

Testing the ALARO0 baseline on Croatian domains in 8 and 4 km resolution on 37 and 73 levels

Abstract

ALARO0 baseline has been tested using cycle AL38T1 on the domain used for operational forecast with 8 km resolution on 37 levels in the vertical. Tests with higher vertical resolution on 73 levels in the vertical and non-hydrostatic dynamics were also performed running 72 hour forecasts for the two whole months, for January and May 2014. It is intended to replace this operational domain with one in 4 km resolution, ALARO0 baseline was applied and tested on 37 and 73 levels in the vertical with hydrostatic and non-hydrostatic dynamics. The standard scores of forecasts in 4 km resolution are superior to the 8 km forecast.

Introduction

The problem of initial and lateral boundary conditions

Operationally, we have two sources of lateral boundary conditions, one is from IFS run in ECMWF (and currently used for operational forecast in 8 km resolution) and the alternative is from ARPEGE run in Meteo-France (these were operational until the end of 2013).

Additionally, the initial conditions can be taken from the operational suite, which uses cycling and 3Dvar (and 6 hourly IFS forecast from the previous run), or we can use the initial file of IFS or ARPEGE and interpolate the fields to the model grid.

The operational forecast in the 8 km resolution is coupled to IFS and the initial file is obtained through the data assimilation cycle using 3Dvar.

It was possible to create initial file for the 8km resolution model on 73 levels directly from the initial file on 37 levels by spectral full-pos. But this was not possible for the initial fields on domain in 4 km resolution since these required horizontal interpolation and data from areas not covered by the operational initial files.

It is not wise to use interpolated fields of IFS as initial fields without any data assimilation since the error created in the procedure is significantly larger than any error due to change in the model version.

The first problem was to establish a reference. The reference run is ALARO0 baseline in AL38T1 coupled to ARPEGE and using interpolated fields of ARPEGE as initial fields without any data assimilation. A number of experiments was performed running Alaro0 baseline in 4 km resolution on 37 levels using interpolated ARPEGE fields for initial and lateral boundary conditions. This could pose a problem for the future operational suite, since the result depends on the coupling fields.

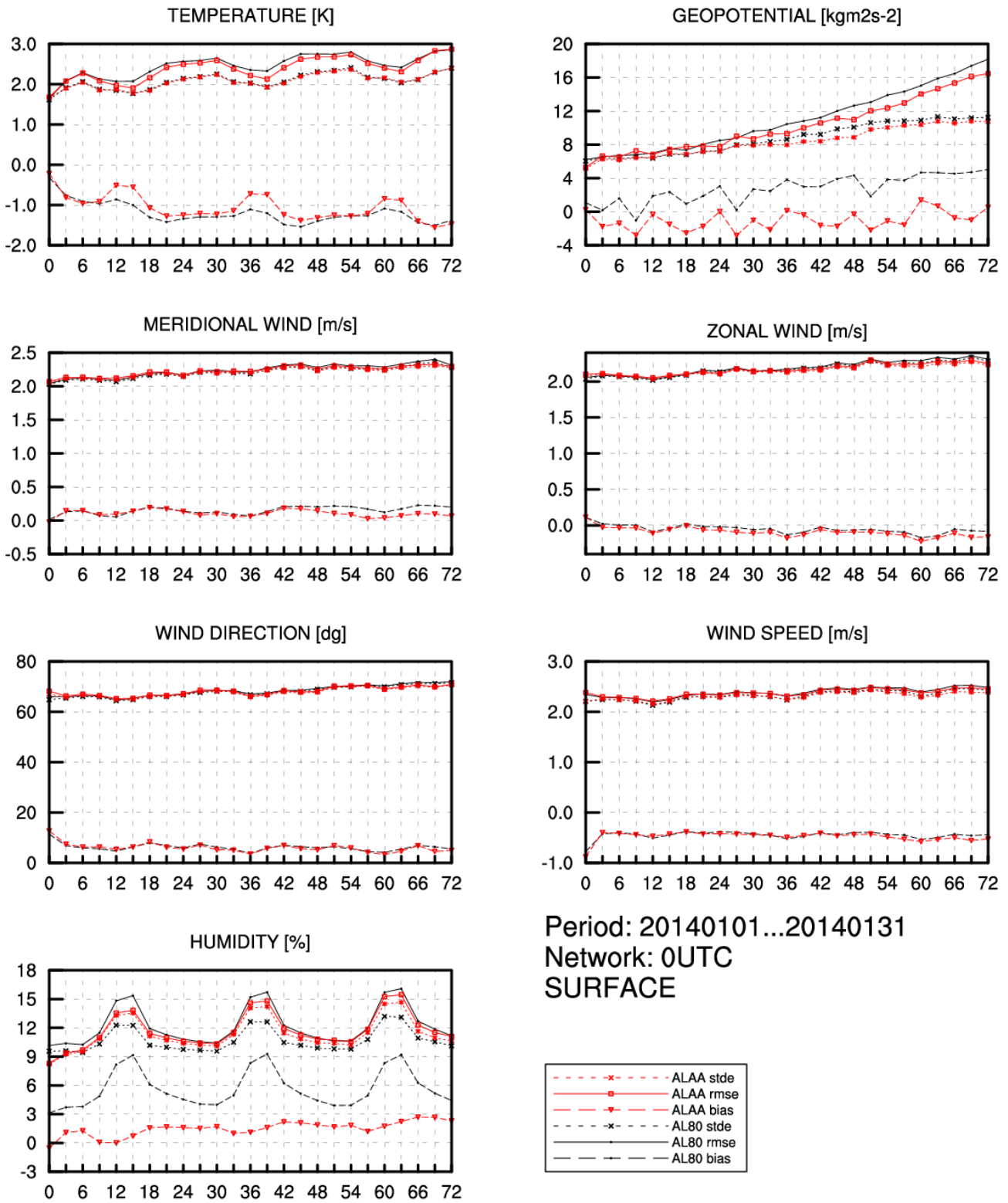
Consequently, there were two types of references tested. In both of them the initial file contained the interpolated fields from the initial file of ARPEGE, but in the first reference, the coupling files were the ARPEGE coupling files and in the second reference the coupling files were from IFS. Since the future operational suite is to be coupled to the IFS and use assimilation cycle with 3Dvar, the latter experiment is used for more extensive testing.

The results of the experiments in 8 km resolution for different initial and lateral boundary conditions are summarized in Table 1.

Table 1. Experiments performed in 8 km resolution in order to provide references for experiments in 4 km resolution.

Code	description	result
80	Alaro0 baseline, 8km, 37 levs, hydrostatic, initial and LBC interpolated ARPEGE	The surface fields are slightly better for Alaro0 baseline coupled to IFS and using operational initial files (with 3Dvar cycling, the AA experiment) than in this experiment with initial and LBC data from ARPEGE, possibly due to data assimilation
81	Alaro0 baseline, 8km, 37 levs, nonhydrostatic	There is no significant difference with respect to 80 experiment
82	Alaro0 baseline, 8km, 73 levs, hydrostatic	Improved T2m, worse RH, wind (?), improved temperature and worse RH close to tropopause
83	Alaro0 baseline, 8km, 73 levs, nonhydrostatic	Similar to 82
84	Alaro0 baseline, 8km, 37 levs, hy, 120 sec	Slightly improved T2m RH2m for May worse for January and worse geopotential close to tropopause
AG	Alaro0 baseline, 8km, 37 levs, hydrostatic, initial interpolated ARPEGE and LBC from IFS	There are differences with respect to AA (Alaro0 starting from operational initial file and coupled to IFS) only in the first 6 hours. The forecasts converge in 6 hours.

Evolution of scores with forecast range



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Figure 1. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (black) and ALAR00 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (red) for January 2014.

Evolution of scores with forecast range

Period: 20140101...20140131 Network: 0UTC
 GEOPOTENTIAL (RMSE)

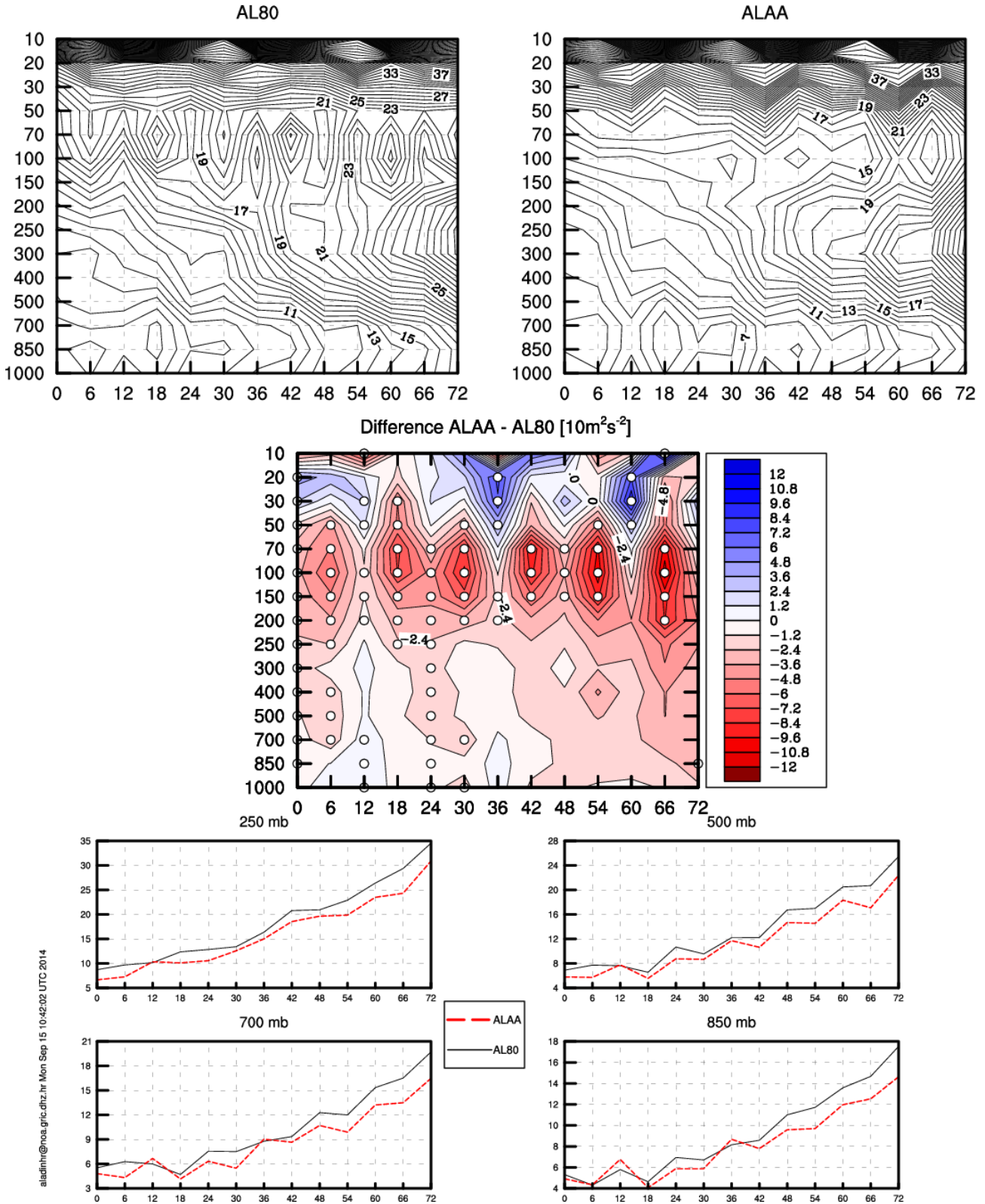
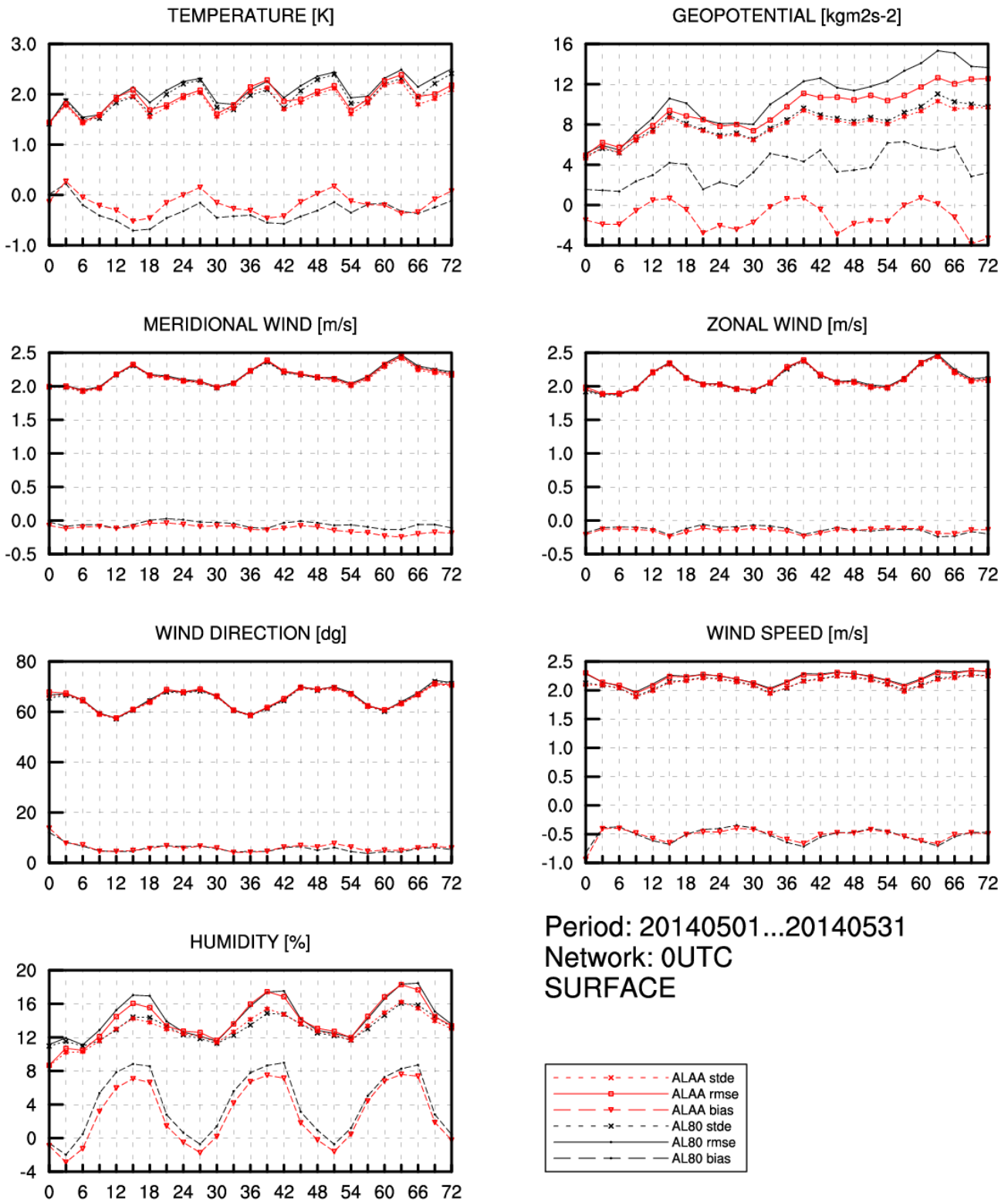


