Sub-3 nm Particles and Sulfuric Acid during the Aerosol Life Cycle IOP 2012: Preliminary Results

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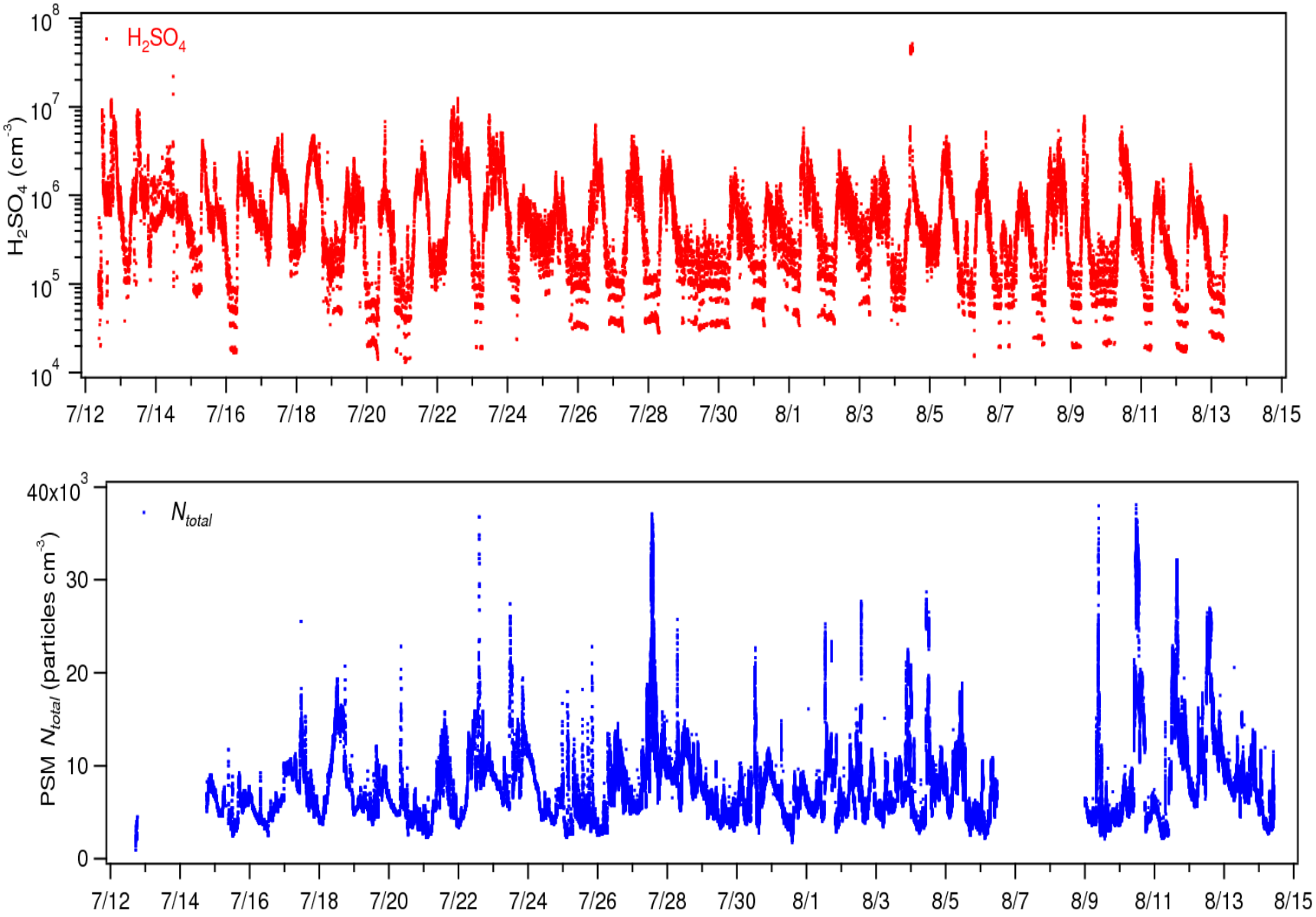
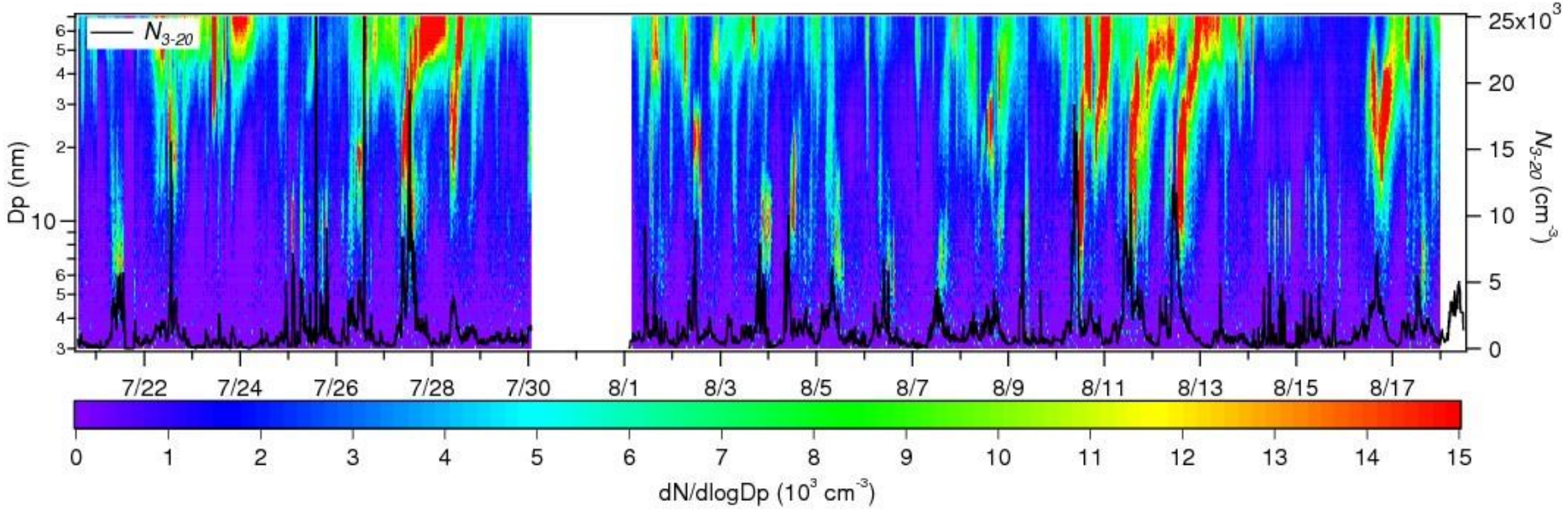
Objectives

