Report about DA installation in DHMZ

Data preprocessing

First we installed and modified Hungarian version of OULAN. In it we modified subroutine that extract SYNOP data in order to use local SYNOP data and also data form Croatian automatic stations. Difficulties in this area are connected with fact that we don have database with observational data so we had to use raw data as starting point.

Installation and tests of different configurations

Installation of AAA cy32t3 was done with gmkpack 6.2.4. There was some difficulties with missing libraries (we didn't have eclib) and with some bugs in the code:
BATOR – bug in subroutine odb/include/fodb.h,
config. 002 – bug in subroutine arp/obs_preproc/first.90 (problem with SSMIS flagging).
We also had problem with dr. Hook so we shut it down.

Tests of different configurations

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In order to test technical correctness of CANARI installation in Croatia, we used data package received from Alena Trojakova (CHMI) containing first guess file, OBSOUL, ECMA data base, climatological files, ISBA polynomial file, analysis file, output listings and plots of analysis increments (T2m and RH2m). From output listings we extracted CANARI namelist and modified it only in part concerning local computer settings. In order to avoid crash of CANARI run one more change was necessary, we changed interpolation from bi-cubic (203) to bi-linear (201). We used given input files and ECMA database. Results showed that in comparison with CHMI output listing there was small differences in rejection of observations data (probably due to different interpolation). Visualization of 2m analysis increments showed very similar forms and comparable magnitudes when compared with CHMI visualization (same for surface fields).

We also used given package to test correctness of creation of ECMA data base with BATOR, so one more test was done; ECMA database was created locally from given OBSOUL file, and analysis was preformed. Results were identical to results from previous test, so we concluded that BATOR also works good (at least for this data). We extracted data from both bases (CRO and CHMI) with MANDALAY and made comparison. Differences were negligible (in 13^{th} digit).
So we can conclude that installed CANARI software in Croatia is technically working good with one restriction – usage of bi-linear (201) interpolation.

CANARI single obs

Single obs experiments were done on guess coming from operational forecast (6h forecast). Two single obs experiments were done:

1) 2m temperature coming from synop data, at location of Zagreb, with innovation $y - H(x_b) = 2\text{K}$. Only T_{2m} CANARI analysis.

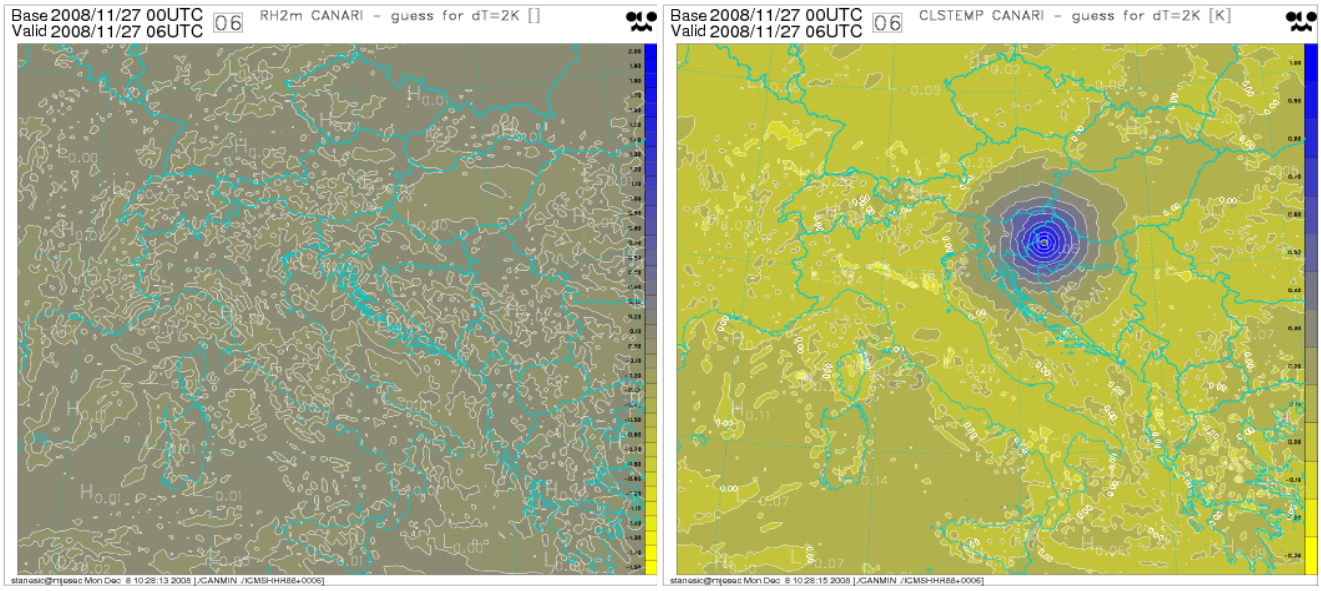

Figure 1. RH2m i T2m difference between CANARI analysis and guess (6h operational forecast)

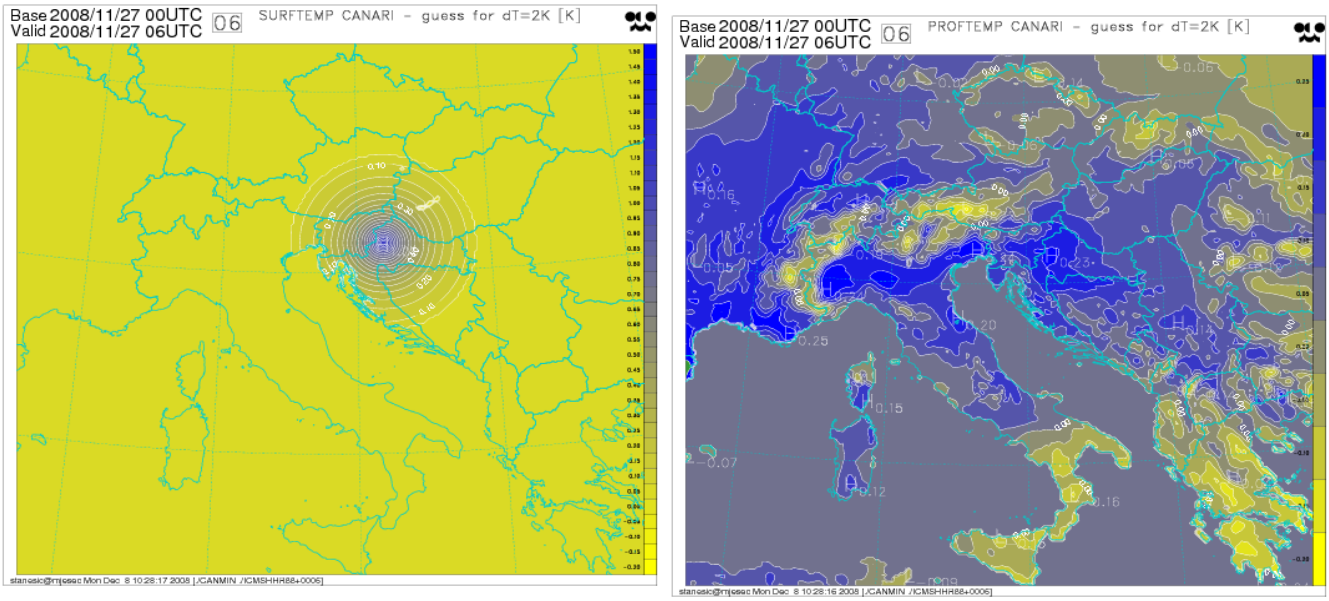

Figure 2. SURFTEMPERATURE and PROFTEMPERATURE difference between CANARI analysis and guess (6h operational forecast).

