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Rainfall Intensity Comparisons from Adjacent 6-Hour and 24-Hour Recording Rain Gages[1]

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Abstract. On the Walnut Gulch experimental watershed near Tombstone, Arizona, precipitation intensities at four locations were measured with adjacent recording rain gages having 6-hour per revolution and 24-hour per revolution time scales. Maximum intensities determined from the 6-hour gage records were found to be significantly greater than intensities determined from the 24-hour gage records for intervals up to 10 minutes. (Key words. Hydrology; precipitation)

Short-time interval rainfall intensities are significant in the study of rainfall-runoff relationships on small watersheds. Rainfall amounts for intervals of less than 10 minutes are difficult to read accurately from the charts of 24-hour recording cycle, weighing-type rain gages. In 1960, four widely separated sites were arbitrarily selected on the Walnut Gulch Experimental Watershed in southeastern Arizona for installation of adjacent 6-hour and 24-hour recording rain gages (about 2 feet apart), so that comparisons might be made of the precipitation intensities as derived from the records from the two types of gages. The maximum 2-, 5-, 10-, and 15-minute intensities for all thunderstorms exceeding 0.25-inch total rainfall were compared for the 4-year period 1960 through 1963. (See Figure 1.)

Rainfall intensities were determined after a meticulous reading of the recorder traces. Time adjustments were applied to the traces if skewness was detected. (The pen travel check usually made when the charts were removed revealed that in some instances the pen in sweeping across the chart did not travel exactly along the time lines.) Similar errors have been observed by the United States Weather Bureau [*U. S. Weather Bureau,* 1964], and time adjustments were made in much the same manner. The recorded amounts were also checked by dumping the water collected in the recording gage into the measuring tube of a standard rain gage, and appropriate adjustments were made. Necessary corrections were easily accomplished in transferring the data to punch cards with the chart reader used [*Osborn,* 1963]. The maximum intensities for the various time intervals were then computed for each event.

Two factors contribute to the higher and more nearly correct short-duration intensity values derived from the 6-hour records as opposed to the 24-hour records. First, because the time scale on the 6-hour record is 4 times larger than the time scale on the 24-hour record, inflection points are much easier to read. These inflection points (representing changes in rainfall intensity) define the true intensities. The process of converting from analog to digital values tends to 'smooth' the data more from the 24-hour records than from the 6-hour records.

The second error results from skewness of the charts on the rain-gage chart drive drum. In some cases this skewness may be random. However, on the Walnut Gulch watershed for three different types of recording rain gages the skew was in a negative direction about 80% of the time. That is, an instantaneous trace, when the chart is in place in the gage, indicates a later time reading at the top than at the bottom of the chart. In effect, the chart indicates that the rain spreads out over a longer than actual period of time, and the apparent intensity is reduced. However, with the expanded scale of the 6-hour chart, this skew error becomes almost negligible.

The results indicated that, on the average, 2-, 5-, 10-, and 15-minute intensities from the 24-hour gages were 13, 6, 5.5, and 2% low, as com-

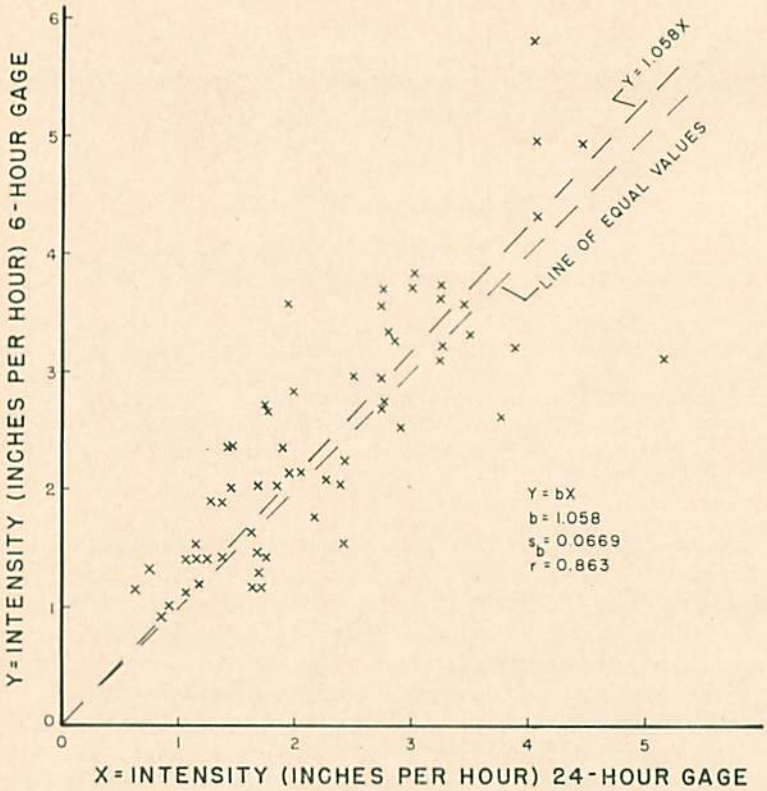

Fig. 1. Comparison of maximum 5-minute precipitation intensities from adjacent 6- and 24-hour recording rain gages.

TABLE 1.

Maximum Intensities	Average Difference, %	s^2	't'	Level of Significance*, %
2-minute	12.8	0.792	+4.00	0.1
5-minute	5.8	0.349	+2.86	1.00
10-minute	5.5	0.093	+2.75	1.00
15-minute	1.9	0.048	+1.43	20.00

* 58 degrees of freedom.

pared with corresponding intensities from the 6-hour gages.

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