Severe Freezing Rain in Slovenia

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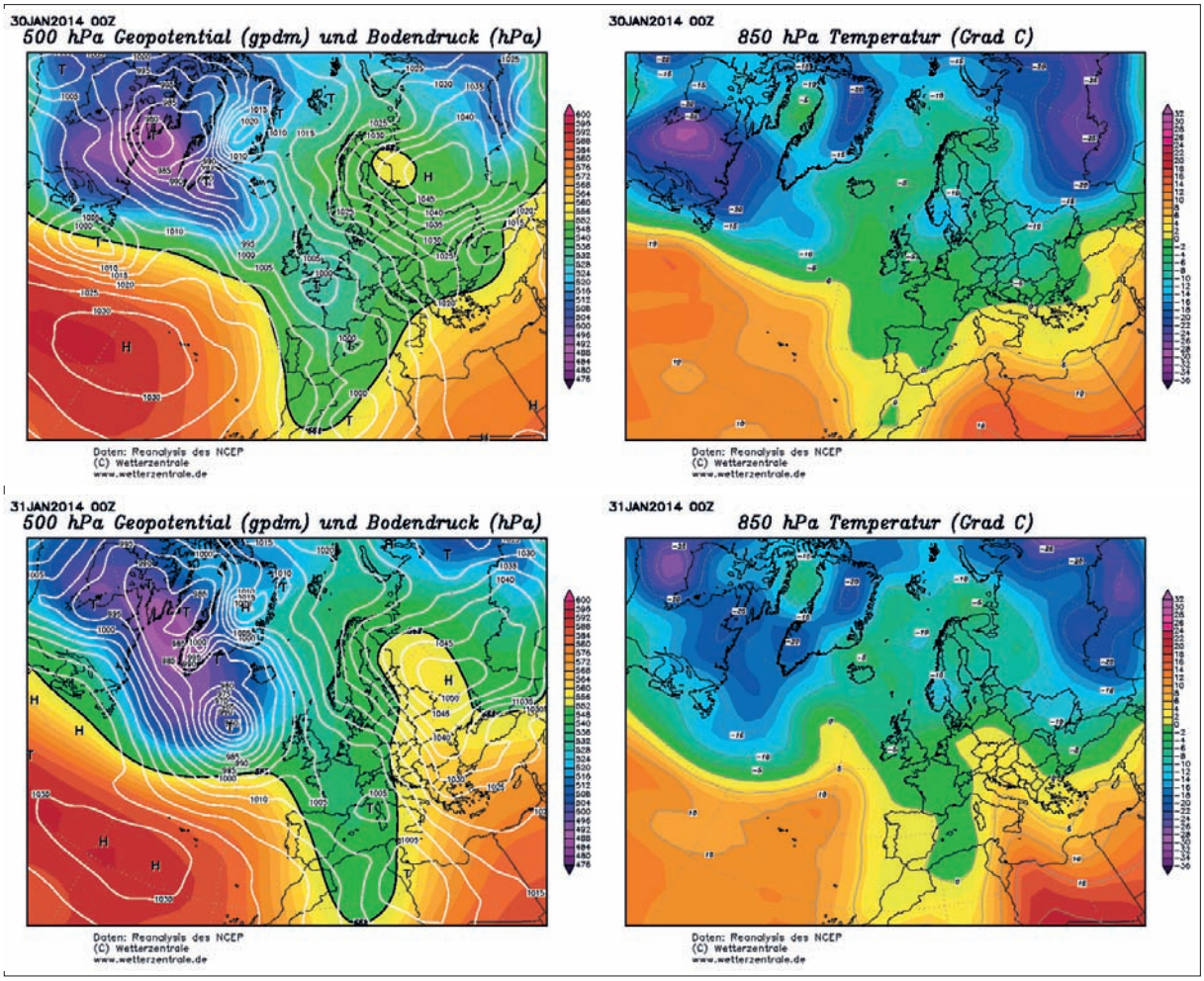
Introduction

At the end of January and at the beginning of February 2014, severe and long-lasting freezing rain affected a major part of Slovenia. Some days before, a cold airmass had been advected from the NE, but later a warm airmass flow started from the S at middle levels between 1200 and 2000 m above sea level. In four days in the region of Postojna, where the maximum damage occurred, more than 150 mm of precipitation was measured. The highest level of weather warnings (red) were issued by the NMS for all five regions in Slovenia. The total damage to forests and forest roads, power and railway infrastructure and the economy was estimated to be 400 million EUR.

