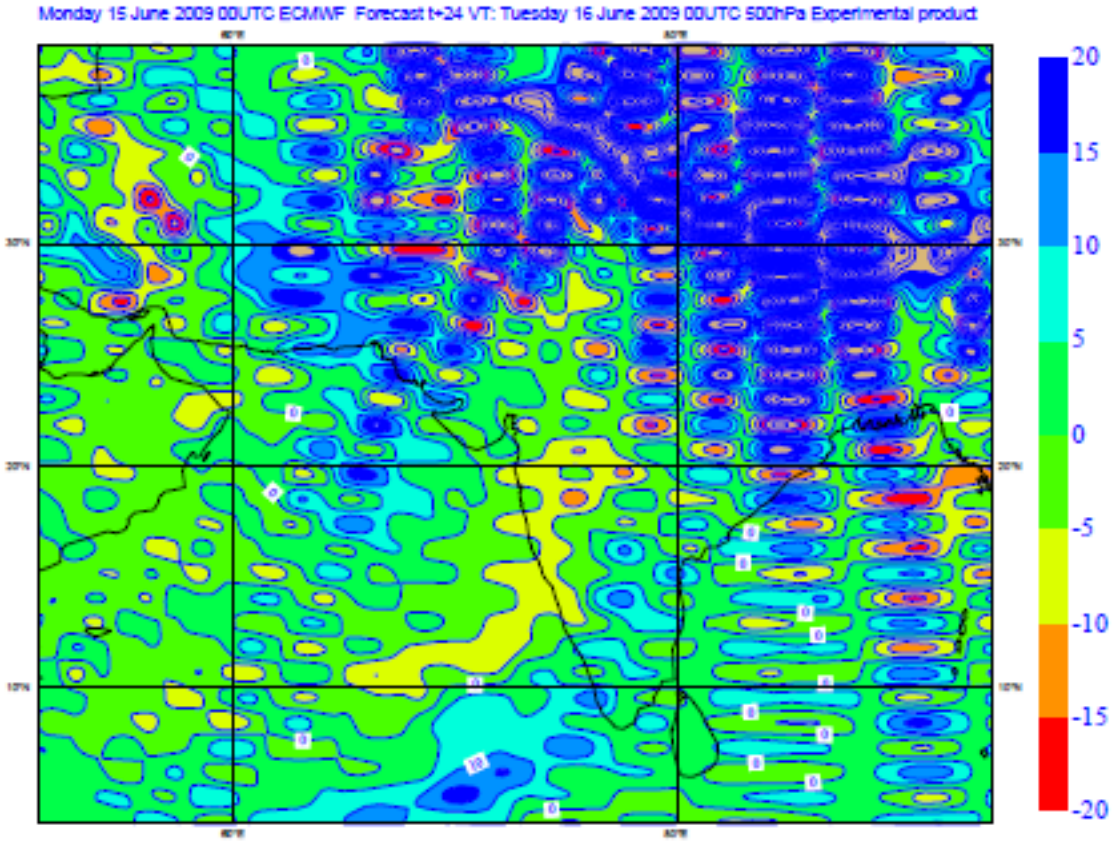
Aliasing and upper levels explosions. Two fixes