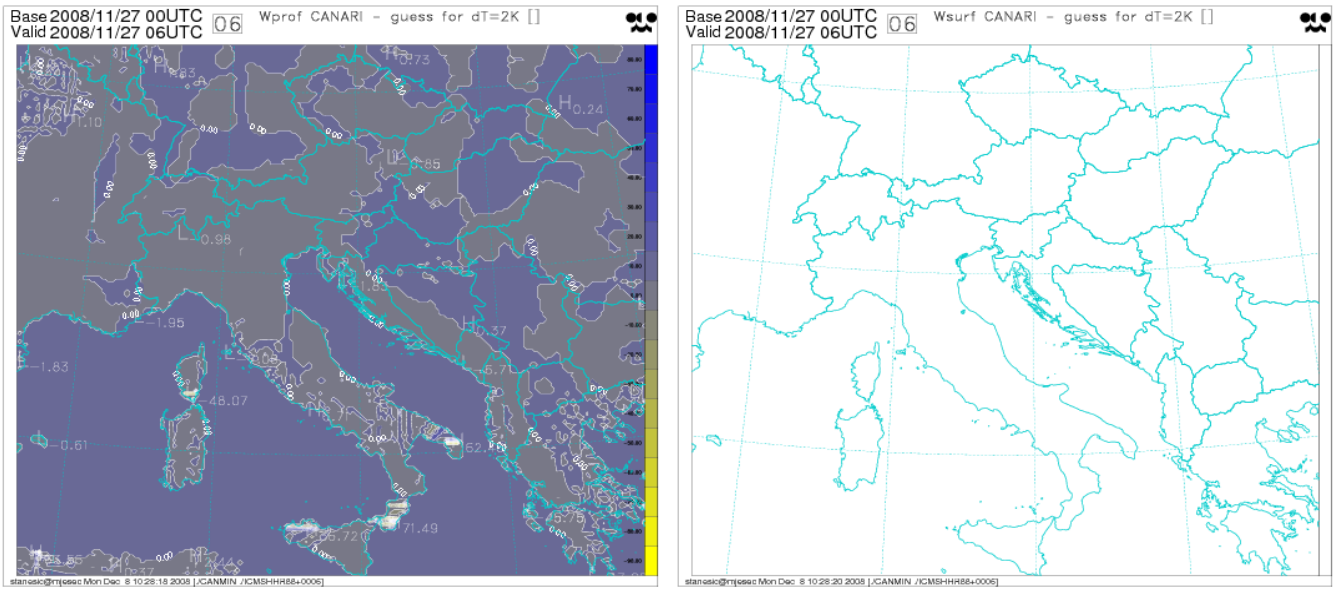

Figure 3. PROFRESERV.EAU and SURFRESERV.EAU difference between CANARI analysis and guess (6h operational forecast).

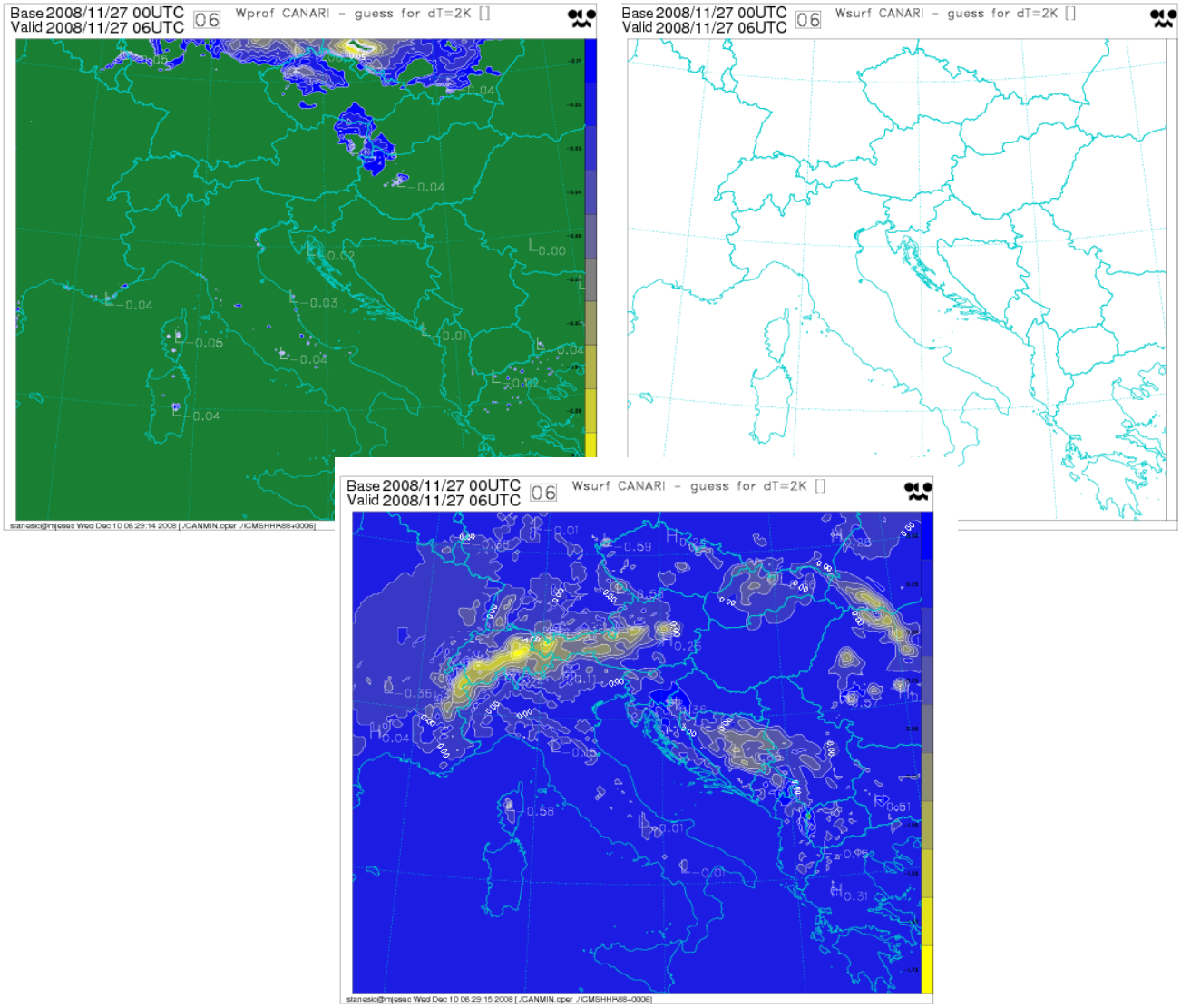

Figure 4. PROFRESERV.GLACE (upper left), SURFRESERV.GLACE(upper left), SURFRESERV.NEIGE (down) difference between CANARI analysis and guess (6h operational forecast).

Results show no increment of RH2m (OK - only T_{2m} CANARI analysis) but there is some noise signal. T_{2m} increment is approximately in agreement with sigma's (σ_0=1.4, σ_b=1.6). Increment of T_{surf} is also good (it should be same increment as for T_{2m}) and increment of T_{prof} is masked because there is relaxation to climatology. When this relaxation is switched off increment is clearly visible and it's value is $\Delta T_{2m}^{analysis}/2\pi$. It is much harder to comment increments of water content because of its relationship with T_{2m} analysis increment is not so straightforward. There are some bigger increments at south of domain for PROFRESERV.EAU, but when compared with values of PROFRESERV.EAU [500-8000 in that case], they are not too big. We think that they come from ARPEGE-ALADIN change of geometry, because the are near coast, and they do not exist if guess is coming from assimilation cycle (because they are smoothed in cycling).

2) Increment of RH_{2m} in Zagreb, coming from synop data, with innovation $y-H(x_b)=-0.1$.
Only RH_{2m} CANARI analysis.

Due to similarity of plots with the one shown before only increment of RH_{2m} is plotted.

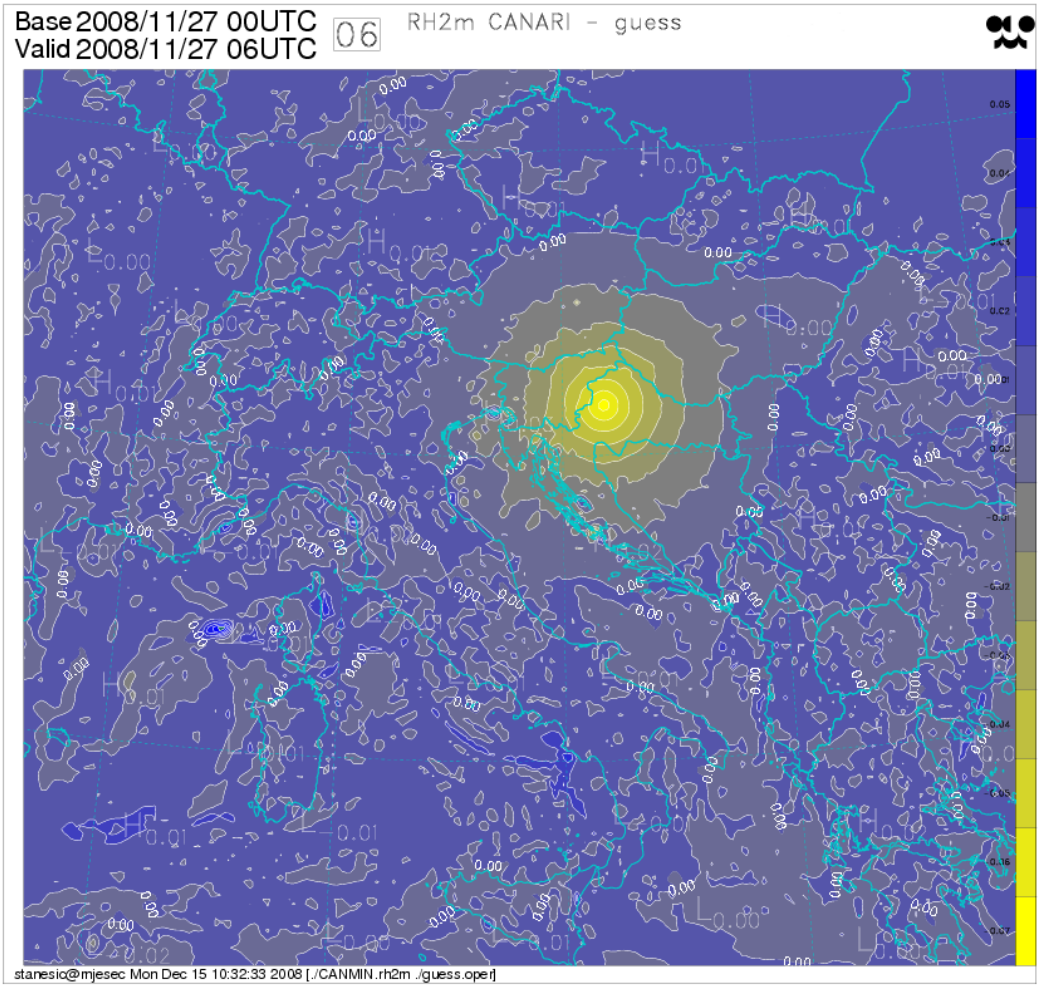

Figure 5. RH_{2m} difference between CANARI analysis and guess (6h operational forecast)

