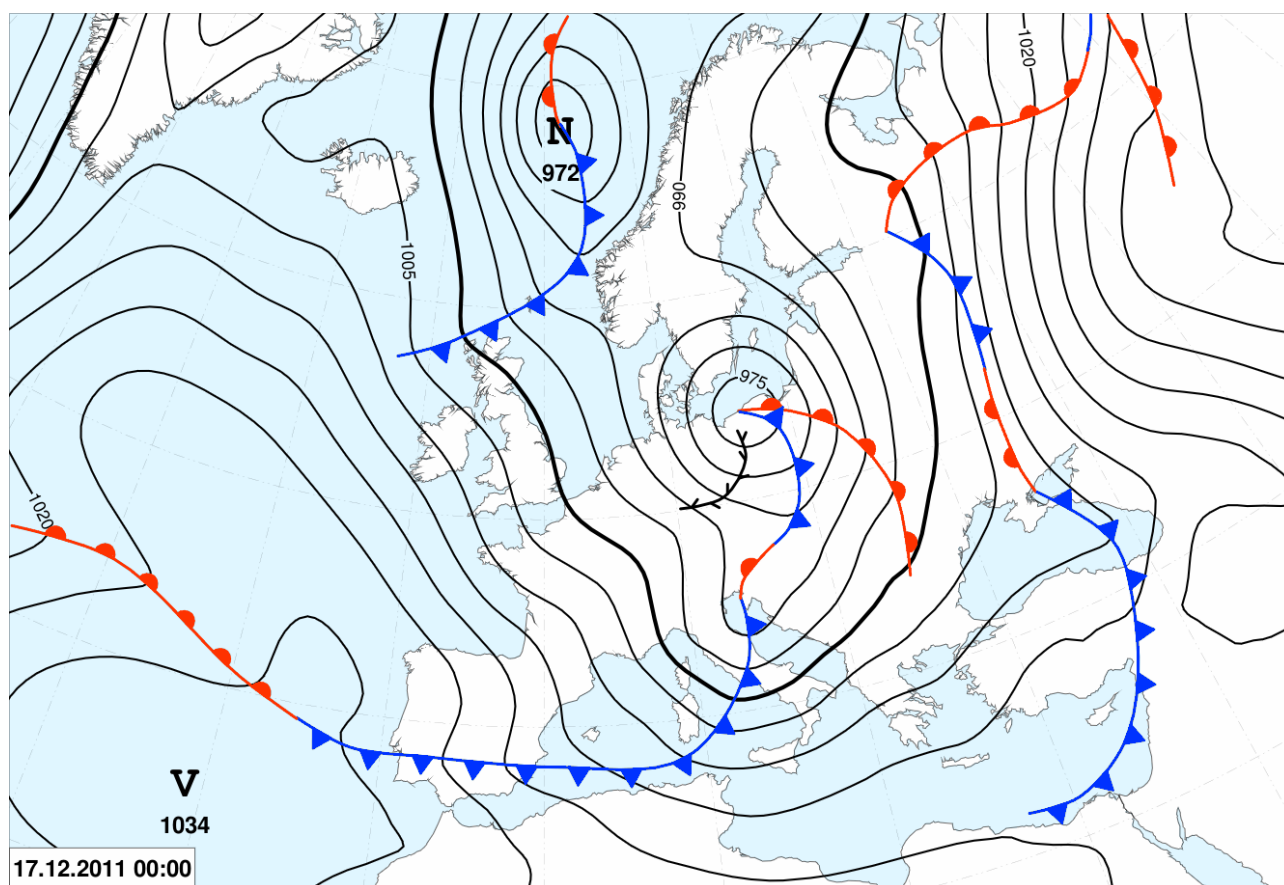


<b>PRODUCT NAME:</b> PR-OBS-4 v1.1		
<b>CASE STUDY PERIOD:</b> 16 December 2011 12:00 UTC - 17 December 2011 23:30 UTC	<b>METEOROLOGICAL EVENT:</b> Low pressure trough with mostly stratiform precipitation followed by scattered snow showers	
<b>VALIDATION INSTITUTE:</b> Slovak Hydrometeorological Institute (SHMI)	<b>Responsible:</b> Ján Kaňák, Luboslav Okon	<b>Contact point:</b> <a href="mailto:Jan.kanak@shmu.sk">Jan.kanak@shmu.sk</a> Luboslav.okon@shmu.sk
<b>PRODUCT DEVELOPER INSTITUTE:</b> CNR- ISAC	<b>Developers:</b> Laviola S., Levizzani V.	<b>Contact point:</b> s.laviola@isac.cnr.it
