Supplement

Ground-based ULF electrical emissions during the Wenchuan M_S=8.0 earthquake.

The Hebei ULF (0.01–10 Hz) electromagnetic observation network was constructed at the beginning of 1980s after the occurrence of the July 28, 1976, Tangshan M_S 7.8 EQ with the aim of monitoring fluctuations in the electromagnetic radiations before seismic activities mainly around Beijing. More details of the observation system can be found in Zhuang et al. (2005) and Li et al (2013).

The system measures electrical signals and a DJ-1 recorder is employed to record the potential difference between two electrodes (SN, South-North and EW, East-West). The recording method uses an analog automatic real-time continuous pen recorder with a speed of 1 mm/s. In general, only parallel lines with perpendicular automatic clock marked signals on the record paper around a drum and six lines are left per hour. A blank record paper replaces the recorded one at 9:00 AM (local time) everyday (seen Figure S1).
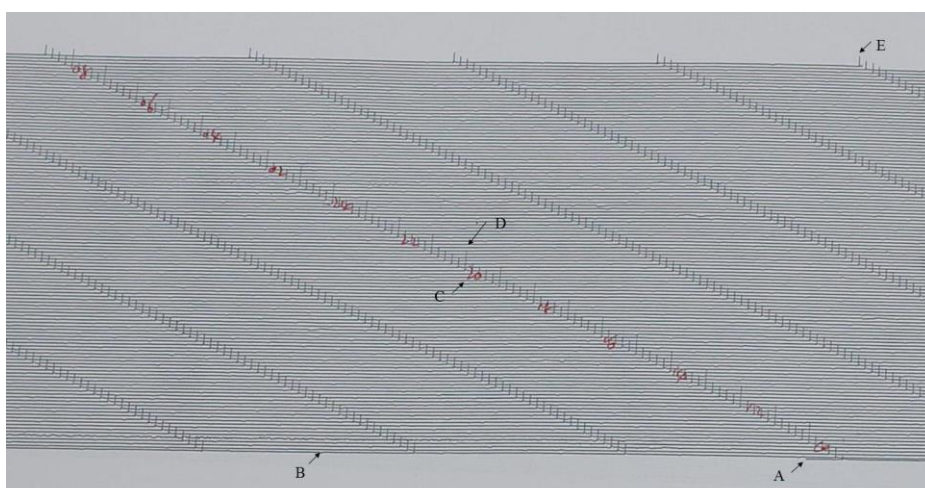
Figure S1 Copy of a part of normal original record (EW component) from 9:00AM, 1 to 9:00 AM, 2, May, 2008 at Gaobeidian station. Corresponding letters: A denotes a start record point, i.e. 9:00 AM, 1, May; B is a normal record line; C indicates a manually marked time, i.e. 20:00, 1, May; D indicates an automatic marked perpendicular hour line, i.e. 20:00, 1, May; and E shows an end record point, i.e. 9:00 AM, 2, May.

During the period from January 2007 to December 2008, electrical emissions were recorded at three among four (only four stations run normally during this time) stations (Figure 1 in the paper) and the recording at Gaobeidian station shows a typical fluctuation character. Anomalous emissions first appeared at the end of October 2007 and the information was not recorded everyday but it is mainly accumulated in SN direction.

On 2 November 2007, our work team went to Gaobeidian station to check observing environment and eliminate probable interferences (Figure S2).

Figure S2 A picture taken on 2 November 2007 at Gaobeidian station. The work team were checking real-time recording paper.

This kind of situation lasted till the beginning of April, 2008, from when relative high frequency and large amplitude signals were recorded almost every day with a persistent time. On May 9, 2008, 3 days before the Wenchuan M_S 8.0 EQ, the amplitudes of signals were suddenly subjected to an abrupt enhancement at the same time, between 5:00 AM and 7:00 AM, both in the SN and EW directions and the abnormity reached to the climax stage (~1.3 mV/m for electric field) till on 17 May, 2008.
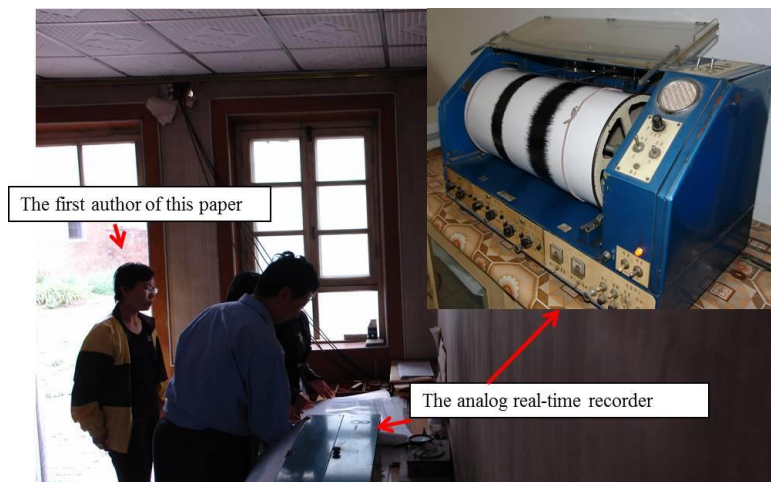
Figure S3 A picture taken on 7 May 2008 at Gaobeidian station. The work team were checking real-time recording paper.

