REPORT

Downscaling of the ECMWF MAP Re-Analysis (e9mi) IFS(ECMWF)/ARPEGE/ALADIN-Blending

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1 Introduction

The Mesoscale Alpine Program (MAP) Special Observing Period (SOP) that took place from 7 September to 15 November 1999 involved the largest number of additional measurements in Europe so far. The availability of MAP ECMWF reanalysis, issued at spring 2003, has allowed the common environment for simulations of the most relevant MAP Intensive Observation Period (IOP) cases. Summary of IOP cases could be found on following MAP Web address http://www.map2.ethz.ch/sop-doc/catalog/overview/summaryofiop.html .

The several possible targets for ALADIN research are: better initial and LBC files as background for ALADIN 3D-Var, test bed for high resolution ALADIN configurations, high resolution verification of well described MAP cases and inter-comparison of models.

During stays in year 2004 in CHMI (Prague) the procedures for proper downscaling of ECMWF MAP Re-Analysis and preparation of ALADIN initial and LBC files were done. Downscaling were done for 66 days, from 11th September to 15th November 1999. The reason why all 70 days of MAP SOP Re-Analysis products were not treated with downscaling procedures, is a strike in Météo-France in 1999, that means that ARPEGE surface analysis does not exist. That is not a big problem because there were no IOP cases during that period.

ECMWF Technical Memo 401 describes MAP Re-Analysis experiment (with 12-hour 4D-Var and 40 km horizontal resolution (T511/159L60), and gives the comparison between the Re-Analysis system in 2003 and operational ECMWF analysis, available at 1999, during SOP. (http://www.ecmwf.int/publications/library/ecpublications/_pdf/tm/401-500/tm401.pdf)

2 Changes in characteristics of the IFS and ARPEGE from 1999 till 2003/04

Characteristics of the 1999 ARPEGE T199 c3.5: quadratic grid, horizontal resolution from 20 km over France to 200 km on antipode, 31 vertical levels, highest model level is at 5 hPa. Characteristic of the operational ARPEGE T358 c2.4: linear grid, horizontal resolution from 23 km over France to 133 km on antipode, 41 vertical level, highest model level is at 1hPa. 3D-Var replaced with 4D-Var Assimilation. Envelope orography is still in use.

Differences between the 1999's ECMWF operational suite and MAP Re-Analysis are: number of vertical levels increased from 50 to 60, no envelope orography and new sub-grid orography fields were introduced. New cloud and convection scheme and new short-wave radiation transfer model was introduced. Model horizontal resolution increased from 60 to 40 km (T319-T511). 4D-Var window extended from 6 to 12-hour, inner-loop in 4D-Var increased T63 to T159 (120 km), assimilation of more channels of satellite data and European wind profiler data, new bias correction for satellite observations.

3 Downscaling procedure

In the following pages steps of the MAP Re-Analysis with IFS/ARPEGE/ALADIN are explained. As it is known IFS and ARPEGE have different surface parameterization. In order to provide better surface data in analysis than climatology, mixing of ARPEGE surface analysis fields with ECMWF upper-air analysis fields was done.

The downscaling procedure was planned and organized in two steps (diagrams are in Appendixes):

A PART - **ECMWF downscaling**:

- downloading of the "ECMWF analysis **e9mi**" from MARS data base with 6 hour interval, GRIB decoding and changing of geometry toward ARPEGE geometry and resolution,
- interpolation of ARPEGE/1999 surface analyses (T199 C3.5 L31) to ARPEGE/2004 resolution (T358 C2.4 L41 linear grid),
- mixing ARPEGE surface part of analysis with ECMWF upper-air level analysis => "**EC-ARP_ana**" products,
- for 00 and 12 UTC: ARPEGE +66h integration (LBC for MFSTEP domain),
- for 06 and 18 UTC: ARPEGE +6h integration (LBC for MFSTEP domain),
- coupling files are stored on delage: **~mrpm620/MAP_e9mi/YYYY/MM/DD/TE COUPLECAR+00xx .**

B PART -**ALADIN Blending initialization**:

- Aim was to produce initial files for integration from Blending production events. Little bit modified MFSTEP set-up of ALADIN Blending assimilation cycles and Production events was used. Initial files for integration or ALADIN 3D-Var are ready. They are stored on delage : **~mrpm620/MAP_e9mi/YYYY/MM/DD/TE ICMSHECARINIT .**
- It is possible to find same file in Prague on archiv (different name than in Toulouse): **~mma140/MAP_adp/YYYY/MM/DD/TE ICMSHOPERINIT** .
- 3rd place, lace ftp server **: ~ftplace/MAP_adp/YYYY/MM/DD/TE ICMSHECARINIT .**

Now it is possible to use 00 Coupling file (A PART) or Initial files from Blending Production cycle (B PART) as initial file for the ALADIN integration and as a first guess for the ALADIN 3D-Var. All Coupling files (A PART) are LBC files. Which to use is your decision.

3.1 First step (IFS/ARPEGE part) of Downscaling of the MAP Re-Analysis

Toulouse and Reading parts:

a) download of the "analyses" from MARS data base with 6 hour interval (from 10 September 1999 to 15 November 1999), 3 grib files per network time: ana.YYYYMMDD.TE.atm.pdg.grib, ana.YYYYMMDD.TE.atm.spe.grib & ana.YYYYMMDD.TE.sol.pdg.grib (T511/159L60) (ECMWF_ana),

b) those grib files are transformed with procedure 901 to ARPEGE files and then geometry was changed using 927 to T358 C2.4 L41 linear grid (212M),

c) transfer of ARPEGE analyses T199 C3.5 L31 to T358 C2.4 L41 linear grid using 927. The new Climatology files are needed. Orography is read from old ARPEGE Climatology file (clim_arpege.t199.02.m09) C3.5. Configuration 923 is executed with same exe as for ECMWF 923, cy24t1_923main.01.L0209.x.exe ,

d) mix upper part of ECMWF analysis (T358 C2.4 L41 linear grid) with ARPEGE surface data,

With this actions (a-d) mixed Analysis is ready (EC-ARP_ana).

That analysis (EC-ARP_ana) was used to start the production. 66 hrs forecast was performed with 3 hrs outputs for runs 00 and 12 UTC, with DFI at the beginning. 6 hour forecast was performed for 06 and 18 UTC runs. The output from 66 hrs forecast will be used as Analysis (+00), Guess (+06) and LBC data for integration (+00, +03, ... , +66).

Total number of files stored on delage:
00 & 12 UTC: EC-ARP_ana file (T358 C2.4 L41 linear grid)
MFSTEP Telecom files 23 (till 66 hrs frequency 3hrs) - file +00 is Analysis, file +06 is Guess,
06 & 18 UTC: EC-ARP_ana file (T358 C2.4 L41 linear grid)
MFSTEP Telecom files for +00 (Analysis) and +06 (Guess).

Diagram I**: Preparation of the IFS(ECMWF) and ARPEGE Analysis for mixture**

Preparation of ECMWF Re-Analysis	Preparation of ARPEGE 1999 Analysis
ana.YYYY.MM.DD.TE.atm.spe.grib ana.YYYY.MM.DD.TE.atm.pdg.grib ana.YYYY.MM.DD.TE.sol.pdg.grib	delage (cougar) /chaine/mxpt/mxpt001/ arpege/oper/assim/ YYYY/MM/DD/rSTE/analyse
▼ **901** ▼	
CN90xa001INIT.YYYYMMDD.TE	
▼ **927** **T511 to tl358** **c1 to c2.4** ▼	▼ **927** **t199 to tl358** **c3.5 to c2.4** ▼
PFECMWF00+0000	PFARPE000+0000

Diagram II: **Mixture of ECMWF upper-air and ARPEGE surface fields.**

upper-air PFECMWF00+0000 + soil (ISBA) PFARPE000+0000
▼ **SURF** ▼
EC-ARP_analyse

Files:
ana.YYYY.MM.DD.TE.???.???.grib : delage ~mrpm620/MAP_grib
CN90xa001INIT.YYYYMMDD.TE : delage ~mrpm620/MAP_e9mi_tmp
EC-ARP_analyse files are stored on delage ~mrpm620/MAP_e9mi/YYYY/MM/DD/TE

Source:
SURF program: tora: ~mrpa649/util/source/SURF.F90

Scripts on tora:
DIR: ~mrpm620/MAP/skripte/
job1_ARPCY25T1_901.job:
Configuration 901 without climatology files,
exe cy25t1_901.01.L0209.x.exe, just once.
job2_ARPCY24T1_923.job:
923 for ECMWF climatology,
exe cy24t1_923main.01.L0209.x.exe, just once per month.

