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Complexity and anomalous diffusion of the Florina (Greece) microseismic activity associated with CO_2 emissions

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It has long been recognized that the diffusion of pressurized fluids in the Earth's crust can induce earthquakes. Characteristic cases can be drawn from earthquake swarm sequences associated with volcanic activity, oil and gas injections and extractions and CO_2 emissions in the crust. Such sequences are typically characterized by strong variations and clustering effects in time and space and can neither be described by a dominant earthquake nor by any simple scaling relation, as the Omori scaling known for aftershock sequences. In 2013-2014 such a sequence occurred in northern Greece, in the area of Florina and has been associated with CO_2 gases emissions through the fault and fracture network below the Florina basin (Mesimeri et al., 2017). A detailed microseismic analysis reveals the structure of the seismic cloud that is distributed in two clusters, the first of a N-S direction dipping to the north and the second of an E-W direction and almost vertical, gently dipping to the south. Furthermore, the two clusters present distinct periods of activation, which may be associated with different phases of CO_2 emissions. The spatiotemporal properties of the earthquake activity inside the two clusters indicate correlated sequences in time and space, with asymptotic power-law distributions of the time and distance intervals between their successive events (e.g., Vallianatos et al., 2016). Moreover, the mean squared displacement of the earthquake activity with time for the two clusters indicate the slow migration of microseismicity. The latter process corresponds to slow sub-diffusion inside the fault segments, which may act as pathways for the migration of CO_2 gases towards the surface.

References

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