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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trans-Pacific dust events observed at Whistler, British Columbia during INTEX-B" *by* I. G. McKendry et al.

I. G. McKendry et al.

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We are grateful for the constructive and careful reviews by the three referees. Not only were they all positively disposed to our work, but they were remarkably consistent with respect to what was required to improve the paper. On that basis, we have made significant revisions to the text as well as to figures and tables. We have attempted to address all general and specific comments made and feel that the paper is much stronger as result.

In our opinion the most significant general issues raised by the reviewers were:

1. Why focus on only two of the events observed during the period and what chemical evidence was there that they were indeed dust events at Whistler? We have added an additional figure showing Calcium and Sulfate concentrations at Whistler during INTEX-

B. This provides compelling evidence that we are indeed dealing with dust events and secondly provides a rationale for examining only two events. i.e. they were of largest magnitude. We have provided some explanation of the weak event associated with April 24/25 dust storms in China.

2. The need for more chemical data to justify the identification of dust events: Again, calcium time series at Whistler have been added for the period (including a new figure). In addition more reference is made to other gaseous pollutants (e.g Ozone) as well as references to related INTEX-B papers in which these data are discussed in much more detail.

3. A more detailed analysis of the significance of the sulfate episodes: We agree that this is of importance. However, it is beyond the focus and scope of this paper. Furthermore this topic is addressed in much more detail in related papers by van Donkelaar et al. and Leaitch et al. 2008, both of which are referenced in this paper. We have made more explicit the connections to these papers.

4. Table 1: the table is poorly organized, Crater Lake is far from Whistler and there are legitimate questions about the comparability of the data. We agree – we have made extensive revisions to the table along the lines suggested as well as removing the rather qualitative categorization of events (low sulfate/high dust) which was admittedly somewhat problematic. With the addition of Whistler data (means etc) we feel that this comparison is now more robust. We note that we are reasonably comfortable with the comparability of the filter samples (˜24hrs). The reference to 48 hr samples in the original text was misleading and not applicable to the Moudi samples that are also presented in the revised version.

5. Why subsidence in southerly case when trajectory appears cyclonic: examination of the meteorology of the events shows this trajectory to lie between low pressure system off the coast of Oregon and inland ridge. Midway between these two systems the trajectory is subject to residual subsidence associated with the inland ridge but over

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time the trajectory has a cyclonic appearance.

6. The methods section is missing important information. The entire section has been redrafted along the lines suggested by the reviewers including the addition of material related to IMPROVE sites as well as the lidar.

7. Figures: some are redundant, some need improvement: Figure 1 redrafted to include all locations. The trajectory map is removed (redundant) and the calcium/sulfate at Crater lake is removed. The latter is replaced by more relevant figure of Ca and Sulfate at Whistler peak (Fig 2b). This latter Figure is important in justifying the choice of events described in this paper and to justify that they are indeed dust events. Figure 5 has been redrafted.

Some Specific responses: Simple changes related to references/typos etc were completed but are not recorded below

Reviewer 1's comments: - ozone is not a good tracer for anthropogenic/BL at Whistler.

- comment 1: this was a mistake, and it has been removed. From 2002-2005 there was a fog detector used to stop flows when the site was in cloud. however, it has not been used since 2005 and was not operational for INTEX-B.

- comments 2 and 3: the Method section is re-written to include more and corrected details.

- comment 4: Hysplit data removed as suggested

- comment 6: figure 2, also Leaitch et al 2008.

- comment 7: coarse particles with sulphate plume were evident throughout the April 22 to May 15 period. Dust emissions were evident from 24-25 April (Figure 3), and they probably reached the Whistler area about May 3-5. That particular period is not discussed here, but some results from that period are presented in Leaitch et al (2008). The May 15 event is consistent with the emissions from Taklamakan on May 7 and 8.

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-comment 8: a brief discussion of the meteorology is added

- comment 9: fine particles means in this sense everything that the AMS measures, which is mostly between 100 nm and 700 nm. The reference to the intensities of sulphate and dust have been clarified.

- comment 10: done.

- comment 11: "The fine particles above 3 km were also larger than those in the boundary layer." Larger is larger; it is defined by comparison of the particle $>$3km compared with those below 3km. The PCASP dist'n is shown in Leaitch et al. (2008). "Fine" is now defined ($<$ 1 um).

- comment 12: corrected.

-comments 15-21: The Crater lake data and table. As mentioned above this section has been significantly reworked to reflect all the comments made. Additional Whistler elemental data (Ca and SO4) is added and the rather qualitative classification of events is removed.

Comment 21: the conclusions we believe are a little vague. Howevr our goal was not to provide detailed meteorological explanation of the trans-Pacific processes affecting each event. Rather we focus on the events as seen at Whistler and compare them to other events documented on the West Coast.

Reviewer 2's comments:

- Figure 5: the legend is not properly labelled. The PCASP number cn is divided by 10, and the caption does not identify this. That has been corrected. Also, the comment about sulfate has been changed in response to this and another reviewer's comments.

- Page 10279, Methods - the methods section has been accordingly revised.

All other detailed comments are addressed as suggested

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Reviewer 3's comments:

- p. 10276, lines 8-10: there is no obvious connection of the dust event and the enhancement in fine organic material. Possible connections between dust and organics are discussed in Leaitch et al. (2008)

-p10278; We retain mention of WCB as used in the literature we have cited.

- re "Method, p.10279-10280"; the method section has been considerably revised. Also, there was a mistaken reference to the SMPS in the initial manuscript: the observations in Figure 2 are from the OPC rather than the SMPS. The SMPS at Whistler Peak did not function properly during INTEX-B, and unfortunately there are no valid data from that measurement. This is mentioned in the revised of the method section.

- p. 10280, lines 18-19: The discussion has been revised to address this point.

- p. 10281, lines 2-7: the two events chosen were the overall highest in terms of coarse particle number concentrations and calcium mass concentrations. We agree that the shift to fine particle dominance is unclear. This section has been re-written to reflect these changes.

- p. 10821, lines 18-20: the emissions of 24-25 April are mentioned now, and they probably did affect the west coast of Canada about May 3-5. That particular event is not discussed here, but results from that period are presented in Leaitch et al. (2008).

-p10281 Figure 8 removed

-p10282 Travel times – additional references (Holzer et al) are added and discussed.

- p. 10282, line 11: done

- p. 10282, lines 10-14: discussion added.

- p. 10282, lines 14-16: corrected.

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- p. 10282, line 20: We do not say that the increase in fine particle size is a result of dust.

- p. 10283, lines 4-8: the increase in sulphate is evident in Fig. 5. Increases in ozone, as well as sulphate, are shown in Leaitch et al. (2008).

- p. 10284, lines 6-11: we don't provide evidence of a direct connection of the organic plume with Asian transport. There is an increase in coarse particles, but it is evident at the surface as well. Calcium was relatively low. We don't consider this to be a "dust" event.

- p. 10284, lines 25-28: Whistler monthly geometeric means added.

-p10284 New Map added

- p. 10285, lines 14-15: done.

-p10285: Figure 9 is removed.

- p. 10286, lines 14-17: we have tried to clarify this.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10275, 2008.

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