Aerosol-Cloud Interactions during Cloud Seeding

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Cloud seeding is a weather modification technique by adding substances to clouds, which encourage precipitation. Despite its potential benefits, the mechanisms of cloud seeding are not well understood. This research aims to investigate the predictability of cloud seeding effects by exploring the nonlinear relationships between aerosol physics, cloud microphysical properties, and regional atmospheric dynamics using advanced machine learning (ML) models.

The study will focus on glaciogenic seeding, which introduces silver iodide (AgI) as an ice-nucleating particle into clouds with temperatures below freezing. To investigate the effects of cloud seeding on clouds, this study reviewed three case studies using a combination of radar, satellite, and onboard aircraft instruments: The first case study showed that adding AgI to clouds makes supercooled cloud droplets change to ice crystals, which releases extra energy to warm the clouds, potentially leading to ice crystals or precipitation formation. The second case study suggested that the response of cloud microphysical characteristics to seeding varies with time and location due to various seeding potentials. The third case study presented quantitative evidence for the effect of AgI seeding on supercooled layer clouds with a top cloud temperature of −15°C, which increased the size of raindrops in seeded rain.

Following these previous case studies, we will use an ensemble of satellite and in-situ observations to train and test the ML algorithms to provide further insights into the understanding of the mechanisms of cloud seeding. The ultimate goal of this study is to gain further insight into the mechanisms of cloud seeding and develop an ML-based model as a predictive tool to estimate accurately the effects of cloud seeding.