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**Monitoring eruptions in Iceland, an intergrated approach**

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The eruption in Eyjafjallajökull in 2010 demonstrated how volcanic eruptions can become international and how widespread the dispersion can be, even from a rather small explosive eruption. The damage to aviation industry from this eruption has been estimated to be 1.7 billion dollars. The Icelandic Meteorological Office (IMO) is a State Volcano Observatory in regards to the International Civil Aviation Authority (ICAO) and is responsible for monitoring pre-eruption volcanic activity, monitoring volcanic eruptions and eruption precursors, monitoring volcanic ash in the atmosphere and informing associated Volcanic Ash Advisory Centers (VAAC) and aviation authorities. The IMO follows an intergrated approach to this task, employing many different systems to monitor volcanic activity. These range from terrestrial sensors such as seismometers, a GPS and strain network, hydrological monitoring systems and an atmospheric monitoring system. These systems are either owned and operated by IMO, operated by IMO but owned by others or in some cases owned and operated by other research and monitoring institutions. The atmospheric monitoring system consists of ~220 weather stations (~120 automatic and ~100 manned stations), thereof two stations that release radio-sondes, two fixed C-band weather radars which cover most of Iceland's active volcanic zone. Furthermore two dual polarization, X band mobile radars have been bought, the first one arrived in spring 2012 and the other is planned to be delivered in 2013. Based on experience from the Grímsvötn eruption in 2011 it is clear that a well located mobile radar can provide higher resolution data than a fixed-point radar. Furthermore, X-band radars operate on shorter wavelengths than C-band radars and can therefore detect smaller particles. A Lidar, owned by NCAS, was installed in South-Iceland in May 2011 as a part of a project between IMO and NCAS in order to test the potential use of LIDARs in the near-field during explosive eruptions and to monitor the re-suspension of ash. IMO has six ceilometers in operation. Currently these are being modified to give information about aerosols in the atmosphere, e.g. suspended and re-suspended ash. Gas emissions provide important information about the volcano activity state. IMO has initiated work on including gas measurements in its monitoring systems and several spectrometers (visible, UV and IR), and other gas sensors have been acquired. Regular measurements are done at Grímsvötn and Krísuvík volcanoes, and Hekla will be continuously monitored from summer 2012. Lightning activity in volcanic plumes often gives indications on the intensity of the eruption. In Iceland,

the ATDnet of the UK Met Office is used for lightning activity monitoring. During the Grímsvötn 2011 eruption the maximum 1-hour lightning rate was 2198 lightning strokes, but the maximum rate during the Eyjafjallajökull eruption in 2010 was 22 strokes. The atmospheric state impacts the volcanic plume. Good information on the ambient atmosphere is therefore a vital part of a volcanic plume monitoring system. During an eruption information is needed on both the source parameters of the volcanic plume (eruption strength, type, ash content, fallout, etc) and the atmospheric conditions. These information need to be intergrated in a timely fashion. The FP7 Futurevolc project which consists of 26 partners from 10 countries aims to provide an in-depth monitoring of volcanic eruption precursors and activity, and facilitate the near real-time intergration of information. To successfully intergrate various types of information, improved models of key processes are needed. Model improvement often depends on new observations and analysis. An example of this is the analysis of motion within the eruption cloud of the Eyjafjallajökull eruption, but images from cameras mounted with a view of the volcano have been analysed to yield data on the velocity field in the eruption plume itself. Such information can be used to validate models of volcanic plume behavior.