COSMO-PL ”failures”

Setup

To assess (more-less automatic) poor forecasts surface parameters were used.

T2M, TD2M, RH, U10M, SFC Press. and PMSL were selected to assess the questionable forecasts and their quality.

The values of all elements have been normalized as follows:

$$N\_Val = abs(FCST - OBS) / maxdif(OBS, FCST; dt)$$

$$0 <= N\_Val <= 1$$

with *dt* being the period (climatological, 2012-2018), maxdif - maximum difference between OBServation and ForeCaST in a given period

For all terms the sum of N_Val from the above elements was determined. The worst forecasts were determined – those for which this sum was the highest.

COSMO-PL ”failures”

Results

One situation was selected for each year for which the forecast deviated most from the measurements.

2018.06.08.00 (two consecutive poor forecasts)
2017.02.13.12
2016.09.25.06
2015.03.20.00
2014.05.29.00 (two consecutive poor forecasts)
2013.01.10.12 (three consecutive poor forecasts)
2012.10.12.06

COSMO-PL ”failures”

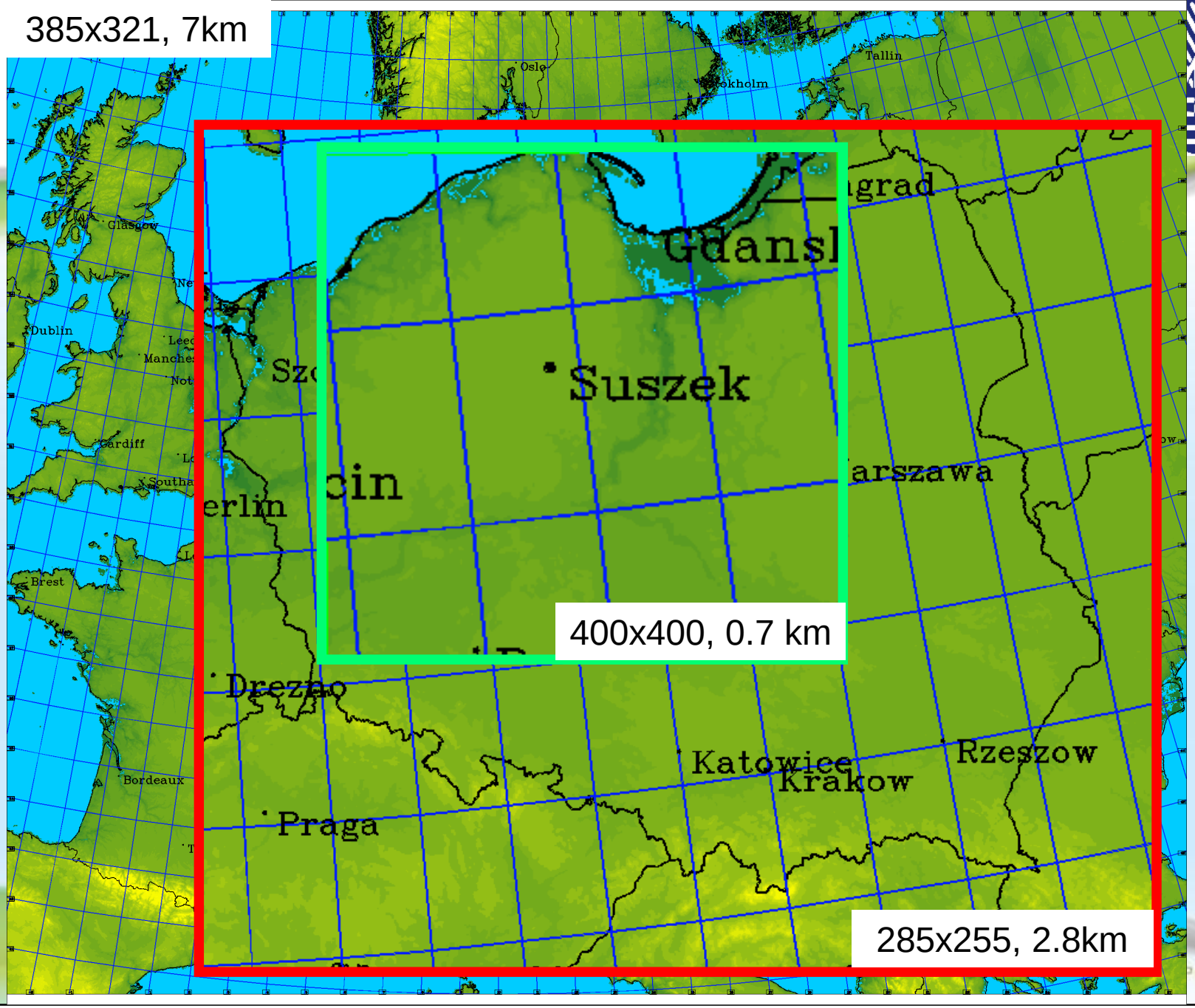
Results

In addition, two terms related to HIW, and especially to intense convective phenomena, were selected to the complete set. 2017.08.11 - most likely supercell moving from south to north, caused major material damage, two deaths at a scout camp, prosecutor's investigation and allegations against synoptics. 2019.08.22 Intensive storm in the Tatra Mountains, the most tragic in the last 80 years - 4 people were killed, more than 100 wounded.

Key issue: given a forecast, should a top-level warning be issued?

HIW on 2017.08.11 was examined in both EPS and deterministic approaches using increasing resolution in nested domains from 7 km through 2.8 to 0.7 (preliminary approach).

Curiosity: VGUST bubble forecasted at a resolution of 2.8 km, 2019.08.30



Setup: nested domains 7km → 2.8km → 0.7km

Suszek, August 11th, 2017, 21:00 UTC

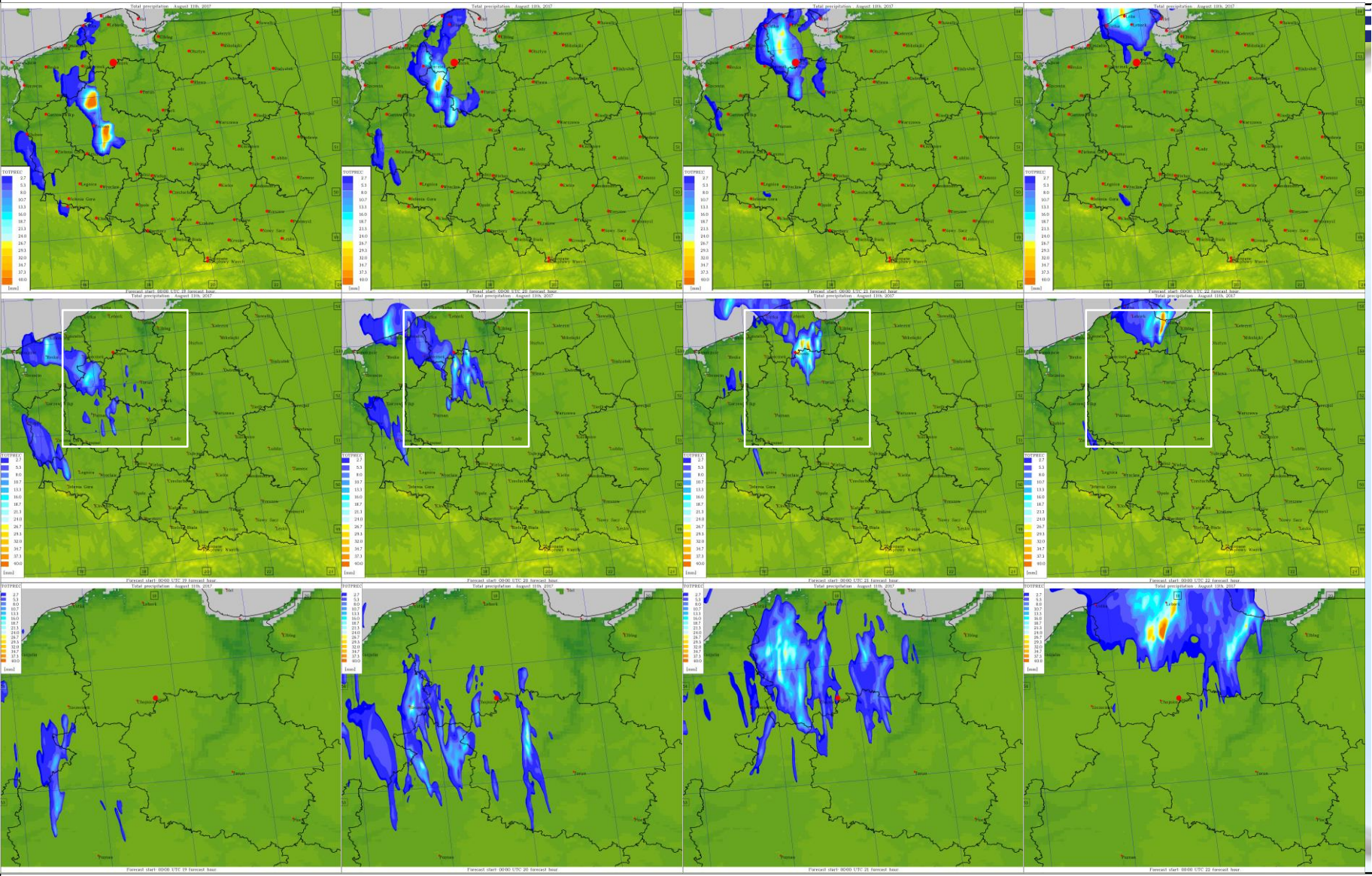
Single case – HIW event from 7 to 0.7km

Fields, indices and indicators used

- Total Precipitation
- Windspeed at 10m agl.
- Maximum windspeed at 10m agl.
- CAPE_3KM
- CAPE_ML
- CAPE_MU
- Derecho Composite Potential
- Supercell Detection Index 1 & 2
- Showalter Index
- Lifted Index
- Universal Tornadic Index
- Radar Reflectivity
- Wind Shear up to 6 km

