

## ***Interactive comment on “Aerosol optical hygroscopicity measurements during the 2010 CARES Campaign” by D. B. Atkinson et al.***

**Anonymous Referee #1**

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### General comments

The paper by Atkinson et al. titled "Aerosol Optical Hygroscopicity Measurements during the 2010 CARES Campaign" presents results from the 2010 CARES study around Sacramento, CA. The paper address a well-know topic, i.e., the optical direct effect of aerosol particles through scattering and absorption of solar radiation, and how these optical effects change with other factors such as particle composition. Specifically, the paper presents measurements of the effect of water uptake on particulate light extinction or scattering made at two different locations during CARES. The water uptake is characterized through the dimensionless optical hygroscopicity parameter  $\gamma$ . The author perform calculations allowing an estimate of the particle growth factor (GF) at 85% relative humidity and the dimensionless hygroscopicity parameter  $\kappa$  for C10633

oxygenated organic aerosol (OA) and for supermicron particles. The derived range of oxygenated OA values are in line with previous observations. The authors explain the relatively large  $\kappa$  values obtained for supermicron particles with the contributions of sea salt-containing particles. To date, there is still significant uncertainty associated with the climate forcing by ambient aerosol particles, and current climate models have to be improved in order to be more accurate at reproducing and predicting the global mean temperature. Therefore, scientific work that pertains to the optical properties of ambient aerosols, and their connections to hygroscopic and chemical properties, is very much needed. The authors make use well of tested measurement techniques and modeling, and present results that are in line with previous publication. Albeit not particularly ground-breaking in its content and in the techniques adopted, I consider this to be a valuable paper that presents results from an important air quality field study and it is definitely appropriate for publication on ACP. Notably, the authors attempt to determine the hygroscopicity of the supermicron aerosol fraction, which represents a somewhat original aspect of the paper. The paper makes a large use of modeling and this comes with some inherent assumptions that unfortunately cannot be avoided. However, the authors do a good job at addressing the uncertainties and use cross sensitivity analysis is useful to determine the relative contribution of sub- and supermicron particles to the total extinction or scattering. The manuscript is well written and clear in all the various sections. The introduction puts the work into context of previous literature and the references are adequate and up to date. The experimental part is accurately described and the authors provide extensive detail on the instruments used to characterized the aerosol properties, and provide accurate information regarding the measurement techniques and modeling / calculations performed. The amount of material (text and figures) provided for the discussion is sufficient and clear. Regarding the concerns raised by Dr. Anne Jefferson in a separate statement (uncertainty for the nephelometer measurements and the derived growth factor as well as the truncation correction of the nephelometer itself), I agree that the authors should provide an estimate of the uncertainty of the derived  $\gamma$  values in the final version of the

paper. I recommend that the response that they already provided should be somehow incorporated in the paper, including the clarifications on the truncation correction to the scattering data, in order to make the paper stronger and clearer. Overall, I have a few comments and questions (see specific comments below), but I believe that the paper can be published basically as it is. I have only one question and one correction.

#### Specific comments

Abstract, Line 9, and later in the paper: the size cut of the "supermicron" particles should be specified, as it is stated in the conclusion (defined here as particles with  $1 \mu\text{m} < d_{p,a} < 2.5 \mu\text{m}$ ). Also, because the AMS nominally measures in the submicron range, does it mean that the authors combine submicron chemical data and supermicron optical data to determine the kappa for OA ? Do the authors use the SPLAT data for the kappa of supermicron particles ?

Introduction, Page 31207, Line 11: correct spelling of the word hygroscopicity

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