- Do sub-3 nm particles exist only during the new particle formation (NPF) events?
- Are sub-3 nm particles correlated with sulfuric acid?
- What are the critical factors for NPF?

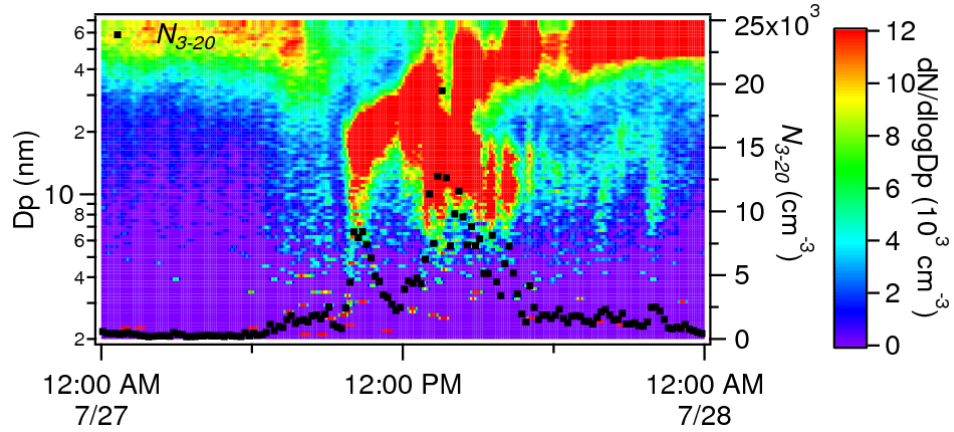
H_2SO_4 by Chemical Ionization Mass Spectrometer (CIMS) and N_{total} (> 1 nm) by Particle Size Magnifier (PSM)