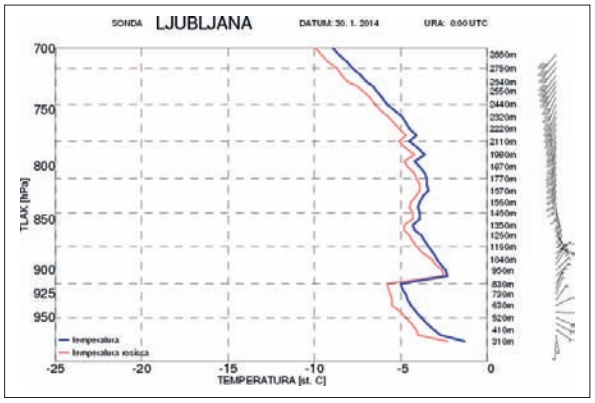
Synoptic Situation

During the period of this severe freezing rain event there was a deep Low in NW Europe with a secondary Low over the Northern Mediterranean, and a strong High pressure field over Western Russia. A day or two before the event, the secondary Low was deepening and at 850 hPa the warm advection had started (see Figure 1). Such a synoptic situation usually brings heavy snowfall in NW parts of Slovenia and severe freezing rain in some other places.

In Figures 2 to 4 the measurements of radio soundings over Ljubljana are shown. On 30 January 2014

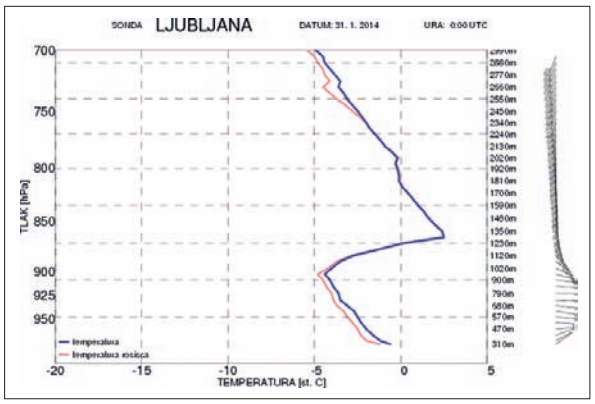


▲ *Figure 1: 500hPa geopotential and MSL pressure field over Europe and North Atlantic (left) and 850hPa temperature field (right) on 30 and 31 January 2014. Source: www.wetterzentrale.de*

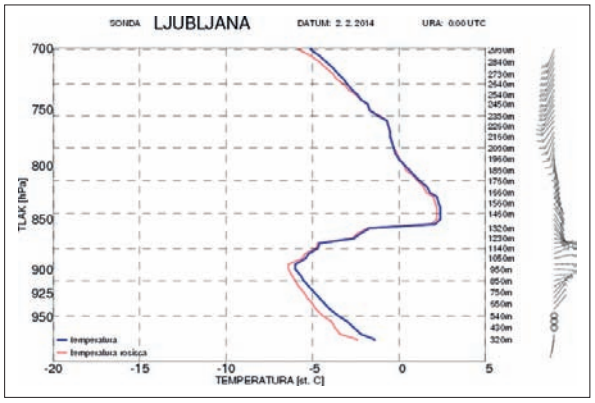


▲ *Figure 2: Temperature profile (blue line), dewpoint temperature profile (red) and wind profile over central Slovenia (Ljubljana) on 30 January 2014..*

the temperature was below zero deg. C in all levels through the whole troposphere, and on that day moderate to heavy snowfall occurred. A day later, on 31 January, the air temperature was above zero in deep layer between 1200 and 1700 m, see Fig. 3.



▲ *Figure 3: Temperature profile (blue line), dewpoint temperature profile (red) and wind profile over central Slovenia (Ljubljana) on 31 January 2014.*

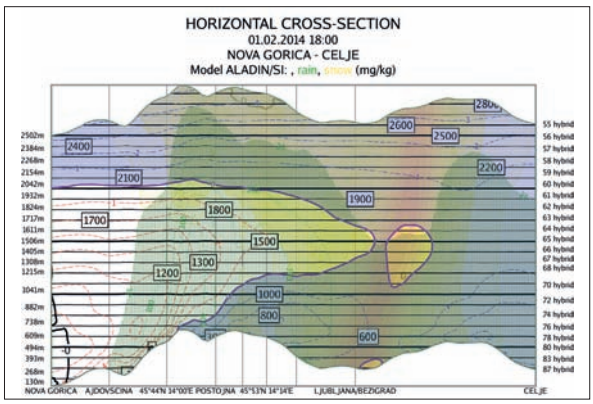


▲ *Figure 4: Temperature profile (blue line), dewpoint temperature profile (red) and wind profile over central Slovenia (Ljubljana) on 2 February 2014.*
In the days after 2 February, the High over Eastern Europe weakened and Slovenia became more and more under the influence of the Low over Western Europe. The precipitation was weak and the moderate SW wind finally pushed out the cold air from the lower layers.