There is clear increment of RH_{2m}, with maximum of around -0.07 (sigmas σ_0=0.1, σ_b=0.18).
Only difference for other variables (in comparison with Figs. 1-3) is that there is no increments for SURFTEMPERATURE, T_{2m} and for PROFTEMPERATURE.

CANARI Cycle

At beginning of October we started assimilation cycle with CANARI analysis. Data that is assimilated includes synop and Croatian automatic stations 2 meter temperature and 2m relative humidity. We have used CHMI approach, where T_{2m} and RH_{2m} are assimilated. We have similar namelist as CHMI, only changes concern specific computer parameters, change of interpolation (201 instead of 203) and smaller horizontal lengthscale for 2 meters temperature (50km) and 2 meters relative humidity (55km). Our assimilation cycle is based on ARPEGE long cut off files, from where we take analysis over sea (BLENDSURF) and we just copy upper air fields from ARPEGE analysis (BLEND). During blending fields are added and divided and their values could became incorrect (example, negative amount of water in soil). Then we run program check_limits in order to be sure that all surface fields are correct.
After that we preform CANARI analysis over land and we use output as initial file for 6h forecast (fig 6.).

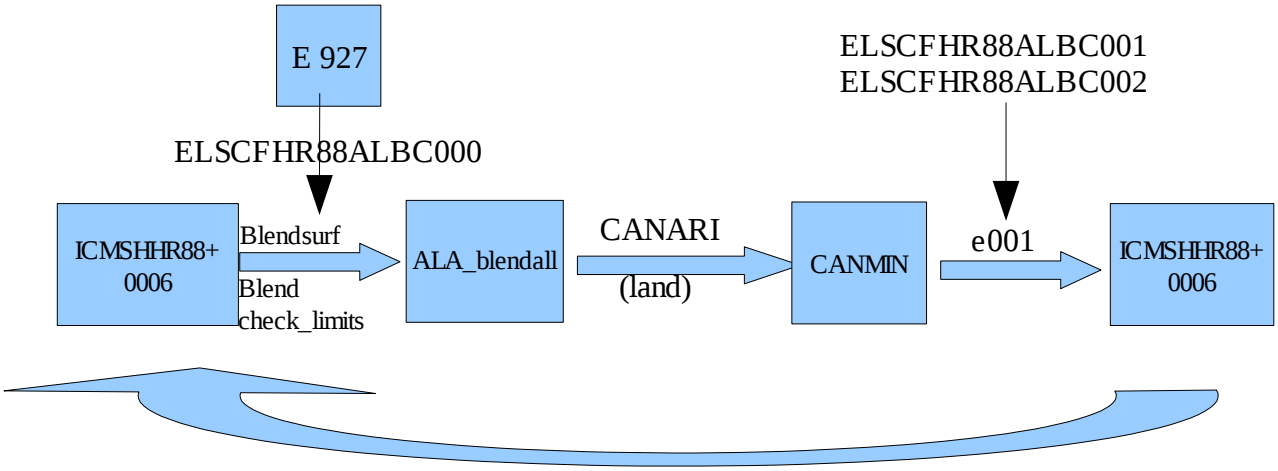

Figure 6. Schematic of CANARI assimilation cycle

For production we use 6h forecast from assimilation cycle and do 72h integration for 00UTC . Before integration firstly we copy upper air fields from short cut off ELSCFHR88ALBC000
and then CANARI analysis over land is performed. Forecast from assimilation cycle is ready 5-6 hours after operational forecast. So far we don't have objective verification (there are plans for installing VERAL verification package) but we have graphs showing operation forecast, forecast from assimilation cycle and observations. This 'verifications' shows that CANARI in general gives smaller RH_{2m} and higher maximum T_{2m} (Fig 7).

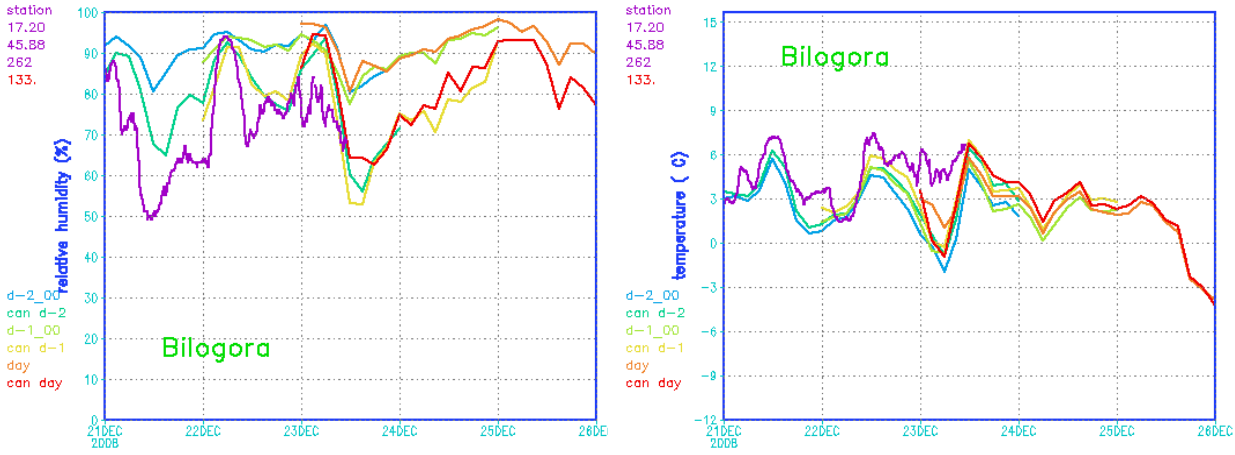

Figure 7. Visual verification of operational and forecast from CANARI assimilation cycle

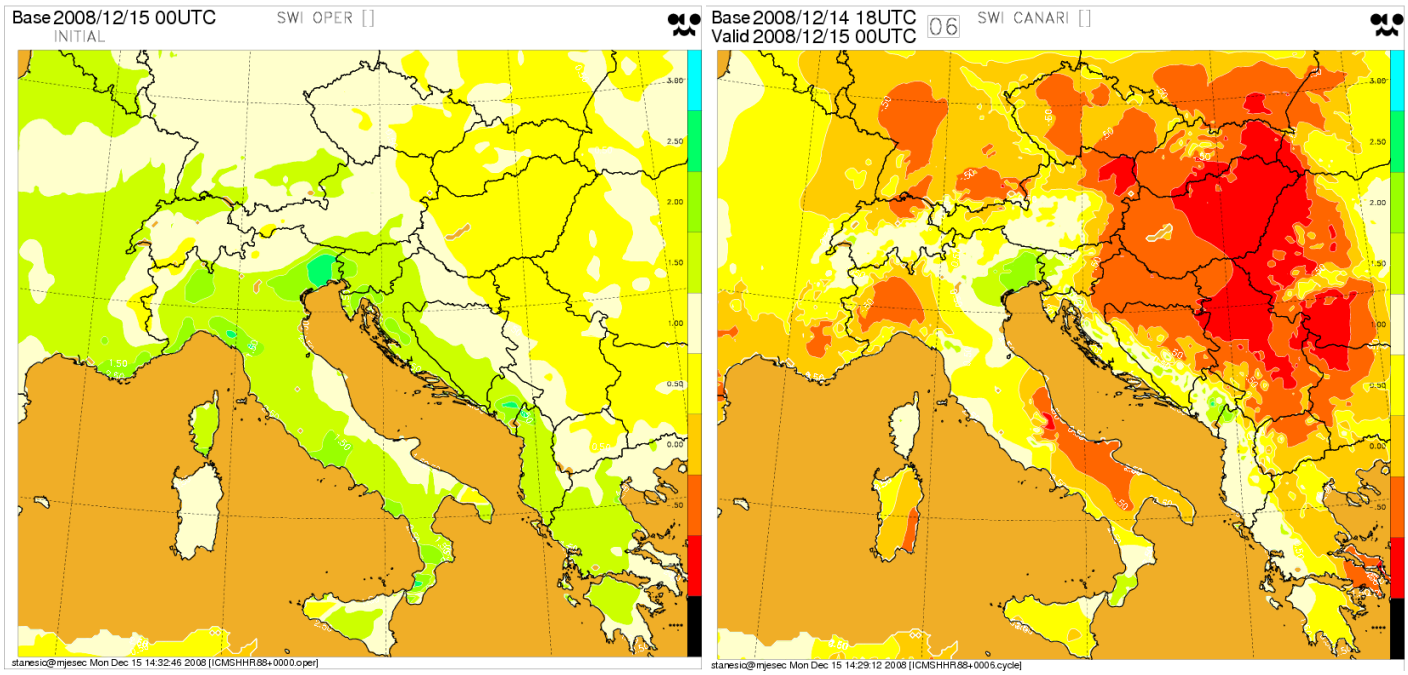

Figure 8. SWI for operational (left) and forecast from CANARI assimilation cycle (right)

