Definition and Parameterization of Unresolved Convection in Cloud-Resolving Models for Weather Prediction

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In this presentation, we will first discuss the definition of unresolved convection in cloud-resolving models (CRMs) for weather prediction. This definition is critical for improving or reconstructing the parameterization representation of unresolved convection through statistical analyses of large eddy simulations. We will then advocate that the separation of resolved and unresolved convection in CRMs should be defined by the scale filtering approach instead of the Reynolds average approach. Using the concept of scale filtering, we will start from the general form of the equations for the mass-flux parameterization of subgrid convection to show that the conventional mass-flux parameterization used currently in weather prediction models assumes vanishing areas occupied by convection in a grid box. Using these equations of general form, we will clarify ongoing confusion about the scale-aware convection parameterization applied at CRM resolutions. We argue that subgrid convection parameterization schemes in CRMs for weather prediction should be as simple as possible for practical tractability. Finally, we will introduce a unified mass-flux parameterization scheme following the argument for simplicity that is currently being tested and evaluated in NOAA's Unified Forecast System (UFS).