Figure 2. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (top left panel and black lines in bottom panels) and ALARO0 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (top right panel and red lines in bottom panels) for January 2014.

Evolution of scores with forecast range



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Figure 3. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (black) and ALAR00 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (red) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: OUTC
 RELATIVE_HUMIDITY (RMSE)

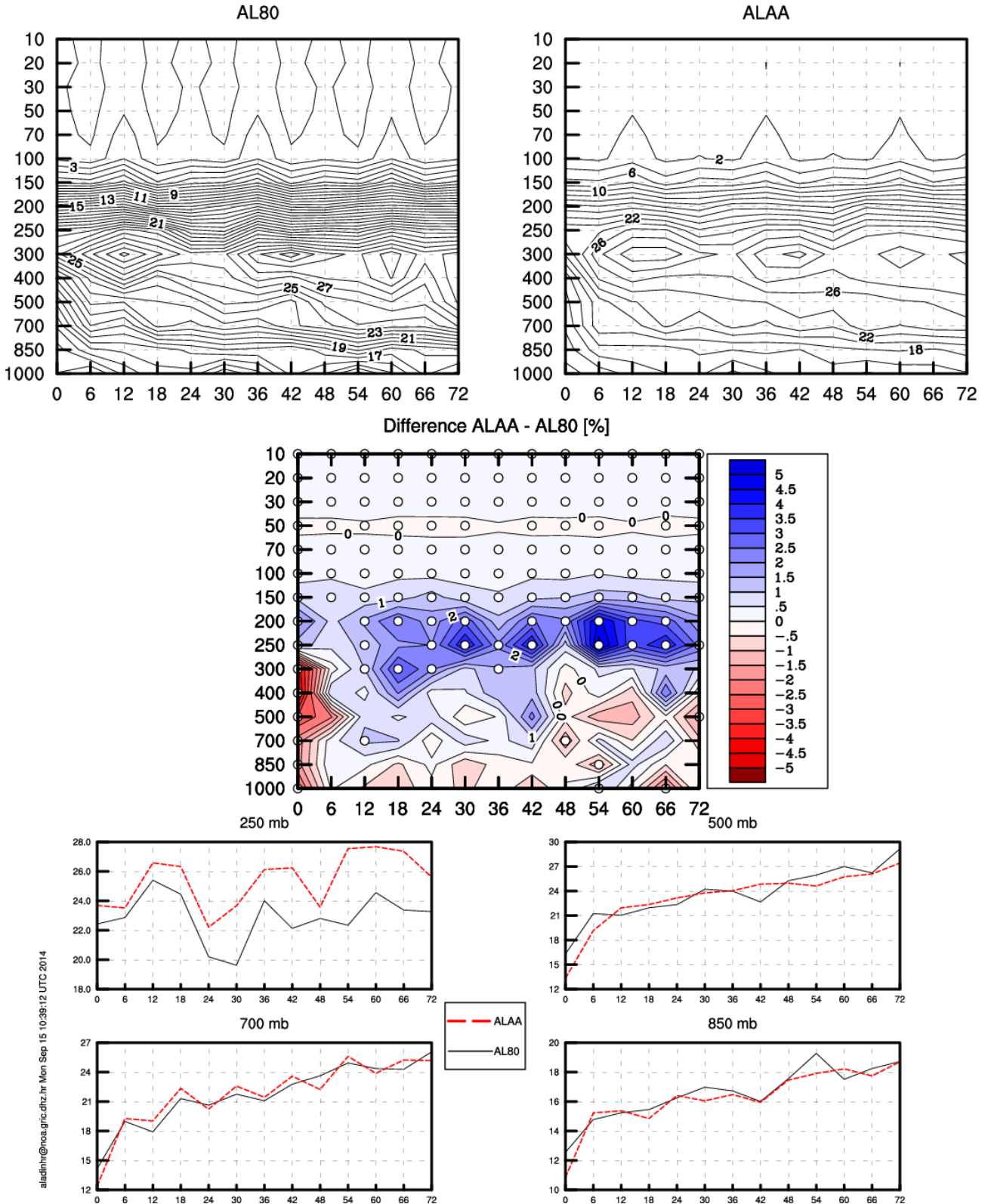


Figure 4. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (top left panel and black lines in bottom panels) and ALARO0 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 GEOPOTENTIAL (RMSE)

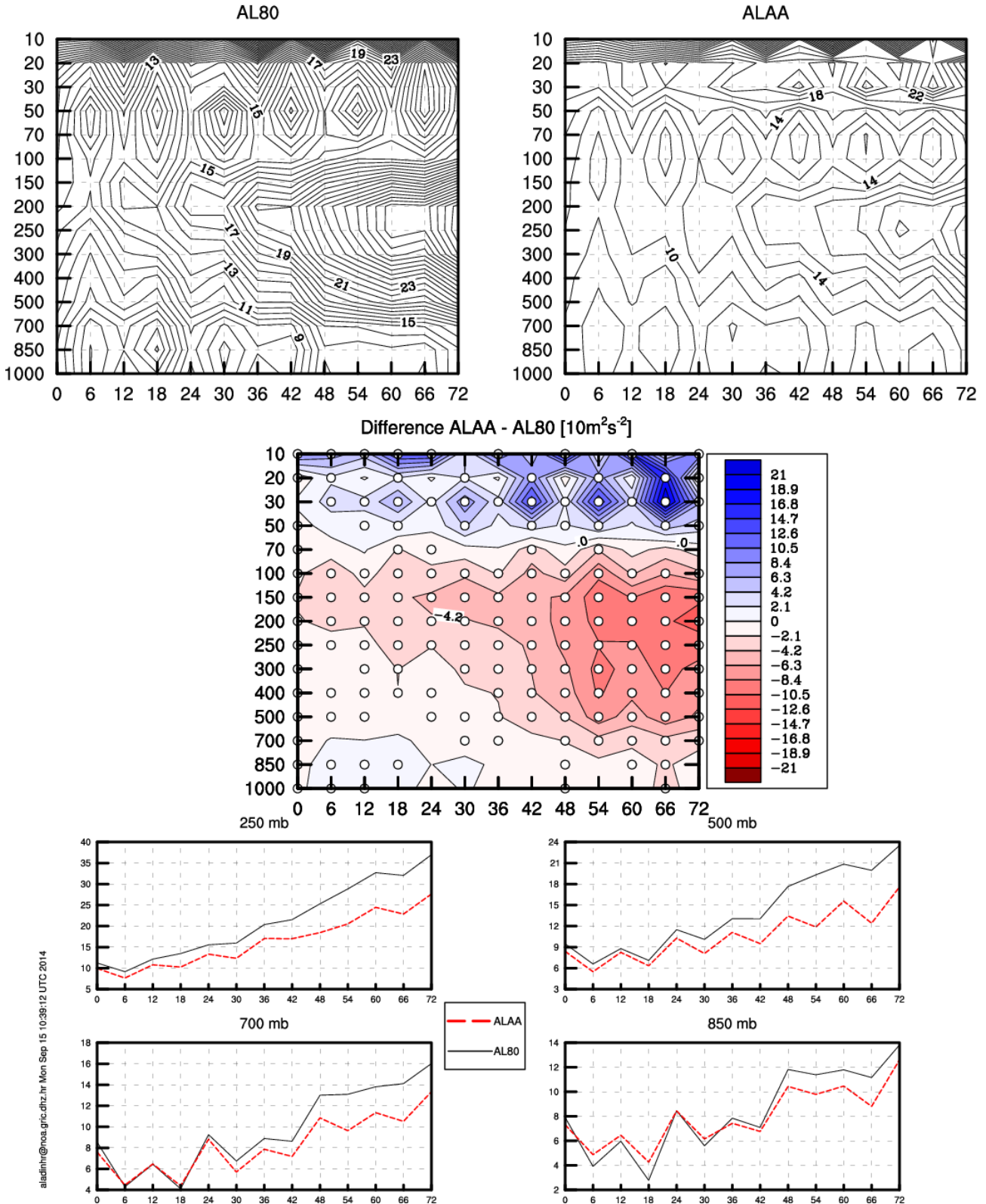


Figure 5. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (top left panel and black lines in bottom panels) and ALARO0 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 RELATIVE_HUMIDITY (BIAS)