M. Hortal
P.L. on dynamics in HIRLAM

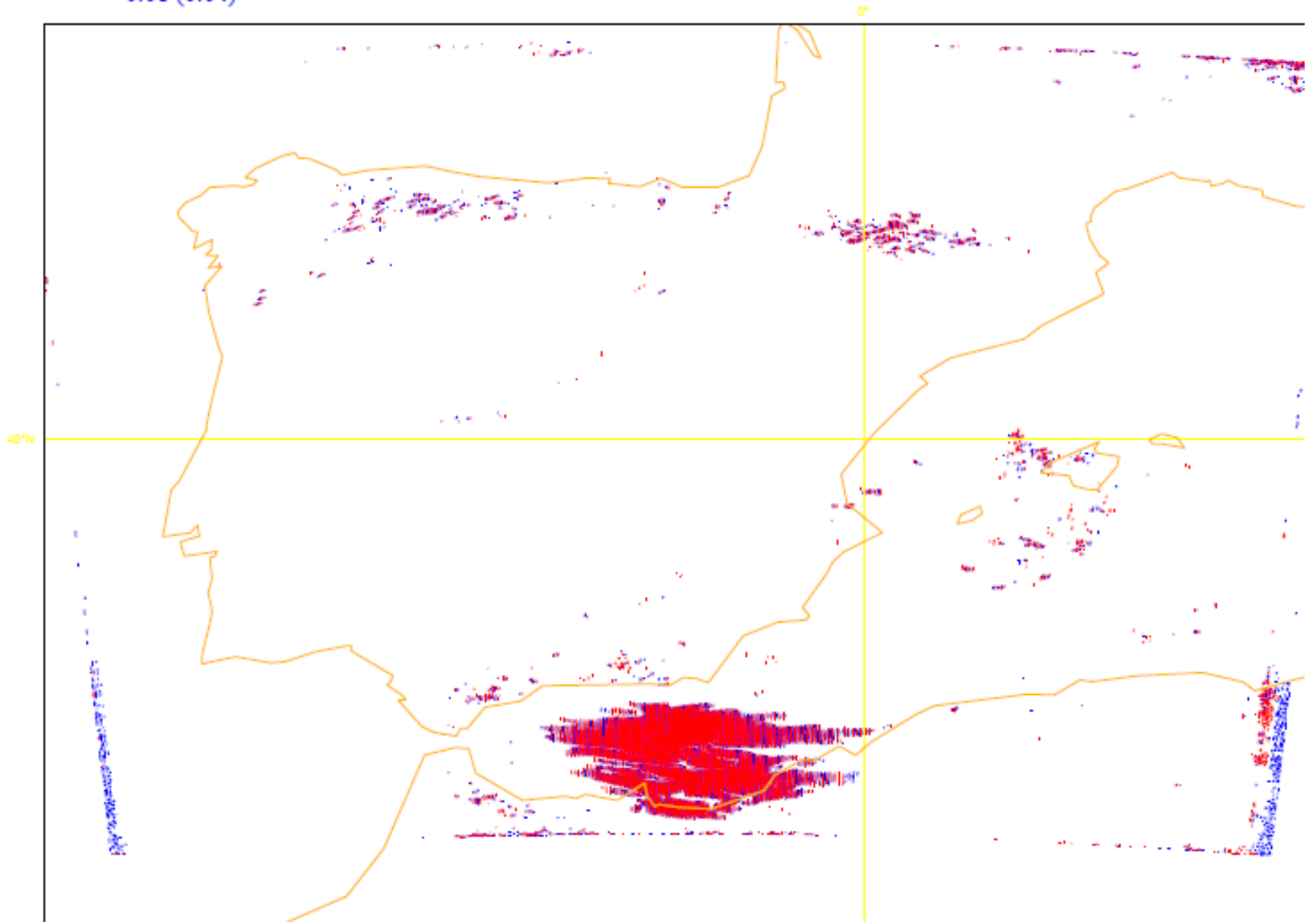
Elimination of aliasing

- In cy38r2 Nils Wedi (ECMWF) introduced a filter to reduce aliasing on vorticity coming from the pressure gradient term.



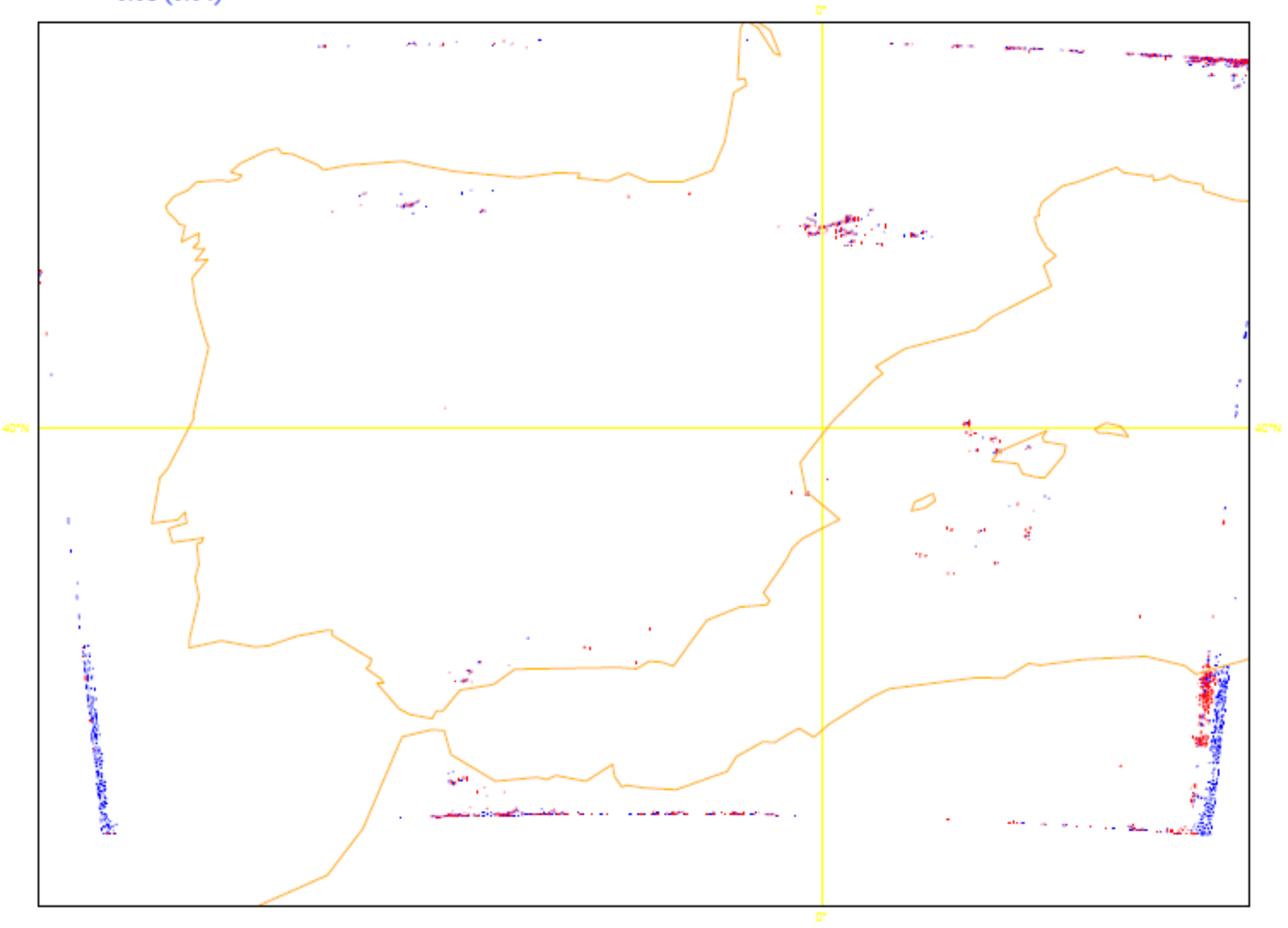
Elimination of aliasing (cont)

- The filter improved substantially the conservation of mass.
- This filter has been implemented in HARMONIE in cy38h1.1, with the addition of filtering also the pressure departure.


Friday 15 November 2013 12UTC t t+6 VT: Friday 15 November 2013 18UTC Surface:
0.01 (0.04)
0°
40°N

Friday 15 November 2013 12UTC t t+6 VT: Friday 15 November 2013 18UTC Surface:

0.01 (0.04)

