WRF-WxMod®: A Comprehensive Model System for Cloud Seeding Research and Applications

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Background/Objectives. The discovery of cloud microphysical responses to artificial ice nucleating particles by Schaefer and Vonnegut in the late 1940s set the stage for glaciogenic cloud seeding as a technology to increase water supplies especially in mountainous regions during wintertime. It is extremely difficult to evaluate cloud seeding effects based on observations only due to a lack of repeatability, small signal to noise ratio, and large variability in natural clouds and precipitation. Numerical models that reasonably reproduce natural cloud and precipitation processes and represent physical processes related to cloud seeding are useful for assessing cloud seeding impacts quantitatively.

Approach/Activities. This talk walks you through the development and applications of the WRF-WxMod® model system that is a novel capability for evaluating the impacts of cloud seeding on precipitation, designing new or optimizing existing cloud-seeding programs, and/or forecasting cloud-seeding opportunities when run in a real-time forecast mode.

Results/Lessons Learned. An observation-constrained ensemble seeding simulation approach is introduced to provide a transferrable framework/tool for quantitative seeding effect assessment with uncertainty estimate. Recent research and development of hygroscopic seeding parameterizations and a piggybacking framework for separating dynamic-microphysics interactions are discussed in the end.