

Reviewers comments in black

Replies to comments in blue

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Reviewer #1

Aerosol water content plays an important role on atmospheric chemistry, especially for liquid reactions, but its mass concentration is difficult to measure directly. This study combined robotic weighing method and mass balance calculation (based on chemical compositions) to gravimetrically estimate water content of PM_{2.5} at different sites. The authors found water content can be attributed to three hygroscopic categories of chemical compositions following the Wilson equation. Overall, this study presents a remarkably detailed gravimetric analysis of aerosol water content, and the results are valuable for further studies in aerosol chemistry. I only have a few minor personal concerns for the authors' consideration.

Reply: Thank you for your affirmation of this work.

1. In Introduction, could you provide a short comparison on present methods of estimating aerosol water content in the atmosphere, for examples, thermodynamics model and/or hygroscopicity measurement?

Reply: We added a short sentence in the introduction referencing a newly added short discussion in the Supplement. This discussion highlights additional methods that could be used to estimate water mass of deposited ambient aerosol. We also reference thermodynamic methods in the discussion.

Main document (lines 151 to 153): “Additional methods to measure water mass associated with deposited ambient aerosols, as well as a method to estimate water mass thermodynamically, are summarized in Supplemental Text S1.”

Supplemental Text S1(Lines 73 to 98): “There are a few other potential methods for measuring water content of aerosol deposited on filters. In principle, these methods should be able to measure water mass, in an offline manner, on a filter or film given enough deposited ambient aerosol mass (Tang et al., 2019). Physisorption analyzers determine the

change in aerosol absorbed water by monitoring the change in water partial pressure after exposure of the deposition to RH (Ma et al., 2010; Hung et al., 2015). Knudsen cells introduce gaseous water to the sample at very low pressures. Water mass associated with the sample is determined by measuring the gas phase water concentration before and after sample exposure (Seisel et al., 2004). Thermogravimetric analyzers alter the temperature and RH of the atmosphere around both a sample pan and an empty pan. Changes in sample mass relative to the empty pan are monitored with changes in RH (Gu et al., 2017). Quartz crystal microbalances attach a film, with deposited aerosol, to an oscillating resonator. Then, upon change in RH, the change in oscillating frequency is related to change in deposition mass (Arenas et al., 2012; Zuberi et al., 2005). Tapered-element oscillating microbalance (TEOM) might also be used off-line by introducing changes in RH (without introducing aerosol) through the sample line to measurement chamber (Rogers et al., 1998).

Thermodynamic modelling can also be used to estimate the water mass given the measured composition of the deposited aerosol at the measurement RH. Masses of ammonium, sulfate, nitrate, sodium, chloride, and organics can be input into a thermodynamic model to estimate water mass. EAIM Model IV (Frieze and Ebel, 2010) (<https://www.aim.env.uea.ac.uk/aim/aim.php>) has the benefit of having a few organic surrogates that can be used to estimate bulk organic water mass response.”

2. The results suggested that water content can be attributed to three hygroscopic categories of chemical compositions following the Wilson equation at 35%-55% RH conditions. How about higher RH conditions (eg. 70%-80%)?

Reply: Our manuscript is for low RH as indicated in the title. The results should not be extrapolated above 55%. This cautionary statement has been added to the conclusion.

Main document (lines 631-632): “Application of this relationship should be limited to RH below 55%.”

3. Its better to add a brief summary on the atmospheric implications of the gravimetric analysis results of water content in this study, such as in mass concentration determination, source apportionment, visibility effect, etc..

Reply: We added a brief summary to the end of the conclusions.

Main document (lines 637-644): “The empirical relationship developed in this study offers a straight-forward method to accurately calculate PM_{2.5} water content on PTFE filters below 55% RH. Such an algorithm is expected to advance understanding of the contribution of aerosol water to reported PM_{2.5} mass concentrations, and application of chemical transport models to represent measured PM_{2.5} mass concentrations. Such an algorithm will also aid mass reconstruction algorithms of particulate matter on PTFE filters, in concert with ongoing efforts to advance characterization of organic matter on these filters (Debus et al., 2022; Ren et al., 2026).”