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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Characteristics of bacterial community in fog water at Mt. Tai: similarity and disparity under polluted and non-polluted fog episodes" *by* Min Wei et al.

**Anonymous Referee #3**

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Min et al examine bacteria present in cloud water samples collected at Mt. Tai, China. They use a variety of techniques to examine the community composition of bacteria in the samples and attempt to assess differences as a function of a variety of environmental parameters, especially fine particle concentration levels. While the dataset is interesting and the work novel, I have numerous concerns about the work and its presentation.

Major comments:

1. The authors never make it very clear why they are examining bacteria in clouds (they are looking at clouds, not fog – see below). They talk about the importance of interaction with fog, but don't clarify why such interactions are important. They speak



about deposition in clouds, but why is this really important if such bacteria would be deposited anyway by wet or dry processes? Bacteria in cloud drops get there through scavenging of aerosol particles that are either themselves bacteria or have bacteria attached. Why, then, is it important to look at bacteria in cloud water? Why not look at them directly in PM2.5 samples? This would allow a much larger dataset to be examined, which would greatly help statistical analyses of relationships with environmental variables. For example, if one is interested in examining changes in bacterial populations with PM2.5 levels, it would be much more straightforward to look at bacteria directly in PM2.5.

2. One might be interested in examining how cloud processing affects bacteria. For example, do they differentially scavenge and deposit bacteria from a certain subset of aerosol particles? Do the bacteria reproduce in clouds as suggested by Fuzzi? Does interaction with fogs alter the viability of bacteria in some way. The authors do not examine any such questions that would be very relevant to bacteria in fog.

3. I have many concerns about the way in which the authors assess differences in bacteria in fog between polluted and nonpolluted conditions. Chief among these is their classification of clean and polluted fog episodes. If one examines the back-trajectories, one finds very similar transport patterns in some cases for polluted and non-polluted cases. Furthermore, one can even find sequential samples within a single fog episode that are classified as clean and as polluted. Episode 7 is a good example, where sample 1 is classified as polluted, sample 2 is clean, and sample 3 again polluted. As shown in Figure 7, these samples all have essentially the same transport pattern. It is completely unreasonable to make such a separation based on PM2.5 concentration, especially since the measured PM2.5 in fog does not represent the actual fine particle load upon which the cloud formed since many particles are scavenged in fog and not, therefore, measured by the PM2.5 monitor inside a cloud.

4. Further issues regarding the author's classification of fog samples are apparent in the various attempts to statistically compare bacterial composition across fog samples.

Looking at fog episode 7 again, as one example, one finds samples 1, 2, and 3 end up in very different clusters in Fig. 2. Likewise sequential "clean samples" 1-2 and 1-3 cluster very differently. These observations suggest to me that the author's approach may not be getting at real differences driving bacterial populations.

5. The manuscript lacks adequate description of sampling methodology. One important issue when measuring cloud composition is how the cloud collector is cleaned. This is particularly true for biological sample characterization as attempted here. How was the cloud collector cleaned? Was it sterilized? Was it cleaned just prior to each cloud event? Was the collector kept closed prior to cloud interception to ensure it did not become contaminated? Were cloud collector blanks taken? What bacteria were found in blanks? How do these relate to bacteria observed in samples? Without such information one cannt trust the measured bacteria to have come only from the cloud and not from the sampler.

6. The manuscript is not well written. Grammar and syntax are very poor. At many points the authors' use of English language makes it difficult for the reader to even understand their meaning. Looking closely just at the abstract I counted more than 20 corrections needed to the text and several instances where the authors' meaning was unclear. I did look at some of the manuscript changes recently posted by the authors in response to other reviewer comments and found some improvements to the manuscript text but still observed many problems with the language.

Minor comments:

A. The cloud collector is not properly described. A CASCC2 has a flow rate below 5 m3/min. The 24 m3/min flow rate specified corresponds to a CASCC collector. See collector descirptions and flow rates in Demoz et al. (1996) On the Caltech Active Strand Cloudwater Collectors. Atmos. Res., 41, 47-62.

B. More information needs to be provided about the trajectory calculations. What heights were used as trajectory endpoints?



C. More information should be given about sample handling. The biological samples should have been frozen, not refrigerated at 4 C. How much sample was collected? How much was used in the DNA workup?

D. Some of the fog collection periods were quite long – up to 9 hrs. Was the fog continuously present during this entire period? If not, collected fog water could evaporate and aerosol particles could be captured on collector surfaces, contaminating the fog sample.

E. It would be helpful to include additional information about the fog samples? At a minimum, the authors should include standard parameters such as cloud liquid water content during the sample, concentrations of major ions (which would provide greater insight into pollution levels), and cloud water total organic carbon.

F. The water samples collected atop Mt. Tai in summer are almost certainly associated with intercepted clouds. I suggest the authors not refer to these as fogs.

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