

Background error sampling with wide E-zone

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Background errors are sampled from forecast differences (NMC, or Ensemble methods). In Aladin/Arome these differences are prepared in spectral space given the fact that Jb is mostly computed in spectral space (although besides spectral also gridpoint and Wavelet spaces are involved). The point here is that the spectral differences will include artificial information due to the grid-point values of the Extension zone (E-zone), where physically meaningless biperiodic fields are present. Namely, the direct FFT will introduce waves in the spectral forecast differences, which are based on non-physical gridpoint values. As a consequence, when sampling the B matrix with such forecast differences, artificial errors will be introduced. This feature becomes important when using large E-zones. To get rid of the problem, when preparing the sample for the B matrix computation, we propose to:

- create the forecast differences in spectral space
- transform them to gridpoint space
- relax the forecast differences to zero in the E-zone
- go back to spectral

In order to keep the biperiodicity of the difference fields we had to ensure equal values on the opposite sides of the C + I zone. This was achieved by a relaxation of the differences to zero already inside (on the edges) of the C + I zone (the so called "rim" zone). To do this, the already existing LEVARGP switch was used (ald/var/suevargp.F90). The following figure demonstrates the impact of this relaxation on the temperature field (L49) of the ALADIN/HU model.

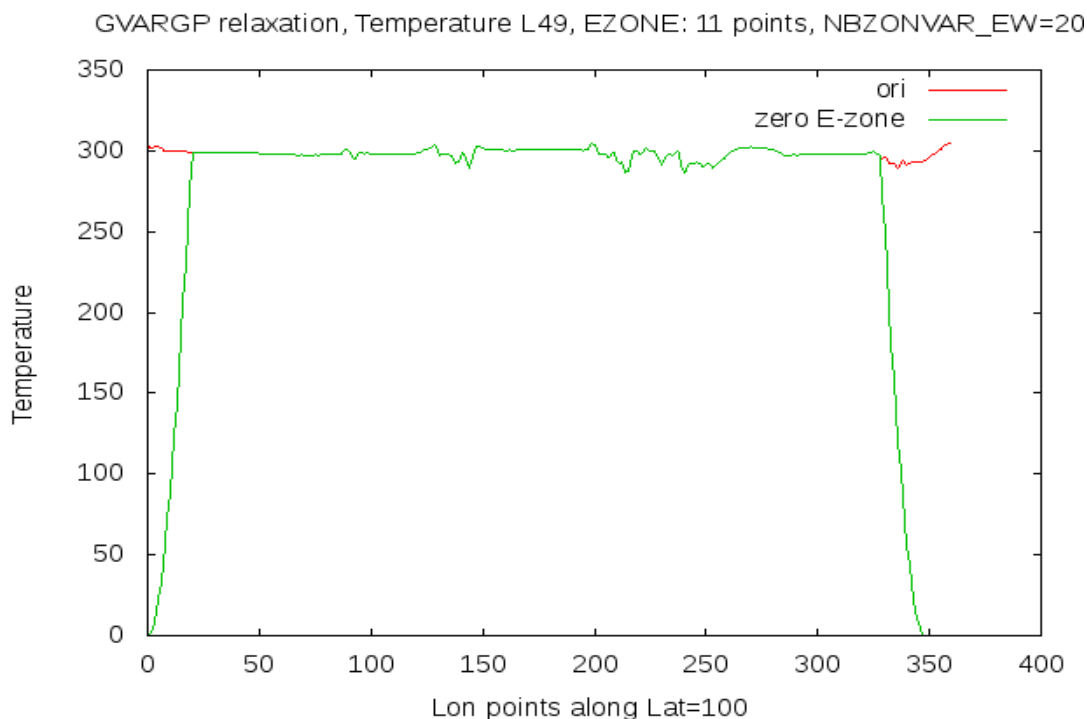


Fig. 1: Temperature of all longitude points for a chosen latitude on model level 49 of the ALADIN/HU model. Red: original, Green: relaxation to zero in the E-zone

The following figures demonstrate the impact of zeroing out the forecast differences in the E-zone. It is done both for sets with usual E-zone (11 points) and with wide E-zone (63 points).

