Description of the case study

During the night and early morning of the 14th of July 2011 the significant cloud layer expanding in the West of the country and slowly moving East produced precipitation and local storms. On the southern shores of the Baltic sea and in Pomerania region the precipitation was described as average to high. The rest of the country was covered by thin layer of clouds at that time. The minimal temperature recorded on the NE part of Poland reached 14°C, the maximum temperature was 19°C on the SW. Wind speed records show 60 km/h in the western regions of the country (during the storms up to 80 km/h) of E and SE direction turning to SW. The weather forecast estimated the precipitation within the storm areas up to 40 mm.

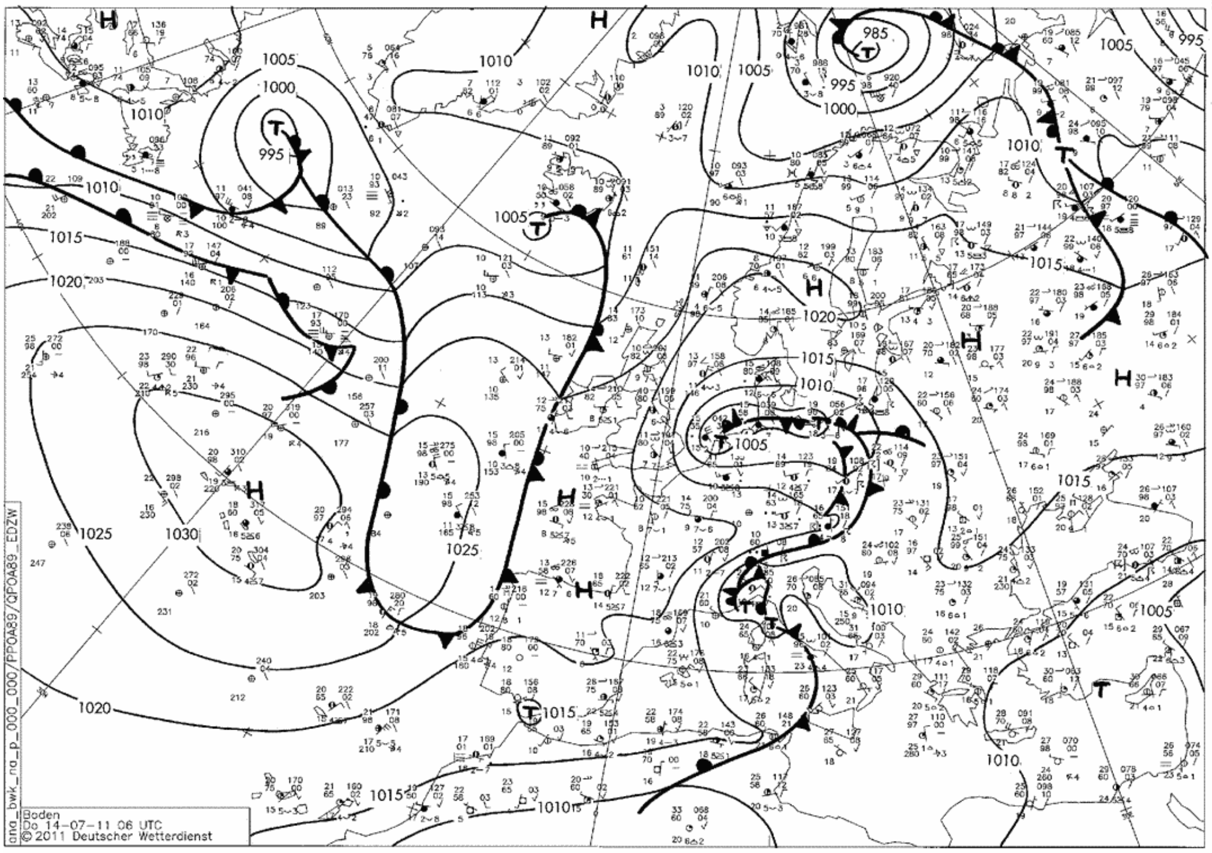

Fig.1 Synoptic chart at 0600 UTC on 14th of July 2011. Courtesy of Deutscher Wetterdienst.

Convective storms where observed over the country on that night and throughout a day. The precipitation was accompanied by lightning activity. On the Fig.2, the lightning activity map for three hour time span (0300 UTC - 0600 UTC) is presented. The map was constructed on the base of data from Polish Lighting Detection System, PERUN.

