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Effect of atmospheric conditions on soil diffuse degassing

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Secondary manifestations of volcanism in the Azores archipelago include low temperature fumaroles (maximum temperature around 100 °C), hot springs, CO_2 cold springs and several diffuse degassing areas. Continuous monitoring of hydrothermal soil CO_2 flux started at Furnas volcano (S. Miguel island) in October 2002 with the installation of a permanent gas station coupled also with several meteorological sensors (barometric pressure, air temperature, wind speed and direction, air relative humidity, rainfall, soil temperature and soil water content). In October 2004, a second station was installed in this volcanic system. Both stations perform measurements by the accumulation chamber method. Daily and seasonal cycles have been observed in the soil CO_2 flux time series. From all the monitored variables, air temperature and barometric pressure are the ones that best correlate with the soil CO_2 flux cycles. Air temperature and soil CO_2 flux behave in an inverse way: the higher soil CO_2 flux values are registered early in the morning (lower air temperature) while lower soil CO_2 flux values in the afternoon (higher air temperature). Barometric pressure shows higher correlation with the CO_2 cycles during winter months and in bad weather conditions. In order to understand the influence of soil conditions on the gas release, several simulations with TOUGH2 geothermal simulator were performed. We used different TOUGH modules to describe multi-component (water, CO_2 and air) and multi-phase (liquid and gas) fluids. Using a 1D model, a parametric study was performed to understand the physical mechanisms producing the observed variations. In this simplified model, only the air temperature was changed. Numerical results, in agreement with the observed data, show that the CO_2 are strongly dependent on domain permeability, gas saturation and temperature changes at the surface. Amplitude of the thermal oscillations influences the amplitude of the observed variations in soil degassing but does not affect their temporal evolution. A main role is played by rock permeability.