Dynamics status in HARMONIE

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P.L. on dynamics in HIRLAM-B

Overview

- Upper nesting boundary conditions in CY41
- Vertical finite elements
- Weak boundary conditions
- The cubic grid

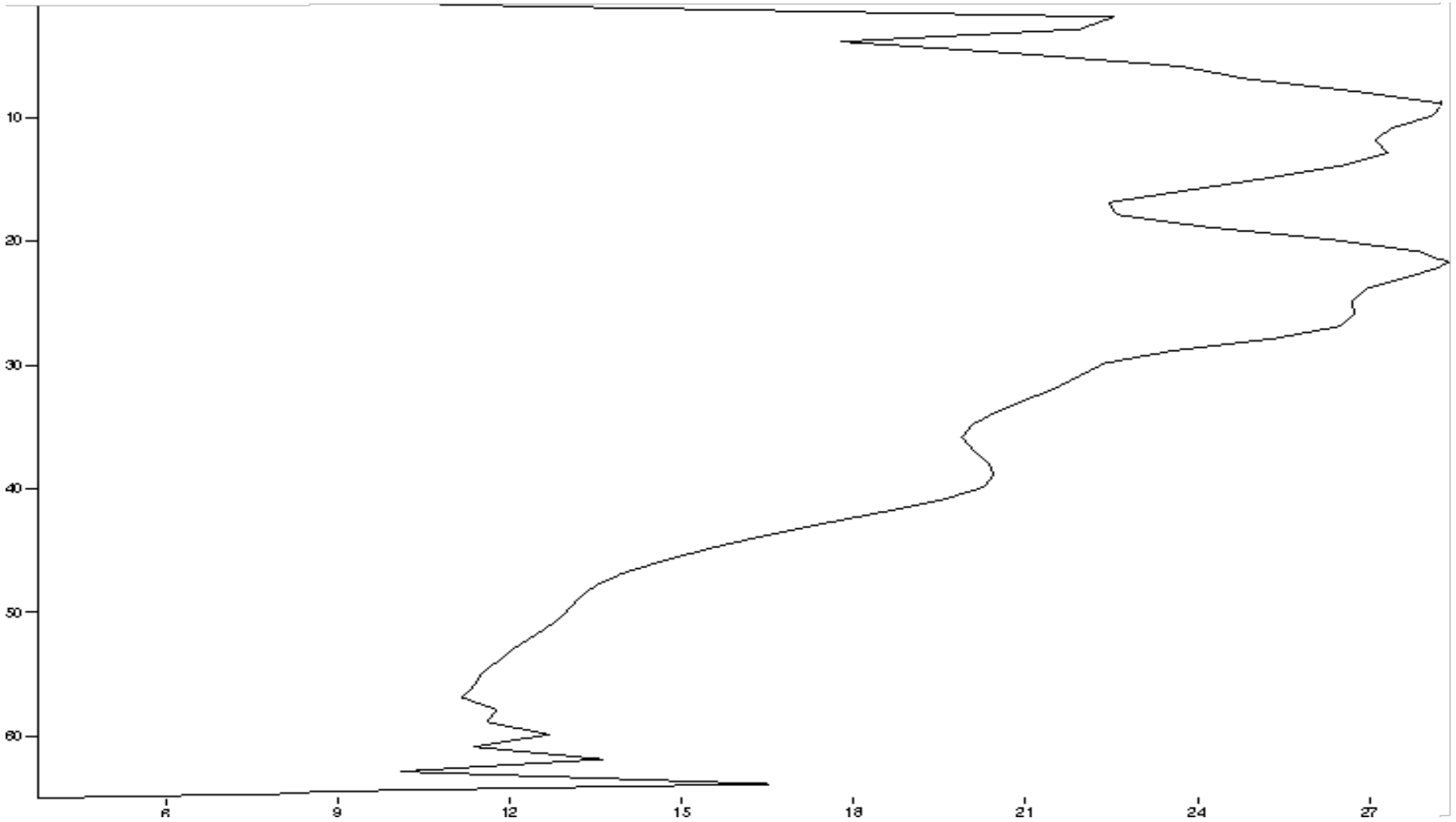
Upper nesting boundary conditions in CY41

- Presented in last year's ASM/ALADIN_WK
- The option LUNBC, to apply upper nesting boundary conditions has been incorporated from CY38h1.2 to CY41h1.alpha.1
- The runs which crashed without its use are stable when the option is switched ON

