High resolution NWP model in operational use in Slovenia

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Introduction

The high resolution NWP model in operational use in the Slovenian Met Service is Aladin/Si with a 9.5 km horizontal grid spacing. This ptrovides the main source of model data for the forecaster when forecasting extreme ('orange' and 'red') events, especially strong winds and heavy and/or long-lasting precipitation. The strong Bora wind event from March 2010, and the floods of Christmas 2009 and September 2010 were well forecast, and the Met Service was praised by both media and government. Aladin fields are also used as NWP input for the INCA analysis and nowcasting system. An Aladin/Si model with 4.4 km horizontal grid spacing is in is testing phase, and is planned to become operational in late spring 2011. Further improvements in extreme weather forecasting are expected. Two severe weather cases involving strong winds are presented.

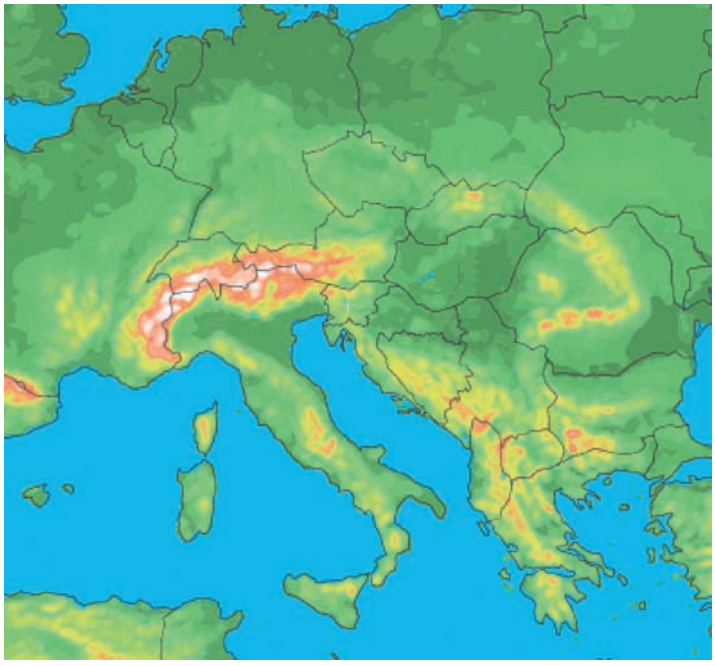


Figure 1
Operational Aladin/Si 9.5 km domain

Aladin/SI

The high resolution NWP model Aladin/Si with a 9.5 km horizontal grid spacing is run 4 times per day (00, 06, 12 and 18 UTC). The fields are calculated for the next 72 hours. The operational domain is shown in Figure 1.

The main characteristics of the current operational model configuration are:

- 43 vertical model levels
- linear spectral elliptic truncation (E134x127, 258*244 points, with extension zone 270*256)
- Lambert projection
- 400s time step
- initial and lateral boundary conditions from ARPEGE
- LBC coupling every 3 hours
- digital filter initialization
- no data assimilation

In addition, daily runs of the Aladin model with initial and lateral boundary conditions from ECMWF/IFS are prepared and used as backup or for additional information.

The Aladin/Si model with 4.4 km horizontal grid spacing and data assimilation is planned to be operational from late spring 2011. Currently products are computed twice a day (00 and 12 UTC). The model configuration is the same as operational except for:

- linear spectral elliptic truncation (E224x215, 439*421 points, with extension zone 450*432)
- 180s time step
- domain is smaller
- data assimilation cycle is in preparation

The INCA analysis and nowcasting system is in operational use at the Slovenian Met Service as a tool for nowcasting and very short range forecasts.

The main characteristics of the INCA are:

- resolution 1 x 1 km, 401x301 points
- NWP input: Aladin/Si fields
- observations: temperature, humidity, wind and precipitation from AMS, SYNOP and radar measurements
- nowcasting initiated from the analysis and converging to NWP model after 12 hours
- temperature, humidity, wind and several convective indices are updated hourly
- precipitation type, rain and snow rate products are updated every half an hour.