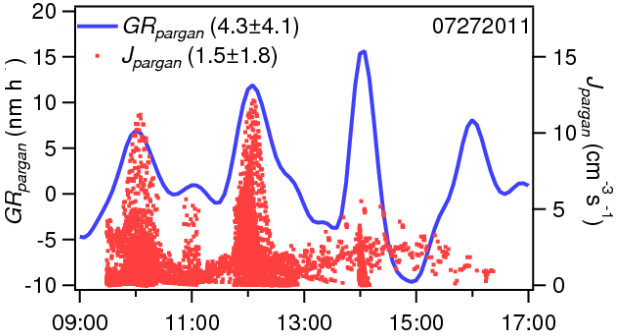


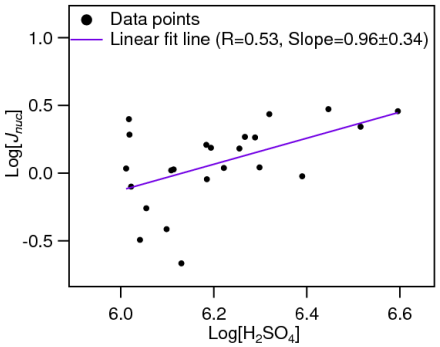
Scanning Mobility Particle Sizer (SMPS) : 5 strong NPF events (Dr. Gannet Haller)



