REPORT

Estimation of 2 m error statistics (part II)

Toulouse, 18th February – 28th March 2002.

Stjepan Ivatek-Šahdan
Croatian Hydrometrological Service
mrpm620@andante.meteo.fr
ivateks@cirus.dhz.hr

Supervisor: François Bouyssel
Météo - France
Francois.Bouyssel@meteo.fr

Toulouse, 28th March 2002.

1. Introduction

This stay is continuing the work done last time, end of last year. The estimation of background error statistics for 2 m Analyses for Canari in the global model ARPEGE was made last time with some assumptions which were not the best ones, for example the standard deviation of observation error was fixed to value which is used currently.
Another important thing was that same weight was given to each class of data, not to each data what is more correct.

2. Statistical model

Canari is OI analysis, and it changes the Guess value of the variable in model grid points. How much it will change depends on the standard deviation of the Observations and Guess errors and of course on background error correlations.

Operational values in ARPEGE namelist are:

$\sigma^G_{T2m} = 2.3$ °C $\sigma^G_{H2m} = 0.17 = 17$ % $\mathbf{\sigma^G=\sigma^G_{namelist}*exp[-\alpha\,(m-\frac{1}{m})]^2}$

$a_{T2m} = 350$ km $a_{H2m} = 300$ km $\mathbf{a^G=a^G_{namelist}*exp[-\alpha\,(m-\frac{1}{m})]}$

$\alpha = 0.02$ is a coefficient that defines how much namelist values will be changed with the stretching factor m, $1/3.5<m<3.5$.

Extreme values of the standard deviation of the Guess and radius of the correlation function for the operational configuration are shown in Table 1. (dependency with the stretching factor m).

Table 1. Extreme values of the standard deviation of the Guess and radius of the correlation function for the operational run

	France (m=3.5)	Antipode (m= 1/3.5)
σ^G_{T2m}	2.02 °C	2.61 °C
σ^G_{H2m}	14.9 %	19.3 %
a_{T2m}	328 km	376 km
a_{H2m}	281 km	320 km

Operational correlation function $\mathbf{\rho_{12}=exp(-\frac{1}{2}\frac{r^2}{a^2})}$

These values were similar to the values when CANARI was used operationally in Assimilation cycles for Upper-air and Surface Analyses. At that time it was a common statistical model and the background error correlation functions were very large. That is the reason why the new statistics are calculated.

3. Calculation of correlation and stand. deviations of Obs and Guess errors

Using a comparison between Obs and 6 hours forecast (Guess) it is possible to calculate coefficient of correlation and standard deviation of Obs and Guess.

Mean difference between Obs and Guess is defined with the following formula:

$$\overline{(O-G)^2}=\overline{(O-T+T-G)^2}=\overline{(O-T)^2+2(O-T)(T-G)+(T-G)^2}=\sigma_O^2+\sigma_G^2$$

where O is value of Observation, G is value of the Guess and T is True value which is not known. It is supposed that correlation between error of Guess and error of Obs is = 0.

Mean difference between Obs and Guess at two points is:

$$\overline{(O_1-G_1)(O_2-G_2)}=\overline{[(O_1-T_1)+(T_1-G_1)][(O_2-T_2)+(T_2-G_2)}= \text{ | all Guess Obs correlation = 0 | =}$$

$$=\overline{(O_1-T_1)(O_2-T_2)}+\overline{(T_1-G_1)(T_2-G_2)}=\overline{(T_1-G_1)(T_2-G_2)}=\rho^G_{12}\sigma_{G1}\sigma_{G2}=\rho^G_{12}\sigma^2_G$$

It is supposed that correlation between Observation errors in two points is = 0.

Because correlation coefficient is a function of the distance between two points, mean difference between Obs and Guess ($\overline{(O_1-G_1)(O_2-G_2)}$) is divided in 28 classes till 600 km (wide from 4 to 40 km) in calculations.

This time, a predefined standard deviation of Observations errors is not used. Instead of that it is used more classes and more domains.

All data for one domain, 0 and 12 UTC run, are used to calculate parameters. Same weight are given to all data. Standard deviation of the Observations, standard deviation of the Guess and radius for correlation function are calculated by minimizing the following cost function $\sum_{i=1}^{N_{class}} N_i\left(F(d_i)-f(d_i)\right)=\min$,

where:

N_i is number of data in class,

$F(d_i)$ is experimental Coeff. of corr. multiplied with square of standard deviation of Guess,

$f(d_i)$ is theoretical Coeff. of corr. multiplied with square of standard deviation of Guess.

With this formulation same weights are given to all data, what is maybe not the best solution but much better than to give the same weight to all classes.

4. Results of statistical calculations

Correlation coefficient multiplied with square of standard deviation of Guess dependency to distance between points is calculated separately for different domains. Calculations are made for every 3rd day: 1st, 4th, 7th, ... , 28th and 30th (exception is February just till 28th) in month from September 2000 till August 2001 for 00 and 12 UTC run for 11 domains. Name of the domain, mean stretching coefficient, lower and higher value of stretching coefficient in domain and geographical borders are present in Table 3.

Table 3. Domains for computation of standard deviations of Observations and Guess, and radius for function which represent coefficient of correlation, with mean, lower and higher stretching coefficient

domain	m. str. coeff.	lo-hi str. coeff.	Lon_West	Lon_East	Lat_South	Lat_North
AFR	2.2	0.5 - 2.7	-20.0	50.0	-35.0	30.0
AFS	0.7	0.5 - 0.9	10.0	40.0	-35.0	-15.0
AMS	0.8	0.6 - 1.0	-50.0	-30.0	-20.0	0.0
AUS	0.4	0.3 - 0.45	110.0	160.0	-40.0	-10.0
CHI	0.6	0.5 - 0.9	110.0	150.0	25.0	55.0
EUE	2.7	2.1 - 3.1	20.0	40.0	40.0	60.0
EUR	3.3	2.8 - 3.5	-10.0	20.0	35.0	60.0
RUS	1.5	1.2 - 1.7	60.0	80.0	50.0	70.0
USA	0.9	0.6 - 1.3	-120.0	-75.0	35.0	60.0
USE	1.2	0.9 - 1.5	-80.0	-60.0	30.0	60.0
USW	0.9	0.7 - 1.1	-130.0	-90.0	45.0	65.0

On Figures 1. and 2. are shown a variability of computed statistical parameters if it is used just one run or the parameters are computed for sum of the both runs.

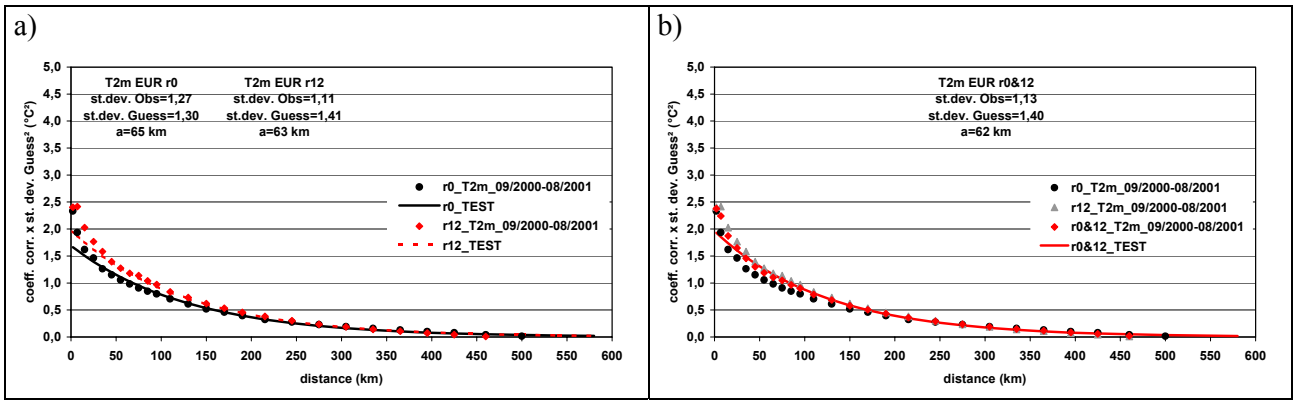

Figure 1. Coefficient of correlation multiplied with square of standard deviation of Guess dependency to distance between the points for 2 m Temperature, for Europe: a) for each 0 and 12 UTC run, b) sum for 0 and 12 UTC run

Difference for 0 and 12 UTC run are not big, for 2 m Temperature the highest differences are for AFS domain (South part of Africa). It is the same case for standard deviation of the Observations and for the standard deviation of the Guess.

