

Isoprene Suppression of New Particle Formation in a Mixed Deciduous Forest

S. Lee

Kent State University, 1550 Ted Boyd Dr, Kent, OH 44242; 330-672-3905, E-mail: slee19@kent.edu

Production of new particles over forests is an important source of cloud condensation nuclei that can affect climate. While such particle formation events have been widely observed, their formation mechanisms over forests are poorly understood. Our observations made in a mixed deciduous Michigan forest, with large isoprene emissions during the summer, show surprisingly rare occurrence of new particle formation (NPF). No NPF events were observed during the 5 weeks of measurements, except two early evening ultrafine particle events as opposed to the typically observed noontime NPF elsewhere (Figure 1). Sulfuric acid concentrations were in the 10^6 cm^{-3} ranges with very low preexisting aerosol particles, a favorable condition for NPF to occur even during the summer. The ratio of emitted isoprene carbon to monoterpene carbon at this site was similar to that in Amazon rainforests (ratio larger than 10), where NPF is also very rare, compared with a ratio smaller than 0.5 in Finland boreal forests, where NPF events are frequent. The two evening ultrafine particle events were associated with the transported anthropogenic sulfur plumes and the ultrafine particles likely formed via ion induced nucleation. It has been suggested that isoprene emissions may suppress NPF formation in forests and our results are consistent with this conclusion although the underlying mechanism for the suppression is unclear and future studies are needed to reveal the mechanism. Changes in land cover and environmental conditions could modify the isoprene suppression of NPF in some forest regions resulting in a radiative forcing that could influence climate. In this presentation, we will also discuss aerosol number concentrations of particles in the size range from 1-3 nm, recently measured in another two locations (Long Island, New York and Kent, Ohio).

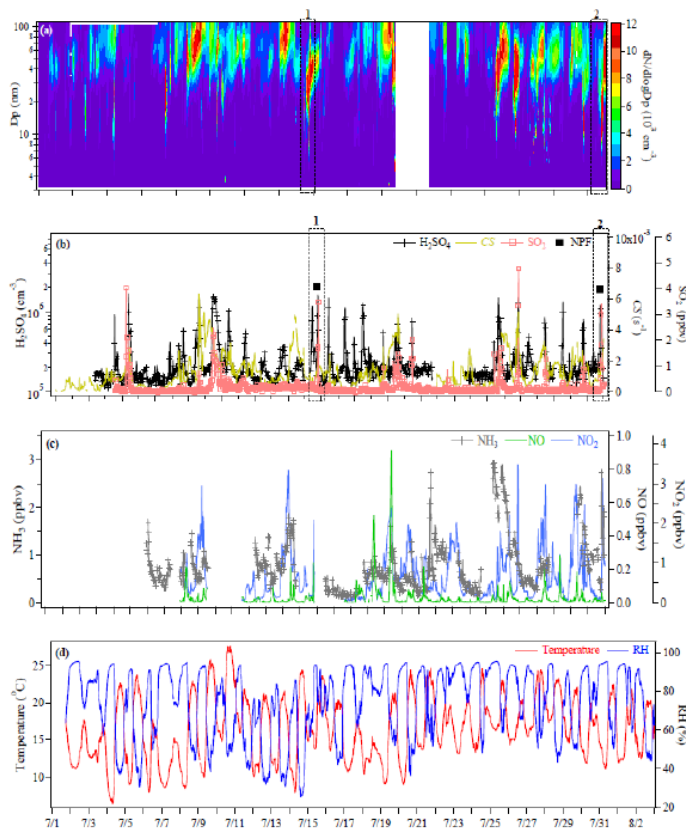


Figure 1. (a) Particle size distributions in the size range from 3-109 nm measured during July 1-August 3, 2009 in the Michigan forest. There were no Nitrosodimethylamine (NDMA) measurements from July 22-24. (b) The measured H_2SO_4 (line with black plus signs), SO_2 (light red open squares), and CS (yellow solid line) during July 1-August 3, 2009 at the same site. The two filled black squares show the observed early evening NPF events (Box 1 and 2 for July 16 and August 2 events, respectively). As mentioned in the main text, there were no conventional NPF events at noontime at all during the summer of 2009. Sharp spikes in particle number size distributions were seen at noontime (e.g. July 8), but these particles did not grow enough to show aerosol size distributions with a typical “banana shape”. (c) The measured NH_3 (line connected by grey plus signs), NO (green solid line) and NO_2 (light blue solid line), and (d) the measured temperature (red line) and RH (blue line) during July 1-August 3, 2009 at the same site.