MAP_01.job

Configuration 901, 1 CPU, max. mem. usage **928 Mb**, CPU-time **152 s**,
exe cy25t1_901.01.L0209.x.exe,
namelist ~mrpm620/MAP/skripte/my_namel_901_e9mi.

MAP_02.job

Configuration 927 for ECMWF and ARPEGE Analysis and
mixing of ECMWF upper-air with ISBA part from ARPEGE,
4 CPUs, max. mem. usage **2880 Mb**, CPU-time **75 s,**
exe cy25t1_op4main.01.L0209.x.exe,
namelists ~mrpm620/MAP/skripte/ my_naml_927_ECMWF &
my_naml_927_ARPEGE .

ARPEGE integration and producing of a coupling files for MFSTEP domain

EC-ARP_analyse files is download from delage:
~mrpm620/MAP_e9mi/YYYY/MM/DD/TE , stored there.

Script

DIR: ~mrpm620/MAP/ARP_run/

AR.fc.fp.job

ARPEGE integration and ALADIN full-pos are performed, 4 CPUs, max. memory usage **2560 Mb**, **6 hrs** forecast with 2 full-pos (00 & 06) **1200 s** , **66 hrs** forecast with 23 full-pos (00, 06, ... , 66) **6700 s**,
00 & 12 UTC network time- produce coupling files for +00, +03,+66 hrs,
06 & 18 UTC network time- produce coupling files for +00 and +06 hrs,
namelist for 001 job: ~mrpm620/MAP/ARP_run/my_namelistfc.ECAR.001,
executable for ARPEGE 001 job: cy26t1_op5.01.L0209.x.exe,
time-step for 001: 981.81818 sec (11 Tsteps in 3hrs),
(with REVGSL=15., LQMHW = LQMHT = LQMP = LQMQ = TRUE),
DFI parameters: number of steps 14, time-step 981.82, hor. diff. in adiab. T-steps, stop-band edge 5h, T-span 3.818h, min. T-span 3.45h,
Full-pos are done for MFSTEP telecom domain,
executable for full-pos: al26t1_op5.01.L0209.x.exe,
namelist for full-pos: ~mrpm620/MAP/ARP_run/my_namelist.ECAR.coupling,

ALADIN MFSTEP coupling files

Coupling files are stored on delage dir.: **~mrpm620/MAP_e9mi/YYYY/MM/DD/TE ,**
size of the **COUPLECAR+00xx** files are 5 Mb.

Characteristics of the coupling files are the same as for MFSTEP domain:

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

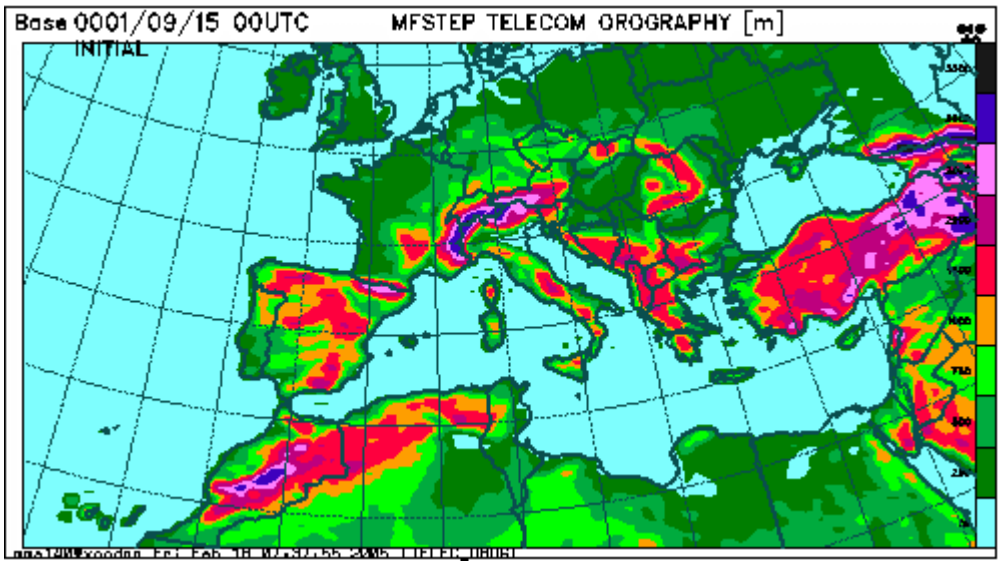


Figure 1. Orography in MFSTEP telecom domain

Clim. for the coupling files are stored on tora, directory ~mrpm620/MAP/climdir/mfstep.q71x39 and in Prague on sx6, directory ~mma007/MFSTEP/clim/telec and on the RC LACE ftp server, directory ~MAP_adp/clim/telec .

3.2 Second step Blending Assimilation suite and production of Blending initial files

This part of the experiment was done in CHMI in Prague.
Library used in experiment (adp) is based on AL25T1 with modifications in physics (mean orography new acdrag, new radiation and nebulosity) with low-level cloudiness modifications, SLHD diffusion schemes. More details about adp suite could be found on CHMI web pages http://www.chmi.cz/meteo/ov/lace/aladin_lace/partests/adp_adn_1/adp.doc . With used executable it is still not possible to run DFI together with SLHD.

Assimilation suite scripts (on sx6):
Directory ~mma140/MFSTEP/preTop/adp/scr/Assim

- shell scripts for automatic submission on jobs are goas1 & goasx ,
- universal jobs are: assim.job1 (for start of suite) & assim.jobx ,

Namelists for Assimilation suite (sx6) ~mma140/MFSTEP/preTop/adp/namelist/Assim

- idfi_bias.name , idfi_incr.namel ,
- lancelot.namel , lancelot_low_3.6.namel ,
- morgane_DFI_low_180005_3.6.namel ,
- morganeDFI.namel & morganeNODFI.namel .

Production of Blending Initial file for Production event (on sx6):
Directory ~mma140/MFSTEP/preTop/adp/scr/Prod

- shell scripts for automatic submission on jobs is go_init ,
- universal jobs is: prod_blend_init.job ,

Namelists for preparation of Blending initial files ~mma140/MFSTEP/preTop/adp/namelist/Prod

- idfi_bias.name , idfi_incr.namel ,
- lancelot.namel , lancelot_prod.namel , lancelot_low_3.6.namel ,
- morgane_DFI_low_180005_3.6.namel ,
- morgane.namel & morganeDFI.namel .

MAP integration domain

Because memory and CPU consumption it was decided to use little bit smaller integration domain than MFSTEP operational domain.

Characteristics of the **computation domain** (ALADIN-MAP),

- Horizontal resolution: 9.509 km,
- 501x309 points (512x320),
- Truncation: 255x159,
- SW corner (349.260°,28.282°), NE corner (49.251°,46.076°),

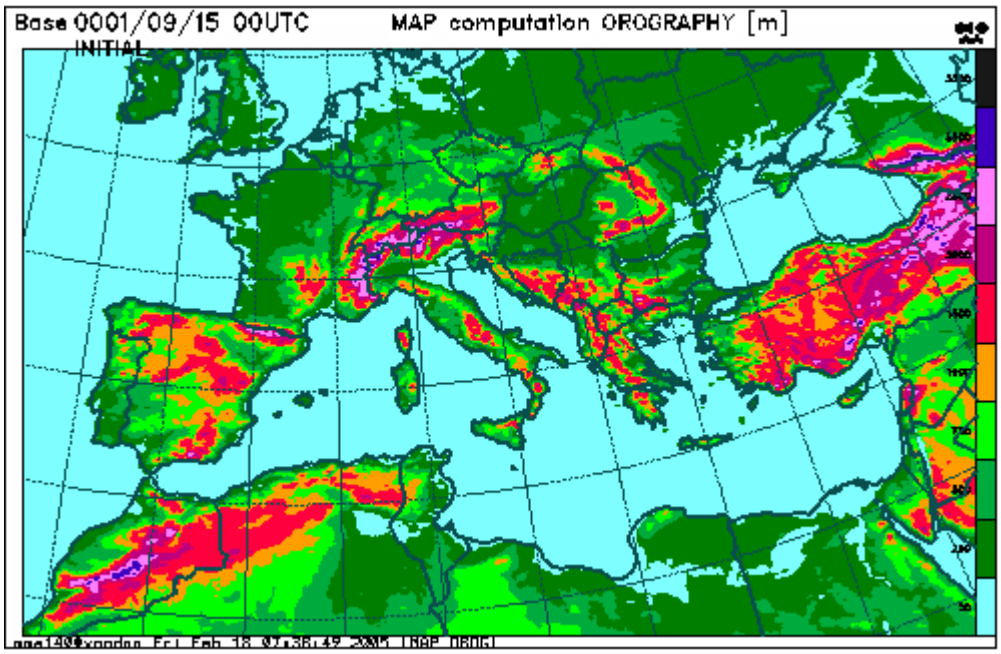


Figure 2. Orography in MAP integration domain

Climatology files for ALADIN-MAP domain with linear grid and without envelope orography are stored in Toulouse on delage, directory ~mrpm620/climdir/map/comp_noenv_lin , in Prague on sx6, directory ~mma140/clim/map/comp_noenv_lin and on RC LACE ftp server, ~MAP_adp/clim/comp_noenv_lin .

