



## Enhancing the Physical Significance of Rainfall Breakpoints through Two-dimensional Video Distrometer Data

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The temporal resolution of any rainfall model limits the degree to which it can physically represent the rainfall process. The recently developed hidden semi-Markov model (HSMM) of rainfall is a statistical model based on breakpoint data in which the progression of rainfall is well-approximated by a succession of periods with steady rainrates. These periods are not of any fixed length, such as an hour, but can vary from being sub-minute for brief heavy showers to being many days for the dry period between events. Since the breakpoint periods have a duration precision of the order of seconds, the HSMM can follow changes at that timescale and so provide a physical representation of rainfall. This inference fails if the breakpoint data itself has no physical significance which raises the question concerning what occurs at a breakpoint to cause a sudden change in the rainrate. The hypothesis advanced was that a breakpoint occurs at a change in the (rain)drop size distribution (DSD) when the rate of rainfall also changes. The Wilcoxon statistic can be used to test for differences in distribution between two samples and time series of this statistic were extracted from data collected by the two-dimensional video distrometer (2DVD) on the size, shape, speed and timing of individual raindrops. Changes in the DSD were located at significant values of the Wilcoxon statistic and these locations compared to those of the breakpoints extracted from the same datasets. Over the 96 daily datasets, the median time gap between a significant Wilcoxon and a breakpoint was about 30 s and Monte Carlo methods showed that for nearly half of the datasets the median time gaps would only be smaller for 1% of all random re-distributions of the breakpoints. Thus the overall degree of the match between the significant Wilcoxon statistics and the breakpoints occurring by chance is negligible and the hypothesis that breakpoints occur at DSD changes acceptable.