SST and forecast precipitation

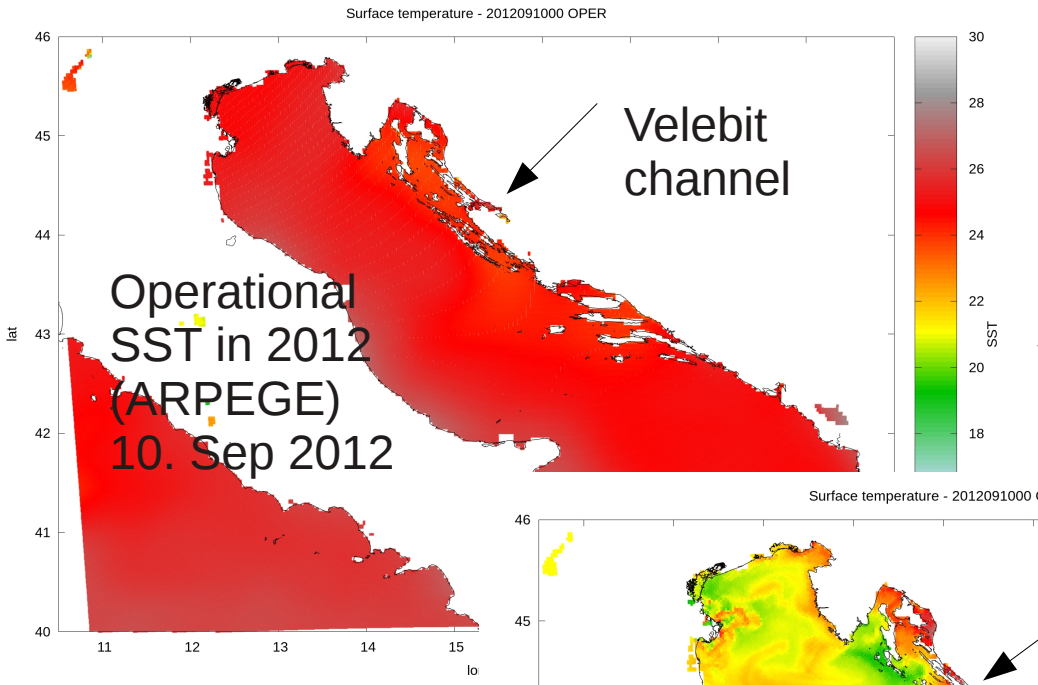
Since the beginning, the high resolution non-hydrostatic forecast produced weak to moderate 24-hourly precipitation over southern Velebit for days and sometimes weeks. Due to absence of in situ measurements there (on the mountain) it was a challenge to see if this precipitation is realistic or not. It was unrealistic.

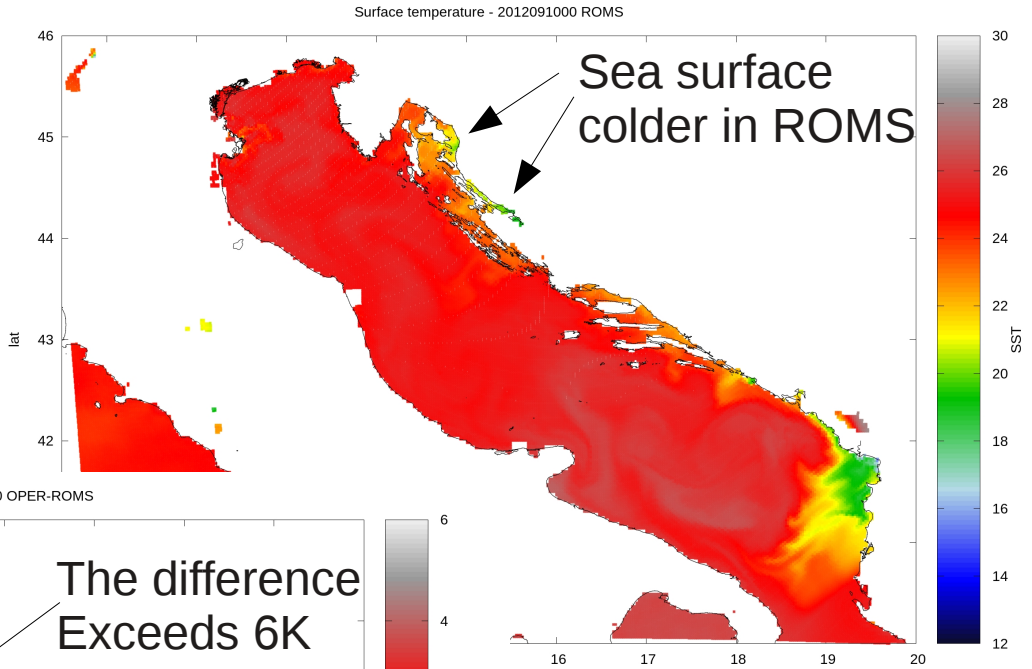
Then testing started to diagnose (and remove) the cause of this bogus precipitation. A number of options was tested in physics and dynamics (this run does not use data assimilation). The conclusion was that the error does not originate in the model forecast.

