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Interactive comment on "Rainfall feedback via persistent effects on bioaerosols" *by* E. K. Bigg et al.

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This interesting paper addresses the question of potential feedbacks between precipitation and the land surface via the emission of bioaerosols that may affect cloud microphysics by acting as ice nuclei (IN) or giant cloud condensation nuclei (GCCN). The stimulated emission of bioparticles and of IN due to rain has been reported in the literature. The authors present a novel and original analysis of extensive old measurements of ice nucleus number concentration over Australia from the 1960ies and of more than 90 years of rainfall measurements across the continent.

The underlying assumption is, that any significant event of precipitation above a certain threshold (termed a 'key day') that will cause a large spontaneous emission of biologi-

cal IN and thus a peak in the IN time series will cause an asymmetry in the time series of IN number concentration centered around the key day, with the IN number on a certain day after the key day being higher than that on the same number of days before the key day. As a measure of asymmetry of a parameter during a precipitation event the cumulated differences between the values on days after key day and the corresponding values on the same number of days before the key day are used. If furthermore the peak of IN number concentration would feed back to the precipitation intensity and frequency, such a signal (an asymmetry) in the IN time series would then propagate into the precipitation time series.

The paper elaborates convincingly that IN concentrations are elevated in the wake of precipitation events, as well as that precipitation (quantity and frequency) following a heavy rain event is increased relative to the days preceding the event. The results support the idea of biological feedbacks in the precipitation-land surface-system. In the historical rainfall records the authors also detect the effects of industrialization and of changing land use around the 1960's, and explain it plausibly by changing particle emissions. The evidence presented here is throughout circumstantial, as no single biological particle, biological IN or pollution particle was identified. However I agree with the authors that their findings open exciting new questions and motivates more direct investigations into the mechanisms proposed here. The manuscript is important, is structured well, and overall is crafted well. I recommend publication in ACP, after a few specific points raised below are addressed.

Specific comments:

1. Is the title "Rainfall feedback via persistent effects on bioaerosols" appropriate? I wonder if circumstantial evidence – i.e. not having measured a single bioparticle - can justify this title ? Why not change the title into a question ?

2. The description of the method could be improved. During the first reading I found it difficult to understand the idea of the data manipulation without having consulted the

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companion paper by Soubeyrand et al (2014), where the method is nicely described. A mathematical formulation and/or a graph in the method section would probably help.

3. P. 25513, L.9: I agree that "the extent of this agreement suggests that IN are an important factor in what amounts to a rainfall feedback effect", but likewise both IN and precipitation might also be affected by the same (admittedly unknown) mechanism ?

4. The discussion of the anthropogenic changes (Figures 6 and 7) in Chapter 4.4 is somewhat confusing, because in the Figures you present the data as pre-Fhν/post-Fhν, ratio, but in the text (P. 25514, L.8 and L.23) you obviously discuss the change of Fhν itself with time. You say in L.9 : "...pre-Fhν/post-Fhν decreased downwind from the power complex ..." , but Fig. 6 shows that it increased downwind of the power plant. A similar case is on P 25514, L24:, where you describe in the text "... a depressing effect on pre-Fhν/post-Fhν " but Fig. 7 shows an increase of pre-Fhν/post-Fhν downwind of the Muja station. Moreover, the reader is already during the presentation of Figs. 6/7 (L8 and following lines) waiting for some explanation of what she/he sees now (which then comes later in the discussion in 5.1 and .2). One sentence of explanation (or a reference to 5.1/2) would probably help.

5. P25518, L16: The 40 Mt yr-1 SO2-emission reported for the Melbourne aluminium smelter are hard to believe. This would be around 40% of the global anthropogenic SO2-emission at that time (see Seinfeld and Pandis, 1998, Fig. 2.1). Please check.

Technical points

P. 25513 , Chpt. 4.3 Results: add reference to (Fig.1) in the first sentence.

P. 25512, L1-5 and Figs. 4,5: Is Fν dimensionless, if yes, say so, if not add dimensions in Text and Figures.

Chapters 5.1 and 5.2: it should be stated somewhere that you are discussing Figure 6 and Figure 7

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Interactive Comment