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Solid Earth Discussions

Interactive comment on "Geomagnetic jerks characterization via spectral analysis" *by* B. Duka et al.

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[1] We also think that there are more unknowns on geomagnetic jerk phenomena than those could be revealed by our paper or other papers recently published. Therefore, it is important to continue investigations of jerks with different methods and datasets.

[2] We regret missing to refer to the three indicated papers, and thank for pointing us about. We now cite all these papers in the revised version of our paper. By the way, the Pinheiro and al. paper ("Occurrence time of Jerks... GGG2011) is an accurate study of the known jerks (1969, 1978, 1991, 1999) over almost all ground observatories. We now point out the differences between our results and theirs regarding the 1991 and 1999 events.

[3] The technique of de-noising SV used in your paper (Wardinski & Holme, GJI 2011) is more physically justified than our technique (using wavelets). We emphasize this in our revised version. As you suggest, we would be indeed interested to study what would happen with spectrograms and wavelet decompositions after correcting time series for physical signals, such as coming from ring current and induction. This will be, however, a new study.

[4] We agree that the third derivative of the field is a sensible tool to look at jerks and the model construction has effects on it. The SV or SA spectra (Fig. 8 of "Holme, Olsen and Bairstow", 2011) show strong effects of damping at degree 4 and above. We think this effect is more important for the early years of the model, in our case (CM4 model) for 1960-1962.5 and less later on. We have not modeled Third Derivative power spectrum to study the deviations from a model. We simply graphed the time variation of Rn3d term of spectrum supplied by CM4 model for different degrees. We consider robust the values of Gauss coefficients and their derivative for the main field of CM4 model (at least up to n = 10) after the first couple of years of its time of coverage. In Fig. 1 we present the spherical harmonic spectra (third derivative of the Gauss coefficients) calculated by your formula (3) for CM4 model at the CMB and those spectra calculated by our formula (5) at the Earth's surface: apart 1960, there is a good consistency. The term values with a finer scale (Fig. 2), indicate that the differences of the values of spectral terms at least up to n = 10 are not "numerical artefacts".

[5] We agree with almost all your minor corrections, so we corrected them in the revised version, and clarified the meaning of "short-term" changes. Regarding your question: "what is the relationship between the STFT and wavelets? They seem to have a similar purpose", it is true that they have a similar purpose. The STFT breaks down a signal into constituent sinusoids of different frequencies for each small time interval of shifting windows, mapping the signal into a two-dimensional function of time and frequency. While the DWT breaks down a signal into wavelet function psi(t,a, b) constituents of different scale a (frequency) and different shifted time b. The sketch of graphs of ex-

amples of wavelet functions psi(t) (Daubechies wavelet in case of orders 2, 3, 4: Db2, Db3, Db4), are presented in Fig. 3. We agree with your comment "that the spectra behave similarly at the surface and CMB must be a damping effect - physically they should be strongly separated by the geomagnetic attenuation factor." "Similar behavior" stands for the fact that the time dependencies of the spectral terms Rn3d (t) are similar at CMB and at the Earth's surface. We don't mean the dependency of such terms on the degree value. Regarding your comment about the number of discussions, as there is only one about the results of d1 coefficient field, we title the last section: Discussion and Conclusions. Regarding your comment on the Appendix A, we agree with you and in our revised version, we avoid the discussion of FFT and DFT, concentrating on the STFT.

Interactive comment on Solid Earth Discuss., 4, 131, 2012.

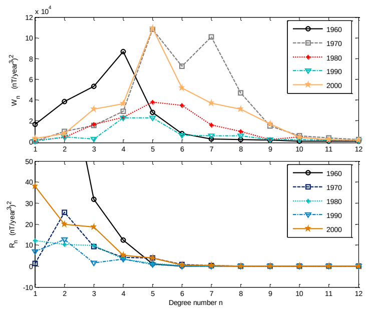

Fig. 1 Power harmonic spectra of CM4 model: (upper) calculated according to the formula (3) of Holme et al. GJI2011: $W_n = (n+1)\left(\frac{a}{r}\right)^{2n+4}\sum_m\left[\dddot{g}_n^{m\ 2} + \dddot{h}_n^{m\ 2}\right]$ at CM boundary; (down) calculated by the formula: $R_n^{3d} = \left(\frac{a}{r}\right)^{2n+4}\sum_m\left[\dddot{g}_n^{m\ 2} + \dddot{h}_n^{m\ 2}\right]$ at the Earth surface.

Fig. 1.

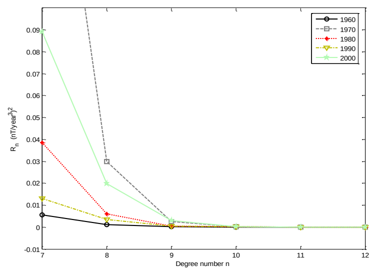

Fig.2 The same as the figure 1 (down) with smaller scale for degrees 7-10

Fig. 2.

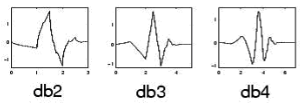

Fig. 3 Daubechies wavelet functions of order 2, 3, 4

Fig. 3.