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Limited area NWP and regional climate modeling: A test of the relaxation vs Eta lateral boundary condition schemes

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With very few exceptions, just about all limited area models (LAMs) used in operational NWP and regional climate modeling use the Davies relaxation lateral boundary conditions (LBCs), even though from the mathematical point of view they are not the best choice one can make. While in the early stages of the primitive equation LAM development in the seventies numerous schemes have been proposed and tested, LAM communities have eventually for the most part settled on the relaxation LBCs with few questions asked. An exception is the Eta model used extensively at NCEP and numerous other centers, in which the Mesinger (1977) LBCs are used. They prescribe variables along the outermost row of grid points only; all of them at the inflow points and one less at the outflow points where the tangential velocity components are extrapolated from inside of the model domain. Additional schemes are in place to suppress separation of gravity-wave solutions on C-subgrids of the model's E grid. A recent paper of Veljovic et al. (2010) included three 32-day forecasts done with both the Eta and the relaxation LBCs and the comparison of some of their verification results. This experiment was subsequently extended by three additional forecasts to arrive at an ensemble of six members run with both schemes, along with a more complete analysis of results. Results of two verification schemes used as well as the inspection of forecast wind fields strongly suggest an advantage of the Eta over the conventional and costlier relaxation scheme, thereby raising doubts as to the justification for its use.