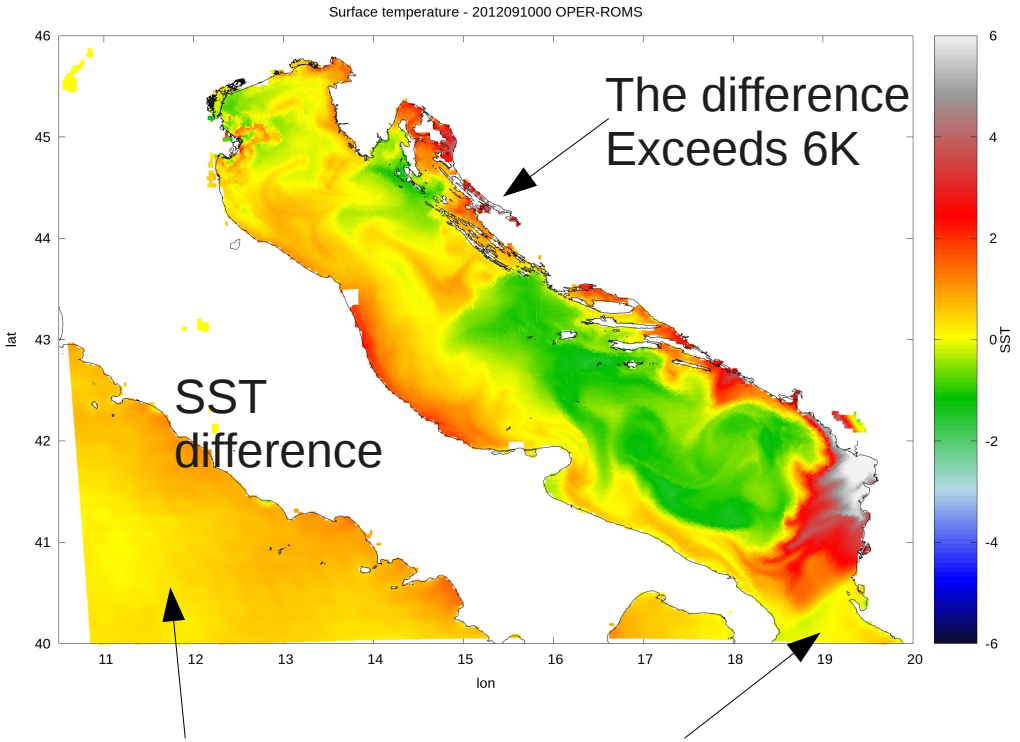
Later, we tried using different sea surface temperature (SST). SST field in the model originated from the global model used for LBCs (ARPEGE until 1st Jan 2014 and ECMWF later). The surface temperature in sea points was replaced by data from OSTIA analysis and ROMS model.

Tests performed using ALARO0 if not stated otherwise.

