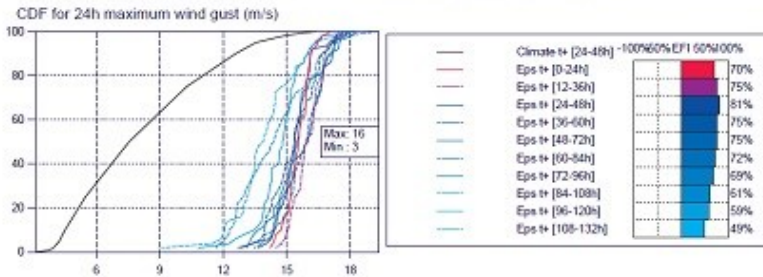
Forecast and M-Climate cumulative distribution functions with EFI values at 44.49°N/20.27°E valid for 24 hours from Saturday 1 February 2014 00 UTC to Sunday 2 February 2014 00 UTC



Forecast and M-Climate cumulative distribution functions with EFI values at 44.19°N/20.27°E valid for 24 hours from Sunday 2 February 2014 00 UTC to Monday 3 February 2014 00 UTC



Forecast and M-Climate cumulative distribution functions with EFI values at 44.49°N/20.27°E valid for 24 hours from Monday 3 February 2014 00 UTC to Tuesday 4 February 2014 00 UTC



CDF for wind gust (m/s) for Belgrade * (Cumulative distribution function)

- black solid line is CDF of the M-Climate
- the other color lines is CDF of the ensemble members
- All forecasting curves are very steep, they are very distant and on the right side from M-Climate

• Feb 1st and 2nd, when the strongest gusts were observed (2nd and 3rd graph):

60, 70% members of the ensemble predicted 120h or 5 days in advance that the wind gusts will be significantly above maximum values of climatology model

percentage increased with each new start model,

48h IN ADVANCE –OVER 90% of the members ensemble predicted wind gusts significantly ABOVE of model CLIMATOLOGICAL VALUE!!

• Based on the last diagram, we can conclude that wind gust on 3rd Feb will begin to weaken

Conclusion:

- The geographical position of Serbia is suitable for the occasional occurrence of the destructive winds, in winter it is Košava. In many cases, the strong winds causing blizzard, snowstorm, snowdrifts
- According to some research, north part of Serbia has the lowest level of forest coverage in Europe and installation of wind protection belts is absolutely necessary. Some projects about these protection belts has already been made by The Faculty of Forestry of the Belgrade University in cooperation with relevant government institutions.
- Numerical models are significantly improved over the last couple of years and some of them could help to forecasters when severe weather is likely to occur. Combination of forecasters experience and model performance will be the key of severe weather forecasting.
- Republic Hydrometeorological Service of Serbia provided timely warnings and forecasts for this extreme weather event, justifying a significant and responsible role in the system of protection and rescue.
- That is why the Hydrometeorological system for early warning and alarm should continue developing in the future.

- **Literature:**
- <http://www.hidmet.gov.rs/>
- <http://www.ecmwf.int/en/forecasts/charts>
- <http://www.eumetrain.org/>
- <http://www2.wetter3.de/fax/>
- <http://www.theweatherprediction.com/>
- <http://ercportal.jrc.ec.europa.eu/Maps/Daily-Maps-Catalogue>
- <http://www.essl.org/cgi-bin/eswd/eswd.cgi>
- METEOROLOGIJA – dr Marko Milosavljević
- Štampa: Blic, Vreme, Politika, Novosti

- ***NAJVIŠE HVALA!***
Milani Vučkovič, Aleksandri Arsić, Miroljubu Zariću i Danici Rajić!