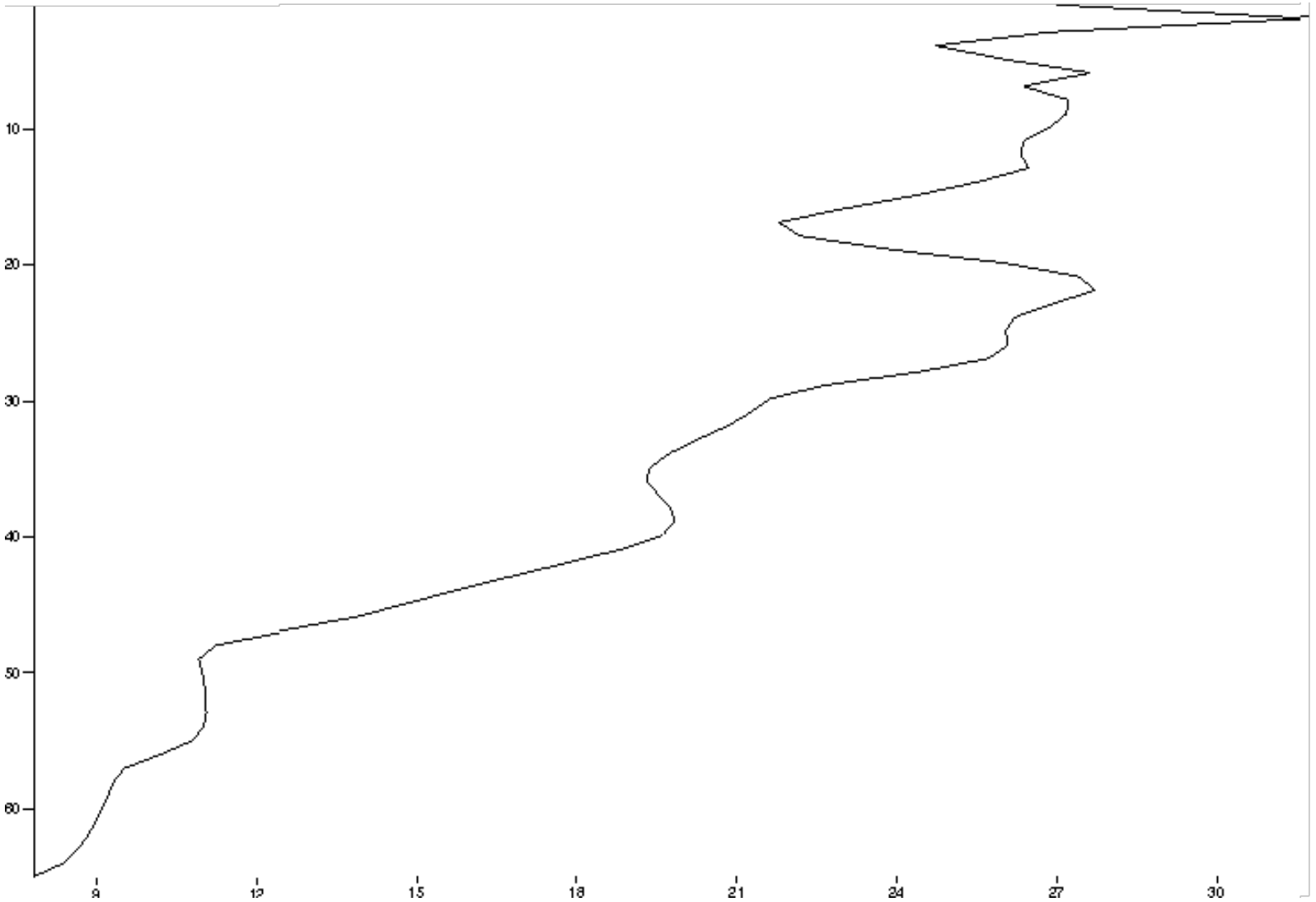
Vertical finite elements

- CY41h1.alpha.1 has been run using LVERTFE (ALADIN version)
- Alvaro has presented the new finite elements to fulfil constraint C1
- No need to use LUNBC to avoid blow-up at the upper levels
- The use of predictor-corrector produces “trajectory underground” warnings very often (also with finite-differences)
- SETTLS found stable with LVERTFE

Low level noise with the PC scheme



Low level noise with the PC scheme (cont)



