Real-time data assimilation of radar-based volcanic ash data in an atmospheric transport model

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Improving the forecasting accuracy of volcanic ash and speeding up the issuing of volcanic ash advisories is vital not only for world aviation but also for people living in volcanic areas. In Japan, the Tokyo Volcanic Ash Advisory Center (VAAC) is responsible for atmospheric volcanic ash forecast in civil aviation flight paths. For this purpose, we developed an atmospheric transport model: the JMA-GATM.

The JMA-GATM uses the volcanic ash source function of Suzuki (1983), which uses assumptions of size distribution, shape of ash clouds, etc. The model shows good performance, but still has the room for improvement in volcanic ash source as initial condition.

We plan to start radar observation of volcanic plume of the Sakurajima volcano from March 2016. The observational data will be assimilated into the model to improve the initial conditions which is essential for realistic forecast.

We have selected the three-dimensional variational method (3D-var) from several data assimilation methods. The 3D-var is a low-costs and speedy methods, and can create initial conditions soon after an eruption occurs.

In this system, analysis variables are density of ash and size distribution parameters (median particle size and dispersion) which are independent of each other. It is assumed that observation error covariance is diagonal. Another important parameter is background error covariance, where the relationship between correlation and distance has the gaussian form.

We use the eruption source model or forecast value as the first guess in 3D-var. Because there is no value of size distribution parameters at the grid points where there is no ash, near first guess or observation values are interpolated.

Currently, we are validating the assimilation system using hypothetical radar observation data, we are developing and checking validation of the data assimilation system.

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