Meso-NH forecast during COPS: Assessment of cloud cover and precipitation

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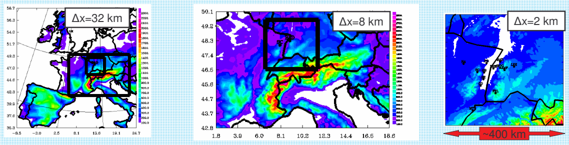
http://mesonh.aero.obs-mip.fr/mesonh/COPS/

Summary

The evaluation of the MESO-NH forecasts conducted in July and August 2007 was made using both the MSG BTs at 10.8 µm and the 24-h accumulated rains. The highest scores are obtained during the less convective periods (i.e. in August) and upwind (i.e. over Vosges). The comparison with BTs points out a too patchy structure in cloud cover as well as the lack of intermediate BTs. On the other hand the evaluation with rain forecasted by AROME and ALADIN has shown the dependency of skill to the spatial scale. When using classical score such as the HSS, a better skill is obtained for the 10-km forecasts compared to the 2-km forecasts. However the rain distribution is better represented by the CRMs.

Numerical setup

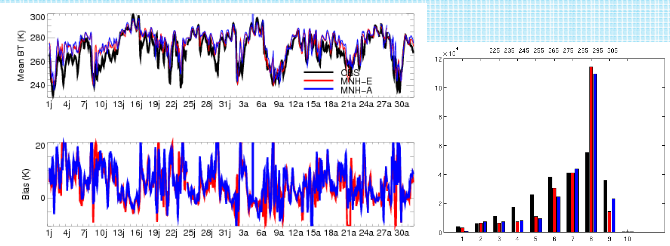
- 3 domains (Δx=32, 8, and 2 km) with 2-way interaction
- vertical grid with 50 levels up to 20 km (Δz=60-600 m)
- initial & coupling fields with ECMWF & ARPEGE operational analysis
- microphysics: cloud, rain, ice, snow, graupel (+hail, inner model only)



Cloud Cover Assessment

Time Evolution and Distribution

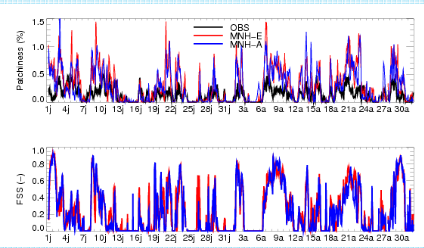
The low (high) BT values correspond to fronts (hot weather) while intermediate BTs with large daytime variability characterize convective periods. The bias between 0 and 5 K is the largest in the transition periods when the mean observed BT is around 260 K. All the distributions show a maximum around 290 K and a shape skewed towards low values. The forecasts underestimate BTs between 300-315 K and between 235-270 K. In the lower range the lack of intermediate BTs can be attributed to a deficiency in the physics (no subgrid cloud scheme).



(left) Time evolution of the mean BT, the bias and (right) the distribution from MSG observation and forecasts.

Scores

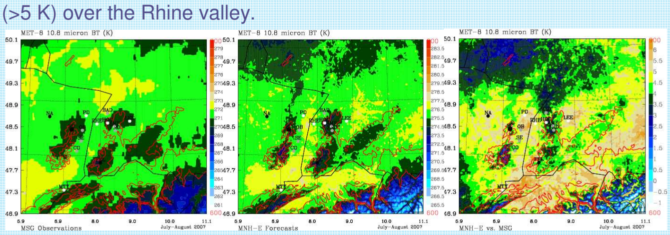
A threshold of 260 K is applied to BTs at 10.8 µm for characterizing high clouds. The patchiness linked to periods of cloudy days is reasonably well forecasted, but with too large values, indicating a lack of organized cloud systems. The skill in forecasting cloud cover is rather high according the Fractions Skill Score (FSS). The highest scores close to 1, the perfect skill, are achieved during overcast periods, particularly in August.



