

*Regional Cooperation for  
Limited Area Modeling in Central Europe*



# ALARO experiences in Croatia

Martina Tudor



**ARSO METEO**  
Slovenia

# Clim files and e923

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ALARO1vA modifications were ported to CY38T1.

Tests were performed on one month, March 2016, as for alternative physiography fields.

So far, the tests reveal higher sensitivity to the change in physiography than to more advanced physics parametrisations. Particularly, the 10 m wind in severe weather conditions is very sensitive to the surface roughness.

The lowest model level is at 17 m.

2 km resolution NH run on a quadratic grid.



ZAMG

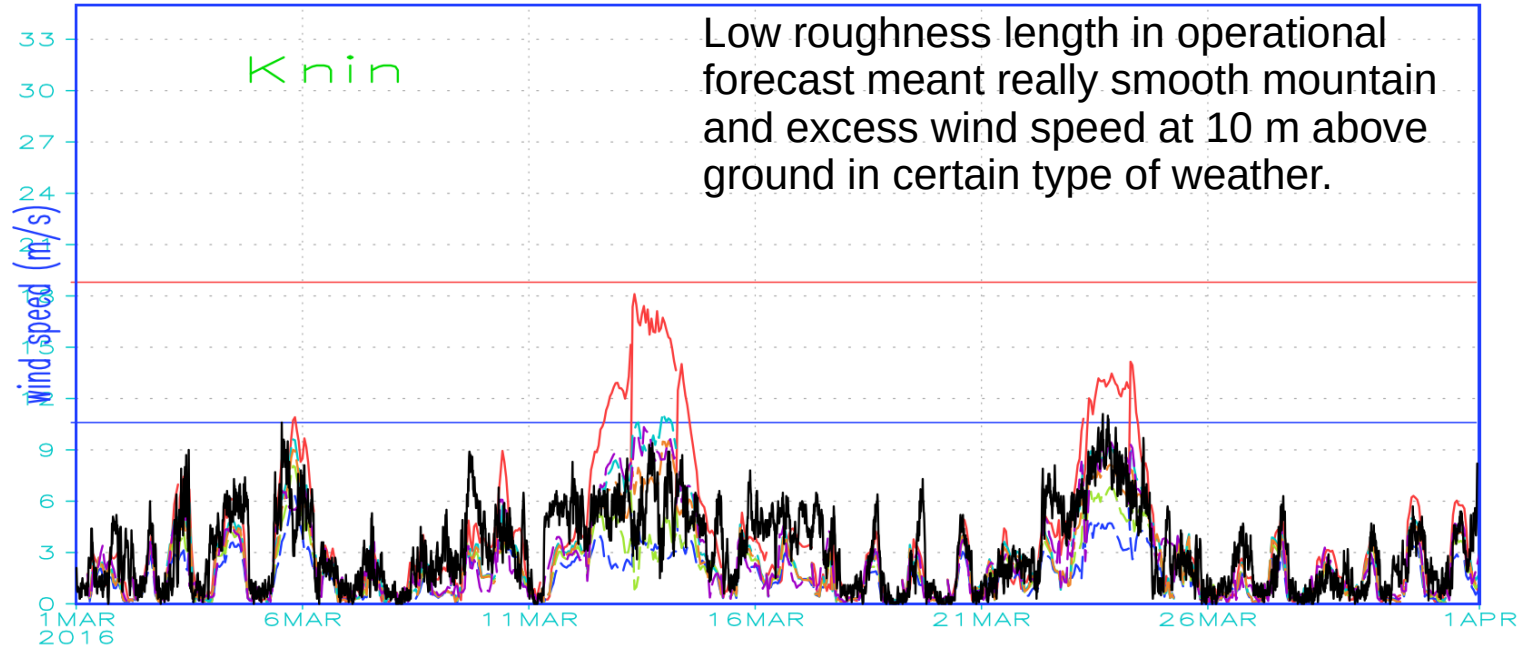


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# Clim files and e923

automatic  
 lon=16.20  
 lat=44.03  
 Hp=255  
 hr22  
 Hm=272.

hr22nc  
 1/2z0  
 1/4z0  
 1/3z0  
 sqrtz0  
 Hm=272.



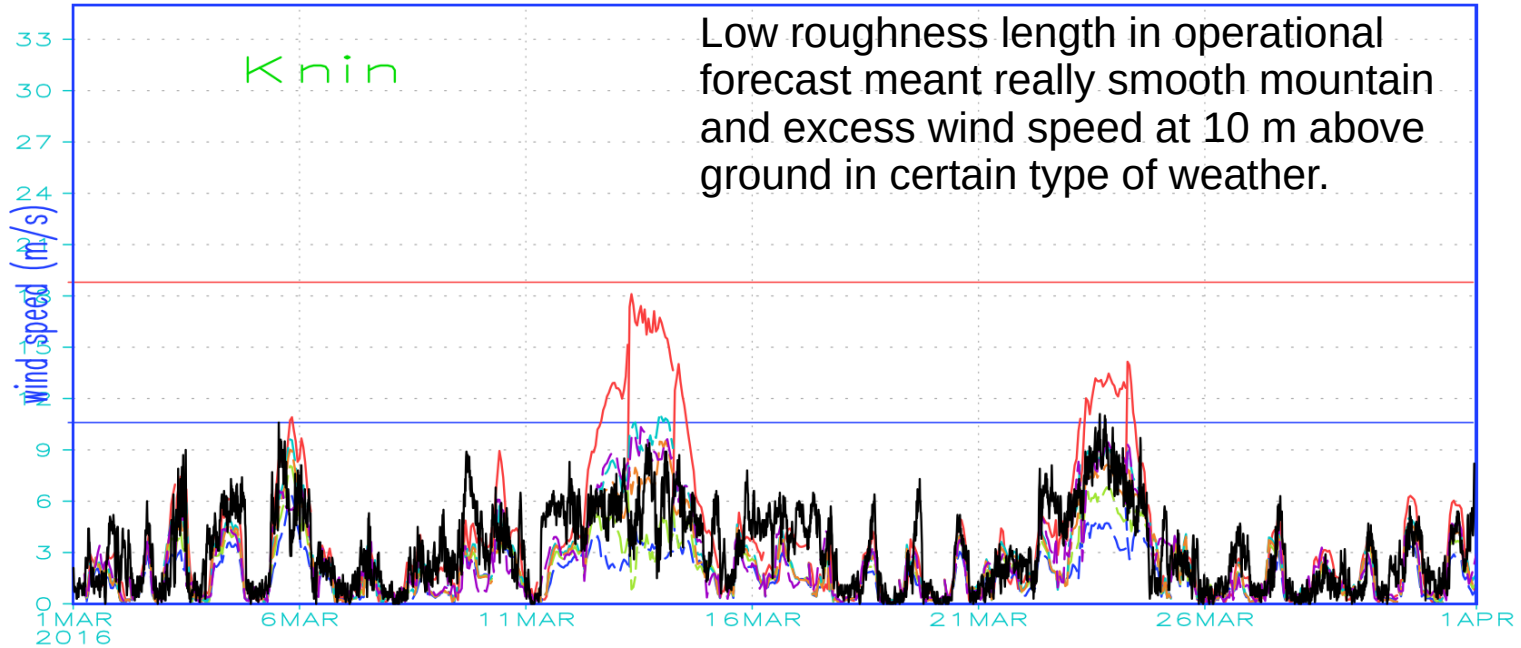
Wind speed at 10m: measured (black), operational 2km NH forecast (red), using new z0 (blue), new z0\*0.5 (green), new z=\*0.25 (light blue), new z0\*0.33 (orange) and 0.5\*sqrt(gz0) (purple) for March 2016 station Knin (above) and Lokvine (below), all using ALAR00.



