Forecasting freezing rain: tools, experiences and case studies

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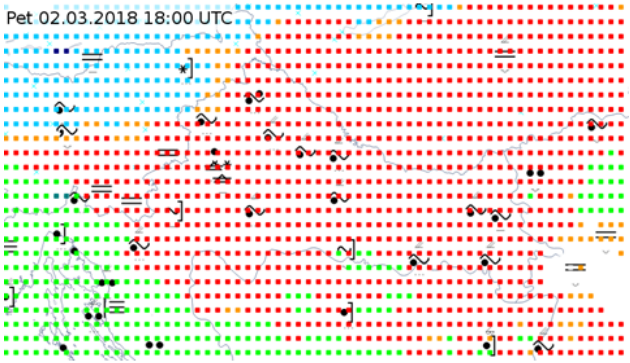
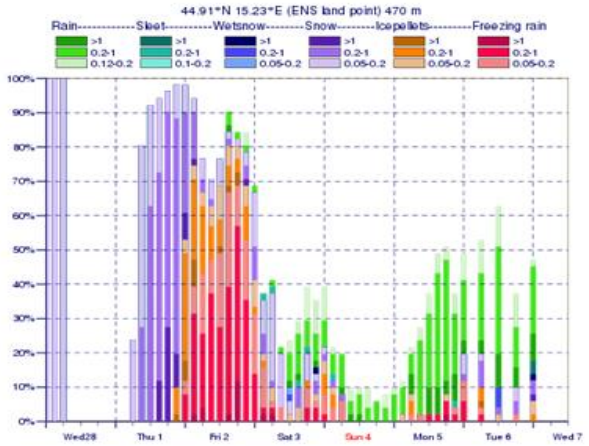
Freezing rain

- introduction/motivation
- severe event in Feb 2014 (CRO/SLO/HU)
- new products (ECMWF precipitation type)
- case study – Feb/March 2018





Freezing rain – Why is it so important?

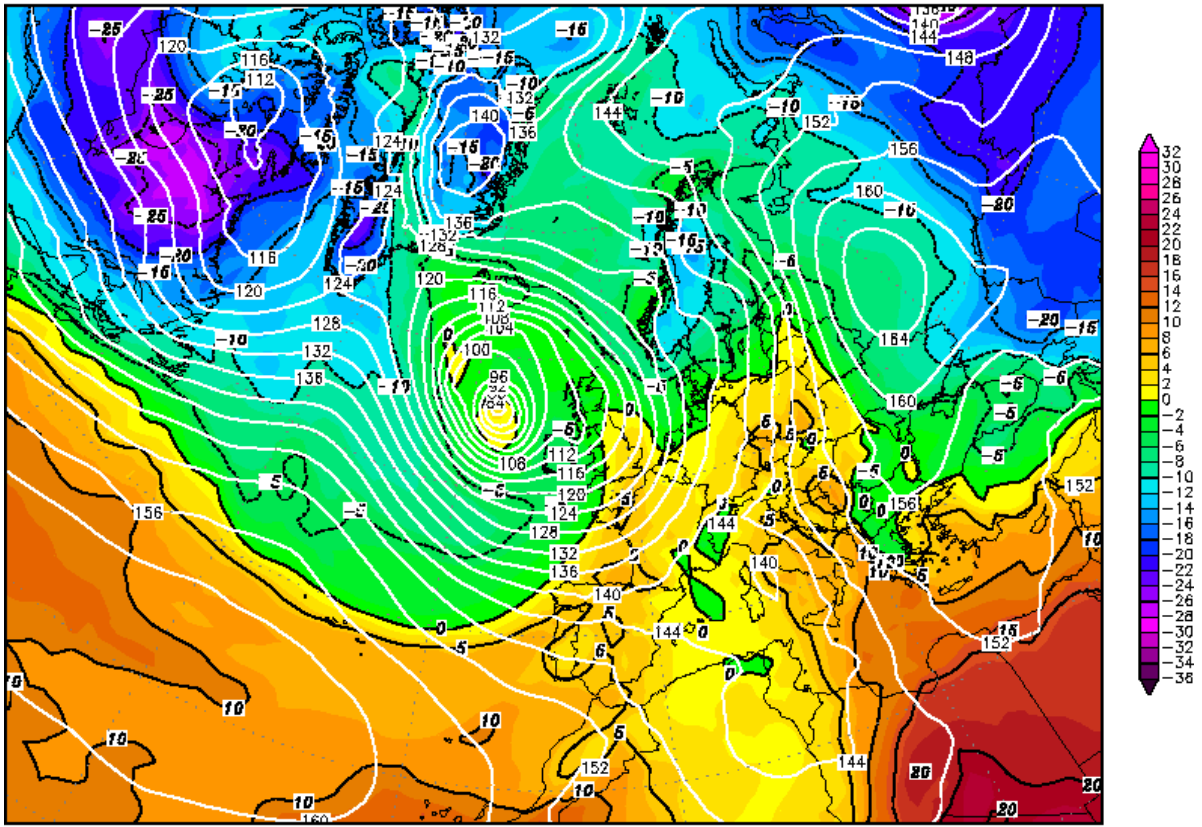
2014 freezing rain

- From Jan 31st to Feb 5th
- Croatia, Slovenia and Hungary
- Damage 3 billion HRK = 400 mil EUR (Croatia)
  - mostly on electricity/rail/energy and forestry
- Was not expected/forecasted in that intensity (Croatia)

Init : Sat,01FEB2014 00Z

Valid: Sat,01FEB2014 00Z

850 hPa Geopot. (gpdm) und Temperatur (Grad C)

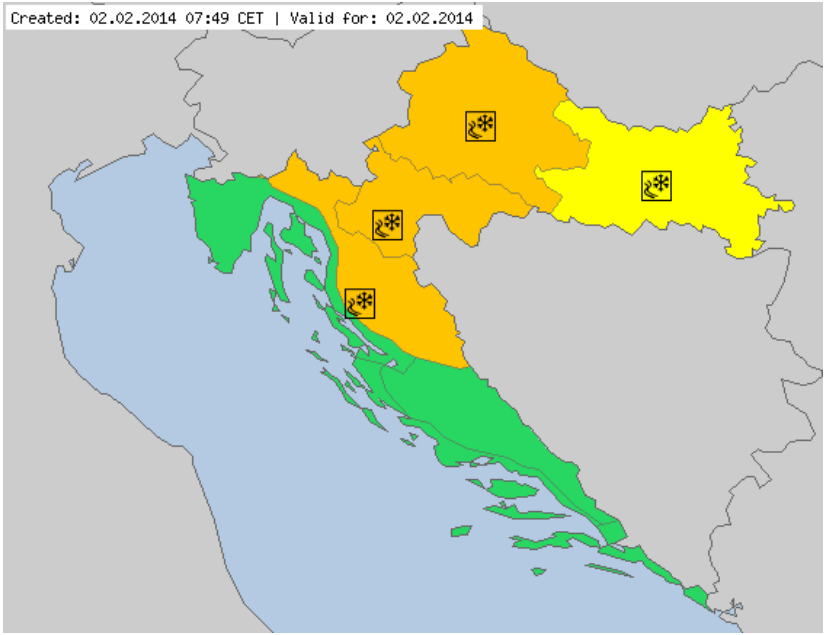


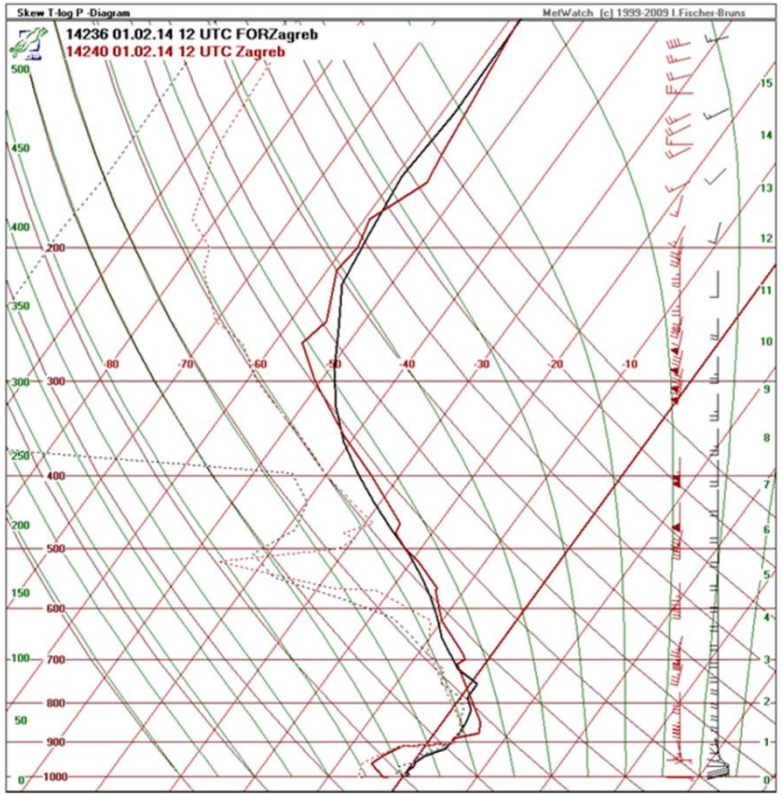
Daten: GFS—Modell des amerikanischen Wetterdienstes

www.wetterzentrale.de

forecast

Not expected in that intensity and duration

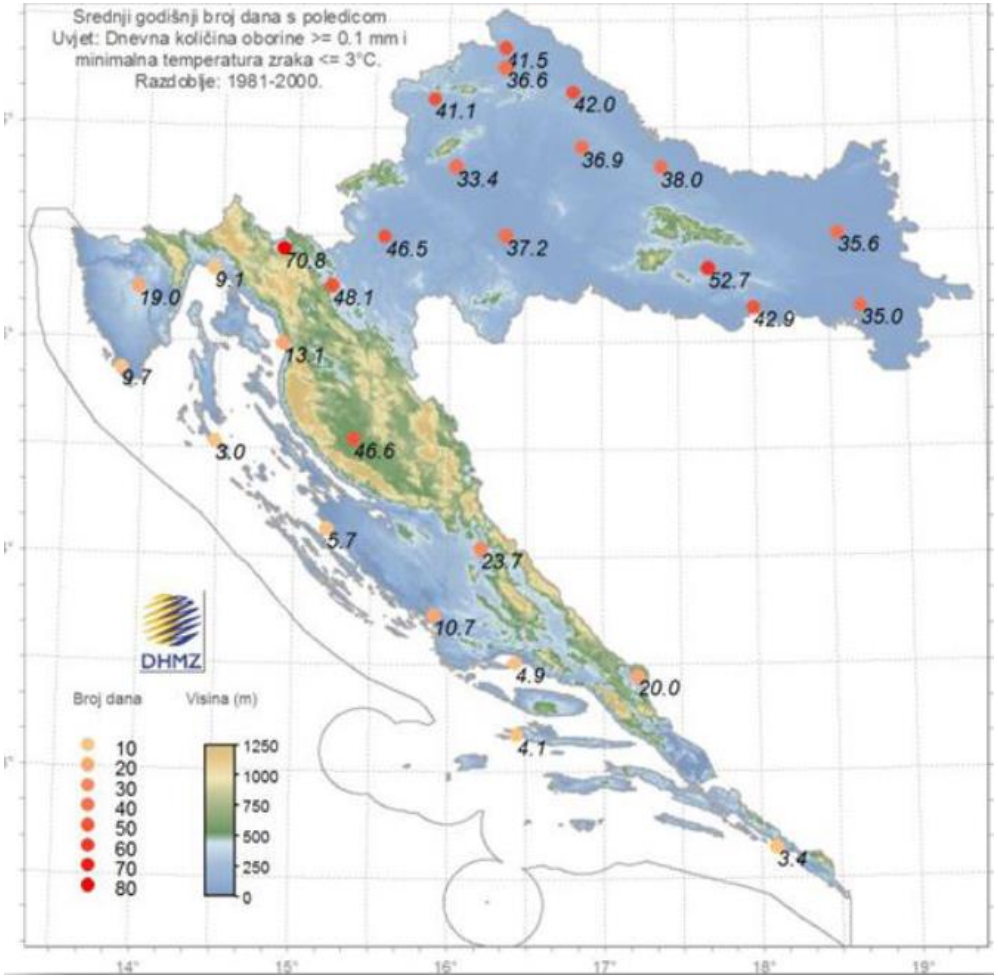




CLIMATOLOGY

Mean annual number of days with black ice

RR24>=0.3 mm
Tmin<=-3°C



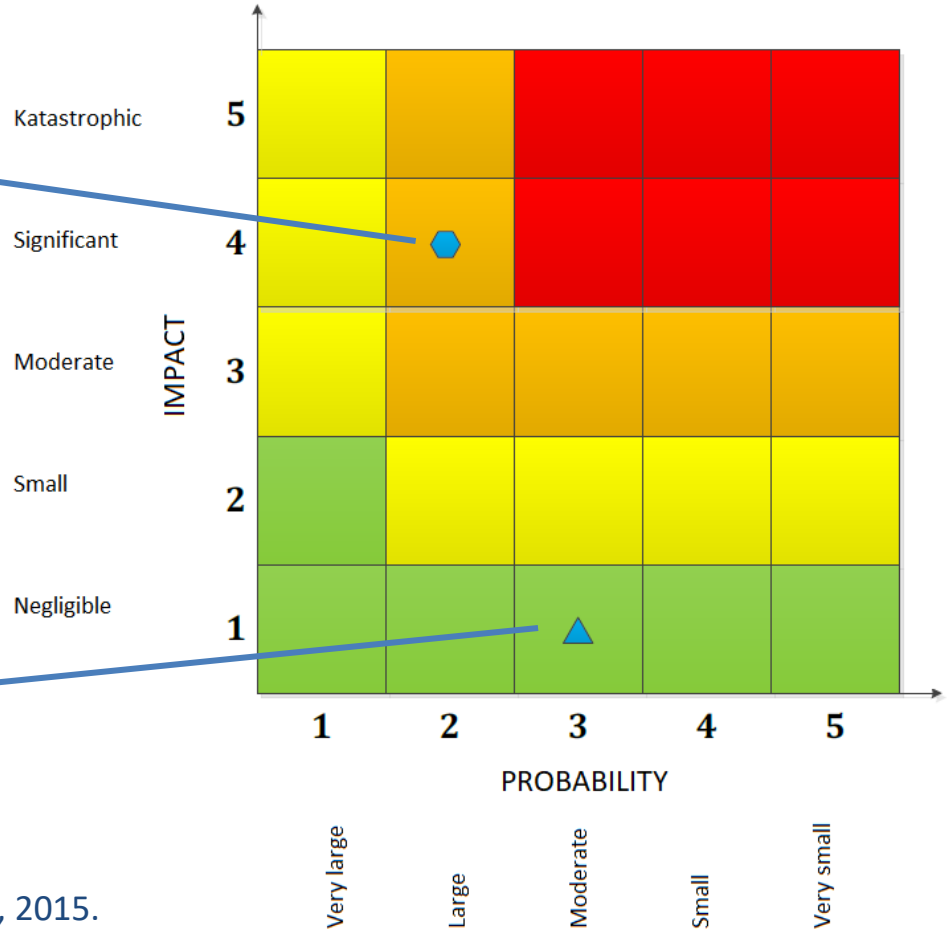
Disaster risk assesment for Republic of Croatia, 2015.

Worst case scenario

Return period = 20 - 100 years

Likely scenario

Return period = 2 - 20 years



Disaster risk assesment for Republic of Croatia, 2015.

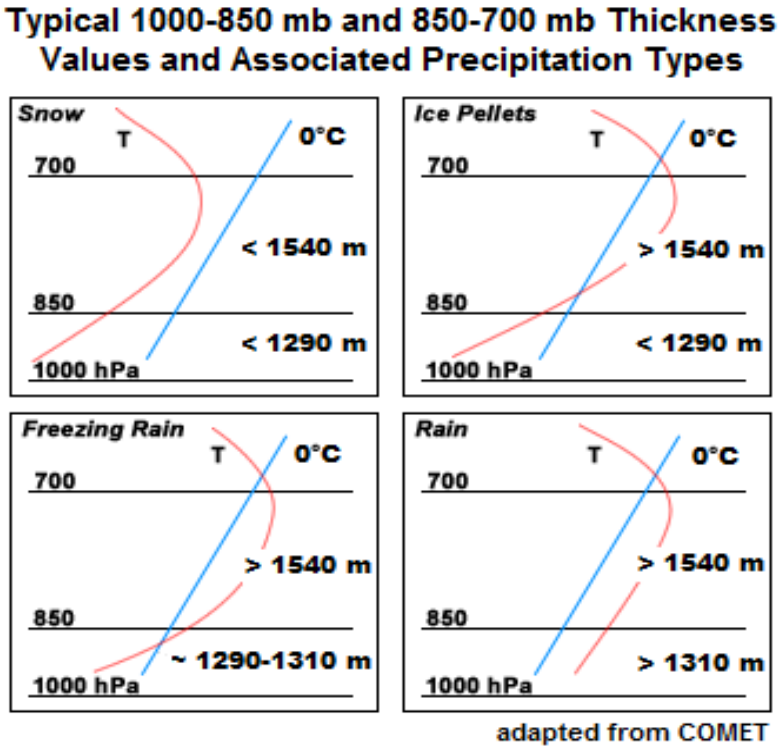
Freezing rain – Why is it so important?

