"In-situ Sampling and Measurements of Volcanic Plumes: Coordinated UAV, Aircraft and Orbital Observations"

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Volcanic plumes present a major regional hazard to international aviation and can result in significant local air pollution. Identification of volcanic plumes by remote sensing from satellites is hindered by a lack of effective detection algorithms, lack of good *in-situ* data for algorithm validation, and the limited choice of bands on operational meteorological satellites. This often results in meteorological (e.g., water vapor or ice) clouds being mistaken for plumes and vice versa. In order to better characterize such phenomena, we have flight tested a modified *Aerosonde* robotic aircraft with the goal of conducting detailed *in-situ* measurements of the physical and chemical properties within volcanic eruption plumes: temperature, pressure, humidity, sulfur dioxide concentration, and ash particle number density and chemistry. In addition, we plan to flight test and deploy, within the next year at Mt. Etna and elsewhere in Italy, a similarly modified and instrumented micro-UAV built by the University of Bologna, in cooperation with INGV and ASI.

Measurements that will be made to: (a) test the range of applicability of the "split window" thermal IR detection algorithm for discrimination of airborne volcanic ash vs. meteorological clouds; (b) validate thermal IR imaging algorithms for volcanogenic SO_2 detection; (c) provide systematic high spatial resolution *in-situ* data as inputs for both atmospheric radiative transfer, and low-altitude small-scale plume dispersion/transport models; (d) provide inputs and validation for high-altitude ash transport models (e.g., VAFTAD and CANERM). Simultaneous airborne scanner and orbital (e.g., ASTER, MODIS, MISR) multispectral, multi-angle VNIR, SWIR, and TIR measurements will be carried out and the *in-situ* UAV data will be utilized for calibration and validation of the remote sensing data.

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