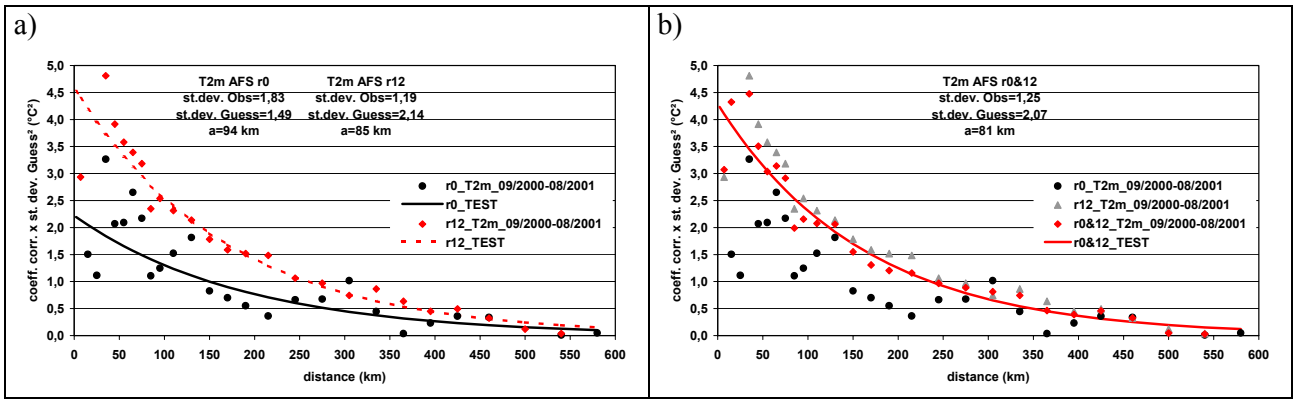

Figure 2. Coefficient of correlation multiplied with square of standard deviation of Guess dependency to distance between the points for 2 m Temperature, for South part of Africa: a) for each 0 and 12 UTC run, b) sum of 0 and 12 UTC runs

Table 4. Standard deviation of Guess and Observation and radius for correlation function for 2 m Temperature computed like sum for 0 & 12 UTC runs

Domain	SD Guess (°C)	SD Obs (°C)	R. cor. f. (km)
AFR	1.92	1.29	142
AFS	2.07	1.25	81
AMS	1.29	0.95	86
AUS	1.08	1.51	203
CHI	1.68	1.51	133
EUE	1.51	1.34	104
EUR	1.40	1.13	62
RUS	1.97	0.95	78
USA	1.79	1.47	113
USE	1.58	1.38	77
USW	1.85	1.58	95

Results of calculations parameters for 2 m Temperature for different domains like sum of 0 and 12 UTC run are shown in Table 4.

On Figures 3. and 4. and Table 5. are shown calculations for 2 m Relative Humidity. Figure 3. is for Europe, Figure 4. present variability of calculations by choosing of the domain with same mean stretching coefficient. On Figure 4. USA and USW domains are chosen, USA have more than 1/3 of the domain same like USW, and USW have more than 1/2 of the domain same like USA.

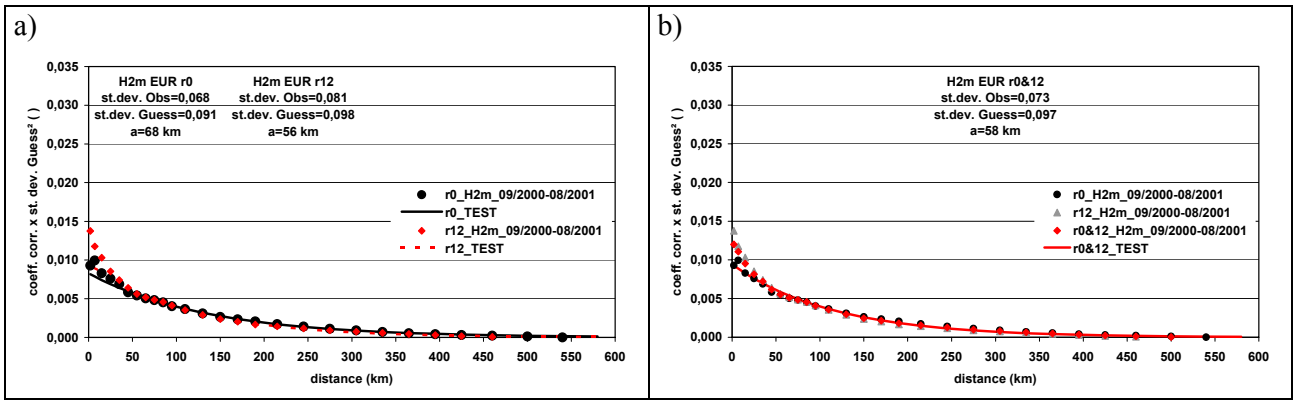

Figure 3. Coefficient of correlation multiplied with square of standard deviation of Guess dependency to distance between the points for 2 m Relative Humidity, for Europe: a) for each 0 and 12 UTC run, b) sum for 0 and 12 UTC run

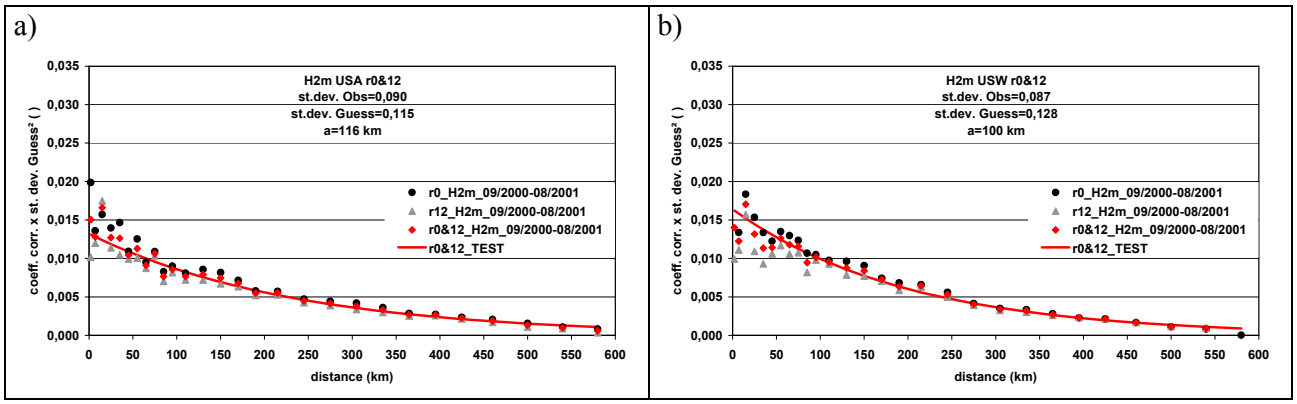

Figure 4. Coefficient of correlation multiplied with square of standard deviation of Guess dependency to distance between the points for 2 m Temperature, together for 0 and 12 UTC run for two domains with similar mean stretching coefficient on North America

Table 5. Standard deviation of Guess and Observation and Radius for Correlation function for 2 m Relative Humidity

Domain	SD Guess (%)	SD Obs (%)	R. cor. f. (km)
AFR	12.9	7.0	137
AFS	12.6	9.4	97
AMS	11.6	6.0	106
AUS	9.9	9.5	131
CHI	13.0	7.7	121
EUE	10.2	5.5	85
EUR	9.7	7.3	58
RUS	11.1	x.x	67
USA	11.5	9.0	116
USE	9.6	9.4	79
USW	12.8	8.7	100

Because the correlation function $\rho_{12}=\exp\left(-\frac{1}{2}\frac{r^2}{a^2}\right)$ does not fit the empirical correlation coefficient, like it was concluded in last stay, the new function $\rho_{12}=\exp\left(-\frac{1}{2}\frac{r}{a}\right)$ was tested, same like last time, but with new namelist values.

Namelist values for tested function are:

$\sigma^G_{T2m} = 1.6$ °C $\quad\quad$ $\sigma^G_{H2m} = 0.18 = 18$ %

$a_{T2m} = 80$ km $\quad\quad$ $a_{H2m} = 85$ km

$\alpha = 0.05$.

Table 6. Extreme values of the standard deviation of the Guess and radius of the correlation function for the test run.

	France (m=3.5)	Antipode (m= 1/3.5)
σ^G_{T2m}	1.16 °C	2.21 °C
σ^G_{H2m}	13.1 %	24.8 %
a_{T2m}	68 km	94 km
a_{H2m}	72 km	100km

Namelist values are calculated in that way that ratio of standard deviation of the Guess and standard deviation of the Observations are conserved for theoretical calculations and parameters which are used in test run. Changing of Analyzed field is depended on that ratio.
It is possible to compare Extreme values in bought cases, operational and test, because in IO Canari standard error of the Observations are defined.

5. Difference between Operational and Test experiment

Analysis in Observation points is calculated as mean value of Analysis values in 4 nearest model points. That mean values were compared with Observation values.

2 m Temperature

Experiment was performed for 2 dates, 15th January 2001. 0 UTC run and 15th August 2001. 12 UTC run.