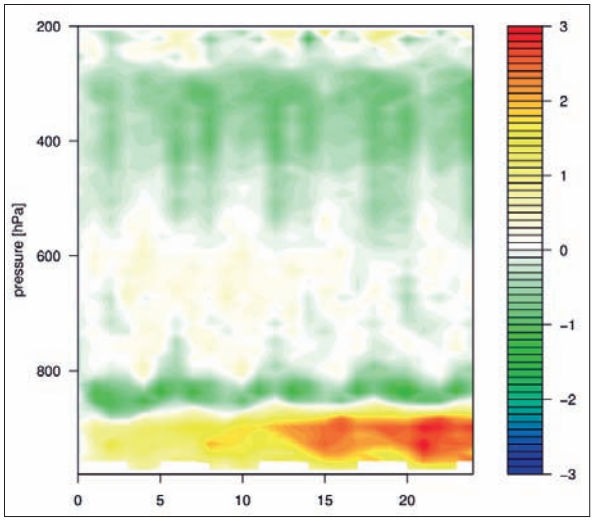
Two days later, on 2 February, the situation over Ljubljana was nearly the same, though the cold advection from the E below 1000 m was even stronger, Figure 4.

Behaviour of NWP models

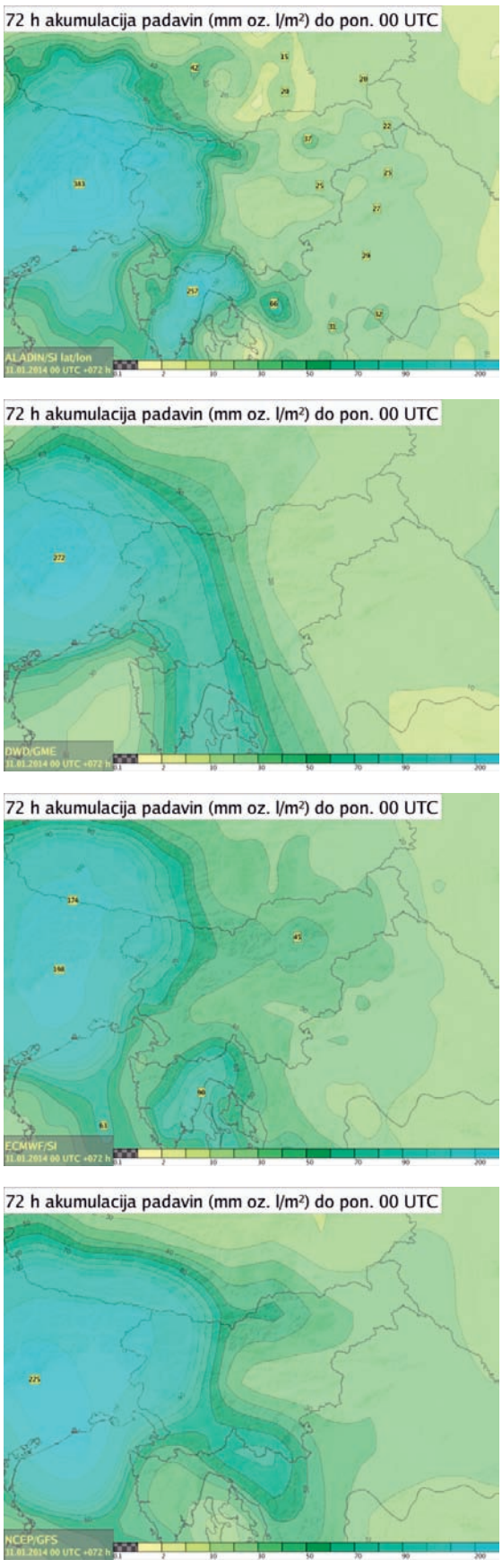
The NWP models were quite good in forecasting the precipitation amounts, but less good in forecasting the type of precipitation. But forecasters on duty reacted quickly and in good time when latest runs of numerical models showed warm advection in upper levels from the south (Figure 5). The model's weakness was that it tended to warm the lower levels and cool the upper levels in with increasing forecast time (Figure 6), which might give the forecaster the impression that the freezing rain should turn to snow, which in reality did not happen. In such cases especially, having a vertical temperature profile measured by radio soundings was a great help to forecasters in providing good forecasts of precipitation type.



