Cloud Seeding to Sustain Waterflow and Reduce Fires in the Arid Southwest

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Background/Objectives. The history of cloud seeding has seen various attempts to reduce hurricane intensity, minimize lightning for wildfire initiation, enhance precipitation, and reduce air pollution. For example, the US government's Project STORMFURY to reduce hurricane intensity failed due to lack of basic understanding of cloud aerosol interactions and inadequate observations. But other nations have taken a keen interest in cloud seeding and are utilizing the approach for both civilian and possibly national security applications. Further, private companies in various parts of the world are utilizing cloud seeding of snow to sustain snow-pack, that is critical for Agriculture in the southwest US. But, even with these recent efforts and purported increases in precipitation, questions still linger regarding whether the approach can lead to statistically significant enhancements of clouds and precipitation.

Approach/Activities. Acutely aware of various national security concerns, e.g., water and agriculture, related to clouds and precipitation, LANL & NSF scientists have started to explore cloud seeding connecting LES modeling of aerosol-cloud-precipitation observations made during field campaigns. Specifically, in the desert southwest a shift in precipitation from winter to monsoon convection has been noted; establishing a need to pivot cloud seeding from enhancing primarily winter precipitation to summer convection. Additionally, pre-monsoon convection contains lightning that can start large wildfires which could be mitigated by cloud seeding. Typically, initiation of monsoon convection is tied to mountain ranges found in the desert southwest with targeted cloud seeding studies being formulated to take advantage of the repetitive convective features.

We are developing a focused experimental study could be undertaken in the Magdalena (just west of Socorro) or the Jemez mountains (just west of Los Alamos) of New Mexico. New Mexico Tech in Socorro has an established lightning detection network which could be used in cross-correlations between cloud seeding and lightning. LANL scientists have started discussions with NCAR scientists regarding deploying both DOE ARM and NSF experimental resources, e.g., radars, lidars, surface stations, and possibly planes, for a significant focused study that would be proposed to ARM/NSF. And, given the recent success of NCAR's next-generation radars used in the SNOWIE project, the hope is that the radars will as well help pinpoint cloud seeding pathways in monsoon convection.

For decades clouding seeding has been typically done using silver iodide aerosol; however, manufactured nanoparticles are now being examined. And, given rapid advances in additive manufacturing, these nanoparticles could be made from a variety of materials and their surfaces roughened to encourage condensation and/or ice nucleation. In fact, recent research within cloud chambers suggests it may be possible to design nanoparticles to produce a desired cloud and/or ice spectrum.

Results/Lessons Learned. We plan to present a brief background of cloud seeding, our current concerns related to cloud seeding to adapt to climate change and national security, new ideas and experimental plans to probe cloud seeding processes, and results from LANL's unique Lagrangian cloud modeling tools that can capture the aerosol micro-physics and dynamics. For the later, simulations will be undertaken employing different aerosol size

spectrums and material types with future observational results being used to help inform the modeling approach.