# Clim files and e923

automatic  
lon=16.20  
lat=44.03  
Hp=255  
hr22  
Hm=272.

hr22nc  
1/2z0  
1/4z0  
1/3z0  
sqrtz0  
Hm=272.



Wind speed at 10m: measured (black), operational 2km NH forecast (red), using new z0 (blue), new z0\*0.5 (green), new z=\*0.25 (light blue), new z0\*0.33 (orange) and 0.5\*sqrt(gz0) (purple) for March 2016 station Knin (above) using ALAR00.



ZAMG

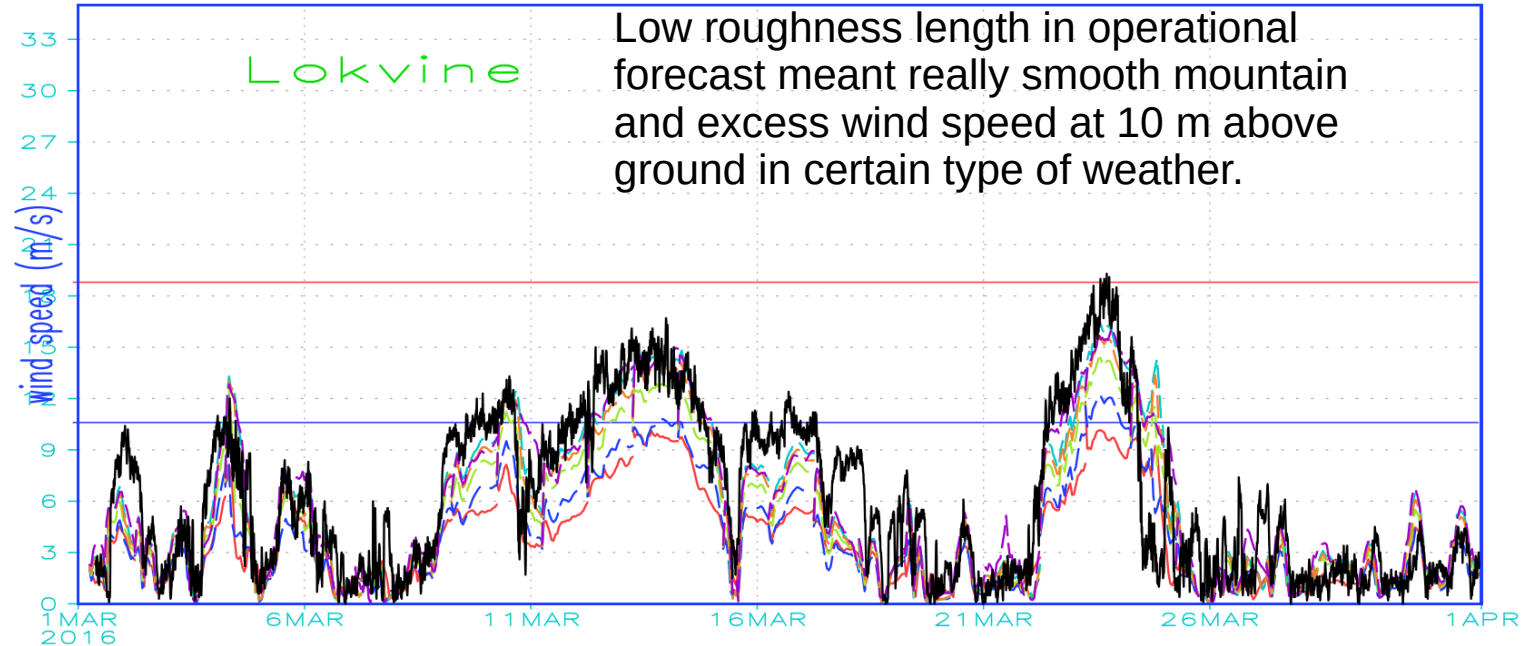


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# Clim files and e923

automatic  
lon=15.78  
lat=44.23  
Hp=490  
hr22  
Hm=674.

hr22nc  
1/2z0  
1/4z0  
1/3z0  
sqrtz0  
Hm=674.



