Atmos. Chem. Phys. Discuss., 9, C1315–C1319, 2009
www.atmos-chem-phys-discuss.net/9/C1315/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of heterogeneous reactions between Asian pollution and mineral dust over the Eastern North Pacific during INTEX-B" *by* C. S. McNaughton et al.

J. Kelly (Referee)

jkelly@arb.ca.gov

Received and published: 28 May 2009

McNaughton et al. have conducted a thorough evaluation of airborne measurements from INTEX-B and MILAGRO field campaigns related to heterogeneous reactions on dust particles. Studies of this type are often hampered by an incomplete dataset, but McNaughton et al. incorporate a wide range of particle, trace gas, and optical measurements to present a relatively clear picture of the processing of Asian dust particles during long-range transport. Also, the authors do a nice job of identifying modeling approaches that are inconsistent with observations and highlighting key focus areas for modelers. The article is suitable for ACP/ACPD, and I recommend publication

after the issues mentioned below are addressed.

General Comments:

1. The log-normal fits to the measured size distributions do a poor job of representing the features of the coarse-particle volume distributions (Fig. 1 and 3). Multiple coarse modes (or, analogously, multiple coarse sections) appear to be necessary to adequately characterize the particle size distribution. Although the log-normal fits conveniently summarize the size-distribution data, they could lead to significant errors if heavily relied upon by modelers. For instance, I would expect the transport and deposition characteristics of the measured size distributions to differ considerably from those of the log-normal fits.

2. The authors conclude that the presence of Asian dust led to a 25 percent smaller number median diameter for the accumulation mode. Such a change in diameter would have significant implications for light scattering by particles. However, I was not convinced that coarse dust necessarily caused a change in the accumulation-mode median diameter. The argument in favor of the causal link appears to be that the accumulation-mode median diameters are smaller in air samples with high dust concentration and that dust particles contain components like nitrate and sulfate, which otherwise might be present in accumulation-mode particles. Although a causal link may exist, it is also possible that accumulation-mode particles had smaller diameters in dust than non-dust cases because of different origins and histories of the air samples. Also, in several places, the authors refer to competition between supermicrometer dust and submicrometer particles for condensing compounds. The concept of surface-area based competition is reasonable for a condensing compound like sulfuric acid, which is effectively non-volatile, but it does not always hold for nitric acid, which is semi-volatile. If fine-mode particles are acidic, then nitric acid may largely exist in the gas phase rather than condense on fine particles in the absence of carbonate-containing dust. In this case, coarse particles would not acquire nitrate at the expense of fine particles, and so the diameters of fine particles would not be strongly influenced by condensation

ACPD

9, C1315–C1319, 2009

of nitric acid on coarse dust.

3. The authors should clarify their use of the terms *internally mixed* and *externally mixed*. These terms (and others such as *source-oriented external mixtures*) have specific connotations in the modeling community that differ slightly from their usage here. Usage of terms like *muticomponent mixture* would be preferable where possible.

4. Are the source regions for the Hawaii and Alaska measurements roughly the same? I am wondering if the authors have conducted any back trajectory or other analysis to estimate air parcel histories for the different measurements. If so, do differences or similarities in measurements in HI and AK correspond with differences or similarities in air parcel history?

5. Evidence of HCl uptake by calcite-containing dust particles has been reported in previous studies. Did the authors find evidence of HCl reactions with dust components in the present study?

Specific Comments:
p. 8474, line 7: The model we used in the Kelly et al. (2007) study did not treat collisional processes so we could not draw conclusions about rainfall suppression. For high concentrations of reacted dust particles, we found that water competition between fine particles and coarse dust particles could reduce the overall number of activated particles compared to a non-dust scenario for certain updraft velocities.

p. 8478, lines 7-8: Is the assumption of ammonium sulfate composition and refractive index supported by the composition and scattering/absorption measurements?

p. 8478, lines 8-14: How important are these optical-to-geometric size adjustments? Does the adjustment of unheated size distributions but not heated ones significantly influence the interpretation of size differences between heated and unheated distributions?

p. 8478, lines 15-18: Here it is stated that inlet passing efficiencies are poor for par-

ACPD
9, C1315–C1319, 2009

ticles greater than 8 microns, but the next page suggests that the 50 percent passing efficiency diameters are as low as 3 microns. Please clarify this apparent discrepancy.

p. 8479, line 22: Please give the full name for PSAP the first time it is used.

p. 8480, line 18: *a* can be removed.

p. 8481, lines 8-9: Can you give a sense of the error in the size-distribution measurements based on the comparison and averaging of the overlapping portions of distributions measured by different instruments?

p. 8484, lines 14-15: Has volume closure been similarly evaluated?

p. 8485, lines 8-9: Is the reduction in number concentration upon heating directly attributable to secondary particles? I would think that some primary particles would evaporate upon heating. Also, are there differences in particle losses in instruments for cases of heating and non-heating that could explain part of the difference in number concentration?

p. 8485 line 24 and p. 8486 line 3: Do the values 0.90 and 0.91 refer to the same measurement?

p. 8486 lines 14-15: Based on Table 3, it looks to me like the values for HI and AK are more comparable than those for Mexico and AK for the mixed aerosol case.

p. 8488, line 25-26. Revise the fragment *And although...*

p. 8491, line 22: Remove the first instance of *are*

p. 8497, line 10: Referring to *aerosol hygroscopicity* might be confusing here because water uptake is directly linked to size. Is *aerosol composition* more appropriate?

p. 8498, line 28: Should *Fig. 8* be *Fig 18*?

p. 8533 p. 8534: Please indicate in the figure legends that these plots refer to the 11-yr MLO record.

ACPD
9, C1315–C1319, 2009

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 8469, 2009.

ACPD

9, C1315–C1319, 2009

Interactive Comment