Geophysical Research Abstracts
Vol. 19, EGU2017-4431, 2017
EGU General Assembly 2017

Modelling of hydrogen sulfide dispersion from the geothermal power plants of Tuscany (Italy)

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The hydrogen sulfide (H2S) is one of the main gaseous substances contained in deep fluids exploited by geo-thermoelectric plant. Therefore, it is a "waste" pollutant product by plants for energy production.
Hydrogen sulfide is perceived by humans at very low concentrations in the air (∼ 0,008 ppm, World Health Organization, hereafter WHO, 2003) but it becomes odorless in higher concentrations (> 100 ppm, WHO, 2003) and, for values close to the ones lethal (> 500 ppm), produces an almost pleasant smell. The typical concentration in urban areas is <0.001ppm (<1ppb); in volcanic plumes it reaches values between 0.1 and 0.5 ppm. WHO defines the concentration and relative effects on human health. We applied the Eulerian code DISGAS (DISpersion of GAS) to investigate the dispersion of the hydrogen sulfide (H2S) from 32 geothermal power plants (out of 35 active) belonging to the geothermal districts of Larderello, Travale-Radicondoli and Monte Amiata, in Tuscany (Italy). DISGAS code has simulated scenarios consistent with the prevailing wind conditions, estimating reasonable H2S concentrations for each area, and for each active power plant. The results suggest that H2S plumes emitted from geothermal power plants are mainly concentrated around the stacks of emission (H2S concentration up to 1100 ug/m3) and rapidly dilute along the dominant local wind direction. Although estimated values of air H2S concentrations are orders of magnitude higher than in unpolluted areas, they do not indicate an immediate health risk for nearby communities, under the more frequent local atmospheric conditions. Starting from the estimated values, validated by measurements in the field, we make some considerations about the environmental impact of the H2S emission in all the geothermal areas of the Tuscany region. Furthermore, this study indicates the potential of DISGAS as a tool for an improved understanding of the atmospheric and environmental impacts of the H2S continuous degassing from geothermal plants but also its potential for reliable prediction of H2S pollution in case of unexpected events, like the blowout of a geothermal well or the malfunctioning of a geothermal plant resulting in an anomalous and not-controlled emission of harmful gas in the atmosphere.