

VALIDATION OF SURFEX IN ALADIN ON A WINTER PERIOD

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

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by

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VALIDATION OF SURFEX IN ALADIN FOR A WINTER PERIOD

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INTRODUCTION

The purpose of this work has been to compare the ALADIN model with and without SURFEX for a winter period in order to evaluate discrepancies related with snow or frozen soil.

The input/output fields for ALADIN are files of FA format while the input/output files from SURFEX are of LFI format. To initialize SURFEX file from an ALADIN file a pre-processing procedure has been applied to prepare the necessary input files. After that a 24-hour forecast has been performed with the operational ALADIN using or not SURFEX (hereafter both models are referred as aladin and aladin+surfex)

The experiments with both models and the comparison of the obtained results were performed over the ALADIN/FRANCE domain (300x300, mesh distance 9.5 km) for the winter case 2006010100.

The comparison between the results, obtained by the operational aladin and (aladin + surfex) has been done in two steps:

-a reference run with 24-hour forecast from aladin has been defined, produced by the executable

/mf/dp/marp/marp001/tampon/bin/ald/al33/al33t1_arome-main.01.SX8RV20.x.exe

(on the pictures the results are marked by oper)

-a run with 24-hour forecast from (aladin + surfex) has been defined, with the input file

/cnrm2_mrpa/mrpa/mrpa657/surfex/ 200601010_923d04.V3.lfi

(on the pictures the results are marked by sfx9)

The report consists of Introduction, 3 sections and 7 Appendices

Section I Comparison of the results between 12- and 24-hour forecast from running the operational ALADIN (aladin) with those from ALADIN initialized with SURFEX fields (aladin + surfex)

Section II Description of the modifications, made in the operational ALADIN (aladin), to simulate the settings in SURFEX

Section III Conclusions and plans for the future work

ACKNOWLEDGMENT

Appendix1

Plots of the 12- and 24-hour forecasts from aladin and (aladin + surfex) , as well as of the differences $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{12}$ and $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{24}$ for T2m, Hu2m, U10m, V10m

Appendix2

Plots of the differences between the 12- and 24-hour forecasts from aladin and aladin_mod3 for T2m, Hu2m, U10m, V10m

Appendix3

Plots of the differences between the 24-hour forecasts from aladin and aladin_mod3 for surface elements [surface fields: deep soil moisture content for ice (PRGL), soil moisture content for ice (SRGL), snow depth (SRNG), deep soil moisture content (PREAU), liquid soil moisture content (SREAU)]

Appendix4

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Section I Comparison of the results between 12- and 24-hour forecast from running the operational ALADIN (aladin) with those from ALADIN with SURFEX (aladin + surfex)

The results of the comparison between the forecasts (12- and 24-hour) for screen level elements (T2m, Hu2m, U10m, V10m) from running aladin and (aladin + surfex) are presented in Appendix1. On the pictures the results from operational aladin are defined as oper, while those from aladin + surfex – as sfx9. It is seen that:

- in the field of T2m the differences vary in the interval (-7, +5) degrees for 12-hour forecast and in the interval (-6, + 6) degrees for 24-hour forecast. The dominant differences are within the interval (0.5, 2) degrees (according to resolution of the plots). For the 24-hour forecast the area with differences within that interval is spread over a larger region in NE part of the domain. Higher differences could be seen mainly over mountainous areas;
- for the field of Hu2m the difference between the results from both runs are seen better for 12-hour forecast and again they are better pronounced over mountainous areas;
- for the fields of U10m and V10m there are spotted areas mainly over the sea.

To understand better the differences between the results from (aladin) and (aladin + surfex) for T2m, we focused on the parametrization of soil water freezing in the operational ALADIN and in SURFEX. The results of that study are given in Section II.

Section II Description of the modifications, made in the operational ALADIN (aladin), to simulate the settings in SURFEX

With reference to Bazile (1999) and the documentation of SURFEX (Meso-NH Masdev4.7β January 2008.Part II. Model Setup), we will present quite schematically the differences between two parametrization schemes, keeping the notation of Bazile (1999).

The comparison of the soil water freezing schemes in operational ALADIN and in SURFEX showed that perhaps the main differences are in the different coefficients in the equations for treatment of soil ice. According to us, those differences are as follows:

- In the prognostic equation for freezing/melting fluxes for the surface and total water content $F_{f/m}^{s/m}$

$$\partial T_p / \partial t = (T_s - T_p) / \tau + C_t L_f (F_f^p - F_m^p)$$

$$\partial T_s / \partial t = C_t (L_f (F_f^s - F_m^s) - L_s E_i)$$

the coefficient C_t is the thermal inertial coefficient (total), while in SURFEX it is C_g - the thermal inertial coefficient for bare ground;

- The value of the characteristic time scale $1/\tau$ is also different :

A/ $1/\tau_p = 3.10^{-5}[s^{-1}]; 1/\tau_s = 5.10^{-5}[s^{-1}]$ for operational ALADIN (GCGEL = 3.E-5, GCGELS = 5.E-5 in the namelist)

B/ $1/\tau_g = 3.10^{-4}[s^{-1}]$ for SURFEX

- The coefficients $K_{p/s}$ for calculation of the fluxes $F_f^P, F_f^S, F_m^P, F_m^S$ are different, since the coefficient $K_{p/s}^3 = 1.8$ in operational ALADIN (GNEIMX= 1.8, GNEIMXS = 1.8) instead of 1 as it is in SURFEX

The details of the notation are given in Bazile (1999)

To simulate SURFEX settings within operational ALADIN, we have created a new executable (/cnrm/gp/mrpa/mrpa657/pack/cy33t1_main.01.a/bin/AROME) based on modification of the routines:

```

adiab/cptends.F90
phys_dmn/acdrov.F90
phys_dmn/acsol.F90
phys_dmn/initaplar.F90
phys_dmn/mf_phys.F90
phys_dmn/aplar.F90

```

In all those routines the field PCT (the total thermal inertial coefficient) is replaced by PCG (the bare ground thermal inertial coefficient)

The namelist also has been changed:

(&NAMPHY1 GNEIMX=1., GNEIMXS=1., GCGEL=3.E-4, GCGELS=3.E-4)

The script for running that modification of the operational aladin (hereafter referred as oper_mod3) is on

tori: ~/mrpa657/previ/e001/aldfra2/scre001_oper2_mod3

With the new executable, which should be as close to (aladin + surfex) as possible, we have performed 12- and 24-hour forecasts and have compared the results with the forecasts from the operational aladin. The results are presented in Appendix2, where the differences between operational aladin (oper) and (oper_mod3) for (T2m,HU2m,U10m,V10m) have been plotted. It is seen that:

- in the field of T2m the differences (oper – oper_mod3) are smaller than the differences (oper – sfx9) and vary in the interval (-2.5, 2.7) for 12-hour forecast and in (-1.7, 3.7) for 24 hour forecast. The area with the well pronounced differences is bigger than those described in Section I and presented in Appendix1.
- The fields for Hu2m of both models almost coincide except over some small area over the Alps.
- The differences for the fields U10m and V10m are also smaller than those obtained in the previous section

For that modification of the operational model we have plotted the differences between the 24-hour forecasts (oper – oper_mod3) for the surface fields (deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU).

The results of the comparison are presented in Appendix3. It is seen that the differences for:

- PRGL are mainly over the central and NE part of the domain and over the Alps
- SRGL are over central part of the domain and over the mountainous regions

- SRNG are spotted in small areas
- PREAU are over the Alps
- SREAU are over central part of the domain and the distribution is similar to that of the SRGL

The further investigation of the differences between the operational aladin (oper) and modified aladin (oper_mod3) included visualization of the 24-hour increments for both models. The results are presented in Appenix4 (oper) and Appendix5 (oper_mod3). It is seen that the differences between the increments for PRGL, SRGL and SREAU are significant from the point of view of the areas and minimal and maximal values (the scale of the plots of the differences is not the same since it is defined by the min and max value of the field)

Non-the-less we tried to simulate the results from (aladin + surfex) model, changing the settings in the operational model itself, we could not answer the question about the source of the difference between the operational aladin and the (aladin + surfex). For that reason we plotted the initial surface fields for both models. The plots of the initial fields for operational aladin (oper) are presented on Appendix6, while those for (aladin + surfex) are presented in Appendix7. It is obvious that the main difference is in the field of PRGL. That is why it is necessary to perform further investigation of the initial fields when using ALADIN fields as input fields for SURFEX.

Section III Conclusions and plans for the future work

To perform further experiments with initial fields for SURFEX taken from ALADIN it is necessary to re-investigate the way of preparation of the input surface fields.

ACKNOLEDGMENT

We would like to thank Eric Bazile for his helpful discussion of the results obtained in this work.

REFERENCES

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Bazile E. (1999) : The soil water freezing in ISBA. HIRLAM Newsletter No. 33, May, 1999, pp.92-95

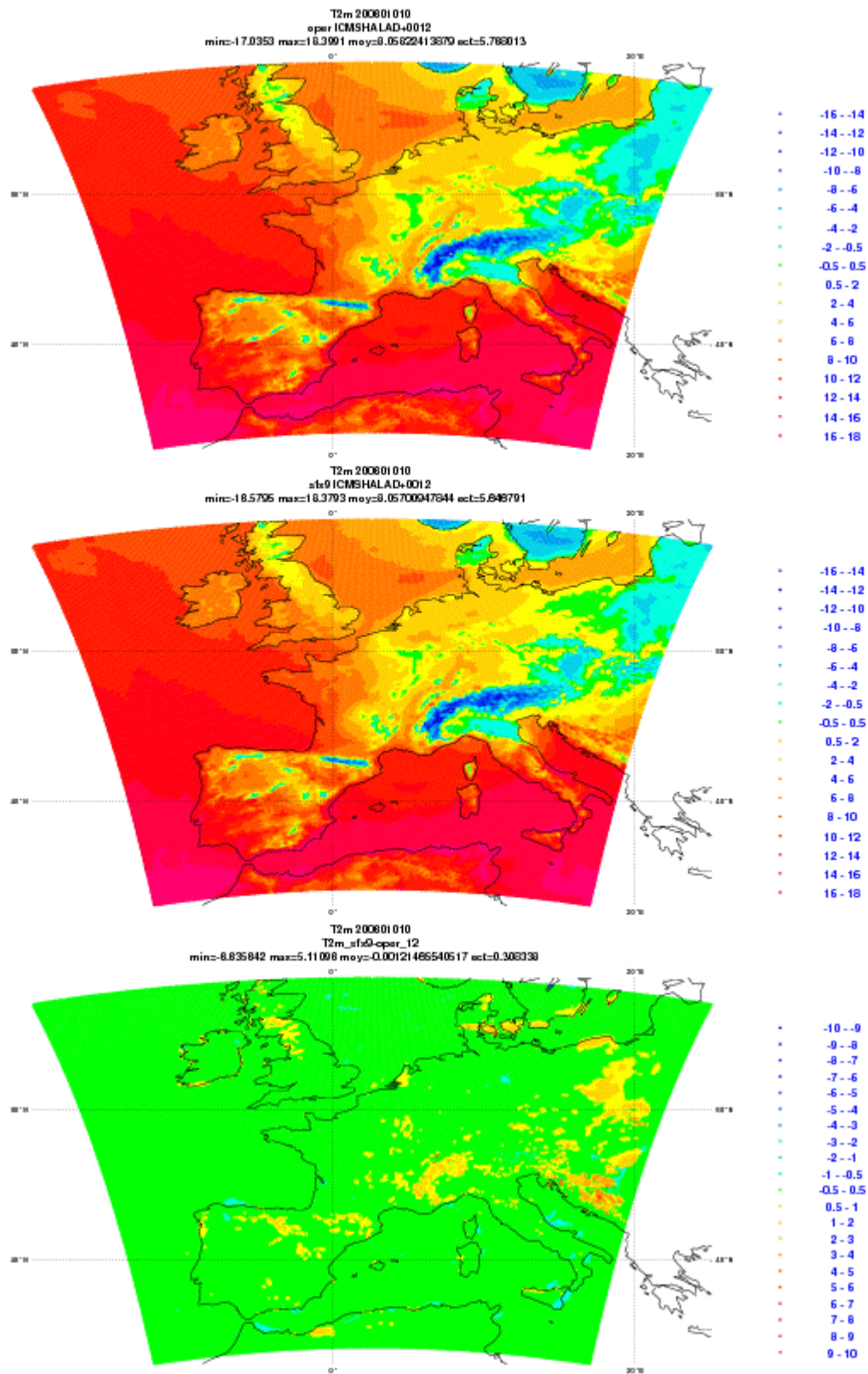
Meso-NH Masdev4.7β January 2008. Part II. Model Setup. 5.4 Soil and Vegetation. pp.58 – 71

Appendix 1

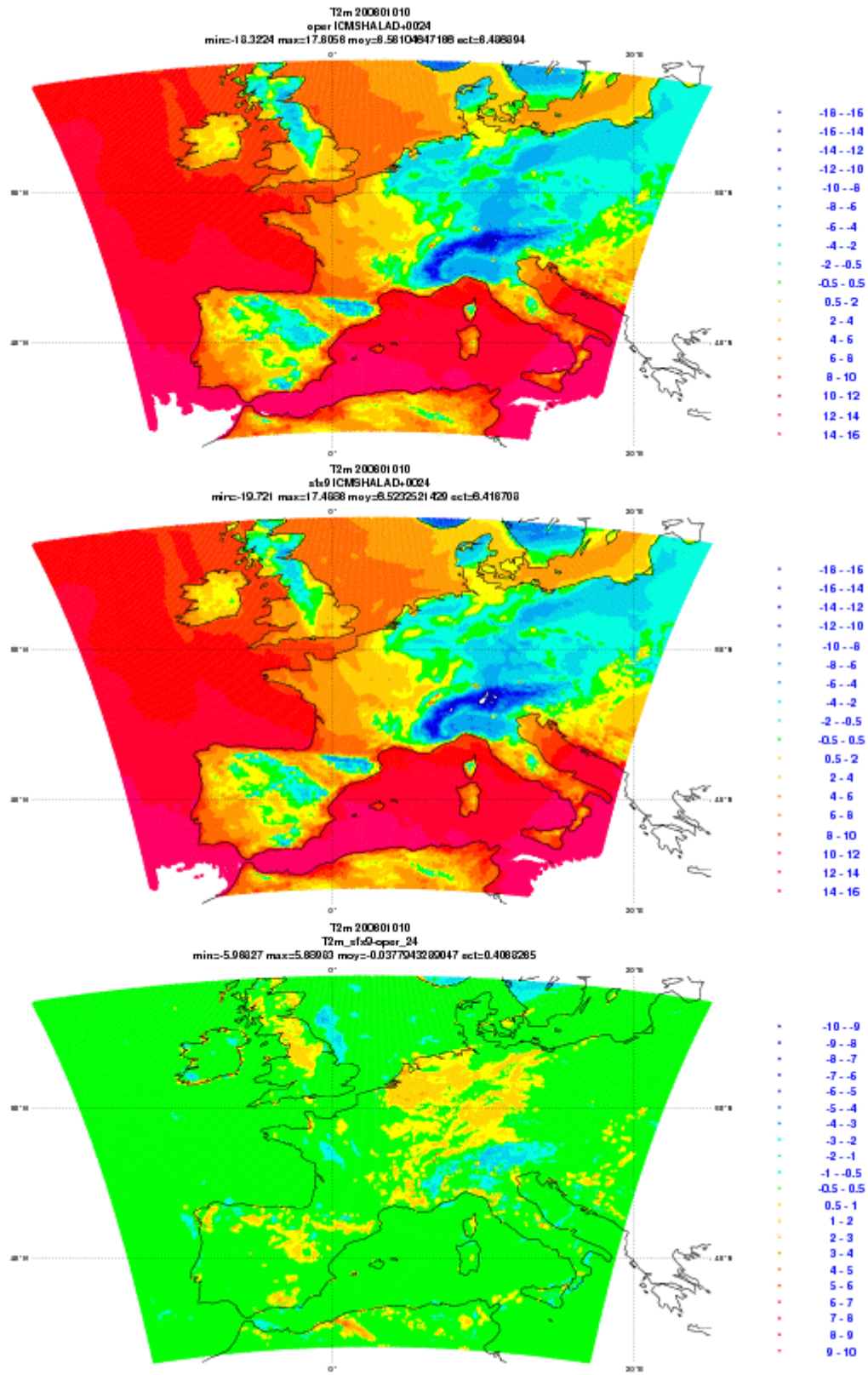
Plots of the 12- and 24-hour forecasts from aladin and (aladin + surfex) , as well as of the differences $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{12}$ and $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{24}$ for T2m, Hu2m, U10m, V10m

For each element the plots consist of:

