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Interactive comment on "Conceptual study on nucleation burst evolution in the convective boundary layer – Part I: Modelling approach" *by* O. Hellmuth

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Authors response to RC3 regarding the low aerosol background concentration.

See also response to part III/ IV

5 Reference case scenarios

To select meaningful reference scenarios for the present feasibility study, both phenomenological and numerical arguments were considered. In paper III, two scenarios

will be investigated with an emission source at the ground but very low background concentrations of aerosol, henceforth called 'clean-air mass' scenarios. Such situations are suspected to occur in anthropogenically influenced CBLs depleted from air pollutants in connection with frontal air mass change and postfrontal advection of fresh polar or subpolar air.

1. Firstly, a ground emission source is required to provide precursor gases for the production of nucleating vapours enabling nucleation. A low background concentration of aerosol particles is required to ensure the absence of condensation sinks, which can condensable vapour prevent from nucleating or thermodynamically stable clusters (TSCs) prevent from growing to detectable size. Such a scenario was hypothesised and observed as a prerequisite for NPF (Nilsson et al. 2001c; Birmili et al. 2003; Buzorius et al., 2003). For example, in a comprehensive NPF-CBL evolution study Nilsson et al. (2001c, subsection 4.1, item (1)) hypothesised, that "*on days when dilution of the pre-existing aerosol number and condensation sink was observed before nucleation, this may itself be enough to trigger nucleation by decreasing the sink of precursor gases at the same time that the precursor production may be increasing due to increasing photochemical activity. Such a scenario would form favorable conditions for nucleation*". The low initial Aitken and accumulation mode number concentrations of 10 and 10 cm^{-3} used in the present study corresponds to the values used for the rural (R1, R2), the urban (U1, U2), and the marine case scenarios (M1, M2, M3) investigated in the modelling study of Pirjola et al., 1998a, Fig. 1). In the binary nucleation study performed by Pirjola et al. (1999, Tan. 1), e. g., initial number concentrations of 100 cm^{-3} for the Aitken mode, and 10 cm^{-3} for the accumulation mode were assumed (see their cases 1 and 2).

2. Spurious oscillations are unwanted solutions of the lonlinear PDE system. They were found to be not critical in the meteorological part. In opposite to this, such oscillations can become critical in the physico-chemical model, especially near

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the CBL top, e.g., where at very low concentrations the physico-chemical variables could cross zero owing to such oscillations. Hence, a low-background concentration scenario is reasonable to evaluate the model behaviour.

The considered scenarios will be quantitatively characterised in part III. They are not claimed to represent the variety of observations. A systematic evaluation of other possible NPF scenarios, or the direct evaluation of a decided measurement campaign is beyond the scope of the present paper and deserves further studies.

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