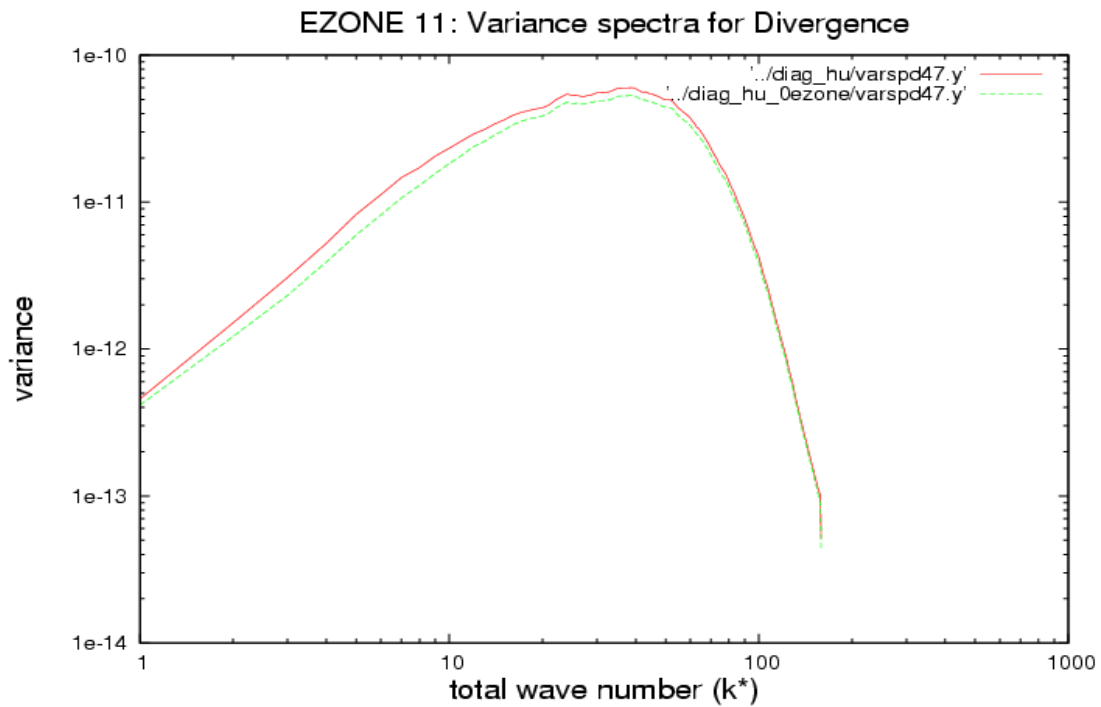
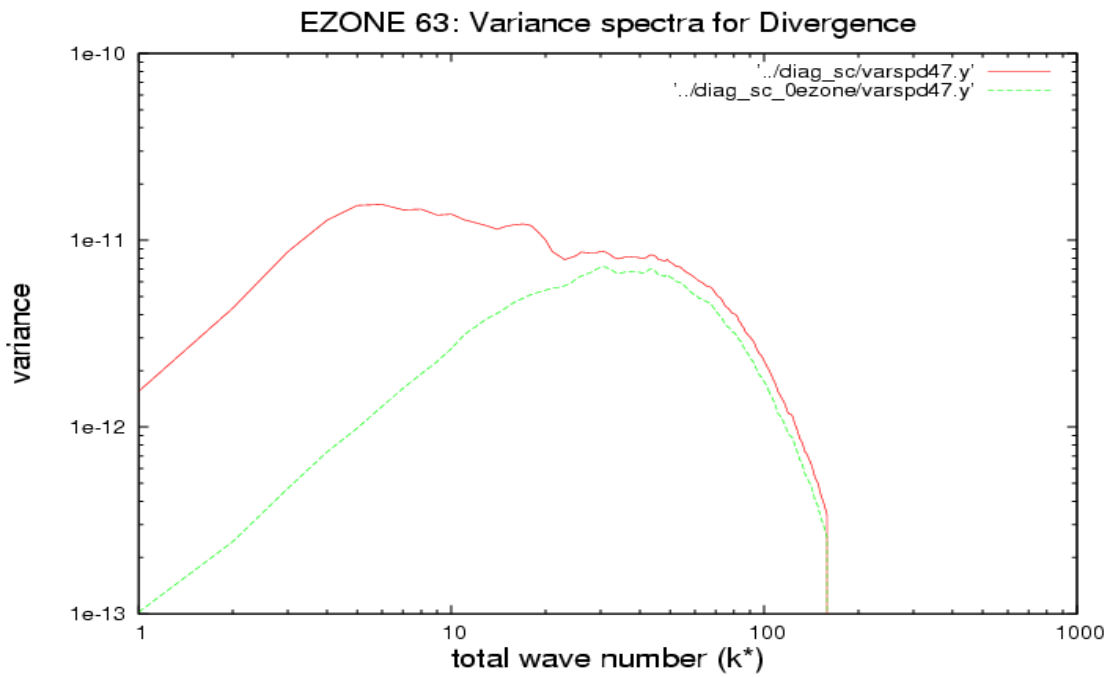


