

Measurements and mapping of volcanic plumes with light aircraft, examples of research flights during eruptions of Eyjafjallajökull, Grimsvoetn and Etna

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Volcanic eruptions can pose a considerable threat to aviation. This became evident by the airspace closures during the eruptions of Eyjafjallajökull 2010 and Grimsvoetn 2011 and interim closures of the airport Catania after paroxysmal eruptions of Etna 2011. In these situations the Laboratory of Environmental Measurement Techniques (LEMT) of the Duesseldorf University of Applied Sciences and the Earthquake Engineering Research Institute (EERI) of the University of Iceland used light aircrafts, equipped with optical particle counters (OPCs) and partly with volcanic gas measurement systems, for exploring the volcanic plumes and for plume mapping.

During the eruption of the Eyjafjallajökull 2010 LEMT performed 14 research flights over North Germany. The results of these flights were compared with the model calculations of the London VAAC. In parallel EERI performed measurement flights over western Iceland. During two of these flights the outskirts of the ash plume were entered directly by the aircraft delivering concentrations of about 2000 micro g/m³. In Germany the Eyjafjallajökull ash plume appeared to be strongly structured in horizontal and vertical direction during the flights. Peak concentrations of up to 330 micro g/m³ could be found.

During the Grimsvoetn eruption 2011 LEMT and EERI performed several cooperative measurement flights over Iceland and northern Germany. A part of the flights on Iceland was performed officially for the Icelandic flight operator ISAVIA. The aircraft measurements in the region over Keflavik and Reykjavik revealed mostly small ash concentrations in contrast to the predictions of the VAAC dispersion model.

Therefore these aircraft measurements helped to re-open the international airport of Keflavik by ISAVIA. In a similar way aircraft measurements over northern Germany on 25 May 2011, which were performed by LEMT for the German Weather Service DWD, showed low ash concentrations over northern Germany, despite of high predicted VAAC model calculations. Therefore the re-opening of the German airports Hamburg, Bremen and Berlin was in accordance with the low measured ash concentrations by the LEMT aircraft.

Moreover this light aircraft was used by LEMT for studies of the volcanic plumes of Etna in 2011 and enabled the determination of SO₂ fluxes.

In general light piston-motor driven aircraft proved to be robust enough to operate even at elevated ash concentrations. Because these aircraft are able to fly at low cruising velocities during measurements they can deliver spatial high resolution results. Moreover, the OPCs of these aircraft were calibrated in a special dust/wind tunnel with volcanic ash, thus delivering ash concentration results with high accuracy.

It is important to note, that the LEMT aircraft is on official standby now for the German Weather Service DWD and the German Transport Ministry for official airborne measurements in Germany in case of another volcanic eruption.