SYNOPTIC ENVIRONMENT STUDY IN COMBINATION WITH MSG IMAGES DURING A LONG HEAVY RAIN PERIOD IN THE BALTIC STATES AND FINLAND 8-12 AUGUST 2005

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Abstract

A remarkable rain period was experienced in the Baltic countries and Finland during the second week of August in 2005. During this period a series of waves formed in moist and warm southeasterly air stream, bringing daily rainfall to large areas in NE parts of Europe.

This study concentrates on two areas at the opposite sides of the low pressure area: in Lithuania, on the SW flank of the low, the event was characterized by the extreme rainfall (locally more than 250 mm) during the period, leading to flooding and thus damage to the property. The gusty south-westerly wind on the 10th August caused the uprooting of trees and some other economical loss (total loss 45M euro). In Finland, at the north-eastern part of the low pressure area, the most remarkable events were those connected with the passing of the cold front in the evening of August, 9, associated with the intensive precipitation and lightnings. These phenomena caused big difficulties in the timely conduct of IAAF World Championships of Athletes in Helsinki that evening. Later on, since the low pressure centre became almost stationary southwest of Finland, the rain bands associated with the occluded front spiral brought the repeated showery rain.

DIAGNOSIS

The first features of cyclogenesis at the lower layers of atmosphere could be detected on 8 August, when the trough from South-west Ukraine over Belarus and Lithuania extended as far as Estonia. A wave along an intensive cold front developed ahead of this trough. The period between 9 and 11 August was of special interest, as the upper level trough (Fig. 1) triggered the deepening of a lower tropospheric trough within a boundary separating the moist, warm airmass in the east from a cooler airmass in the west. The surface low pressure quickly deepened (Fig. 2) and the system acquired a rather vertical axis. This caused the movement of the cut-off low to be slow, and it further enabled a prolonged rainfall episode to take place.

Particularly intensive cyclonic development and strong release of convective instability occurred within the cold front moving from SE Lithuania to the north approaching Finland on 9th August and developing to an occlusion on 10-11th August. The conditions within the warm air mass ahead of the cold front (high equivalent potential temperature, wind shear at the lower troposphere and a potentially unstable stratification of the air in a rather deep layer) were favourable for deep convection to occur (Fig. 3).

Different stages of frontal evolutions within the low pressure determined various types of precipitation and weather phenomena: extremely intensive thundery showers with downbursts in Finland and prolonged heavy rain, showers and strong southwesterly wind over the Baltic States. For example in Lithuania it has never been recorded such heavy rain (near the seaboard it was an extreme phenomenon – 82 mm precipitation in 12 h) and prolonged (for about 4 days) rain (Fig. 4).

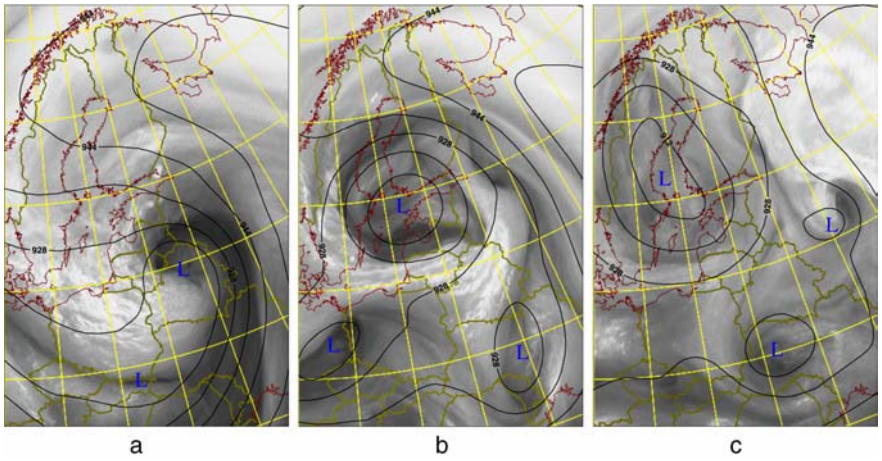

Figure 1. **MSG WV 6.2 μm and ECMWF geopotential height at 300 hPa (black line, in decametres). Blue L denotes the location of the upper level low centres. (a) 9 August 12 UTC. (b) 10 August 12 UTC. (c) 11 August 12 UTC.**

