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Microphysical Consistency between Grid-Resolved and Subgrid Cloud Parameterizations at Grey-Zone Resolution

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A great challenge in developing NOAA's Next-Generation Global Prediction System (NGGPS) is the lack of a cloud parameterization package that can be seamlessly applied across the grey-zone resolutions ($\sim$1 to 10 km). Properly dealing with the challenge gives rise to two issues associated with subgrid cloud parameterization: assumptions of subgrid-cloud microphysics properties and the impact of the parameterization of subgrid clouds on radiation. These two issues are related to a fundamental question: To what degree should the subgrid cloud microphysics processes be parameterized consistently with the grid-resolved cloud microphysics parameterization? This presentation will focus on major results from a series of numerical sensitivity experiments that are designed to address this fundamental question. The sensitivity experiments are carried out using the resolution-aware Grell and Freitas (2014) subgrid-cloud parameterization scheme in the Advanced Research WRF (ARW) model for an idealized tropical cyclone intensification case. The presentation will demonstrate how the subgrid-cloud parameterization scheme behaves as the microphysics of subgrid clouds become consistent with those of grid-resolved clouds. The implication of these results in the development of cloud parameterization packages suitable for weather and climate simulations at grey-zone resolution will also be discussed in the presentation.