ASR Science Team Meeting

March 19-23, 2018

Unsolved challenges for aerosol standards

CCN

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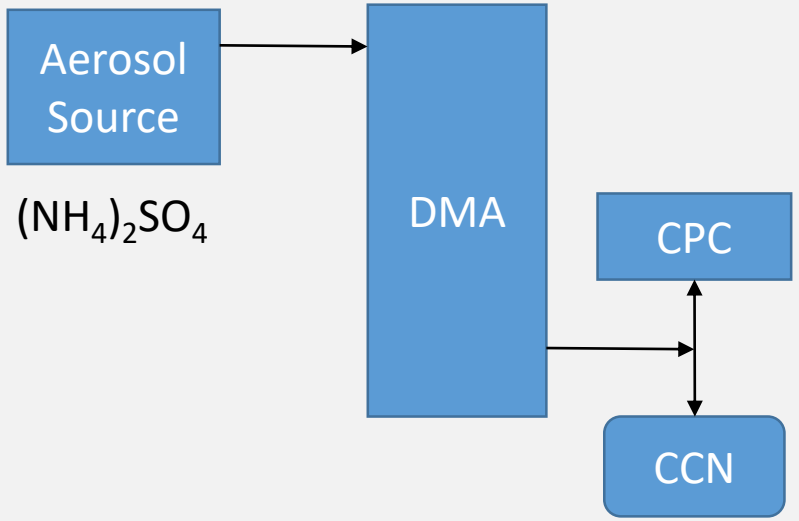
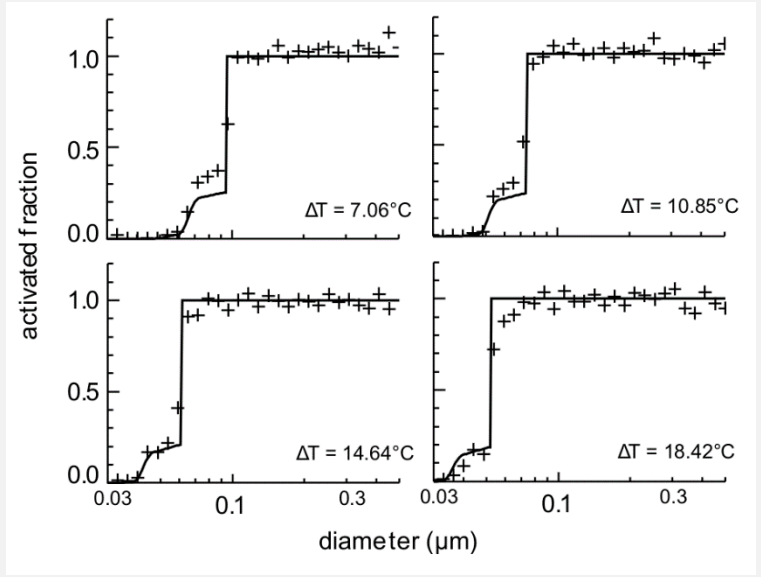
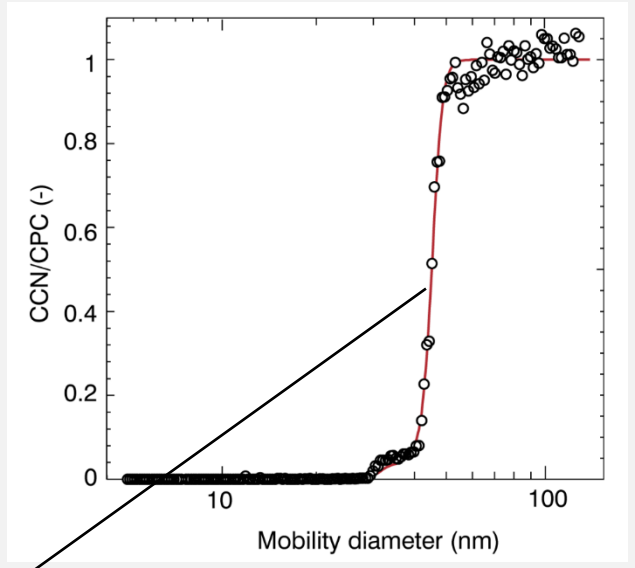
[redacted]

Standard CCN calibration procedure





[Wex et al., 2009]