On Figure 8. SWI is plotted for operational and forecast from CANARI assimilation cycle valid at 20081215 at 00 UTC. It is visible that land is dryer in CANARI than in operational forecast.
One problem should be mentioned here. When we first started cycling we used operational 00 initial file for start. After some cycling we tried to plot SWI but it was not possible. After conversation with Alena Trojakova it came out that one should always use forecast for CANARI analysis. It seams that there is division by forecast length in routine CACSTS so it can not be zero.
It is hard to tell without objective verification whether CANARI cycling gives positive impact. Subjectively it looks so, but objective verification is needed.
Also just copying of upper air fields is probably not good solution, but when we install 3DVAR this problem will be solved.

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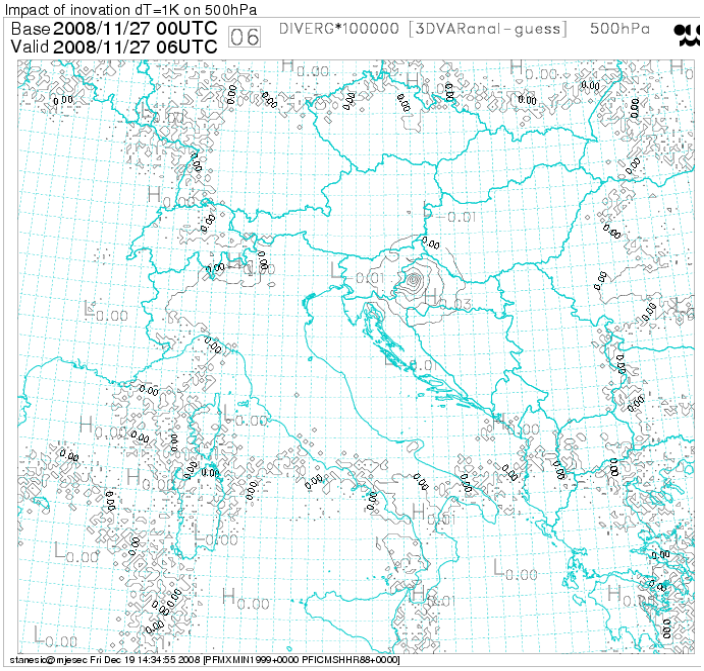
Screening configuration and minimization is tested on synop and temp data. Some single obs experiments are done, but still further verification is needed. Also tests with complete set of data are planned soon. B matrix is calculated (K. Horvath) from 100 forecast with standard NMC method.

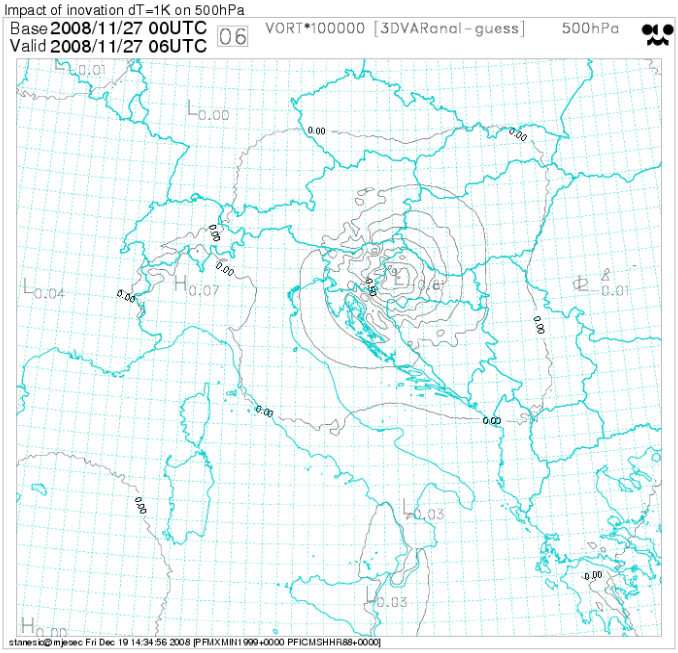
Two single obs experiments are showed below.

1) Temperature innovation of 1K at 500hPa coming from temp data, at location of Zagreb.
Figure 9. shows horizontal increments.

