Geophysical Research Abstracts
Vol. 20, EGU2018-6451-1, 2018
EGU General Assembly 2018

Chemical and optical properties of volcanic ashes: Laboratory measurements and remote sensing applications.

Alexandre Deguine (1,2), Denis Petitprez (2), Lieven Clarisse (3), and Hervé Herbin (1)

(1) Univ. Lille, CNRS, UMR8518 - LOA – Laboratoire d'Optique Atmosphérique, F-59000 Lille, France., (2) Univ. Lille, CNRS, UMR 8522 - PC2A - Physicochimie des Processus de Combustion et de l'Atmosphère, F-59000 Lille, France., (3) Laboratoire de Chimie Quantique et Photophysique, Université Libre de Bruxelles, Brussels, B-1050, Belgium

During a volcanic eruption, a huge amount of aerosols are emitted into the atmosphere which can be transported over long distances. By absorbing and scattering radiation, volcanic ashes influence strongly the Earth radiative budget. These particles may also affect human health and for some intense events may perturb or interrupt air traffic.

Aerosols can be detected by remote sensing using in particular from infrared spectrometers. These instruments record the extinction signal of a mixing gas and aerosols contribution. From these observations, the main objective is to estimate the chemical composition, the size and the number concentration of the particles. However, the retrieval of these parameters needs to use the appropriate complex refractive indices m, which are mainly unknown and are, up to now, one of the main sources of uncertainty for studying aerosols from infrared remote sensing instruments.

For this purpose, a new methodology has been applied in order to retrieve complex refractive indices in a large spectral range from the measurement of the extinction spectra of various sampling aerosols. Volcanic ashes powder was dispersed by a mechanical agitation in a flow of nitrogen (5 L min-1) within a glass container. Then the aerosol flow is directed through two spectrometers recording the extinction spectra from UV-visible (MAYA 2000 PRO, Ocean Optics 200 to 1100nm) to Infrared (Antaris IGS Analyser, Thermo Scientific 2,5 to 25 μm) and finally to an aerodynamic particle sizer (TSI APS 3321) to record the size distribution in the range 0.5-20 μm. A combination of experimental data, Kramers-Kroning relationship and optimal estimation method is used to determine both the real n and imaginary k parts of the complex refractive index.

This methodology has been successfully applied for five volcanic ashes samples collected from Chile (Cordon Caulle, Chaiten, Calbuco) and Iceland (Grimsvötn, Eyjafjallajökull). Moreover, a chemical analysis has been performed for each sample using X-ray diffraction (XRD) to establish the link between chemical and optical properties of materials. These results are then use to retrieve volcanic aerosol parameters from IASI/MetOp satellite instruments.

The authors thank The LABEX CaPPA, the Hauts-de-France Regional Council, the Ministère de l'Enseignement Supérieur et de la Recherche (CPER Climibio), and the European Fund for Regional Economic Development for their financial support.
The CaPPA project (Chemical and Physical Properties of the Atmosphere) is funded by the French National Research Agency (ANR) through the PIA (Programme d'Investissement d'Avenir) under Contract "ANR-11-LABX-0 0 05-01" and by the Regional Council "Hauts de France" and the "European Funds for Regional Economic Development" (FEDER).