Review of “Using spectral analysis to detect singular events such as jerks in the geomagnetic field time series” by B. Duka et al, submitted to Solid Earth Discussions

General comments:

This paper deals with the spatial extension of geomagnetic jerks at the Earth's surface and the detection of such events in time series from observatories data and from synthetic data computed from magnetic field models. The paper presents some well-known methods which are applied onto both real and synthetic data.

The two main results of this paper are: the possible preferable four longitudinal paths for the occurrence of the geomagnetic jerks and the possibility that the jerks are more dominant in the odd spherical harmonic degrees.

However, I am afraid that some characteristics of the main field geomagnetic models have not been taken into account and directly impact onto the results given in this paper.

Specific and Technical comments:

- Page 617, Introduction, line 0 to 5:

The definition of geomagnetic jerks by Courtillot et al.(1978) was slightly upgraded by the work done in Alexandrescu et al. (1996). Indeed the regularity of the event is not seen as 2 but closer to 1.5. Please, slightly correct the definition accordingly.

- Page 617, Introduction, line 28 to 29:

The third method proposed appears to be power spectra of the secular acceleration Gauss coefficients along with time. The term *“spatial spectral analysis in spherical harmonics”* appears confusing here.

- Page 618, section 2, line 7:

“The first king of dataset is superior (...)”

The adjective *“superior”* is not properly chosen here. The data are not superior. Their nature is different. Some data are real, direct measurements of the field, whereas the other type of data are synthetic ones, computed from geomagnetic field models.

- Page 618, section 2, line 11:

“*In addition, some synthetic data have been generated by means of specific functions to simulate geomagnetic jerks (...)”*

What are these specific functions ?

- Page 619, sub-section 2.1.1 :

This sub-section is a recall of what was extensively already underline in many papers. I do not think this recall is necessary here.

The associated Figure 1 may be advantageously summed up in only 6 panels by overlapping the monthly and yearly data series. The monthly ones been scattered in front on the yearly ones, obviously.

- Page 619, sub-section 2.1.2:

This sub-section may be directly added to the section 2.1. The sub-levels are not necessary here.

- Page 619, sub-section 2.1.2, line 18:

What are the longer and shorter times series ? What are the chosen duration thresholds for the selection of observatories data ?

- Page 619, sub-section 2.1.2, line 20 and 21:

Please, erase the sentence:

"Although all the components of geomagnetic field have been studied, we will present below mainly the results for the Y-component."

The fact that the authors considered the Y component, as the clearer component for describing the geomagnetic jerks, has already been explained extensively (page 617, line 11 to 15).

- Page 620, sub-section 2.2.1, line 13 to 15:

"The capacity of this model to represent geomagnetic jerks has been already investigated (Sabaka et al., 2002; Chambodut & Mandea., 2005). "

The limitation of the model to represent the geomagnetic jerks has also been investigated. Indeed, time-dependant geomagnetic field models, such as CM4, are using B-splines modeling for the time-dependency of the Gauss coefficients. Thus, the position of the B-splines nodes will necessarily appear in any wavelet analysis of a synthetic series calculated from such model (That was the reason why wavelet analysis were only performed onto real data in Chambodut & Mandea (2005)).

- Page 621, sub-section 3.1.1:

This part is extremely similar to textbook material, it would be better to place it in an appendix.

- Page 621, sub-section 3.1.1, line 21:

“Its obvious that considering (...)”

Please, if this is obvious, DO NOT indicate it.

- Page 622-623, sub-section 3.1.2.:

Onto Figure 2, please, indicate the data analyzed (first difference of the synthetic signal) under its spectrogram.

- Page 623-624, sub-section 3.1.3:

Onto Figure 3, please, indicate the data analyzed (first difference of the Y component at NGK observatory) under its spectrogram.

- Page 623, sub-section 3.1.3, line 21:

“Its obvious that spectrograms (...)”

Please, if this is obvious, DO NOT indicate it.

