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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evidence for Asian dust effects from aerosol plume measurements during INTEX-B 2006 near Whistler, BC" *by* W. R. Leaitch et al.

W. R. Leaitch et al.

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General Responses We thank both reviewers for their time and comments, especially in view of the length of the paper. Since both reviewers have the same major concerns, we address those with one response.

One of the major concerns is that the data do not support the idea that SOA preferentially condensed on coarse particles during transport. We agree that there is no direct evidence of SOA on the coarse particles. About this, what we concluded was the following: "Asian plumes reaching Whistler, BC during the INTEX-B study were enhanced in sulphate and coarse particles. Fine particle organic material was not only reduced, but organic compounds were found attached to coarse particles in significant quantities.

Scavenging of organic particle precursors by dust nearer the sources is a possibility, and any SOA formation during transport from the source regions in Asia across the Pacific had to have been principally taken up on the coarse particles." We have modified the above conclusion to read "Asian plumes reaching Whistler, BC during the INTEX-B study were enhanced in sulphate and coarse particles. Fine particle organic material was not only reduced, but organic compounds were found attached to coarse particles in significant quantities. Suspension of dust with deposited organic material and scavenging of organic particle precursors by dust nearer the anthropogenic sources are possible explanations for the presence of the dust. Any SOA formation during transport from the source regions in Asia across the Pacific had to have been principally taken up on the coarse particles; although there is no direct evidence for significant SOA formation on any particles." Accordingly, we have modified the relevant section of the abstract as follows: "Asian plumes reaching Whistler, BC during the INTEX-B study were not only significantly reduced of fine particle organic material, but organic compounds were attached to coarse particles in significant quantities. Suspension of dust with deposited organic material and scavenging of organic materials by dust near anthropogenic sources are suggested, and if any secondary organic aerosol (SOA) was formed during transport from Asian source regions across the Pacific it was principally associated with the coarse particles." Further modifications have been made elsewhere in the text in consideration of this point.

The reviewers consider the statistics, especially those related to Figure 17 as weak and worrisome, but we clearly stated the significance level of these regressions. Both reviewers suggest that the relatively high r2 value in Fig 17 is determined by one point. To some degree this may have been stimulated by our reference to the removal of two points in Figure 13 (page 18548, lines 15-19), and we have removed these lines as it is incorrect to remove a point from a dataset just because it changes a correlation. To evaluate the effect of the single point on Figure 17, we systematically removed each individual point and calculated the coefficient of variance based on the remaining 7 points. For the sulphate curve, the r2 ranged from 0.09-0.74. For the organic curve, the

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r2 ranged from 0.09 to 0.55; removal of all but one point maintained the r2 at or above 0.3. The single points that lead to the r2 of 0.09 are different between the sulphate and organic datasets (i.e. removal of one point that lowers the correlation in one case increases the correlation in the other case). This is what would be expected for a small dataset, and it would be equally reasonable to argue that we should remove the single points that bring the r2 values down from 0.74 and from 0.55. Among other things, variability in this relationship could follow from differences in trajectories, in the origins of the coarse particles and in the source regions the aerosol passed over. We have added a sentence to make it clear that this relationship needs further investigation.

Both reviewers express concern about the significance and importance of the 37 individual particle analyses. First, these were not the only observations of organics in coarse particles; the observations from the Whistler Peak site indicate formate associated with the dust. However, those bulk observations from the Peak can not determine that the organic was on the dust particles as opposed to being an external mix, and that is one of the reasons that the 37 individual particle samples are important; they do demonstrate that organics existed on the dust particles. But another equally important reason for these samples is that they show a latitudinal difference suggesting that these observations were more likely towards the north than towards the south along the west coast of North America during INTEX-B.

Specific responses Reviewer #1 T and P; they are referenced to standard T and P, and this has been added to the text.

We address the first AMS question with the second such question at the top of p S9328.

We have changed the text to identify this as water soluble calcium etc.

We only measured fine particles ($<$1 um) through the aircraft intake and the airspeed was relatively low (50 m/s). We have added this to the experimental discussion. The FSSP300 was mounted under a wing and is non-intrusive.

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The comparisons of the AMS data are not just with the filter (and we point out the limitations with that comparison). There are two other more specific comparisons: with the Hi-Res AMS at the Peak (Figure 3), and with the PCASP (Figure 7). These address the reviewer’s concern about variability of the AMS during the flight. Simple summary statistics representing the differences of the comparisons in Figures 3 and 4 has been added to the text.

MSL is now defined in the text.

Line 20 - we are not certain which sentence is referred to here, but we have tried to clarify this.

Line 4 - changed

Line 17 - added

Lines 19-25 (Ion balance); Whether we expect calcium carbonate or not depends on how much there was to start with and how much gas-phase nitrogen, sulphur etc there was. Calcium carbonate was indicated in some of the individual particle analyses from the C-130 samples and certainly may have been present in the dust at its source. Carbonate was not one of the ions measured in the samples collected at Whistler.

Line 15 - fixed

Line 21 - corrected

Reviewer #2 1st full paragraph on p S11040 - The issue of sample statistics is discussed above. We agree with the reviewer that organics on the dust at the dust source point is a significant possibility, and we did allow for this in the original manuscript (line 552 of revised manuscript) although perhaps not as clearly as we should have. We now make this point again on lines 789-791, where we also include the Mayol-Bracero reference as suggested by the reviewer. Further, we make this point in the abstract and conclusions (as above).

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2nd full paragraph on p S11040 - We did not suggest a chemical mechanism because we did not suggest that SOA formation occurred. As above, we say that if it did, it would have to have been preferential to the coarse particles. As for the question of why we saw formate but not oxalate in the coarse particles at Whistler Peak, we do not have an answer for this either. We did find oxalate in the fine aerosol at Whistler Peak, but that could have been from regional sources also (Sun et al., ACPD). One difference that might be important is that at normal atmospheric temperatures formic acid has a higher vapour pressure than oxalic acid, but given the possible temperature histories and many other processes that could have occurred we could only offer very speculative suggestions to explain the formate vs. oxalate observations.

Section 2.2 - the speed has been added as above. James Allan's name has been corrected.

Section 2.3 - corrected

Section 3.1 - changed

Line 18 - fixed.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18531, 2008.