Source influences on the aerosol size distribution and CCN activity at the Resolute Bay Ground site

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1. Abstract:

Aerosol measurements at the Canadian Aerosol Baseline Measurement station at Resolute Bay, NU began in May 2013. The on-going measurements are particle light absorption, particle light, particle light scattering, particle size distribution, SO_2, O_3, NO_x and $PM_{2.5}$. Additional measurements of Cloud Condensation Nucleus (CCN) number concentrations were also made during the July 2014 NETCARE campaign and observed growth that may enhance their CCN activity at supersaturations (SS) between 0.,4% and 1%. Two different source influences are presented in this poster : clean air for possible new particle formation (NPF) on July 9 and 2) wildfires influence on July 14 to 16 and July 25 to 27. GEM-MACH model results are also discussed.

2. Method:

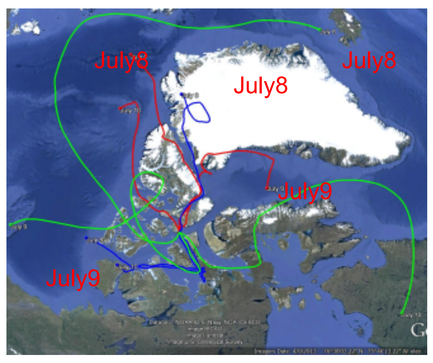
Aerosol sample was pulled through a ¾" Stainless Steele tubing at 27 slpm through a 1 um size cut URG cyclone. Particle light absorption and light scattering were measured by Continuous Light Absorption Photometer (CLAP, NOAA/ ESRL) and 3563, 3-wavelength Nephelometer (TSI Inc.). Particle size distribution measurements were made by 3034 Scanning Mobility Particle Sizer (SMPS, TSI Inc.) between 10 and 500 nm particles and CCN measurements were made by model 200 (DMT).

7-d back-trajectories were computed by using Hy-Split at three different heights.

GEM-MACH Arctic 15 km; Emissions: Anthropogenic, fires, marine/shipping.

3. Results and discussion

Event 1 – Possible New particle formation NPF (July 9-10)



7-d back-trajectories suggest airmass influence from coastline of Greenland and Ellesmere for ammonia emissions from bird colonies (Croft et al., 2015)

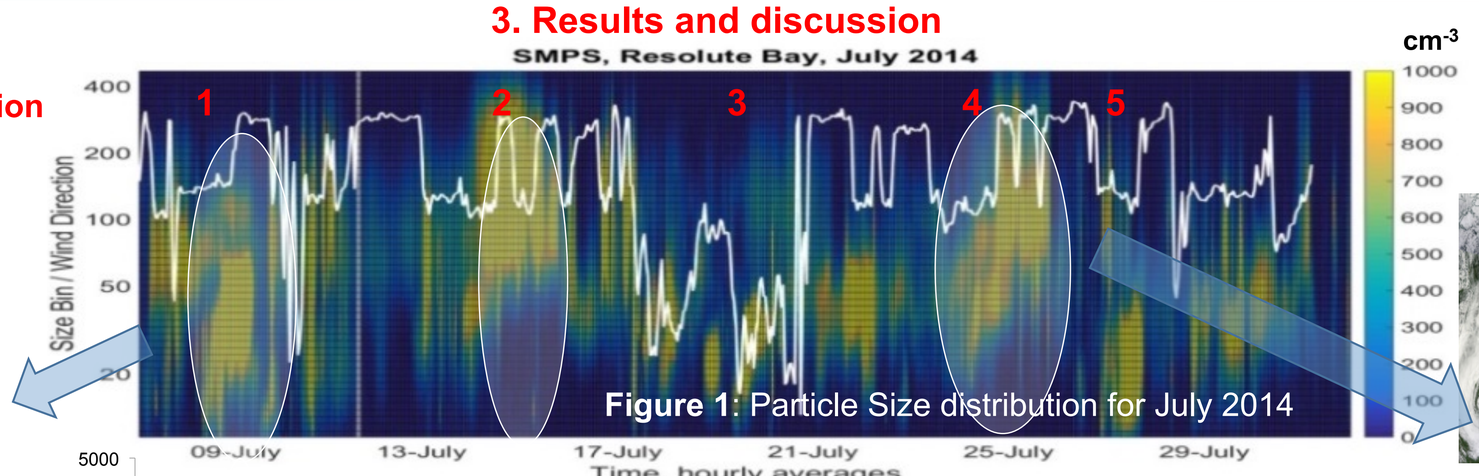
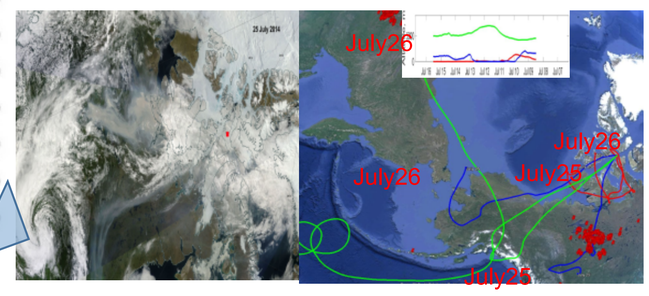


Figure 1: Particle Size distribution for July 2014

Event 4 – Wildfires influence (July 25-26)



7-d back-trajectories support influence of Canadian wildfires at the Resolute Bay site on July 25 and 26 event.

