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Multi-parameter anomalies before the Wenchuan and Yushu earthquakes in China

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During earthquake preparatory phase, the stress enhancement and energy accumulation in local lithosphere could cause anomalous changes in atmosphere and ionosphere. A variety of precursory anomalies were reported based on the integrated analysis of ground and satellite observations. On the one hand, thermal anomalies including thermal infrared radiation, surface temperature, surface latent heat flux, and outgoing longwave radiation, were observed in the intersecting zone of tectonic faults or around the epicenter several days to several weeks before medium to strong earthquakes. On the other hand, short-term ionospheric disturbances such as total electron content and electron density were found to be possibly associated with impending earthquakes. Besides, pre-earthquake anomalous behaviors in geophysical parameters were also widely recorded, e.g., groundwater. Recently, quasi-synchronism of multi-parameter anomalies in atmosphere and ionosphere has been discovered in some earthquake cases. Both the 2008 Wenchuan earthquake (Ms8.0) and the 2010 Yushu earthquake (Ms=7.1) happened on the boundary active fault around the Bayan Har faulting-block in the Tibetan plateau. Thus, they can be treated as a unitive study object with similar active tectonic background. This study aims to investigate quasi-synchronism of multi-parameter anomalies by reanalyzing and summarizing published literatures.
Firstly, groundwater temperature data was investigated at Delingha seismic station, which is about 900 km and 470 km away from the Wenchuan and Yushu epicenter, respectively. The groundwater temperature sudden rose 5 and 11 days before the Wenchuan and Yushu mainshock, respectively. The temperature increase of 0.0112 °C for Wenchuan is larger than that of 0.0108 °C for Yushu. Secondly, radon concentration data was investigated at Guza seismic station, which is about 160 km and 940 km away from the Wenchuan and Yushu epicenter, respectively. The radon concentration rose 5 and 6 days before the Wenchuan and Yushu mainshock, respectively. Furthermore, the reported short-term anomalies before the two eartquakes were summaryed. In the case of Wenchuan earthquake, various ionospheric anomalies exist from 7 to 1 days before the mianshock. Meanwhile, multi-anomolies of atmosphere and earth surface parameters were also identified with relatively longer duration from 13 to 1 days before the mianshock. In the case of Yushu earthquake, multi-parameter anomalies from earth surface up to ionospheric layer have been reported from 6 to 1 days before the mianshock. Finally, consistent time windows of multi-parameter anomalies within about one week before both earthquakes were revealed.