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Reliable Measurement of Ozone in Volcanic Plumes by Gas-Phase Chemiluminescence

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Atmospheric ozone plays an important role in the chemistry of volcanic plumes, for instance its photolysis is a source of hydrogen radicals and it oxidises halogen atoms and hydrocarbons. The ozone level inside a plume is therefore a good indicator of turbulent mixing and chemical activity. For instance, already small amounts of halogen oxides can lead to significant or even complete O_3 destruction. At the same time O_3 is difficult to measure in volcanic plumes due to the interference of other constituents on common O_3 measuring devices. In particular, SO_2 has a positive interference with the most common technique for O_3 measurement, short-path UV absorption. Typically, the interference signal due to volcanic SO_2 will exceed the atmospheric O_3 signal by one to two orders of magnitude. Therefore, it is difficult to find reliable O_3 measurements in volcanic plumes.
Here we present a lightweight (< 2 kg) O_3 instrument based on gas-phase chemiluminescence following the O_3 + C_2H_4 (Ethylene) reaction, which is suited for ground based and airborne (drone) deployment. We discuss the detection limit, response time, and possible interferences of the instrument as well as studies made possible by the instrument.

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