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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of interannual variations in aerosol particle sources on orographic precipitation over California's Central Sierra Nevada" *by* J. M. Creamean et al.

Anonymous Referee #3

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The study of Creamean et al. "Impact of interannual variations in aerosol particle sources on orographic precipitation over California's Central Sierra Nevada investigates the variability and associated impacts of different aerosol sources on precipitation in the California Sierra Nevada. The offline analysis of precipitation samples focuses on single-particle mass spectrometry and includes remote sensing and surface meteorology measurements for interpretation.

I recommend this paper for acceptance in "Atmospheric Chemistry and Physics" as it provides useful information towards the understanding of aerosol-cloud interactions and precipitation formation from an experimental perspective.

However, comparing the conclusions drawn from the results to those of the accompanying and regularly cited studies of Ault et al., 2011 and Creamean et al., 2013, 2014a – the additional gain in knowledge should be worked out more precisely. It should be differentiated what data was directly taken from previous work, what data was reanalyzed and exactly what data is new. This would help to better distinguish between new conclusions and conclusions already drawn from previous work.

One particular concern relates to the classification of the particle types into a) dust, b) mixed dust, c) bio, and d) biomass. To my knowledge the identification of biomass burning particles by single particle MS is pretty straight forward, whereas the identification of pure biological material and/or biological material on dust (= soil dust?) and/or pure dust is rather complicated. Therefore I wonder if the datasets of all three years were treated consistently concerning the classification process? This is important and might bias the interpretation since the difference in IN properties (activation temperature) and thus the impact on precipitation formation between pure dust and soil dust should be rather small compared to pure dust and pure biological particles. Did the authors grouped the particles in a similar manner, and were the mass spectra of the dust/biological types comparable? In the current study, the mixture of biological material with dust is combined to dust (p940, l22ff), and in a next step the categories dust and bio are combined to an IN-active fraction. Was this done in a similar way in the previous studies, and what is the fraction of the mixed dust/bio type in the dust class?

Figure 2 shows the representative mass spectra for each of the precipitation residue types. Are these average mass spectra after classification (i.e. after application a clustering scheme), or a these representative single particle mass spectra? How would a mixed dust/bio particle look like?

Further remarks:

- P935, l7: The IN population is influenced by dust rather than the IN itself as the dust most likely represents the IN.

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- P935, l10: I wonder if the Pratt et al., 2009 citation is the correct one in terms of showing that bio IN a more effective than dust IN. Isn't it rather a case study of a mixed-phase cloud that included more bio residuals than other types? Can the authors draw the cited conclusion from this result?

- P936, l24ff: The study investigates the impact of different aerosol sources on precipitation. In this context, I wonder if besides the precipitation samples in-situ ATOFMS measurements were made of the interstitial aerosol and the total aerosol during non-precipitation periods – and if yes, how do those compare to the residual. This analysis might be beyond the scope of this paper, but it's an interesting scientific question from the atmospheric perspective but might also help to understand some of the caveats associated with the aerosolization process (p939, l14ff). These caveats, by the way, should be repeated briefly as the analytical method and its potential errors are important for this paper.

- P940, l24: "possibly" is a vague word. Can the authors be more precise how likely the occurrence of soil dust is in comparison to the production of agglomerates during aerosolization?

- P942, l20: "potentially" and "we demonstrate" are two rather conflicting expressions. How assured are the results? Do the authors demonstrate how ... could potentially influence..., or do they demonstrate how they influenced ...

- Section 3.2.1 Check figure numbering

- P946, l17ff: this sentence is a bit unclear. Did the authors conclude that the bio residues induce the formation of ice precipitation due to the corresponding correlation between bio residues and precip? Can this be done without any doubt taking the aerosolization process into consideration, the small number of sample residues analyzed and the typically low concentration of IN in the atmosphere. One might have to be more careful here.

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- Section 5: the conclusions contain to a large fraction already published results and a rather long outlook. Please emphasize the contribution of this study in more detail.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 931, 2015.