VARPACK BASED ON THE NEW VERSION OF THE 3DVAR/ALADIN SURFACE SCHEME

Final report based on the work done in METEO-FRANCE during the time

31st of September – 13th of November 2004

By

Lora Taseva

National Institute of Meteorology and Hydrology,
Bulgarian Academy of Sciences
66, Tzarigradsko chaussee , 1784 Sofia , Bulgaria
Email: Lora.Taseva@meteo.bg

Ludovic Auger

METEO - FRANCE / CNRM/ GMAP
42, av. G. Coriolis, 31057 Toulouse Cedex, France
Email : Ludovic.Auger@meteo.fr

METEO – FRANCE / CNRM / GMAP, TOULOUSE

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Lora Taseva (1), Ludovic Auger (2)

(1) National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences
(2) Meteo - France / CNRM/ GMAP

INTRODUCTION

The beginning of the work on Varpack started in early 2004 and was based on the results, obtained by Auger (Auger L. (2004)). At that time the basic 3DVar/Aladin scheme was modified in the following way:

- at each step of the minimization the surface temperature Ts was artificially updated according to the temperature at the last model level (T41 at approx. 17 m) to enable more physical fit to the 2m temperature through the observation operator;
- in addition, bigger values of the model error co-variances had been given in the PBL (planetary boundary layer).

The comparison between the Diagpack CANARI OI scheme and the Varpack/Aladin (2004), based on the 3DVAR/Aladin scheme was done by:

- comparison of the meteorological fields (T, RH, wind on the last model levels) (Auger L. (2004))
- comparison of the distribution of some diagnostic parameters (CAPE and MOCON) used for nowcasting purposes (Taseva L., L.Auger (2004))

It was shown that:

- for the meteorological fields, both schemes gave similar results and there was a possibility to improve the application of the 3DVar/Aladin as a diagnostic tool;
- MOCON fields, derived from Varpack, were very similar to those, derived from Diagpack, but smoother;
- CAPE fields, derived from Diagpack and Varpack were quite different;
- the further evaluation of CAPE and MOCON, derived from Diagpack and Varpack analysis required intensive study of more synoptic situations of different type and study and comparison of the Diagpack and Varpack humidity analysis.

In summer 2004, L. Auger modified the 3DVar/Aladin surface scheme by introducing the difference (T s – T41) at the observation point as a new control variable in the vector state (here T41 stands for the temperature of the last model level and Ts is the surface temperature).

The purpose of this work (31st of September – 13th of November 2004) has been to perform tests and validate the results, obtained by Varpack/Aladin (2004b), based on the new 3DVar/Aladin surface scheme by comparison with the results, obtained by Diagpack and Varpack/Aladin (2004).

The validation tests have been done for three cases (2001081518, 2001081800 - 2001081815 and 2004100912 - 2004100917) over the ALADIN/FRANX01 domain (304 x 300, mesh distance 9.5 km).

The report consists in five sections and 3 appendices:

Section I - Short description of the Varpack/Aladin (2004b), based on the new version of the 3DVar/Aladin surface scheme and post-processing of the analysis data

Section II - Case study 2001081518

Section III - Case study 2003081810 - 2001081815

Section IV - Case study 2004100912 - 2004100917

Section V - Conclusions and plans for the future work

Appendix 1 - Case study 2001081518. List of the figures.Table.1 (a – e). Table.2. Fig. 1 – Fig. 3

Appendix 2 - Case study 2001081810 - 2001081815. List of the figures. Table. 3 – Table. 14. Fig. 4 – Fig. 9

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Section I. Short description of the Varpack/Aladin (2004b), based on the new version of the 3DVar/Aladin surface scheme and the post-processing of the analysis data

The 3DVar/Aladin surface scheme has been used to perform analysis of temperature, wind and specific humidity on the model levels, using only SYNOP data after screening. The description of the basic ideas of the new 3DVar/Aladin surface scheme is prepared by L. Auger and is given below.

Section I.1 Basic ideas of the new 3DVar/Aladin surface scheme - surface temperature in the control variable.

In the 3dVar formalism, the goal is to minimize a coast function:

$$J = J_b + J_o = \frac{1}{2}\delta x^t B^{-1} \delta x + \frac{1}{2}(H \delta x - d)^t R^{-1} (H \delta x - d)$$

Where:

$d = y - H(x^b)$ is the departure between the observation y and the model equivalent computed from the background x^b and δx is the control variable.
The goal of the algorithm is to minimize the J coast function with respect to δx.
So far in Aladin 3dvar only altitude fields were used inside the control variable.
But when analysing 2 meters observations, one need to be able to modify during the minimization cycle also the surface variables because the observation operator H is using surface parameters to compute the model equivalent at 2 meters or 10 meters.
Let's call T_S the surface temperature departure (actual temperature minus background temperature) and T_N the last level temperature departure.
The difference $T_S - T_N$ was introduced as a new control variable. With this new control variable was associated a forecast error standard deviation $\sigma_{T_S - T_N}$ representing the mean error made by model on this parameter. So the new model error coast function writes:

$$J_b = \frac{1}{2} \delta x^t B^{-1} \delta x + (T_S - T_N)^t \sigma^{-2}_{T_S - T_N} (T_S - T_N)$$

Introducing $T_S - T_N$ as a control variable provides a correlation between surface and last level temperature without having to modify the B matrix (model forecast covariances error). The main problem with using a B matrix which would include surface parameters is that in Aladin, altitude fields are specified in spectral space whereas surface fields are specified as gridpoints. It also seems difficult to compute a reliable B matrix near the ground because the model forecast error inside the boundary layer might be quite important.

More details about the new 3DVar/Aladin surface scheme will be given in (Auger L. (2004b)).

Section I.2 Technical aspects of running Varpack/Aladin (2004b) and post-processing of the 3DVar/Aladin analysis data to derive CAPE and MOCON

The experiments with Varpack/Aladin (2004b) for the case studies 2001081518 and 2001081810-2001081815 have been done with an executable, based on the cycle al26t1:
/u/gp/mrpa/mrpa645/pack/varcont3/pbin/ALADIN

The scripts and the namelists for performing Varpack/Aladin are on
tora: ~mrpa657/script_2004b/file_date
Obs2Lamodb.ksh
AnalysAld_diag.ksh

~mrpa657/script_2004b/namelist/lamflag_odb.nml
scr_3d_diag.nml
assim_diag.nml

The scripts for performing fullpos are on
tora: ~mrpa657/script_2004b/fp_lam_var
fp_lam_var_3
fp_prepmocon
melange.ksh
fp_moconvar

The post-processing (fullpos) of the meteorological fields and the computation of CAPE and MOCON have been done as described in (Taseva L., L.Auger (2004)) with:

- /u/dp/marp/marp001/tampon/bin/ald/al26/al26t1_main.01.L0209.x.exe for computing CAPE;
- /u/gp/mrpa/mrpa645/pack/fullpos/pbin/ALADIN for computing MOCON;
- script fp_lam_var with NFPCAPE = 1 in NAMFPCAPE to calculate CAPE from the last model level and script fp_lam_var_3 with NFPCAPE=3 to calculate CAPE from mto standard height (2m) as recomputed values;
- as far as in 3DVar/Aladin analysis there are no 2m fields, some procedures have been applied before computation of MOCON, namely: script fp_prepmocon to transforms the temperature, specific humidity and wind on the last model level to grid-point fields; melange.ksh to write those fields as CLS fields; fp_moconvar to compute MOCON as div (q41, V41) on the last model level

The experiments for the case study 2004100912 – 2004100917 have been done with an executable based on cycle al28t1 within the frame of the OLIVE software.

Section II - Case study 2001081518

The results of the experiments with Varpack/Aladin (2004b) for the case 2001081518 are presented in Appendix 1, Table.1 (a – e), Table.2, and Fig.1 – Fig.3
The experiments have been done with different values of the parameter TSCVER in the new namelist NAMTS. By giving different values of TSCVER we define different weights for the different (Ts – T41) – giving bigger (smaller) values of σ_{Ts-T41} we give more (less) freedom to the model to modify Ts during the minimization resulting in better (worse) fit to the 2m temperature.
We have performed four experiments, giving different values of TSCVER:
- TSCVER=1 (mod4 experiment)
- TSCVER=0.5 (mod5 experiment)
- TSCVER=2 (mod6 experiment)
- TSCVER=0.01 (mod7 experiment)

In Table.1 (a-e) we have presented the diagnostic JO–table before minimization and after minimization for the different experiments, while the diagnostics for the quality of the minimization for the different experiments have been presented in Table.2. From Table.1 (b-e) and Table.2 it is seen that there is only small advantage for mod4 and mod6 experiments – the values of the normalized JO/n cost functions, the ratio final/initial gradient and ratio final/initial cost function are smaller.

Further study of the results, obtained by the different experiments with Varpack/Aladin (2004b) included comparison of some meteorological fields with those, obtained by Diagpack and Varpack/Aladin (2004). We have chosen the specific humidity and wind on the last model level, as well as of the derived MOCON field (MOCON values are multiplied by 10**6, the distribution only of the higher positive values of MOCON ([1.2,8]) are drawn) We have made the following comparison:

- the radar image for 2001081518 (Fig.1);
- the distribution of wind, specific humidity at level 41 and MOCON for guess (left panel), Diagpack (middle panel) and Varpack (2004)(mod3 experiment) (right panel) (Fig.2)
- the distribution of the same fields for Varpack/Aladin (2004b) mod4 (left panel), mod5 (middle panel) and mod6 (right panel) experiments (Fig.3).

As it could be seen from Fig.1, there are two areas with big echoes (in the NW and the central part of the domain) and some smaller areas with less pronounced echoes in the lower part of the domain, distributed mainly meridionally. Fig. 2 shows that there are patterns in wind field and MOCON from guess and Diagpack that correspond to the meridionally oriented area of radar echoes, while Varpack/Aladin (2004)(mod3 experiment) gives smoother fields in that region. From Fig.3 it is seen that the three experiments with Varpack/Aladin (2004b) give:

- MOCON patterns that correspond better to the area with big radar echoes in the central part of the domain and the meridionally distributed areas with higher echoes values
- the values of the wind field are bigger than those obtained by Varpack/Aladin (2004), but are different from wind field, obtained by Diagpack.

The conclusion that can be done on the basis of the performed experiments is that:

- all four values of TSCVER give similar results both from point of view of JO Tables and from point of view of the obtained meteorological fields, so TSCVER=1 (mod4 experiment) seems to be a reasonable value;
- the meteorological fields, obtained by Varpack/Aladin (2004b) are closer to those, obtained by Diagpack;
- wind field analysis in 3DVar/Aladin scheme might be problematic due to the reliability of the 10m wind observations.

Section III - Case study 2003081810-2001081815

The aim of that case study has been to compare the results, obtained by:

- Diagpack;
- Varpack/Aladin (2004) (mod3 experiment)(Taseva L., L. Auger (2004))
- Varpack/Aladin (2004b)(mod4 experiment, Section II of this report)

The results of the experiments with case 2001081810-2001081815 have been presented in Appendix 2, Table.3 – Table.14, Fig.4 – Fig.9.

In Table.3 – Table.14 we have presented the diagnostic JO–table after minimization for the Varpack/Aladin (2004)(mod experiment) and Varpack/Aladin (2004b)(mod4 experiment), while on Fig.4 – Fig.7 we have presented the time distribution of:

- ratio final/initial cost function for mod and mod4;
- total normalized JO/n cost function before (INI) and after minimization for mod and mod4;
- total normalized JO/n after minimization for mod and mod4
- normalized JO/n with respect to T2m for SYNOP, Land Manual report (Codetype 11)

It is obvious, that with Varpack/Aladin (2004b)(mod4 experiment) we achieve smaller values of JO cost function, i.e. better fit to the observations.

With Diagpack, Varpack /Aladin (2004)(mod experiment), and Varpack/Aladin (2004b)(mod4 experiment), we have computed CAPE (with NFPCAPE=3) and MOCON for 2001081810-2001081815 (Fig. 8 – Fig. 9)
On Fig. 8, the time evolution of CAPE, computed by Diagpack (left panel), Varpack/Aladin (2004) (middle panel) and Varpack/Aladin (2004b) (right panel) is presented.
It can be seen that:
- CAPE values, obtained by both versions of Varpack, are similar, but quite different from the CAPE values, obtained by Diagpack;
- In general, both versions of Varpack give higher values of CAPE, especially over the mountains.

On Fig. 9 the time evolution of MOCON is presented (left panel –Diagpack, middle panel – Varpack/ALADIN (2004), right panel –Varpack/Aladin (2004b))(the values of MOCON are multiplied by 10**6 and the distribution only of the higher positive values of MOCON ([1.2,8]) are presented).
It is seen that:
- the distribution of MOCON, computed by both versions of Varpack is smoother;
- there are some areas of coincidence of the spots with big values of MOCON, computed with Diagpack, Varpack/Aladin (2004)(mod experiment) and Varpack/Aladin (2004b)(mod4 experiment).

The main conclusion from the experiments in that section is that:
- with Varpack/Aladin (2004b) we obtain results close to the observations;
- CAPE and MOCON fields are still different from those, computed from Diagpack - MOCON field is closer to that, computed by Diagpack, but CAPE is much different. One reason for that is the fact that we started from a field post-processed with the configuration ee927, instead of an Aladin forecast.

Section IV - Case study 2004100912 _ 2009100917

That case has been chosen because at 2004100912 the CAPE, obtained by Diagpack, indicated a signal for a storm, that developed in the following few hours.
To create a reference run for 2004100912 with the new 3DVar/Aladin surface scheme, consistent with the settings of Diagpack, the following modifications have been done:
- the data base included only the observations within the 10 minutes interval around the observation time;

- the old blacklist has been modified by excluding the French RADOME observations from it; the new blacklist is on tora: /u/gp/mrpa/mrpa645/const/black_list.loc.200402.01
- smaller values of the observation errors have been given /u/gp/mrpa/mrpa645/const/modif_sigma0
- the operational 6-hour ALADIN forecast has been taken as first guess ~oper/2004/10/09/r6/ICMSHALAD+0006
- the 3DVar/Aladin surface scheme has been modified with a complete de-correlation of the temperature and humidity and a new executable has been created /u/gp/mrpa/mrpa645/pack/var5/pbin/ALADIN_nocorhu3
- in screening and minimization the default values of RGBQC were taken
- in minimization with LTSCV=. T. (LTSCV is the new logical flag for activating the Ts control variable) the value TSCVER=0.5 was taken
- in minimization bigger values of the model error co-variances had been given in the PBL (planetary boundary layer) (with the file nmc_vertical_coef)
- in forecast no DFI was applied (NAMINI /NEINI=0)
- in fullpos CAPE was computed from the last model level (NAMFPC/NFPCAPE=1).

