Geophysical Research Abstracts
Vol. 16, EGU2014-2943, 2014
EGU General Assembly 2014

Impact of meteorological clouds on detection of volcanic ash during the Eyjafjallajökull 2010 eruption: A modelling study

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Volcanic ash is commonly detected by infrared detectors in space using various variations of the reverse absorption technique. The reverse absorption technique explores the brightness temperature difference (BTD) between the 10.8 and 12,0 μm regions of the thermal spectrum. Several factors affect the infrared detection of volcanic ash. For a cloudless sky (no ice nor liquid water clouds), the density, altitude (temperature), particle size and shape of the ash cloud and the surface temperature, impact the infrared volcanic ash signature. In the presence of ice and/or liquid water clouds the BTD between 10.8 and 12.0 μm may change. The effect of ice and liquid water clouds on detection of volcanic ash may not readily be made based on experimental methods due to the inherent problem in comparing overcast and cloudless cases and the need for in-situ ice and liquid water cloud information together with volcanic ash information. Thus a model based approach was adopted. Simulated 10.8 and 12.0 μm Spinning Enhanced Visible and Infrared Imager (SEVIRI) images for the full duration of the Eyjafjallajökull 2010 eruption were used as input to standard reverse absorption ash detection methods. Simulation of images were made both with and without realistic water and ice clouds taken from European Centre for Medium-Range Weather Forecast (ECMWF) analysis. The volcanic ash cloud fields were taken from simulations by the Langrangian particle dispersion Flexpart model. The effect of clouds on detection of volcanic ash was highly variable. For situations with large areas affected by ash, up to 40% of pixels with mass loading $> 2 g/m^2$ went undetected due to the presence of water and ice clouds.