COMPLEMENTARY SUB-GRID UPDRAFT AND NON-SATURATED DOWNDRAFT

Prague stay report

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1. Introduction

During the stay, the complementary sub grid (CSD) updraft and non saturated downdraft parameterisation, developed by Luc Gerard, was implemented in the frame of the Alaro-0 baseline operational version in Prague (cy36t1_op8). A lot of experiments were carried out for the developments validation an free parameter tuning.

The main part was dedicated to the non saturated downdraft which is foreseen to be merged with the developments in radiation and turbulent diffusion parameterisation in the first step of ALARO-1.
The basic tuning of the free parameters was done for the 29th of July 2009 while the verification was carried out for an intense convective (with a pronounced diurnal cycle) period of 10 days between 21 and 30 June, 2009. Additionally the CSD parameterisation was tested for a more recent date , 13th of July 2013, when the operational model failed to simulate the precipitation bands develop over the Czech territory.

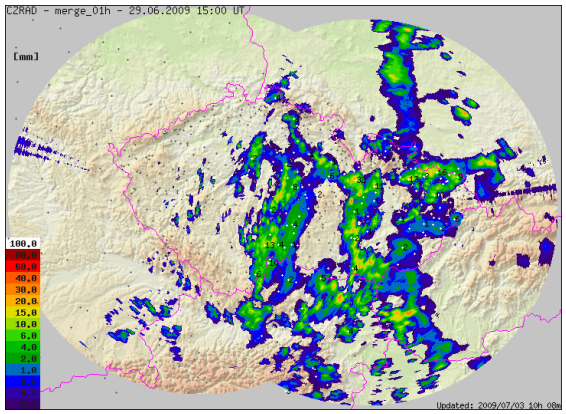
Few experiments were done including as well the complementary sub grid updraft.

The results are shortly summarized in sections 2 and 3.

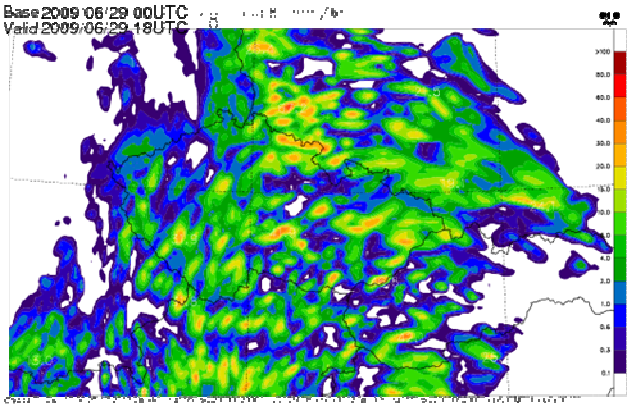
After the stay, the work was continued by cleaning the code and isolating only the non-saturated downdraft part. The technical description of the non-saturated downdraft, including the validation is contained in the "**Implementation of the non saturated downdraught in the CHMI Alaro reference operational version (CY36T1ope_op8**)" which is annexed to this report**.**

2. Experimental results for 29th of June 2009

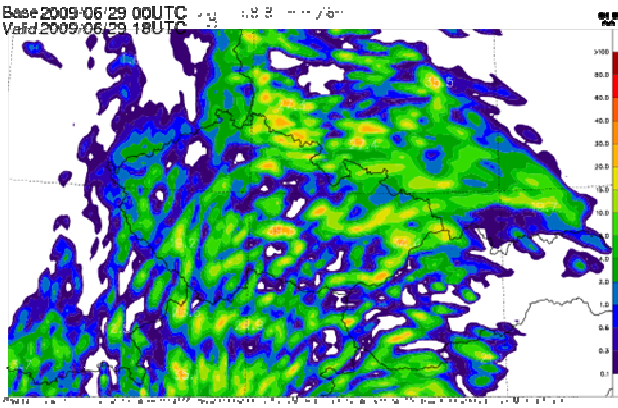
The operational forecast from 29th of June 2009, 00 run (experiment oop8) simulated quite well the precipitation pattern and the diurnal cycle over the Czech Republic. The experiments carried out with complementary sub-grid non-saturated downdraft showed similar precipitation pattern (fig.1). However cores of the maximum precipitation are a bit less intense. Also the precipitation sum, over a sub-domain covered by Czech radar, is lower in the case of non-saturated downdraft (fig. 2) despite the tuning of the specific free parameters (the best tuning was found for the experiment d818 The objective verification showed a slight improvement of the scores with respect to the operational version. It seems however that the choice of the advection of the up & down draft mass flux instead of mesh fraction and vertical velocity draft gives a more structured precipitation fields (experiment d821). A first attempt to "re-scale" $omega_u/sigma_u$ was tried for the case of the draft mass flux advection (experiment d822); this would require further development.



