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Determining volcanic SO_2 plume heights in satellite observations using meteorological wind fields

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Satellite observations nowadays provide the global monitoring of volcanic plumes via sulphur dioxide (SO_2) that is injected into the Earth's atmosphere. In turn, SO_2 may lead to the formation of sulphate aerosols that can influence climate via direct and indirect radiative effects. The retrieval of SO_2 requires an accurate plume height estimate in order to constrain total amounts for such events.
One of the main difficulties for the retrieval is the typically unknown atmospheric profile resulting from unknown initial conditions (individual explosions over an extended time period leading to different gas layer altitudes and influencing the atmospheric transport pattern). In recent years, satellite observations helped to improve global SO_2 estimates, but still large uncertainties exist. Passive satellite remote sensing using measurements in the UV/vis spectral range for example offers the opportunity to observe the location of a plume in two dimensions, but information about the corresponding height is sparse. Furthermore, information about these plume profiles is not only interesting in itself (e.g. to assess the radiative effect of volcanic plumes). It is also important for the quantitative interpretation of satellite observations.
Here, we present first results for a newly developed approach using the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) in combination with data for different volcanic SO_2 plumes as observed by the second generation Global Ozone Monitoring Instrument (GOME-2). The main plume information that can be retrieved by the satellite (i.e. plume location and observation time) are used as initial input parameters in order to estimate the plume's profile at the time of the measurements. For selected case studies we use these trajectories to further estimate values the eruption time and height. The correspondingly modelled values can also be used to verify the results when they are compared to direct local observations and reports.