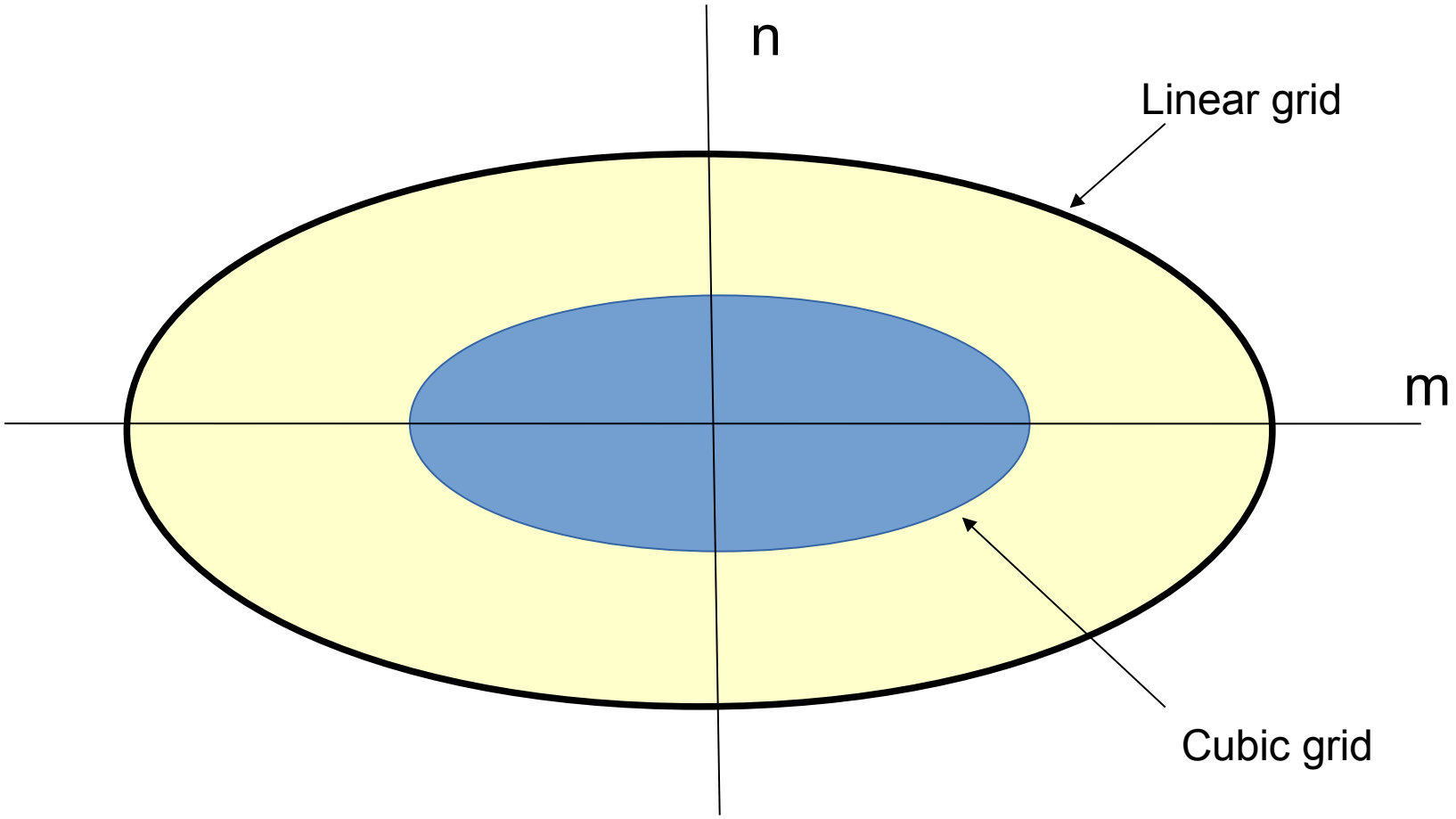
Weak boundary conditions

- A meeting was held in Brussels to initiate a collaboration between ALADIN and HIRLAM in this area
- The continuous and discrete energy method was presented as a tool to analyse the boundary value problem
- Marco Kupiainen has shown that SBP/SAT (summation by parts/ simultaneous approximation term) produces a high-order accurate, stable approximation for the compressible Euler equations
- An implementation on RCA5 confirms the design convergence rate
- With the spectral method, the differentiation matrix does not see the lateral boundaries, therefore it is not clear how to implement the method in HARMONIE
- The application to the upper boundary in HARMONIE is being prepared

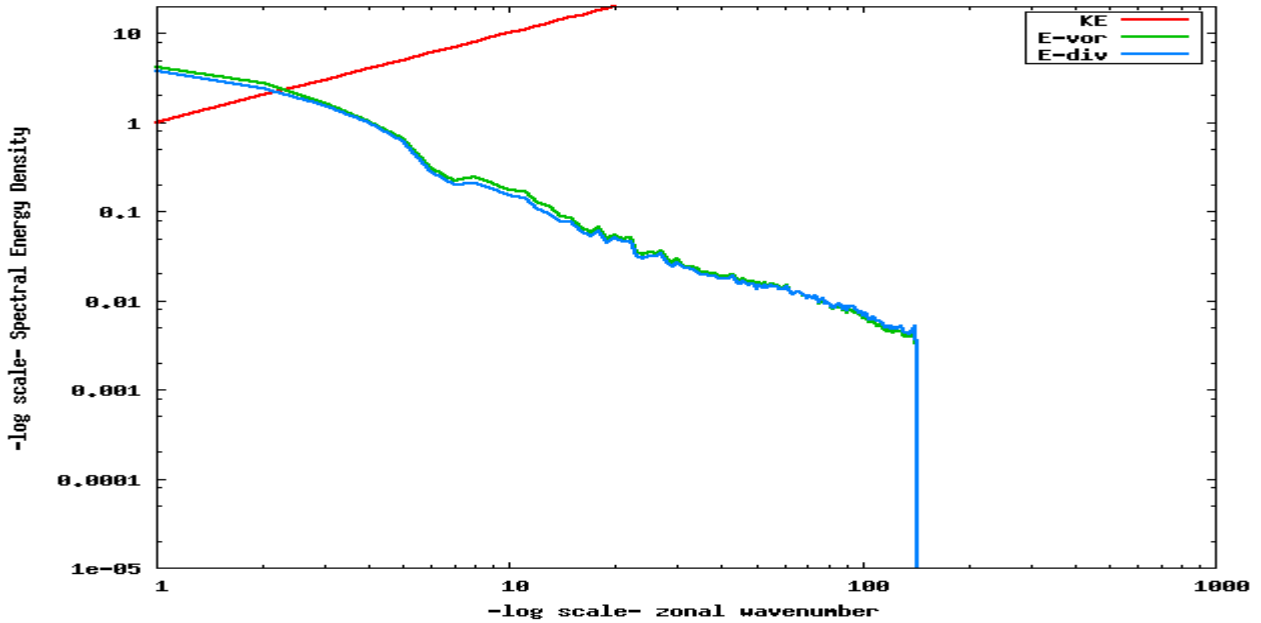
The cubic grid

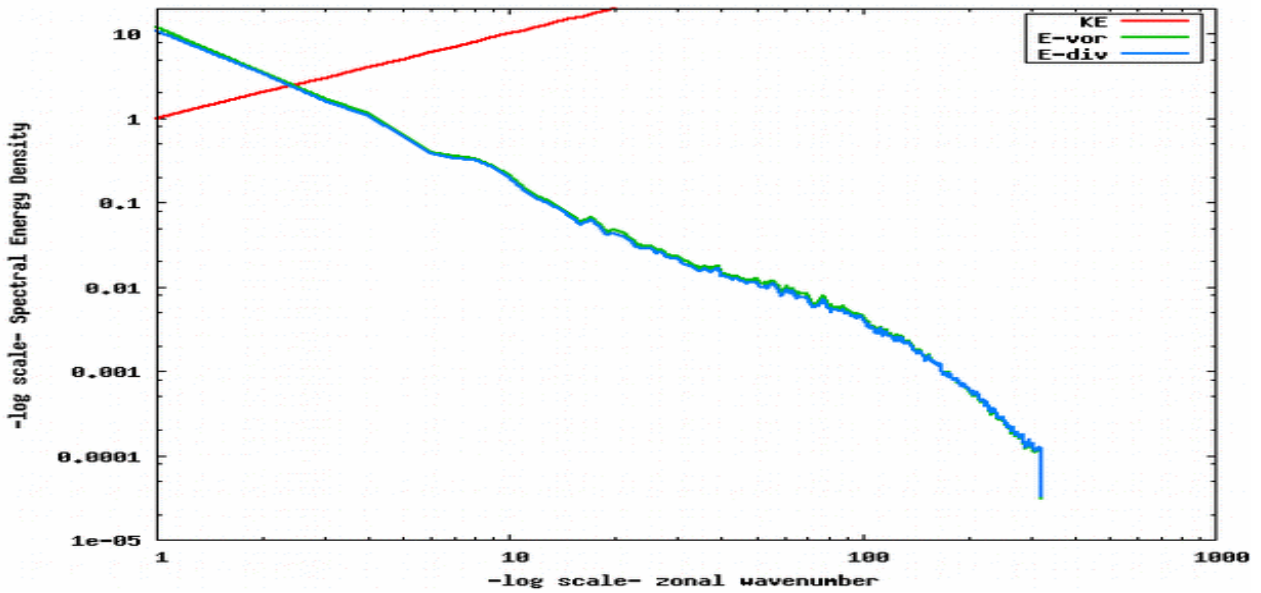
- Following a suggestion from ECMWF, a simulation of a cubic grid has been implemented in CY38h1.2
- This grid eliminates the aliasing of terms up to cubic order
- The only difference with the linear grid is that the spectral truncation is half the one of the former (therefore the CFL limit is double with the cubic grid)
- The distribution of spectral waves among processors is different than with the linear grid
- In the simulation, the distribution is identical to the linear grid, but the shortest waves are nullified
- This practically eliminates the horizontal diffusion
- The option of aliasing elimination LGRADSP becomes redundant