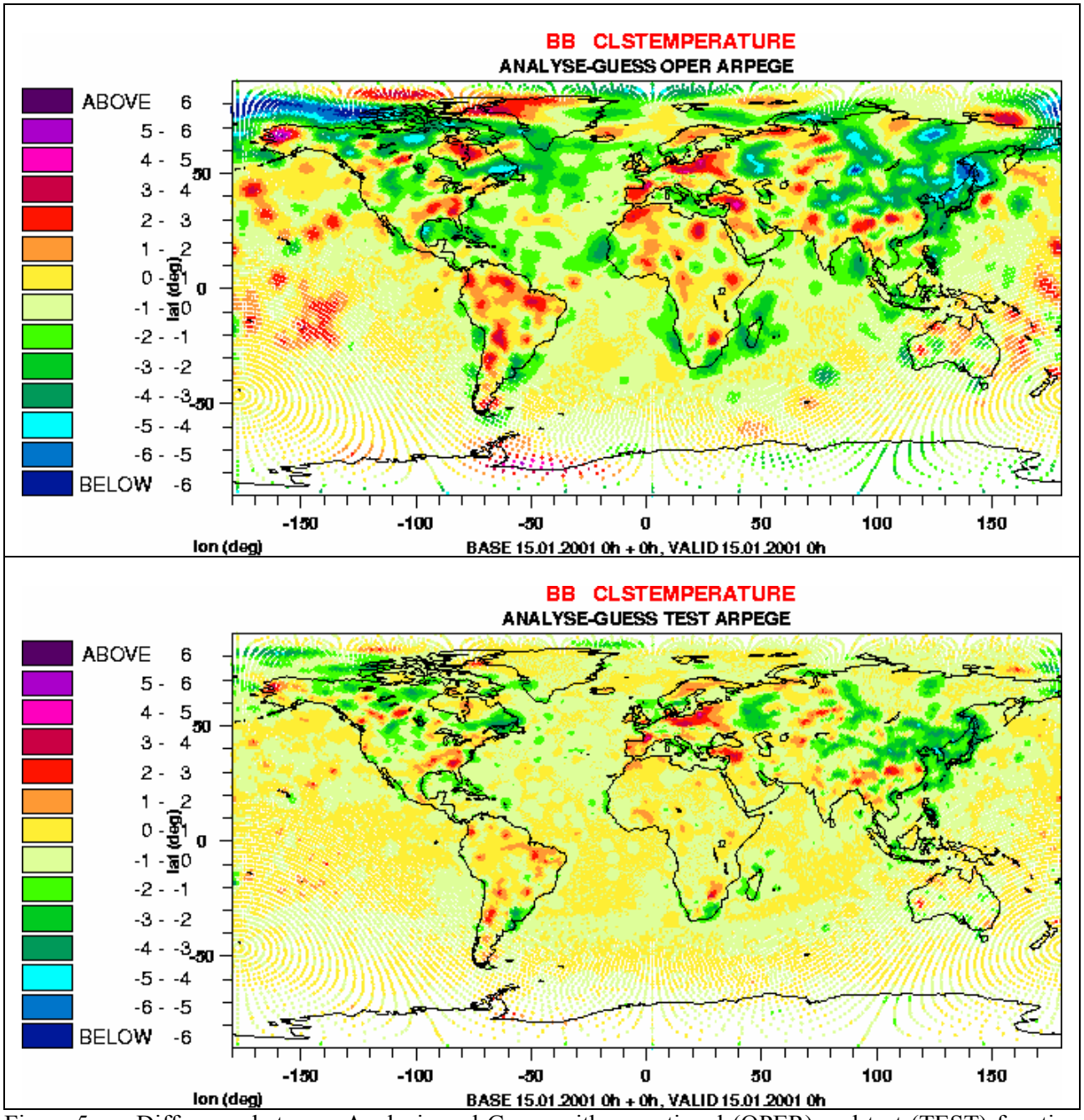

Figure 5. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Temperature for 15th January 2001. 0 UTC run

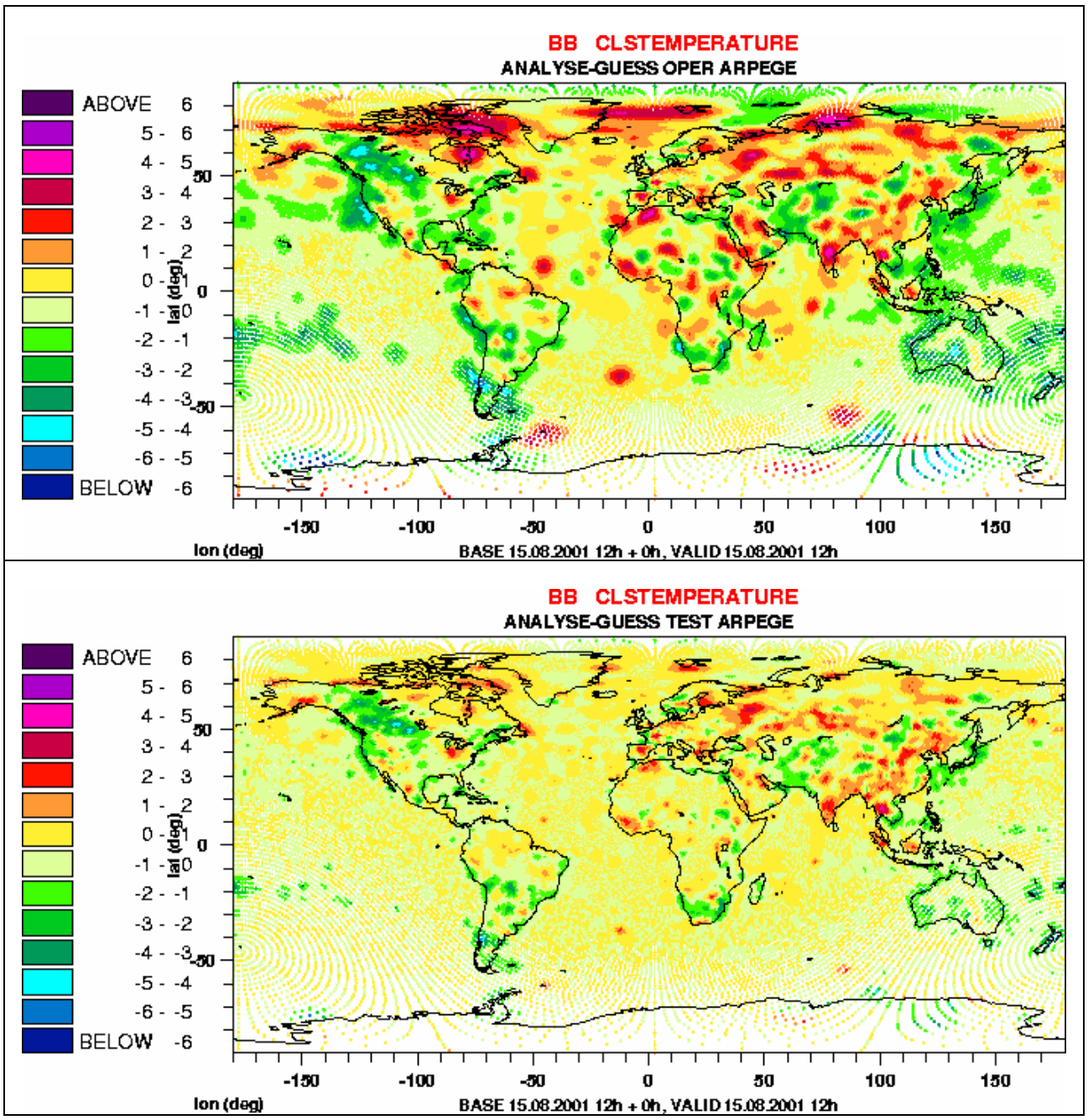

Figure 6. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Temperature for 15th August 2001. 12 UTC run

Amplitude and radius of changes are smaller with the new function and new values in namelist. It was expected because ratio between standard deviation of the Guess and standard deviation of the Observation are lower for tested values in the namelist and value of the correlation function for same distance are lower for tested correlation function.

On European domain the highest difference is over the Iberian Peninsula (Spain) where there is not to much Observations like in other parts of the Europe, it is possible to see on Figure 9. for 15th January 2001. 0 UTC run. In other parts difference between Analysis and Guess are just little bit intensive and radius of the impact of the one Observations are lower.

