MAP Re-Analysis with IFS/ARPEGE/ALADIN

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14th ALADIN Workshop, Innsbruck, 1-4 June 2004

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Why to care about MAP-SOP Period?

- The largest field experiment in Europe,
- In Autumn 1999 Mesoscale Alpine Program (MAP) start with 70 days of Special Observing Period (SOP),
- Additional measurements during MAP-SOP: SYNOP, TEMP (radiosondes and Europe dropsondes), PILOT (Europe profilers), instrumented flights,
- Additional data $\Rightarrow$ quite a lot of data for assimilation, verification and comparison of the NWP model,
- We would like to have fine background for ALADIN 3D-Var and other research activities in ALADIN community.

Problem, for ALADIN we need initial and boundary condition!

What has been changed in available operational global models in mean time?

Modification in operational models from 1999 to 2003 ARPEGE

- number of vertical levels increased from 31 to 41
- highest model level moved from 5 hPa to 1hPa,
- 3D-Var replaced with 4D-Var Assimilation,
- assimilation of more channels of satellite data,
- horizontal resolution, stretching factor and orography changed from T199 c3.5 quadratic grid (20-200 km) to T358 c2.4 linear grid (23-133 km),
- still envelope orography in usage.

Modifications in operational models from 1999 to 2003 ECMWF

- number of vertical levels increased from 50 to 60,
- no envelope orog. and new subgrid orog. fields were introduced,
- new cloud and convection scheme,
- 4D-Var window extended from 6 to 12-hour,
- model hor. res. increased from 60 to 40 km (T319-T511),
- inner-loop in 4D-Var increased T63 to T159 (120 km),
- new shortwave radiation transfer model,
- assimilation of more channels of satellite data, European wind profiler and other data,
- new bias correction for satellite observations.

The objectives of the ECMWF MAP Re-Analysis

- Produce a comprehensive set of analyses describing the state of atmosphere (5.5 times more data are used in analysis),
- Create a formatted archive of the additional MAP observations,
- Foster European and international research by making the obs. and analyses archive widely available (MARS data-base),
- Perform validation and diagnostic studies,
- Indicate the benefit of the use of additional obs. through data impact studies (for example European wind profilers).

We would like to have fine background for ALADIN 3D-Var and other research activities in ALADIN community.

Why not to use that 4D-Var MAP Re-Analysis and we don't need to run 4D-Var ARPEGE Re-Analysis for 70 days?

Surface problem

- with configuration 901 it is possible to transfer ECMWF Analysis from GRIB file format to ARPEGE FA-file format,
- but, ECMWF has different surface parameterisation, climatology data for surface parameterisation are written in ARPEGE file with 901!

Solution

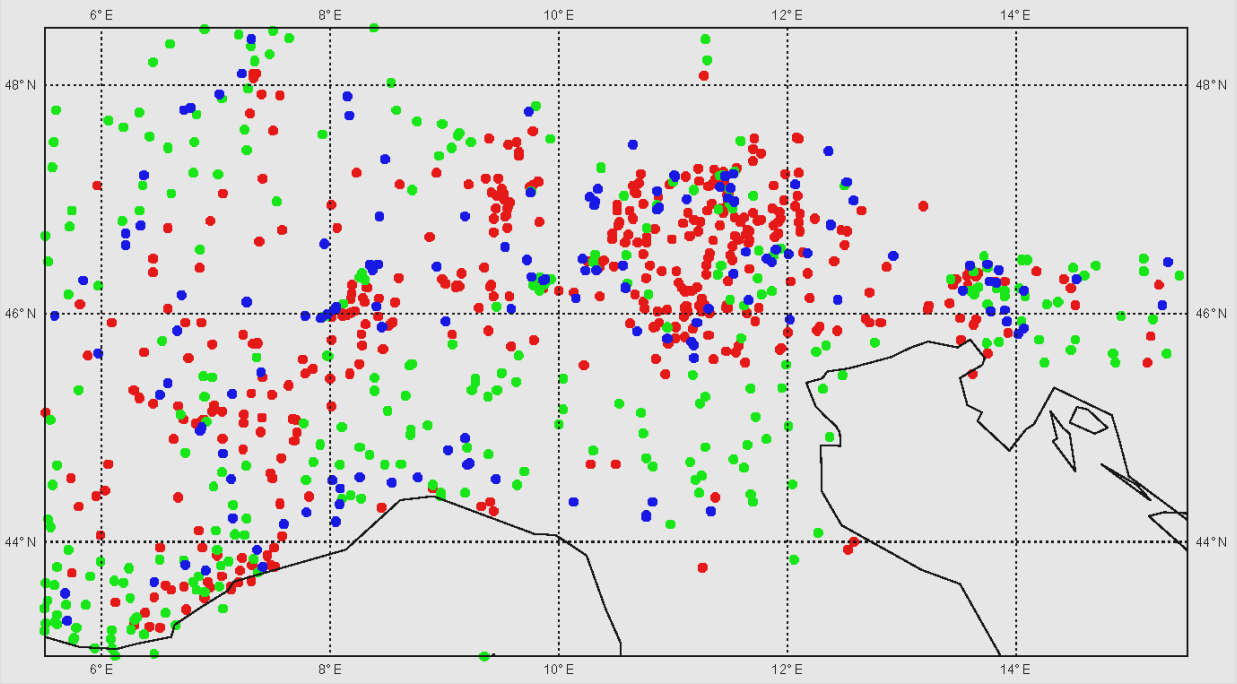
- to mix ECMWF upper-air from Re-Analysis and surface fields from ARPEGE long cut-off Analysis done in 1999,

Components of the ECMWF-ARPEGE (ECAR) cocktail

- ECMWF T511c1.0L60 (40km) $\Rightarrow$927$\Rightarrow$ ECT358c2.4L41 (23-133 km),
- ARPEGE T199c3.5Q31 (20-200) $\Rightarrow$ 927 $\Rightarrow$ ART358c2.4L41 (23-133)
- upper-air ECT358c2.4L41 + surface ART358c2.4L41 $\Rightarrow$ **ECAR**

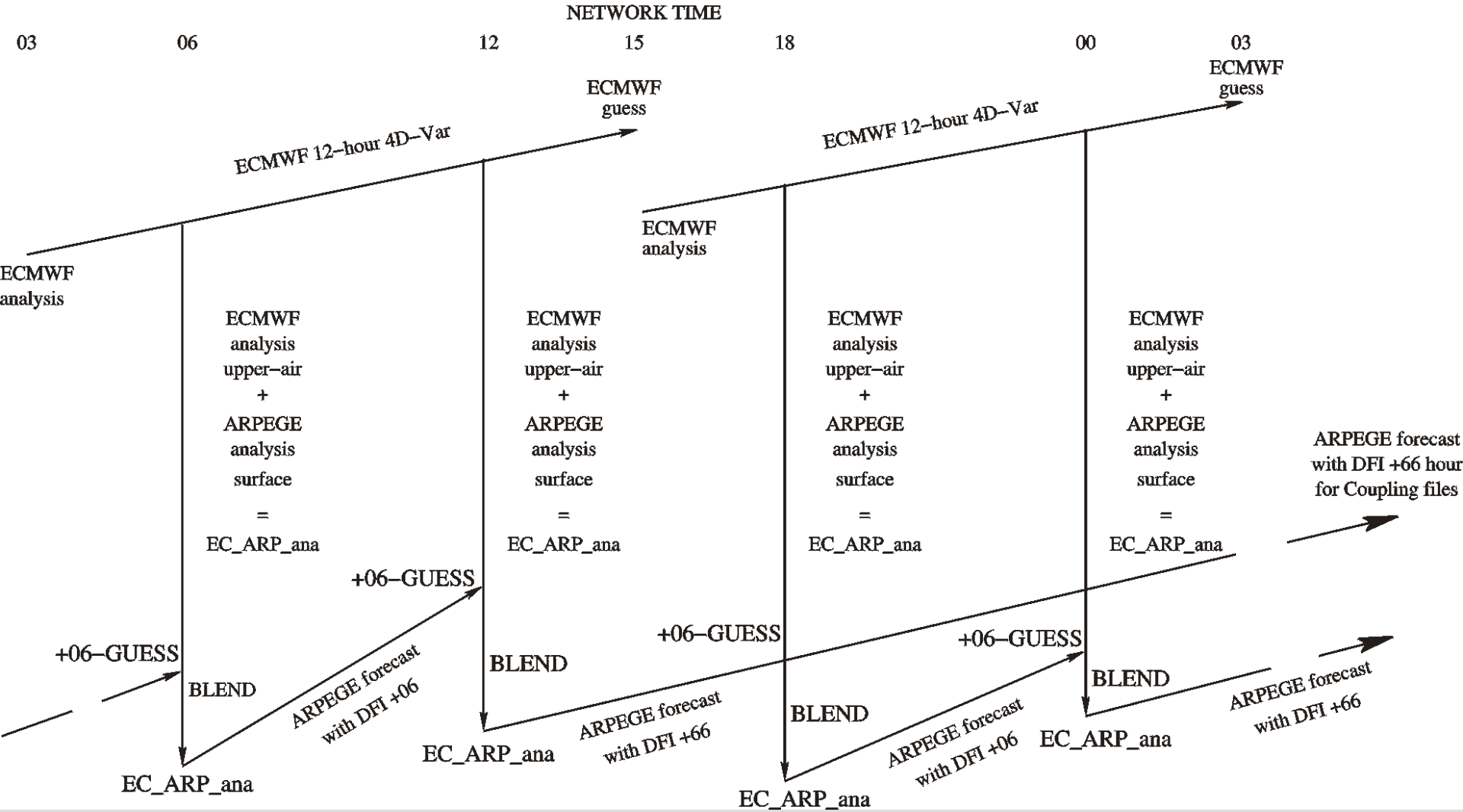
Surface station Analysed in ECMWF Alpine region

- green colour points: used data in MAP Re-Analysis
- 40 % of stations are blacklisted due to the difference in station altitude and model orography larger than 200 m (blue-peaks, red-valley)



There is still some space left to improve the analysis for the better horizontal resolution.

Proper downscaling of ECMWF
ECMWF-ARPEGE Analysis



ARPEGE set-up for Coupling files

- executable - cy26t1_op5.01.L0209.x.exe (operational till last week),
- time-step for 001: 981.81818 sec (11 T-steps in 3hrs),
- DFI parameters: 14 steps, T-step 981.82, hor. diff. in adiab. T-steps, stop-band edge 5h, T-span 3.818h, min. T-span 3.45h
- Coupling files, 3-hour frequency, size of COUPLECAR+00xx 5 Mb

Delage: **/cnrm2_a/mrpm/mrpm620/MAP_e9mi/YYYY/MM/DD/NT**

- Horizontal resolution: 28.960 km, 216x120 points, trunc. 71x39,
- SW corner (340.198°,25.552°), NE corner (51.671°,46.001°),

For 00 & 12 UTC 23 files xx=00, 03, ... , 66 . 5 Mb x 23 = **115 Mb**

For 06 & 18 UTC 2 files xx=00 & 06 . 5 Mb x 2 = **10 Mb**

Total per day for coupling files **250 Mb**

ECMWF/ARPEGE Coupling files +

At the end of ECMWF/ARPEGE Re-Analysis

ALADIN coupling files are ready!

But why not to prepare even better initial fields?

- For this purpose we could use DF Blending.

Should we use the No Envelope orography?

Should we use a different gravity-wave drag parameterisation?

Should we use SLHD scheme?

Should we use the new radiation scheme?