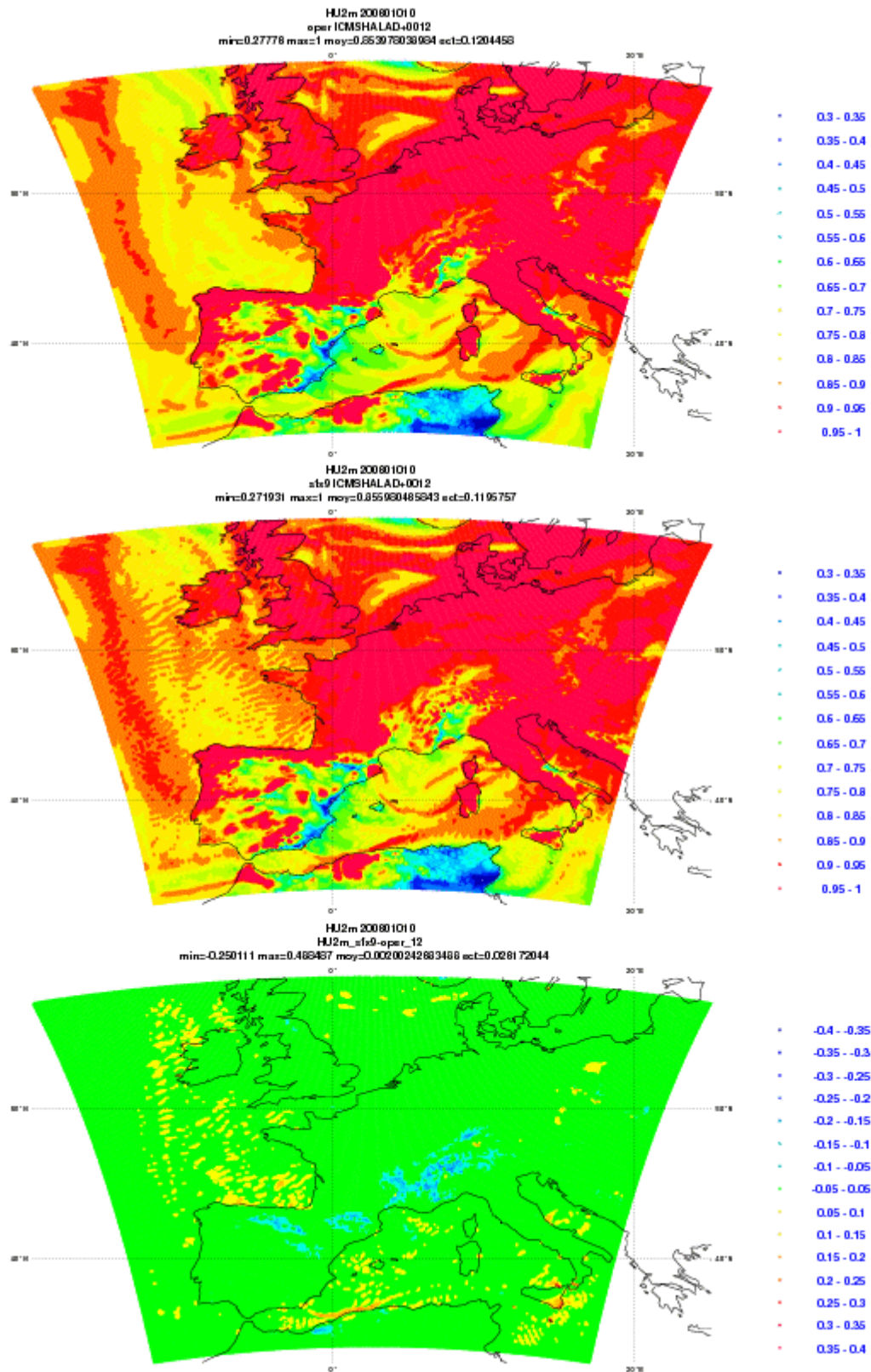
- 12-hour forecasts from operational aladin (oper)
- 12-hour forecasts from (aladin + surfex) (sfx9)
- the difference $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{12}$ between 12-hour forecasts from operational aladin and (aladin + surfex) (sfx9-oper)
- 24 -hour forecasts from operational aladin (oper)
- 24 -hour forecasts from (aladin + surfex) (sfx9)
- the difference $[(\text{aladin} + \text{surfex}) - \text{aladin}]_{24}$ between 24-hour forecasts from operational aladin and (aladin + surfex) (sfx9-oper)



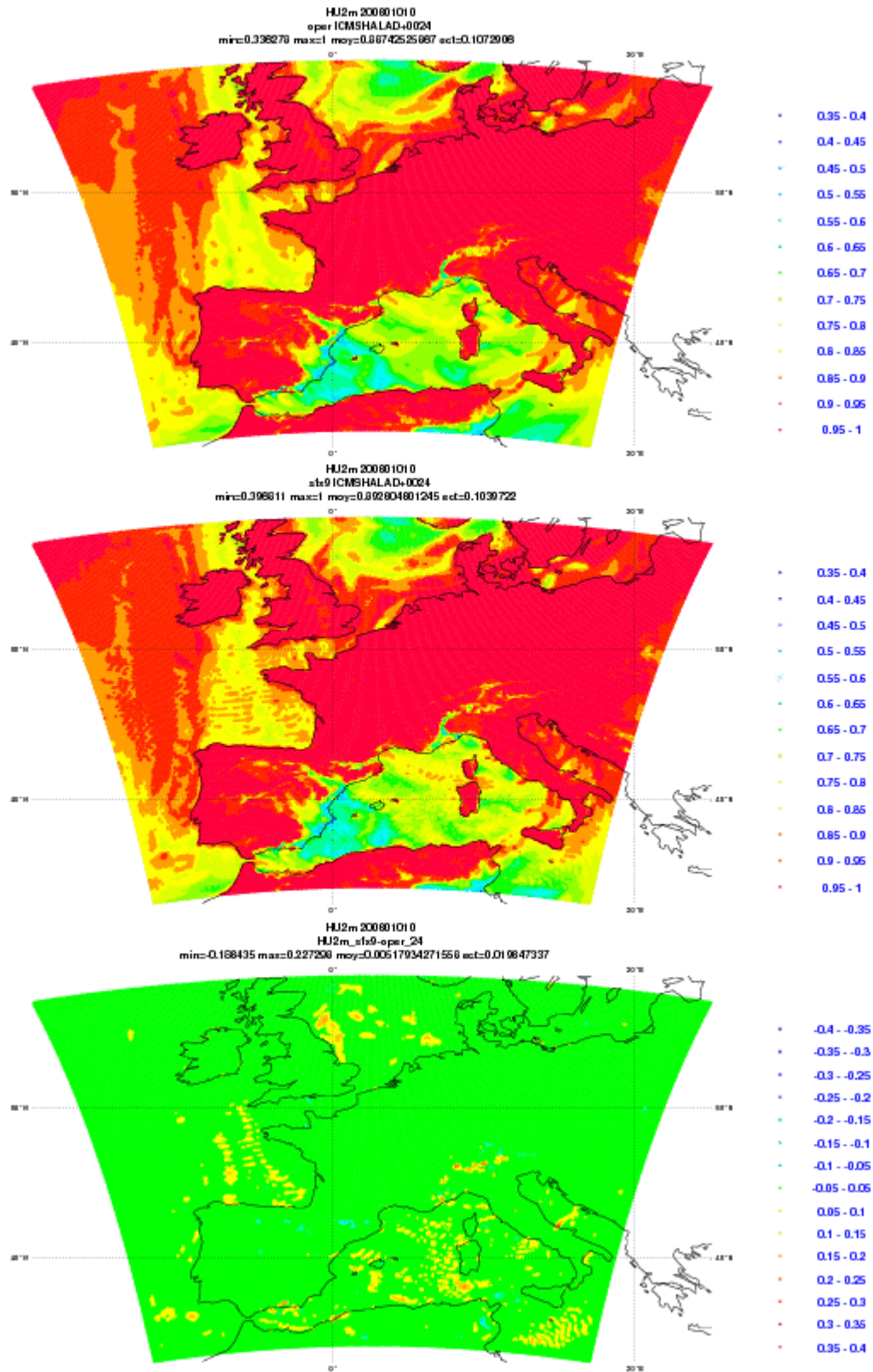
Plots of the differences between 12-hour forecasts from operational aladin and (aladin+surfex) for T2m



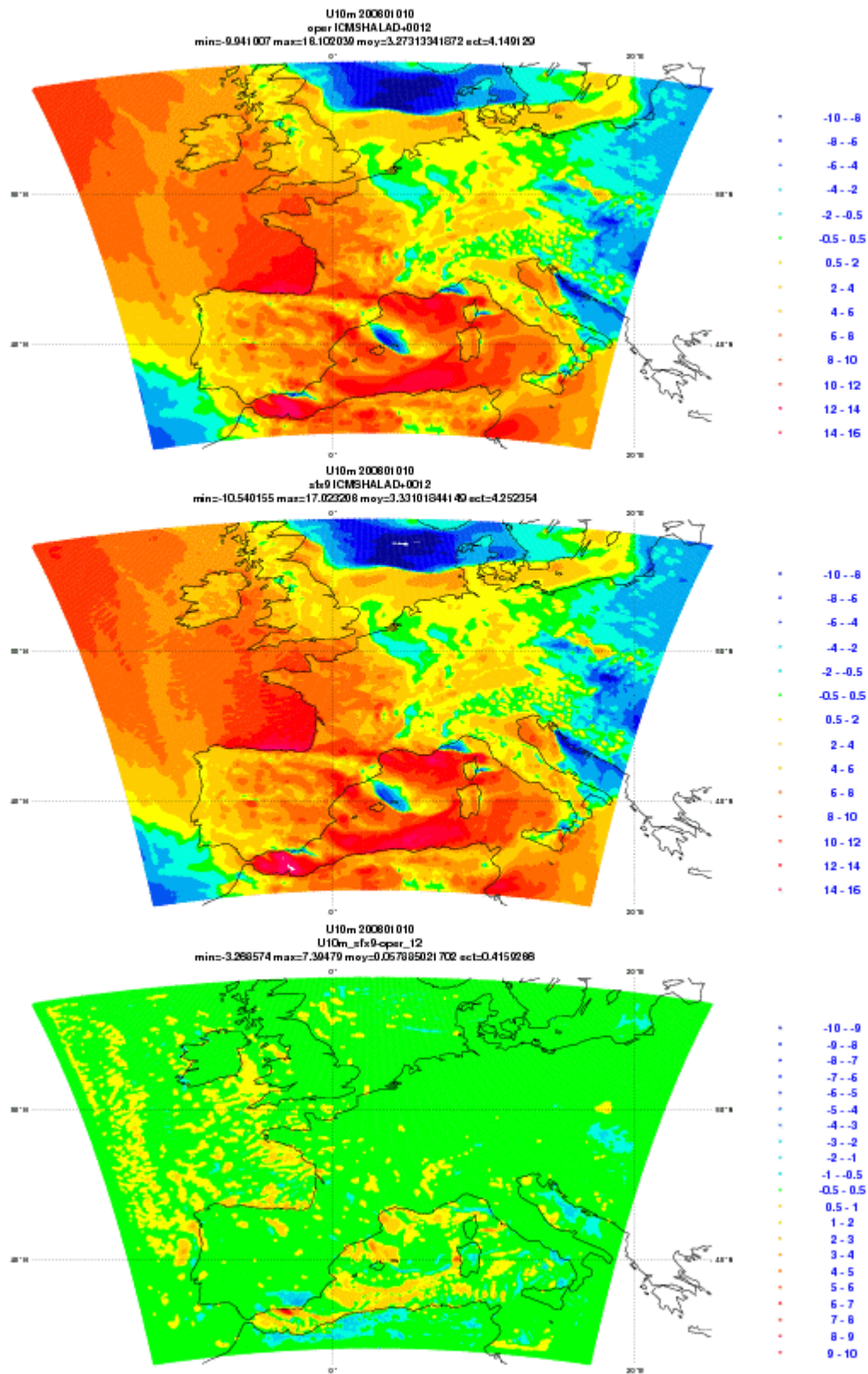
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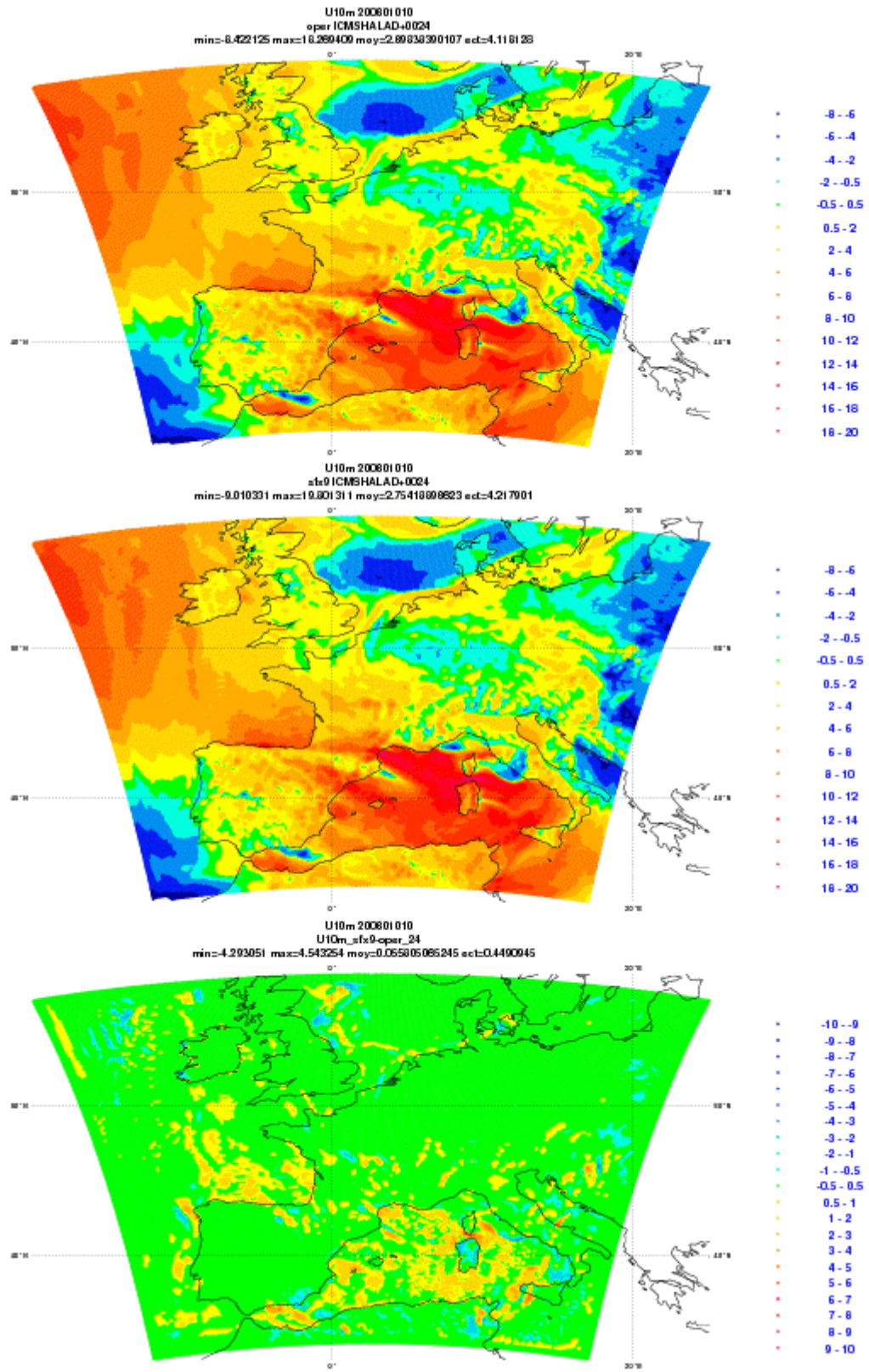
Plots of the differences between 12-hour forecasts from operational aladin and (aladin+surfex) for Hu2m



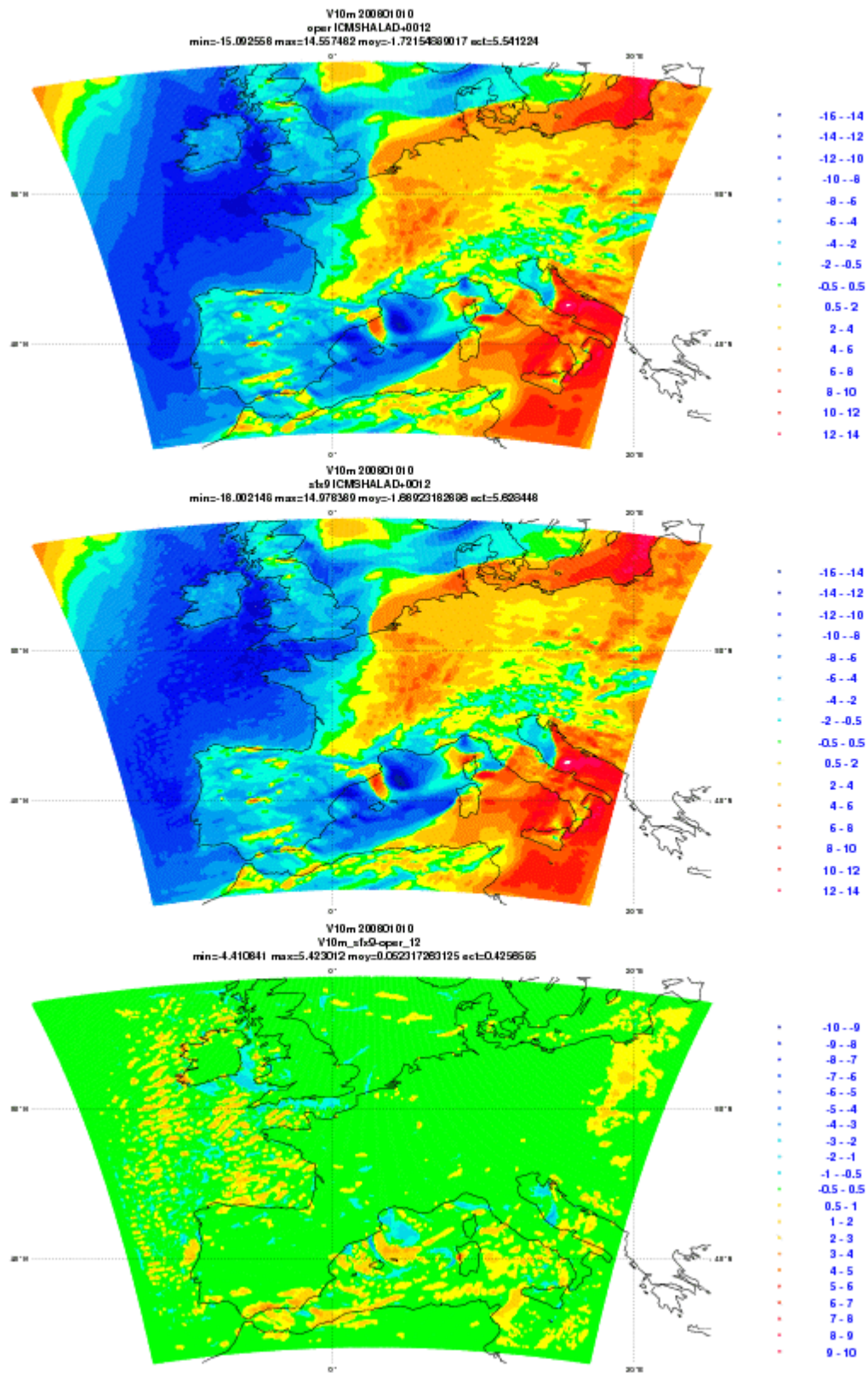
Plots of the differences between 24-hour forecasts from operational aladin and (aladin+surfex) for Hu2m