Single case – HIW event from 7 to 0.7km

Total precipitation



7km

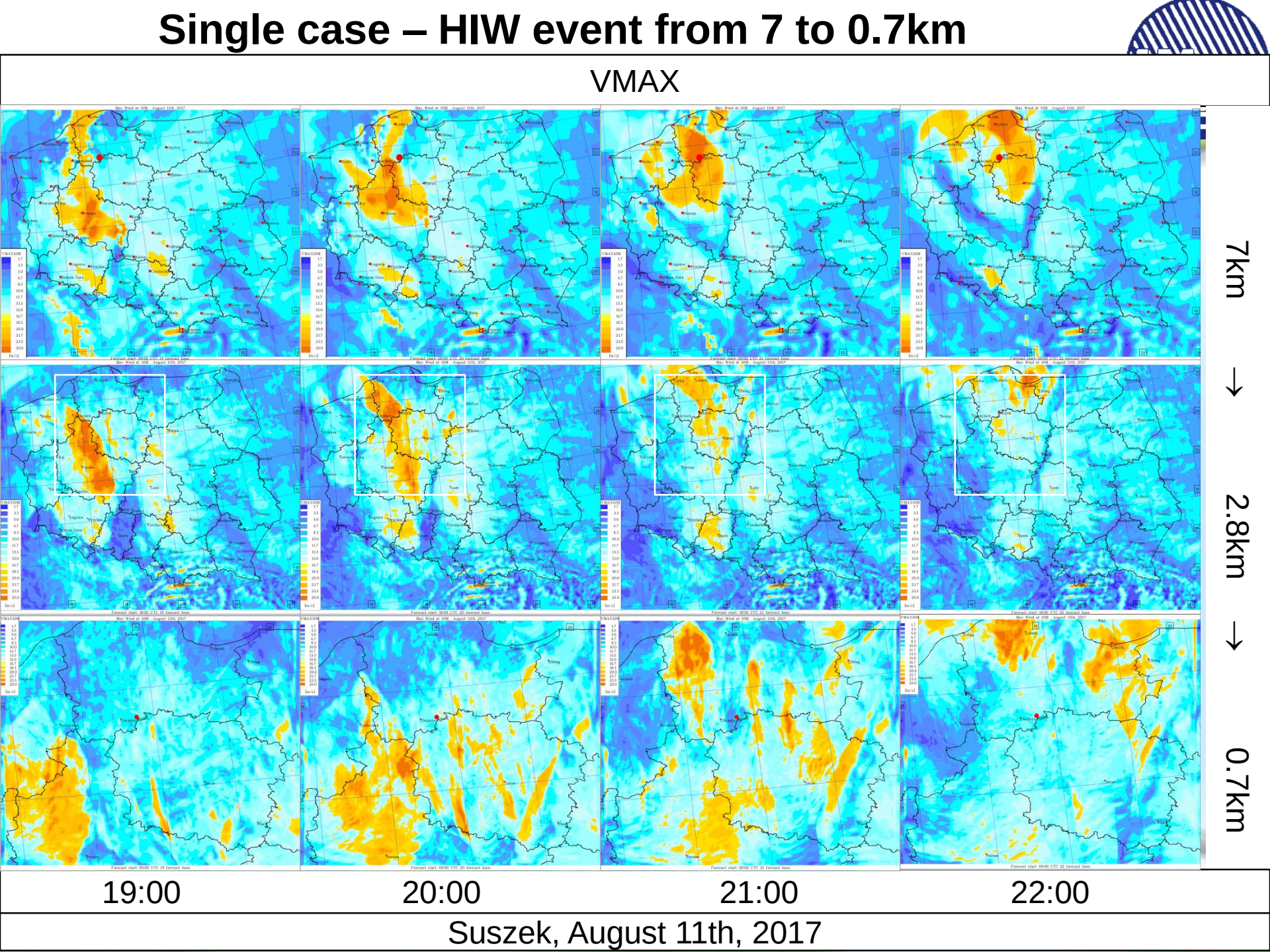
2.8km

0.7km

19:00 | 20:00 | 21:00 | 22:00

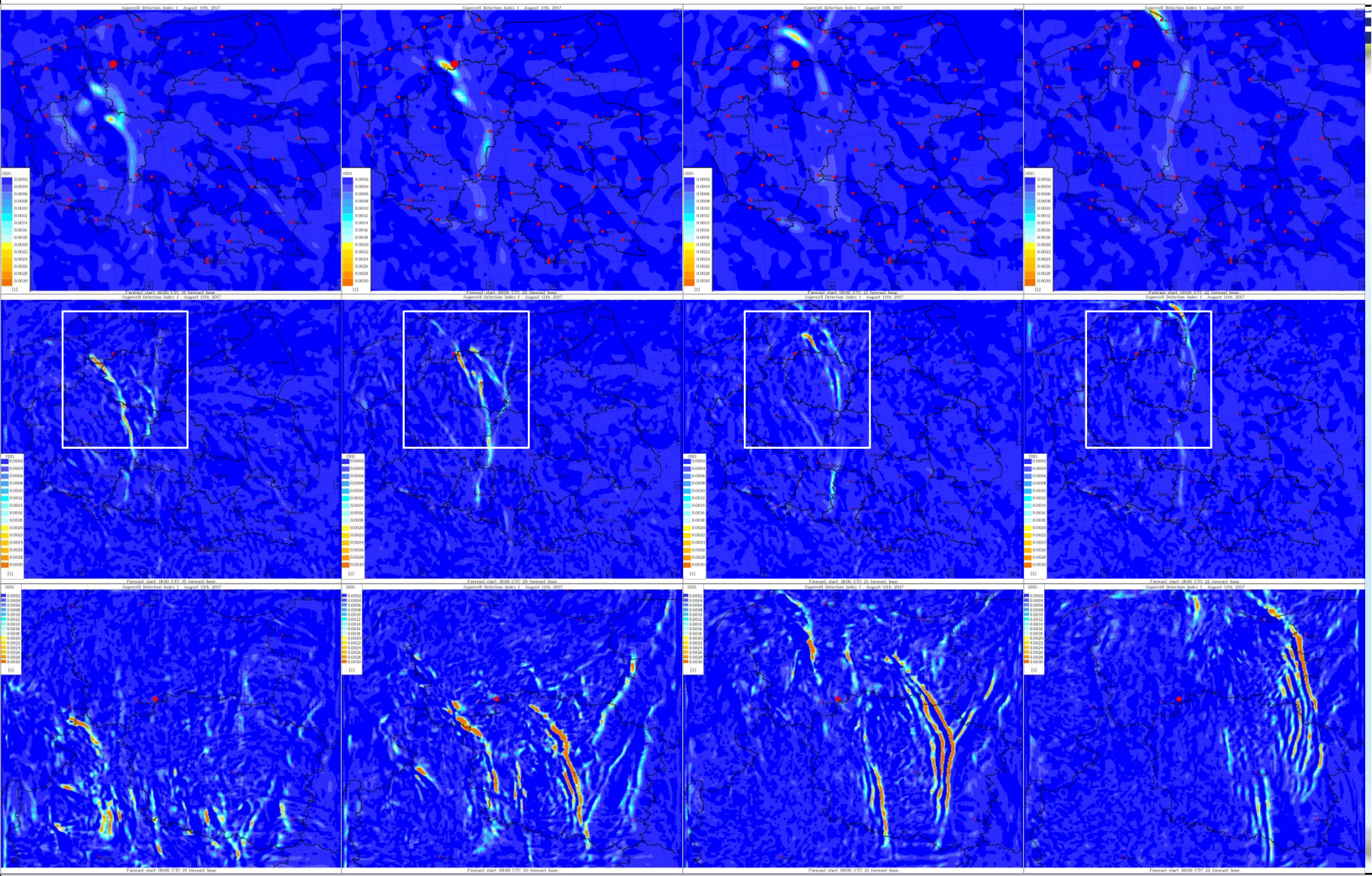
Suszek, August 11th, 2017

Single case – HIW event from 7 to 0.7km



Single case – HIW event from 7 to 0.7km

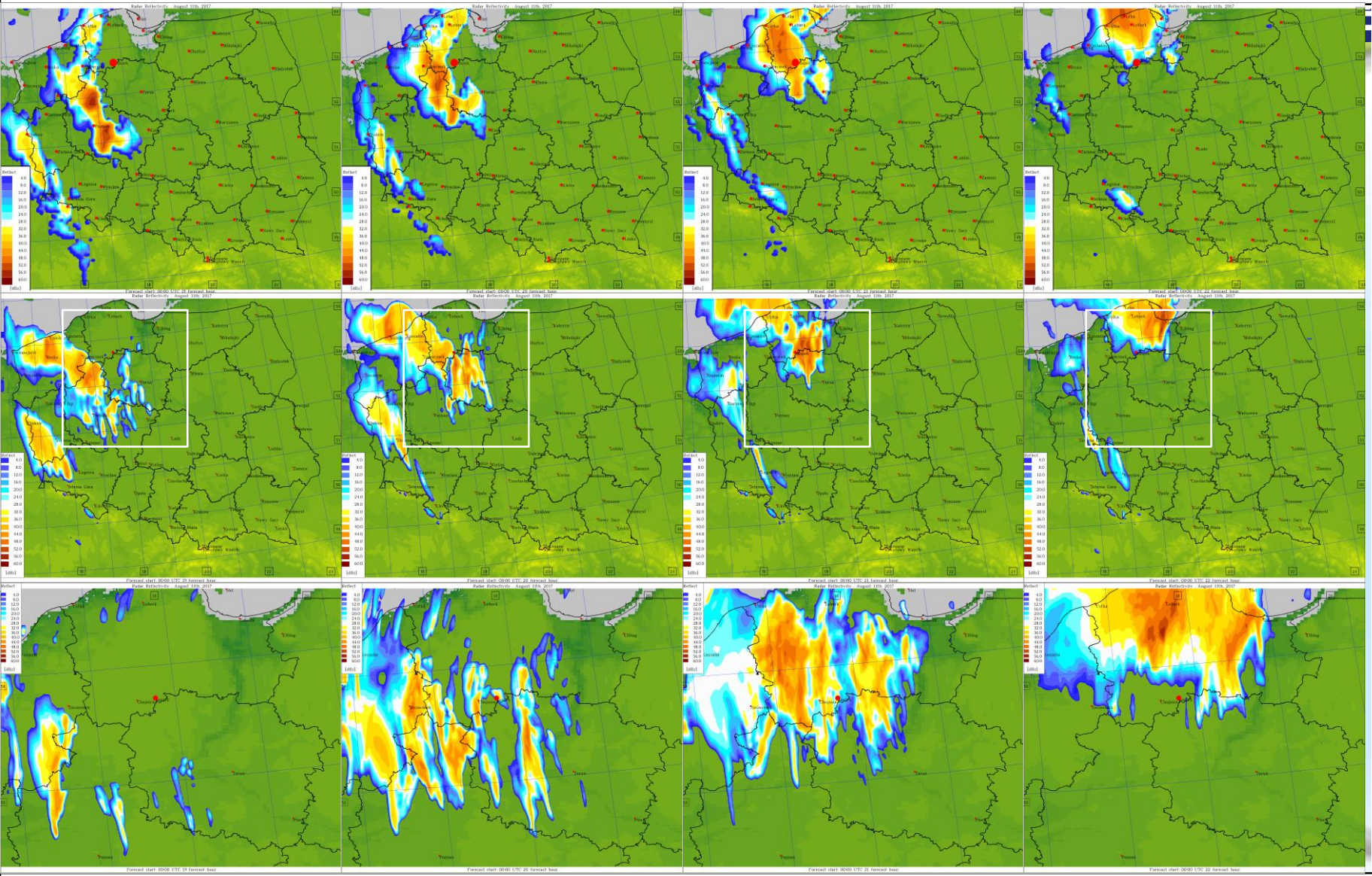
Supercell Detection Index (SDI)