Additionally the CAPE values for 20041009, 12 to 17 UTC have been calculated from mto standard height (2m) as recomputed values (NFPCAPE=3)

The results of the experiments for case 20041009, 12 to 17 UTC, have been presented in Appendix 3, Table.15 – Table.17 (Diagnostic JO tables before screening, before and after minimization for Varpack/Aladin (2004b) for 20041009, 12 UTC (reference run)), Fig.10 – Fig.13. Hereafter under Varpack/Aladin we will consider Varpack/Aladin (2004b)

The analysis of the JOT tables before screening, before and after minimization shows that:

- screening has rejected mainly U10 observations for all subtypes of SYNOP data (11-land manual report, 14-land automatic report, 15-French automatic land report, 16-French RADOME)(Table.15 – Table.16);
- the result of the minimization is a state, close to the observations – the values of the normalized JO/n have decreased an order of magnitude for all SYNOP subtypes and all variables (Table.17)

On Fig.10 the radar data for 20041009, 12 to 17 UTC is presented. It is seen that there is a weak signal at 12 UTC over SW part of the domain, which increases and at 16 UTC the storm is well seen.
On Fig.11 the time evolution of CAPE, derived by Diagpack (left panel), Varpack/Aladin with NFPCAPE=1 (middle panel) and Varpack/Aladin with NFPCAPE=3 (right panel) is presented.
It is seen that:

- the CAPE values, obtained by the different NFPCAPE are quite different;
- the signal in CAPE, obtained by Diagpack, obtained at 12 UTC near the location of the beginning of the storm, is not present in CAPE fields, derived from Varpack/Aladin

On Fig. 12 is presented the time evolution of 2m temperature, obtained by Diagpack and T41 (temperature at the last model level), obtained by Varpack/Aladin. It can be

seen that there is a good agreement between the two temperature fields non-the less level 41 corresponds approx. to 17 m height.
On Fig.13 is presented the time evolution of relative humidity at 2m (RH2), obtained by Diagpack as directly analysed variable, and relative humidity at the last model level, recomputed from the temperature and specific humidity, with correction for the MSL pressure, obtained by Varpack/Aladin.
It is seen that:

- they are different mainly in the southern part of the domain;
- those differences seem to explain the differences between the CAPE fields, obtained by Diagpack and Varpack/Aladin

The comparison with the observed RH2 values have shown that when there are no observations in an area with a certain size with approx. 50 km width, Diagpack takes locally the values from the guess field and produces false big values of RH2, due to the characteristic size of CANARI structure function (20041009, 16 UTC). For such cases Varpack/Aladin gives RH field that better fits to the observations.

The main conclusion that could be made is that:

- Diagpack and Varpack/Aladin give similar temperature fields, which are close to the observations
- Diagpack and Varpack/Aladin give different relative humidity fields. Sometimes Varpack/Aladin gives RH fields which globally better fit to the observations
- due to the different humidity fields and the way of post-processing, the CAPE fields, obtained by Diagpack and Varpack/Aladin are different.

Section V Conclusions and intents for the future work

The study presented in that report is an attempt to evaluate the Varpack/Aladin (2004b), based on the new version of the 3DVar/Aladin surface scheme.

The main conclusions that could be done on the basis of three case studies are:

- there is a significant advantage of Varpack/Aladin (2004b) with respect to Varpack/Aladin (2004). Besides the results, obtained by Varpack/Aladin (2004b) are scientifically more satisfying due to the new control variable (Ts – T41);
- the temperature fields, obtained by Diagpack and Varpack/Aladin (2004b) are similar;
- the humidity fields, obtained by Diagpack and Varpack/Aladin (2004b) are different. In some of the cases we looked at, the 3DVar/Aladin humidity analyses seemed at least as good, as Diagpack one in comparison with the RH2 observations;
- the CAPE fields, derived from Diagpack and Varpack/Aladin (2004b) are still different due to the different humidity fields and the way of post-processing. But as this field is used for convective activity diagnostic and is not 100% reliable, it is difficult to compare its quality on the base of studying so few cases.
- MOCON fields derived from Diagpack and Varpack/Aladin (2004b) are close

The further study of Varpack/Aladin analysis requires:

- to study more the Varpack/Aladin humidity analysis;
- to study the possibility of using new observation types

Acknowledgements

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References

Auger L. (2004) - Analyse diagnostique de type variationnel (Diagnostic analysis with variational method). Internal Workshop (07.05.2004), MeteoFrance, Toulouse, France.

Auger L. (2004b) - 3Dvar surface assimilation for diagnostic purposes. SRNWP/Met Office/HIRLAM Workshop "High-resolution data assimilation: towards 1- 4 km resolution" (15th - 17th Nov 2004), Met Office, Exeter, UK.

Taseva L., L.Auger (2004) – VARPACK. Technical Report (June 2004), Meteo-France/CNRM/GMAP, Toulouse, France.

Appendix 1

Case study 2001081518

List of the tables and figures

```
2001081518

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=     0 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          662             646.4580029758           0.98
0.200E+01   0.817E+00
                   H2           359             725.1223727582           2.02
0.150E+00   0.100E+00
                   T2           366             1160.023731602           3.17
0.140E+01   0.798E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          506             447.4035766203           0.88
0.200E+01   0.698E+00
                   H2           312             629.8255428584           2.02
0.150E+00   0.100E+00
                   T2           315             840.7444406745           2.67
0.140E+01   0.757E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           34             20.92492910548           0.62
0.300E+01   0.772E+00
                   H2            15             18.20555693968           1.21
0.150E+00   0.100E+00
                   T2            17             14.28541395159           0.84
0.140E+01   0.792E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           46             46.91011598563           1.02
0.300E+01   0.722E+00
                   H2            21             24.47197693838           1.17
0.150E+00   0.100E+00
                   T2            24             111.7609255068           4.66
0.140E+01   0.774E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          504             411.0742382019           0.82
0.200E+01   0.758E+00
                   H2           383             746.0138272122           1.95
0.150E+00   0.100E+00
                   T2           430             1307.776864182           3.04
0.140E+01   0.776E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:        3994             7151.001515513           1.79
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```
2001081518
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
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        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          662            59.68147336003           0.09
0.200E+01   0.817E+00
                   H2           359            204.4393117869           0.57
0.150E+00   0.100E+00
                   T2           366            16.78171673702           0.05
0.140E+01   0.798E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          506            30.41572458220           0.06
0.200E+01   0.698E+00
                   H2           312            215.7095926944           0.69
0.150E+00   0.100E+00
                   T2           315            15.02371978881           0.05
0.140E+01   0.757E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           34            1.097935543526           0.03
0.300E+01   0.772E+00
                   H2            15            1.145902755669           0.08
0.150E+00   0.100E+00
                   T2            17           0.5565725993747           0.03
0.140E+01   0.792E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           46            4.527529364622           0.10
0.300E+01   0.722E+00
                   H2            21            3.690941381957           0.18
0.150E+00   0.100E+00
                   T2            24           0.9593514931299           0.04
0.140E+01   0.774E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          504            36.99091301645           0.07
0.200E+01   0.758E+00
                   H2           383            179.5454106811           0.47
0.150E+00   0.100E+00
                   T2           430            29.35256570172           0.07
0.140E+01   0.776E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:       3994            799.9186614869           0.20
```

```
2001081518
mod5 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
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        --------------------------------------------------
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  ObsErr      BgErr
                   U10          662            61.52194706764           0.09
0.200E+01   0.817E+00
                   H2           359            207.3059978288           0.58
0.150E+00   0.100E+00
                   T2           366            18.86557033851           0.05
0.140E+01   0.798E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
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0.200E+01   0.698E+00
                   H2           312            217.6502684917           0.70
0.150E+00   0.100E+00
                   T2           315            17.35916367470           0.06
0.140E+01   0.757E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           34            1.161896302824           0.03
0.300E+01   0.772E+00
                   H2            15            1.225737382265           0.08
0.150E+00   0.100E+00
                   T2            17           0.5955338796568           0.04
0.140E+01   0.792E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           46            4.768374058966           0.10
0.300E+01   0.722E+00
                   H2            21            3.789106642533           0.18
0.150E+00   0.100E+00
                   T2            24            1.093135195813           0.05
0.140E+01   0.774E+00
                   T2            24            1.093135195813           0.05
0.140E+01   0.774E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          504            38.24049480450           0.08
0.200E+01   0.758E+00
                   H2           383            181.9130240146           0.47
0.150E+00   0.100E+00
                   T2           430            34.90964881292           0.08
0.140E+01   0.776E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3994            821.9767688094           0.21
```

```
2001081518
mod6 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          662            59.35537687714           0.09
0.200E+01   0.817E+00
                   H2           359            204.0478930032           0.57
0.150E+00   0.100E+00
                   T2           366            15.68171689068           0.04
0.140E+01   0.798E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          506            30.42062503790           0.06
0.200E+01   0.698E+00
                   H2           312            215.7446441695           0.69
0.150E+00   0.100E+00
                   T2           315            13.36545390222           0.04
0.140E+01   0.757E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           34            1.112513986637           0.03
0.300E+01   0.772E+00
                   H2            15            1.154294124764           0.08
0.150E+00   0.100E+00
                   T2            17           0.5315320880846           0.03
0.140E+01   0.792E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           46            4.501463291047           0.10
0.300E+01   0.722E+00
                   H2            21            3.687628462739           0.18
0.150E+00   0.100E+00
                   T2            24           0.8677518203015           0.04
0.140E+01   0.774E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          504            37.11040455887           0.07
0.200E+01   0.758E+00
                   H2           383            180.0258837805           0.47
0.150E+00   0.100E+00
                   T2           430            25.96067603197           0.06
0.140E+01   0.776E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3994            793.5678580256           0.20
```

2001081518
mod7 experiment

Diagnostic JO−table (JOT) MINIMISATION JOB T0149 NCONF= 131 NSIM4D= 999 NUPTRA= 0

==

Obstype 1 === SYNOP, Land stations and ships

Codetype 11 === SYNOP Land Manual Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	662	61.56535074815	0.09	0.200E+01	0.817E+00
H2	359	205.8966518542	0.57	0.150E+00	0.100E+00
T2	366	19.66298164534	0.05	0.140E+01	0.798E+00

Codetype 14 === SYNOP Land Automatic Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	506	31.50821916566	0.06	0.200E+01	0.698E+00
H2	312	216.7599841634	0.69	0.150E+00	0.100E+00
T2	315	18.48500121776	0.06	0.140E+01	0.757E+00

Codetype 21 === SYNOP−SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	34	1.155445899038	0.03	0.300E+01	0.772E+00
H2	15	1.209224389210	0.08	0.150E+00	0.100E+00
T2	17	0.6113328558154	0.04	0.140E+01	0.792E+00

Codetype 24 === SYNOP Automatic SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	46	4.780478758323	0.10	0.300E+01	0.722E+00
H2	21	3.727035811316	0.18	0.150E+00	0.100E+00
T2	24	1.149411201131	0.05	0.140E+01	0.774E+00

Codetype 15 === French SYNOP Automatic Land Repo

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	504	38.14792926121	0.08	0.200E+01	0.758E+00
H2	383	181.2397688730	0.47	0.150E+00	0.100E+00
T2	430	37.01976751487	0.09	0.140E+01	0.776E+00
ObsType 1 Total:	3994	822.9185833585	0.21		

```
2001081518
Diagnostics for the quality of the minimization

mod4(TSCVER=1)
 INITIAL GRADIENT NORM SQUARED :  0.2558950E+07 COST FUNCTION :  0.7151002E+04
   FINAL GRADIENT NORM SQUARED :  0.3650477E+02 COST FUNCTION :  0.1333980E+04
 --- Variational job : diagnose quality of the minimization ----------------
 RATIO FINAL/INITIAL  GRADIENT :  0.1426553E-04 COST FUNCTION :  0.1865444E+00

mod5(TSCVER=0.5)
 INITIAL GRADIENT NORM SQUARED :  0.2528199E+07 COST FUNCTION :  0.7151002E+04
   FINAL GRADIENT NORM SQUARED :  0.6858189E+02 COST FUNCTION :  0.1350638E+04
 --- Variational job : diagnose quality of the minimization ----------------
 RATIO FINAL/INITIAL  GRADIENT :  0.2712677E-04 COST FUNCTION :  0.1888739E+00

mod6(TSCVER=2)
 INITIAL GRADIENT NORM SQUARED :  0.2681953E+07 COST FUNCTION :  0.7151002E+04
   FINAL GRADIENT NORM SQUARED :  0.1743732E+03 COST FUNCTION :  0.1309229E+04
 --- Variational job : diagnose quality of the minimization ----------------
 RATIO FINAL/INITIAL  GRADIENT :  0.6501726E-04 COST FUNCTION :  0.1830833E+00

mod7(TSCVER=0.01)
 INITIAL GRADIENT NORM SQUARED :  0.2518359E+07 COST FUNCTION :  0.7151002E+04
   FINAL GRADIENT NORM SQUARED :  0.4853167E+02 COST FUNCTION :  0.1357188E+04
 --- Variational job : diagnose quality of the minimization ----------------
 RATIO FINAL/INITIAL  GRADIENT :  0.1927115E-04 COST FUNCTION :  0.1897899E+00
```

