Time-Splitting Scheme for Nonhydrostatic Atmospheric Model

Andrei Bourchtein (Pelotas State University), Ludmila Bourchtein

Complete three-dimensional models of the atmosphere have solutions of different space and time scales. The fastest atmospheric waves are the acoustic ones, which do not contain any significant part of the atmospheric energy. The slower gravity waves are more energy valuable, while slow advective processes and Rossby waves carry the main part of the atmospheric energy. In this study, a time-splitting semi-implicit scheme is proposed for the nonhydrostatic atmospheric model, which approximates implicitly the fast acoustic and gravity waves, while slow processes are treated explicitly. Such time approximation requires solution of three-dimensional elliptic equations at each time step. Efficient elliptic solver is based on decoupling in the vertical direction and splitting in the horizontal directions. Stability analysis of the scheme shows that the time step is restricted only by the maximum velocity of advection. The performed numerical experiments show computational efficiency of the designed scheme and accuracy of the predicted atmospheric fields.