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Creating a 4D SO2 dataset with high vertical resolution by connecting volcanic cloud observations through trajectory modelling

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After major volcanic eruptions, sulphur dioxide (SO_2) can be released in large quantities to the stratosphere. The sulphur dioxide is later oxidised into sulphate aerosol which reflect incoming sunlight and cools the surface temperatures around the globe. The duration length is highly dependent on the altitude of the SO_2 cloud and its geographical location. Today, infrared sensors on-board satellites can give an estimate of the SO_2 cloud top height and lidar instruments can give height profiles in their narrow field-of-view. Both these classes of instrument lack the capability to fully map the vertical distribution of the SO_2 clouds. We propose a scheme to create a SO_2 dataset with high vertical resolution. The scheme consists of distributing SO_2 column densities from ultra-violet and infrared satellite instruments into SO_2 profiles using scattering data from the CALIOP lidar on-board the CALIPSO satellite. The CALIOP lidar has a vertical resolution of up to 60 m in the region of interest. Since CALIOP only collect data along narrow fields-of-view, this initially gives us the SO_2 dataset only where CALIOP has collected data. To make the most of this information we run the FLEXPART trajectory model. If air parcels that were initially in CALIOP's field-of-view and later in another part of the SO_2 cloud, then the output from FLEXPART gives us this information. Thus, from CALIOP we shift the vertical information in time to other parts of the SO_2 cloud using the trajectory model.