



Siberian cold and tropical humid air rendezvous over Budapest

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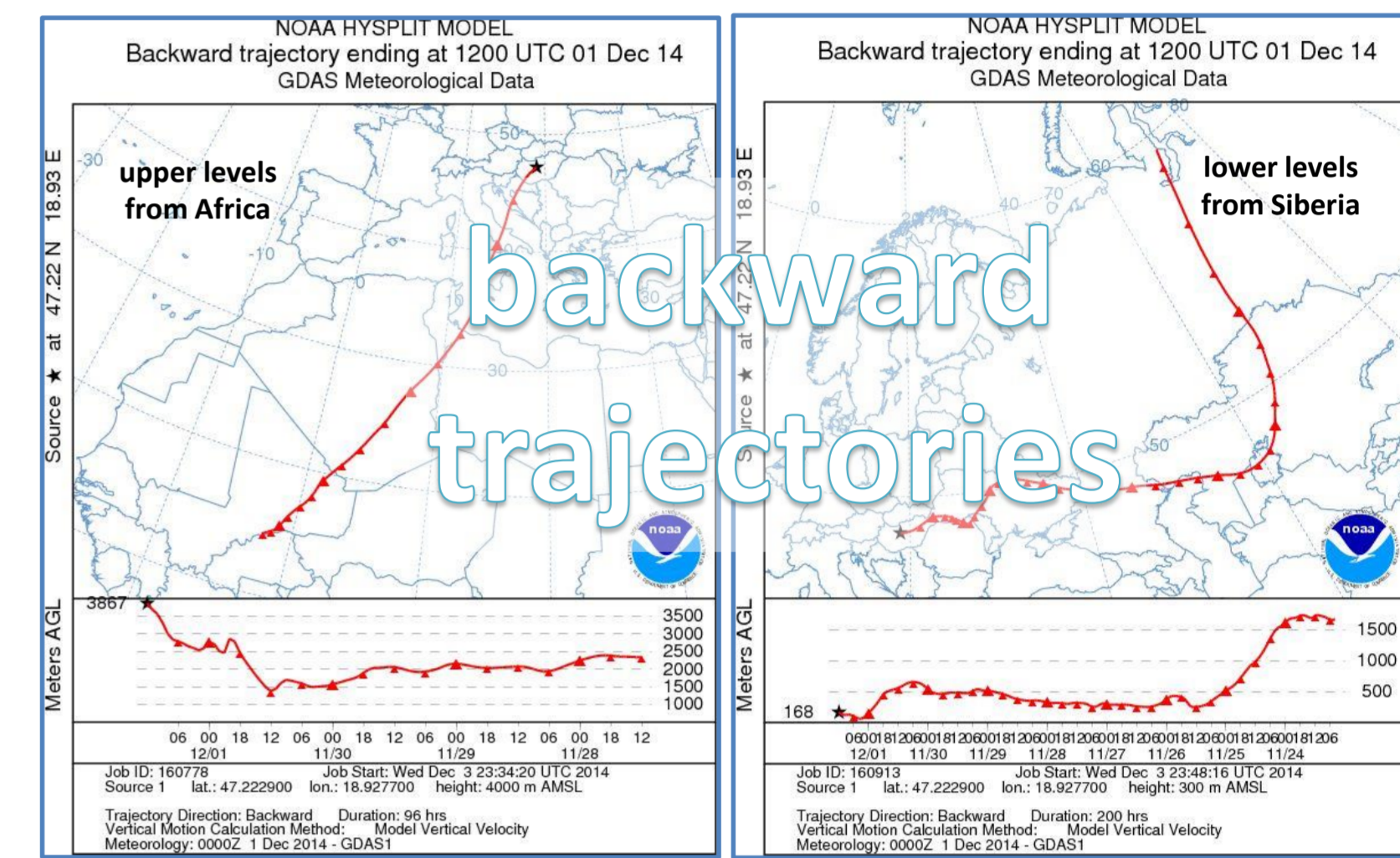
