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Seismicity and observed anomalies after the 2012 Emilia earthquake. Hints from numerical modelling of shallow fluid circulation.

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The 2012 Emilia earthquake was accompanied by a number of observed shallow anomalies, including changes in water wells and unusual soil heating in the epicentral area.
Here we show some results of numerical modelling of shallow fluid circulation carried out to explore the causative mechanisms of such phenomena. We show that the overpressure due to the mainshock on May 20, 2012 is responsible for the observed co-seismic water level rise, but the subsequent evolution is captured only introducing permanent changes of the rock properties. On the contrary, soil heating appears to have an alternative explanation, related to the exothermic oxidation of methane. Numerical modelling describes the methane ascent through an unconfined aquifer and the exothermic reaction is simulated by placing heat sources within a shallow peat layer. The strength of the sources is computed as a function of the methane flux entering the layer. The simulations explore different methane fluxes, the efficiency of methane oxidation and account for seasonal effects. A good match between observed and simulated temperature profiles suggests that the main features of the process are captured by the model. While the seismic sequence may have enhanced the methane flux, the phenomenon seems to be unrelated to seismicity.