Suszek, August 11th, 2017

Single case – HIW event from 7 to 0.7km

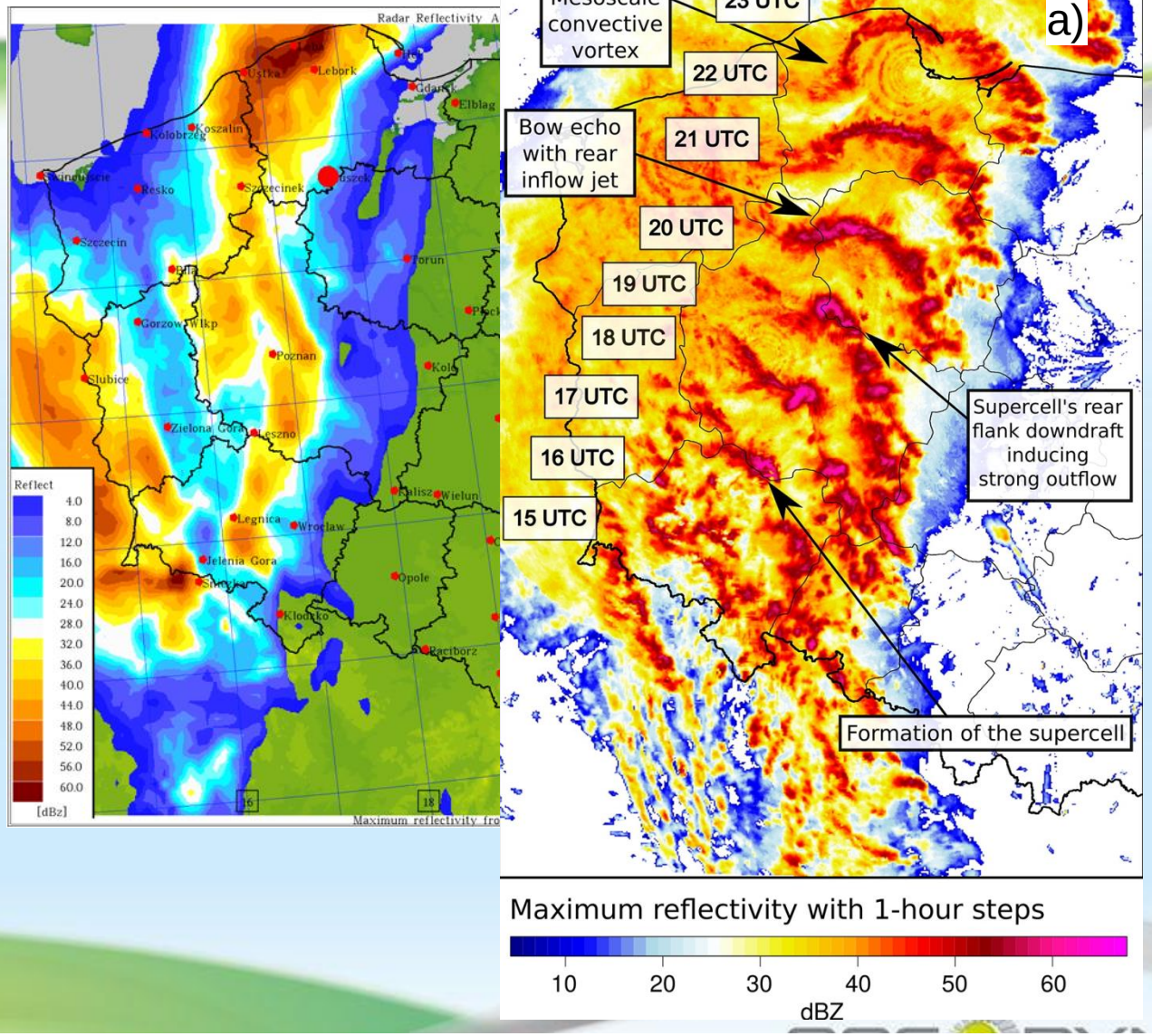
Radar Reflectivity forecast



Suszek, August 11th, 2017

Single case – HIW event from 7 to 0.7km

Radar Reflectivity forecast

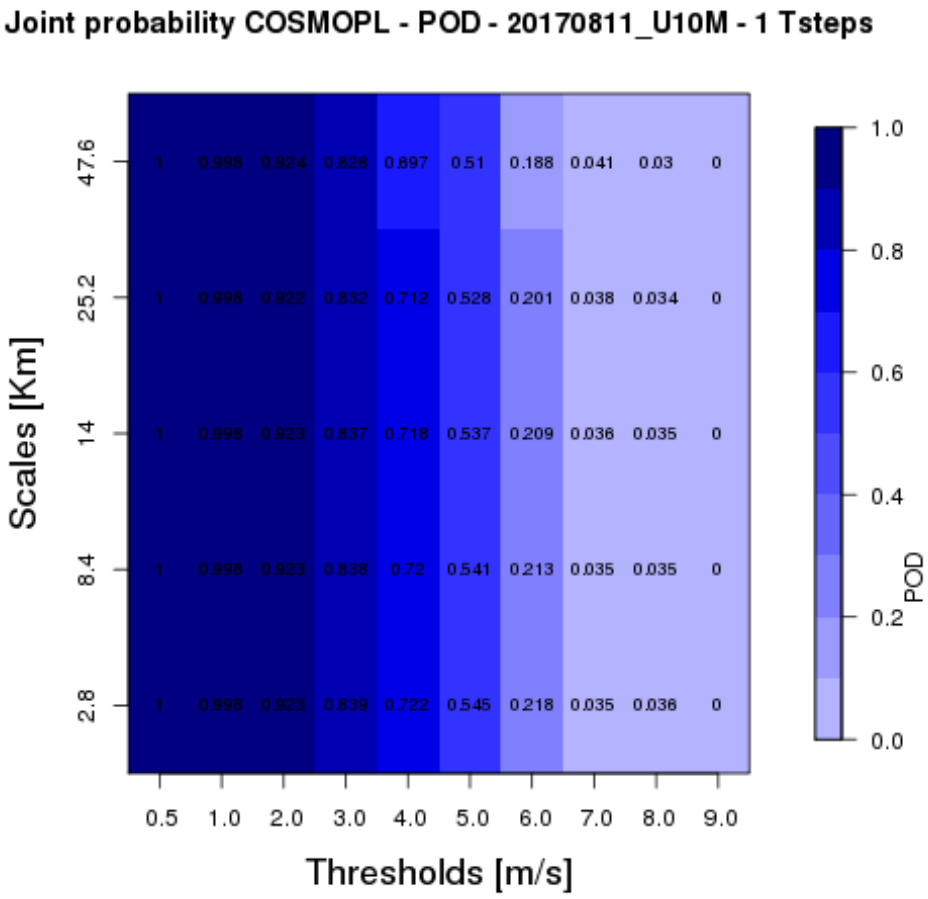


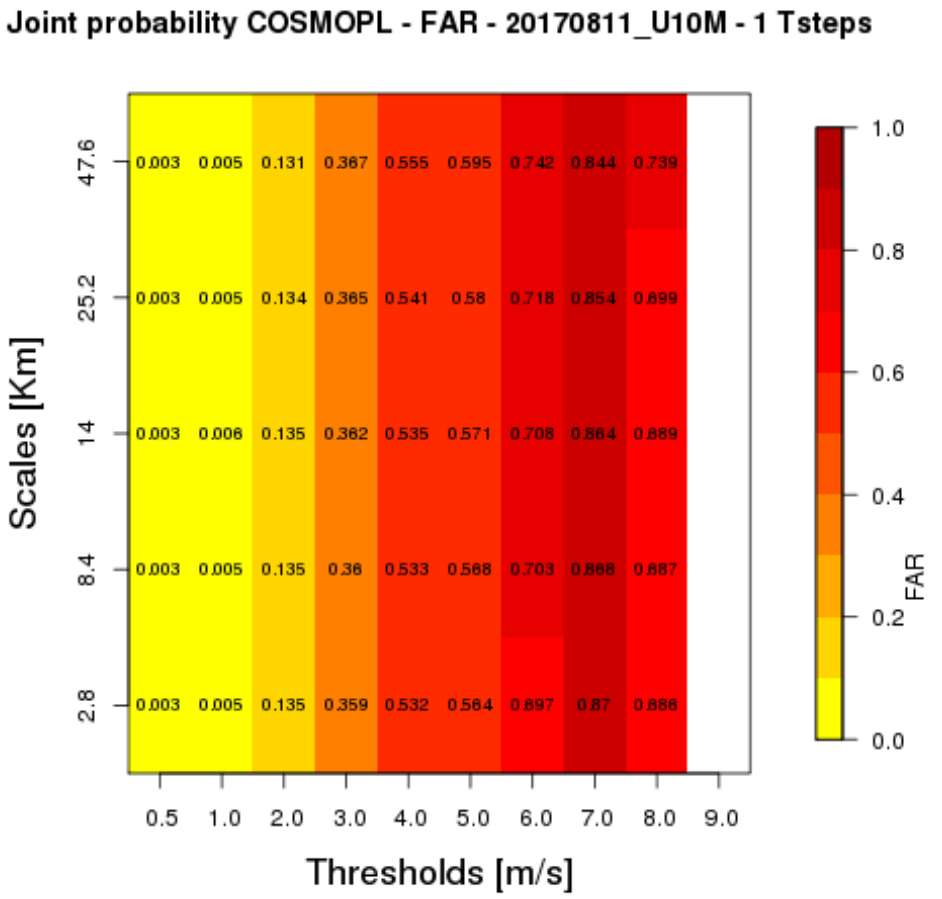
a) Taszarek *et al.*(2019)*:* Derecho Evolving from a Mesocyclone — A Study of 11 August 2017 Severe Weather Outbreak in Poland: Event Analysis and High-Resolution Simulation (Mon.Wea.Rev., https://doi.org/10.1175/MWR-D-18-0330.1). PL radar network.

