

Topic: Improvements in modelling processes, interactions, and feedbacks

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The problem of a series of days without rainfall in a view of efficiency of agricultural output under climate change.

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Modelling future is key issue in studying CC impacts on agriculture across disciplines and scales. Improving models basing on empirical data coming from diverse micro regions let obtain synergic effects important in shaping food security. Especially, rainfall distribution is most important factor determining agricultural output.

The amount of cereal yield depends on an occurrence of long series of days without rain during a growing season. Based on statistical analysis of daily totals it was found that in Central Poland the length of series of days without rainfall during growing season is 40 days. Statistical analysis was done for years 1971-2015. The data allowed finding empirical probability distribution of a length of the series. Average value of the length of series is 4.31 while SD is 4.41. Values of parameters of gamma distribution estimated by the likelihood method are: $\alpha=0.9542$, $\beta=4.5150$. Value of the parameter α (shape parameter) suggests that distribution of the length of series is similar to exponential distribution.

Goodness of fit test with gamma distribution was carried out using λ -Kolmogorov and χ^2 -Pearson tests. Both prove high conformity between empirical and gamma distribution. Based on assumption that gamma distribution can be accepted as distribution of the length of rainless series, further is determined distribution of the length of the longest series in n-element random sample. On the theory of distributions of asymptotic order statistics it is known that the random variable $T(n)$ with appropriate normalization has asymptotic double exponential distribution. Based on that one can conclude that probability to occur 30-day rainless series or longer equals approx. to 0.48. This is useful in forecasting agricultural output depended on rainfall distribution.