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Firework pollution measurements on New Year's Eve in Reykjavík – an analogue for an eruption cloud in Iceland

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The Icelandic public launches a considerable amount of fireworks on New Year's Eve. The concentration of air pollution from the fireworks differs depending on weather conditions and is raising concerns regarding community health. We measured aerosols and gas in the atmosphere over Reykjavík from 30 December 2018 to 7 January 2019 using equipment that is planned to be used to measure volcanic emissions during the next eruption in Iceland. The deployed equipment included a Leosphere scanning lidar with depolarization functionality, a Vaisala ceilometer, a TSI optical particle counter (OPC), webcams, and a Multigas, which were located at the Icelandic Meteorological Office's site in Reykjavík. Particulate matter and gas measurements were also made at several measurement stations operated in urban areas in Reykjavík.

We find a clear correlation between the backscatter coefficients derived from the ceilometer and lidar. These instruments clearly detect particles in the atmosphere related to the firework displays on New Year's Eve 2018 and a re-suspension event on 1 January 2019. It is possible to discriminate between firework particles and ice clouds based on time series analysis of backscatter coefficients and the depolarization data from the lidar. The latter also displays an increase in non-spherical particles in the atmosphere in the hours around midnight.

The OPC data displays a clear increase in particles in the PM10 and PM2.5 size ranges on New Year's with a maximum value of 600 μg/m3 about one hour after midnight and an additional increase the following afternoon, consistent with resuspension of particulates in the atmosphere. This signal is also observed on the ceilometer and lidar data.

The effect of the fireworks on gas concentrations is minor, and only the more sensitive urban station measured a small SO_2 and NO_2 peak around midnight, while the less sensitive MultiGAS neither measures detectable changes in SO_2 nor CO_2.

The results demonstrate that this combination of measurements from multiple instruments is effective in discriminating between different types of particulates in the atmosphere. The deployment of these various instruments and near-real time data interpretation will be used during the next volcanic eruption in Iceland.