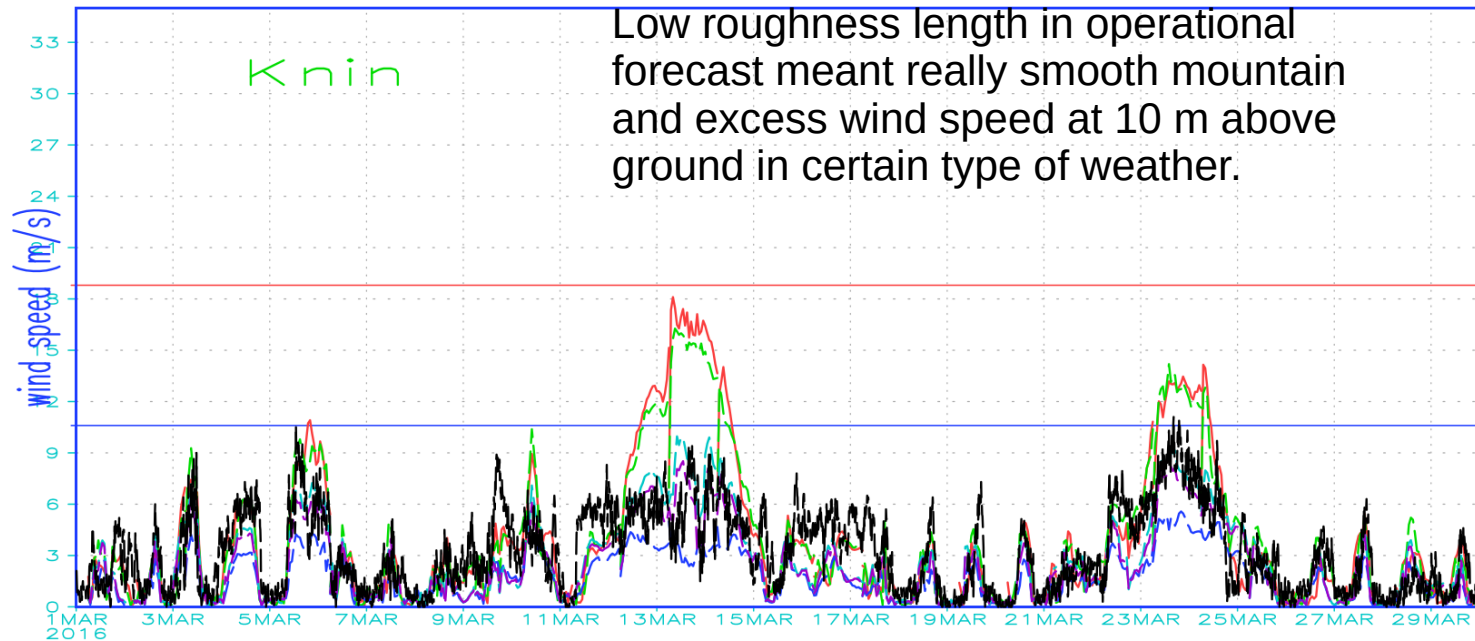
Wind speed at 10m: measured (black), operational 2km NH forecast (red), using new z0 (blue), new z0\*0.5 (green), new z=\*0.25 (light blue), new z0\*0.33 (orange) and 0.5\*sqrt(gz0) (purple) for March 2016 station Lokvine using ALAR00.



# Clim files and e923

automatic  
lon=16.20  
lat=44.03  
Hp=255  
hr22  
Hm=272.

alaro1  
a1nc  
241.  
1/4z0  
sqtz0



Wind speed at 10m: measured (black), operational 2km NH forecast using ALAR00 (red), using ALAR01vA and operational z0 (green), ALAR01 with new z0 (blue), new z0\*0.5 (green), new z=\*0.25 (light blue), new z0\*0.33 (orange) and 0.5\*sqrt(gz0) (purple) for March 2016 station Knin.



ZAMG

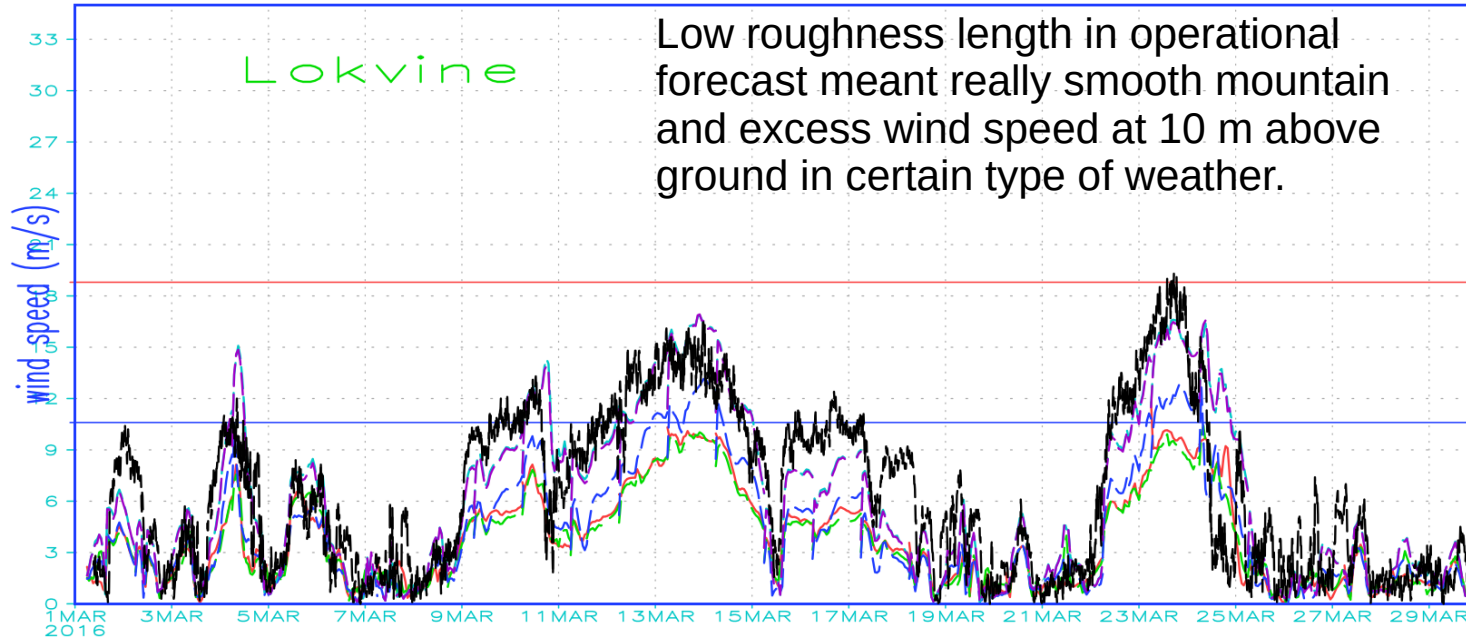


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# Clim files and e923

automatic  
lon=15.78  
lat=44.23  
Hp=490  
hr22  
Hm=674.

alaro1  
a1nc  
712.  
1/4z0  
sqrtz0



Wind speed at 10m: measured (black), operational 2km NH forecast using ALARO0 (red), using ALARO1vA and operational z0 (green), ALARO1 with new z0 (blue), new z0\*0.5 (green), new z=\*0.25 (light blue), new z0\*0.33 (orange) and 0.5\*sqrt(gz0) (purple) for March 2016 station Lokvine.