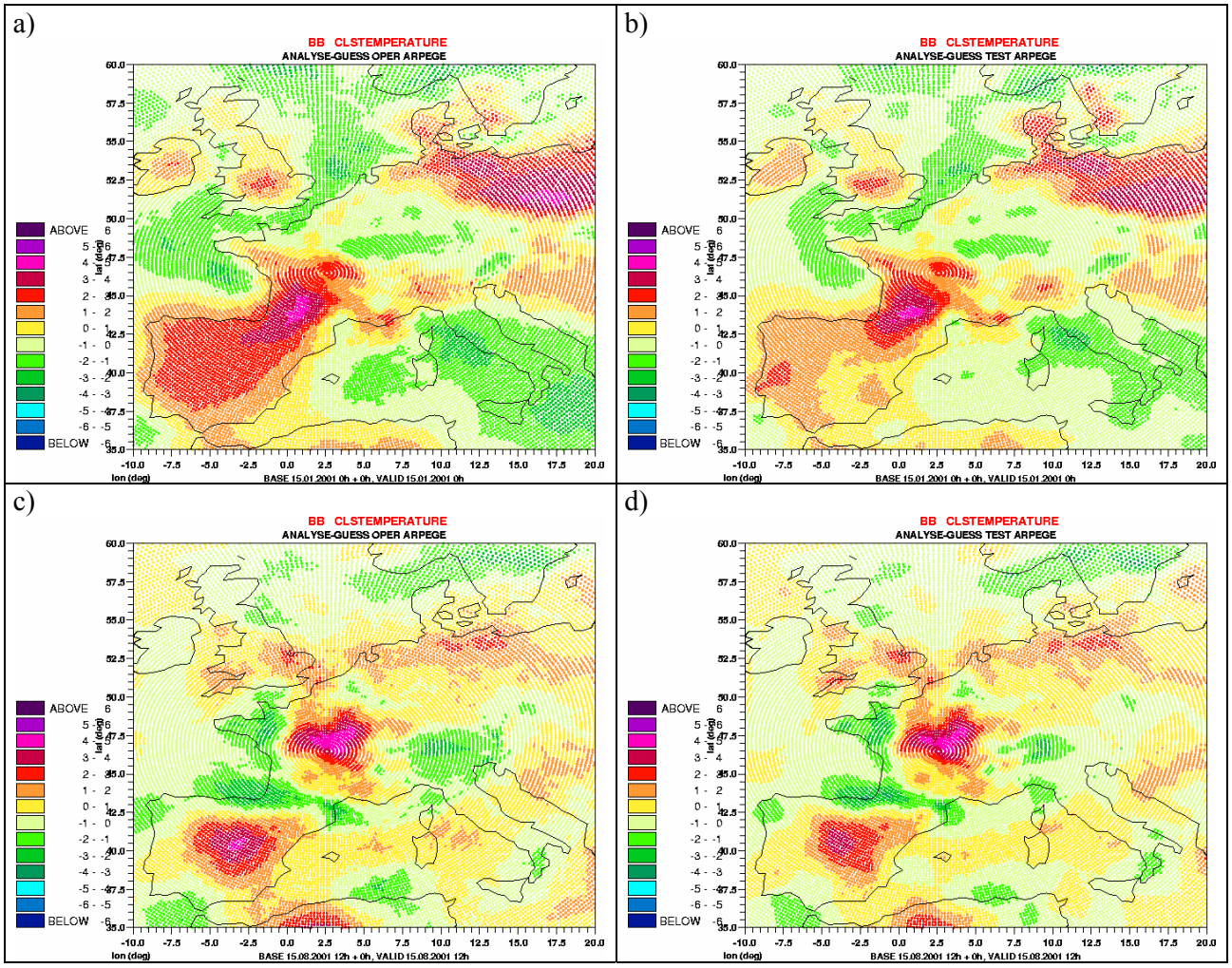

Figure 7. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Temperature over Europe: a)-b) for 15th January 2001. 0 UTC run and c)-d) for 15th August 2001. 12 UTC run

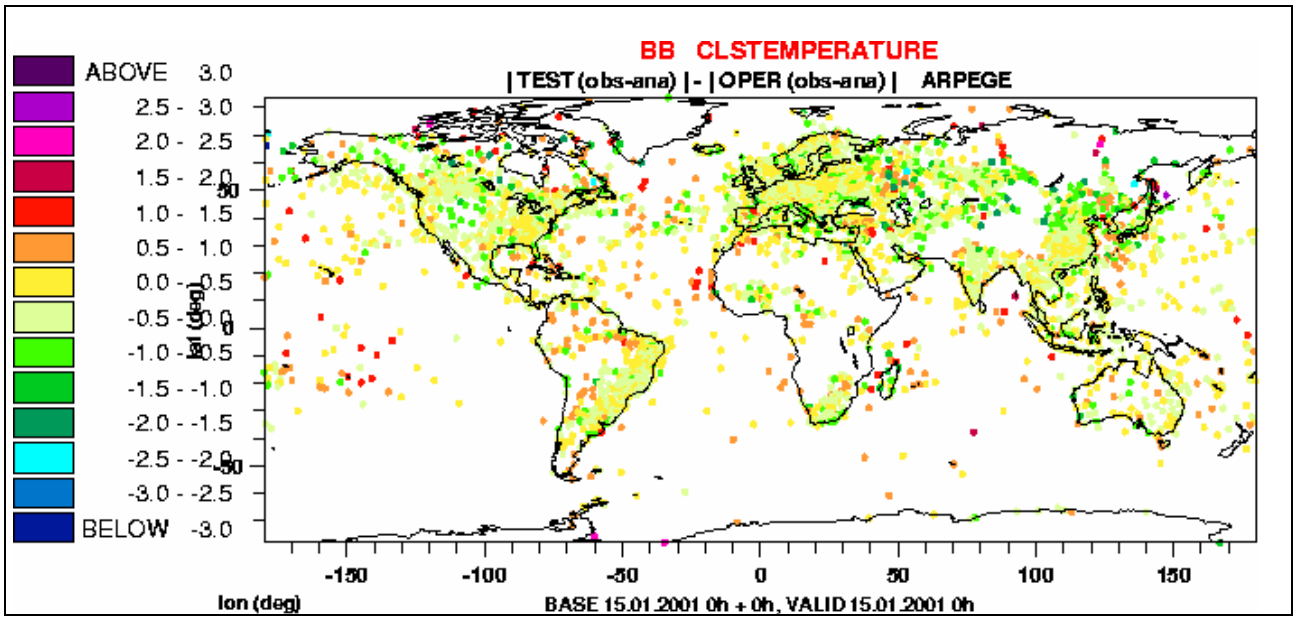

Figure 8. Absolute value of Observation and Analysis differences of 2 m Temperature difference between new (TEST) and operational (OPER) analysis for 15th January 2001. 0 UTC run

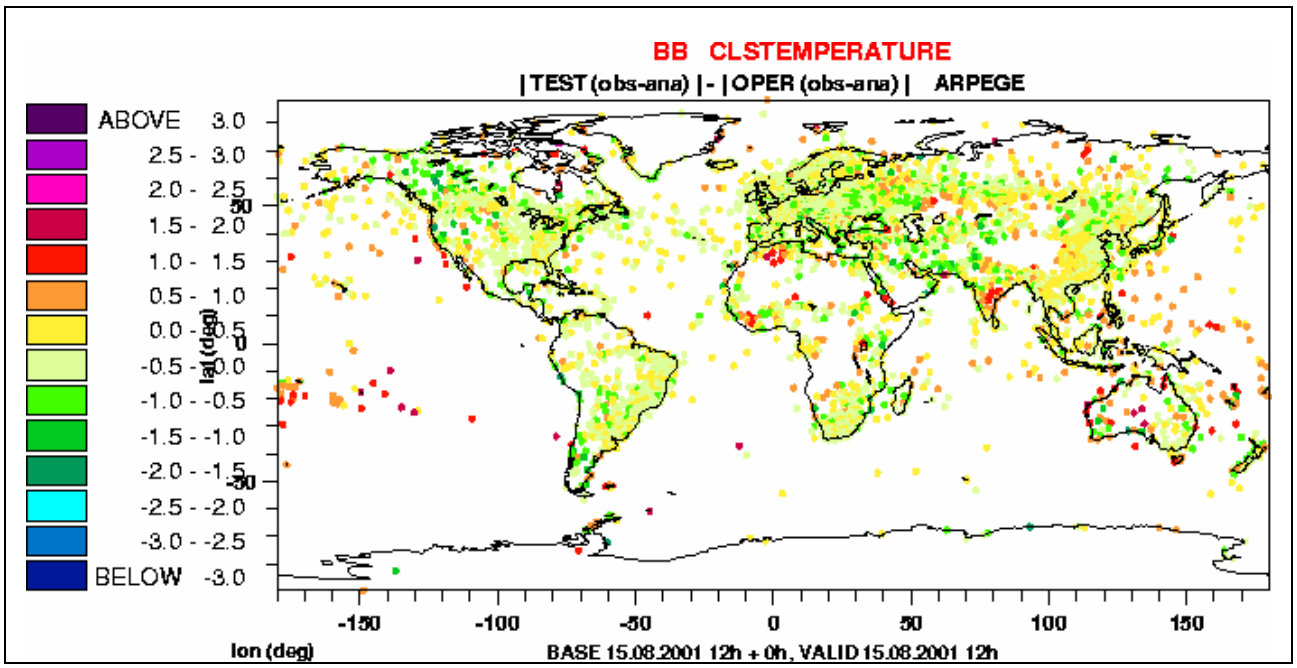

Figure 9. Absolute value of Observation and Analysis differences of 2 m Temperature difference between new (TEST) and operational (OPER) analysis for 15th August 2001. 12 UTC run

It looks like that better scores are over land for Test analysis and over sea, especially Pacific Ocean.

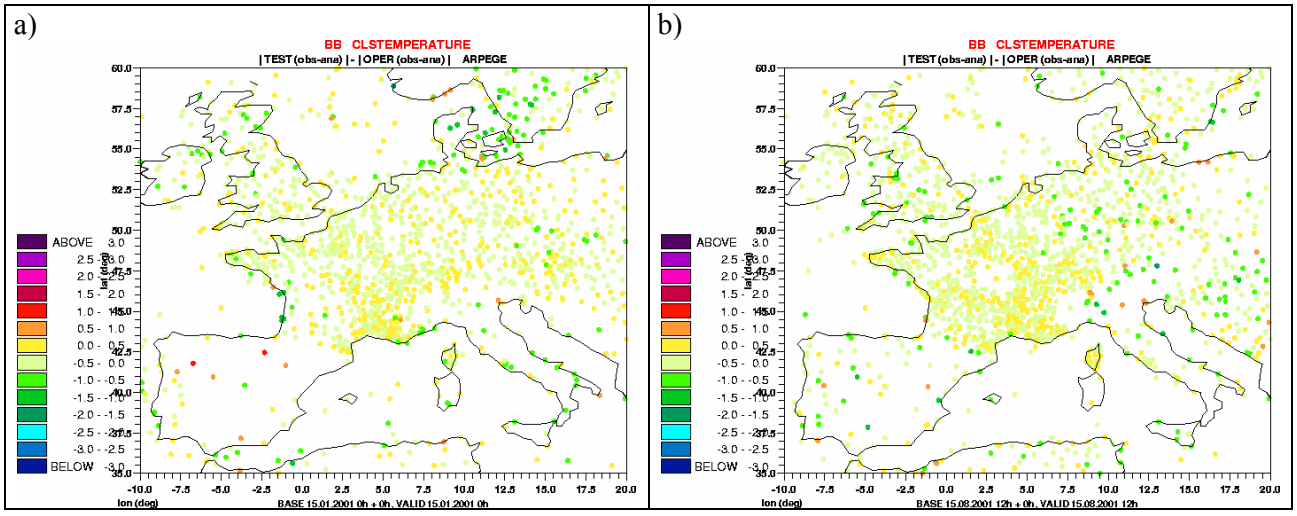

Figure 10. Absolute value of Observation and Analysis differences of 2 m Temperature difference between new (TEST) and operational (OPER) analysis over Europe: a) for 15th January 2001. 0 UTC run and b) for 15th August 2001. 12 UTC run

Over the Europe for 15th January 2001. 0 UTC run tested parameters give worst Analysis over the Spain because there were not available a lot of data like it was a case over the other part of the Europe. For 15th August 2001. 12 UTC run it look like that better results are for tested Analysis even over the Spain but to be sure if the tested Analysis is better test with the Assimilation cycle is needed.