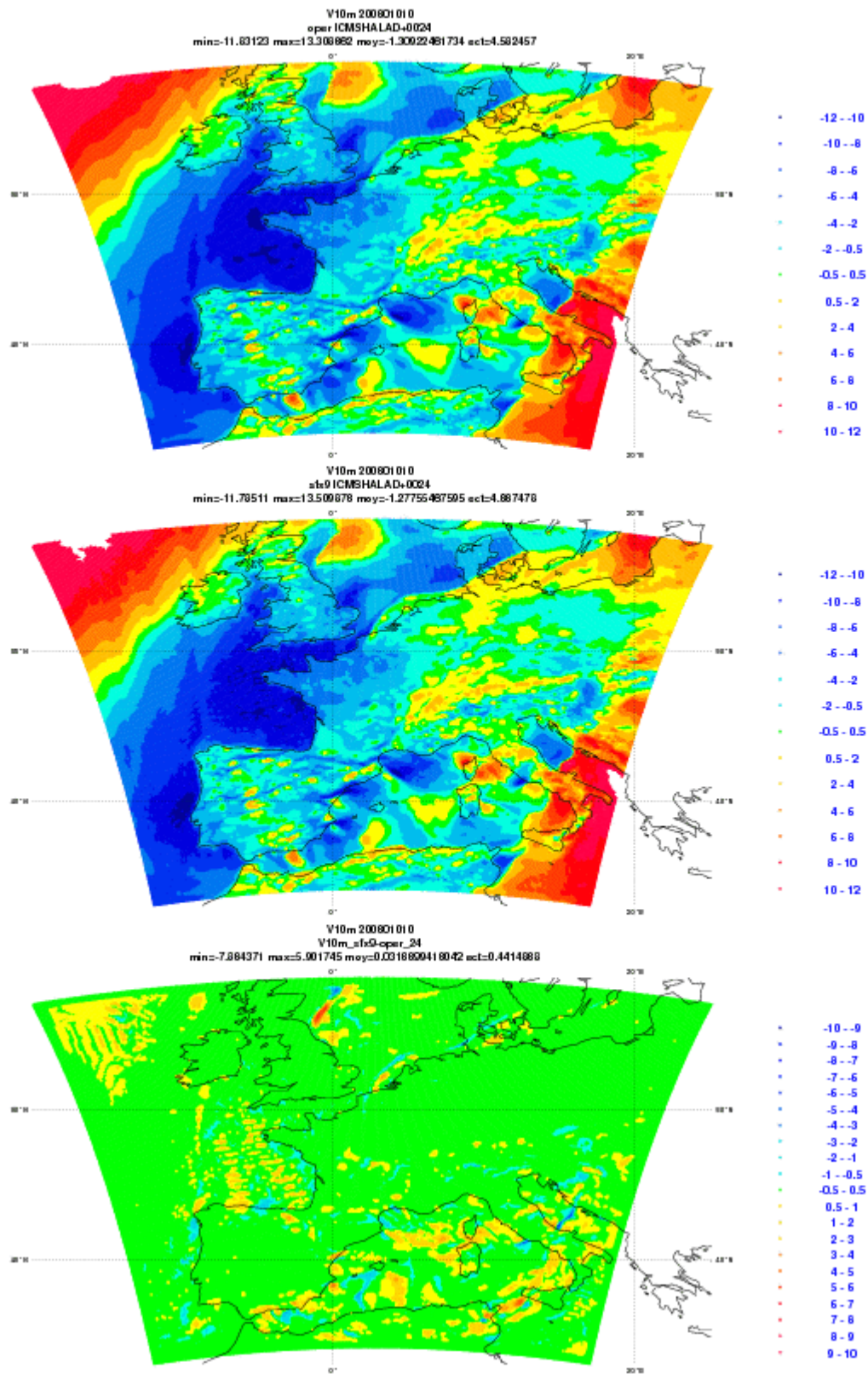
Plots of the differences between 12-hour forecasts from operational aladin and (aladin+surfex) for U10m



Plots of the differences between 24-hour forecasts from operational aladin and (aladin+surfex) for U10m



Plots of the differences between 12-hour forecasts from operational aladin and (aladin+surfex) for V10m



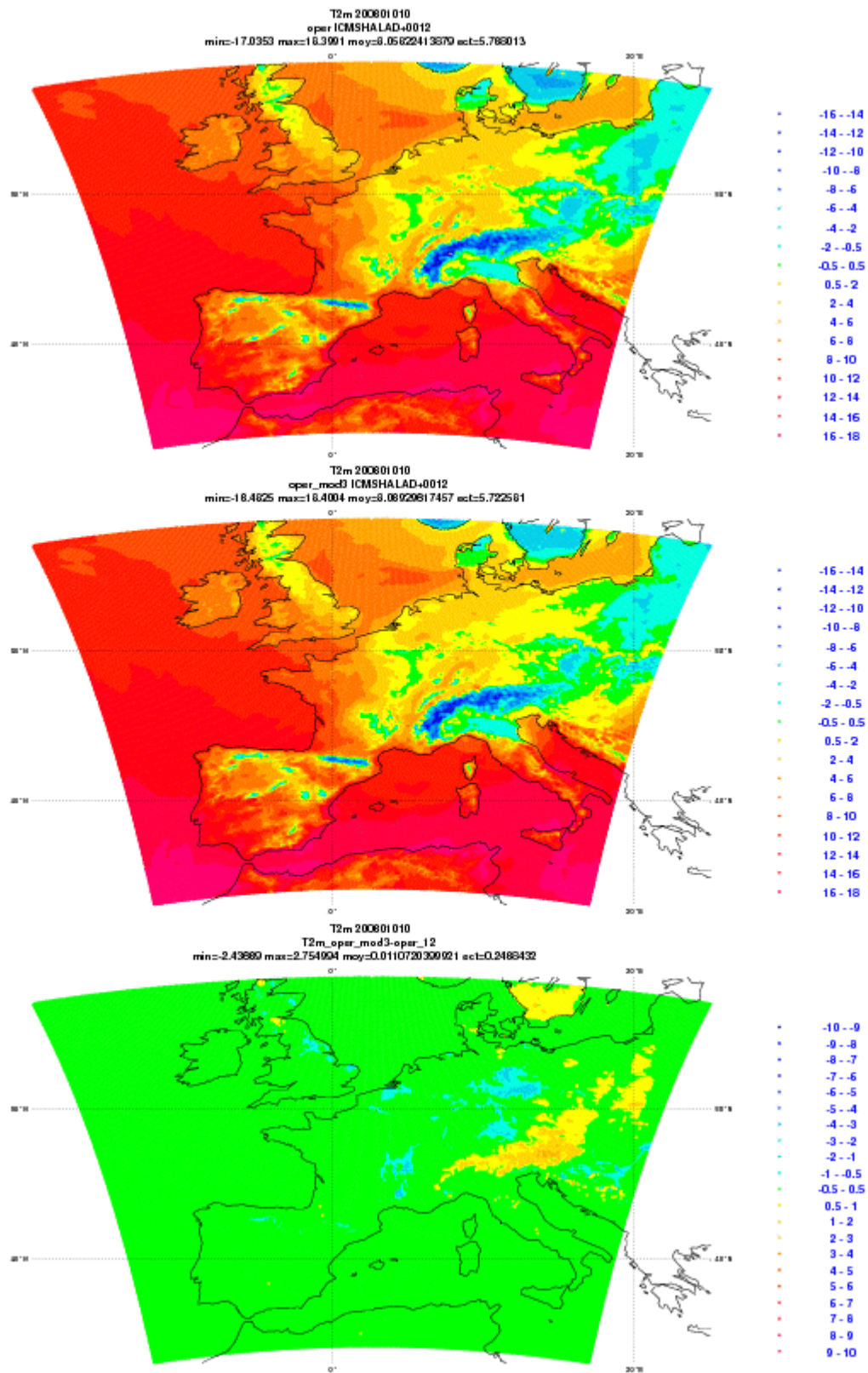
Plots of the differences between 24-hour forecasts from operational aladin and (aladin+surfex) for V10m

Appendix2

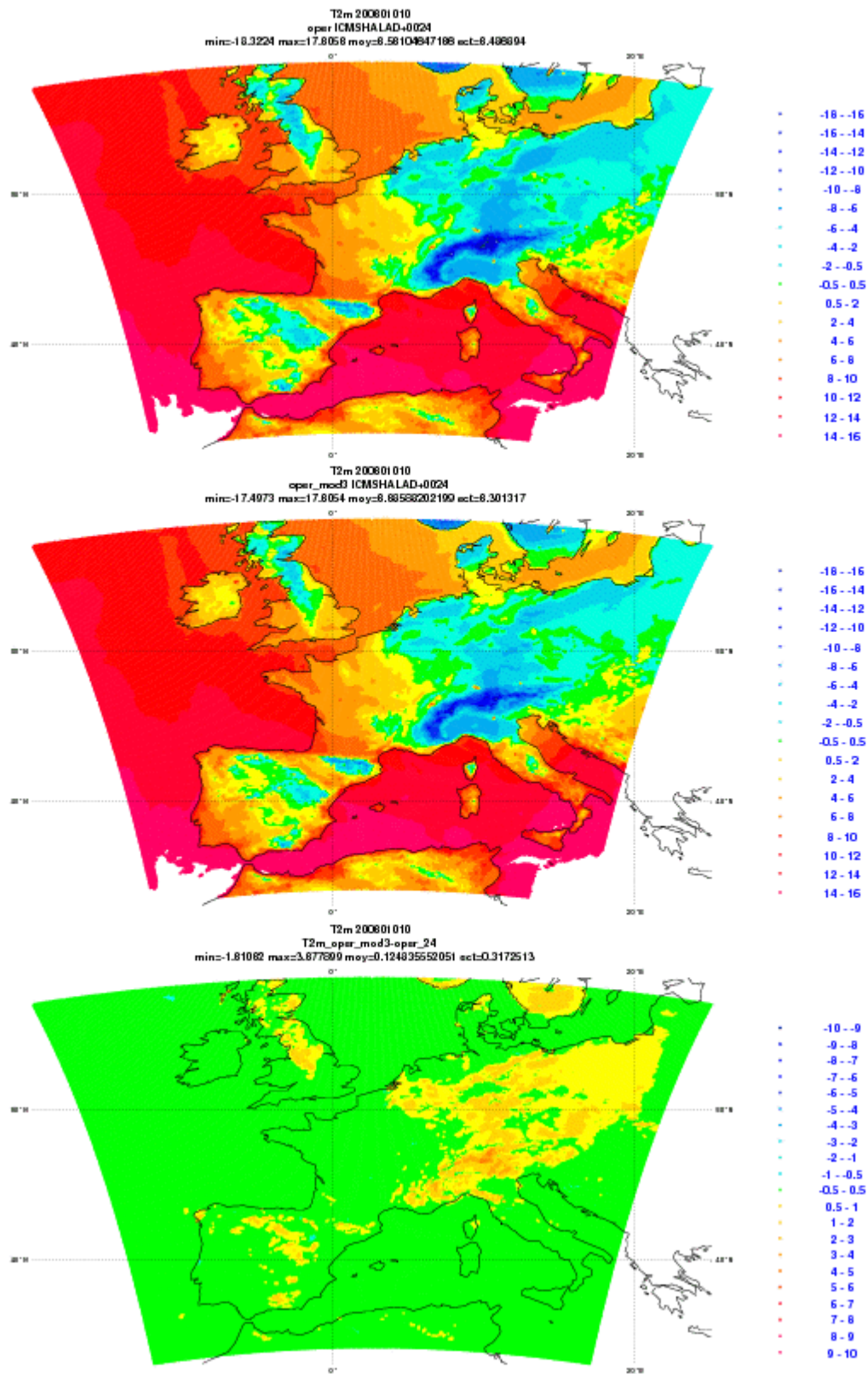
Plots of the differences between the 12- and 24-hour forecasts from operational aladin (oper) and modified aladin (oper_mod3) for T2m, Hu2m, U10m,V10m

For each element the plots consist of:

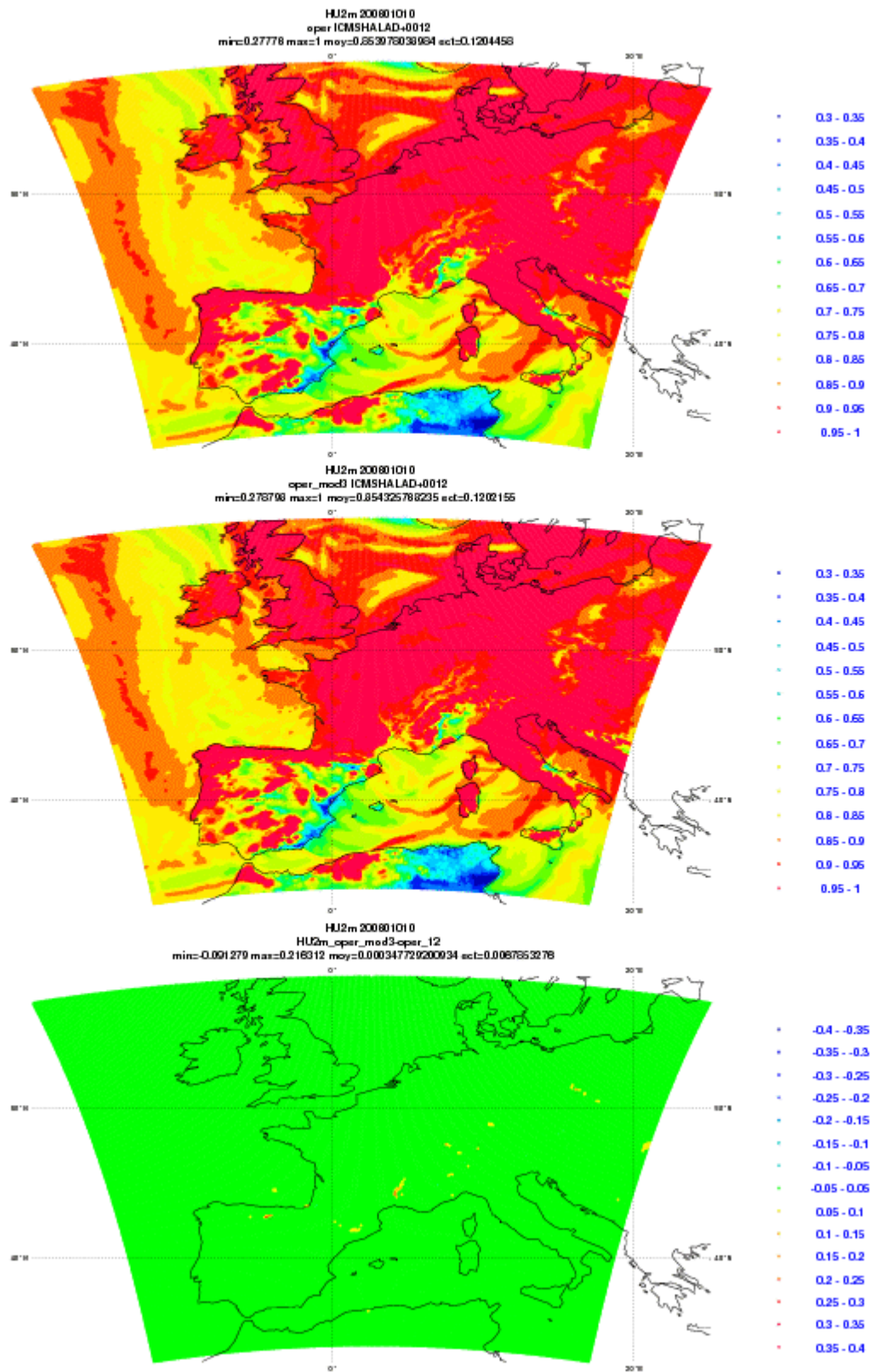
- 12-hour forecasts from operational aladin (oper)
- 12-hour forecasts from modified aladin (oper_mod3)
- the difference (oper_mod3 – oper)_12 between 12-hour forecasts from operational aladin and modified aladin (oper_mod3-oper)
- 24 -hour forecasts from operational aladin (oper)
- 24 -hour forecasts from modified aladin (oper_mod3)
- the difference (oper_mod3 – oper)_24 between 24-hour forecasts from operational aladin and modified aladin (oper_mod3 -oper)



