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STUDY OF THE PLUVIAL BEHAVIOR IN THE DOURADOS REGION, IN THE BRAZILIAN STATE OF MATO GROSSO DO SUL, MS

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ABSTRACT: Dourados municipality is the main regional center of the Dourados River Basin. With around 165,000 people, it represents 47.8% of the total basin's population. As a region with great potential for agricultural development, it suffers from short spells of rainfall shortage, known as *veranicos* (short summers) and prolonged draughts, which have inhibited the full development of this potential. Thus, the study of precipitation patterns becomes relevant to plan agricultural activities, allowing for predictions with better approximation and more secure decisions. On the basis of this approach, precipitation distribution was evaluated in the Dourados region, in the Brazilian State of Mato Grosso do Sul, MS. Results obtained pointed to the following conclusions: the precipitation regime presents a uni-modal oscillation, with a rainy period extending between the months of October through March; all months within the rainy season present a drastic reduction in mean precipitation; and the occurrence of dry spells of seven days in the rainy season is greater in the second fortnight of each month.
KEYWORDS: mean precipitation, short summers, climatology

INTRODUCTION: Short dry spells, known as *veranicos*, and prolonged draughts have inhibited the full agricultural development potential of the Dourados region, in the Brazilian State of Mato Grosso do Sul, MS. These events are part of the regional vocabulary, but little is known about their frequency of appearance, persistency and timing. ESPINOZA (1979) related that agricultural activities in the *Cerrado* region – a type of bushy savannah – within which Dourados is included, are frequently affected by *veranicos*, originating an hydrological deficit for crops, with a negative effect on production, depending on crop type and on the stage of plant development. The *veranicos* phenomenon starts to show its effects approximately seven days after the last rainfall, there being two periods within which its occurrence produces negative effects: in the emerging stage and during flowering.

The study of rainfall becomes relevant in the planning of agricultural activities, allowing for predictions with better approximation and more secure decisions, besides the importance of characterizing a region's climate (ASSAD & CASTRO, 1991).

Yearly regional rainfall availability is, amongst others, the determining factor to quantify crop irrigation needs (BERTONI & TUCCI, 2002). Most agricultural projects, which consider rainfall contribution, use mean rainfall values as dimensioning parameters. However, to consider rainfall frequency distribution is a more recommended practice, allowing for more accurate dimensioning, based on risk levels (FIETZ et al., 2002).

The present study, based on this approach, evaluates rainfall behavior in the Dourados region, in the Brazilian State of Mato Grosso do Sul, MS, for better agricultural planning and management.

METHODOLOGY: Two meteorological weather stations were used to study rainfall behavior in the Dourados region; one belonging to EMBRAPA Agropecuária Oeste (CPAO, Western Research Centre for Agronomy and Animal Husbandry) and the other to Universidade Federal da Grande Dourados (UFGD- Federal University of the Great Dourados Region), for a total analysis of 27 years. Starting from 2000, mean data obtained from the two meteorological stations were used.

The pluviometric frequential analysis was based on the inferior, median and superior one ten-per-cent, proposed by FRANQUIN & FOREST (1977). The methodology consists on the following divisions: frequency of rainfall occurrence in two years within ten years (inferior one tenth of the distribution), that is, 20% of observed values are inferior to the calculated value, and 80% are superior; frequency of rainfall occurrence five years in every ten years (median), that is 50% of observed values are inferior to the calculated value, and 50% are superior; and frequency of rainfall occurrence in eight years within ten years (superior one tenth of the distribution), that is, 80% of observed values are inferior to calculated value and 20% are superior. For the set frequencies 5, 10 and 30 days periods of analysis were considered. The monthly period was the first to be analyzed, followed by the periods of 10 and 5 days.

Periods were fixed in such a way as to be able to perform a continuous analysis, to identify the periods of rainfall reduction during the rainy season. Inasmuch as to characterize the *veranicos* periods, a dry day was considered one with zero precipitation. The quantification of the dry periods was performed adding the successive rainless days, in the interval of one day to the greater or equal to ten days, according to ASSAD & CASTRO (1991).