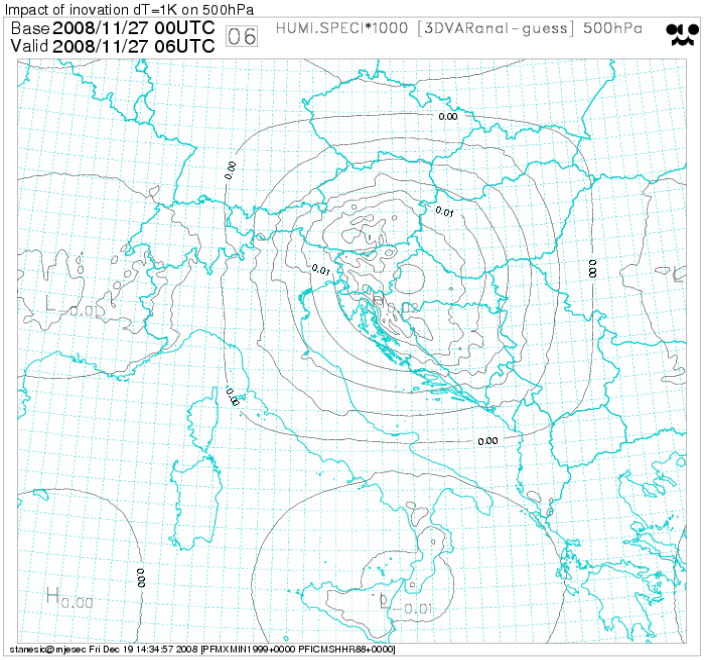
Impact of inovation dT=1K on 500hPa



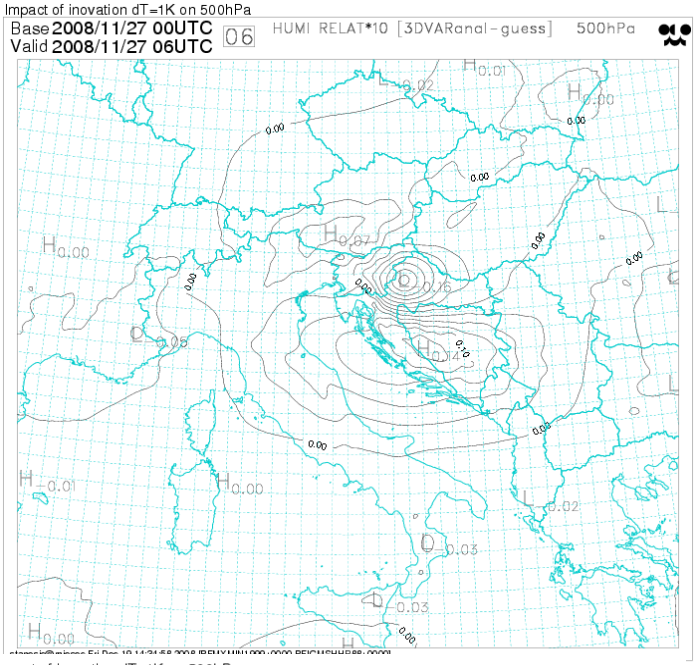
Impact of inovation dT=1K on 500hPa



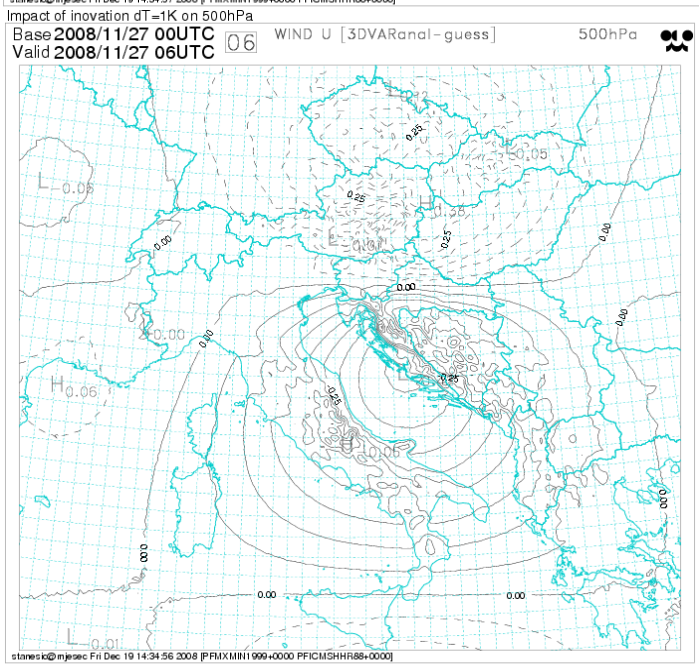
Impact of inovation dT=1K on 500hPa



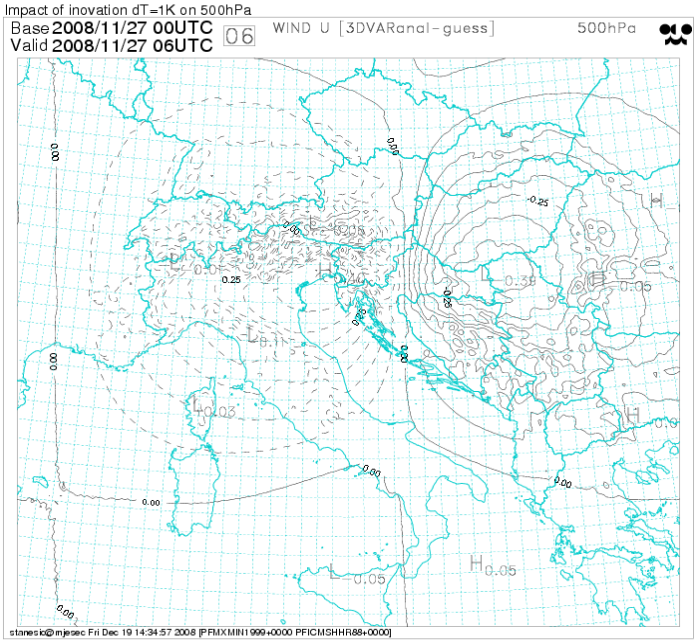
Impact of inovation dT=1K on 500hPa



Impact of inovation dT=1K on 500hPa



Impact of inovation dT=1K on 500hPa



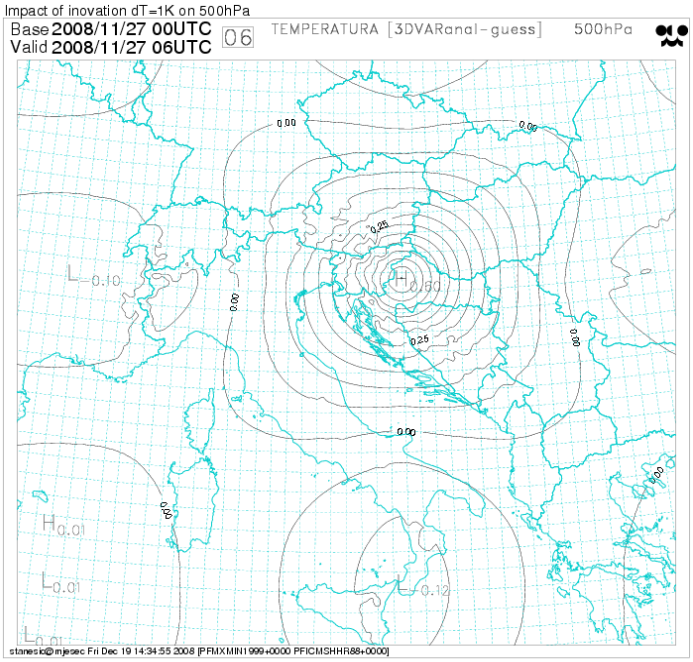
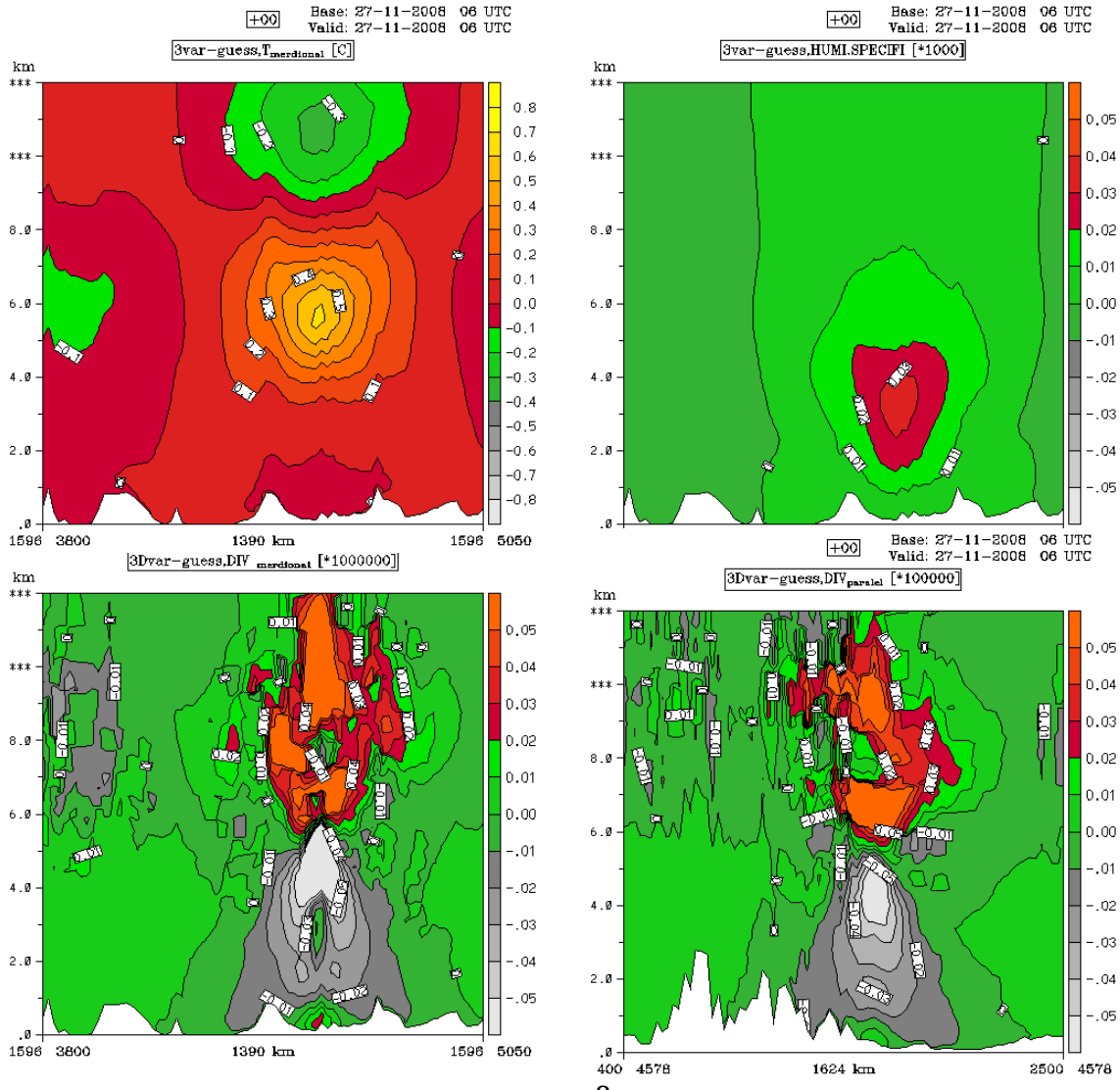


Figure 9. Horizontal analysis increments for temperature innovation of 1K at 500hPa.

In vertical increments are as follows.