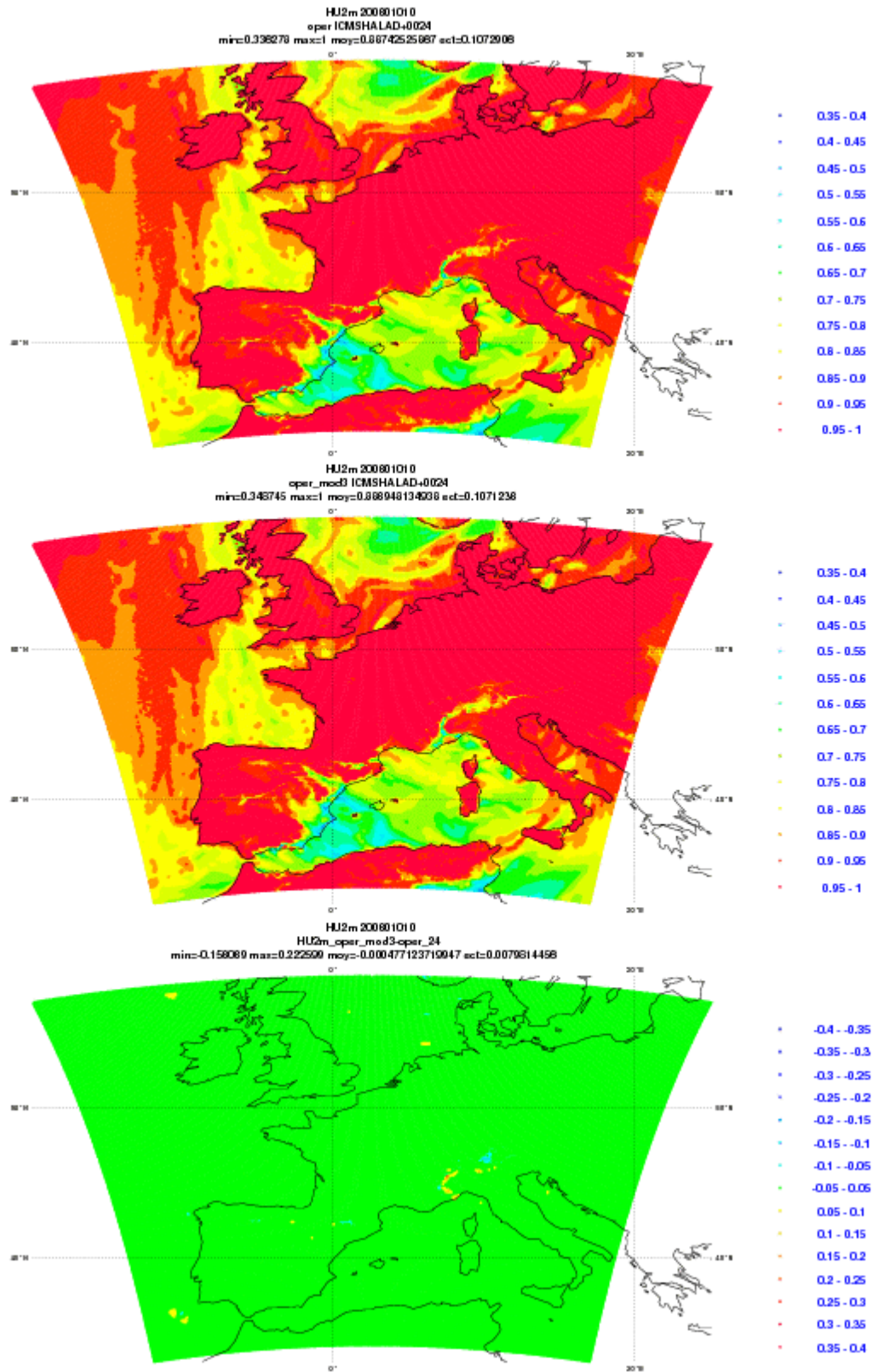
Plots of the differences between 12-hour forecasts from (oper) and (oper_mod3) for T2m



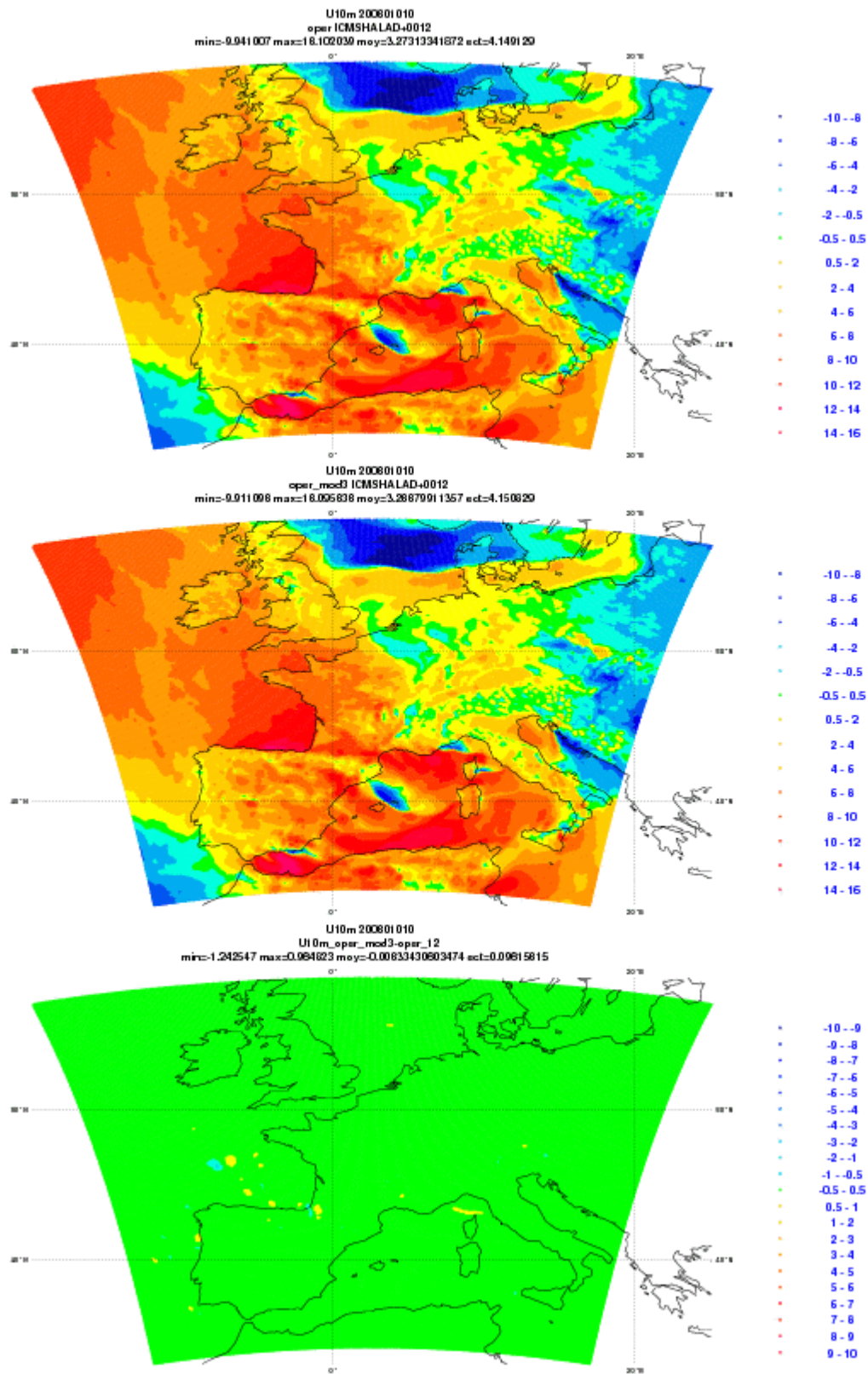
Plots of the differences between 24-hour forecasts from (oper) and (oper_mod3) for T2m



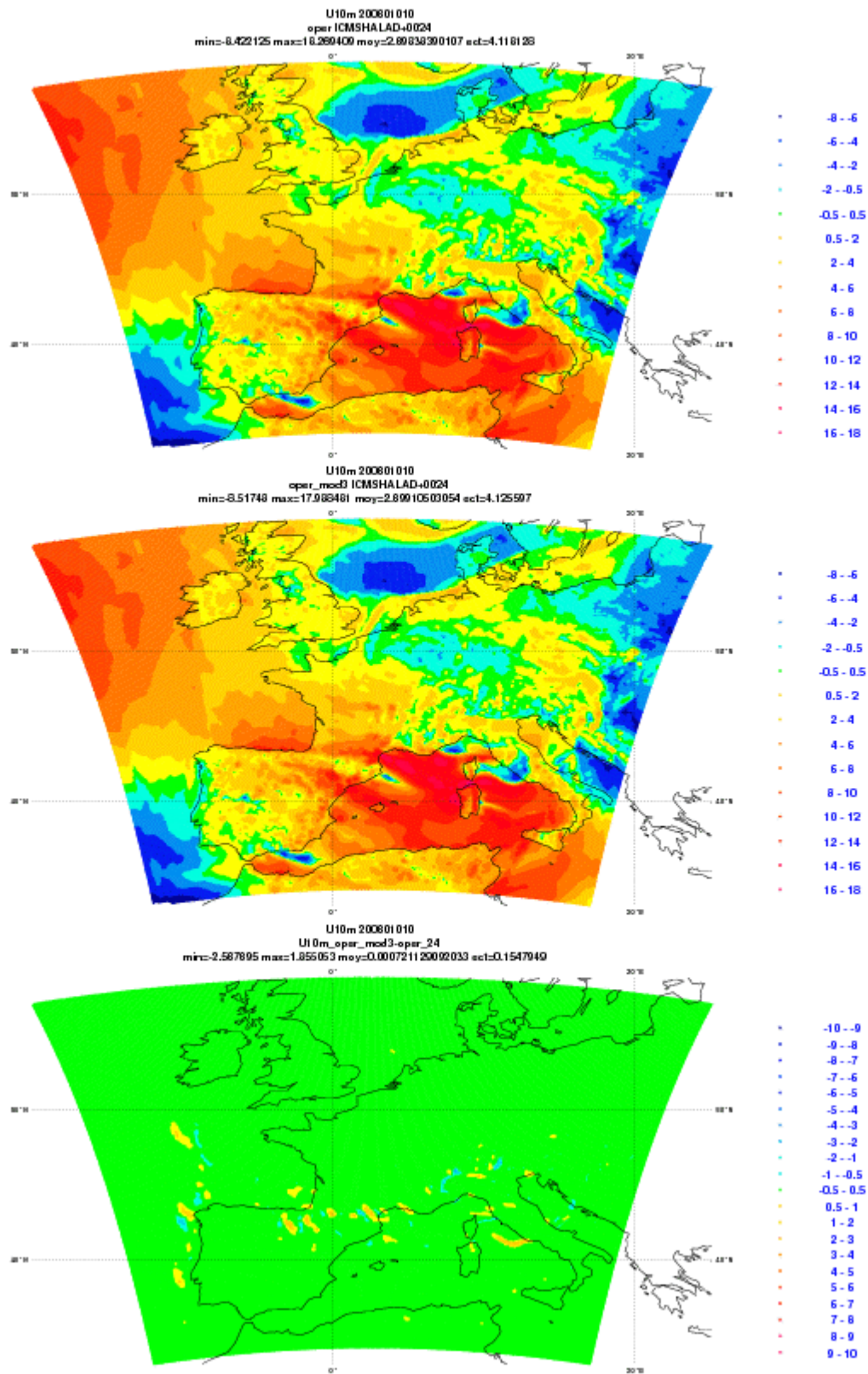
Plots of the differences between 12-hour forecasts from (oper) and (oper_mod3) for Hu2m



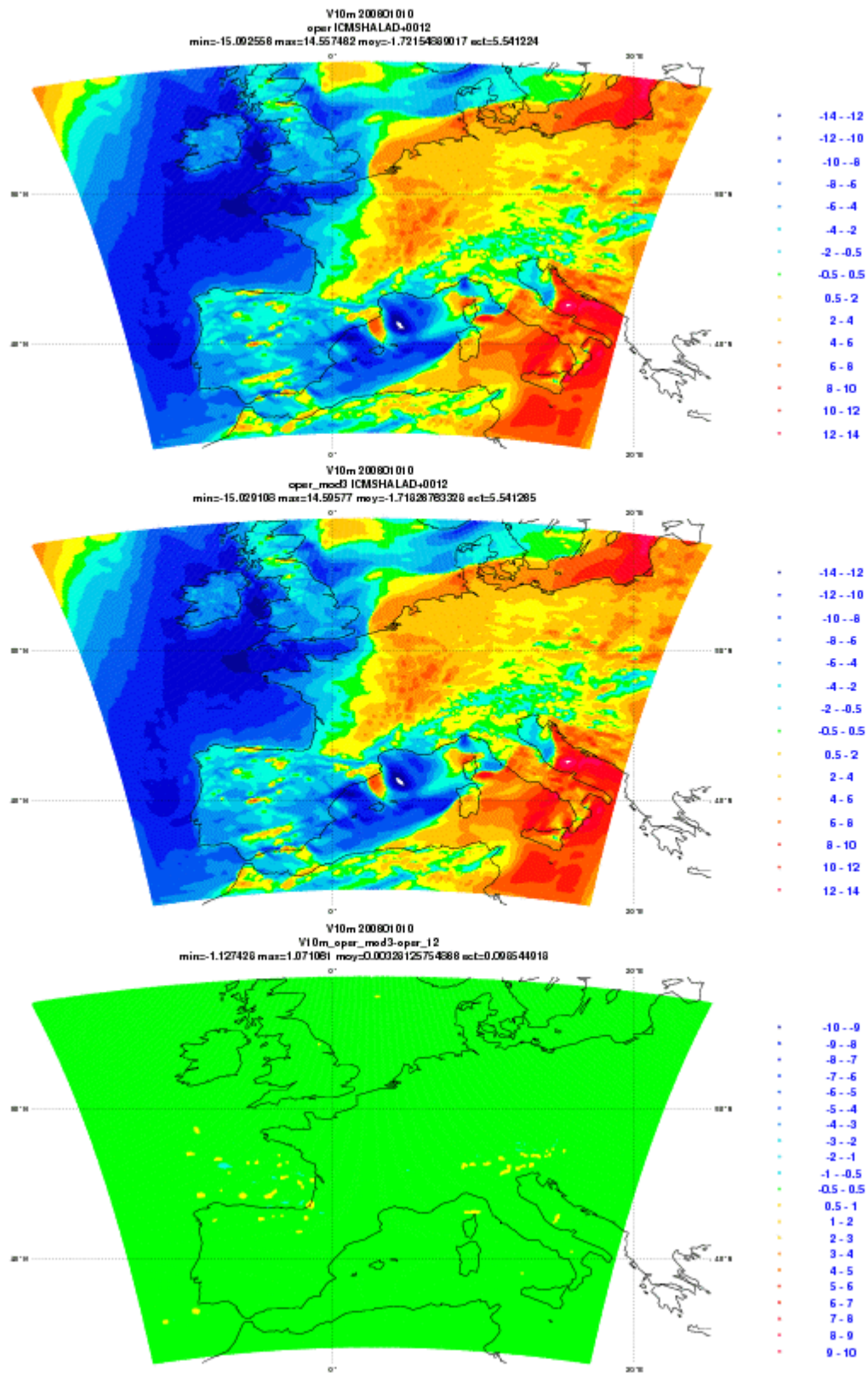
Plots of the differences between 24-hour forecasts from (oper) and (oper_mod3) for Hu2m



