

Manuscript Review
The mixing state of carbonaceous aerosol particles in Northern and Southern California measured during CARES and CalNex 2010

J. F. Cahill et al

The study reported in this paper evaluates the relationship between particle mixing state, particle sources and location in California. This is a concise paper with results that are clearly presented showing the distinct differences in mixing state related to the southern (Los Angeles) and northern (Sacramento) regions California. Although there is little discussion of the actual processes involved that lead to the various mixing states, without a chemical transport model, it would be difficult to do more than just hypothesize so these data will provide solid information to which model results can be compared.

In addition to a few points of clarification that I would like the authors to include in a revised version, there are two additional analysis details that I strongly recommend should be part of the final manuscript.

The authors never provide much information on the size dependency of the mixing state. Given that there are more than 75,000 particles analyzed in the southern California data set and 60,000 particles from the northern California flights, surely there are sufficient number of particles to show the mixing state as a function of size. This does not have to be stratified in that many bins, but given that the instrument should capture a large portion of the accumulation mode and at least part of the coarse mode, it might at least shed some light on the processes that led to the various internal mixtures.

The second detail that should be addressed has to do with the temporal evolution of the mixing states during the day, particularly during the morning flights. Although little is said about photochemical processes that are likely very important in the growth and mixing of the particles, the morning flights that started at 8 am in the morning and extended until around noon, all in the same general area, offer the opportunity to see if the particle chemistry is changing as the boundary layer grows and the sun rises. Likewise, why not also compare the average properties in the morning with those in the afternoon.

Additional Comments

The term soot needs defining at the very beginning since I started reading thinking that the authors were talking about the mixture of EC and OC such as is usually the case when talking about soot; however, I later realized that they were using soot as another name for elemental carbon. This was rather confusing throughout.

The detection limits for mass need defining. At one point reference is made to the fact that "soot" is below the detection limit of the mass spectrometer when it is freshly

emitted, but this was referring to its aerodynamic diameter. The paper goes on to explain that the soot grows into the size range of the instrument but what isn't clear to me is the minimum mass that can be detected. The growth of the soot is not the soot itself actually growing, if it is indeed EC (unless it is growth by coagulation with other EC particle), but is soot that is acquiring a coating of OC or some inorganic. If the core of the particle is EC, but its mass is below the detection limit of the mass spectrometer, then a fair amount of soot mass is possibly being missed.

Nothing is said about the counting statistics and how representative these measurements are. There are over 75,000 particles in the one case and 60,000 particles in the other. This sounds like a lot, but given the approximately 115,000 seconds of sampling time in the 75,000 particle case (8 flights at approximately 4 hours per flight) and 288,000 seconds in the 60,000 particle case, this works out to be 7 particles and 2 particles per kilometer, respectively, assuming a cruise velocity of 100 ms^{-1} . This is an uncertainty that needs addressing with respect to how representative the data are.

The other uncertainty not addressed concerns the particle losses in the inlet system. Is it isokinetic, is there dynamic heating that would lead to volatilization, how long is the distance between inlet and spectrometer, etc.?

Does the TSI 3010 really have a lower cut-size of 10 nm? I thought it is usually reported as $> 20 \text{ nm}$.