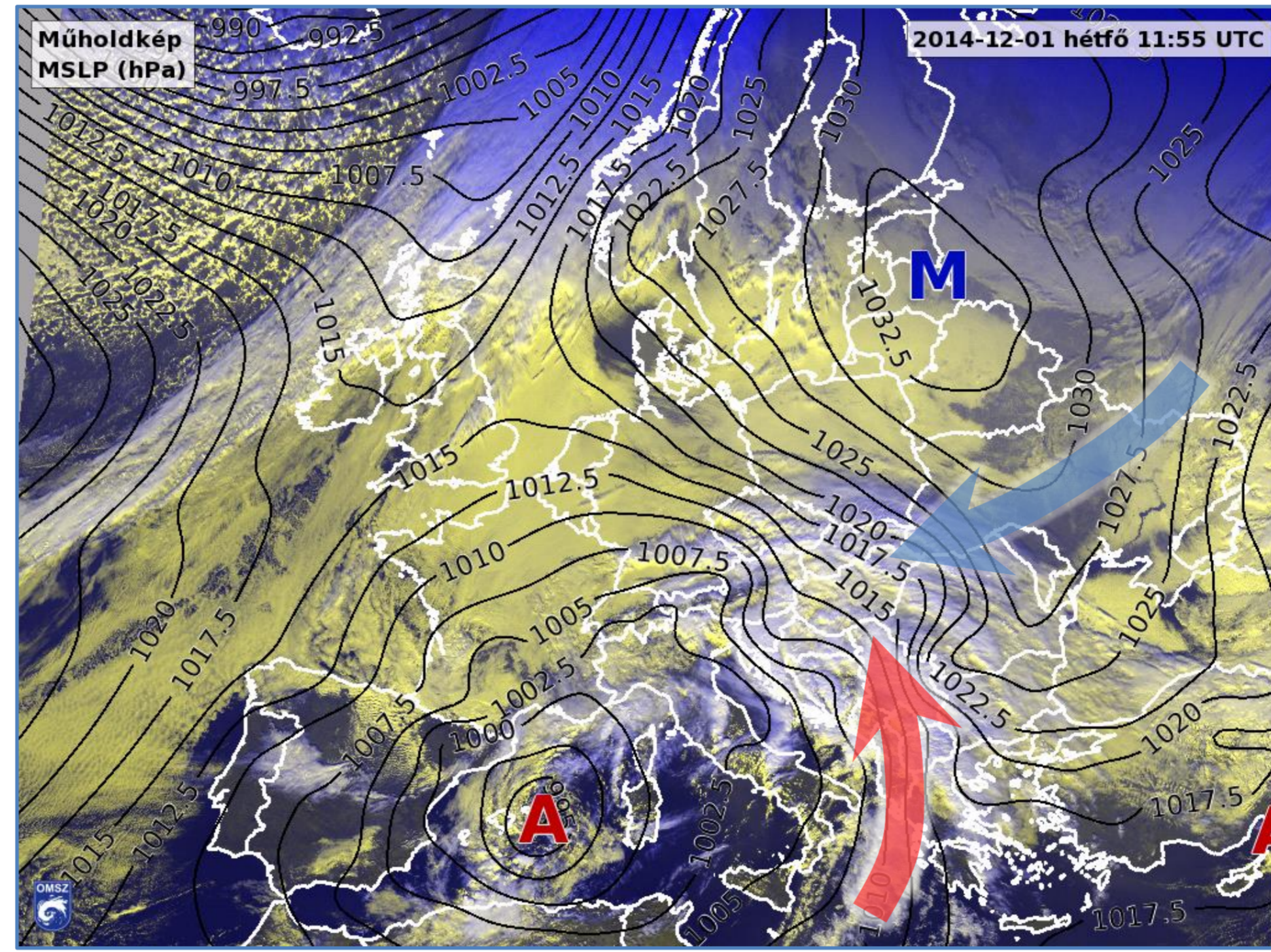
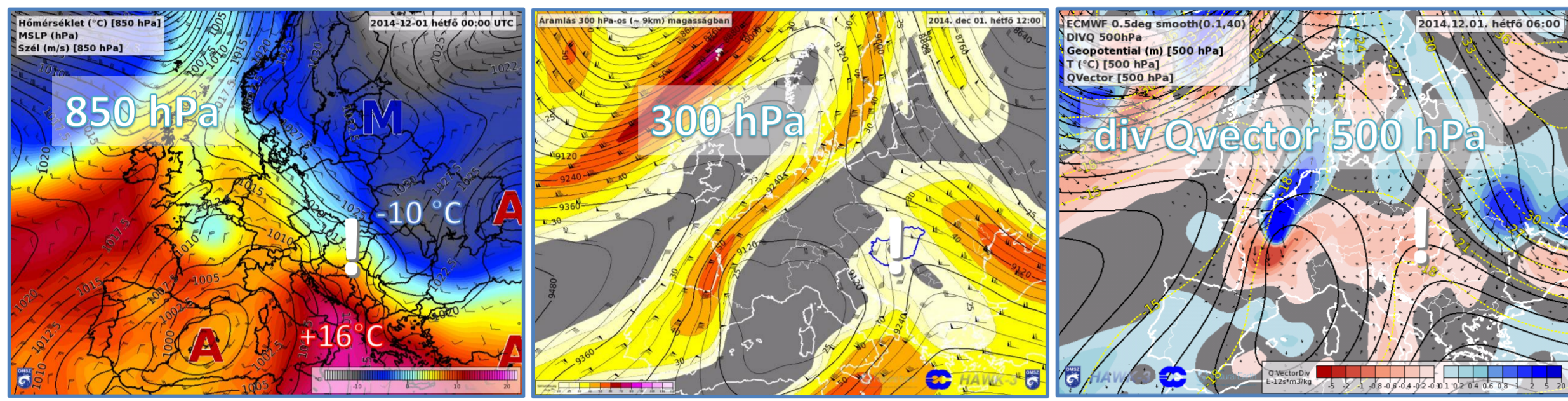


40 mm freezing rain on the hills around Budapest, Hungary. Were ECMWF forecast products successful?

