Response to Referee #1 (Dr. Steven J. Ghan):

Thanks for the careful review and instructive comments. We have revised the paper carefully based on the reviewer's comments. This is described as follows (*italic text in blue color is from the reviewer*).

Comments:

This study uses in situ measurements of aerosol, updraft velocity, and droplet number to evaluate a new method for estimating cloud droplet number concentration. In addition to quantifying the mean relative error (MRE), it isolates contributions to that error from uncertainty in various inputs. This is a valuable contribution that is presented clearly, is reproducible, and of high quality.

However, its conclusions would be much stronger if it added, as it suggests at the end, a comparison with the performance without the quasi-steady state approximation (QSSA), i.e., using a rising parcel model with the same inputs. Without such a comparison, it is difficult to draw conclusions about the contribution of the QSSA to the MRE.

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Response:

We greatly appreciate the reviewer's comments. The reviewer affirmed the value of our work and put forward the constructive suggestion, that is, comparing the results of the QDGE scheme with the parcel model to reinforce our conclusions.

In the revised version, we examine the performance of the QDGE scheme by comparing it with parcel model results by conducting a series of experiments as described in Ghan et al., (2011). Considering different assumed aerosol types, the biases of simulated maximum supersaturations to the parcel model (i.e. the benchmark) are all below 0.18 %, showing that the QDGE scheme performs decently. Under the above premise, we carried out the closure experiments and analyzed the contributions of the QDGE to the MRE. The above simulations and comparison with the parcel model are included in Sect. 2.2 of the revised paper.