Isoprene Suppression of New Particle Formation on Long Island

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ABSTRACT

New particle formation (NPF) occurs in the atmosphere in the presence of sulfuric acid and water. As NPF affects the size distribution of aerosols and may affect the number that can survive to form cloud drops, NPF is an important process. A growing number of studies have found that isoprene, a gas released from deciduous trees, inhibits NPF. The presumed mechanism is that isoprene reduces the amount of OH^- available for the formation of sulfuric acid. It is hypothesized that the frequency of NPF will be positively correlated with sulfuric acid concentration and negatively correlated with isoprene concentration. This hypothesis was investigated during an Intensive Observation Period (IOP) from July 15 through August 15, 2011 at Brookhaven National Laboratory (BNL). Due to BNL's location in a region made up of coniferous and deciduous trees, the potential effects of isoprene on NPF can be studied. During this IOP, several instruments measured quantities that aided in this investigation. The Nano-Scanning Mobility Particle Sizer (Nano-SMPS) provided information on the sizes of small aerosol particles using an electrical mobility detection technique and the Ultrafine Condensation Particle Counter (UCPC) counted the number of particles in a given size range coming from the Nano-SMPS. The Chemical Ionization Mass Spectrometer (CIMS) measured the concentration of sulfuric acid by its conversion to a unique ion via a suitable precursor ion. The Proton Transfer Reaction Mass Spectrometer (PTRMS) measured the concentration of isoprene via ionization by hydronium. Currently, not enough data has been analyzed to determine if correlations between concentrations of isoprene and sulfuric acid with the frequency of new particle formation exists. With further research, it is expected that the better understanding of the effects of isoprene on new particle formation will lead to improvements of isoprene parameterization in global climate modeling.

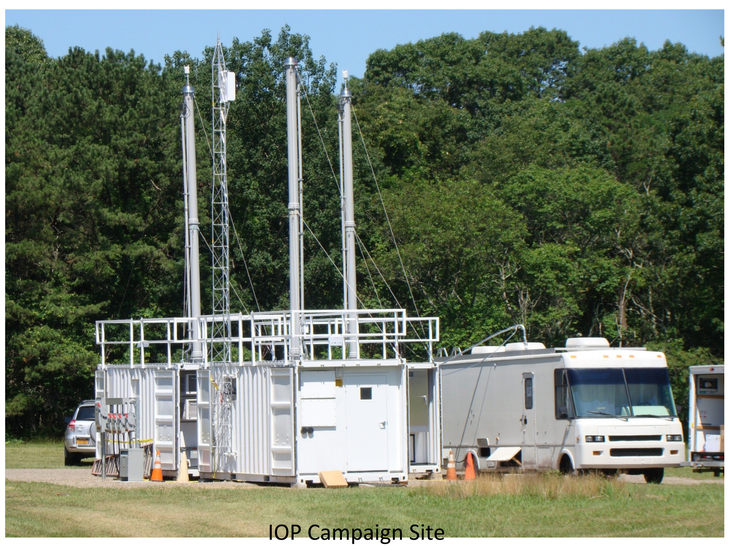
INTRODUCTION

- New particle formation (NPF) occurs in the atmosphere in the presence of sulfuric acid and water.
- NPF can affect the size distribution of aerosols and may affect the number that can survive to form cloud drops.
- Studies have found that isoprene, a gas released from deciduous trees, inhibits NPF. The presumed mechanism is that isoprene reduces the amount of OH^- available in the formation of sulfuric acid.
- It s hypothesized that the frequency of NPF will be positively correlated with sulfuric acid concentration and negatively correlated with isoprene concentration.
- This hypothesis was investigated during an Intensive Observation Period (IOP) from July 15 through August 15, 2011 at Brookhaven National Laboratory.

METHODS

During this IOP, several quantities pertinent to the study of NPF suppression by isoprene were measured:

- Concentrations of particles with diameters from 2.5-68 nm were measured using the Nano-Scanning Mobility Particle Sizer (Nano-SMPS) and the Ultrafine Condensation Particle Counter (UCPC).
- The concentration of sulfuric acid was measured with the Chemical Ionization Mass Spectrometer (CIMS).
- Isoprene concentration was measured with the Proton Transfer Reaction Mass Spectrometer (PTRMS).