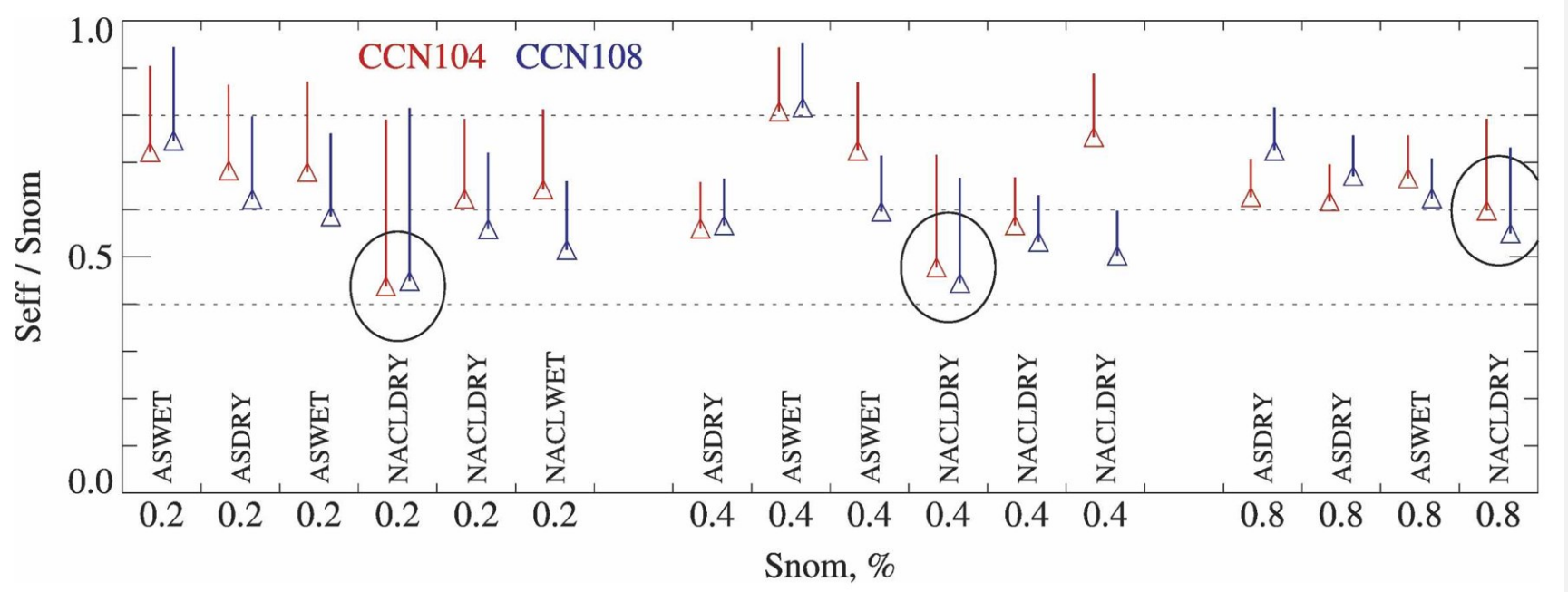


[Petters and Petters, 2016]

Water activity parameterization + Köhler theory + Activation diameter = CCN instrument supersaturation
(E-AIM or others) (Some form) (Measurement)

Issues

There is no closure between modeled supersaturation and predictions from Köhler theory



[Snider et al., 2006]

