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Volcanic SO_2 plume forecasts based on UV satellite observations

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We present how SO_2 observations from satellites were used to facilitate forecasts of volcanic sulphur dioxide (SO_2) plumes. Volcanic SO_2 is often co-located with volcanic ash and can in many cases be considered as a proxy for volcanic ash. Satellite retrievals of SO_2 total columns from GOME-2, OMI and SCIAMACHY for the eruptions of Grímsvötn and Eyjafjallajökull in May 2011 and 2010 were inter-compared and used to (i) estimate source strength and injection height and (ii) to provide SO_2 initial conditions for forecasts by means of data assimilation. The forecasts were carried out as an activity within the European MACC project (Monitoring of atmospheric composition and climate). MACC builds and runs a near-real-time system for the forecast of global atmospheric composition using the integrated forecast system of ECMWF.
Our study found that OMI retrievals had the highest maximum values and that GOME-2 observations provided the most complete spatial coverage. Basic estimates of plume parameters were inferred from the satellite retrievals by finding the best match with an ensemble of plume forecasts injected at different levels. Further, the SO_2 retrievals were assimilated with ECMWF's 4D-VAR algorithm to obtain initial conditions for the plume forecasts. These initialized plume forecasts were also used to validate the consistency of the satellite observations for consecutive days. The Grímsvötn plume could mostly be predicted by the initialized forecasts, whereas the forecasts of the Eyjafjallajökull plume benefited more from the source term estimate.