Spectral resolutions for the same g.p. distribution

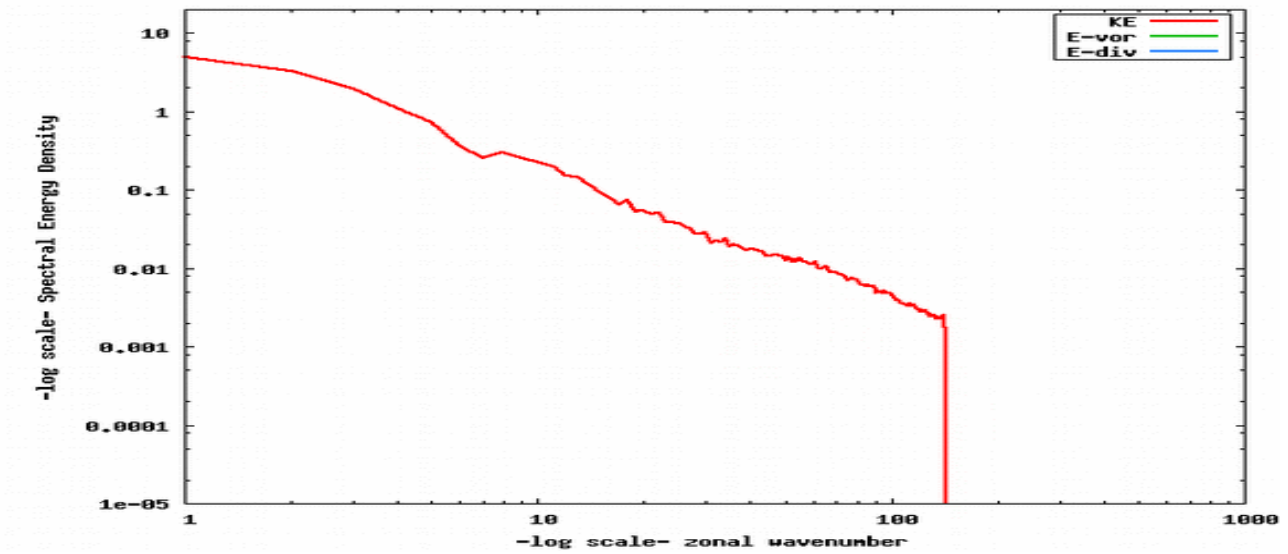


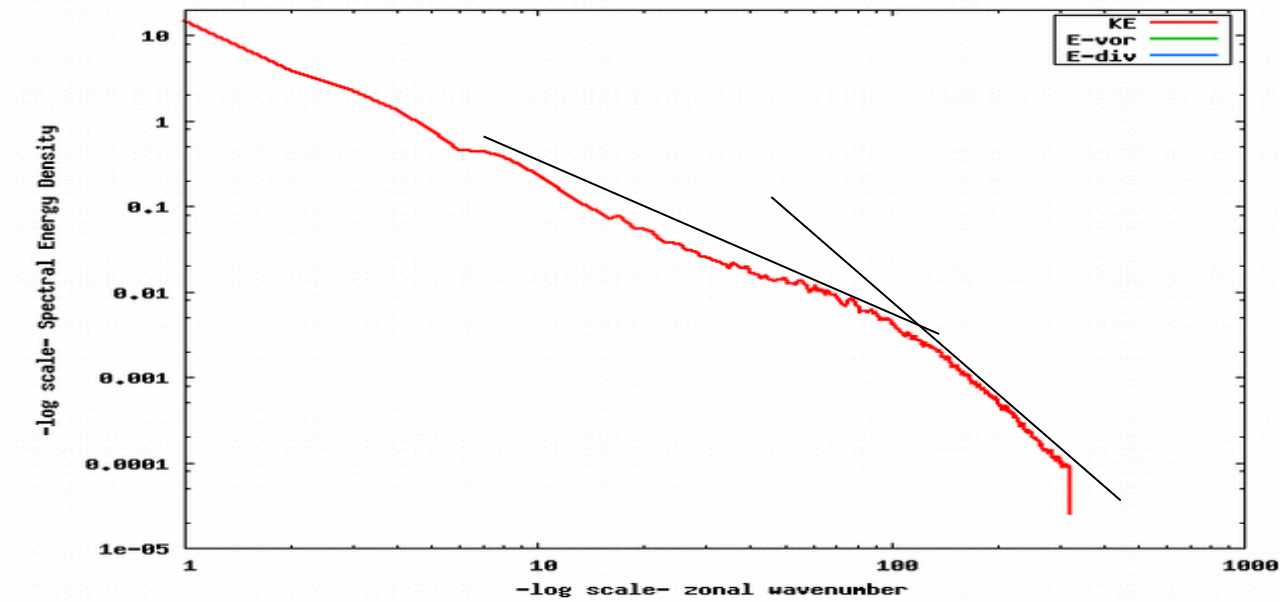
Orography spectra

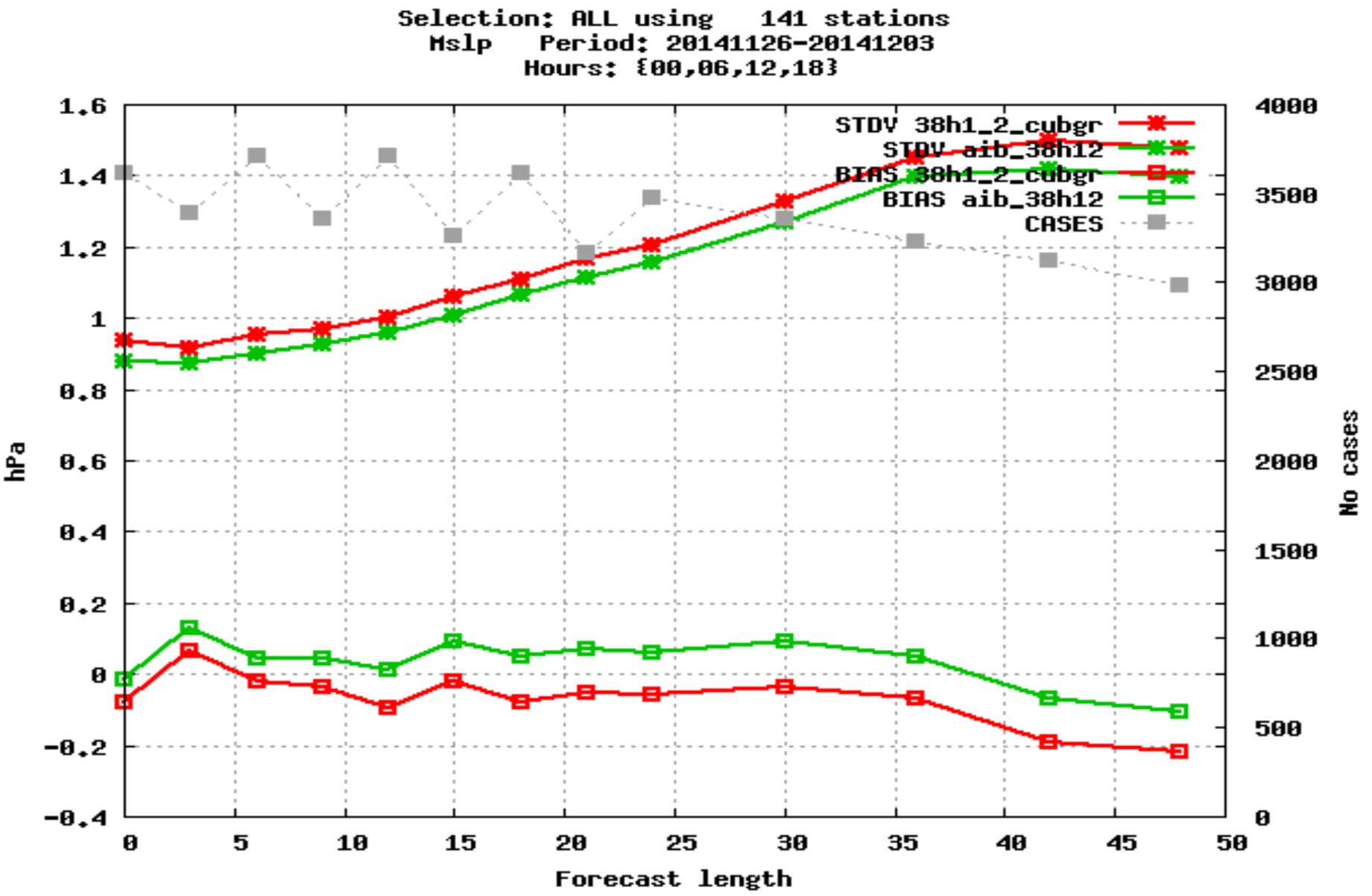




Kinetic energy spectra and effective resolution



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Hours: {00,06,12,18}
