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Abstract. Reply to Reviewer # 1

Seismo-electrics, electro-seismics, and seismo-magnetics for earth sciences by L.Jouniaux and F. Zyserman, Reply to Reviewer #1

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1 Introduction

Dear Reviewer, we are glad you have found our manuscript worthy of publication. Below you can find your comments and our answers to them, detailing the changes introduced in our work.

2 Comments and Answers

C1. Electrokinetic effect is one of the generation mechanisms of the coupling between seismic and EM wave-fields. There are also some other mechanisms, such as piezoelectric and piezomagnetic effects, that can result in seismo-EM coupling. Therefore, I suggest the authors to provide some information in the title indicating that the concerned seismo-EM coupling is based on electrokinetic effect.

R1. We have changed the title of the manuscript.

C2. Page 2564, Line 12. Add ”(SEM)” after ”seismo-electromagnetic”.

R2. We just replaced seismo-electromagnetic by SEM; its meaning was already introduced in the abstract.

C3. The concerned SEM is based on electrokinetic effect and electrokinetic effect is related to electric double layer. In Section 1, the authors should give some introduction on the electrokinetic effect and electric double layer, just as those in Jouniaux and Ishido (2012), but can be more brief.

R3. We added a brief explanation on the electrokinetic effect as you suggested.

C4. The abbreviation is given in the above and should be used in the following text. Page 2565, Line 5. Replace ”seismo-electromagnetic” with ”SEM”. Page 2565, Line 20. Replace ”seismoelectric” with ”SE”. Pay attention to similar mistakes.

R4. We introduced the suggested changes throghout the manuscript.

C5. Page 2565, Lines 5-10. References regarding the two kinds of conversions should be added. I believe ”IR” is abbreviation of ”interface response” (see Haines and Pride, 2006).

R5. We added references, and changed ”interface conversion” to ”interface response”.

C6. Page 2565, Line 21. The author tried to show that the SE signals have low amplitudes. The electric potential difference is shown by ”from 100 μV to mV”. If it is possible, provide the length of the potential-measuring electrode, or use electric field strength (V/m) rather than electric potential difference. Then the readers can have a better understanding.

R6. Usually the length of the dipole is 1 m, so that the electric field is about 100 μV/m to mV/m. In some rare cases the dipole length can be 0.5 m or 2 m. We have added this comment in the manuscript.

C7. Page 2578, Lines 5-9. The authors provide some introduction on the electric double layer here. I suggest moving this part to Section 1.

R7. We moved the suggested lines, along with the explanation on the electrokinetic effect, to Section 1.

C8. References regarding all equations should be clearly pointed out. Some of the equations are lack of references, for example eqs. (2), (6), (7), (20), (21), and (26).

R8. We added the required references.

C9. Section 8. This article focuses on the industrial application of electrokinetic effect. Actually, electrokinetic effect is also esteemed as a possible generation mechanism of EM signals associated with natural earthquakes and volcanic activities. SEM has been expected to play an important role in the prediction of seismic and volcanic activities. Further studies regarding these matters are likely to provide better and comprehensive understandings of natural SEM coupling phenomena and should be significant in seismic and volcanic hazard study. Maybe, a short and brief description on the SEM associated with natural earthquakes and volcanic activities will help readers to have a better picture of the potential applications of electrokinetic effect.

R9. We added the following paragraph:

Electric and magnetic fields can also be linked to seismic and volcano activity (Johnston, 1997).

Electromagnetics signals accompanying seismic waves can be observed in the field, recorded most of the time as coseismic signals. Among the possible mechanisms at the origin of these signals, the electrokinetic effect produced the largest one (Gershenzon et al., 2014). The orders of magnitude of these observed coseismic electric and magnetic signals are usually 1 to 100 mV/km and $0,01$ to 1 nT (Ren et al., 2015). Coseismic electric signals during earthquakes of magnitude above 5 have been observed by Mogi et al. (2000). Coseismic magnetic fields have been reported for the magnitude 6 Parkfield earthquake (Johnston et al., 2006), and for the magnitude 9.4 Sumatra earthquake (Guglielmi et al., 2006). Both electric and magnetic signals have been measured during the Izmit earthquake (Honkura et al., 2002; Matsushima et al., 2002). Many approaches have been developed to model such electromagnetic signals induced by the electrokinetic effect (Gershenzon et al., 2014; Gao et al., 2013a,b; Ren et al., 2011; Hu and Gao, 2011; Fenoglio et al., 1995). Recently Ren et al. (2015) numerically modeled the coseismic signals related to a finite fault displacement. These authors concluded that the electrokinetic effect combined with a surface-charge assumption is a good candidate to explain the EM coseismic signals.

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