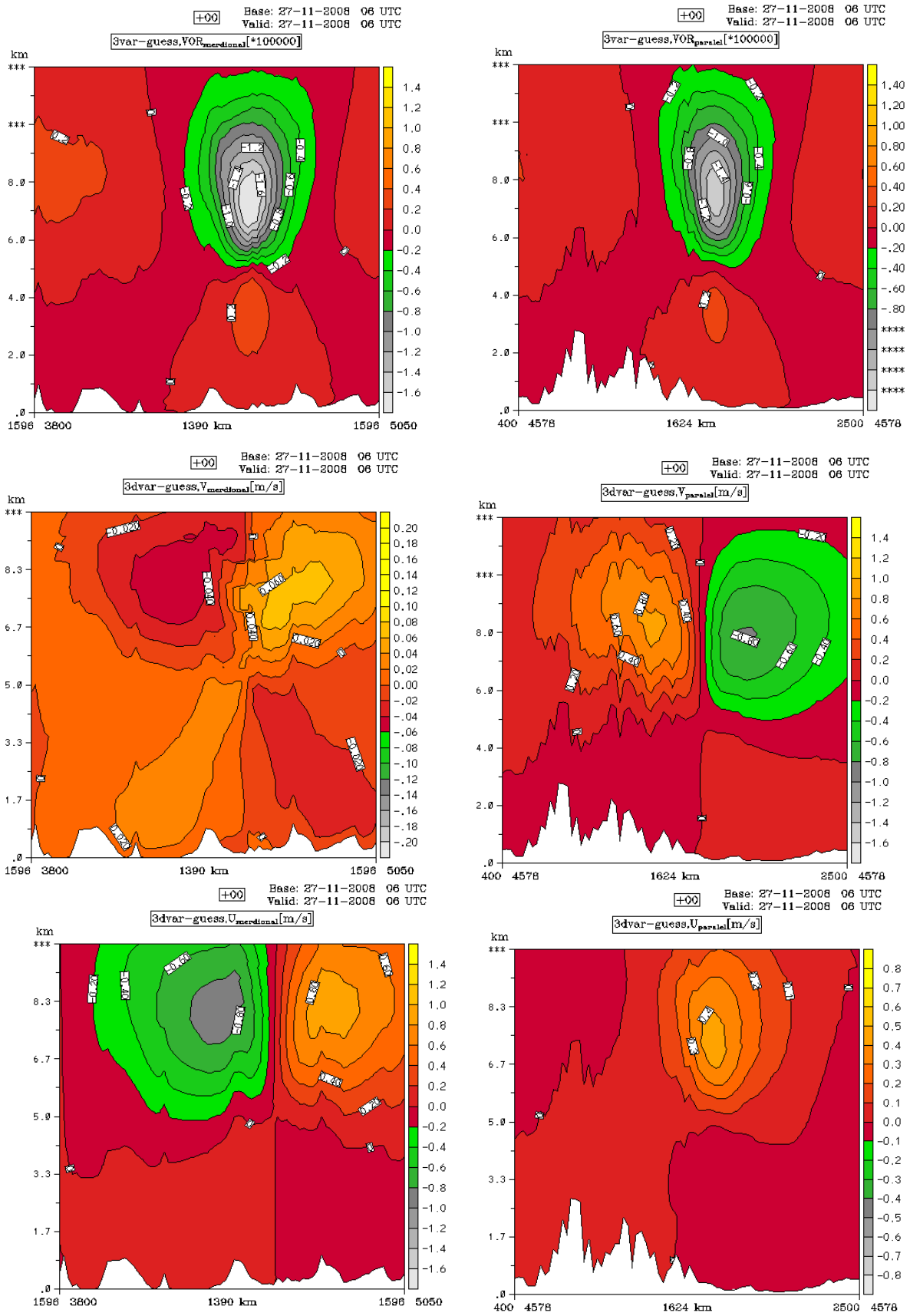
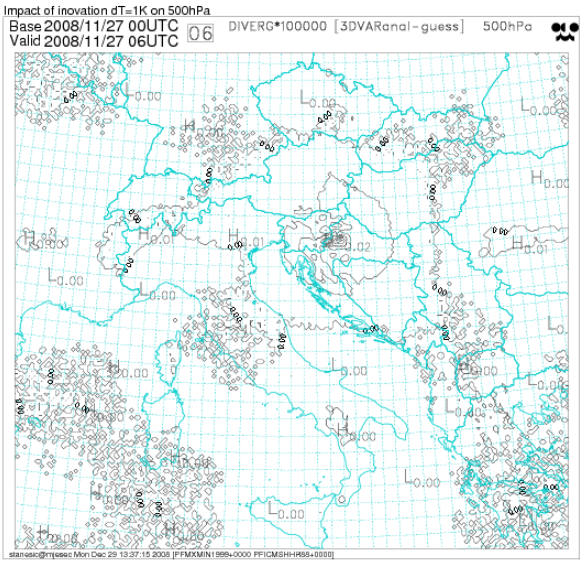
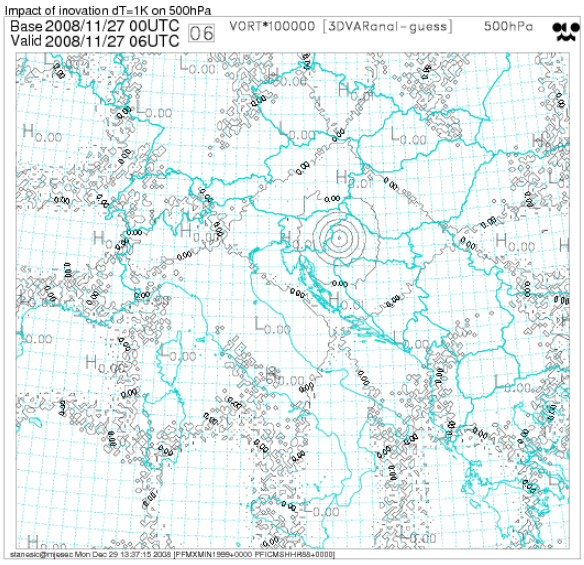
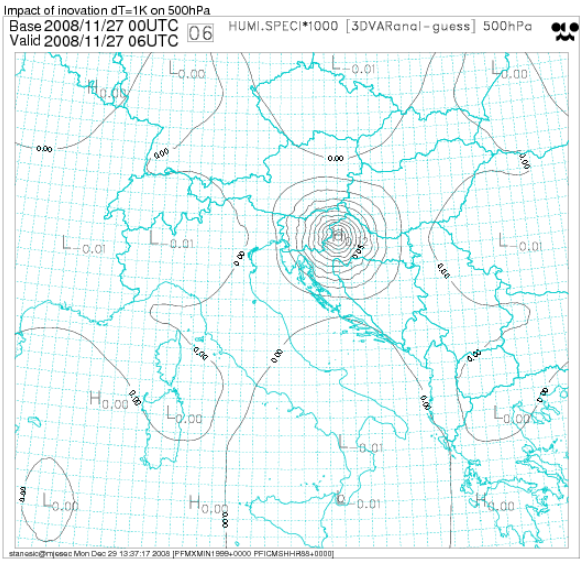


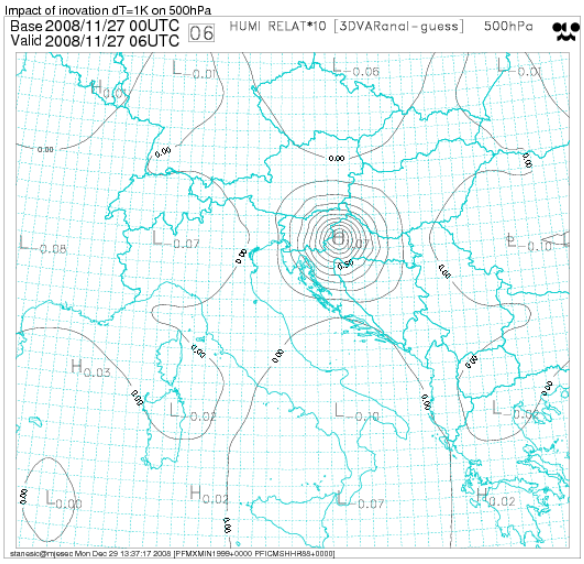
Figure 10. Vertical analysis increments for temperature innovation of 1K at 500hPa.

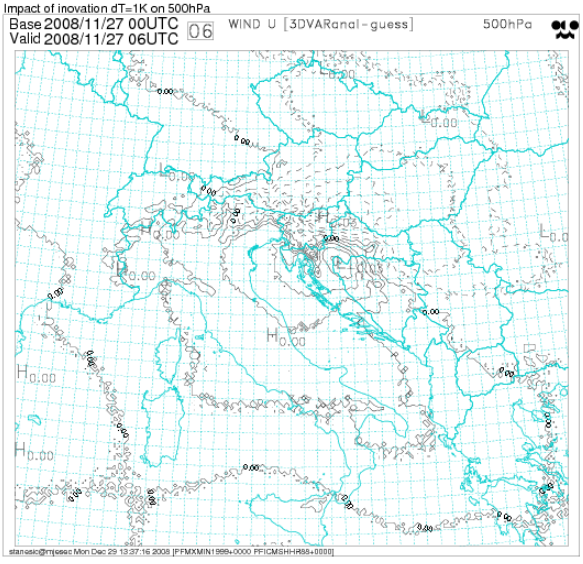
2) Relative humidity innovation of 0.1 at 500hPa coming from temp data, at location of Zagreb. Figure 11. shows horizontal increments.