Fig. 2: Background error variance spectra of divergence on model level 47. Red: based on differences with original E-zone, Green: based on differences relaxed to zero in the E-zone. Top: large E-zone, Bottom: usual E-zone

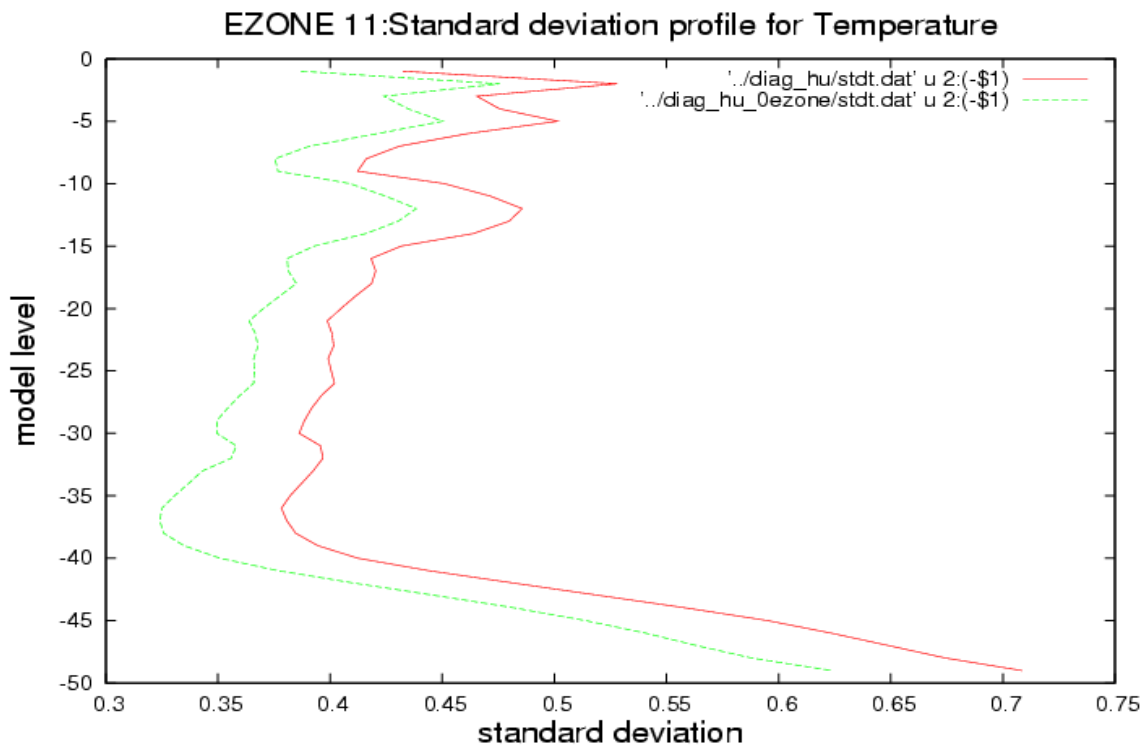
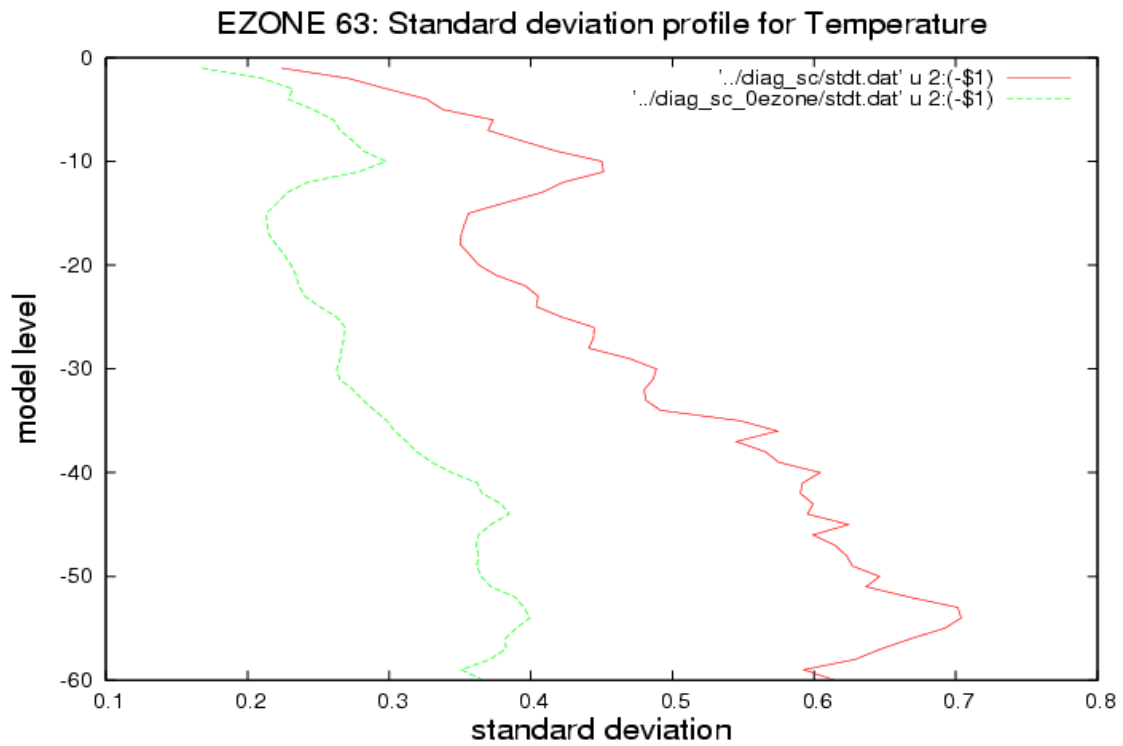


Fig. 3: Background error standard deviation profiles of temperature. Red: based on differences with original E-zone, Green: based on differences relaxed to zero in the E-zone. Top: large E-zone, Bottom: usual E-zone

