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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "On the possibility of precursors of earthquakes in VLF range observed by DEMETER Satellite" *by* D. K. Sondhiya et al.

Anonymous Referee #3

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General comment

This paper presents observations of the VLF electric fields made by the DEMETER satellite as it passes close to the epicentre of three earthquake (EQ) preparation zones. It argues that the changes in the VLF electric field amplitudes are due to ionospheric perturbations caused by changes in the lithosphere and lower atmosphere in the precursory phase of major earthquakes. Whilst this is an interesting topic that has been the subject of numerous research publications, this paper fails to present any convincing evidence for seismo-induced changes of the ionospheric VLF electric field. It is unclear how some sections of the analysis were performed or the reason why (eg calculation of statistics, region of spectrum for which the gradient was calculated). Vital information such as to the location of the observations in relation to the seismic sources

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has been omitted. There are no figure descriptions to highlight significant features of the figures.

Below are a few examples.

Specific comments

Figures

The figures are extremely difficult to decipher. Their main problem is that the scales are unreadable, the text is too small. It is therefore difficult to ascertain exactly what the figure represents. The captions provide very little extra information and there is absolutely no description of them in the text of the manuscript. Usually there is just a line informing the reader that it is a waveform, a spectrogram, a PSD, the skewness of the distribution, or its kurtosis. There is nothing to guide the reader as to the significant features of the plots.

Introduction

The introduction provides no discussion of the results of previous publications regarding VLF electric/magnetic field observations by low Earth orbiting satellites such as DEMETER, e.g. Parrot, M. and Mogilevsky, M. M.: VLF emissions associated with earthquakes and observed in the ionosphere and the magneto- sphere, Physics of the Earth and Planetary Interiors, 57, 86–99, doi:10.1016/0031-9201(89)90218-5, 1989, Onishi, T., Berthelier, J.-J., and Kamogawa, M.: Critical analysis of the electrostatic turbulence enhancements observed by DEMETER over the Sichuan region during the earthquake preparation, Natural Hazards and Earth System Science, 11, 561–570, doi:10.5194/nhess-11-561-2011, http:// www.nat-hazards-earth-syst-sci.net/11/561/2011/, 2011. Thus, it is difficult to interpret the results in terms of previous studies and to determine how this paper builds on and extends these results.

Theoretical framework

In equation 1, the parameter psi is not defined. It isn't until later on that it mentions the

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Morlet wavelet is used.

The equation for the bispectrum (p981 line 17) contains an error.

The phase relation (p982 line 2) is overly complex. It is simpler to write w3 = w1 +- w2.

Results and discussion

This section presents the results of the application of the analysis methods discussed above to three instances of the precursory activity that led up to large EQs. These queries can be applied to the results and discussion of each EQ reported.

For the first EQ that occurred on September 26 2008 at 18:46:19 UT the authors only show observations from a DEMETER pass on September 17. Thus we have only a glimpse of observations 9 days before the EQ. The observations presented and analysed were actually made after DEMETER passes closest to the epicentre and so we have no observations in the vicinity of the EQ. How, therefore do the authors link changes in the ionosphere to the seismically active region ? How do these observations compare to similar passes when there was no seismic activity ?

There is no orbit information regarding the satellite. Were these observations made on a night time or day time half orbit ? How close was DEMETER to the epicentre at the time of these observations ? Did DEMETER pass close to the location magnetically conjugate to the epicentre ?

Figure 1 shows the waveform. What is the significance of the red line ?

Does Figure 1a show the wavelet spectrum as mentioned in the text (p983 lines 22-25) ? If so, what is in the left hand panel of Figure 1b ? The y-axis is labeled frequency and the ticks range from 0.003-6e-5 Hz. What dataset was analysed to get such low frequencies (the DEMETER VLF receiver covers the frequency range 15Hz-17.4kHz) or are they wavelet scales ?

What is the time period shown in this plot ? The X axis runs from 0 to 0.8. How does

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this time scale relate to Figure 1a ?

Where does white appear on the colour scale ?

What is the parameter chi (p984 line 10) ?

On p984, line 12-13 the authors mention the autocorrelation coefficient and the frequency at which it occurs. Then, in lines 13-14 it is mentioned that this result is not significant since it lies outside the cone of influence. So why mention it ?

What in the significance of the bispectrum results (p984 line 16) ?

In figure 1d what led the authors to choose that particular part of the spectrum for which to determine the gradient (I cannot read the frequency range on the figure) ?

Figure 2 shows the related statistics of the data set. How does the PDF differ from Gaussian ? Is the red line a fit to the data of the modelled red noise spectrum ?

How were the skew and kurtosis calculated ? Did the authors use some sort of moving average for data in the period 04:33-05:00 ? Or does the result come from the analysis of many orbits of data collected in the vicinity of the EQ (it is difficult to tell when you cannot read the axis labels) ?

What is the significance of the red line ? How is it related to the location of the EQ ? The peaks in skewness and kurtosis occur $\sim$23 minutes (assuming I've interpreted the unreadable time scale correctly) after the closest approach to the epicentre. How does this imply that they are related to the EQ preparation processes ?

Summary

Since the results cannot be interpreted in a scientific manner, I feel that I cannot comment at all regarding the summary/conclusions.

As mentioned above, these results show snapshots of the electric field. It is not shown that they occur only around the time period of the seismic event. In fact, it does not

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even show evidence that the location of these statistical fluctuations occur in the vicinity of the EQ epicentre or its magnetically conjugate points. Although geomagnetic activity does appear to have been ruled out there is the possibility that the increased fields may be due to other sources eg terrestrial transmitters.

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 977, 2014.