During this period, the work team went to all running stations to check related recordings (See Figure S3 at Gaobeidian station and Figure S4 at Ningjin station) and their observing environment. And we were right at Sanhe station when the Wenchuan earthquake took place.
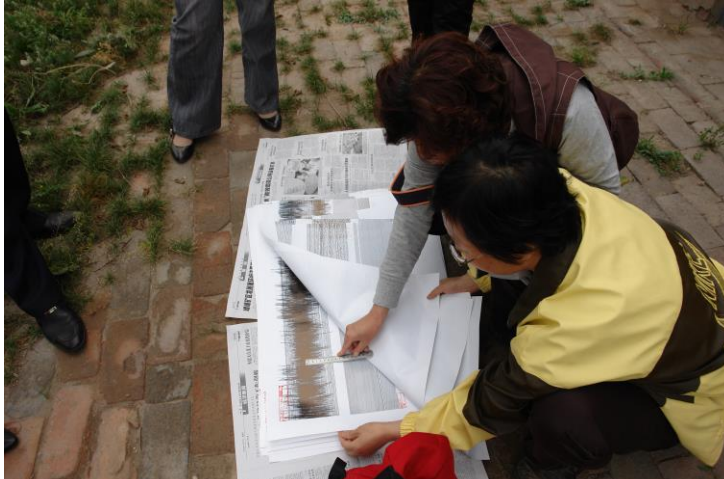
Figure S4 A picture taken on 7 May 2008 at Ningjin station. One of the observers of Langfang station and the first author of this paper were measuring the magnitude of recorded signals.

After May 18, the total signal amount decreases sharply and the character of the signals at this stage is more like that before April 2008. The SN information lasted till the end of September 2008 except for high emissions appearing before several powerful aftershocks. It is the first time that the abnormality is with such a large amplitude and such a long duration in the observation history of this network although several strong EQs were recorded before (Li et al., 2013).

Fortunately, our reseach team traced this kind of obvious emissions during all this period and went to the stations several times to check observing environment and search probable interferences but found none. While the large Wenchuan M_S=8.0 earthquake took place during this period. So this obvious ULF eminssions probably are related to this event.

In addition, figures S5–8 attached also are some ULF real-time recordings at Gaobeidian station:
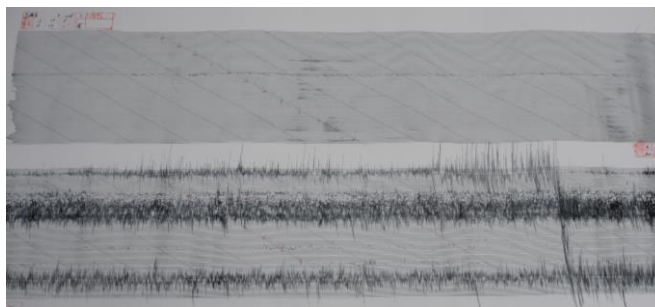
Figure S5 Picture of real-time recordings from 9:00 AM, 13 to 9:00 AM, 14, February, 2008 at Gaobeidian station.
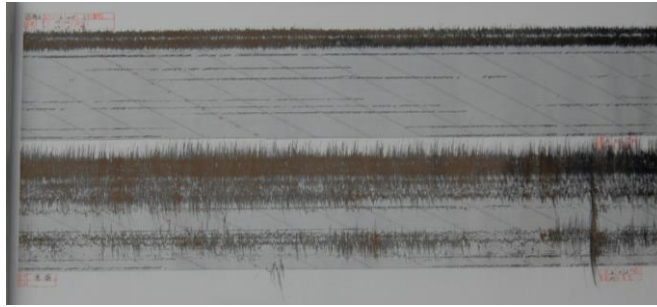
Figure S6 Picture of real-time recordings from 9:00 AM, 8 to 9:00 AM, 9, May, 2008 at Gaobeidian station.

Figure S7 Picture of real-time recordings from 9:00 AM, 12 to 9:00 AM, 13, May, 2008 at Gaobeidian station.
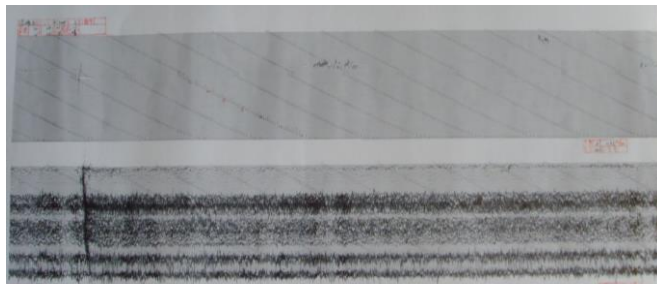
Figure S8 Picture of real-time recordings from 9:00 AM, 20 to 9:00 AM, 21, May, 2008 at Gaobeidian station.

Please also refer to:

Li, M., Tan, H., Cao, M. (2016). Ionospheric influence on the seismo-telluric current related to electromagnetic signals observed before the Wenchuan M_S 8.0 earthquake. *Solid Earth*, *7*, 1405–1415. https://doi.org/10.5194/se-7-1405-2016

Li, M. & Lu, J. (2009) ULF electromagnetic abnormity recorded at Gaobeidian and Ningjin stations before Wenchuan 8.0 earthquake. *Int. Seismol. Dynam.*, *367*, 76–82, 2009 (in Chinese with English abstract).

Li, M., Lu, J., Parrot, M., Tan, H., Chang, Y., Zhang, X., & Wang, Y. (2013). Review of unprecedented ULF electromagnetic anomalous emissions possibly related to the Wenchuan $M_S = 8.0$ earthquake, on 12 May 2008. *Nat. Hazards Earth Syst. Sci.*, *13*(2), 279–286. https://doi.org/10.5194/nhess-13-279-2013.

Zhuang J, Vere-Jones D, Guan H, et al. Preliminary Analysis of Observations on the Ultra-Low Frequency Electric Field in the Beijing Region. Pure & Applied Geophysics, 162(6), 1367-1396, 2005.