

Seasonal Significance of New Particle Formation Impacts on Cloud Condensation Nuclei at Storm Peak Laboratory

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Abstract: New particle formation (NPF) events are defined as a sudden burst of aerosol followed by growth and can impact climate by growing to larger sizes and under proper conditions, potentially forming cloud condensation nuclei (CCN). Field measurements relating NPF and CCN are crucial in expanding regional understanding of how aerosols impact climate. To quantify the possible impact of NPF on CCN formation, it is important to not only maintain consistency when classifying NPF events but to also consider the proper timeframe for particle growth to CCN relevant sizes. Here, we analyze 15 years of direct measurements of aerosol size distributions and CCN concentrations and combine them with novel methods to quantify the impact of NPF on CCN formation at Storm Peak Laboratory (SPL), a remote, mountain top observatory in Colorado. Findings show that NPF occurs on 50% of all days considered in the study. Events with persistent growth are common in the spring and winter while burst events are more common in the summer and fall. For the first time, results clearly demonstrate the significant impact of NPF on CCN in montane North American regions demonstrating the potential for widespread impact of NPF on CCN. NPF significantly enhances CCN during the winter by a factor of 1.36 and the spring by a factor of 1.54, suggesting that the enhancement of CCN by NPF occurs on a regional scale.