On-line coupling of volcanic ash with global and regional meteorological models

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Large explosive volcanic eruptions can inject significant amounts of tephra and gaseous materials into the atmosphere inducing an multi-scale array of physical, chemical and biological feedbacks within the environment. The assessment of the tephra dispersion hazards is critical when determining local and regional environmental and socio-economic disruptions. Additionally, stratospheric sulfate aerosols generated from volcanic sulfur gases and fine ash particles might result in disturbance of the energy balance and chemistry of the atmosphere at a global scale. Effective models for forecasting the spatial and temporal distribution of volcanic ash and sulfate aerosols are necessary to assess the magnitude of these feedback effects, and they have become critical tools in addressing the scientific, economic and political issues associated with large volcanic eruptions. However, the magnitude of these feedback effects within the climate system still remains poorly documented.

In the frame of the NEMOH network, a training network under the European Community FP7 for the numerical, experimental and stochastic modelling of volcanic processes and hazards, we aim at validating the off-line hypothesis currently assumed by most tephra transport models, by analyzing the extent to which the near-source and regional meteorology is affected by dense ash clouds altering the radiative budget and the climate system in general. The first step of this 3-year project, is to compare the spatial and temporal distribution-sedimentation of volcanic ash outputs from the off-line FALL3D-TTDM with those on-line from the new non-hydrostatic Multiscale Meteorological model on a B grid (NMMB). For this purpose, the transport and sedimentation module for volcanic ash existing in the FALL3D model is coupled to a new version of the NMMB model. This presentation summarizes the capabilities, limitations, and sources of uncertainty from modelling ash dispersal for large volcanic eruptions, both off and on-line with meteorological models.

The NMMB model is the evolution of the WRF-NMME meteorological model. The BSC is also implementing an on-line gas-aerosol chemical module to model sulfate aerosols generated during large explosive volcanic eruptions and evaluate their impact within the climate system.