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Satellite remote sensing of volcanic sulfate aerosols

Sulfate aerosols are formed from precursory sulfur dioxide (SO_2) gas emissions following a complex chain of chemical and physical processes. How secondary sulfate aerosols form and evolve in the peculiar atmospheric environment that prevails within volcanic plumes is still poorly understood.

Standard satellite retrieval analyses (e.g. from MODIS) provide an estimation of the optical depth of aerosols but do not allow for discriminating the compositional characterization of aerosols and their origin, especially if aerosols from various sources are mixed. To tackle this issue, we propose here to explore advantage of the recent achievements in retrieving the aerosol composition from multi-spectral, multi-directional and polarimetric POLDER satellite imagery using GRASP (Generalised Retrieval of Aerosol and Surface Properties) algorithm (Lei Li PhD thesis, 2018, Li et al., in preparation, 2018, and Dubovik et al., 2014).

To better describe and understand the lifecycle of sulfur in volcanic clouds, we will develop a multi-sensor approach for the joint analysis of volcanic SO_2 and sulfur-rich aerosols observations over a 3 yr period (Jan 2006 - Dec 2008). We will study contrasting volcanic activities and atmospheric impacts by focusing on specific case studies of emissions from both stratospheric eruptions and passively degassing volcanic activity in the lower troposphere.

SO_2 satellite observations from a variety of sensors spanning the UV to IR range (UV-OMI and IR-IASI) will be exploited to unambiguously identify the volcanic cloud and constrain the emission, dispersal and destruction rate of the volcanic SO_2 gaseous precursor. A combination of spaceborne aerosol observations (POLDER, MODIS, IASI, CALIOP) will jointly be used to explore the formation and atmospheric evolution of secondary sulfur-rich aerosols.

Key words: Volcanic plumes, volcanic sulfate aerosols/sulfur dioxide gas, atmospheric aerosol composition