Developing particle standards having known size, shape and composition to improve measurement and model performance

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Purpose of 2018 PI meeting breakout:

- Bring together theorists, modelers and experimentalists in order to **articulate needs for new types of aerosol standards** that will both aid in interpreting lab and field **measurements** as well as assure that those measurements address the needs of **models**.
- The discussion addressed **methods that could be employed in the near term** with established technologies as well as **new types of standards that need to be developed**.

Outcome: Develop a white paper!

Chapters (all drafts completed)

I. Aerosol Size Distributions and Number Concentrations (Kuang)
II. Species-Resolved Mass Concentration Standards for Aerosols (>50 nm) (Canagaratna, Croteau, Gaston, and Jimenez)
III. Species-Resolved Mass Concentration Standards for Aerosols (<50 nm) (Smith and Johnston)
IV. Soot Particles (Sedlacek and Onasch)
V. Particle Hygroscopicity: Water Uptake and CCN Measurements (Petters)
VI. Aerosol standards for ice nucleating particle measurement methods (DeMott)

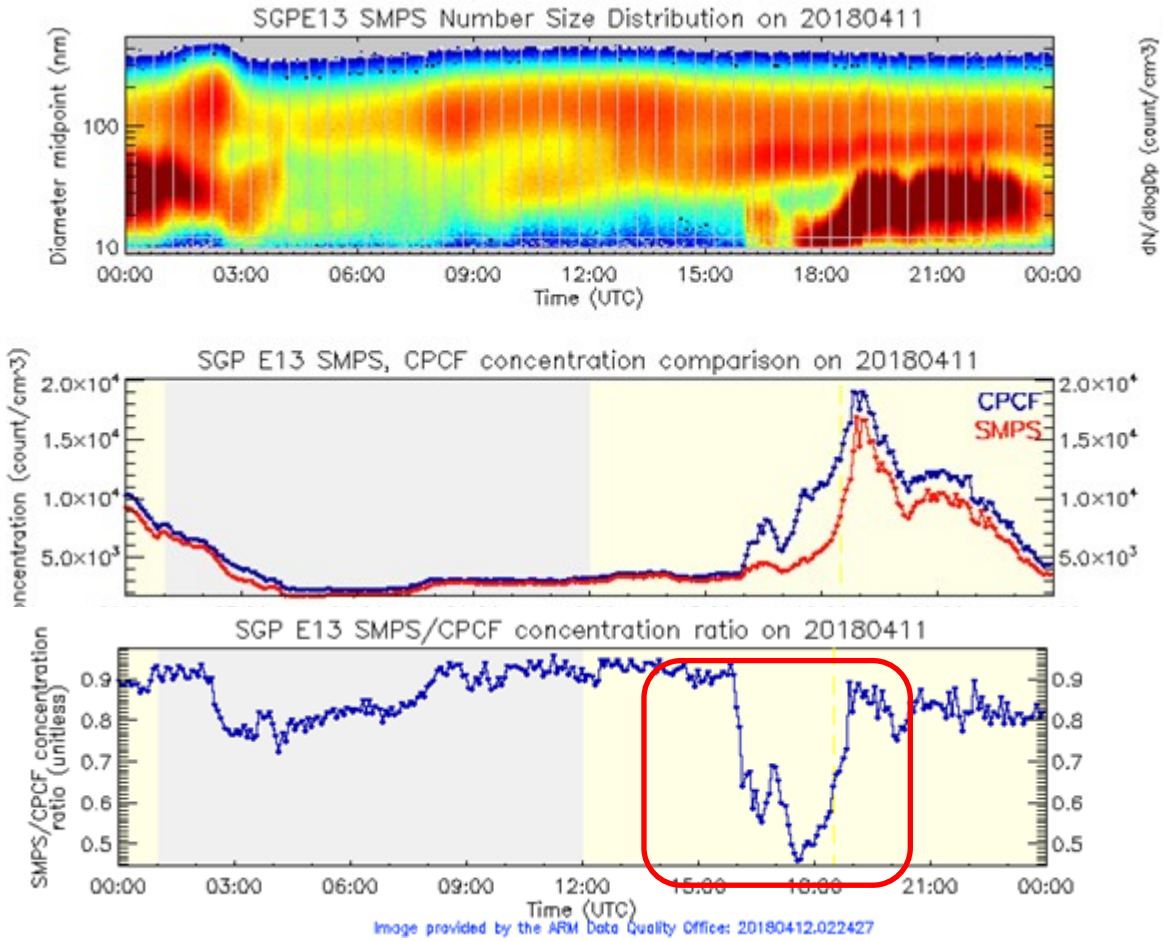
Outcome: Develop a white paper!