4 Additional scripts & information

Forecast with Blending initial files and usual dynamical adaptation from coupling files

It is possible to use scripts for adp suite to make forecast up to 66 hours. With the same script it is possible to make a forecast that starts once from initial file made by Blending and once from coupling file as initial file (usual dynamical Adaptation). At the moment only coupling files for a few days in September were transferred to Prague. In spring 2004 there was a problem with free space on archive machine (archiv) in Prague. Script for submission and universal job should be copied to directory from where you want to launch it. Then you should change directory in the script go_FC .

Directory ~mma140/MFSTEP/preTop/adp/scr/Prod

- shell scripts for automatic submission on jobs is go_FC ,
- universal jobs is: FC_from_INIT_FC_from_COUP.job ,

Namelists for preparation of Blending initial files ~mma140/MFSTEP/preTop/adp/namelist/Prod

- lancelot_prod.namel ,
- morgane.namel & morganeDFI.namel .

CMAFOC files for verification

CMAFOC files in ASCII format are stored on delage in directory: ~mrpm620/LACE_CMAFOC
File name is cmafoc_cplYYYYMMDD_TE.gz . Those files were made form cmafoc_cpl files but just the data valid for the interval +/-1 hour from Network time are in the file.
cmaofocf files were not used because precipitation amount is included in the cmafoc_cpl file.
The same files are in Prague too on machine archiv in directory: ~mma140/LACE_CMAFOC with the same name cmafoc_cplYYYYMMDD_TE.gz .
Page with lot of on-line data: (http://www.map.ethz.ch/sop-doc/sop_info/sop_info.htm).

Database with 24-hour precipitation

Cumulative 24-hour precipitation is available on address:
(http://www.map.ethz.ch/owa/mappub/query_rain06sop?the_table=rain_sop06&html_back=/sop-doc/sop_info/sop_info.htm&sdate=07.09.1999&edate=16.11.1999).

5 Verification results

In this report verification scores for coupling files (MCPL) and initials files for integration from Blending Production events (ADPI) are compared. In MCPL coupling files are first transferred from telecom to integration resolution and then verification scores are computed. Verification scores for 850 hPa and surface levels and for 00 and 12 UTC network time. Scores for the whole Blending Assimilation suite will be published on RC-LACE Web.

Verification scores for 850 hPa, shows that there is no important difference between 00 and 12 UTC network time.
For 850 hPa geopotential, bias is worse for blending initial files than for coupling files. For other parameters for 850 hPa, bias is similar for blending initial and coupling files.
For 850 hPa, rms is similar or better for blending initial than for coupling files.

For surface, verification scores are dependent on network time. MSL pressure and 2m-humidity biases are better in coupling files for 00 & 12 UTC. 2m-temperature bias is better for coupling files for 00 UTC and better for blending initial files for 12 UTC. Wind bias is better for blending initial files.
For surface, rms scores are better for 00 UTC for 2m-temperature and almost the same quality for MSL pressure and 2m-humidity. For 12 UTC rms is worse just for 2m-humidity. Rms for wind is better for blending initial files.