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DHMZ



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# Clim files and e923

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The impact of modified roughness length was tested by running 31 forecasts in 8 and 2 km resolutions starting from 00 UTC for March 2016.

The forecast of wind at 10m above ground depends on the roughness length.

The introduction of new, rougher surface reduced the wind speed in most cases with strong to severe bura wind (that blows from northeast therefore from land to sea).

The reduction in wind speed varies from place to place, at few places, it increased.



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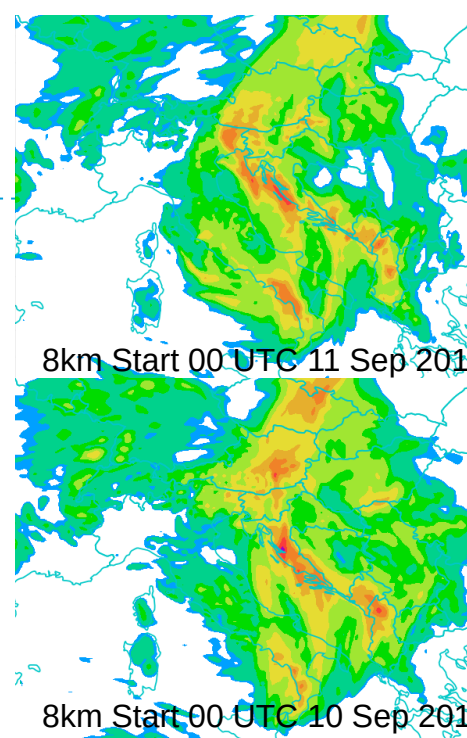
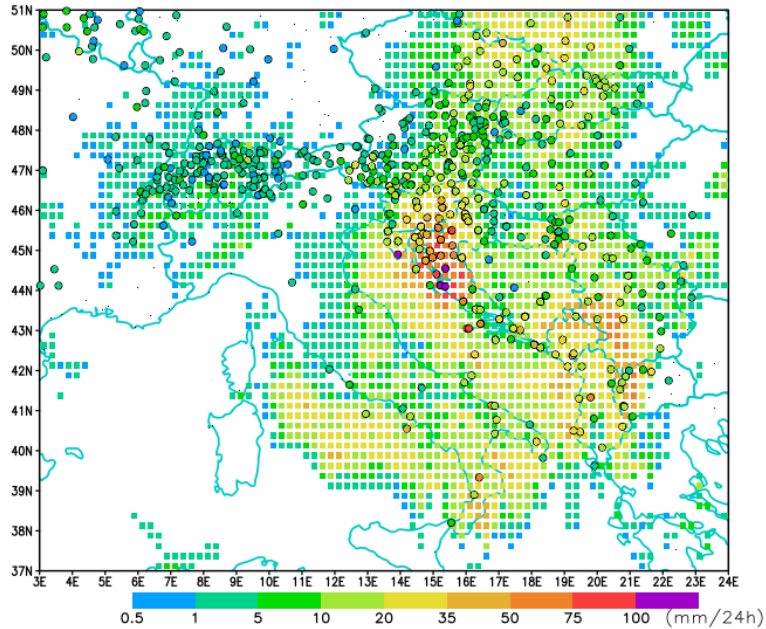


24 hours amount precipitation. 09/11/2017 at 18:00 UTC  
(100 of 5889 stations)

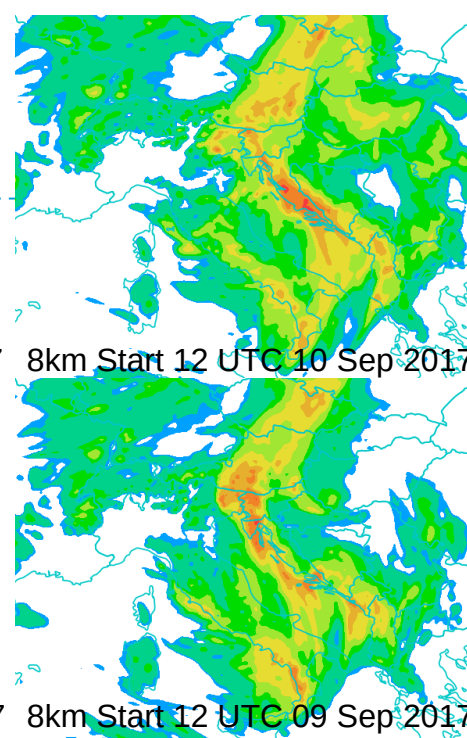
|    |  |                 |
|----|--|-----------------|
| 1  | <a href="#">Zadar / Zemunik (Croatia)</a>  | <b>323.0 mm</b> |
| 2  | <a href="#">Zadar Puntamika (Croatia)</a>  | <b>284.0 mm</b> |
| 3  | <a href="#">Daet (Philippines)</a>   | <b>239.0 mm</b> |
| 4  | <a href="#">Jacksonville, Jacksonville International Airport (United States)</a> | <b>218.0 mm</b> |
| 5  | <a href="#">Balakot (Pakistan)</a>   | <b>199.0 mm</b> |
| 6  | <a href="#">Agartala (India)</a>   | <b>131.0 mm</b> |
| 7  | <a href="#">Orlando, Orlando International Airport (United States)</a>           | <b>123.0 mm</b> |
| 8  | <a href="#">Gospic (Croatia)</a>   | <b>120.0 mm</b> |
| 9  | <a href="#">Savannah, Savannah International Airport (United States)</a>         | <b>119.5 mm</b> |
| 10 | <a href="#">Amahai (Indonesia)</a>   | <b>114.0 mm</b> |



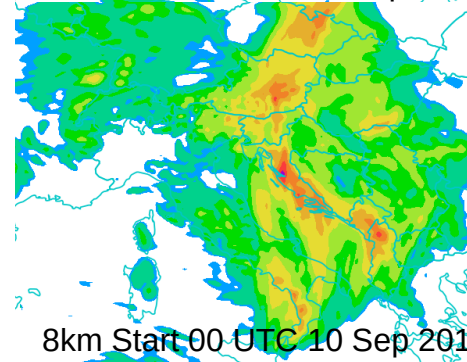
MJERENJA UK. OBORINA od 06 UTC 11SEP2017 do 06 UTC 12SEP2017