2 m Relative Humidity

Experiment was performed for 2 dates, 15th January 2001. 0 UTC run and 15th August 2001. 12 UTC run.

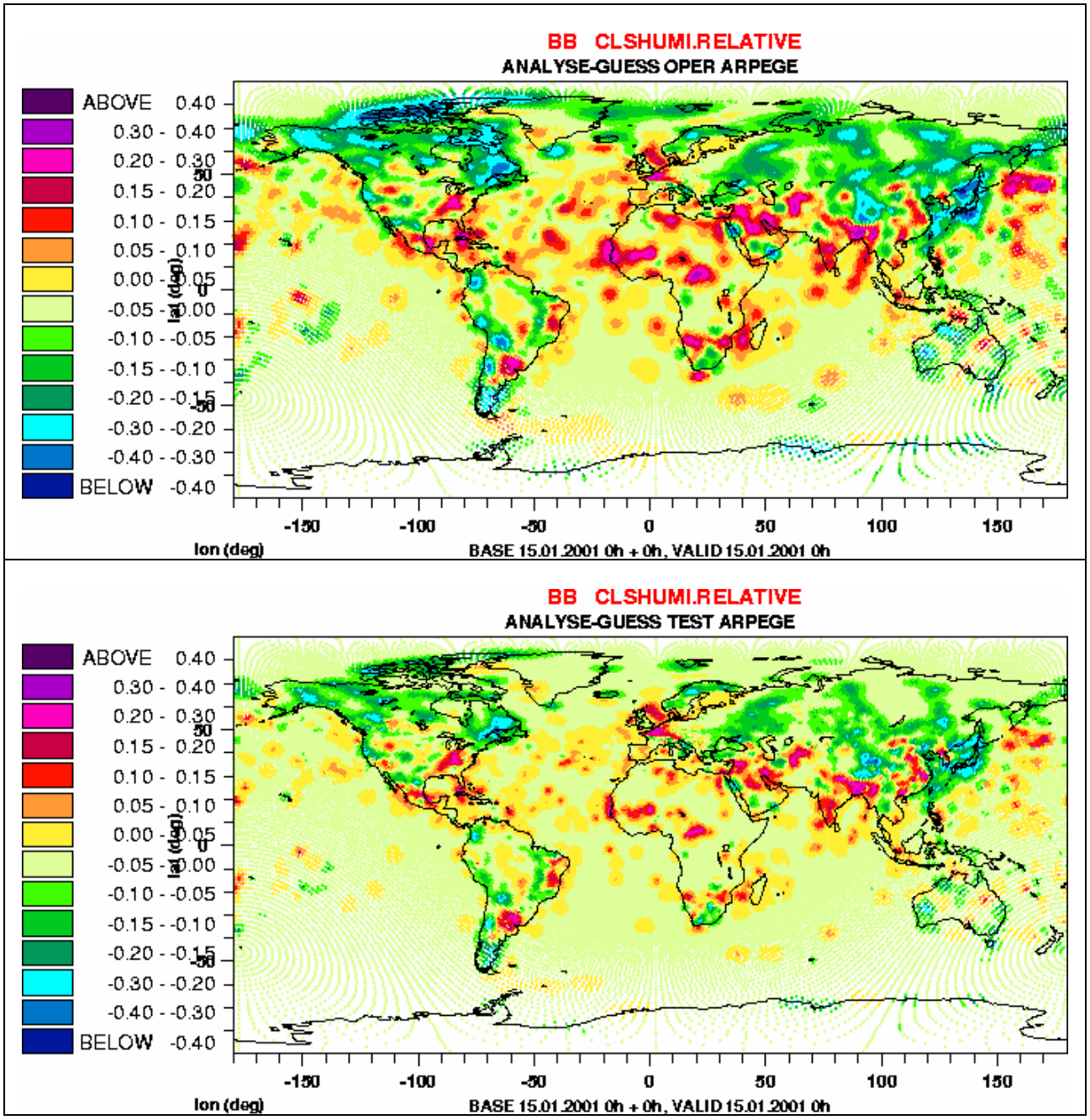

Figure 11. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Relative Humidity for 15th January 2001. 0 UTC run

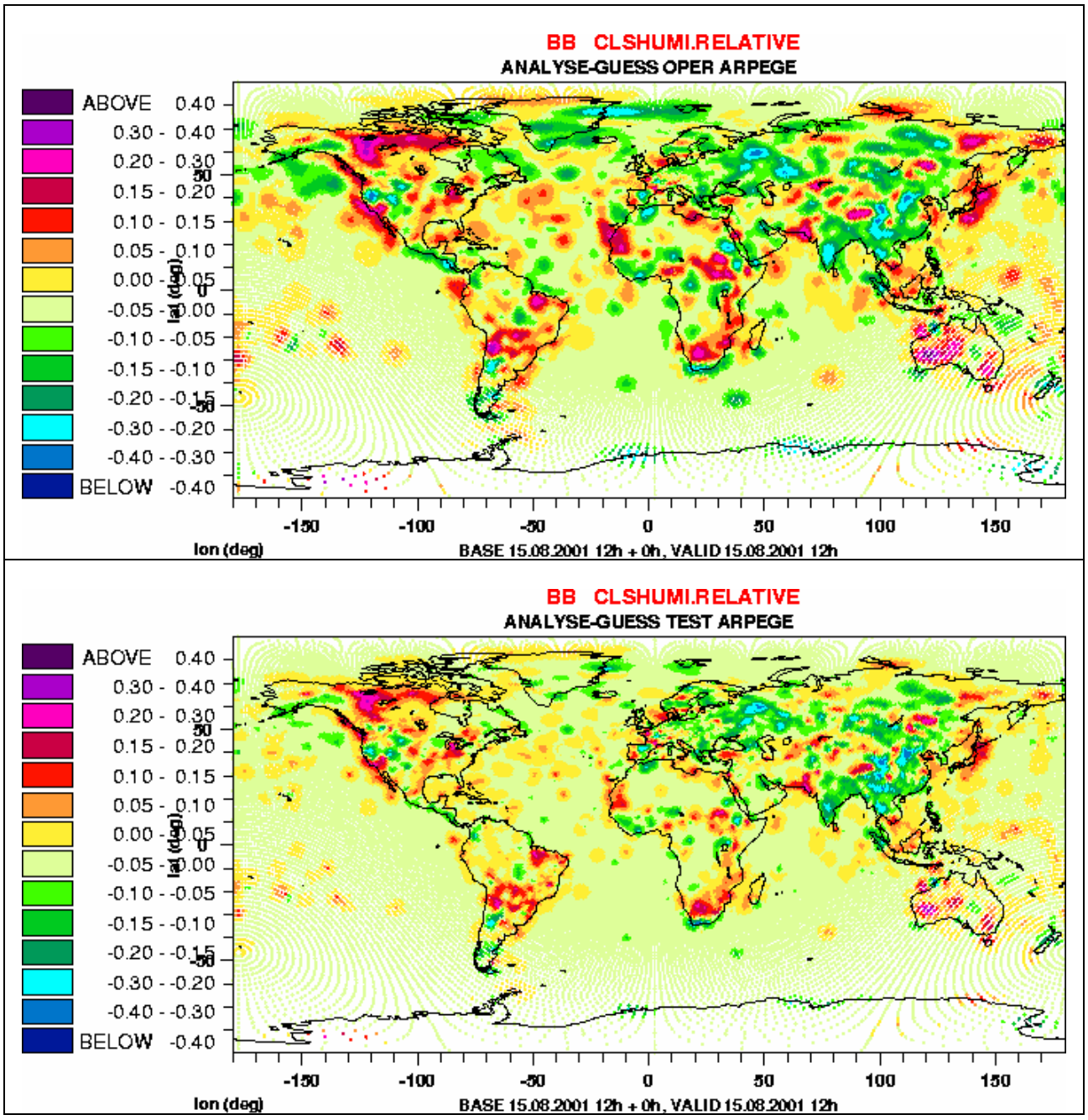

Figure 12. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Relative Humidity for 15th August 2001. 12 UTC run

Amplitude of changes are smaller or similar for Areas which are not in Europe with the new function and new values in namelist. Radius of changes are similar for Europe and smaller for the new function and new values in namelist. Over the Europe amplitude of changes are higher for the new function and new values in namelist for Relative Humidity field. The reason why it is like that is increasing of the standard deviation of the Guess.

On next page zoom area over Europe is shown.