Subjects covered by each section

A. Description of measurement method that section addresses
B. Data objectives to meet the needs of modelers
C. Summary of calibration methods that are currently used
D. Concise discussion of measurement errors or inconsistencies that are not being addressed by existing calibration techniques
E. Intercomparisons, standards, best practices, etc., that promise to reduce uncertainties

Highlights from white paper

From *Chapter I: Aerosol Size Distributions and Number Concentrations (Kuang)*



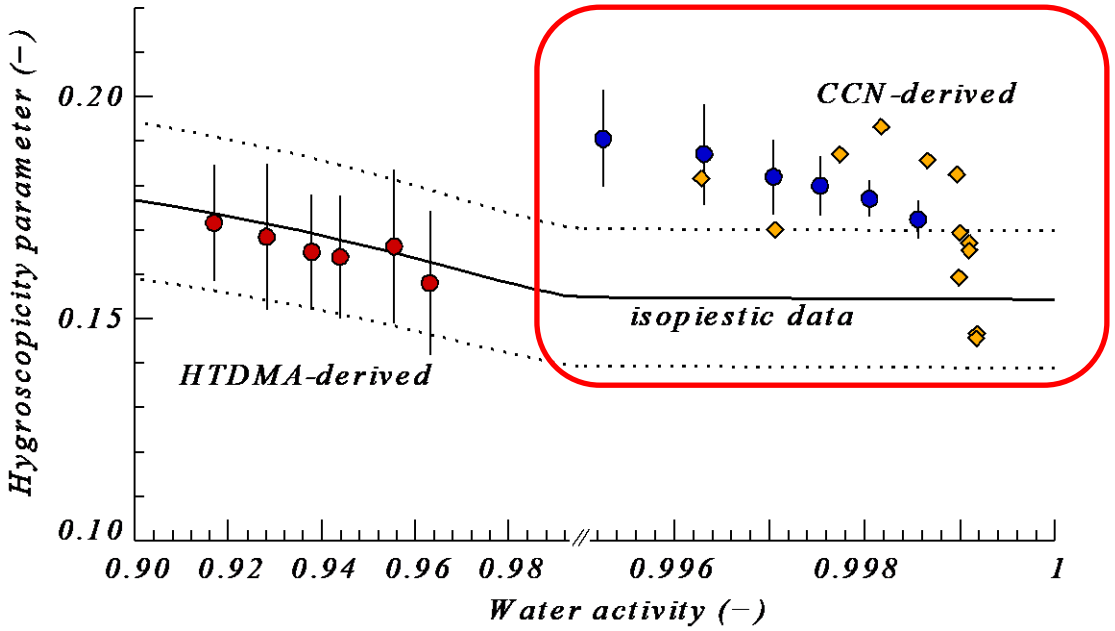
In field studies, integrated SMPS size distribution measurements regularly under-predict number concentrations compared to direct measurements by CPCs (almost always this occurs during new particle formation)

- Improved calibration procedures for SMPS and CPC are needed
- For SMPS, improvements can be gained by operating in dual polarity mode and improvements in “stitching together” measurements to obtain total size distribution

Highlights from white paper

From *Chapter V: Particle Hygroscopicity: Water Uptake and CCN Measurements* (Petters)

Measured hygroscopicity parameter (κ) of lab-generated sucrose particles



For CCN studies two different standards disagree, pointing to a bias (both instruments were calibrated with $(NH_4)_2SO_4$)

- The bias from laboratory studies in controlled environments with nominally well-behaved systems is on the order of 20%. Experimental uncertainties in field experiments are likely larger.
- It will likely require significant effort to further reduce the uncertainty.

Outcome: Develop a white paper!

Vision for White Paper

- White paper will be a “living document” that can evolve over time as technologies improve.
- It will likely be published as a Google Doc, with editing access for the authors, and commenting access for everyone else.
- Google Docs keep a revision history, so we can look at past versions and see the changes that have been made, and when and by whom, if that's relevant.

Opportunities to leverage European instrument calibration guidelines and facilities

Alfred (Ali) Wiedensohler, head of the World Calibration Centre for Aerosol Physics (WCCAP)

- The WCCAP is responsible for the sites of the Global Atmosphere Watch (GAW) program.
- WCCAP is also part of the ACTRIS European Center for Aerosol Calibration (in-situ measurements), is **open for international cooperation** to harmonize calibration standards and thus to help to improve the quality of measurements.
- As such, ARM is welcome to link their activities with WCCAP as appropriate. The WCCAP is purely project-funded, meaning they charge for calibration activities (“they are not really expensive”).