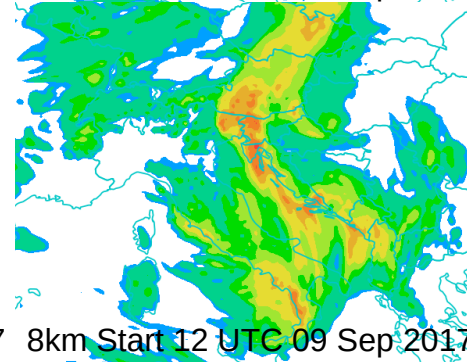
8km Start 00 UTC 11 Sep 2017



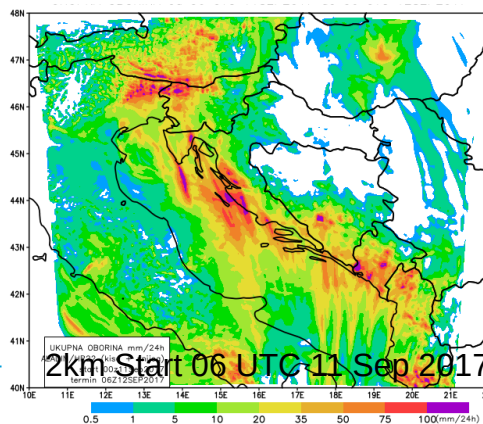
8km Start 12 UTC 10 Sep 2017



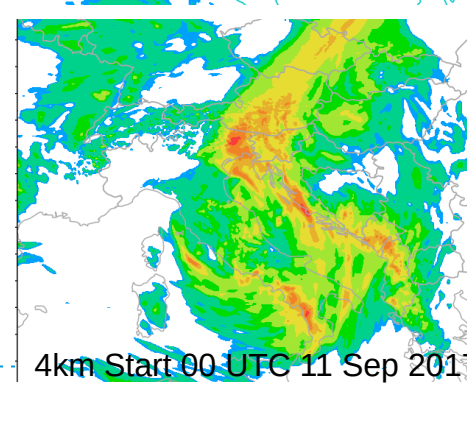
8km Start 00 UTC 10 Sep 2017



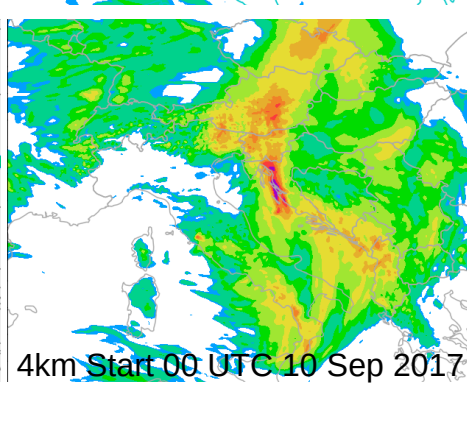
8km Start 12 UTC 09 Sep 2017



2km Start 06 UTC 11 Sep 2017

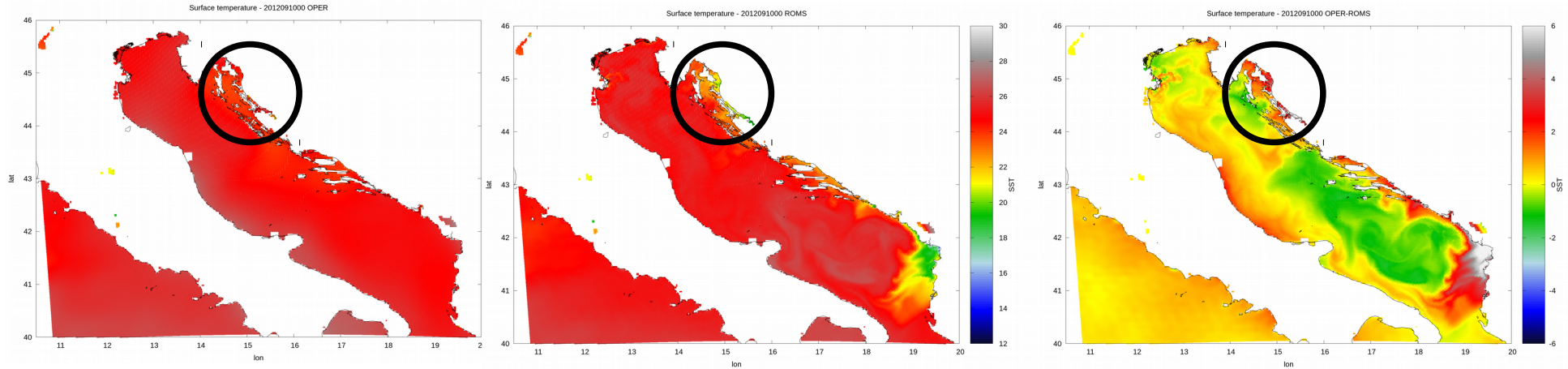


4km Start 00 UTC 11 Sep 2017



4km Start 00 UTC 10 Sep 2017

# Sea surface temperature



SST at 10th September 2012 from the operational run in 2 km resolution (left) and when SST from ROMS was used over Adriatic (centre) and their difference (OPER-ROMS, right).