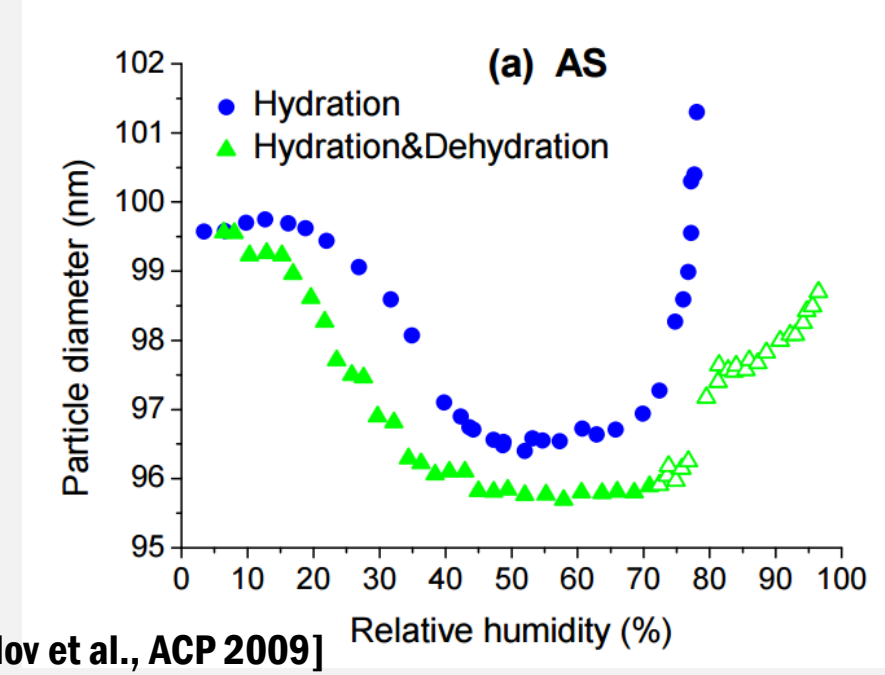
Implication: We cannot independently verify correctness of calibration procedure

Issues

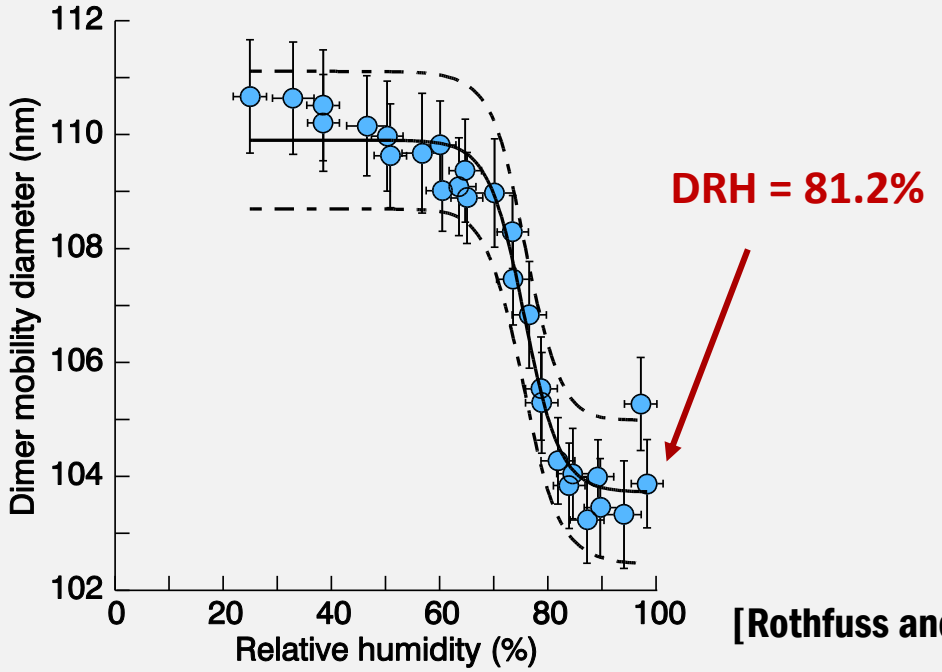
There is no closure between modeled instrument supersaturation and predictions from Köhler theory

Issues with test particles

(1) Supersaturation calculation requires particle mass. Calibration usually done based on mobility diameter. Particle sphericity and void space are an issue.



[Mikhailov et al., ACP 2009]



[Rothfuss and Petters, 2016]

- Characterize particle shape/force particle restructuring (Mikhailov et al., 2009)
- Use wet size selection technique (Snider et al., 2006; Nakao et al., 2014)
- Use mass based selection.

