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Satellite detection of volcanic ash from Eyjafjallajökull and the threat to aviation

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Earth orbiting satellites provide an excellent means for monitoring and measuring emissions from volcanic eruptions. The recent eruption of Eyjafjallajökull in Iceland on 14 April, 2010 and the subsequent movement of the ash clouds were tracked using a variety of satellite instruments as they moved over Europe. Data from the rapid sampling (every 15 minutes) SEVIRI on Meteosat Second Generation were especially useful during this event as the thermal channels between 10–12 μm could be used to detect the ash signal and perform quantitative ash retrievals of mass loadings, optical depths and effective particle size. Higher-spatial resolution ($\sim 1 \text{ km}^2$) information from the MODIS sensors on NASA's Terra and Aqua platforms were also analysed to determine ash microphysics and also to provide ash cloud top height. High-spectral resolution data from the IASI and AIRS sensors showed that initially quantities of ice, potentially with ash cores, were present, and that multi-species retrievals could be performed by exploiting the spectral content of the data. Vertically resolved ash layers were detected using the Calipso lidar on board the Calipso platform. Ash was clearly detected over Europe using the infra-red sensors with mass loadings typically in the range 0.1–5 gm^{-2} , which for layers of 500–1000 m thickness, suggests ash concentrations in the range 0.1–10 mg m^{-3} , and therefore represent a potential hazard to aviation.

Little SO_2 was detected at the start of the eruption, although both OMI and AIRS detected upper-level SO_2 on 15 April. By late April and early May, 0.1–0.3 Tg (SO_2) could be detected using these sensors.

The wealth of satellite data available, some in near real-time, and the ability of infrared and ultra-violet sensors to detect volcanic ash and SO_2 are emphasised in this presentation. The ash/aviation problem can be addressed using remote sensing measurements, validated with ground-based and air-borne, and combined with dispersion modelling. The volcanic ash threat to aviation can be ameliorated by utilising these space-based resources.