1. Rare
2. Hard to forecast
3. Can cause extreme damages/casualties

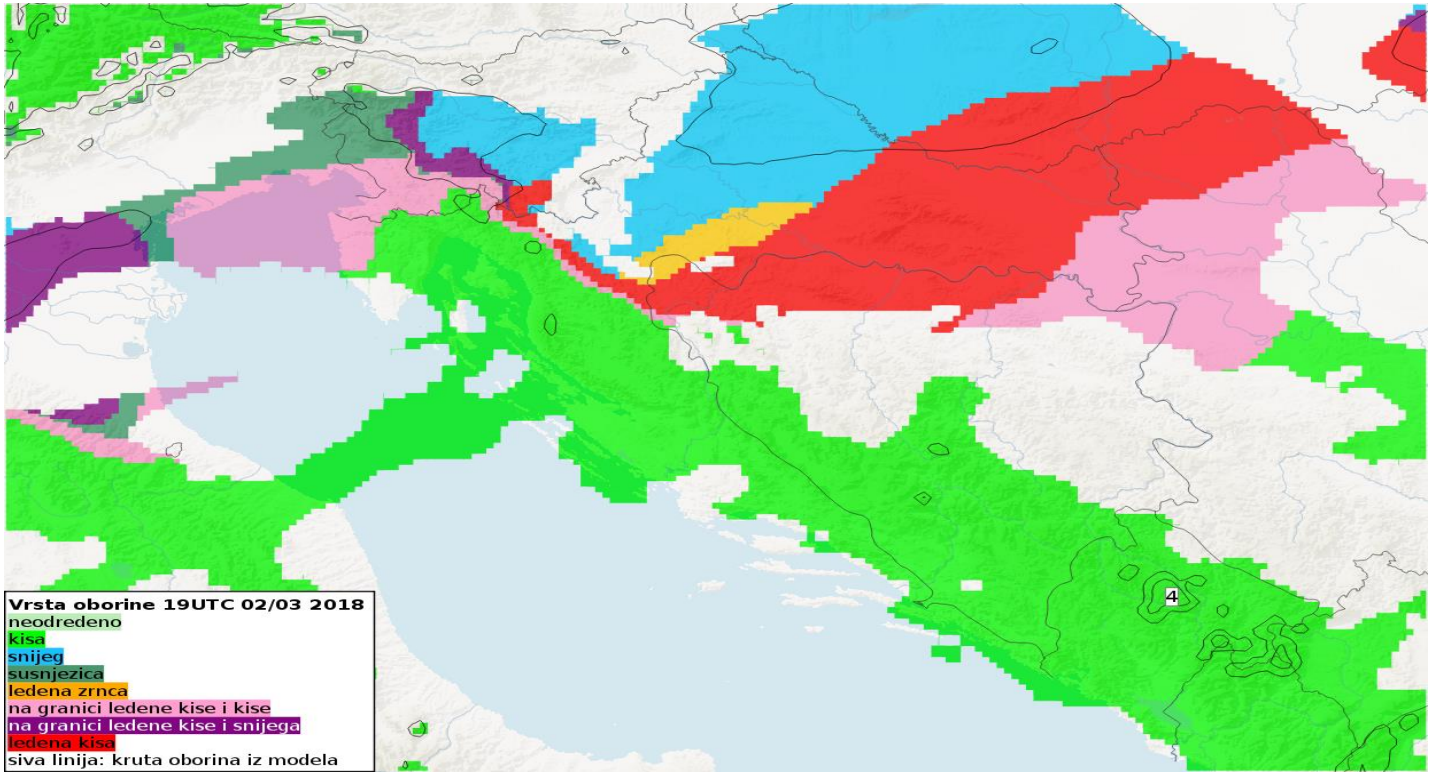
Vertical profiles

- Keeter, K. K., and J. W. Cline (1991)
- (for North Carolina)

- 1000-850 mb
- 850-700 mb



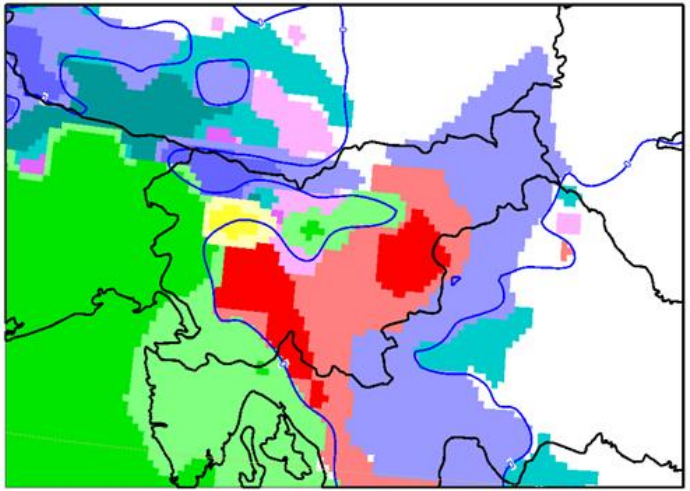
New operational product



ECMWF – precipitation type

Modification of the cloud scheme slows down the re-freezing process.

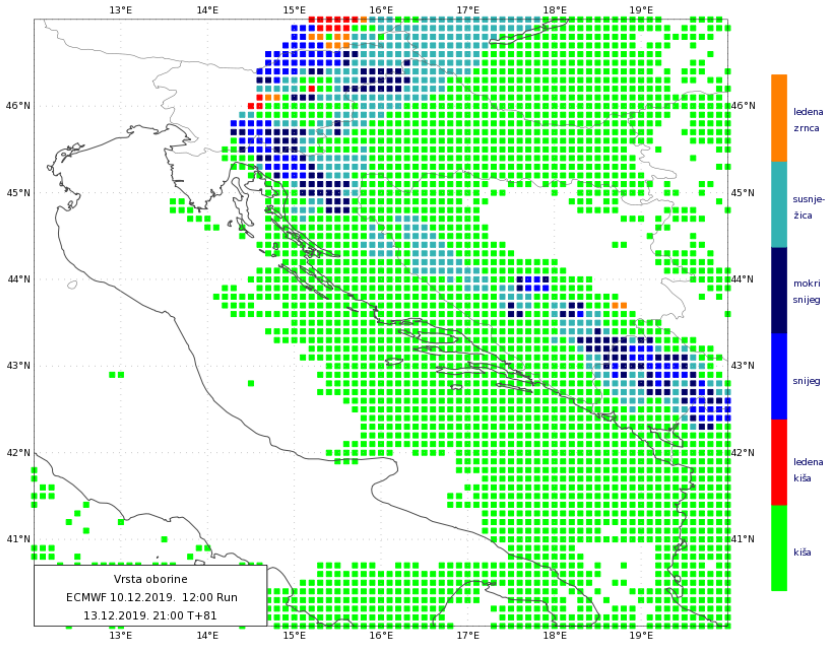
New physics: the fraction of snow at the bottom of the warm layer determines whether precipitation will fall as freezing rain or ice pellets

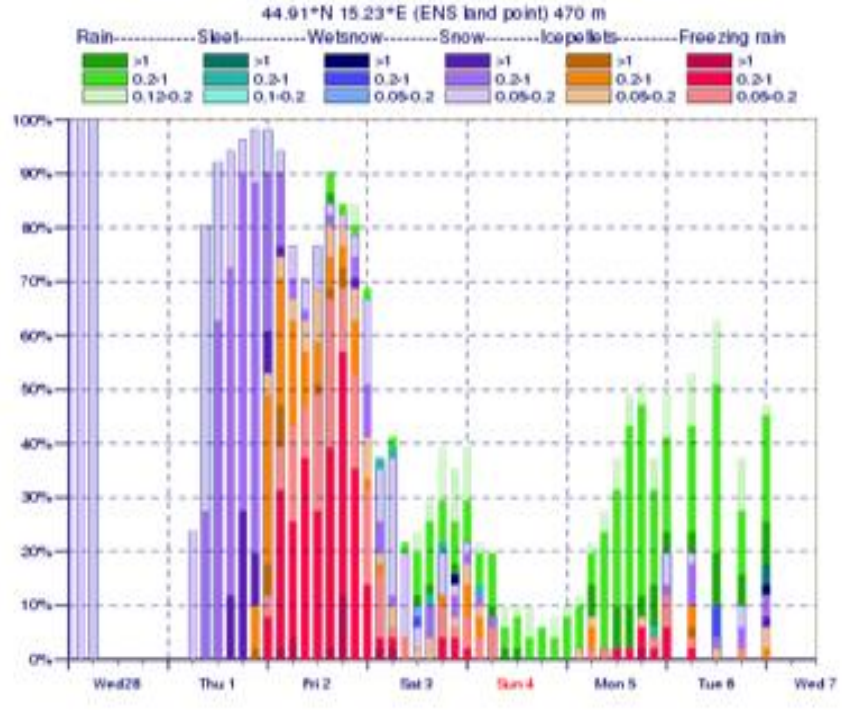


02/02/2014 12UTC

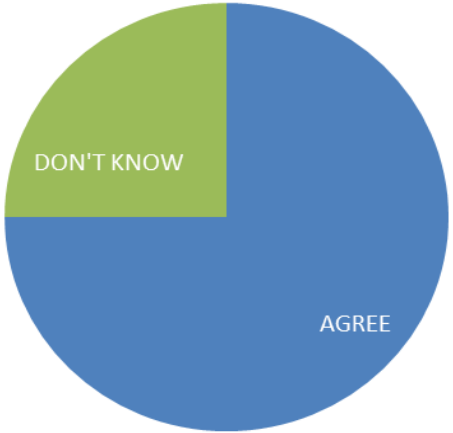
Courtesy of Estibaliz Gascon (ECMWF)

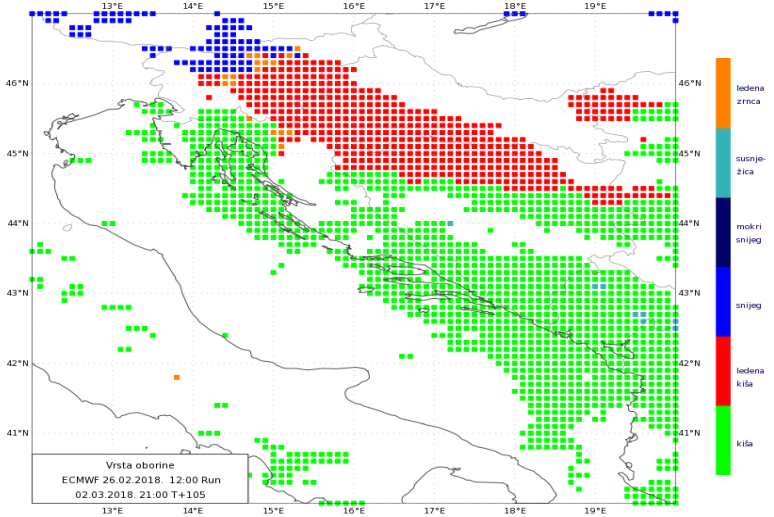
ECMWF – precipitation type





forecasters survey:ECMWF precip. type product (freezing rain) reliable?

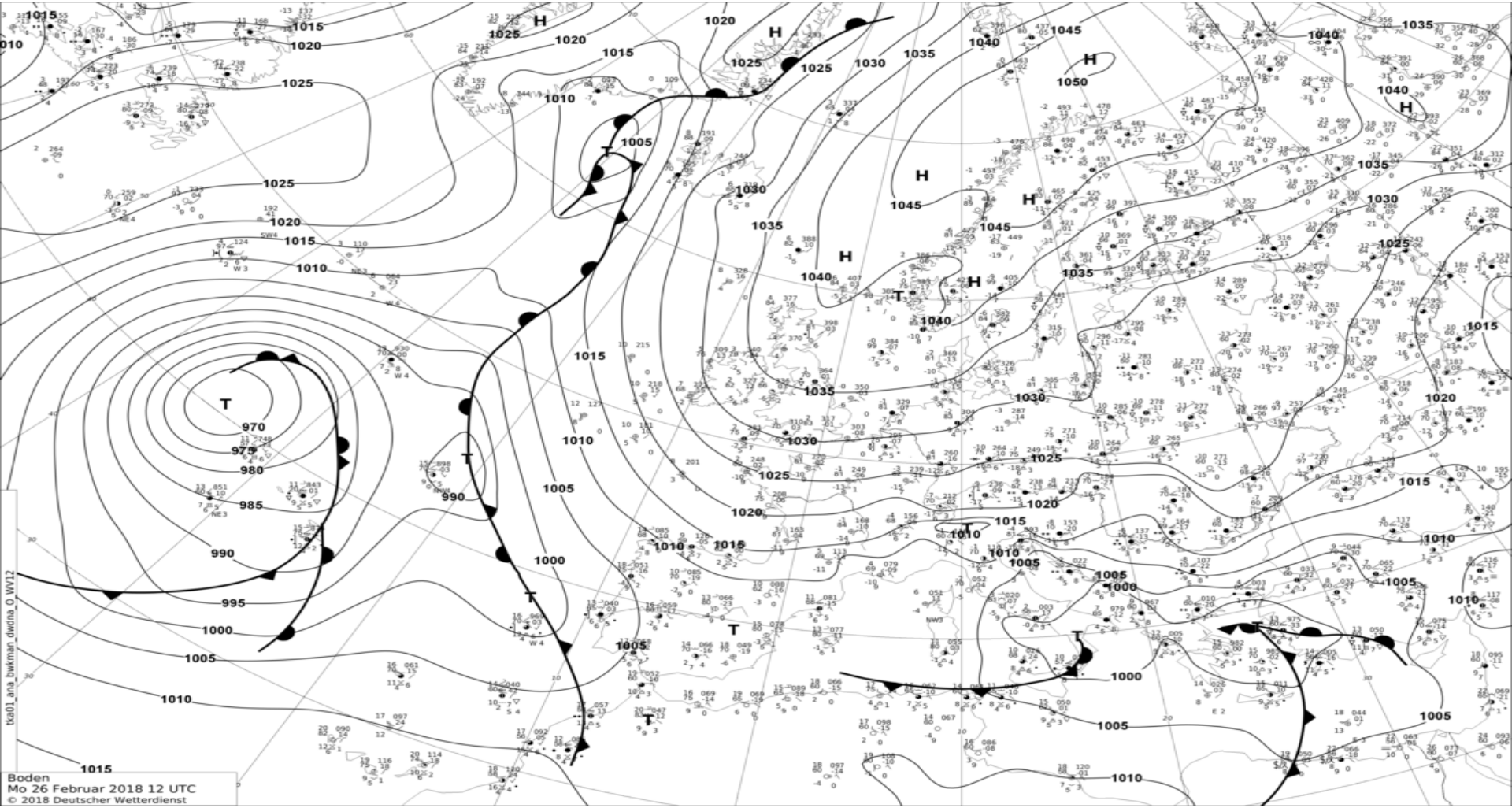




- particularly when the signal is strong – very reliable (duration, amount)
- for weak signal – take care