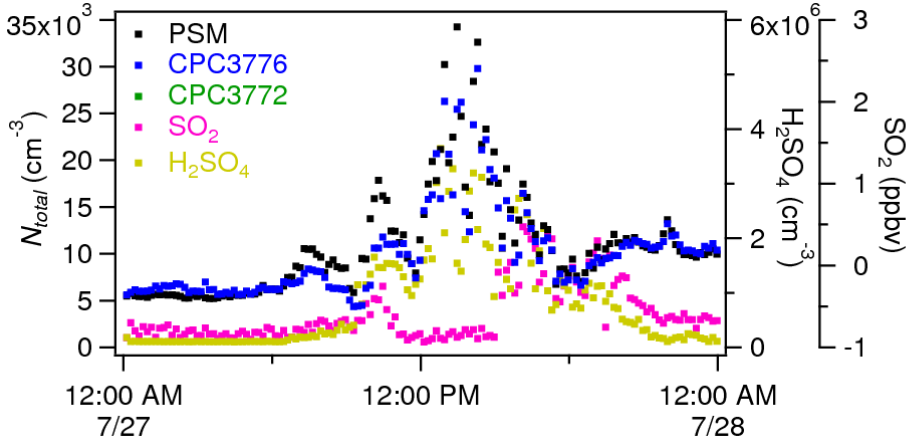
07/27/2011

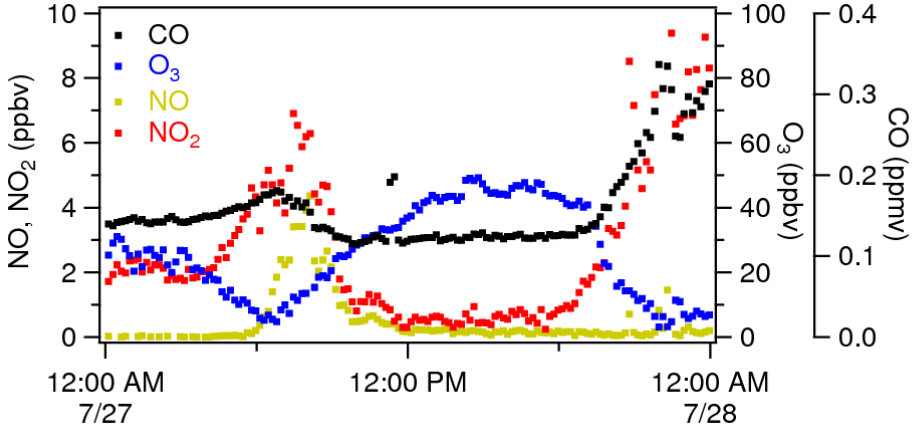


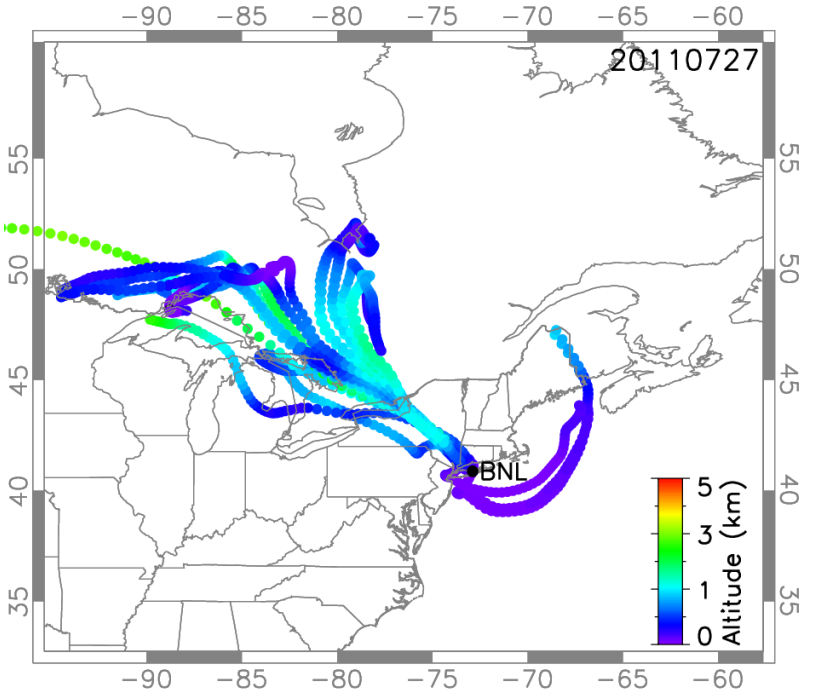




SMPS (Haller)
CPC (Wang and Kuang)
Trace gases (Springston)