STDV 38h1_2_cubgr
STDV aib_38h12
BIAS 38h1_2_cubgr
BIAS aib_38h12
CASES
hPa
No cases
Forecast length
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
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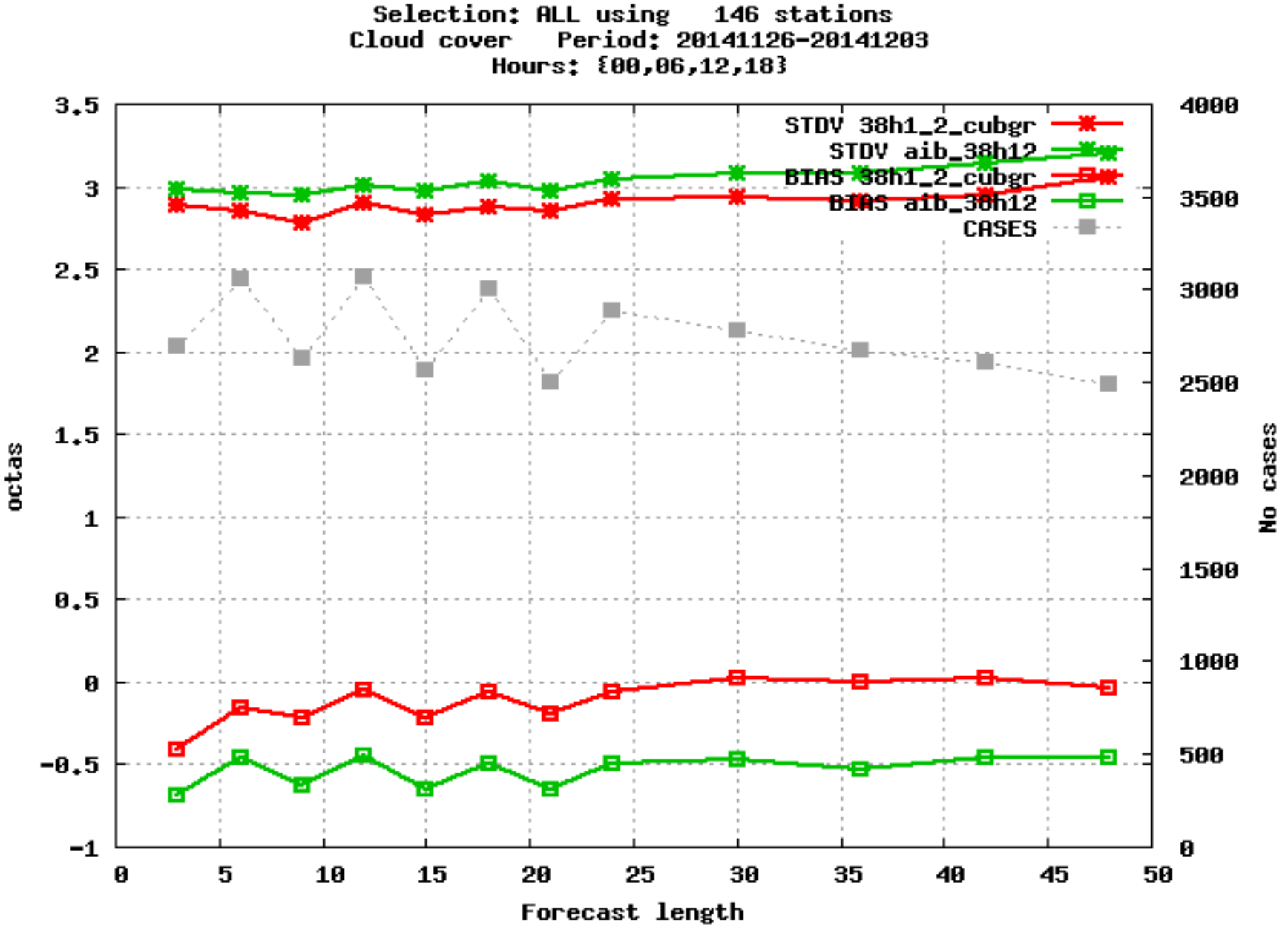
5
10
15
20
25
30
35
40
45
50


