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Near crater observations of gas and aerosols variability at Mount Etna during the EPL-RADIO and EPL-REFLECT measurement campaigns.

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During the EPL (Etna Plume Lab) campaigns occurring in 2017 (EPL-RADIO) and 2019 (EPL-REFLECT), gas and aerosol measurements were performed at Mount Etna (Sicily, Italy) to better assess the role of volcanic aerosols on both regional climate system and local health hazard. Gas related to volcanic emissions (such as SO₂, H₂S and others) were measured with low cost sensors (Alphasense) and HCl/SO₂ ratio was validated in comparison to FTIR measurements. Aerosol physical and chemical properties were measured using low-cost Optical Particle Counters (OPCN2 from Alphasense) and filter measurements dedicated to organic acids, inorganic ions, soluble metals and total metals. During the EPL-REFLECT campaign, in-situ measurements were performed during: 1) the hike up, 2) a 2-hours period in the close vicinity of the Bocca Nuova crater, 3) the hike down and 4) in Milo (city on the flank of the Etna). Moreover, few OPCs were left unattended at the Bocca Nuova crater for two full days.

Gas abundances at the crater-rim ranged from a few to 10's ppmv SO₂, with correlation to PM. The analysis of the 2 days measurements highlights a clear diurnal variation of aerosol size distributions. Indeed, at sunrise the total number and mass concentration is rapidly increasing from 15mg/m³ to 125mg/m³ in less than 2 hours. The variation of PM₁/PM₁₀ ratio shows a constant trend throughout the day except during a short period of time associated with high wind speeds. These results suggest that most aerosols are emitted through degassing and conversion of precursor gases to particles.

Moreover, analysis of aerosol samples collected on filters showed a change in metal solubility from the samples collected at the crater and the samples collected after atmospheric transport in

Milo. This may indicate that the volcanic plume underwent processing in the aqueous phase during transport.