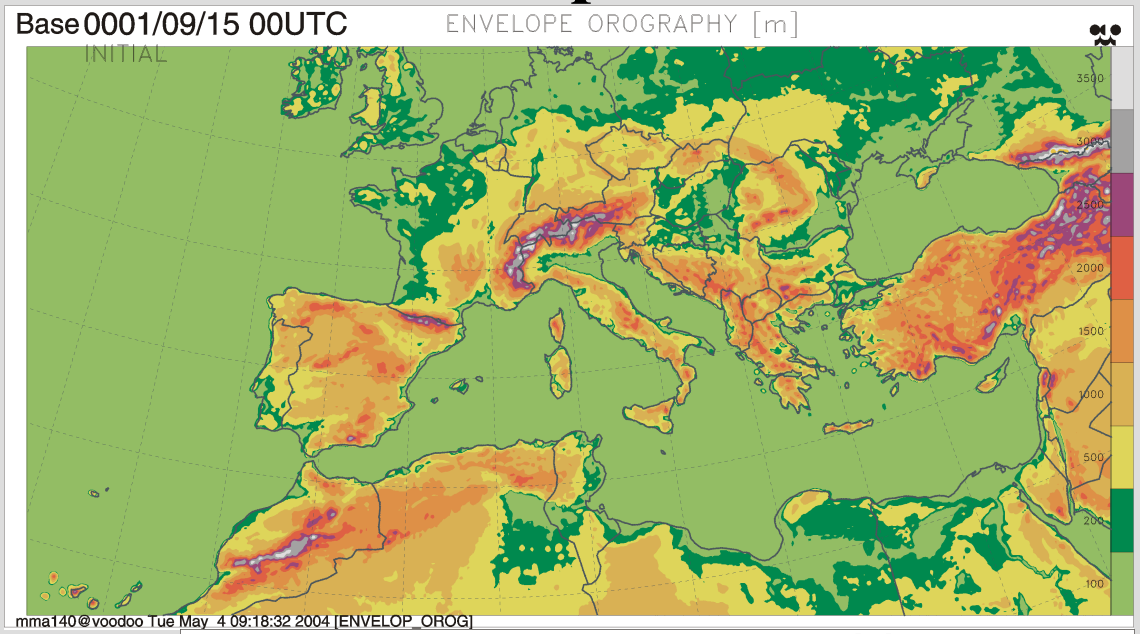
Orography used in ALADIN experiments

Envelope orography:

- orography is higher,

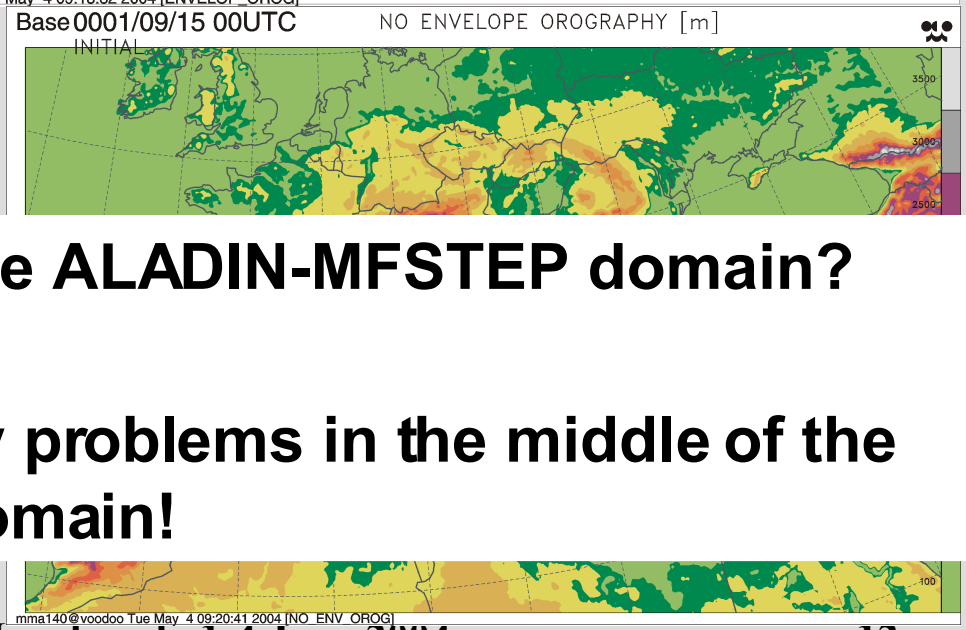
- higher peaks,

- valley are higher or don't exist at all.



No Envelope orography:

- orography is lower than with

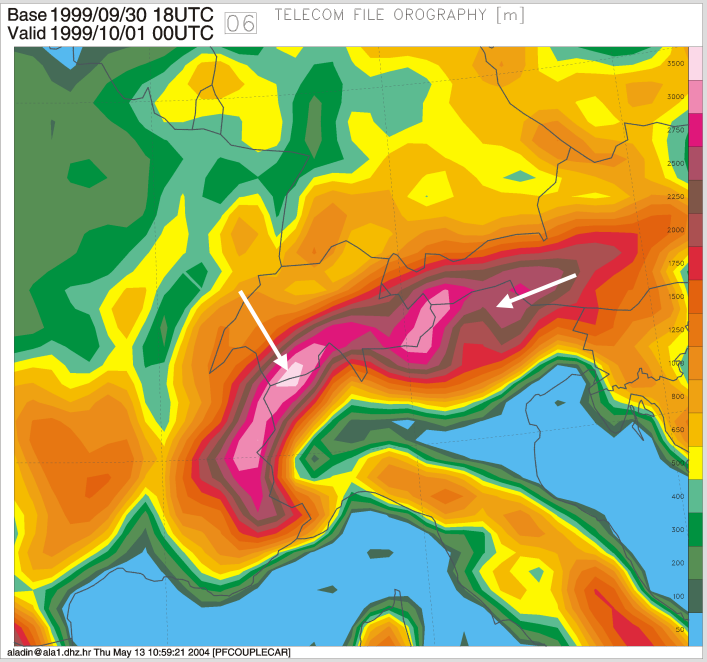


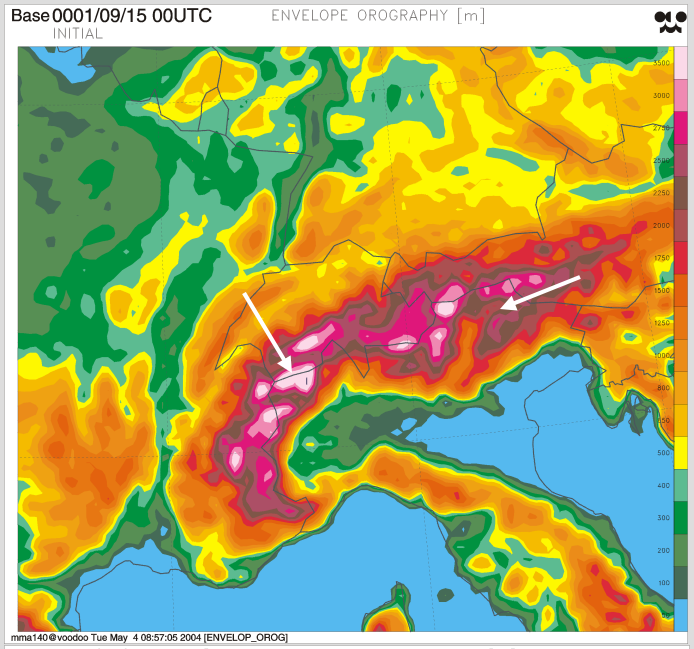
Why coupling files for the ALADIN-MFSTEP domain?

To avoid LBC inconstancy problems in the middle of the domain!

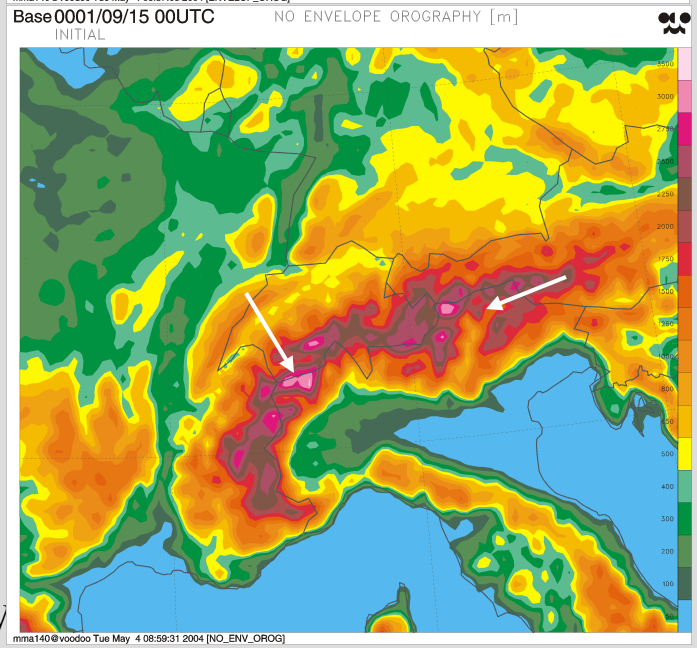
Comparison of the Orography on the MAP area