SST in the Velebit channel





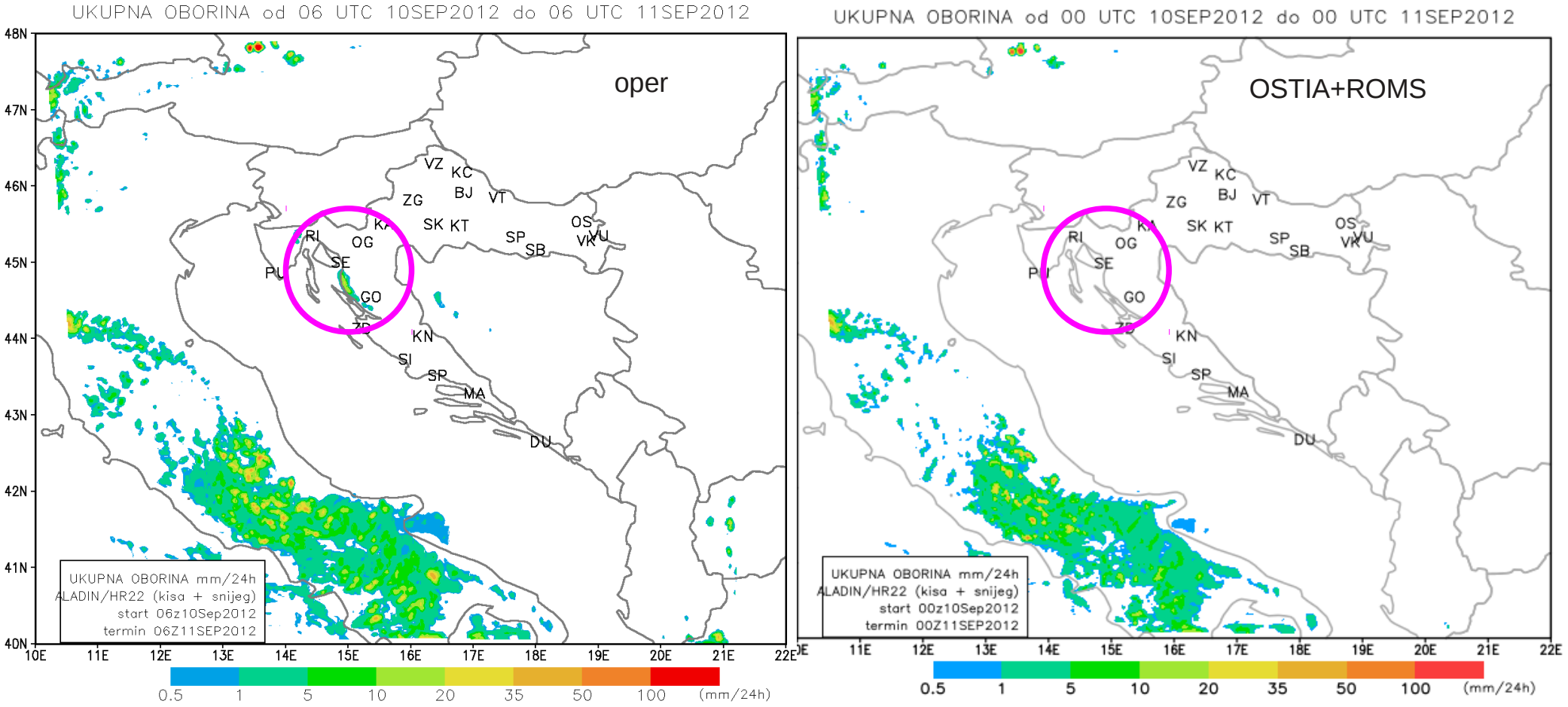


The figures show SST in 2 km resolution from operational forecast (top), from ROMS above Adriatic (top left) and their difference (right).