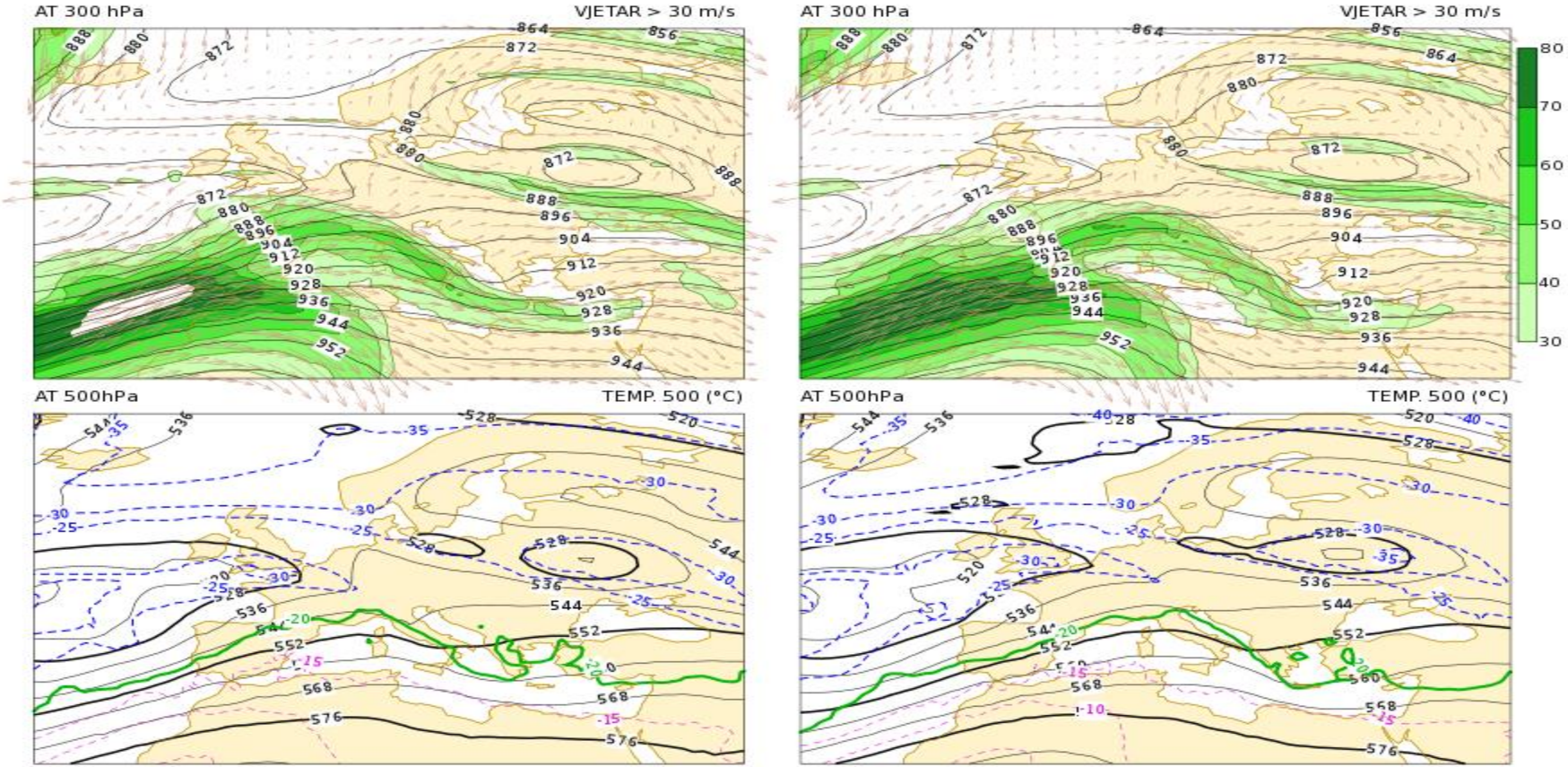
Case study

Freezing rain case (2018 Feb 28 – March 3)


Boden
Mo 26 Februar 2018 12 UTC
© 2018 Deutscher Wetterdienst
tka01_ana_bwkman_dwdna_O_WV12