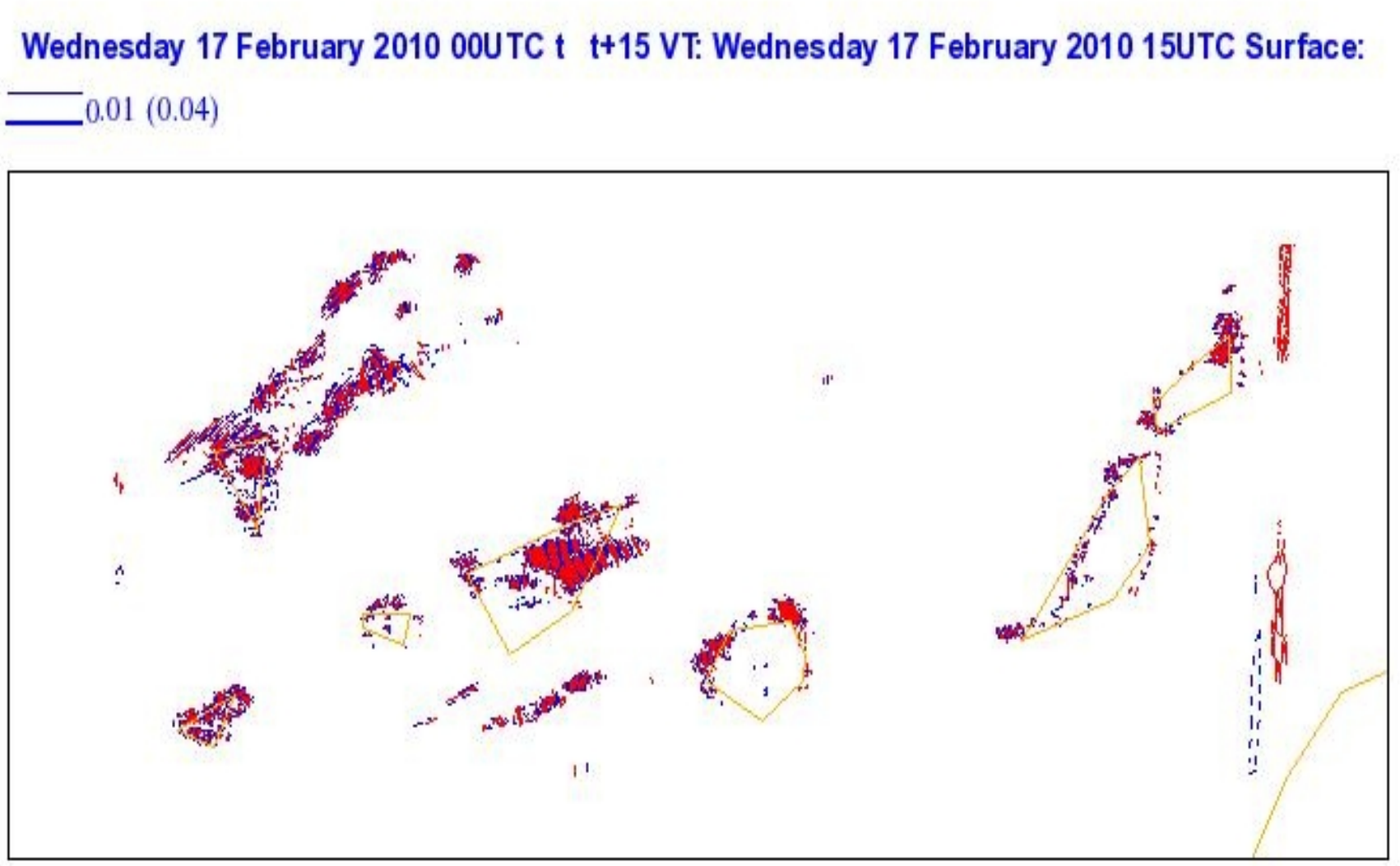


1Km resolution run over Canary Islands

```
LGRADSP=.FALSE.
LUNBC=.FALSE.

 11:22:16 STEP 1917 H=  15:58 +CPU=  0.280
 11:22:17 STEP 1918 H=  15:59 +CPU=  0.280
 11:22:18 STEP 1919 H=  15:59 +CPU=  0.280
 11:22:19 STEP 1920 H=  16:00 +CPU=  0.580
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
 11:22:19 STEP 1921 H=  16:00 +CPU=  0.280
 11:22:20 STEP 1922 H=  16:01 +CPU=  0.280
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
SMILAG TRAJECTORY OUT OF ATM      2 TIMES.
 11:22:20 STEP 1923 H=  16:01 +CPU=  0.280
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
SMILAG TRAJECTORY OUT OF ATM      1 TIMES.
SMILAG TRAJECTORY OUT OF ATM      7 TIMES.
 MAX U WIND= 329.635130312659044
 U WIND = 329.635130312659044  IS TOO STRONG, EXPLOSION.
 LEVEL=  6  POINT=  1
 LON  =  16.27795122362926 25  degrees
 LAT  =  28.391181428337080 9  degrees
 NLATGPP= 96   NLONGPP= 213
ABORT!  103  !U WIND TOO STRONG, EXPLOSION!!!
```

