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Interactive comment on "A technique for the measurement of organic aerosol hygroscopicity, oxidation level, and volatility distributions" *by* Kerrigan P. Cain and Spyros N. Pandis

Anonymous Referee #2

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In this submission, the author combines several established aerosol instruments to measure hygroscopicity, volatility, and oxygen to carbon ratio simultaneously. A new inversion technique to handle the output from the instruments is used. This technique assigns hygroscopicity, and oxygen to carbon ratio to each volatility bin in log10(C*) space. This requires several assumptions, and no support for the legitimacy of the assumptions are made, however, to do so would be difficult and likely beyond the scope of the submission. There appears to be enough information to reproduce the experiment as well as the inversion routine.

The conclusion is original and adds to the discussion of oxygen-to-carbon ratio and

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Discussion paper

hygroscopicity as a function of volatility bin. Several studies in this area contradict one another and sometimes theory. The paper's conclusion offers a possibility for previous results to be complimentary, but would require a shift in the proposed theory.

The author submits the results of 4 experimental conditions, and the paper uses a single experiment as an example. The results of other experiments appear to generally corroborate the author's conclusions and are located in the supplemental material. All experiments are used to test the noise and limitations of the proposed analysis method.

Several comments are listed below. In addition to those comments, a rewrite of the abstract should also be entertained as the first sentences are long and confusing. The main body of the document is clear and mostly precise. No large rewrites are deemed necessary, and I have no major objections.

Page 1 line 28: Acute not proper for all 3 cites. Miller is a long term study, Dockery is for acute aerosol episodes (not acute mortality), but Brooks seems appropriate.

Page 2 line 12: Soften statement. Authors studying cancer causing aerosols may disagree with the "three of the most important properties of organic aerosol."

Page 2 line 14-15: Hygroscopicity is the measure of a volume of water associated with a unit volume of solute. This is a bit more precise than "ability to absorb water." Hygroscopicity is not a measure of a particles ability to form cloud droplets.

Page 3 line 7-8: Massoli et al doesn't seem to make those conclusions. The Massoli paper cites Good et al 2010 and Petters et al 2009 which do make the proposed explanations.

Page 3 line 18-19: Insert comma before "and."

Page 3 line 26-29: These two sentences can be combined to reduce repetitive nature.

Page 5 line 14: Please specify which diffusivity. Mass diffusivity describes the movement of the mass, while thermal diffusivity describes the movement of energy.

Page 5 line 15: Replace “its” with a proper noun to avoid confusion.

Page 5 line 15: replace “a” with “an”

Page 6 line 10: Confused by the word “adding.” Does the author mean that we look up the activation diameter on the log(Sc)-log(Dd) plot? A few more words may be necessary.

Page 6 line 14: “higher sensitivity” may not be necessary. If used, should specify that the author desired a higher sensitivity to signal and not mass-to-charge.

Page 8 line5-7: The thermogram (figure 2a) displays the evaporation of Ammonium Sulfate below 150C, but page 7 line 28 says Ammonium Sulfate is involatile below 150C. In my experience, the thermogram is correct.

Page 8 line 10-12: Which theory? Kohler theory or previous observations. Appears Ammonium Sulfate is still stable at 100C, but disassociates at higher temperatures. Is the hygroscopicity of disassociated Ammonium Sulfate the same as pure Ammonium Sulfate? What about when including impurities? Are these in the “theory?”

Page 9 line 23-25: Some may contend that 0.39 is oxidized, especially when compared to alpha-pinene. A comparison may be better.

Page 11 line 18-19. In order to use equation 4, you must also assume density is constant between all volatility bins.

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