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Gas-sensors-equipped drone measurements of volcanic plume gas composition and flux at Pisciarelli, Campi Flegrei, Italy

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The fumarolic field of Pisciarelli is the most active vent of the Campi Flegrei caldera, a volcano in the metropolitan area of Naples (Italy) in a current state of unrest. Recent studies have identified a clear escalation of degassing activity at Pisciarelli since 2012, raising concern on a possible acceleration of the unrest. The absence of sulfur dioxide prevents UV spectroscopy from determining the volcanic gas flux, and researchers have tried alternative techniques for measuring CO₂ and H₂S fluxes. Here we report observations of CO₂, H₂S, and H₂O concentrations in the plume of Pisciarelli derived on December 2019 and October 2020 with a hexacopter drone equipped with miniaturized diffusive gas sensors. The drone flew at a constant altitude (~50 m above ground level), transecting the gas plume multiple times. This technique allowed us to calculate the CO₂, H₂S, and H₂O gas fluxes by combining the georeferenced gas concentrations with the plume vertical rising speed derived from thermal and visible camera footages. Similar to previous gas composition and flux measurements, our results suggest that gas-sensors-equipped drones are a cost-effective technique for monitoring gas fluxes on active volcanoes, where UV spectroscopy cannot be used, and that can be made from safe distances.