▲ *Figure 5: ALADIN/SI 6-hour forecast Horizontal Cross-section SW to NE valid for 18 UTC on 1 February 2014.*



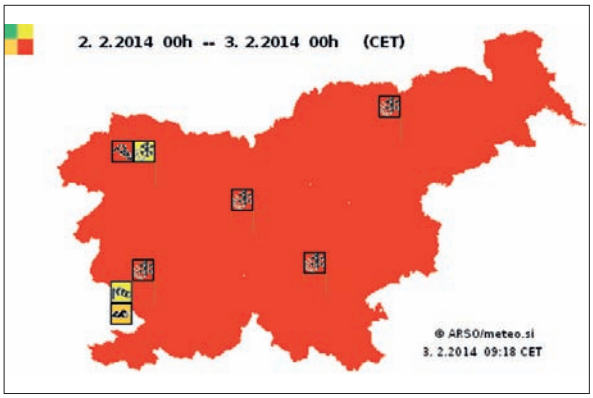
▲ *Figure 6: Temperature BIAS (colour scale in K) – the strength of the inversion is diminishing during forecast*



▲ *Figure 7: Predicted 72-hours accumulation of precipitation from different NWP models (ALADIN/SI, DWD/GME, ECMWF, NCEP/GFS) in the time period from 31 January 00 UTC to 3 February 00 UTC.*

Issued Warnings

Due to heavy precipitation predicted by different NWP models (Figure 7 – all showing the 72 hours accumulation in the time period 31 January 00 UTC to 3 February 00 UTC), the NMS issued many severe weather warnings starting with the first warning on the morning of 30 January. In the first warning only heavy snowfall for some regions was mentioned, but on the evening of the same day, severe freezing rain was added into the warning text. In the following days severe weather warnings were issued twice a day and, in accordance to the text, the appropriate colour on the Meteoalarm map was used. The most severe situation was predicted for Sunday, 2 February 2014, when for all five regions in Slovenia the highest level of weather warnings were declared (Figure 8).



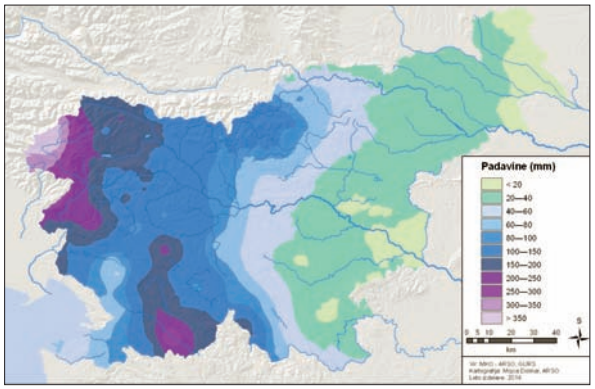
▲ *Figure 8: Meteoalarm chart valid for 2 February 2014.*

Precipitation Amount and Damage Caused by Freezing Rain

The precipitation started on 30 January, spreading from West to East. A day later the precipitation was intense and freezing rain started in some regions. On 1 February in the first half of the day precipitation was weak, but intensified in the afternoon. Intense precipitation occurred also on 2 February.

Precipitation accumulation for four days (30 January to 3 February 2014) is shown in Figure 9.

There are two maxima with more than 300 mm precipitation accumulation. The first one is in the western part of Slovenia, in the area of the automatic weather station at Bovec, where there are high mountains and a narrow valley. In the mountains it was snowing, but in the valley mostly raining. The second maximum is located in the S-SW of Slovenia, where the automatic weather station Ilirska Bistrica is located. In this area precipitation was only in the



▲ *Figure 9: Measured 4 days total precipitation (30 January to 3 February)*

form of rain, and some minor flooding occurred. In all other regions of the western half of Slovenia - except the most SW part - precipitation amounts of 40 to 200 mm were reported and damage caused by freezing rain occurred. The most affected region was around the town of Postojna, where 165 mm of precipitation was measured, nearly all in the form of freezing rain (Figure 10).

▲ *Figure 10: Freezing rain in Postojna 2 Feb. 2014.*

The damage was very great in the forests and forest roads, and also on power system infrastructure (Figure 11). Some parts of the most affected regions were without electrical power for up to ten days. International help in form of electric generators was necessary.

▲ *Figure 11: Damage in forests and on power and railway infrastructure, Feb. 2014.*

The railway infrastructure – in particular the connection between Ljubljana and the coast (Koper) - was severely damaged. Pylons of power lines were broken and for more than a year only diesel locomotives maintained rail transport from and to the Port of Koper.

