Forecast of Sulfur Dioxide Flow from Miyake Volcano with a High Resolution Regional Transport Model

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1. Background

Mt. Oyama in Miyake Island (34.1N, 139.5E), which is located 180km south of Tokyo, erupted in July 2000. Even now a huge amount of sulfur dioxide which runs up to 10,000－20,000 t/day is discharged from the volcano every day. The emitted toxic gas occasionally spreads over Japan, depending on wind direction. The concentration of SO2 gas sometimes exceeds an environmental standard. The increase in concentration brings about nasty smell to us, damage to agricultural crops, increase in rejection rate of semiconductor production, and so on.

2. Model

For forecasting SO2 gas flow, we have newly developed a regional transport model which uses output from the Regional Spectral Model (RSM). RSM has a horizontal resolution of 20km and 40 vertical levels up to 10hPa.

The regional transport model adopts a Lagrangian approach, in which many tracer particles are released at the time and location of pollutant emission and displaced due to horizontal and vertical advection and diffusion. The model makes use of the 3-hourly model-level horizontal wind data of RSM, calculates the vertical wind on the hypothesis of hydrostatic equilibrium and advects each particle 3-dimensionally.

The vertical diffusion coefficient is decided following Mellor&Yamada's Level 2 Closure Model (Mellor and Yamada 1982) and each particle is displaced vertically on random walk process. In regard to horizontal diffusion, a random variation to the subgrid-scale turbulent velocity is given to each particle step by step following Langevin's equation (Gifford 1982).

3. Operation

Since June 2001, we have run the model up to 36 hours every day (00UTC initial) and JMA forecasters utilize products of the model for issuing two day forecast on SO2 gas from Miyake Volcano. The model assumes a constant SO2 emission from the initial time and uniform release from 0 to 1500m above the sea-level.

4. Examples of Forecast

The model forecasts generally show good agreements with the observed increase in SO2 concentration. Two examples are shown, in which SO2 gas reached far away.

Example 1: The model forecast starting from 00UTC 7 July 2001 predicted an inflow of SO2 gas into a channel between Shikoku Island and Kii Peninsula on 8 July 2001. High SO2 concentrations were observed at both sides of the channel on that day. The topography used in RSM and analysis of surface wind at 12UTC on 8 July 2001 is also shown (Fig. 1).

Example 2: The model forecast starting from 00UTC 15 August 2001 predicted a high concentration of SO2 gas on 16 August 2001 in Kyusyu Island, which is about 800km west from Miyake Volcano. High SO2 concentrations were observed in the central and eastern parts of Kyusyu Island on that day (Fig. 2).

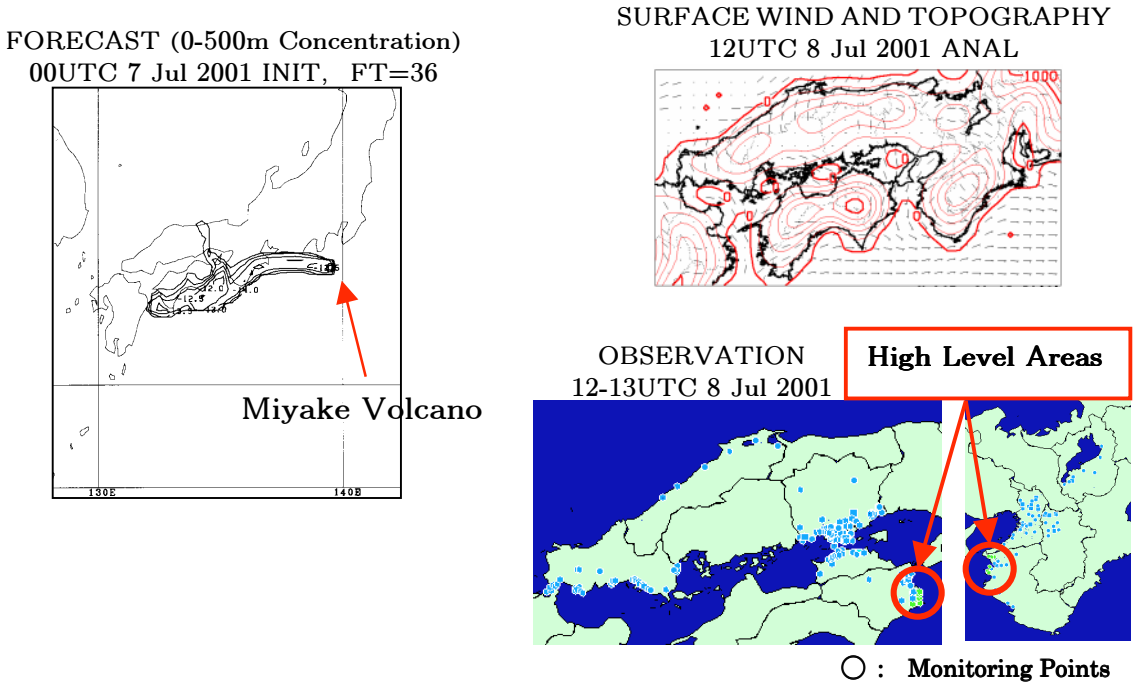

Fig. 1: An example of model forecast. The 36 hour forecast starting from 00 UTC 7 July 2001 is verified against the observation provided by the Ministry of the Environment of Japan. The upper right panel shows the surface wind analysis at the verification time and the model topography.

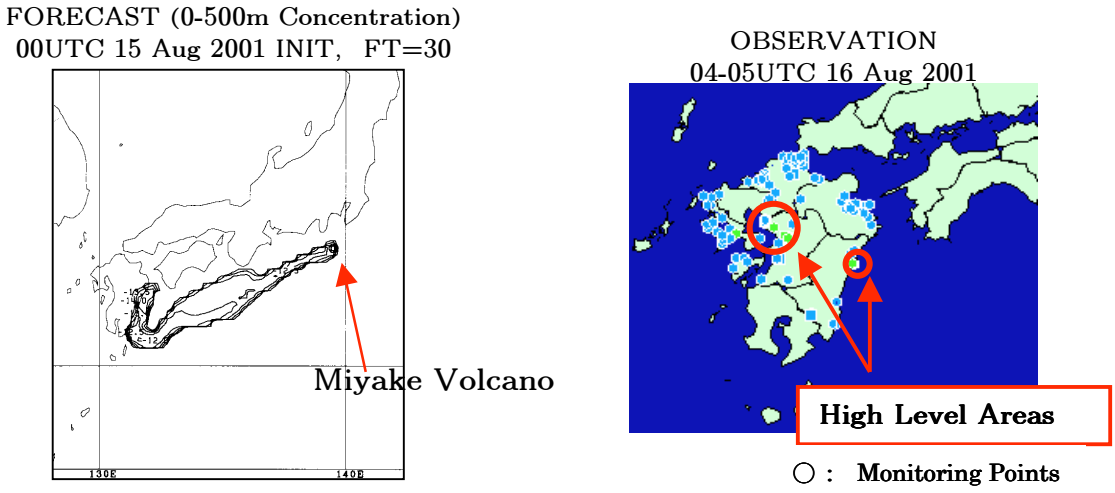

Fig. 2: Same as Fig. 1 except for the 30 hour forecast starting from 00 UTC 15 August 2001.

References

Gifford, F. A., 1982: Horizontal diffusion in the atmosphere: A Lagrangian-dynamical theory. *Atmos. Environ.,* **16**, 505-512.

Mellor, G. L. and T. Yamada, 1982: Development of a turbulence closure model for geophysical fluid problems, *Rev. Geophys. Space Phys.,* **20**, 851-875.