ROMS model forecast Covers only Adriatic. ROMS is regional ocean model. Forecasts run every day at Ruđer Bočković Institute (Janeković et al. JGR-Oceans 2014)

Outside of the ROMS domain, we use OSTIA

Precipitaiton over Velebit



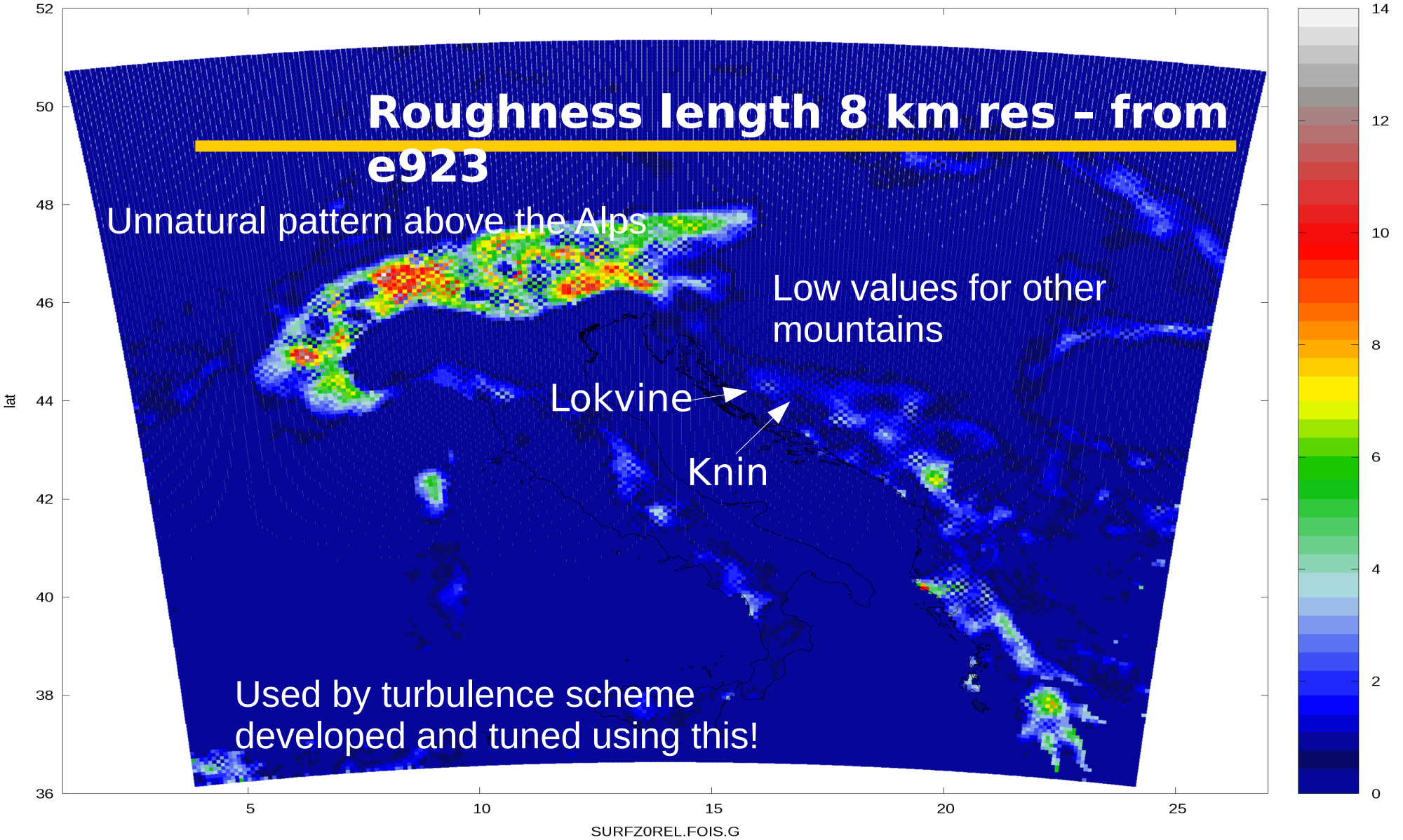
Accumulated 24 hourly precipitation since 06 UTC 10 September 2012, operational forecast (left) and an experiment using ROMS SST (right). Bogus precipitaion was caused by too warm SST in the Velebit channel.

