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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical note: The MESSy-submodel AIRSEA calculating the air-sea exchange of chemical species" *by* A. Pozzer et al.

Anonymous Referee #1

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The MESSY submodel AIRSEA is described in this technical note. The AIRSEA submodel calculates the atmosphere-ocean exchange of chemical species. In specific case studies the authors demonstrate the importance of calculating sea-air exchange. This technical note is well written and good structured. I suggest it for publication in ACP after major revisions, listed in the following.

General remarks:

My major concern is that the submodel is not detailed enough documented within this paper. It is not clear for which chemical compounds (except CO2 and acetone) the submodel can be used. Also, a reference to the assumed tracer specific values (molar volume at boiling point, Henry's Law coefficient, ...) is missing.

For some mechanisms different complex parameterizations are implemented (e.g. gas exchange including bubble bursting effects). A table summarizing what kind of parameterization are default and which have to be changed by the user would improve this documentation.

There are several parameterizations available for the piston velocity but implemented is only the one by Wanninkhof et al. (1992). Different parameterizations of the piston velocity result typically in very different flux estimates. It would improve this submodel, when also other common accepted parameterizations (Liss and Merlivat, 1986 and Nightingale et al. 2000) are implemented.

For the case studies the authors show differences between a simulation including AIRSEA and one without. In the abstract they state that differences can be up to 300%. These difference are for a single day in November. It is not clear whether this is an exceptional day or if this difference is observed e.g. throughout a year.

Specific comments:

Introduction:

... AIRSEA can be be easily extended to many tracers with only a few restrictions, for example, acids and basis with a pH-dependent solubility.

What kind of other restrictions? Please, be more specific.

Submodel description:

The salinity effect on the tracer's solubility is taken into account using the Setschenow equation. ... However, it is highly recommended to check this values with experimental data.

Is this implemented as default? Are there other parameterizations available? How uncertain is this parameterization. A more quantitative estimate would certainly help the user of this submodel interface.

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For Kw different estimated exist, ...

Why is only the Wanninkhof (1992) parameterization implemented and not the others (Liss and Merlivat, 1986; Nightingale, 2000). In the Messy submodel ONLEM the Liss and Merlivat (1986) parameterization is used to simulate the DMS sea-air exchange (Kerkweg et al., 2006). Shouldn't this be consistent.

Implementation:

The parameters specific for each tracer are provided via a namelist

It is not clear, whether these values are already implemented for some tracers or not. A table summarizing which tracers are implemented together with the specific parameters and the references, would be very helpful for the user.

Evaluation:

4.2. Transfer velocity and satellite measurements

... The differences between the application of Eq.7 and Eq 8 are quite consistent. The Wanninkhof (1992) parameterization (Eq. 7) predicts higher transfer velocities ....

In the Model description it is stated that bubbles (included in Eq. 8) enhance the transfer. Why does the Wanninkhof (1992) parameterization than lead to higher transfer velocities?

... however, the equatorial minimum is still reproduced.

Do you mean the equatorial minimum is simulated almost identical.

... This agreement between satellite observation and model simulation corroborates the accurate representation of the process by the submodel.

This sentence is a bit misleading. It should be clearly stated that these satellite climatologies are not derived from direct satellite measurements of the transfer velocities, but rather are calculated based on the same method as applied in this study applying

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the 10m wind speed retrieved from satellites. Therefore, the comparison shows only that the calculation of the transfer velocity is done similar as in the cited studies and that U10 and T are simulated within the ECHAM5 model comparable to the satellite retrieval. A difference, which should be mentioned here is the fact that the climatologies based on satellite retrieved wind speeds use monthly mean wind speeds. I suppose in your calculation the instantaneous wind speed is used. This can make quite a difference and should be mentioned. In addition, do you refer to the comparison with Carr et al. (2002) data? How different is this climatology from the Boutin and Etcheto (1997) one.

4.3 Meteor 55 ship cruise

... during Cruise 55 of the research ship Meteor

It would be helpful to have some more basic information about the ship cruise, like start date and end date and the frequency of acetone measurements. Are these measurements surface measurements.

... The resolution used is T42L90MA

Please, give more details as Joeckel et al. 2006 is only in preparation. It is not clear, which GCM for example is used. Is the simulation performed a nudged one or using observed SST?

... a constant concentration of 14 nmol/l was assumed.

on what is this based? In the abstract you state that the simulation of acetone are constrained with measured oceanic concentrations. Please, give a reference here.

Figures 6/7 show the distributions of point-by-point differences ..

Please, give also the number of total measurements and the averaged concentration for both the model and the observation. I have no idea what the averaged concentration of acetone is. Is 100pmol/mol a larger error?

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Figure 8 The figure caption should be: Example of the vertical acetone (CH3COCH3) profile, ...

Figure 9 shows the relative changes throughout the the troposphere during a single day,....

Why do you show only a single day and not an annual or seasonal mean.

... over the Atlantic ocean during this period the atmospheric mixing ratios generally decrease by up to 50

This is only for a particular day. Is this day on the low end or on the high end of the simulated differences? In the abstract you state: the simulation ... shows relative changes in the atmospheric surface layer mixing ratios over the Atlantic Ocean up to 300%. I assume that this values is also for the single day in November. Again, is this representative for the differences during e.g. a whole year?

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 8189, 2006.