Abstract for WGNE, Montreal June 19-23, 2017

Addressing Precipitation Displacement Errors due to Hydrometeor Drift

Jason Milbrandt
Environment and Climate Change Canada

Amongst the various challenges related to precipitation in numerical weather prediction (NWP) models, one source of error is the displacement of precipitation. Even when the dynamical and thermodynamical forcing in the model is correct, errors associated with the treatment the horizontal advection of precipitation as it falls – hydrometeor drift – can result in precipitation displacement errors in models. This applies to models over a wide range of resolutions, from sub-km scale limited-area models to coarse-resolution global models, particularly in regions subject to orographic enhancement. Current NWP models generally treat grid-scale precipitation prognostically, using a bulk microphysics scheme to compute cloud microphysical processes, where precipitation fields are advected by the model dynamics. Precipitation displacement errors associated with hydrometeor drift can therefore be traced back to the representation of ice-phase hydrometeors and their terminal fall speeds in the model microphysics.

The root cause of such displacement errors is the partitioning of ice-phase hydrometeors into representative categories as is done in most bulk microphysics schemes. This approach allows for different ranges of ice fall speeds to be modeled. However, it necessitates the conversion between categories, a process which is purely artificial and is based on arbitrary thresholds and on which the model solution is sensitive. It is argued that in order to address this problem properly and with solid physical basis, modelers should abandon the the use of traditional category-based microphysics schemes and employ or develop schemes based on the "free" category concept, as introduced in the recently developed Predicted Particle Properties (P3) scheme. With this approach, several ice particle properties, including terminal fall speeds, evolve smoothly and are free of abrupt changes due to conversion processes. As such, precipitation displacement associated with hydrometeor drift due to fall speed errors can be adjusted systematically and with a physical basis.