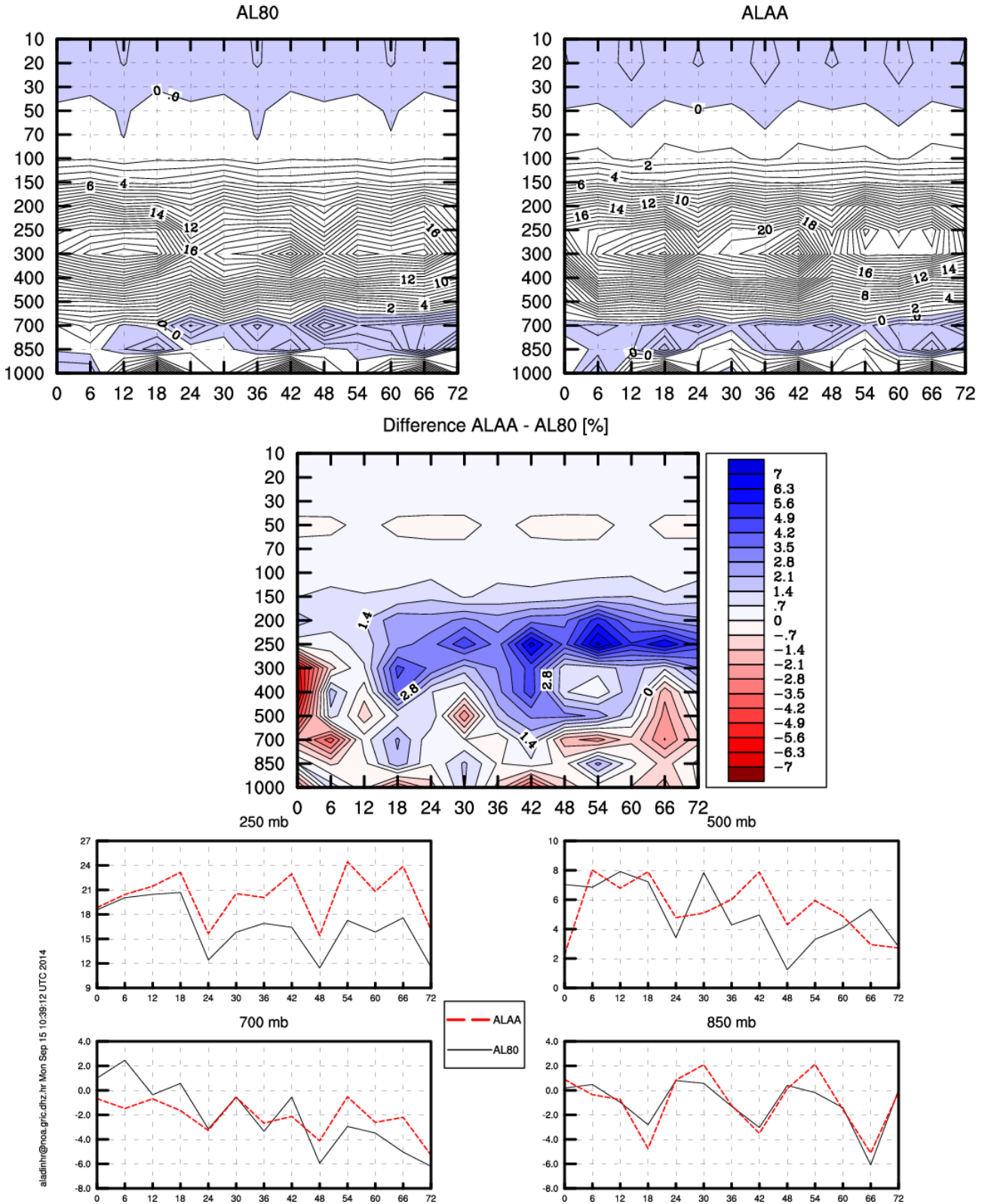
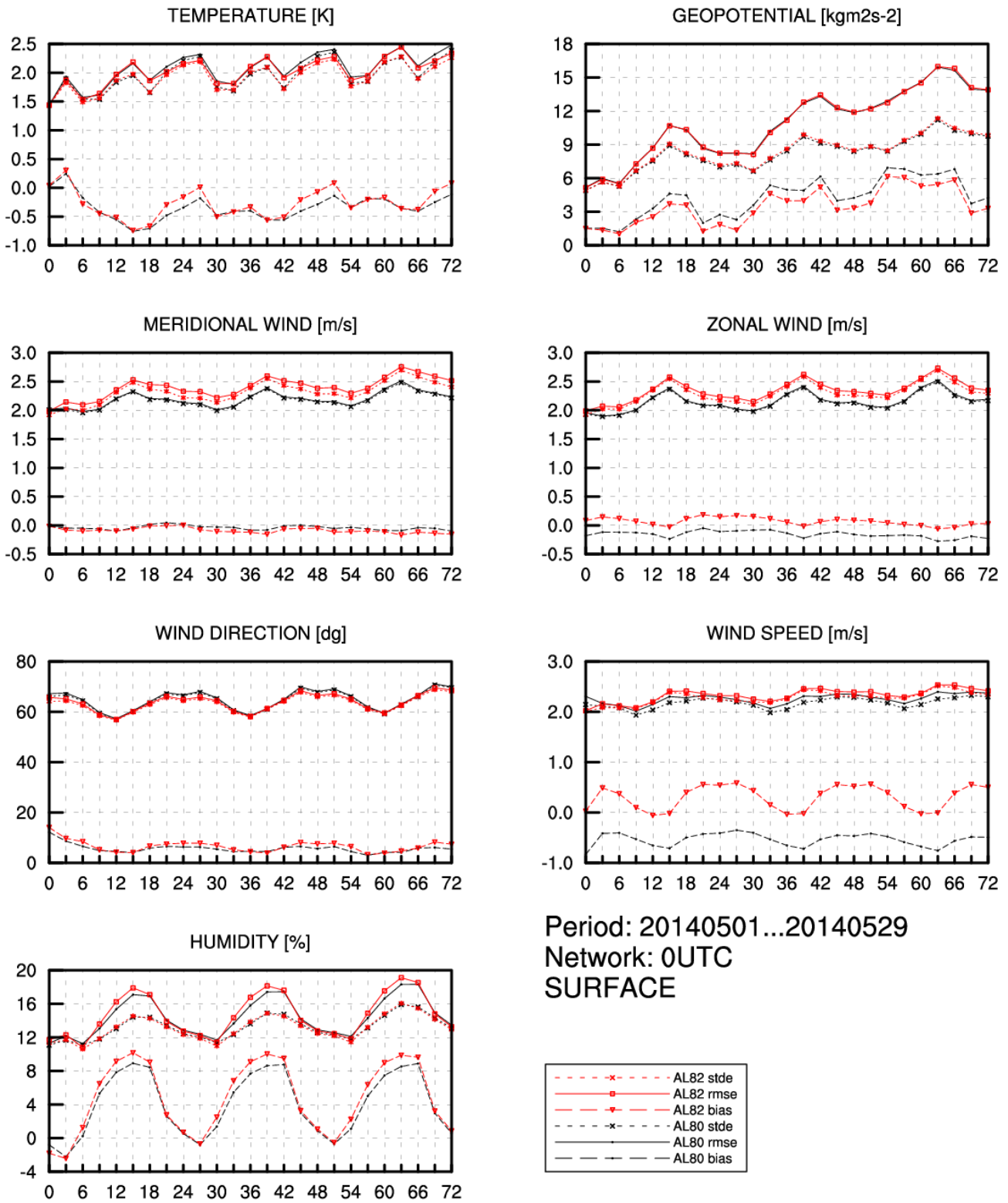


Figure 6. Bias for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file (top left panel and black lines in bottom panels) and ALARO0 baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range



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Figure 7. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels (black) and ALARO0 baseline forecast on 73 levels (red) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140529 Network: 0UTC
 RELATIVE_HUMIDITY (RMSE)

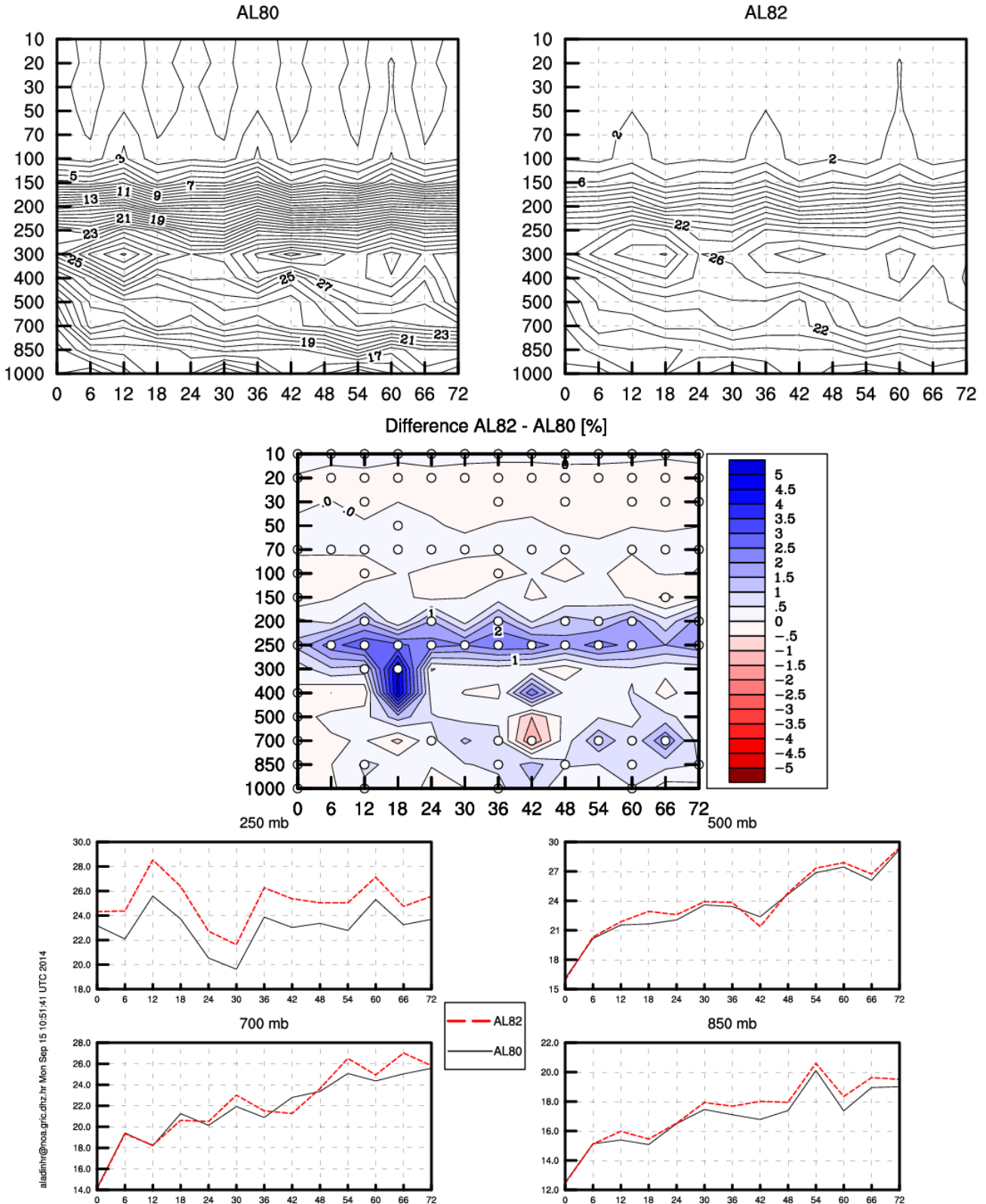


Figure 8. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels (top left panel and black lines in bottom panels) and on 73 levels (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140529 Network: 0UTC
TEMPERATURE (RMSE)

