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Comment on egusphere-2022-865

Anonymous Referee #3

Referee comment on "Rain process models and convergence to point processes" by Scott Hottovy and Samuel N. Stechmann, EGU sphere,
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Review of the paper "Rain process models and convergence to point processes"
by Scott Hottovy and Samuel N. Stechmann

This paper establishes a novel connection between a widely used empirical point process model for rainfall time and stochastic model for moisture evolution. The authors prove that the moisture model converges to a point process for large rain rates. This is done by using formal asymptotic expansion of the Fokker-Planck equation, as well as, rigorous convergence analysis.

Although, I am not an expert on the rigorous analysis and because of this cannot verify the corresponding part (Sec. 3.2, 3.3) of the paper, I agree with the authors that the demonstrated connection is very interesting and revealing. However, the authors should be much more specific about the possible applications of their results in the context of constructing physically constrained models of precipitation. For example, is it possible to make statements about the limitations of existing purely empirical point process models? In the concluding section the authors mention error rates for point processes. Can such estimates be given in the revised paper using some observational data? Similar estimates will demonstrate the potential of the results to the NPG-readers. Alternatively, the authors might consider submitting the paper to a more mathematical journal in order to access the mathematical interested readers.

Some additional major comments:

In eq. 1 the water vapor mass mixing ratio, q , can become negative

which is clearly non-physical. Can the approach be modified to account for positive values of q only? If not, this limitation should be discussed in the paper.

Eq. 2 and line 97. What are the correct values for the rain process $\sigma(t)$: $\{0, 1\}$ or $\{0, r/\epsilon\}$? Both values can be found at various places in the paper (e.g. equation 8), but since σ converges to a Delta function, r/ϵ should be the correct one.

Fig.2. What value for ϵ was used for Fig.2a and Fig2.b? Axis tick values and labels are missing. In order to prove convergence large raining rates are assumed; is this large compared to the moistening rate m ? Is ϵ defined as m/r ? Can you give an estimate of ϵ from real data? What rain and moistening rates are used in other models, or what are the corresponding dry and rain event duration τ^d and τ^r , respectively?