New surface roughness and ALARO1 (TOUCANS)

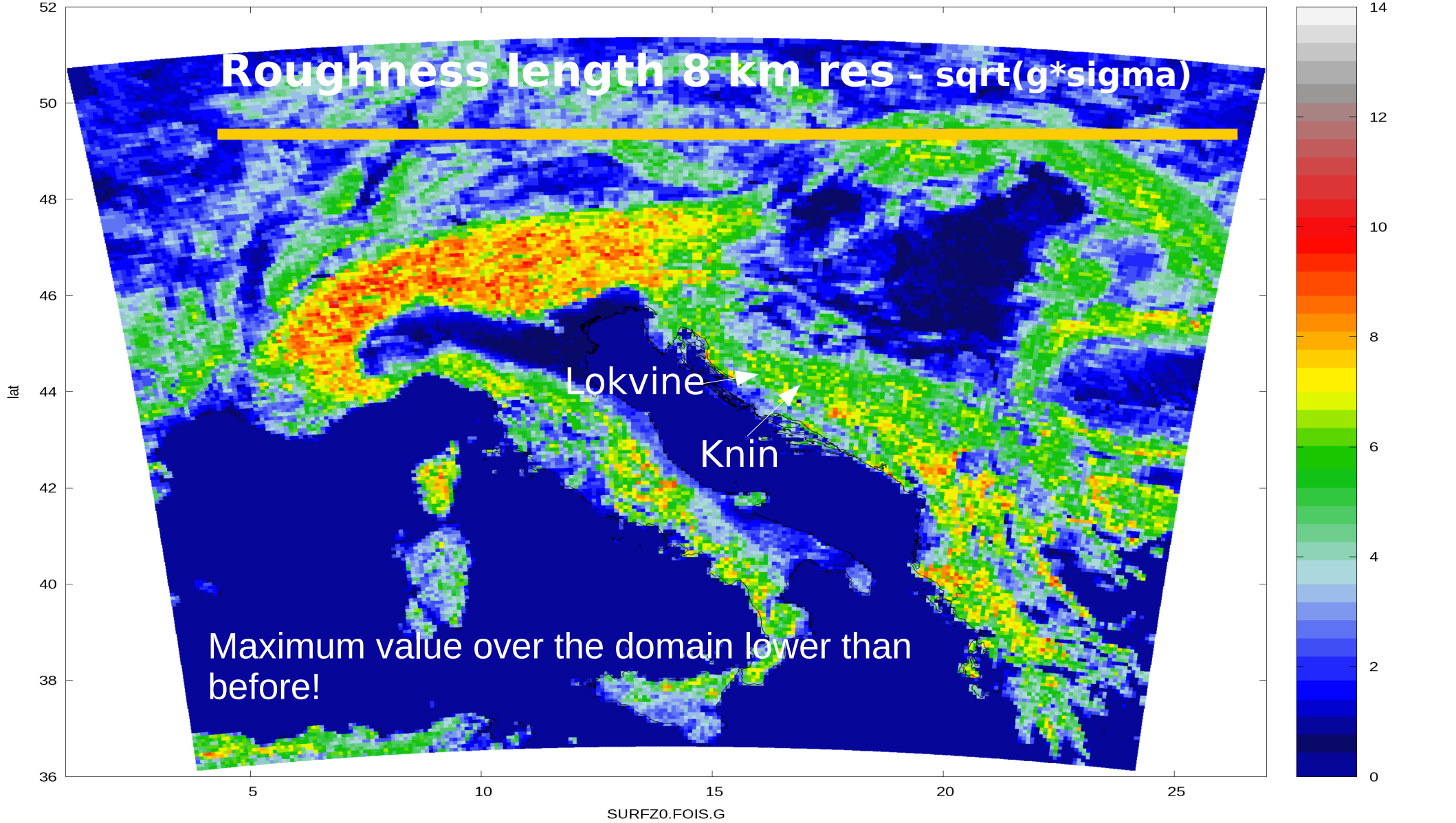
Surface fields that describe the properties such as the percentage of land in a grid-point and surface roughness were unrealistic.