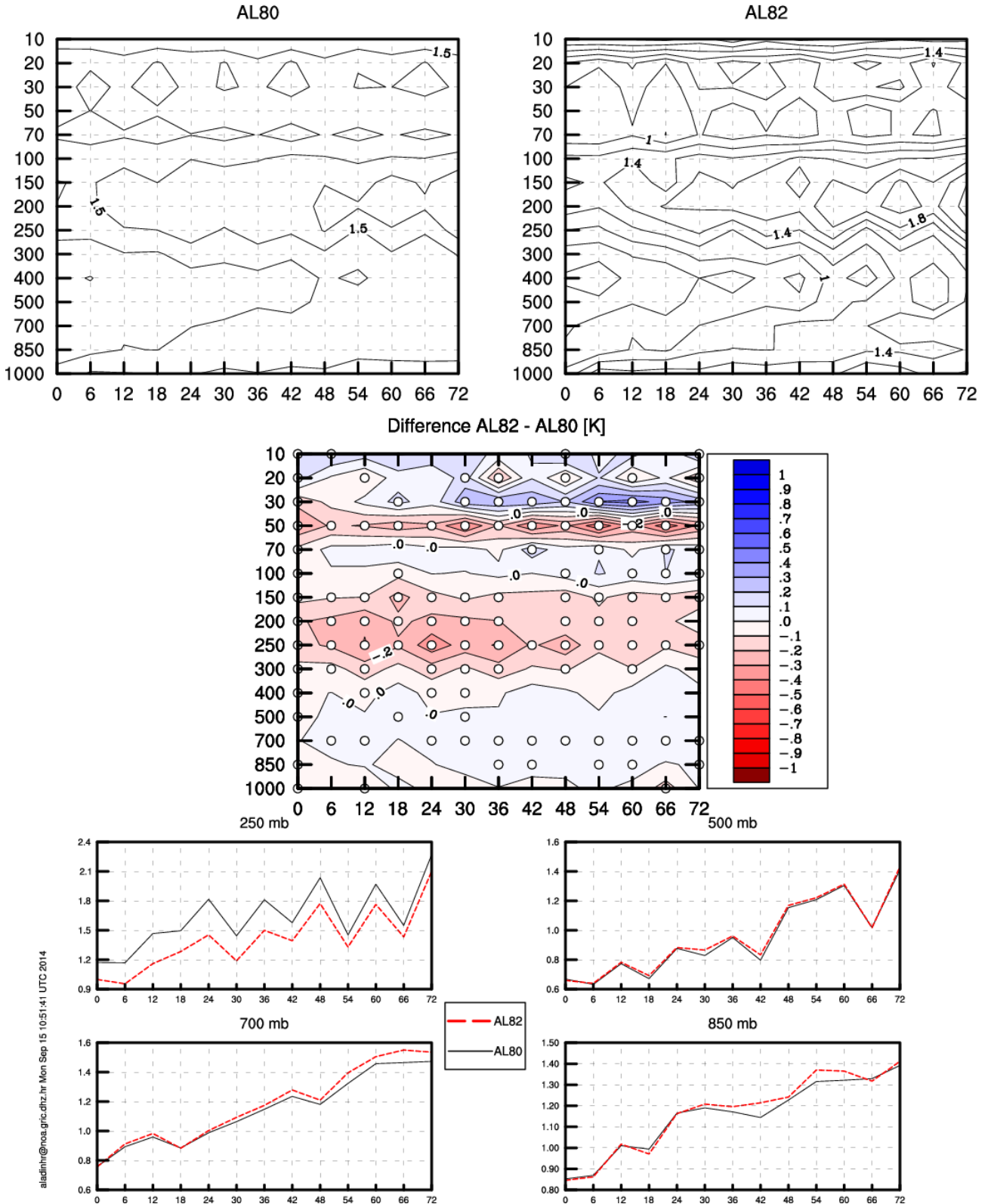
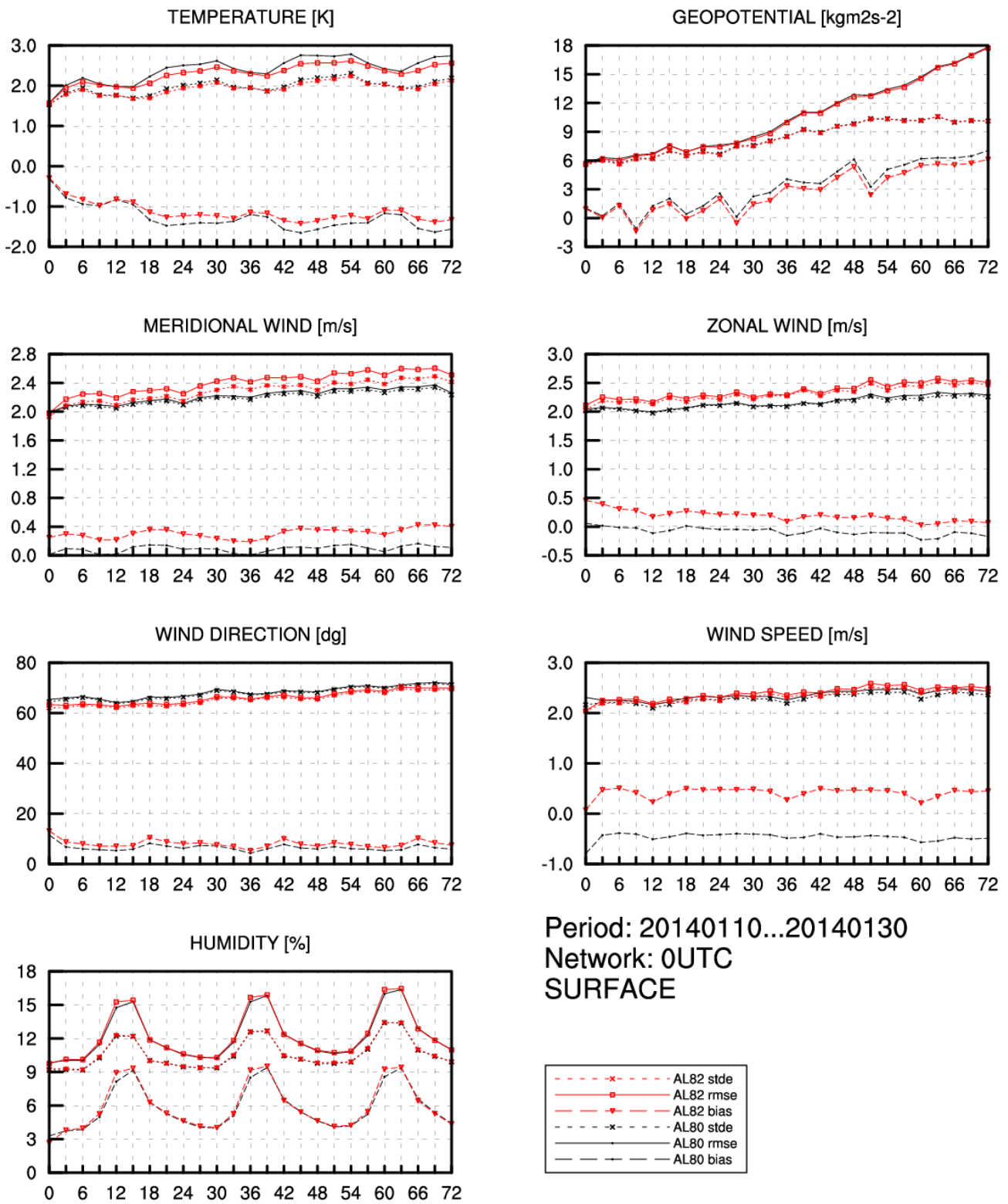


Figure 9. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels (top left panel and black lines in bottom panels) and on 73 levels (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

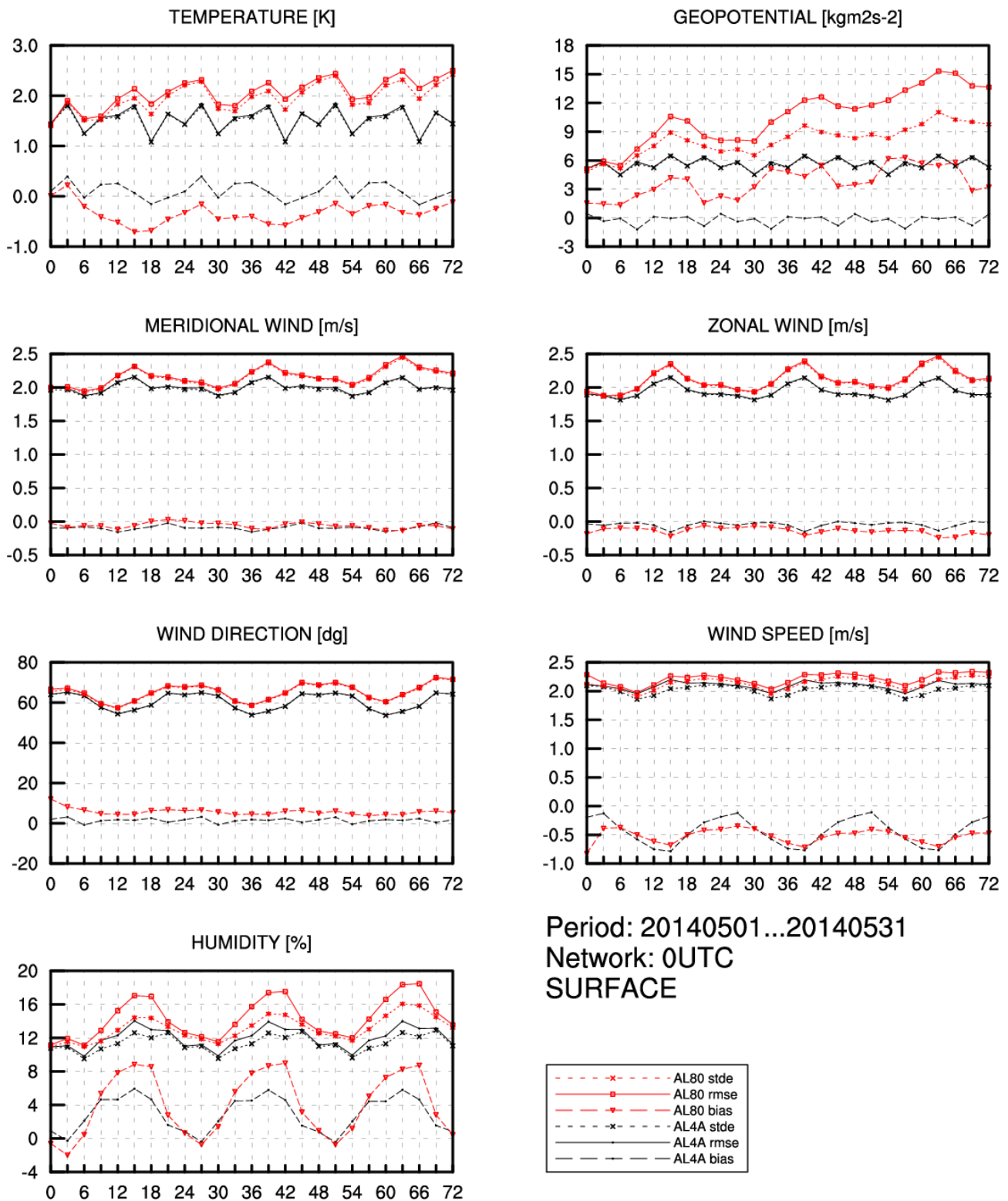


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Figure 10. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels (black) and ALAR00 baseline forecast on 73 levels (red) for January 2014.

Results of experiments in 4 km resolution coupled to ARPEGE

Evolution of scores with forecast range



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Figure 11. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 8 km resolution (red) and ALAR00 baseline forecast on 37 levels in 4 km resolution (black) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 RELATIVE_HUMIDITY (RMSE)

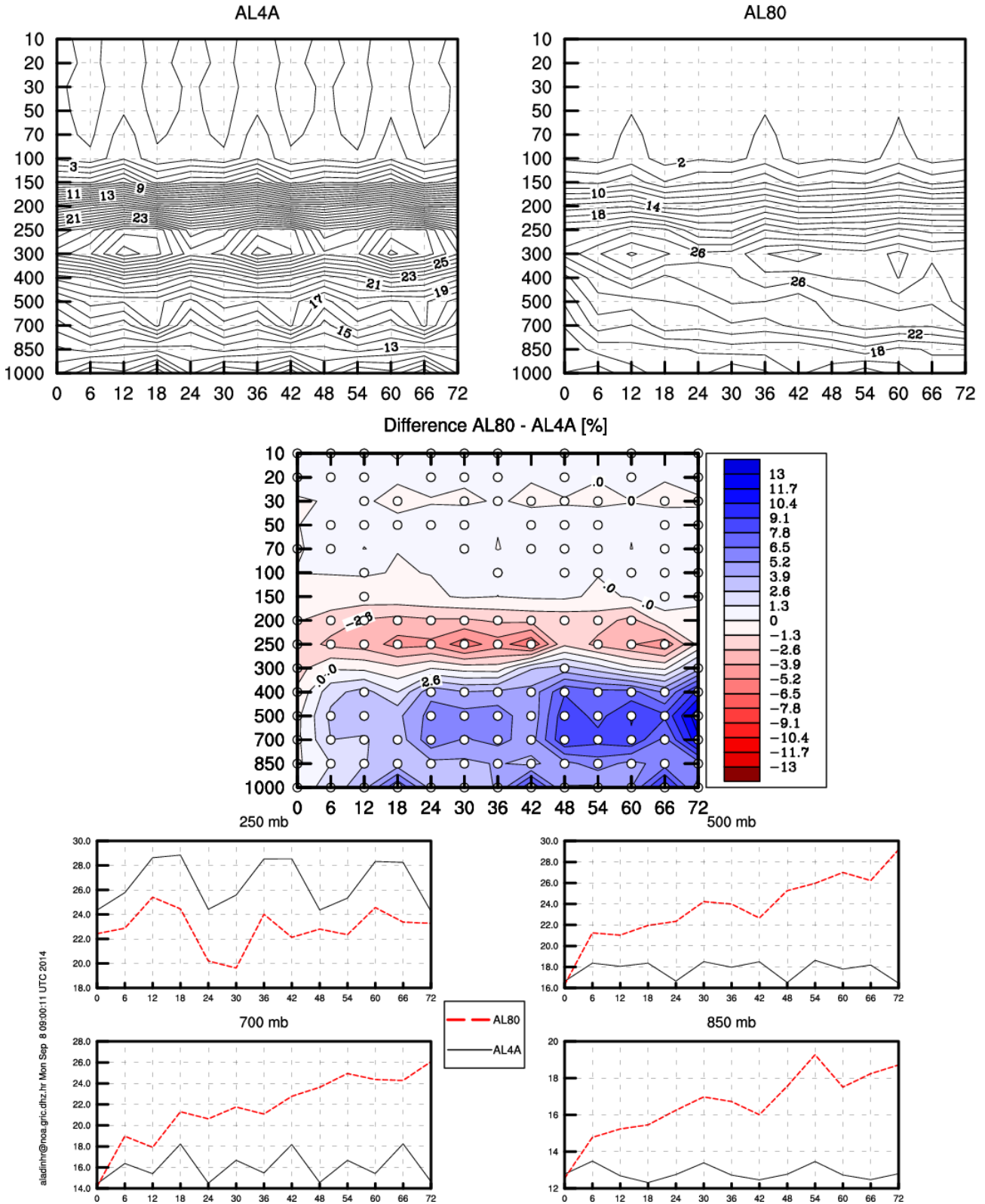


Figure 12. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 GEOPOTENTIAL (RMSE)

