This work uses bayesian estimation techniques, generally applied to on-line control problems, to estimate aerosol microphysics from data. These aerosol microphysical processes are important to constrain since they lead to uncertainty in climate change. The estimation technique applied in this work is novel to the field of aerosol microphysics. A filter and smoother is investigated to estimate aerosol nucleation, growth, and loss rates. These methods could be very useful to several experiments and datasets since they not only estimate the microphysical rates but also their uncertainty. I recommend this paper is published given that the following comments are addressed.

General comments:

It seems odd that there is no source term for nucleation in equation (1). I see that it is included as a boundary condition on particle flux in, but even with that it seems like these equations do not correctly represent particle nucleation and growth. Since if the net growth by condensation of d_p^{min} is set to J, then either there is no growth of d_p^{min} to larger sizes or the loss of d_p^{min} is included in J. Additionally, J is defined as flux of particles (number of particles per area per time), but then is referenced as particle concentration rate (# $cm^{-3}s^{-1}$) later in the discretized model and numerical simulation. In the discretized model there is in fact a nucleation and growth term for the first bin, so it seems like the error is in the representation of the continuous GDE in equations (1) and (2). This needs to be corrected or clarified. Also, in equation (1) d_0 is used as the lower limit integrated over for coagulation sink but d_0 is not defined.

It is noted that Case 1 & 2 are set-up to study estimation stability to see if the method can estimate time-invariant wall loss even though the loss rate follows a 1st order Markov model. However, the estimated loss rate is only shown at one time and it is not discussed further. Did the estimated loss rate vary over time, and by how much?

What is the range in SNR between cases 1 and 2 as well as between cases 3 and 4? How is SNR adjused?

The observed difference in estimated and true nucleation rates in cases 3 & 4 is quite interesting. It seems like perhaps the nucleated mass rate matches closer than the nucleated number. Is this the case? If so, it would be interesting to note that FIKS can recover the nucleated mass rate when there are uncertainties in the nucleated particle size.

Minor corrections / suggestions:

1. Line 31-32 “...paying also attention to the uncertainties” is confusing wording. Maybe change to “analyze the data with care and pay attention ...”
2. In general, the citations should have the format (Author1, year1; Author2, year2; ...) unless the citation is a subject in your sentence in which case the format should be just the year in parenthesis, i.e., “this thing was described by Author1 (year1) and Author2 (year2)”
3. GR needs to be defined as growth rate when it is introduced in line 38.
4. Citations are repeated in the paragraph starting at line 60. This needs to be fixed.
5. Line 70 change to “the Bayesian approach was adopted to estimate aerosol size distributions”
6. Line 182 - describe what the notation $]0,1[$ means. I am used to seeing $x \in (0,1)$ for $0 < x < 1$ and $x \in [0,1]$ for $0 \leq x \leq 1$
7. It would be helpful to explicitly describe what $\bar{y}^k$ and z^k represent (number of particles counted?).
8. Figures 7a - 7d need timestamps.
9. Reference Appendix B in the text (near lines 180-190) to describe how r_φ is chosen.
10. In algorithm 2, it seems like it should be a loop over $k = K-1, ..., 1$ or there should be a separate case for if $k = K$ since it is not clear that $\Gamma^{K+1|K}$ or $X^{K+1|K}$ exist.

11. Figures 2a and 2b look very similar to my eyes. It would be nice to show the surface plot of their difference, potentially instead of the current figure 2b.