<b>OPERATIONAL CHAIN INSTITUTE:</b> CNMCA	<b>Responsible:</b> Zauli F, Melfi D.	<b>Contact point:</b> zauli@meteoam.it

#### METEOROLOGICAL EVENT DESCRIPTION

A low pressure trough associated with cyclone over Baltic Sea was passing across Central Europe towards East. The frontal system brought mostly stratiform precipitation followed by scattered snow showers behind the cold front.



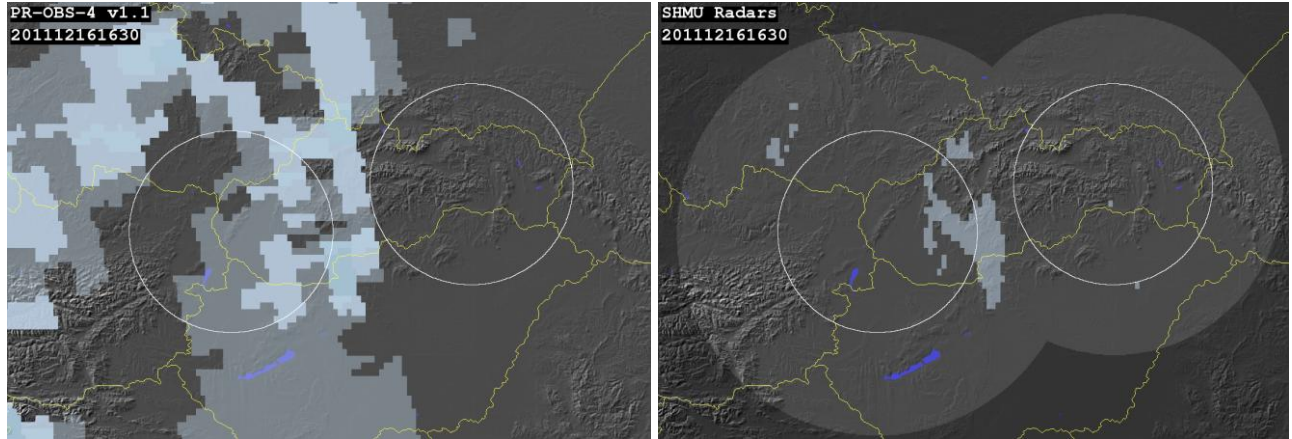
## DATA/PRODUCTS USED

Left – Precipitation intensity field from the PR-OBS-4 product

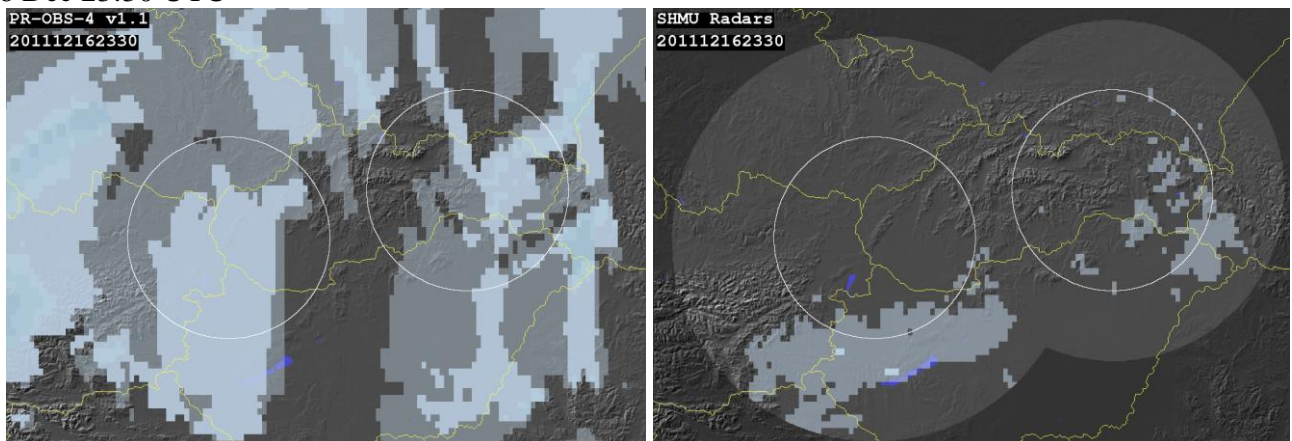
Right – Upscaled precipitation intensity field from SHMI radars (integer values)