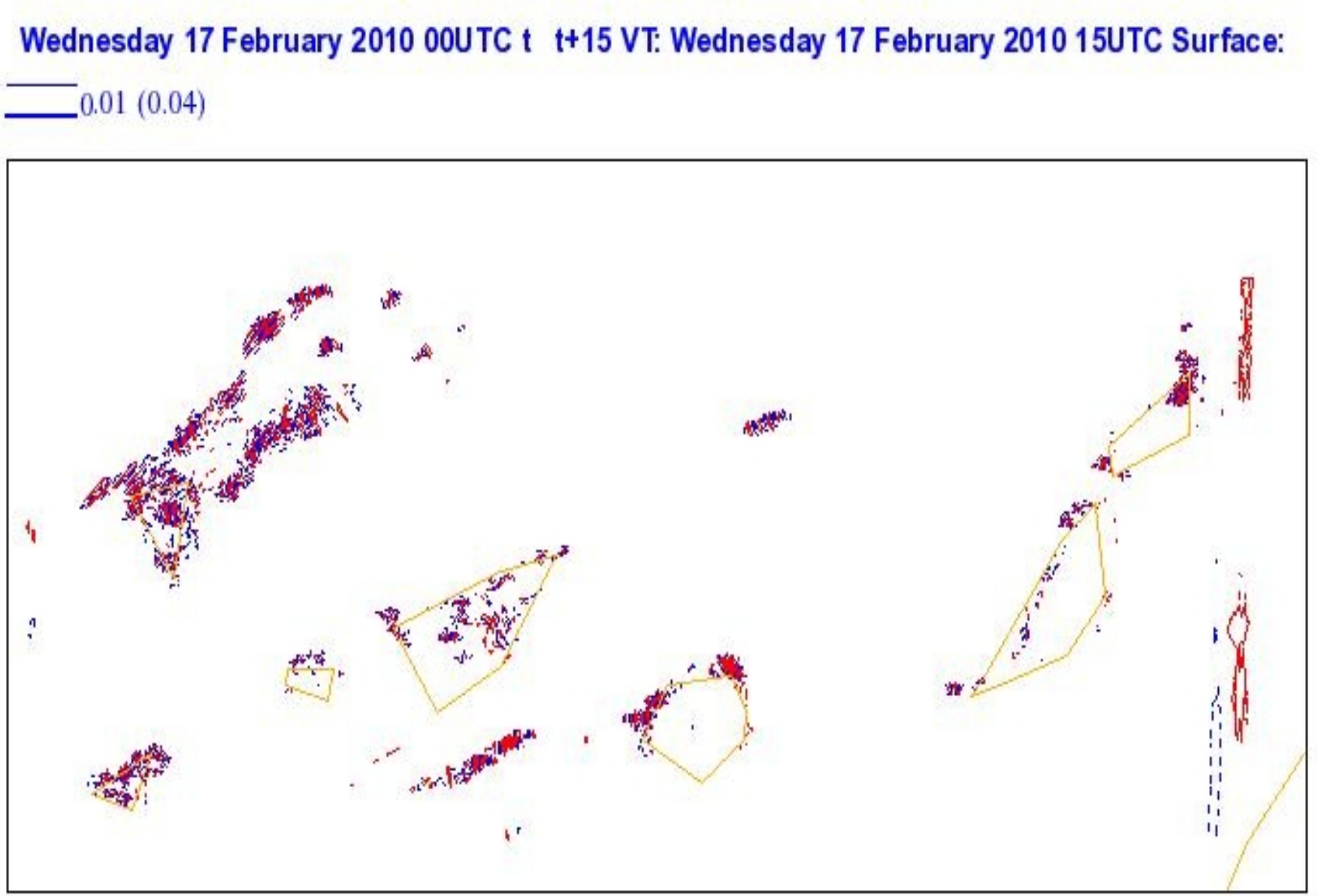
X-component of pressure gradient at level 2



```
LGRADSP=.TRUE.
LUNBC=.FALSE.

  15:48:47 STEP 2120 H=  17:40 +CPU=  0.290
  15:48:48 STEP 2122 H=  17:41 +CPU=  0.290
  15:48:49 STEP 2123 H=  17:41 +CPU=  0.280
  15:48:49 STEP 2124 H=  17:42 +CPU=  0.280
  15:48:50 STEP 2125 H=  17:42 +CPU=  0.290
 SMILAG TRAJECTORY OUT OF ATM      2 TIMES.
  15:48:50 STEP 2126 H=  17:43 +CPU=  0.280
JSETSIG: sl->active = 0
signal_harakiri(SIGALRM=14): New handler installed at 116939cc8; old preserved
at 0
***Received signal = 8 and ActivatED SIGALRM=14 and calling alarm(10), time =
1297.36
[myproc#103,tid#1,pid#5505198,signal#8(SIGFPE)]: Received signal :: 1552MB
(heap), 572MB (rss), 100MB (stack), 1556 (paging), nsigs 1, time  1297.36
tid#1 starting drhook traceback, time = 1297.36
[myproc#103,tid#1,pid#5505198]:  MASTER
[myproc#103,tid#1,pid#5505198]:   CNT0<1>
[myproc#103,tid#1,pid#5505198]:    CNT1
[myproc#103,tid#1,pid#5505198]:     CNT2
[myproc#103,tid#1,pid#5505198]:      CNT3
[myproc#103,tid#1,pid#5505198]:       CNT4
[myproc#103,tid#1,pid#5505198]:        STEPO
[myproc#103,tid#1,pid#5505198]:         SCAN2M
[myproc#103,tid#1,pid#5505198]:          GP_MODEL
[myproc#103,tid#1,pid#5505198]:           CPG
[myproc#103,tid#1,pid#5505198]:            MF_PHYS
[myproc#103,tid#1,pid#5505198]:             APL_AROME
[myproc#103,tid#1,pid#5505198]:              ARO_ADJUST
[myproc#103,tid#1,pid#5505198]:               ICE_ADJUST
[myproc#103,tid#1,pid#5505198]:                CONDENSATION
tid#1 starting sigdump traceback, time = 1297.36
```

X-component of pressure gradient at level 2



Upper nesting boundary conditions (u.n.b.c.)