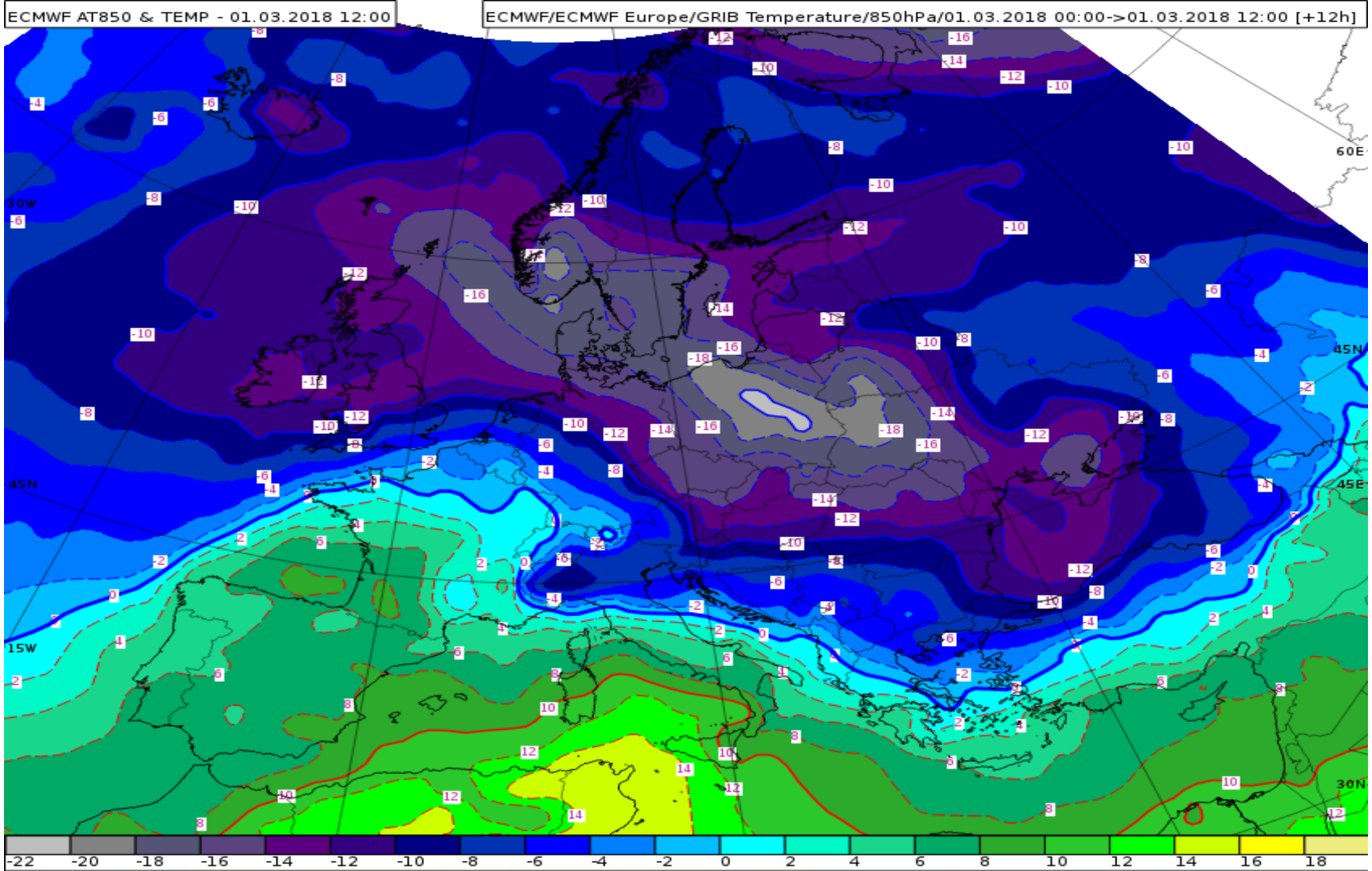
02 Ožu (Pet) 18 UTC

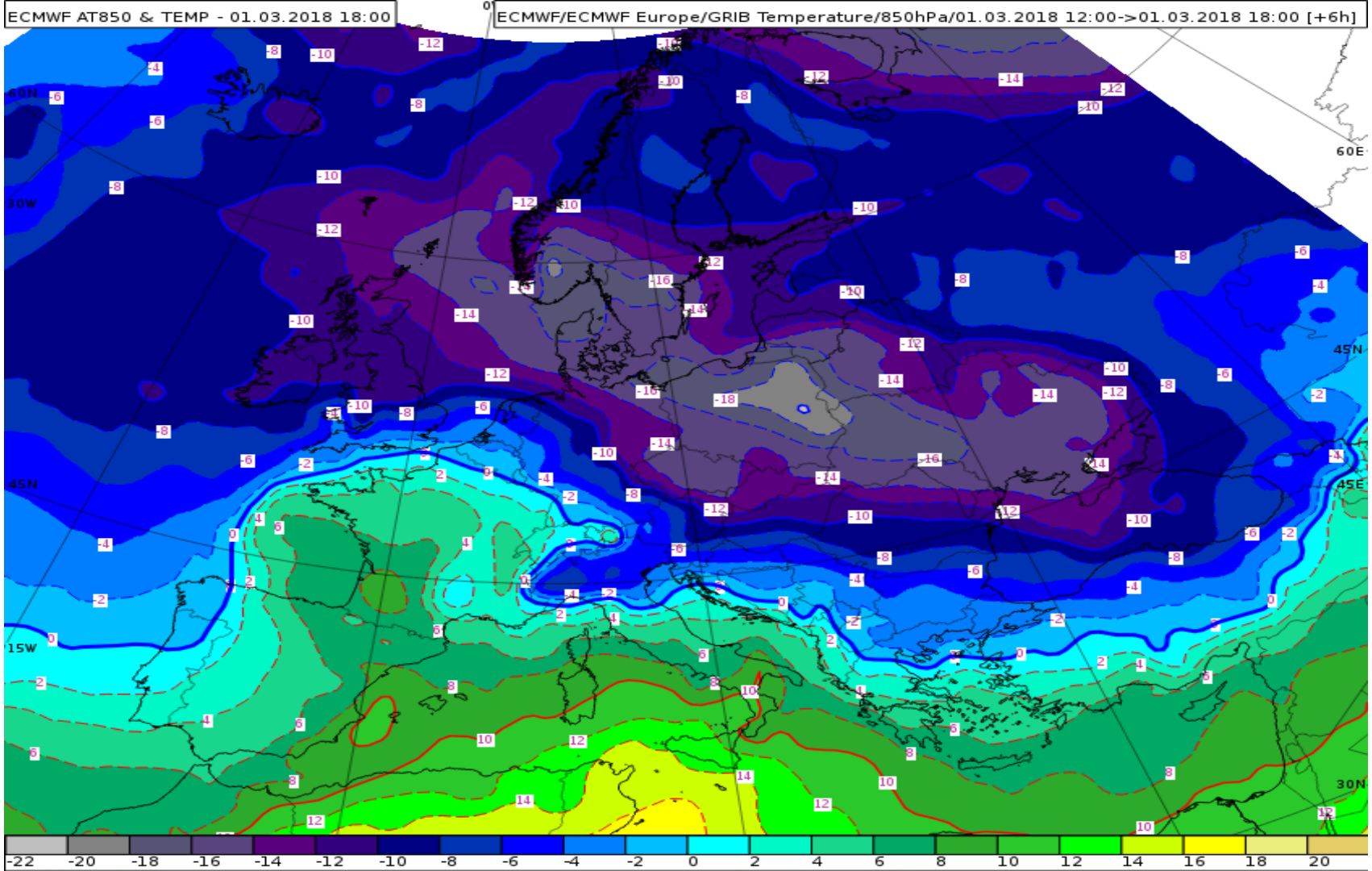
03 Ožu (Sub) 00 UTC

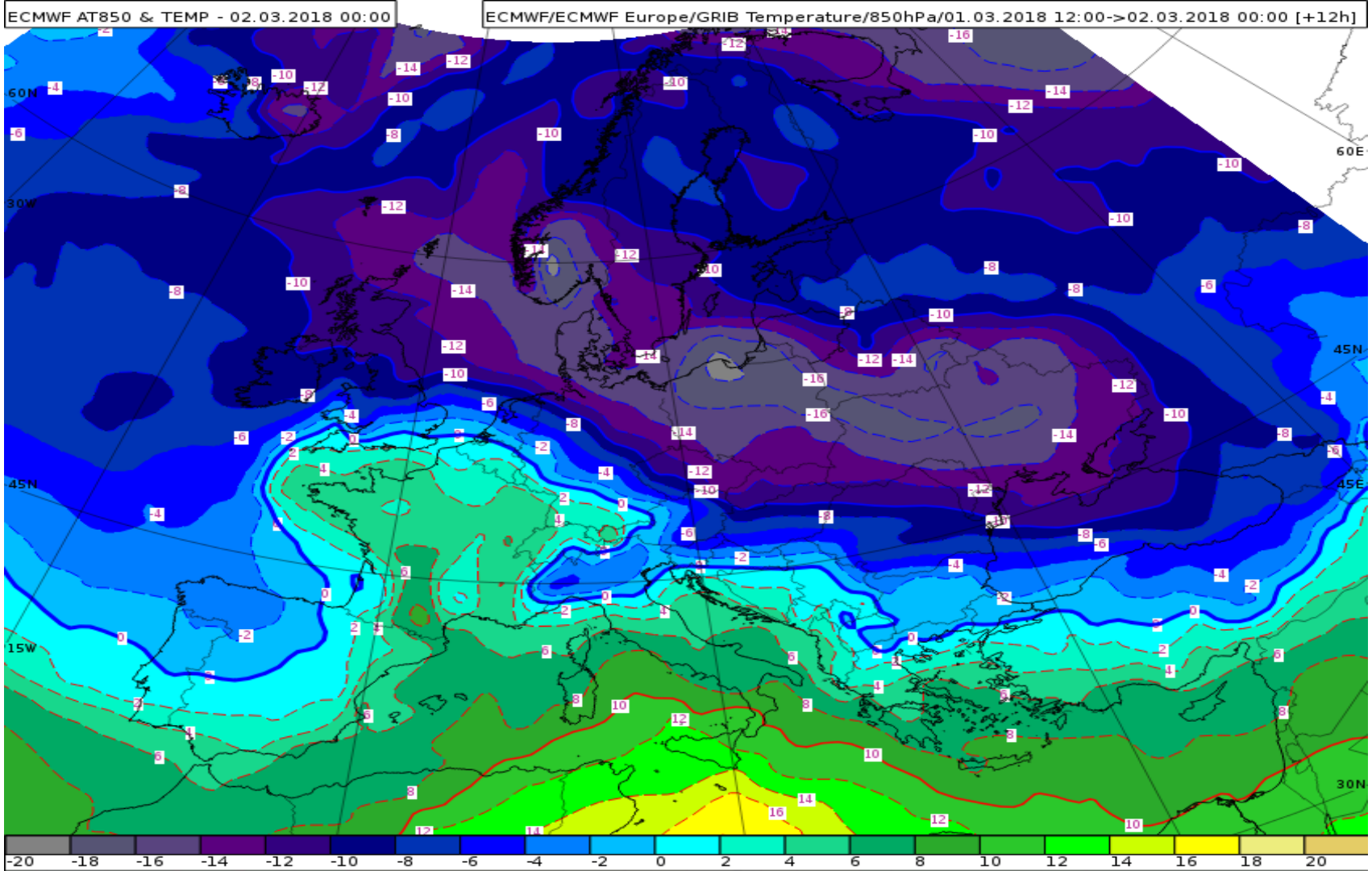


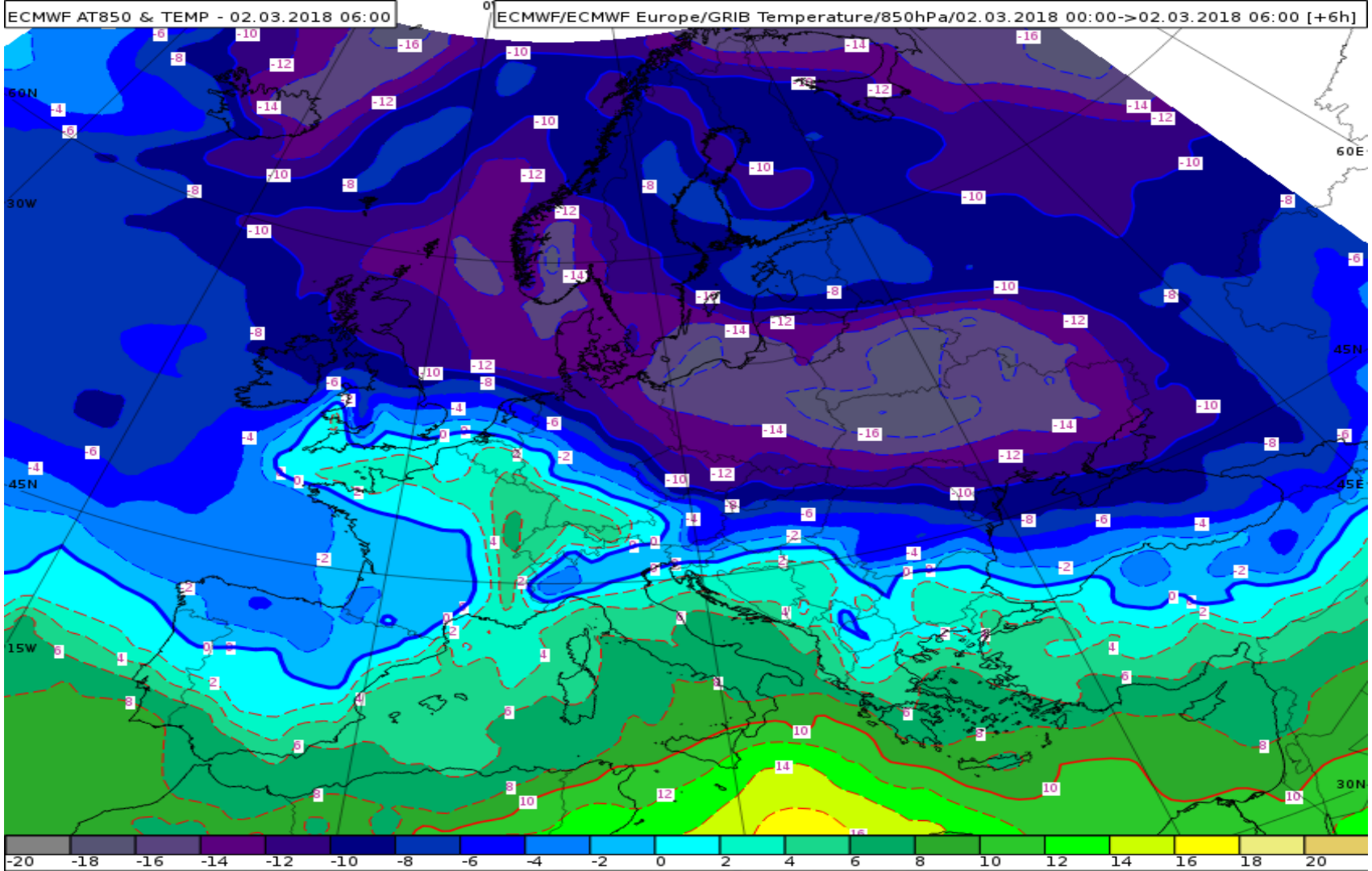
ECMWF RUN_12

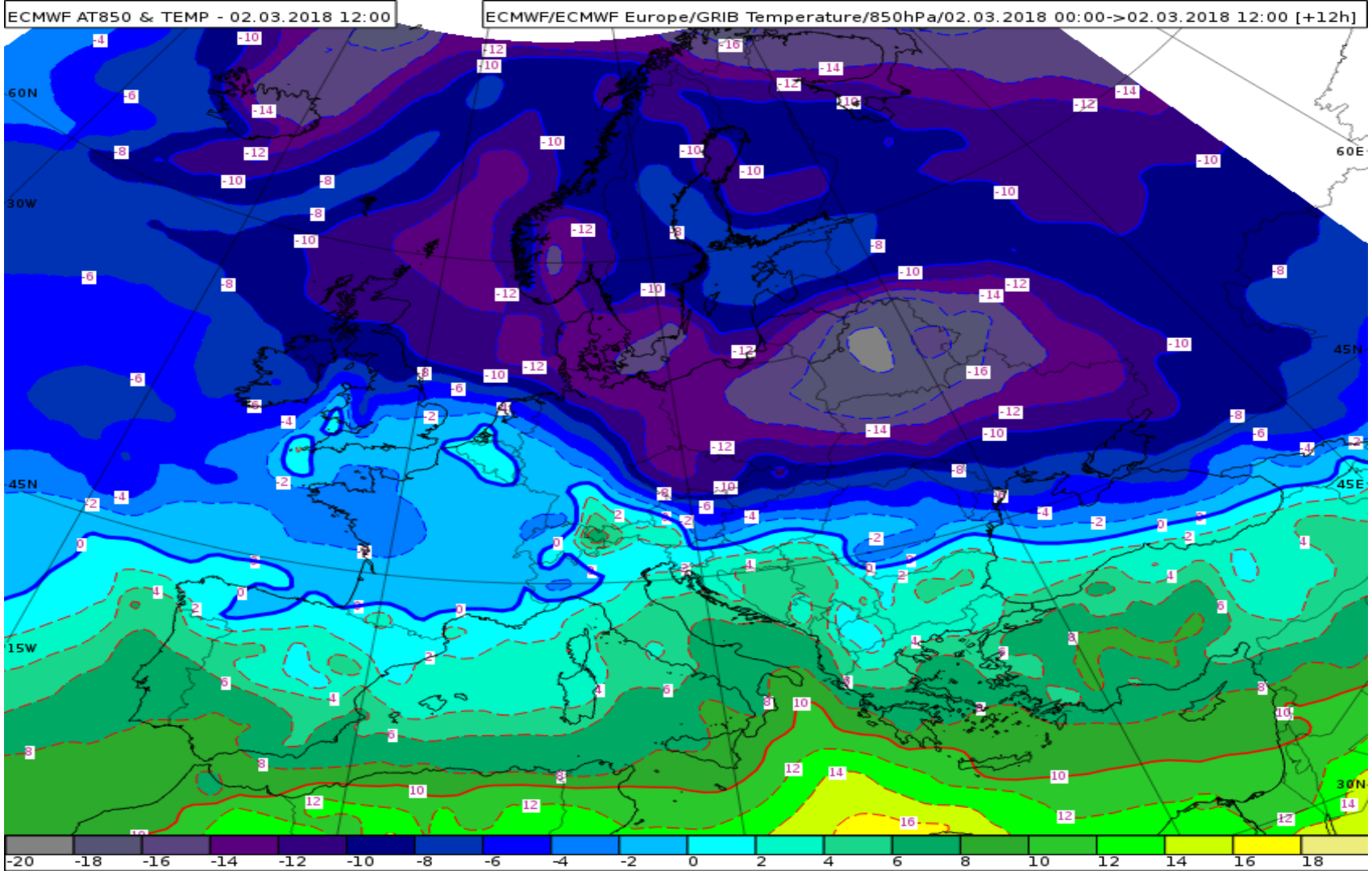
start modela: Ponedjeljak 26.02.2018. 12 UTC

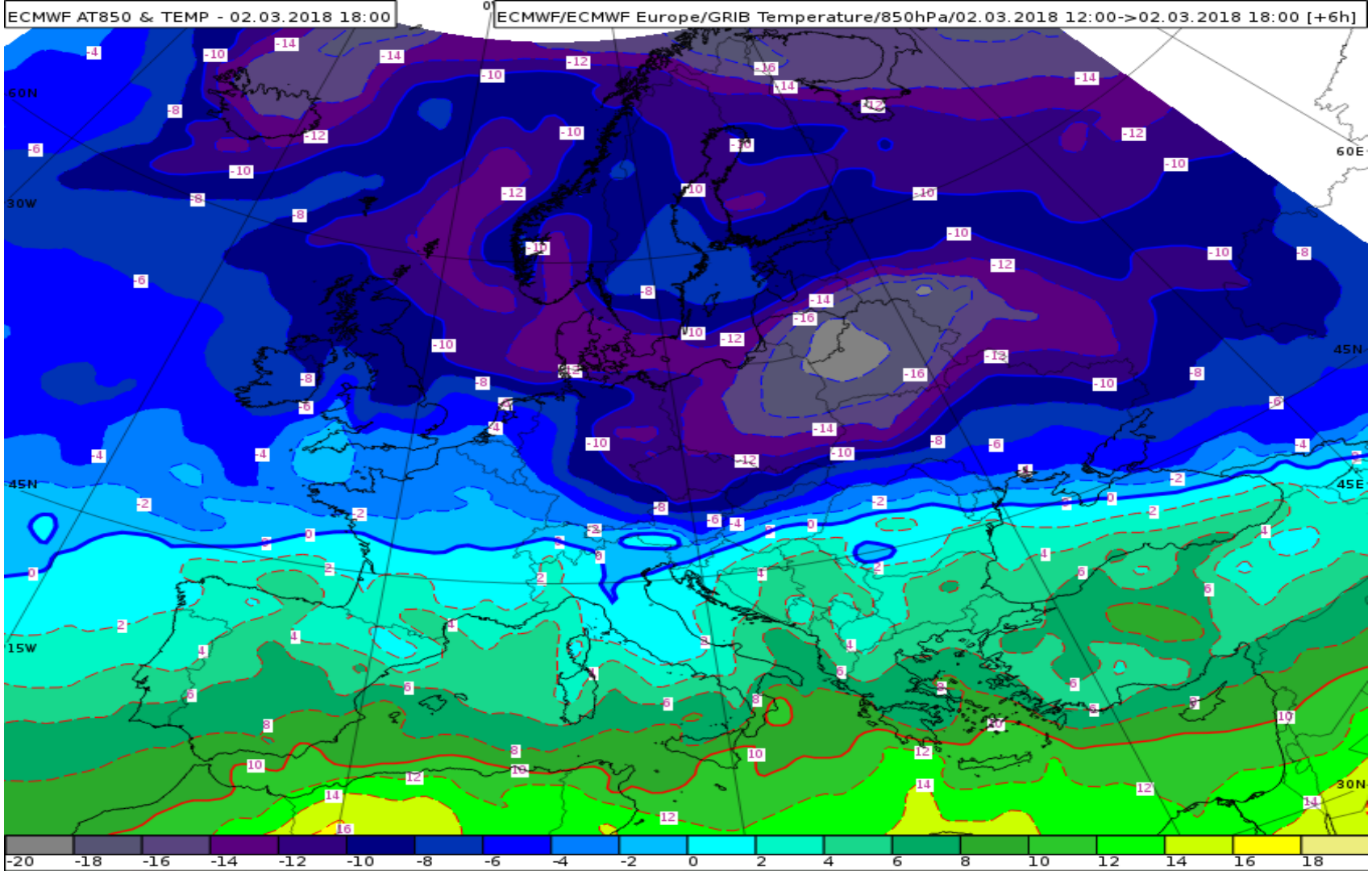

ECMWF AT850 & TEMP - 01.03.2018 12:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/01.03.2018 00:00->01.03.2018 12:00 [+12h]
60E
30W
45N
45E
15W
30N
-22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18

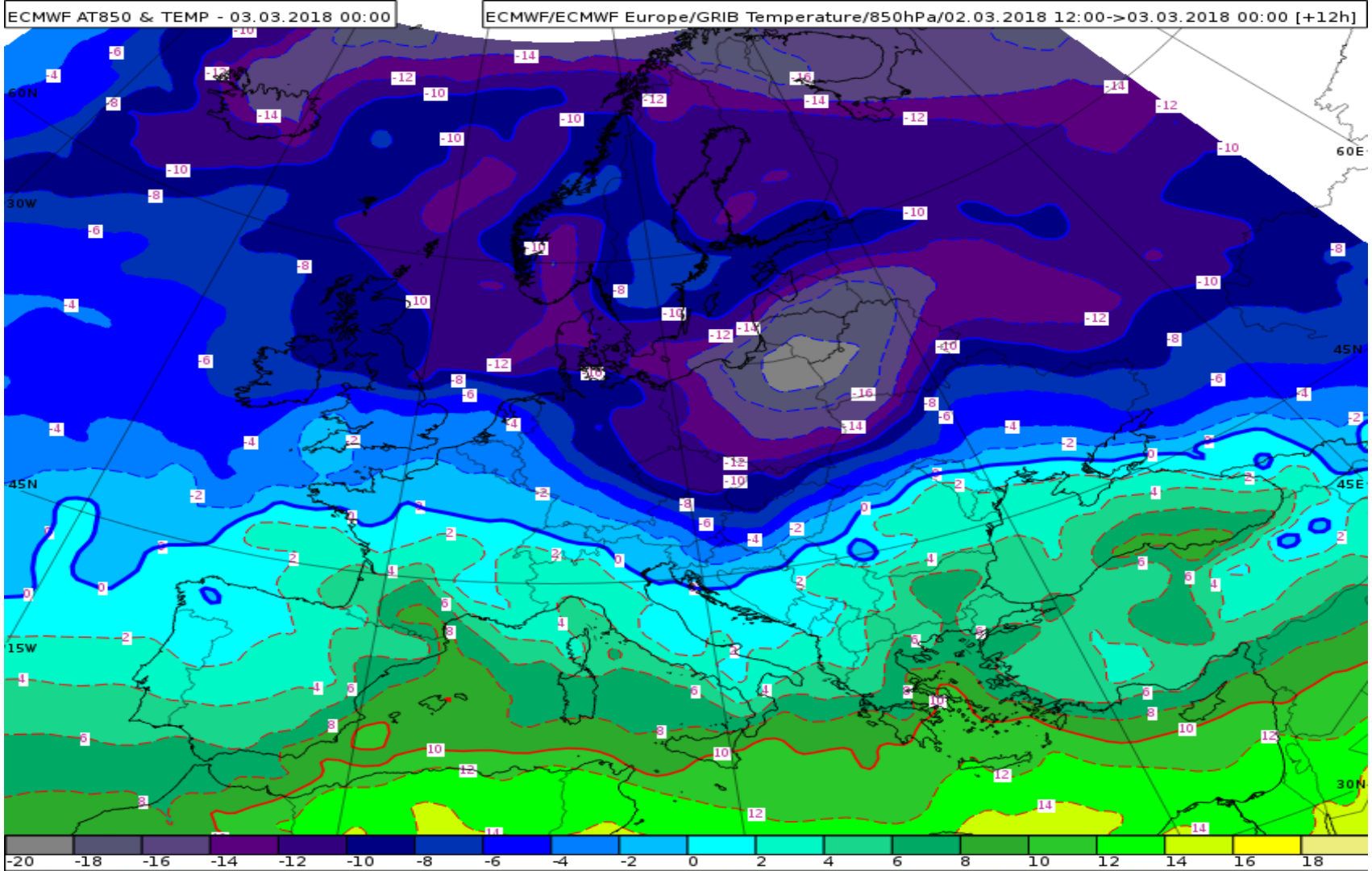

ECMWF AT850 & TEMP - 01.03.2018 18:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/01.03.2018 12:00->01.03.2018 18:00 [+6h]
60N
30W
45N
15W
60E
45E
30N
-22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20

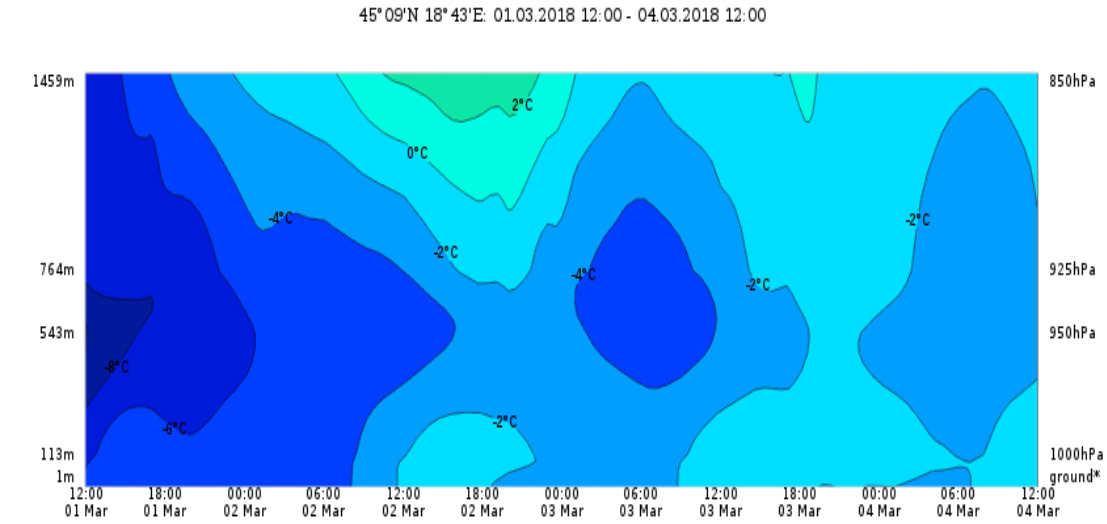

ECMWF AT850 & TEMP - 02.03.2018 00:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/01.03.2018 12:00->02.03.2018 00:00 [+12h]
60N
30W
60E
45N
45N
45E
15W
30N
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20