On the 1st of December, 2014 a catastrophic icing event occurred on the higher ground in central Hungary and partly on the hilly part of Budapest due to large amount of freezing rain. The consequences were severe damages in the forests (~50 thousands of hectares), collapsed power networks, closed roads and power outage in some settlements for days. Forestry experts estimated more than 100 years return period for such a forest damage event.

synoptic scale background

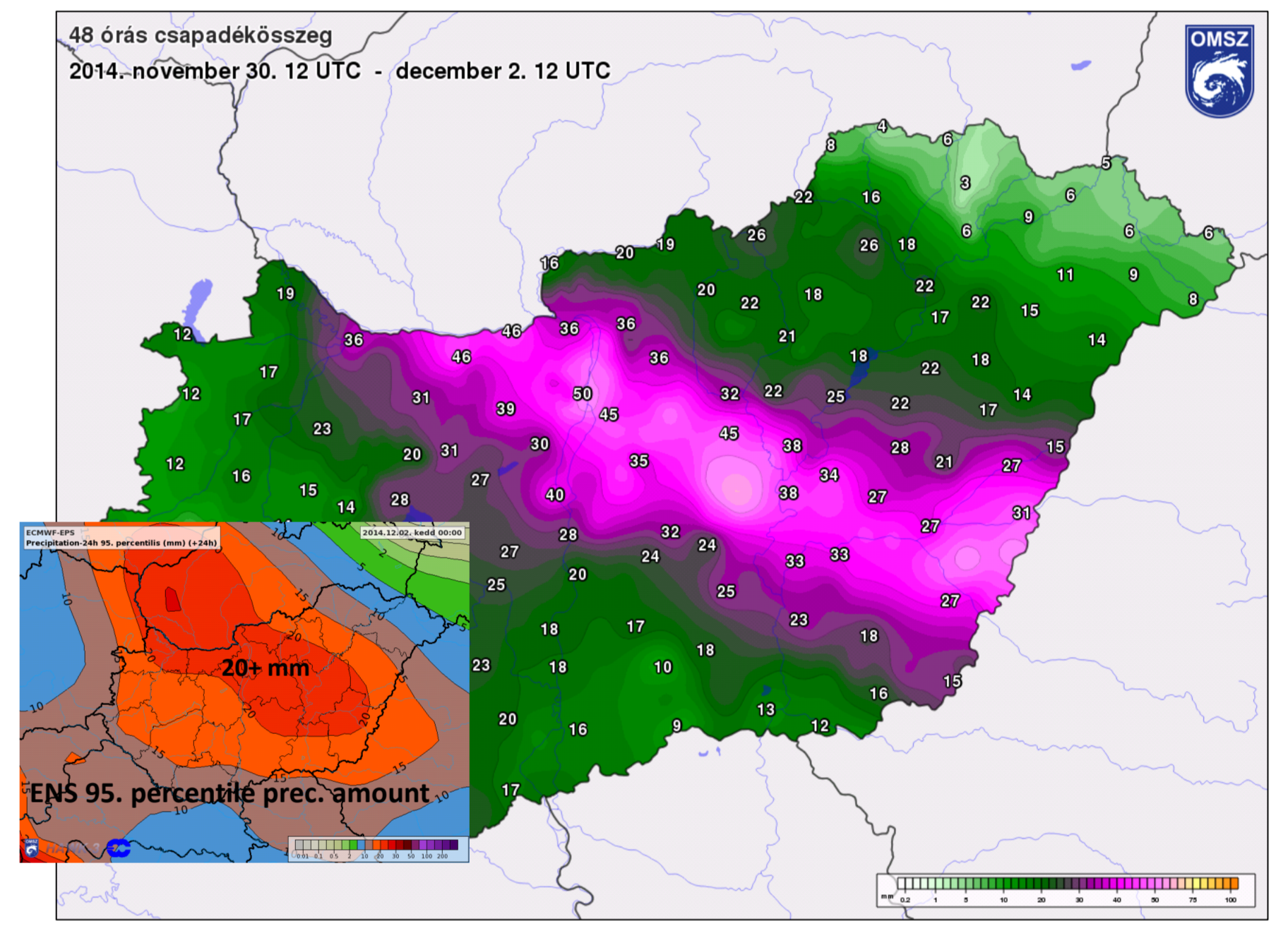
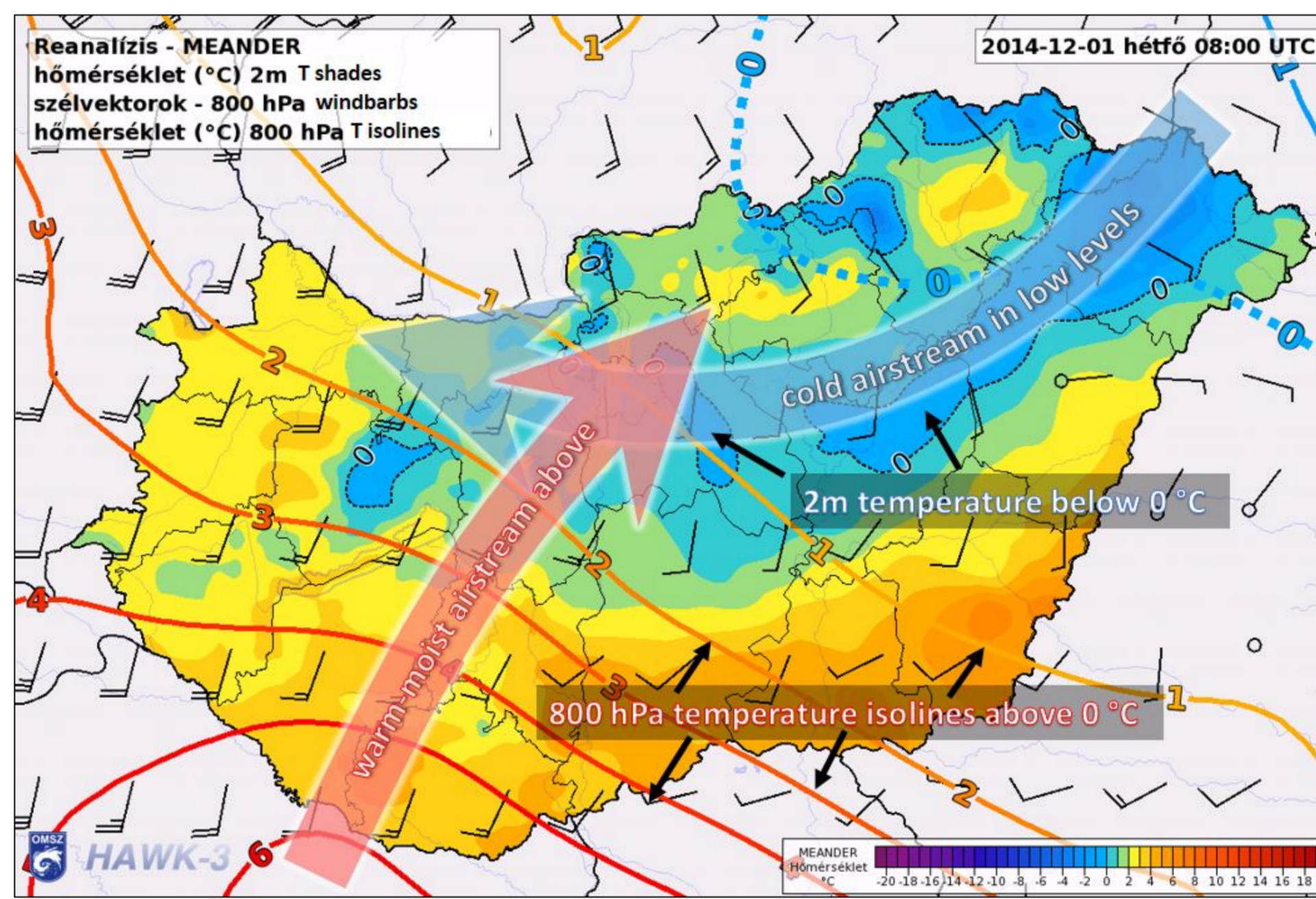
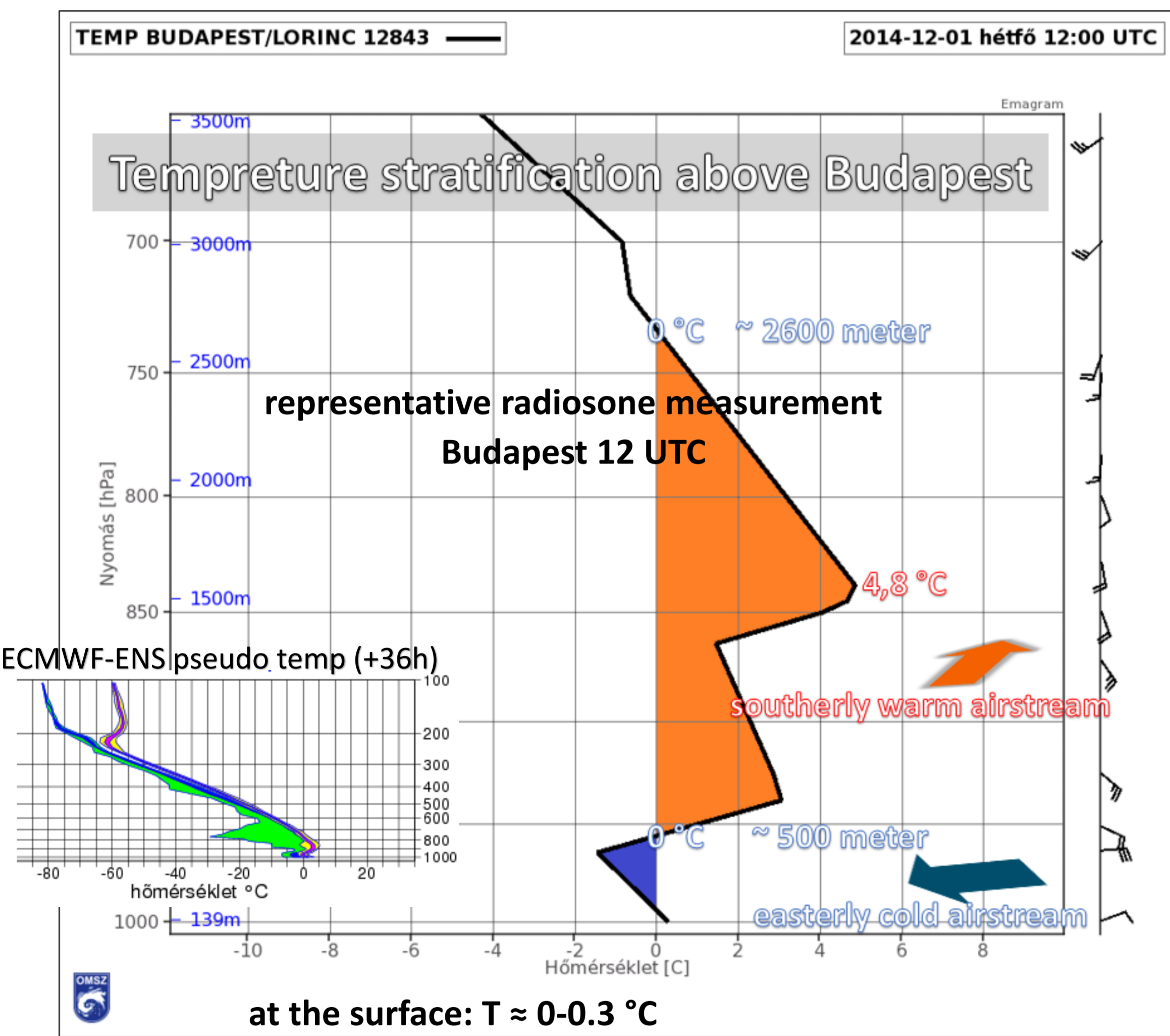
between a mediterranean cyclone and an eastern european anticyclone with large temperature gradient