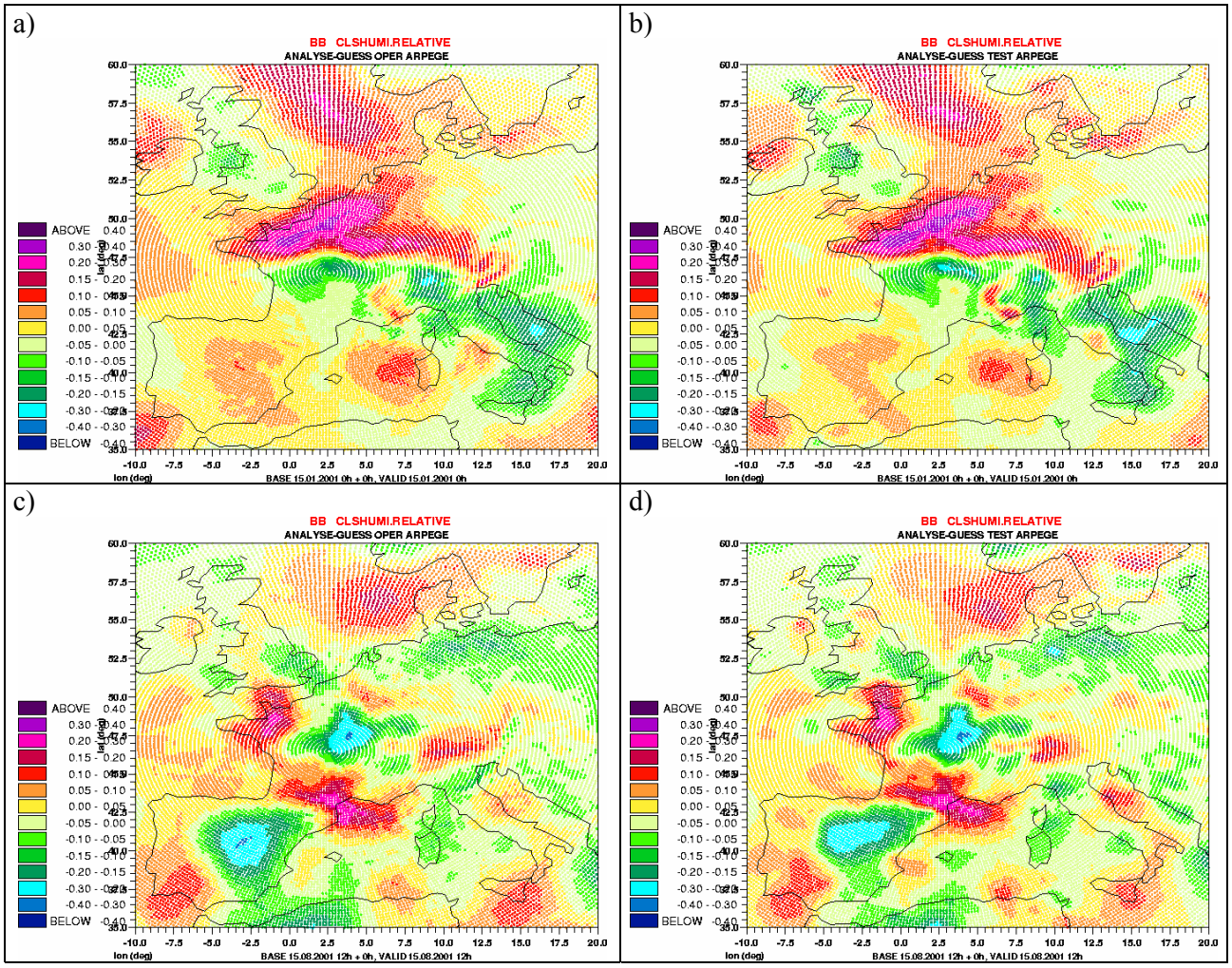

Figure 13. Difference between Analysis and Guess with operational (OPER) and test (TEST) function and namelist for 2 m Relative Humidity over Europe: a)-b) for 15th January 2001. 0 UTC run and c)-d) for 15th August 2001. 12 UTC run

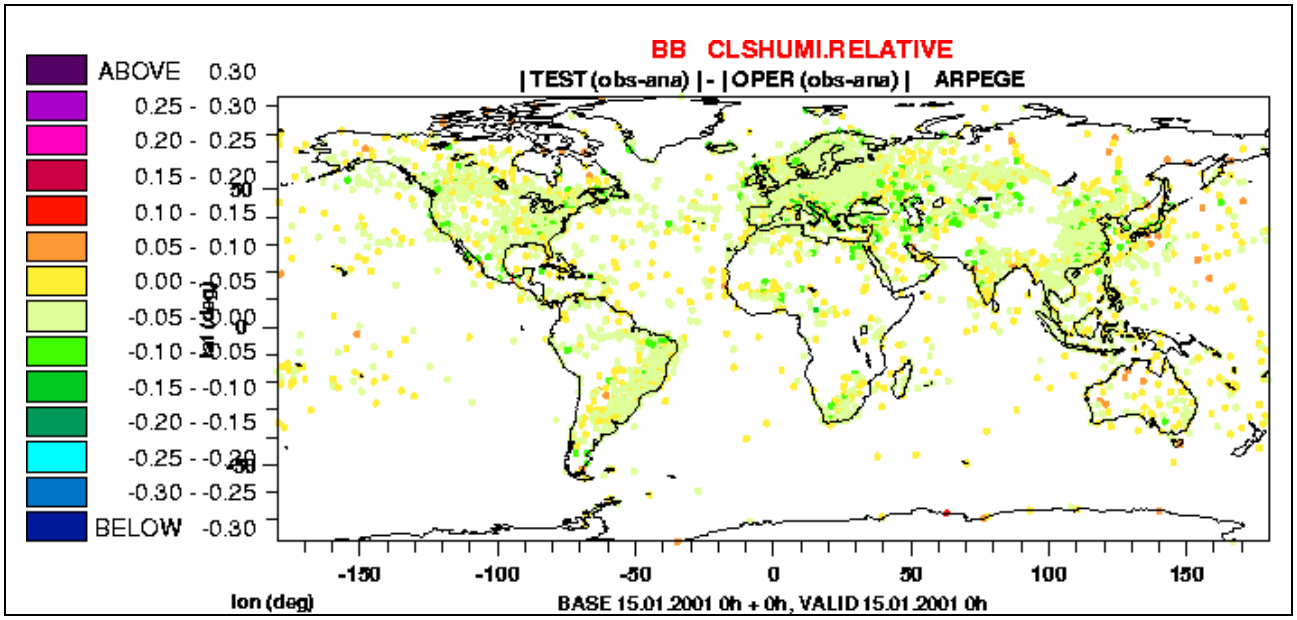

Figure 14. Absolute value of Observation and Analysis differences of 2 m Relative Humidity difference between new (TEST) and operational (OPER) analysis for 15th January 2001. 0 UTC run

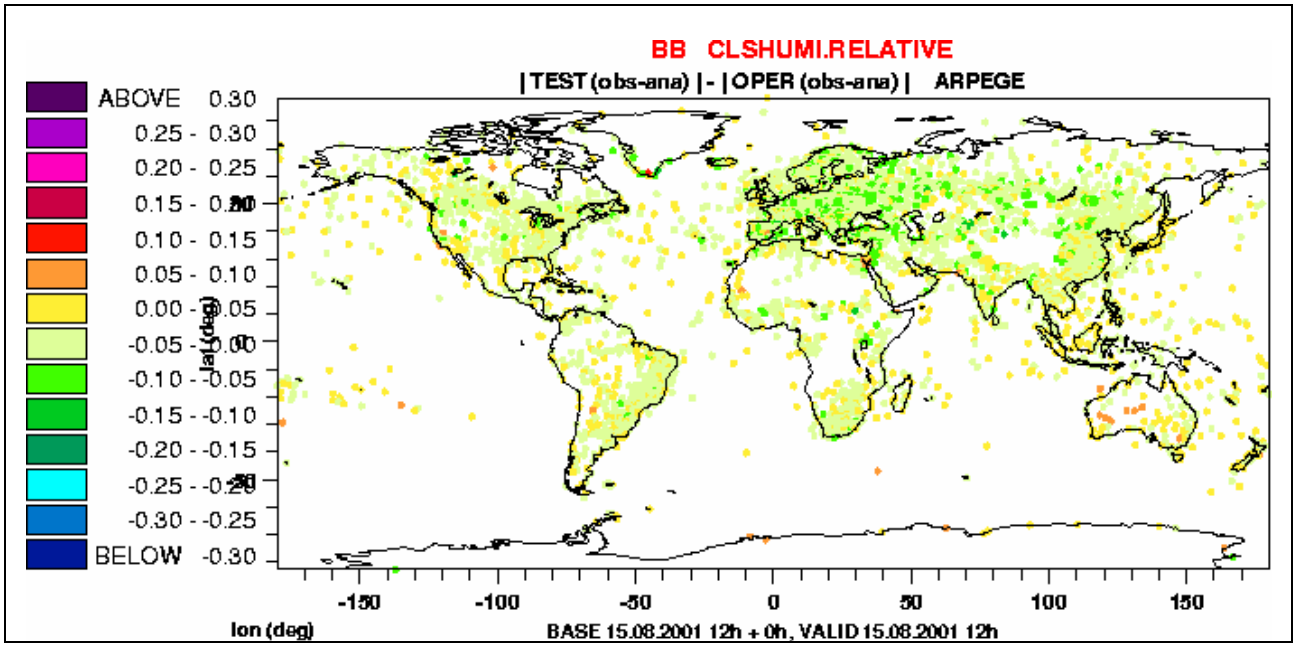

Figure 15. Absolute value of Observation and Analysis differences of 2 m Relative Humidity difference between new (TEST) and operational (OPER) analysis for 15th August 2001. 12 UTC run

From the Figures it looks like that the scores are better or equal over sea for Operational, and over land for Test analysis. Over the Europe it looks like that the tested analysis is better, especially for 15th August 2001. 12 UTC run.