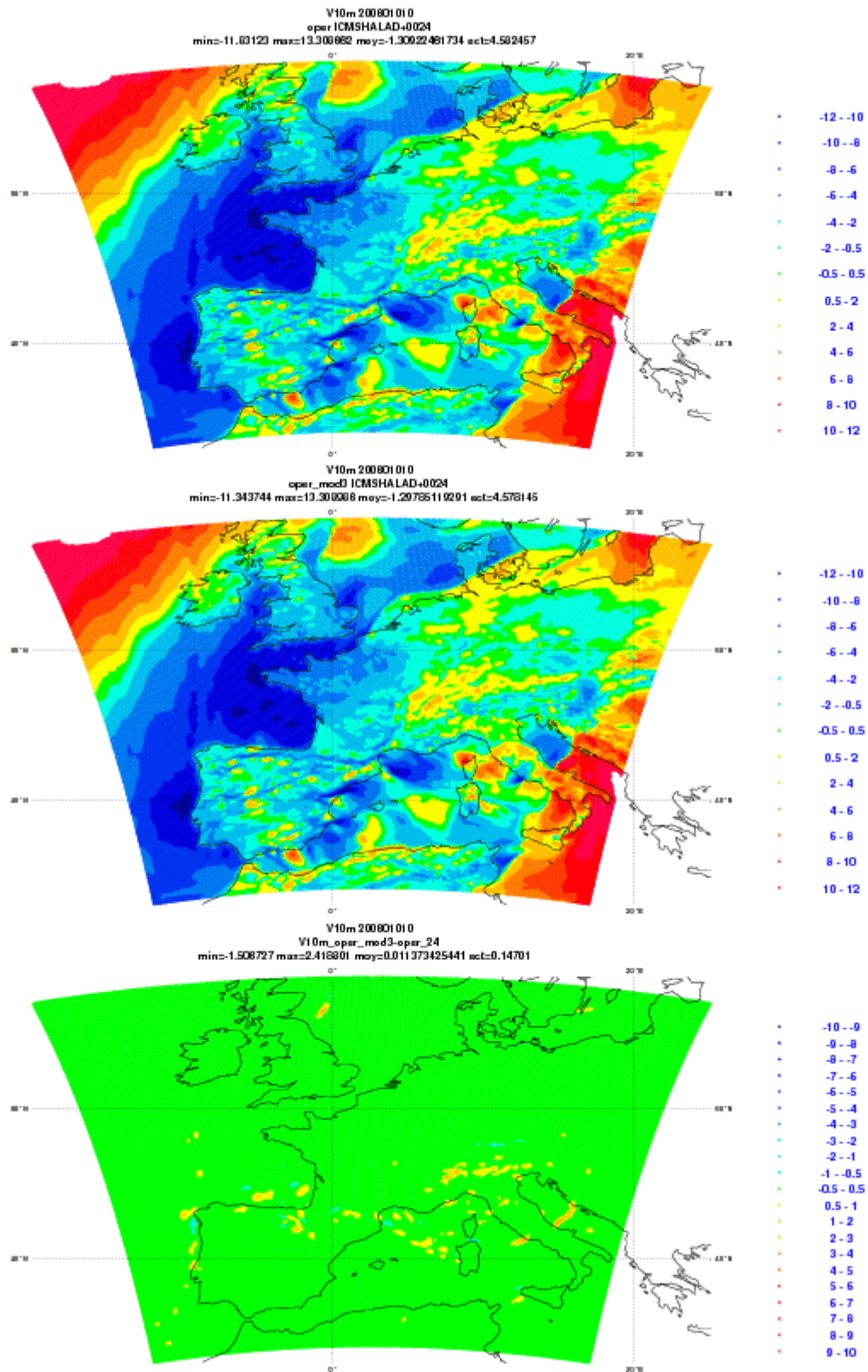
Plots of the differences between 12-hour forecasts from (oper) and (oper_mod3) for U10m



Plots of the differences between 24-hour forecasts from (oper) and (oper_mod3) for U10m



Plots of the differences between 12-hour forecasts from (oper) and (oper_mod3) for V10m



Plots of the differences between 24-hour forecasts from (oper) and (oper_mod3) for V10m

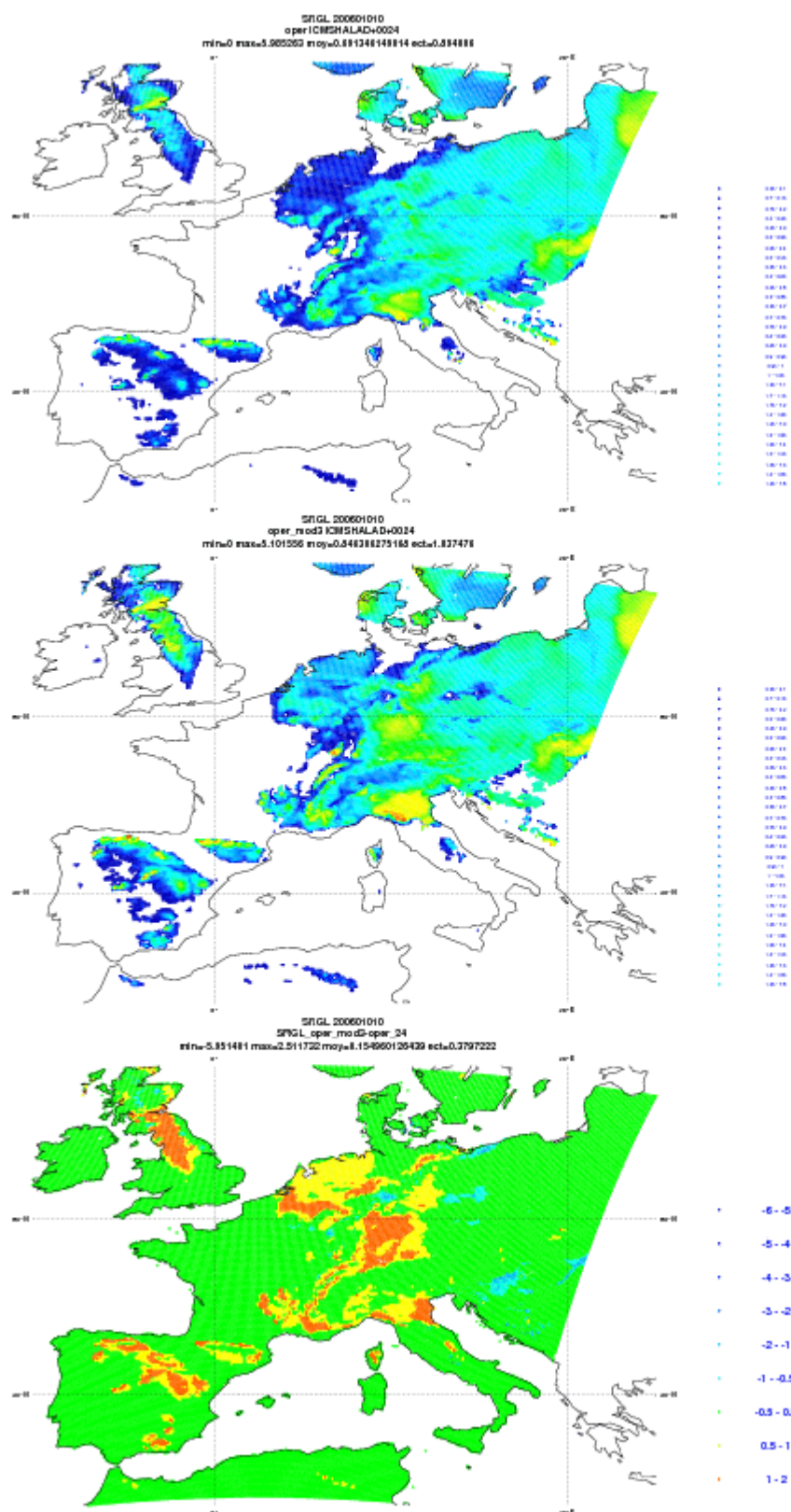
Appendix3

Plots of the differences between the 24-hour forecasts from operational aladin (oper) and modified aladin (oper_mod3) for surface fields (deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU)

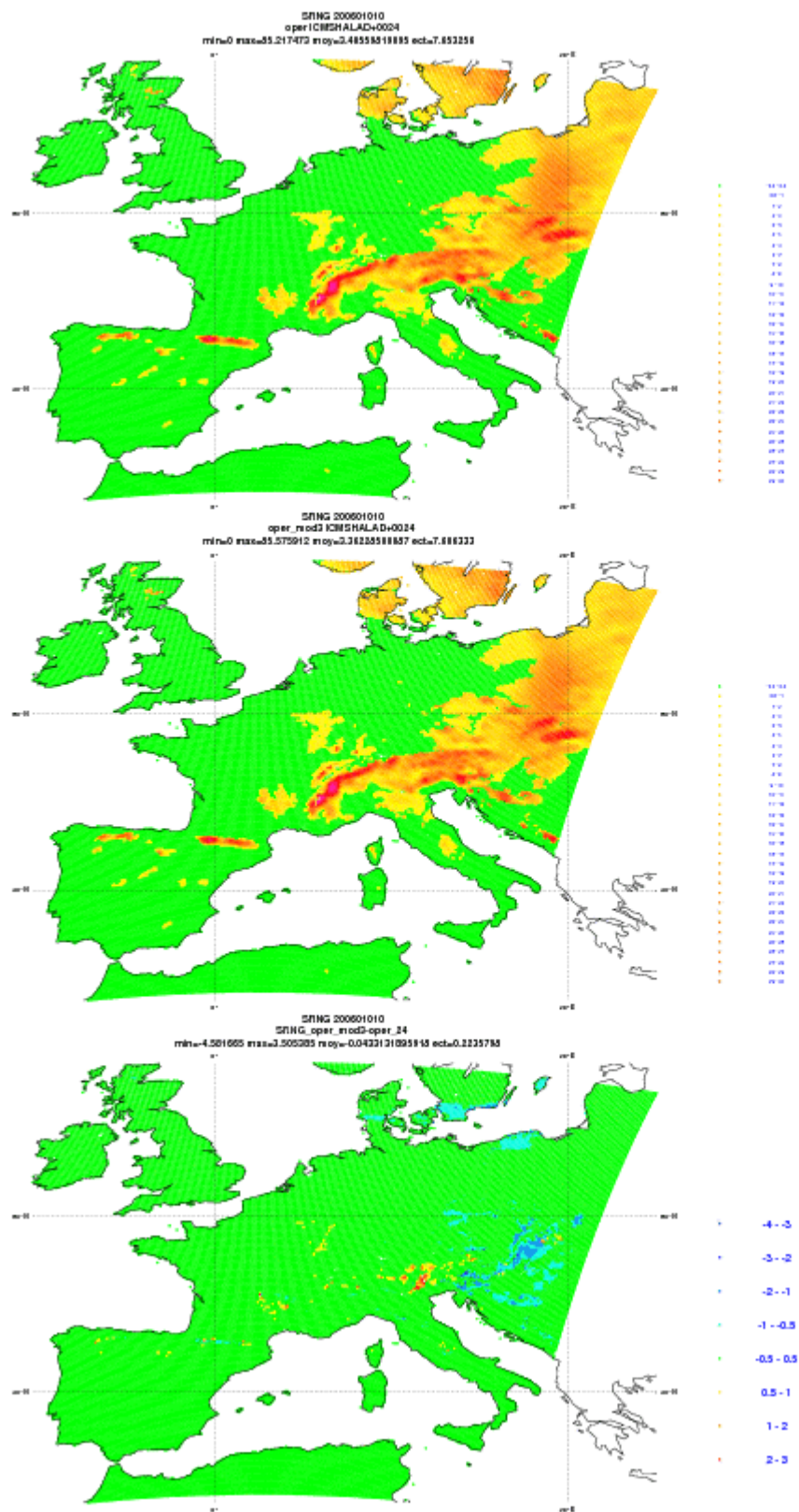
PRGL => PROFRESERV.GLACE,
SRGL => SURFRESERV.CLACE,
SRNG => SURFRESERV.NEIGE,
PREAU => PROFRESERV.EAU,
SREAU => SURFRESERV.EAU

For each element the plots consist of:

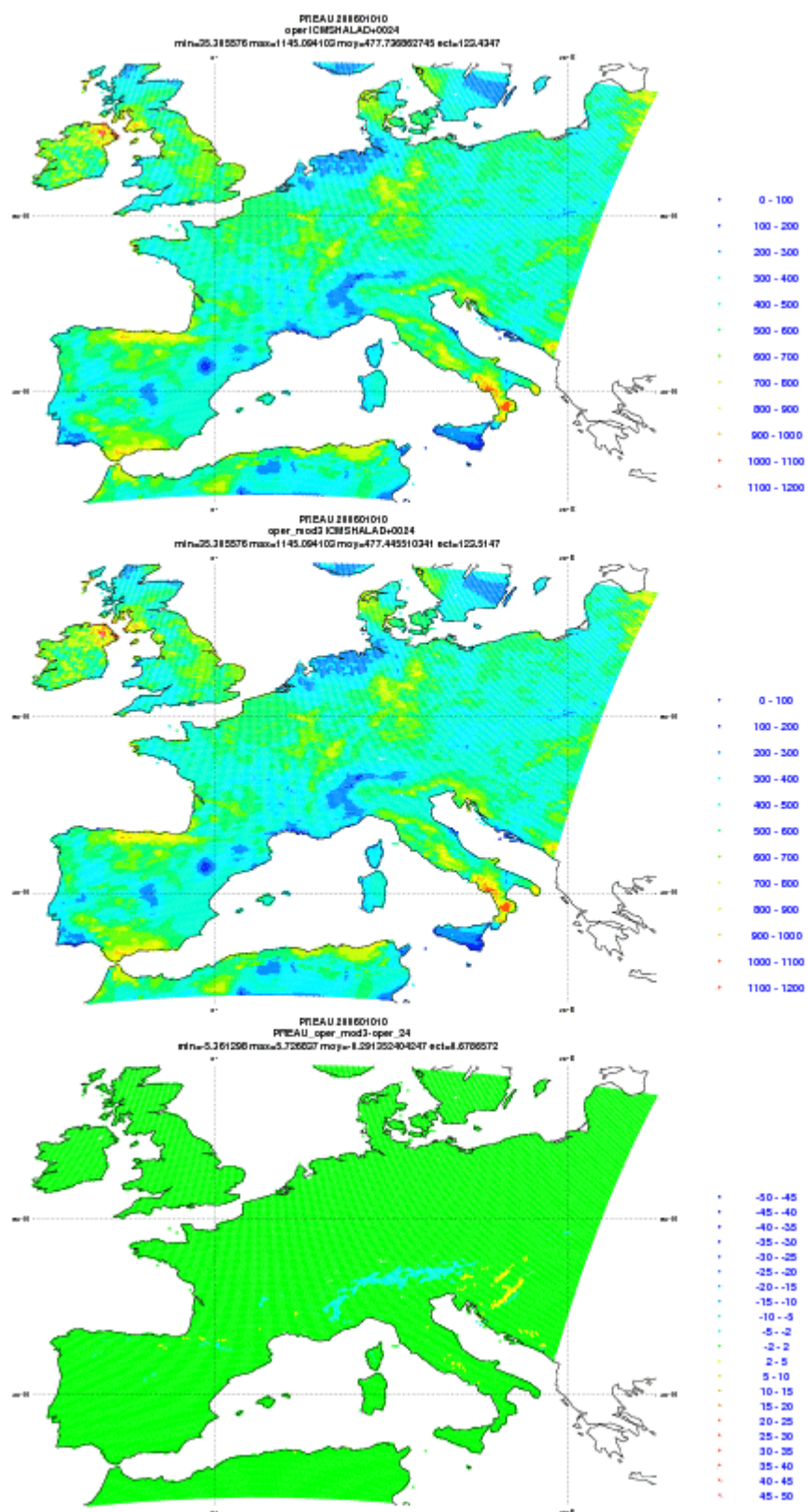
- 24 -hour forecasts from operational aladin (oper)
- 24 -hour forecasts from modified aladin (oper_mod3)
- the difference (oper_mod3 – oper)_24 between 24-hour forecasts from operational aladin and modified aladin (oper_mod3 -oper)



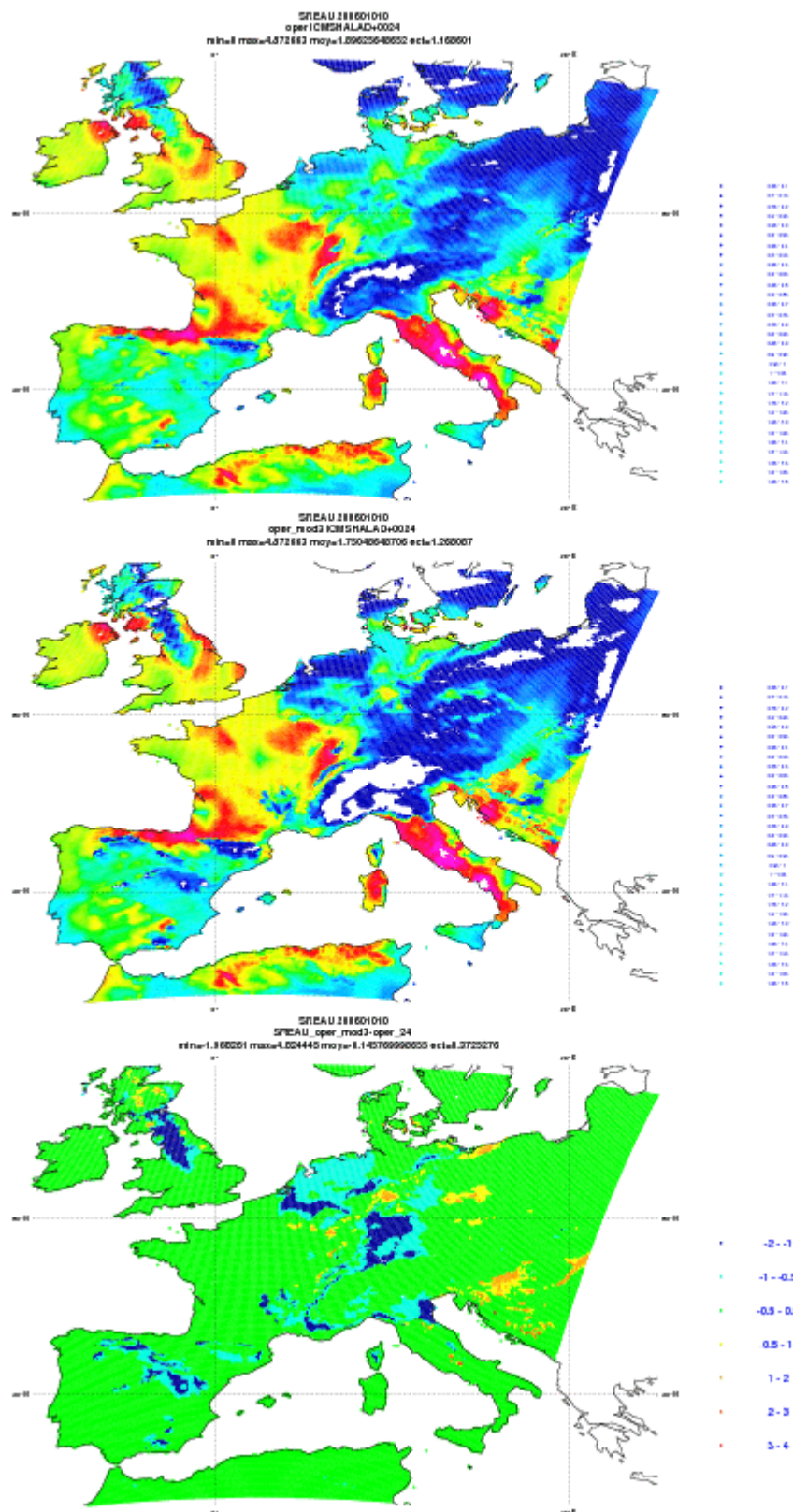
Plots of the differences between the 24-hour forecasts from (oper) and (oper_mod3) for SRGL