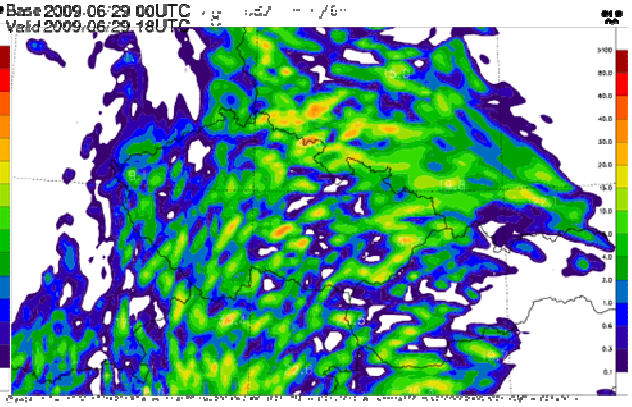
Radar



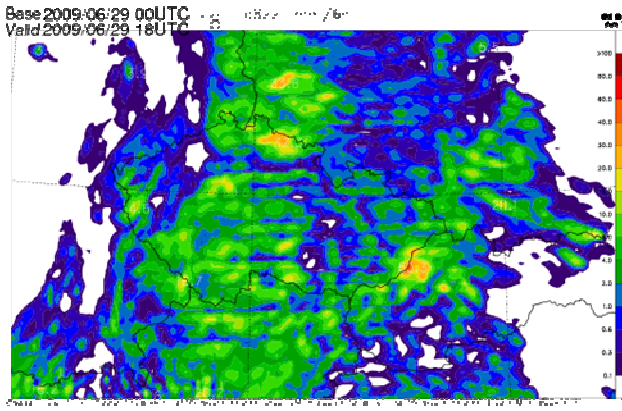
operational : cy36t1 op8



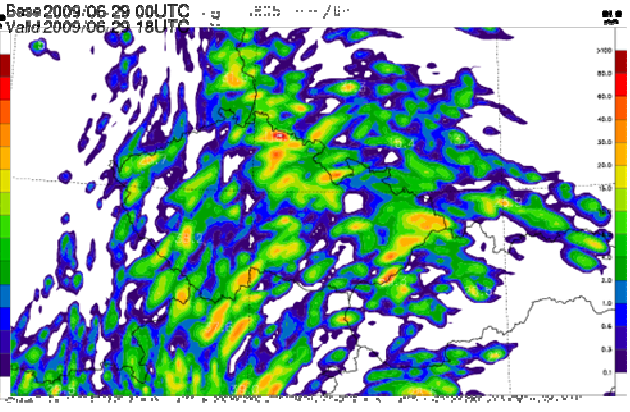
Complementary sub grid downdraft : d818
'shape preserving' advection (LQM=T)
for up&down draft mesh fraction and velocity



Complementary sub grid downdraft: d821
'shape preserving' advection (LQM=T)
for up & down draft mass flux



Complementary sub grid downdraft : d822
'shape preserving' advection (LQM=T)
for up & down draft mass flux
're-scaling' $omega_u/sigma_u$



Complementary sub grid up & down draft: u805
'shape preserving' advection (LQM=T)
for up & down draft mass flux

Fig.1 6h accumulated precipitation, 29.06.2009 12-18 UTC given by radar and different experiments; for explanations see the text above

It is worth to mention that the 'quasi monotonic' or 'shape preserving' option for the advection of draft velocity, draft mesh fraction and `pseudo-historical' convective cloudiness. As well the updraft free parameters were not changed. On the other hand the experiments did not include an assimilation cycle. The initial model state was taken from the simulation done by the operational version.

The inclusion of the complementary sub-grid updraft is illustrated by only an experiment, u805, which gives a reasonable precipitation pattern.

The hourly sum of the precipitation over the Czech radar domain is presented in figure 2.

