Atmos. Chem. Phys. Discuss., 9, C12304–C12309, 2010
www.atmos-chem-phys-discuss.net/9/C12304/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosols in the tropical and subtropical UT/LS: in-situ measurements of submicron particle abundance and volatility" *by* S. Borrmann et al.

S. Borrmann et al.

stephan.borrmann@mpic.de

Received and published: 30 April 2010

Reply-letter to Reviews for the manuscript:

Aerosols in the tropical and subtropical UT/LS: In-situ measurements of submicron particle abundance and volatility, by S. Borrmann, D. Kunkel, R. Weigel, A. Minikin,T. Deshler, J. C. Wilson, J. Curtius, C. M. Volk, C. Homan, A. Ulanovsky, F. Ravegnani, S. Viciani, G. N. Shur, G. V. Belyaev, K. S. Law, and F. Cairo.

General remarks: We prepared a major revision of the manuscript. The main changes are enumerated below and in our reply to the individual reviewers we refer to these items:

(0.) We very much thank all three referees for their extraordinarily constructive comments, which caused us to very thoroughly revise the manuscript.

(1.) A new section (2.1) is included on the connection between the aerosol measurements and atmospheric dynamics. One additional figure with correlations between submicron particle data and trace gas (CO, N2O, O3) measurements is added and discussed (Figure 8 of the revised manuscript). For this we included four new co-authors and text/references on their instruments. (2.) In the meantime a number of relevant publications appeared or was submitted and we included 29 new references. (3.) In addition to the parameterization for the tropical profiles we supply now a second parameterization from the Figure 9 (of the revised ms) for the profiles in mid-latitudes. However this parameterization is given in terms of particle number concentrations instead of mixing ratios because of lack of adequate temperature data for several flights. (4.) In order to demonstrate the particle concentration maximum is indeed a maximum with decreases below and above we integrated the data from the DLR Falcon-20 into Figure 6 for altitude levels below 350 K.

Response to the Anonymous Referee #1:

Summary: We hope by including what is mentioned in General Remark (1.) the data are better placed into the atmospheric context.

Question 3; Are substantial conclusions reached ? Initially we had a much larger manuscript. With growing size we increasingly focused on the particle data, such that in the end all reference to the other (trace gas) data was left out. Now, for the revised version, we re-inserted this, condensed into the new Figure 8. It provides correlations with CO, N2O and ozone together with a brief discussion. (A short reference to old mid latitude measurements below the polar vortex after Pinatubo also is made in the graphs.) For Figure 8 it needs to be mentioned, that the instruments did not deliver data for all flights. For example the CO instrument was not always on board of “Geophysica”, and ozone was not measured during all transfer flights. The new sec-

ACPD

9, C12304–C12309, 2010

tion 2.1 was introduced, which –based on recently published or submitted literature- explains briefly the connection with: (1.) boundary layer influence through convective outflow, (2.) cross hemispheric transport, (3.) overshooting convection, (4.) isentropic mixing of extratropical stratospheric air, and (5.) cross subtropical tropopause transport. We think that not much more can be done without detailed modeling which is somewhat beyond the scope of this –already fairly long- paper. Of course, for consideration of the gas phase measurements we invited four more co-authors. Accordingly the manuscript grew in size (as did the number of references) although we shortened the text quite a bit. Finally, the measurements from the transfer flights in Figure 4 were comprehended into summarizing profiles for the mid-latitudes, sub-tropics, and tropics. For this the "Koeppen classification" of the geographical location for the airports of the intermediate landings and the main part of the flights was applied. This suggestion of the reviewer was quite useful as it demonstrates (much better than the individual data points previously did) how the profiles indeed differ in the transition from mid-lat to the tropics. A detailed comparison with the literature was left out because of the lack of observations and because the Brock et al., 1995, publication provides only a "summary-profile" termed as "extratropical" data. However, we hope these changes are considered as sufficient for addressing the major point raised by this reviewer.

Question 7: Credit to related work: See our General Remark #2 above. From the 28 new references 7 are from modeling (or trajectory analyses) and 3 pertain to tracer correlation and transport. This is limited, however, to literature concerning TTL processes and dynamics. We stayed away from reviewing the large body of literature with respect to stratospheric aerosols and only quote the SPARC assessment by Thomason and Peter, 2006, which contains the most important references.

Question 9: The abstract is too long: SB shortened the abstract. But the "net gain in shortness" is not so large because we included data from three more instruments for gas phase species.

Question 10: Structure and clarity: The COPAS part has been reduced by erasing a few

ACPD
9, C12304–C12309, 2010

sentences, but the instrument section itself was extended to properly introduce the CO, ozone and N2O instruments. We think the instrument part is essential for the credibility of the data. And because Reviewer #3 asked more questions about the specifics of COPAS we still have quite some text on it in the revised version. Concerning the criticism about the discussion of f we condensed and abbreviated the text significantly.

Question 11 and 12: Language: A thorough revision was done and hopefully most errors were found and removed.

Question 13: Mixing ratio vs. number concentration: Here we have a different opinion. From experience in field campaigns where one frequently tries to juxtapose the actual measurements of the day with literature data we find it quite useful to have profiles in terms of concentration AND mixing ratio. Unfortunately not for all vertical profiles of Figure 8 (now Figure 9 in the revised ms) and for all flight segments in Figure 2 we had trustworthy data from the ambient temperature measurement system. Since these are needed for the mixing ratios we stayed with concentration here. Also we would like to keep Figure 2 because it demonstrates the variability. We consider this as important for example in the context of the Heintzenberg et al., 2003, paper.

Question 13: Schematic diagram: Because there are already so many figures, we stayed away from a "cartoon" of the TTL. Instead we abbreviated and focused the TTL description in the introduction somewhat such that the readers should have a fairly clear picture in mind. If the editor asks us for this, we can of course prepare one. We did change Figure 4 along the reviewer's comment and comprehended the data into mid-latitude, sub-tropical, and tropical profiles (as mentioned above). However, we stayed away from reorganizing the plots in terms of altitude vs. latitude with color coded mixing ratios. For the experimenter's perspective we find the direct presentation of the vertical profiles better suited for comparison with other publications.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/9/C12304/2010/acpd-9-C12304-2010-

ACPD
9, C12304–C12309, 2010

supplement.pdf

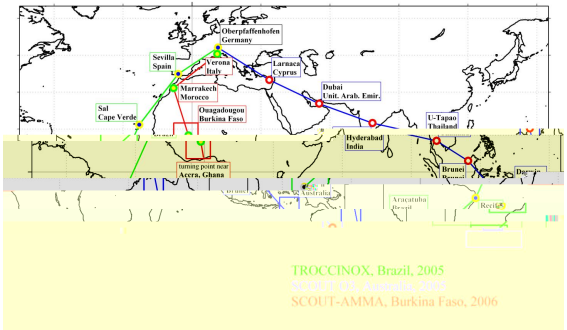
Interactive comment on Atmos. Chem. Phys. Discuss., 9, 24587, 2009.

ACPD

9, C12304–C12309, 2010

Interactive Comment

Figure 1 (FIGURES-100430)



1

Fig. 1.

ACPD
9, C12304–C12309, 2010

Interactive Comment