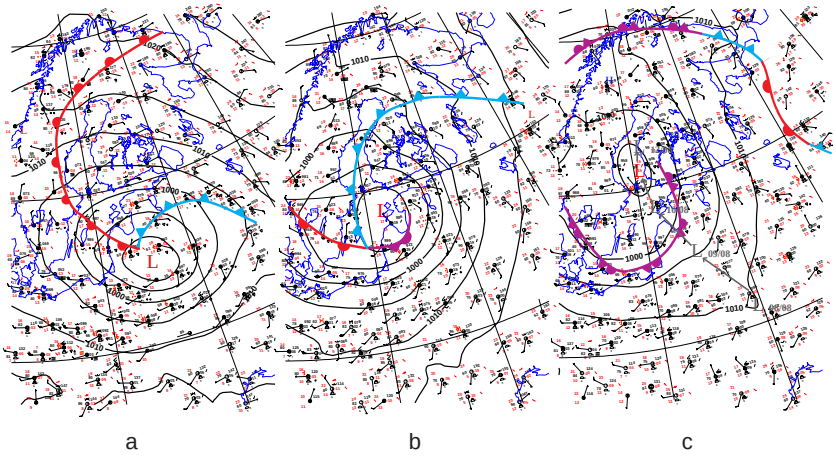

Figure 2. **The synoptic observations, frontal analysis and ECMWF mean sea level pressure (black line, in hPa). On the last chart the track of low pressure centre 8-12 August is shown (grey arrows; "L" denotes the location of the surface low pressure at 12 UTC). (a) 9 August 12 UTC. (b) 10 August 12 UTC. (c) 11 August 12 UTC.**

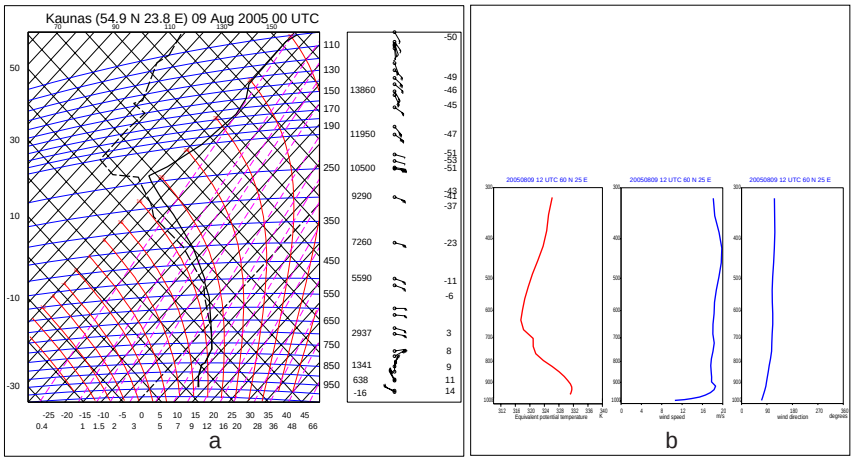

Figure 3. **(a) Radio sounding at Kaunas (Middle Lithuania) 09 August 00 UTC. (b) ECMWF vertical profile of equivalent potential temperature (left), wind speed (middle) and wind direction (right) in Helsinki 9 August 12 UTC.**

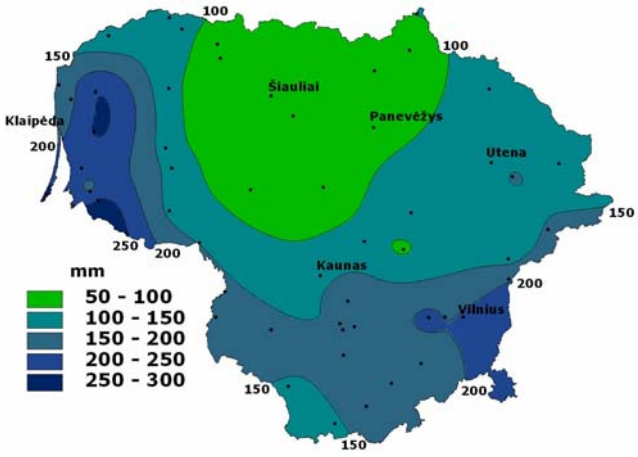

Figure 4. **Total rainfall measurements in Lithuania 8 August 18 UTC – 11 August 18 UTC.**

MSG RGB PRODUCTS

The MSG images were used to monitor the clouds during the whole event. The images below (Fig. 5a-d) show the cloud spiral over the Baltic States 9 August 15 UTC. At this stage the low was beginning to occlude; the associated cold front was approaching Finland from the south-southeast.