Radar echo, 15 AUGUST 2001 18 UTC

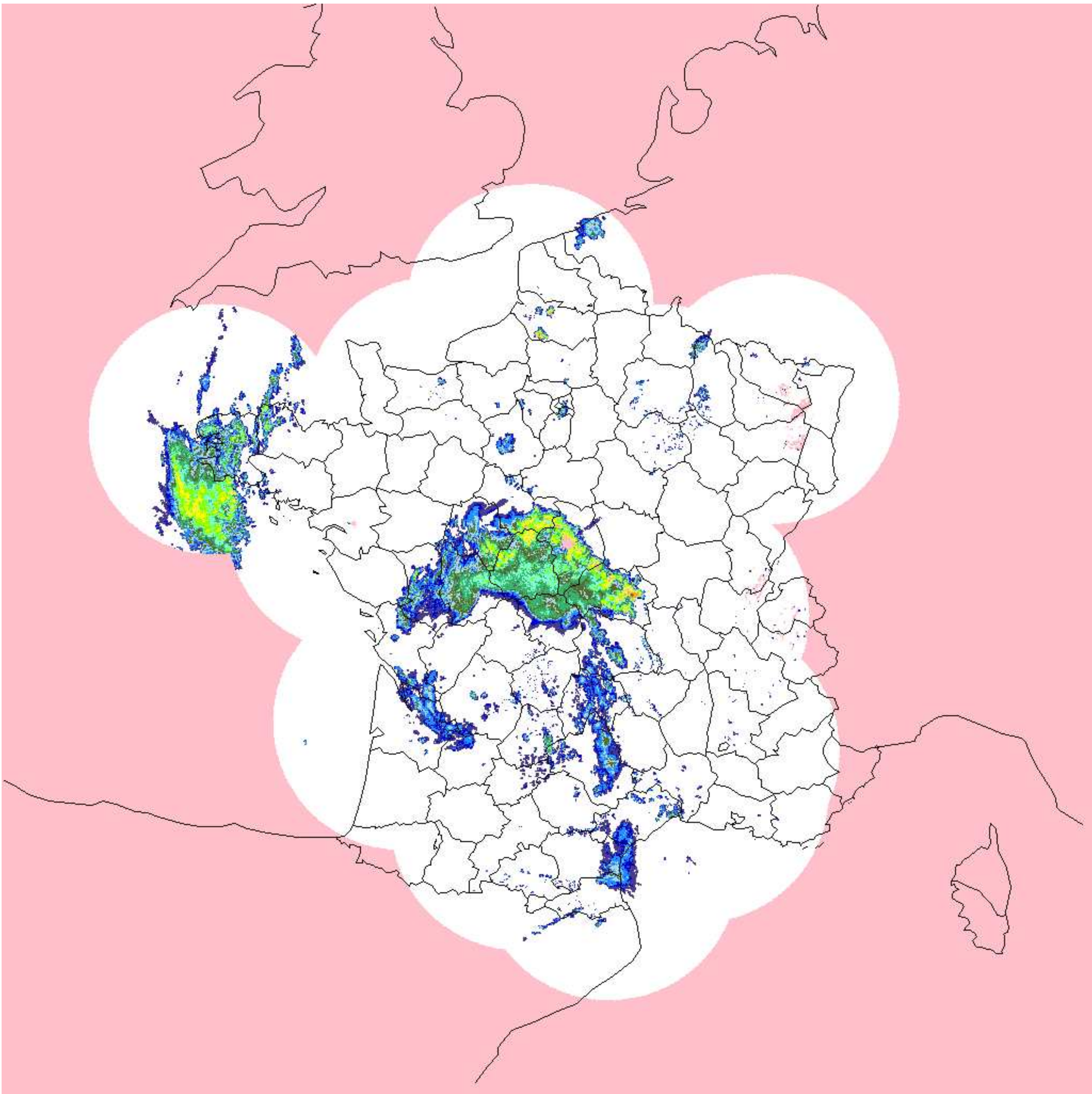
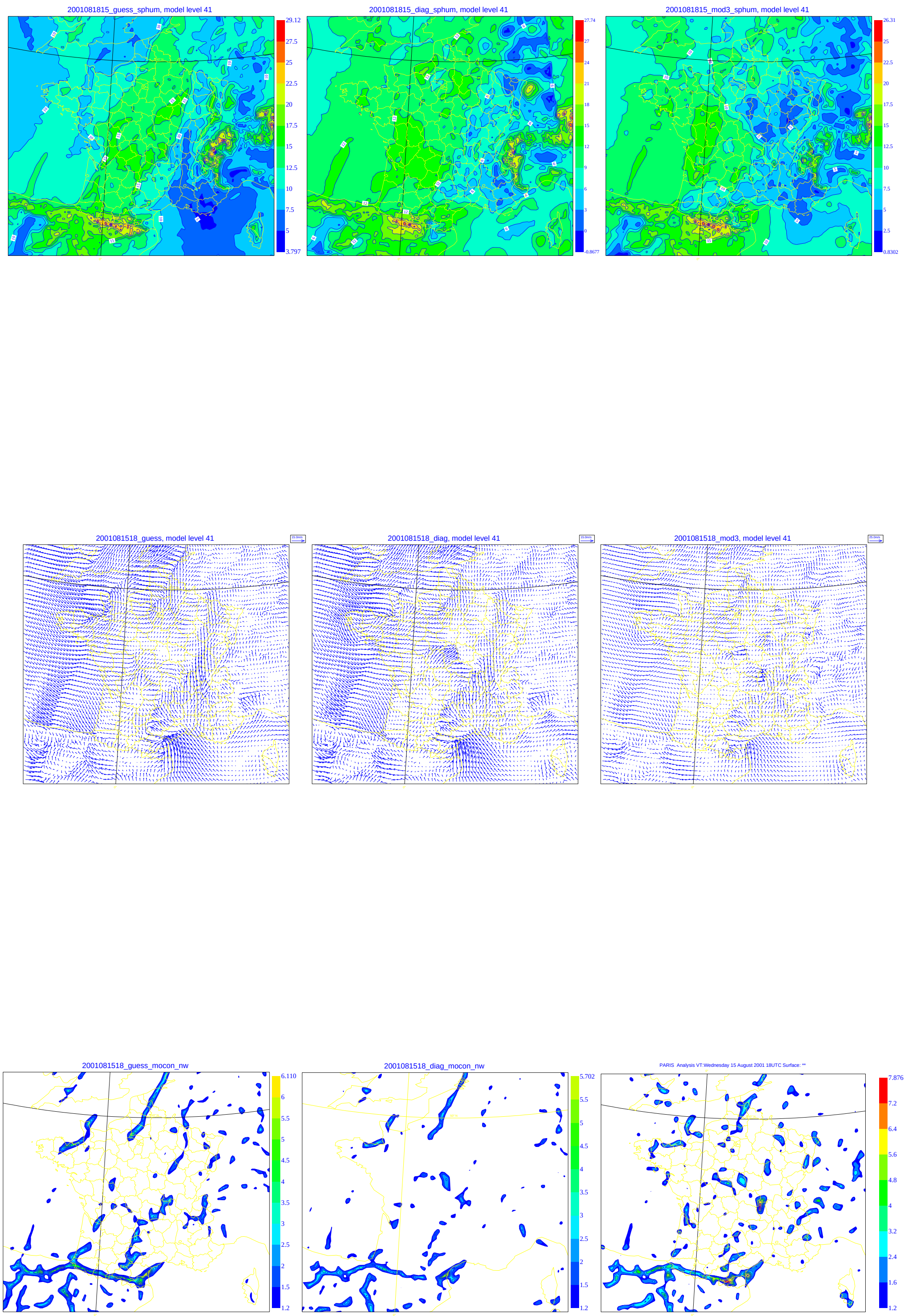


Fig 1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2001081815_diag_sphum, model level 41
2001081815_mod3_sphum, model level 41
2001081518_guess, model level 41
2001081518_diag, model level 41
2001081518_mod3, model level 41
2001081518_guess_mocon_nw
2001081518_diag_mocon_nw
PARIS Analysis VT:Wednesday 15 August 2001 18UTC Surface: **

Fig 2

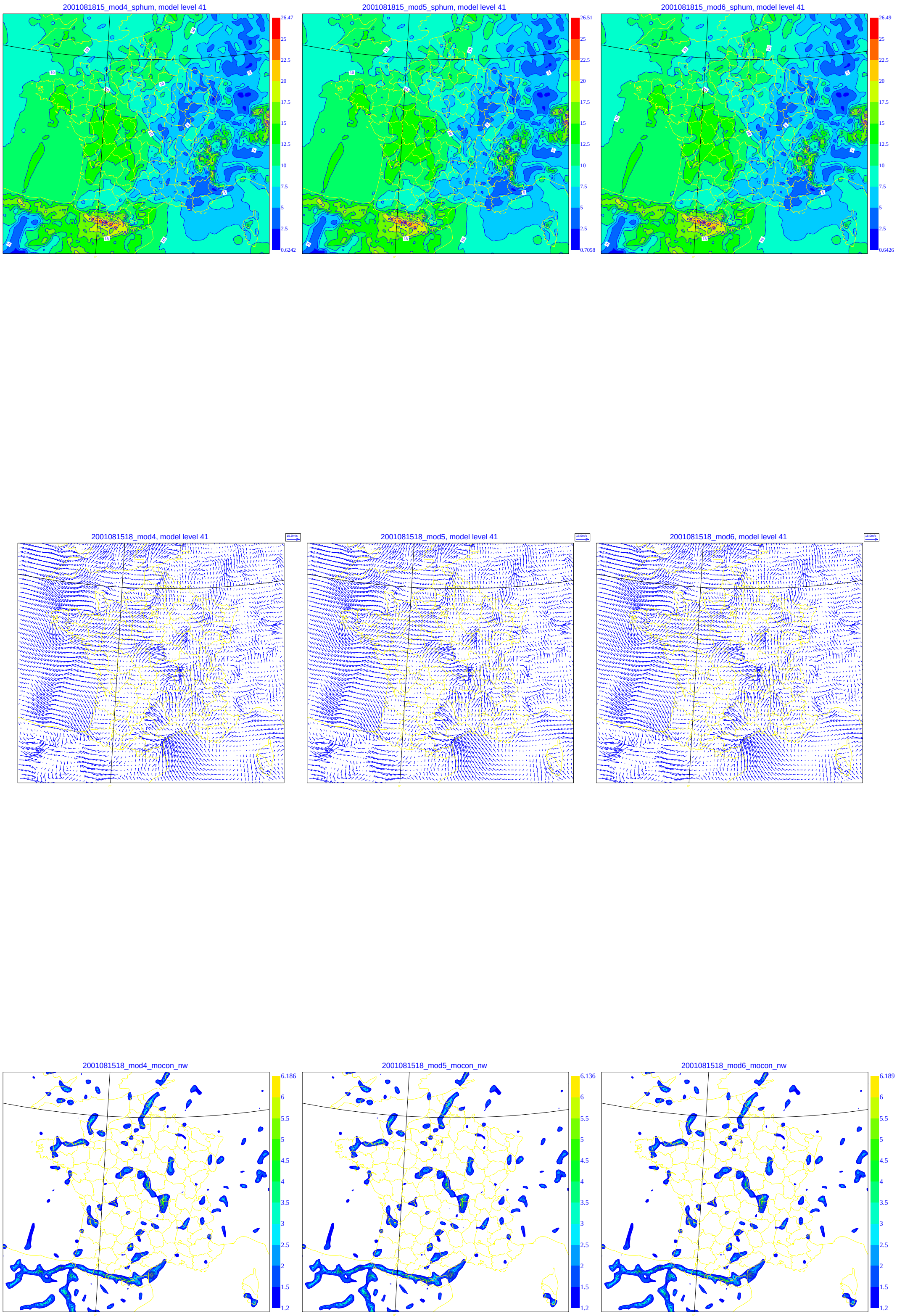

2001081815_mod4_sphum, model level 41
26.47
25
22.5
20
17.5
15
12.5
10
7.5
5
2.5
0.6242
2001081815_mod5_sphum, model level 41
26.51
0.7058
2001081815_mod6_sphum, model level 41
26.49
0.6426
2001081518_mod4, model level 41
2001081518_mod5, model level 41
2001081518_mod6, model level 41
2001081518_mod4_mocon_nw
6.186
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1.2
2001081518_mod5_mocon_nw
6.136
2001081518_mod6_mocon_nw
6.189

Fig 3

Appendix 2

Case study 2001081810 - 2001081815

List of the tables and figures

Table.3 – Table.14 Diagnostic JO tables after minimization for Varpack/Aladin (2004), mod experiment and Varpack/Aladin (2004b)(mod4 experiment) for 20010818, 10 to 15 UTC.

Fig.4 The time distribution of the ratio final/initial cost function for Varpack/Aladin (2004)(mod experiment) and Varpack/Aladin (2004b)(mod4 experiment) for 20010818, 10 to 15 UTC.

Fig.5 The time distribution of the total normalized JO/n cost function before minimization (INI) and after minimization for Varpack/Aladin (2004)(mod experiment) and Varpack/Aladin (2004b)(mod4 experiment) for 20010818, 10 to 15 UTC.

Fig.6 The time distribution of the total normalized JO/n cost function after minimization for Varpack/Aladin (2004)(mod experiment) and Varpack/Aladin (2004b)(mod4 experiment) for 20010818, 10 to 15 UTC.

Fig.7 Same as Fig.6 but for the JO/n with respect to T2m for SYNOP, Land Manual Report (Codetype 11).

Fig.8 Comparison between the distributions of CAPE obtained by Diagpack (_diag_cape), Varpack/Aladin (2004)(mod experiment) (_3mod3D_cape) and Varpack/Aladin (2004b)(mod4 experiment) (_3mod43d_cape) for 20010818, 10 to 15 UTC.
CAPE, obtained by Varpack is computed from 2m height as recomputed values (NFPCAPE=3)

Fig.9 Comparison between the distribution of MOCON, obtained by Diagpack (_diag_mocon_nw), Varpack/Aladin (2004)(mod experiment)(_mod3D_mocon_nw) and Varpack/Aladin (2004b)(mod4 experiment)(_mod43D_mocon_nw) for 20010818, 10 to 15 UTC.
MOCON values are multiplied by 10**6, only higher positive values ([1.2,8]) are presented

2001081810
mod experiment

Diagnostic JO−table (JOT) MINIMISATION JOB T0149 NCONF= 131 NSIM4D= 999 NUPTRA= 0
===

Obstype 1 === SYNOP, Land stations and ships

Codetype	Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
11 === SYNOP Land Manual Report						
	U10	510	7.995614478711	0.02	0.200E+01	0.710E+00
	H2	268	29.29718231961	0.11	0.150E+00	0.100E+00
	T2	268	19.29909480926	0.07	0.140E+01	0.762E+00
14 === SYNOP Land Automatic Report						
	U10	424	8.237419091474	0.02	0.200E+01	0.707E+00
	H2	219	30.89290118004	0.14	0.150E+00	0.100E+00
	T2	220	15.27007653730	0.07	0.140E+01	0.765E+00
21 === SYNOP−SHIP Report						
	U10	4	0.1146503544820E−01	0.00	0.300E+01	0.605E+00
	H2	2	0.1230145955979	0.06	0.150E+00	0.100E+00
	T2	2	0.7192860076829	0.36	0.140E+01	0.729E+00
24 === SYNOP Automatic SHIP Report						
	U10	42	0.5846153824038	0.01	0.300E+01	0.721E+00
	H2	18	0.7749223348018	0.04	0.150E+00	0.100E+00
	T2	22	0.8477845608365	0.04	0.140E+01	0.775E+00
15 === French SYNOP Automatic Land Repo						
	U10	476	12.87112839580	0.03	0.200E+01	0.753E+00
	H2	364	97.43385442932	0.27	0.150E+00	0.100E+00
	T2	407	42.22768188856	0.10	0.140E+01	0.773E+00
ObsType 1 Total:		3246	266.5860410468	0.08		

2001081810
mod4 experiment

Diagnostic JO−table (JOT) MINIMISATION JOB T0149 NCONF= 131 NSIM4D= 999 NUPTRA= 0
===

Obstype 1 === SYNOP, Land stations and ships

Codetype 11 === SYNOP Land Manual Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	510	7.591270365824	0.01	0.200E+01	0.710E+00
H2	268	29.02199416200	0.11	0.150E+00	0.100E+00
T2	268	10.64767883054	0.04	0.140E+01	0.762E+00

Codetype 14 === SYNOP Land Automatic Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	424	8.287769637503	0.02	0.200E+01	0.707E+00
H2	219	30.45578822365	0.14	0.150E+00	0.100E+00
T2	220	8.445141521937	0.04	0.140E+01	0.765E+00

Codetype 21 === SYNOP−SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	4	0.1055841751578E−01	0.00	0.300E+01	0.605E+00
H2	2	0.1218799787301	0.06	0.150E+00	0.100E+00
T2	2	0.5266802456180	0.26	0.140E+01	0.729E+00

Codetype 24 === SYNOP Automatic SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	42	0.5824006162014	0.01	0.300E+01	0.721E+00
H2	18	0.7247340486021	0.04	0.150E+00	0.100E+00
T2	22	0.5259632834582	0.02	0.140E+01	0.775E+00

