WP 3.8.1: final report

Identify cause for observed precipitation differences

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Thanks to Guido Schröder, Günther Doms and Francis Schubiger

The problem (I)

month	aLMo	LMD	avg	diff	diff/avg
2000 12	33	28	31	5	0.15
2001 01	56	51	54	6	0.10
2001 02	54	43	49	11	0.22
2001 03	140	113	126	27	0.21
2001 04	90	72	81	18	0.23
2001 05	82	48	65	34	0.51
2001 06	122	86	104	35	0.34
2001 07	92	60	76	32	0.42
2001 08	81	46	63	35	0.55
2001 09	94	72	83	22	0.26
2001 10	45	29	37	16	0.42

Table 1: Average predicted precipitation over Switzerland, in mm.

The problem (II)

Threshold	Winter 00	Spring 01	Summer 01	Autumn 01
0.1 mm / 6 h				
aLMo	139	137	148	130
LMD	121	112	107	112
2.0 mm / 6 h				
aLMo	101	124	115	112
LMD	86	92	80	89
10 mm / 6 h				
aLMo	69	113	93	105
LMD	52	66	51	72
30 mm / 6 h				
aLMo	74	133	182	112
LMD	22	14	73	62

Table 2: Frequency bias (%) of predicted precipitation over Switzerland. For all 6-h sums from + 6h till + 48h of all 00 UTC and 12 UTC forecasts, compared to 69 ANETZ stations. The model precipitation is the mean over 5 gridpoints.

Test cases: 2001 06 25 00 and 2001 07 08 00 (A)

Sensitivity runs

102: quasi-operational version (LM version 2.14)

103: 102 & 35 levels (instead of 45)

104: 102 & no averaging of forcing fields before calling convection routines

105: 102 & 4th order linear horizontal diffusion (instead of 4th order linear monotonic with orographic limiter)

107: 102 & starting from LM nudging analysis (instead of GME interpolation)

109: 102 & starting from LM nudging analysis with soil moisture from DWD soil moisture analysis

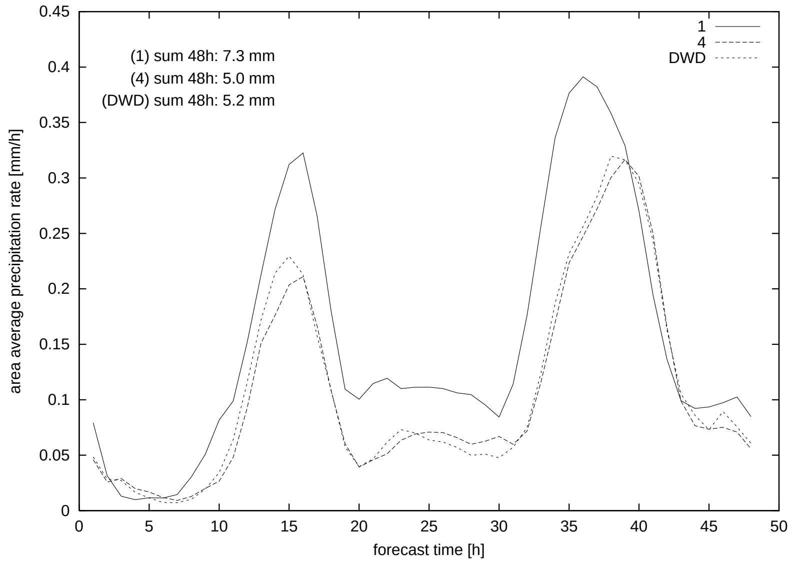
Note: Differences due to different PBL schemes not checked ...

Test cases: 2001 06 25 00 and 2001 07 08 00 (A)

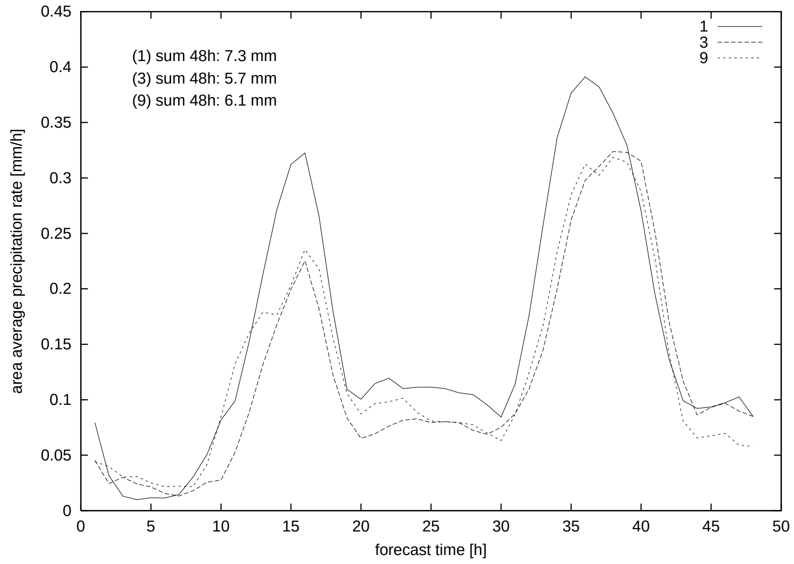
Conclusions so far . . .

