Verification of ALADIN*: CY29 vs CY25*

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Part 4: Validation, Physical parametrizations

1 Introduction

In autumn 2005 ALADIN CY29T2 was successfully installed at ZAMG, first tests with the prognostic cloud scheme on orographic precipitation cases brought promising results. It was set in parallel suite in December 2005. By the reason of unrealistic cloudiness fields it could not become operational. After upgrading some physics- and setup-routines (CY29t2_op2) in March 2006 the cloudiness problem seemed to be solved and CY29 was set in parallel suite again. During May 2006 CY29 was compared with CY25 (which is the operational ALADIN version at ZAMG for the time being) to decide whether using CY29 (with the prognostic cloud scheme is) as operational model is justifiable. In the following some of the verification results are presented.

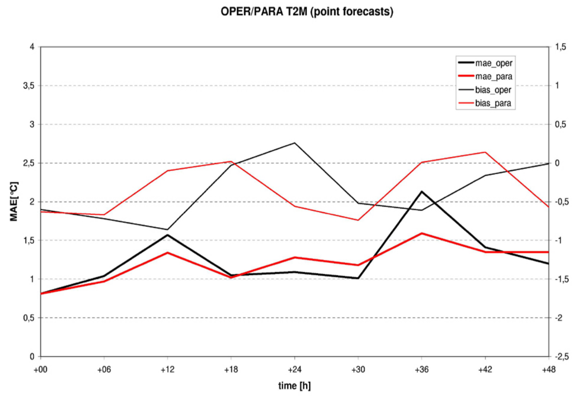
2 Data

For 2m temperature, mean sea level pressure, wind speed and wind direction ALADIN was verified using observations from 8 stations, representing the provincial capital cities of Austria. In the case of precipitation and cloudiness, data from INCA (Integrated Nowcasting through comprehensive Analysis) was used for verification. INCA represents an analysis and nowcasting tool which is being developed at ZAMG. Precipitation analyis is generated by combining radar-data and rain gauge measurements. In the case of cloudiness satellite data and observation build the input. To compare the coarser ALADIN fields (horizontal resolution 9.6km) with INCA (1km), both fields are interpolated on a regular lat-lon grid.

3 Results

3.1 Point Forecasts

Figure 3.1 shows MAE (thick lines) and BIAS (thin lines) for 2m temperature. A comparison of operational (CY25, labeled as "*oper*" in the following figures) and parallel suite (CY29, "*para*") shows that CY29 performs better, except for the forecast hours +24h, +30h and +48h. The verification was done for 00-UTC-runs only, so these forecast time represent periods during the night. When taking into account BIAS it seems to be obvious that higher MAE during night time is caused by underestimation of temperature.



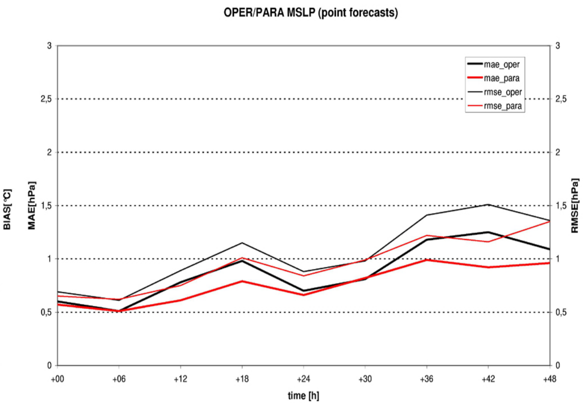
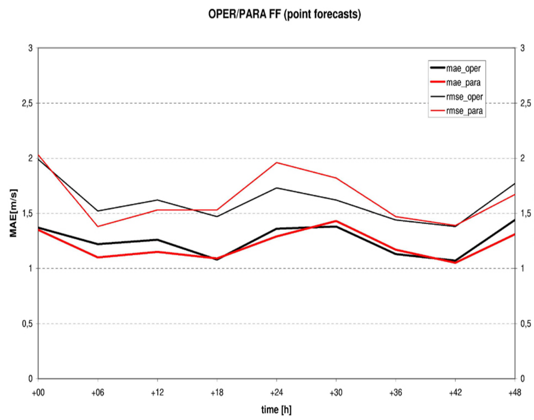


