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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Numerical simulation of flow, H_2SO_4 cycle and new particle formation in the CERN CLOUD chamber" *by* J. Voigtländer et al.

Anonymous Referee #1

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General comments: The authors present CFD-FPM simulations results of mixing state together with particle nucleation and growth in 26 mˆ3 CLOUD-09 chamber situated at CERN (Switzerland). The manuscript is structured and also reads well. However, it is not very convincing about its scientific significancy in its current form. The authors found that one-fan configuration is not ideal, the flat shaped fan copies well the experimental data obtained from H2SO4 loss experiment but does not reproduce the velocity profile experiment. The arc shaped fan does not reproduce well H2SO4 loss experiment (either temperature jump sims) but can reproduce velocity profile measurements. Finally, they concluded that two-fan (flat or arc) configuration is favourable to obtain well mixed tank. Since the author list shares names with current publication of Kirkby et al., (2011) one would expect direct comparison to data published in there, it is pity this would significantly increase scientific value of the manuscript. Of course it

is understandable that each manuscript has its own history.

Specific comments:

1. 4.1.2 Simulation results, page 20020, lines 6-17, concerning diffusion coefficient. This part is bit confusing, can authors make this part clear and be bit more specific, what value of diffusion coefficient and what method of estimation they have actually used for the experimental conditions (T=291.65 K, RH=38%)? How their estimate of DC compares to others, for example Fuller method?

2. Just from curiosity, did the authors try another approach to obtain DC? For example, to keep DC as a free parameter and by iteration to find the right value of DC that fits experimental observations?

3. Since authors consider only first-order loss to wall, what particle number concentration would be critical for their system to find secondary loss of H2SO4 to particles significant? What is the actual measured and simulated wall loss factor (WLF)? How the obtain WLF compares to other studies concentrating H2SO4 – H2O nucleation measurements?

4. 4.5 Simulation of particle nucleation and grow, page 20028, lines 20 and further. The authors speculate about unidentified condensable vapours and insufficient growth rates at very low H2SO4 concentrations, why?? Again if they would directly use and compare to data from Kirkby et al (2011), where H2SO4 concentrations are for "pure" experiment about 5x10ˆ8 cmˆ(-3) and nucleation rate 1/ccm/s, they could avoid any speculation.

Technical corrections:

Abstract, page 20014, line 7, the abbreviation "FPM" is not explained in (CLOUD-FPM), the first appearance of explanation is on page 20017, line 8.

Introduction, page 20015, line 22, "but smaller (12 mˆ2)", probably should be"(12 mˆ3)".

Introduction, page 20016, line 2, the abbreviation “FPM” is not explained in (CLOUD-FPM).

4.2. Cross section profiles, page 20024, lines 16 and 17, “Cross section profiles for the arc shaped fan,. . ., in Fig. 8 (velocity) and Fig. 9 (turbulent intensity)”, should be “Cross section profiles for the arc shaped fan,. . ., in Fig. 10 (velocity) and Fig. 11 (turbulent intensity)”.

page 20029, line 4, “. . .about 6 cmˆ(-3)sˆ(-3). . .”, should be “. . .about 6 cmˆ(-3)sˆ(-1). . .”

References:

Kirkby et al: Role of sulphuric acid, ammonia and galactic cosmic rays in atmospheric aerosol nucleation, Nature 476, 429–433, doi:10.1038/nature10343, 2011.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 20013, 2011.