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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Negentropy anomaly analysis of the borehole strain associated with the Ms 8.0 Wenchuan earthquake" *by* Kaiguang Zhu et al.

Anonymous Referee #2

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Review of the manuscript entitled: "Negentropy anomaly analysis of the borehole strain associated with the Ms 8.0 Wenchuan earthquake" by Zhu et al.

I reviewed this manuscript based on the author's responses to reviewer 1, consequently I did not comment the statistical method (for which I'm not expert), which part has been answered by the authors.

The authors analyze the strain data recorded by a borehole strainmeter (GUZA) distant from the epicenter of the 2008 Wenchuan earthquake by about 150 km. They use negentropy to investigate possible precursor strain anomalies which they attempt to relate to the earthquake nucleation process. The manuscript is mostly well organized and

written, the figures are mostly of sufficient quality excepted Fig.1 which is too dark and lack details about the active faults and the earthquake rupture location. The method is interesting and the crustal strain changes highlighted are intriguing. However, the authors are too optimistic about their results and should discuss their findings more carefully.

1. Major comments :

1 - In particular, the nearbiest strain station (GUZA) is located far from the earthquake source (150 km) , so that the network configuration to study strain precursors is far to be optimal. If the precursory phase implied widespread crustal changes, some changes should have been detected by other sensors, therefore other set of data (GPS ? Seismometers ? Groundwater ? ...) located in the near-field of the earthquake should be analyzed. Despite strainmeters are highly sensitive instruments, I have concerns about their capability to detect subtle strain changes at such large distance. Strain signals are mostly sensitive to local variations (hydrology, rain, air pressure, ...), so it would be interesting to see precipitation, groundwater and barometric records near GUZA station if available. I agree that the observed strain changes are spurious and the fact that they may roughly coincide with the onset time of the event makes them even more interesting, but there is absolutely no evidence that they are linked to the precursory phase of the earthquake. If the negentropy increased before the earthquake,why did it stay to a high level months after the rupture (Fig. 4) ?

In particular at L. 305-307 (and also L. 296-299), the authors stated that Âń negentropy anomalies ... may be a reflection of the subsurface medium and fault activities in the focal area associated with the Wenchuan earthquake Âż. This is a strong conclusion which came with no proof. Thus, based on only one station, the authors should point out that some strain changes are spurious but they shouldn't try to link these changes to the precursory phase with such a few observations. Therefore, the Discussion section should be modified and it should be clearly stated that further data are required to decipher a potential precursory phase.

2- It's not clear which data the authors use for the statistical analysis. Equations (1) and (2) describe the protocol to derive areal strain from borehole gauge measurements and they show that the 3 ways provide roughly similar areal strain signal. However, in L. 91-92, the authors calculate the difference in the data. Why that ? And what does this sentence (L. 91-92) means ? Is it the difference in strain data which is used for negentropy analysis ? If yes, why not using directly the areal strain signals which are a robust measure of crustal strain changes ? The authors removed tidal strain, but what about borehole trend and air pressure correction ? The description of the data is confusing and should be improved.

2. Other comments :

- Abstract (L. 7) : 12 May 2012 → 12 May 2008.

- Introduction : L. 22-27 is confusing as it gives the impression that precursory strain has been detected prior to the 2013 Ruisui earthquake (Canitano et al., 2015), which has not.

Besides, as the study involves the use of strain signals to study preseismic changes, it would be interesting to have exemples of previous studies which aimed to detect changes in the hypocentral regions of large earthquakes using strain data. For instance, short- period strain observations prior to the 1987 Supersition Hills earthquake (Agnew & Wyatt, 1989), 1989 Loma Prieta EQ (Johnston et al., 1990), 2010 L'Aquila (Amoruso & Crescentini, 2010) or 2013 Ruisui (Canitano et al., 2015) were all unsuccesfull. Note that those studies have been conducted on several stations located in the near-field of the shock, therefore under more optimal detection conditions.

- L. 25 : 'borehole strain data, which record the direct crustal changes' → borehole strainmeters which detect the crustal changes. Why 'direct' crustal changes ?

- L. 43 : non-Gaussian → non-Gaussian distribution.

- L. 57-58 : Âń Hence, it is implied ... preparation processes Âż : do you have a

reference for this sentence ?

- L. 65-66 : 'dozens of meters' : can you be more specific ?

- L. 178-180 : it is not clear why negentropy anomalies clustered on the left side of the parabola could be a signature of crustal deformation related to earthquake ?

- L. 200 : please consider remove 'famous'.

- L. 237-238 : the authors stated that anomalies increased in 2008 when earthquake aproaches and decreased after. That's no so obvious according to Fig. 4 for which anomaly rate seems to increase after the earthquake. Can you explain why ?

- L. 244-245 : Can you explain how you link the earthquake moment with the estimate of the inflection point based on negentropy analysis ? What does that mean that the earthquake moment is proved to be a critical time during the earthquake ?

- Fig. 8 : where is the critical point ? Can you explain it further ?

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