Time evolution of (left) patchiness from (black) the MSG observation and (grey) the Meso-NH forecasts and (right) FSS between Meso-NH and MSG.

Spatial Distribution

The mean BTs are the lower over the mountains and the higher in the valleys. This difference is due to the BT sensitivity both to the surface temperature under clear conditions and to the cloud top temperature under cloudy conditions. The biases are the lowest on the crests and the largest (>5 K) over the Rhine valley.

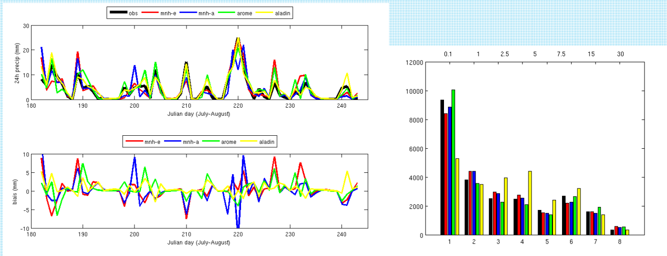


(left) Observed mean BT (K) and BT biases (K) for (middle) MESO-NH-E and (right) MESO-NH-A. The black lines indicate the topographic heights of 600 and 900 m.

Precipitation Assessment

Time Evolution and Distribution

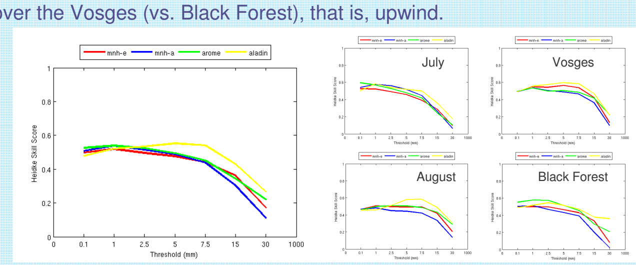
The frequency of the rain peak in the forecasts is close to the measurements, but with some disagreements in their intensity. There is no systematic bias, but the CRMs present a larger amplitude. This is expected because of the largest values predicted by the CRMs can lead to larger errors than the ALADIN forecasts. The rain distribution is represented by the CRMs well with no outstanding difference between MESO-NH and AROME. In contrast ALADIN underestimates the frequency of light rain and overestimates intermediate rain amounts.



(left) Time evolution of the 24-h accumulated rain, the bias, and (right) the distribution from observation and forecasts

Scores

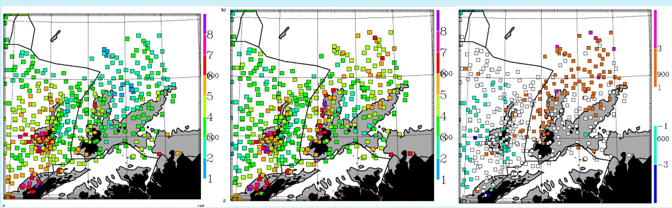
The Heidke Skill Score is shown for all the models (left). A lower skill is achieved for heavy rain as these events are less frequent. ALADIN shows higher skill except for small rain amounts. The poorer results for the CRMs can be attributed to the double penalty effect. Further results (right) show higher scores in August (vs. July) when condition were less convective and over the Vosges (vs. Black Forest), that is, upwind.



HSS as function of the rain threshold. results (right) for the whole period and (left) in (a) July and (c) August and between (b) the Vosges and (d) the Black Forest.

Spatial Distribution

Observations show heavy rain upwind and on the crests, with larger values over the Vosges than the Black Forest. The bias between MESO-NH-E and the observation shows a good agreement over the Vosges, but a larger bias over the Black Forest. This is also the case for MESO-NH-A, but with some reduced values in bias downwind the Black Forest.



(left) Observed mean rain (mm) and biases (mm) for the (middle) MNH-E and (right) MNH-A forecasts. The shading indicate the topographic heights of 600 and 900 m.