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# Inversion Technique for Estimating Emissions of Volcanic Ash from Satellite Imagery

Rachel Pelley, Michael Cooke, Alistair Manning, David Thomson, Claire Witham, and Matthew Hort
Met Office, Exeter, United Kingdom (rachel.pelley@metoffice.gov.uk)

When using dispersion models such as NAME (Numerical Atmospheric-dispersion Modelling Environment) to predict the dispersion of volcanic ash, a source term defining the mass release rate of ash is required. Inversion modelling using observations of the ash plume provides a method of estimating the source term for use in NAME. Our inversion technique makes use of satellite retrievals, calculated using data from the SEVIRI (Spinning Enhanced Visible and Infrared Imager) instrument on-board the MSG (Meteosat Second Generation) satellite, as the ash observations.

InTEM (Inversion Technique for Emission Modelling) is the UK Met Office's inversion modelling system. Recently the capability to estimate time and height varying source terms has been implemented and applied to volcanic ash. InTEM uses a probabilistic approach to fit NAME model concentrations to satellite retrievals. This is achieved by applying Bayes Theorem to give a cost function for the source term. Source term profiles with lower costs generate model concentrations that better fit the satellite retrievals. InTEM uses the global optimisation technique, simulated annealing, to find the minimum of the cost function. The use of a probabilistic approach allows the uncertainty in the satellite retrievals to be incorporated into the inversion technique. InTEM makes use of satellite retrievals of both ash column loadings and of cloud free regions.

We present a system that allows InTEM to be used during an eruption. The system is automated and can produce source term updates up to four times a day. To allow automation hourly satellite retrievals of ash are routinely produced using conservative detection limits. The conservative detection limits provide good detection of the ash plume while limiting the number of false alarms. Regions which are flagged as ash contaminated or free from cloud (both meteorological and ash) are used in the InTEM system. This approach is shown to improve the concentrations in the modelled plume both near to and far from the volcano. The system has been tested using data from the 2010 Eyjafajallajökull eruption and the 2011 Grímsvötn eruption.