Orography in coupling files





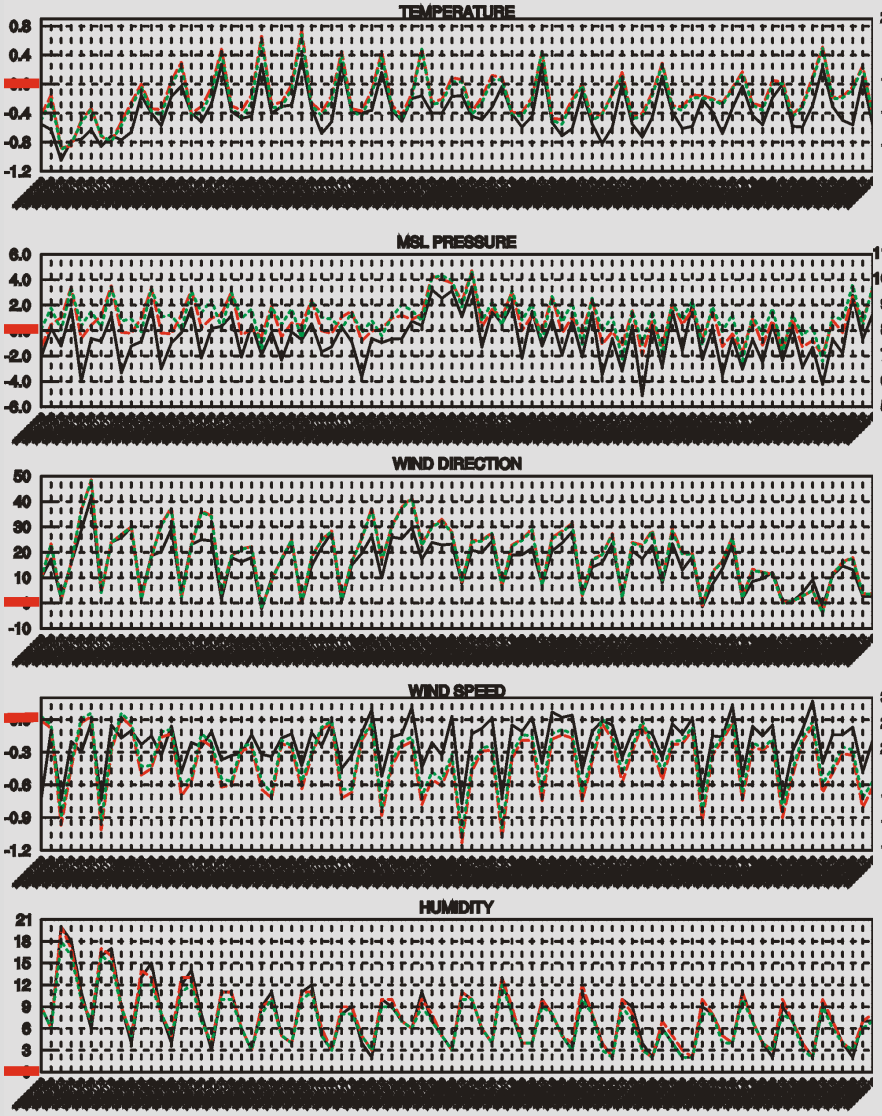
Envelope Orography



No Envelope Orography

Diurnal cycle of the verification score

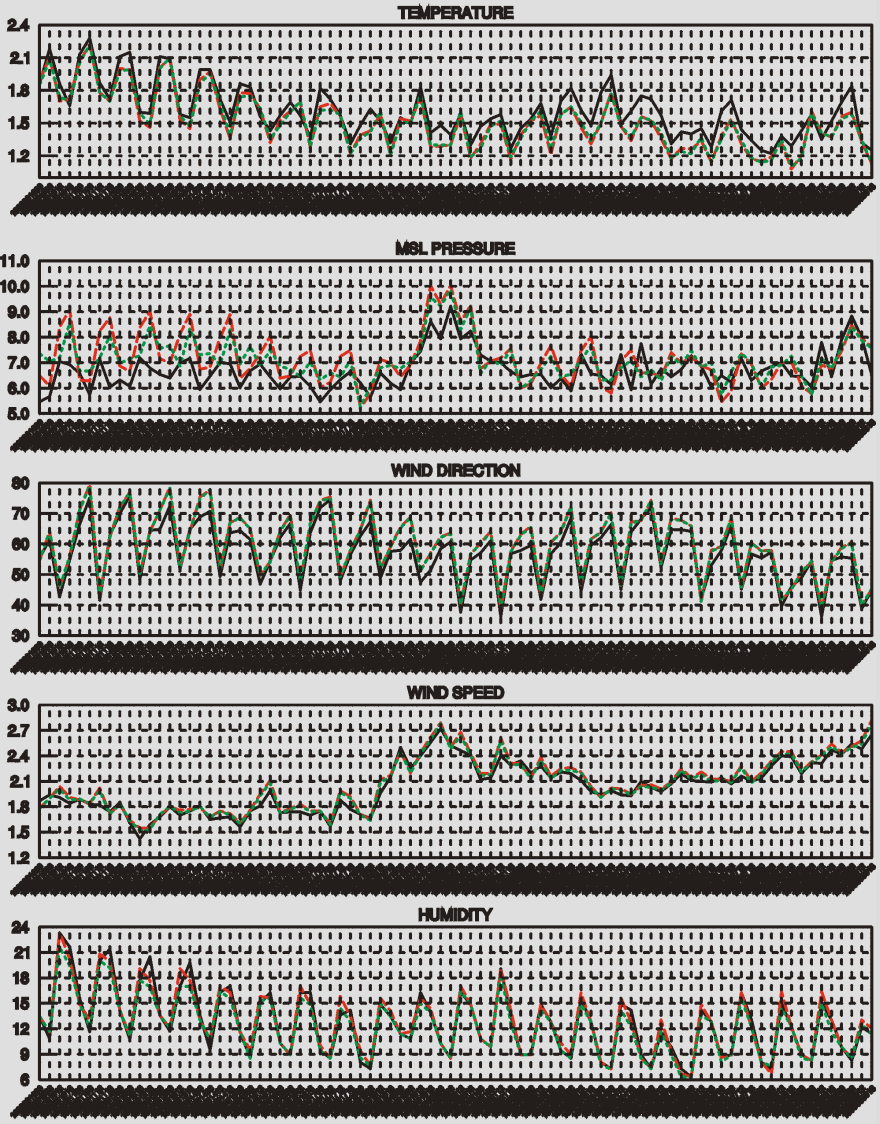
BIAS of individual runs



PERIOD: 19990910...19990930
Network: 0UTC
SURFACE
Range: +00 hours

MCPL
COUP
ALAS

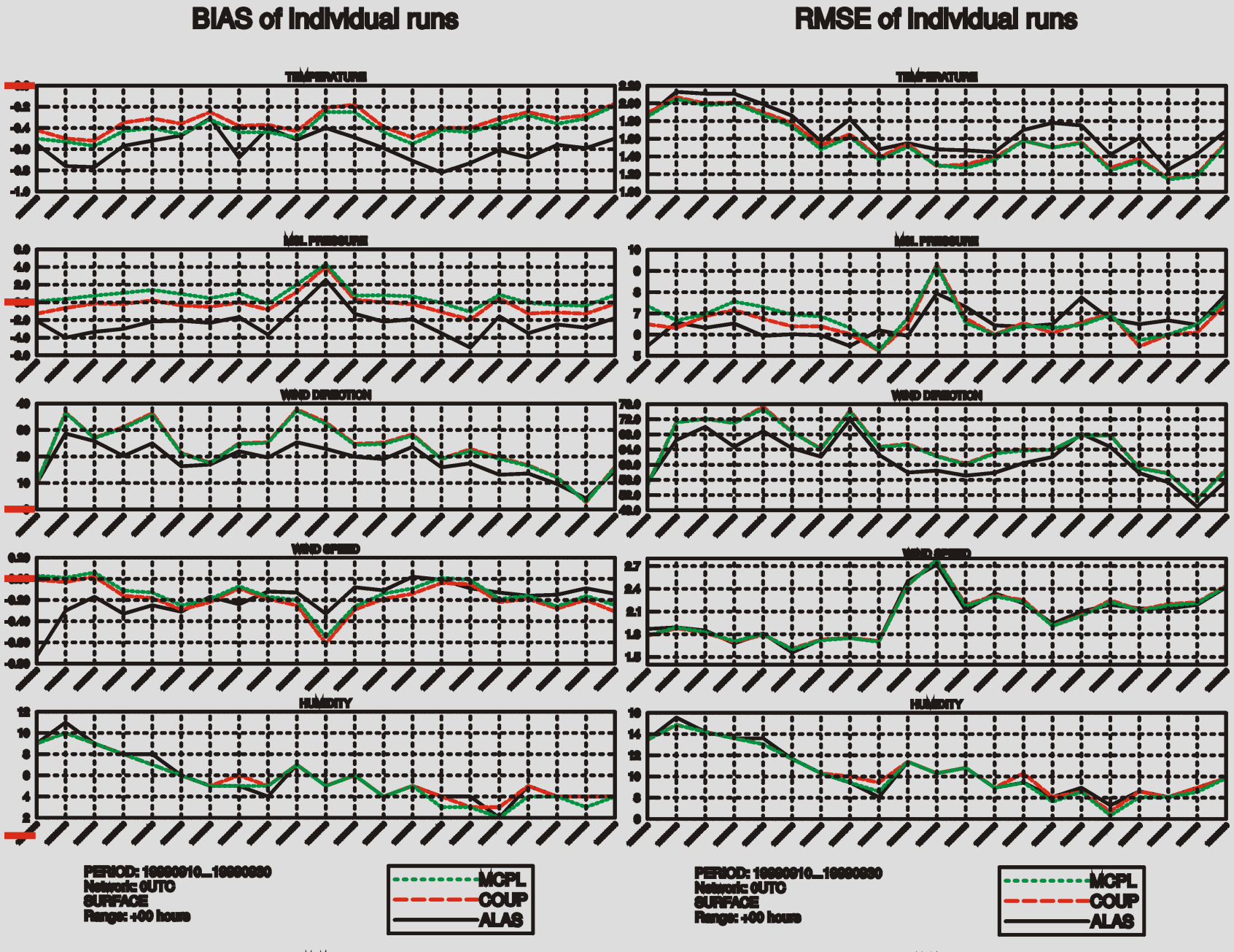
RMSE of individual runs



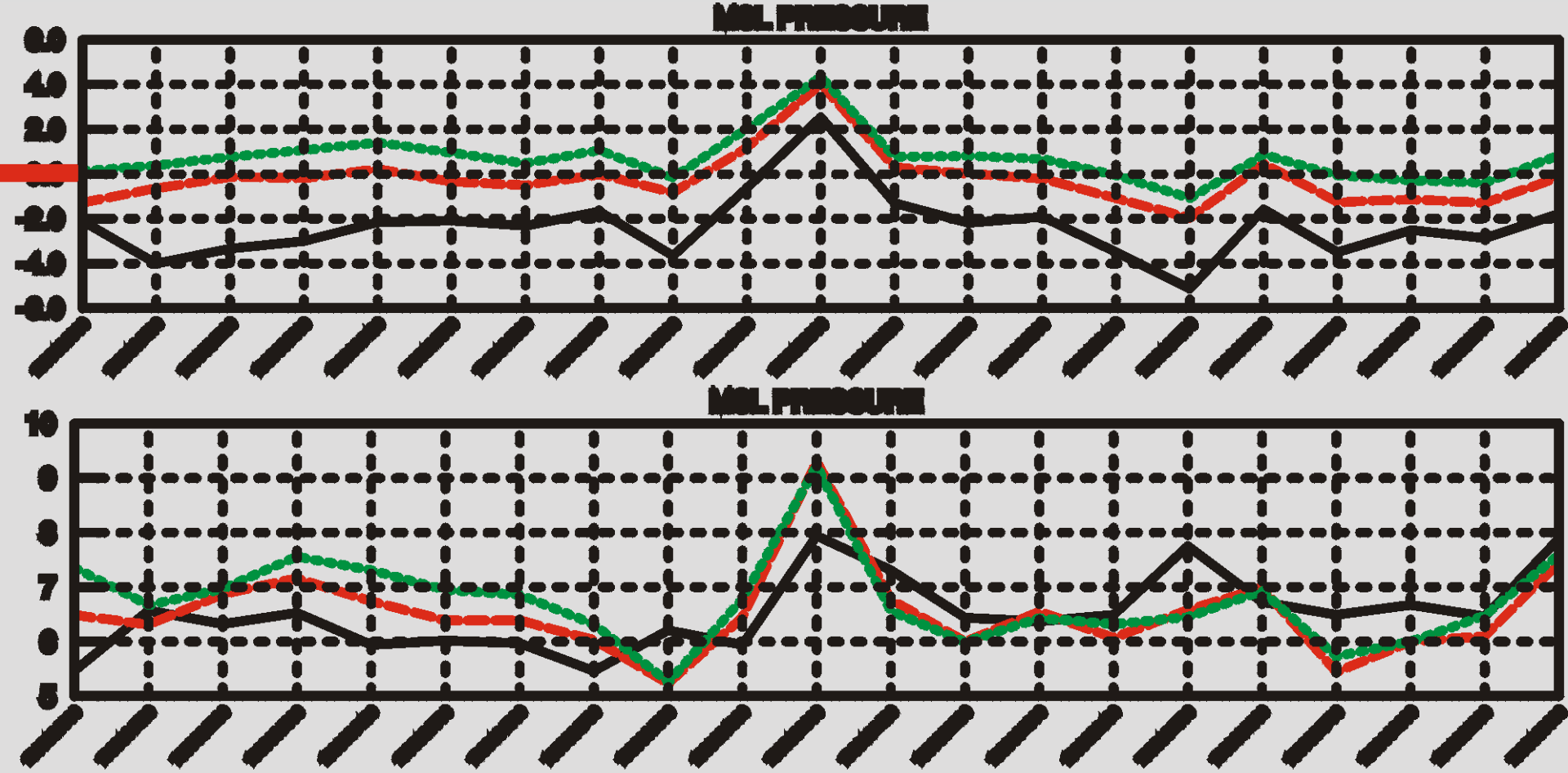
PERIOD: 19990910...19990930
Network: 0UTC
SURFACE
Range: +00 hours

MCPL
COUP
ALAS

MSLP & T2m problem @ 00 UTC



MSLP problem @ 00 UTC

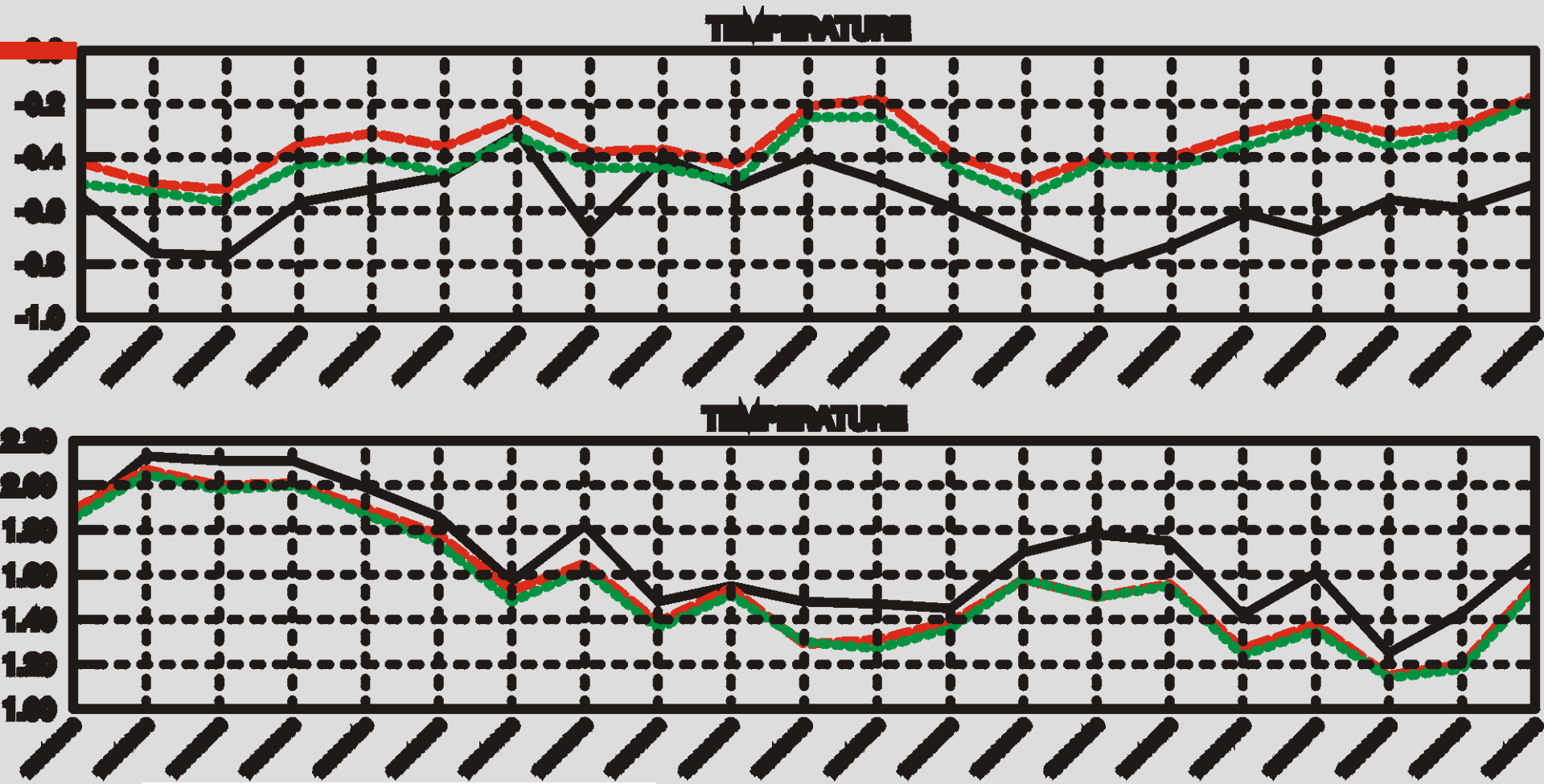


Period: 19990910-19990930
Network: 00 UTC
SURFACE
Range:+00 hours

e927 No Env.
Telec. Env.
Bl. Assim. No Env.