RESULTS AND DISCUSSION: In the Dourados region, total annual rainfall, in the period of 1980 to 2006, varied from 1,062.6 mm (in 1991) to 1,827.0 mm (in 1982), with a mean long period of 1,402.9 mm; standard deviation was of 204.6 mm and the variation coefficient of 14.6%, which indicates a low inter-annual variation. It was observed, by the analyzed historic series, that in 100% of the years, yearly precipitation rates were superior to 1,000 mm, which, according to ASSAD & CASTRO (1991), grants good water availability for dry crop systems.

Mean monthly precipitation for long periods, standard deviation and variation coefficient are presented in Table 1. Precipitation distribution concentrates in the months from September to May, with precipitation above 100.0 mm; the rainiest months were in the period from October to March, representing 65% of regional rainfall, with precipitations above 140.0 mm, with the exception of February, which presented a mean pluvial precipitation of 128.3 mm.

TABLE 1. Mean monthly precipitation, standard deviation and variation coefficient of the mean monthly precipitation, in the period of 1980 to 2006

Month	Mean (mm)	Standard Deviation (mm)	Variation Coefficient (%)
January	154.2	68.8	44.4
February	128.3	62.6	48.8
March	141.1	91.7	65.0
April	118.0	64.5	54.7
May	111.1	83.8	75.4
June	74.2	67.2	90.6
July	38.1	31.1	81.5
August	46.3	57.2	123.6
September	104.0	70.6	67.9
October	145.3	73.2	50.4
November	154.3	69.6	45.1
December	188.0	80.2	42.7

As evidenced in Table 1, variation coefficients for mean monthly precipitation were high and standard deviations for the rainiest months (October to March) varied from 62.6 to 91.7 mm; these variations indicate that mean monthly precipitation are not the most adequate as precipitation indicators; this fact is proven by the analysis of the monthly frequency, where the periods of dry spells, *veranicos*, are not evidenced, as per Figure 1.

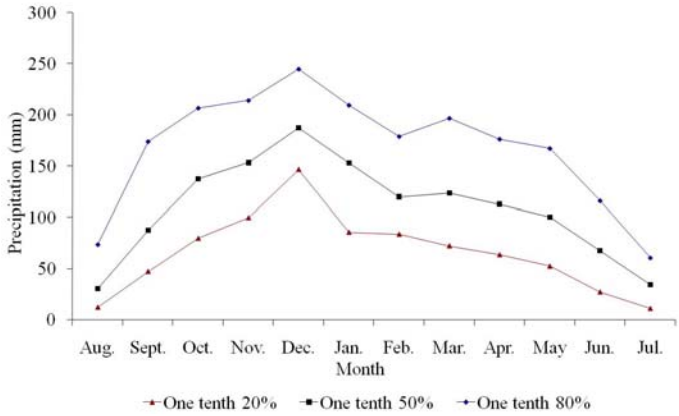
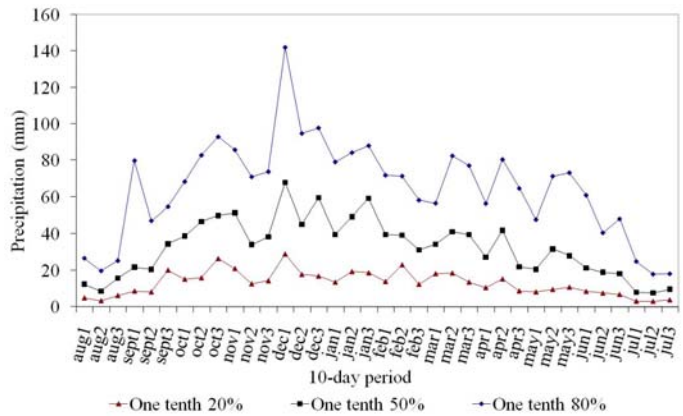


FIGURE 1. Frequency analysis of mean monthly pluvial precipitation in the one tenth of 20, 50 and 80%, for the Dourados region, MS, in the period of 1980 to 2006.