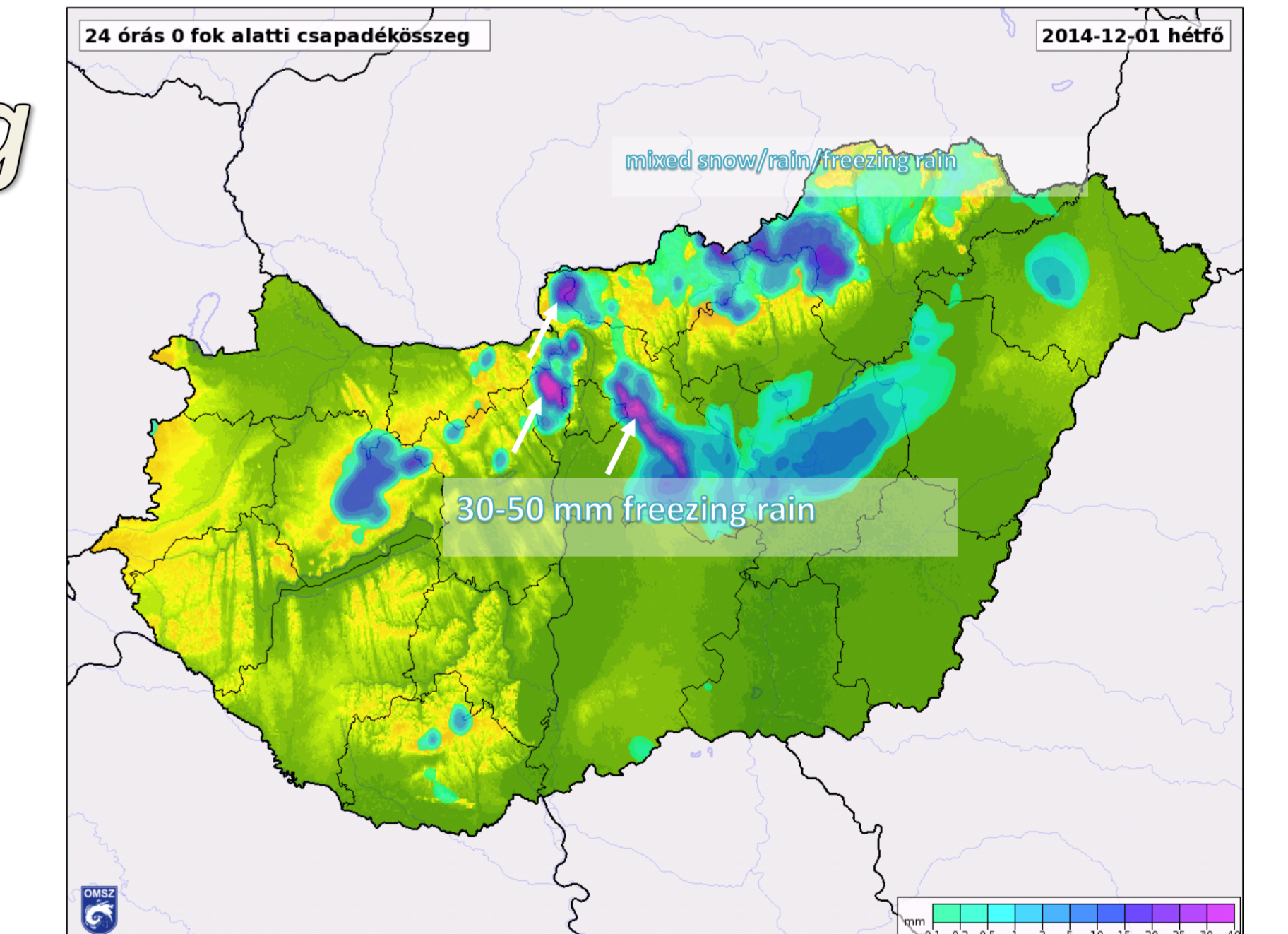
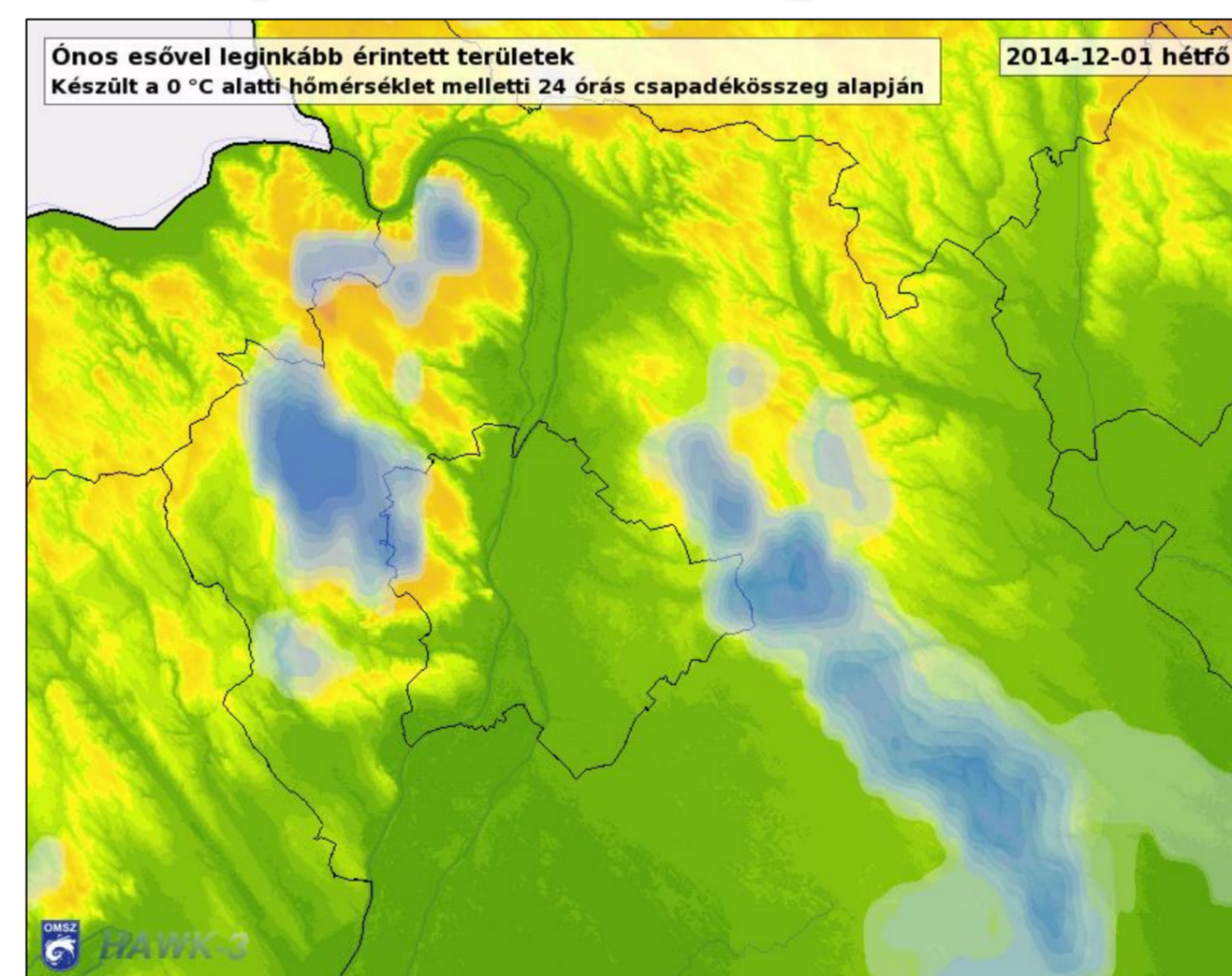
large scale configuration/basic ingredients were well forecasted