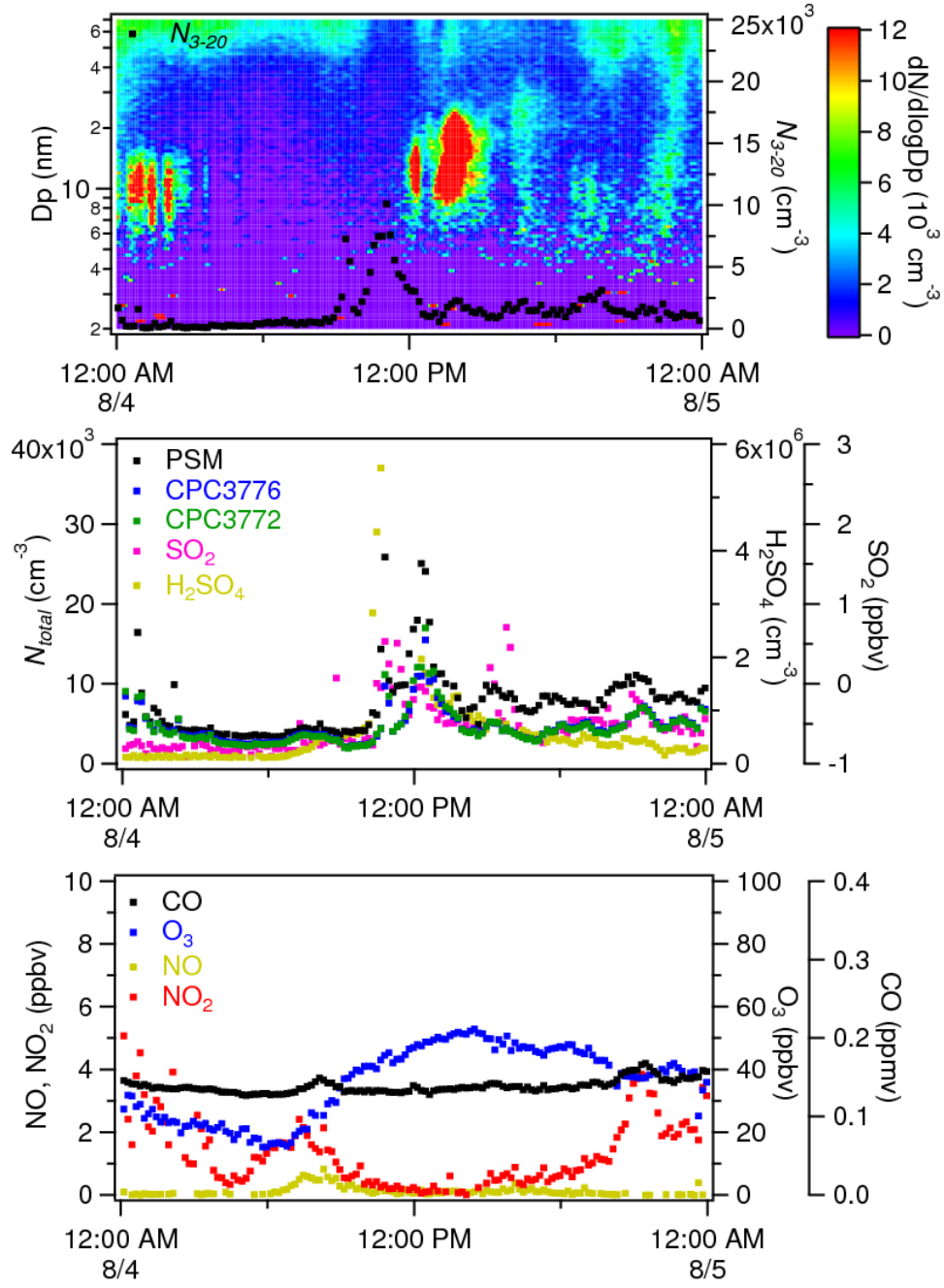




Growth rates (GR_{pargan} and GR_{H2SO4}), nucleation rate (J_{pargan}) and time lag (Δt) for NPF events

Date	GR_{pargan} (nm h^{-1})	J_{pargan} (cm^{-3} s^{-1})	GR_{H2SO4} (nm h^{-1})	Δt (min.)
07/27	4.3±4.1	1.5±1.8	0.13±0.08	25
08/10	4.5±3.5	1.8±2.4	0.18±0.1	18
08/11	3.1±2.3	0.8±0.9	0.1±0.02	83
08/12	1.7±1.2	0.4±0.3	0.1±0.03	122

