P4208 L17: Please say what ACI is in the abstract

P4208 L17 : A short describtion was added.
"ACI describes the sensitivity of cloud property, e.g. CDNC, to a change in the aerosol property, in our case number concentration.

P4209 L22-26: The description of the M7 (or similar scheme) is a bit confusing here (e.g. "(containing several compositions for internal mixing)"). Please expand to make this more clear.

P4209 L22-26: Explanation was expanded.
"In a modal model the aerosol distribution can be represented for example by a sum of four modes covering the size range from nucleation (D_p<10nm) to coarse (D_p>1μm) sizes (each mode can include several compositions to account for internal mixing) with three parallel modes to take into account external mixing [Vignati et al., 2004]. Mode can be described by using number and mass of particles as prognostic variables, and then the average particle diameter can be derived from these variables if the mode standard deviation and composition (densities of particle phase components) are known."

P4209 L29: "standard deviation and composition . . . are known" or *assumed*! The standard deviation is never "known" with the modal schemes, it is always assumed.

P4209 L29: "assumed" was added.

P4210 L14-: This paragraph confused me at first. Specifically because it started with "In modal models" and never mentioned anything about *spatial* finite differencing. I thought you were talking about finite differencing in the aerosol size distribution. It would be better to say "In 3D aerosol models, the aerosol properties are usually described across space using a finite difference...".

P4210 L14- : The paragraph was rephrased.

P4211 L7: "The larger mode also decreases *in size* due to..."

P4211 L7 : "in diameter" was added.

P4211 L22: Please describe what the ACI is qualitatively (e.g. the sensitivity of CDNC to a change in aerosol number (keeping the shape of the size distribution the same))

P4211 L22 : A qualitative description wasadded.

P4212 L3: Why does only EC (I'm assuming elemental carbon, but not explicitly defined) count towards uncertainty in the direct forcing. Shouldn't scattering aerosols contribute to this too?

P4212 L3 : Typo was fixed, EC changed into q_{ext} (extinction coefficient)

P4212 L18: Can you explain how the threshold diameters work? There will always be a tail of a lognormal mode that will go above these sizes (to infinity). Also, on P4215, you say "The emission mode mean diameter is also ∼50 nm larger than the largest allowed average diameter for the

Aitken mode." Since the emissions diameter is 80 nm, this implies that the largest allowed average diameter is 30 nm. How does this fit with the 100 nm threshold diameter? This is not clear.

P4212 L18 : The description of the threshold diameter expanded along with distinction from the largest allowed diameter.
"Note that these are not the limits for the average diameter but instead to the leading edge of the mode. When a predefined (often very small fraction of the modes mass exceeds the threshold diameter, that mass along with its number is then reallocated to the following larger mode. Note the difference between threshold diameter, and the largest mean diameter which can be reached by the mode without the leading edge of the mode exceeding the threshold diameter."

P4214 Eqn 3: Since your sectional model is being used as your "truth", shouldn't you take the difference from just that simulation?

P4214 Eqn 3 : We are comparing the reallocating approach against the unrestricted model in addition to the sectional one. Using the chosen expression removes bias between the two modal models.

P4215 L11: Please describe what the background aerosol is.

P4215 L11 : Meaning cleared by adding "pre-existing".

P4216 L8: This overestimation is not shown... all values are negative in Figure 2.

P4216 L8 : The paragraph is rephrased to emphasize how the given scenario is not the one shown in the figures but is instead a worthy remark.

P4216 L29: (and several other places shortly after including the labels of Figures 3 and 4): You discuss the difference between the reallocating modal model and the unre stricted modal model. However, on P4215 L13 you mention that you will only compare the reallocating modal model to the sectional model for this part of the paper. I re alize that the sectional model and unrestricted modal models give the same solution here, but for consistency it would be better if you referred to your "truth" model as the sectional model as you established on P4215 L13.

P4216 L29 : In this first experiment the idea is to compare the effects of reallocation only, without any processes included. For that reason we use two models with only distinction being the lack of reallocation.

Section 3.2: Can you include a size-distribution-timeseries figure similar to Figure 8 for the experiment in this section? Figure 8 was really useful for visualizing why the 3 schemes diverged in the nuc/growth experiment, and I think it would be useful here too.

Section 3.2: Since there is no time propagation in the simulation, similar figure is not possible. The figure would have two dimensions, practically identical to Figure 3.

Equation 4 (and discussion surrounding it): I found a number of things about this equation confusing. You refer to it as a injection rate, but give it "C" like it is a concentration. For C0, you don't provide units (at least initially), which would clear this up. The term "injection

concentration" doesn't clarify this either. Later you say "2.6 x 10ˆ8 molecules cm-3", which makes me thing that this value is C0 (it matches the value given earlier) and that C is a concentration, and not an injection rate (as initially stated) in any way. Additionally, when you say "The decreasing injection concentration in the presence of a condensation sink leads in (–typo, I think–) to quickly decreasing H2SO4 concentrations...", does the "T-t/T" term represent the loss of C due to the condensation sink, or is the condensation sink and losses explicitly resolved (e.g. the condensation sink will be changing during you simulation as the size distribution changes)? If it were a fixed condensation sink, should the expression be C_SA=C0*exp(-t/Tau) rather than a linear decay? (I'm not sure this matters for illustrating your point, but readers will likely be confused in a number of places). Overall, this paragraph is very confusing.

Equation 4: Units and more detailed description of H2SO4 mechanics was added.
"The injection rate (C_{SA}) of H_2SO_4 into the system at each time step was defined by

$$C_{SA} = C_0 \frac{T-t}{T} \tag{1}$$

where C_0 ($2.6 \cdot 10^8$ molecules/cm^3) was a constant concentration, T (18 h) and t were the total simulation time and the current time (in hours) at a given time step. In addition to this linearly decreasing injection rate, explicitly resolved condensation and H2SO4 consumption in new particle formation affected the vapor phase concentration."

End of page 4218: "causing the Aitken mode to grow by 45 nm" 45 nm above which size?

End of page 4218: The sentence was rephrased to clarify the growth mechanisms
"Note also that the average diameter of the Aitken mode in the modal models increases not only by condensation (contribution 25 nm to the growth of the particle diameter during the 18 hours) but also by the addition of mass from the emitted particles to the Aitken mode (contributing to the growth by additional 45 nm)."

P4219 L26: "particle *number* concentration."

P4219 L26 : "number" was inserted.

P4221 L8: "by *the* reallocating model".

P4221 L8 : "the" was inserted.

P4221 L29: "to *the* sectional one"

P4221 L29 : "the" was inserted.

P4222 L10: "For the *initial* accumulation mode". Same on line 17

P4222 L10 : "initial" was inserted, also on line 17