Figure 3.1 and 3.2.: *Verification of T2M (left) and MSLP (right) for the period 20060501– 20060531.*

In the case of MSLP (Figure 3.2) the conclusion is the same: CY29 performs better than CY25. In addition MAE and RMSE were computed for wind direction and wind speed (Figures 3.3 and 3.4), whereas comparison was done just in the case of observed wind speeds higher than 2 m/s. The graphs show that in the case of wind speed parallel suite produces slightly lower MAE for most of the timesteps, but higher RMSE for +18,+24, +30 and +36 indicating few cases with greater deviations to observed wind speed.



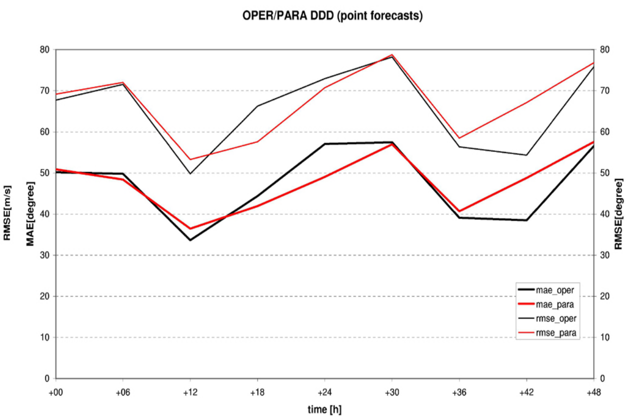


Figure 3.3 and 3.4: *Verification of wind speed (left) and wind direction (right) for the period 20060501 – 20060531.*

3.2 Cloud Cover

ALADIN cloud cover was verified using INCA-analysis as observational data. The evaluation was done for all grid points covering Austria on one hand side and in addition for 5 smaller areas representing Alpine regions and areas in the lowland (see Figure 3.5) on the other hand side.

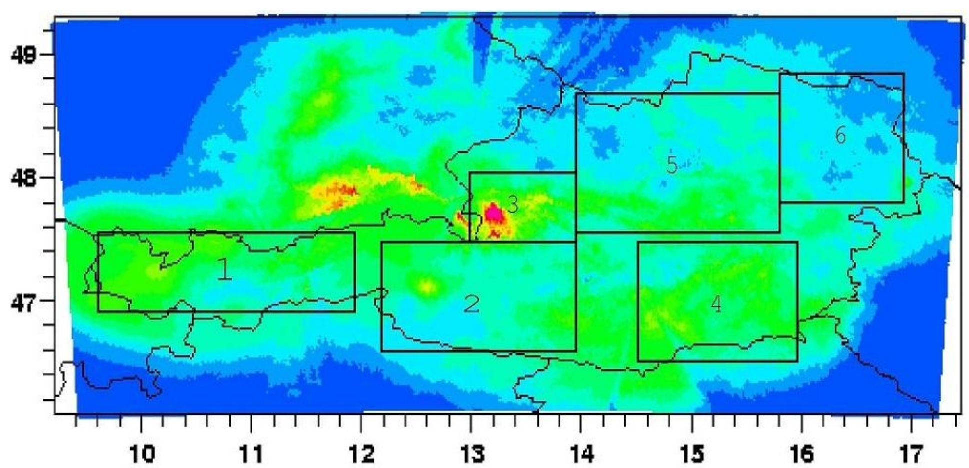


Figure 3.5: *Location of different areas, graphic by Eric Bazile (GMAP, Météo-France).*

In the following selected figures and tables are shown in order to give an idea about the major results. Tables 3.1 – 3.3 show MAE for (total) cloud cover for different areas. When taking into account all gridpoints within area 1, CY29 (with prognostic cloud scheme) gives better results for all timesteps (table 3.1). Area 1 represents a mountainous region in Tyrol and Vorarlberg in the Western part of Austria. The same conclusion can be drawn for area 4 (table 3.2). For area 6 the situation seems to be less obvious, but the scores for parallel suite are better for most of the timesteps.