08/04/2011



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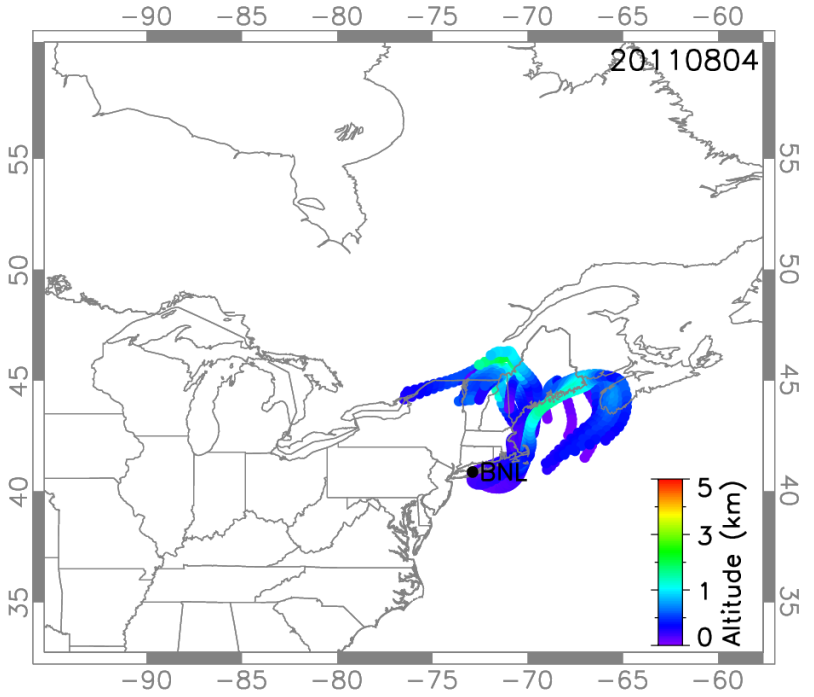
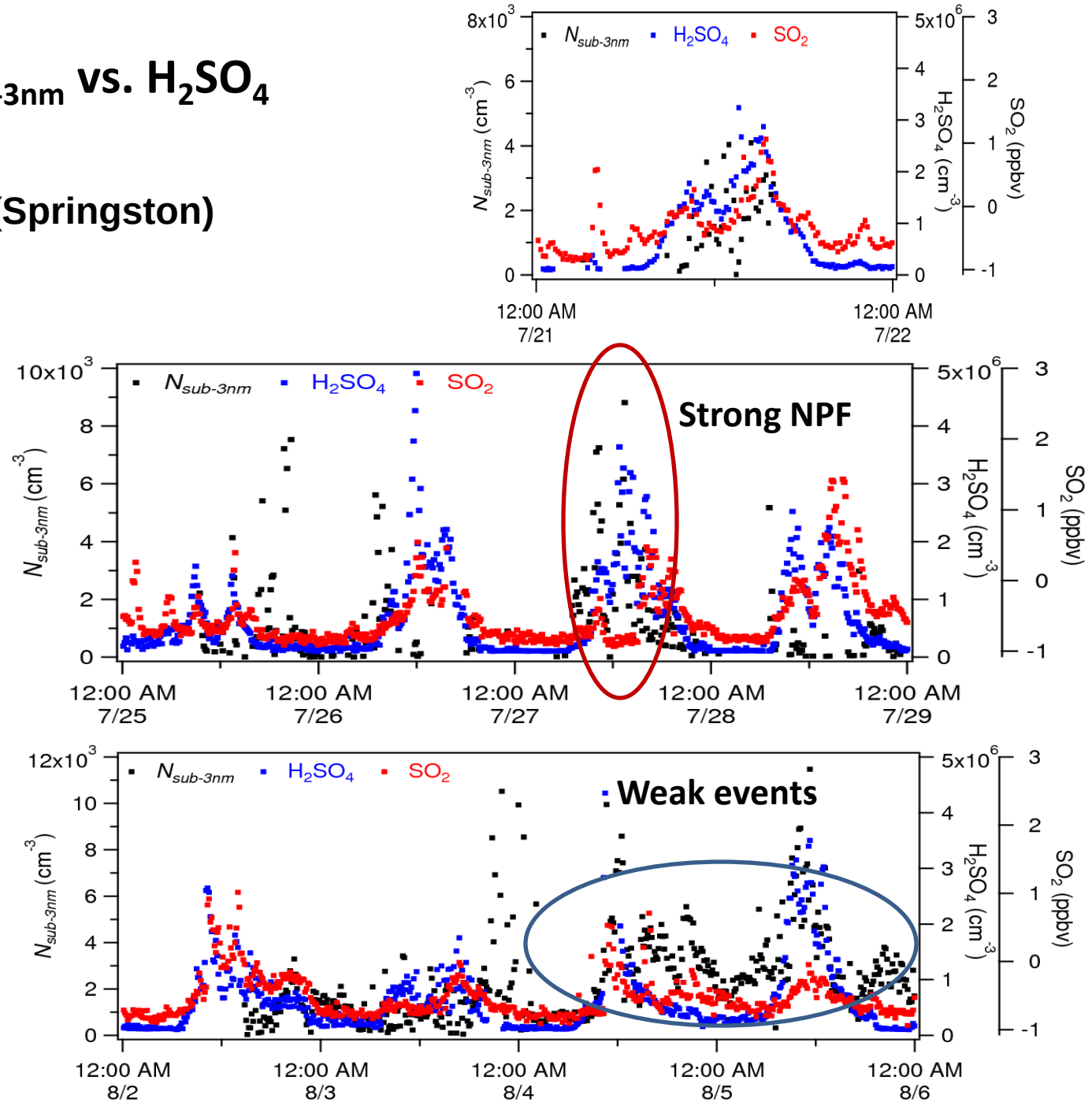
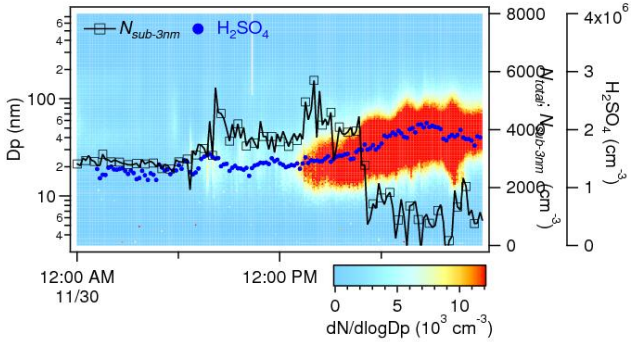