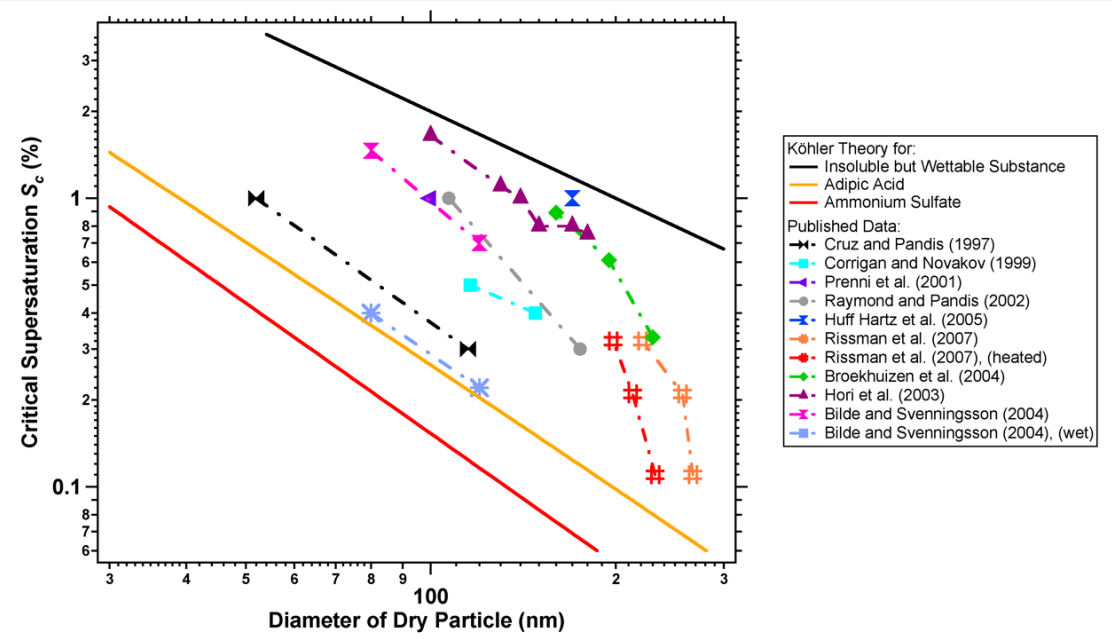
Issues

There is no closure between modeled instrument supersaturation and predictions from Köhler theory

Issues with test particles

(1) Supersaturation calculation requires particle mass. Calibration usually done based on mobility diameter. Particle sphericity and void space are an issue.

(2) Purity of particle composition



[Hings et al., ACP 2008]

- Work with more concentrated solutions and very clean water.
- Purity of particle composition difficult to establish

Issues

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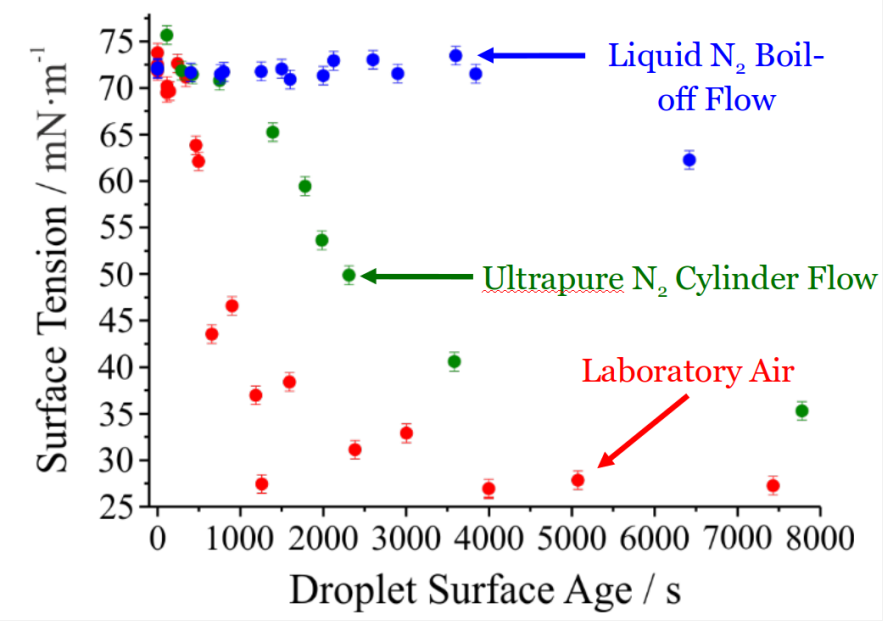
Issues with test particles

(1) Supersaturation calculation requires particle mass. Calibration usually done based on mobility diameter. Particle sphericity and void space are an issue.