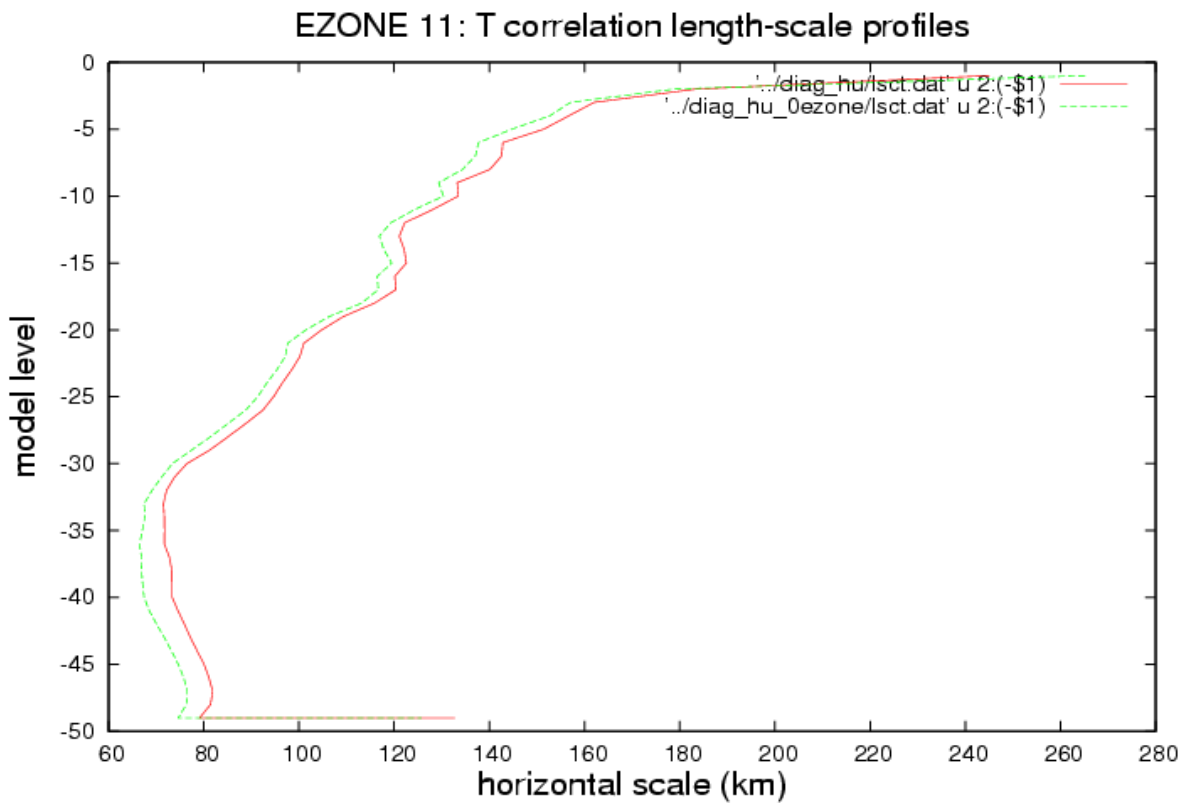