Single case – HIW event

Wind speed at 10 m, 2017.08.11

- POD
- FAR



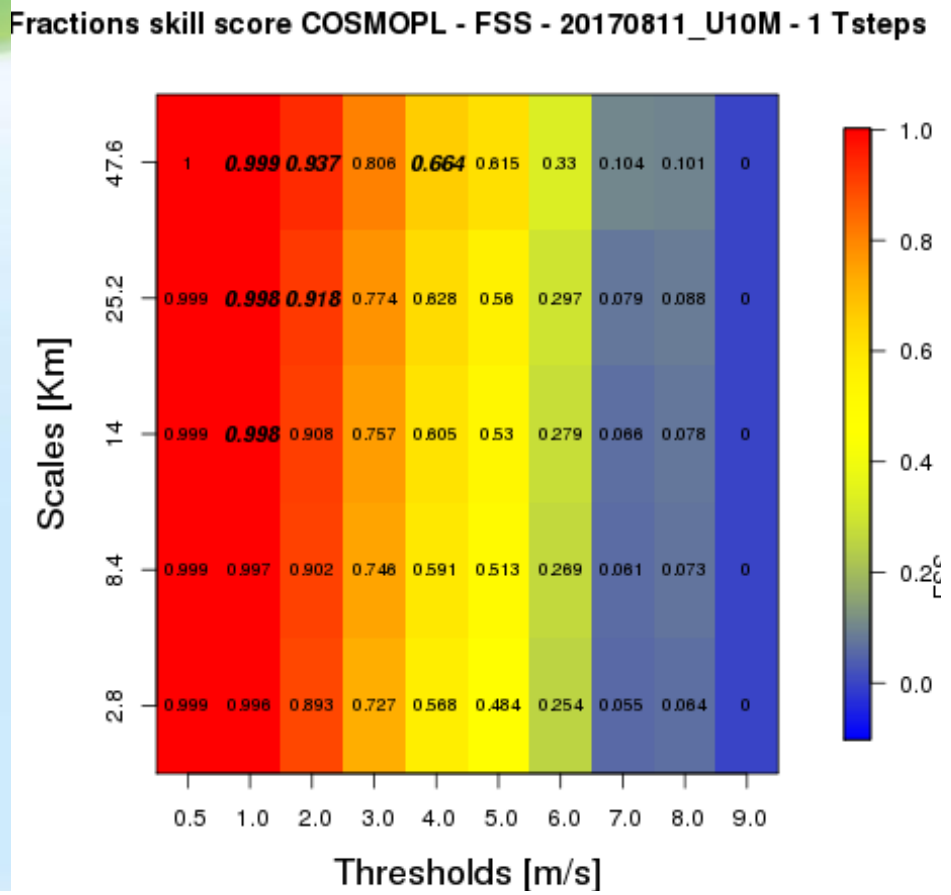


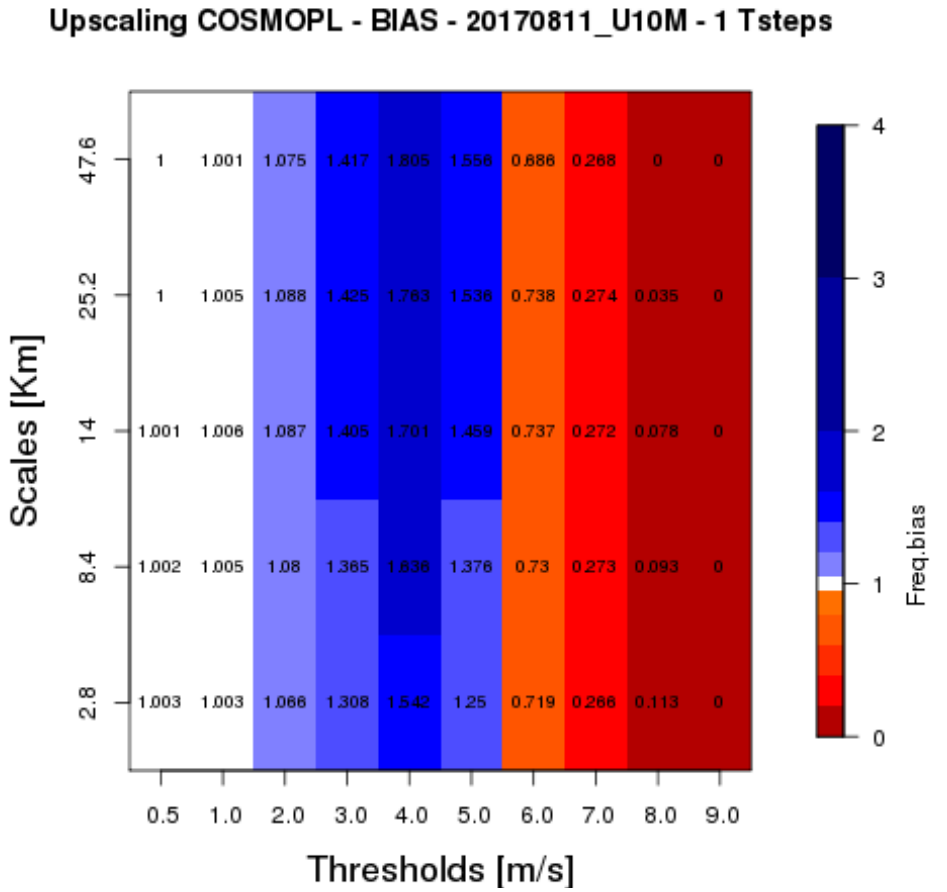
POD and FAR results show greatest skill for low wind speeds. The variation in skill with spatial scale is small.

Single case – HIW event

Wind speed at 10 m, 2017.08.11

- FSS
- BIAS



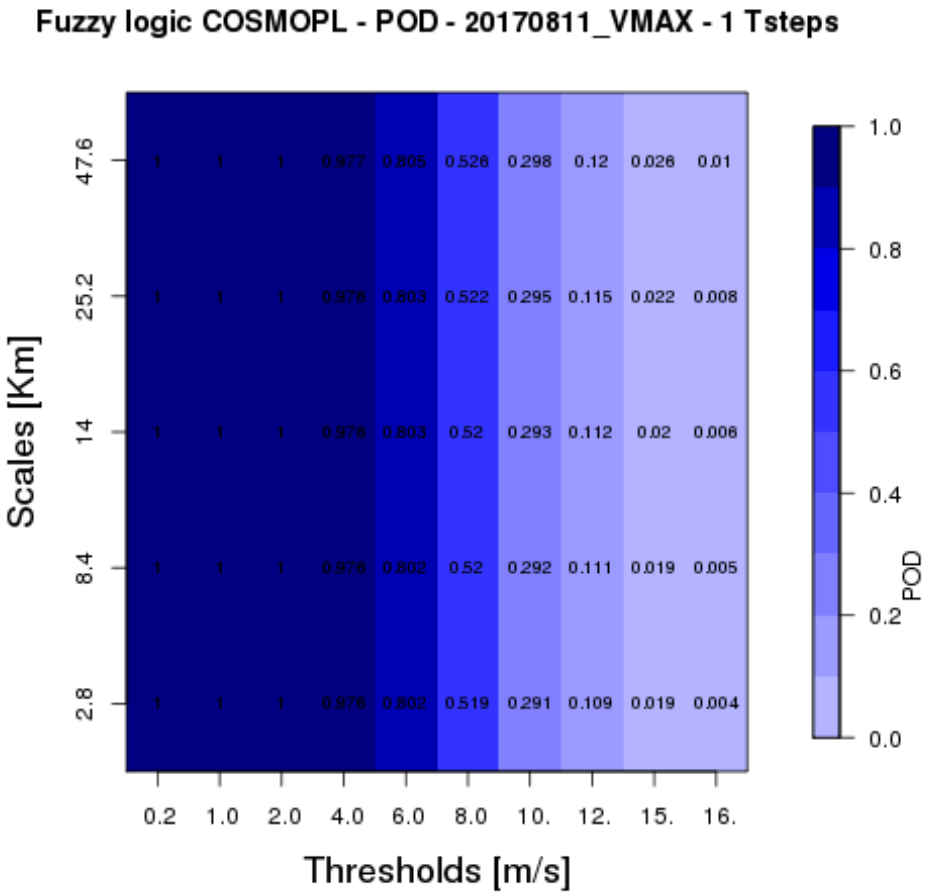


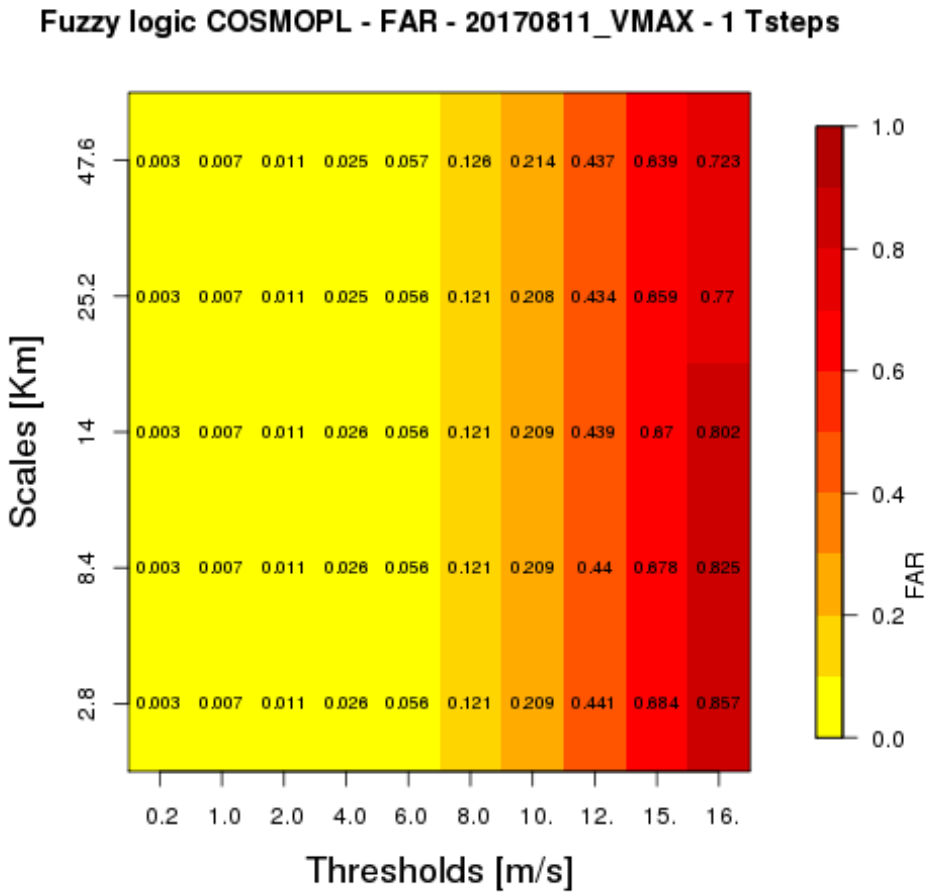
Low wind speeds (below 5.0 m/s) are overestimated by COSMO whilst larger wind speeds (above 5.0 m/s) are underestimated. FSS results show greatest skill for low wind speeds at large spatial scales. The skill decreases with wind speed and smaller spatial scales.

