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Geoscientific Model Development Discussions

Interactive comment on "The impact of periodization methods on the kinetic energy spectra for limited-area numerical weather prediction models" *by* V. Blažica et al.

V. Blažica et al.

vanja.blazica@gmail.com

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We would like to thank Referee #4 for his/her comments and suggestions for the paper improvement. In response to the comments, some additional changes to the paper have been made to correct the errors and provide better clarity.

Replies to the specific comments and questions are provided below using the same organization as in posted interactive comments. The referee comments are italicized.

1. In Figure 1, it would be better to show (or to add) spectra computed in free troposphere rather than in the stratosphere as the paper deals with mesoscale NWP models with a focus on the $k^{-5/3}$ dependence (as described by the authors for example in their

introduction or later for generating the random wind fields that obey the $k^{-5/3}$ KE distribution). Clearly, the spectra shown in Figure 1 follow a k^{-3} dependence in the large scales but the transition to a $k^{-5/3}$ is only weakly discernible. This transition would be better represented for spectra calculated in the free troposphere. k^{-3} and $k^{-5/3}$ should be mentioned in the legend of Figure 1 as they are represented in Figure 1. (a) and (b) should be indicated in Figure 1 as Figure 1a and Figure 1b are mentioned in the text.

The reason we plot spectra in the stratosphere is that the effect is most noticeable there (see below the same plot for the free troposphere as part of this response). We now additionally stress that in Conclusions by rephrasing the third bullet: "In many HIRLAM and ALADIN applications, the impact of periodization may pass nearly unnoticed in the spectra as extension zones are usually narrow and prognostic fields have large amplitudes at scales most affected by the E-zone. This primarily applies to the fields in the planetary boundary layer and to a smaller extent to fields in the troposphere. It does not apply to stratospheric circulation dominated by large-scale waves, as illustrated in Fig. 1."

We removed referencing to Fig. 1a and 1b from the text and added $k^{-5/3}$ and k^{-3} to the figure and to the figure caption, as suggested.

2. The difference between the impact of the two widths (11 and 25 points) for the E-zone seems to disappear above about 250-300 km instead of 200 km.

The text has been changed in accordance with the suggestion.

3. The "erf" function is not mentioned in formula (7).

The "erf" was missing because of our error, the equation is now corrected.

4. p6497 section 2.2 "... although the reasons are not clear." Could you give some assumptions about that?

The text has been changed to reflect that model calculations can be influenced by the extrapolated values in extension zone through, for example, spectral calculations of

derivatives.

*5. section 2.5 "Figure 3 ... for each of the discussed methods." In fact, for each method except for DCT, indeed as mentioned in the legend, DCT is not included in Figure 3. It should be interesting to include it in a Figure 3b by adding the mirror image of the wind field ; otherwise, at least change the text in section 2.5. It is not clear in the text if the detrending method is applied on the entire domain (60 points * 60 points) or only on the reduced domain (60-18 points * 60 -18 points). From Figures 3 and 4, I suppose it is applied on the entire domain. This is also consistent with section 3 where we can read "Note that the outer domain remains the same for all the discussed methods." DCT and detrending methods are applied on the entire domain (60 points*60 points in section 2.5, 432 points*432 points in sections 3,4), is it correct?*

Regarding the DCT method in Figure 3, we corrected the text as suggested. Regarding the application of the detrending method, we added a sentence in section 2.5 to make the text clearer: "... all the methods were applied to an arbitrary field with a small domain and a large extension zone (60×60 grid points, with 18 points in the extension zone). The detrending method, which does not require an extension zone, was applied on the entire domain (60×60 grid points)."

6. In the continuation of the previous comment, it is not clear what has been done for Figure 1b. Figure 1b compares spectra with E-zone (entire domain with 11 points of the E-Zone) and detrended spectra for real fields. I suppose that the detrended spectra are computed over the ALADIN domain minus 11 points, i.e. only over the physical zone). It should be noted that the domains for computing the spectra do not have strictly the same size.

Yes, the detrended spectra are computed on a slightly smaller domain (in the specific case the physical zone was 439×421 points compared to 450×432 points with the extension zone included). For this reason the dependency is shown with wavelength and not with wavenumber, so that the spectra are aligned. Because Figure 1 is shown

for illustrative (or motivational) purpose, we do not explain the experiments in more detail. We however added a reference to the study at the end of the paragraph: "Further details on this aspect are available in Blažica et al., 2013."

7. Section 3. last paragraph. I agree with the authors about the possible advantages by using artificial fields for the detrending method and the Boyd method although these effects are probably weak. These possible advantages should be briefly recalled in the conclusion with a sentence.

We have now made our comments less strong on the possible advantages for the Boyd and detrending methods, and we consider that it is not necessary to mention these "speculations" in the conclusions.

8. Small corrections:

- *p6493, section 2: The latter two are ... –> The latter two methods are ...*
- *p6496, section 2.1: the first sentence is not clear (in particular "models" is repeated twice).*
- *P6500 section 4: While the Boyd and the detrending method ... –> While the Boyd and the detrending methods ...*

We revised the paper according to the suggested corrections and made the text clearer. We thank the referee for his/her thorough reading.

Yours sincerely,

V. Blažica, N. Gustafsson, and N. Žagar

Interactive comment on Geosci. Model Dev. Discuss., 7, 6489, 2014.

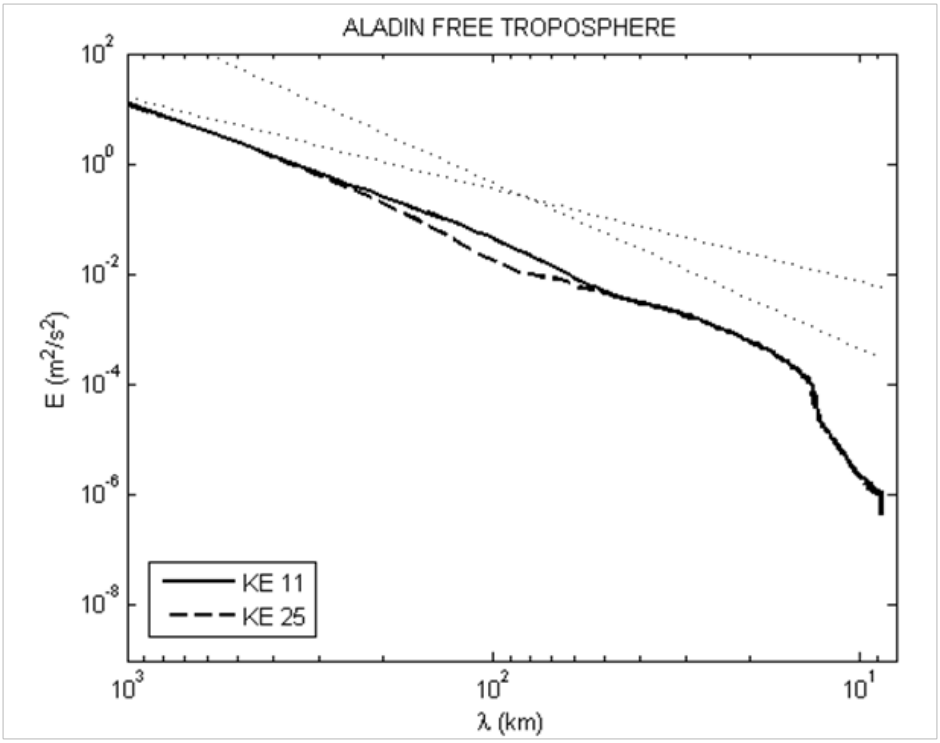

Fig. 1.