- The new fields were computed from the new (high resolution) database and results seemed more physical.
- New roughness length had lower maximum value than the old one, but it is obviously higher over most of the domain.

  Previously, high resolution wind forecast used to exaggerate 10 m wind speed at location Knin in specific wind situations (some events of bora, but not all). The roughness length there was low, so we hat a really smooth mountain (unrealistic – so the forecast was unrealistic too).
- New (higher) roughness removed these excess wind speed, but the 10 m wind was now underestimated.

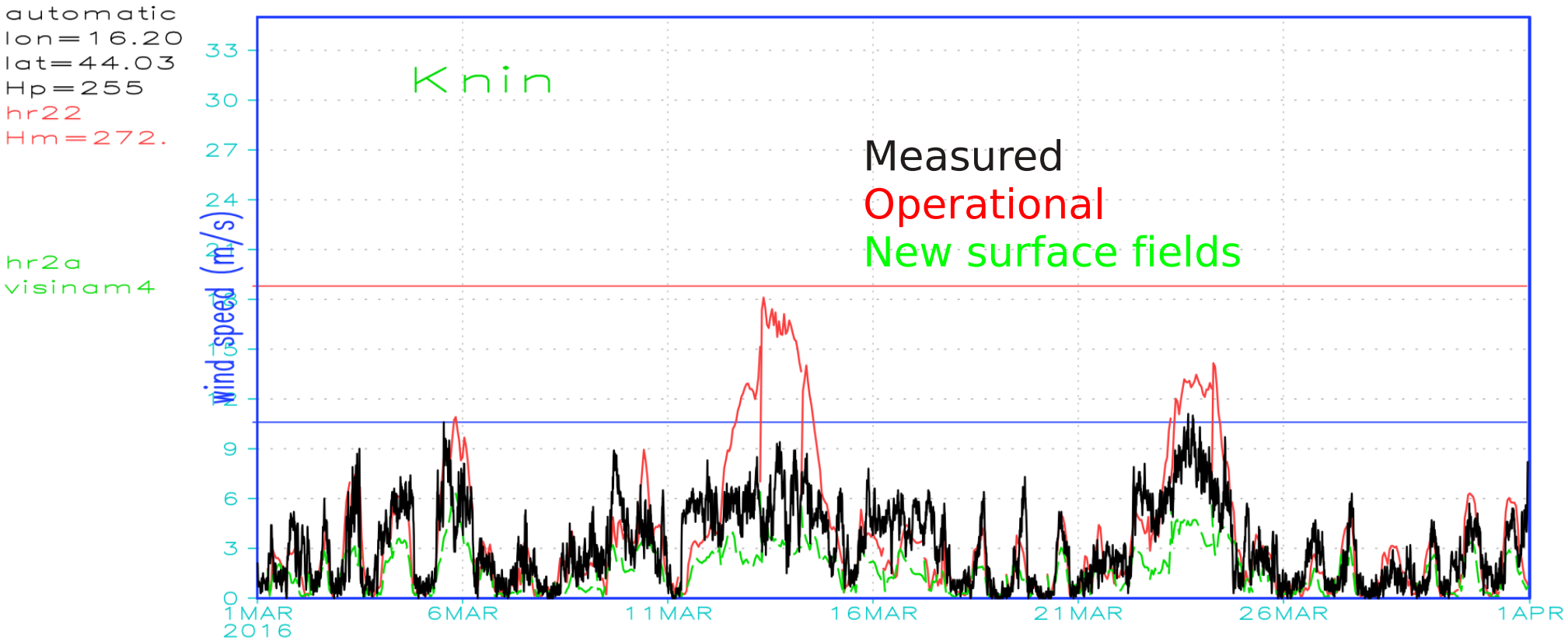


This is roughness length from 8 km resolution (shown here for clarity). Too smooth over Dinaric Alps, and probably other mountains except the Alps. It is as smooth in 2km resolution.