Single case – HIW event

Wind gust, 2017.08.11

- POD
- FAR



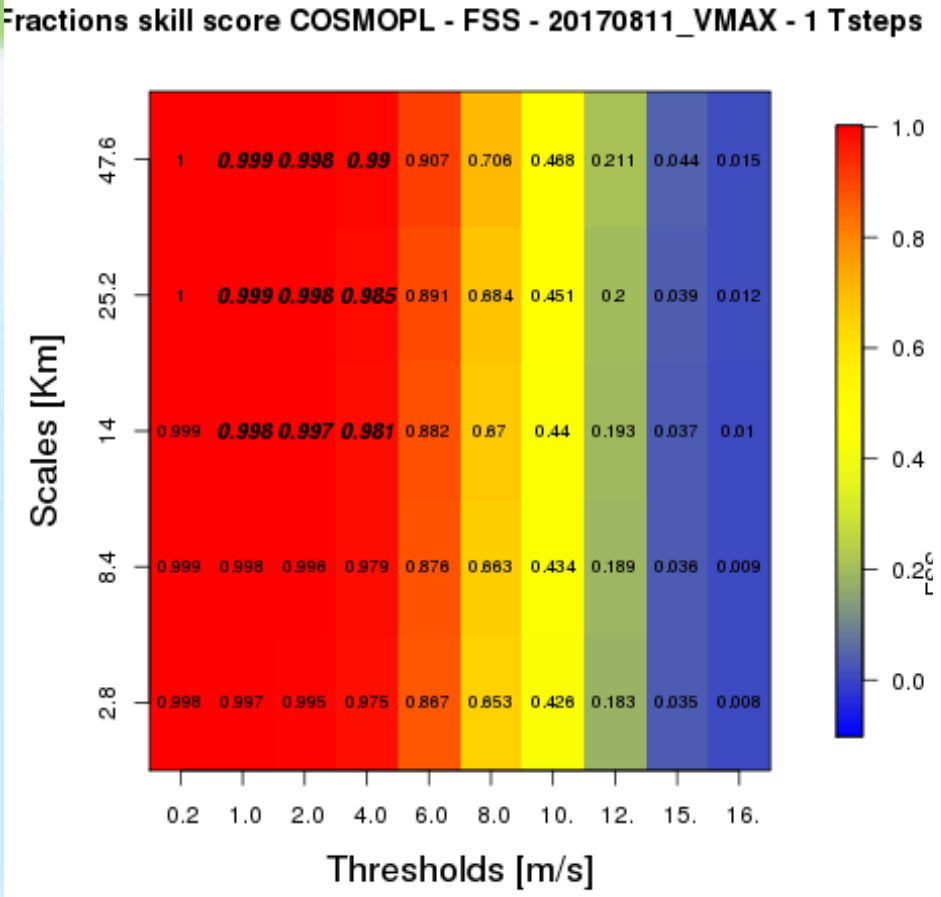


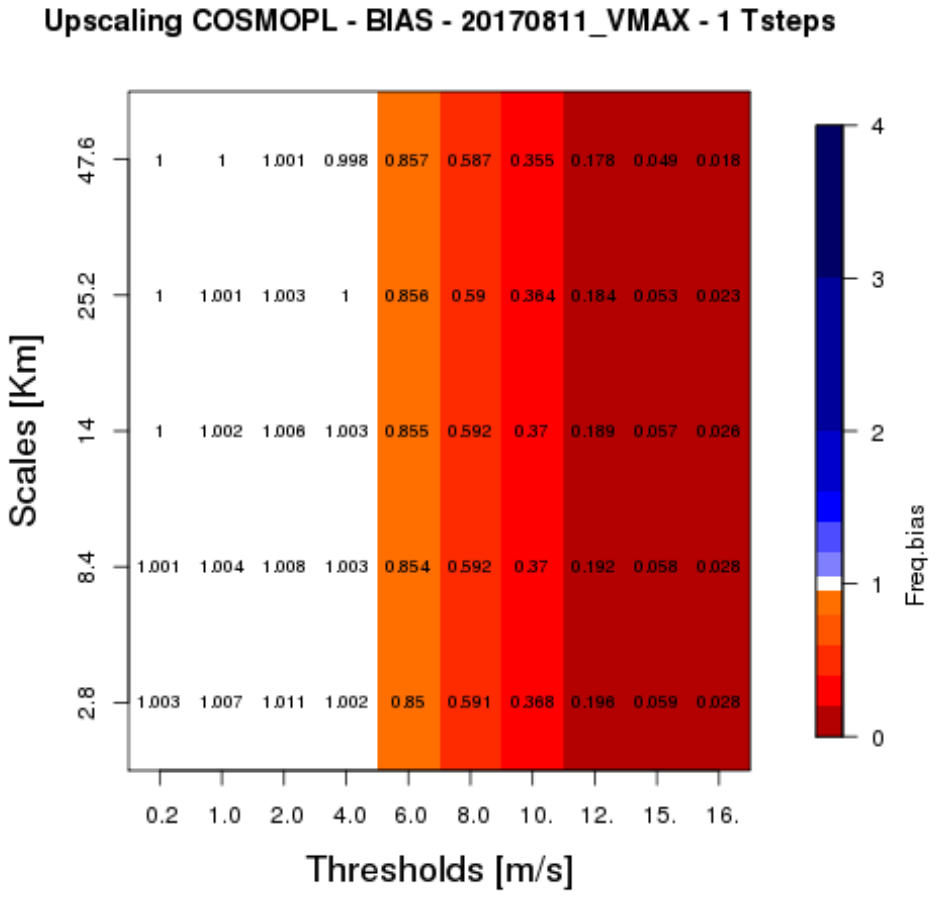
POD and FAR results show greatest skill for low wind gust speeds. The variation in skill with spatial scale is small.

Single case – HIW event

Wind gust, 2017.08.11

- FSS
- BIAS



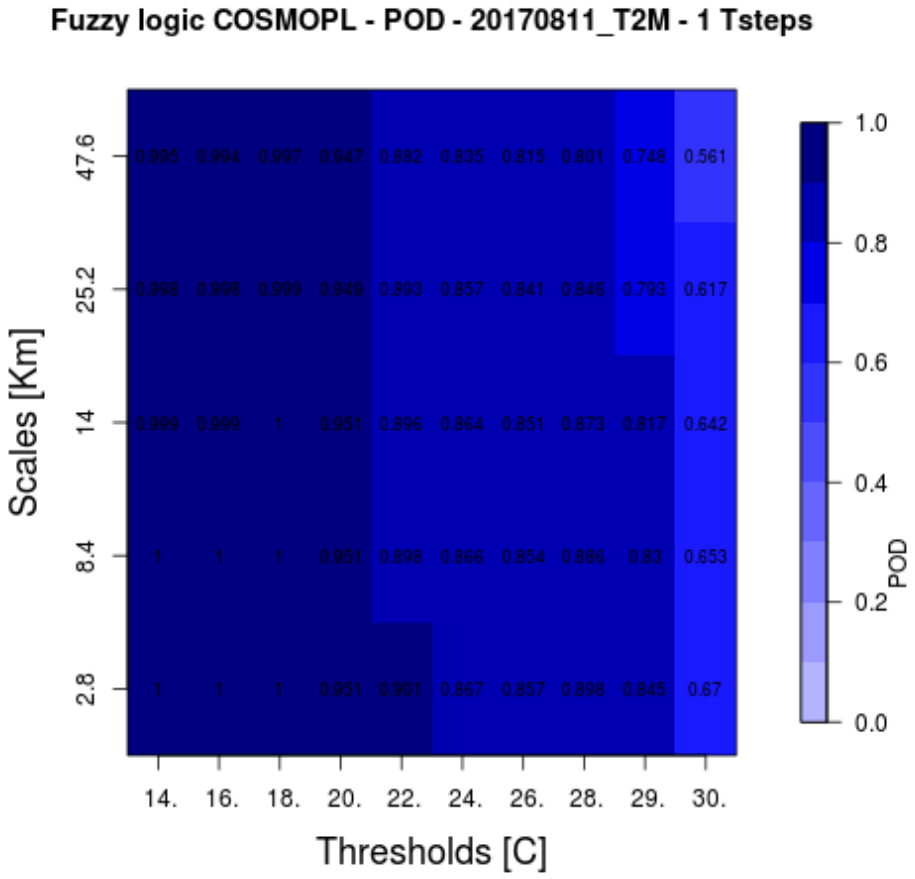


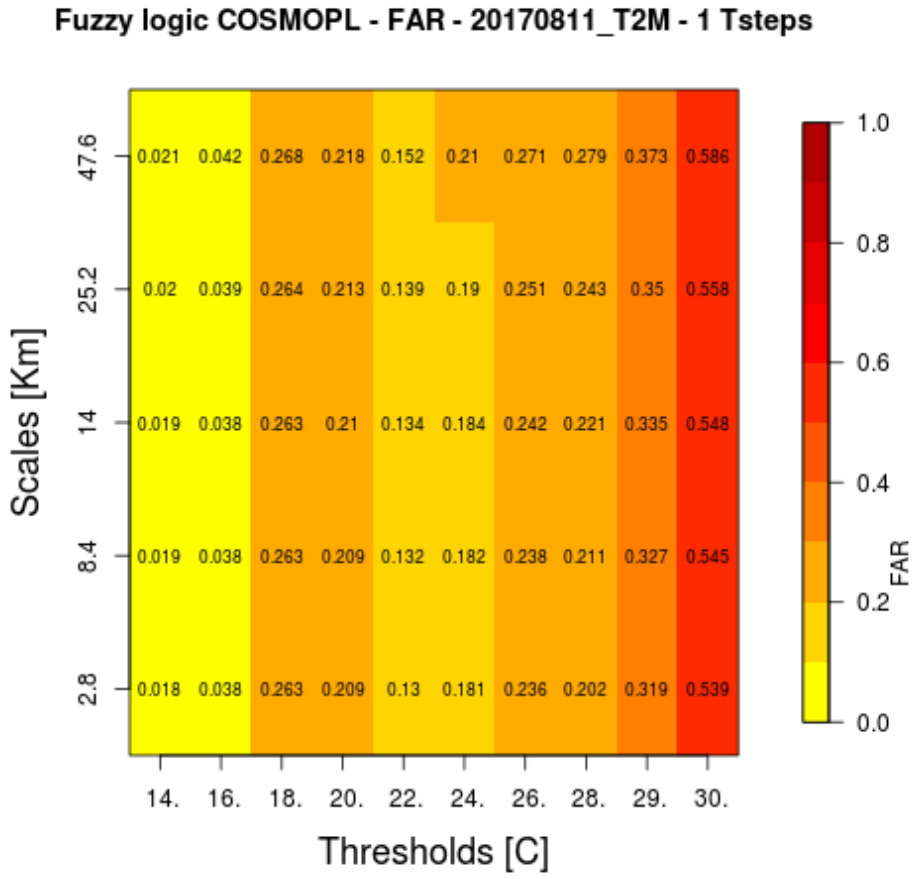
Wind gusts above 6m/s are underestimated by COSMO , with the degree of underestimation increasing with gust speed. FSS results show greatest skill for low wind gust speeds. There is a small variation in skill with spatial scale, with greater skill at larger scales.