Due to known limitations of precipitation detection by radars (see COMMENTS), precipitation fields were compared only inside 120 km effective radar range (white circles).

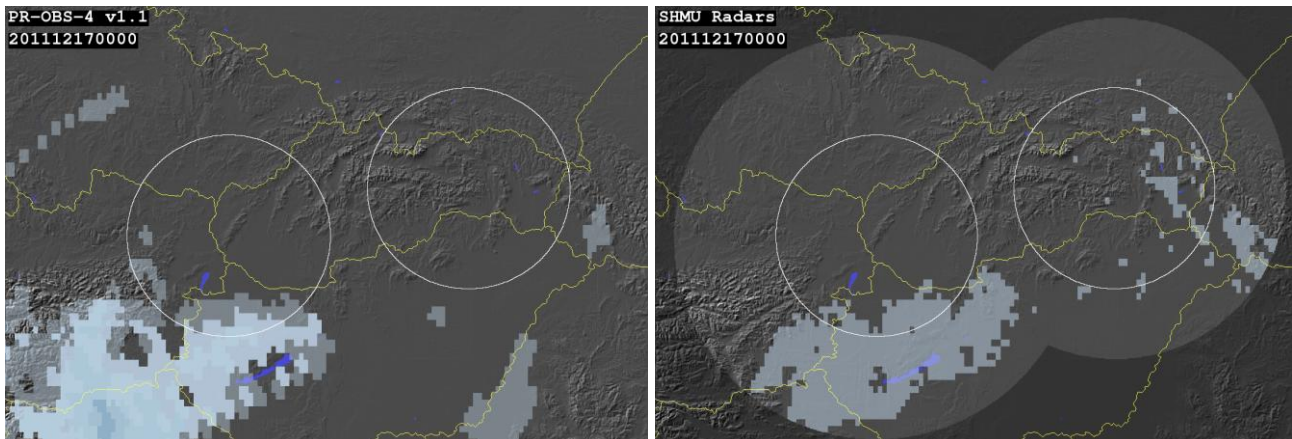
16 Dec 16:30 UTC



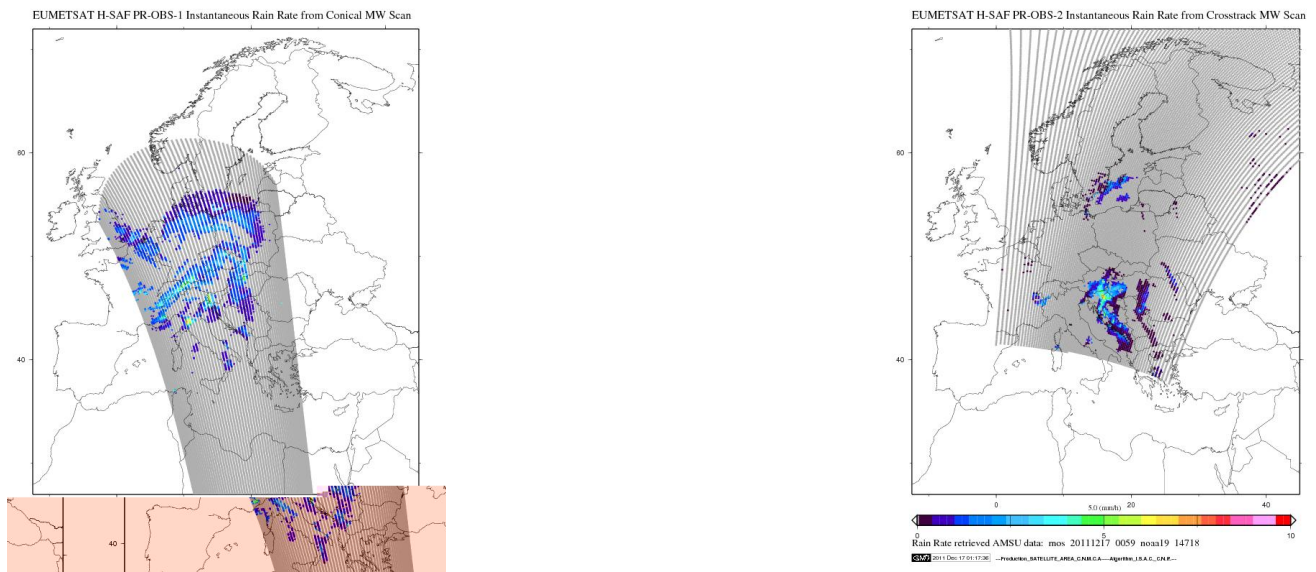
16 Dec 23:30 UTC



17 Dec 00:00 UTC



Precipitation intensity fields from the PR-OBS-1 and PR-OBS-2 satellites overpasses closest to times of above shown precipitation fields:



### RESULTS OF COMPARISON

In the studied period, several cases of sudden changes in the PR-OBS-4 precipitation patterns, nearly at times of the MW satellites overpasses, can be observed (see pictures from 16 Dec 23:30 and 17 Dec 00:00 UTC). It looks like there were some problems with the morphing technique, as if the MW precipitation patterns were sometimes simply extrapolated in one direction in time till next satellite overpass. Resulting precipitation field longer time after last overpass therefore differed significantly from radar field as in case of 16 Dec 23:30 UTC. After update of the PR-OBS-4 precipitation field by new MW measurements, there was however quite good match with radars as shown on pictures from 17 Dec 00:00 UTC.

By visual comparison, the PR-OBS-4 mostly overestimated precipitation intensities and spatial extent of precipitation area compared to radars, especially at times close to the PR-OBS-1 satellites overpasses. According to statistical results (Mean error, Multiplicative bias) medium intensities of 2-10 mm/h were however underestimated by PR-OBS-4 (see Table 1).