- horizontal diffusion (105) and especially nudging (107 & 109) explain a good portion of the observed differences
- effect mainly on stratiform precipitation
- check multiple switches . . .
- test cases not ideal — we should look for (heavy precipitation) cases, where aLMo rains too much and LMD too little . . .

Test case: 2001 07 08 00 (S & D)



Run 1 uses the new horizontal diffusion scheme and interpolated GME data. Run 4 and DWD (run 0) use the old diffusion scheme and nudging analysis data. DWD is the operational forecast at the time.



All runs use the new horizontal diffusion scheme. Run 1 uses interpolated GME data, run 3 starts from nudging analysis data and run 9 starts from interpolated GME data except for the soil moisture and the 3-d specific humidity, which were taken from the nudging analysis. Therefore, we can conclude that the main differences between case 1 and case 3 are caused by the different amount of humidity in the initial state (the impact of soil moisture alone was found to be rather small)

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Test case: 2001 07 08 00 (S & D)

Conclusions so far . . .

- minor effect due to different horizontal diffusion schemes
- initial data (interpolation vs nudging) has large effect
- different horizontal diffusion scheme & different initial data has larger impact than different initial data alone
- difference in 3-d specific humidity for different initial data is main reason for the observed differences
- different PBL schemes have negligible effect

Note: One test case only . . .

Source: Guido Schröder and Günther Doms: "Differences in aLMo and LMD Precipitation Forecasts Over the Alps", 7 pages.

More test cases (A)

case, fct	aLMo	LMD	avg	diff	diff/avg
2001 06 04 12 +40h	9	1	5	8	1.62
2001 08 02 00 +32h	12	3	7	9	1.28
2001 08 09 12 +23h	13	4	9	9	1.01
2001 08 19 12 +23h	11	3	7	8	1.08

Table 3: 12h sum of predicted precipitation over Switzerland, in mm.