- ✓ large horizontal temperature gradient
- ✓ high specific humidity/precipitable water (22-25 mm)
- ✓ Strong upward motion
- ✓ temperature close to 0 °C in low levels
- ✓ HRES/ENS forecasts indicates high amount of precipitation

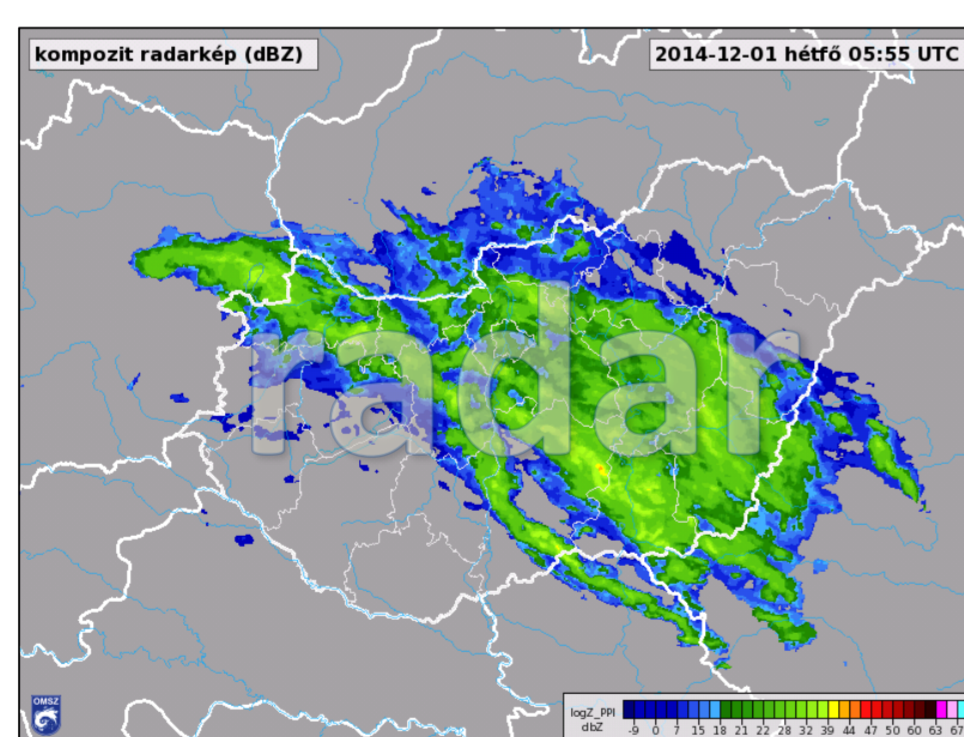
mesoscale over Hungary



severe freezing rain icing



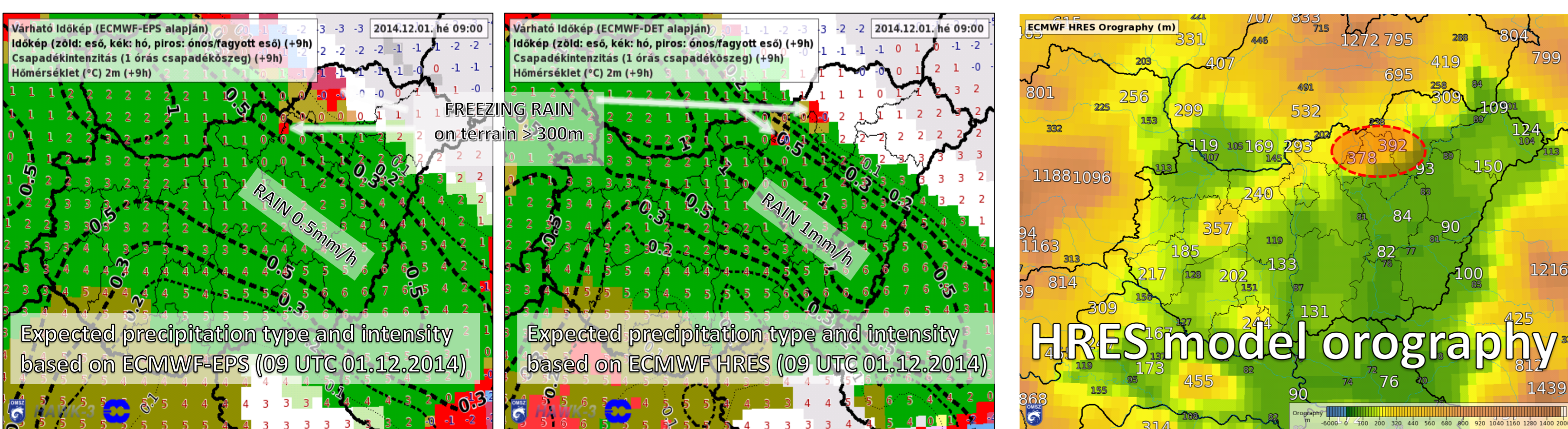
Intensive and prolonged precipitation in central Hungary rain and embedded showers