Single case – HIW event

Temperature at 2m, 2017.08.11

- POD
- FAR



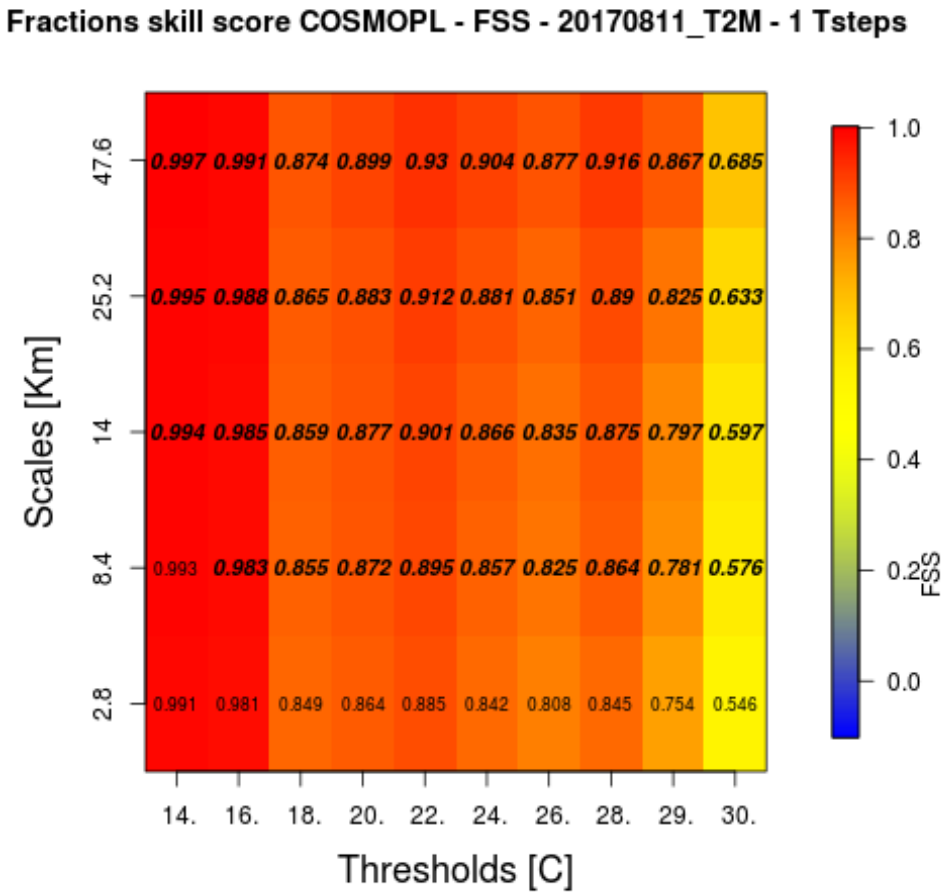


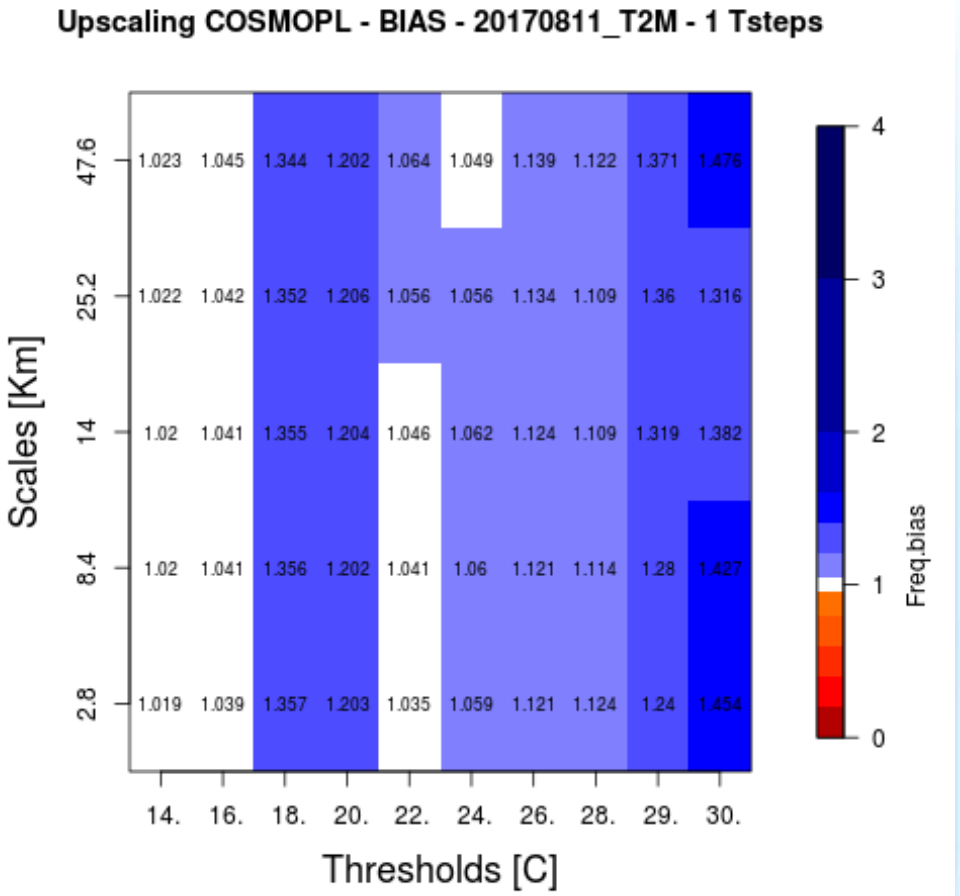
POD and FAR results show greatest skill for lower temperatures. The variation in skill with spatial scale is small.

Single case – HIW event

Temperature at 2 m, 2017.08.11

- FSS
- BIAS



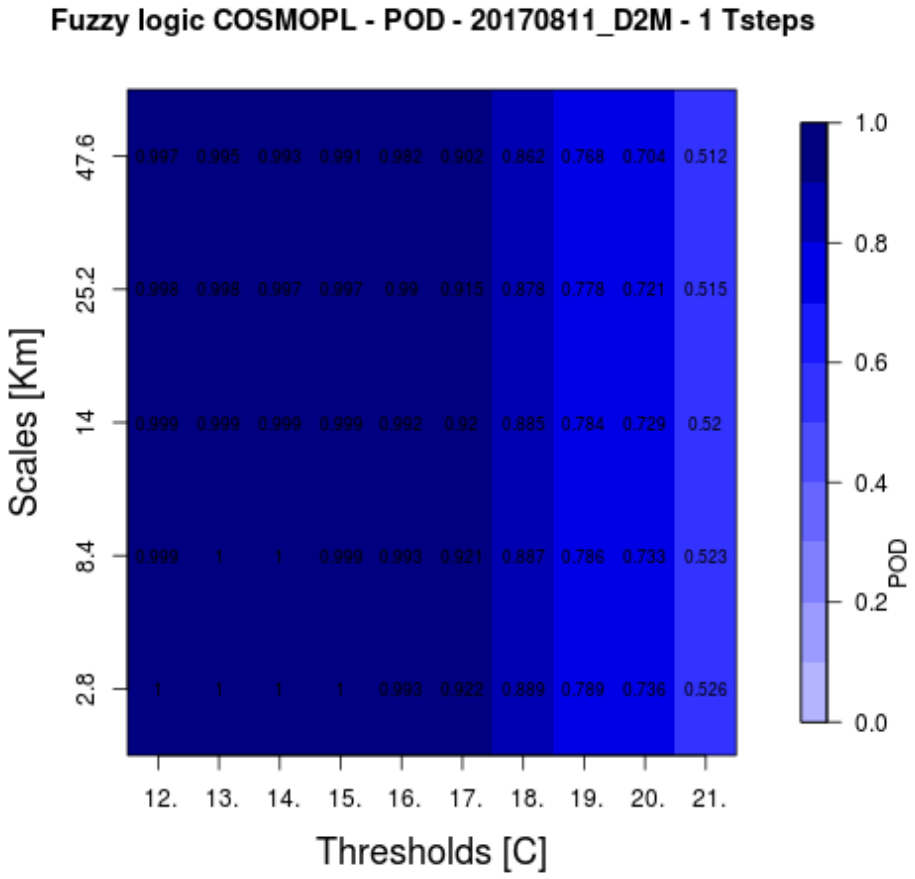


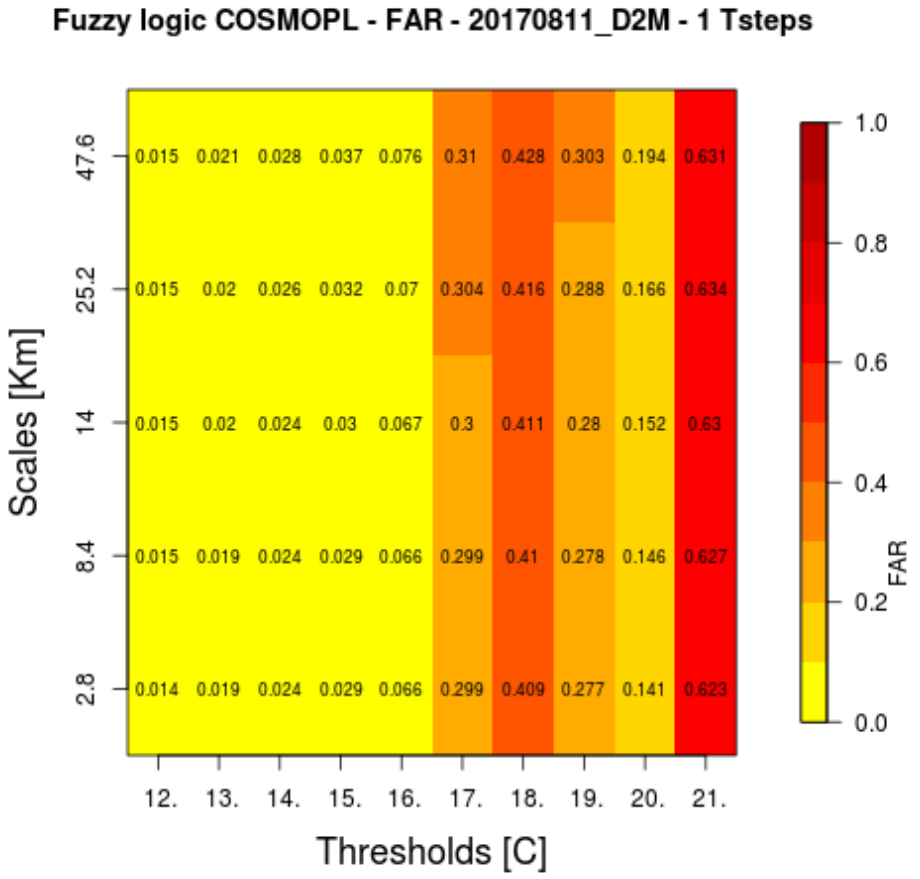
The temperature bias shows a slight overestimation. FSS results show greatest skill for lower temperatures.