Plots of the differences between the 24-hour forecasts from (oper) and (oper_mod3) for SRNG



Plots of the differences between the 24-hour forecasts from (oper) and (oper_mod3) for PREAU

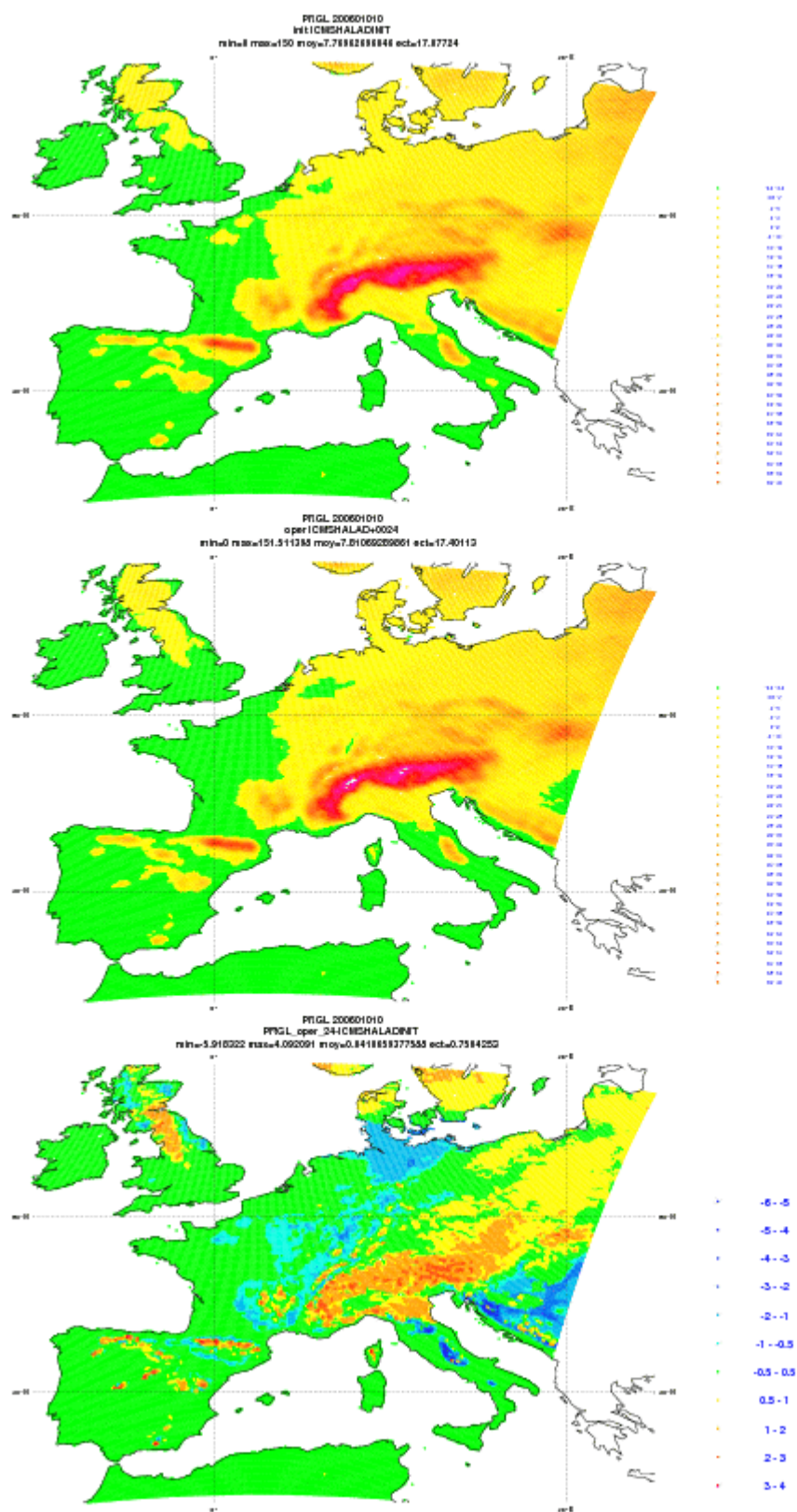


Plots of the differences between the 24-hour forecasts from (oper) and (oper_mod3) for SREA

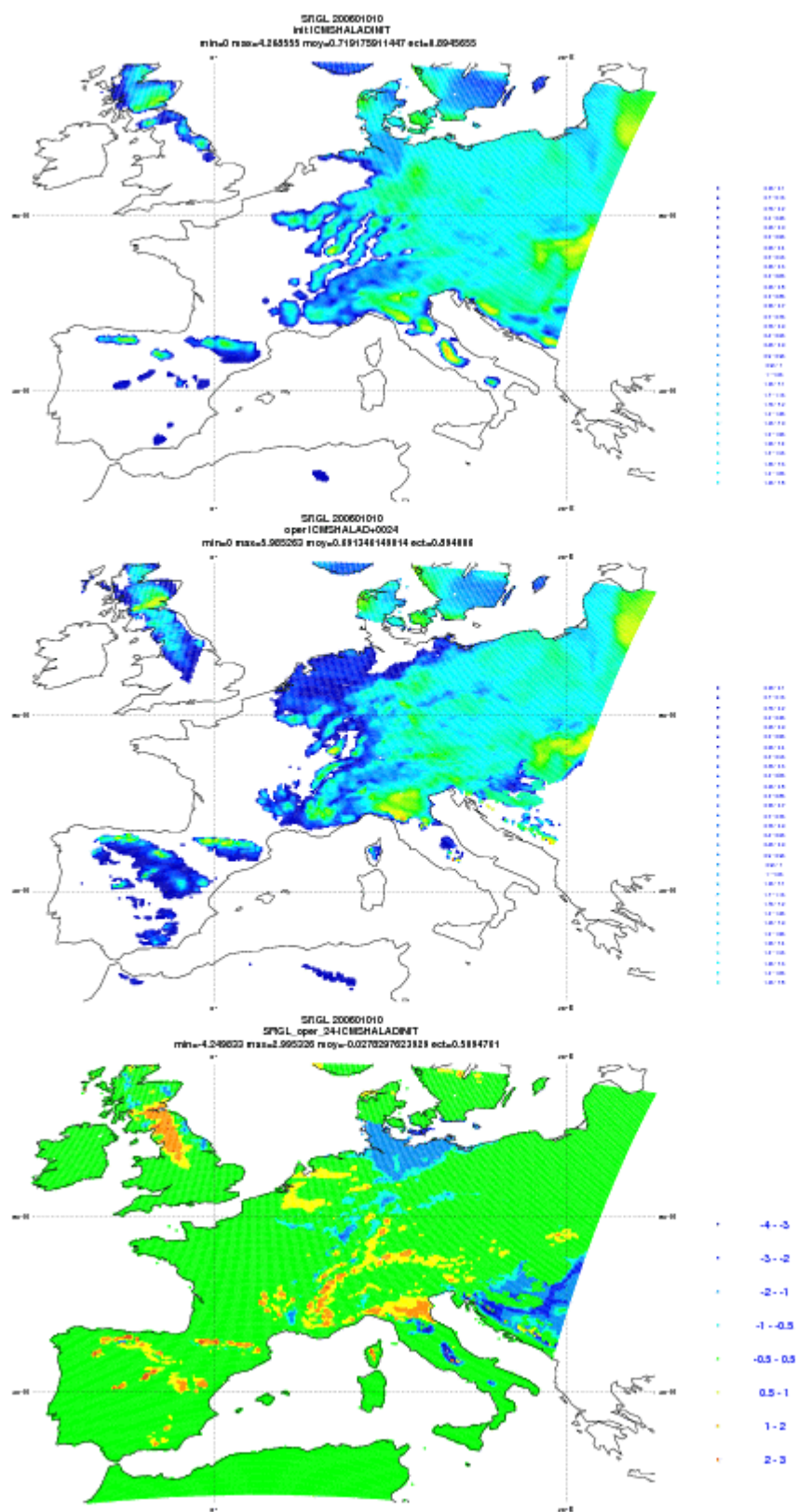
Appendix4

Plots of the 24-hour increments of the operational aladin (oper) for the surface fields
(deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth
SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU)

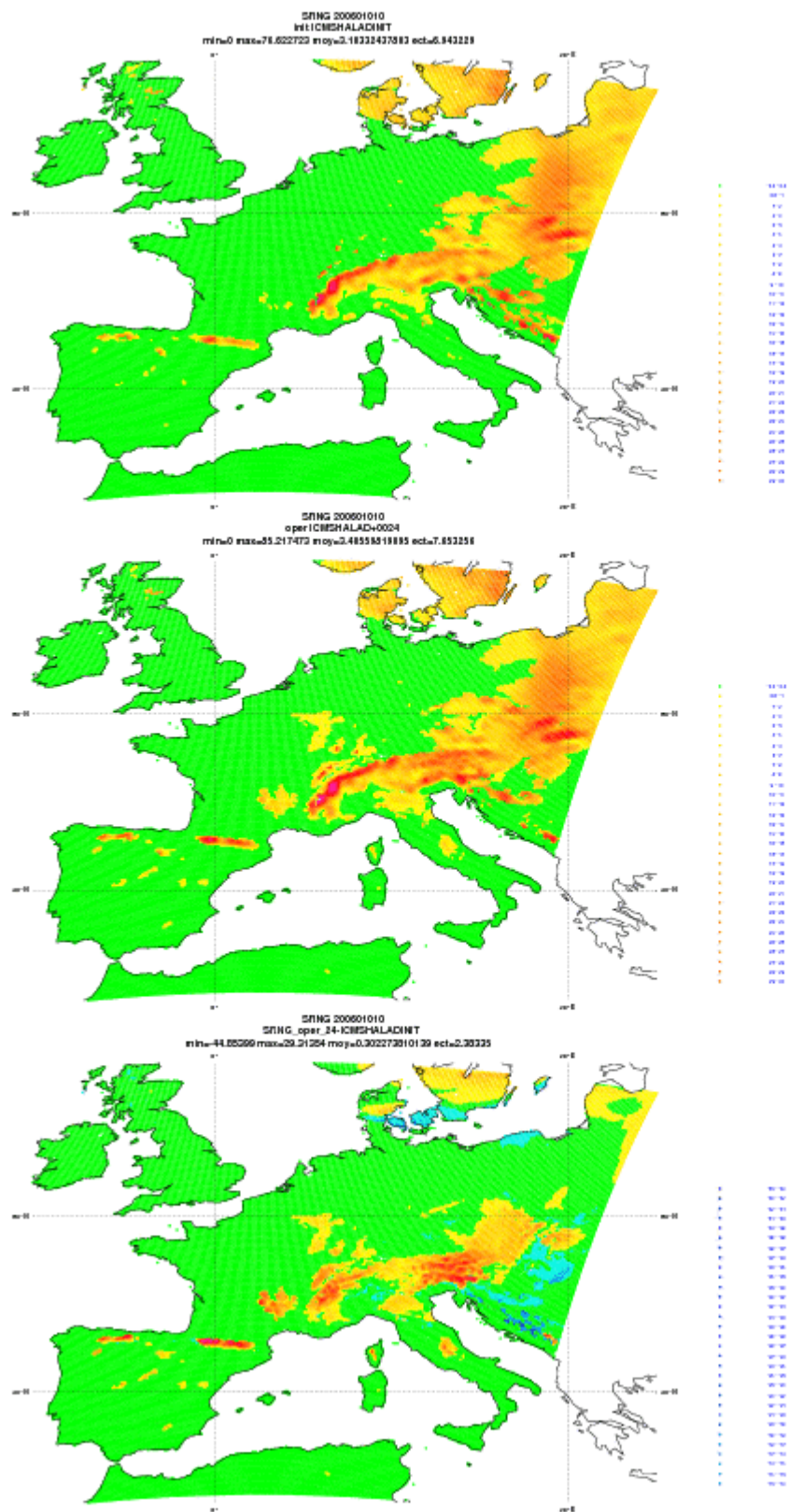
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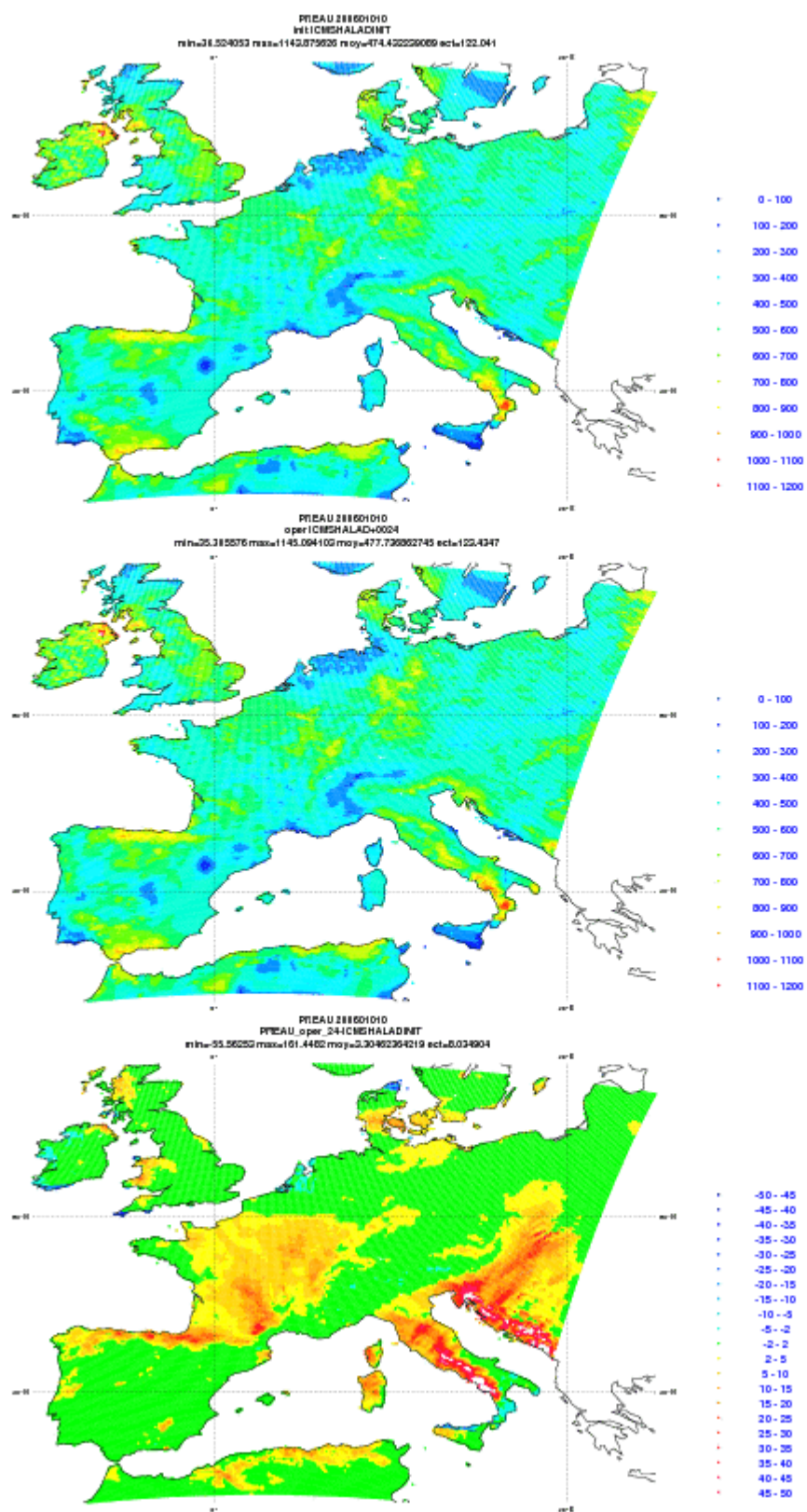
Plots of the 24-hour increments of the operational aladin (oper) for PRGL