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DHMZ



OMSZ



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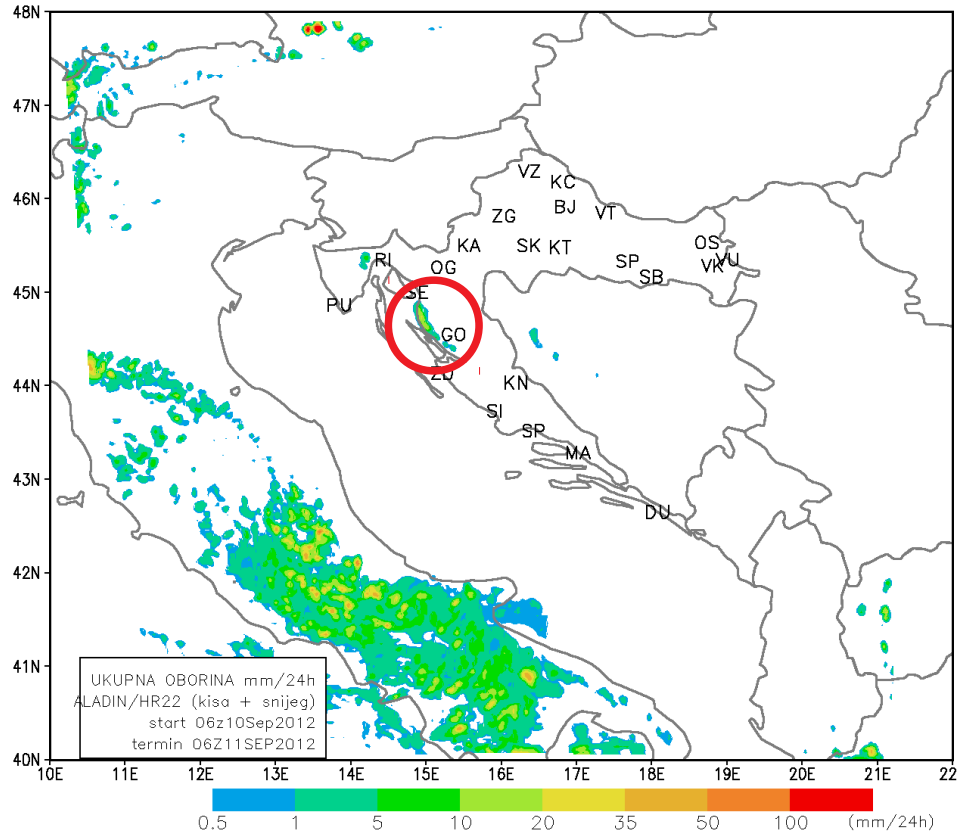


SHMU

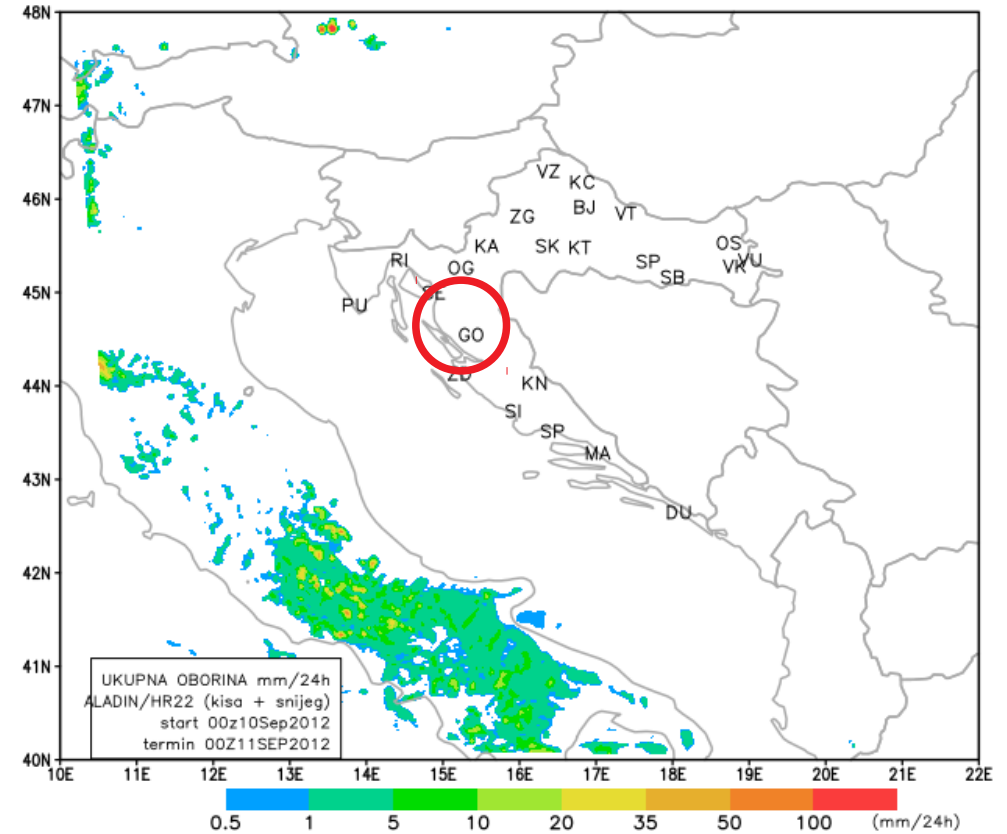


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UKUPNA OBORINA od 06 UTC 10SEP2012 do 06 UTC 11SEP2012