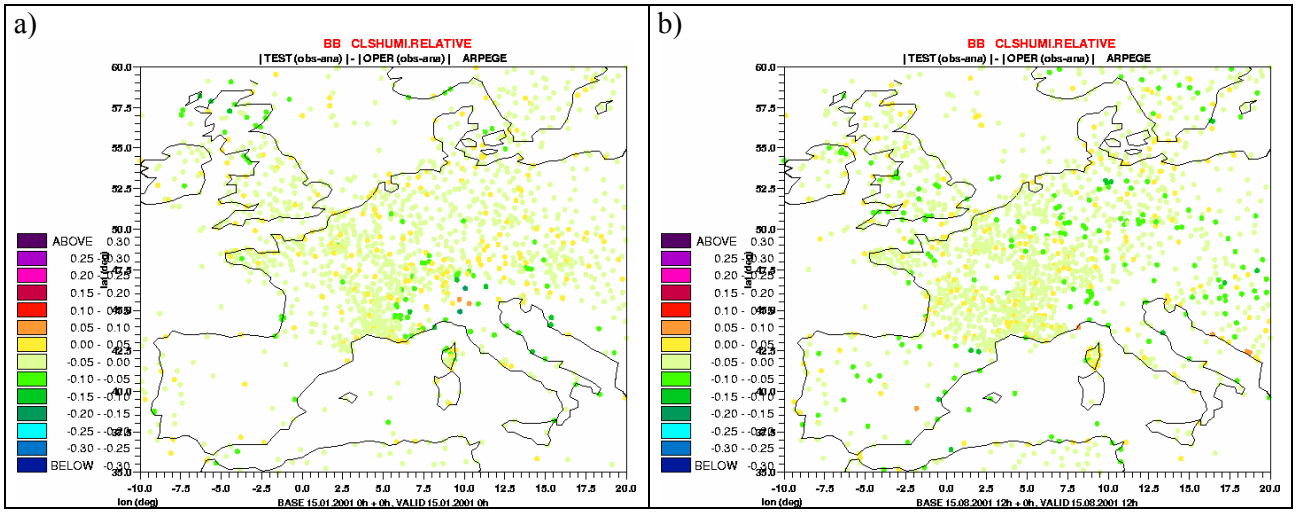

Figure 16. Absolute value of Observation and Analysis differences of 2 m Relative Humidity difference between new (TEST) and operational (OPER) analysis over Europe: a) for 15th January 2001. 0 UTC run and b) for 15th August 2001. 12 UTC run

6. Bias and RMS statistics for different domains

In next tables, results of statistics for different domains for 2 runs for 15th January 2001. 0 UTC run and for 15th August 2001. 12 UTC run and for 2m Temperature and 2m Relative Humidity are shown. Operational is with **O** and the new with **T**.

Table 7. Domains for statistics computation

DOMAIN	LAT_NORTH	LAT_SOUTH	LON_EAST	LON_WEST
FRANCE	51.00	43.00	8.00	-5.00
EUROPE	60.00	35.00	20.00	-10.00
ALA_FR	57.00	33.00	25.00	-12.00
N_AM_N	70.00	40.00	-60.00	-130.00
N_AM_S	40.00	10.00	-70.00	-120.00
S_AM_N	10.00	-20.00	-30.00	-80.00
S_AM_S	-20.00	-50.00	-40.00	-80.00
N_ATLA	70.00	10.00	-20.00	-60.00
AUSTRA	-10.00	-40.00	160.00	110.00
AFRI_N	35.00	0.00	50.00	-20.00
AFRI_S	0.00	-35.00	50.00	10.00
EUAS_E	70.00	40.00	80.00	25.00
EUAS_W	70.00	20.00	150.00	80.00
PACI_N	50.00	10.00	-120.00	-180.00
PACI_S	10.00	-60.00	-85.00	-180.00
NOR_PO	90.00	70.00	180.00	-180.00
SOU_PO	-60.00	-90.00	180.00	-180.00
S_ATLA	0.00	-60.00	10.00	-40.00
PACI_W	50.00	0.00	180.00	140.00
IND_OC	10.00	-60.00	100.00	50.00

Table 8. Bias and RMS for 2 m Temperature on different domains for 15th January 2001. 0 UTC run and for 15th August 2001. 12 UTC run

20010115r0	**20010815r12**
obs_ana_T2M_**T**.dta obs_ana_T2M_**O**.dta	obs_ana_T2M_**T**.dta obs_ana_T2M_**O**.dta
WORLD Nb. Points= 5185 5185	WORLD Nb. Points= 6000 6000
bias= 0.776991 < bias= 0.869776	bias= 0.899842 < bias= 0.939622
rms= 2.294299 < rms= 2.389614	rms= 2.409683 < rms= 2.499657
FRANCE Nb. Points= 515 520	FRANCE Nb. Points= 691 697
bias= 0.762932 bias= 0.715154	bias= 0.840955 bias= 0.803027
rms= 2.120636 < rms= 2.189150	rms= 2.482997 < rms= 2.558691
EUROPE Nb. Points= 1427 1429	EUROPE Nb. Points= 1691 1694
bias= 0.623371 bias= 0.602841	bias= 0.758232 bias= 0.744191
rms= 2.105031 < rms= 2.224526	rms= 2.383170 < rms= 2.520186
ALA_FR Nb. Points= 1462 1466	ALA_FR Nb. Points= 1685 1690
bias= 0.674740 bias= 0.644625	bias= 0.814546 bias= 0.787077
rms= 2.105944 < rms= 2.210430	rms= 2.422156 < rms= 2.553799
N_AM_N Nb. Points= 496 498	N_AM_N Nb. Points= 562 565
bias= 1.243750 < bias= 1.400482	bias= 0.971548 < bias= 1.088708
rms= 2.764169 < rms= 2.866304	rms= 2.557366 < rms= 2.756255
N_AM_S Nb. Points= 198 202	N_AM_S Nb. Points= 210 211
bias= 0.522677 < bias= 0.619059	bias= 0.615429 < bias= 0.831185
rms= 2.186461 < rms= 2.303413	rms= 2.129092 < rms= 2.217592

Table 8. Bias and RMS for 2 m Temperature on different domains for 15th January 2001. 0 UTC run and for 15th August 2001. 12 UTC run

20010115r0				**20010815r12**			
obs_ana_T2M_**T**.dta		obs_ana_T2M_**O**.dta		obs_ana_T2M_**T**.dta		obs_ana_T2M_**O**.dta	
S_AM_N	Nb. Points=	192	192	S_AM_N	Nb. Points=	207	207
bias=	1.240938	bias=	1.120781	bias=	1.286860 <	bias=	1.384734
rms=	2.679227	rms=	2.674623	rms=	2.763705 <	rms=	2.871212
S_AM_S	Nb. Points=	139	139	S_AM_S	Nb. Points=	155	155
bias=	1.372950 <	bias=	1.380719	bias=	1.031871 <	bias=	1.330000
rms=	3.312744	rms=	3.202974	rms=	2.801358 <	rms=	2.951599
N_ATLA	Nb. Points=	125	126	N_ATLA	Nb. Points=	122	123
bias=	-0.345600	bias=	0.149921	bias=	0.375820	bias=	0.252764
rms=	1.258543 <	rms=	1.294517	rms=	1.419807 <	rms=	1.554745
AUSTRA	Nb. Points=	108	108	AUSTRA	Nb. Points=	116	116
bias=	0.233611 <	bias=	0.301389	bias=	-0.200690 <	bias=	0.415690
rms=	1.736672	rms=	1.681337	rms=	1.695935	rms=	1.608896
AFRI_N	Nb. Points=	199	199	AFRI_N	Nb. Points=	271	272
bias=	0.623417	bias=	0.551809	bias=	0.786310	bias=	0.691765
rms=	1.806477 <	rms=	1.838879	rms=	1.979215 <	rms=	2.002089
AFRI_S	Nb. Points=	115	115	AFRI_S	Nb. Points=	218	219
bias=	0.795478 <	bias=	1.066609	bias=	0.842844 <	bias=	0.979726
rms=	1.911725 <	rms=	2.029568	rms=	1.813689 <	rms=	1.954475
EUAS_E	Nb. Points=	399	400	EUAS_E	Nb. Points=	401	402
bias=	0.534261 <	bias=	0.593550	bias=	0.750873	bias=	0.568756
rms=	1.786607 <	rms=	1.959104	rms=	2.002229 <	rms=	2.165387
EUAS_W	Nb. Points=	554	554	EUAS_W	Nb. Points=	721	721
bias=	1.319188 <	bias=	1.712040	bias=	1.695631	bias=	1.672829
rms=	2.958471 <	rms=	3.176157	rms=	2.953906	rms=	2.951567
PACI_N	Nb. Points=	118	119	PACI_N	Nb. Points=	102	103
bias=	1.692034	bias=	1.631008	bias=	0.763824 <	bias=	1.064466
rms=	3.198435	rms=	3.132328	rms=	2.870087	rms=	2.850308
PACI_S	Nb. Points=	48	49	PACI_S	Nb. Points=	34	34
bias=	0.511458	bias=	0.064082	bias=	-1.457647	bias=	-0.492059
rms=	1.296351	rms=	0.898577	rms=	1.766823	rms=	0.924521
NOR_PO	Nb. Points=	39	39	NOR_PO	Nb. Points=	64	64
bias=	-0.140256 <	bias=	0.338974	bias=	1.131250	bias=	0.681875
rms=	2.169233	rms=	2.045396	rms=	1.883987	rms=	1.541312
SOU_PO	Nb. Points=	33	33	SOU_PO	Nb. Points=	39	39
bias=	1.767273	bias=	1.651515	bias=	1.787436 <	bias=	2.083846
rms=	3.275537	rms=	3.151965	rms=	4.438668	rms=	4.397125
S_ATLA	Nb. Points=	50	50	S_ATLA	Nb. Points=	47	47
bias=	0.135800 <	bias=	0.242200	bias=	0.434894 <	bias=	0.470426
rms=	1.086331 <	rms=	1.087550	rms=	1.251221 <	rms=	1.316781
PACI_W	Nb. Points=	71	71	PACI_W	Nb. Points=	52	52
bias=	0.011972 <	bias=	0.312817	bias=	-0.597692	bias=	-0.091923
rms=	1.341077	rms=	1.337340	rms=	1.184473	rms=	0.962934
IND_OC	Nb. Points=	47	49	IND_OC	Nb. Points=	63	63
bias=	-0.497660	bias=	-0.056531	bias=	0.090159	bias=	-0.021905
rms=	1.197155	rms=	0.908907	rms=	1.014667	rms=	0.949045