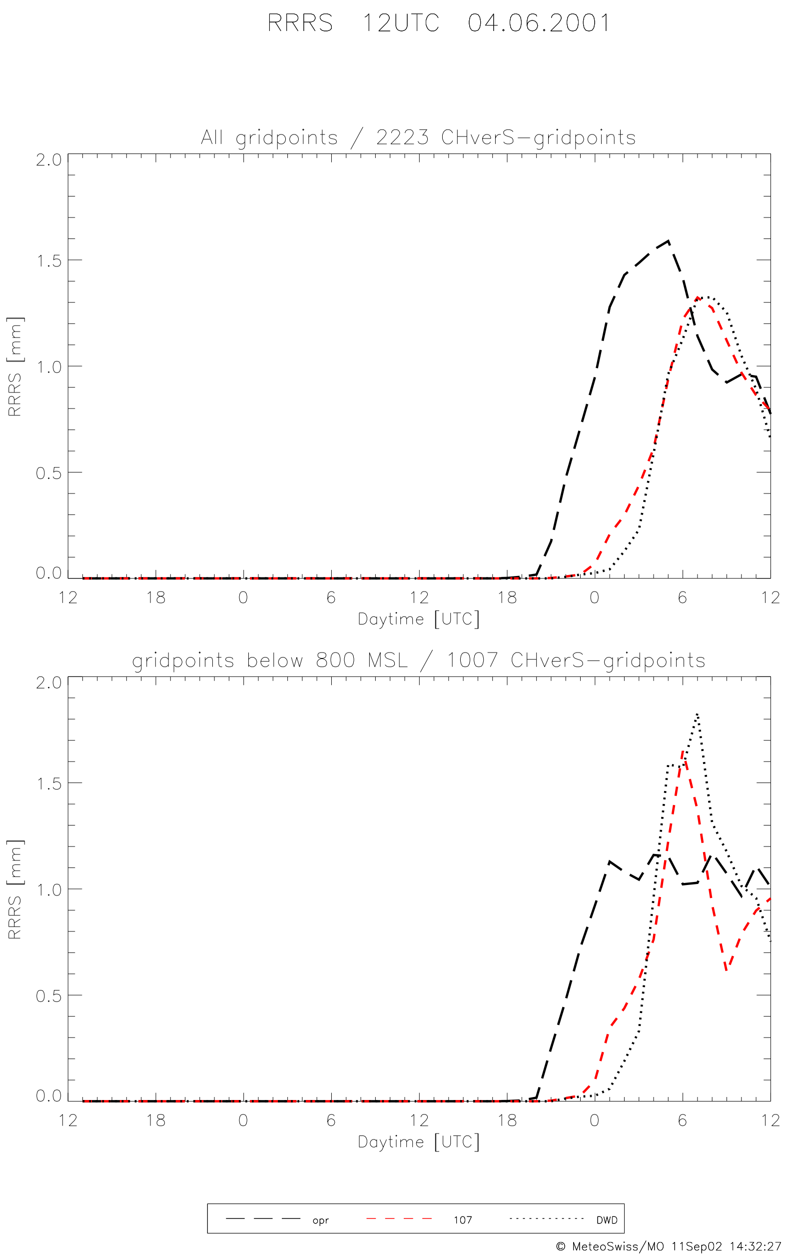
Sensitivity runs

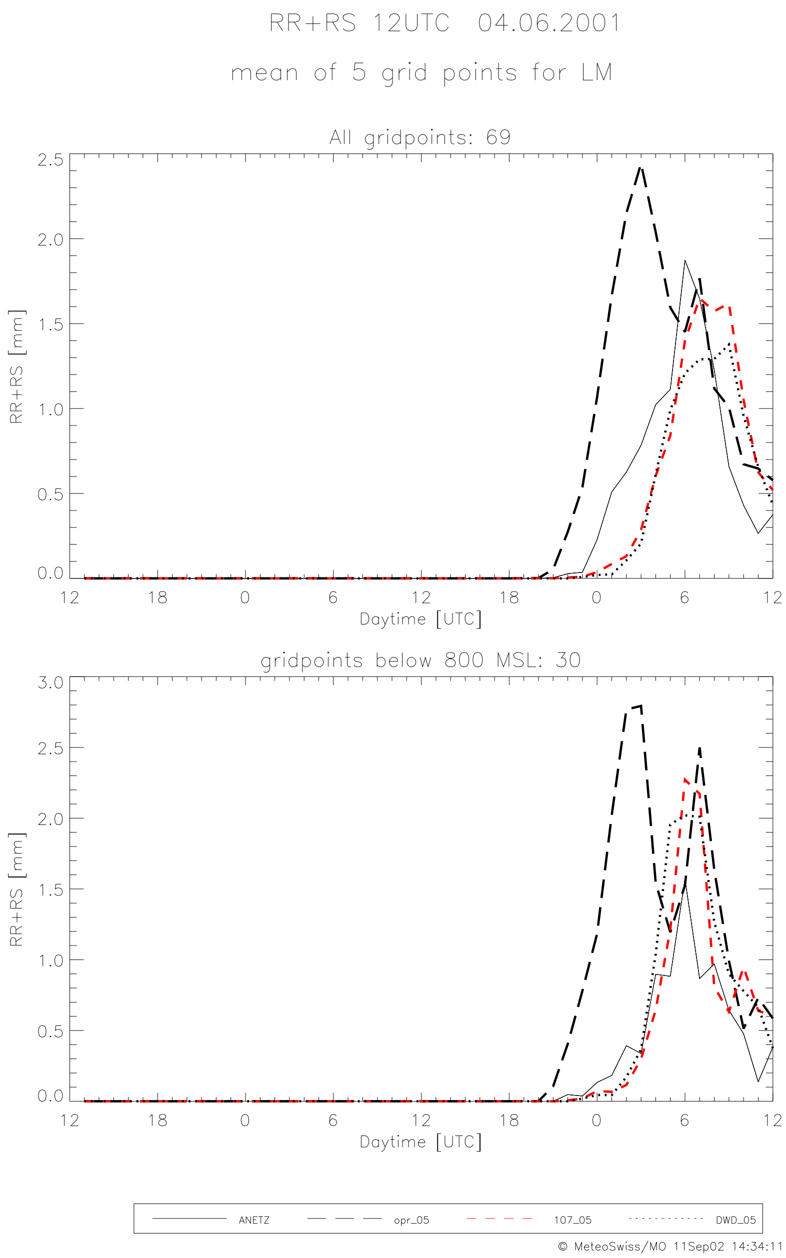
102: quasi-operational version (LM version 2.14)

