The ALMANAC Model's Sensitivity to Input Variables

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Crop models frequently require complicated input data. We were interested in how to simplify input data sets to make crop models easier to apply.

Objective
- To predict 10 years of county maize and sorghum yields with the ALMANAC
- Use this data to test sensitivity of yields to solar radiation, rainfall, soil depth, curve number, and plant available water of the soil

Methods
A. Original input data

- One county in each of the five primary districts of maize and sorghum production in Texas
- Weather data from nearest available weather station
- Soil type with the largest acreage in each county's soil survey
- Soil parameters from the soils database
- Realistic values for culture parameters from yield trials for each county

B.Scenario input data

Changed one variable at a time
- -11% to 10% for daily solar radiation based on the maximum changes for growing season
- -20% to 20% for rainfall, based on the variance ratio of long term measured rainfall
- Soil layer depths of 1.5m, 1.2m, 1.0, and 0.8m
- -25% to 26% of total Plant Available Water (PAW) in original soil depths based on the possible varying scopes of PAW for different soil types reported by Ratliff et al. (1983)
- Highest and lowest curve numbers (CN) were selected for each soil type

C.Relative sensitivity (Wilkerson et al., 1983) equation

$$\text{Relative Sensitivity} = |(Y(X+\Delta X)-Y(X))/(\Delta X/X)|$$

Where Y is the simulated result, and X is the variable studied.

Conclusion
- Curve number is the most important of variables for the crop modeling. How to estimate its value accurately is worth discussing.

- With different scenario data sets, the coefficient variance of simulated yields was larger than that with original data sets. This would be interesting for future studies.

Results

Table 1 Bias (simulated minus measured grain yields) and root mean square error (RMSE) (Mg ha^{-1}) for 10 yr under different conditions in Texas

County	--------- Maize --------		--------- Sorghum --------	
	Bias	RMSE	Bias	RMSE
	----------------------------------- Mg ha^{-1} -----------------------------------			
Irrigated mean	0.27	0.46	-0.17	0.16
Dryland mean	0.04	0.64	0.09	0.24
Combined mean	0.15	0.55	-0.04	0.19

Table 2 The average relative sensitivity of solar radiation (SR), rainfall (R), soil depth (SD), soil plant available water (PAW), and curve number (CN) (10 yr at each county).

County	SR	R	SD	PAW	CN
Maize					
Dryland mean	0.60	1.54	0.40	0.38	8.29
Irrigated mean	0.69	0.96	0.26	0.23	2.26
Combined mean	0.65	1.25	0.33	0.31	5.28
Sorghum					
Dryland mean	0.40	1.00	0.32	0.29	5.95
Irrigated mean	0.92	0.28	0.18	0.11	1.00
Combined mean	0.66	0.64	0.25	0.20	3.48

References
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