MCPL
COUP
ALAS

T2m problem @ 00 UTC

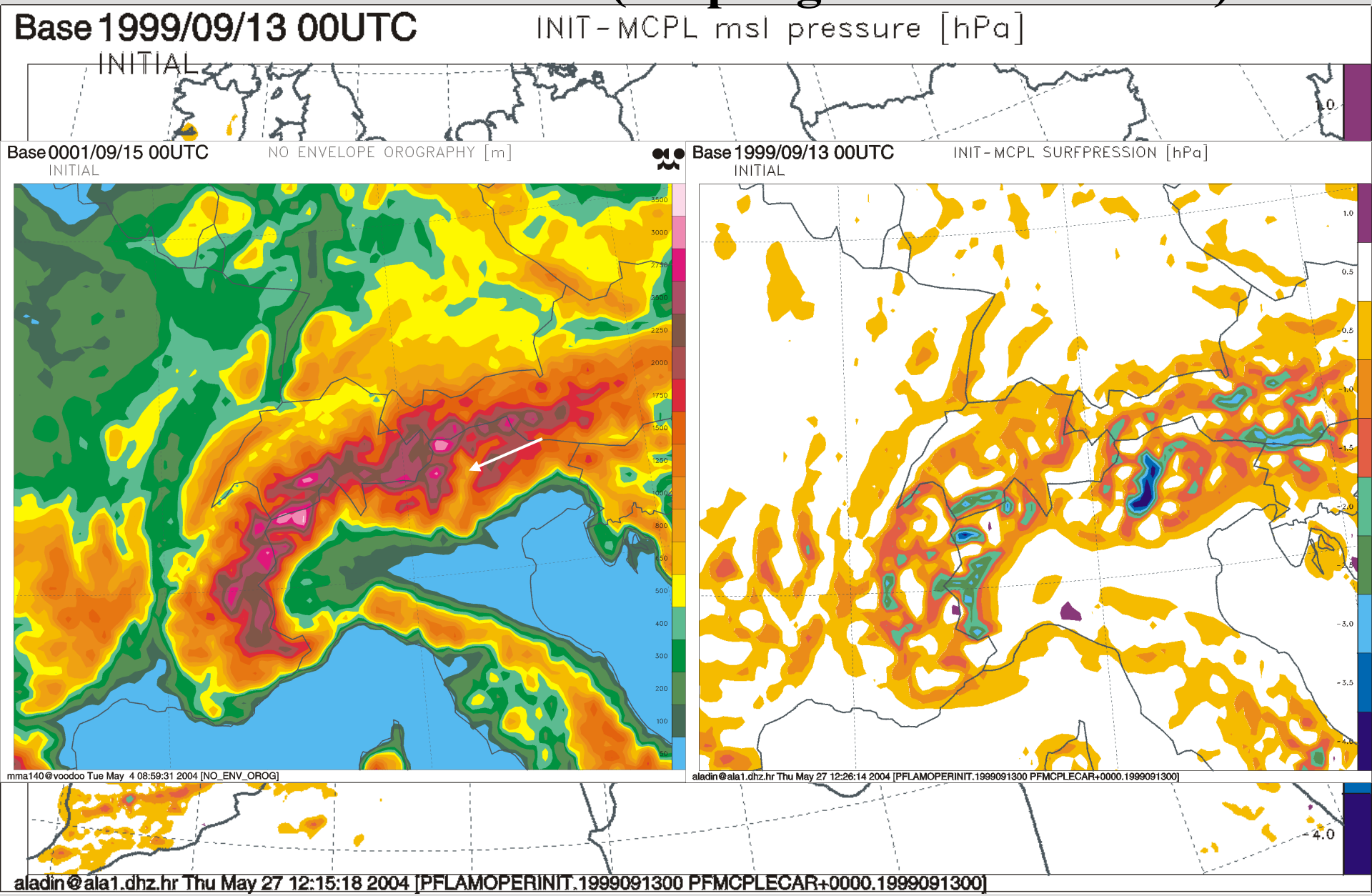


Period: 19990910-19990930
Network: 00 UTC
SURFACE
Range:+00 hours

e927 No Env.
Telec. Env.
Bl. Assim. No Env.

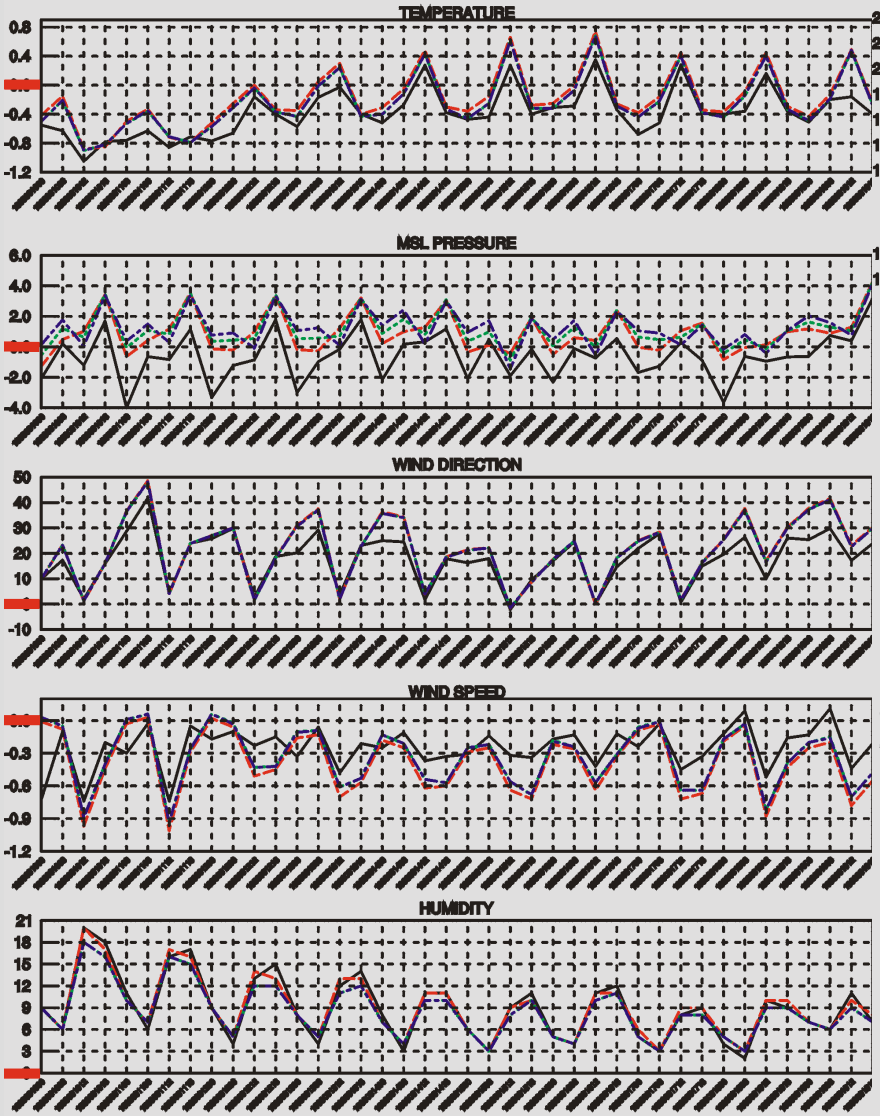
MCPL
COUP
ALAS

Difference in MSLP (coupling assimilation files)