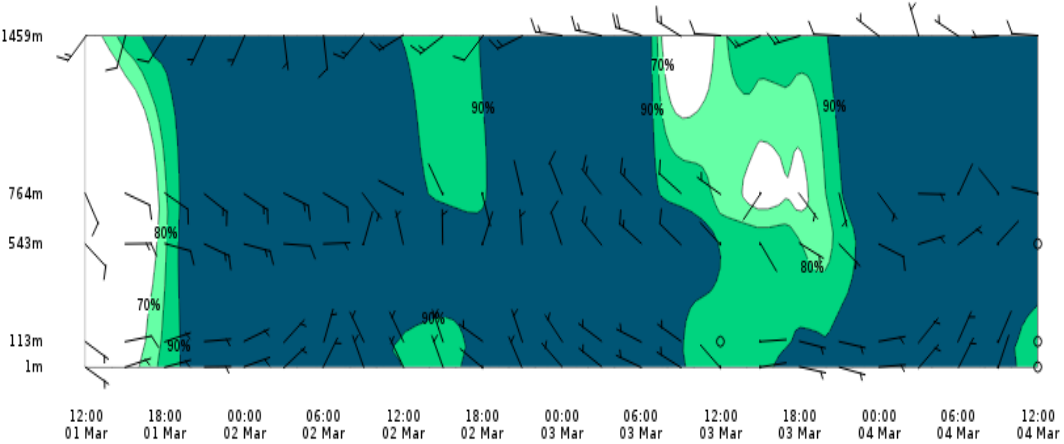

ECMWF AT850 & TEMP - 02.03.2018 06:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/02.03.2018 00:00->02.03.2018 06:00 [+6h]
60N
30W
45N
15W
60E
45E
30N
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20

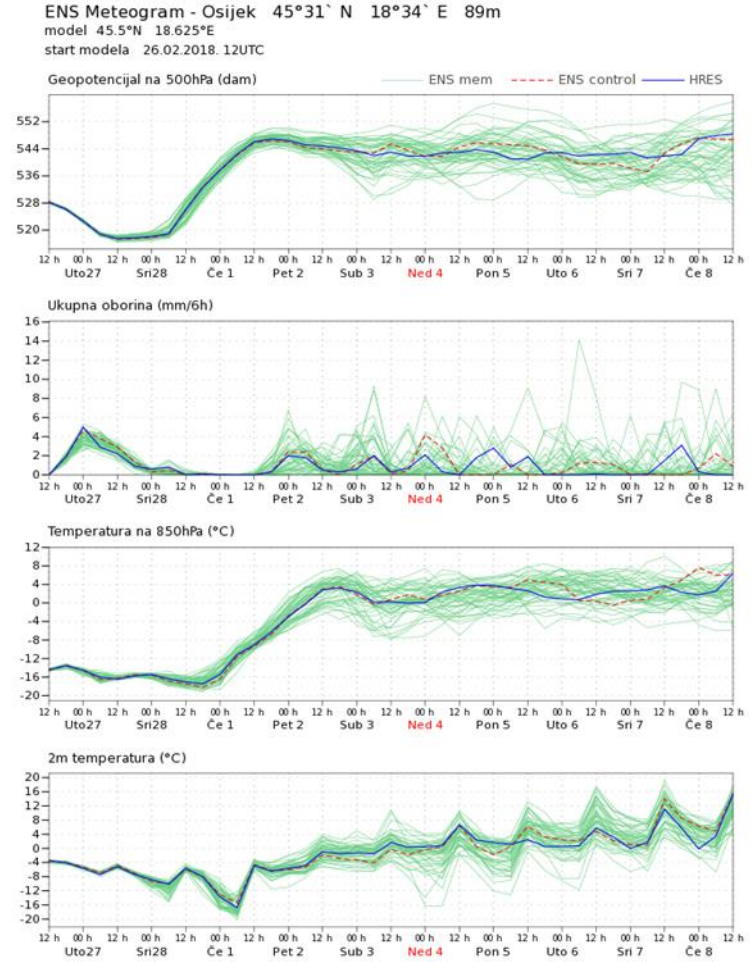

ECMWF AT850 & TEMP - 02.03.2018 12:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/02.03.2018 00:00->02.03.2018 12:00 [+12h]
60N
30W
45N
15W
60E
45E
30N
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18

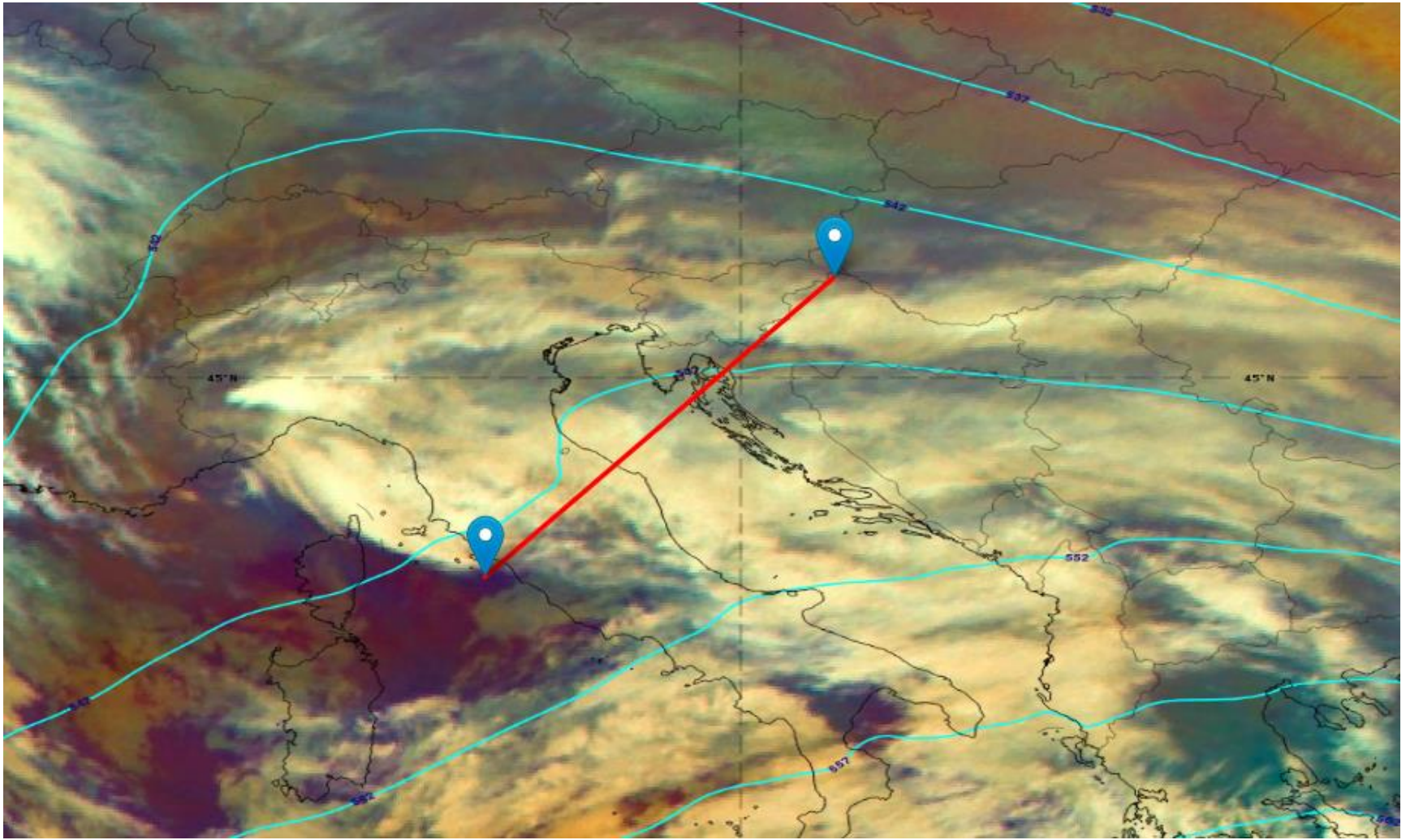

ECMWF AT850 & TEMP - 02.03.2018 18:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/02.03.2018 12:00->02.03.2018 18:00 [+6h]
60N
30W
60E
45N
45N
45E
15W
30N
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18

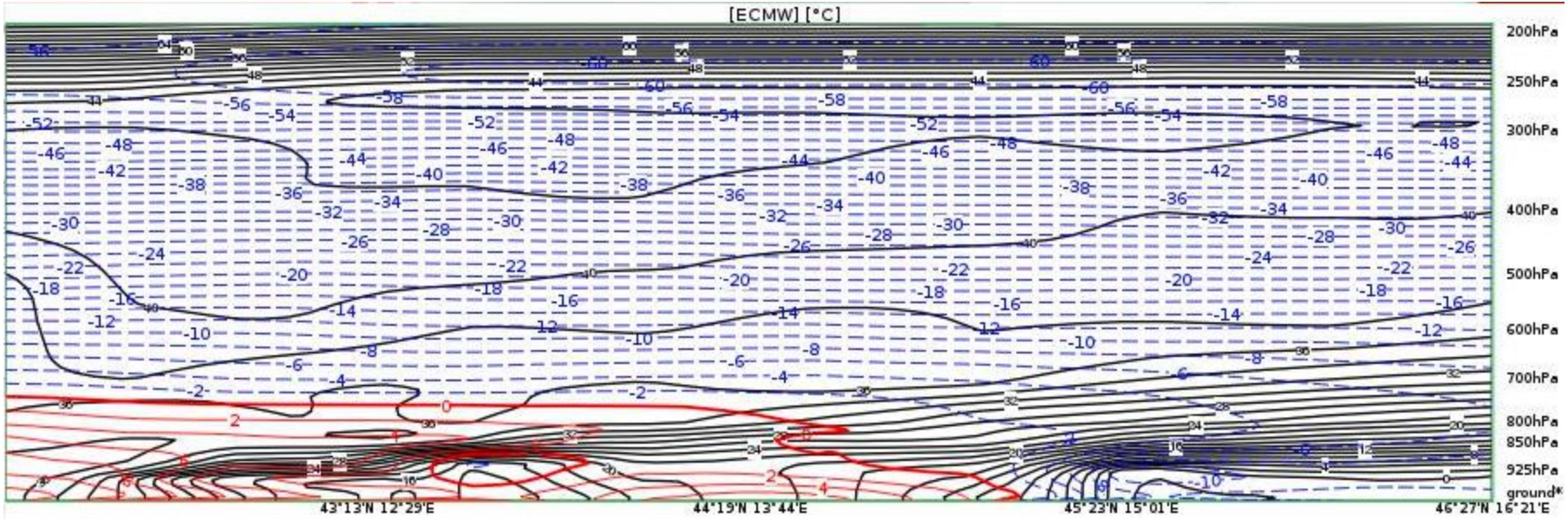

ECMWF AT850 & TEMP - 03.03.2018 00:00
ECMWF/ECMWF Europe/GRIB Temperature/850hPa/02.03.2018 12:00->03.03.2018 00:00 [+12h]
60N
30W
45N
15W
60E
45E
30N
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18


45°09'N 18°43'E: 01.03.2018 12:00 - 04.03.2018 12:00
1459m
764m
543m
113m
1m
850hPa
925hPa
950hPa
1000hPa
ground*
2°C
0°C
-4°C
-2°C
-4°C
-2°C
-2°C
-8°C
-6°C
-2°C
12:00 01 Mar
18:00 01 Mar
00:00 02 Mar
06:00 02 Mar
12:00 02 Mar
18:00 02 Mar
00:00 03 Mar
06:00 03 Mar
12:00 03 Mar
18:00 03 Mar
00:00 04 Mar
06:00 04 Mar
12:00 04 Mar

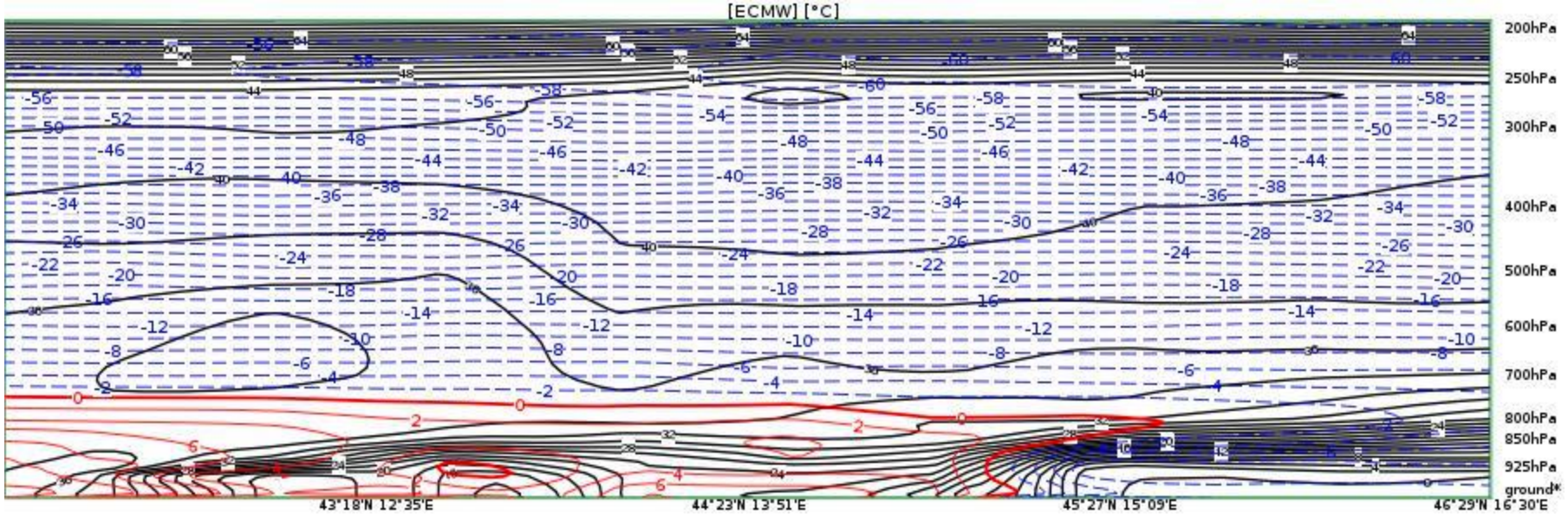

1459m
764m
543m
113m
1m
70%
90%
90%
90%
80%
80%
70%
90%
90%
12:00 01 Mar
18:00 01 Mar
00:00 02 Mar
06:00 02 Mar
12:00 02 Mar
18:00 02 Mar
00:00 03 Mar
06:00 03 Mar
12:00 03 Mar
18:00 03 Mar
00:00 04 Mar
06:00 04 Mar
12:00 04 Mar


ENS Meteogram - Osijek 45°31` N 18°34` E 89m
model 45.5°N 18.625°E
start modela 26.02.2018. 12UTC
Geopotencijal na 500hPa (dam)
ENS mem
ENS control
HRES
552
544
536
528
520
Ukupna oborina (mm/6h)
16
14
12
10
8
6
4
2
0
Temperatura na 850hPa (°C)
12
8
4
0
-4
-8
-12
-16
-20
2m temperatura (°C)
20
16
12
8
4
0
-4
-8
-12
-16
-20
12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h 00 h 12 h
Uto27 Sri28 Če 1 Pet 2 Sub 3 Ned 4 Pon 5 Uto 6 Sri 7 Če 8