Single case – HIW event

Dew Point Temperature, 2017.08.11

- POD
- FAR



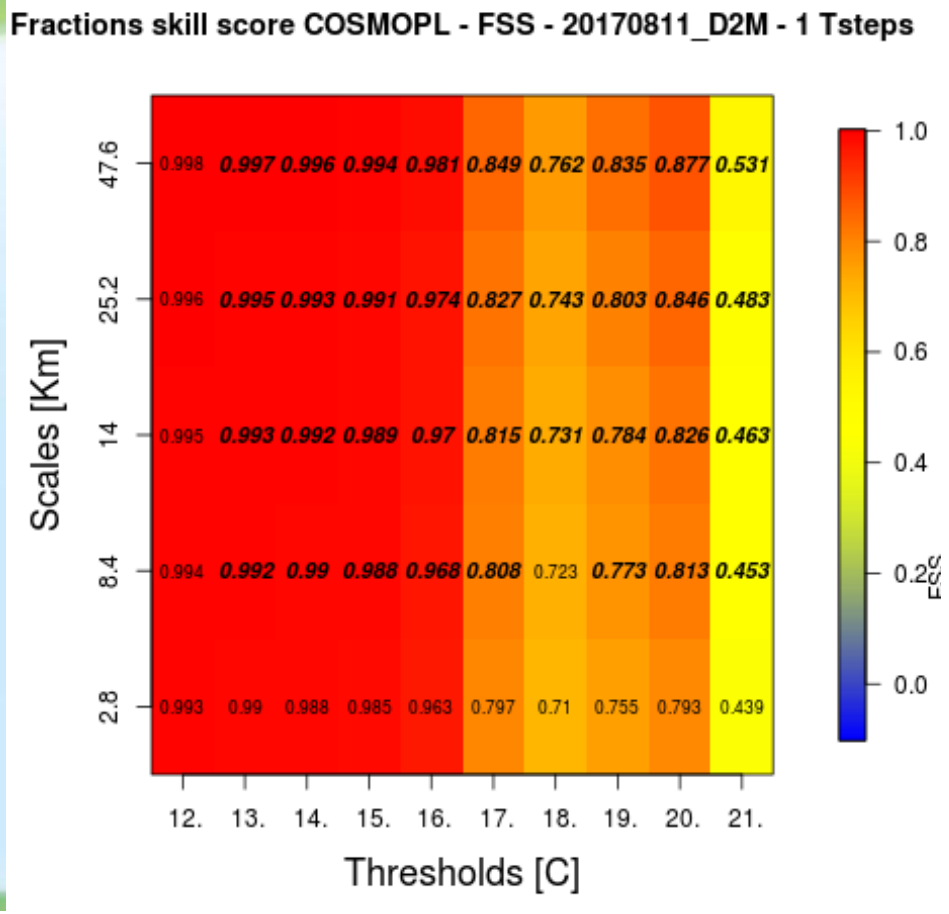


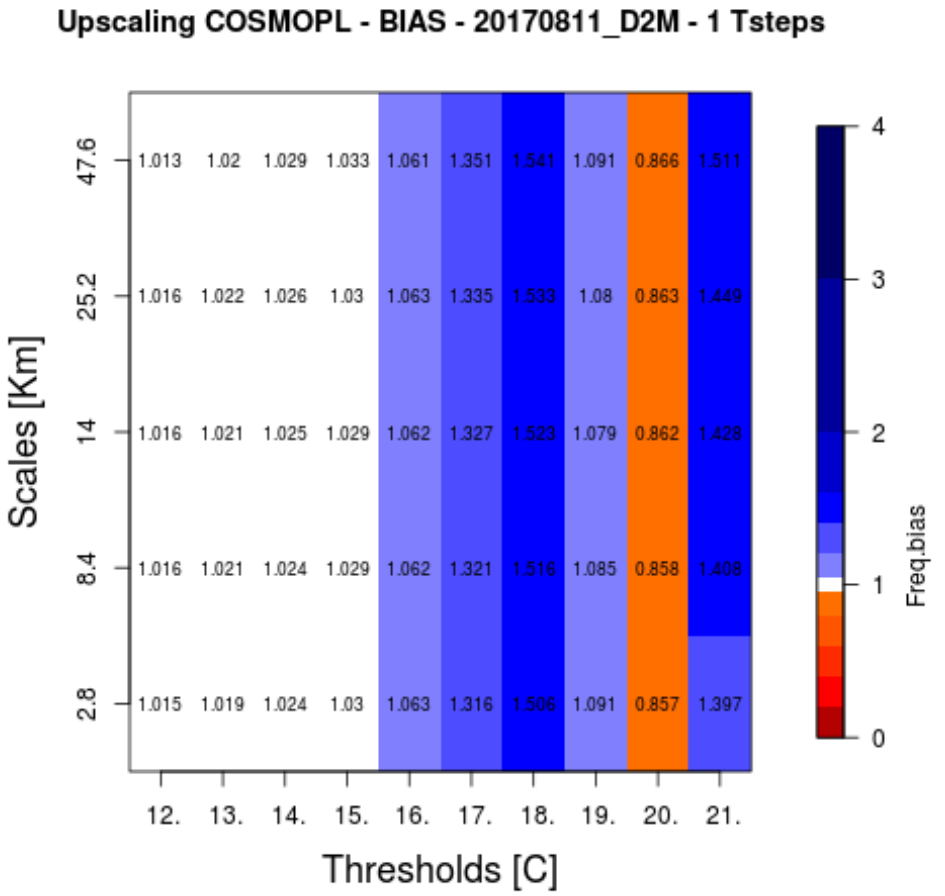
POD and FAR results show greatest skill for lower dew point temperatures.

Single case – HIW event

Dew Point Temperature, 2017.08.11

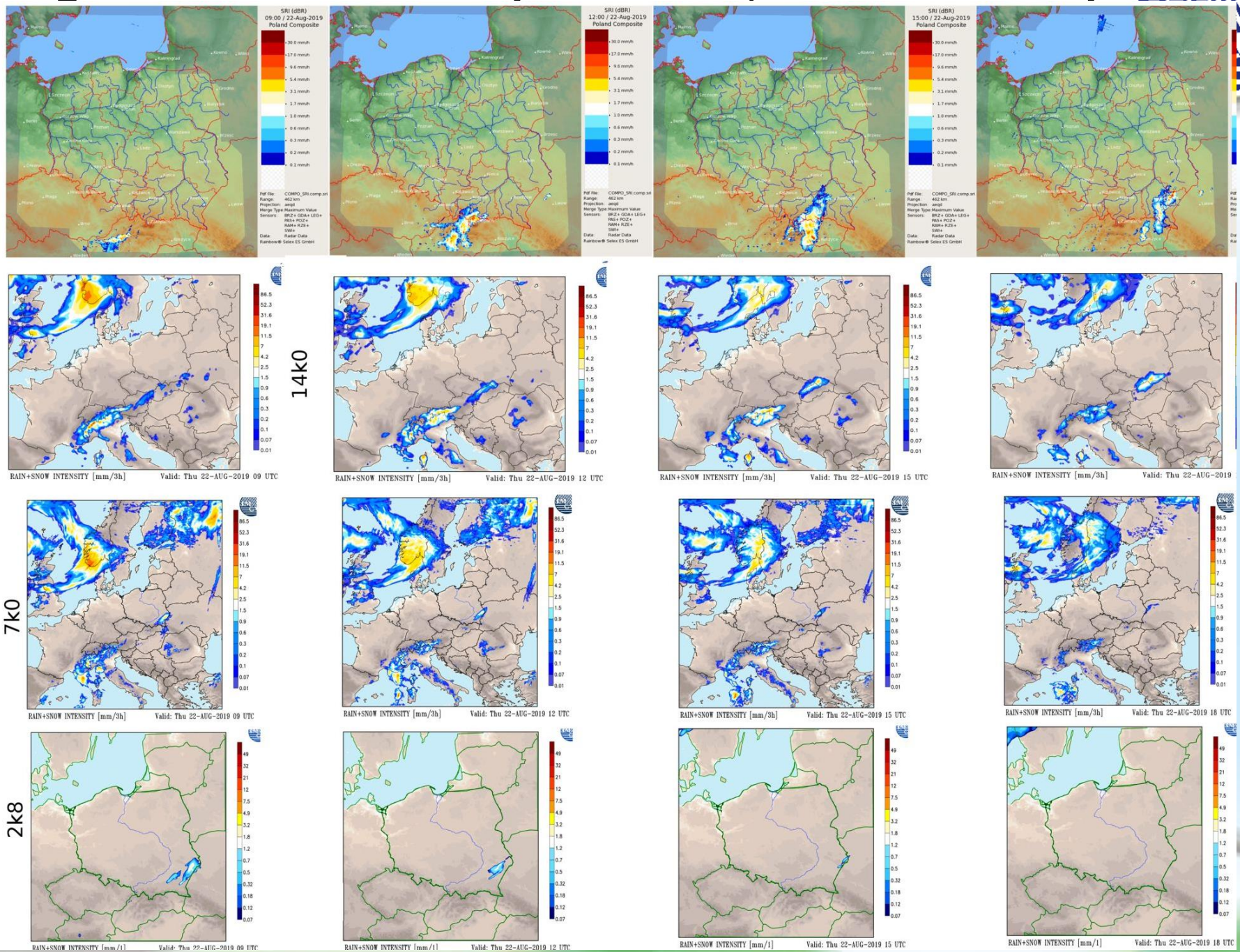
- FSS
- BIAS



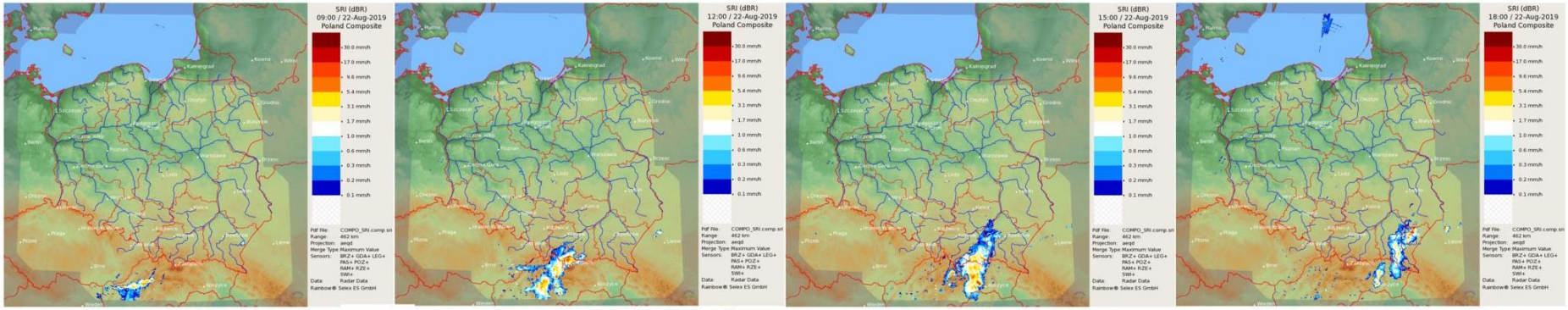


The dew point temperature bias shows a slight overestimation apart from a strange anomaly at 20 degrees. FSS results show greatest skill for lower dew point temperatures. More investigation is needed to analyse the anomaly.