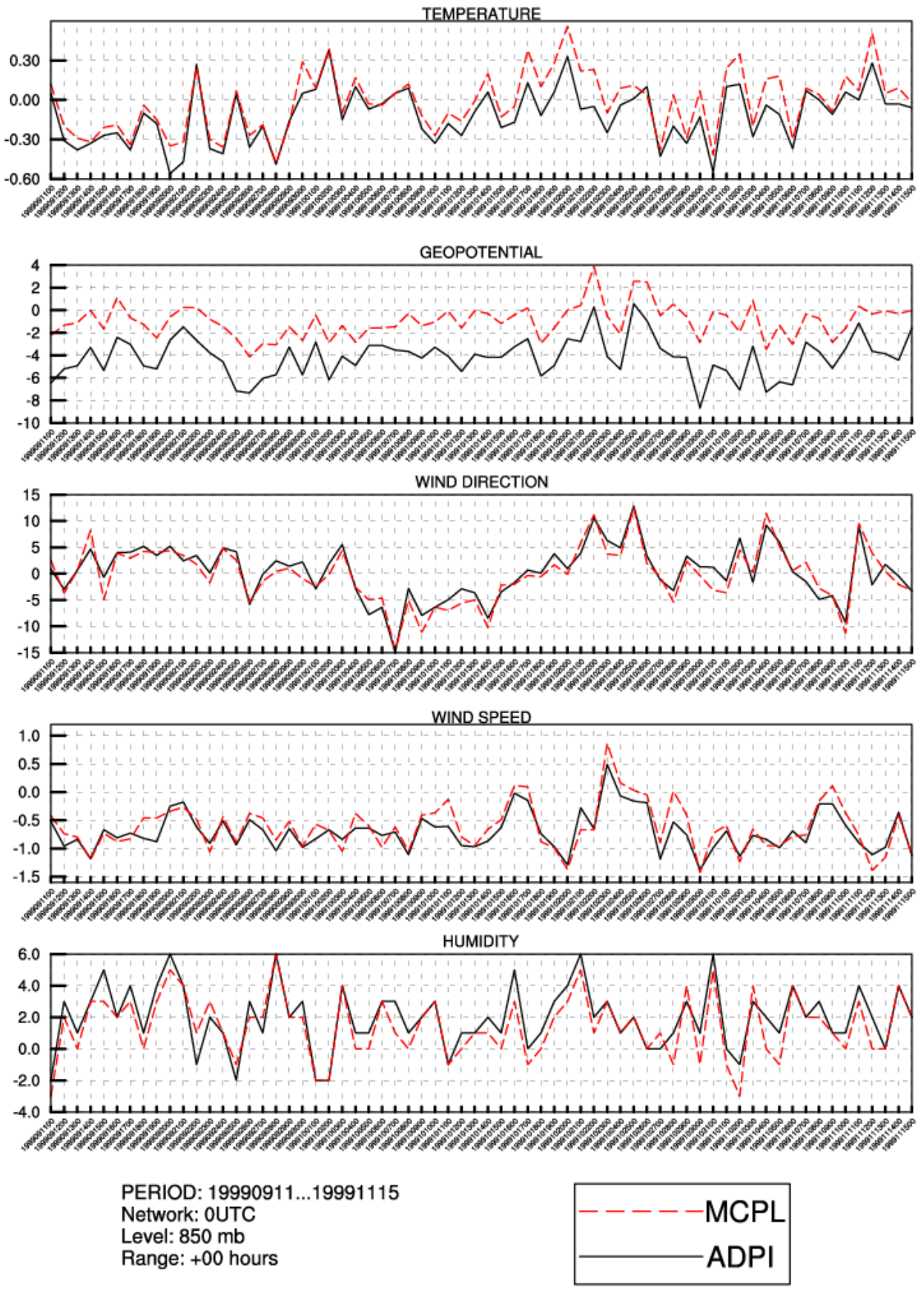


Figure 3. Verification scores BIAS on 850 hPa for whole MAP period for 00 UTC

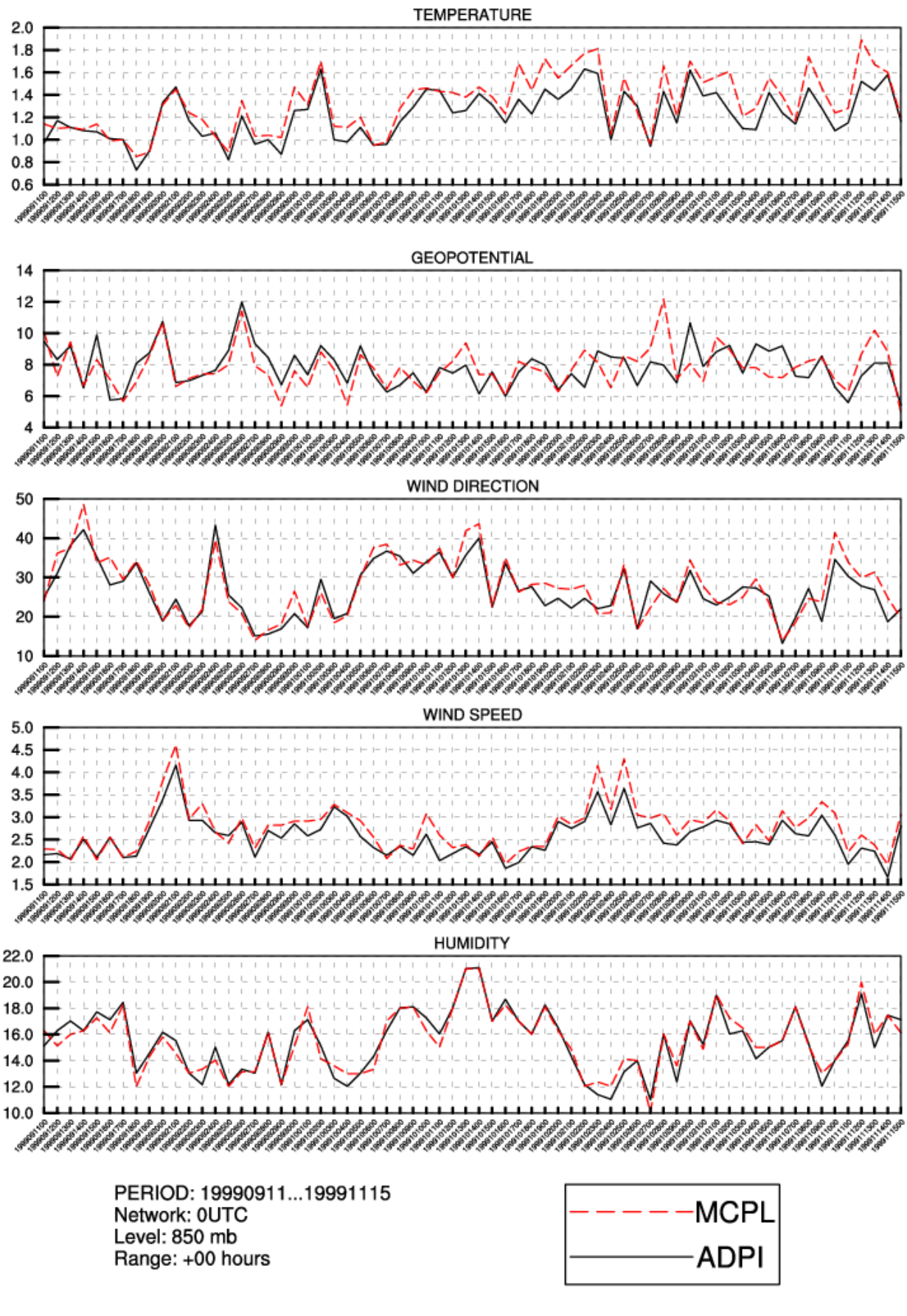


Figure 4. Verification scores RMS on 850 hPa for whole MAP period for 00 UTC

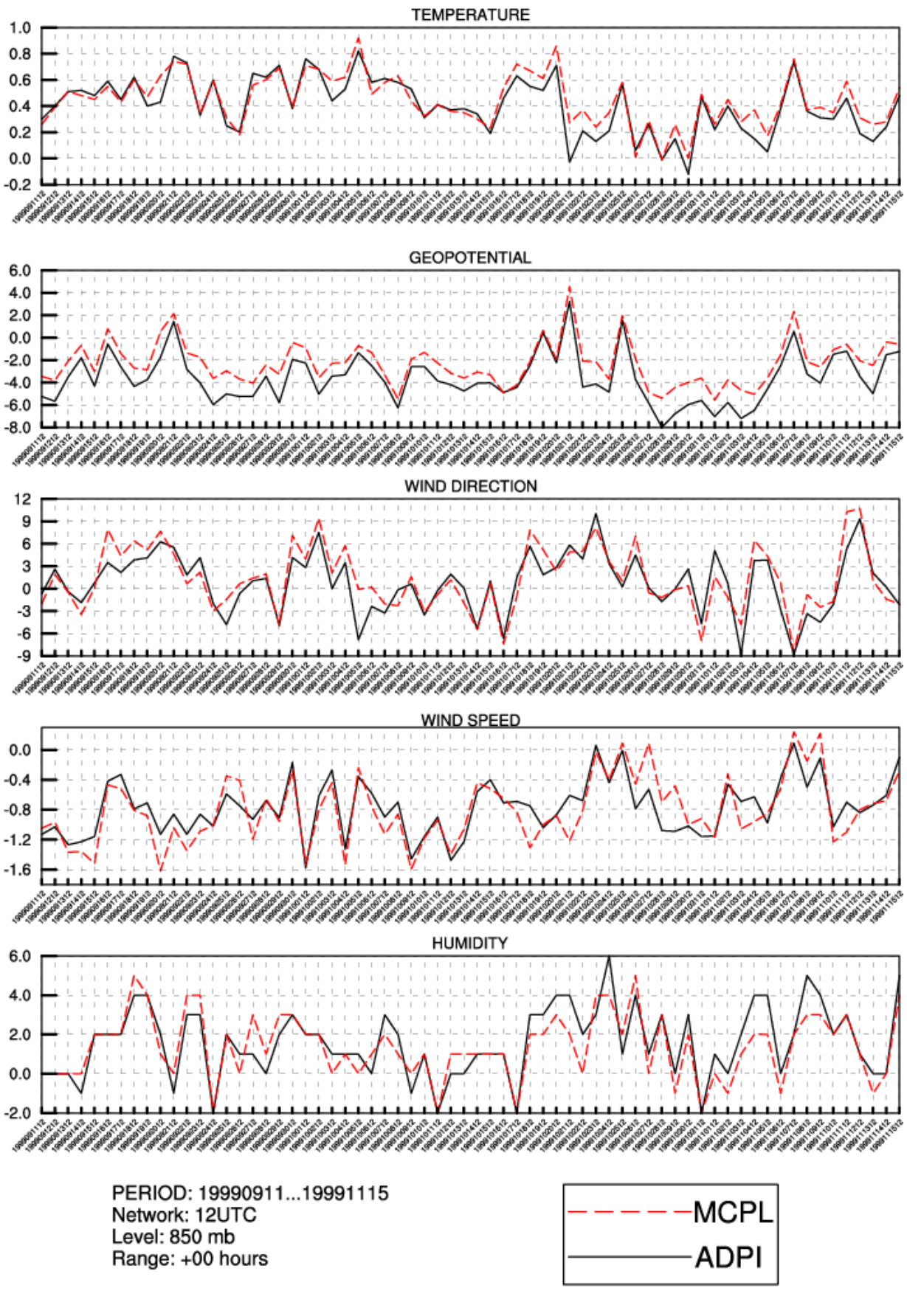


Figure 5. Verification scores BIAS on 850 hPa for whole MAP period for 12 UTC

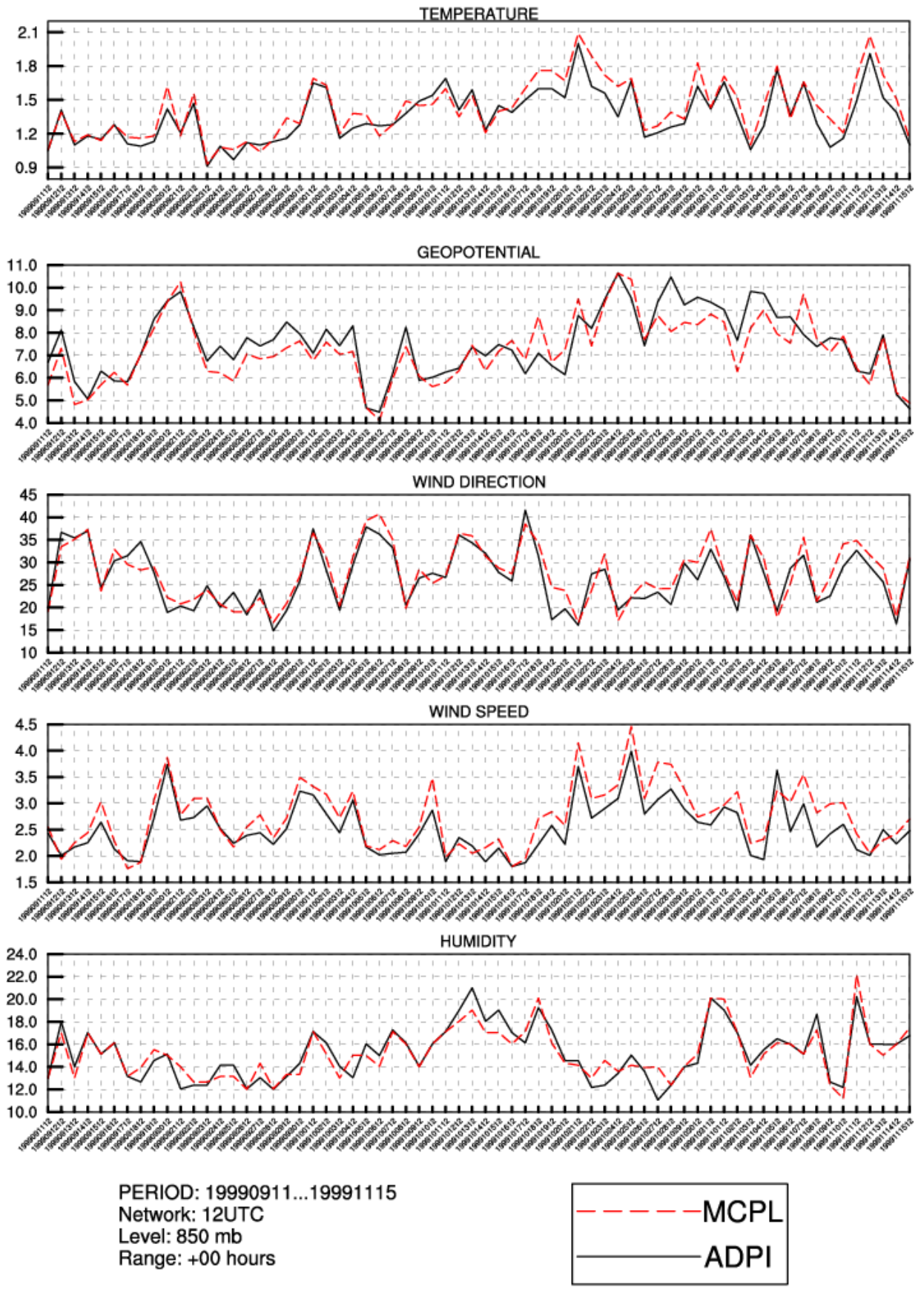


Figure 6. Verification scores RMS on 850 hPa for whole MAP period for 12 UTC

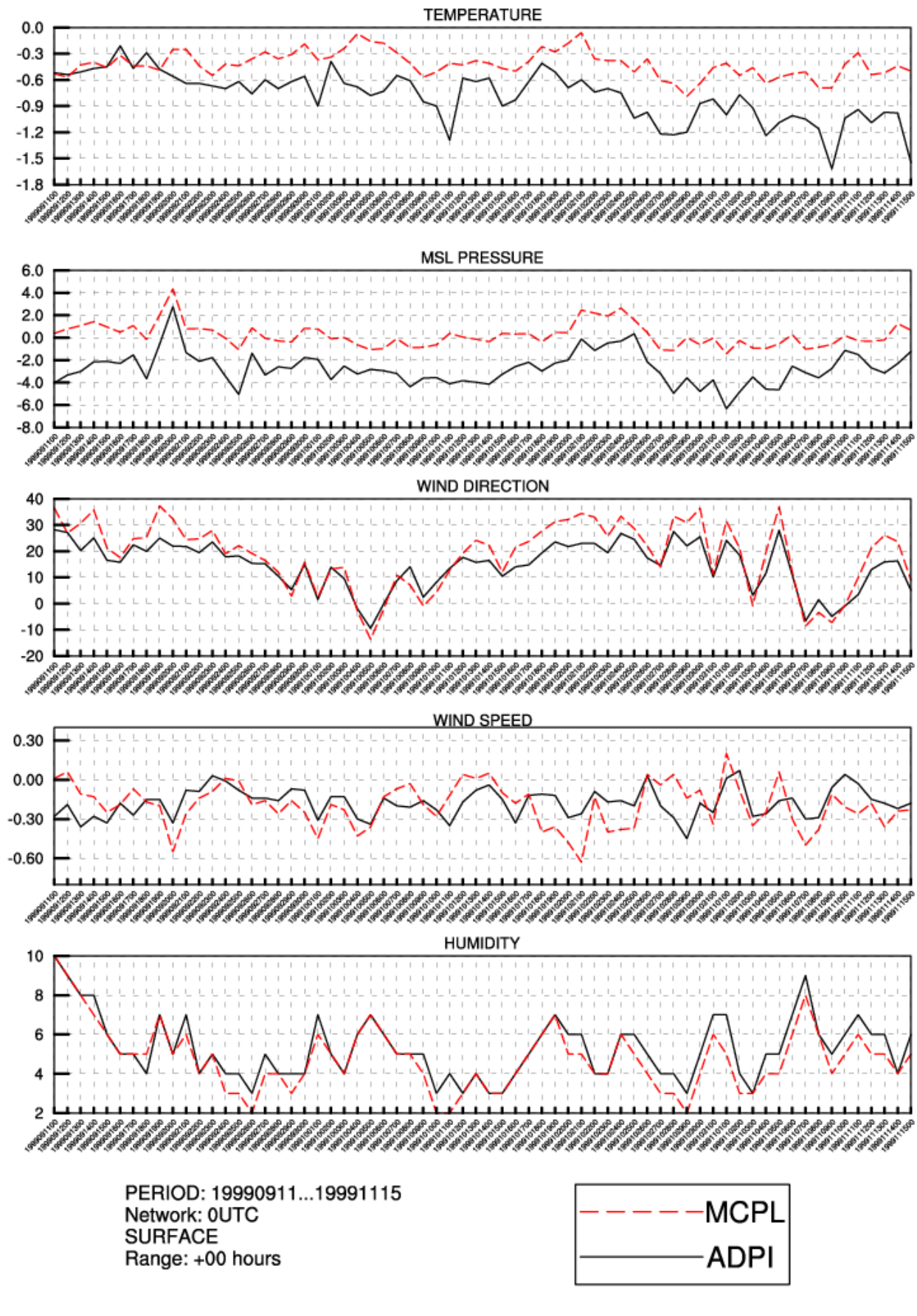


Figure 7. Verification scores BIAS on surface for whole MAP period for 00 UTC

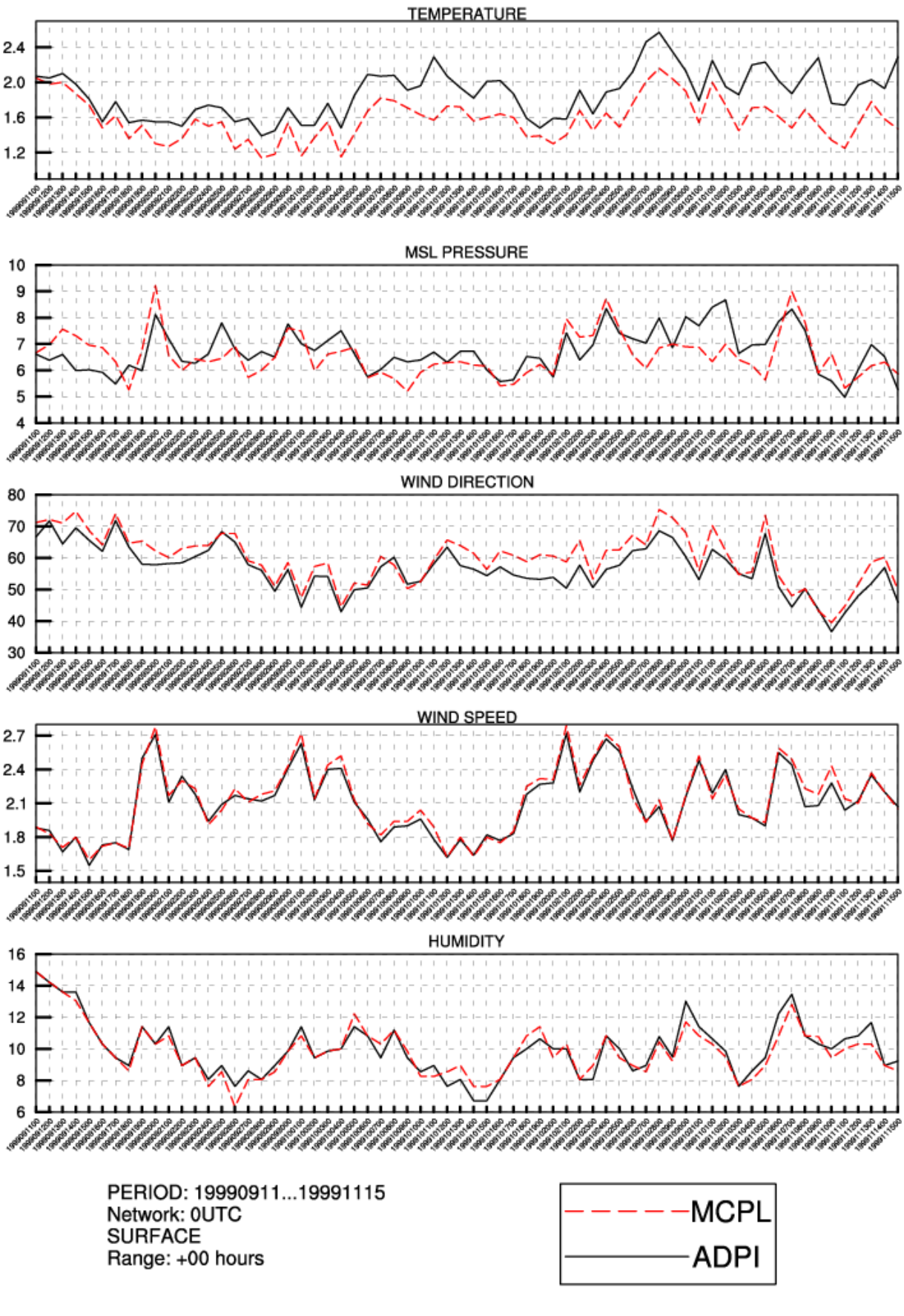


Figure 8. Verification scores RMS on surface for whole MAP period for 00 UTC

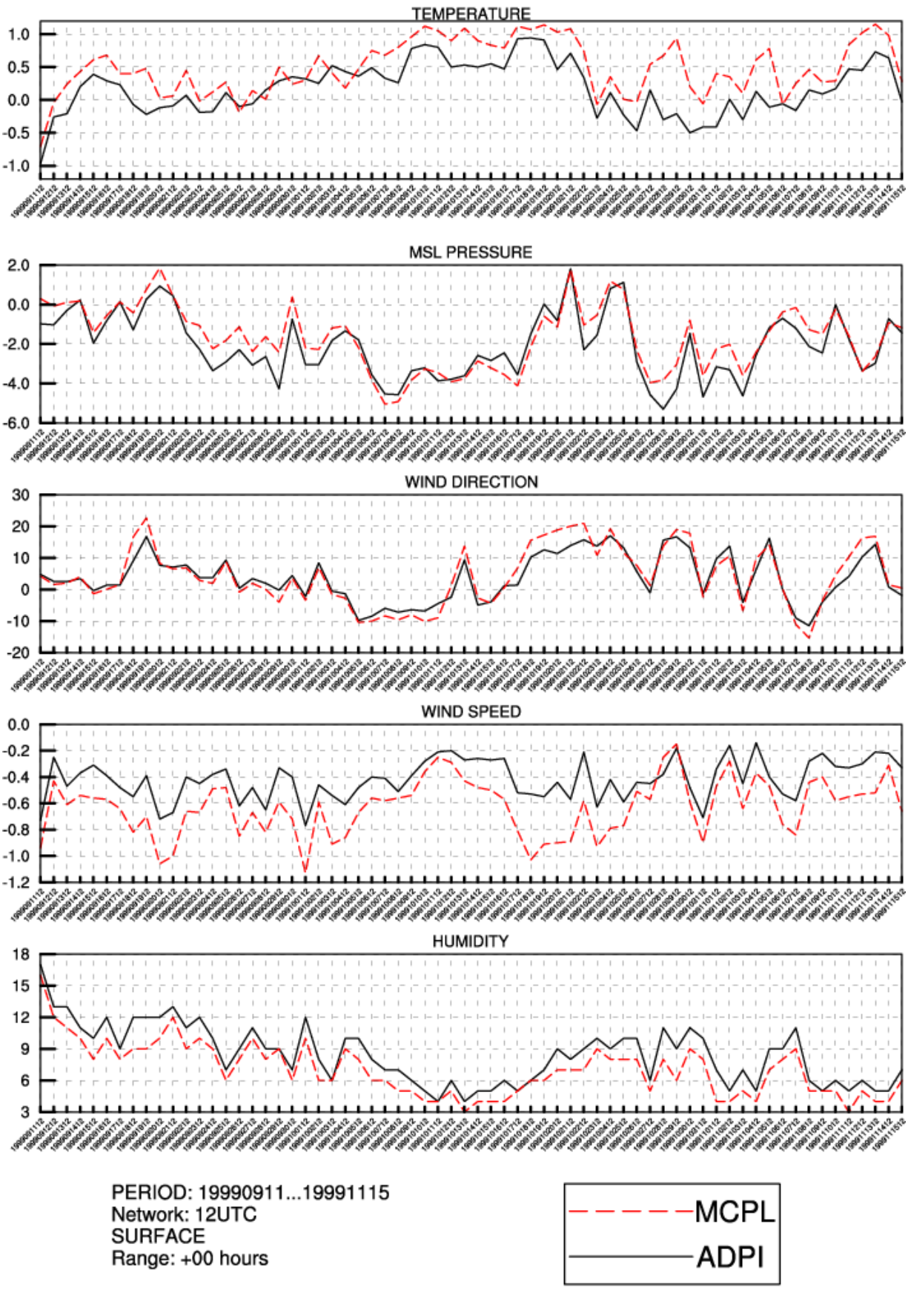