537
542
45°N
45°N
552
557

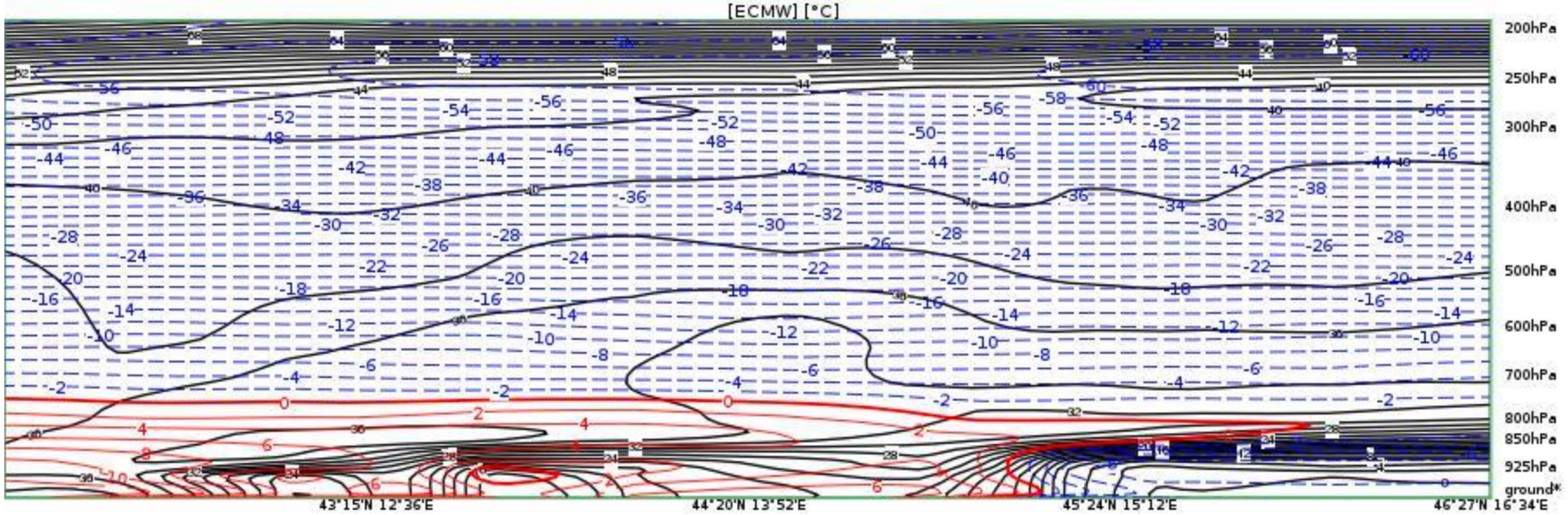


Cross-Section from map **Equivalent Potential Temperature** and **Temperature**
for 42°07'N 11°17'E - 46°27'N 16°21'E, valid 01.03.2018 18:00

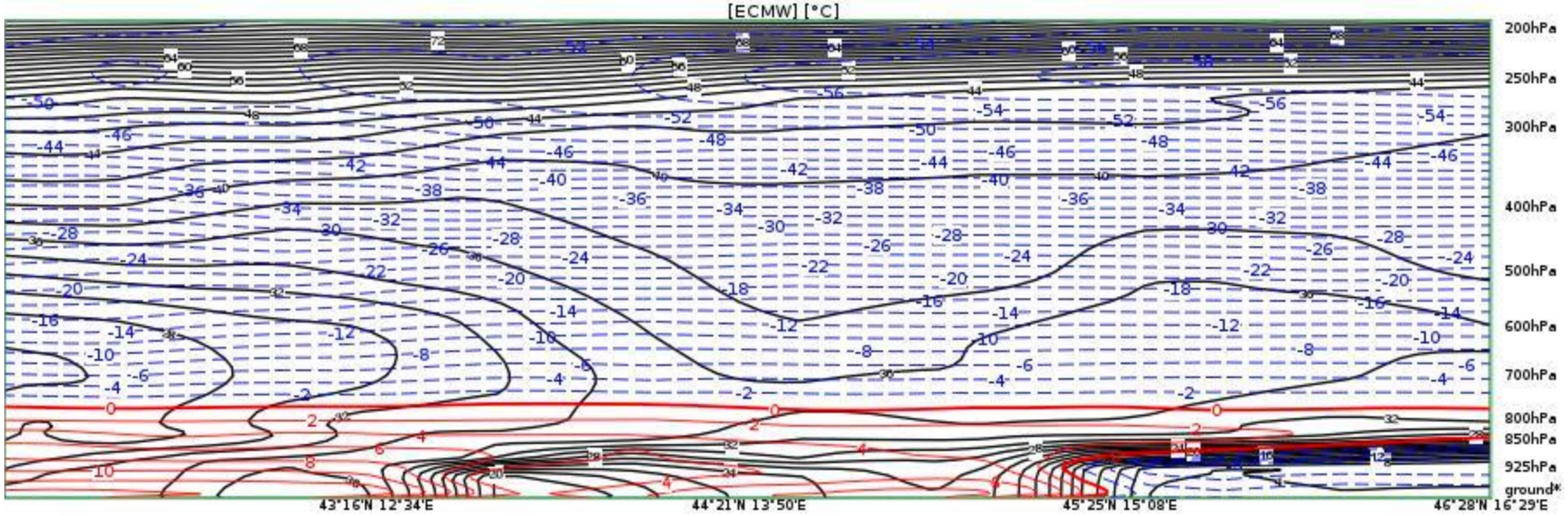


Cross-Section from map **Equivalent Potential Temperature** and **Temperature**

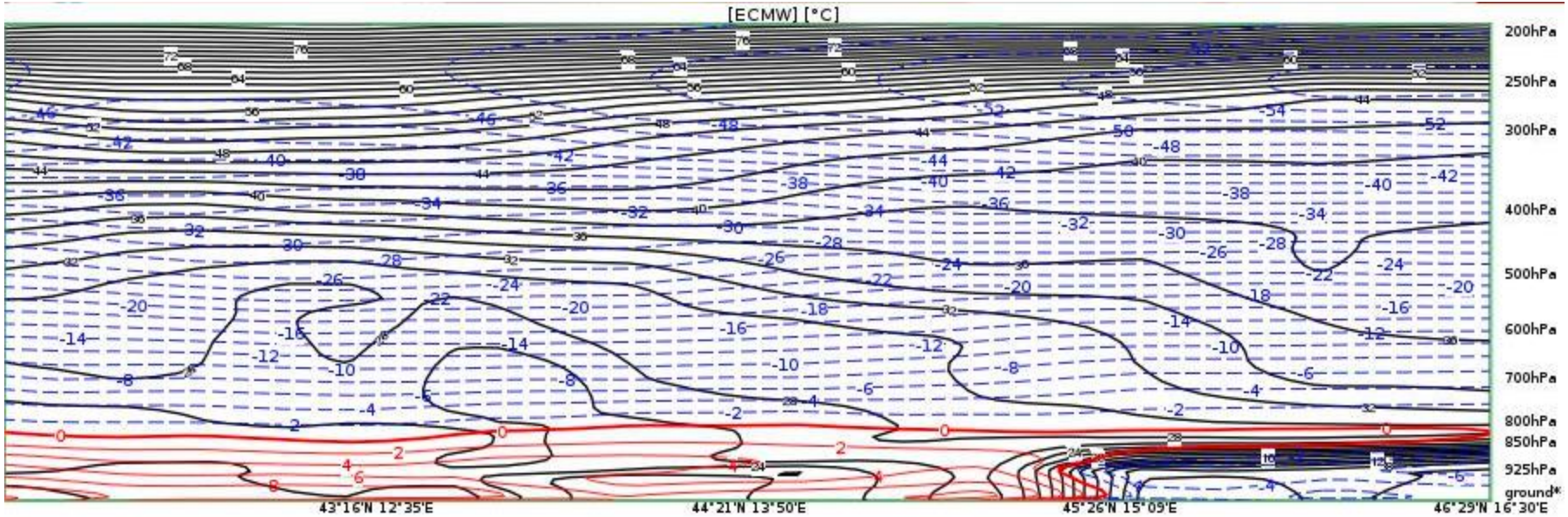
for 42°13'N 11°23'E - 46°29'N 16°30'E, valid 02.03.2018 00:00



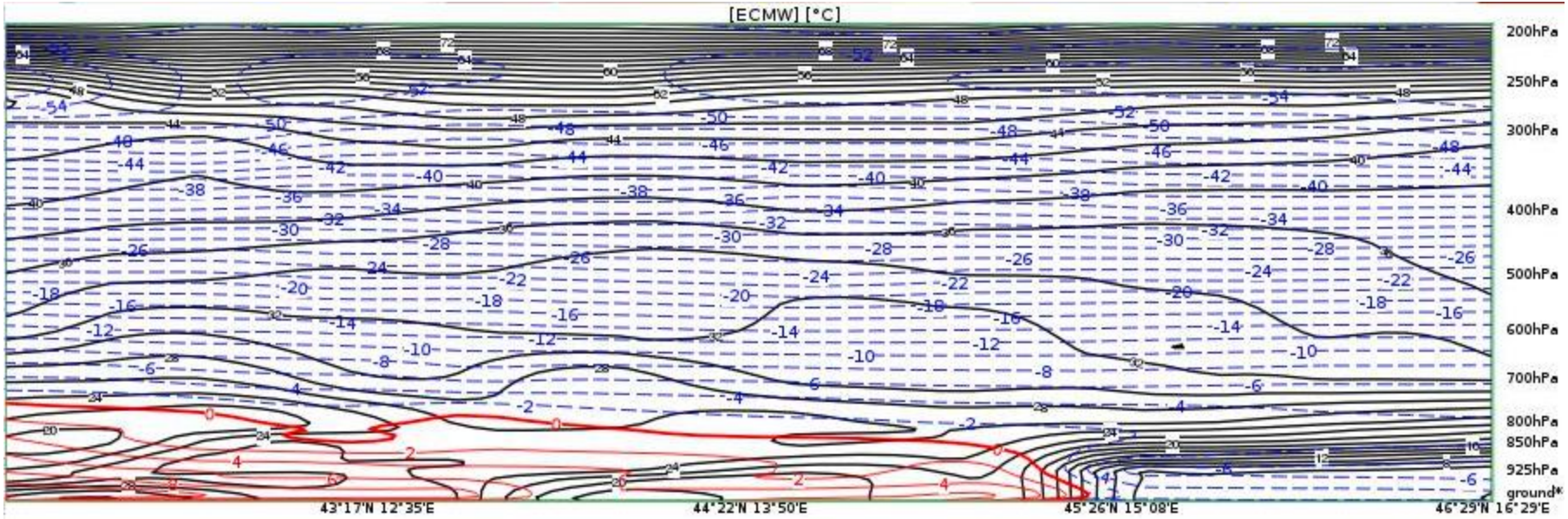
Cross-Section from map **Equivalent Potential Temperature** and **Temperature**
for 42°10'N 11°22'E - 46°27'N 16°34'E, valid 02.03.2018 06:00



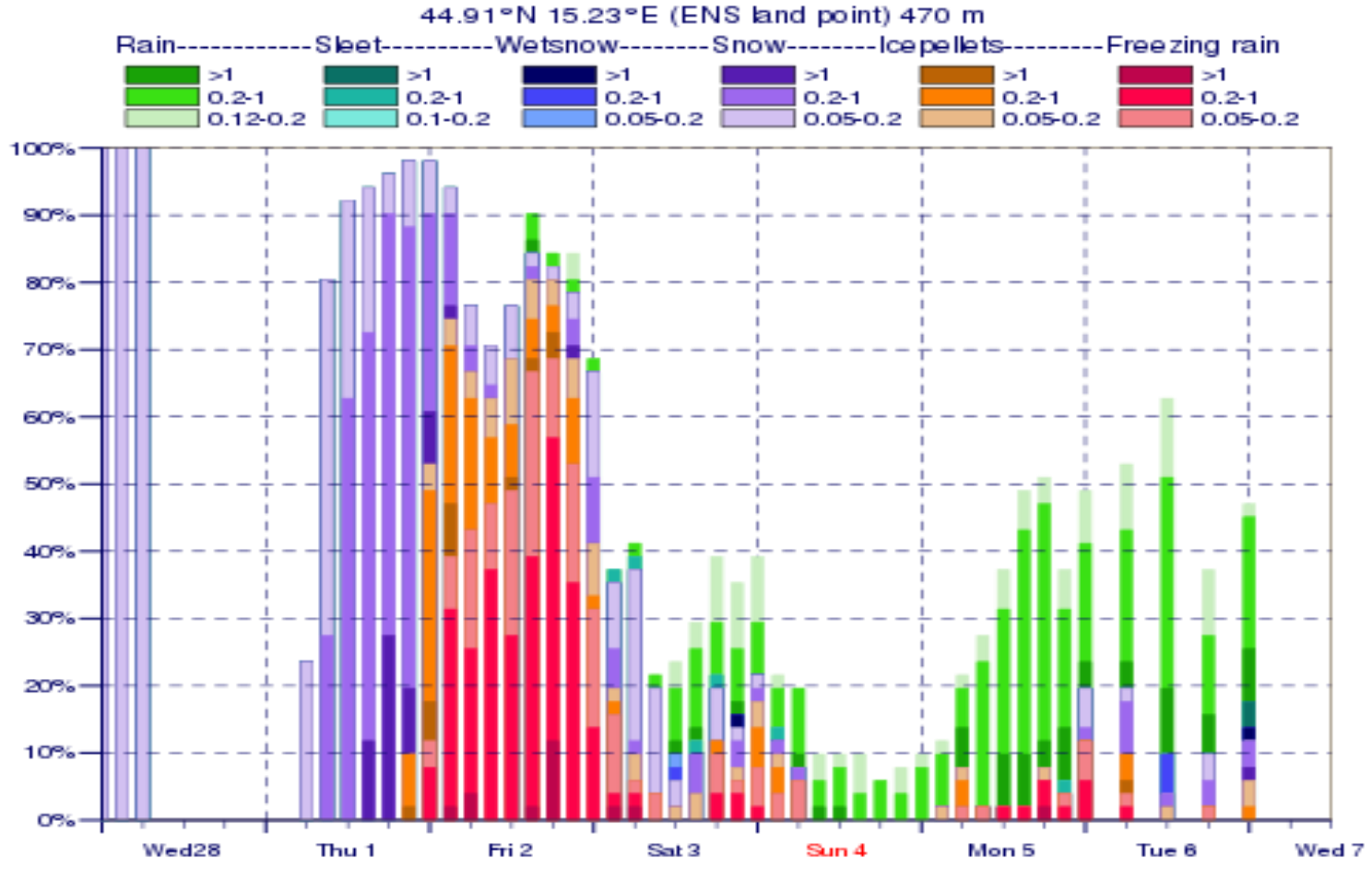
Cross-Section from map **Equivalent Potential Temperature** and **Temperature**
for 42°10'N 11°22'E - 46°28'N 16°29'E, valid 02.03.2018 12:00