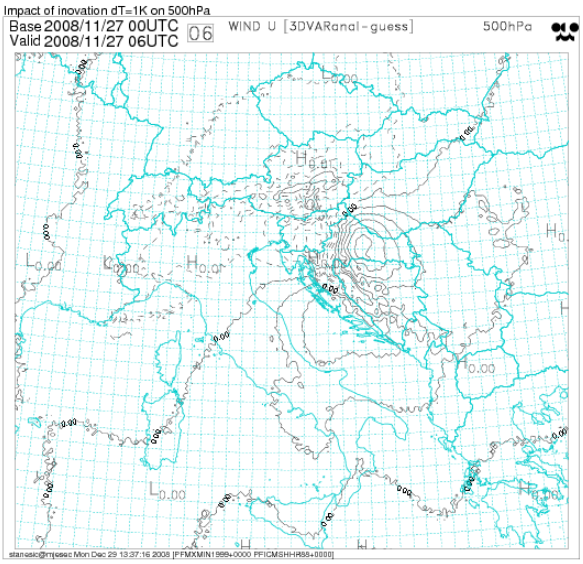












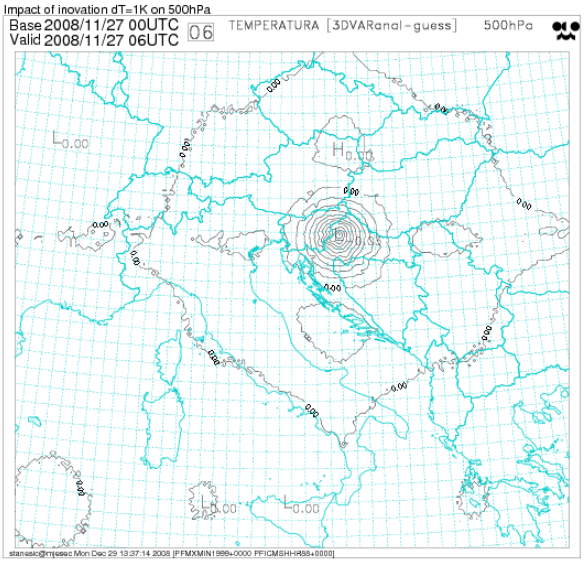
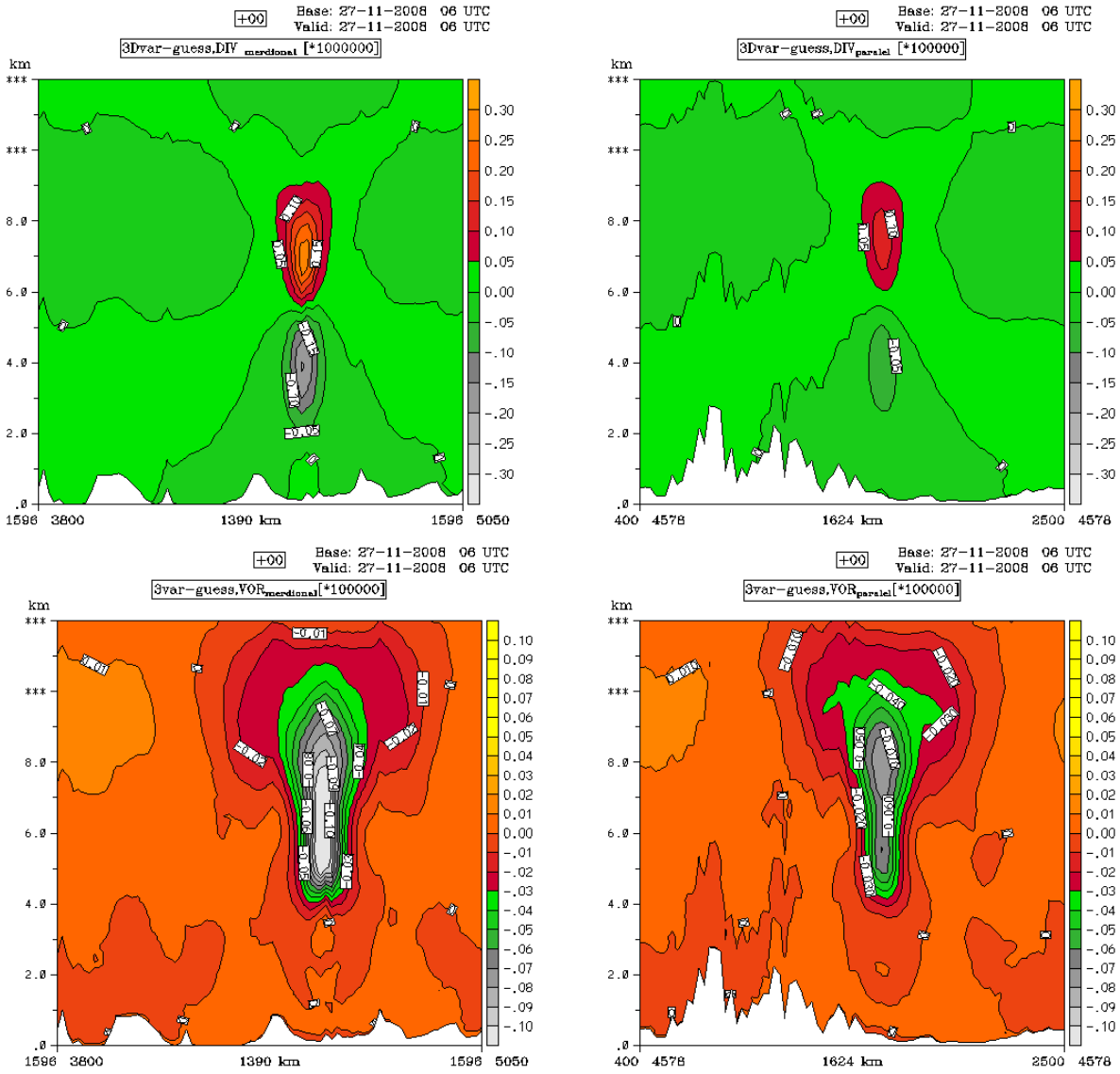


Figure 11. Horizontal analysis increments for relative humidity innovation of 0.1 at 500hPa.

In vertical increments are as follows.



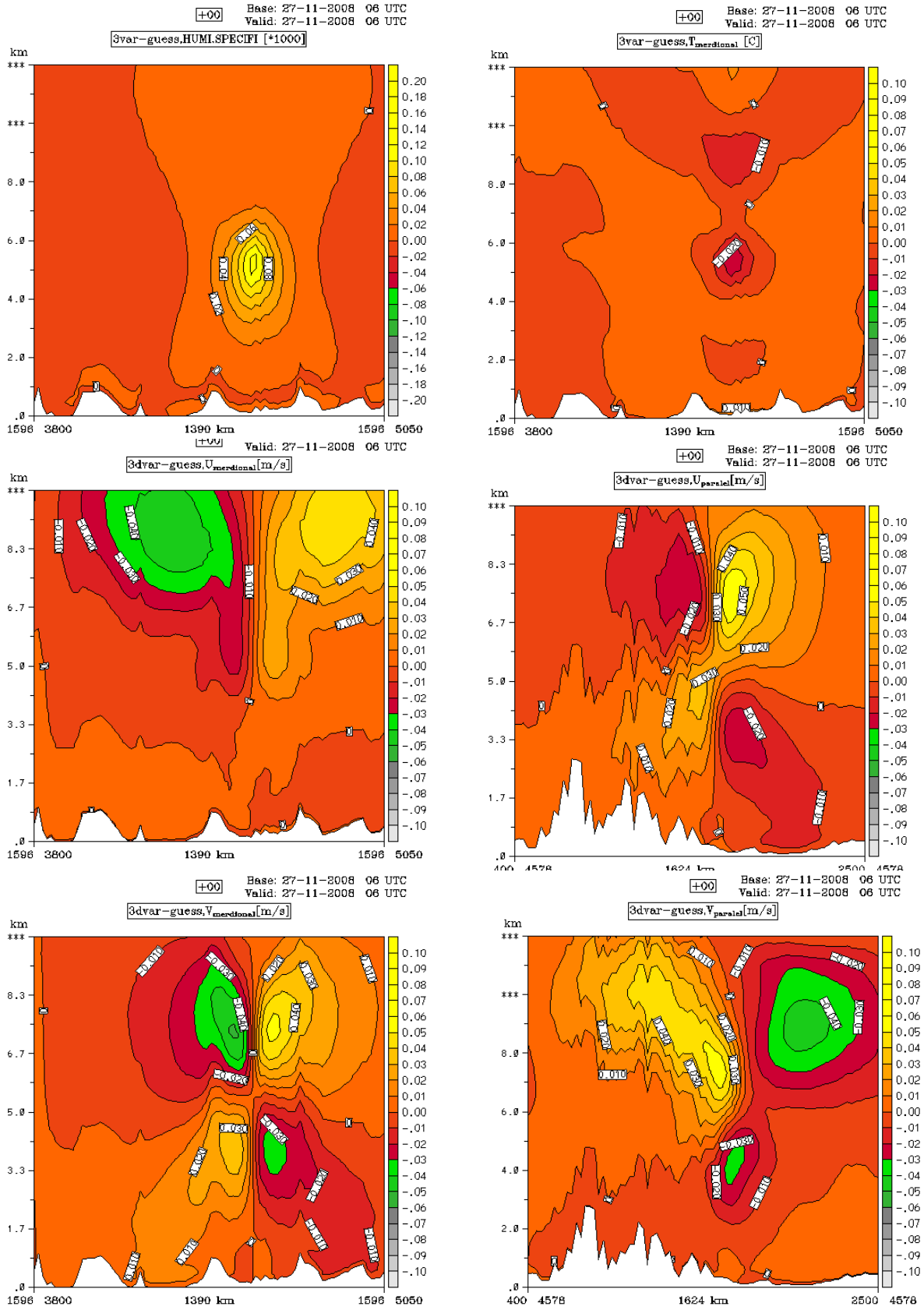


Figure 12. Vertical analysis increments for relative humidity innovation of 0

B matrix

B matrix was computed with standard NMC method using 100 forecast (K. Horvath). Some diagnostic figures are showed below (figure 13).

