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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.

Anonymous Referee #4

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Recommendation: accept with minor revisions

This paper aims to evaluate 5 different methods of periodization of meteorological fields for limited-area models in order to compute kinetic energy (KE) spectra:

- the discrete cosine transform (DCT) method,

- the detrending method,

- the application of an extension zone using trigonometric functions (HIRLAM method), spline functions (ALADIN method), or infinitely differentiable windowing functions (Boyd method).

In particular, the impact of the extension zone (used in the ALADIN, HIRLAM, and Boyd methods) on the spectra is deeply analyzed. For that, random wind fields that obey the kˆ-5/3 dependence are used, this allows a comparison of these different methods for an idealized flow with a known KE spectrum. This study is very relevant for the community using spectral models. The contamination of the spectra by the E-zone is known, at least in the ALADIN/AROME community. This is the reason why a new tool has been developed based on DCT in Ricard et al, 2013 instead of using the standard EDF tool from the PINUTS library that uses the spectral fields from the FFT to compute spectra. Thus, the problem is not new but this study gives some interesting insights to explain and document this contamination by using artificial fields and testing several widths for the E-zone. Moreover, this study generalizes this issue by comparing several periodization methods. I have really appreciated this systematic comparison between these 5 methods and the analysis of the structure of spectra from 1D spectra averaged only in the E-zone (from Nyi+1 to Ny) or only in the physical field (from 1 to Nyi).

To resume, this paper is well written, the methodology is well explained and the results are very interesting. Thus, I think this paper is suitable for GMDD publication with minor revisions. I recommend to implement the following specific comments.

Specific comments:

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 kˆ-5/3 dependence (as described by the authors for example in their introduction or later for generating the random wind fields that obey the kˆ-5/3 KE distribution). Clearly, the spectra shown in Figure 1 follow a kˆ-3 dependence in the large scales but the transition to a kˆ-5/3 is only weakly discernible. This transition would be better represented for spectra calculated in the free troposphere. kˆ-3 and kˆ-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.

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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.

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

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

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?

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.

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.

Small corrections:

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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 ...

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