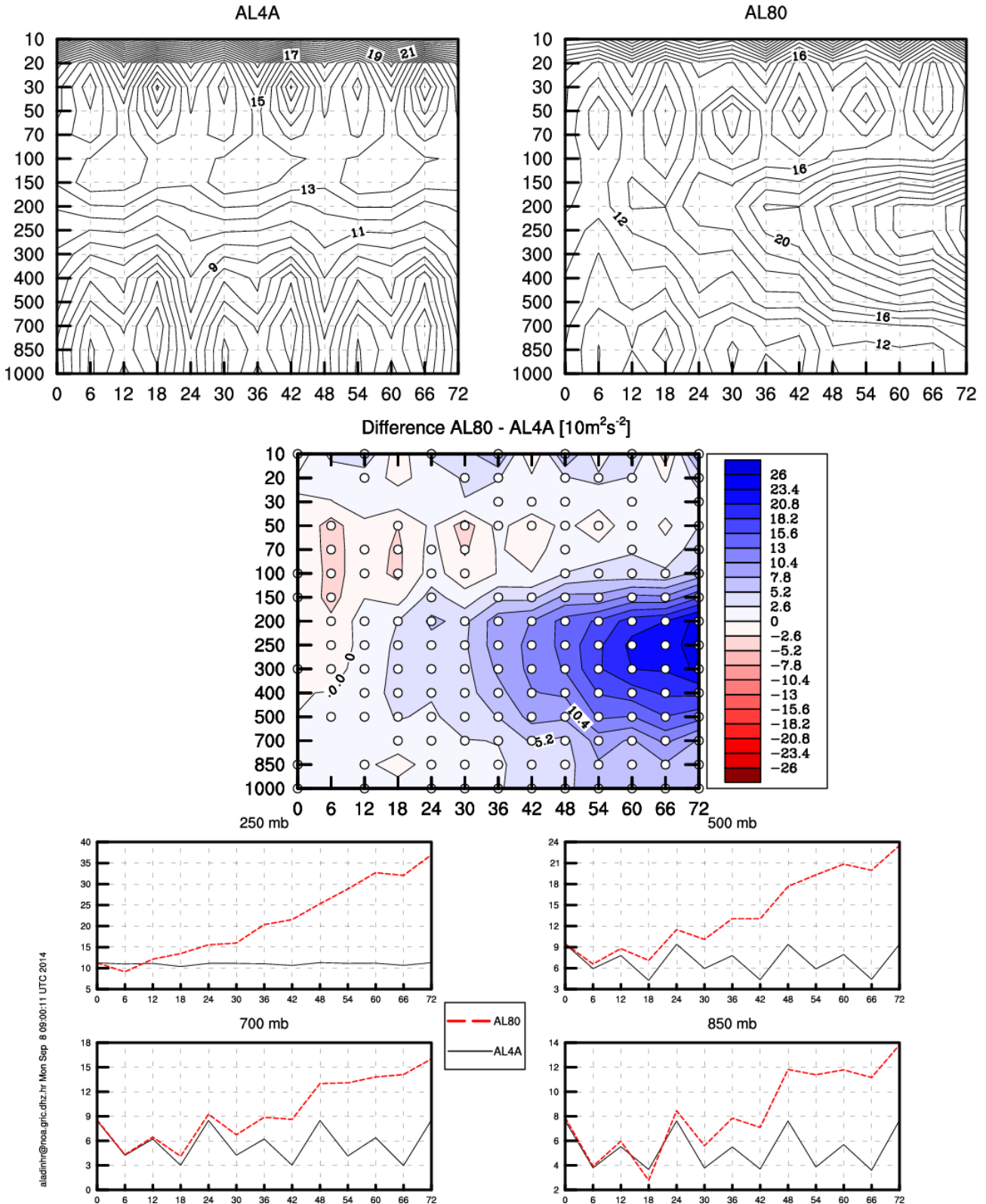


Figure 13. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
TEMPERATURE (RMSE)

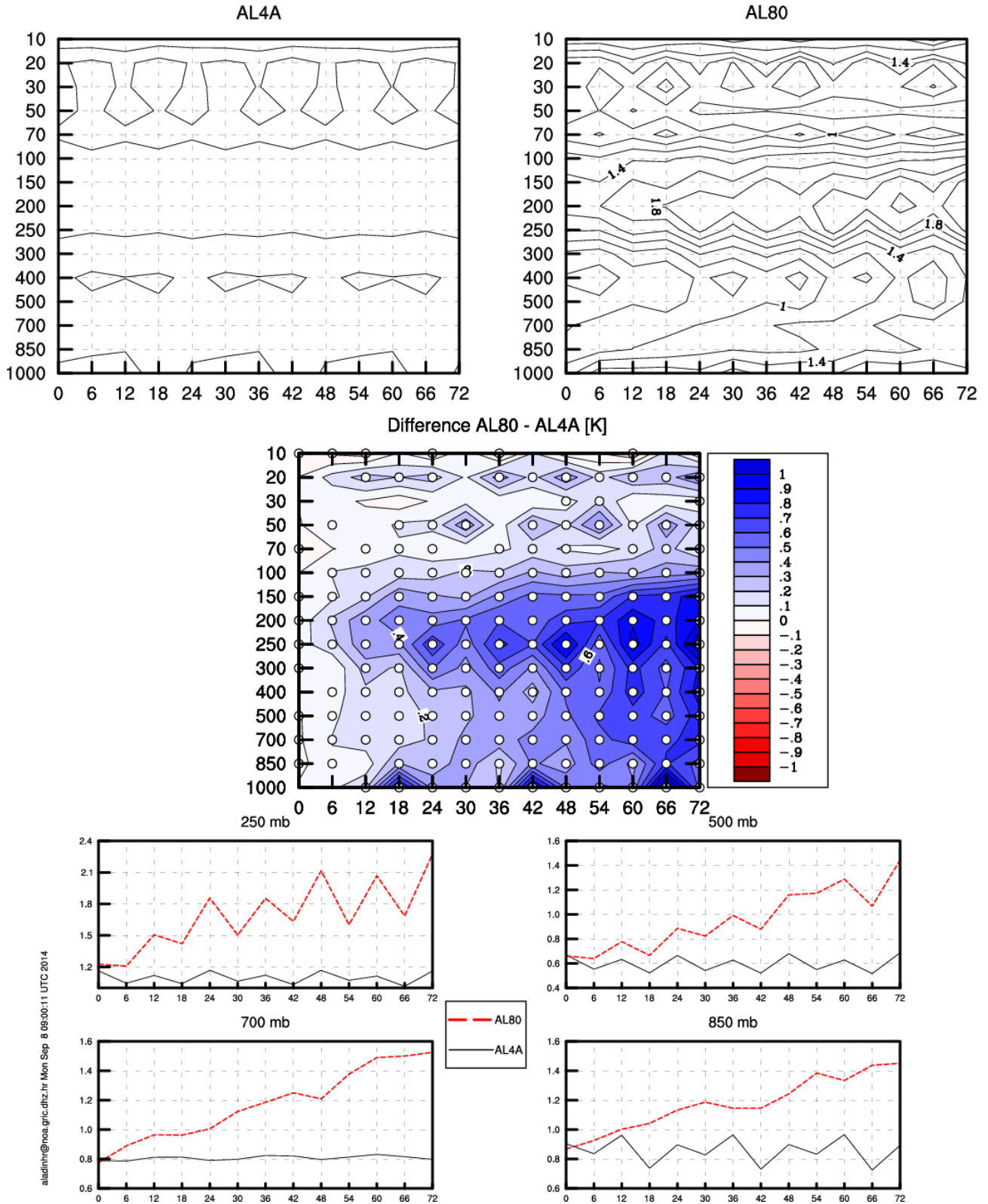


Figure 14. Root mean square error for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 RELATIVE_HUMIDITY (BIAS)

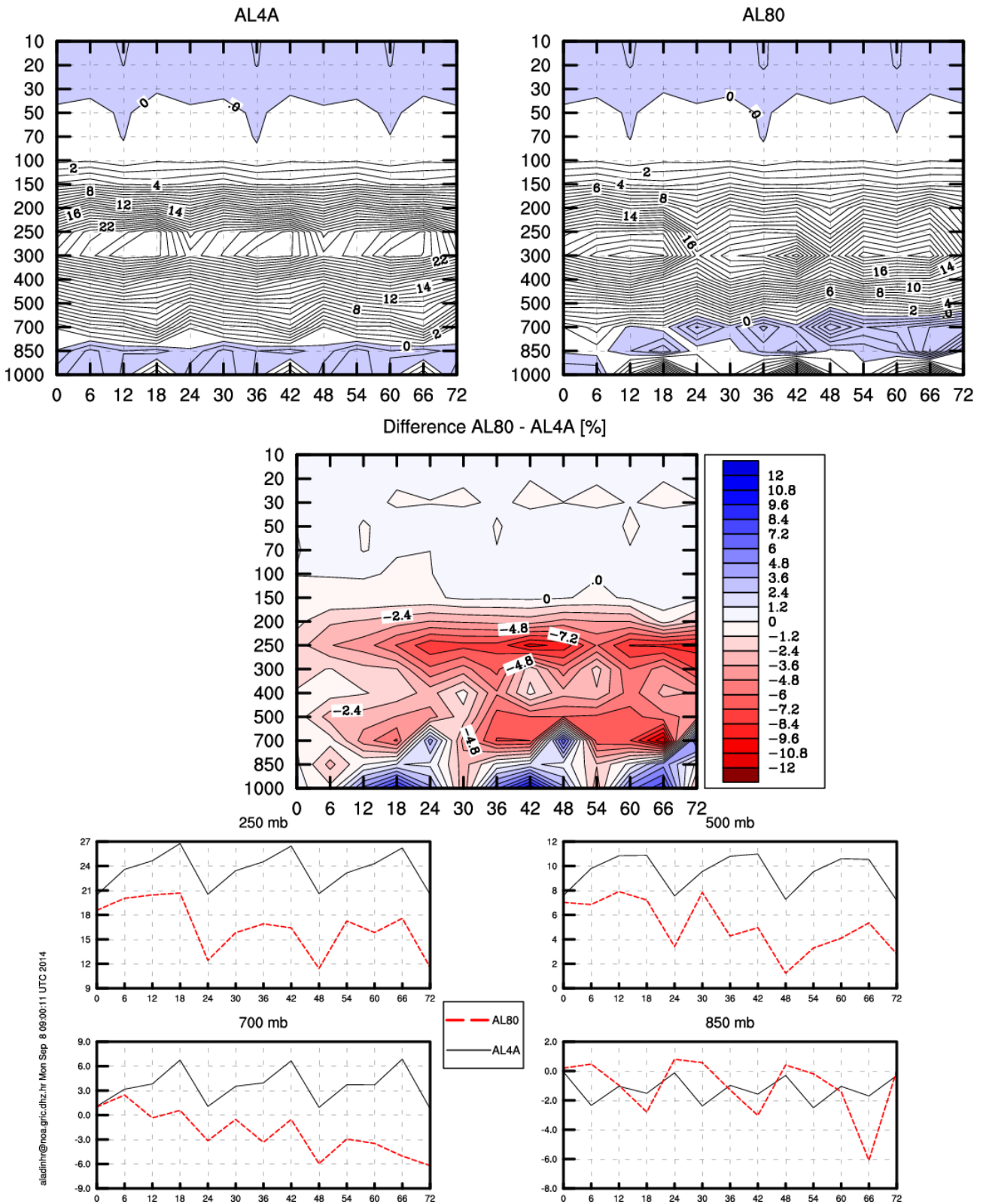


Figure 15. Bias for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

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Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 GEOPOTENTIAL (BIAS)