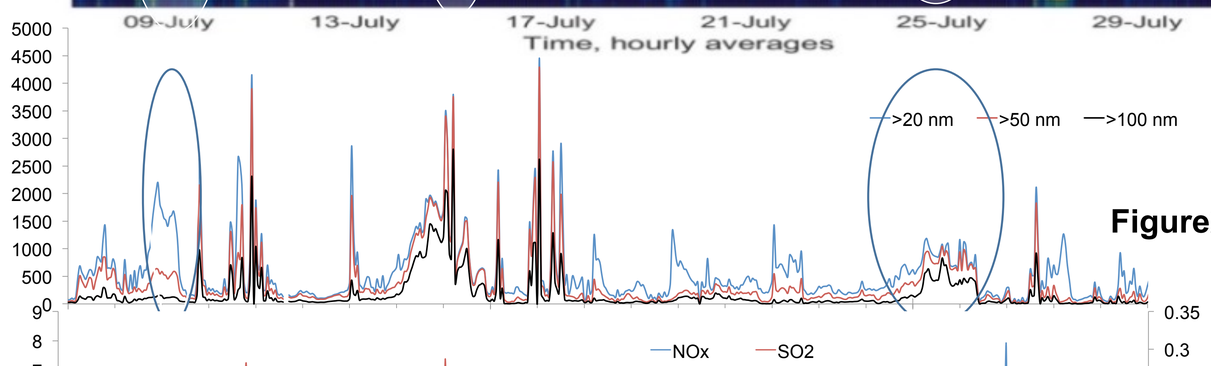


Figure2: Particle # concentrations > 20, 50 and 100 nm

Figure 3:NO_x and SO_2 levels

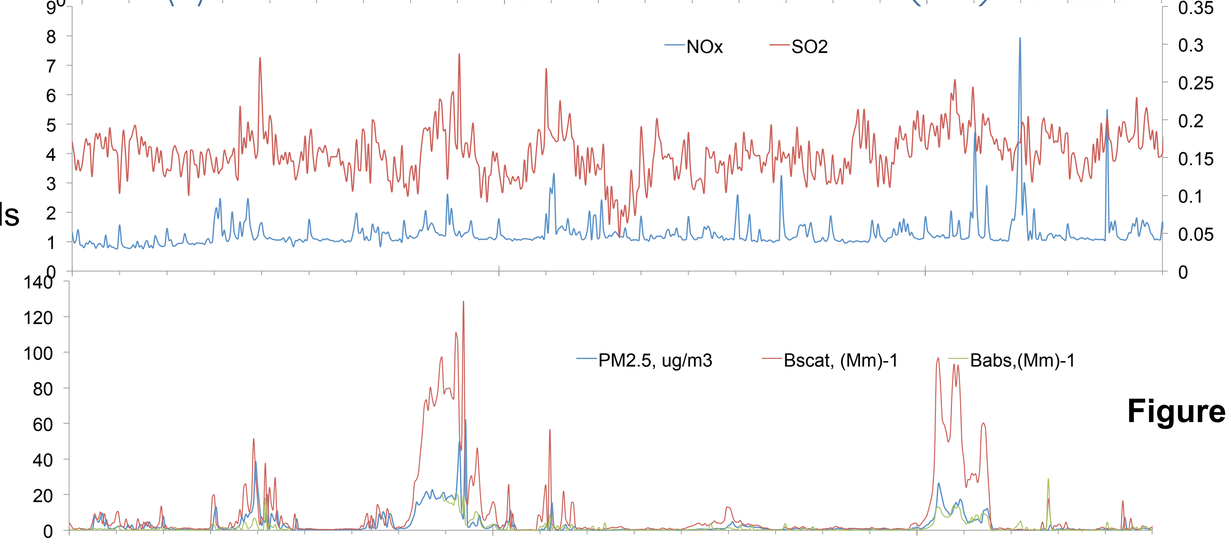


Figure 4: $PM_{2.5}$, light scattering and absorption

Figure 5: Comparison of $PM_{2.5}$ model vs measurements

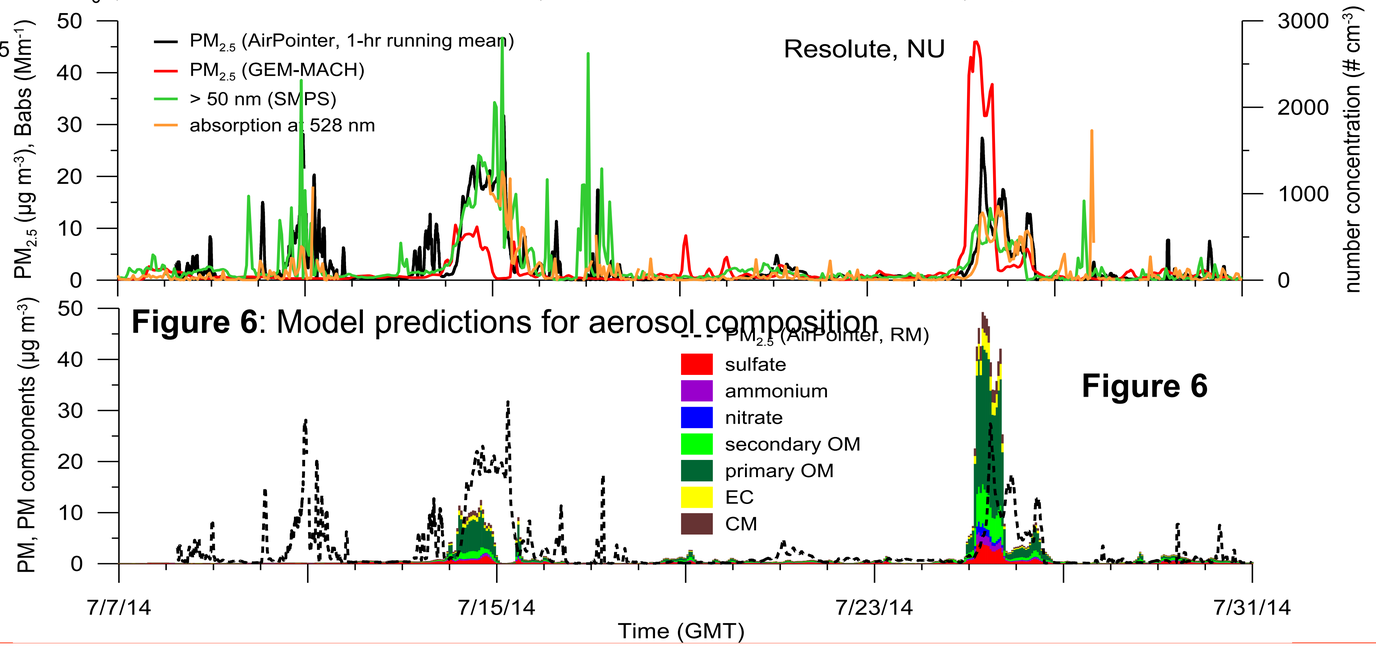


Figure 6: Model predictions for aerosol composition

Figure 6

Figure 7: SMPS and CCN concentrations during event 1

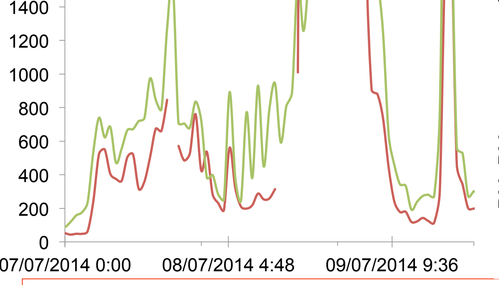
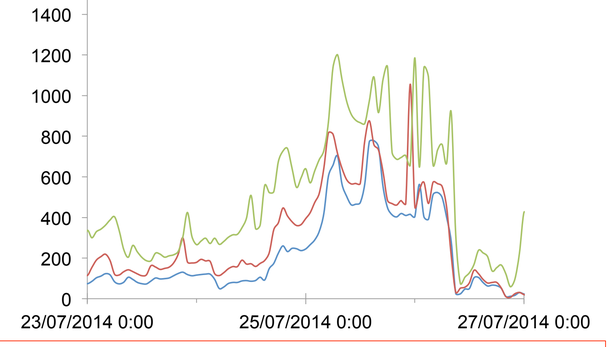


Figure 8: SMPS and CCN concentrations during event 4.



Events 1 and 4:

Figures 1 and 2 show total particles concentrations in >20nm, >50 nm and >100 nm. NPF is evident where >20 nm particle concentrations are much higher than the other two modes which suggests a low condensation sink. July 9 NPF episode was also observed on a larger spatial scale via POLAR 6. Much higher >100nm particles present during fire event.

Figures 3, 4, 5 and 6 show low anthropogenic influence with low SO_2 and NOx levels and aged airmass with lower NOx levels also during wildfires events. Presence of higher light absorption and scattering measurements during fire event which is not present during NPF event. GEM-MACH model predicts all events. For events with fire influence, model predicted higher primary organic as major component of $PM_{2.5}$. Emissions from bird colony are missing in the model and thus model underestimates the NPF event 1. Ammonia from the bird colonies with SO_2 from biogenic emissions is speculated to give rise to small particles.

Figures 7 and 8 show total SMPS and CCN concentrations at 0.4% SS (started July 19) and 1% SS. July 9 event shows CCN concentrations much higher than total SMPS particle. Wild fire event shows that at both saturation levels particles approximately 50% of particles have ability to be CCN.

4. Conclusion: 1. CCN activity appears to be higher for the event that may be NPF and lower under the wild fire influence. 2. Model predicted organics as major contributor of $PM_{2.5}$ from fires and ammonia from bird colonies possible an important ingredient in small particle formation during NPF events.