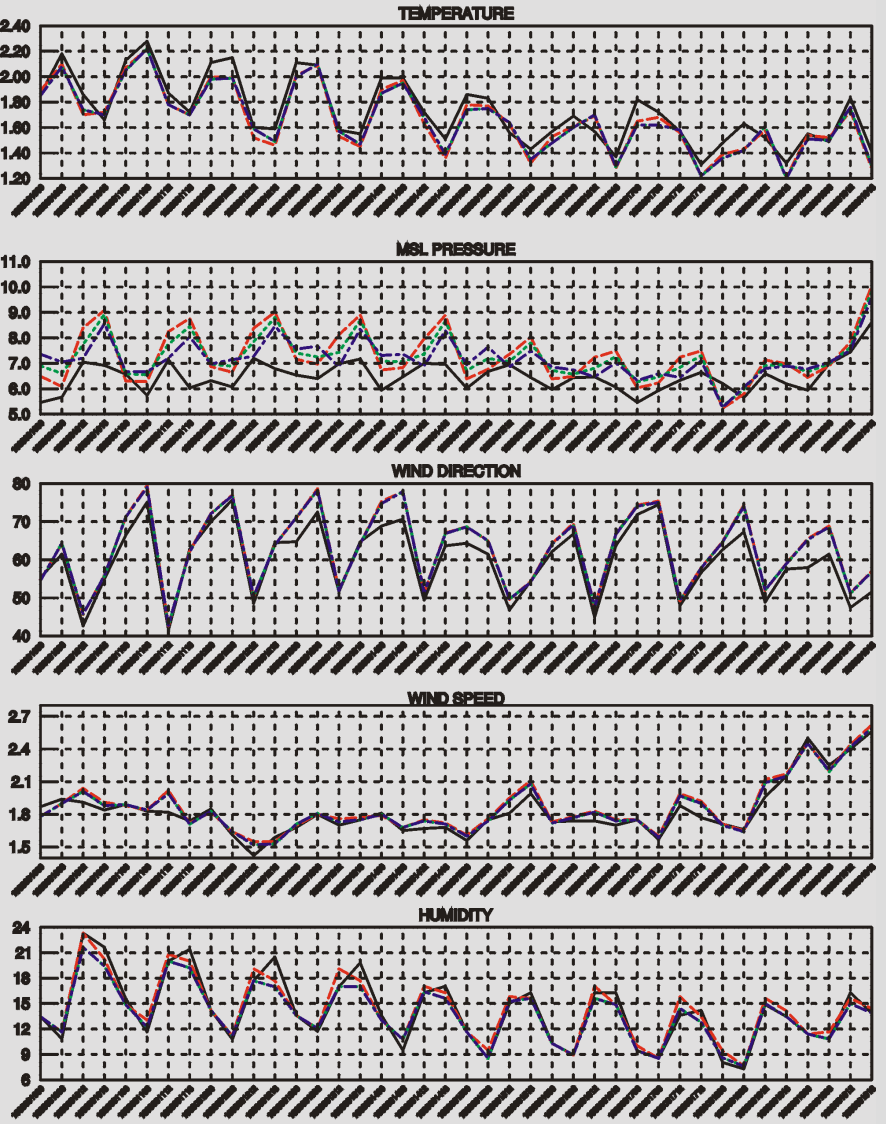


Difference in ver. scores after e927 No Envelope & Envelope

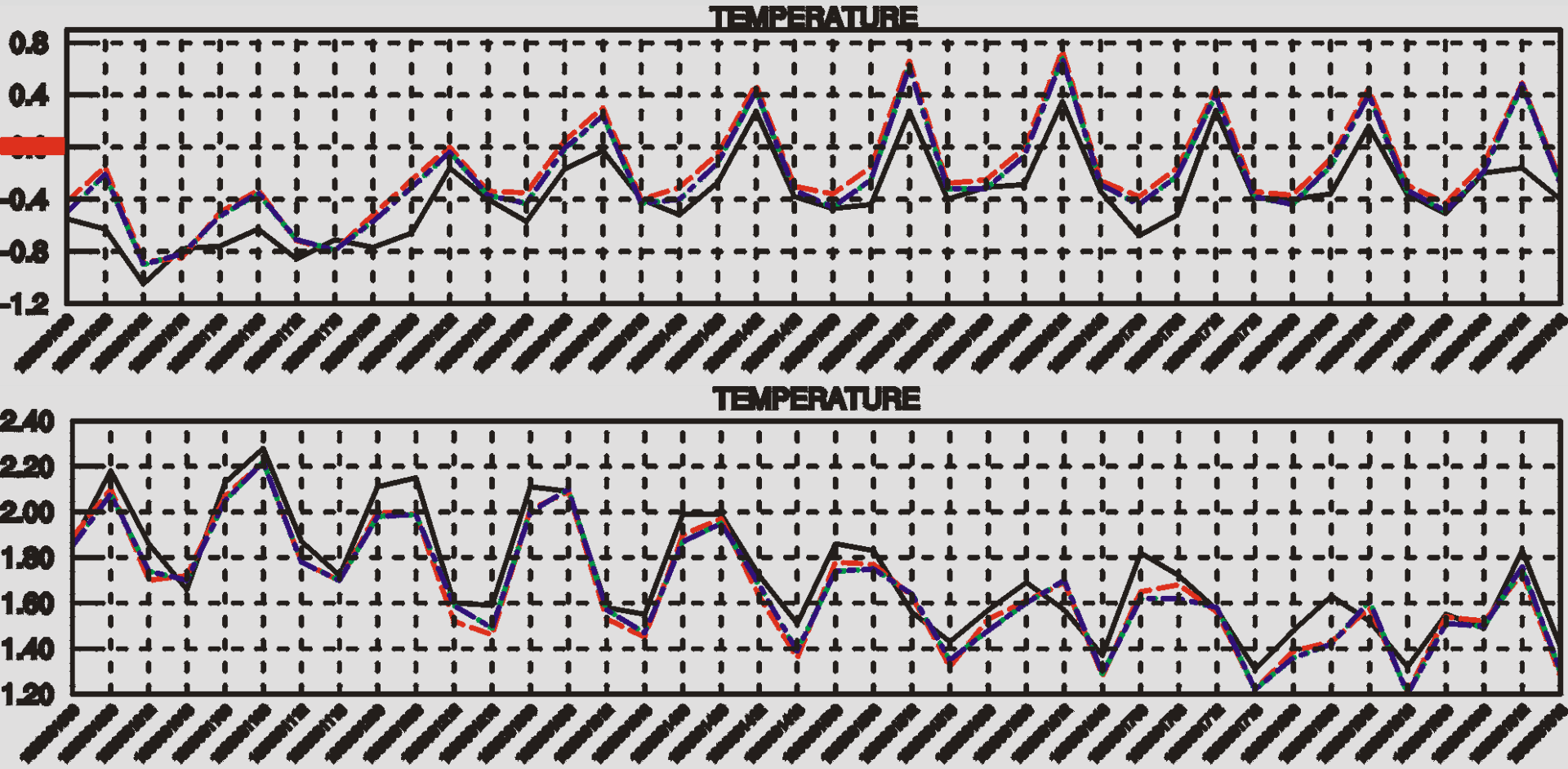
BIAS of individual runs



RMSE of individual runs



Difference in ver. scores after e927 No Envelope & Envelope

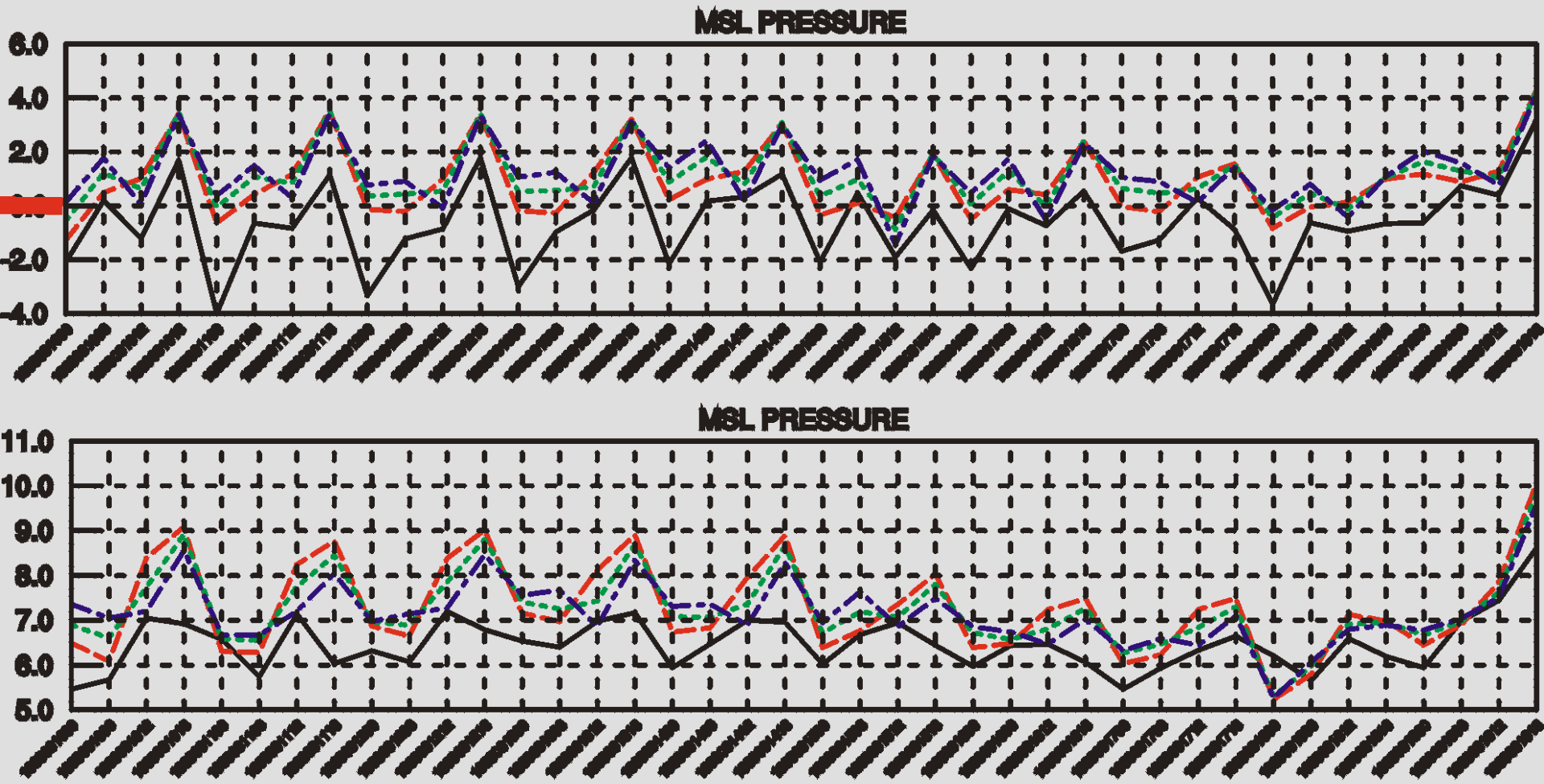


Period: 19990910-19990919
Network: 00,06,12 & 18 UTC
SURFACE
Range:+00 hours

e927 No Env.
e927 Env.
Telec. Env.
Bl. Assim. No Env.

MCPL
ECPL
COUP
ALAS

Difference in ver. scores after e927 No Envelope & Envelope



Period: 19990910-19990919
Network: 00,06,12 & 18 UTC
SURFACE
Range:+00 hours

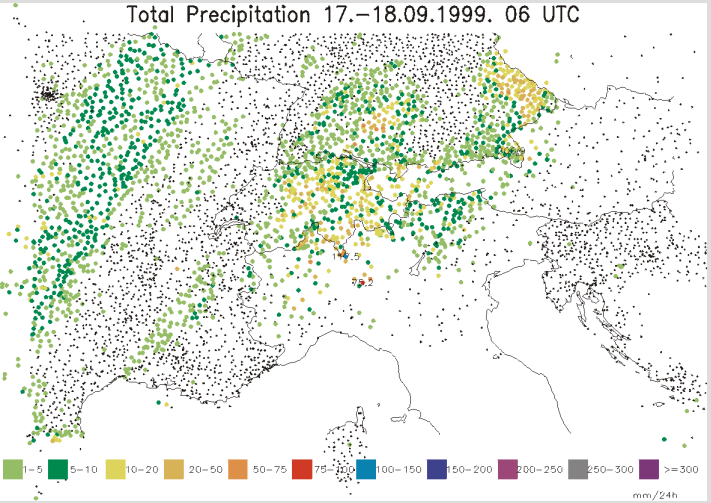
e927 No Env.
e927 Env.
Telec. Env.
Bl. Assim. No Env.

MCPL
ECPL
COUP
ALAS

Forecast of precipitation 17-18.09.1999 06 UTC

start 17.09.1999 00UTC

24-h tot. prec.



start 17.09.1999 12UTC

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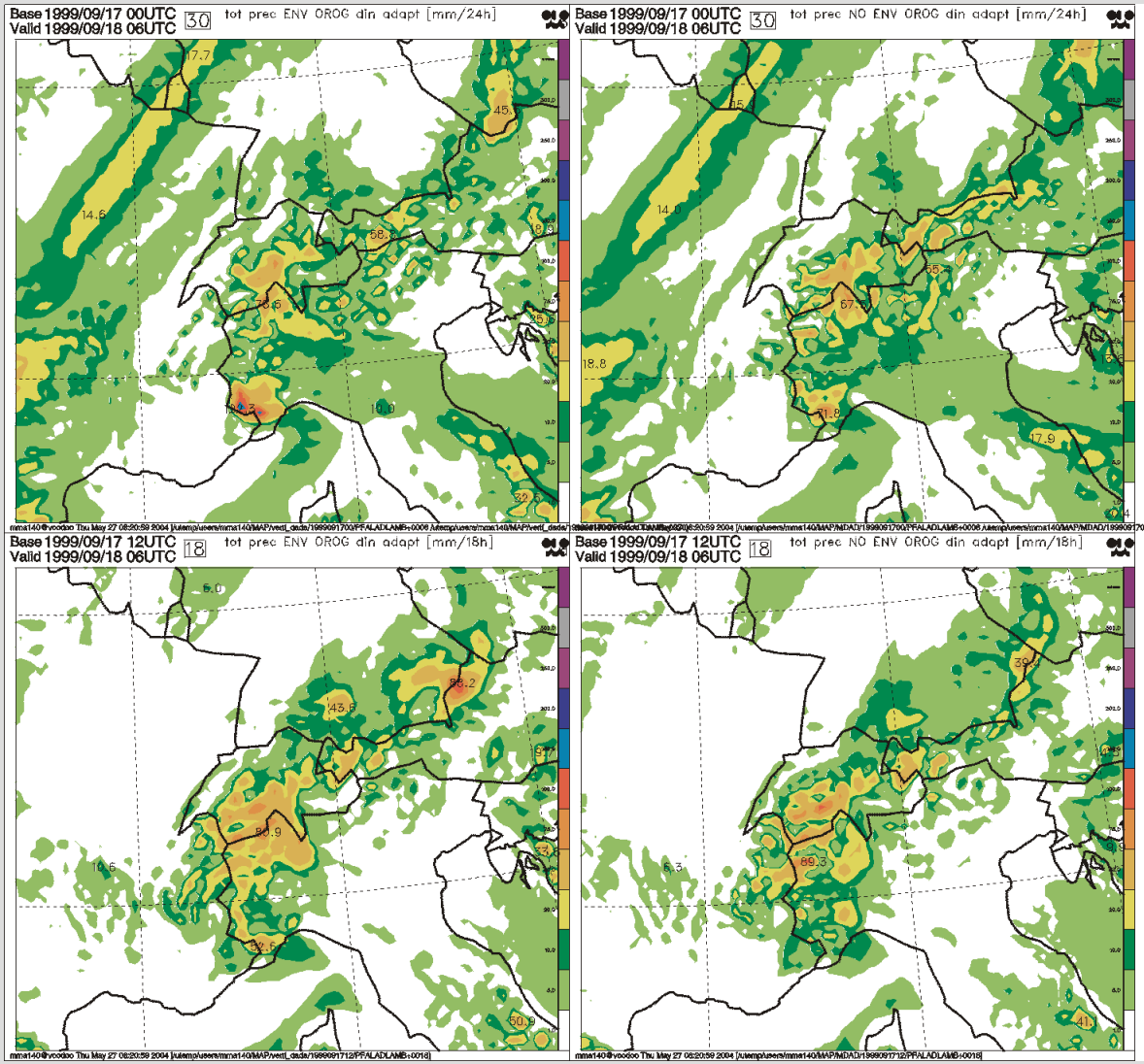
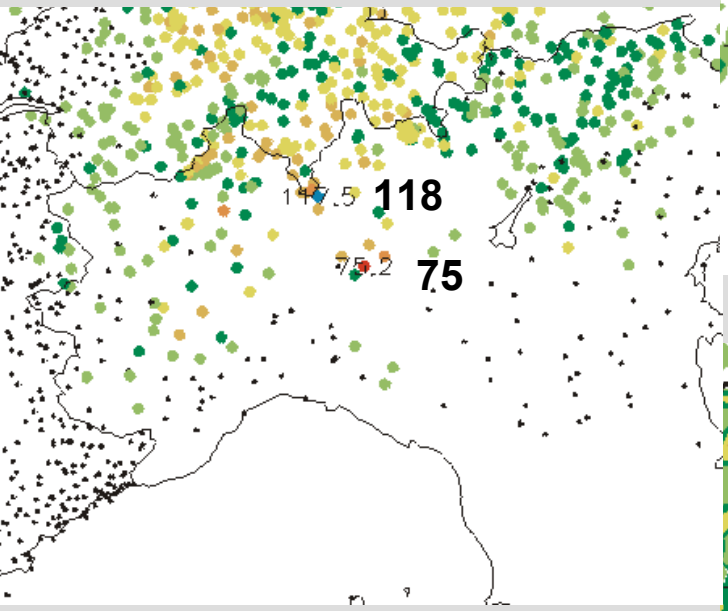
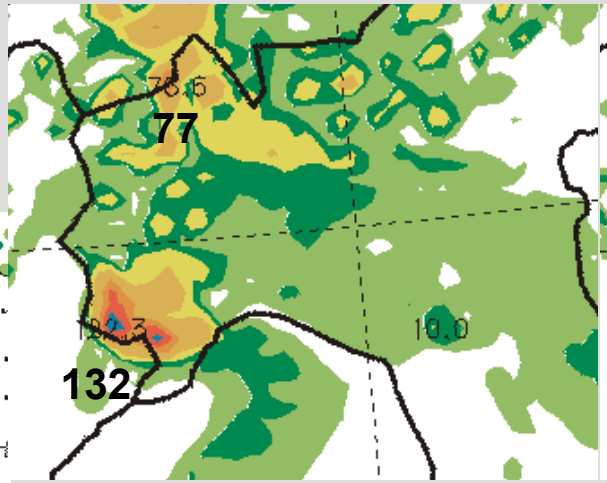


