

Effects of Multiyear Precipitation Variations on Watershed Runoff and Sediment Yield

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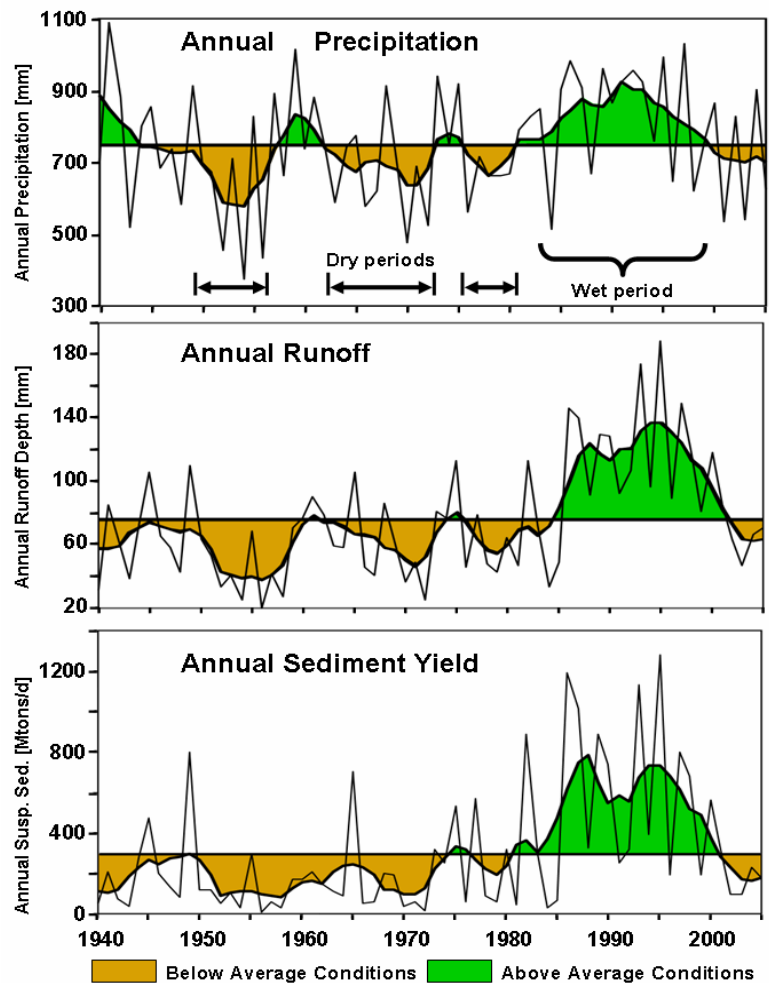
A study was conducted on the Fort Cobb reservoir watershed (787 km²[304 mi²]) in central Oklahoma to investigate impacts of persistent multiyear precipitation variations on watershed runoff and sediment yield. Precipitation variations lasting five or more years with predominantly above or below average annual precipitation are commonly found in long-term precipitation records, and are referred to as wet or dry periods. Evaluation of the 1940 to 2005 annual precipitation record for central Oklahoma identified three dry periods and one wet period. Watershed runoff data were available for 1940 through 2005, and sediment yield was estimated based on a suspended sediment-discharge rating curve developed with runoff and suspended sediment measurements made in 2004 to 2005. As such, estimated sediment yield is the yield that would likely have existed if the 2004 to 2005 land use, agronomic practices, and conservation measures were in place for the entire 1940 to 2005 period. The study showed that runoff and estimated sediment yield were sensitive to wet and dry periods. For the case at hand, a mean annual precipitation difference between wet and dry periods of 33% led to a 100% difference in runoff, which in turn led to a 183% difference in estimated sediment yield. Thus, small or moderate multiyear variations in precipitation can amplify into comparatively large watershed runoff and sediment yield variations.

The existence of multiyear precipitation variations and the sensitivity of runoff and sediment yield to wet and dry periods lead to three practical and conservation-relevant considerations. First, measurement of watershed runoff and sediment yield and assessment of conservation practices that are based on less than 5 or 10 years of data will depend on precipitation conditions that prevailed during the time of data collection. Long-term climate record of the region should be examined to establish the representativity of the climate during the data collection period. For example, assessment of cumulative sediment yield for a reservoir sedimentation study should include a mix of wet and dry periods representative of long-term climate conditions. On the other hand, assessment of effectiveness of soil conservation practices is best performed under wet period conditions, as these are conditions for which conservation practices are intended to work.

Second, soil and water conservation assessments performed with computer models require site-specific calibration and validation that reflect watershed physiographic and climatic boundary conditions. Climatic characteristics of weather data used in model calibration and validation should be evaluated against long-term climate records to reveal the presence of wet/dry periods and establish the adequacy of available weather data to address study objectives. For example, simulations of drought impacts on water resources are preferably conducted with a model that has been calibrated and validated for dry periods, as the latter better reflects intended drought

conditions. Also, any disparities between calibration and validation may be traced back to the presence of wet/dry periods. In practical applications, available data for calibration and validation, particularly sediment yield data, are often limited and concurrent weather data may be less than ideally suited to address study objective. Thus, in the presence of wet/dry periods, calibration, validation and study findings should be qualified and interpreted in terms of climatic characteristics underlying each simulation aspect.

Third, some agricultural chemicals have a tendency to bind to sediments, and their movement and transport within the watershed are closely linked to that of sediments. By association, one can infer that movement and transport of sediment bound agricultural chemicals are also sensitive to wet/dry periods. In turn, other conclusions pertaining to sediment movement and yield under wet/dry periods may be extendable to sediment bound agricultural chemicals.



Annual precipitation, runoff, and sediment yield in a Conservation Effects Assessment Project benchmark watershed, 1940 to 2005.

In summary, climate records underlying assessments of soil and water conservation should always be examined for wet and dry periods, and study findings interpreted in terms of characteristics of the climatic record. The suitability of a climatic record for conservation assessments is preferably determined on a case-by-case basis under consideration of study objectives and diverse perspectives from climatologists, scientists, conservationists, practitioners and policy makers.