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The role of radon and other geogases in the Lithosphere-Atmosphere – Ionosphere Coupling associated with pre- earthquake processes

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We are studying the interaction between gases from the Earth (radon, methane, CO_2) that may be associated with pre-seismic activities and the standard atmosphere in order to assess their potential thermodynamic impact. There is an increasing amount of observational evidence that the concentration of these gases increases before major earthquakes. We formulate a hypothesis that an increase in the concentration of these gases triggers a thermodynamic coupling between the lithosphere-atmosphere-ionosphere coupling (LAIC) and is linked to the seismic cycle. Therefore, by studying the LAIC processes we can detect variability in the Earth's gases, which allows us to make an inference about seismic activity. We use radon measurements on the ground installed and coordinated in five different seismically active regions: Southern California, Taiwan, Central Italy, Western Greece and South Eastern Japan. For this study we utilize both NASA and NOAA remote sensing data together with GPS/TEC observations. With Gold and Soter's initial hypothesis of the deep origin of radon and methane (1985), and the fact that the activation of faults leads to an increase in the emanation of gases, we are exploring the feasibility of detecting these gases by measuring their coupling impact on the Earth's atmosphere through ground and space observation. For this analysis we selected 8 large earthquakes from different seismo-tectonics regions: (1) M9.3, Sumatra, Dec 26, 2004; (2) M9.0 Tohoku, Japan, March 11, 2011; (3) and (4) M7.8 and M7.3 Gorkha, Nepal, 2015; (5); M8.2 Tehuantepec, Sept 8, 2017 and; (6) M7.1, Puebla, Mexico, Sept 19, 2017, (7) Mw 6.8 Zakynthos , Greece of Oct 25 , 2018 (8) M6.6 Meinong , Taiwan, Feb 6, 2016,. We have found that: (i) radon and atmospheric anomalies have been observed before all of the analyzed events, (ii) large seismic events (M8+) could produce radon anomalies far from the epicenters; and (iii) long lasting seismic swarms could generate temporary elevation of radon levels in the near zone. We examined the possible correlation between magnitude and the spatial size of the earthquake preparation zone (Dobrovolsky- Bowman) in the framework of the LAIC concept. Our data analysis suggests that the pre-earthquake phase follows a general temporal-spatial evolution pattern; in which radon plays a critical role in understanding the LAIC involving different layers of the ionosphere, atmosphere and lithosphere.

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The Possibility of Earthquake Forecasting: Learning from nature, Institute of Physics Books, IOP Publishing, Dec 2018, 168pp (S. Pulinets and D. Ouzounov)