103: 102 & 35 levels (instead of 45)

105: 102 & 4th order linear horizontal diffusion (instead of 4th order linear monotonic with orographic limiter)

107: 102 & starting from LM nudging analysis (instead of GME interpolation)





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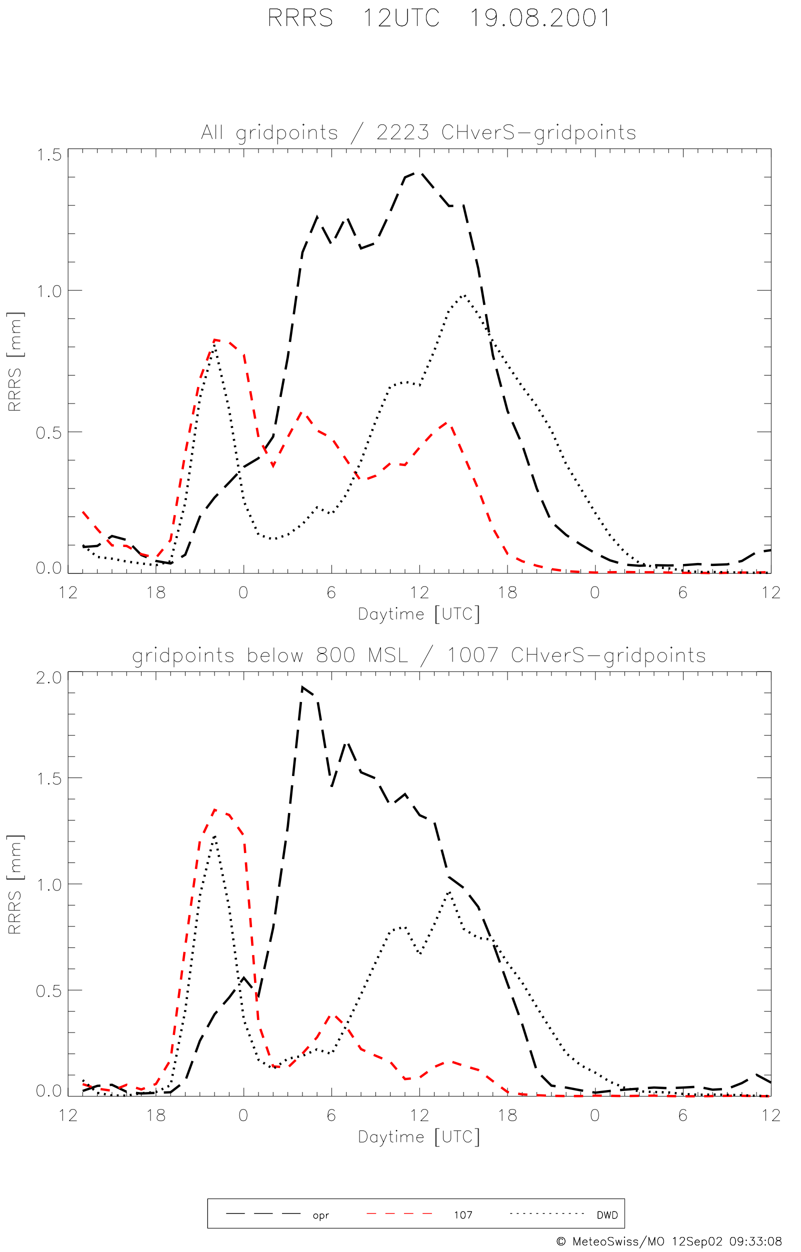