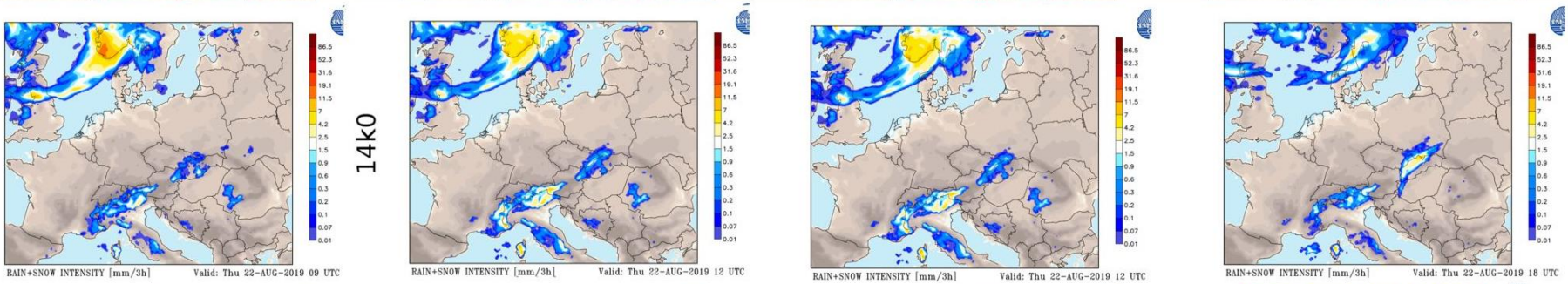
Single case – HIW event (2019.08.22, fcst start 00:00)



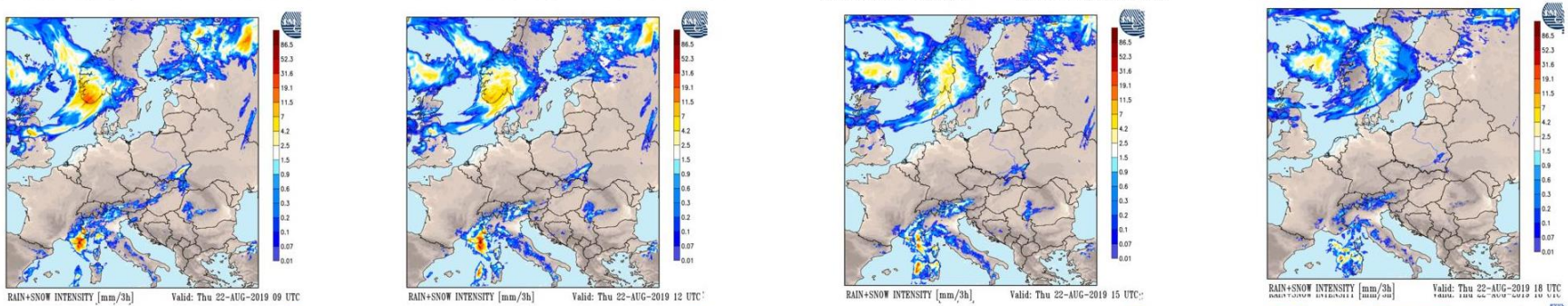
Single case – HIW event (2019.08.22, fcst start 06:00)



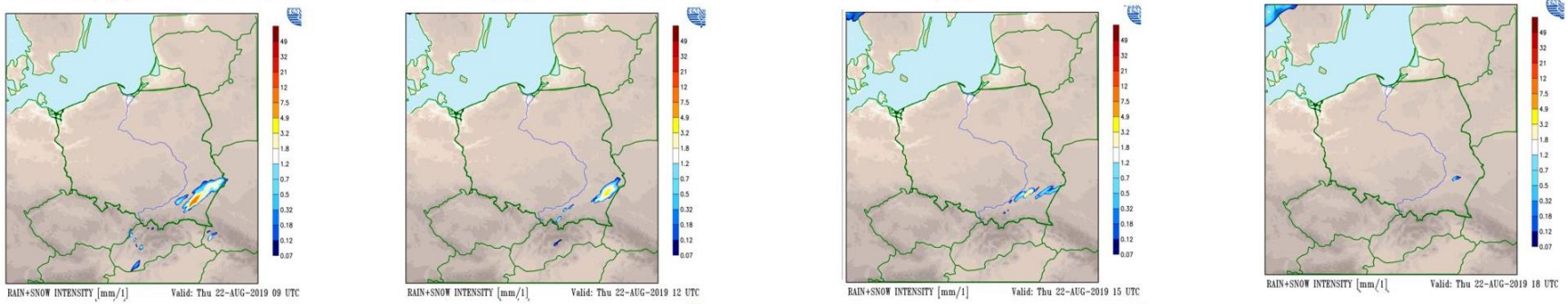
14k0



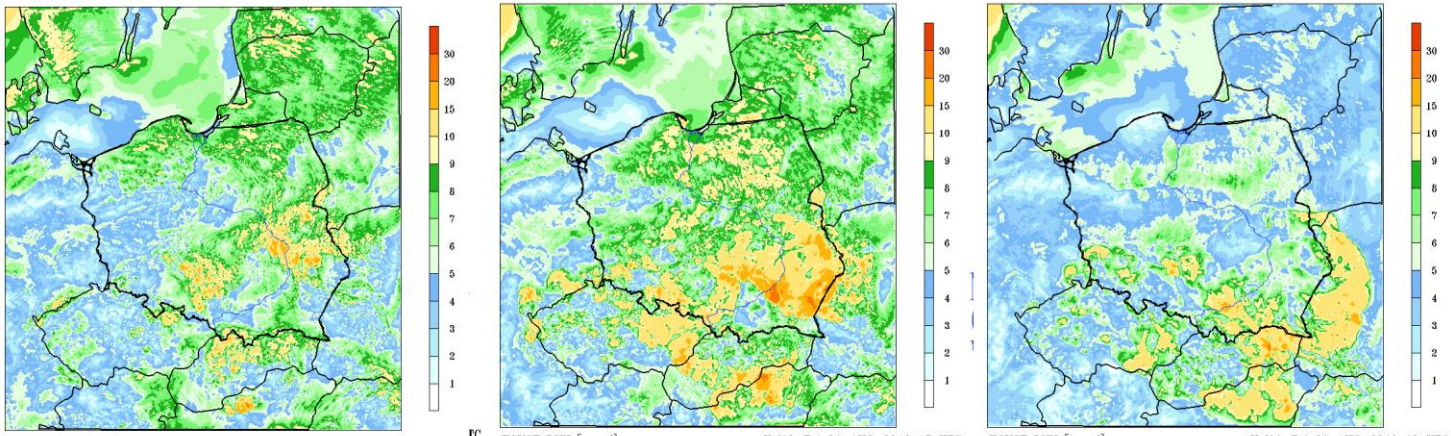
7k0

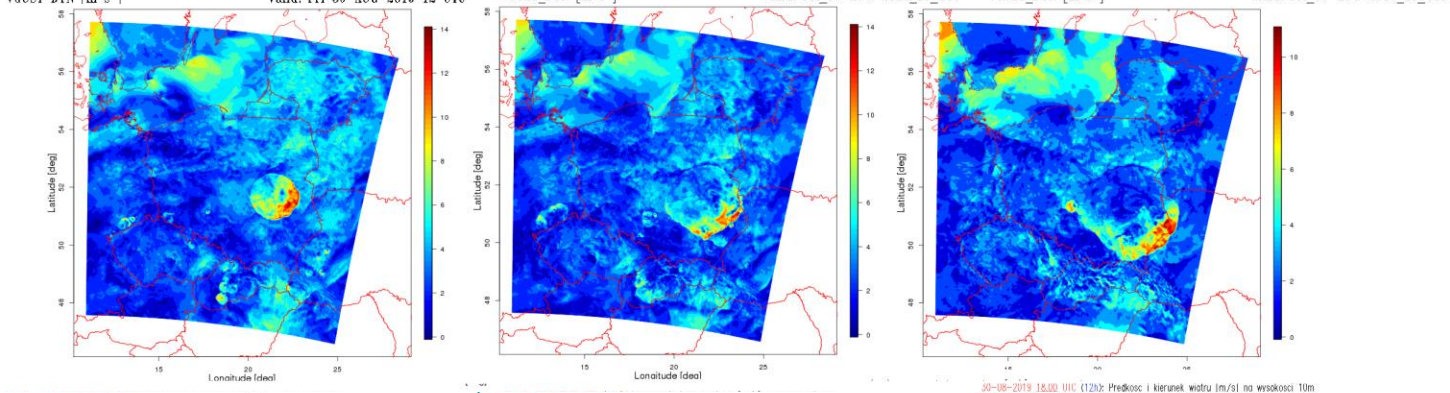


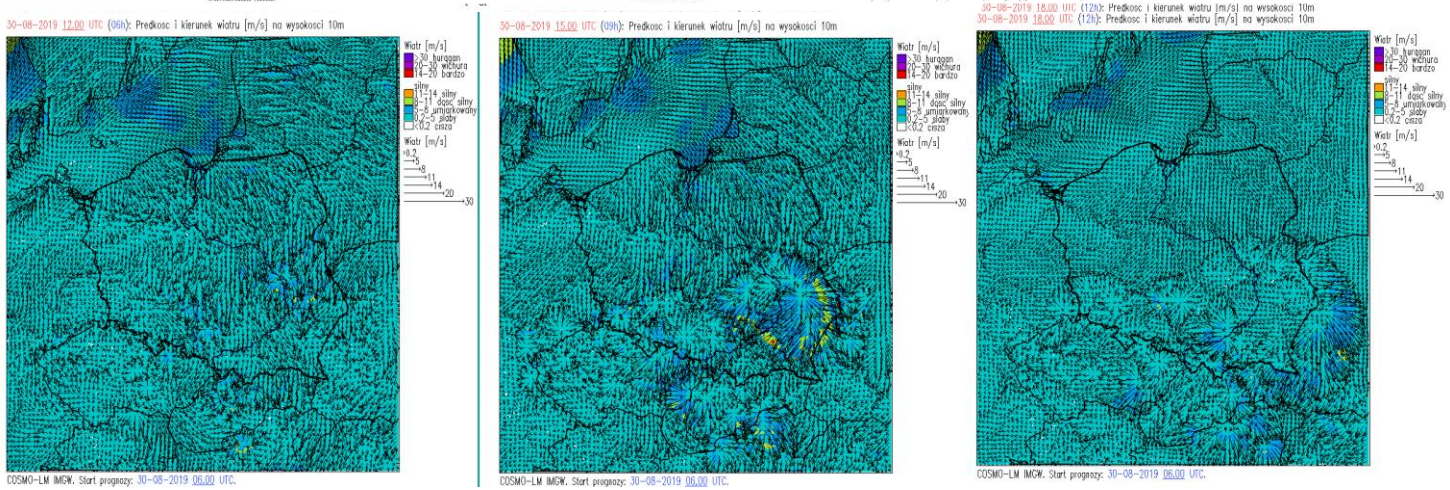
2k8



Single case – HIW event (2019.08.30, fcst start 06:00)







Conclusions

Most effective in very high resolution – Supercell Detection Index. (identifies the path of the supercell northward), VMAX (as DMO), reflectivity forecasts.

Fuzzy logic verification looks promising as a tool to assess a quality of forecast.

Single case – HIW event (2019.08.22) – strange that only 14km (and EPS 2.8) COSMO-PL predicted precipitation correctly, regardless of the forecasts start…

Single case – the huge bubble VGUST forecasted at a resolution of 2.8 km – definitely a very thorough investigation needed!