area 01	oper	para
+06	24,94	23,96
+12	35,25	21,81
+18	24,96	20,87
+24	35,07	32,96
+30	26,02	24,9
+36	34,41	25,25
+42	24,43	21,63
+48	35,68	30,62

area 04	oper	para
+06	19,96	19,03
+12	30,04	17,22
+18	19,68	23,95
+24	35,03	31,39
+30	22,66	19,76
+36	29,1	21,48
+42	22,83	24,28
+48	34,17	29,41

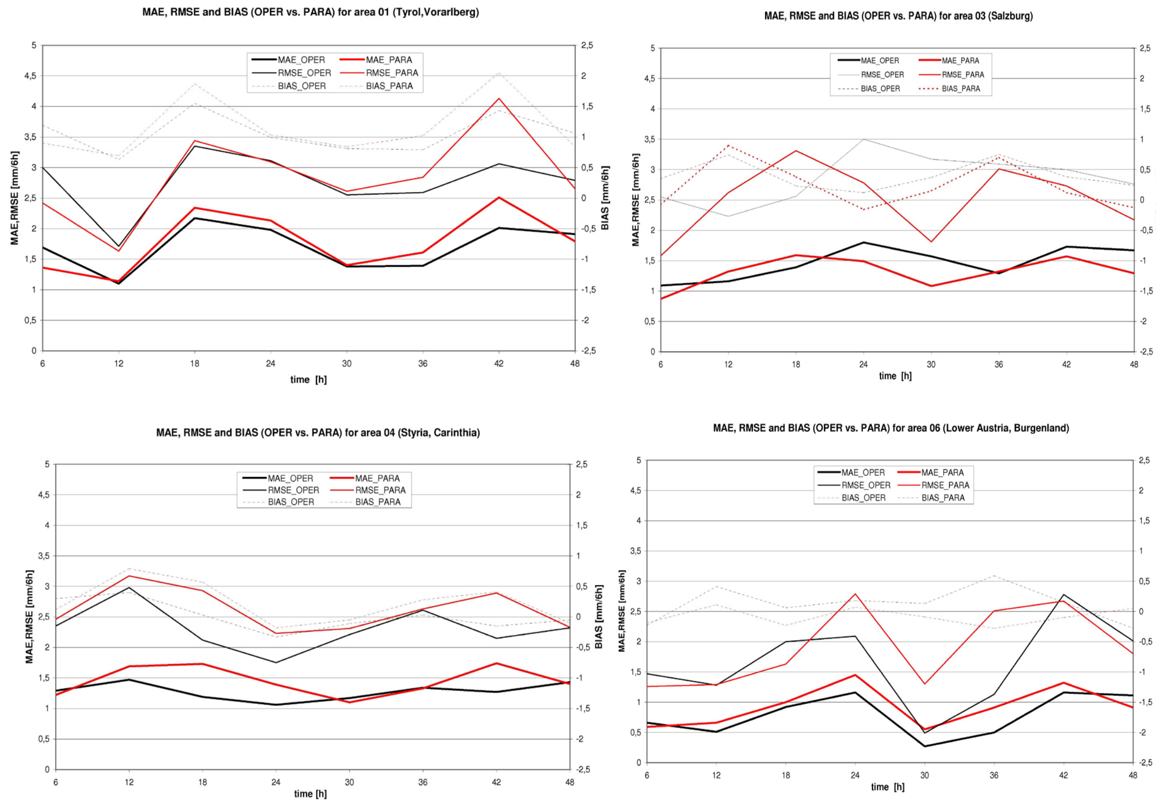
area 06	oper	para
+06	20,84	22,27
+12	20,89	17,47
+18	20,03	25,87
+24	26,52	21,28
+30	19,95	18,69
+36	21,45	19,15
+42	19,73	21,55
+48	26,33	25,65

Tables 3.1 -3.3.: *MAE cloud cover for area 01 (left), area 04 (middle) and area 06 (right)* **.** *20060501 – 20060531.*

Beside the shown results several other statistical scores (ETS, FAR, etc.) were computed to evaluate the cloudiness parameter, all bringing similar results as shown in tables 3.1-3.3.