Figure 9. Verification scores BIAS on surface for whole MAP period for 12 UTC

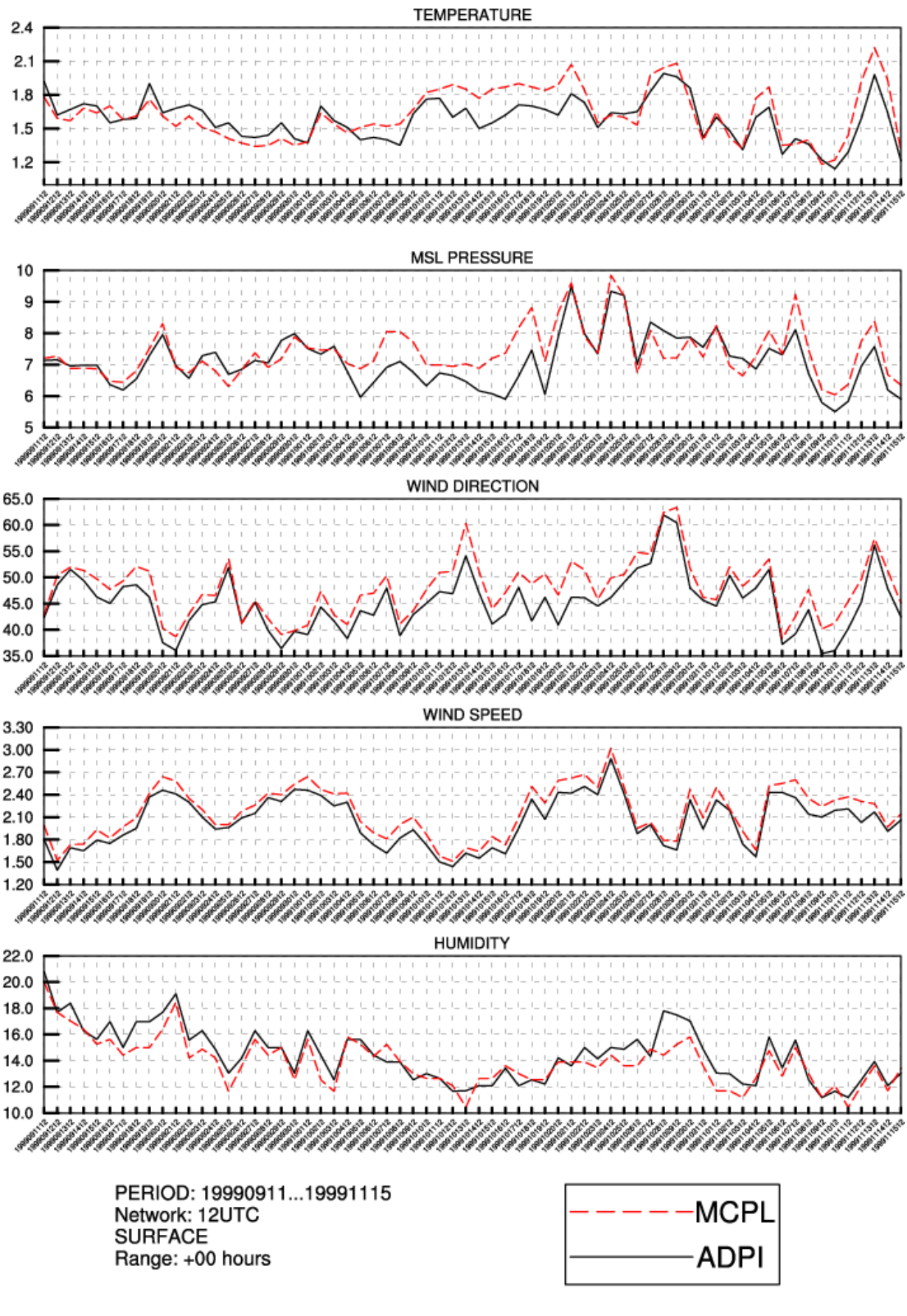
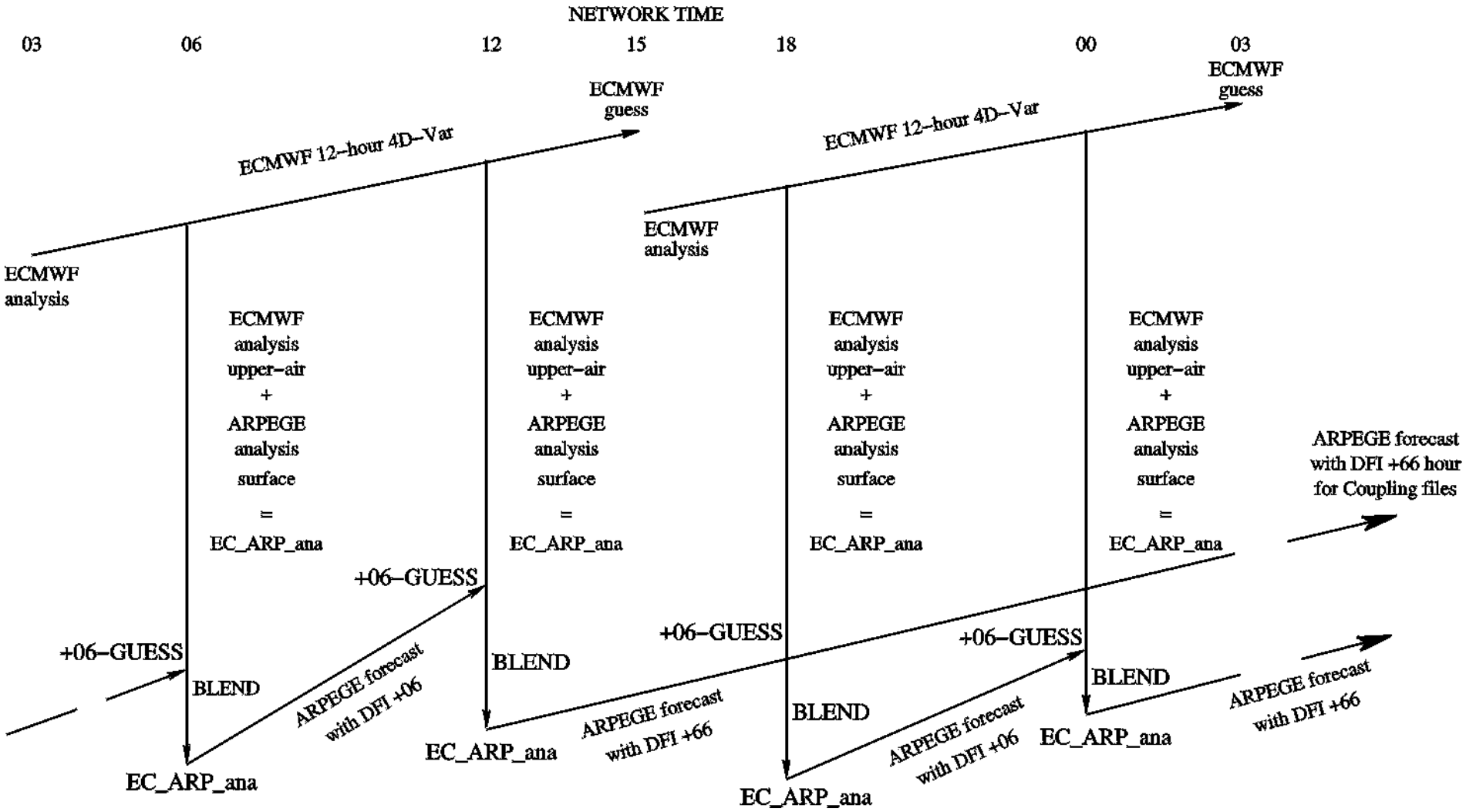


Figure 10. Verification scores RMS on surface for whole MAP period for 12 UTC

Appendix I: ECMWF(IFS)/ARPEGE/ALADIN Blendig Cycle



Appendix II. MAP Re-Analysis preparation of mixed IFS (ECMWF)-ARPEGE (Meteo-France) analysis (upper air form IFS MAP Re-Analysis (e9mi) - surface (ISBA) Analysis ARPEGE)

MAP Re-Analysis MARS field e9mi are to be stored on delage (all grib files **146 Mb** x 4 runs)
ana.YYYY.MM.DD.TE.atm.spe.grib **(91 Mb)**
ana.YYYY.MM.DD.TE.atm.pdg.grib **(40 Mb)** ⇒ **901** ⇒ CN90xa001INIT.YYYYMMDD.TE ⇒ **927 T511 to tl358** ⇒ PFECMWF00+0000
ana.YYYY.MM.DD.TE.sol.pdg.grib **(15 Mb)** (**stored temporary on delage 212 Mb**) **c1 to c2.4**

Per day for grib files **584 Mb**