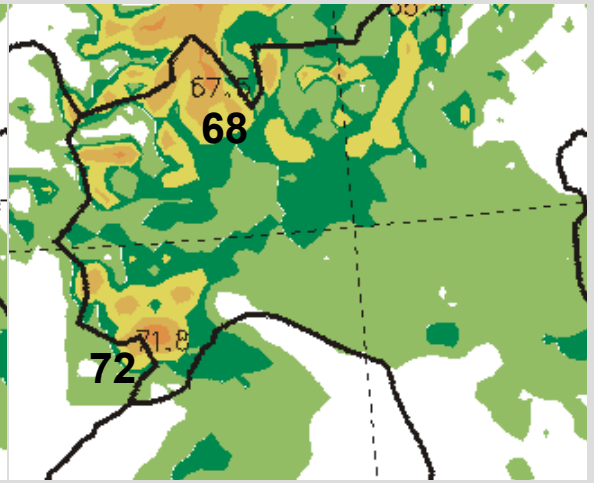
Forecast of precipitation 17-18.09.1999 06 UTC

start 17.09.1999 00UTC

24-h tot. prec.







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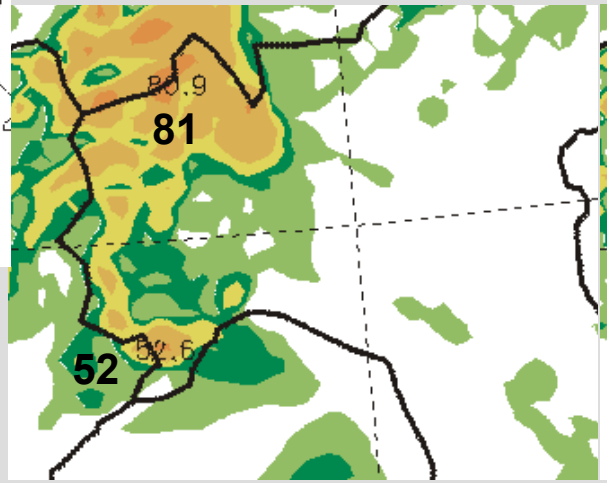

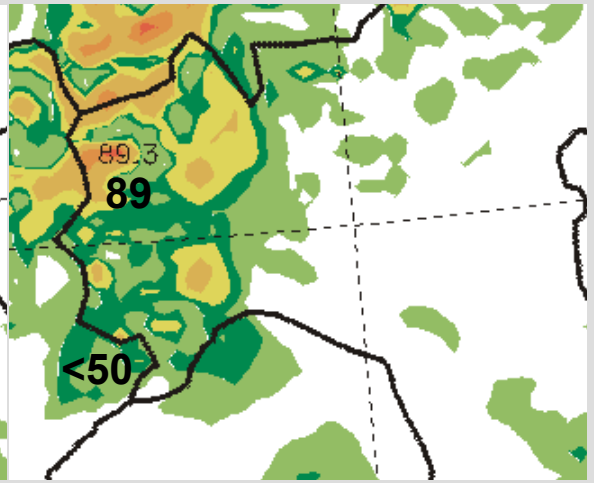

start 17.09.1999 12UTC

Forecast of precipitation 18-19.09.1999 06 UTC

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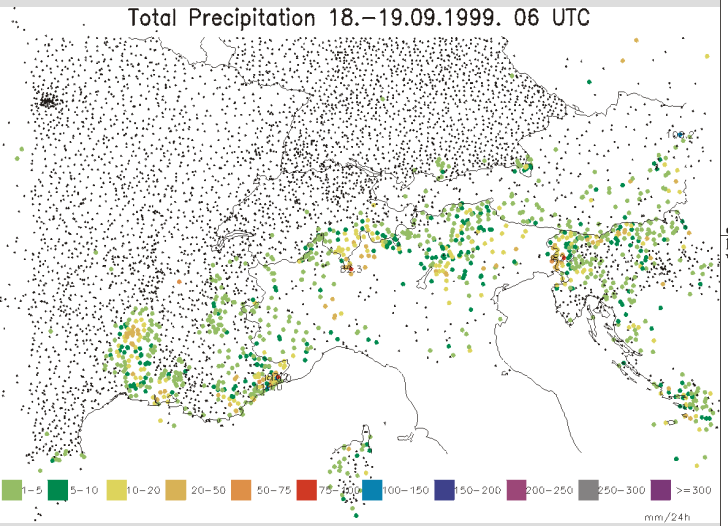
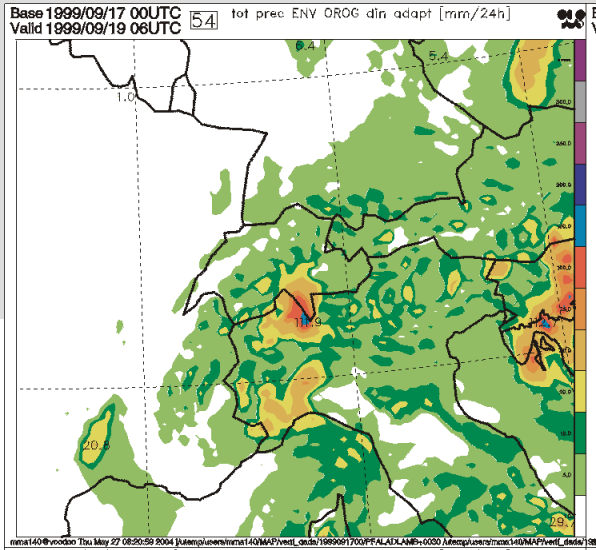
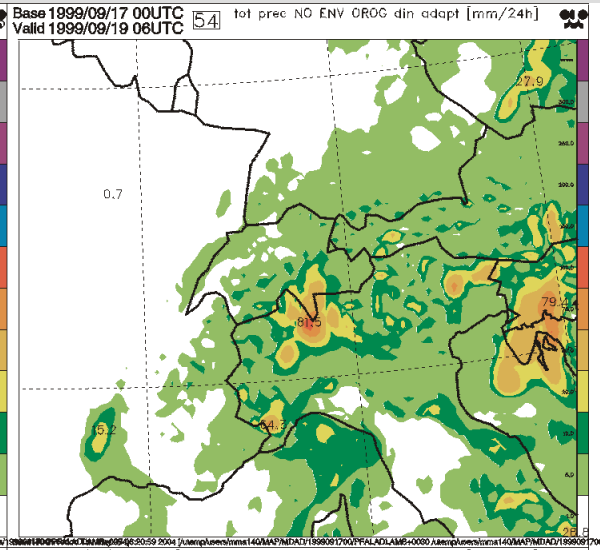
start 17.09.1999 00UTC

24-h tot. prec.







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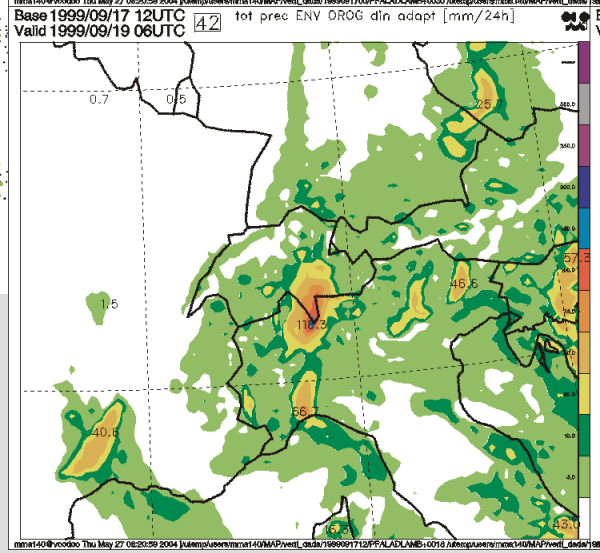
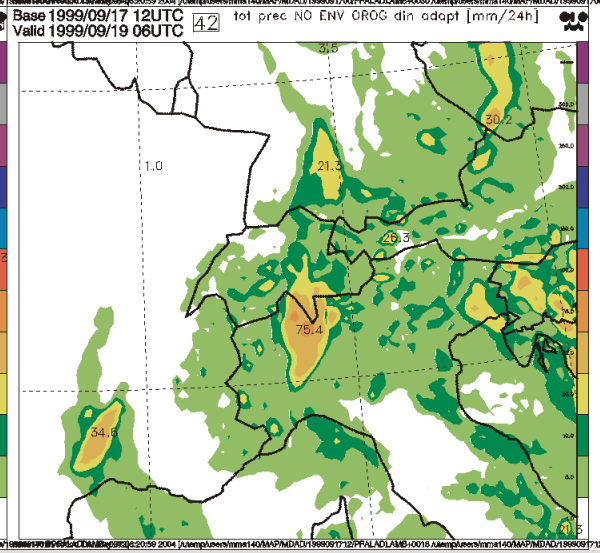
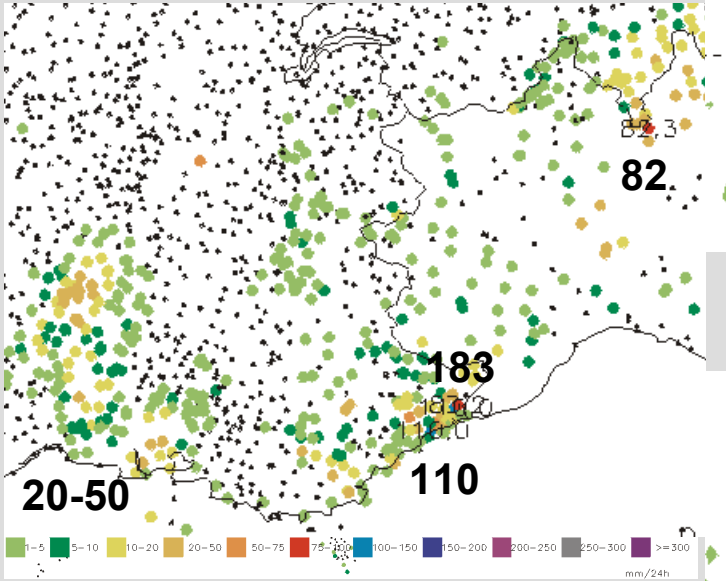


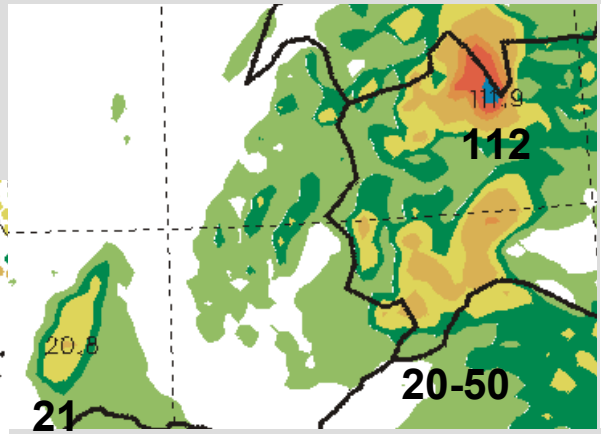


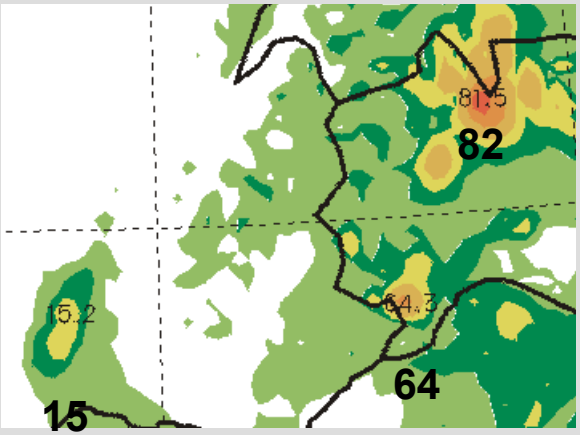
Forecast of precipitation 18-19.09.1999 06 UTC

start 17.09.1999 00UTC

24-h tot. prec.