- Page 623, sub-section 3.1.3, 22, footnote number 1:

If an element is not presented here, there is no need to explain anything about it. If you would kike to explain the *“shift toward the higher frequencies”,* please, show the spectrogram of the SA.

- Page 624, sub-section 3.1.4, line 7 to 22:

The topic of the running-average to avoid noisy signals has already been extensively discussed in the literature and particularly in the geomagnetic jerks' literature. This part may be erased.

The associated Figure 4 is useless. This figure even jeopardizes your demonstration : Indeed, why to apply STFT and calculate spectrograms whereas the 12-month running-average onto data is sufficient to see the date of jerks occurrence? What is the final aim of such an application in this paper?

- Page 624-625, sub-section 3.1.4, from page 624 line 23 to page 625 line 22:

Why speaking about “Huber average” if you conclude that you cannot *“gain too much in the cleaning of the data by using a new method of averaging”*? The interest of this paragraph is difficult to handle.

- Page 625-626-627-628, sub-section 3.2.1:

This part is extremely similar to textbook material, it would be better to place it in an appendix.

Please, consider also other references such as:

- Grossmann A, Holschneider M, Kronland-Martinet R and Morlet J 1987 Detection of abrupt changes in sound signals with the help of wavelet transforms Inverse Problems: An Interdisciplinary Study (Adv. Electron. Electron. Phys. 19) (San Diego, CA: Academic) pp 298-306.
- Holschneider M 1995 Wavelets: An Analysis Tool(Oxford: Oxford University Press)
- Meyer – 1992, Wavelets and operators
- Meyer – 1993, Wavelets: Algorithms and Applications.

- Page 629-630:

What is the interest of using wavelets to de-noise the signal ?

Some methods such as the one proposed in Alexandrescu et al.(1995) directly analyzed the monthly means series, the time of occurrence is determined together with the regularity of the event.

The present method needs the calculation of the derivative (SV) then its de-noising before the spectrogram computation.

Please, what are the benefits and scientific advances of such a method?

- All spectrogram Figures:

Please, for each figure, indicate from which method is computed the spectrogram. Indeed, the STFT show breakdowns of the spectrogram at the time of jerks (Figures 2, 3 and 5), whereas the DWT show a maxima of the spectrograms (Figures 6 and 7).

- Figure 7:

The API spectrogram does not get the same abscissa as the de-noised signal presented above it.

- Figure 10:

Please, replace the green square that covers the lowest part of the graph by a dashed line at the average value of d1 coefficients. I would like very much to see the hidden part.

- Page 633-634-635, sub-section 3.2.4. and Figure 11:

Did you check that the DWT does not extract preferably the nodes time used in the B-spline construction of the model?

Indeed, the CM4 model is using B-splines of order 5, whose 21 nodes are separated by 2.5 years. The Gauss coefficients are calculated up to order 4 derivative.

The Gufm1 model is using B-splines of order 4, whose 163 nodes are separated by 2.5 years.

May the lowest order of the B-splines introduce an apparent “better analysis” for the Gufm1 model (page 634, line 7 to 9) rather than the effect of the longer synthetic time series ?

- Page 635-636-637, Sub-section 3.3:

The table 2 does not appear convincing especially when the Figure 12 is observed in parallel.

Would it be possible that the B-splines nodes appear, may be superimposed to a real signal?

Would it be possible to give a more neutral, objective and factual explanation?

What would be the reason for a particular signature of geomagnetic jerks into the odd spherical harmonic degrees rather than the even? The authors are saying that this question is beyond the scope of this paper (page 636, line 24 to 29), nevertheless what are the assumptions of the authors?

- Page 637-638, section 4:

A too large part is given to the supplemental material (movie). The main results have to be recall, especially the position and possible nature of the preferable four longitudinal paths for the occurrence of the geomagnetic jerks and the possibility that the jerks are more dominant in the odd spherical harmonic degrees.