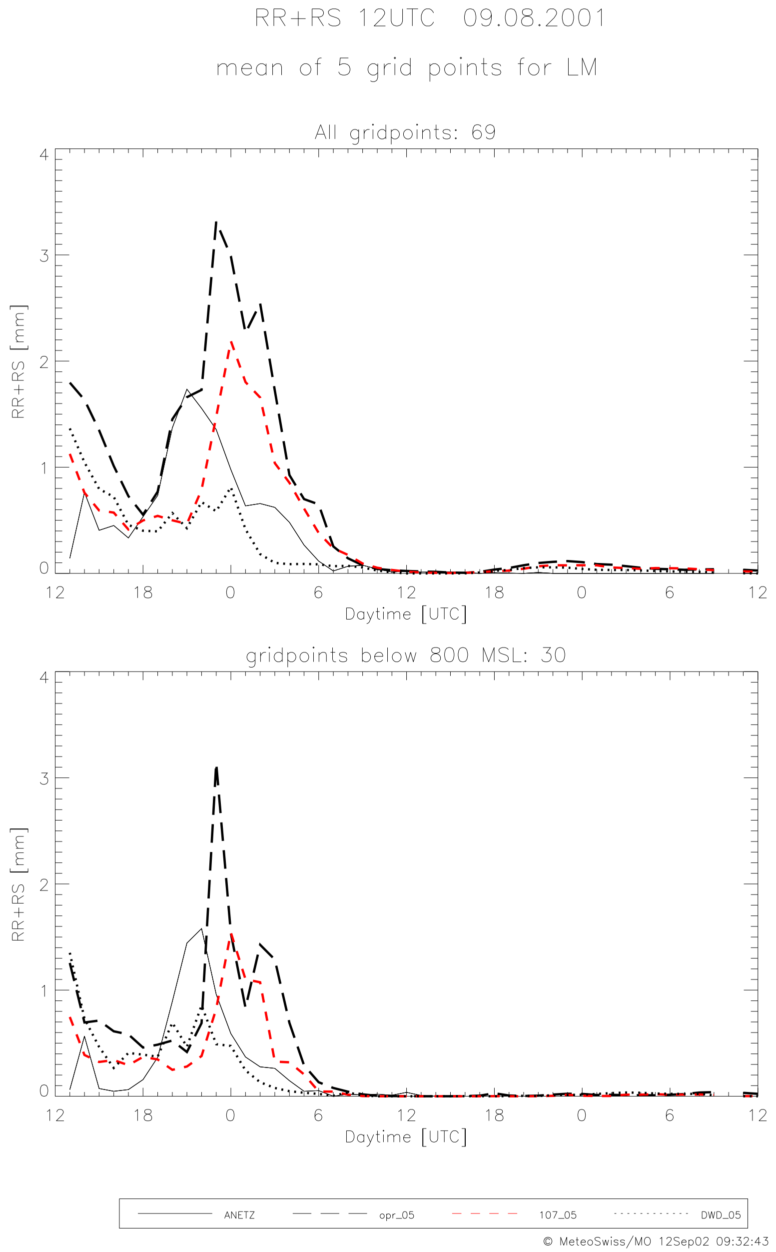

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More test cases (A)

Conclusions so far . . .

- 107 (*i.e.*, nudging vs interpolation) explains *some* of the observed differences;
  105 (horizontal diffusion scheme) and 103 (number of vertical levels) only have minor impact
- effect larger for stratiform precipitation (not shown)
- check multiple switches . . .

Final conclusion (I)

month	aLMo	LMD	avg	diff	diff/avg
2000 12	33	28	31	5	0.15
2001 01	56	51	54	6	0.10
2001 02	54	43	49	11	0.22
2001 03	140	113	126	27	0.21
2001 04	90	72	81	18	0.23
2001 05	82	48	65	34	0.51
2001 06	122	86	104	35	0.34
2001 07	92	60	76	32	0.42
2001 08	81	46	63	35	0.55
2001 09	94	72	83	22	0.26
2001 10	45	29	37	16	0.42
aLMo starts from nudging, LMD switches to new horizontal diffusion scheme					
2001 11	54	52	53	3	0.05
2001 12	52	59	55	–7	–0.13
2002 01	19	24	22	–4	–0.21
2002 02	82	87	85	–5	–0.06
2002 03	55	55	55	0	0.00
2002 04	43	41	42	2	0.05
2002 05	102	102	102	1	0.01
2002 06	90	73	82	18	0.22
2002 07	100	89	94	10	0.11
2002 08	92	82	87	10	0.12

Table 4: Average predicted precipitation over Switzerland, in mm.

Final conclusion (II)

Threshold	Winter 01	Spring 02	Summer 02
0.1 mm / 6 h			
aLMo	164	151	157
LMD	176	141	141
2.0 mm / 6 h			
aLMo	133	108	135
LMD	145	102	119
10 mm / 6 h			
aLMo	106	69	96
LMD	123	70	87
30 mm / 6 h			
aLMo	100	66	132
LMD	132	70	114

Table 5: Frequency bias (%) of predicted precipitation over Switzerland. For all 6-h sums from + 6h till + 48h of all 00 UTC and 12 UTC forecasts, compared to 69 ANETZ stations. The model precipitation is the mean over 5 gridpoints.