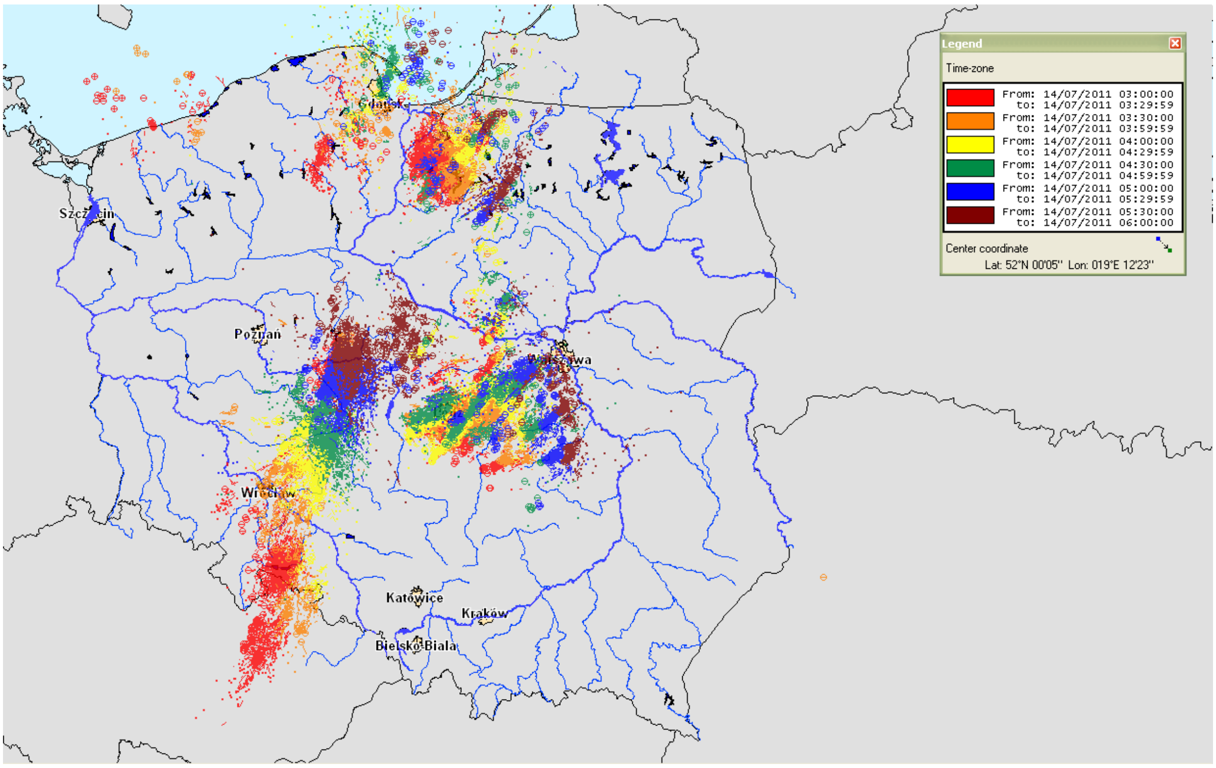

Fig.2 Total lighting map of Poland showing electrical activity between (0300 UTC - 0600 UTC) on 14th of July 2011.

Vaisala lightning sensors installed in Poland detected 6927 intra cloud events, 204 positive cloud-to-ground events and 4099 negative cloud-to-ground events in the reference time period.

Data and products used

Reference data: data from Polish automatic rain gauges network (IMWM-NRI)
H-SAF product: PR-OBS-5 3h cumulation
Ancillary data (used for case analysis):

- Polish meteorological radar network, POLRAD (IMWM-NRI)
- Polish Lighting Detection System, PERUN (IMWM-NRI)
- Weather charts (courtesy of Deutscher Wetterdienst)

Comparison

This event is dominated by convective systems of limited spatial scales moving across Poland. The highest peak measured by rain gauges is of about 26.6 mm, at the same time radar records 42.4 mm while PR-OBS-5 shows a peak value of 18.0 mm.

On the Fig.3 the PR-OBS-5 product is visualized for the morning 3h cumulation. For comparison, the distribution of 10 minute precipitation obtained from RG and radar data measured at closest to the given time slot are presented. All precipitation maps were prepared using Nearest Neighbor method.