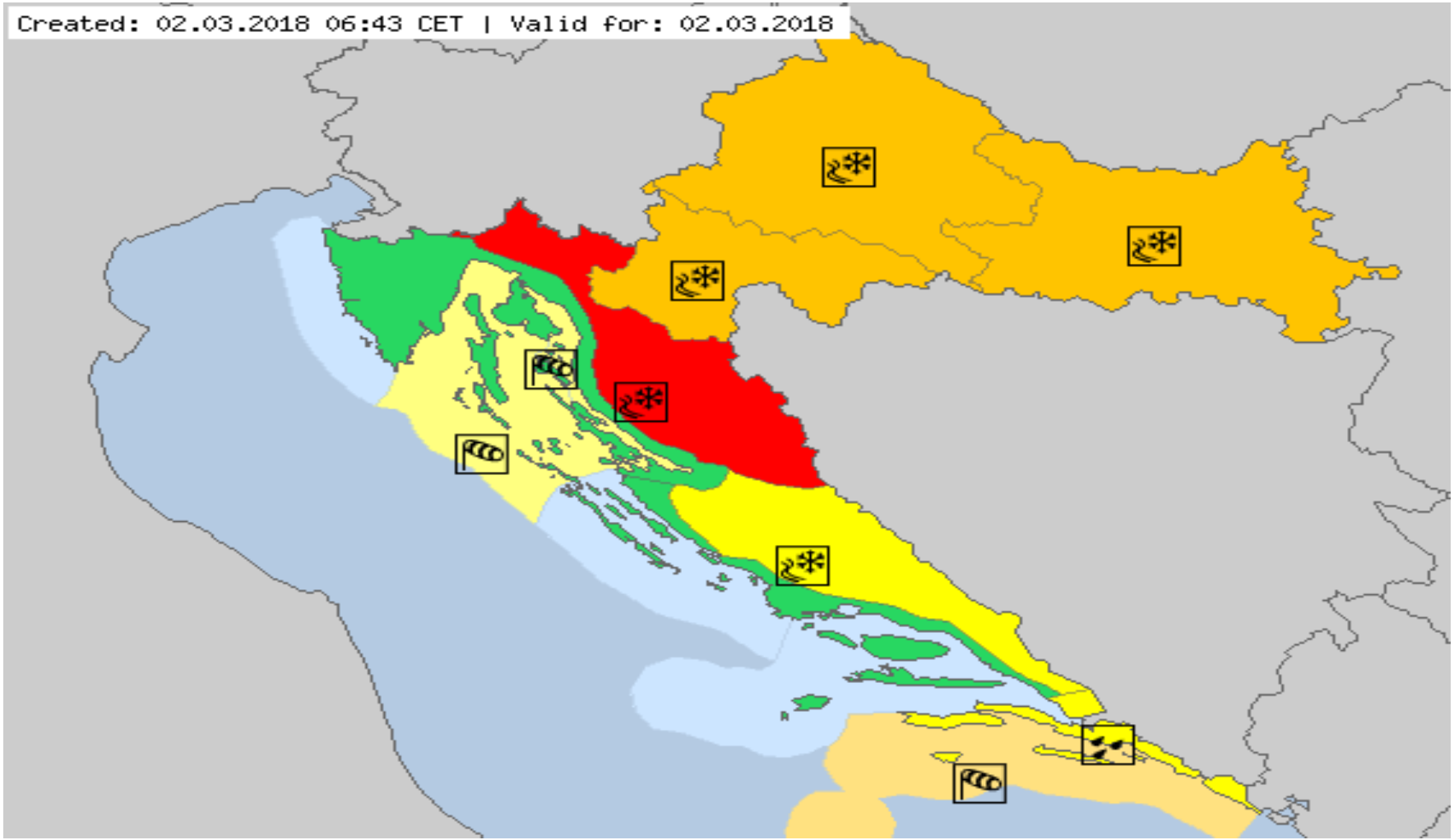


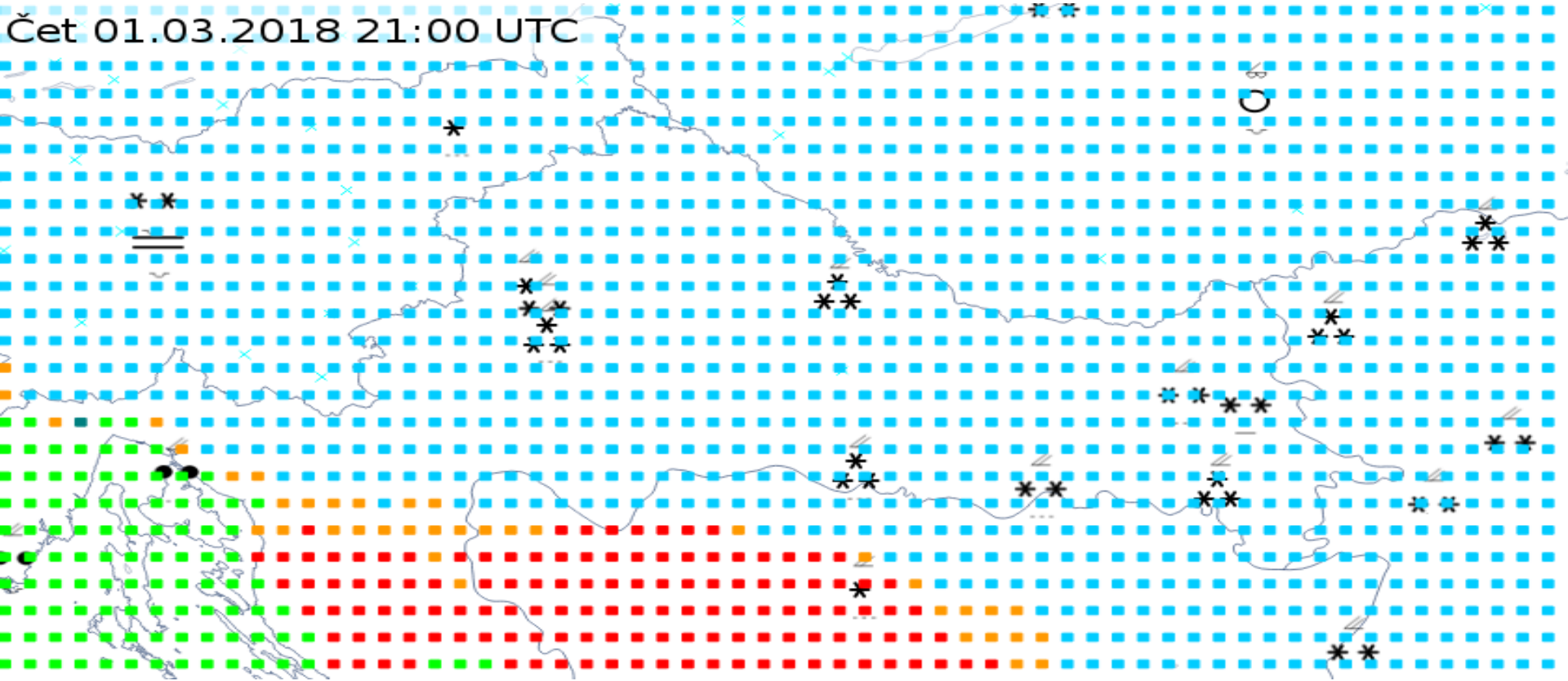
Cross-Section from map **Equivalent Potential Temperature** and **Temperature**
for 42°10'N 11°22'E - 46°29'N 16°30'E, valid 02.03.2018 18:00

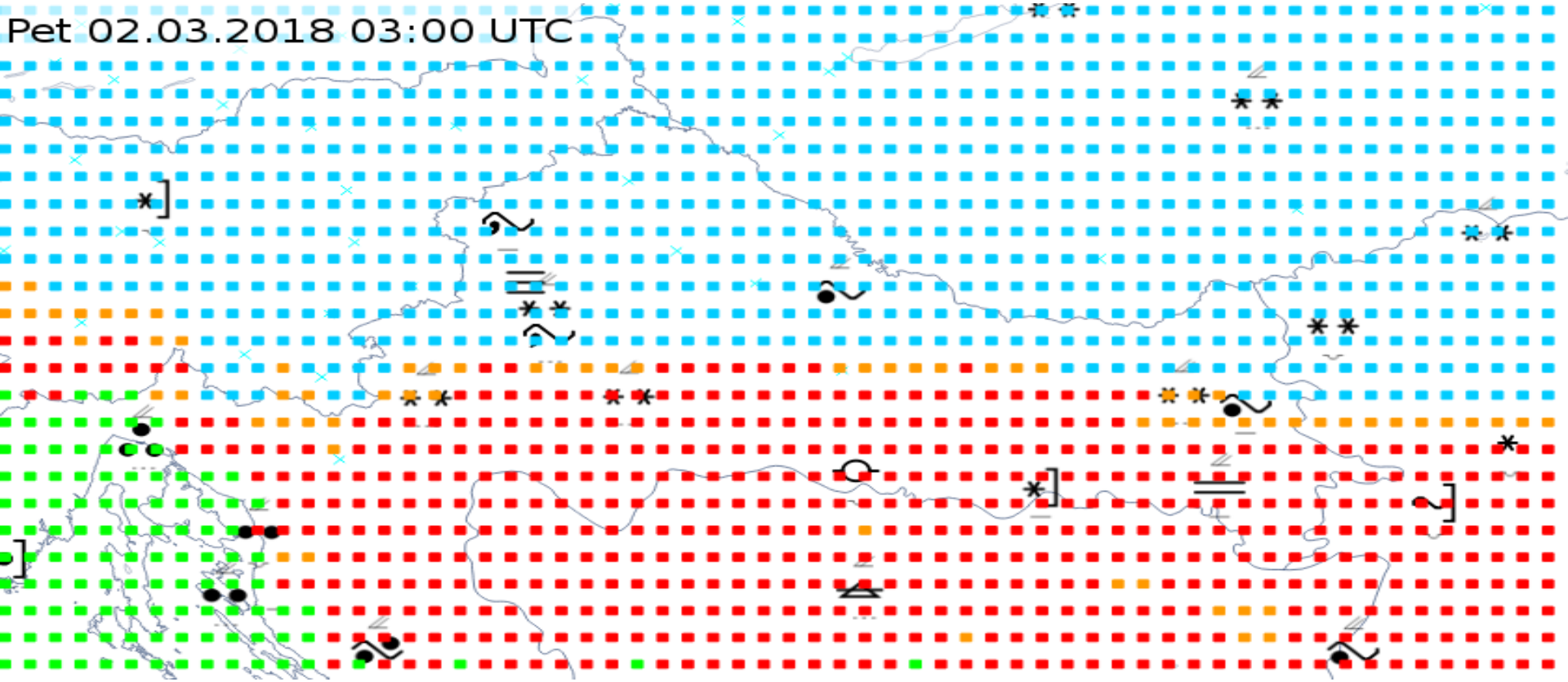


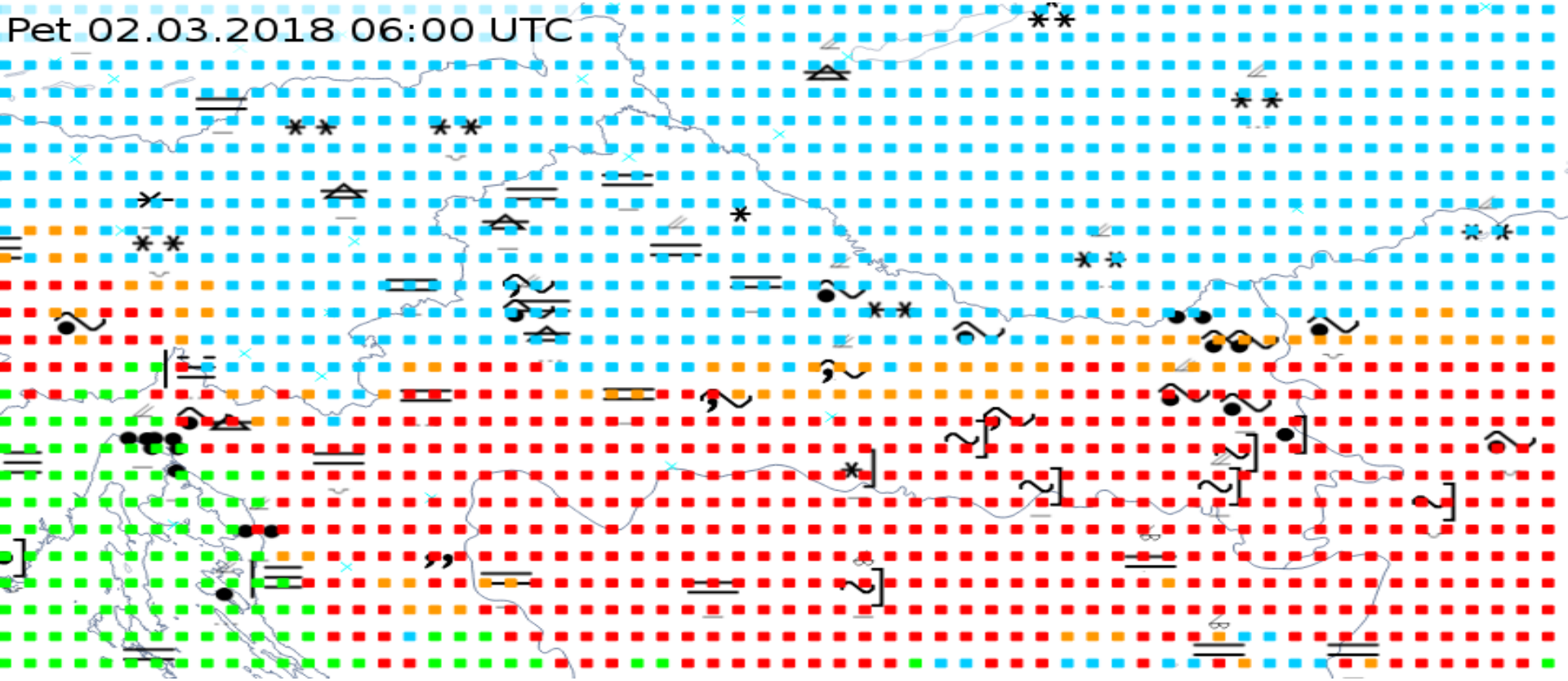
Cross-Section from map **Equivalent Potential Temperature** and **Temperature**
for 42°11'N 11°23'E - 46°29'N 16°29'E, valid 03.03.2018 00:00

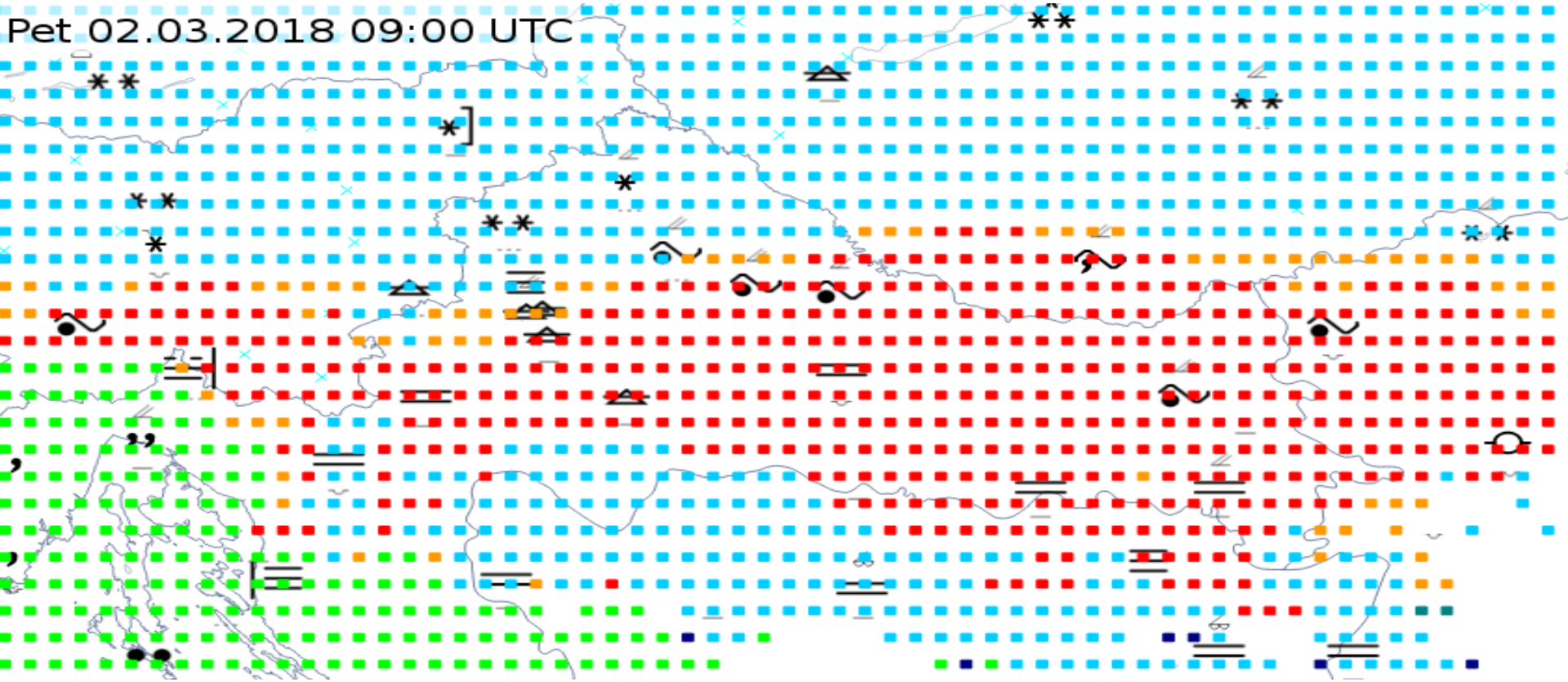

44.91°N 15.23°E (ENS land point) 470 m
Rain----------Sleet----------Wetsnow--------Snow--------Icepellets---------Freezing rain
>1
0.2-1
0.12-0.2
>1
0.2-1
0.1-0.2
>1
0.2-1
0.05-0.2
>1
0.2-1
0.05-0.2
>1
0.2-1
0.05-0.2
>1
0.2-1
0.05-0.2
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Wed28
Thu 1
Fri 2
Sat 3
Sun 4
Mon 5
Tue 6
Wed 7