Codetype 15 === French SYNOP Automatic Land Repo

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	476	11.90022510522	0.03	0.200E+01	0.753E+00
H2	364	96.50103812079	0.27	0.150E+00	0.100E+00
T2	407	20.09267625186	0.05	0.140E+01	0.773E+00
ObsType 1 Total:	3246	225.4357988095	0.07		

```
2001081810
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          510            7.591270365824           0.01
0.200E+01   0.710E+00
                   H2           268            29.02199416200           0.11
0.150E+00   0.100E+00
                   T2           268            10.64767883054           0.04
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          424            8.287769637503           0.02
0.200E+01   0.707E+00
                   H2           219            30.45578822365           0.14
0.150E+00   0.100E+00
                   T2           220            8.445141521937           0.04
0.140E+01   0.765E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            4           0.1055841751578E-01       0.00
0.300E+01   0.605E+00
                   H2             2           0.1218799787301           0.06
0.150E+00   0.100E+00
                   T2             2           0.5266802456180           0.26
0.140E+01   0.729E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           42           0.5824006162014           0.01
0.300E+01   0.721E+00
                   H2            18           0.7247340486021           0.04
0.150E+00   0.100E+00
                   T2            22           0.5259632834582           0.02
0.140E+01   0.775E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          476            11.90022510522           0.03
0.200E+01   0.753E+00
                   H2           364            96.50103812079           0.27
0.150E+00   0.100E+00
                   T2           407            20.09267625186           0.05
0.140E+01   0.773E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:       3246            225.4357988095           0.07
```

```
2001081811
mod experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          496            8.997715497857           0.02
0.200E+01   0.706E+00
                   H2           269            49.72404499798           0.18
0.150E+00   0.100E+00
                   T2           269            20.72865630453           0.08
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          438            9.109112825780           0.02
0.200E+01   0.710E+00
                   H2           224            38.51441770660           0.17
0.150E+00   0.100E+00
                   T2           226            19.51727238659           0.09
0.140E+01   0.766E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            4           0.1643297910563           0.04
0.300E+01   0.595E+00
                   H2             2           0.8949469778313E-01       0.04
0.150E+00   0.100E+00
                   T2             2           0.5517947133544           0.28
0.140E+01   0.726E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           36           0.6472012574856           0.02
0.300E+01   0.711E+00
                   H2            18           0.9837961271699           0.05
0.150E+00   0.100E+00
                   T2            19           0.4986726221107           0.03
0.140E+01   0.771E+00
                   T2            19           0.4986726221107           0.03
0.140E+01   0.771E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          488            17.40017357255           0.04
0.200E+01   0.755E+00
                   H2           373            123.4117600885           0.33
0.150E+00   0.100E+00
                   T2           417            50.15381972158           0.12
0.140E+01   0.774E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:        3281            340.4922623109           0.10
```

```
2001081811
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          496            8.779692334277           0.02
0.200E+01   0.706E+00
                   H2           269            49.19771624429           0.18
0.150E+00   0.100E+00
                   T2           269            10.80155461643           0.04
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          438            8.979897201239           0.02
0.200E+01   0.710E+00
                   H2           224            38.16479020038           0.17
0.150E+00   0.100E+00
                   T2           226            10.16786563916           0.04
0.140E+01   0.766E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            4           0.1624480651173           0.04
0.300E+01   0.595E+00
                   H2             2           0.8359780726236E-01       0.04
0.150E+00   0.100E+00
                   T2             2           0.3805626282381           0.19
0.140E+01   0.726E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           36           0.6285148500760           0.02
0.300E+01   0.711E+00
                   H2            18           0.9308846307190           0.05
0.150E+00   0.100E+00
                   T2            19           0.2891706520306           0.02
0.140E+01   0.771E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          488            16.34556646903           0.03
0.200E+01   0.755E+00
                   H2           373            122.4411509962           0.33
0.150E+00   0.100E+00
                   T2           417            26.30528491558           0.06
0.140E+01   0.774E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3281            293.6586972501           0.09
```

```
2001081812
mod experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          788            27.05773410244          0.03
0.200E+01   0.808E+00
                   H2           428            133.1721098226          0.31
0.150E+00   0.100E+00
                   T2           437            48.79138503358          0.11
0.140E+01   0.793E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          396            11.54514496470          0.03
0.200E+01   0.693E+00
                   H2           229            189.3906030934          0.83
0.150E+00   0.100E+00
                   T2           230            17.83989302773          0.08
0.140E+01   0.758E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           44            10.37357295610          0.24
0.300E+01   0.797E+00
                   H2            21            1.703686343817          0.08
0.150E+00   0.100E+00
                   T2            21            1.383758461891          0.07
0.140E+01   0.809E+0
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           42           0.8098993132236          0.02
0.300E+01   0.720E+00
                   H2            18           0.9379935747600          0.05
0.150E+00   0.100E+00
                   T2            21           0.5923964342326          0.03
0.140E+01   0.777E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          500            20.18473371039          0.04
0.200E+01   0.758E+00
                   H2           408            193.9837639055          0.48
0.150E+00   0.100E+00
                   T2           464            74.85470734600          0.16
0.140E+01   0.777E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:       4047            732.6213820905          0.18
```

```
2001081812
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          788            25.56536254332           0.03
0.200E+01   0.808E+00
                   H2           428            131.1460966444           0.31
0.150E+00   0.100E+00
                   T2           437            27.40693397144           0.06
0.140E+01   0.793E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          396            10.57129696685           0.03
0.200E+01   0.693E+00
                   H2           229            187.5661349750           0.82
0.150E+00   0.100E+00
                   T2           230            9.098048356429           0.04
0.140E+01   0.758E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           44            10.28183322487           0.23
0.300E+01   0.797E+00
                   H2            21            1.607757306364           0.08
0.150E+00   0.100E+00
                   T2            21            1.034928757525           0.05
0.140E+01   0.809E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           42           0.8089628496586           0.02
0.300E+01   0.720E+00
                   H2            18           0.8499493083401           0.05
0.150E+00   0.100E+00
                   T2            21           0.3994935576743           0.02
0.140E+01   0.777E+00
                   T2            21           0.3994935576743           0.02
0.140E+01   0.777E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          500            18.88055410477           0.04
0.200E+01   0.758E+00
                   H2           408            193.3988993441           0.47
0.150E+00   0.100E+00
                   T2           464            39.64563874989           0.09
0.140E+01   0.777E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       4047            658.2618906607           0.16
```

```
2001081813
mod experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          492            9.909168082133           0.02
0.200E+01   0.708E+00
                   H2           258            53.39244764133           0.21
0.150E+00   0.100E+00
                   T2           258            17.07576317682           0.07
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          436            13.48504388981           0.03
0.200E+01   0.708E+00
                   H2           226            46.44375123807           0.21
0.150E+00   0.100E+00
                   T2           227            23.53632729561           0.10
0.140E+01   0.765E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            6           0.1241995028734           0.02
0.300E+01   0.612E+00
                   H2             3           0.3424471054639           0.11
0.150E+00   0.100E+00
                   T2             3           0.5832601405525           0.19
0.140E+01   0.732E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           40           0.7286061207817           0.02
0.300E+01   0.724E+00
                   H2            16           0.9698133697193           0.06
0.150E+00   0.100E+00
                   T2            20           0.8104218498660           0.04
0.140E+01   0.778E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          516            29.70084617049           0.06
0.200E+01   0.754E+00
                   H2           408            205.9847523533           0.50
0.150E+00   0.100E+00
                   T2           453            58.75483986167           0.13
0.140E+01   0.774E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:        3362            461.8416877985           0.14
```

```
2001081813
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ===============================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          492            9.480303389180           0.02
0.200E+01   0.708E+00
                   H2           258            53.72686349731           0.21
0.150E+00   0.100E+00
                   T2           258            9.331133635211           0.04
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          436            12.60645920720           0.03
0.200E+01   0.708E+00
                   H2           226            45.68832916357           0.20
0.150E+00   0.100E+00
                   T2           227            12.03326154120           0.05
0.140E+01   0.765E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            6           0.1280176980998           0.02
0.300E+01   0.612E+00
                   H2             3           0.3420074829946           0.11
0.150E+00   0.100E+00
                   T2             3           0.4128231196700           0.14
0.140E+01   0.732E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           40           0.7423160143306           0.02
0.300E+01   0.724E+00
                   H2            16           0.9653236199121           0.06
0.150E+00   0.100E+00
                   T2            20           0.5193490699513           0.03
0.140E+01   0.778E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          516            28.00210788859           0.05
0.200E+01   0.754E+00
                   H2           408            204.7385354079           0.50
0.150E+00   0.100E+00
                   T2           453            31.35333458697           0.07
0.140E+01   0.774E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:       3362            410.0701653220           0.12
```

```
2001081814
mod experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ===============================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          474            12.59981885828           0.03
0.200E+01   0.707E+00
                   H2           250            65.35202034254           0.26
0.150E+00   0.100E+00
                   T2           250            16.29716778182           0.07
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          458            19.33568636901           0.04
0.200E+01   0.709E+00
                   H2           236            49.14861446527           0.21
0.150E+00   0.100E+00
                   T2           238            20.85982874784           0.09
0.140E+01   0.765E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            8           0.3986489721899           0.05
0.300E+01   0.609E+00
                   H2             3           0.3994458589508           0.13
0.150E+00   0.100E+00
                   T2             4           0.9563534472524           0.24
0.140E+01   0.730E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           44           0.7310965472042           0.02
0.300E+01   0.721E+00
                   H2            20            1.387694321049           0.07
0.150E+00   0.100E+00
                   T2            23            1.073817640238           0.05
0.140E+01   0.775E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          530            30.02682784312           0.06
0.200E+01   0.754E+00
                   H2           414            228.6820120760           0.55
0.150E+00   0.100E+00
                   T2           464            66.41274552430           0.14
0.140E+01   0.774E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3416            513.6617787950           0.15
```

```
2001081814
mod4 experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          474            11.79204473034           0.02
0.200E+01   0.707E+00
                   H2           250            65.36898117118           0.26
0.150E+00   0.100E+00
                   T2           250            8.481579905343           0.03
0.140E+01   0.762E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          458            18.66179322743           0.04
0.200E+01   0.709E+00
                   H2           236            48.08959902953           0.20
0.150E+00   0.100E+00
                   T2           238            11.17485162305           0.05
0.140E+01   0.765E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10            8           0.3283745572975           0.04
0.300E+01   0.609E+00
                   H2             3           0.3624059234069           0.12
0.150E+00   0.100E+00
                   T2             4           0.5048368502283           0.13
0.140E+01   0.730E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           44           0.6991114757628           0.02
0.300E+01   0.721E+00
                   H2            20            1.230467415304           0.06
0.150E+00   0.100E+00
                   T2            23           0.5936170651264           0.03
0.140E+01   0.775E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          530            26.83286617715           0.05
0.200E+01   0.754E+00
                   H2           414            225.4618822115           0.54
0.150E+00   0.100E+00
                   T2           464            31.93974326688           0.07
0.140E+01   0.774E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3416            451.5221546295           0.13
```

```
2001081815
mod experiment

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========


        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          704            34.54169223121           0.05
0.200E+01   0.796E+00
                   H2           382            143.4480192583           0.38
0.150E+00   0.100E+00
                   T2           388            41.15599546184           0.11
0.140E+01   0.789E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          420            11.23788315421           0.03
0.200E+01   0.694E+00
                   H2           243            210.9325068482           0.87
0.150E+00   0.100E+00
                   T2           244            19.33849835901           0.08
0.140E+01   0.758E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           12           0.1955917668000           0.02
0.300E+01   0.792E+00
                   H2             6           0.3215677312335           0.05
0.150E+00   0.100E+00
                   T2             6           0.5377808268535E-01       0.01
0.140E+01   0.797E+00
                   T2             6           0.5377808268535E-01       0.01
0.140E+01   0.797E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           46           0.8531572278219           0.02
0.300E+01   0.718E+00
                   H2            21            1.172453235132           0.06
0.150E+00   0.100E+00
                   T2            24           0.4684133936114           0.02
0.140E+01   0.774E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          534            37.40426595075           0.07
0.200E+01   0.756E+00
                   H2           442            259.6300274743           0.59
0.150E+00   0.100E+00
                   T2           497            70.30911797241           0.14
0.140E+01   0.776E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       3969            831.0629681476           0.21
```

2001081815
mod4 experiment

Diagnostic JO−table (JOT) MINIMISATION JOB T0149 NCONF= 131 NSIM4D= 999 NUPT
RA= 0

==

Obstype 1 === SYNOP, Land stations and ships

Codetype 11 === SYNOP Land Manual Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	704	29.15455286720	0.04	0.200E+01	0.796E+00
H2	382	142.4752933760	0.37	0.150E+00	0.100E+00
T2	388	18.73123672716	0.05	0.140E+01	0.789E+00

Codetype 14 === SYNOP Land Automatic Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	420	10.46955038275	0.02	0.200E+01	0.694E+00
H2	243	209.8154898937	0.86	0.150E+00	0.100E+00
T2	244	8.917109200042	0.04	0.140E+01	0.758E+00

Codetype 21 === SYNOP−SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	12	0.1811183675125	0.02	0.300E+01	0.792E+00
H2	6	0.2462287607651	0.04	0.150E+00	0.100E+00
T2	6	0.3679282032831E−01	0.01	0.140E+01	0.797E+00

Codetype 24 === SYNOP Automatic SHIP Report

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	46	0.8301759556524	0.02	0.300E+01	0.718E+00
H2	21	1.053505299865	0.05	0.150E+00	0.100E+00
T2	24	0.2534968427024	0.01	0.140E+01	0.774E+00

Codetype 15 === French SYNOP Automatic Land Repo

Variable	DataCount	Jo_Costfunction	JO/n	ObsErr	BgErr
U10	534	32.63310681387	0.06	0.200E+01	0.756E+00
H2	442	256.1347765872	0.58	0.150E+00	0.100E+00
T2	497	32.90729099100	0.07	0.140E+01	0.776E+00
ObsType 1 Total:	3969	743.8397248858	0.19		