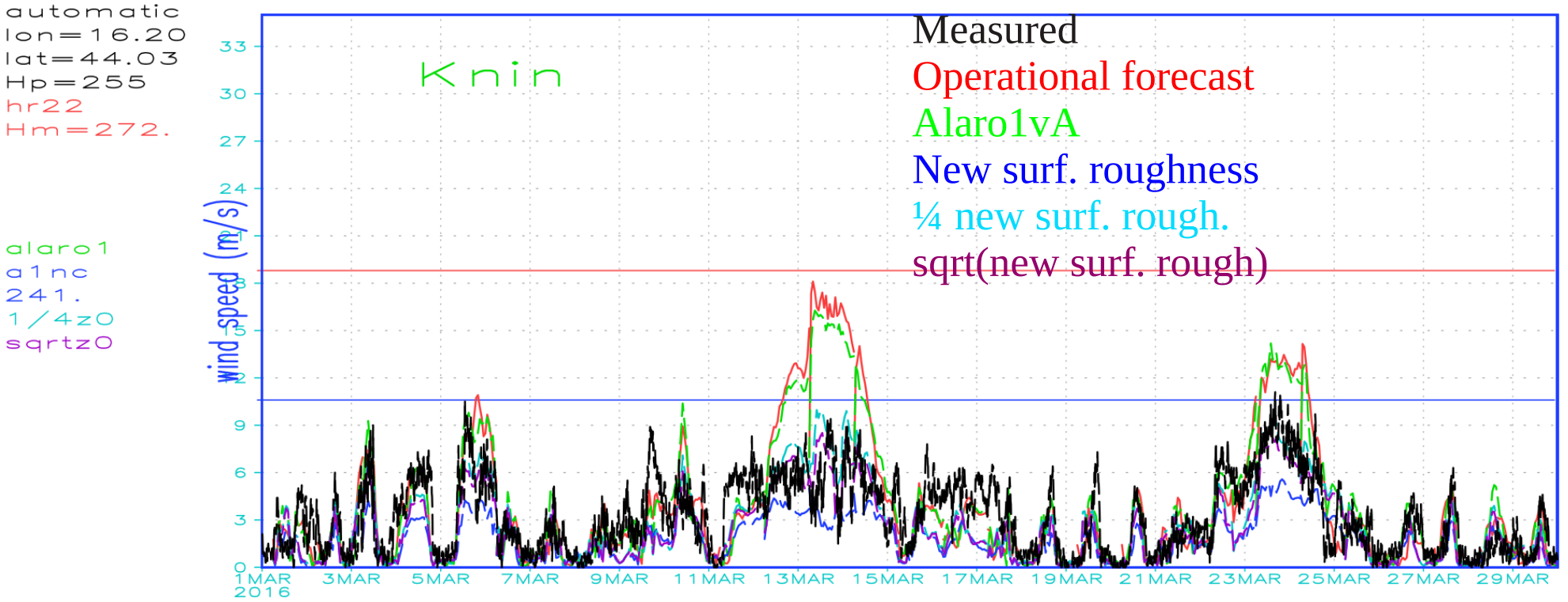
The maximum in the map above is LOWER than in the map on the previous slide. Obviously, the mountains have much rougher surfaces.