(2) Purity of particle composition

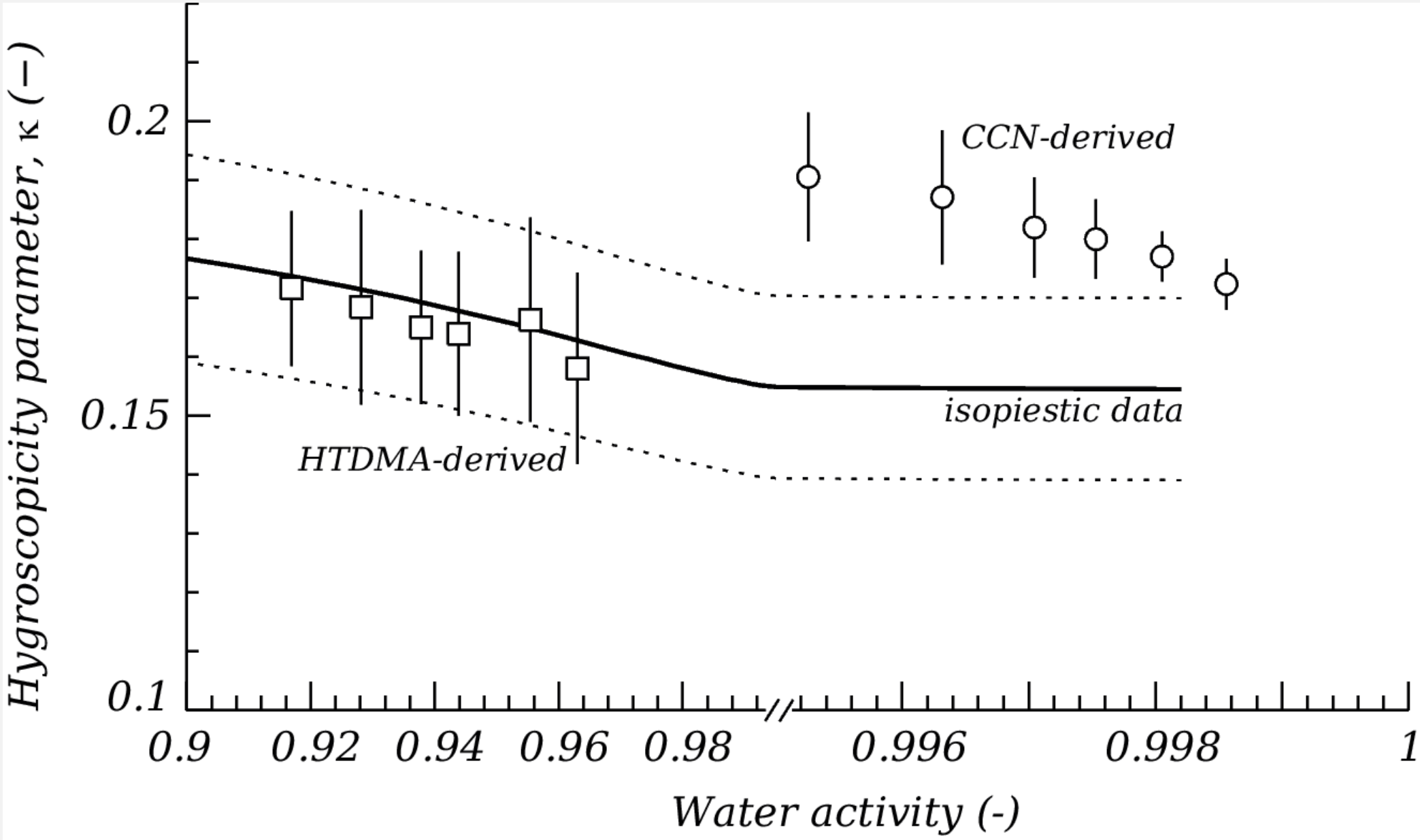
(3) Cleanliness of particle surfaces



[Bzdek et al., Chem Sci. 2016]

- Unknown if this is an issue for calibration
- Unclear how to account for it, if it is an issue

Different calibration standards disagree



Questions

There is no closure between modeled instrument supersaturation and predictions from Köhler theory

Issues with test particles

(1) Supersaturation calculation requires particle mass. Calibration usually done based on mobility diameter. Particle sphericity and void space are an issue.
(2) Purity of particle composition
(3) Cleanliness of particle surfaces

State of the Science

(1) Atomized ammonium, dried, mobility-selected ammonium sulfate is the *de facto* aerosol standard for calibrating CCN instruments.
(2) Methods for generation and models to compute supersaturation are not standardized.
(3) Quality of test aerosol is unclear.

What would a good CCN calibration standard look like?