IOP Campaign Site

Figure 1

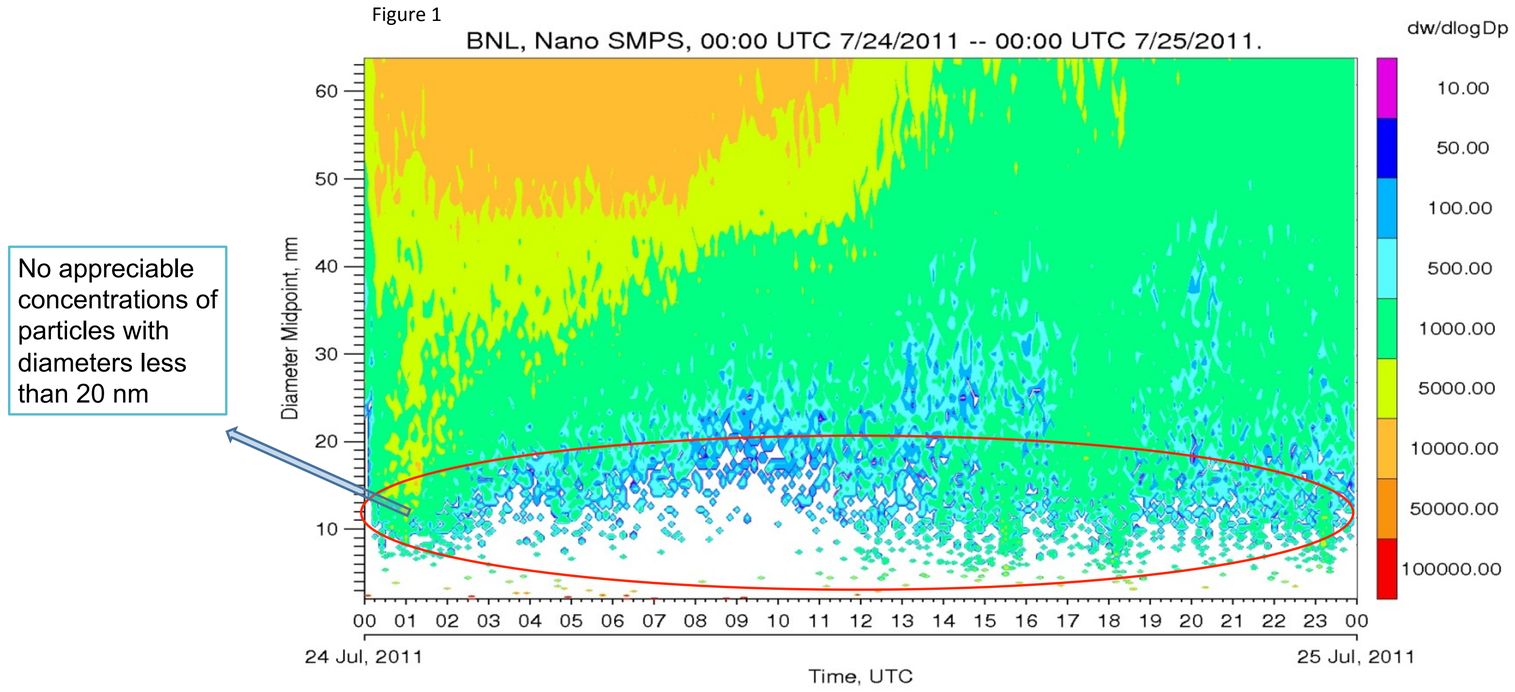
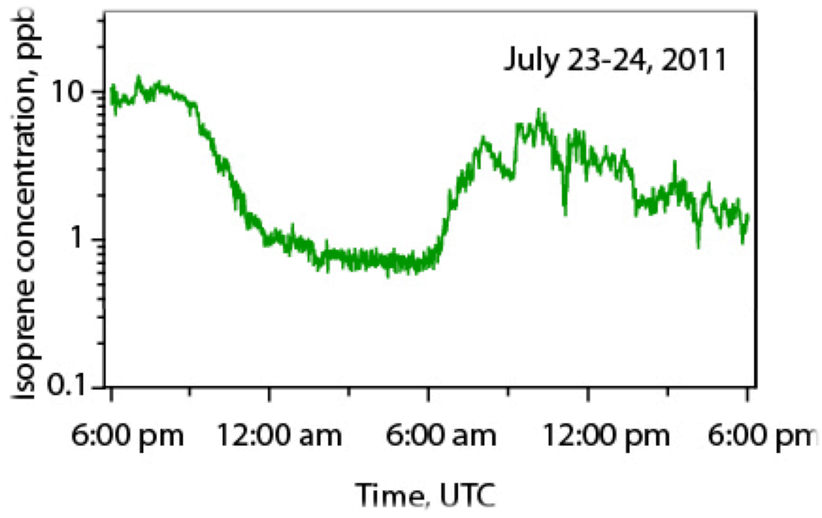


