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Comparison of paired observations from a tipping-bucket and a drop counting gauge in a monsoon driven tropical rainfall regime

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The Hong Kong Observatory is in charge of managing meteorological instruments, including rain gauges, for the operational observing network in Hong Kong. There are over 100 rain gauges over Hong Kong. The rainfall data are recorded at a resolution of 1 minute. Current developments aim at improving the measurement of rainfall intensity, especially when rainfall rates of several hundreds of mm/hour can be observed in the summer monsoonal rain events or tropical cyclones. Tipping bucket rain gauges are mostly used, although the accuracy of this kind of rain gauge deteriorates quite rapidly with increasing rainfall rate in the absence of proper calibration.
At the Hong Kong international airport two kind of rain gauges are installed, a tipping-bucket and a catching type drop counting gauge. The latter instrument is manufactured by Ogawa Seiki Co. Ltd (Japan). The instrument is designed as a high-sensitivity drop counter type rainfall counter. This instrument is micro-computerized to execute data processing in the online mode. It displays the precipitation and drop count together with the time at once. The Observatory is currently implementing new automatic correction algorithms for the drop counting rain gauges in order to comply with the WMO recommendations about the accuracy of rain intensity measurements. The tipping bucket instrument is manufactured by Casella with a resolution of 0.5 mm.
Thorough analysis and discussion of a series of paired measurements performed over a long term period at the resolution of 1 minute are presented. The variability of the deviations observed and their distribution with respect to rainfall intensity, intermittency, rainfall variation, and other ancillary meteorological variables measured at the same site (e.g. wind velocity, humidity, pressure, etc.) is investigated. The paper also reports the results of the laboratory tests performed to allow correcting the drop counting rain gauges, so as to make them compliant with the specifications of the World Meteorological Organisation (WMO) at one minute time resolution for Rainfall Intensity (RI) measurements. These tests were limited to the steady state conditions, with known and constant flow rates provided to the instrument at various reference intensities for a sufficient period of time, in order to compare the measures provided by the gauge with the reference figures provided by a suitable steady flow generation device (which is known as dynamic calibration). Dynamic calibration of the rain gauges was performed according to the WMO specifications.