Compressible modeling of a cloudy atmosphere using a general pressure evolution equation

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An accurate formulation of a pressure evolution equation that is valid for cloud processes and rainfall is presented by using an approach of Fedkiw and Osher. This equation is coupled with a conservative prognostic total energy equation. Although the description of dissipative heating and moist processes will yield higher complexity, it is a desired criterion to ensure global energy conservation, because simulation results can differ significantly if traditional prognostic equations are used (e.g. dry potential temperature). For numerical reasons, it could be more effective to use an additional pressure tendency equation than a diagnostic relation, where pressure has to be a function of the thermodynamical variable and the additional moisture variables. Spatial discretization is realized by standard finite-volume methods. For the time integration we outline an implicit procedure by Rosenbrock time integrators and a special adapted split-explicit method. Results of different model setups will be illustrated by simulating idealized test cases.

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