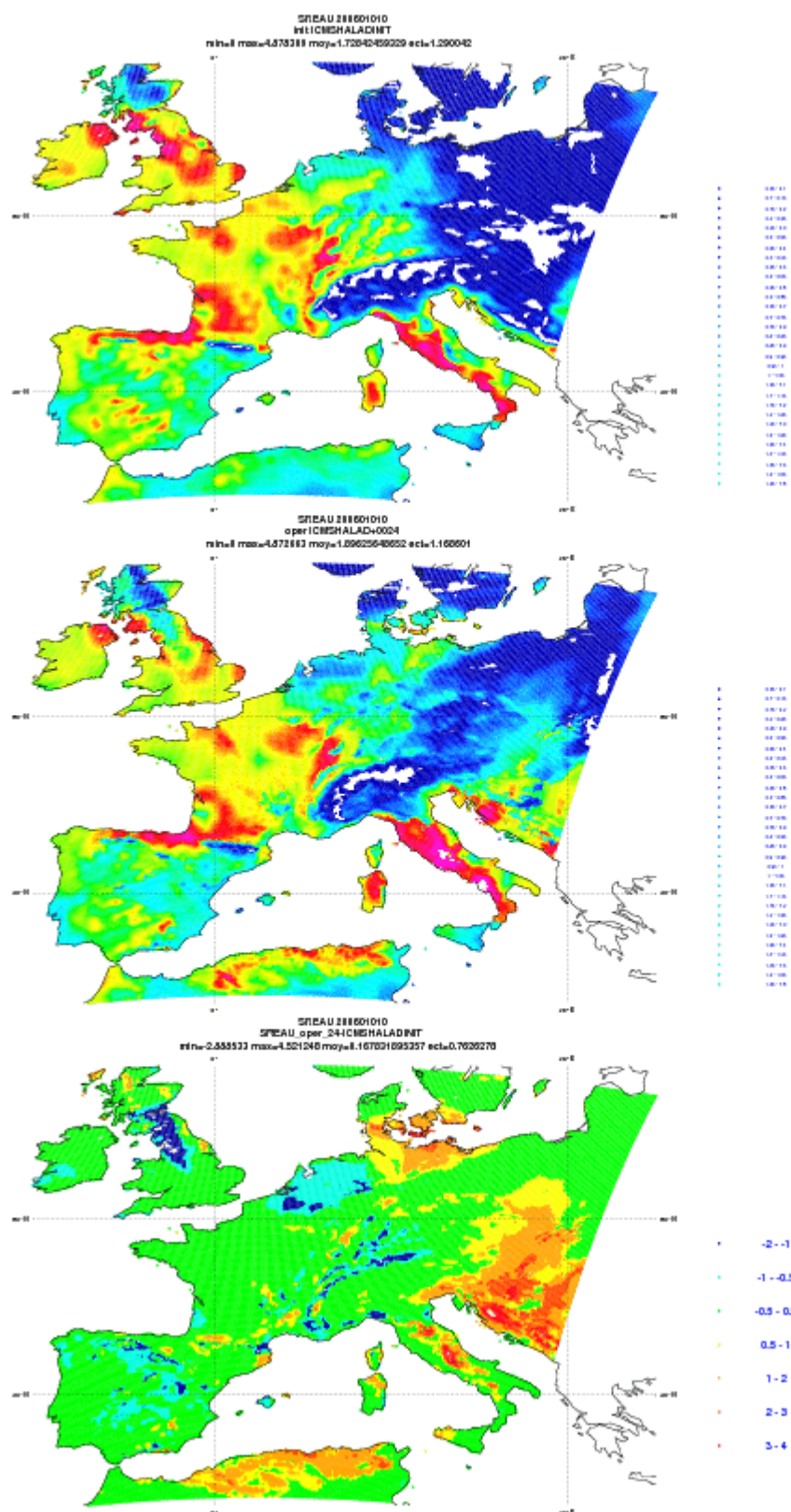
Plots of the 24-hour increments of the operational aladin (oper) for SRGL



Plots of the 24-hour increments of the operational aladin (oper) for SRNG



Plots of the 24-hour increments of the operational aladin (oper) for PREAU

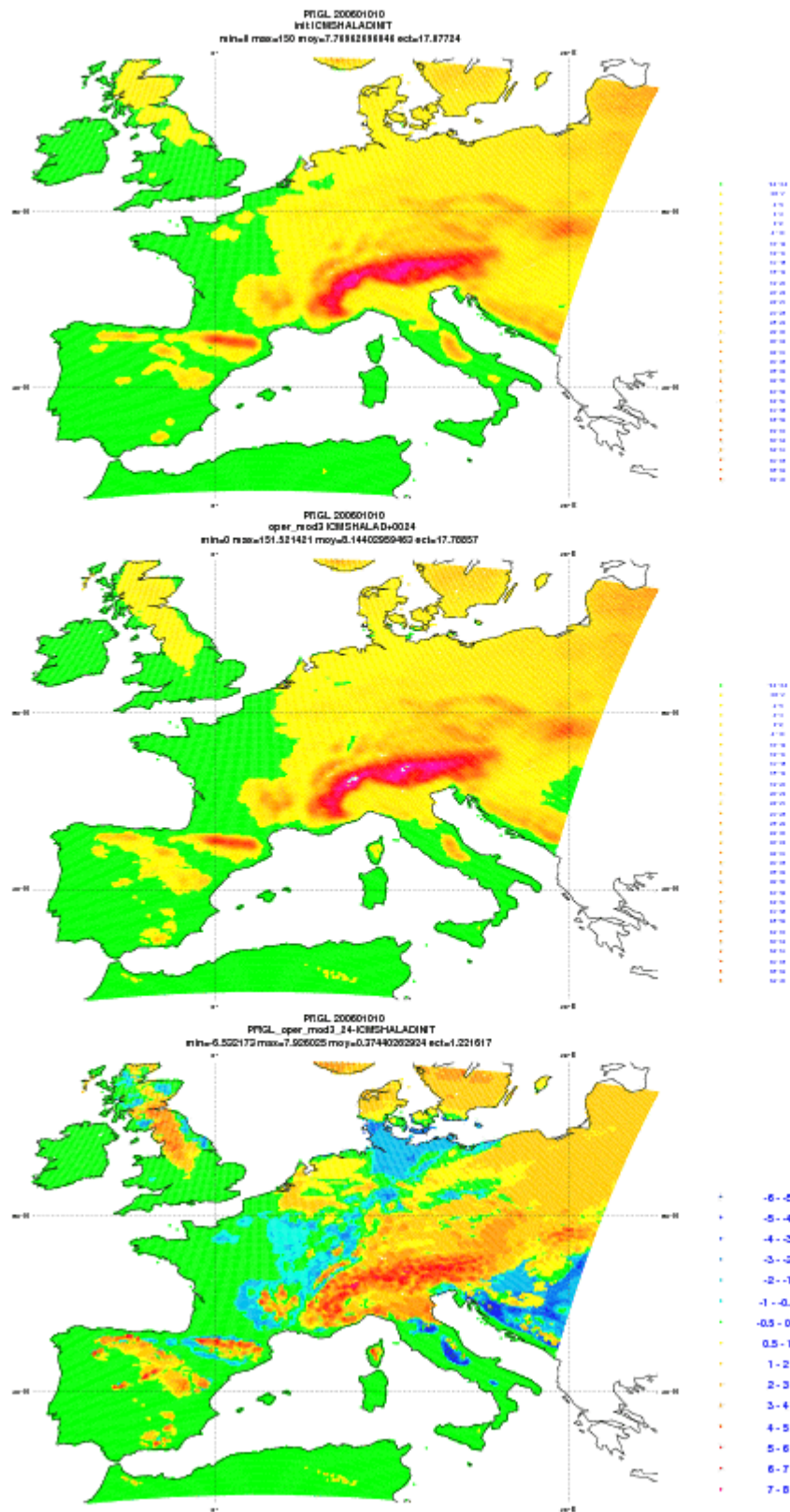


Plots of the 24-hour increments of the operational aladin for SREAU

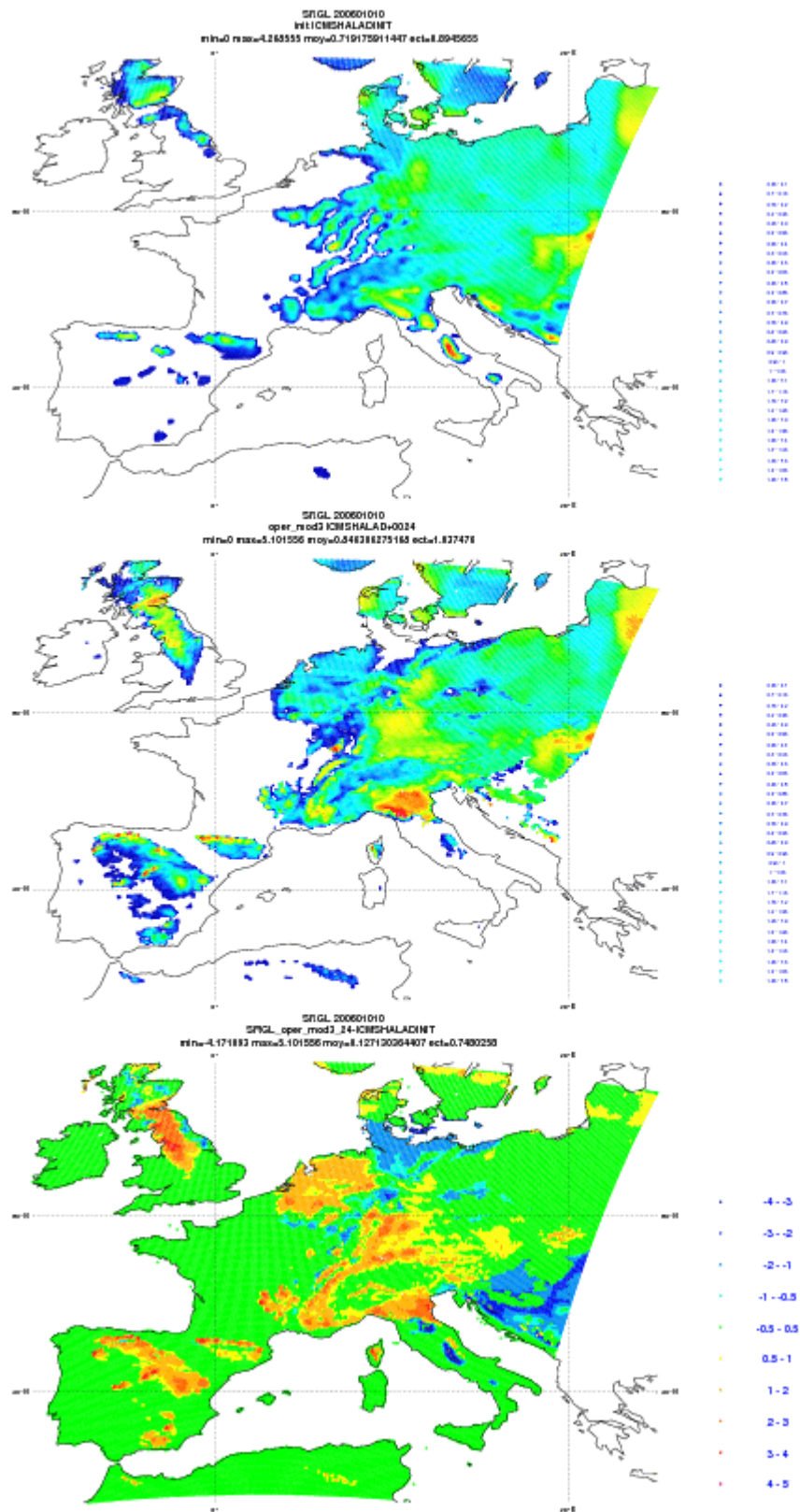
Appendix5

Plots of the 24-hour increments of modified aladin (oper_mod3) for surface fields (deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU)

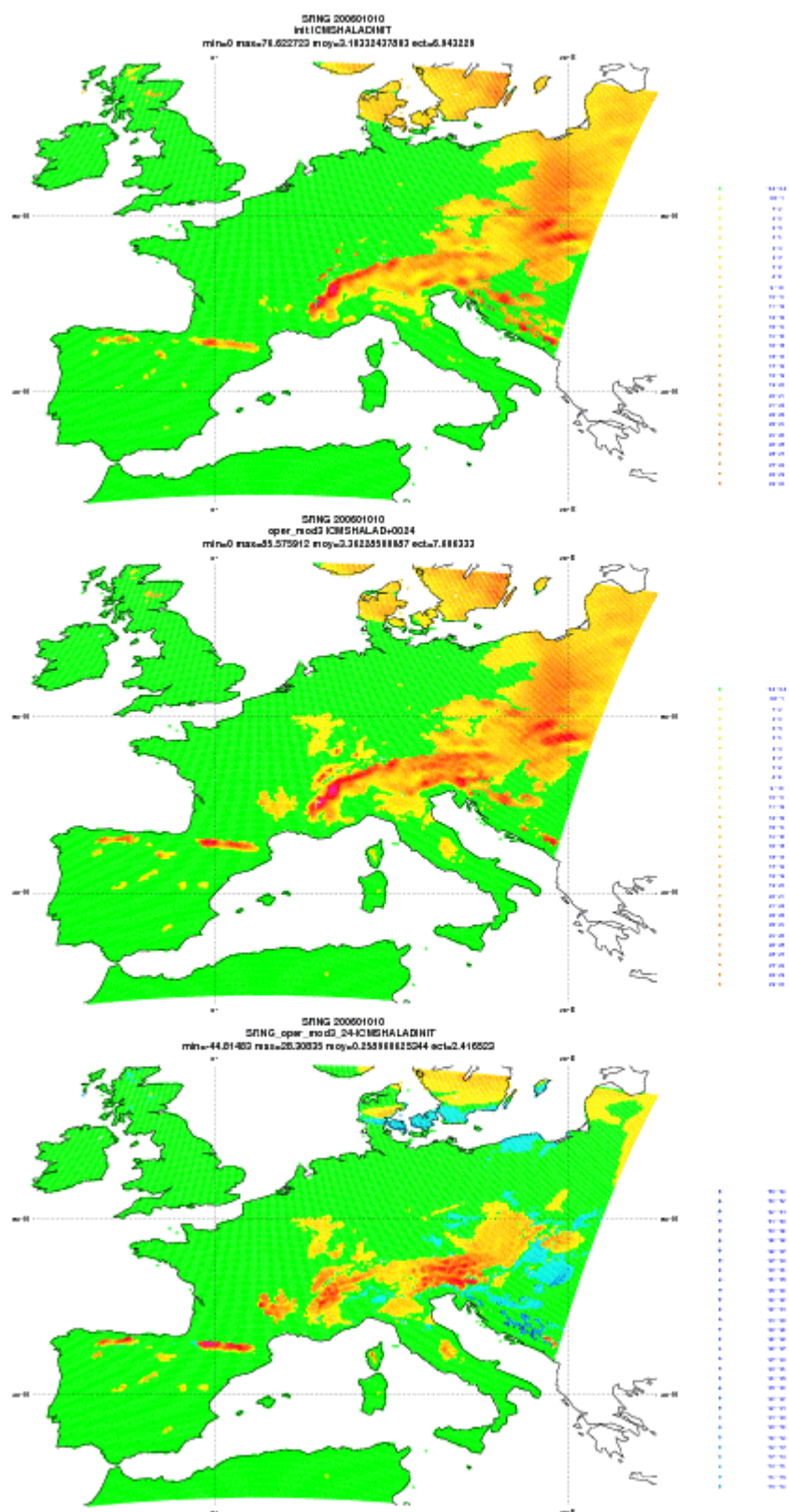
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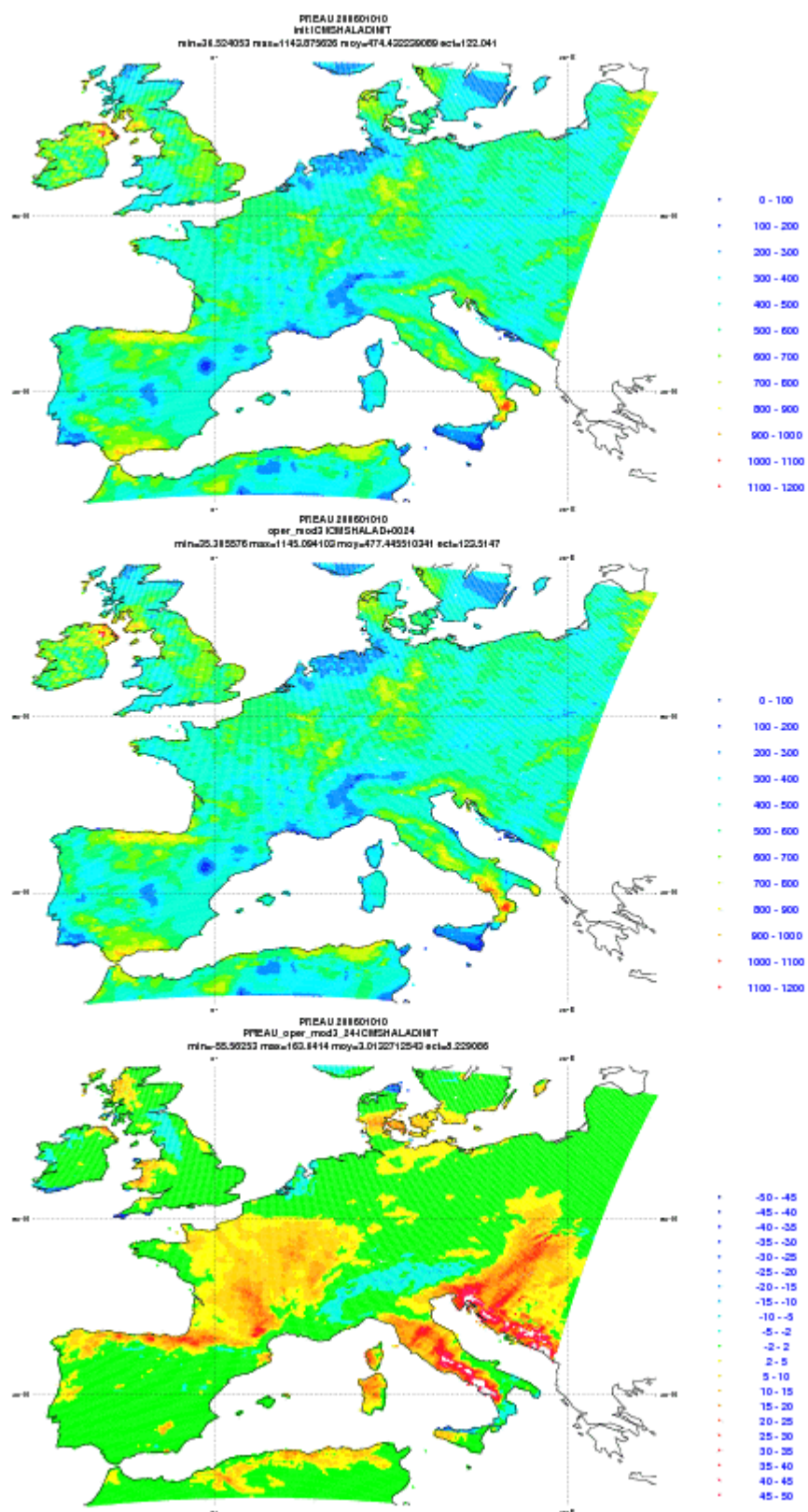
Plots of the 24-hour increments of the modified aladin(oper_mod3) for PRGL