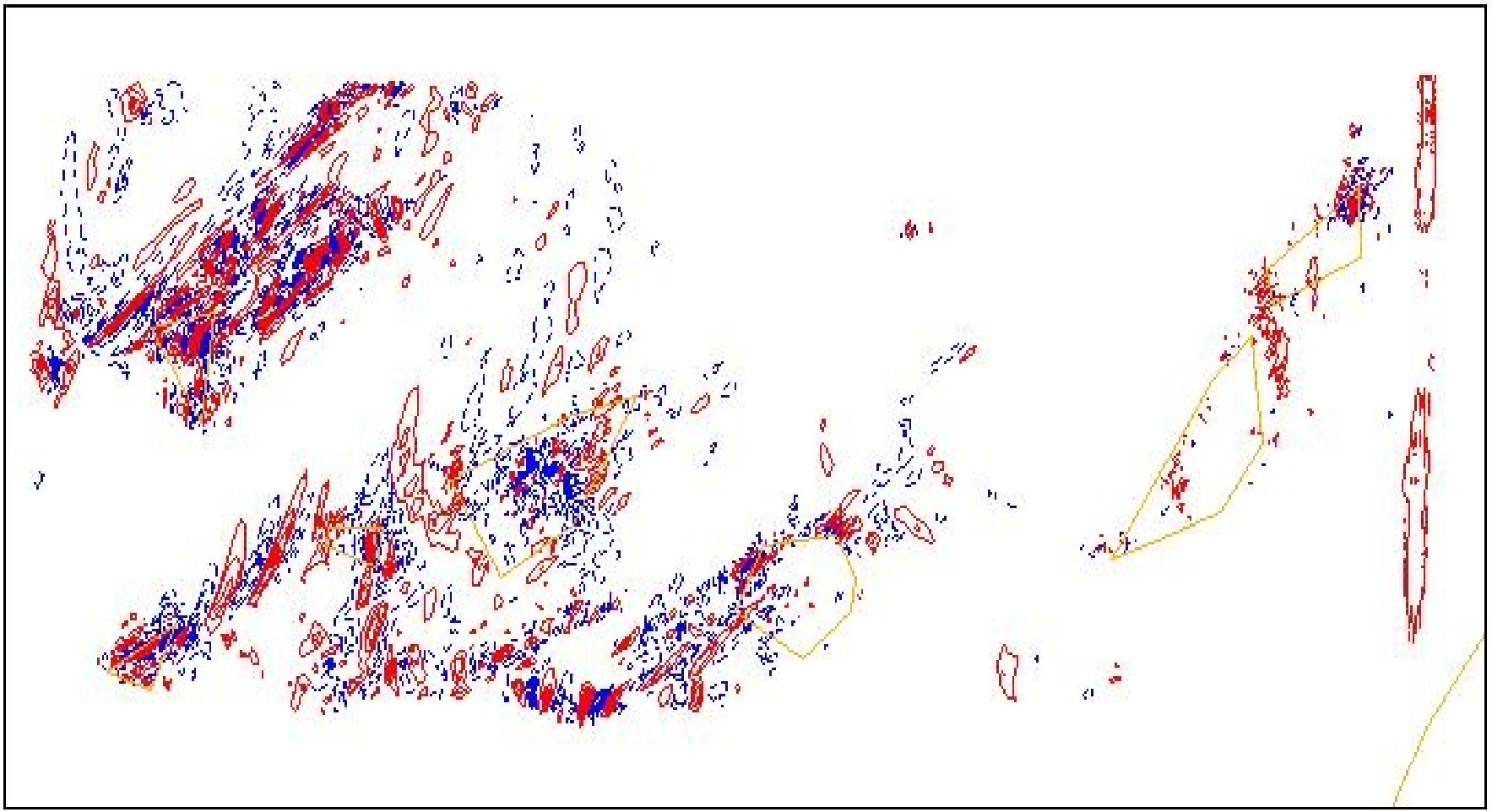
- Use Davies relaxation in the upper boundary in the same way as it is done in the lateral boundary
- The relaxation coefficients have not yet been adjusted to the non-uniform spacing of the vertical levels

LUNBC=.TRUE.
LGRADSP=.TRUE.

16:28:34 STEP 2864 H= 23:52 +CPU= 0.290
16:28:35 STEP 2865 H= 23:52 +CPU= 0.290
16:28:36 STEP 2866 H= 23:53 +CPU= 0.290
16:28:36 STEP 2867 H= 23:53 +CPU= 0.290
16:28:37 STEP 2868 H= 23:54 +CPU= 0.290
16:28:37 STEP 2869 H= 23:54 +CPU= 0.280
16:28:38 STEP 2870 H= 23:55 +CPU= 0.290
16:28:39 STEP 2871 H= 23:55 +CPU= 0.290
16:28:39 STEP 2872 H= 23:56 +CPU= 0.290
16:28:40 STEP 2873 H= 23:56 +CPU= 0.290
16:28:40 STEP 2874 H= 23:57 +CPU= 0.290
16:28:41 STEP 2875 H= 23:57 +CPU= 0.280
16:28:41 STEP 2876 H= 23:58 +CPU= 0.290
16:28:42 STEP 2877 H= 23:58 +CPU= 0.290
16:28:43 STEP 2878 H= 23:59 +CPU= 0.290
16:28:43 STEP 2879 H= 23:59 +CPU= 0.280
16:28:47 STEP 2880 H= 24:00 +CPU= 1.280
Dir is /scratch/ms/es/mdx/hm_home/aic_38h1_1_1km/20100217_00/forecast
total 19136

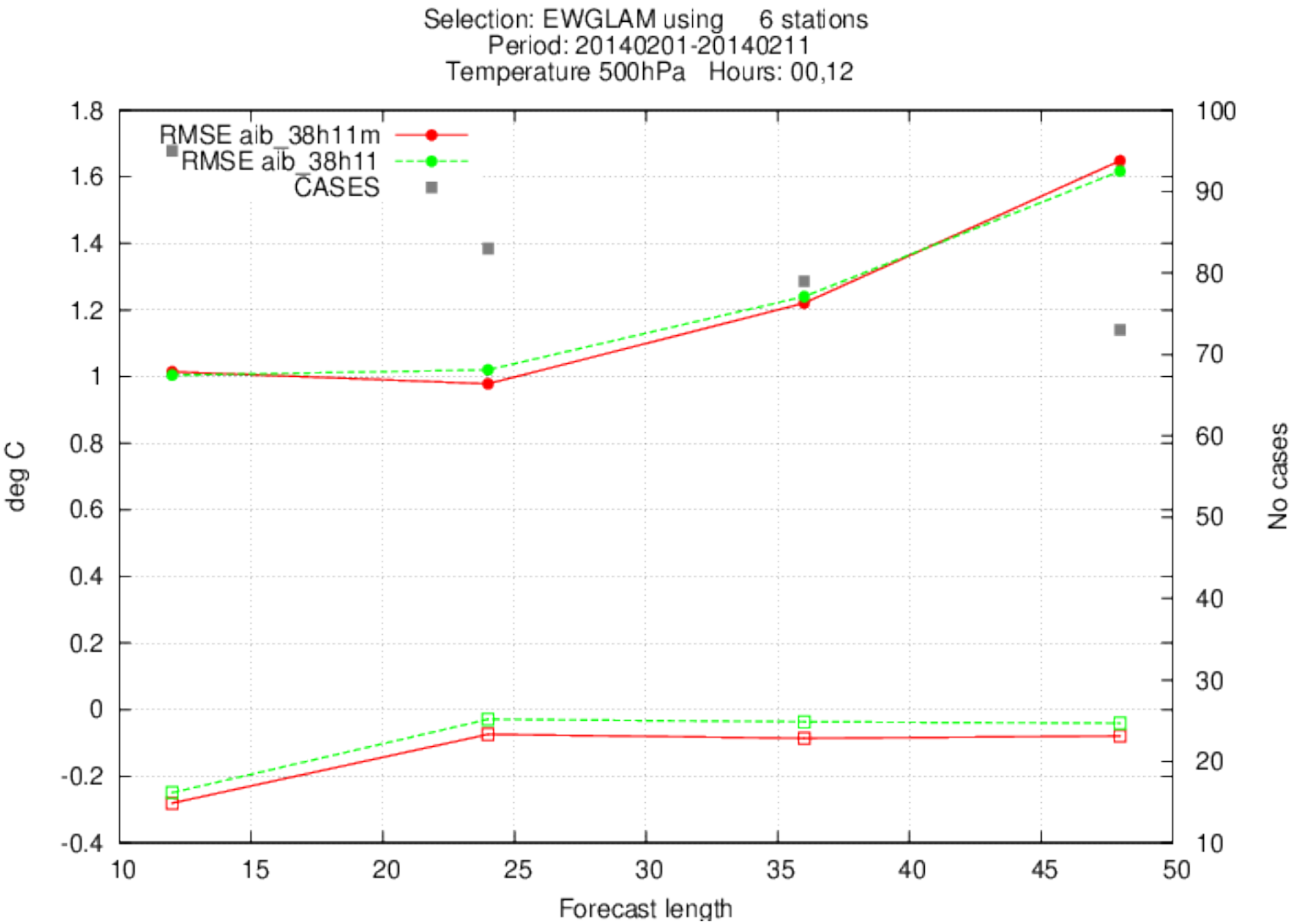
Wednesday 17 February 2010 00UTC t t+15 VT: Wednesday 17 February 2010 15UTC Surface:

