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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A revised parameterization for gaseous dry deposition in air-quality models" *by* L. Zhang, J. R. Brook, and R. Vet

Anonymous Referee #3

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General comments

The purpose of the study is to present a revision of the dry deposition scheme described in Zhang et al 2002a adopting the non stomatal resistance parameterizations presented in Zhang et al. 2002b and 2003, and including additional developments that concern the treatment of cuticle and ground resistances during the winter and the handling of a number of seasonnaly dependent parameters. The paper described rather clearly the parameterizations used. The authors used the model to provide minimum, maximum and typical values of the deposition velocity of a number of species. Additional outputs (additional tables and enlargement of already included tables, see details below) would be beneficial to the interested community.

Specific comments

page 1778 line 9: what do you mean by a 'leaf-stomatal-resistance model'? What are the other models that could be used?

page 1781 line 17: I don't fully agree to the sentence: 'The uncertainties in Ra and Rb from the different models are small.'. Fistly, what different models have you in mind? Secondly, the literature reports that uncertainties can be large for instance in stable conditions (i.e., Wesely, 2000).

page 1781 line 19: please specify the reference(s) for equations (2) and (3)

page 1782 line 18: the sentence 'However, there are some exceptions...strong.' should be more explicit; I suggest :'However, there are some exceptions such as morning dew and sunshine immediately after rain when the solar radiation is strong. In such cases, we calculate a small Rst (see equations 6); however stomata can be partially blocked because of the water film and the Wst term will then increase the surface resistance. Thus, the following ....

page 1783 equation 6f: the water stress is only dependent on the solar radiation and not on the soil water content. Could you comment on that?

page 1786 equations 8b: could you cite reference(s) for distinguishing among soil wetted by rain and soil wetted by dew?

page 1787 line 11: according to equations 10a and 10b, Rgd and Rcutd can increase much more than double their original value

page 1788 line 8: I would suggest to remove the word 'extremely'. There are other parameters that also appear important, such as the minimum stomatal resistance Rsmin; in a number of stomatal resistance parameterizations it is the ratio Rsmin/LAI that controls the results.

page 1788 line 22: what is this function of wind speed?

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page 1789 line 8: deciduous forest: please specify the latitude and longitude of the observations, as well as the period of observations from which the mean presented in figure 3 has been calculated. Provide also details on how the modeled estimates have been made: what are the meteorological data used in input (hourly GEM model outputs?), have any meteorological observations been used also? Explain what you mean by (line 16): 'since meteorological conditions are not explicitly considered'.

As you differentiate wet by dew and by rain for SO2, what do the results you present in figure 3 correspond to?

page 1789 line 20: 'compare better than do earlier models'; Such an affirmation should be accompanied with corresponding curves in Figure 3: you need to include the curves that correspond to the results from these earlier models for all four cases presented. Then the impact of revisions of the scheme would be visible.

page 1790 line 14 : what are your reference(s) for the range of friction velocity you present? Upper values for forests seem really high to me.

page 1790 line 28: what are the results you obtain under wet conditions? I think it would be very interesting to present these as you include in this paper developments concerning wet conditions. I also think that Table 2 should be extended to include all chemical species (31).

page 1790 line 29: The sentence 'The model test results in Table 2 indicate that' is misleading: most indications you cite concerning conditions for maximum deposition velocity cannot be derived from Table 2. They are known from the various equations used. Furthermore, the role of the LAI term in the stomatal resistance is not underlined in the equations presented in this paper.

Could you comment on why ozone deposition velocities for tropical forests (class 8) is lower than those of a number of other LUCs, and indeed much lower than observations?

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page 1791 line 22: what are the references for the typical values presented in Figure 4?

page 1792 line 4: larger LAI and smaller rsmin : please cite example(s)

page 1792 line 5: could you comment on (1) why SO2 Vd increases substantially for a number of LUCs and increases much less for others; (2) for a number of LUCs O3 Vd increases while for others it decreases. I would suggest that instead of figure 5 you provide a Table with the actual numbers, and not only for the four typical conditions you present but also for typical night wet conditions that relate directly to the revisions you propose.

page 1793 line 7: 'compared to other existing models': as I already indicated before, you need to include in your article results from the other models you cite (earlier versions of your model or results from different models). Then depending on the results you present this sentence needs to be changed to 'compared to models A, B or C...'

page 1793 line 18: could you develop more on 'Separate measurements of stomatal and non-stomatal uptake is important for estimating O3 damage to crops'.

Technical corrections

page 1777 line 7: Non-stomatal (no space after hyphen)

page 1780: line 17: (LUC, 15) line 23: the sentences: 'Furthermore, this LUC scheme is based....elsewhere.' should be changed into:'The LUCs of the present work are also based on BATS, with an extra 6 categories. Choosing this 26-category scheme could benefit air-quality models developed elsewhere.'; and moved after 'a widely-used scheme in North America.

page 1782 line 22: (so called two-big-leaf) ... approach (Zhang et al. 2002a).

page 1782: equation (4): Rx(O3)

page 1783 line 6: I suggest to change the sentences: 'A sunlit/shade ... calculated as:'

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into: 'The following sunlit/shade stomatal resistance sub-model (Zhang et al 2002a) is used for calculating Rst for all gaseous species:

page 1783 line 8: in equation (6) remove the parenthesis before Di

page 1783 line 17: equation 6b is wrong; it should be : bt=(Tmax -Topt)/(Topt-Tmin)

page 1783 equation 6f: Equation 6f and equation 22b of Brook (1999a) are different, and so are the values of Psic1 and Psic2 in your paper and in Brook (1999a). Please check, it seems to me that there could be an error either in equation 6f and/or in units.

page 1784 line 26: for all LUCs. For some LUCs

page 1785 equation 7a: correct equation is : Rac0(t)=Rac0(min)+

page 1785 line 11: change Surface resistance into Ground resistance

page 1785 line 12: The following equation

page 1788 line 1: (sd in cm)

page 1788 line 19: affects aerodynamic, quasi-laminar and non stomatal resistances

page 1789 line 6: I suggest changing the second sentence of the paragraph into: 'Measurements of O3 and SO2 dry deposition data at one of these sites (deciduous forest in Pennsylvania, lat: long: USA) are presented here to show the performance of the revised model.

page 1789 line 22: maximum Vd appears.

page 1790 line 7: seasonal variations, ...Due to these large variations,

page 1790 line 23: 5Â°C

page 1791 line 4-5: I don't read the same ranges of values from Table 2 as the ones you present. I read : 0.9-1.7 for SO2; 0.6-1.4 for O3; and 3.2-5.3 for HNO3

Table 1: include units for the resistance terms (Rac0, etc...)

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Table 1: bvdp: why are values different from the ones in Brook 1999a (Table 3) as units are the same?

Table 1: Psic1 and Psic2: what's the link between the unit in your article and the unit in Brook 1999a's (Table 3).

Table 1: what are the references for the rsmim values (I am used to much larger values for tropical forests (250s/m) and much lower values for crops (40 s/m))

Table 1: same question for zo (I am used to much larger values for forests: 2 to 4 meters)

page 1801 figure 3: why are lines interrupted in d? Specify period of averaging, and on the figures the type of canopy. Label also the axes (Hour, local?) (Deposition velocity cm/s)

A table that would recapitulate the nomenclature used (SR, etc...), and that would also include units would be helpful to the reader

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Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1777, 2003.