Low (even negative) correlation coefficients could be partially due to the above mentioned problems with morphing technique. Very high FAR values with moderate POD values (see Table 2) confirm the observed overestimation of precipitation area.

Table 1 Selected scores of continuous statistics

Precipitation class (mm/h)	1	2 - 10	$\geq 11$	$\geq 1$
Mean error (mm/h)	0.100	-0.906	-	0.081
Multiplicative bias	1.100	0.561	-	1.080
Correlation coefficient	-	-0.237	-	-0.002
URD-RMSE (%)	96.9	75.8	-	96.6

Table 2 Selected scores of dichotomous statistics

Precipitation threshold (mm/h)	$\geq 1$	$\geq 2$
POD	0.678	0.461
FAR	0.902	0.996
CSI	0.093	0.004

## COMMENTS

Precipitation further from radars might be underestimated by radars due to beam attenuation in precipitation, orographical blockage and due to radar beam overshooting the clouds. On the other hand, bright band effect might cause overestimation of precipitation in the vicinity of radars.

## INDICATIONS TO DEVELOPERS

The morphing algorithm seems not to work properly during this event causing in several cases sudden changes in precipitation pattern at times of the MW satellites overpasses.

Precipitation intensities were overestimated by PR-OBS-4 compared to radars except for medium intensities (2-10 mm/h) which were underestimated. PR-OBS-4 also overestimated spatial extent of precipitation in this event, especially due to MW measurements from input PR-OBS-1 product.