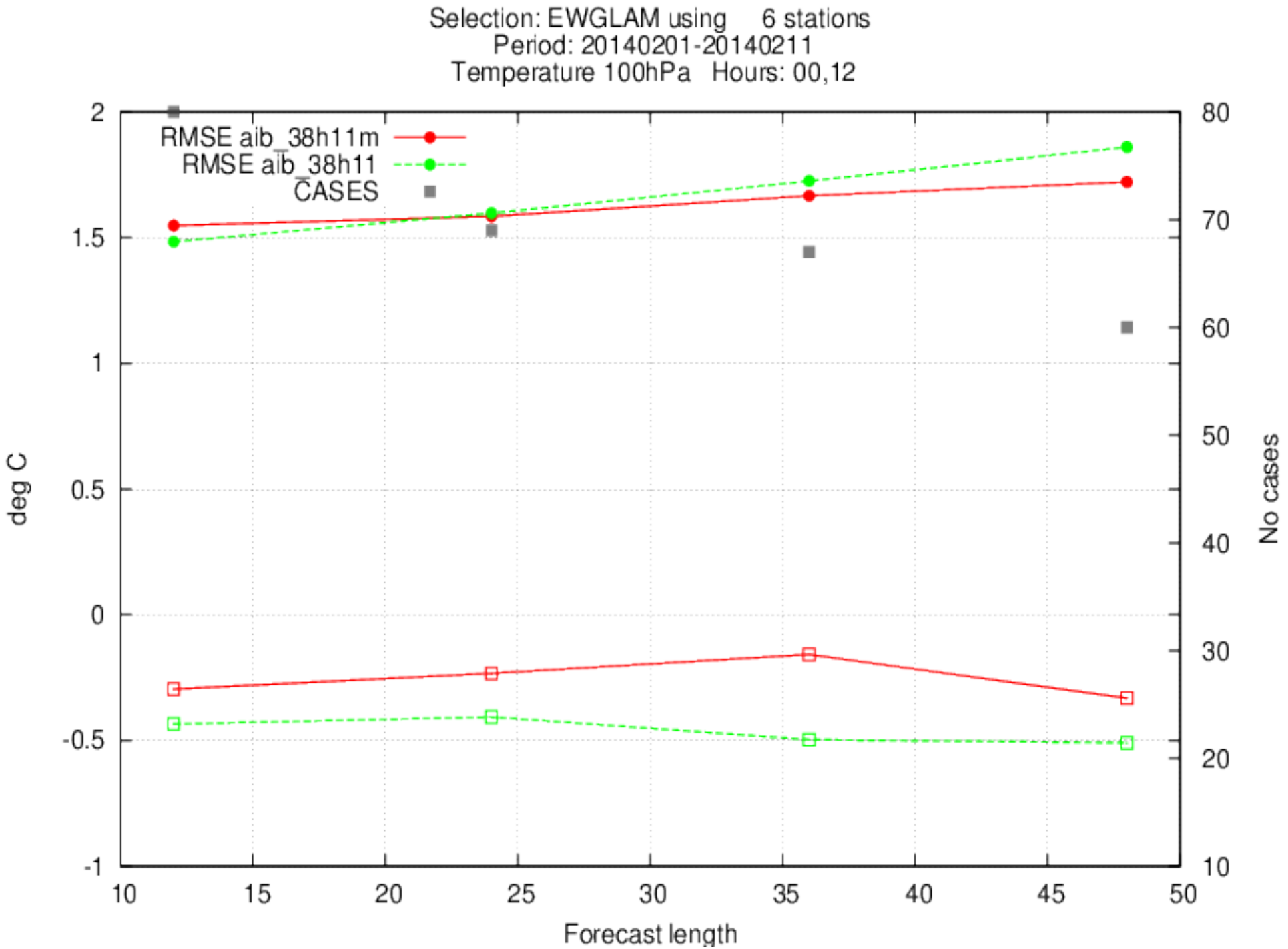
0.01 (0.04)