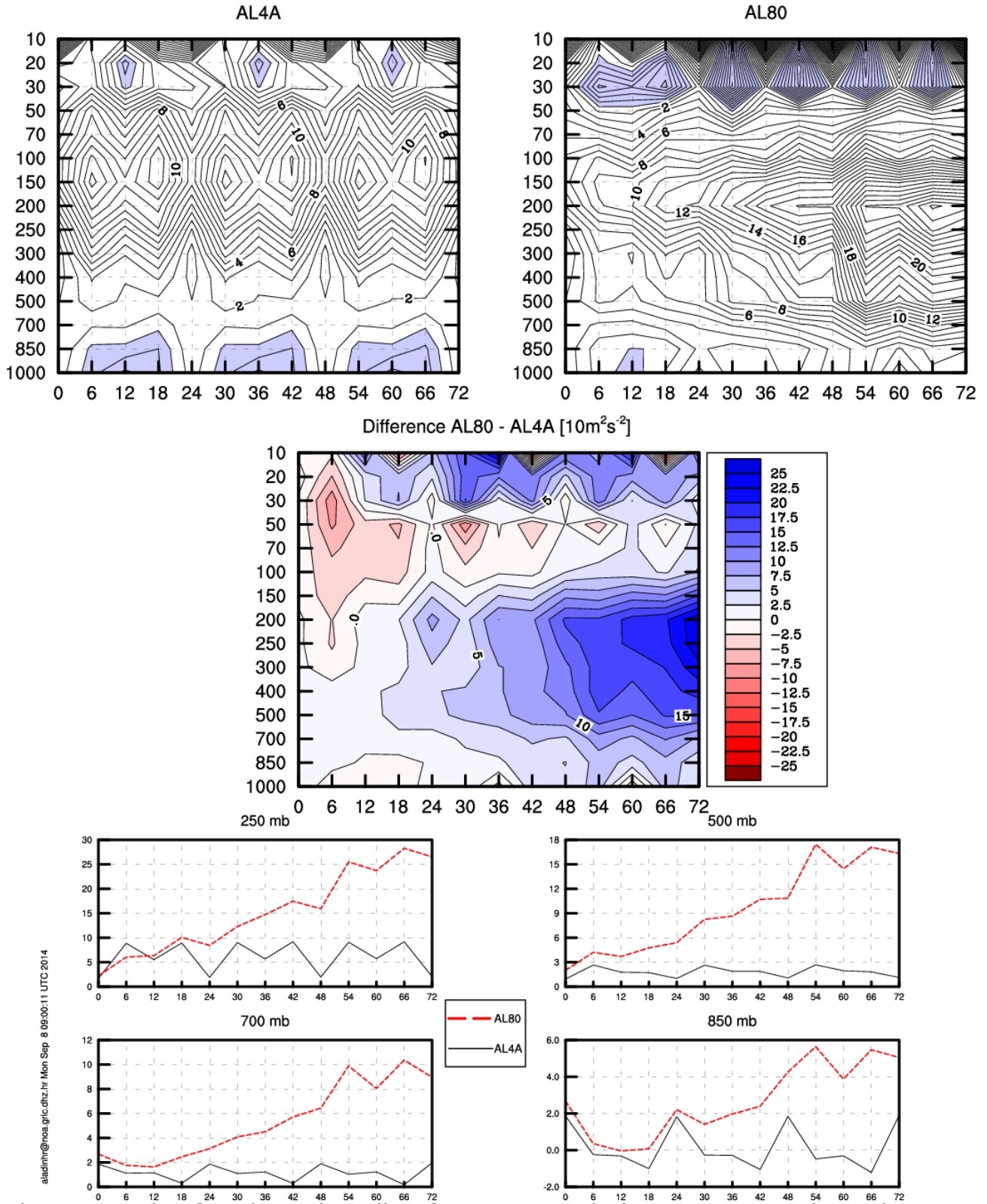


Figure 16. Bias for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
TEMPERATURE (BIAS)

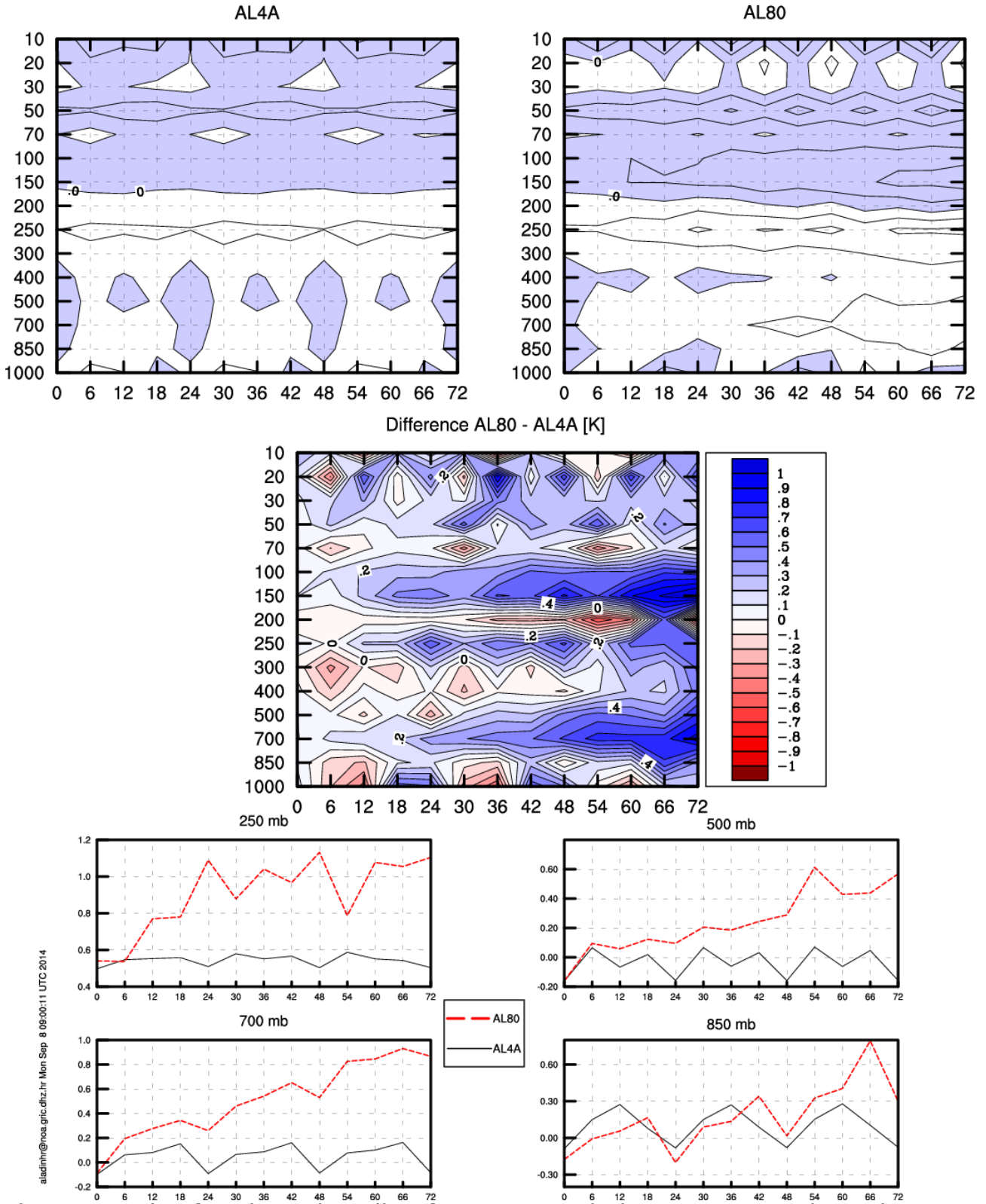
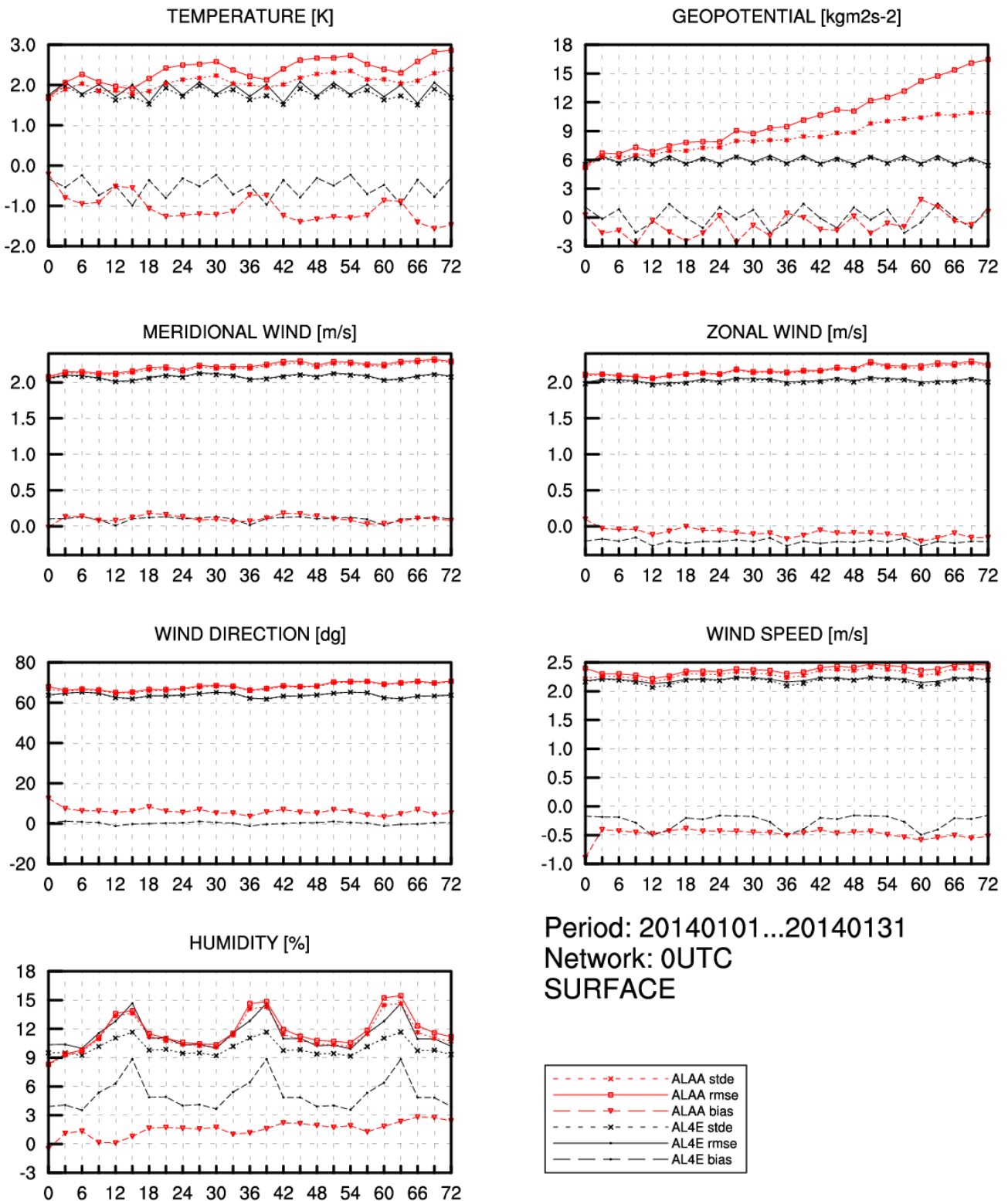


Figure 17. Bias for Alaro0 baseline forecast coupled to ARPEGE and starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and in 8 km resolution (top right panel and red lines in bottom panels) for May 2014.

Results of experiments in 4 km resolution coupled to IFS

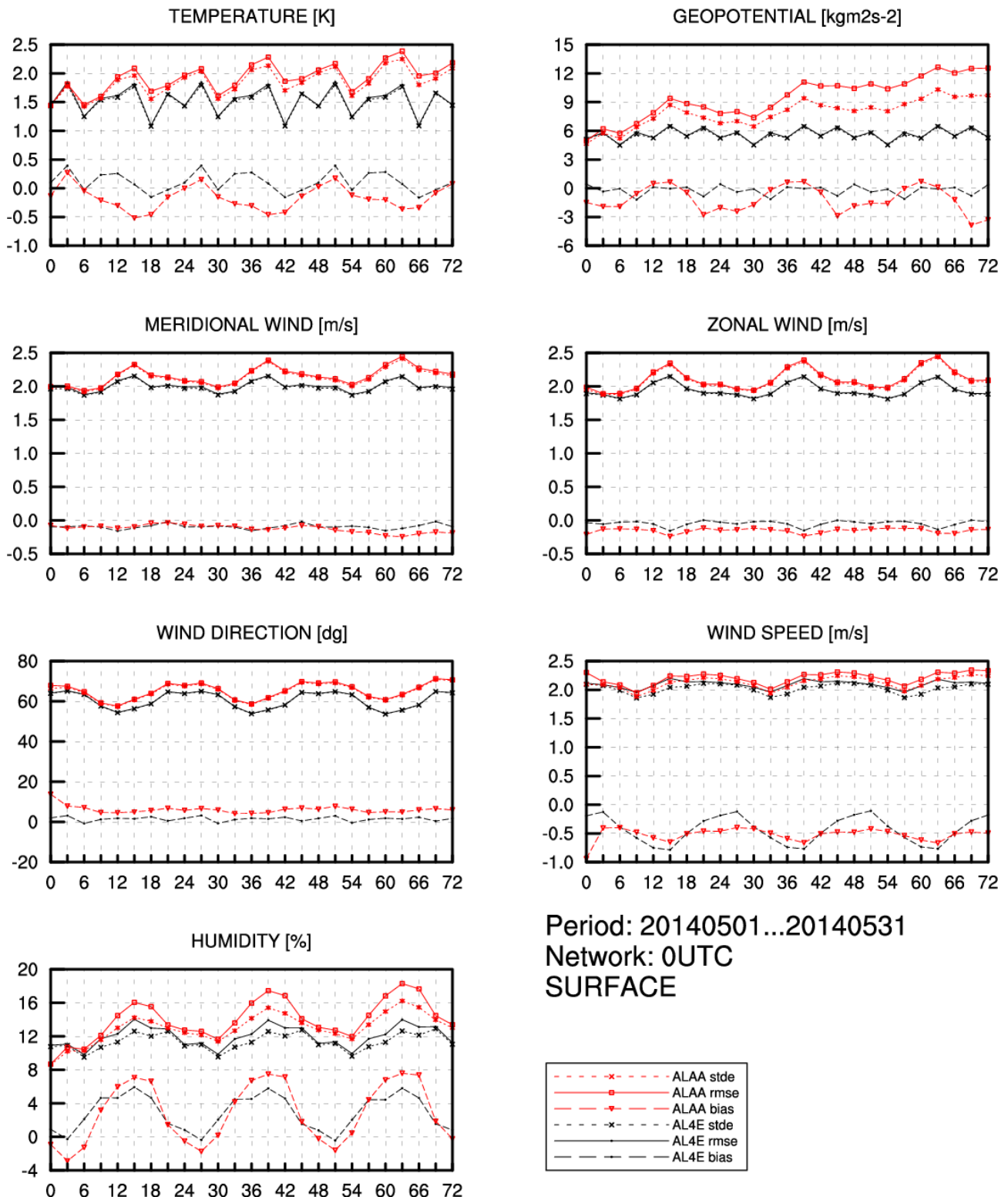
Evolution of scores with forecast range



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Figure 18. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file in 4km (black) and 8 km resolution ALAROO baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (red) for January 2014.

