# Validation 19.6.2013

Chamber model was tested using eight different cases and running the simulation with seven different amounts of sections. The results of each case were studied as well as the effect of number of sections on the accuracy of results.

The particle distribution consisted of two log-normal distributions in each case. The distributions were defined so that the particles with smaller diameter grew by condensation near the size of bigger particles. The bigger particles represent background aerosol and the smaller ones aerosol created by nucleation.

Parameters that were varied are: concentration of particles (N), mean diameter of particles in the distribution (mu), dilution, vapor concentration (Cvap0) and geometric standard deviation of distribution (sigma). All calculated combinations of these values are in table 1. Vapor concentration was held constant during the simulation, so the Cvap0 represents the amount of vapor in all time points.

N had realistic values of 1000 and 100 particles/cm3, which makes the total concentration 1100 particles/cm3. In addition, a remarkably higher concentration was tested defining N as 50 000 and 3000 particles/cm3, so that total concentration was 53 000 particles/cm3.

Vapor concentration, which affects the growth rate of particles, had a realistic value of 1.4e7, but also a remarkably higher value of 5e8 was tested.

Table : Used parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| case | N | mu | dilution | Cvap0 | sigma |
| 1 | [1e3, 1e2] | [50e-9, 140e-9] | off | 1.4e7 | [1.25, 1.3] |
| 2 | [1e3, 1e2] | [50e-9, 140e-9] | on | 1.4e7 | [1.25, 1.3] |
| 3 | [1e3, 1e2] | [40e-9, 200e-9] | off | 5e8 | [1.25, 1.4] |
| 4 | [1e3, 1e2] | [40e-9, 200e-9] | on | 5e8 | [1.25, 1.4] |
| 5 | [5e4 3e3] | [50e-9, 140e-9] | off | 1.4e7 | [1.25, 1.3] |
| 6 | [5e4 3e3] | [50e-9, 140e-9] | on | 1.4e7 | [1.25, 1.3] |
| 7 | [5e4 3e3] | [40e-9, 200e-9] | off | 5e8 | [1.25, 1.4] |
| 8 | [5e4 3e3] | [40e-9, 200e-9] | on | 5e8 | [1.25, 1.4] |

Results show that the values of N and V do not differ significantly between different amounts of sections, except when the number of sections is 10. The error of the results (results of 200 sections was used as reference) was always less than 2 % when the number of sections was 20 or more, and in most cases the error was less than 1 %. This means that in many cases using 20 sections is enough. Also the distribution had a similar shape for all numbers of sections above 10; for large number of sections the distribution was more accurate, but had also more artifacts.

The real time needed to calculate one hour of simulation follows function time (secs) = 0,0908e0,0813x (x=number of sections) for a small number of sections (10-60) and function time= 0,0003x3 - 0,0297x2 + 0,8307x - 5,5138 for larger amount of sections.

More data in validation.xlsx.