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3-dimensional atmospheric chemistry modelling of the halogen species in a volcano plume: the representativeness issue

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During an eruption, a volcano emits magma, ashes and gases. Whether it is an explosive or an effusive eruption, the influence on the atmospheric chemistry is different. The main gases present in the plume are H_2O, CO_2, SO_2 and halogens species. It is known that the presence of halogens species in the plume has an impact on ozone, thanks to the formation of bromine monoxide (BrO). Because the concentration of this species is weak and BrO was unexpected, BrO was only detected in 2003 (Bobrowski et al., 2003), in a volcanic plume at the Soufriere Hills (Montserrat). Several 0-D modelling studies (e.g. Roberts et al., 2009) showed that BrO is produced rapidly ("bromine explosion") from heterogeneous reactions within the plume on sulphate aerosols and consequently the ozone concentration is reduced locally. We added the chemical cycle which products BrO in the volcanic plume proposed by Roberts et al. (2009) in a state-of-the-art 3-dimensional numerical atmospheric chemistry model (MOCAGE chemistry transport model).

The simulations performed for a medium-size eruption with a 0.5°x0.5° latitude/longitude resolution and with realistic estimates of volcanic volatile fluxes do not provide a bromine explosion in the plume. This is because of the too coarse resolution of the atmospheric model which is not able to represent plume chemistry occurring at a finer scale. To improve the results we have designed a sub-grid scale parametrisation in the model. We will present the method used and the results in one dimensional framework for the evolution of BrO and ozone during a volcanic eruption.

References

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