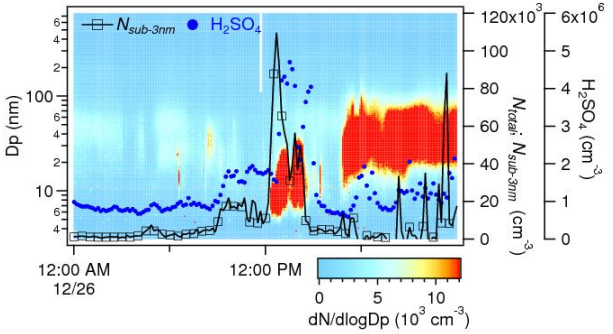
$N_{sub\text{-}3nm}$ vs. H_2SO_4

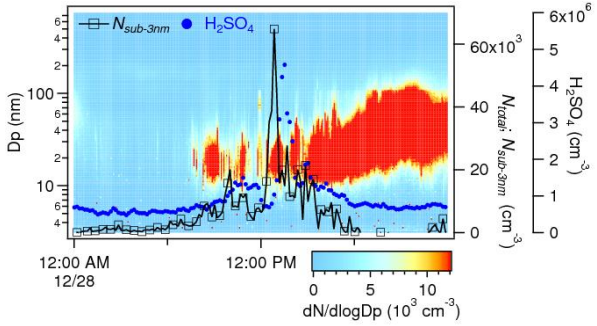
SO_2 (Springston)