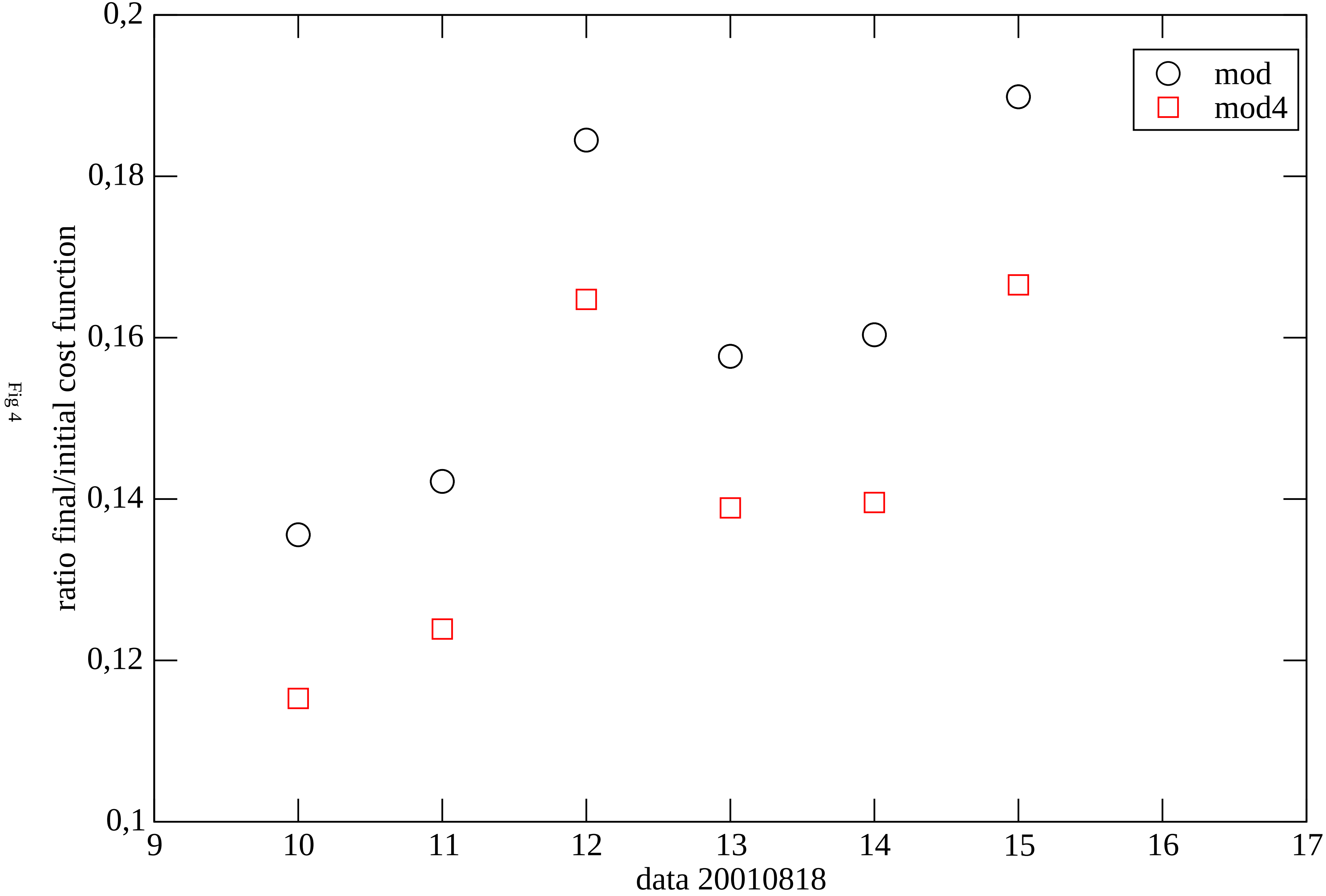
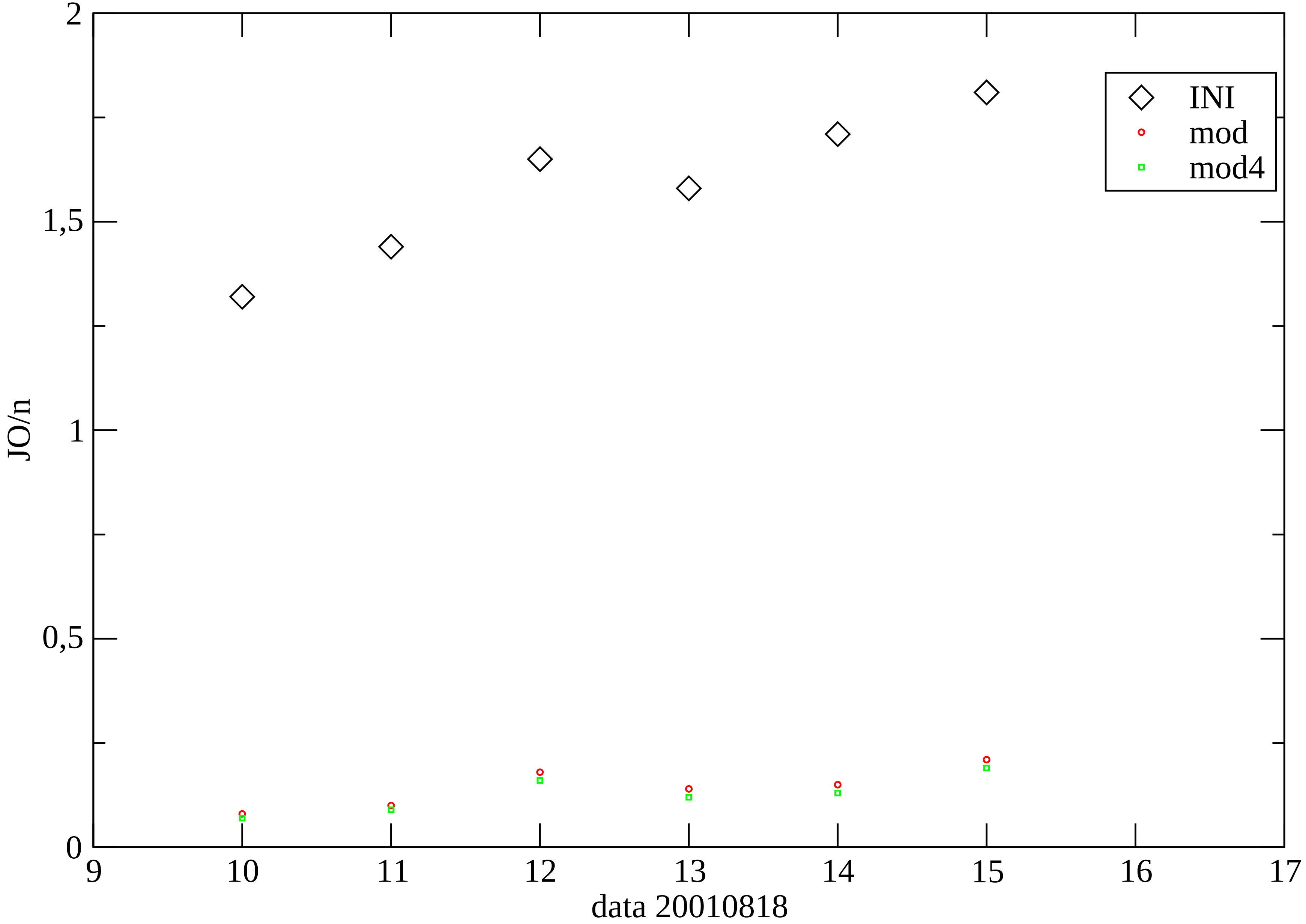
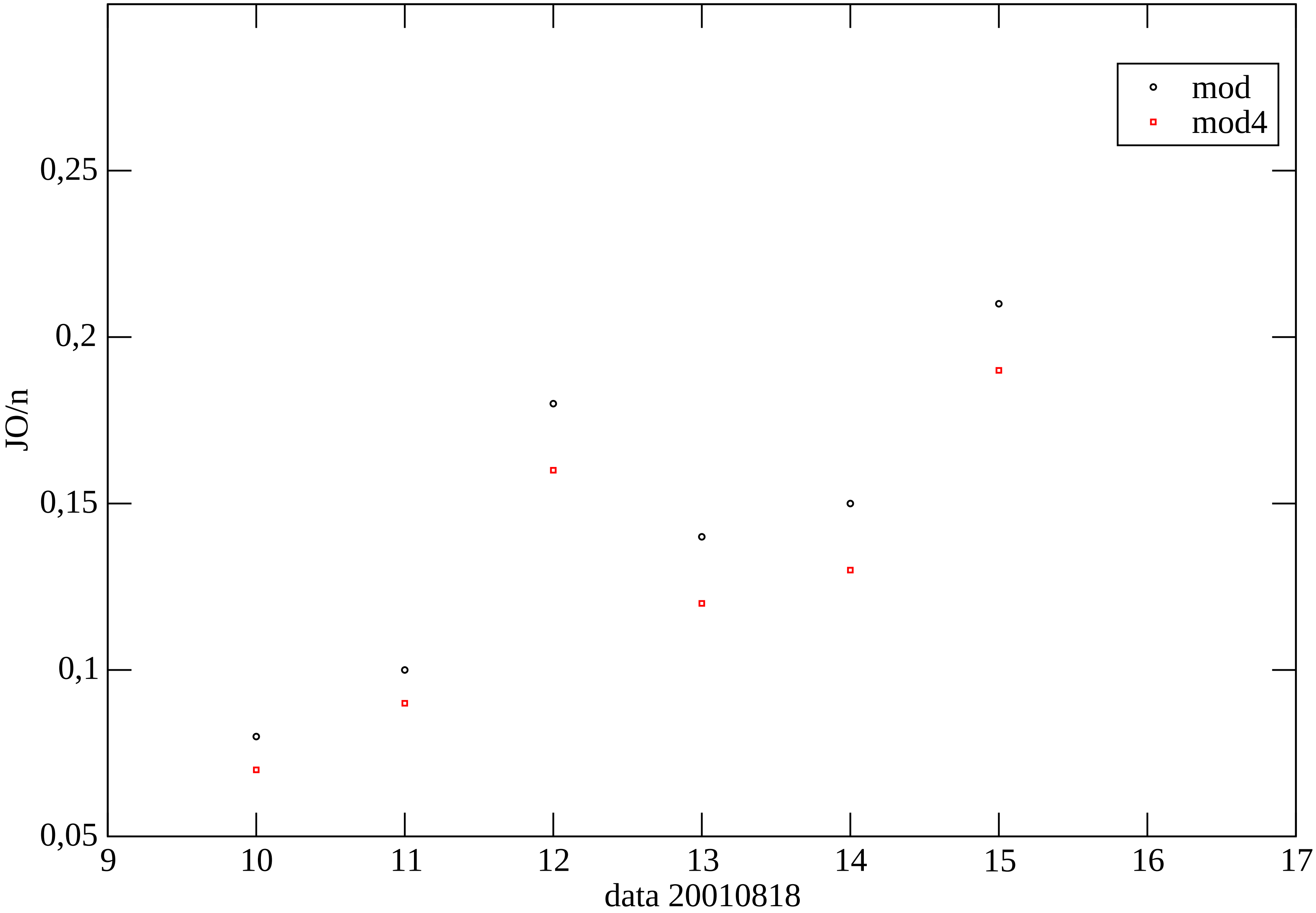


Fig 4
ratio final/initial cost function
data 20010818
mod
mod4
0,1
0,12
0,14
0,16
0,18
0,2
9
10
11
12
13
14
15
16
17

Fig 5




mod
mod4
0,25
0,2
0,15
0,1
0,05
JO/n
9
10
11
12
13
14
15
16
17
data 20010818
Fig 6

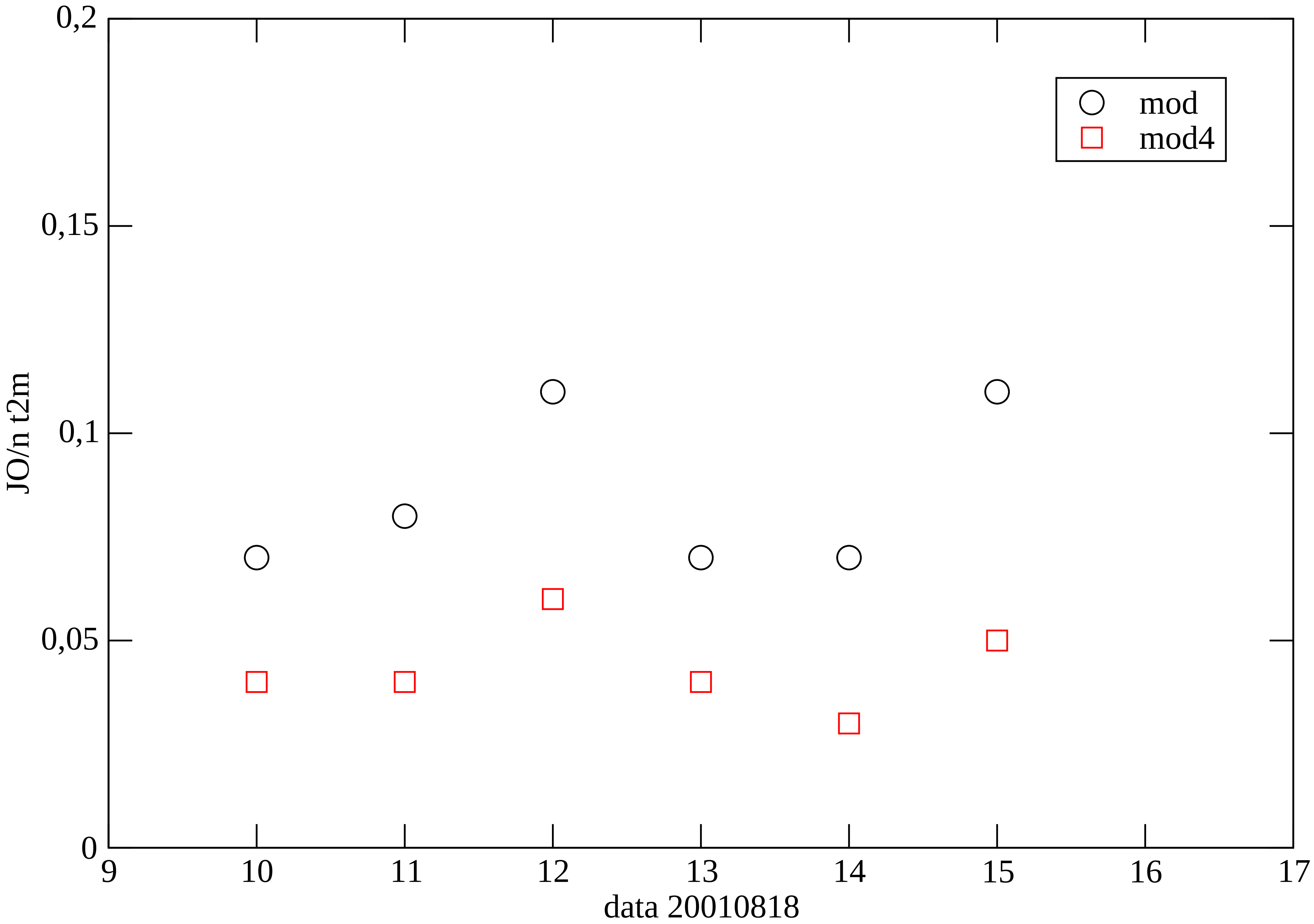

0,2
0,15
0,1
0,05
0
JO/n t2m
9
10
11
12
13
14
15
16
17
data 20010818
mod
mod4

Fig 7

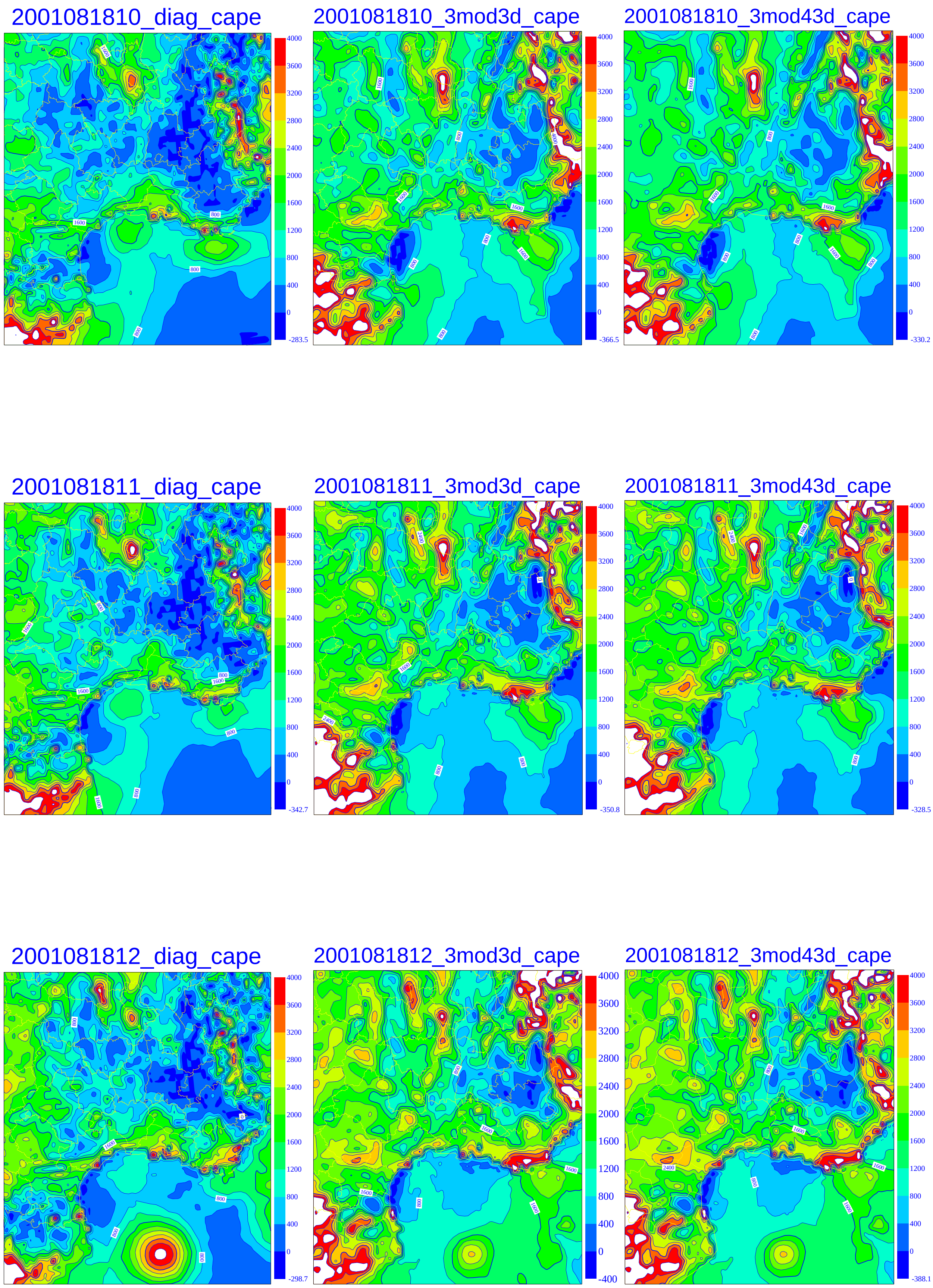

2001081810_diag_cape
2001081810_3mod3d_cape
2001081810_3mod43d_cape
2001081811_diag_cape
2001081811_3mod3d_cape
2001081811_3mod43d_cape
2001081812_diag_cape
2001081812_3mod3d_cape
2001081812_3mod43d_cape
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
-283.5
-366.5
-330.2
-342.7
-350.8
-328.5
-298.7
-400
-388.1

