# Atmospheric aerosol episodes over Lithuania after the May 2011 volcano eruption at Grimsvötn, Iceland

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Volcanic eruptions emit large amounts of gaseous and particulate material into the atmosphere. In particular, $SO_2$ is abundant in volcanic gases (Hobs et al. 1991). $SO_2$ emitted from volcano could act as a precursor of the formation of sulfuric acid particles. Information of the composition and size distribution of volcanic aerosol particles in the troposphere is important to evaluate their effects on atmospheric radiation and cloud formation.

We present measurements of $PM_1$ components concentration and size distribution in the vicinity of Vilnius at the Institute of Physics (54°38'N; 24°11'E) on 24-29 May 2011 after the eruption of the volcano at Grimsvötn in Iceland. An Aerodyne Quadrupole Aerosol Mass Spectrometer (Q-AMS) has been used to provide on-line measurement of size dependent chemical composition of non-refractory components (ammonium, nitrate, nss-sulfate, organics) in submicron aerosol particles ($PM_1$). In order to determine air mass transport routes to Vilnius, forward and backward trajectories were calculated every 1-3 h with a total of 120 h duration for the sites (Grimsvötn and Vilnius) using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model (Draxler and Rolph, 2003).

To distinguish volcanic and non-volcanic origin of $PM_1$ components four concentration episodes at Vilnius during 24-29 May 2011 have been selected for analysis. Episode 1 (0700-1400 UTC 25 May) and 2 (0400-1100 UTC 26 May) were selected according to trajectories of air masses which travelled from Iceland over North Atlantic Ocean before the arrival to Vilnius. Episode 3 (1200-2300 UTC 26 May) was selected as transitional one when the air masses originated from Iceland travelled over North Atlantic Ocean, and over Scandinavia and partly passed over polluted industrial regions (Great Britain, Germany). During Episode 4 (from 0600 UTC 27 May to 0000 UTC 28 May) air masses were mainly passing over Central Europe.

This study shows that the sulfate emissions from the volcano at Grimsvötn in Iceland reached distances farther than 3000 km, and they can have an influence on the local concentration and size distribution spectra of $PM_1$ chemical components. Over the period of the volcanic eruption (Episode 1) the sulfate concentrations increased by a factor of 3 and reached 90% of $PM_1$, while the nitrate and organic levels remained low and unchanged (Fig.1). Air mass trajectory analysis indicates that the volcanic aerosol from Iceland was carried to Vilnius by air masses at the height of 3000–4500 m. The ammonium to sulfate molar ratio (ASR) during Episodes 1 and 2 is 0.81, suggesting that sulfate particles were partially neutralized by ammonium and determined by volcanic eruptions. However, during Episodes 3 and 4 the ASR was higher (1.0) and determined by both volcanic and non-volcanic origin components.

Combining air mass transport analysis as well as investigations of aerosol chemical composition and size distribution parameters, allowed us to explain possible sources of atmospheric submicron aerosol particles.

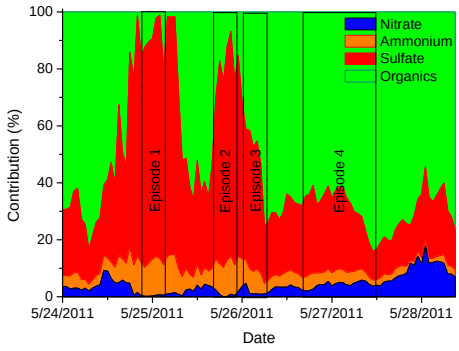


Figure 1. Relative contribution of chemical components of $PM_1$ measured at Vilnius from 24-29 May 2011.

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Hobbs, P.V., Radke, L.F., Lyons, J.H., Ferek, R.J. and Coffman, D.J. (1991) *J. Geophys. Res.* **96**, 18735–18752.

Draxler, R.R. and Rolph, G.D. (2003) *HYSPLIT Model* access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php). NOAA Air Resources Laboratory, Silver Spring, MD

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