The estimated total damage caused by this long lasting freezing rain was around 400 million EUR. As can be seen in Figure 12, the major part of Slovenia was damaged by freezing rain/snow and a small region in the South by flooding.

Conclusion

A severe freezing rain has hit Slovenia in the last days of January and the first days of February 2014, leading to significant damage to forests, and railway and power system infrastructure. The highest level of weather warning was issued for all five regions of Slovenia. In the most affected region more than 150 mm of precipitation in form of freezing rain occurred. The issued warnings helped the civil protection authorities to organize the work in all affected areas. International help in form of electric generators was needed.

A discussed case of severe freezing rain has led to some improvements in modelling of precipitation type also in the big centres like ECMWF.

References:

1. Meteorological archive of EARS
2. Daily bulletins of Civil protection authorities
3. http://www.wetterzentrale.de
4. Tim Hewson: Current activities at ECMWF related to severe weather prediction (presentation at WGCEF meeting in Geneve 2014)

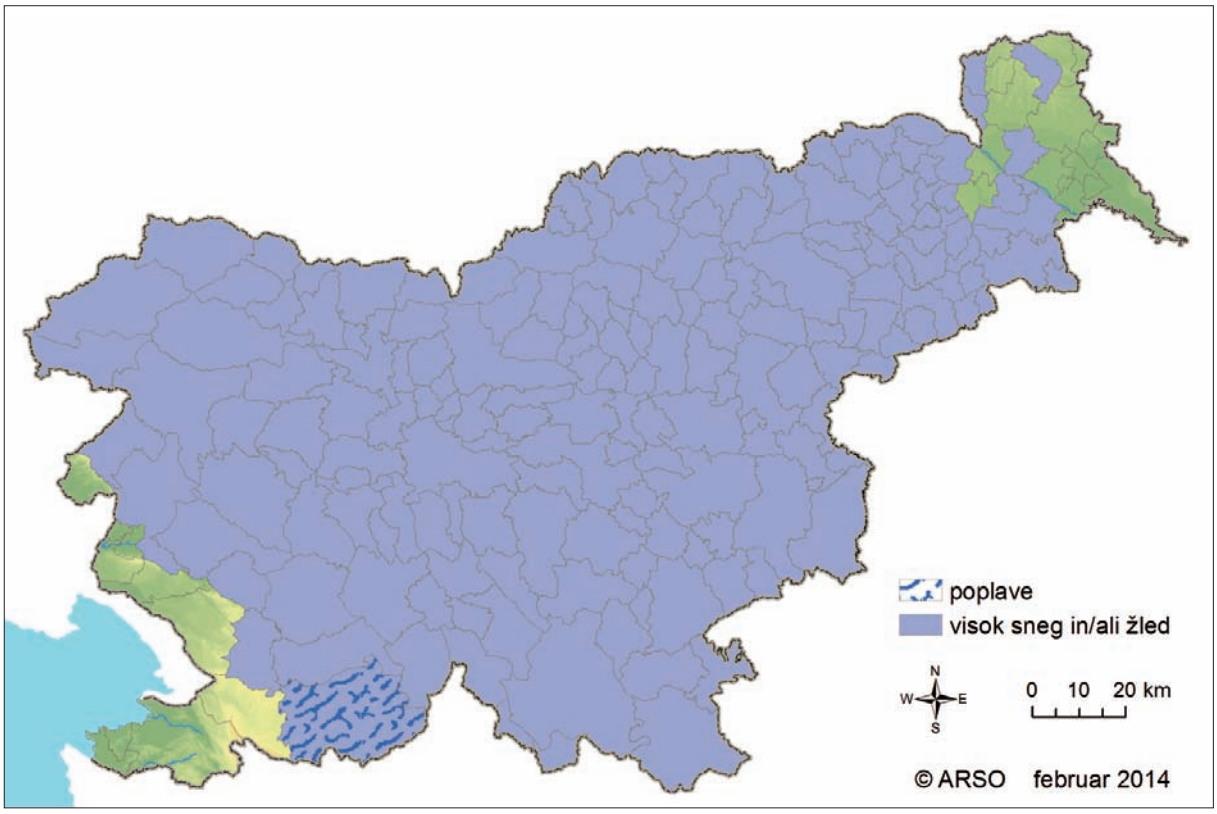


Figure 12: Territory with material damage due to freezing rain or snow (purple) and due to flooding (blue cross-hatching). Source: Daily Bulletin of Civil Protection Authorities.