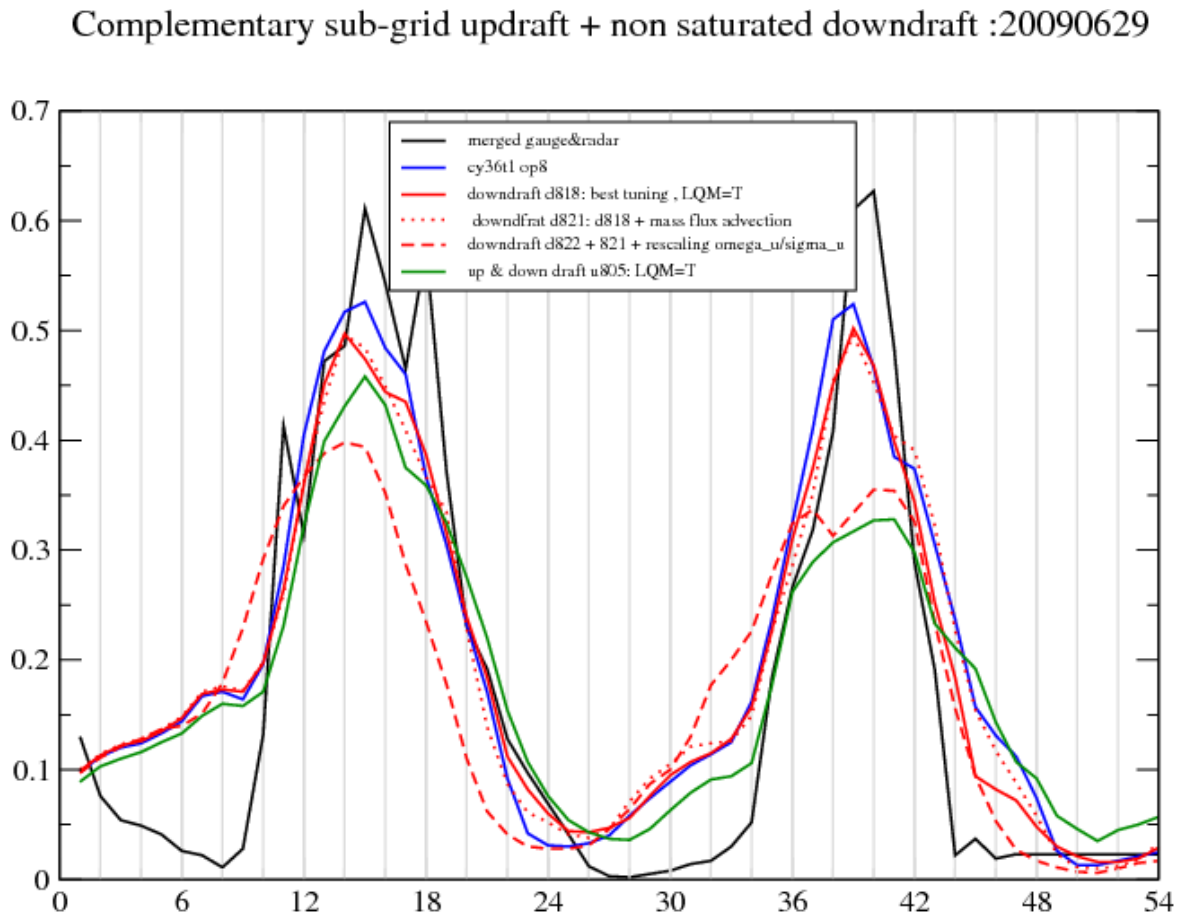
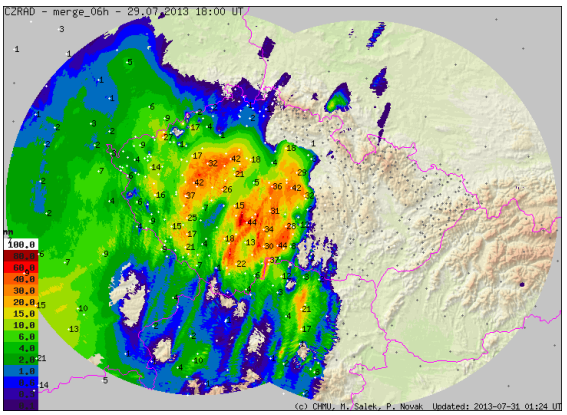


Fig. 2 Precipitation diurnal cycle over the Czech "radar domain" for 29th of June 2009 given by radar data (merged with gauges measurements) and by different experiments

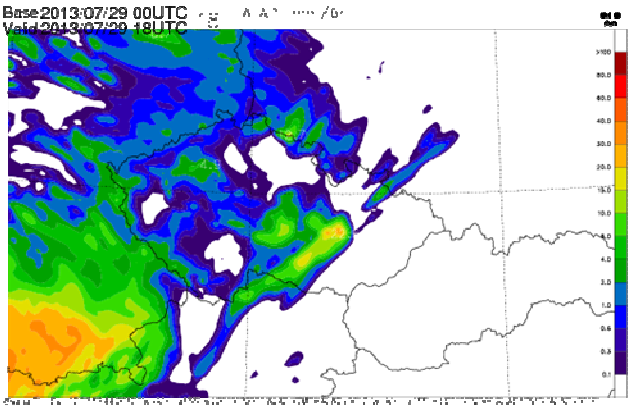
For the non-saturated downdraft, the diurnal cycle is quite close to the reference (exception – the 're-scaling experiment) but the peak values are under the reference ones.

