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# The 2011-12 explosive sequences of Mt. Etna observed by remote $SO_2$ and HCl fluxes

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Explosive volcanic eruptions are the tangible evidence of the vigour of volcanoes. Among the types of explosive regimes, lava fountaining is one of the most spectacular as well as one of the most powerful eruptive phenomenon commonly observed at basaltic volcanoes. Between 2011 and 2012, Mt. Etna displayed a period of intense eruptive activity consisting of 25 short-lived lava fountaining episodes from the summit South-East crater (SEC), occasionally replaced by strombolian explosions fed by the Bocca Nuova (BN) summit crater. Throughout the 24-month, we carried out bulk volcanic plume measurements of $SO_2$ flux by Mt. Etna's scanning spectrometer network FLAME, and discrete FTIR observations of $SO_2$/HCl molar ratio. Over time $SO_2$ and HCl fluxes showed simultaneous fluctuations related to waxing and waning degassing phases. Applying a close-system degassing model over the entire observed period, our results, presented as cumulative fluxes, underline three main phases of coupling-decoupling between the two time series. Integrating our results with observations of the eruptive activity on field, we can infer that the behaviour exhibited by the two geochemical signals (fluxes as well as cumulative fluxes) might be associated with the modalities with which magma gas-rich batches rapidly/slowly ascent through the shallow portions of Mt. Etna feeding system; thus triggering lava fountains from SEC or strombolian activity at BN, respectively. Our results highlight the ability of $SO_2$ and HCl fluxes for tracking of shallow long and/or short timescale eruptive phases, confirming the feasibility of these remote-retrieved signals as an effective tool for volcano surveillance and monitoring. Particularly over long-period observations, the combination of cumulative $SO_2$ and HCl masses might likely provide thresholds useful for refining models on basaltic volcano feeding systems and for volcano monitoring hazard alerts.