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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Signatures of the self-affinity of fracture and faulting in pre-seismic electromagnetic emissions" *by* S. M. Potirakis et al.

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Dear Referee 1,

After receiving the review of the Referee 2, we have carefully re-considered your comments and suggestions and we believe that before proceeding to a possible revision it is necessary to ask first for a clarification on specific points of your review.

It is not clear to us what you mean by "The main door - or rather gapping gate - left open to criticism is that they did not demonstrate the properties and limitations of the data set used in the analysis. The authors have to present strong evidence supporting

the quality of data used. In addition they have to present ALL the cases available and to inform the reader where the method supported by the data and where fails and the most crucial why happened so. An extended discussion and analysis on all available data is missing. I force the authors to reorganize their work including analysis of all the records proposed as earthquake forerunners." Do you want us to discuss about specific statistical or other properties of our data, and which would these be? What is it meant by "quality", "properties" and "limitations"? This part is really unclear to us. Moreover, what is it meant by "including analysis of all the records proposed as earthquake forerunners", should we analyze the total length of kHz time series acquired during the last 20 years and present the results in relation to all earthquakes that have happened in Greece (or in Greece and Italy, since our observatory has reported anomalous kHz electromagnetic activity during the L'Aquila EQ)? Because this wouldn't be possible in the frame of a single paper. On the other hand, if you are referring to just the recordings prior to the Athens EQ, please keep in mind that there is a long list of already published articles in which we have analyzed in depth the Athens EQ MHz and kHz EMEs.

Given the opportunity, we would like to clarify that the validity of the fracture-induced electromagnetic emissions (EME) is checked in two ways:

The first condition is that strict criteria have to be satisfied before the classification of an emerged EME anomaly as a possibly EQ-related one by investigating for the existence of specific EQ-compatible features embedded in it. These features are summarized through a proposed four stages model for the preparation of an EQ by means of its observable EME activity, which has been recently put forward (please see the following papers:

Eftaxias, K. and Potirakis, S. M.: Current challenges for pre-earthquake electromagnetic emissions: shedding light from micro-scale plastic flow, granular packings, phase transitions and self-affinity notion of fracture process, Nonlin. Processes Geophys., 20, 771–792, doi:10.5194/npg-20-771-2013, 2013;

Eftaxias, K., Potirakis, S. M., and Chelidze, T.: On the puzzling feature of the silence of precursory electromagnetic emissions, Nat. Hazards Earth Syst. Sci., 13, 2381–2397, doi:10.5194/nhess-13-2381-2013, 2013;

Y. Contoyiannis, S.M. Potirakis, K. Eftaxias, L. Contoyianni: Tricritical crossover in earthquake preparation by analyzing preseismic electromagnetic emissions, Journal of Geodynamics, 84, 40-54, 2015, doi: 10.1016/j.jog.2014.09.015;

Donner, R. V., Potirakis, S. M., Balasis, G., Eftaxias, K., and Kurths, J.: Temporal correlation patterns in pre-seismic electromagnetic emissions reveal distinct complexity profiles prior to major earthquakes, Phys. Chem. Earth, 85/86, 44–55, 2015;

S. M. Potirakis, Y. Contoyiannis, N. S. Melis, J. Kopanas, G. Antonopoulos, G. Balasis, C. Kontoes, C. Nomicos, K. Eftaxias: Recent seismic activity at Cephalonia (Greece): a study through candidate electromagnetic precursors in terms of non-linear dynamics, Nonlin. Processes Geophys., 23, 223-240, 2016, doi: 10.5194/npg-23-223-2016).

In summary, the proposed four stages of the last part of the EQ preparation process and the corresponding EME observations, for which specific features have been identified using appropriate time-series analysis methods, appear in the following order: first stage: valid MHz anomaly; second stage: kHz anomaly exhibiting tricritical characteristics; third stage: strong avalanche-like kHz anomaly; fourth stage: electromagnetic quiescence. It is noted that, according to the aforementioned four-stage model, the pre-EQ MHz EME is considered to be emitted during the fracture of a part of the Earth's crust that is characterized by high heterogeneity. During this phase the fracture is non-directional and spans a large area that surrounds the family of large high-strength entities distributed along the fault sustaining the system. Note that for an EQ of magnitude approximately 6, the corresponding fracture process extends to a radius of approximately 120 km. The specific signal features that define a valid MHz anomaly or a valid strong avalanche-like kHz anomaly have been described in detail in the above mentioned papers. Please note that in the case of the EME observed prior to the Athens

EQ (the kHz part of those EME are analyzed in the submitted paper), all the above requirements are fulfilled.

The second condition is that a sequence of MHz and kHz EMEs which emerge one after the other within a short time interval and each of them fulfills the criteria set within the above mentioned four-stage model should also be in consistency with other seismogenic precursors, before being classified as possibly EQ-related. Please note that this also happens for the EME observed prior to the Athens EQ (the kHz part of those EME are analyzed in the submitted paper).

We would also like to mention that we have performed an analysis of our data using the revised expression by Telesca (BSSA, 2012) and we got similar results. Therefore, in a possible revision, we can make an appropriate reference to this fact and of course on the main information concerning the revised expression.

All the rest of the remarks can easily be covered in a possible revision.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 2981, 2014.