Thresholds for runoff generation in ephemeral streams with varying morphology in the Sonoran Desert in Arizona, USA

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Abstract. In ephemeral streams, infrequent surface flow can be the main source of moisture that sustains plants throughout long dry periods. The objective of this research is to determine precipitation thresholds necessary for runoff generation in ephemeral stream channels with different stream morphologies. Two watersheds on the Yuma Proving Grounds (YPG) in the Sonoran Desert near Yuma, Arizona were instrumented with eight tipping bucket rain gauges to monitor precipitation. To measure runoff, 18 pressure transducers were placed in the channel beds of five different channel types with distinct morphology and contributing areas ranging from 0.0018 Km^2 to 225 Km^2. Precipitation event intensities and magnitudes were compared to the record of runoff events to determine possible thresholds in rainfall intensity and magnitude for runoff generation in the different channel types. Over approximately two years of data collection, between 13-92 rain events were recorded at the rain gauge sites. Stream types with bedrock channels and small watershed areas between 0.0046 Km^2 and 0.093 Km^2 produced runoff during events where the peak 30-minute precipitation intensity exceeded approximately 10 mm/hr. Of the precipitation events recorded at these sites, 18 percent of the events produced flow. Streams incised into bedrock with some alluvium fill in channel beds produced runoff when the 30-minute peak intensity during a rain event was greater than 20 mm/hr. Contributing areas for these sites were 0.83 Km^2 to 2.2 Km^2, and six percent of precipitation events at these sites produced flow. Precipitation thresholds for runoff generation in streams with larger contributing areas (3 Km^2 to 225 Km^2) were not clearly defined due to the influences of variable precipitation in upstream tributaries. Because of transmission losses of streamflow through channel bed alluvium, stream types with the least amount of alluvium in their channel and the highest percent of low permeable surfaces in their watershed produced the most frequent runoff with the lowest precipitation intensity and magnitude thresholds for runoff generation.