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A new dynamical Core for compressible atmospheric Models

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A new dynamical core for compressible atmospheric models is introduced and evaluated with a suite of standard test cases. The equations are discretized in space in a cartesian or longitudinal-latitudinal grid with the z-coordinate as height. Orography and other obstacles are incorporated by the cut cell approach. In time the spatially discretized equations are integrated by Rosenbrock methods with special chosen approximate Jacobian matrices. This type of approximation allows to split the solution of the linear system in two separate ones, The first linear system is of the advection-diffusion type and the second one is a positive definite Helmholtz system. Both systems are solved by special iterative methods of conjugate gradient type with suitable preconditioning. Rosenbrock methods are linearly implicit time integration methods and fall in the class of the different proposed semi implicit methods found in the literature. Therefore the time step is not restricted by sound and gravity waves. The numerical method is parallelized by nonoverlapping domain decomposition and allows different spatial resolution in different domains. Test cases include warm and cold air bubbles, flow over hills of Agnesi type and flow around buildings.