Selection: ALL using 146 stations
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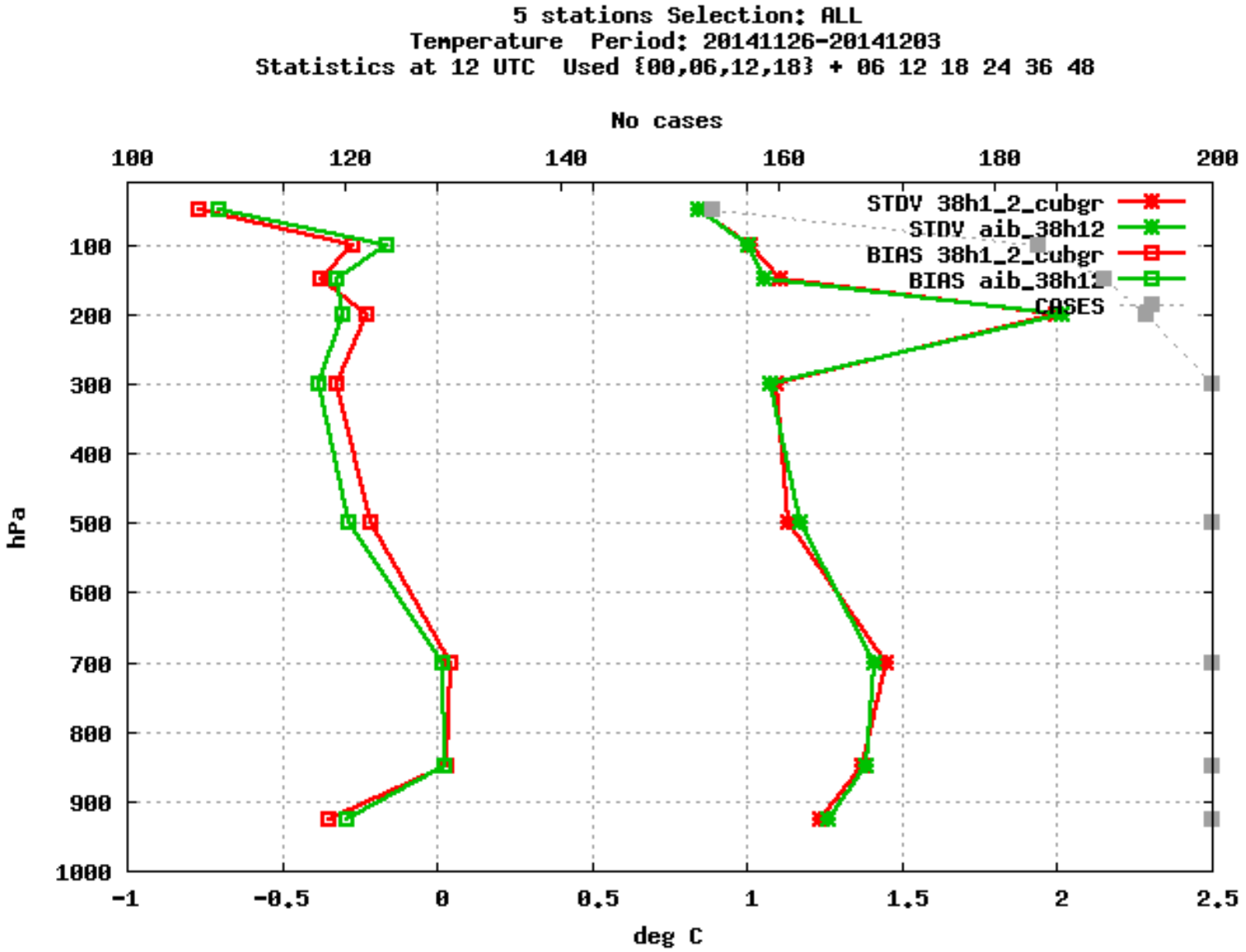
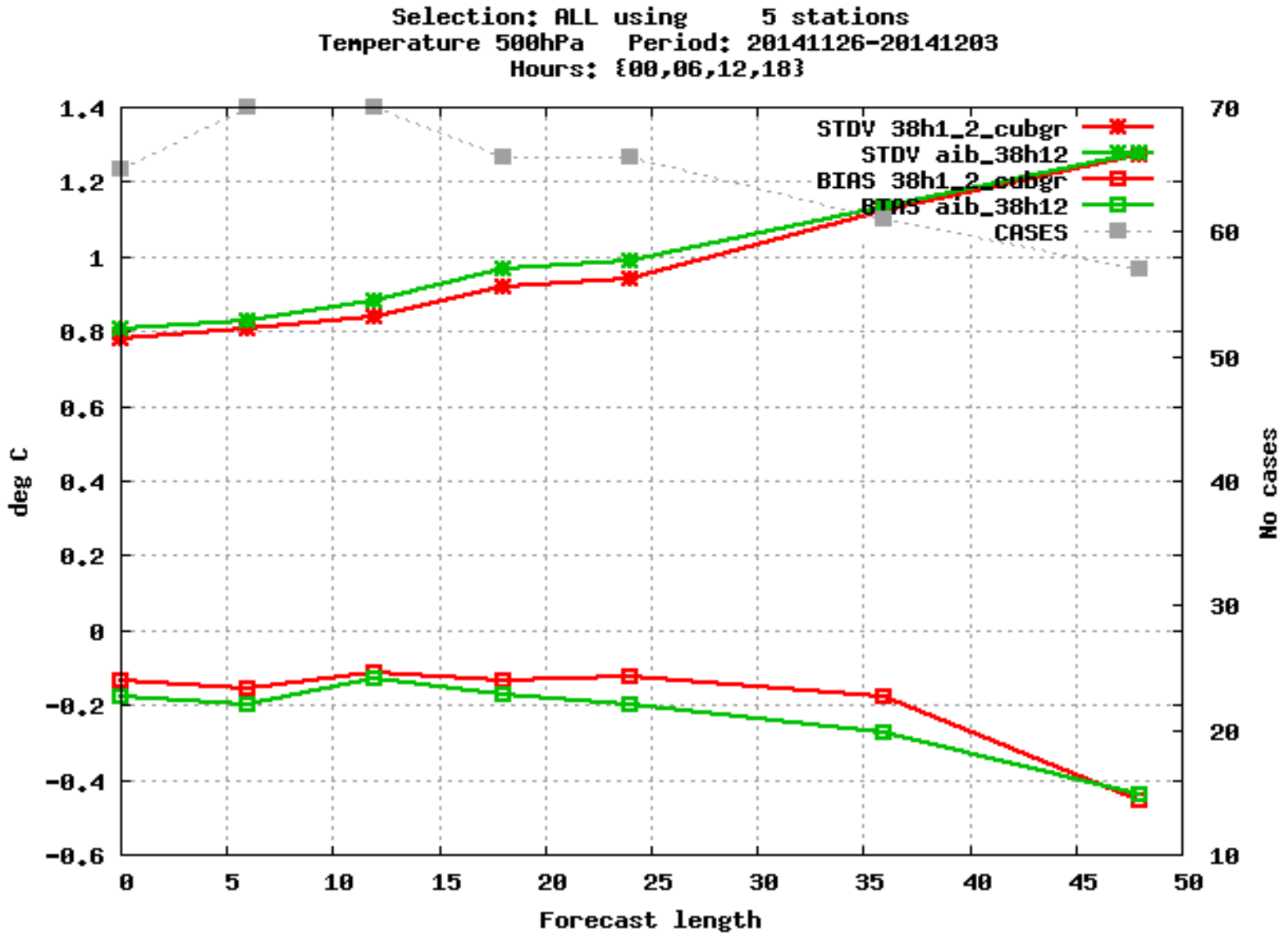