The territory of freezing rain were mainly limited to elevated places around Budapest, but part of Budapest, villages, roads, power networks were heavily affected

precipitation amount below 0 °C (high resolution reanalysis) around Budapest in the elevated forestry areas the precipitation type was freezing rain all of the period

Both HRES forecast and majority of ENS perturbed members indicates temperature below 0 °C and liquid precipitation phase on elevated ground (above 300 m) 80-100 km NE of Budapest. It may be considered a caution sign, but the forecasted stratification just above Budapest have to be investigated (model levels, pseudo temps)



Forecasting problem of extreme winter precipitation, like large amount of freezing rain and strong icing

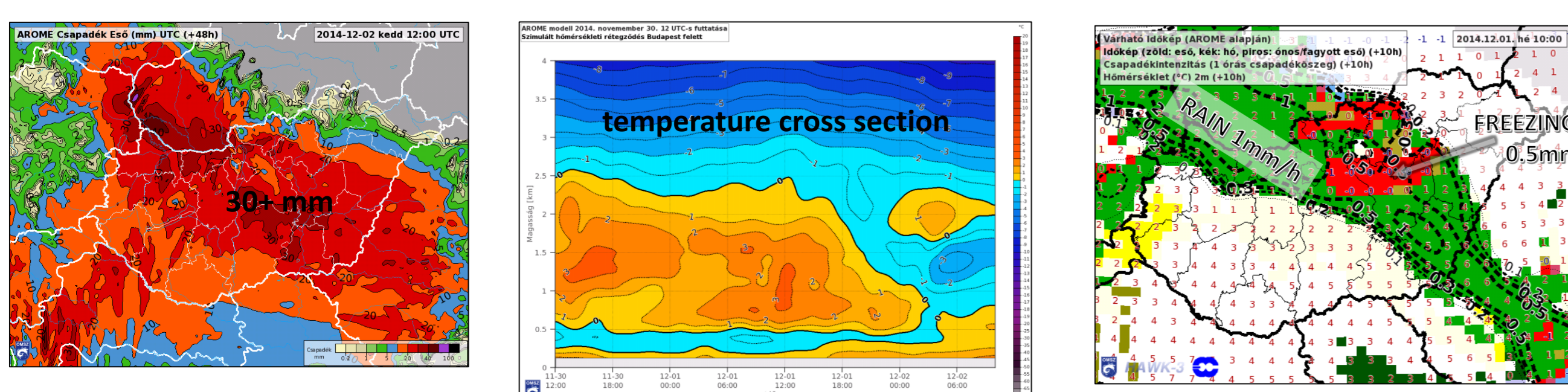
- Synoptic scale weather scenario can be very well forecasted
- Precipitation pattern and amount can be reasonable forecasted
- Precipitation type can be very sensitive to the low level temperature stratification
- Temperature (below or above 0 °C) forecast can be much dependent on model orography

What we can do?

- Examine the chance of different stratification types with large amount of precipitation
 - T ≤ 0 °C and rain: FREEZING RAIN ICING
 - T ≥ 0 °C and snow: WET SNOW ICING
- Consider the fine detail of the forecasted stratification (model levels needed at low altitudes)
 - Pseudo temps, ECMWF-ENS pseudo temps*
- Consider the nearby grid points with higher or lower altitudes
- Possible products for determining the precipitation type:
 - Direct ECMWF model output / new precipitation type parameter
 - Own statistical methods / Babolcsai-Hirsch and Fövényi methods (OMSZ) /
 - In short range LAM NWP with detailed microphysics/hydrometeor prognostic variables



AROME with ECMWF boundary conditions: enhanced precipitation amount, successful temperature stratification



Is there any effective way to produce altitude corrected precipitation type on the real orography? usage of hydrometeor profiles?

*ref: Ihász, I. and Tajti, D.: 2011: Use of ECMWF's ensemble vertical profiles at the Hungarian Met. Service ECMWF Newsletter 129.