Plots of the 24-hour increments of the modified aladin(oper_mod3) for SRGL



Plots of the 24-hour increments of the modified aladin (oper_mod3) for SRNG

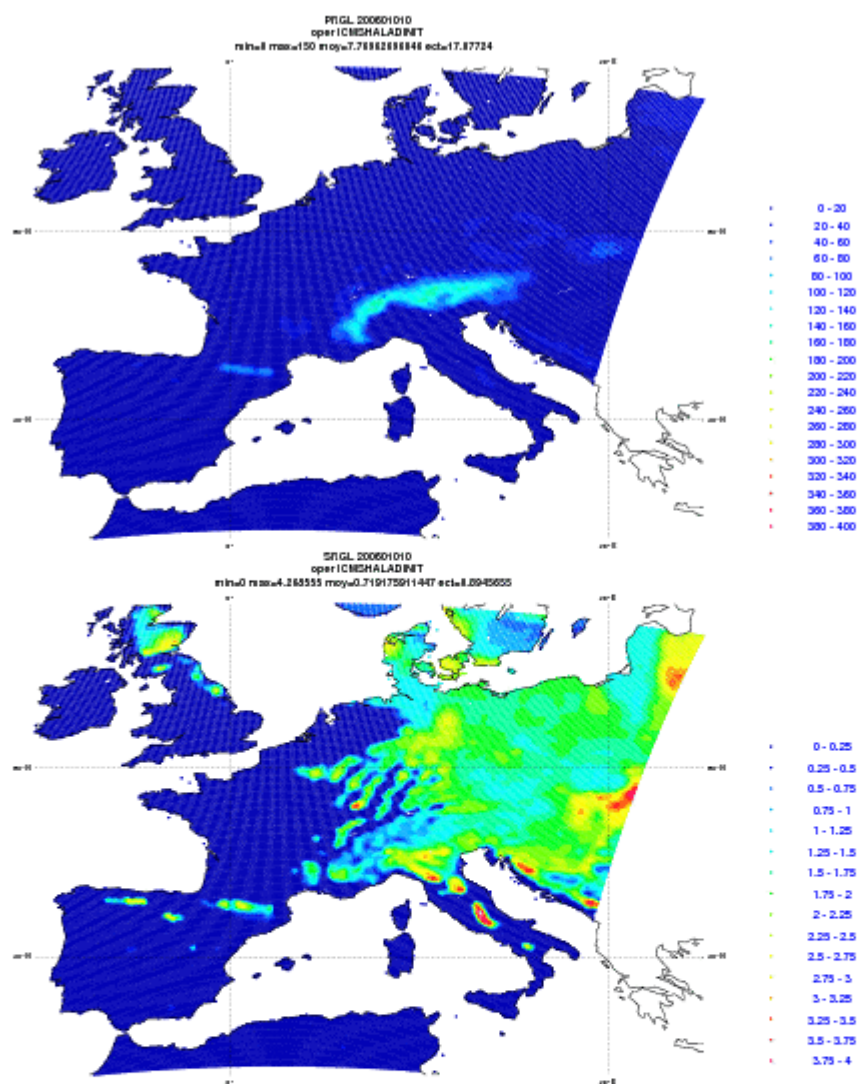


Plots of the 24-hour increments of the modified aladin (oper_mod3) for PREAU

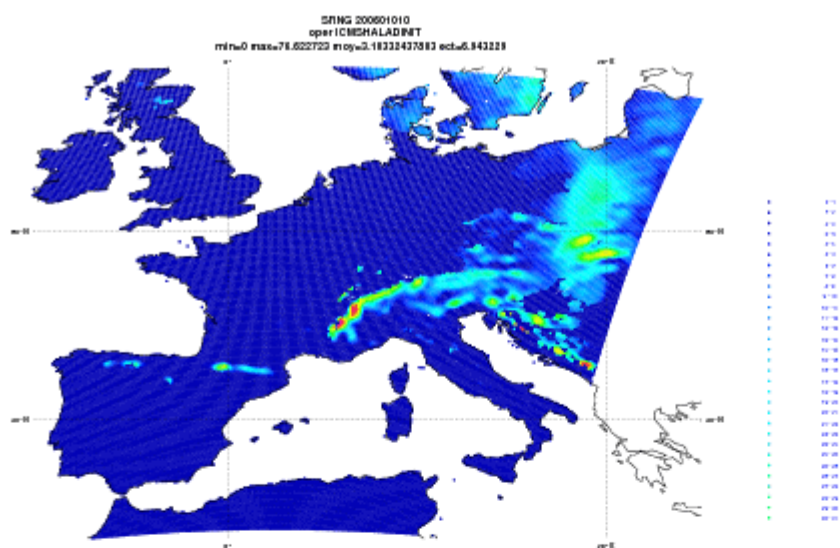
Appendix6

Plots of the initial surface fields for operational aladin (oper) (deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU)

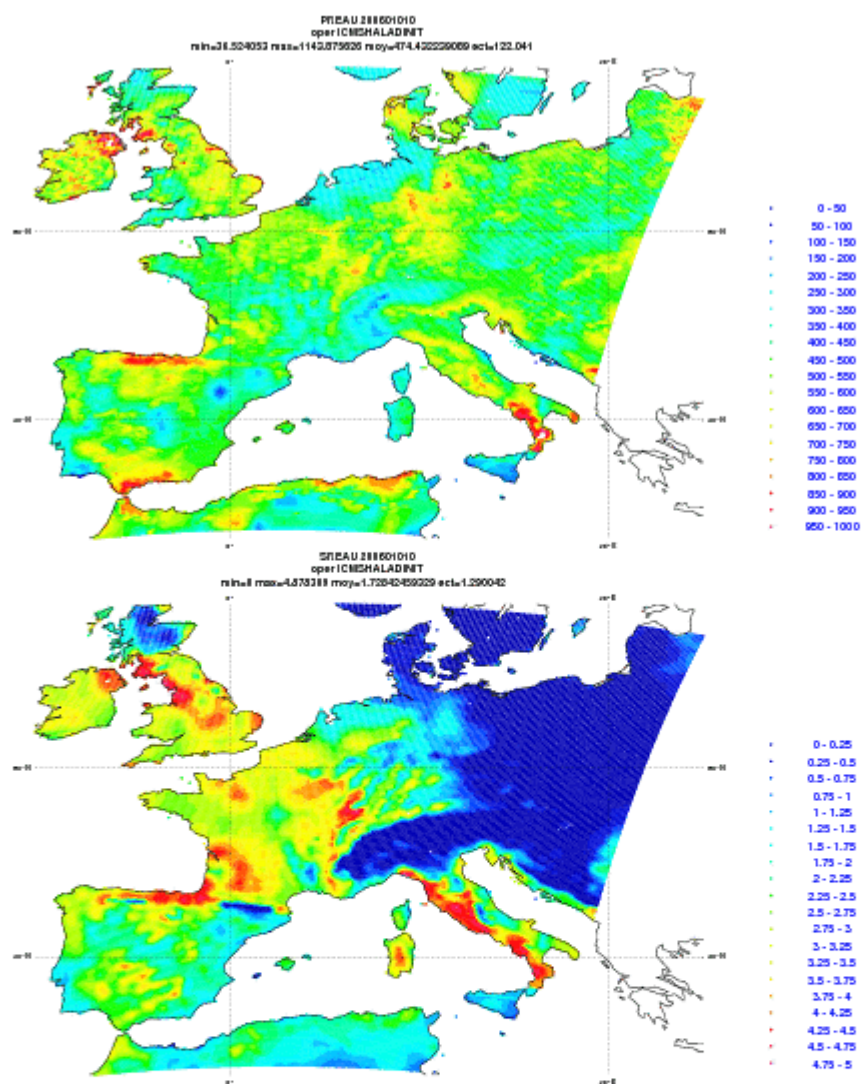
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PREAU => PROFRESERV.EAU,
SREAU => SURFRESERV.EAU



Plots of the initial fields PRGL and SRGL for operational aladin (oper)



Plots of the initial fields SRNG for operational aladin (oper)

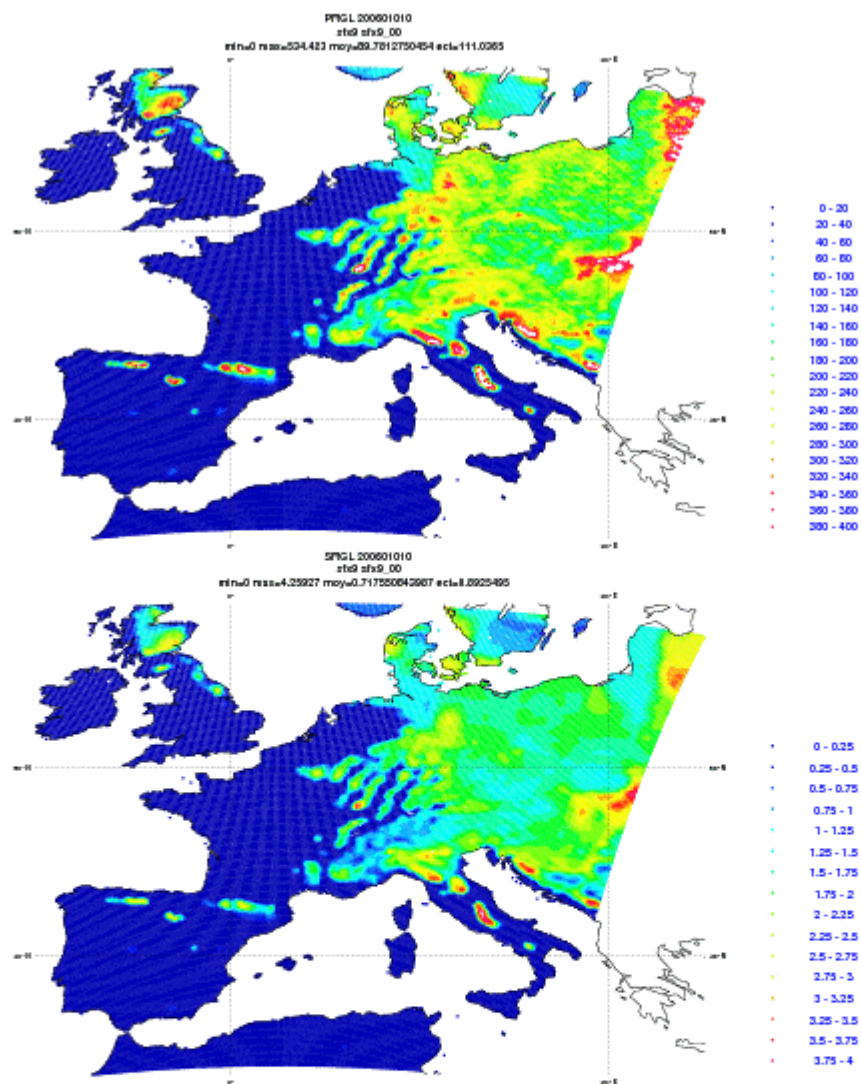


Plots of the initial fields PREAU and SREAU for operational aladin (oper)

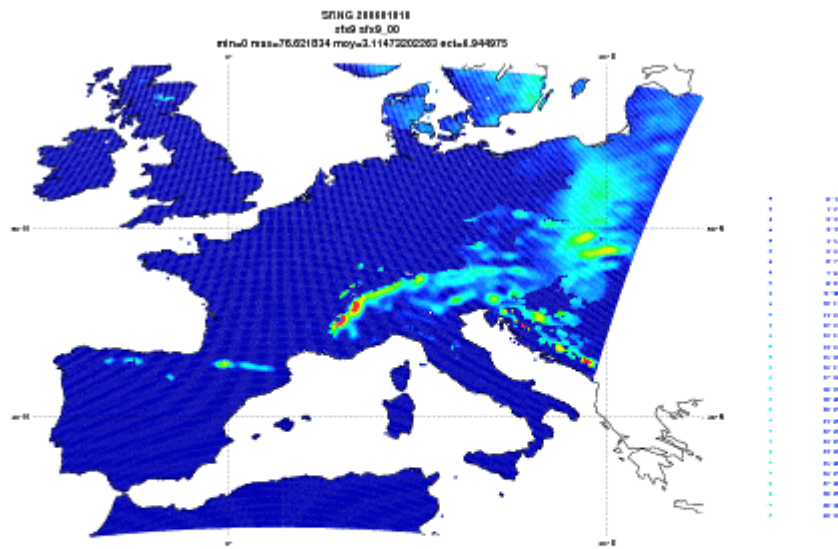
Appendix7

Plots of the initial surface fields from SURFEX for (aladin + surfex) (deep soil moisture content for ice PRGL, soil moisture content for ice SRGL, snow depth SRNG, deep soil moisture content PREAU, liquid soil moisture content SREAU)

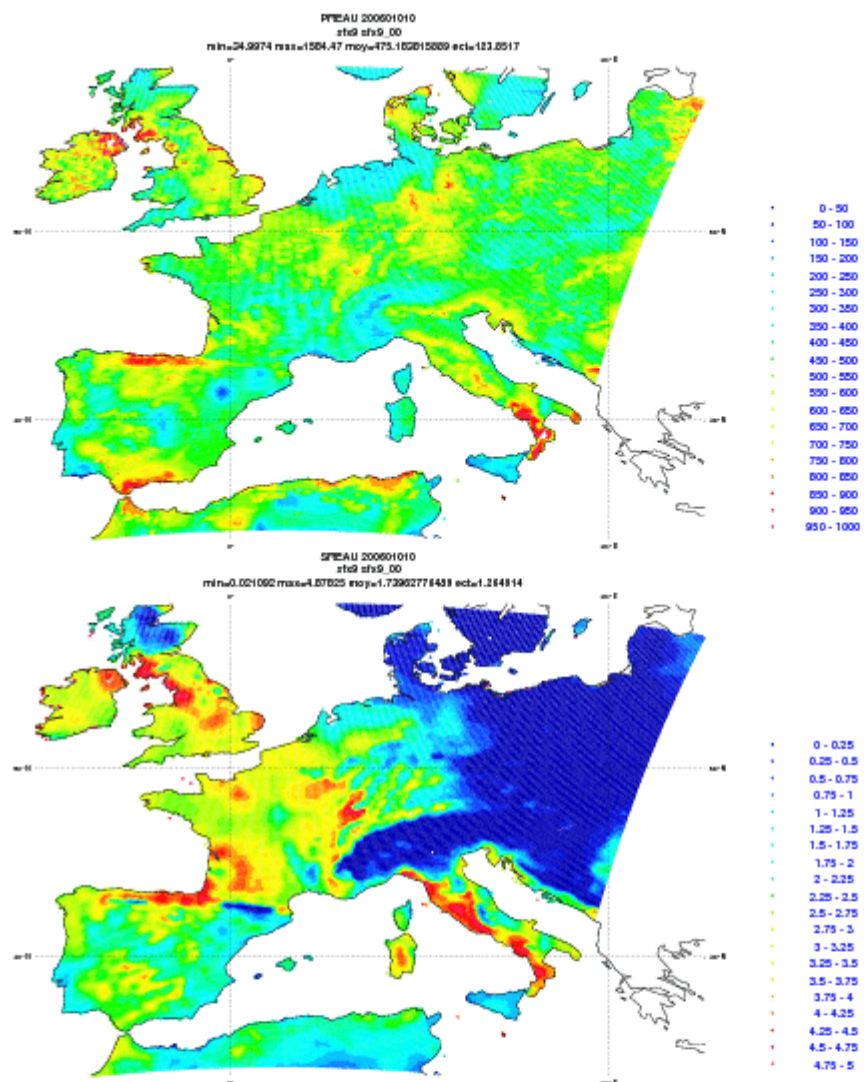
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SRGL => SURFRESERV.CLACE,
SRNG => SURFRESERV.NEIGE,
PREAU => PROFRESERV.EAU,
SREAU => SURFRESERV.EAU



Plots of the initial surface fields PRGL and SRGL for (aladin + surfex) (sf9)



Plots of the initial surface field SRNG for (aladin + surfex) (sfx9)



Plots of the initial fields PREAU and SREAU for (aladin + surfex) (sf9)