UKUPNA OBORINA od 00 UTC 10SEP2012 do 00 UTC 11SEP2012

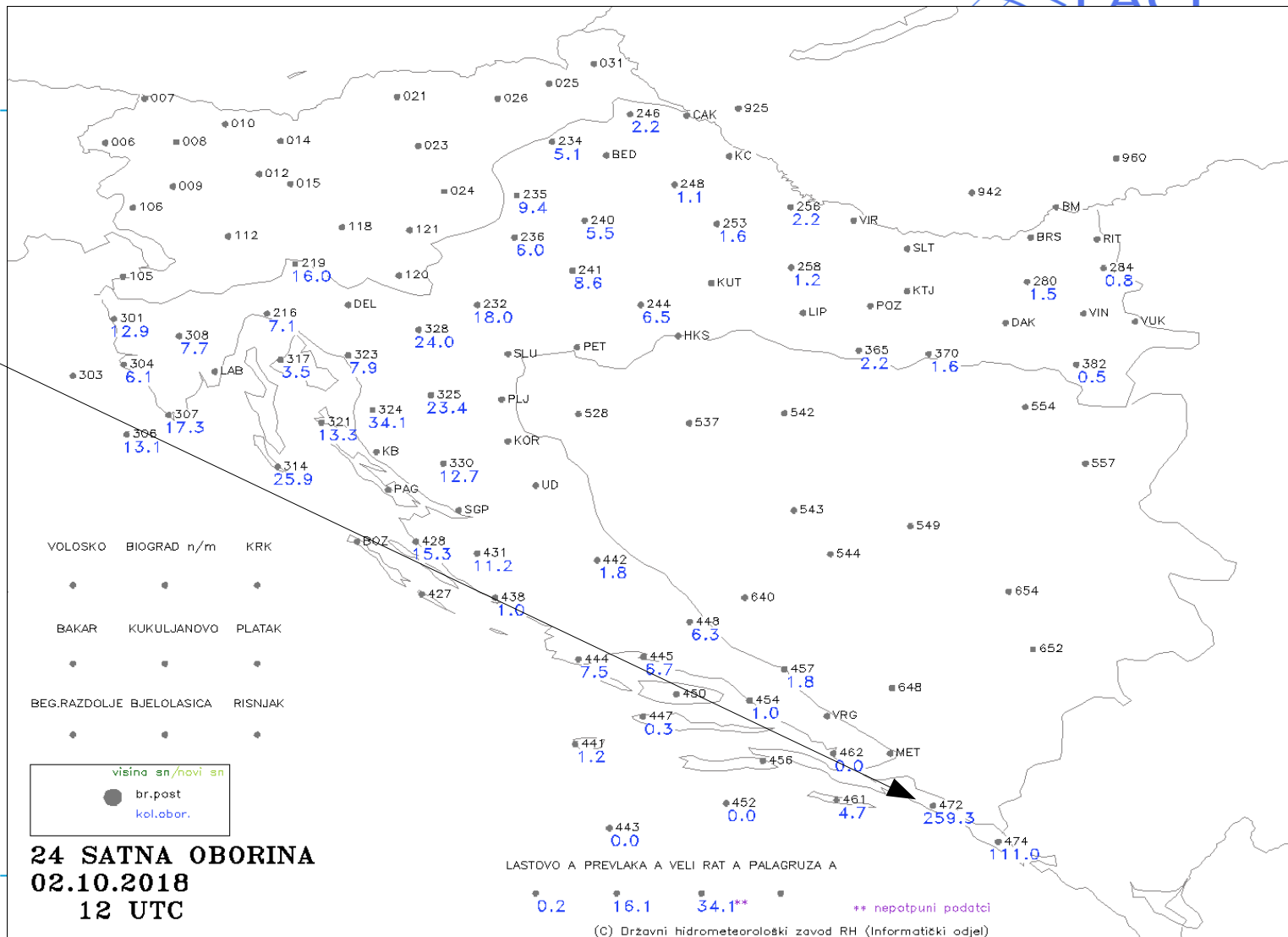


Accumulated 24 hourly precipitation forecast from 06 UTC 10 September 2012: the reference run in 2km resolution, using SST obtained in the coupling files of the operational IFS (left) and from the run using ROMS model SST and OSTIA analysis (right). Warm SST in the Velebit channel was the cause of wrong precipitation forecast over Velebit



# Rain

Extreme rainfall  
2.10.2018. morning  
3-6 UTC  
259.3 mm  
In Dubrovnik



# Rain



Dubrovnik  
2.10.2018

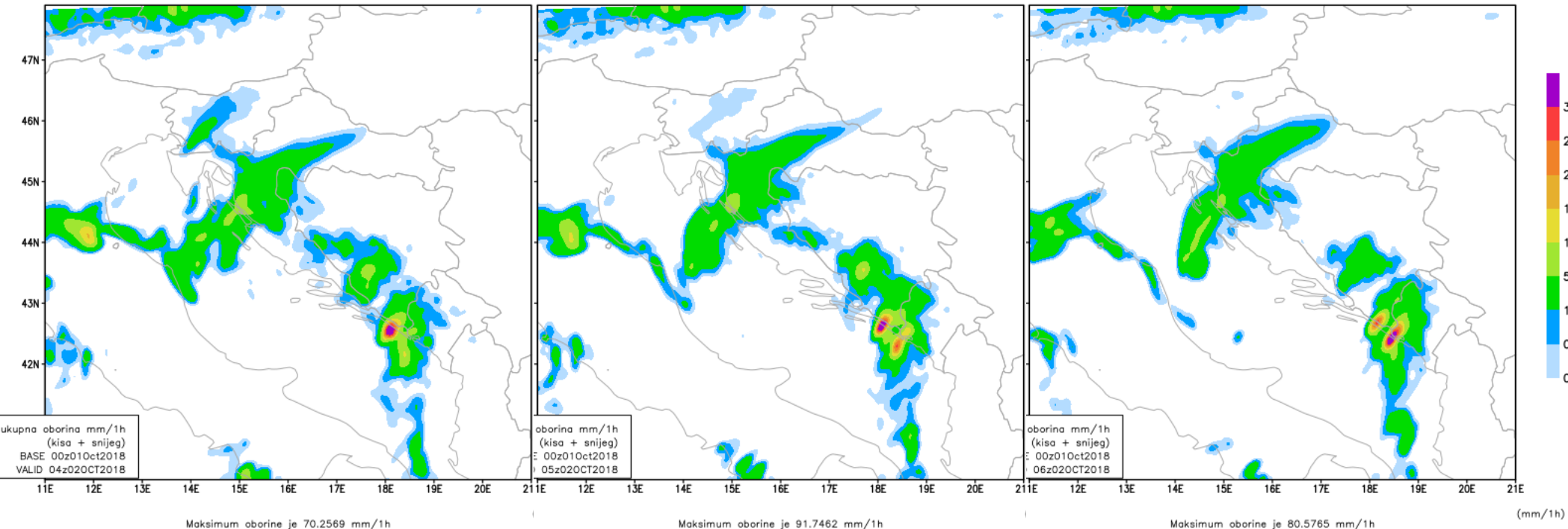


# Rain

HR22 UKUPNA OBORINA u 02OCT2018 04UTC 22h prognoza

HR22 UKUPNA OBORINA u 02OCT2018 05UTC 23h prognoza

HR22 UKUPNA OBORINA u 02OCT2018 06UTC 24h prognoza



Hourly accumulated precipitation from operational HR22, 2 km res, ALARO NH run  
 Max total ~ 240 mm/3hr