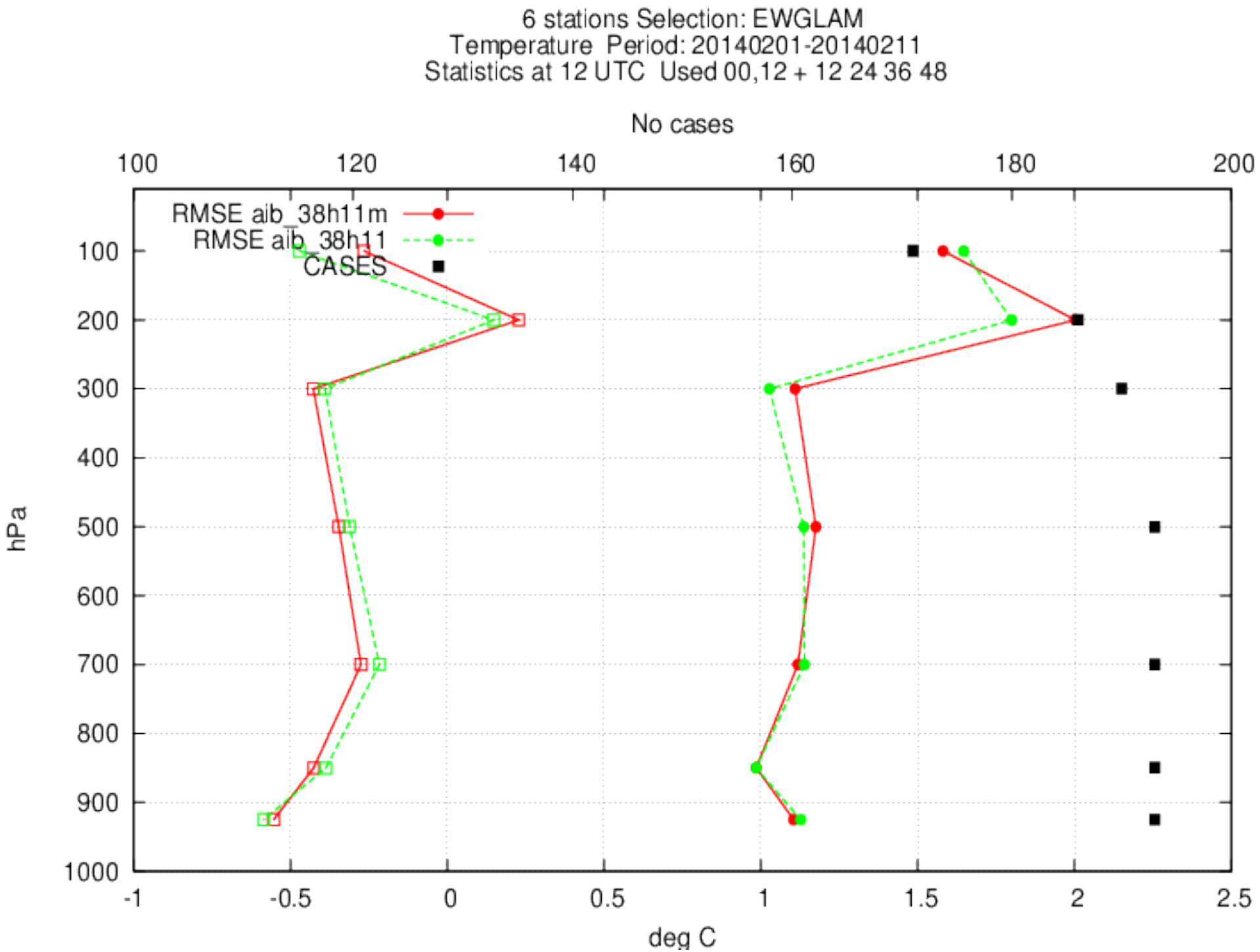


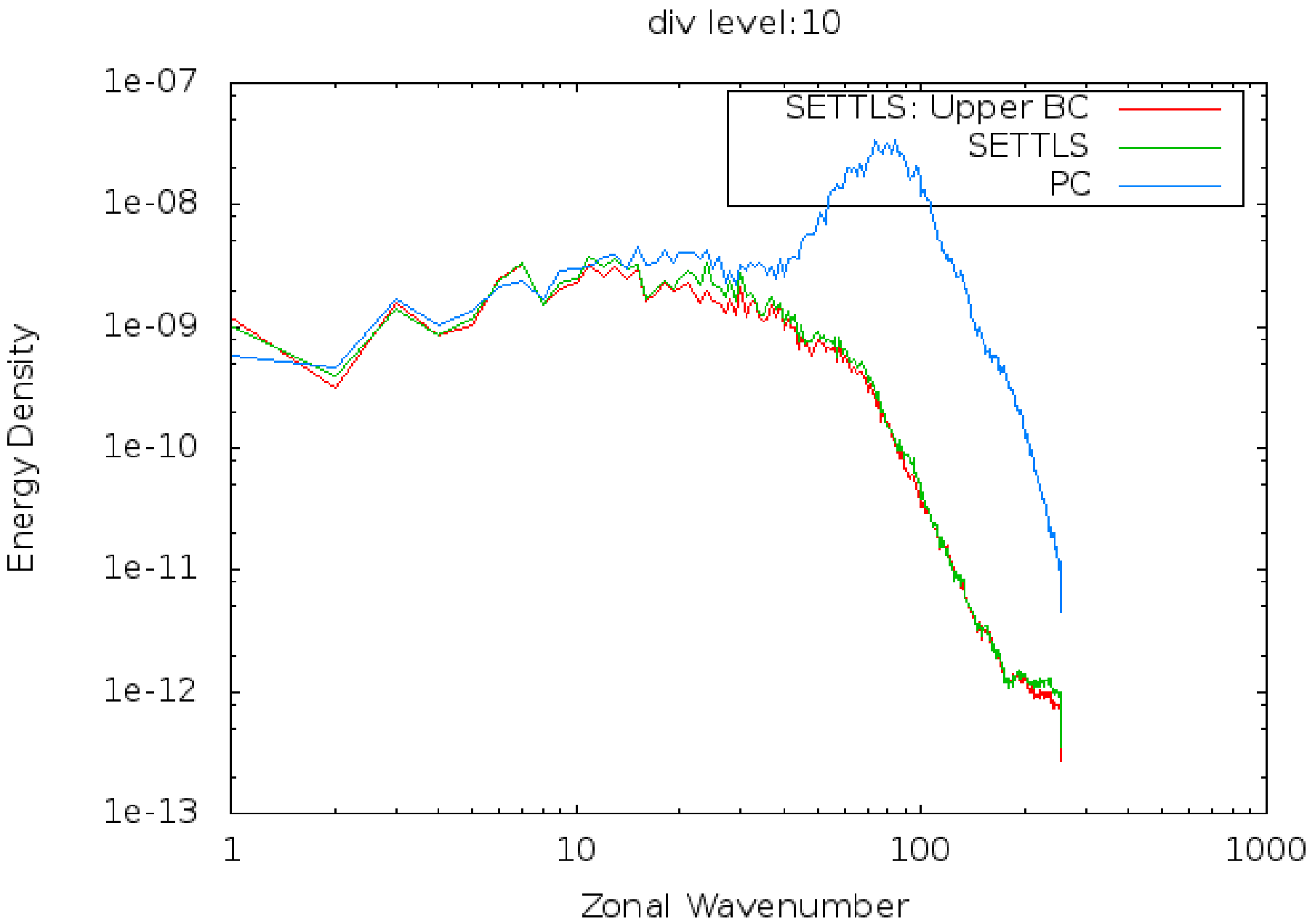
Runs using the upper nesting boundary conditions

