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Development and application of a hybrid time-differencing scheme for the Naval Research Laboratory's Coupled Ocean/Atmosphere Mesoscale Prediction System

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The development and application of a hybrid time differencing scheme targeted for use in research and forecasting applications utilizing the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS^{TM}) is described. The development follows the methodology of previous investigators by treating the advection of the scalar fields on a forward time step while retaining the leapfrog time-differencing scheme for solution of the model dynamics. The hybrid scheme presented here differs somewhat from these previous applications in that we utilize the positive-definite advection scheme described by Bott (1989) for the scalar updates. This scheme is known to reduce the numerical diffusion while retaining good phase characteristics and computational efficiency on modern parallel computer architectures. We will briefly present results comparing the performance of this hybrid scheme against previously published two-dimensional idealized benchmarks. We then show results from idealized and real data experiments of heavy orographic coastal rainfall using the hybrid system together with a recently implemented two-moment microphysics scheme that contains prognostic equations for aerosol evolution. The discussion will focus on the impact of the initial aerosol distribution on the resulting spatial distribution and amount of simulated rainfall against the windward slope. An emphasis is also placed on the complexity in the simulated leeward aerosol structure that arises from rainout and mountain-induced wave dynamics. The implications of these findings for implementing such microphysics schemes into operational mesoscale models with active data assimilation systems will be discussed.