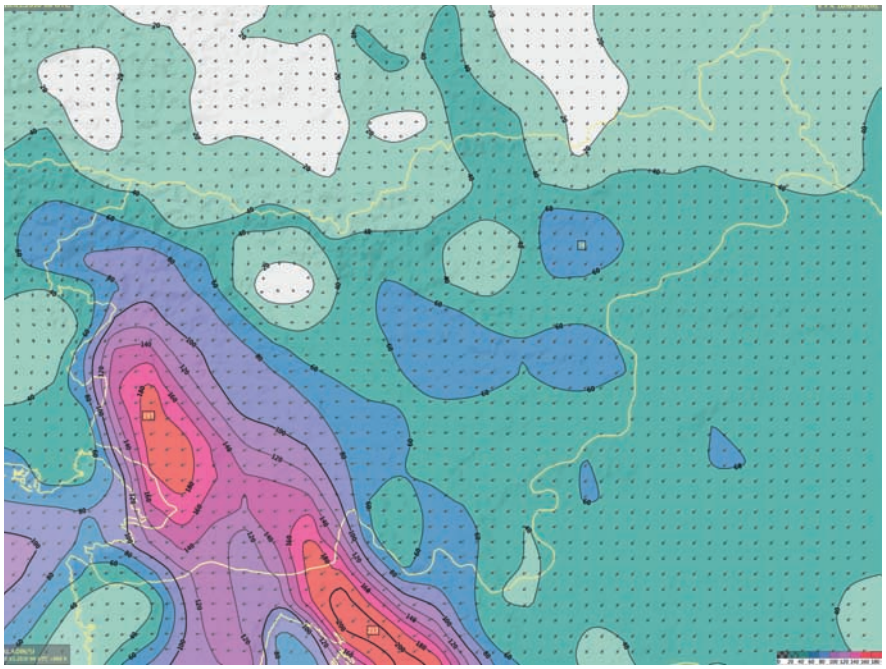
Case Study of an Extreme Bora Wind

In the late Winter of 2010, Slovenia experienced extreme weather, with a strong Bora wind blowing in the SW part of the country. The highest wind gusts were measured by road weather stations on the motorway passing the Vipava valley. On Wednesday 10th March, the maximum wind speed exceeded 187 km/h.

The main reason for such devastating wind was the air pressure difference between a high pressure area over Middle Europe and a low pressure area, which was moving from the Northern Mediterranean eastwards, passing the Northern Adriatic region on 10th of March.

The operational Aladin/Si NWP model predicted maximum wind gusts of more than 180 km/h in the SW part of Slovenia on the morning of the 10th March, as shown in Figure 2.

The model run which calculated the wind field showed in Figure 2 was from 00UTC on the 10th March. However, previous model runs also predicted nearly the same wind field. The operational forecaster could issue a severe weather warning to Civil Protection authorities and media in good time. There was a press conference a day before the maximum wind speeds occurred. The Meteoalarm code was set to 'red' for SW part of the country.



▲ *Figure 2*

Aladin/Si model wind gusts (km/h) over Slovenia valid for 10th of March 08 UTC

Aladin/SI 9.5 versus Aladin/SI 4.4 – Case Study of an Extreme Event

Some severe weather events can cause damage across a relatively small area. With the current resolution of the operational Aladin/Si model these localised pnenomena are often not resolved and forecasters have to rely on their experience. It is expected that with higher model resolution (Aladin/Si 4.4 km) forecasters will get a better tool for detecting some severe weather situations. One such case is the so called Tramontana (meaning 'from the mountains') wind (NNW-N), which usually has just a few strong wind gusts and sometimes causes damage in the coastal region of Slovenia.

One such case was on the 30th August 2010. A cold front passed through the Nothern Adriatic region early in the afternoon. Usually before the passage of the cold front moderate winds from S to SE are

blowing. In the majority of cases at and after the passage of cold front a Bora wind (NE) starts to blow. This Bora wind can be moderate or strong. But sometimes at the passage of cold front for short time the Tramontana wind with its few strong gusts can cause damage in the coastal region.

In this case Aladin/Si 9.5 failed to predict the Tramontana wind (Figure 3), but Aladin/Si 4.4 forecast it well (Figure 4).

The verification shows, that in this case the Tramontana wind really occured. In Figure 5 and Figure 6 the wind speed and wind direction in the port of Koper are shown.