Evolution of scores with forecast range



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Figure 19. Standard deviation (short dash), root mean square error (full line) and bias (long dash) for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file in 4km (black) and 8 km resolution ALAROO baseline forecast coupled to IFS and starting from operational initial file obtained with 3Dvar (red) for May 2014.

Evolution of scores with forecast range

Period: 20140101...20140131 Network: 0UTC
 GEOPOTENTIAL (RMSE)

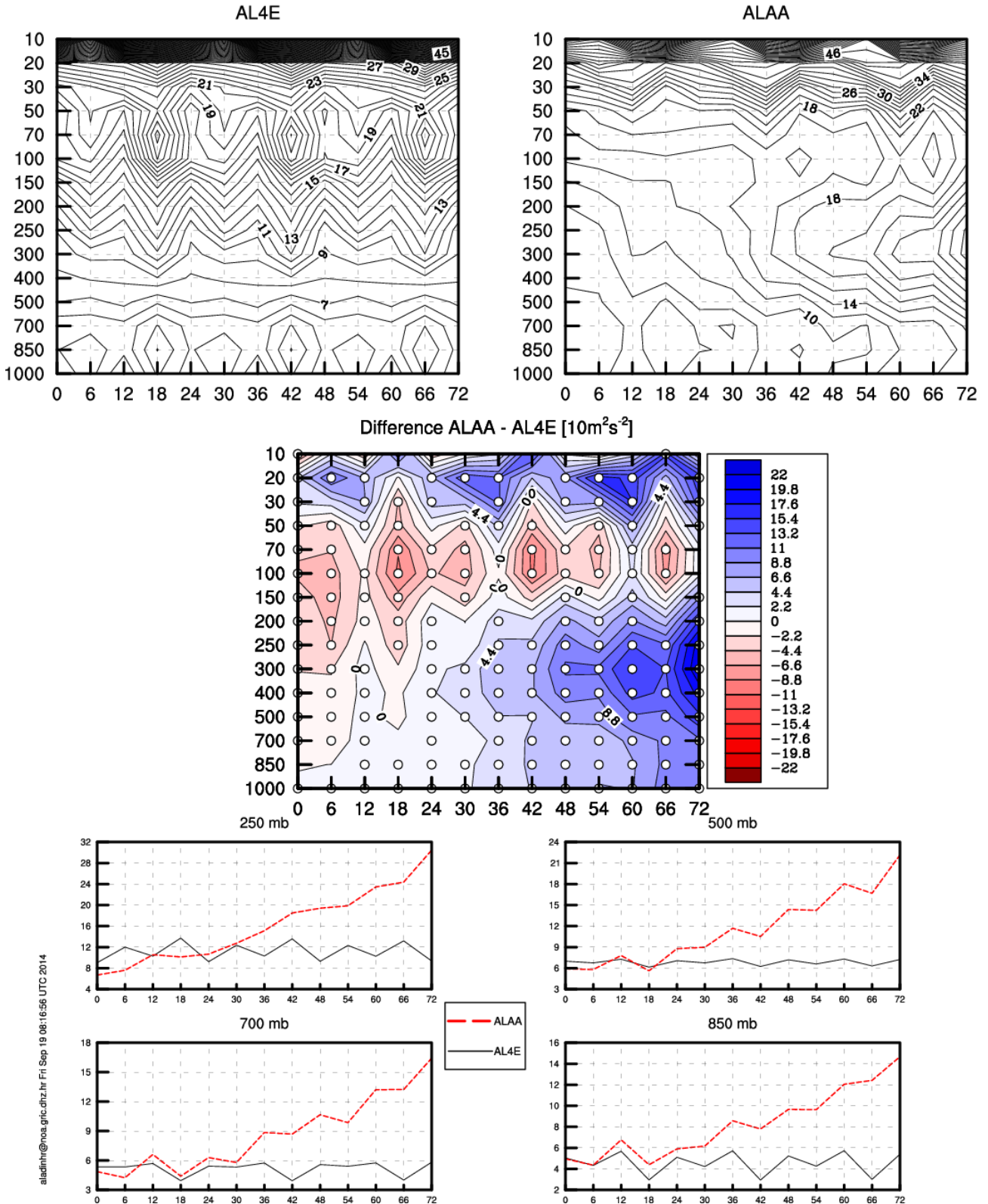


Figure 20. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for January 2014.

Evolution of scores with forecast range

Period: 20140101...20140131 Network: 0UTC
 TEMPERATURE (RMSE)

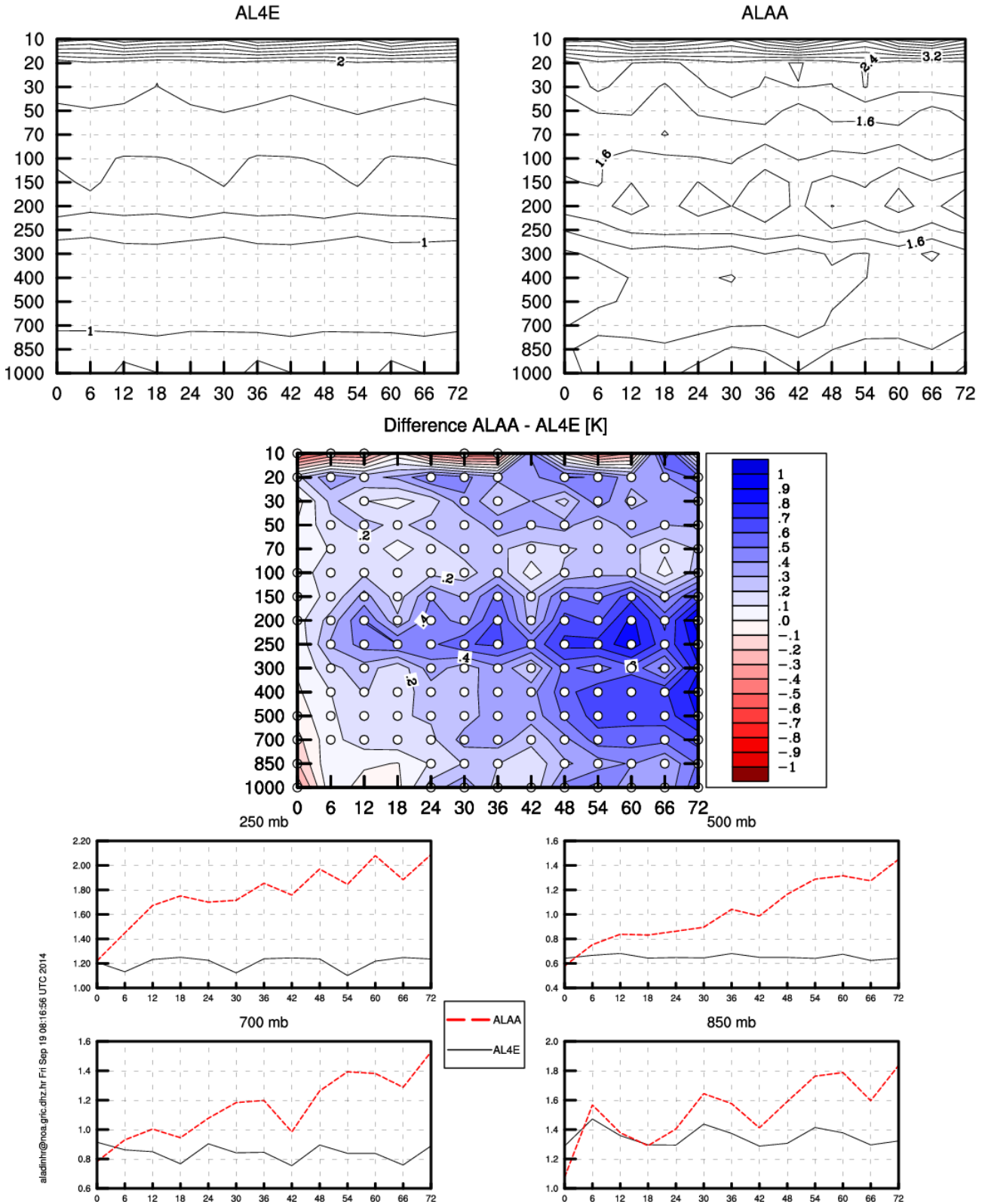


Figure 21. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for January 2014.

Evolution of scores with forecast range

Period: 20140101...20140131 Network: 0UTC
 RELATIVE_HUMIDITY (RMSE)

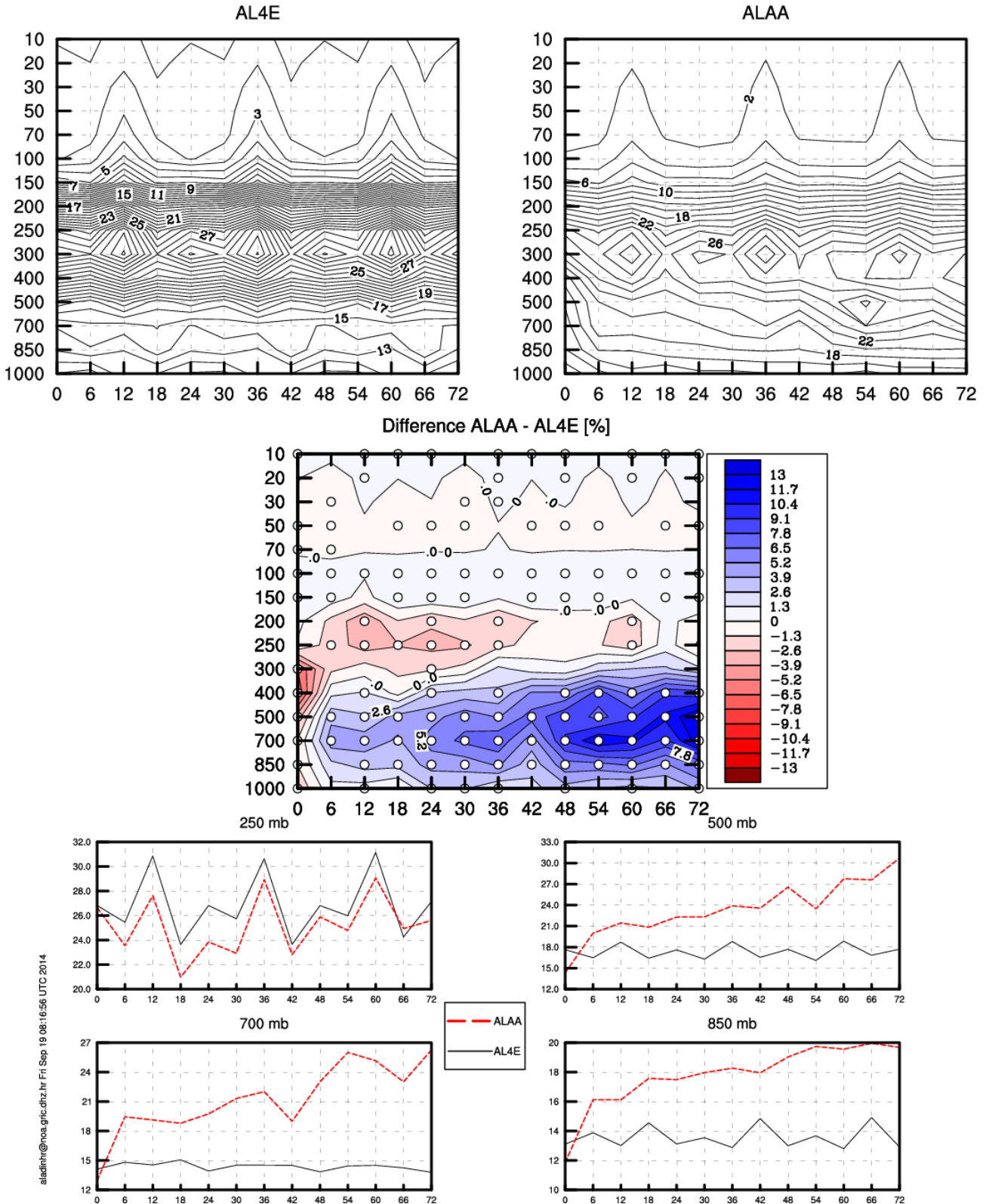


Figure 22. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for January 2014.

