Atmos. Chem. Phys. Discuss., 5, S4950–S4953, 2005
www.atmos-chem-phys.org/acpd/5/S4950/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

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

O. Hellmuth

Received and published: 11 January 2006

Response to referee 3 (anonymous)

1. General remarks and change of the title

See response to referee 1

2. Response to specific comments

2.1 RC3: Explanation of the motivation behind low background concentrations

AC:

(a) A new section has been inserted: 5.Reference case scenarios

(b) Both synoptically (not climatological!) and numerical arguments were considered for the selection of the test cases.

(c) The scenarios refer to an anthropogenically influenced CBL depleted from air pollutants in connection with frontal air mass change and postfrontal advection of fresh polar or subpolar air.

(d) References are given for the background concentration.

(e) Please see the revised manuscript (new section 5).

2.2 RC3: Page 11421; Annotation 'filtered' and 'non-filtered'

AC: Revised. To be more consistent with the annotation used by Stull (1997), the term 'nonfiltered equations' (p. 11442) is replaced with 'model equations', and the term 'filtered equations' (p. 11450) is replaced with 'averaged model equations'. The manuscript will be correspondingly corrected.

2.3 RC3: Page 11423; Discussion of monodisperse vs. sectional approach

AC: Added.

a) Page 11423, line 9-10, to be inserted:

"As the total number of equations exponentially increases with the number of predictive variables in a third-order closure (Stull, 1997, p.198-199, Table 6-1 and 6-2) an aerosoldynamical model with a low number of predictive variables is applied."

b) To be added: 3.2.8 Alternative approaches

“Alternatively to the third-order approach presented here, a ‘mixed closure model’ can be realised, e.g., third-order closure running for PBL dynamics, and the first-order closure running for chemistry and aerosol dynamics, respectively. Then, a higher number of predictive physico-chemical variables can be considered, such as organic compounds and size bins of a sectional aerosoldynamical model. Doing so, special care has to be taken to appropriately parameterise the turbulent fluxes. First-order closure is based on diagnostic flux-gradient relations, i.e., the fluxes are represented by the down-gradient approach, eventually semi-empirically corrected for countergradient flows. For the eddy diffusivity of scalars one can either use an “ad hoc” approach (O’Brien, 1970), a diagnostic relation based on "truncated" flux equations (Holtslag et al., 1991; Holtslag et al., 1995), or a semi-empirical expression based on the turbulence spectrum, such as proposed and evaluated, e.g., by Degrazia et al. (1997a), Degrazia et al. (1997b), Degrazia et al. (1998), and Degrazia et al. (2001). Generally, the closure type depends mainly on the question and scale of interest, as well as on the flow characteristics, e.g., on atmospheric stability. To investigate turbulence-related NPF the present approach opens a suitable way. But when focussing, e.g., on NPF in boreal forests, where a large number of organic compounds, and perhaps, size bins must be considered, then either a pure first-order closure, or even a mixed third-/ first-order closure is recommended to use.”

2.4 RC3: Page 11424, line 25 to page 11425, line 14; Re-evaluation of the paper of Berndt et al. (2005)

AC: Rewritten.

2.5 RC3: Parameters affecting the humidity growth factor

AC: Added. In the paragraph "3.2.6 Humidity growth" at page 11428, line 19, the corresponding reference to the appendix (were the expression is given) is added:

"3.2.6 Humidity growth The water uptake of dry aerosol is considered by applying the empirical humidity growth factor of Birmili and Wiedensohler (2004, pers. communication, see appendix B6, Eq. (B17))."

2.5 RC3: Subsection on numerical tests

AC: Added. See response to RC1. A new section 4 on numerical realisation and basic

ACPD

5, S4950–S4953, 2005

Interactive Comment

test has been added.

2.6 RC3: Page, 11424, line 2; "the lower the vapour concentration"

AC: To be revised in the final version. Thanks.

2.7 RC3: Number of typos in the article

AC: To be revised in the final version. Thanks.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11413, 2005.