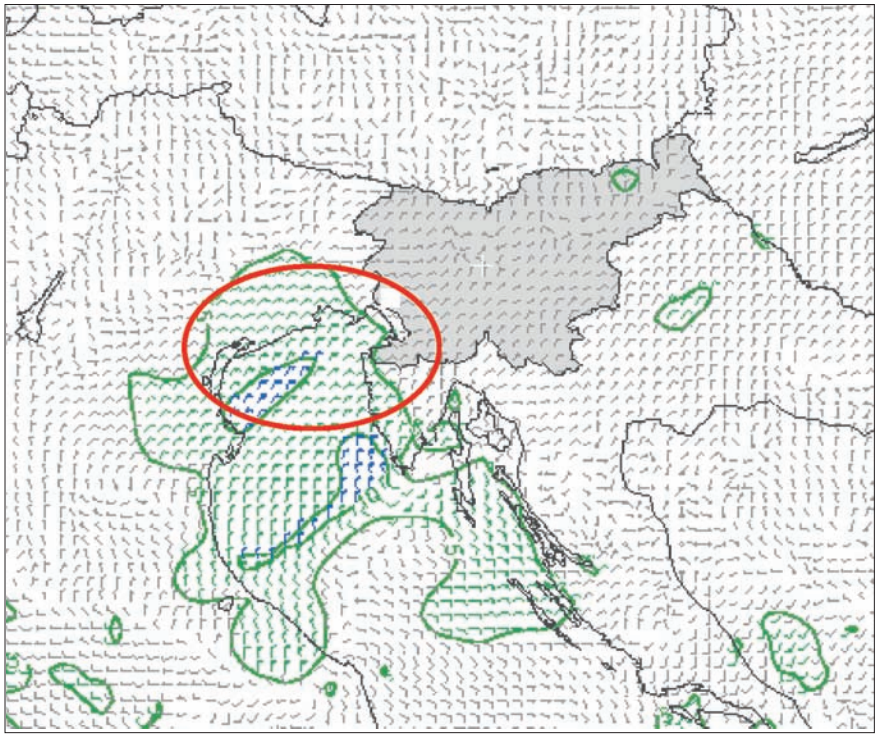


Figure 3

Predicted Aladin/Si 9.5 wind field valid for 30th Aug. 2010 12 UTC

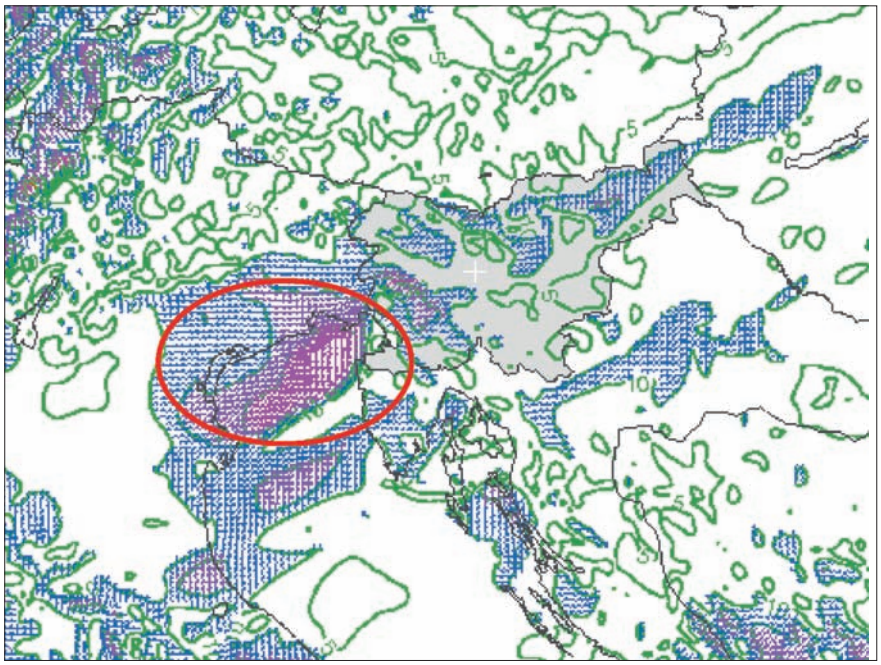


Figure 4

Predicted Aladin/Si 4.4 wind field valid for 30th Aug 2010 12 UTC

Conclusion

Aladin/Si is the main high resolution NWP model in operational use in Slovenia. Following the operational implementation of the Aladin/Si 4.4 km horizontal grid spacing NWP model, better severe weather forecasts for small areas of impact are expected. But even at present, the predicted wind fields are quite good, especially for the main winds which may cause damage in Slovenia. Precipitation amount are also well predicted. This was the case in last two flood events, which affected many parts of the country, the details of which are not presented here.