ENV OROG

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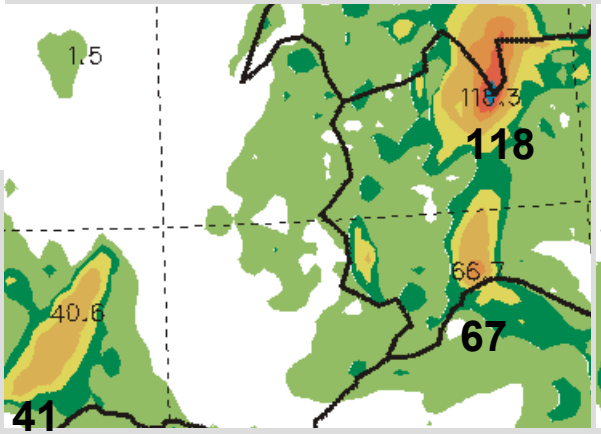
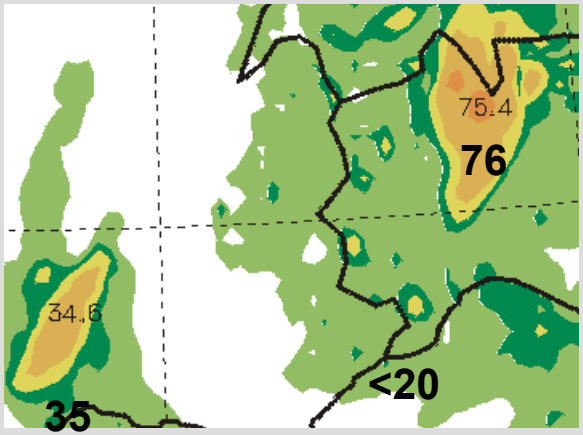
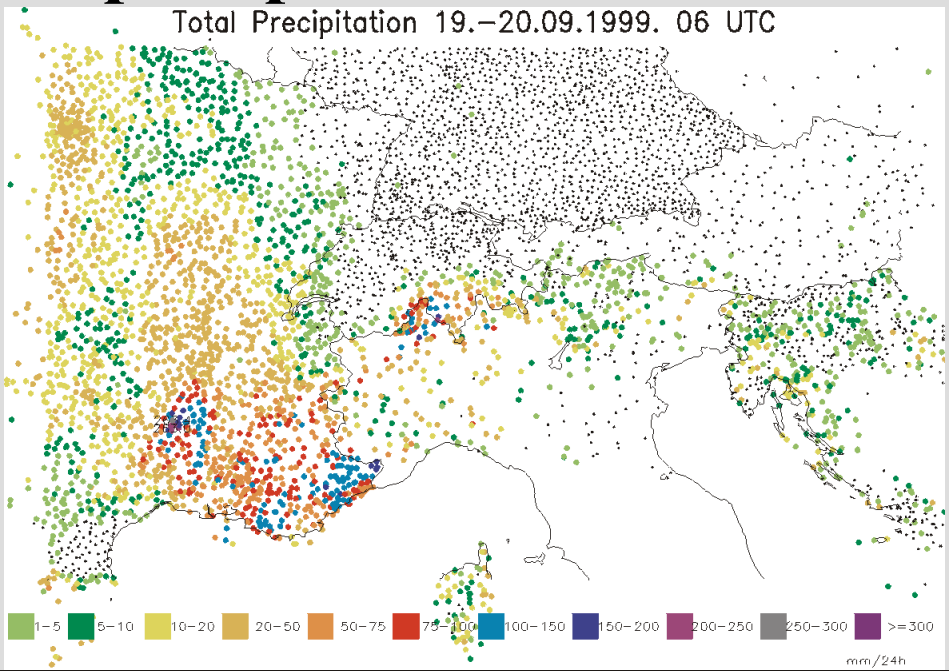




start 17.09.1999 12UTC

Forecast of precipitation 19-20.09.1999 06 UTC

24-h tot. prec.



start 17.09.1999 12UTC

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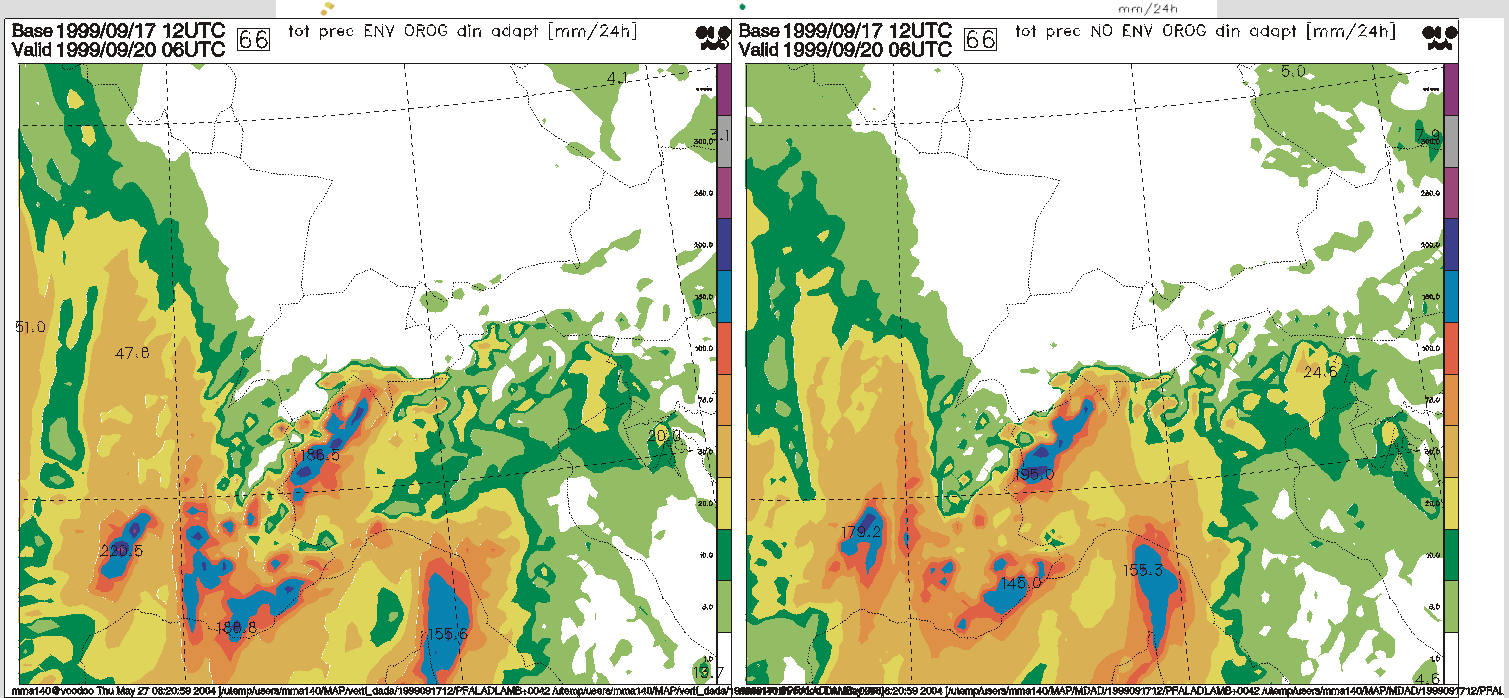

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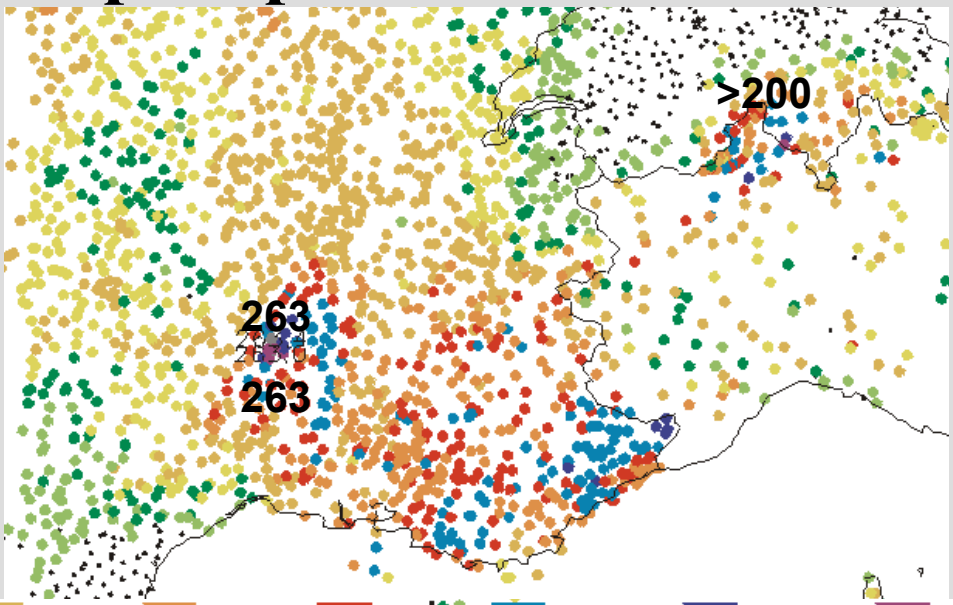
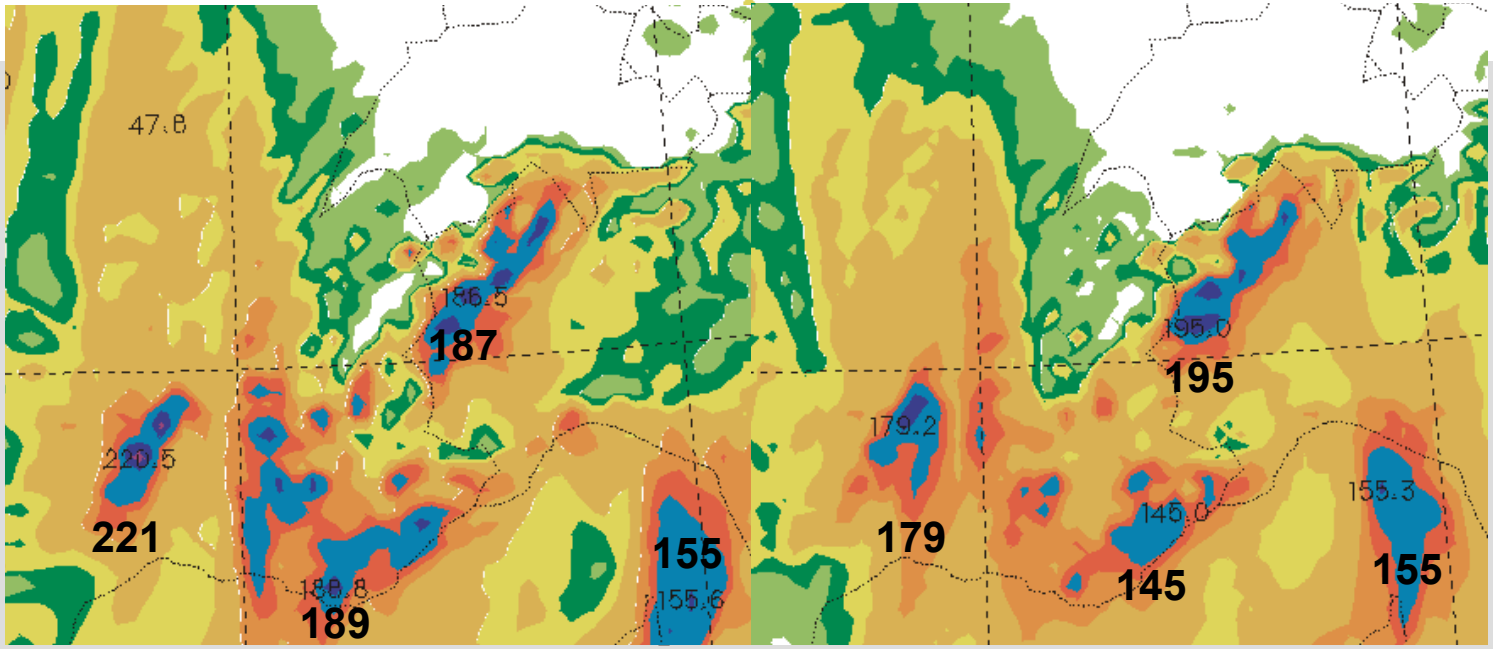
Forecast of precipitation 19-20.09.1999 06 UTC