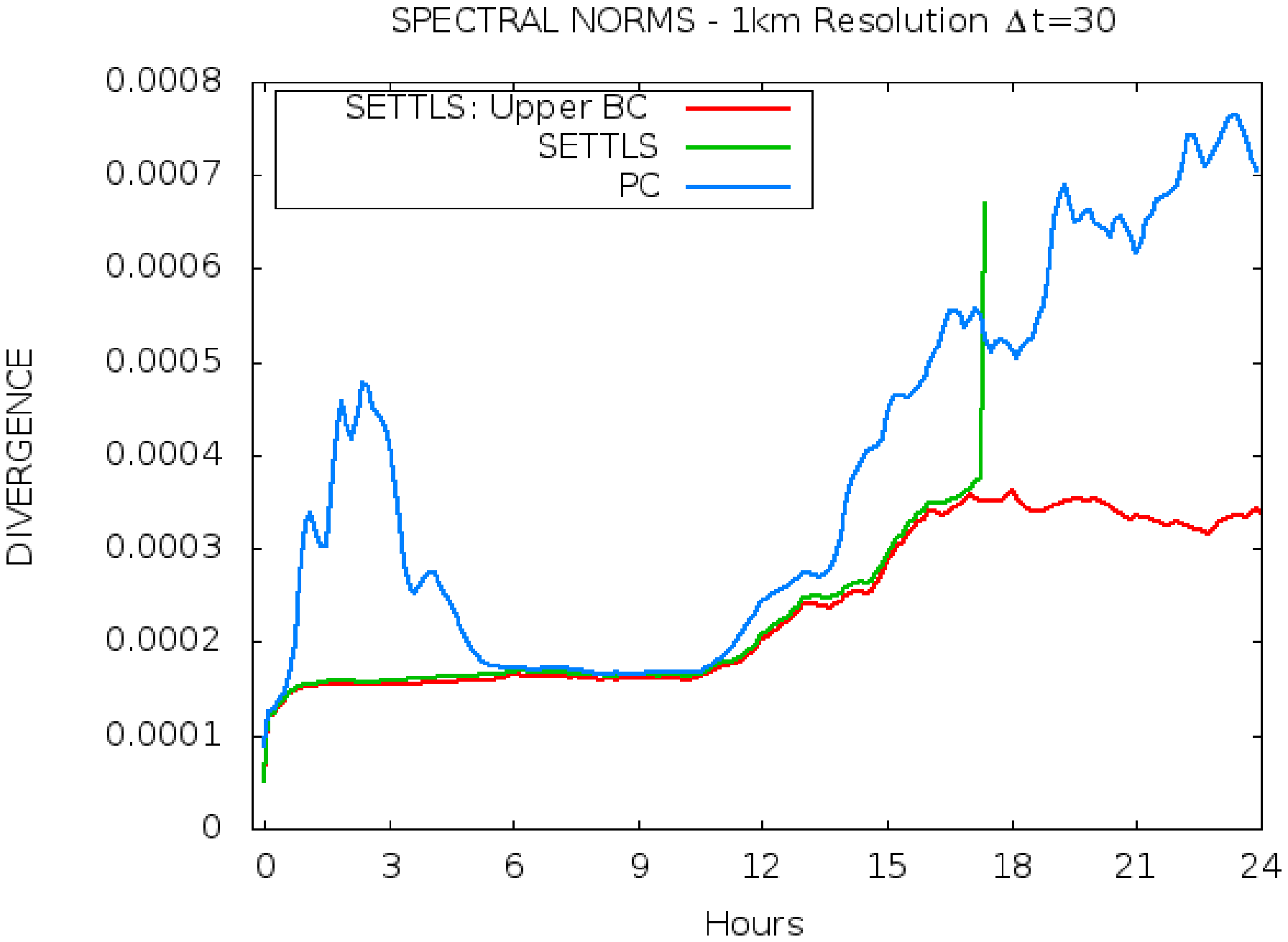
- Javier Calvo has ran and verified a series of experiments using the u.n.b.c. vs not using them
- Imanol Guerrero has produced some diagnostics comparing one exploding case, the rerun using predictor-corrector (and LGWADV) and the run with u.n.b.c.


Selection: EWGLAM using 6 stations
Period: 20140201-20140211
Temperature 500hPa Hours: 00,12
RMSE aib_38h11m
RMSE aib_38h11
CASES
deg C
No cases
Forecast length
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
100
90
80
70
60
50
40
30
20
10
10
15
20
25
30
35
40
45
50


Selection: EWGLAM using 6 stations
Period: 20140201-20140211
Temperature 100hPa Hours: 00,12
RMSE aib_38h11m
RMSE aib_38h11
CASES
deg C
No cases
Forecast length
2
1.5
1
0.5
0
-0.5
-1
80
70
60
50
40
30
20
10
10
15
20
25
30
35
40
45
50


6 stations Selection: EWGLAM
Temperature Period: 20140201-20140211
Statistics at 12 UTC Used 00,12 + 12 24 36 48
No cases
RMSE aib_38h11m
RMSE aib_38h11
CASES
hPa
deg C
100
120
140
160
180
200
100
200
300
400
500
600
700
800
900
1000
-1
-0.5
0
0.5
1
1.5
2
2.5


div level:10
SETTLS: Upper BC
SETTLS
PC
1e-07
1e-08
1e-09
1e-10
1e-11
1e-12
1e-13
Energy Density
1
10
100
1000
Zonal Wavenumber


SPECTRAL NORMS - 1km Resolution Δt=30
SETTLS: Upper BC
SETTLS
PC
DIVERGENCE
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
0
3
6
9
12
15
18
21
24
Hours