Renewal of the JMA Atmospheric Transport Model on the Volcanic Ash Advisory and Ash Fall Forecast Distribution System

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The Japan Meteorological Agency (JMA) has been issuing volcanic ash advisories (VAAs) since April 1997 and volcanic ash fall forecasts (VAFFs) since March 2008. VAAs had been mainly based on the outputs of global atmospheric transport model (JMA-GATM; Hasegawa and Hayashi, 2019a) since December 2013, while VAFFs had been based on the other outputs of regional atmospheric transport model (JMA-RATM; Shimbori et al., 2009; Hasegawa and Hayashi, 2019b) since the beginning. The JMA-GATM was driven by the gridded data of the global spectral model (GSM) and the JMA-RATM by those of the meso-scale model (MSM) or local forecast model (LFM) based on the nonhydrostatic model ASUCA.

In March 2021, we have developed the new atmospheric transport model (JMA-ATM; Shimbori and Ishii, 2021) to unify the JMA-GATM and JMA-RATM, and then implemented in the JMA's supercomputer system connected to the volcanic ash advisory and ash fall forecast distribution system (VAFS). Main features of the JMA-ATM are as follows: This model is an offline Lagrangian model, which the time tendency of tracer variables is calculated in each process and integrated at the last time step in order that dynamical and physical processes are commutative at each time step. The element conversion of gridded data is executed during preprocessing. The coordinate system of the JMA-ATM can accommodate beyond the input datasets of the GSM, MSM and LFM, i.e. the vertical coordinates of the JMA-GATM and JMA-RATM are the σ-p hybrid coordinate of the GSM and the hybrid terrain-following coordinate of the ASUCA, respectively, but the JMA-ATM unifies the models by converting the gridded data to identical z-coordinates. Hence previous workflows on the supercomputer had two independent main flows corresponding to the JMA-GATM and JMA-RATM; on the other hand, current workflows consist of several preprocessors and one main flow corresponding to the JMA-ATM (Fig. 1).

An example of volcanic ash fall predictions is shown in Fig. 2. As an operational model, a first objective of the JMA-ATM, which is to maintain the accuracy of JMA-GATM and JMA-RATM predictions, has been achieved.

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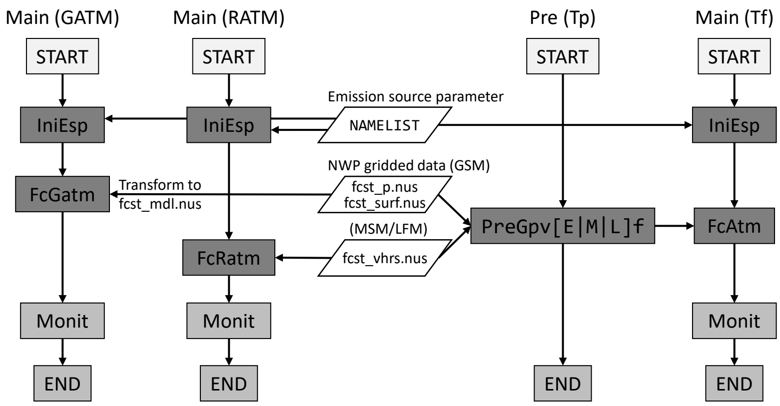
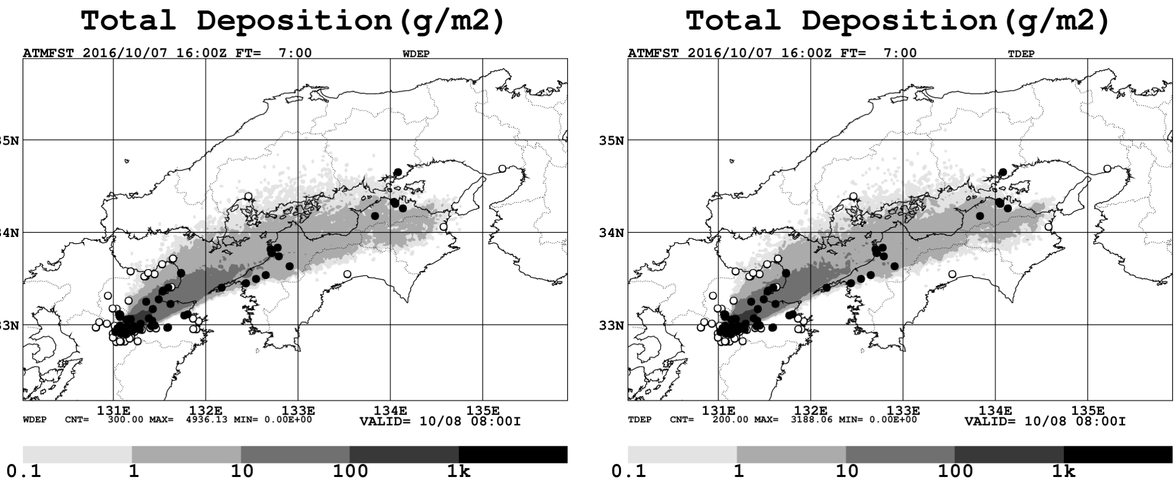


JMA-G/RATM　　　　JMA-ATM

Fig. 1 Comparison of workflows (see Fig. B.1 of Shimbori and Ishii (2021))



JMA-RATM　　　　JMA-ATM

Fig.2 Six-hour volcanic ash fall predictions of the eruption at Aso Volcano on 7 Oct. 2016 from the event time at 16:46 UTC to the valid time at 23:00 UTC with a plume height of 11,800 m above the crater. The symbols of ash-fall observations are as follows: ● observed; ○ unobserved. (see Fig. 5.13 of Shimbori and Ishii (2021))