Table 9. Bias and RMS for 2 m Relative Humidity on different domains for 12 UTC and 18 UTC runs

20010115r0	**20010815r12**
obs_ana_H2M_**T**.dta__obs_ana_H2M_**O**.dta	obs_ana_H2M_**T**.dta__obs_ana_H2M_**O**.dta
WORLD Nb. Points= 4897 4897	WORLD Nb. Points= 5646 5646
bias= 0.008330 < bias= 0.011646	bias= 0.013091 < bias= 0.013999
rms= 0.071897 < rms= 0.082966	rms= 0.078125 < rms= 0.092096
FRANCE Nb. Points= 485 490	FRANCE Nb. Points= 637 643
bias= 0.010969 < bias= 0.012061	bias= 0.004050 < bias= 0.004292
rms= 0.074891 < rms= 0.091873	rms= 0.069927 < rms= 0.086679
EUROPE Nb. Points= 1379 1381	EUROPE Nb. Points= 1617 1620
bias= 0.011226 < bias= 0.011854	bias= 0.009079 bias= 0.008821
rms= 0.072615 < rms= 0.088643	rms= 0.081937 < rms= 0.101656
ALA_FR Nb. Points= 1417 1421	ALA_FR Nb. Points= 1614 1619
bias= 0.009993 < bias= 0.010718	bias= 0.007212 < bias= 0.007437
rms= 0.071725 < rms= 0.087400	rms= 0.083072 < rms= 0.103320
N_AM_N Nb. Points= 449 451	N_AM_N Nb. Points= 476 478
bias= -0.001782 < bias= 0.007140	bias= 0.018908 bias= 0.016297
rms= 0.062434 < rms= 0.072906	rms= 0.077611 < rms= 0.088177
N_AM_S Nb. Points= 190 194	N_AM_S Nb. Points= 201 202
bias= 0.039211 bias= 0.038814	bias= 0.025721 < bias= 0.020891
rms= 0.097643 < rms= 0.108621	rms= 0.073987 < rms= 0.075982
S_AM_N Nb. Points= 190 190	S_AM_N Nb. Points= 205 205
bias= 0.006737 < bias= 0.009000	bias= 0.009707 bias= 0.006585
rms= 0.063710 < rms= 0.078301	rms= 0.059604 < rms= 0.069229
S_AM_S Nb. Points= 137 137	S_AM_S Nb. Points= 152 152
bias= 0.014453 < bias= 0.022701	bias= 0.022961 bias= 0.018618
rms= 0.074618 < rms= 0.079198	rms= 0.098472 < rms= 0.100003
N_ATLA Nb. Points= 113 113	N_ATLA Nb. Points= 108 109
bias= 0.008850 bias= 0.005133	bias= 0.008056 < bias= 0.014495
rms= 0.052174 < rms= 0.065270	rms= 0.074318 < rms= 0.081736
AUSTRA Nb. Points= 91 91	AUSTRA Nb. Points= 98 98
bias= 0.012198 < bias= 0.026923	bias= 0.051020 bias= 0.041429
rms= 0.084353 rms= 0.081003	rms= 0.121008 rms= 0.111721
AFRI_N Nb. Points= 195 195	AFRI_N Nb. Points= 266 267
bias= 0.041641 bias= 0.026769	bias= 0.012782 bias= 0.012097
rms= 0.090242 < rms= 0.102076	rms= 0.069304 < rms= 0.079876
AFRI_S Nb. Points= 90 90	AFRI_S Nb. Points= 191 192
bias= 0.012778 bias= 0.009889	bias= 0.035654 bias= 0.033906
rms= 0.080932 < rms= 0.088135	rms= 0.088148 < rms= 0.096477
EUAS_E Nb. Points= 393 394	EUAS_E Nb. Points= 396 397
bias= -0.006310 bias= 0.003122	bias= 0.001692 < bias= 0.010630
rms= 0.045595 < rms= 0.064310	rms= 0.069222 < rms= 0.098778
EUAS_W Nb. Points= 523 523	EUAS_W Nb. Points= 715 715
bias= -0.004340 < bias= 0.007132	bias= 0.010811 < bias= 0.014727
rms= 0.082946 < rms= 0.093058	rms= 0.071096 < rms= 0.086161
PACI_N Nb. Points= 87 88	PACI_N Nb. Points= 74 75
bias= 0.011609 < bias= 0.012273	bias= 0.036892 < bias= 0.038267
rms= 0.073960 < rms= 0.075408	rms= 0.115962 rms= 0.115349

Table 9. Bias and RMS for 2 m Relative Humidity on different domains for 12 UTC and 18 UTC runs

20010115r0				**20010815r12**			
obs_ana_H2M_**T**.dta		obs_ana_H2M_**O**.dta		obs_ana_H2M_**T**.dta		obs_ana_H2M_**O**.dta	
PACI_S	Nb. Points=	47	48	PACI_S	Nb. Points=	33	33
bias=	-0.015532	bias=	-0.007917	bias=	0.016667	bias=	0.006970
rms=	0.053415	rms=	0.037305	rms=	0.060877	rms=	0.048461
NOR_PO	Nb. Points=	34	34	NOR_PO	Nb. Points=	53	53
bias=	-0.045294	bias=	-0.013824	bias=	-0.003208	bias=	0.000943
rms=	0.081277	rms=	0.066044	rms=	0.048893 <	rms=	0.055644
SOU_PO	Nb. Points=	26	26	SOU_PO	Nb. Points=	27	27
bias=	-0.041538	bias=	-0.021154	bias=	-0.025926	bias=	-0.012963
rms=	0.095636	rms=	0.068021	rms=	0.080737	rms=	0.062450
S_ATLA	Nb. Points=	48	48	S_ATLA	Nb. Points=	44	44
bias=	0.023542	bias=	0.019375	bias=	0.005000 <	bias=	0.005682
rms=	0.056624 <	rms=	0.070519	rms=	0.057208 <	rms=	0.067907
PACI_W	Nb. Points=	64	64	PACI_W	Nb. Points=	50	50
bias=	0.005469 <	bias=	0.009844	bias=	0.041000	bias=	0.028800
rms=	0.082906	rms=	0.078948	rms=	0.072760	rms=	0.065452
IND_OC	Nb. Points=	44	46	IND_OC	Nb. Points=	59	59
bias=	0.029318	bias=	0.020435	bias=	0.027119 <	bias=	0.030847
rms=	0.052332	rms=	0.043439	rms=	0.064964 <	rms=	0.068766

For whole globe bias and rms are beter for bouth dates. The bias of 2 m Temperature for European domains are better for the operational then for the test run, but rms is better for test run. For all domains 14 times test run was better for bias and rms, 18 times was better just bias or rms and 10 times worst for bouth.

For whole globe bias and rms are beter for bouth dates for 2 m relative Humidity. For 3 Europe domains and 2 runs test was better for all in rms scores and in 5 of 6 in bias scores. For 2 m Relative Humidity bias and rms are better for 18 domains for test run, 16 times was better just bias or rms and 8 times worst for bouth.

7. Conclusion

Because the calculated values of the correlation coefficients were not similar to the operational Gauss correlation function $\rho_{12}=\exp\left(-\frac{1}{2}\frac{r^2}{a^2}\right)$ it was proposed that new function is tested $\rho_{12}=\exp\left(-\frac{1}{2}\frac{r}{a}\right)$.

Namelist values for tested function are: σ^G_{T2m}= 1.6 °C, σ^G_{H2m}= 0.18 = 18 %, a_{T2m}= 80 km, a_{H2m}= 85 km and α= 0.05.

It is not possible to conclude if the impact of the new Analyses will improve or not 2 m scores without Assimilation cycles.