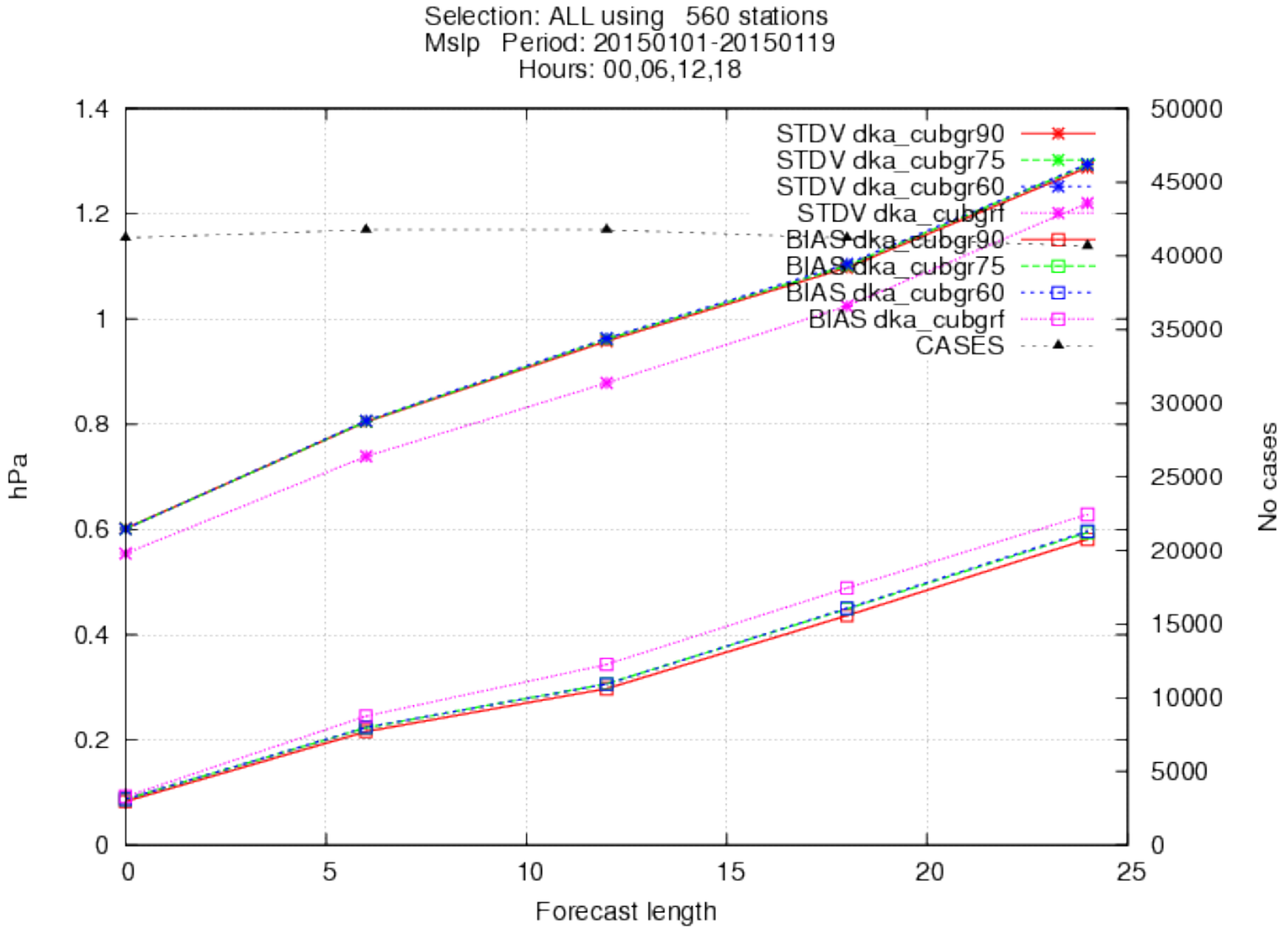
STDV aib_38h12
BIAS 38h1_2_cubgr
BIAS aib_38h12
CASES
octas
No cases
Forecast length
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
45
50