Bura 23. Feb 2019

ACE  
Europe

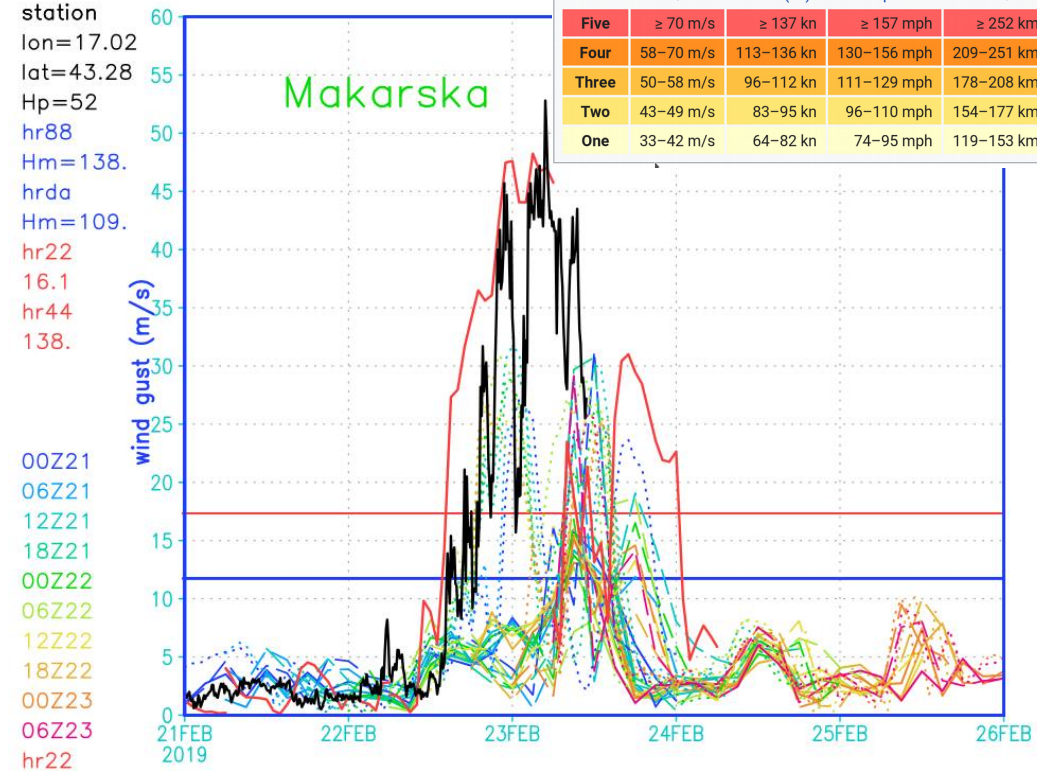
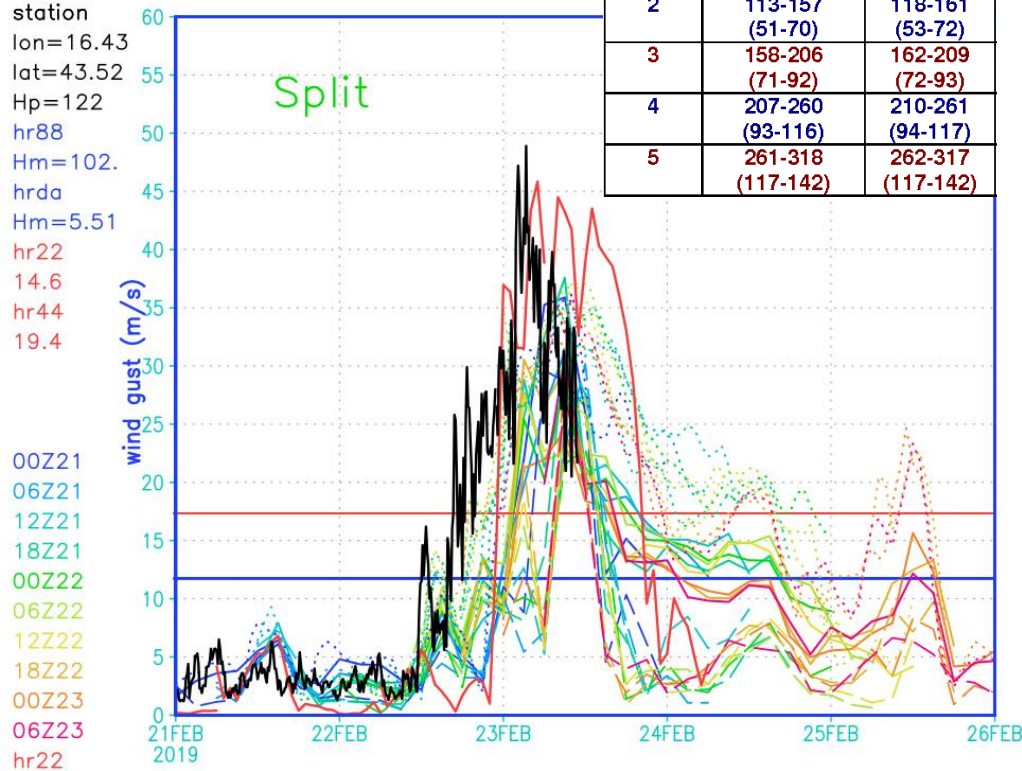


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# Bura

| FUJITA SCALE |   |   |
|--------------|---|---|
| F Level      | Fastest 1/4-mi in mph<br>(m s <sup>-1</sup> ) | 3-s Gust in mph<br>(m s <sup>-1</sup> ) |
| 0            | 40-72<br>(18-32)                              | 45-78<br>(20-35)                        |
| 1            | 73-112<br>(33-50)                             | 79-117<br>(35-52)                       |
| 2            | 113-157<br>(51-70)                            | 118-161<br>(53-72)                      |
| 3            | 158-206<br>(71-92)                            | 162-209<br>(72-93)                      |
| 4            | 207-260<br>(93-116)                           | 210-261<br>(94-117)                     |
| 5            | 261-318<br>(117-142)                          | 262-317<br>(117-142)                    |



### Saffir-Simpson scale

| Category | Wind speeds<br>(for 1-minute maximum sustained winds) |            |             |              |
|----------|---|------------|-------------|--------------|
|          | m/s   | knots (kn) | mph         | km/h         |
| Five     | ≥ 70 m/s  | ≥ 137 kn   | ≥ 157 mph   | ≥ 252 km/h   |
| Four     | 58-70 m/s   | 113-136 kn | 130-156 mph | 209-251 km/h |
| Three    | 50-58 m/s   | 96-112 kn  | 111-129 mph | 178-208 km/h |
| Two      | 43-49 m/s   | 83-95 kn   | 96-110 mph  | 154-177 km/h |
| One      | 33-42 m/s   | 64-82 kn   | 74-95 mph   | 119-153 km/h |

Wind gusts forecasts and measurements 21-25 Feb 2019 for Split and Makarska

