IASOA Aerosol Working Group

18 October 2017

Attendees: Jessie Creamean, Taneil Uttal, John Backman, Rebecca Sheesley, Patrick Hayes, Kerri Pratt, Andreas Massling, Julia Schmale

Introductions

Paper updates:

- **Lauren Schmeiser's optical property climatology** paper is currently under revision with her coauthors. Her goal is to submit to ACP, but open to other suggestions. She pulled station photos from the IASOA website for Figure 1, and would like to give photo credits if anyone knows who took those pictures. She will be reaching out to group members to take a closer look at station descriptions to accuracy and details on inlets, in addition to asking to acknowledging.

- **John Backman's paper on aethalometer corrections** was accepted before the summer, but the dataset needs to be made publically available before publishing. He is working on circulating the dataset to the originators and will publish in a week or so. The paper presents data from 2012 – 2014 IASOA stations. This led to discussion on creating an automated absorption product from John’s algorithm, but in order to do so, manual filtering and processing needs to happen first.

Presentation on INARCO ice nucleation measurements (Jessie Creamean): Presented initial ice nucleation results from Ice Nucleation over the ARctic Ocean (Aug – Sep 2017) in the Bering and Chukchi Seas. Results indicate phytoplankton blooms, regions of ocean upwelling, and fresh sea ice melt are potentially important sources of ice nucleating particles (INPs). This started discussion on the aerosol measurements of interest for IASOA sites and future directions of the aerosol WG.

Discussion on future IASOA aerosol WG priorities:

- **Focus of the WG for the near future.** There are two possible directions for the aerosol WG that were discussed:
  - Write a joint paper using IASOA data; or
  - Serve as a team of advisors for implementation of measurements to fill gaps in observations at IASOA sites

- **Gaps in observations at IASOA sites.** The group discussed what aerosol measurements were most important in terms of our own interests and general interest of a wider community. The following measurements were listed:
  - Optical properties – already implemented at most sites
  - Chemistry
  - Ice nucleating particles (INPs)
  - CCN

- **Complete size distributions (i.e., from 3 nm – 20 or so μm)** – this was considered the most crucial parameter to have at IASOA sites with regard to aerosol.
  - Most sites do not have complete size distributions. A combination of an uCPC, CPC, SMPS/UHSAS, and OPC would be the ideal suite of sizing instrumentation to obtain a complete size distribution.
  - A time series of full size distributions is crucial to evaluating the sources of aerosols (see figure below; image acquired from Buseck & Adachi (2009).
Additionally, consistent time series data of aerosol size and number serve as useful supporting measurements for more details characterization IOP studies at IASOA sites.

The source and composition of aerosols is important to decipher because these characteristics govern their subsequent direct and indirect climate impacts.

Additionally, process level modelling of aerosol-cloud interactions can use number and size and input parameterizations.

Further, combined size and optical properties can be used to infer aerosol composition. Size is important for direct aerosol effects, i.e., aerosol scattering and absorption can be a function of size (in addition to composition). For example, a highly scattering coarse mode aerosol might be sea salt, while a highly absorbing coarse mode aerosol might be mineral dust. As another example, highly absorbing Aitken mode aerosol can be inferred as black carbon while highly scattering Aitken mode aerosol might be inferred as some sort of organic aerosol.

Size (and number) can be used to corroborate aerosol importance as cloud nuclei. For example, CCN have been observed down to 20 nm, but are conventionally efficient starting at 100 nm. CCN in high concentrations can have more consequential impacts on cloud radii size, optical properties, and lifetime. INPs are typically larger in size, starting around 100 nm but conventionally thought to be 500 nm or larger (biological fragments adhered to larger particles can be much smaller, on the kDa scale, but are
rarely observed alone in the atmosphere). INPs are also typically lower in concentration in the atmosphere—1 in $10^5$ particles is capable of serving as an INP.

- **WG science questions discussion.**
  - Andrea Massling mentioned a Nordic cryosphere-atmosphere feedback loop effort with regard to question (1).
  - Julia Schmale discussed a pre-industrial climatology project currently underway for the Antarctic, but that could be replicated for the Arctic with regard to question (2).

**Action items:**

- For next meeting, we will continue discussion on future directions and goals for the WG (i.e., focus on paper or addressing and closing gaps in measurements from those existing).
- Develop a list of representative(s) for each station to serve as contacts for addressing gaps in the measurements.
- We will also discuss how our objectives address the science questions:
  1. How the changes in sea-ice and climatic conditions reflect in Arctic aerosols? Identifying major feedback loops between cryosphere and atmosphere in the Arctic.
  2. What is the contribution of anthropogenic versus natural sources in the Arctic and how this is changing historically and in future?
  3. What are the mechanisms and precursors for secondary aerosol production in the Arctic?
  4. What is the vertical distribution of Arctic aerosols and how does this change over the course of the year?
  5. How homogeneous, in vertical and horizontal scales, are aerosols and their properties in the Arctic?
  6. What role do aerosols have in modulating the surface energy budget directly and indirectly?
  7. What role do aerosols have in modulating Arctic cloud properties by serving as cloud condensation nuclei and/or ice nucleating particles?