Test Iberia_2.5 20141126 to 20141203




Selection: ALL using 5 stations
Temperature 500hPa Period: 20141126-20141203
Hours: {00,06,12,18}
STDV 38h1_2_cubgr
STDV aib_38h12
BIAS 38h1_2_cubgr
BIAS aib_38h12
CASES
deg C
No cases
Forecast length
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
70
60
50
40
30
20
10
0
5
10
15
20
25
30
35
40
45
50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Hours: 00,06,12,18
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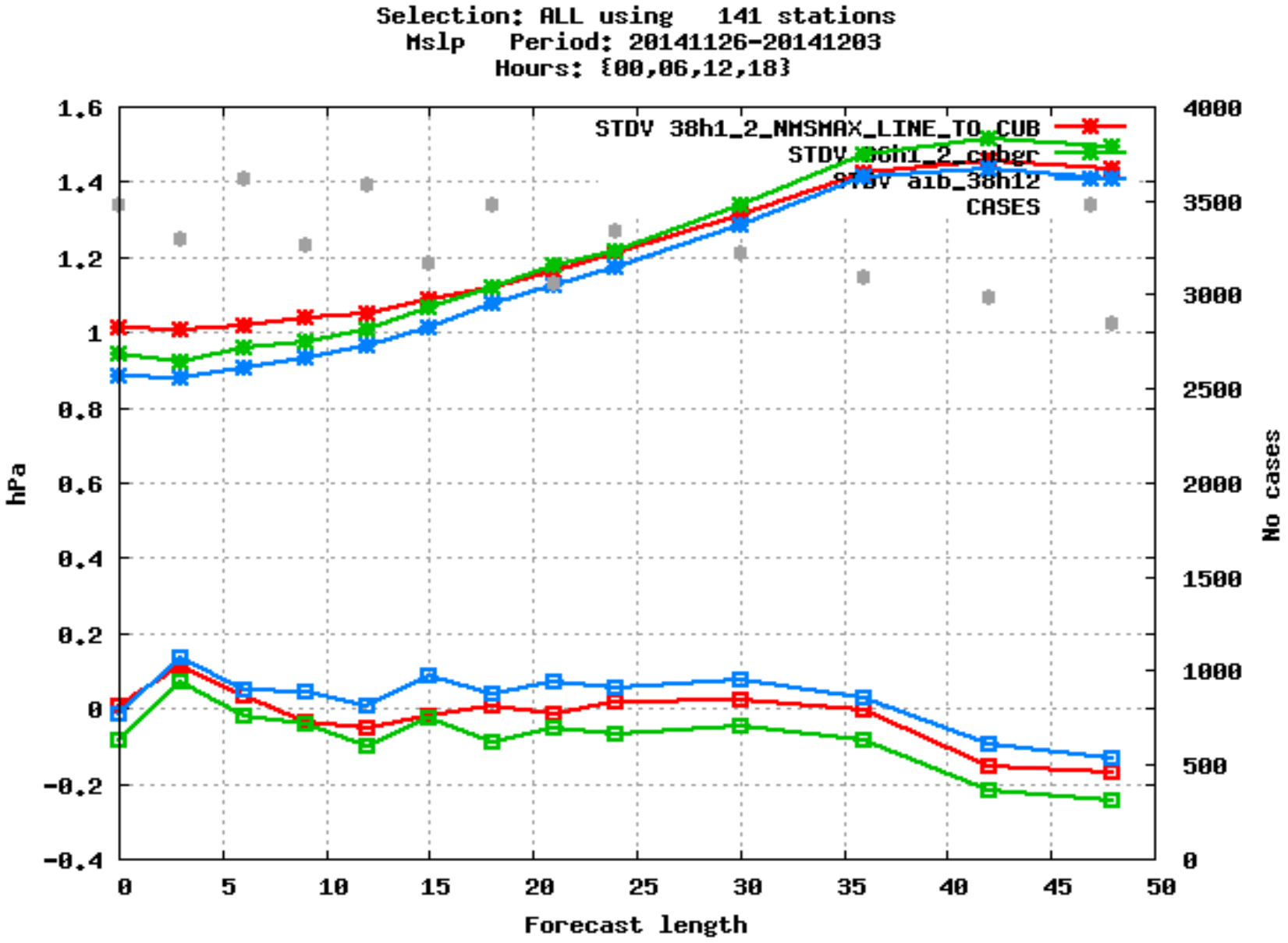
STDV dka_cubgr75
STDV dka_cubgr60
STDV dka_cubgrf
BIAS dka_cubgr90
BIAS dka_cubgr75
BIAS dka_cubgr60
BIAS dka_cubgrf
CASES
hPa
No cases
Forecast length
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
0
5
10
15
20
25

Two different implementations of the cubic grid



Problems using the cubic grid

- Many runs explode during the first few time steps unless I use first order scheme in the trajectory computation and for the non-linear terms for a few timesteps.
- Some unexplained very large values of the Temperature before the Helmholtz solver.
- More investigation needed.

Thanks for your attention