Geophysical Research Abstracts
Vol. 20, EGU2018-5739-1, 2018
EGU General Assembly 2018

Radon activity - the hidden driver behind pre-earthquake anomalies in the Earth atmosphere-ionosphere environment

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We are presenting experimental data and theoretical estimates of radon measurements recorded before large earthquakes. We use radon measurements on the ground installed and coordinated in five different seismic active regions: Southern California, Taiwan, Central Italy, Western Greece and South Eastern Japan. Radon measurements are obtained indirectly by means of gamma ray spectrometry of its radioactive progenies 214Pb and 214Bi (emitted at 351 keV and 609 keV, respectively) and also by Alfa detectors.

We have found that: (i) large seismic events (M8+) could produce radon anomalies far from the epicenters, such as the 2017 M8.2 in Mexico where we observed an anomaly 3200 kilometers north (in Orange, Southern California) 6 days in advance of the main shock. (ii) Long lasting seismic swarms (as in Central Italy 2016) could generate temporary elevation of radon levels in the near zone, but radon levels immediately return back to normal when the seismicity becomes low; (iii) the low magnitude local seismicity could produce dominant anomalies for the radon data (as in the Western Peloponnese, Greece). We have observed that detection of remote earthquakes is possible in case of low local seismicity.

We studied also the correlation of radon pre-earthquake anomalies with the temperature of the atmosphere boundary layer, outgoing earth infrared radiation and GPS/TEC, namely their temporal and spatial variations several days before the onset of recent earthquakes. Our data analysis in California, Italy, Taiwan, Greece and Japan suggest that pre-earthquake phase follows a general temporal-spatial evolution pattern in which radon plays a critical role in understanding the LAI coupling, involving different layers of the ionosphere, atmosphere and lithosphere. This pattern could be revealed only with multi instrument observations and has been seen in other large earthquakes worldwide.