

Interactive comment on “Geosphere Coupling and Hydrothermal Anomalies before the 2009 Mw 6.3 L’Aquila Earthquake in Italy” by L. X. Wu et al.

L. X. Wu et al.

shuozheng1030@gmail.com

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We thank very much the Anonymous Referee #1 for his or her kind and detailed comments. Point-to-point reply: 1) We add interpretations of “LCA” and “b-value” in the abstract, i.e. add “lithosphere-coversphere-atmosphere” and “b-value (a seismicity parameter from Gutenberg–Richter law)”, and replace all abbreviations “EQ” with “earthquake” in the paper.

2) We give a simple explanation of term “coversphere” in Line 55. The definition of “coversphere” could be referred to Wu et al., 2012. We use coversphere to emphasize the transferring of energy and mass from lithosphere to atmosphere through their interface media (coversphere), which has not been mentioned in Lithosphere-Atmosphere-Ionosphere coupling (LAIC) model. The coversphere is an integral representation of

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the three dimensional geometry, mass distribution and its spatial difference of the ge-entities (including soil and sand layers, surface water bodies, forests, and vegetation) between lithosphere and atmosphere. And, the word “coversphere” is in consistent with lithosphere, atmosphere, ionosphere. etc., in word structure for better understanding the sphere-shaped components of planet Earth. Hence, we use coversphere instead of Earth’s surface.

3) We agree with you that air temperature and aerosol may be not belonging to hydrothermal parameters from hydrogeological term. Here we using “hydrothermal parameters” in a broad meaning which including the water phase change and energy exchange in process of lithosphere-coversphere-atmosphere coupling. By the way, the analyses of air temperature and aerosol in this paper were based on ground observations, and the using meteorological “air temperature” and aerosol is actually an additional manner to further illustrate the energy-mass exchanges among lithosphere, coversphere and atmosphere to validate possible mechanisms of pre-earthquake anomalies.

4) “ERA” is not an abbreviation but the capital of “era”, we add some introduction of “ERA-Interim”.

5) The “512° ..256°” description on the gridded data is wrong. Thanks again. We modify it to be “512 lines of longitude and 256 lines of latitude”.

6) Thanks for this indication. We use “probable anomaly ” instead of “alternative anomaly”.

7) Thanks for the kind reminding. The Line 194 – formula is not bad, but the last sentence in the line 193 is wrong (some words was erased by mistake). We change “The result reflected a normal background” to be “The result reflected the current deviation of the parameter value referring to a normal background”.

8) and 9) Thanks for the suggestions. We replace all of abbreviation with full words in

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Fig2.1-2.6.

10) Actually, there are some reported/alleged gas anomalies about CO₂, CH₄, and Rn emission (Voltattorni et al., 2012; Quattrocchi et al., 2011; etc.) as introduced in Chapter 1 and Table 1. In Chapter 4, we use the alleged CO₂ anomaly (Frezzotti et al., 2009; Chiodini et al., 2000, 2004, 2011; Minissale et al., 2004) to speculate a possible LCA coupling mechanism with fluid between lithosphere blocks and fluid from lithosphere to coversphere and atmosphere; we use the alleged CH₄ anomaly (Chiodini et al., 2000, 2004 and 2011) to speculate a possible mechanism of AOD anomaly caused by emitted CH₄; and, we use the alleged Rn (Pulinets et al. 2010) to speculate a possible mechanism of hydrothermal anomaly due to emitted-Rn caused air ionization and variations in humidity and latent heat exchange. Although the gas data were not related with meteorological parameters and the speculations are based on reported anomalies and our limited knowledge, it is worthy of mention to assistant further understanding of LCA coupling related to L'Aquila earthquake, and it is of inspiration meanings to researches on other earthquake cases. So, we want to keep most of this speculations (in condition of paper-length permitted), but canceled some sentences (such as in line 639-642: Some key matters, such as CO₂, CH₄, and radon, can be enriched at a shallow depth and transported to the surface along the two seismic faults to finally cause regional thermal anomalies) . We expect your understanding and kind support.

11) Thanks for your nice suggestion. We remove Fig 3.1 from the paper in that it is relatively regular and similar work had been reported in De Santis, A. et al. (2011).

12) For the thermal anomalies related with earthquake are usually much weak, the anomalies in the figures (Fig 2.1, 2.3, 2.6, and 4.1) are not so “weak” (reached two times of standard deviation) as compared with normal background. The positive anomalies of Δ STL1 and TMP2m are remarkable as represented in red-color in Figure 2.3 and 2.6, respectively. The representation of thermal anomalies in Figure 2.3 and 2.6 is in a wider region (the whole Italy) but not the very limited Abruzzi region, which may have miss led your reading. To make a spatial contrast among thermal anomalies,

tectonic faults, geological rocks, hydrogeological aquifers and landcovers, we use also “NTG” thermal anomaly (Piroddi and Ranieri, 2012) in Fig 4.1. In fact, the work of Pergola et.al 2010 is also very good, we had mentioned it in the introduction Chapter and added it in Table 1.

Very Sorry for the delayed response because my travelling to Vienna to participate the EGU 2016 assembly.

Sincerely yours Lixin Wu (on behalf of all co-authors) April 24, 2016

Please also note the supplement to this comment:

<http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2015-346/nhess-2015-346-AC2-supplement.pdf>

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