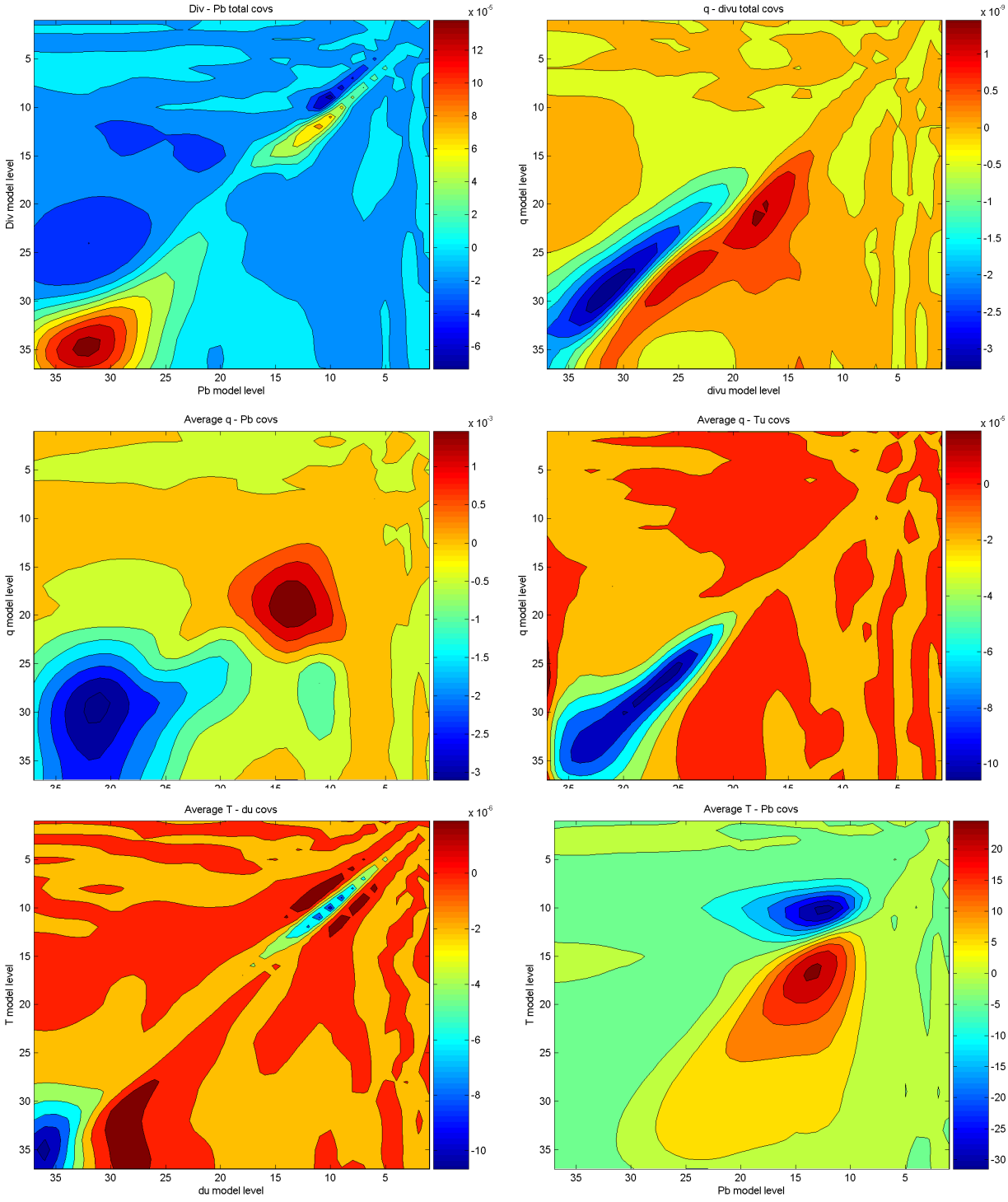


Figure 13. Covariances of different parameters

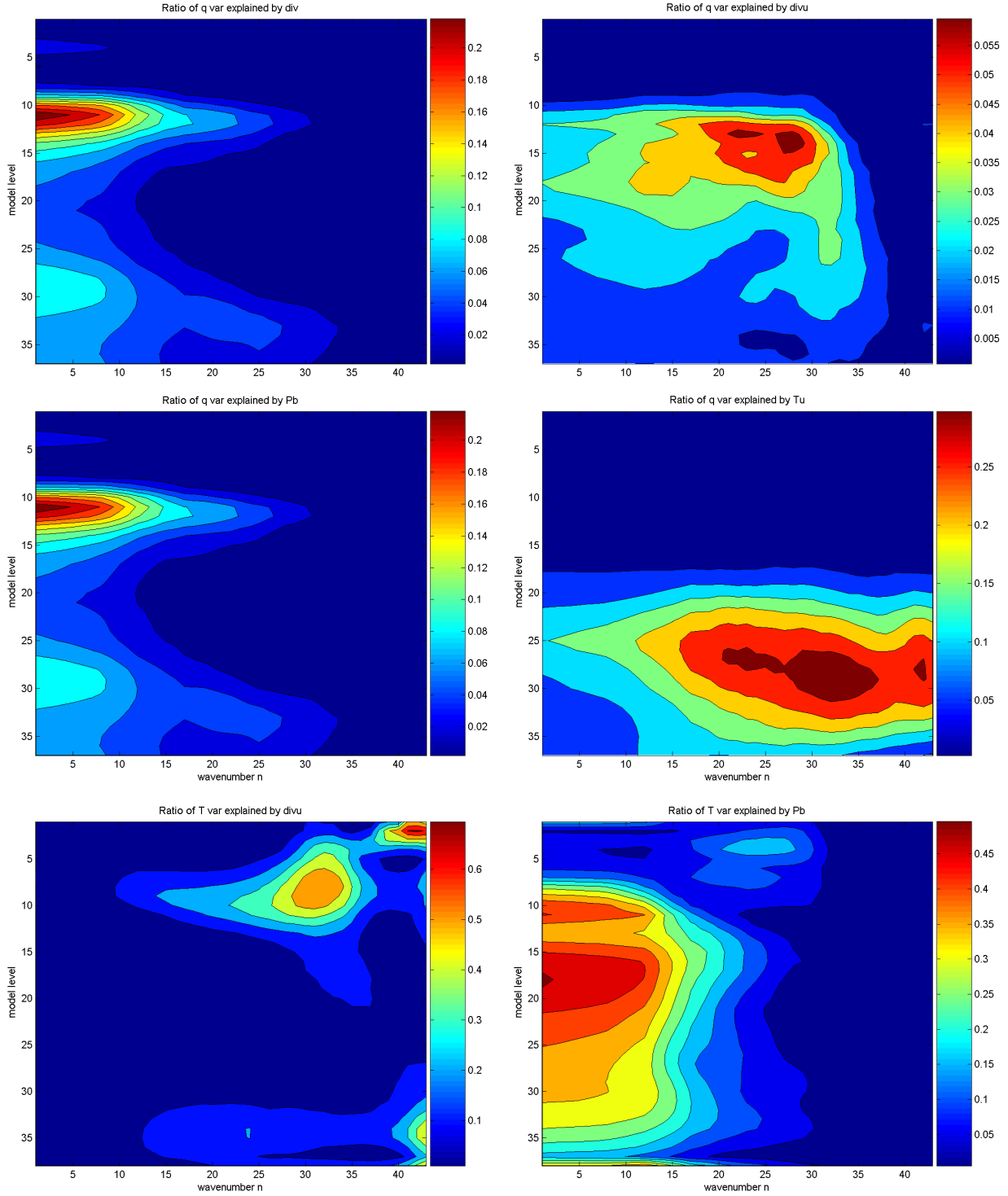


Figure 14. Ratios of explained variances among different parameters