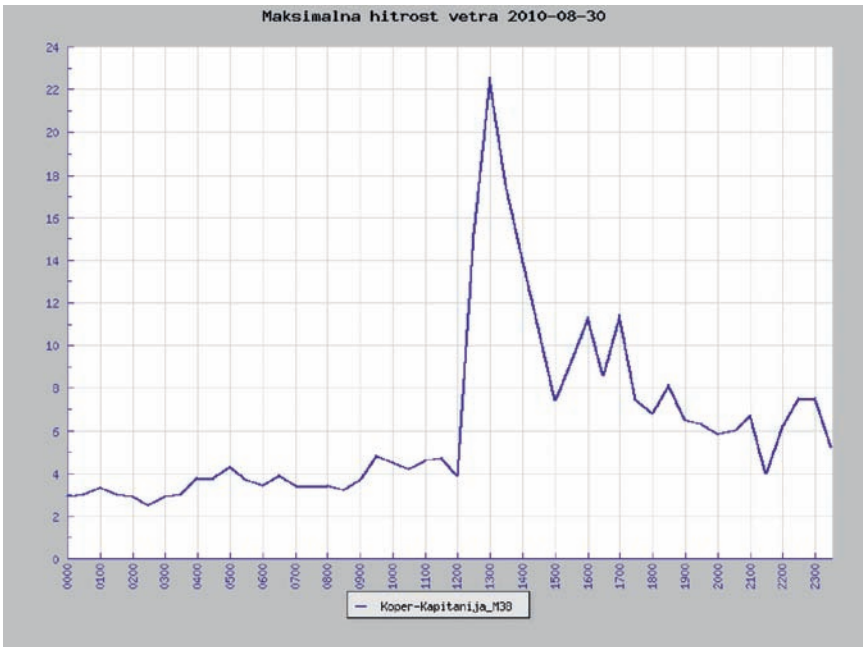


Figure 5

Maximum wind speed (m/s) in the port of Koper on 30th Aug 2010

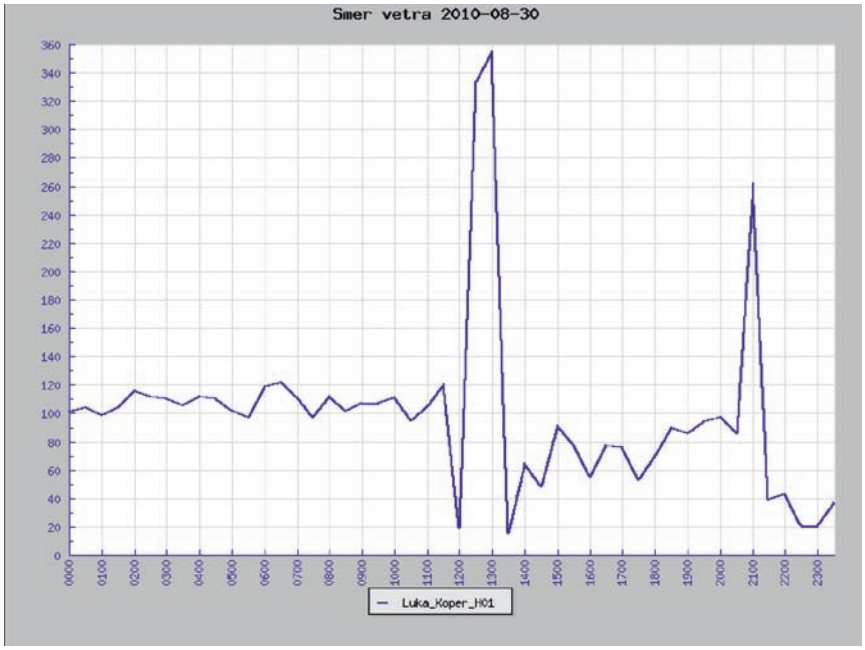


Figure 6

Wind direction in the port of Koper on 30th Aug 2010