Figure 2



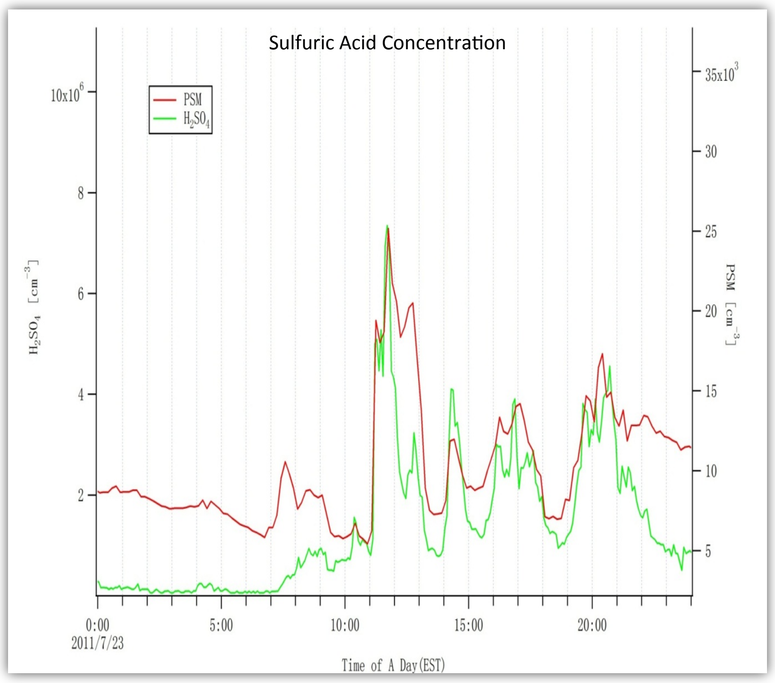
RESULTS

- So far only data from one day (July 24) have been analyzed. These preliminary data show periods of increased isoprene (Fig. 2) and sulfuric acid (Fig. 3) concentrations with no evidence of new particle formation (Fig. 1), as shown by the lack of appreciable concentrations of particles with diameters less than 20 nm.

DISCUSSION AND CONCLUSION

- Currently, conclusions of isoprene suppression can not be drawn from this study due to an insufficient amount of data.
- A positive correlation is expected between the frequency of new particle formation and sulfuric acid concentration.
- In the presence of isoprene, no NPF is expected to seen.
- As data are made available in the future, correlations will be assessed.

Figure 3



REFERENCES

- Sulfuric acid data provided by Dr. Shunhu Lee, Jason Yu, and Yi You from Kent State University (Kent, OH).
- Isoprene data provided by Dr. Yin-Nan Lee from the Brookhaven National Laboratory (Upton, NY).
- Nano-SMPS data provided by Dr. Gannet Hallar from Storm Peak Laboratory, Desert Research Institute (Steamboat Springs, CO).
- IOP campaign site picture provided by Dr. Stephen Springston.

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