

Coupling isobaric physics with isochoric dynamics

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Abstract

A regional nonhydrostatic model of the Japan Meteorological Agency employs constant height-based coordinate. The model couples physical processes that used to be adopted by the former operational models with hydrostatic assumption and pressure-based vertical coordinate. In converting tendencies evaluated by physics to those of prognostic variables of the dynamical core, differences of some assumptions between the dynamics and the physics have to be taken into account. Because the dynamical core adopts the finite volume method and employs total density as a prognostic variable, it is the simplest way to assume that total density in each cell is kept constant. With this coupling method, latent heat released by the microphysics process makes the pressure increased in constant volume cells, and then the local high pressure is mitigated through the following dynamics steps, which often causes acoustic waves. Since this representation of the process seems to be unrealistic, we are exploring a new way to consider the difference of assumption between the isochoric dynamics and the isobaric physics in the coupling.

A new coupling way which incorporates the change of cell volume in physical processes is tested. In the new experimental coupling, when the dynamics receives tendency $d\theta$ from physics in a cell in which condensation is occurred, tendency dp is diagnosed assuming that pressure in the cell is kept constant. Then the change of cell volume is also diagnosed from the tendency dp , with simple assumption that the cell expands only in upward at same column. Considering the change of each cell volume in a column, total mass in a column is redistributed to each cell. Through the idealized warm-bubble test, it has been confirmed that the experimental coupling can keep the representation of essential features of rising warm-bubble and suppress acoustic noises which are seen in the test with the current coupling.

In the presentation, we will talk about details of the new experimental coupling and some test results.