ARPEGE analysis from delage /chaine/mxpt/mxpt001/arpege/oper/assim/YYYY/MM/DD/rSTE/analyse ⇒ **927 t199 to tl358** ⇒ PFARPE000+0000
rSTE = r0, r6, r12 & r18 **c3.5 to c2.4**

upper-air PFECMWF00+0000 + soil (ISBA) PFARPE000+0000 ⇒ **SURF** ⇒ EC-ARP_analyse **(202 Mb)**

Per day for analysis **808 Mb**

ana.YYYY.MM.DD.TE.???.???.grib are on delage /cnrm2_a/mrpm/mrpm620/MAP_grib
CN90xa001INIT.YYYYMMDD.TE are on delage /cnrm2_a/mrpm/mrpm620/MAP_e9mi_tmp
EC-ARP_analyse files are to be stored on delage /cnrm2_a/mrpm/mrpm620/MAP_e9mi/YYYY/MM/DD/TE
source of SURF program are on tora: /u/gp/mrpa/mrpa649/util/source/SURF.F90

Scripts

DIR: /u/gp/mrpm/mrpm620/MAP/skripte/
job1_ARPCY25T1_901.job - configuration 901 without Climatology files, exe cy25t1_901.01.L0209.x.exe, just once.
job2_ARPCY24T1_923.job - 923 for ECMWF Climatology, exe cy24t1_923main.01.L0209.x.exe, just once for each month.
MAP_01.job - for configuration 901,
1 CPU, max. memory usage **928 Mb**, total CPU-time **152 Secs (one day 580 Secs)**,
exe cy25t1_901.01.L0209.x.exe, namelist /u/gp/mrpm/mrpm620/MAP/skripte/my_namel_901_e9mi .
MAP_02.job - for ECMWF and ARPEGE 927 and mixing upper-air from ECMWF and ISBA part from ARPEGE,
4 CPUs, max. memory usage **2880 Mb**, total CPU-time **75 Secs (one day 280 Secs)**,
exe cy25t1_op4main.01.L0209.x.exe, namelists /u/gp/mrpm/mrpm620/MAP/skripte/ my_naml_927_ECMWF & my_naml_927_ARPEGE

Appendix III. ARPEGE integration and producing of a coupling files for MFSTEP domain

EC-ARP_analyse files is download from delage /cnrm2_a/mrpm/mrpm620/MAP_e9mi/YYYY/MM/DD/TE , stored there.

