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A Dynamic Approach to Lightning Prediction for Convection Resolving Mesoscale Models

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Recent advances in computing technology have made it feasible to use convection-allowing forecast models in operational forecasting. Even so, the vertical and horizontal resolution of weather forecast models is not sufficient to explicitly predict charge generation and charge dissipation within clouds. For this reason, charge generation and charge dissipation (through lightning flashes) must be parameterized in convection allowing forecast models. Towards this end, a new prognostic spatial and time dependent variable was added to the Weather Research and Forecasting Model (WRF). This variable is referred to as the Potential Electrical Energy (Ep). The source of Ep is the non-inductive electrification process involving collisions of graupel and ice particles in the presence of liquid water. The dissipation of Ep occurs when Ep exceeds threshold values, generating lightning (cloud-to-ground and cloud lightning). Three case studies were simulated. The accuracy of the forecast lighting was highly dependent on the model predicted location of convection. To address this issue, observed lightning fields were used with short-term model forecast lightning fields to improve the depiction of convection in the initial conditions. The new set of initial conditions led to a better lightning forecast (and by implication: convective initialization) within the first 12 hours of the forecast. The dynamic approach developed here is contrasted with the statistical approach to predicting lightning and differences are noted between them.