3.3 Precipitation

Among all verified parameters precipitation is the most important parameter to decide whether CY29 can be set in operations or not. Up to now the prognostic cloud scheme was predominantly tested in case studies at ZAMG. The tests brought quite promising results, compared to the diagnostic scheme Lopez seems to do a better job in mountainous areas, improving the weakness of the old scheme (unrealistic luv-side precipitation peaks while overestimating the lee-side precipitation). As already mentioned several areas were defined in order to verify areal precipitation means. Figures 3.6-3.9 show MAE, RMSE and BIAS for 6h-periods beginning with +06h, ending with +48h. Areas 1 and 3 represent mointainous regions, whereas area 4 and 6 can be seen as intermediate and lowland areas respectively.

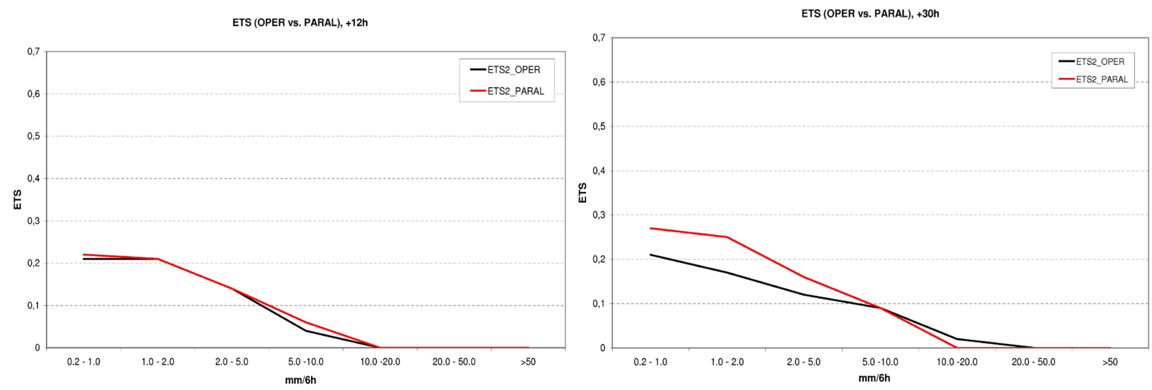


Figures 3.6-3.9: *MAE, RMSE and BIAS for 6h accumulated precipitation; area 01 (upper left), area 03 (upper right), area 04 (bottom left) and area 06 (bottom right). Period 20060501 – 20060531.*

The graphs for area 1 indicate significant better results for operational run. Higher MAE is associated with higher BIAS, indicating a further overestimation of precipitation amounts (with respect to the operational suite). This (somehow suprising) result can also be seen in figure 3.8 for area 4. For rather flat areas the results are different in the way that higher MAE is associated with negative BIAS (further underestimation of areal means with respect to CY25). Among all areas the prognostic scheme performs best for area 3 (figure 3.8).

Several other scores were computed (FAR, HR, grid point MAE, etc) showing similar results: In the case of precipitation CY29 is not yielding crucial improvements, for most of the areas the scores indicate the opposite (better scores for CY25). As already mentioned, different scores give similar results. ETS (equitable thread score) is somehow an exception.

When taking into account just ETS, the results are quite neutral, indicating that the qualitiy of precipitation forecasts is quite similar. An example is given in figures 3.10 and 3.11 showing ETS for forecast hour +12 and +30.



Figures 3.10-3.11: *Equitabe Thread Score for area 00 (all gridpoints within Austria) for +12 (left) and +30 (right). Verification period 20060501 – 20060531.*

4 Conclusions and Outlook

To conclude it can be pointed out that CY29 brings better (or at least equal) scores for 2m temperature, mean sea level pressure, wind speed and wind direction. The same can be concluded for cloud cover. In the case of precipitation (as, scores are not sufficient in order to change operational ALADIN version from CY25 to CY29 (with Lopez) for the time being. The simpression of more realistic precipitation patterns gained with Lopez cannot be underlined sufficiently by several scores. The weakness of this present verification is its duration, which is rather short (1 month for precipitation and cloud cover).

Before starting any further experiments or verifications it seems to be favourable to upgrade the Lopez-routines with the changes included in CY30 (splitting of prognostic variable qp into qr and qs, etc).

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