# Redesign of the Japan Meteorological Agency Atmospheric Transport Model

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The Meteorological Research Institute (MRI) of the Japan Meteorological Agency (JMA) will develop a new Atmospheric Transport Model (ATM) called the JMA-ATM.

The JMA is currently operating the Global ATM (JMA-GATM) and Regional ATM (JMA-RATM) to issue Volcanic Ash Advisories (VAAs) and Volcanic Ash Fall Forecasts (VAFFs). The JMA-GATM and RATM are driven by the grid point values of Global Spectral Model (GSM) and Meso-Scale Model (MSM) or Local Forecast Model (LFM) based on the nonhydrostatic model ASUCA (Forecast Department, 2014), respectively. The MRI is planning to renew the JMA's ATM and join a volcanic ash data assimilation system (Ishii *et al.*, 2017) under one of the MRI research plans which start in April 2019.

The new JMA-ATM is designed from the point of view of robustness, promptness, flexibility and manageability. *Robustness*: To avoid any abnormal ends in operation, the JMA-ATM takes Lagrangian description. *Promptness*: To issue VAAs and VAFFs immediately, the JMA-ATM calculate offline. Further, element conversion of grid point values executes in preprocess and main ATM calculation runs parallel processing using Message Passing Interface (MPI) on high performance computers. *Flexibility*: ATM tracers are not limited to volcanic ash generated by an eruption column model as initial condition and the ATM coordinate is not customized only for the input data of GSM, MSM or LFM. *Manageability*: In order to review and share source codes within the JMA, project management and version control systems are used in the ATM development. With regard to the above design, the offline Lagrangian model is the same as current ATMs. Whereas the vertical coordinate of JMA-GATM is $\sigma$-$p$ hybrid of GSM and that of JMA-RATM (Shimbori *et al.*, 2016) is hybrid terrain-following of ASUCA, the JMA-ATM takes identical $z$-coordinate of the converted grid point values. Therefore two current ATMs can be unified to the single ATM (see Fig. 1). For readability, the JMA-ATM are written in the Fortran in accordance with the standard coding rule (Muroi *et al.*, 2002) and all subroutines are modularized. In order that dynamical and physical processes are commutative in a timestep of the JMA-ATM, time tendency of tracer variables is calculated in each process and integrated at the last timestep. The JMA-ATM project is managed with Redmine and its source code version is controlled with Subversion (SVN) which have been installed in JMA (Forecast Department, 2017).

A first object of the new ATM as an operational model is to maintain the same accuracy of JMA-GATM and RATM predictions. In particular, to precisely predict the atmospheric transport phenomena near ground surface, suitable treatments of model terrain in terms of $z$-coordinate are primary subjects. A technical platform, such as visualization and verification tools, is also needed. We are going to publish the documentation of the JMA-ATM in the Technical Reports of the MRI in 2020. Furthermore, for the purpose of accuracy improvement of the JMA-ATM prediction, we are planning to implement processes of aggregation and resuspension, in addition to joining the data assimilation system for volcanic ash that observed by weather radars (*e.g.*, Sato *et al.*, 2019) and so on.

**References**

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volcanic ash data assimilation system for atmospheric transport model. *Proc. JpGU-AGU Joint Meeting*, MIS02-P02.
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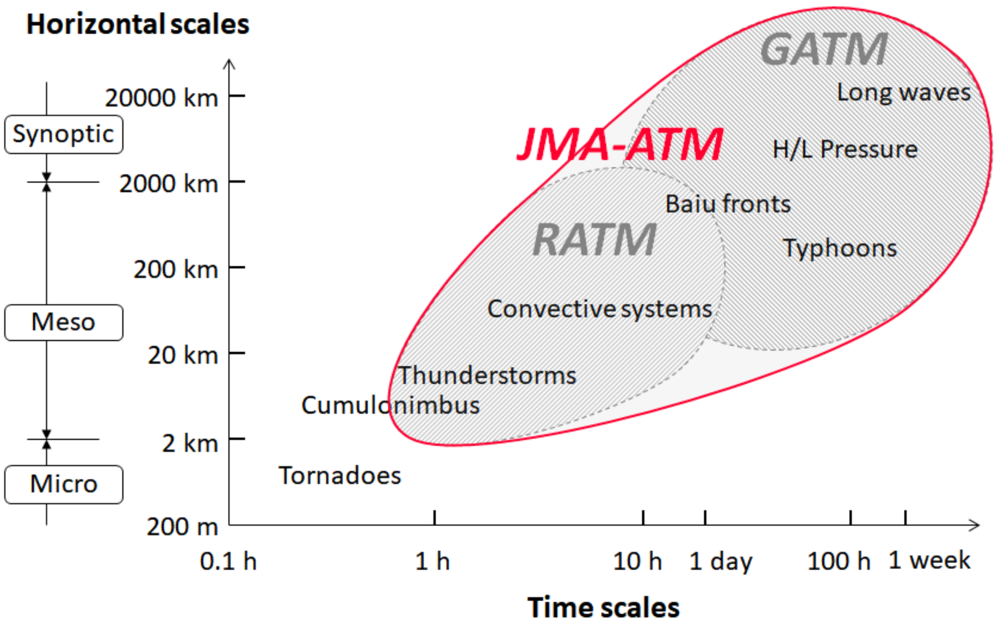


Fig. 1 Horizontal and time scales of atmospheric phenomena covered by the JMA's ATMs (after Shimbori, 2016).

 