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Specific variations of air temperature and relative humidity around the time of Michoacan earthquake M8.1 Sept. 19, 1985 as a possible indicator of interaction between tectonic plates

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Abstract

The recent development of the Lithosphere–Atmosphere–Ionosphere (LAI) coupling model and experimental data of remote sensing satellites on thermal anomalies before major strong earthquakes have demonstrated that radon emanations in the area of earthquake preparation can produce variations of the air temperature and relative humidity. Specific repeating pattern of humidity and air temperature variations was revealed as a result of analysis of the meteorological data for several tens of strong earthquakes all over the world. The main physical process responsible for the observed variations is the latent heat release due to water vapor condensation on ions produced as a result of air ionization by energetic α-particles emitted by ^{222}Rn. The high effectiveness of this process was proved by the laboratory and field experiments; hence the specific variations of air humidity and temperature can be used as indicator of radon variations before earthquakes.

We analyzed the historical meteorological data all over the Mexico around the time of one of the most destructive earthquakes (Michoacan earthquake M8.1) that affected the Mexico City on September 19, 1985. Several distinct zones of specific variations of the air temperature and relative humidity were revealed that may indicate the different character of radon variations in different parts of Mexico before the Michoacan earthquake. The most interesting result on the specific variations of atmosphere parameters was obtained at Baja California region close to the border of Cocos and Rivera tectonic plates. This result demonstrates the possibility of the increased radon variations not only in the vicinity of the earthquake source but also at the border of interacting tectonic plates. Recent results on Thermal InfraRed (TIR) anomalies registered by Meteosat 5 before the Gujarat earthquake M7.9 on 26 of January 2001 supports the idea on the possibility of thermal effects at the border of interacting tectonic plates.

Keywords: Tectonic plate; Radon; Ionization; Thermal anomaly

1. Introduction

Satellite technologies (GPS and InSAR) drastically improved our abilities to detect the tectonic deformations (Zhao et al., 2004; Johansen and Bürgmann, 2005). But they are able to detect only the surface deformations, and do not reflect the processes having place within the Earth's crust. At the same time it is possible to detect the tectonic activity using the indirect methods, for example, the radon activity (King et al., 1993). It was demonstrated that the radon gas geochemistry is a good indicator of the tectonic activity (Toutain and Baubron, 1998).

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Unfortunately, regular radon monitoring data are available only for very few places, so one should look also for the indirect methods of the radon activity monitoring. It was detected recently that there exist high correlation between the radon variations and the air temperature (Garavaglia et al., 2000) and between the radon variations and relative humidity (Prasad et al., 2005). The mechanism of such correlation was developed by Pulinets et al. (2006), and it was demonstrated both for the air temperature and the relative air humidity that means that the air temperature and humidity variations can serve as indicators of the radon activity. Dunajecka and Pulinets (2005) analyzed the meteorological data around the time of several strong earthquakes in Mexico, and confirmed experimentally the theoretical results of Pulinets et al. (2006). They observed the diminishing of the air humidity and increase of the air temperature few days before the strong earthquakes ($M \geq 7$) in Mexico that they interpreted as a result of radon activity. Except the physical mechanism Pulinets et al. (2006) revealed the typical pattern of atmospheric parameters variations before strong earthquakes analyzing the meteorological data around the time of recent major earthquakes (Fig. 1a).

One more confirmation of the connection between the increased tectonic activity, radon, and surface temperature are the results of satellite monitoring of the surface temperature around the time of strong earthquakes (Ouzounov and Freund, 2004; Tronin et al., 2004). The satellite infrared images demonstrate the increased temperature over the structure of active tectonic faults and its dynamics with time. Genzano et al. (2006), analyzing the Meteosat 5 satellite IR images for the time period close to the Gujarat earthquake (M7.9) on 26 of January 2001, detected the thermal anomalies not only within the area of earthquake preparation but also at the border of Eurasian and Indian tectonic plates.