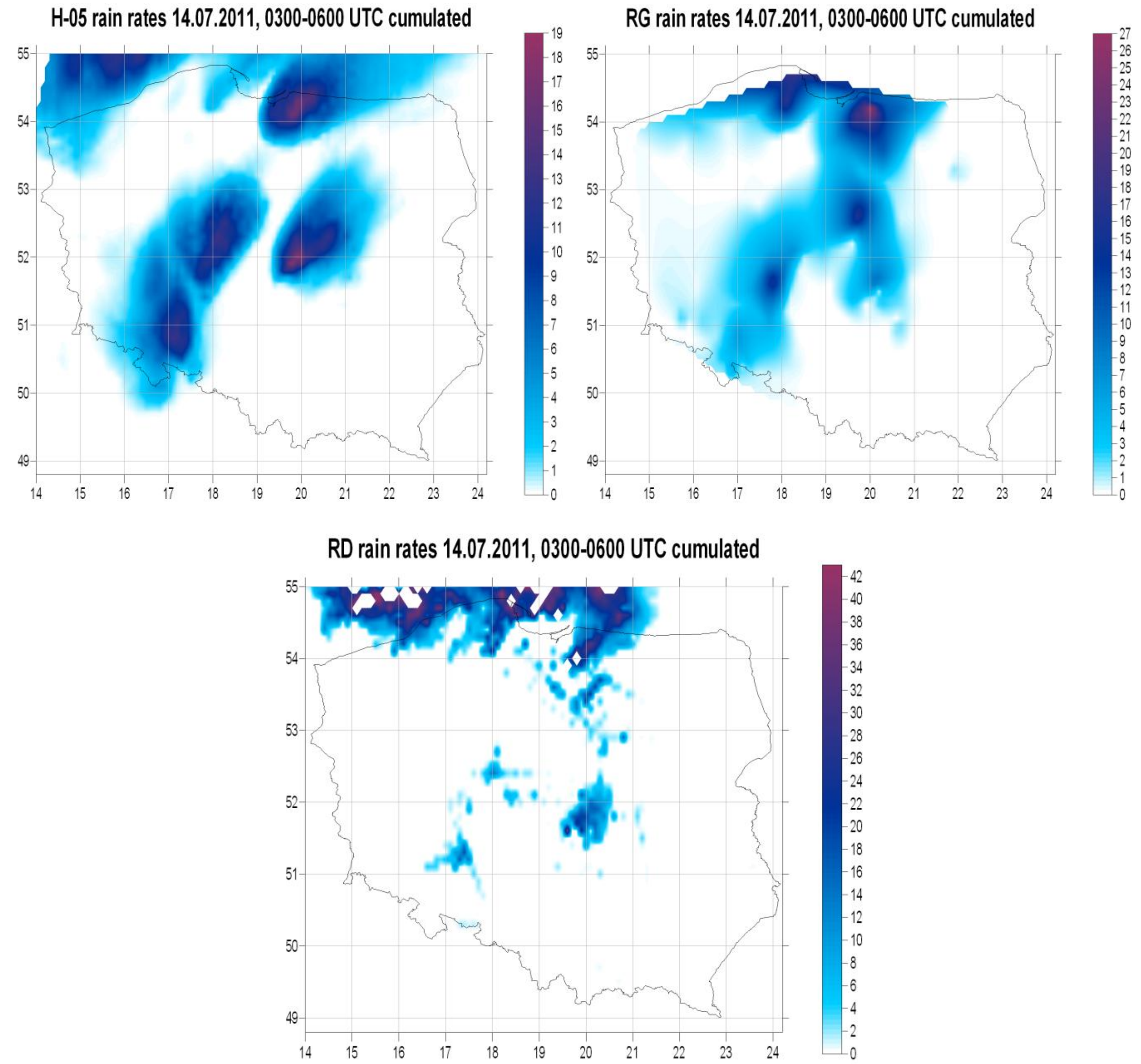

Fig.3 Cumulated PR-OBS-5 from 0300 – 0600 UTC on the 14th of July 2011 (left panel), cumulated precipitation interpolated from RG data from 0300 – 0600 UTC (right panel) and cumulated precipitation from 0300 – 0600 UTC derived from radar data (bottom panel). *Note diverse scale notation!*

On both maps (H-05 and rain gauge), the precipitating areas reveal the lightning activity spatial correlation (see Figure 2). There is also quite good agreement in the layout of the rainfall and amounts of precipitating water in above mentioned maps. Radar map traditionally overestimates these amounts and represents different precipitation area. The white dots over the Baltic Sea are the result of the radar beam attenuation over sea.