New surface fields applied to 2km NH forecast



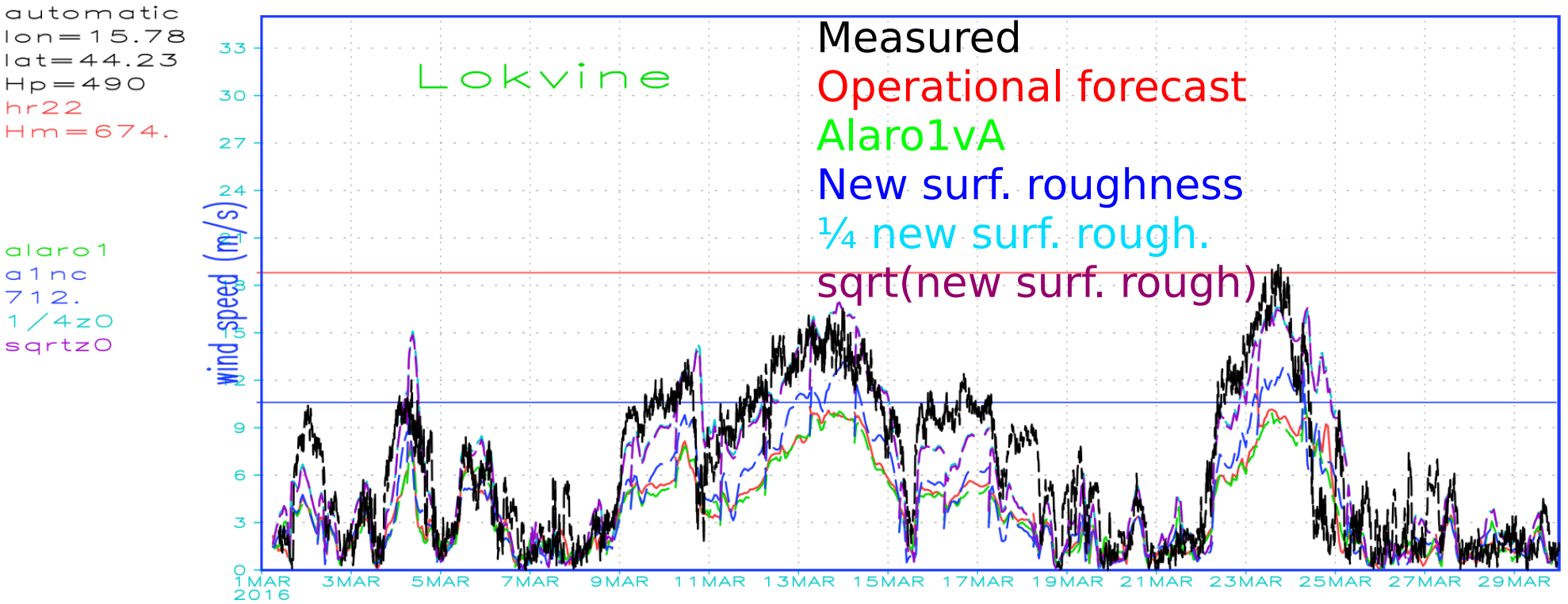
Measured and forecast 10m wind in Knin for March 2016.
The turbulence scheme (pTKE used here) was developed and tuned using roughness length from the old database (too smooth there).
Since the forecast underestimates the 10 m wind speed using new surface fields, but apparently follows the evolution – the idea was to tune the roughness length instead of tuning the turbulence scheme.

New surface fields applied to 2km NH forecast



Measured and forecast 10m wind in Knin for March 2016. Using ALARO1vA (TOUCANS scheme for turbulence in place of pTKE) did not fix the problem. The two forecasts are very similar (compare the green and the red line above, both of them use old surface roughness). Z0 was more important than turbulence scheme in this case. Surface roughness was recomputed: divided by 4 (light blue) or a square root was taken (dark red) and both of these experiments yield wind speed that fits the measured values.

New surface fields applied to 2km NH forecast



Measured and forecast 10m wind in Lokvine for March 2016. However, wind speed was underestimated at a different location (for the same cases of bura). Surface roughness there is also larger when computed from the new database, but the wind speed there increased with larger surface roughness (blue line) and increased even more when it was scaled (light blue and dark red). Conclusion: more realistic surface roughness allowed for model dynamics to develop local features at appropriate place and time and produce correct forecast.

TO DO

- Validate results that use SST from ROMS and new surface fields (particularly z0) combined (several experiments run, analysis to do)
- Repeat tuning z0 using TOUCANS (ALARO1vA) in different horizontal and vertical resolutions (4km, 2km, 73 and 37 levs).