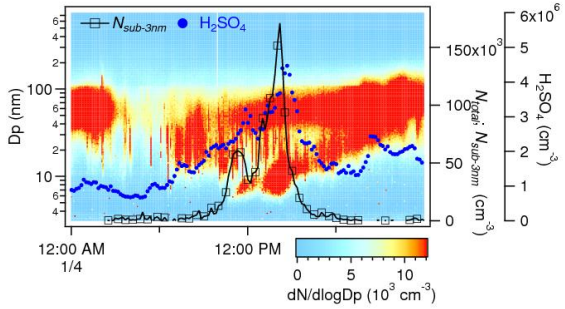


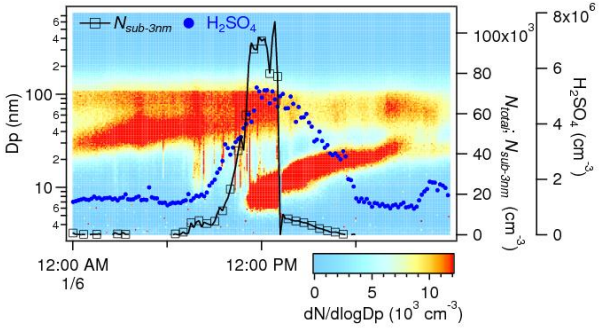
Kent observation: $N_{sub\text{-}3nm}$ vs. H_2SO_4

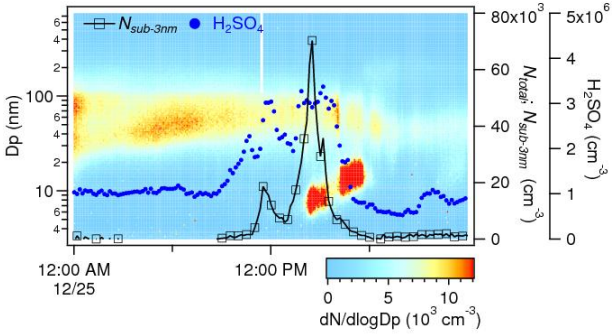


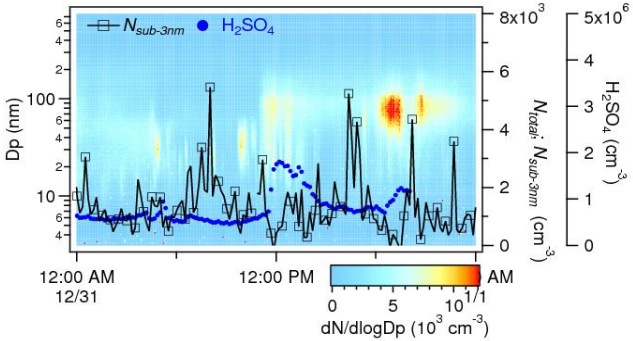


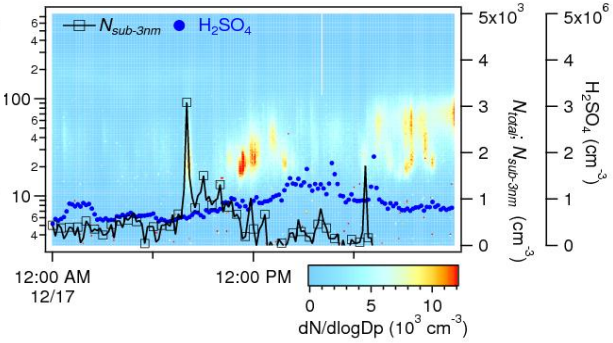












Summary

- **Do sub-3 nm particles exist only during the NPF events?**
  - Exist during NPF and non-NPF events both, but the concentrations are much higher during NPF.

- **Are sub-3 nm particles associated with sulfuric acid?**
  - Reasonably well-correlated, especially for NPF days; showing the same diurnal variations and noontime peaks.

- **Similar results were also found in Kent, Ohio.**

- These results are consistent with laboratory studies showing that formation of sub-3 nm particles is very sensitive to H_2SO_4 (than amines and ammonia) [Yu et al. GRL 2012].

- And consistent with atmospheric observations showing that H_2SO_4 is critical for NPF.

- NPF occurred with air masses from Great Lakes. Polluted air may contain more SO_2, VOCs and secondary organics, which contribute to growth of sub-3 nm particles?