Fig 8 (1/2)

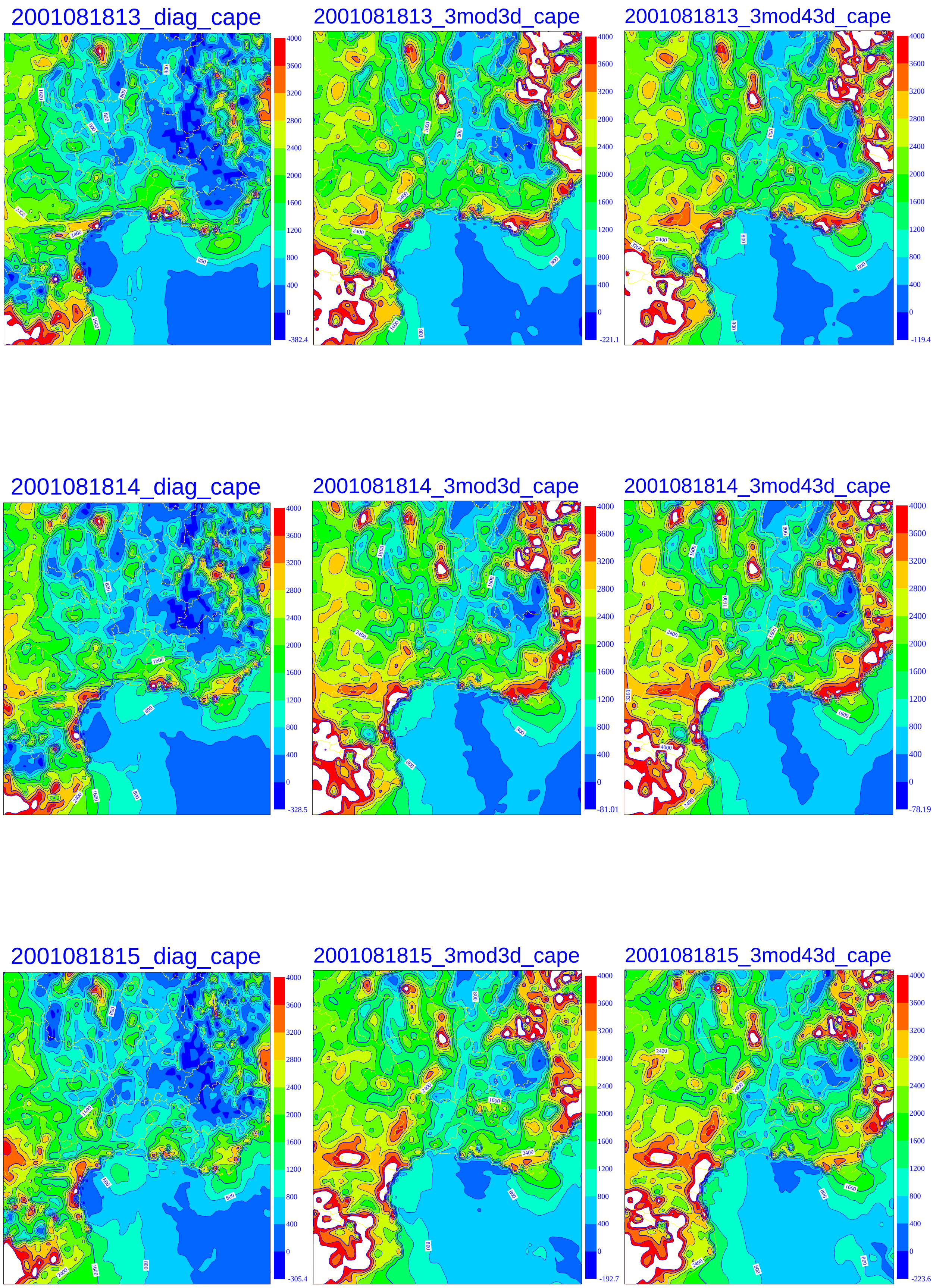

2001081813_diag_cape
2001081813_3mod3d_cape
2001081813_3mod43d_cape
2001081814_diag_cape
2001081814_3mod3d_cape
2001081814_3mod43d_cape
2001081815_diag_cape
2001081815_3mod3d_cape
2001081815_3mod43d_cape
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
-382.4
-221.1
-119.4
-328.5
-81.01
-78.19
-305.4
-192.7
-223.6

Fig 8 (2/2)

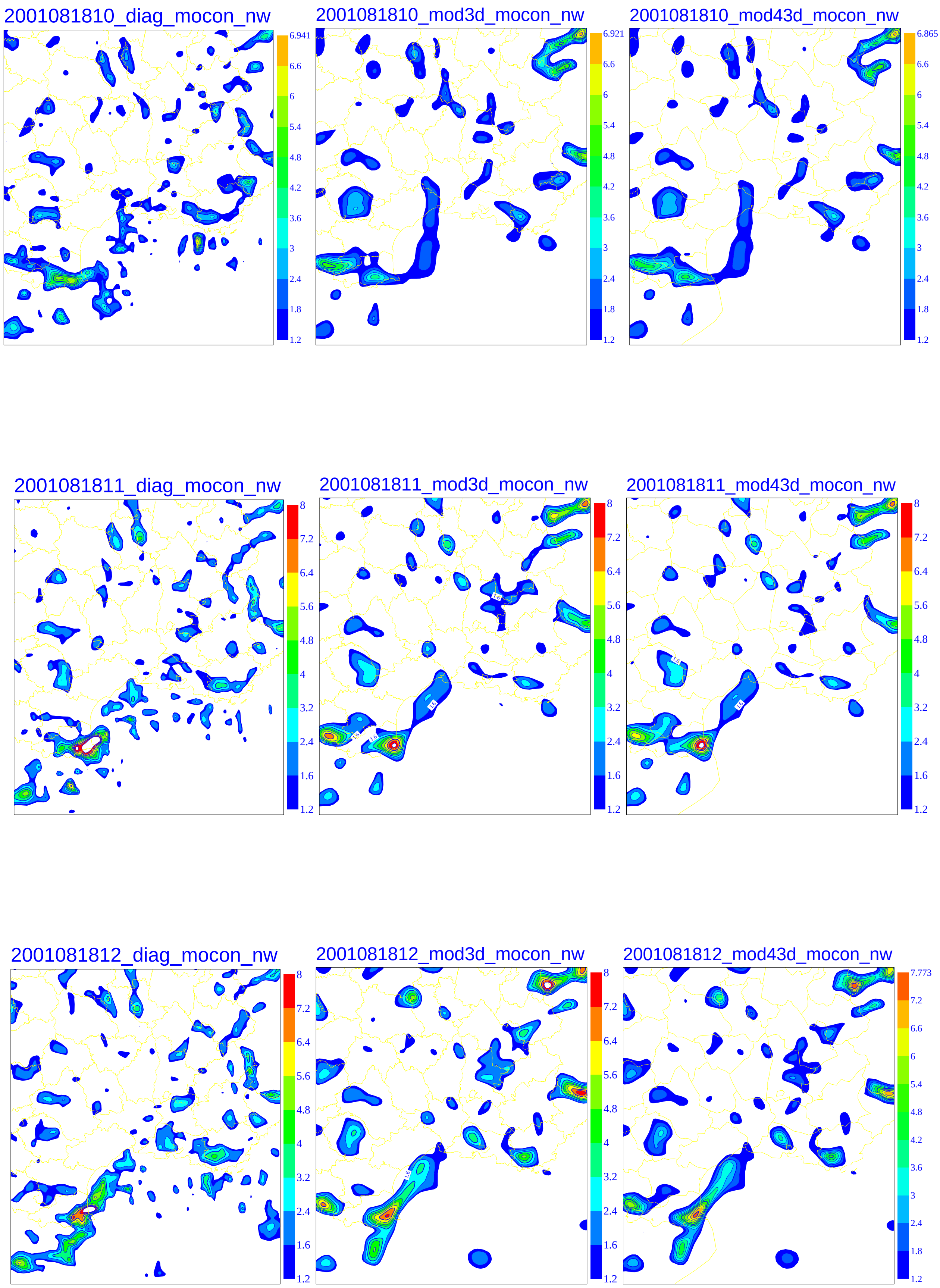

2001081810_diag_mocon_nw
6.941 6.6 6 5.4 4.8 4.2 3.6 3 2.4 1.8 1.2
2001081810_mod3d_mocon_nw
6.921 6.6 6 5.4 4.8 4.2 3.6 3 2.4 1.8 1.2
2001081810_mod43d_mocon_nw
6.865 6.6 6 5.4 4.8 4.2 3.6 3 2.4 1.8 1.2
2001081811_diag_mocon_nw
8 7.2 6.4 5.6 4.8 4 3.2 2.4 1.6 1.2
2001081811_mod3d_mocon_nw
8 7.2 6.4 5.6 4.8 4 3.2 2.4 1.6 1.2
2001081811_mod43d_mocon_nw
8 7.2 6.4 5.6 4.8 4 3.2 2.4 1.6 1.2
2001081812_diag_mocon_nw
8 7.2 6.4 5.6 4.8 4 3.2 2.4 1.6 1.2
2001081812_mod3d_mocon_nw
8 7.2 6.4 5.6 4.8 4 3.2 2.4 1.6 1.2
2001081812_mod43d_mocon_nw
7.773 7.2 6.6 6 5.4 4.8 4.2 3.6 3 2.4 1.8 1.2

Fig 9 1/2

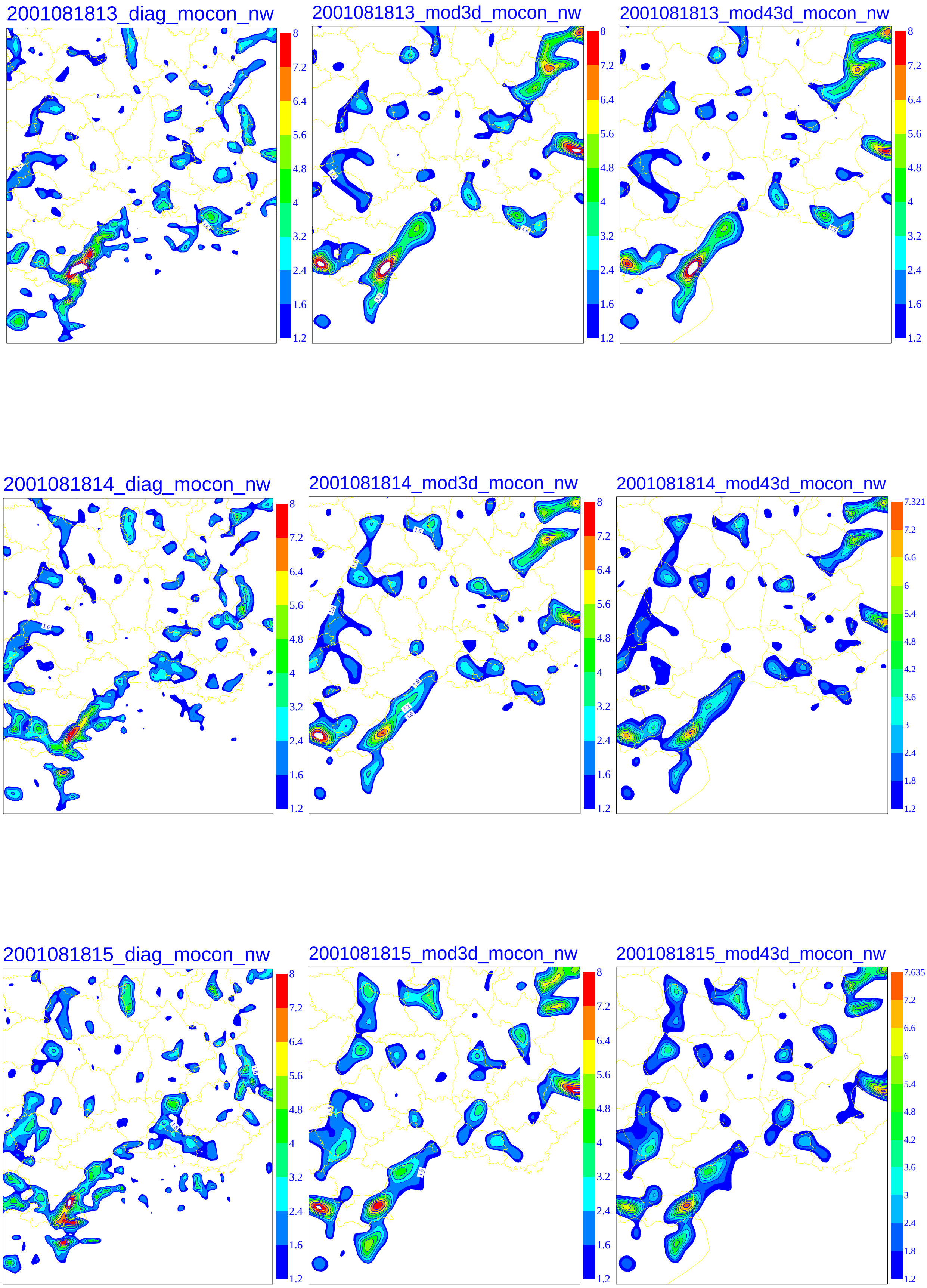

2001081813_diag_mocon_nw
2001081813_mod3d_mocon_nw
2001081813_mod43d_mocon_nw
2001081814_diag_mocon_nw
2001081814_mod3d_mocon_nw
2001081814_mod43d_mocon_nw
2001081815_diag_mocon_nw
2001081815_mod3d_mocon_nw
2001081815_mod43d_mocon_nw

