

Einar Magnús Einarsson¹, Haraldur Ólafsson¹
& Jón Egill Kristjánsson²

1) University of Iceland, Institute of Meteorological Research
& The Icelandic Meteorological Office. 2) University of Oslo.

1. INTRODUCTION

On 14-15 August 2003, a heavy precipitation event took place in central Norway, in connection with a deep cyclone over southern Scandinavia

The development of the atmosphere was simulated with initial conditions provided by the ECMWF starting 120, 96, 72, 48 and 24 hours before the event. It emerges that the main changes in the forecast quality are between the 72 and 48 hours runs and here we present comparison of these two simulations.

This project is a part of the THORPEX research programme which aims at improving short and medium-range weather forecasts (Shapiro and Thorpe, 2002).

2. NUMERICAL MODEL SETUP

The numerical model we use is the PSU/NCAR MM5 mesoscale model (Grell et al., 1995). In both runs we have 36 km horizontal resolution and 23 vertical levels.

Like stated before we here compare two model runs. One starts at 00UTC on 12 August 2003 and finishes at 00UTC on 15 August. The other one starts 24 hours later, at 00UTC on 13 August but finishes at the same time as the first one. For simplicity, they will from now on be called the Aug12 and the Aug13 runs, respectively, where the Aug13 run is the more correct one.

3. SENSITIVITY TO THE INITIAL CONDITIONS

When the ECMWF analysis at 00UTC 13 on August is compared to the Aug12 run at the same time, it emerges that the Aug12 run underestimates the vorticity at higher altitudes and overestimates the height of pressure levels. This can be seen at the 300hPa pressure level in figure 1. The upper level vorticity in the Aug13 run triggers a chain reaction.

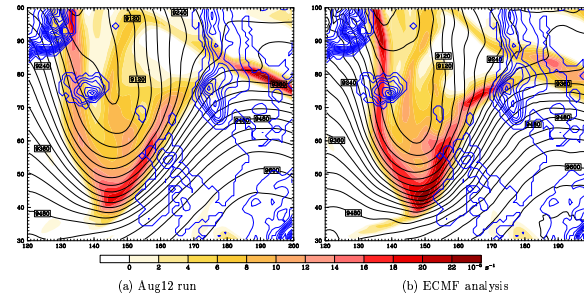


Figure 1: Geopotential height and vorticity at 300hPa in the ECMWF analysis and in the Aug12 run at 00UTC on 13 August 2003.

4. CHAIN REACTION

By classical interaction between upper level vorticity and lower level temperature advection (Hoskins et al., 1985), the high values of the vorticity in the upper layers cause the low over Southern Scandinavia to end up being about 10hPa deeper than expected from the Aug12 run (Figure 2).

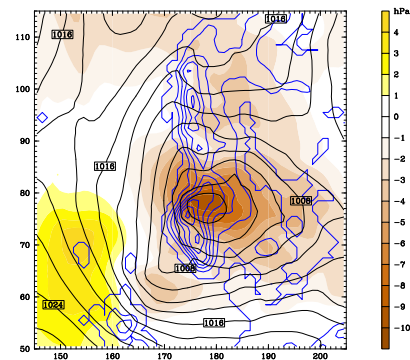


Figure 2: Sea level pressure [hPa] in the Aug13 run at 00UTC on 14 August. The color scale shows the difference in sea level pressure between the Aug13 and the Aug12 run. Negative values indicate lower pressure in the Aug13 run.

*Corresponding author: Veðurstofa Íslands, Bústaðavegi 9, IS 150 Reykjavík, ICELAND, e-mail: eme@vedur.is.

Lower sea level pressure causes greater advection

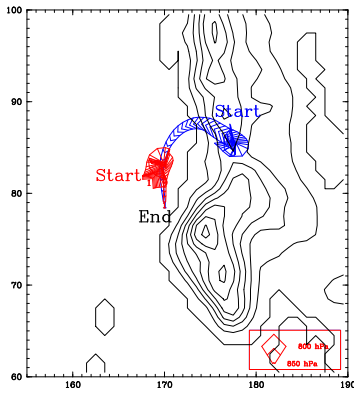


Figure 3: The origin of the air mass west of Norway. The trajectories show the route of the air mass from 00UTC on 13 August to 12UTC on 14 August. The red trajectory is from the Aug12 run but the blue from the Aug13 run.

of warm air mass from Central Scandinavia over the Norwegian coastal waters off central Norway (Figure 3).

Figure 4 shows that this warm advection leads to roughly 4°C warmer air in the Aug13 run and a strong east-west temperature gradient is created (Figure 5).

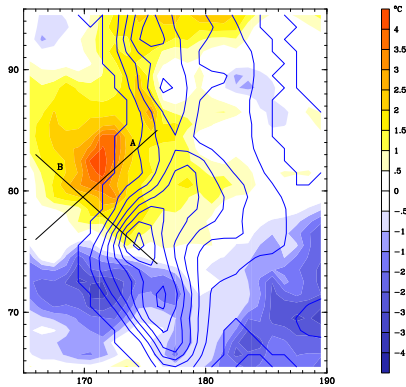
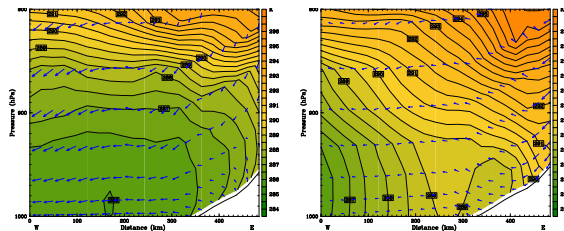


Figure 4: Temperature difference between the two runs at the 850 hPa pressure level at 06UTC 14 on August. Positive values indicate higher temperatures in the Aug13 run.

This temperature gradient causes the northerly wind to be much stronger than simulated in the Aug12 run as can be seen in Figure 6.

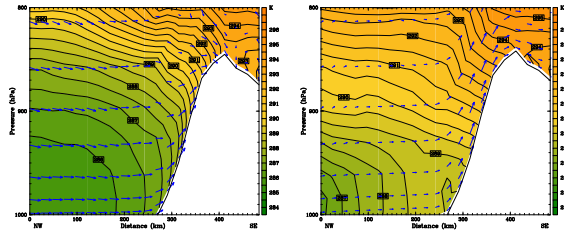
This strong northerly wind in the Aug13 run impinges the Norwegian highlands and there is strong ascending motion which is almost absent in the Aug12 run (Figure 6).



(a) Aug12 run

(b) Aug13 run

Figure 5: Wind vectors and potential temperature in a cross section along line A in Figure 4.



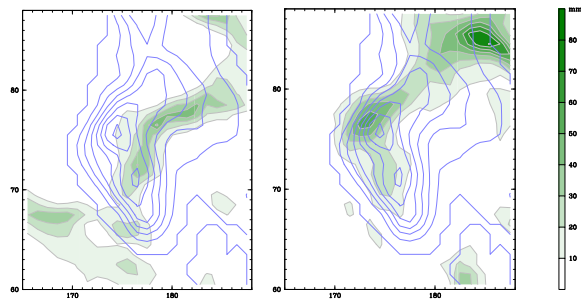
(a) Aug12 run

(b) Aug13 run

Figure 6: Wind vectors and potential temperature in a cross section along line B in Figure 4.

5. HEAVY PRECIPITATION

The ascending air in the Aug13 run causes heavy precipitation that is absent in the Aug12 run (figure 7).



(a) Aug12 run

(b) Aug13 run

Figure 7: 24 hour accumulated precipitation during 14 August 2003 in the two model runs.

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