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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Analysis of Spatiotemporal variations in mid-upper tropospheric methane during the Wenchuan Ms8.0 earthquake by three indices" *by* Jing Cui and Xuhui Shen

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The manuscript investigates the spatiotemporal variation in methane in the mid-upper tropospheric before during and after the Wenchuan earthquake. On the whole, the paper is well presented and written, with efforts from the authors to present clearly the main ideas and concepts. They show that the methane concentration distribution before during and after the earthquake broke the distribution features of the background field.

A crucial question in this field of research refers to how can we link an individual precursor with a distinctive stage of the EQ preparation. In this direction, we focus on

the result presented by the authors that "a large anomalous area was centered at the epicenter area Âńeight daysÂż before the earthquake occurred".

The generation of such a seismic anomaly requires physical and chemical transformations which occur in a spatially extended preparation (activation) zone of an impending EQ.

Earthquakes exhibit in general complex correlations in time, space and magnitude. It is widely accepted that the observed EQ scaling laws indicate the existence of phenomena closely associated with the proximity of the system to a critical point [1]. Therefore, such a requirement is satisfied during the appearance of the "critical window", i.e., the epoch during which the short-range correlations have evolved to long-range ones in an extended area, where the "critical radius R" is given by the empirical relation logR $\approx$ 0,5M, where M is the EQ magnitude [2]. Notice, based on the recently introduced concept of the "natural time" by Varotsos and his colleagues [3] it has been shown that the foreshock seismic activity that occurs in the region around the epicentre of the upcoming significant shock Âńa few days up to one weekÂż before the main shock occurrence, behaves as critical phenomenon.

Therefore, the hypothesis that the large anomaly in methane Âńeight daysÂż before the earthquake occurred corresponds to the critical point- window of the earthquake preparation process cannot be excluded. Accumulated experimental evidence supports the aforementioned hypothesis as follows:

The EQ preparatory process has various facets which reflect correspondingly different precursors. Importantly, precursors emerge during the same period, Âńa few days up

to one weekÂż before the main shock occurrence, while they behave as critical phenomena, as well. Characteristically, such as precursors are: (i) ULF magnetic field variations recorded by ground-based magnetic observatories before significant EQs, e.g., [4,5] (ii) MHz fracture induced MHz EM anomalies [6]. The generation of such a seismic anomaly also requires physical and chemical transformations which occur in a

spatially extended preparation (activation) zone of an impending EQ.

Characteristic precursors are athe short-lived seismo-ionospheric EM precursors and EM anomalies rooted in preseismic LAI-coupling [7,8]. Pulinets et al. [7] have provided strong evidence for the occurrence of ionospheric precursors well before the main shock: ionospheric precursors within Âń5 daysÂż before the seismic shock were registered in 73% of the cases for EQs with a magnitude 5, and in 100% of the cases for EQs with a magnitude 6.

The aforementioned results seem to support the hypothesis that the observed anomaly in terms of spatiotemporal variation in methane is rooted in the stage of critical point-epoch of the earthquake preparation process.

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