Statistical scores

The results presented below were calculated on the satellite sub-dataset for which satellite pixels were attached to rain gauges. It means that precipitating satellite pixels which were not set in pairs with rain gauges (but are still present on the maps above) were excluded from this calculation.

The ability of PR-OBS-5 product to recognize the precipitation was analysed using dichotomous statistics parameters. The 1 mm threshold was used to discriminate rain and no-rain cases. In the

Table 1 the values of Probability of Detection (POD), False Alarm Rate (FAR) and Critical Success Ratio (CSI) are presented.

Table 1 Results of the categorical statistics obtained for PR-OBS-5 on the 14th July 2011 0300 – 0600 UTC.

Parameter	Scores
POD	0.76
FAR	0.36
CSI	0.53

Higher value of POD than the value of FAR indicates that the product ability to recognize the convective precipitation is very good.

The quality of PR-OBS-5 in estimating the convective precipitation is presented on the Figure 4. The points on the scatter plot are mostly arranged above and below the diagonal, what indicates that PR-OBS-5 tends to underestimate the moderate precipitation.

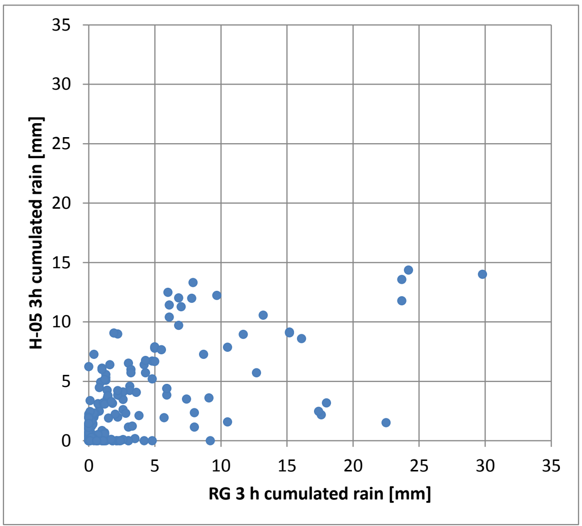

Fig.4 Scatter plot for measured (RG) and satellite derived (H-05) rain rate obtained for all PR-OBS-5 data on the 14th of July 2011 0300 – 0600 UTC.

Finally, the analysis of rain classes was performed. The categories were selected in accordance with the common validation method. Figure 5 shows the percentage distribution of satellite derived precipitation categories within each precipitation class defined using ground measurements.

One can easily notice very good ability of PR-OBS-5 to recognize both, no-rain and light precipitation situations – respectively, 442 out of 485 and 47 out of 81 of ground cases was properly allocated by satellite product. The moderate precipitation is properly recognized in almost 50% of cases.

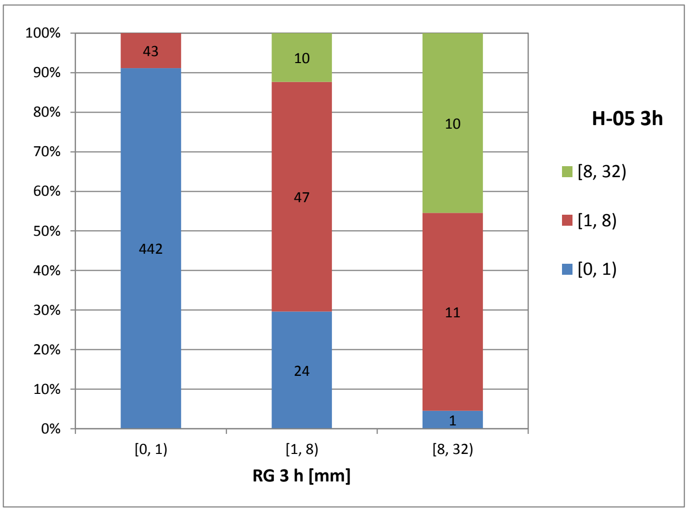

Fig.5 Percentage distribution of PR-OBS-5 precipitation classes in the rain classes defined using rain gauges (RG) data on the 14th of July 2011.

Some Conclusions

To sum it up, the analysis performed for situation with convective precipitation showed very good ability of PR-OBS-5 product in recognition of precipitation layout and good in amount recognition. Relation between POD and FAR proves good product ability to recognize the convective precipitation. No rain and light precipitation are well recognized by H-05.