24-h tot. prec.



start
17.09.1999
12UTC

ENV
ORO



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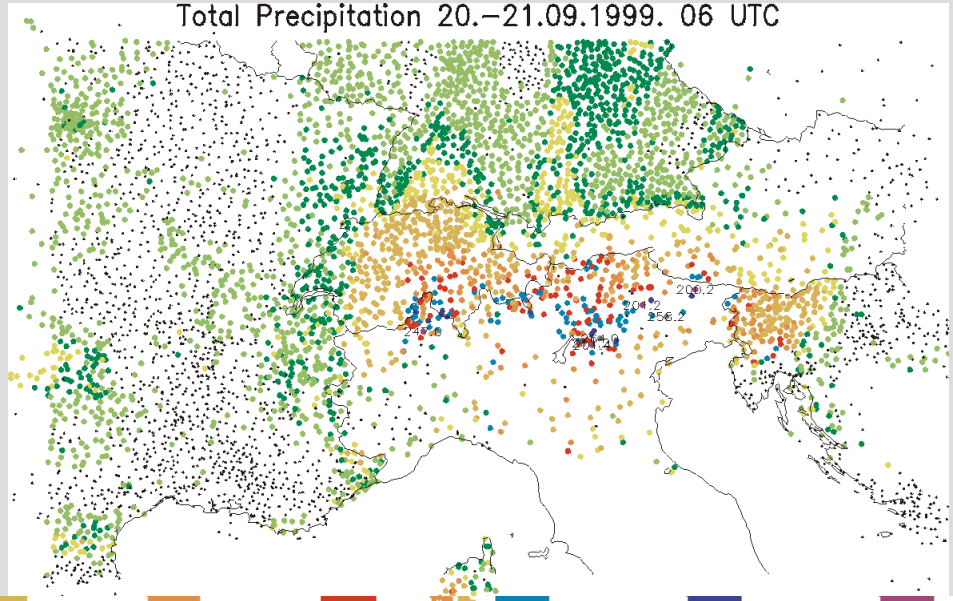
ENV
ORO

Forecast of precipitation 20-21.09.1999 06 UTC

No Envelope



start
20.09.1999
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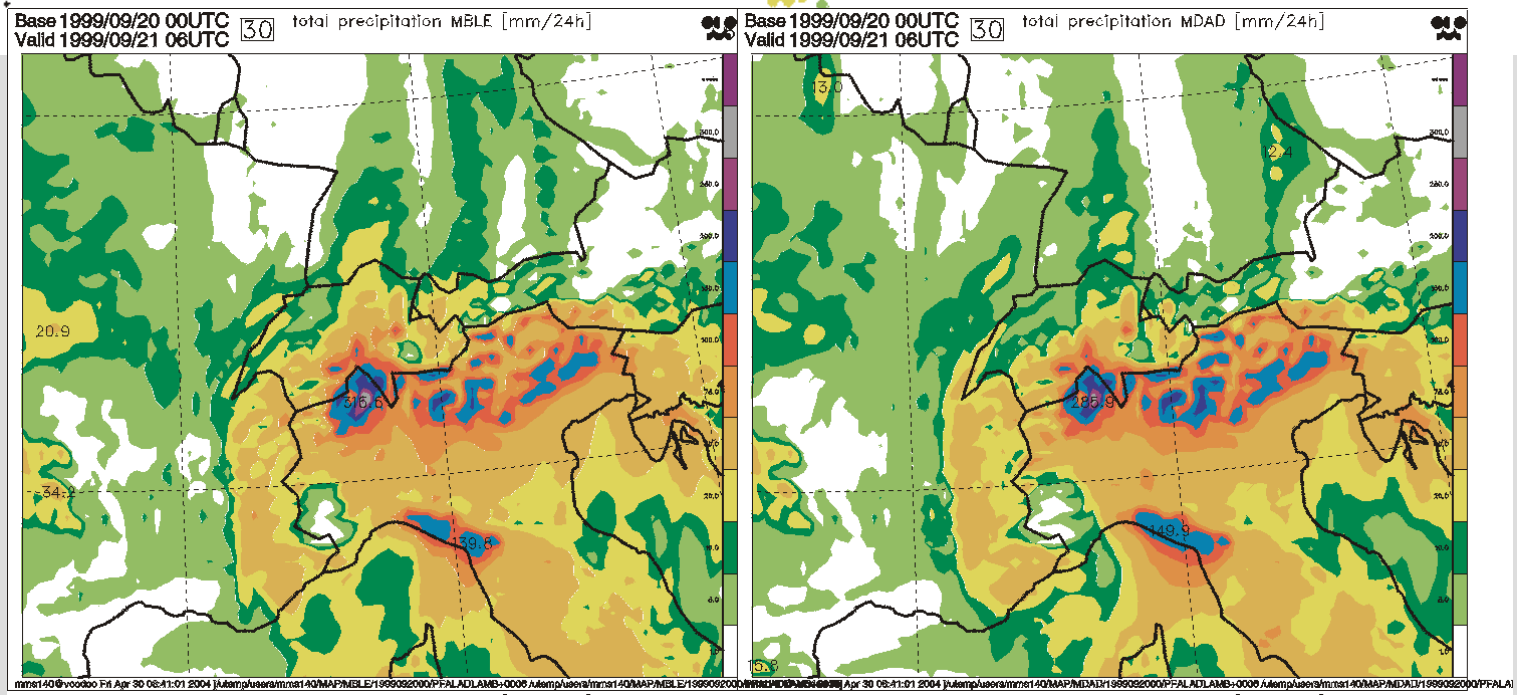
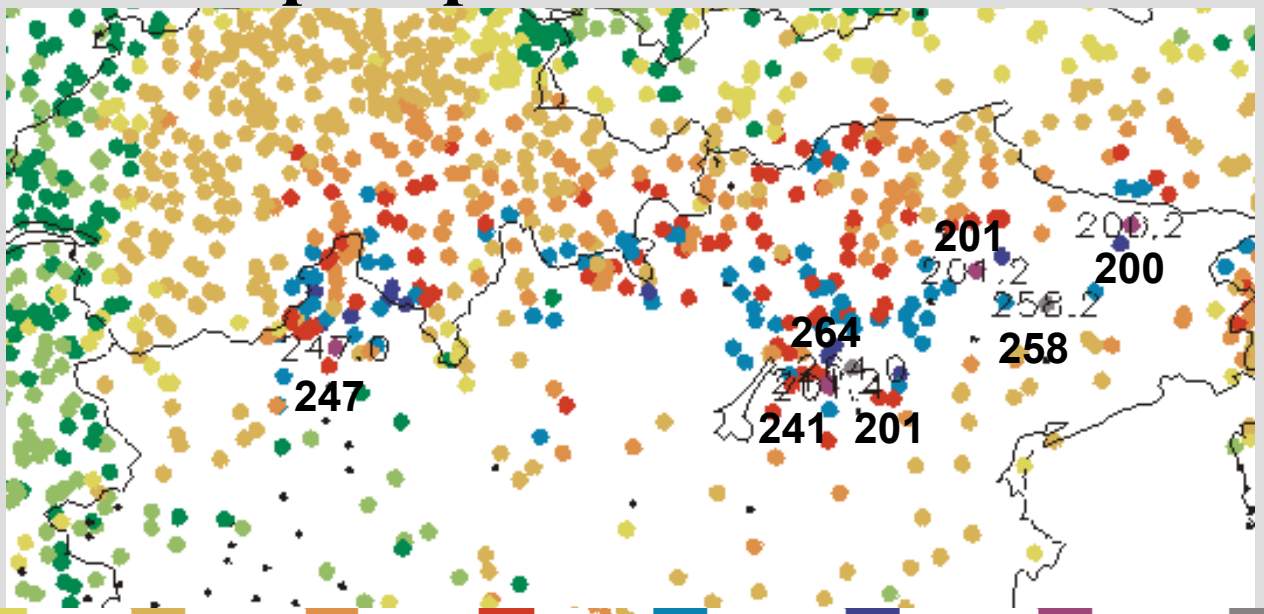
Blending

Dyn. Adaptation



Forecast of precipitation 20-21.09.1999 06 UTC

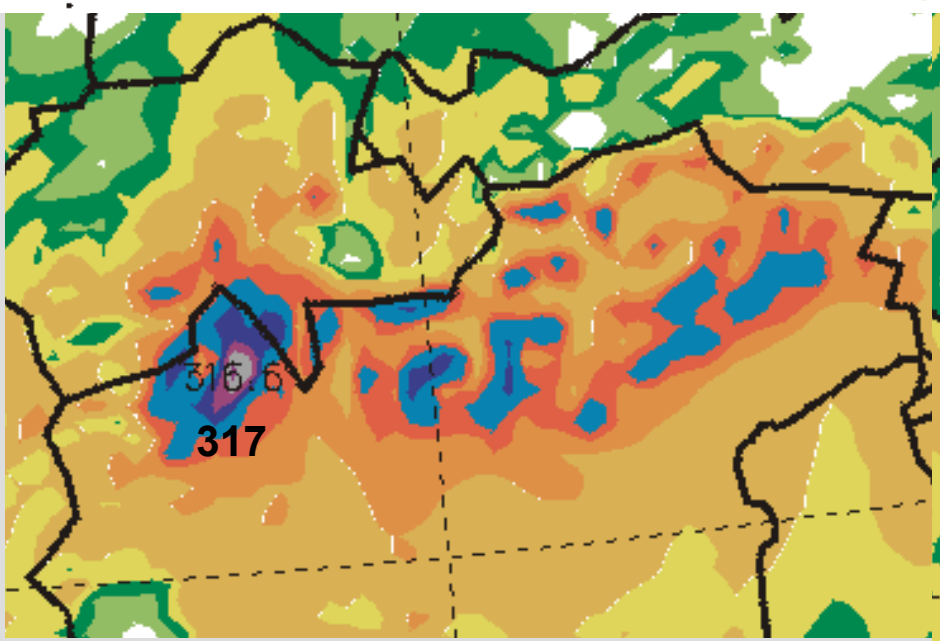
No Envelope

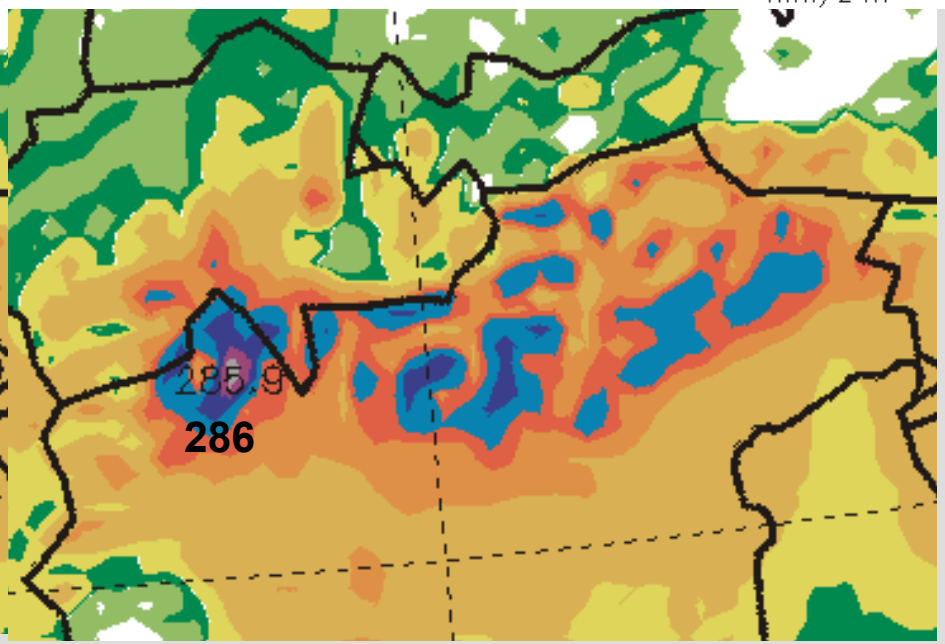


start 20.09.1999 00UTC

Blending

Dyn. Adaptation





What was done and what should be done

What was done:

- Transfer of MAP Re-Analysis GRIB files from Reading $\Rightarrow$ Toulouse
- 901 of ECMWF MAP Re-Analysis from GRIB format $\Rightarrow$ FA
- Mixing of ECMWF upper-air and ARPEGE surface $\Rightarrow$ ECAR init files
- Preparation of coupling files for MFSTEP domain (ECAR 001)
- Testing of different orography $\Rightarrow$ using of No Envelope orog
- Testing of different gravity drag coefficients $\Rightarrow$ GWDCD=GWDLT=1

What should be done in the near future?

- To finish DF Blending assimilation suite in Prague,
- To start using the available ECMWF/ARPEGE/ALADIN Re-Analysis data.