Atmos. Chem. Phys. Discuss., 3, S1203–S1207, 2003
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Operational mapping of atmospheric nitrogen deposition to the Baltic Sea" *by* O. Hertel et al.

Anonymous Referee #1

Received and published: 7 August 2003

Review of ŞOperational mapping of atmospheric nitrogen deposition to the Baltic SeaŤ By O. Hertel, C. Ambelas Skjøth, J. Brandt, J. H. Christensen, L. M. Frohn, and J. Frydendall Atmos. Chem. Phys. Discuss., 3, 3493-3523, 2003

General comments The paper presents preliminary results from a chemistry-transport model ACDEP that simulates nitrogen and sulphur compounds in the Baltic Sea region. The paper emphasises rightly the interest of reaching a high spatial (a few tens km) and temporal (day) resolution in order to better investigate the connections between the nitrogen deposition to the sea and algal blooms that have been recorded there. Indeed deposition field from such a model can be used in marine ecological model to understand or forecast algal blooms.

The presented results are straightforward simulations for one year displaying annual,

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monthly and daily averaged of concentrations in air and rain and deposition of SOx, tot. nitrate, total ammonium and NO2. Simulations cover only one single year. The modelled results are compared with measurements from a few EMEP stations around the Baltic Sea. The model system seems to be destined to various applications and has been validated earlier. Thus this paper provides only limited innovativeness as such computations have been performed earlier (e.g., EMEP). Wider scientific interest can be achieved if deeper insight is sought as to advantages and disadvantages of the ACDEP model system compared to other models and how this can explain the agreements and discrepancies in the results. Furthermore, since deposition data are of interest for environmental authorities, the paper should have at least one paragraph addressing the issue of the total load to the Baltic Sea, how it compared with other assessments (EMEP, HELCOM, etc) and what new information the higher-resolution brings compared to other ŞbulkŤ estimates.

A second main weakness of the model is that the comparison with data is performed without consideration of the location of the monitoring stations with respect to their environment. Many of these stations are coastal so that they grasp quite different conditions depending on the wind direction. It is expected that the model performs differently under both situations. A more attentive investigation would have thus helped to trace back some deficiencies or quality in the model.

Thus, this paper could gain in scientific insight and interest as well as in impact for the benefit of users of scientific information by providing more details on the basic meteorological input and how input data are treated in the model system. More explanation based on scientific arguments should be provided in commenting the results and more analysed comparison with other similar works should be provided.

Specific comments p.3495, line 15: Ş50% of N-load from atmospheric depositionŤ, you should specify whether this is for coastal waters (as is implied by the previous sentence, line 13) or for the Baltic Sea as a whole. I presume there is a clear difference between them since coastal waters are greatly affected by direct and river discharge.

ACPD

3, S1203–S1207, 2003

p.3496, 2nd paragraph: the simulations of ACDEP seems to be based on input data from a variety of sources (Eta, DEOM, THOR). This is not very clear. I would suggest to elaborate on that (even using a diagram) showing what parameters with what resolution are produced by what and how the matching in time and space resolution between different models is performed. Also what are the input to the Eta-model, especially how clouds/precipitation are simulated and transferred to ACDEP. What is the resolution of Eta and DEOM, how boundary conditions are treated (climatological background conditions?), how ACDEP is initialised? In the light of the importance of wet deposition (ca. 80%) for the total deposition of nutrients to the Baltic Sea, the paper is too short on describing the features and capacity of the model system to simulate rain events and rain amount. p.3496, line 17: is 30x30 km the resolution of the simulation in this paper?, on p. 3501(line 11) reference is made to 16.7 km. This should be made clearer in the paper. p. 3496, 3rd paragraph: Another weakness is the lack of consideration of the structure of the model with respect to the quality of the results. For instance, the air parcel is limited to 2 km. There is no explanation on whether some exchange is allowed with a reservoir layer above, how clouds/rain are considered above 2 km (I suppose they are present in Eta). Some more details should be given here, whereas consequences discussed in section 3.3 (p. 3501-3502). p.3498, lines 7-10: the plume growth of 1/10 should be better substantiated (scientific argument + reference). Also it is reasonable that it is distance dependent, different at short range than at long-range (cf. puff or plume dispersion). p 3498, section 3: some consideration on the representativeness of the stations is required. Some represents maritime Baltic conditions part of the time, some other ones are inland and even at higher altitude. Meteorological and emission conditions can be very different on each side of a station when the wind is along the shore. p. 3499 3500: under- or overestimations of modelled values vs. observed ones are reported here and there but without real scientific explanation. For instance, the capacity of the model to simulate the chemical transformation is never addressed. Although uncertain emission data is a clear culprit, the chemical module is certainly as important. p. 3499-3500 and in the conclusions: the authors are very

ACPD

3, S1203–S1207, 2003

Interactive Comment

satisfied with frequent correlation coefficients below 0.7 which in fact means explaining only 50% (r2) of the variance. I would call for some moderation in the degree of satisfaction. p.3501, lines 15-20 and figures 9: Is this a one event simulation or a monthly or annual average? Depending on this, explanations would also differ. p.3501, lines 20-25: The explanation is probably valid for the structured analysed field observed above the western part of the main Danish peninsula (is there some orography there?). On the other hand, this probably does not apply to the difference in amount above the 2 large eastern islands (where Copenhagen is located). p.3502, line 23: the Şnearby agricultural activitiesŤ influence the Danish waters but probably not the other coastal zones. p.3503, line 3: the overall value of the deposition load to the Baltic should be given and compare with determinations from other authors/sources. The geographical gradients and the spatial variability also should be compared to other sources. p.3503, line 10-12: some short consideration on the climatic feature of the year 1999 should be given. How representative? etc.

Technical corrections The language is often clumsy. A check by a native English-speaker should be performed, so that I am not providing any correction list on grammar and vocabulary. Abstract, line 16: should 1999 (not 2000) p.3495: line 7: after Şin a number of papersŤ give some references for such papers. p.3501, line 9: Şthere are still dataĚŤ p. 3501, last line: replace Şdistributed onŞ by Şstratified intoŤ. Table 1: write Şnumber of stationsŤ instead of Şnumber of dataŤ. Captions of Figs.1, 2, 3 and 4: write rather ŞThe station code in the figureŤ than ŞThe station in the figureŤ. Correct Şstraight linesŤ, not ŞstraitŤ Figs. 1, 2, 3: start the caption by: ŞComparison between observed and calculated annual mean concentration ofĚĚŤ Fig.3: the caption refers to annual mean concentrations in precipitation, but the text along the x- and y-axis refers to wet deposition ! Figs.5-8: in all figures the upper panels are very small; make all numbers/letters visible for the final version of the paper. The frequency distribution in Figs. 5 and 7 for observed and modelled data should have the same scale for the y-axis for the sake of easy readability. Figs.5-8: For the sake of reader-friendliness, the modelled and monthly histograms could be in blue colour (like in the

ACPD

3, S1203–S1207, 2003

time series) Fig.7: the caption refers to wet deposition but the text (p. 3500, line 8) refers to concentrations in precipitation. Fig.9: correct to ŞGridded precipitation on a 10x10 km grid from observed..Ť Fig. 11: You could have superimposed isolines of deposition obtained in other publications to make an interesting comparison. p.12: You could have affected also a colour code to your grid numbers (for instance 3 different colours stratified in southern, central and northern grids) or whatever has a scientific and/or administrative meaning.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 3493, 2003.