Geophysical Research Abstracts
Vol. 13, EGU2011-3476-2, 2011
EGU General Assembly 2011


# Tephra sedimentation during the 2010 Eyjafjallajökull eruption (Iceland) from deposit, radar and satellite observations

Costanza Bonadonna (1), Genco Riccardo (2), Gouhier Mathieu (3), Pistolesi Marco (4), Alfano Fabrizio (1), Cioni Raffaello (5), Hoskuldsson Armann (6), and Ripepe Maurizio (2)

(1) Université de Genève, Section des sciences de la Terre et de l'environnement, Genève, Switzerland (costanza.bonadonna@unige.ch, +41 22 379 3601), (2) Universita' di Firenze, Firenze, Italy (r.genco@yahoo.it), (3) Centre National d'Études Spatiales, Clermont-Ferrand, France (M.Gouhier@opgc.univ-bpclermont.fr), (4) University of Pisa, Pisa, Italy (pistolesi@dst.unipi.it), (5) Universita' di Cagliari, Cagliari, Italy (rcioni@unica.it), (6) University of Iceland, Reykjavik, Iceland (armh@hi.is)

The 14 April – 21 May 2010 eruption of Eyjafjallajökull volcano (Iceland) was characterized by a nearly continuous injection of tephra in the atmosphere up to 9 km above sea level with a large production of ash that was mainly dispersed towards the east and south-east reaching as far as the southern parts of Europe and causing significant damage to vegetation and various economic sectors in Iceland and a global-wide interruption of air traffic. During 4-8 May 2010 various experiments were carried out in order to investigate particle sedimentation and comparisons have been made between deposit observations and both radar and satellite data.
Tephra accumulation and tephra accumulation rate varied between 0.02-0.68 kg/m2 and 0.06-7 x 10-4 kg/m2/s respectively at different locations between 1.5 – 55 km from the vent and over collection periods between 600 and 8220 seconds. Associated tephra deposits show one or two populations with Mdphi and sorting varying between -0.9 – 4.5 phi and 0.8 – 1.2 respectively. Accumulation rate shows two exponential segments with break-in-slope at about 20 km from the vent, whereas Mdphi shows a linear increase until about 20 km from vent reaching a plateau of about 4.5 phi between 20-55 km. Volcanic particles fell as ash clusters, coated particles, structureless pellets and liquid pellets. While the first three types are ubiquitous in the collected samples, liquid pellets were only retrieved at one location and are not directly related to the occurrence of meteoric rain. Nonetheless dedicated collections showed that aggregate typologies changed spatially and that a same location can be characterized by different types of aggregates.
Particle and aggregate settling was investigate with the Doppler-radar PLUDIX (i.e. X-band Doppler radar designed for the detection of hydrometeors). For the first time, the PLUDIX was calibrated to transform frequency shift and power spectrum in size distribution and intensity of ash fall applying adapted inversion methods of Gouhier and Donnadieu (2008), which showed very promising agreement with observations. For three selected samples we have i) analyzed the Doppler spectrum, ii) derived the associated settling velocity spectrum by inversion, iii) calculated the grainsize distribution and iv) compared the PLUDIX-derived grainsize distribution with the grainsize distribution observed in the field. Two proximal samples (1.5 and 10 km from vent) show a well defined Gaussian distribution in the range 300-900 Hz and 150-350 Hz respectively, whereas the most distal sample analysed (20 km from the vent) does not show any well defined Guassian distribution but only small peaks around 50 Hz. Associated settling velocities vary between 0-16 m/s, whereas granulometry could only be well constrained for particles >750 microns. The use of PLUDIX allowed also for a thorough testing of settling-velocity models for both ash and lapilli size particles.
Quantitative ash cloud characteristics have also been retrieved using MSG-SEVIRI measurements during May 6, 2010, which has been recorded as the most powerful episode of the April-May, 2010 Eyjafjallajökull eruption and for which we also have detailed deposit and PLUDIX data. Satellite data well complement ground-based techniques as they provide insights on the dynamics of ash cloud far from the vent (>100 km). Minimum sedimentation and sedimentation rate is of 24 t/s and 0.2 to 0.4x10-6 kg/m2/s respectively (based on images acquired from 18:30 U.T. and 19:30 U.T.), which is in good agreement with ground observations for that day. Typical ash concentrations calculated during this event range between 0.5 to 4 mg/m3, with 3 distinct ash radius modes of 1.2, 2.8, and 4 $\mu$m.