Journal of
Irrigation and
Drainage
Engineering

Karlinger and Skrivan (24) computed a radius of influence of 250 mile for the spatial correlation of mean annual rainfall amounts in the Powder River Basin of Montana and Wyoming. Because of the smaller variation in topography in the region studied by the authors, when compared with that in the Powder River Basin, one would expect the radius of influence in Kentucky, Indiana, and Tennessee to be at least 250 mile, and possibly much greater. The implication of this is that the mean annual precipitation values of Table 3 are not independent. Thus, the regression relationships of Eqs. 1–7 may not be valid and the corresponding correlation coefficients may not be statistically significant. That is, the associations between P_i and R may be the result of two clusters of points rather than 17 independent observations.

In summary, the writer believes the results of the study are questionable because the dependency within the data base was not properly accounted for. There are three sources of dependency that need further consideration: (1) The Markov probabilities; (2) the lack of independence within the five-day AMC computations; and (3) the spatial correlation that exists between the two clusters of mean annual precipitation amounts. These sources of dependency may lead to incorrect estimates of antecedent moisture condition probabilities when the results of the authors study are used.

APPENDIX.—REFERENCES

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Discussion by H. B. Osborn,[10] and K. G. Renard,[10] Members ASCE

The authors have presented a study on antecedent moisture condition probabilities for use with the SCS curve number method or the Illinois Urban Drainage Area Simulator (ILLUDAS). They used linear regression of average annual rainfall amounts from stations in Indiana, Kentucky, and Tennessee to propose equations for predicting the probability of antecedent moisture conditions in various class intervals. Although the equations may have some applications in the Midwest, the writers take exception to the conclusion that "these equations also may be used, although with caution, to provide estimates of upper or lower boundaries for other areas, particularly more arid areas, until such time as local results are calculated." The authors stated in the text that, "The equations

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TABLE 7.—Antecedent Moisture Probabilities for Two Walnut Gulch Rain Gages 63.082 and 63.082 (1963–1976)

Rain gage (1)	Soil Conservation Service Antecedent Moisture Condition Probabilities			Illinois Urban Drainage Area Simulator Probabilities			
	P_1 (2)	P_{II} (3)	P_{III} (4)	P_1 (5)	P_2 (6)	P_3 (7)	P_4 (8)
63.082	0.79	0.15	0.06	0.06	0.35	0.35	0.24
63.083	0.95	0.05	0	0.12	0.44	0.23	0.21

are reliable only for locations having similar distributions to those studied, and average annual precipitations between about 33 in./yr and 55 in./yr." Average annual precipitation is less than 33 in./yr over most of the Southwest.

Furthermore, the seasonal distribution of precipitation varies considerably, which could have an effect on grazing season AMC probabilities. The writers feel that the study in no way justifies the use of these equations in arid areas, either with or without caution. Not only could use of the equations lead to erroneous answers, but they also imply a greater accuracy for the methods than is justified. Most important, they would imply a greater significance to antecedent moisture conditions in the arid Southwest than has been indicated on experimental watersheds.

Conclusions made by the writers are based on several rainfall/runoff analyses of data collected on the USDA-ARS Walnut Gulch experimental watershed in southeastern Arizona (31, 27, 28, and 29) and a more recent evaluation of ILLUDAS for arid rangelands (30).

Probabilities of SCS and ILLUDAS AMC's for Walnut Gulch are shown in Table 7. Raingage 63.082 is representative of the "wettest" antecedent conditions experienced on Walnut Gulch, while rain gage 63.083 represents "normal" antecedent moisture conditions on Walnut Gulch. Antecedent moisture conditions are normally "dry" for most runoff-producing thunderstorms on Walnut Gulch.

Based on Eqs. 1, 2, and 3, the SCS, AMC probabilities were 99.8%, 4.2%, and −4.1%, for AMC I, II, and III, respectively, for a 12-in. annual precipitation. For Eq. 3 to have physical meaning, average annual precipitation must be 23.3 in. or greater.

Simanton, Renard, and Sutter (32) suggested that in more arid areas SCS antecedent moisture Class I should be divided into four sub-groups which are surprisingly similar to the moisture classes of ILLUDAS:

1. AMC_{I_1} = 0.00 in. → 0.20 in.
2. AMC_{I_2} = 0.21 in. → 0.50 in.
3. AMX_{I_3} = 0.51 in. → 0.90 in.
4. AMC_{I_4} = 0.90 in. → 1.40 in.

When this distinction was used on some plot data in southeastern Arizona, they were able to demonstrate changes in the curve number in relation to these moisture classes. The significant point was that there was almost a complete absence of storms in the more conventional mois-

ture "wetter" groupings shown in Table 1 for the growing season.

The writers have found very little correlation between antecedent moisture conditions and peak discharge on rangeland watersheds in southeastern Arizona. Temporal and spatial variability of storm rainfall has far more effect on runoff peak discharge than does antecedent moisture. Very high evaporation rate differences in soils and cover and losses of runoff in dry alluvial streambeds may also contribute to the lack of correlation between antecedent moisture and peak discharge.

Efforts to adapt ILLUDAS for use on arid land watersheds have been partially successful, but there are uncertainties in the model that far outweigh the concern with which antecedent moisture condition to use for a particular event. Based on Eqs. 4, 5, 6, and 7, the ILLUDAS AMC probabilities were 18.6%, 48.5%, 21.8%, and 11.1%, respectively. The estimated probabilities were similar to the probabilities shown in Table 7. However, even assuming dry conditions, ILLUDAS tended to overpredict most runoff peaks on Walnut Gulch. When the writers assumed a higher antecedent moisture condition than that for "bone-dry," in an attempt to better match the suggested ILLUDAS antecedent moisture condition, they increased the overprediction. Also, the writers found that spatial and temporal rainfall variability could significantly affect the estimates of peak discharges using ILLUDAS, even for small rangeland watersheds (about 1 sq mile).

Finally, as is so often the case with linear regression, the proposed equations have no physical meaning. Futhermore, the correlations are poor, particularly for ILLUDAS, and do not suggest great confidence in them, even for use in the Midwest. The writers feel strongly the authors have overstated their case by suggesting their equations would be helpful in more arid areas.

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