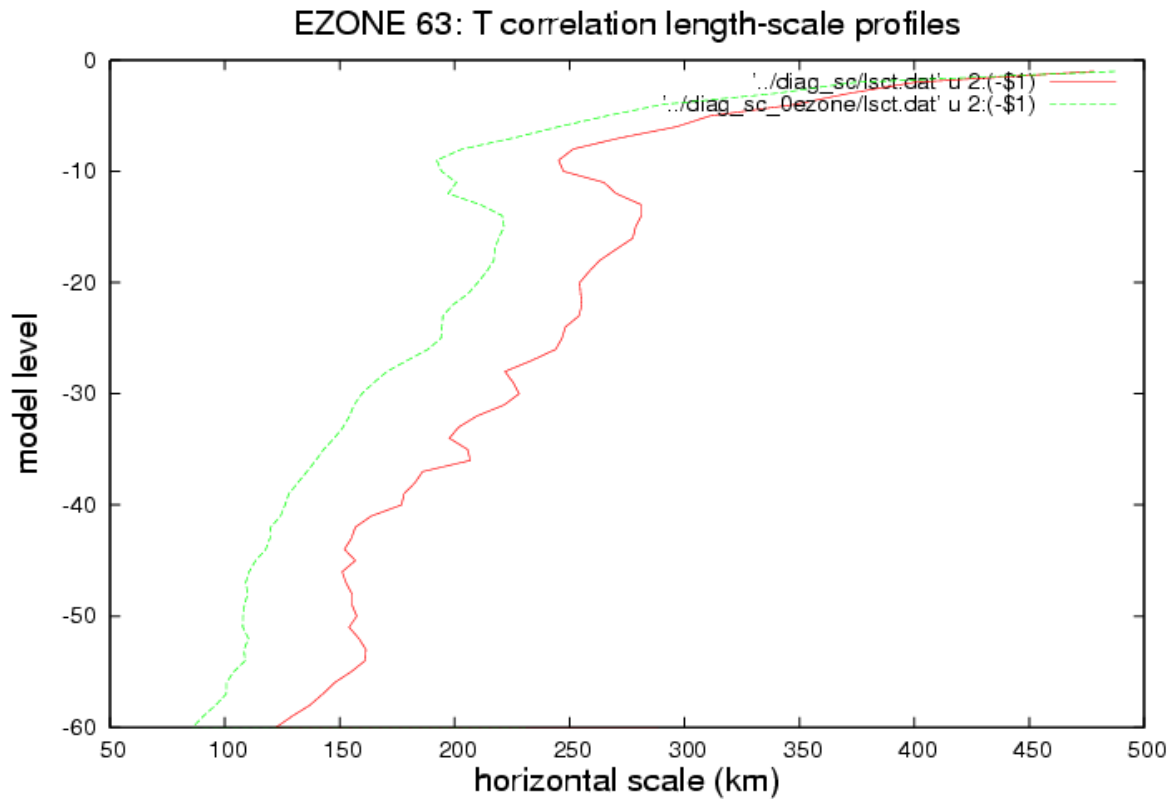


