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Effusive Eruption Modelling project: Assessing UK impacts of trace species and sulphur deposition

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The Effusive Eruption Modelling project undertook to determine the extent to which sulphur dioxide and sulphate aerosol might be hazardous at ground and flight levels during a future eruption scenario based on a Laki-type eruption. In order to do this the model source term was constructed and comprised five weeks of daily emissions followed by one week of no emissions. In order to sample different meteorology, the 6-week model source term is repeated eighty times over 10 years of meteorology. The scenario was run using both the NAME model, and the EME4UK model. Detailed results are presented in Witham et al. This presentation reports the results of an assessment of UK impacts of trace species and sulphur deposition.

A limited literature survey was carried out and conservative initial ratios of HCl, HF and H_2S with respect to SO_2 were selected. HCl emissions of the same magnitude as SO_2, modelled in EMEP4UK as a soluble species with the same properties as nitric acid, X_{sol}, resulted in average hourly concentrations at the UK surface of mostly <1 μg.m^{-3}, 95th percentile hourly concentrations of <5 μg.m^{-3}. Maximum hourly concentrations over all the 80 eruptions modelled are of the order 200-300 μg.m^{-3} but high concentrations were of very short duration. Human health air quality limits for HCl, HF or H_2S were not exceeded in the UK. Results are only indicative as to the likely impact of such an event due to large uncertainties for all three species considered. The results will be discussed in terms of the UK ambient concentrations of trace species. Further studies at volcanoes and fundamental parameters being measured in the laboratory are required to improve this type of analysis.

Sulphur deposition modelling was undertaken using critical loads assessment and dynamic (VSM) modelling. The assessment of potential impacts on the environment was carried out using two scenarios: (i) baseline concentrations and deposition for 2005, (ii) concentrations and deposition for an average Laki-type eruption lasting 5 weeks within the same year (2005); Results show that for an average Laki type eruption annual sulphur deposition in the UK could increase by approximately 50%, to levels similar to the peak of industrial sulphur pollution in the early 1970s. This would result in an increase in the area of sensitive eco-systems exceeding their critical load**.** Although the magnitude of the critical load exceedance more than doubles it remains relatively low across the UK. Scotland would experience the greatest proportional increase due to sensitive habitat locations. The UK area exceeding the SO_2 critical levels did not change and pH impacts were found to be localised. The effects of concentrated, short-term peaks of sulphur deposition could not be fully evaluated using the yearly model applied in the study. The deposition modelling suggests that periods of high sulphur concentrations in near-surface atmosphere would be brief and short-term therefore severe acidification episodes are unlikely. Results will be discussed in the context of the current Icelandic eruption.