Precipitation impact from bio-aerosols

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Abstract

Aerosol plays a key role in the cloud life cycle by serving as cloud condensation nuclei to initiate cloud formation and determine cloud radiative properties. Moreover, a large proportion of precipitation formation is governed by the processes that associated with the glaciation of clouds where ice nuclei play a crucial role.

For over 30 years, some meteorologists and plant pathologists have suspected that plants may be another important source of rain-making ice nuclei. This idea is based on the fact that plants - whether healthy or diseased – are covered with bacteria and that some of these bacteria have the very unique capacity of catalyzing ice formation at relatively warm environment by the process of heterogeneous nucleation. Many observations found bioaerosol particles in precipitation, cloud water, rain water, graupel, ice crystals, and snow. It has also been shown that bioaerosols are more efficient ice nuclei than others. Thus, sufficient evidences and meteorological tools have emerged to re-ignite interest in bio-precipitation (Schnell, et al., 1972).

This research investigate the role of bio-aerosols in cold cloud system and precipitation processes. The present model simulations enable us to analyze the relative susceptibility of precipitation, cloud water, rain water, snow, graupel, etc. We present the results of a numerical simulation of a rainfall event using the Penn State–NCAR Mesoscale Model Version 5 (MM5). We employed the two-moment bulk formulas of Chen and Liu (2004) to parameterize warm-cloud microphysical processes in MM5, as well as incorporating several mathematical formulations for describing the ice nuclei number concentrations and ice nucleation rates.

For our present study we choose Huffman's equation (Huffman, 1973) as an empirical formula for nucleation process from natural ice nuclei (i.e. mineral dust). In addition, we incorporate bioaerosol and their nucleation rate in our cloud resolving model to demonstrate their effect on precipitation. Relative importance of mineral dusts and bioaerosols are compared to see their relative importance.

References

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