Fig. 4: Background error correlation length-scale profiles of temperature. Red: based on differences with original E-zone, Green: based on differences relaxed to zero in the E-zone. Top: large E-zone, Bottom: normal E-zone

One can conclude based on the above figures that indeed background errors are affected by noise in of the E-zone but it becomes important only in case of large E-zones. Some sensitivity is also present in case of the usual 11 point E-zones in the length-scales, however much less important than in case of large E-zones.

Technical notes:

A program to prepare forecast difference samples for B matrix computation was written with the following aims:

- include option to do the E-zone relaxation to zero
- include option to treat AROME files (q present in gridpoint space in the FA file)
- avoid call for the model time step (which was done earlier as the difference creation was done in CNT3 after calling CNT4)

An example of the program can be found on C1A in the following pack: ~hub/pack/bdiff
This is based on /ms_perm/hirald/pack/36t1_V7gmap3b.01.XLF121.x

The content of the modset is as follows:

- ald/programs/bdiff.F90 - main program
- ald/setup/suect0.F90 - initialize new namelist variables L_ZERO_EZONE, L_GPQ_BDIFF
- arp/module/yemct0.F90 - define the logical variables above
- arp/ald_inc/namelist/nemct0.h - include the above variables to namelist
- arp/setup/suctrl_gflattr.F90 - avoid abort due to LSPRT=.F. and YQ_NL%LGP=.T. if L_GPQ_BDIFF
- L_ZERO_EZONE: default is F, if set to T, then the differences are relaxed to 0 through the rim zone defined by SUEVARGP and NEMVAR
- L_GPQ_BDIFF: default is F, if set to T then an abort is avoided in SUCTRL_GFLATTR, which does not let to use LSPRT=.F. and YQ_NL%LGP=.T. together. Note that in case of AROME we need these 2 switches together because we want T in the diff files (not R*T) and we have Q in GP space...
- a bit more explanation is written in ald/programs/bdiff.F90

Necessary namelist settings:

NAMGFL:

YQ_NL%LGP=.T. - means q present in GP space (default F)

YQ_NL%LSP=.F. - means q not present in SP space, maybe it is not really needed but i put there for safety(default T)

NEMCT0:

L_GPQ_BDIFF=.T. - means that you want to use LSPRT=.F. with YQ_NL%LGP=.T. together, which is normally forbidden in the model integration (suctr_gflattr.F90)

NEMVAR:

These settings are related to the relaxation to zero in the "rim" and E-zones. What is called the "rim" zone is a few gridpoints on the borders of the C+I zone where the smooth relaxation

is done. The namelist settings are:

NBZONVAR_EW=20,- "size" of the "rim" zone in no. of gridpoints (as larger as smoother, but also using more from C+I)

EXPVAR=1.0, - defines the shape of the relaxation

EVAREPSILON=1.E-10, - the value to which the differences are relaxed/reduced in the "rim" and E-zone (can't be exact 0 otherwise SUEVARG aborts on purpose)

LEVARGP=.TRUE., - switch for "activating" the relaxation in SUEVARGP