Fig 9 2/2

Appendix 3

Case study 2004100912 - 2004100917

List of the tables and figures

```
2004100912

Diagnostic JO-table (JOT) SCREENING JOB    T0149 NCONF=     1 NSIM4D=     0 NUPT
RA=     0
  ================================================================================
===========

        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          472            511.0578894831          1.08
0.200E+01   0.000E+00
                   H2           236            139.8596368363          0.59
0.150E+00   0.000E+00
                   T2           241            239.9948802122          1.00
0.140E+01   0.000E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          226            170.7737816055          0.76
0.200E+01   0.000E+00
                   H2           113            106.3850665680          0.94
0.150E+00   0.000E+00
                   T2           114            150.3499270866          1.32
0.140E+01   0.000E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U              2           0.9419579643984          0.47
0.300E+01   0.000E+00
                   H2             1           0.1230107896440          0.12
0.150E+00   0.000E+00
                   T2             1           0.9880277844883          0.99
0.140E+01   0.000E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U             10            7.640751834853          0.76
0.300E+01   0.000E+00
                   H2             4            4.076802728377          1.02
0.150E+00   0.000E+00
                   T2             5            13.39230555109          2.68
0.140E+01   0.000E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           40            33.26529639868          0.83
0.200E+01   0.000E+00
                   H2            22            15.15939631099          0.69
0.150E+00   0.000E+00
                   T2            23            29.09703166082          1.27
0.140E+01   0.000E+00
             Codetype    16 === French RADOME
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          542            616.0885940545          1.14
0.200E+01   0.000E+00
                   H2           277            184.6260866719          0.67
0.150E+00   0.000E+00
                   T2           306            478.1397856766          1.56
0.140E+01   0.000E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       2635            2701.960229218          1.03
```

```
2004100912

Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=     0 NUPT
RA=     0
  ================================================================================
===========

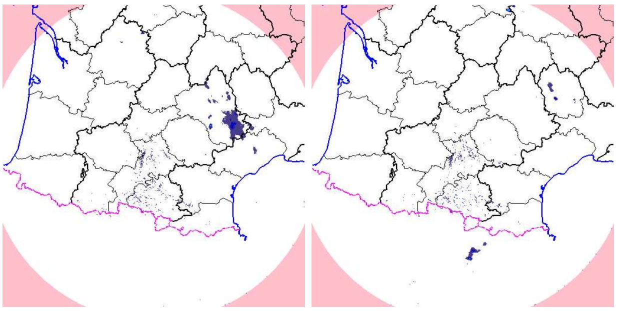
        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          430            367.6850215550          0.86
0.200E+01   0.150E+01
                   H2           236            139.8596368363          0.59
0.150E+00   0.100E+00
                   T2           241            239.9948802122          1.00
0.140E+01   0.926E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          204            140.8088509744          0.69
0.200E+01   0.152E+01
                   H2           113            106.3850665680          0.94
0.150E+00   0.100E+00
                   T2           114            150.3499270866          1.32
0.140E+01   0.927E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U              2           0.9419579643984          0.47
0.300E+01   0.133E+01
                   H2             1           0.1230107896440          0.12
0.150E+00   0.100E+00
                   T2             1           0.9880277844883          0.99
0.140E+01   0.902E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U             10            7.640751834853          0.76
0.300E+01   0.168E+01
                   H2             3            3.703063697280          1.23
0.150E+00   0.100E+00
                   T2             5            13.39230555109          2.68
0.140E+01   0.940E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           28            24.80916855429          0.89
0.200E+01   0.143E+01
                   H2            22            15.15939631099          0.69
0.150E+00   0.100E+00
                   T2            23            29.09703166082          1.27
0.140E+01   0.914E+00
             Codetype    16 === French RADOME
                Variable      DataCount           Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          448            515.5678398253          1.15
0.200E+01   0.151E+01
                   H2           276            177.6552379132          0.64
0.150E+00   0.100E+00
                   T2           305            454.8593468429          1.49
0.140E+01   0.913E+00
                             ----------   ---------------------------   --------
       ObsType  1 Total:       2462            2389.020521962          0.97
```

```
2004100912

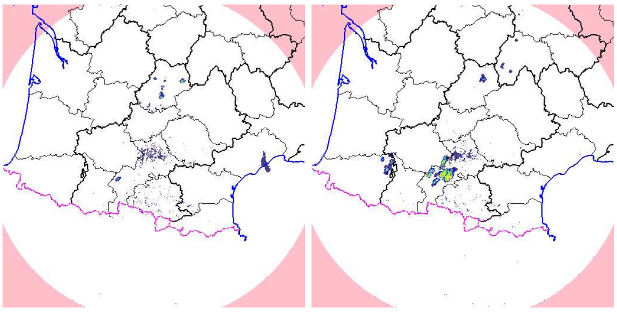
Diagnostic JO-table (JOT) MINIMISATION JOB T0149 NCONF=   131 NSIM4D=   999 NUPT
RA=     0
  ================================================================================
===========

        Obstype     1 === SYNOP, Land stations and ships
        --------------------------------------------------
             Codetype    11 === SYNOP Land Manual Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          430            9.948212243605           0.02
0.200E+01   0.150E+01
                   H2           236            3.054531040759           0.01
0.150E+00   0.100E+00
                   T2           241            7.794175868167           0.03
0.140E+01   0.926E+00
             Codetype    14 === SYNOP Land Automatic Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          204            4.194191125991           0.02
0.200E+01   0.152E+01
                   H2           113            1.282042958347           0.01
0.150E+00   0.100E+00
                   T2           114            3.962236943845           0.03
0.140E+01   0.927E+00
             Codetype    21 === SYNOP-SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U              2           0.7174360283851E-02       0.00
0.300E+01   0.133E+01
                   H2             1           0.1358580204398E-01       0.01
0.150E+00   0.100E+00
                   T2             1           0.1265490185417E-01       0.01
0.140E+01   0.902E+00
             Codetype    24 === SYNOP Automatic SHIP Report
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U             10           0.9097198356464E-01       0.01
0.300E+01   0.168E+01
                   H2             3           0.9075036946577E-02       0.00
0.150E+00   0.100E+00
                   T2             5           0.5948647671081           0.12
0.140E+01   0.940E+00
             Codetype    15 === French SYNOP Automatic Land Repo
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10           28            1.352139147323           0.05
0.200E+01   0.143E+01
                   H2            22           0.8225854002227           0.04
0.150E+00   0.100E+00
                   T2            23           0.8433356390865           0.04
0.140E+01   0.914E+00
             Codetype    16 === French RADOME
                Variable      DataCount          Jo_Costfunction       JO/n
  ObsErr      BgErr
                   U10          448            12.29451952916           0.03
0.200E+01   0.151E+01
                   H2           276            2.436819257879           0.01
0.150E+00   0.100E+00
                   T2           305            10.85134788000           0.04
0.140E+01   0.913E+00
                         ----------   ---------------------------   --------
       ObsType  1 Total:       2462            59.56446388619           0.02
```

Radar echo, 09 October 2004 12,13 UTC



Radar echo, 09 October 2004 14,15 UTC



Radar echo, 09 October 2004 16,17 UTC

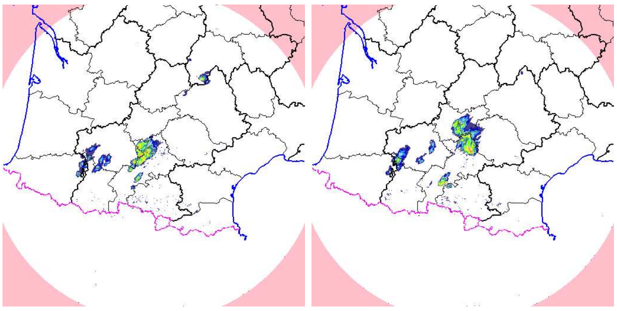
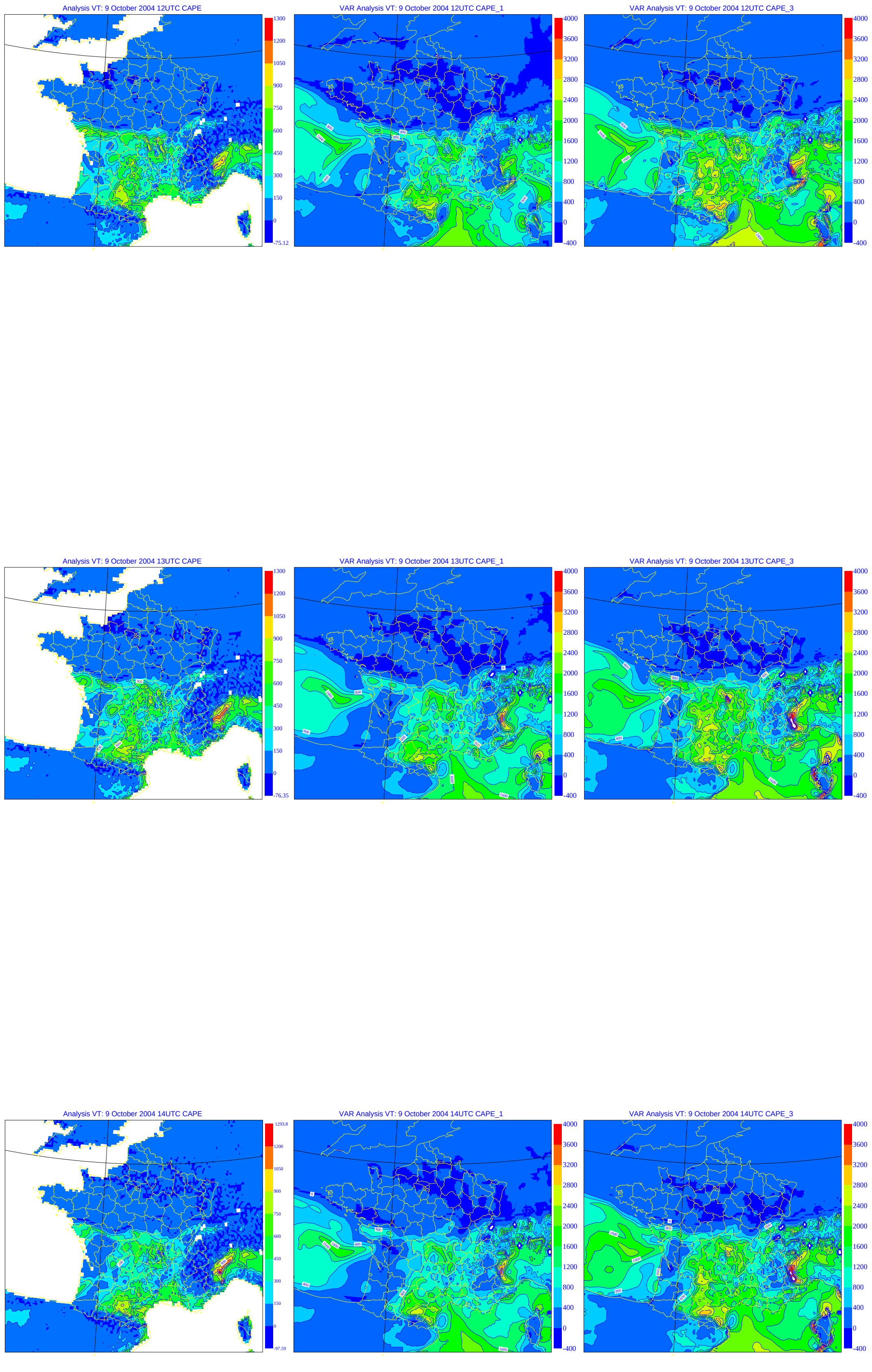


Fig 10


Analysis VT: 9 October 2004 12UTC CAPE
VAR Analysis VT: 9 October 2004 12UTC CAPE_1
VAR Analysis VT: 9 October 2004 12UTC CAPE_3
Analysis VT: 9 October 2004 13UTC CAPE
VAR Analysis VT: 9 October 2004 13UTC CAPE_1
VAR Analysis VT: 9 October 2004 13UTC CAPE_3
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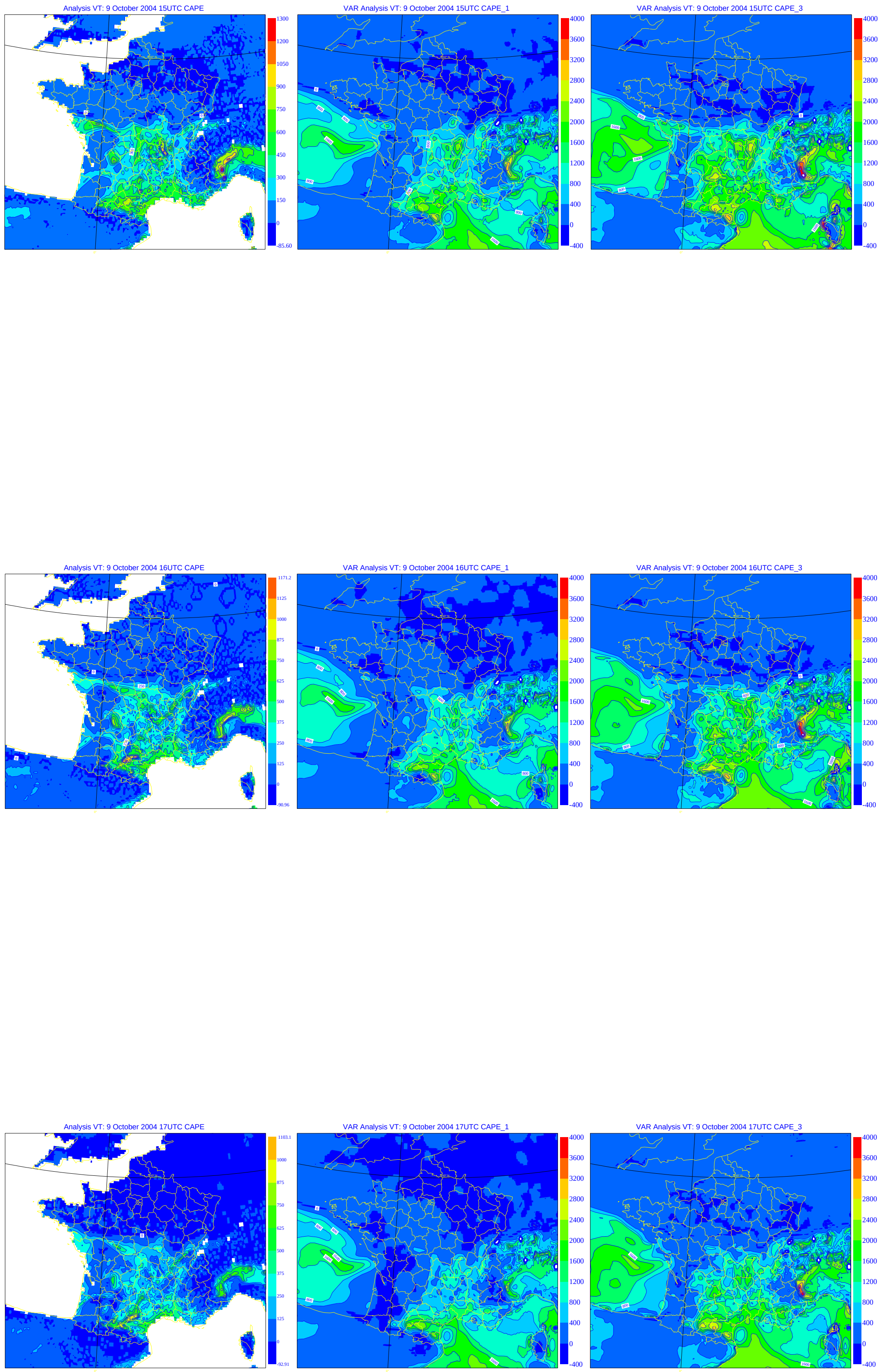
VAR Analysis VT: 9 October 2004 14UTC CAPE_3

Fig 11 (1/2)


Analysis VT: 9 October 2004 15UTC CAPE
VAR Analysis VT: 9 October 2004 15UTC CAPE_1
VAR Analysis VT: 9 October 2004 15UTC CAPE_3
Analysis VT: 9 October 2004 16UTC CAPE
VAR Analysis VT: 9 October 2004 16UTC CAPE_1
VAR Analysis VT: 9 October 2004 16UTC CAPE_3
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VAR Analysis VT: 9 October 2004 17UTC CAPE_3

Fig 11 (2/2)