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Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 GEOPOTENTIAL (RMSE)

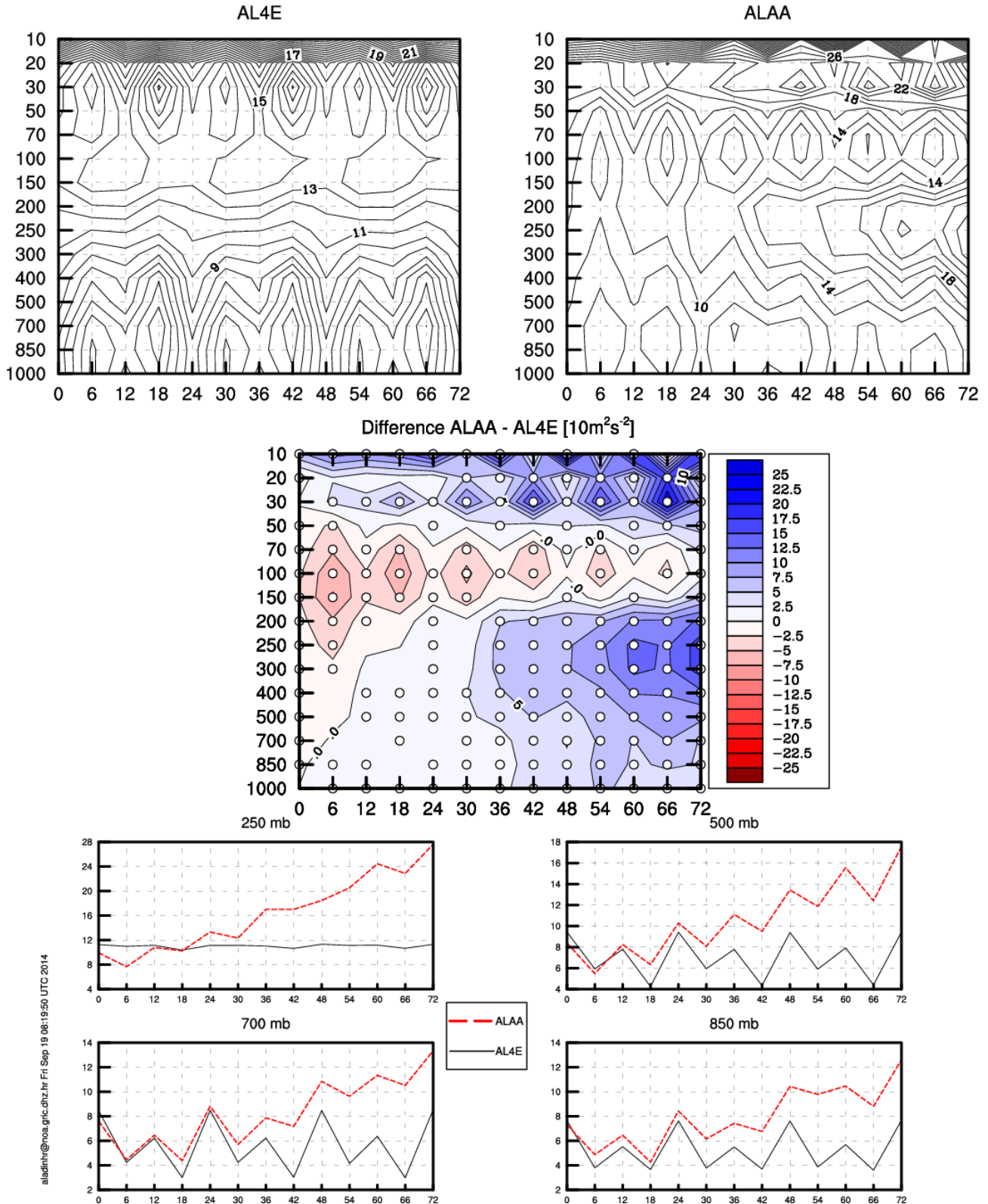


Figure 23. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 TEMPERATURE (RMSE)

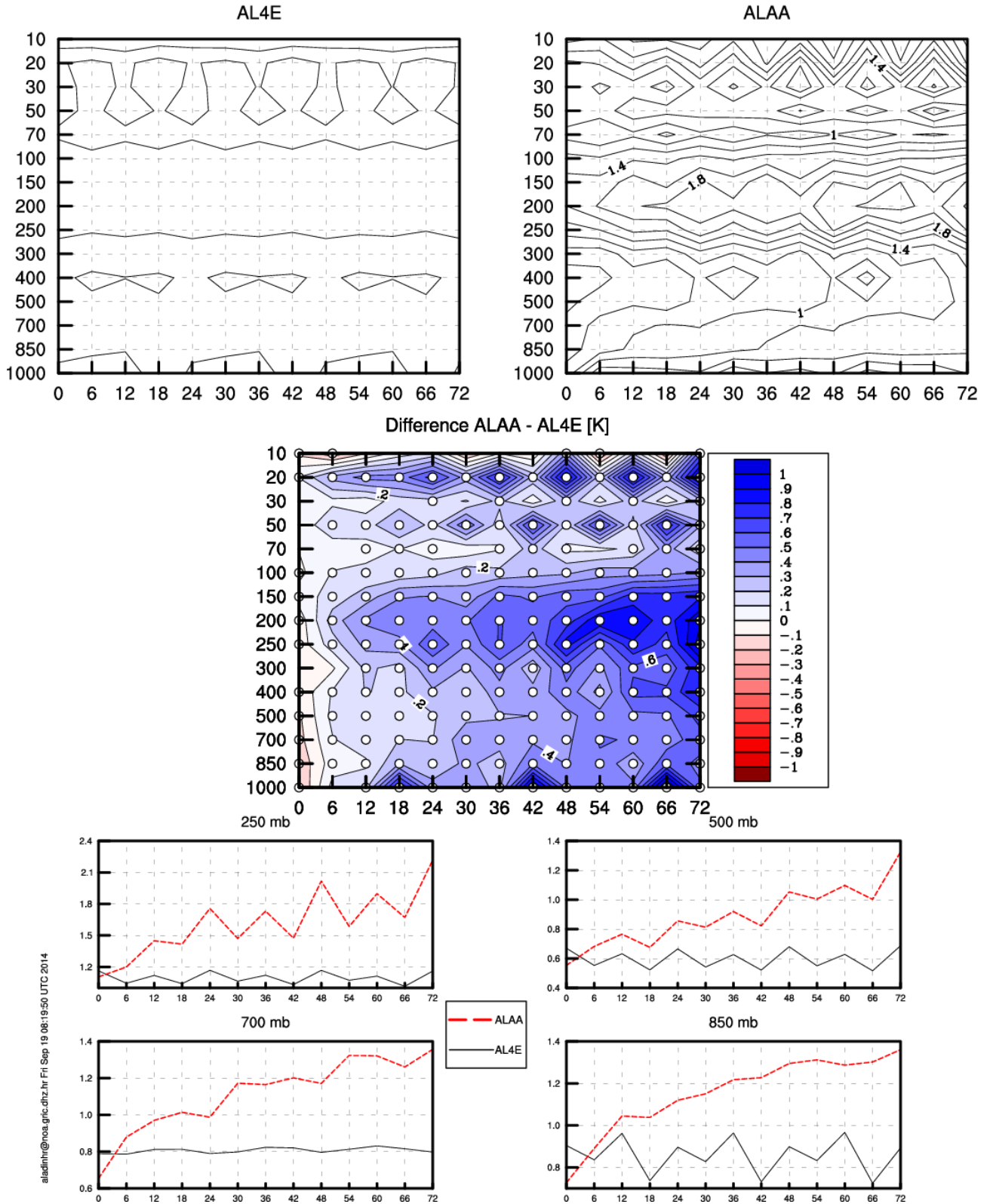


Figure 24. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for May 2014.

Evolution of scores with forecast range

Period: 20140501...20140531 Network: 0UTC
 RELATIVE_HUMIDITY (RMSE)

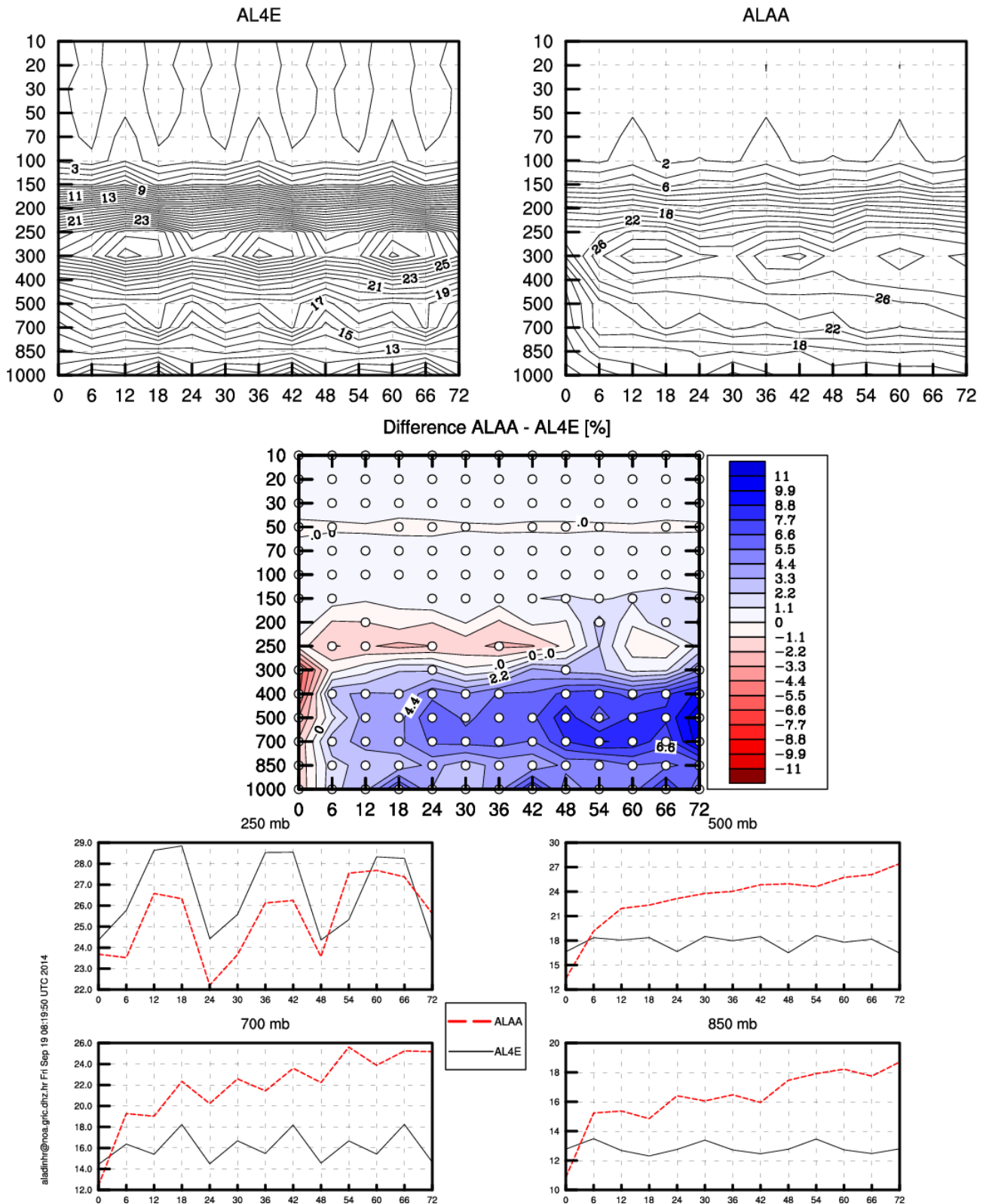


Figure 25. Root mean square error for Alaro0 baseline forecast coupled to IFS but starting from ARPEGE initial file on 37 levels in 4 km resolution (top left panel and black lines in bottom panels) and 8 km resolution Alaro0 baseline starting from operational initial file coupled to IFS (top right panel and red lines in bottom panels) for May 2014.