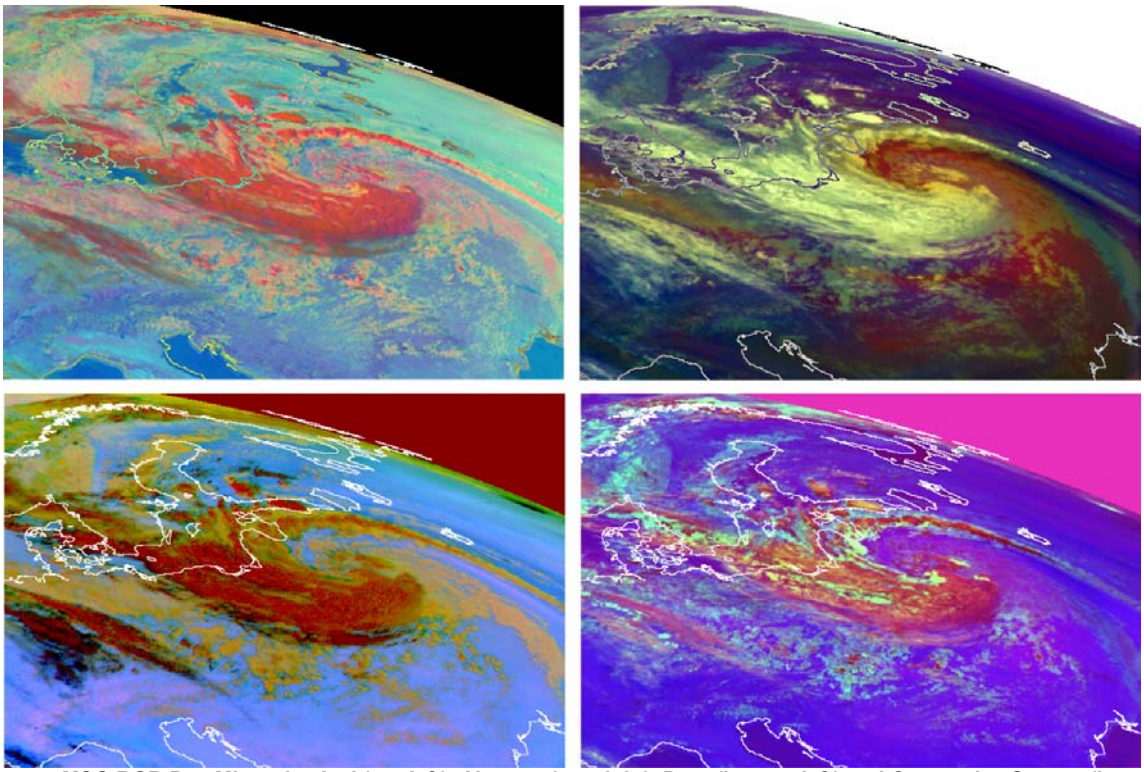

Figure 5. **MSG RGB Day Microphysical (top left), Airmass (top right), Dust (bottom left) and Convective Storms (bottom right, temperature scale adjusted) 9 August 15 UTC.**

The information from different RGB composites can be summarized as follows:

- Day Microphysical product shows that the occluding front consists of thick, precipitating clouds with mostly large ice particles and cold cloud tops (large areas with red colours).
- Airmass product: Intensive red colour indicates high upper tropospheric PV values: cut-off cyclone is clearly at its early stages of development.

- Dust product: this product shows the humidity contrasts across the cold front. The tongue of moist air (deep blue colours) at lower troposphere ahead of the cold front can be seen, while very dry boundary layer at the rear of the cold front has rather cyan colours.

- Convective Storms product: The yellowish colour in developing MCS over the Gulf of Finland indicates small ice particles associated with strong updrafts within Cb clouds.

CONCLUSION

Convergence at the surface associated with upward vertical motion in the lowest layers of the atmosphere provided heat and moisture for storms with strong winds and heavy rains over the Baltic States and Finland. The most intensive convection occurred over the western and southern Lithuania, where the wet bulb maximum potential temperature and the strongest convergence coincided.

ECMWF and DWD numerical forecasts provided a very good guidance about the southern cyclone development and its track 3 days in advance of the event. It allowed forecasters to predict weather very well and issue the warnings in time. In the short range forecasting the forecasters were also well aware of the severity of the event and issued exceptional warnings for the media and authorities. MSG and other remote sensing data are crucial for monitoring such weather systems.

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