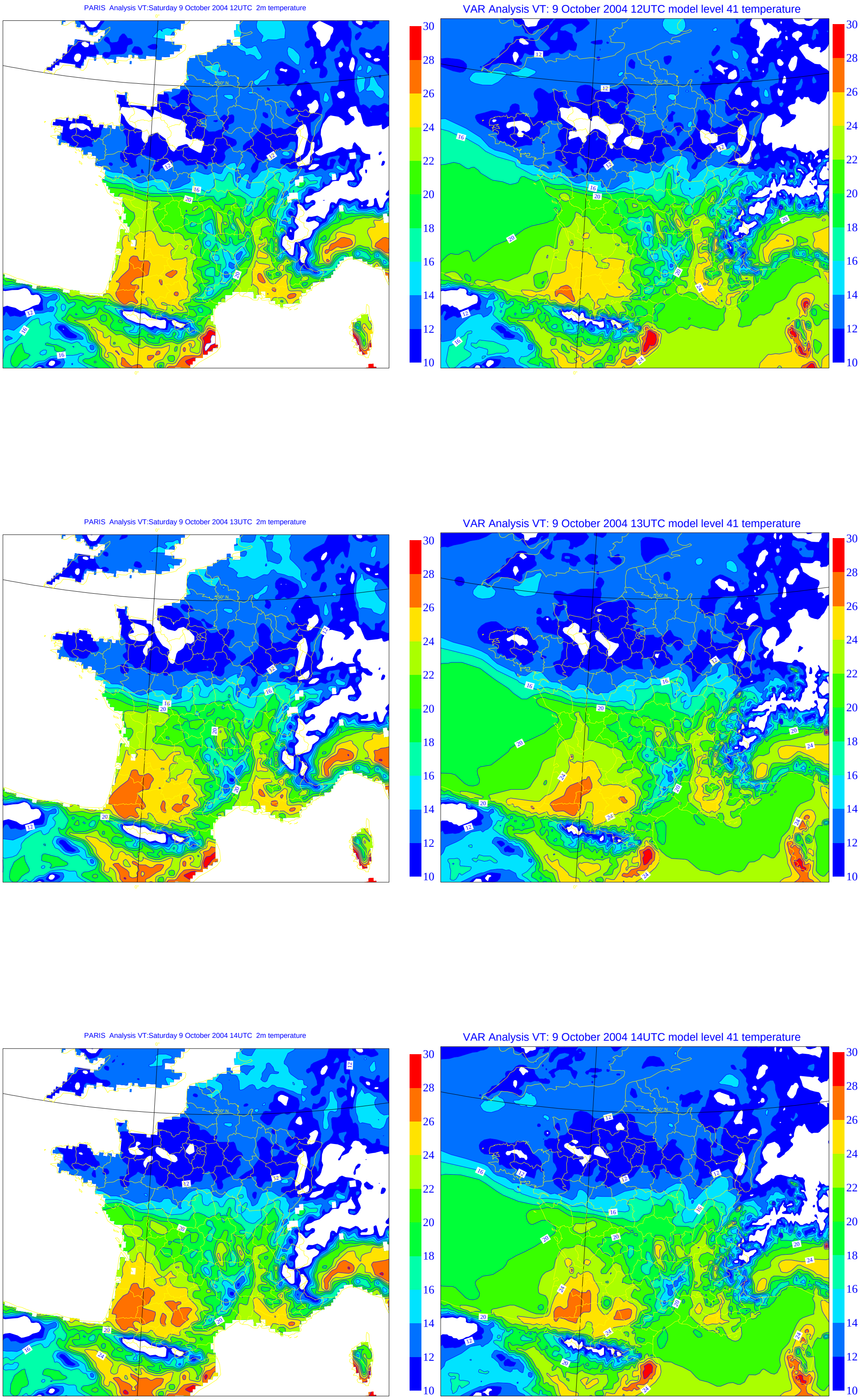
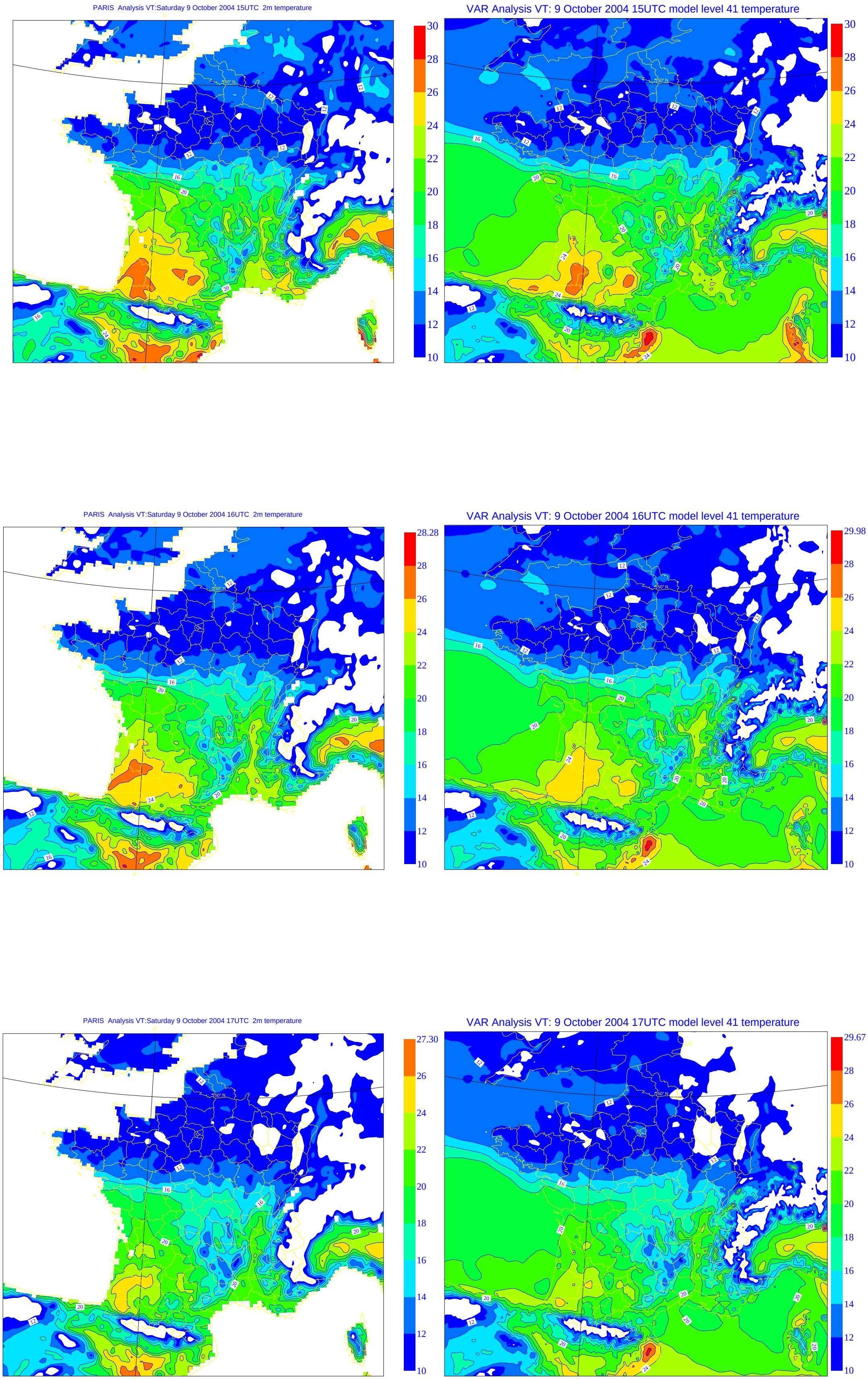

PARIS Analysis VT:Saturday 9 October 2004 12UTC 2m temperature
VAR Analysis VT: 9 October 2004 12UTC model level 41 temperature
PARIS Analysis VT:Saturday 9 October 2004 13UTC 2m temperature
VAR Analysis VT: 9 October 2004 13UTC model level 41 temperature
PARIS Analysis VT:Saturday 9 October 2004 14UTC 2m temperature
VAR Analysis VT: 9 October 2004 14UTC model level 41 temperature
30
28
26
24
22
20
18
16
14
12
10

Fig 12 (1/2)


PARIS Analysis VT:Saturday 9 October 2004 15UTC 2m temperature
VAR Analysis VT: 9 October 2004 15UTC model level 41 temperature
PARIS Analysis VT:Saturday 9 October 2004 16UTC 2m temperature
VAR Analysis VT: 9 October 2004 16UTC model level 41 temperature
PARIS Analysis VT:Saturday 9 October 2004 17UTC 2m temperature
VAR Analysis VT: 9 October 2004 17UTC model level 41 temperature
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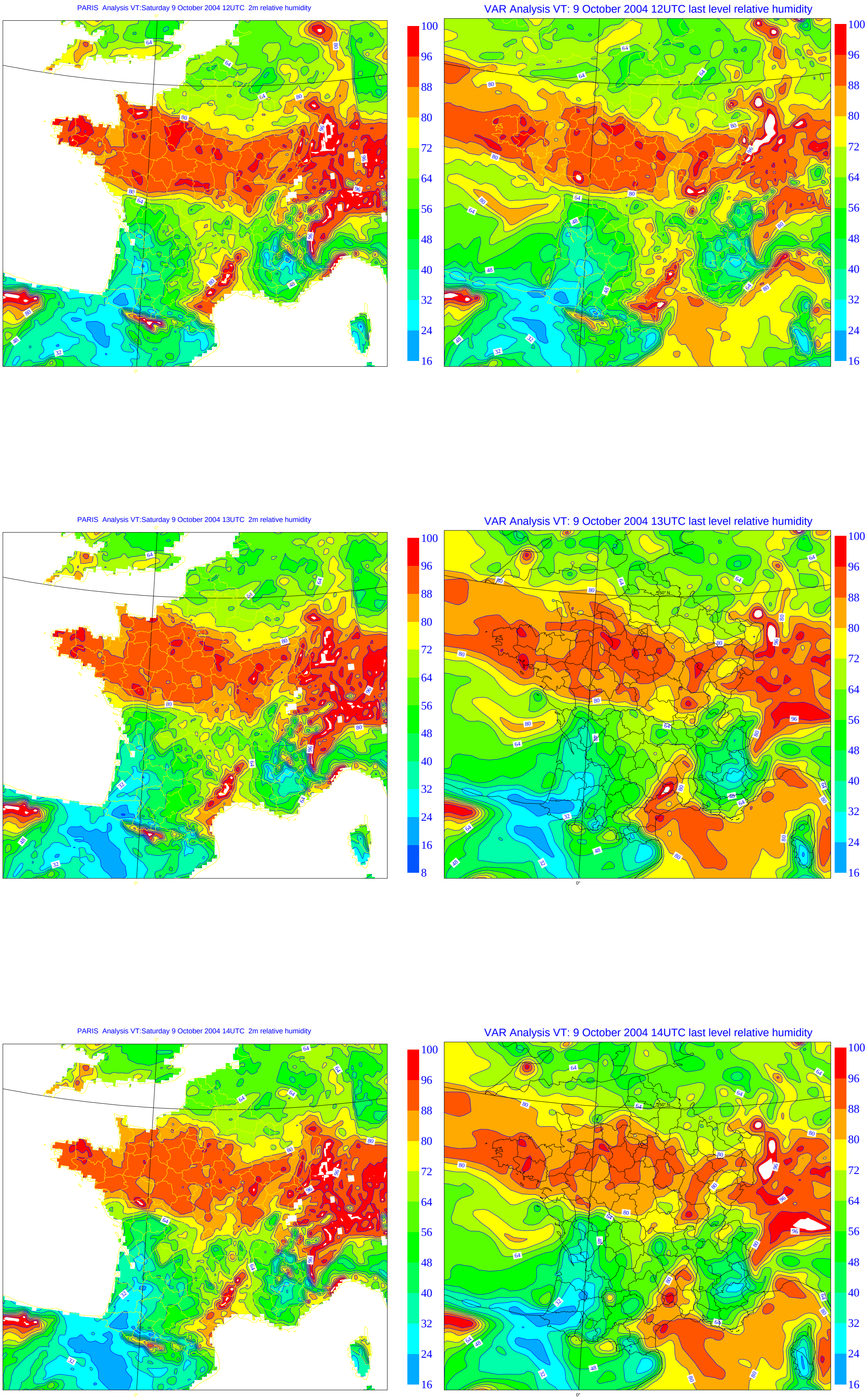
29.98
27.30
29.67

Fig 12 (2/2)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100 96 88 80 72 64 56 48 40 32 24 16
VAR Analysis VT: 9 October 2004 12UTC last level relative humidity
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PARIS Analysis VT:Saturday 9 October 2004 13UTC 2m relative humidity
100 96 88 80 72 64 56 48 40 32 24 16 8
VAR Analysis VT: 9 October 2004 13UTC last level relative humidity
100 96 88 80 72 64 56 48 40 32 24 16
PARIS Analysis VT:Saturday 9 October 2004 14UTC 2m relative humidity
100 96 88 80 72 64 56 48 40 32 24 16
VAR Analysis VT: 9 October 2004 14UTC last level relative humidity
100 96 88 80 72 64 56 48 40 32 24 16

Fig 13 (1/2)

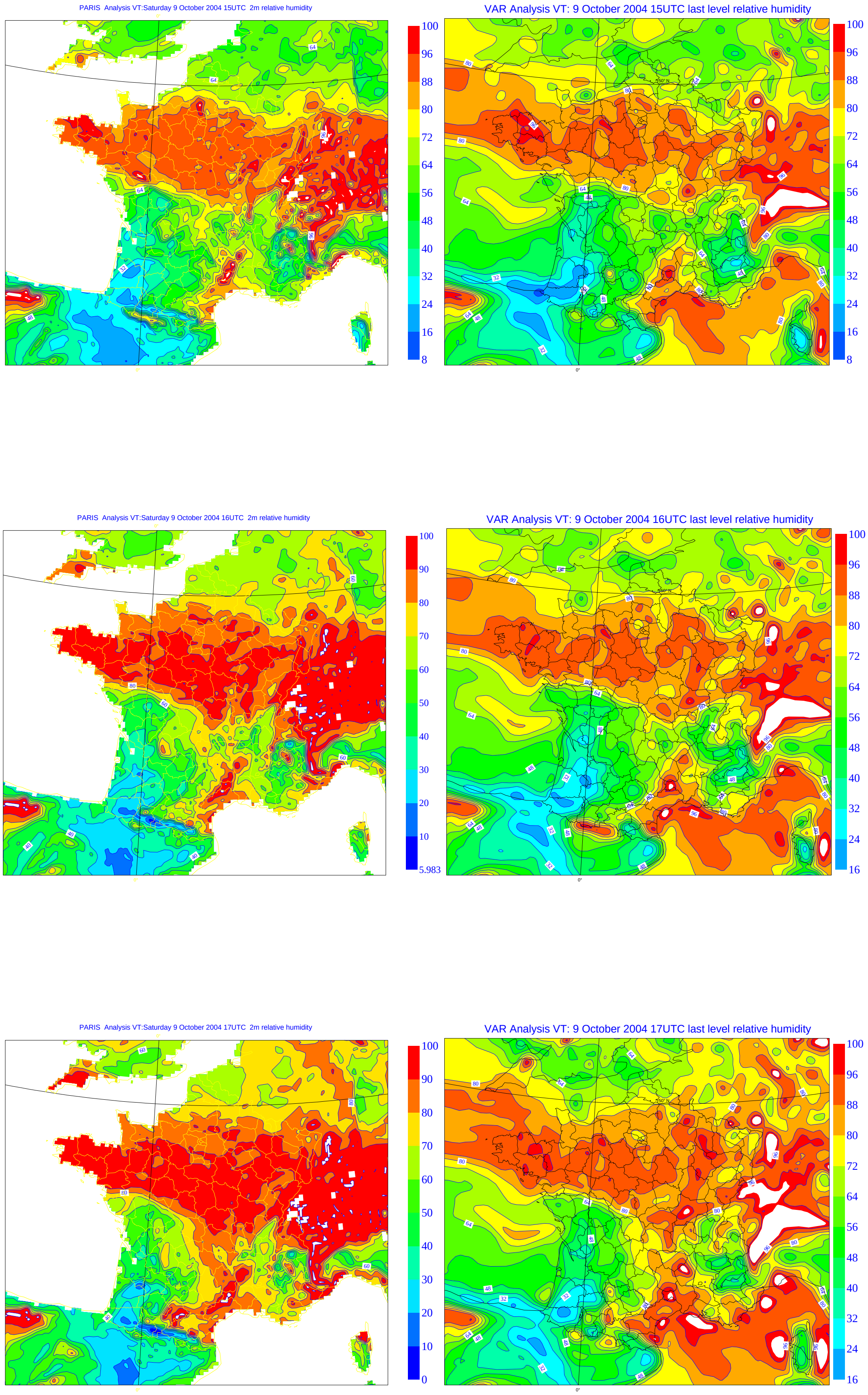
PARIS Analysis VT:Saturday 9 October 2004 15UTC 2m relative humidity
VAR Analysis VT: 9 October 2004 15UTC last level relative humidity
PARIS Analysis VT:Saturday 9 October 2004 16UTC 2m relative humidity
VAR Analysis VT: 9 October 2004 16UTC last level relative humidity
PARIS Analysis VT:Saturday 9 October 2004 17UTC 2m relative humidity
VAR Analysis VT: 9 October 2004 17UTC last level relative humidity

Fig 13 (2/2)