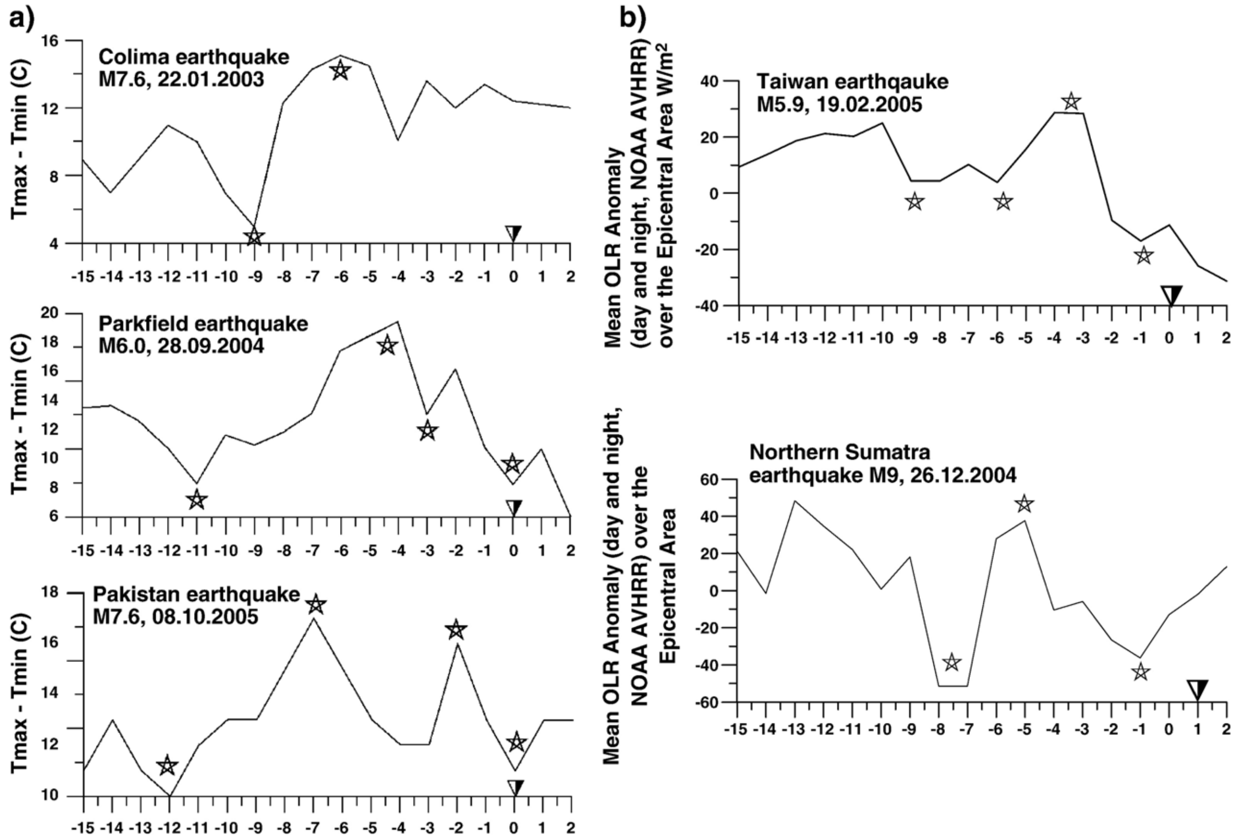

Fig. 1. a) Daily surface air temperature range variations registered close to the epicenters of strong earthquakes. From top to bottom: Colima earthquake M7.6 of 2003, (Mexico); Hector Mine earthquake M7.0 of 1999, (USA); Parkfield earthquake M6 of 2004, (USA). ▼ indicates the earthquake moment, stars indicate the parameters peculiarities which we interpret as precursors phenomena. b) Top panel – variations of Ongoing Longwave Radiation (OLR) over the epicenter of Taiwan earthquake M5.9, Feb. 18, 2005. Bottom panel – the same but for the Sumatra earthquake M9, Dec. 26, 2004. ▼ indicates the earthquake moment, stars indicate main characteristic moments of the range variations before earthquake.