3. Experimental results for 29th of July 2013

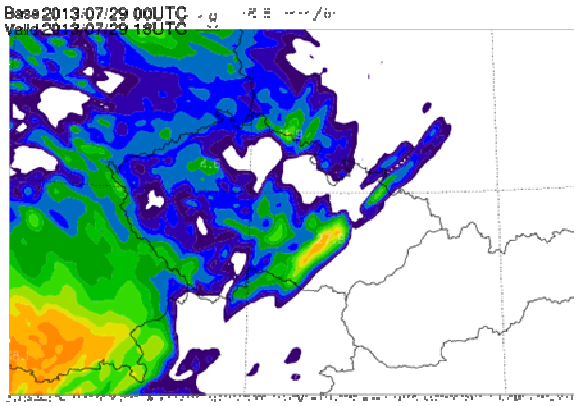
The equivalent series of experiments were carried out for the case of the 29th of July 2013. r818 ≈ d818 r821 ≈ d821, r822 ≈ d822, ru05 ≈ u805, that are presented in figure 3. The 6 h accumulated precipitation simulated b the Alaro operational version is very far from that given by radar and gauges. The experiments do not succeed to improve significantly the precipitation pattern.



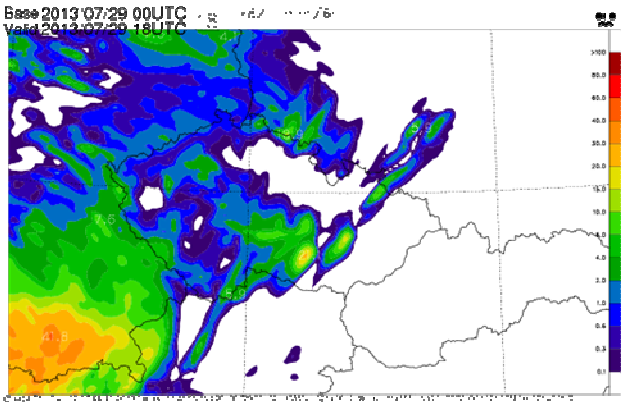
Radar



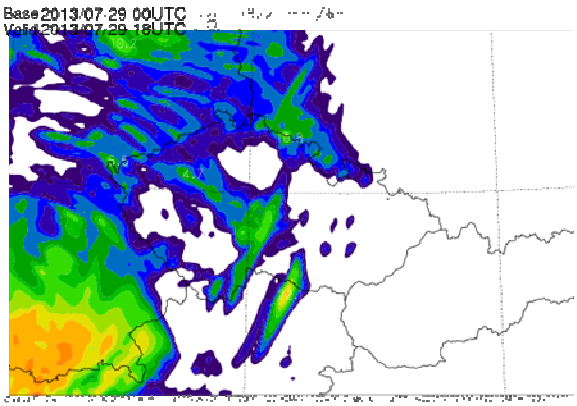
operational : cy36t1 op8



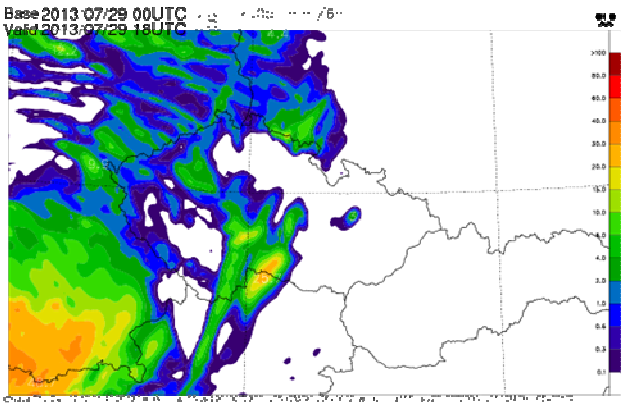
Complementary sub grid downdraft : r818
'shape preserving' advection (LQM=T)
for up&down draft mesh fraction and velocity



Complementary sub grid downdraft: r821
'shape preserving' advection (LQM=T)
for up & down draft mass flux



Complementary sub grid downdraft : r822
'shape preserving' advection (LQM=T)
for up & down draft mass flux
're-scaling' omega_u/sigma_u



Complementary sub grid up & down draft: ru05
'shape preserving' advection (LQM=T)
for up & down draft mass flux

Fig.3 6h accumulated precipitation, 01.07.2009 12-18 UTC given by radar and different experiments; for explanations see the text above

The analysis of the results led to the conclusion that a re-tuning of the updraft part is absolutely necessary. In order to obtain better forecast, using the non-saturated downdraft, than the operational one.