Geophysical Research Abstracts
Vol. 18, EGU2016-1663, 2016
EGU General Assembly 2016

Exploiting hyperspectral sounders for volcanic ash remote sensing

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Assumptions are made when retrieving properties of volcanic ash clouds using passive infrared satellite remote sensing. Assumptions in the retrieval method lead to larger uncertainties in the retrieved volcanic ash cloud properties. It is a general desire to reduce these uncertainties by removing some of the assumptions that must be made. Hyperspectral sounders provide the spectral capabilities to explore many of the physical parameters that describe volcanic ash clouds – the question is, which parameters is it possible to retrieve? We show that using the Infrared Atmospheric Sounding Interferometer (IASI) it is possible to retrieve the mass column loading and cloud top pressure of a volcanic ash cloud, together with the effective radius and spread of the ash particle size distribution, as well as the cloud top pressure of any underlying water cloud using an optimal estimation technique. We discuss the capabilities and shortcomings of the method. The consideration of an underlying water cloud is of importance for improving retrievals, and we place a particular focus on how well the particle size distribution can be described. More specifically, we investigate the viability of using either a lognormal or a gamma distribution to describe the distribution of ash particles, and we show that it is possible to retrieve information about the spread of a lognormal distribution of particles, whereas it is not for a gamma distribution. Some preliminary conclusions on the size distribution of volcanic ash are presented.