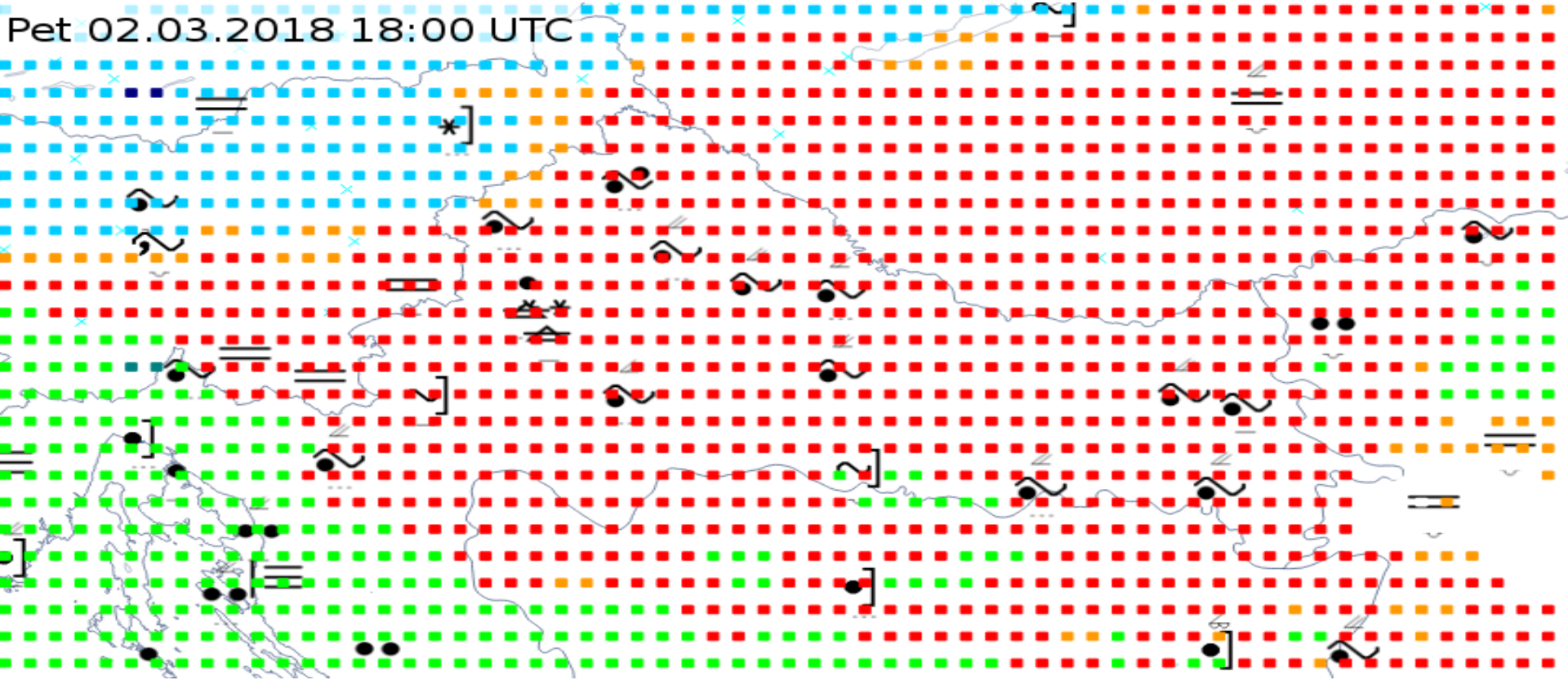

Created: 02.03.2018 06:43 CET | Valid for: 02.03.2018

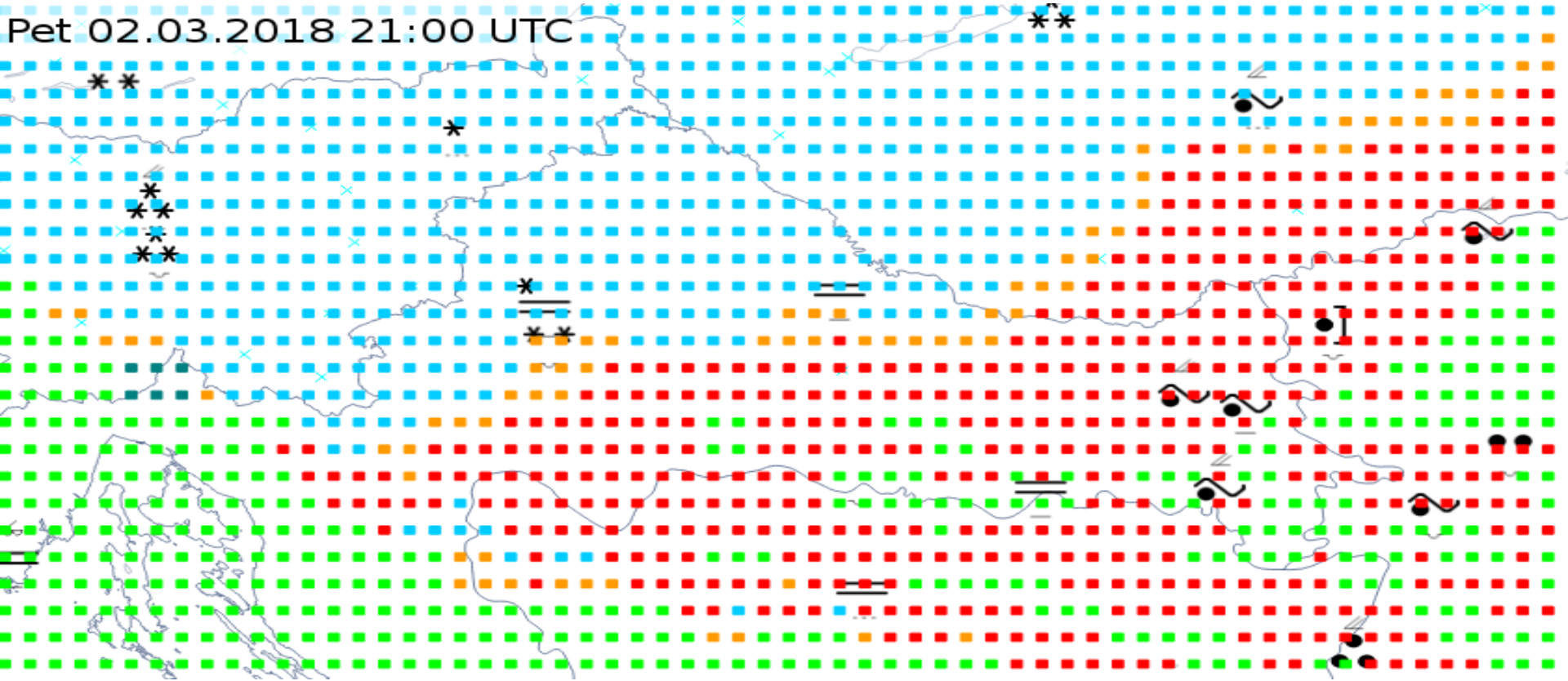

Čet 01.03.2018 21:00 UTC

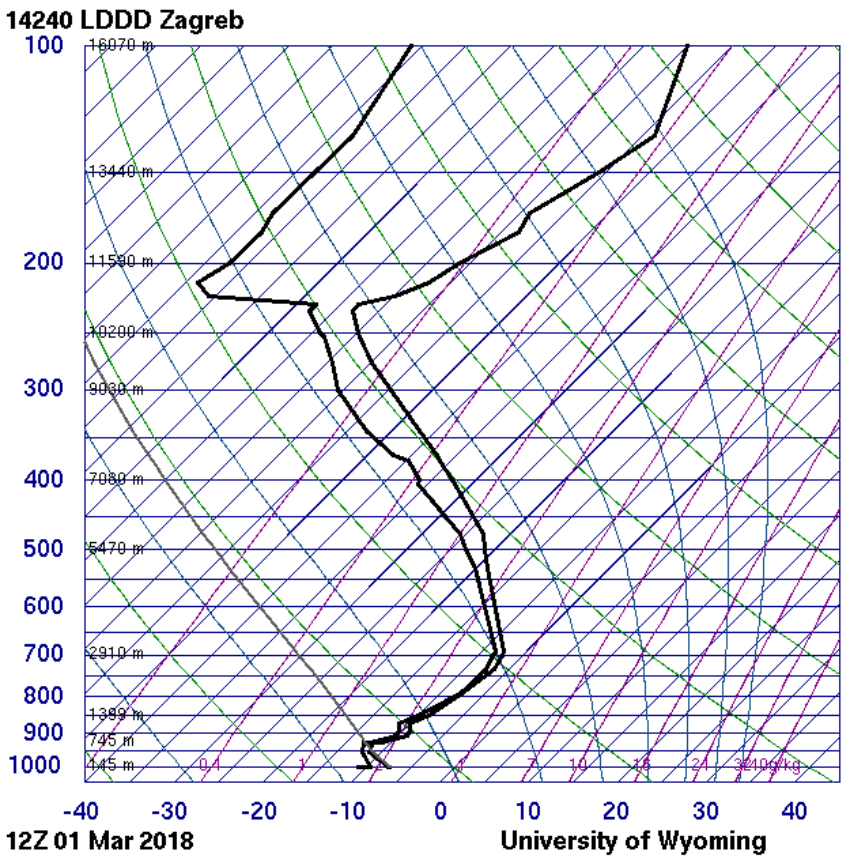

Pet 02.03.2018 03:00 UTC


Pet 02.03.2018 06:00 UTC


Pet 02.03.2018 09:00 UTC


Pet 02.03.2018 18:00 UTC


Pet 02.03.2018 21:00 UTC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745 m
145 m
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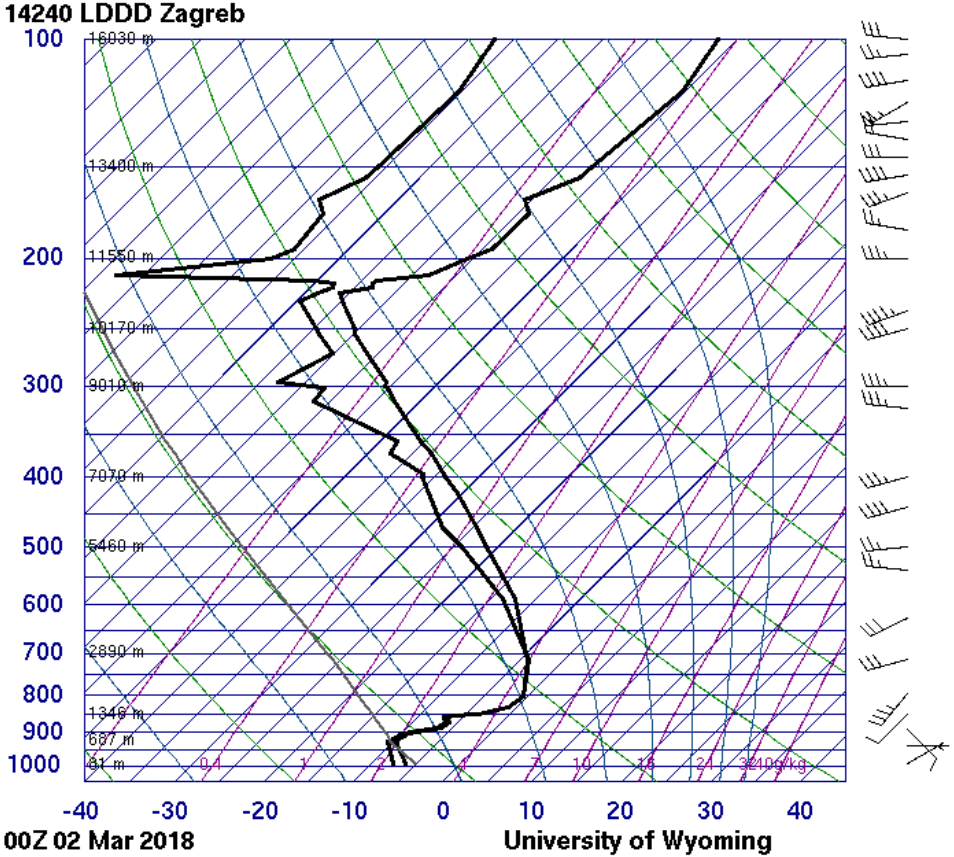
12Z 01 Mar 2018
University of Wyoming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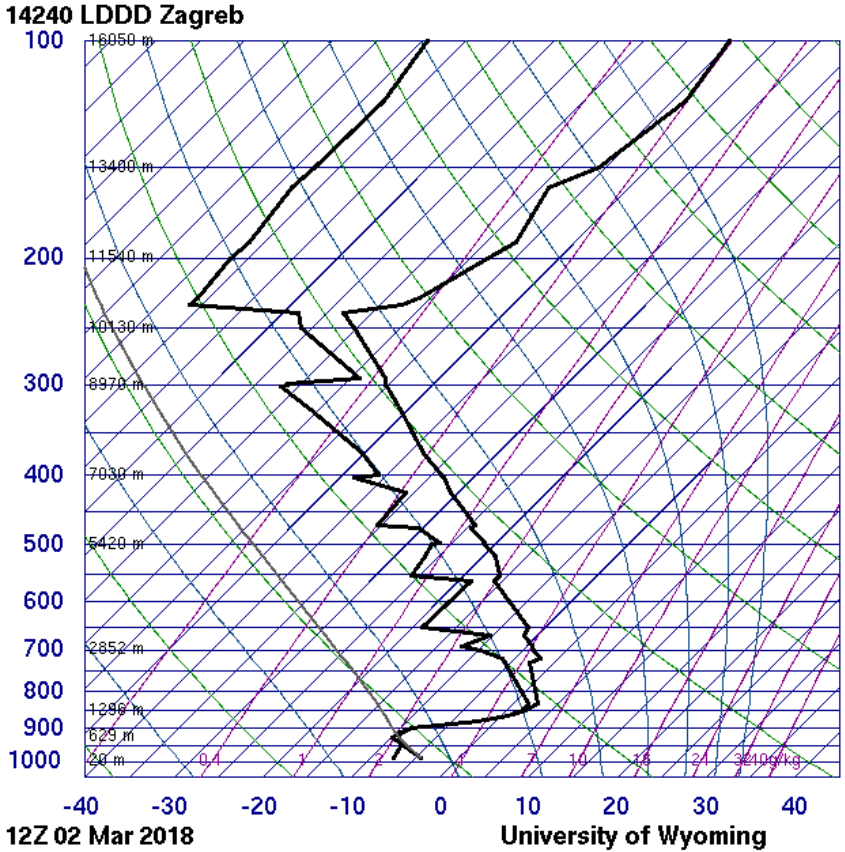
University of Wyoming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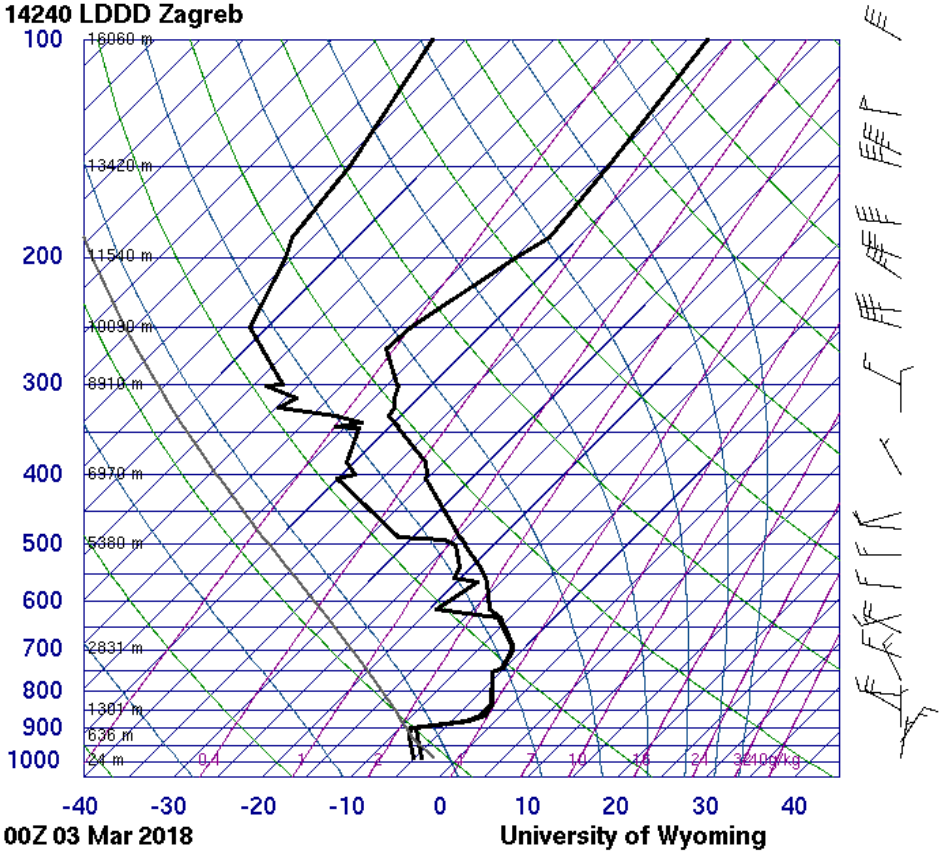
University of Wyoming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6970 m
5380 m
2831 m
1301 m
636 m
24 m
-40 -30 -20 -10 0 10 20 30 40
00Z 03 Mar 2018
University of Wyoming


Not much damage?!

to conclude...

- more experience with the phenomenon
- new products available
- subjective verification so far very good
- still a major challenge – forecasting the impact!

Thank you!

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