Script

DIR: /u/gp/mrpm/mrpm620/MAP/ARP_run/

AR.fc.fp.job
- for 00 and 12 UTC script produce coupling files for MFSTEP domain for +00, +03, ... , +66 hrs,
- for 06 and 18 UTC script produce coupling files for MFSTEP domain for +00 and +06 hrs,
- Analysis for blending cycle is +00 file and Guess for blending cycle is +06 hrs ,
- namelist for 001 job is /u/gp/mrpm/mrpm620/MAP/ARP_run/my_namelistfc.ECAR.001 ,
- executable for ARPEGE 001 job cy26t1_op5.01.L0209.x.exe ,
- time-step for 001: 981.81818 sec (11 Tsteps in 3hrs),
- namelist for full-pos is /u/gp/mrpm/mrpm620/MAP/ARP_run/my_namelist.ECAR.coupling
- executable for full-pos al26t1_op5.01.L0209.x.exe,
- whit REVGSL=15. ,
- with LQMHW = LQMHT = LQMP = LQMQ = TRUE ,
- DFI parameters: number of steps 14, time-step 981.82, hor. diff. in adiab. T-steps, stop-band edge 5h, T-span 3.818h, min. T-span 3.45h
- ARPEGE integration and after that ALADIN full-pos are performed,
- 4 CPUs, max. memory usage **2560 Mb**, **per day** CPU-time **15600 Secs**
- **6 hrs** forecast with 2 full-pos (00 & 06) **1200 Secs** ,
- **66 hrs** forecast with 23 full-pos (00, 06, ... , 66) **6700 Secs** ,

Files are stored on delage directory: /cnrm2_a/mrpm/mrpm620/MAP_e9mi/YYYY/MM/DD/TE
size of COUPLECAR+00xx files - 5 Mb
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**

The CMAFOC files in ASCII format are stored on delage directory: /cnrm2_a/mrpm/mrpm620/LACE_CMAFOC
file name is cmafoc_cplYYYYMMDD_TE.gz. This file were made form cmafoc_cpl file but just +/-1 hour from Network time is file.
Precipitation amount is same in file, that is the reason why cmaofocf files were not used.
The cmafoc_cplYYYYMMDD_TE.gz files will be stored on archive too.

Appendix IV ALADIN DFI blending for ECMWF/ARPEGE/ALADIN MAP Re-Analysis - I

(No DFI in ass. incremental DFI in ass. & prod.) and simple surface blending

Assimilation cycle (00, 06, 12 & 18 UTC) (ICMSHALAS+0006.prev)

ICMSHALAS+0006.prev →ee927$_{AL2LOW}$→ ICMSHALARINIT
ELSCFALARALBC000
ELSCFALARALBC001
} →DFI$_{LOW}$→ ICMSHALAR+0000 →ee927$_{LOW2AL}$→ ICMSHALAI+0000

COUPLECAR+0000 →ee927$_{AR2AL2LOW}$→ ICMSHARPRINIT
ELSCFARPRALBC000
ELSCFARPRALBC001
} →DFI$_{LOW}$→ ICMSHARPR+0000 →ee927$_{LOW2AL}$→ ICMSHARPI+0000

COUPLECAR+0000 →ee927$_{AR2AL}$→ ICMSHARPR+eeAR

COUPLECAR+0006.prev →ee927$_{AR2AL}$→ ICMSHARPR+6eAR

Surface blending
ICMSHALAS+0006.prev + (ICMSHARPR+eeAR − ICMSHARPR+6eAR) → ICMSHALASINITA

Surface blending
0.95 ICMSHALASINITA + 0.05 ICMSHARPR+eeAR → ICMSHALASINITB
Surface constants are from ICMSHARPR+eeAR *and spec. are from* ICMSHALAS+0006.prev

Check_limits for surface
Check_limits [ICMSHALASINITB] → **ICMSHALASINITC**
Surface constants are from ICMSHARPR+eeAR *and spec. are from* ICMSHALAS+0006.prev

Spectral blending in **ICMSHALASINITI**
Surface constants from ICMSHARPI+0000 *and surface data are from* **ICMSHALASINITC**

ICMSHALAS+0006.prev + (ICMSHARPI+0000 − ICMSHALAI+0000) → **ICMSHALASINITI**

Incremental DFI
ICMSHALAS+0006.prev } **IncDFI biass** *(guess – DFIguess)* } → **ICMSHBIAS+0000**

Incremental DFI
ICMSHBIAS+0000
ICMSHALASINITI
} **IncDFI increment** *(DFI ana + IncDFI biass)* } → **ICMSHALASINIT**

ICMSHALAS+0006.prev + (ICMSHARPI+0000 − ICMSHALAI+0000) → **ICMSHALASINIT**
COUPLECAR+0000 →ee927$_{AR2AL}$→ ELSCFALASALBC000
COUPLECAR+0006 →ee927$_{AR2AL}$→ ELSCFALASALBC001
} **→e001 NoDFI→** ICMSHALAS+0000 **archiv**
ICMSHALAS+0006

Appendix IV ALADIN DFI blending for ECMWF/ARPEGE/ALADIN MAP Re-Analysis - II

(No DFI in ass. incremental DFI in ass. & prod.) and simple surface blending

Production event (00 & 12 UTC)

ICMSHALAS+0006.prev →ee927$_{AL2LOW}$→ ICMSHALARINIT
ELSCFALARALBC000
ELSCFALARALBC001
→DFI$_{LOW}$→ ICMSHALAR+0000 →ee927$_{LOW2AL}$→ ICMSHALAI+0000

COUPLECAR+0000 →ee927$_{AR2AL2LOW}$→ ICMSHARPRINIT
ELSCFARPRALBC000
ELSCFARPRALBC001
→DFI$_{LOW}$→ ICMSHARPR+0000 →ee927$_{LOW2AL}$→ ICMSHARPI+0000

COUPLECAR+0000 →ee927$_{AR2AL}$→ ICMSHARPR+eeAR

COUPLECAR+0006.prev →ee927$_{AR2AL}$→ ICMSHARPR+6eAR

Surface blending
ICMSHALAS+0006.prev + (ICMSHARPR+eeAR − ICMSHARPR+6eAR) → ICMSHALASINITA

Surface blending
0.95 ICMSHALASINITA + 0.05 ICMSHARPR+eeAR → ICMSHALASINITB
Surface constants are from ICMSHARPR+eeAR *and spetral are from* ICMSHALAS+0006.prev

Check_limits for surface
Check_limits [ICMSHALASINITB] → ICMSHALASINIC
Surface constants are from ICMSHARPR+eeAR *and spectral are from* ICMSHALAS+0006.prev

Spectral blending in **ICMSHALASINIT**
Surface constants from ICMSHARPI+0000 *and surface data are from* **ICMSHALASINITC**

ICMSHALAS+0006.prev + (ICMSHARPI+0000 − ICMSHALAI+0000) → **ICMSHALASINIT**

Incremental DFI
ICMSHALAS+0006.prev } **IncDFI biass** *(guess – DFIguess)* } → ICMSHBIAS+0000

Incremental DFI
ICMSHBIAS+0000
ICMSHALASINIT
} **IncDFI increment** *(DFI ana + IncDFI biass)* } → **ICMSHECARINIT**

ICMSHECARINIT archiv on delage
ICMSHOPERINIT archiv on archiv

Integration will not be performed

COUPLECAR+0000	→ee927$_{AR2AL}$→	ELSCFECARALBC000
COUPLECAR+0003	→ee927$_{AR2AL}$→	ELSCFECARALBC001
…	…	…
COUPLECAR+0066	→ee927$_{AR2AL}$→	ELSCFECARALBC022

e001 NoDFI →
ICMSHALAD+0000
ICMSHALAD+0006
…
ICMSHALAD+0066

Appendix IV ALADIN DFI blending for ECMWF/ARPEGE/ALADIN MAP Re-Analysis - III

(No DFI in ass. incremental DFI in ass. & prod.) and simple surface blending

Cold start (just once at the beginning, 00, 06, 12 or 18 UTC)

COUPLECAR+0000.hh →$ee927_{AR2AL}$→ ICMSHALASINIT
COUPLECAR+0000.hh →$ee927_{AR2AL}$→ ELSCFALASALBC000 } →e001 DFI→ ICMSHALAS+0006.hh
COUPLECAR+0006.hh →$ee927_{AR2AL}$→ ELSCFALASALBC001 }

Legend	
COUPLECAR+0000	e927 applied on the ECMWF/ARPEGE analysis initialised with DFI
COUPLECAR+0003	e927 applied on the 3h forecast of ARPEGE integration started from the ECMWF/ARPEGE analysis
COUPLECAR+0006	e927 applied on the 6h forecast of ARPEGE integration started from the ECMWF/ARPEGE analysis
COUPLECAR+00NN	e927 applied on the NNh forecast of ARPEGE integration started from the ECMWF/ARPEGE analysis
$ee927_{AR2AL}$	ee927 transforming a file with the resolution of ARPEGE to the resolution of ALADIN
$ee927_{AL2LOW}$	ee927 transforming a file with the resolution of ALADIN to the low resolution for DFI_{LOW}
$ee927_{AR2AL2LOW}$	ee927 transforming a file with the resolution of ARPEGE to the low resolution for DFI_{LOW} (via the ALADIN resolution)
$ee927_{LOW2AL}$	ee927 transforming a file with the low resolution from DFI_{LOW} to the resolution of ALADIN
DFI_{LOW}	DFI with low resolution filtering short waves