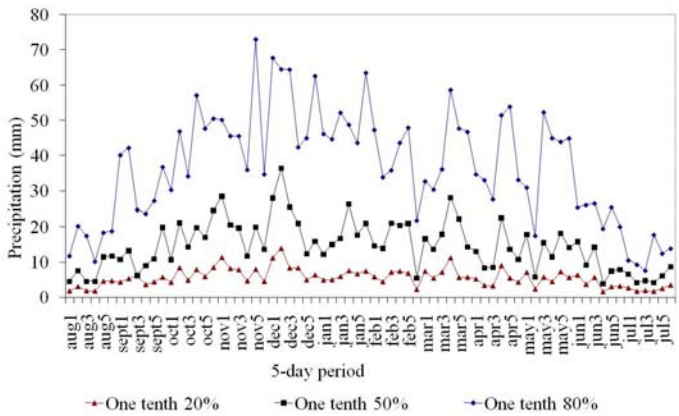
Considering the frequency analysis of the mean precipitation for the 10 and 5 days periods (Figure 2), the reduction of mean precipitation is observed in more detail. Strong precipitation reductions are seen for 10 day periods (Figure 2A), in all analyzed frequencies, principally in the months considered to be rainy. In February, there was a precipitation loss during the 10 day periods in the analysis of the one tenth measures for 50 and 80%. This didn't occur in March. This shows why the month of March has a mean precipitation for a long period greater than February. Analyzing mean precipitation for 5 day periods (Figure 2B), reductions are observed for the 50% one tenth, from the 5th of December until the 3rd of January (corresponding to the period from the 25 of December to the 15th of January) and from the 1st of February to the 2nd of February, to the 6th of February (relative to the period of 1 to 10 February and the last five days in February). The calculated values for the 20% one tenth measures indicate the occurrence of extremely dry periods during all the rainy season (October to March), which is a handicap for dry crop systems.

A.



1. Firs 10 days of the month; 2. Second 10 days of the month; 3. Third 10 days of the month.

B.



1. First 5 days of the month; 2. day 6 to day 10; 3. day 11 to day 15; 4. day 16 to day 20; 5. day 21 to day 25; 6. last five days of the month.

FIGURE 2. Frequency analysis of mean precipitation in the one tenth measures of 20, 50 and 80% for the Dourados region, MS, in the period from 1980 to 2006. Being: a) 10-day period; e b) 5-day period.

Analyzing the rainy period in relation to a seven successive day period without rain and considering the first and second fortnights of the months (Table 2), one verifies the greater probability of occurrence of dry spells, *veranicos*, in the second fortnight in relation to the first, principally so for the months of December (71.4%) and March (66.7%), in which the probability of the rainy period, called at random, was expressively smaller with 8.6 and 20.5%, respectively.

TABLE 2. Analysis of the rainy period in relation to a seven successive days-period without rain

Month	Seven-day rainless periods 1st fortnight of the month (%)	Seven-day rainless periods 2nd fortnight of the month (%)	Seven-day rainless periods random (%)	Total of Seven-day rainless periods
October	23.1	38.5	38.4	26
November	30.9	32.7	36.4	55
December	20.0	71.4	8.6	35
January	23.1	38.5	38.4	26
February	16.7	22.2	61.1	18
March	12.8	66.7	20.5	39

January resulted in 26 periods of more than seven successive days without rain, where 38.5% of the years present dry periods in the second fortnight of the month. 23.1% in the first and 38.4% were considered random. These results can strengthen some observations that certain periods are more favorable than others for the occurrence of dry spells, or *veranicos*.
Although the analysis shows some remarkable differences between the first and the second fortnight of January there was a greater occurrence of seven-days *veranicos* in the second fortnight. This fact shows that the rains in the second fortnight of January are more spaced out than in the first one, with a point for the importance of supplementary irrigation, even in months traditionally considered rainy.

CONCLUSION: Results showed that 65% of the rains in the Dourados region occur between the months of October through to March. Variations in mean monthly precipitation indicate that these are not in themselves the most adequate indicators for precipitation. An analysis performed at lesser intervals points out to the dry spells, *veranicos*. All months of the rainy season witness drastic reductions in mean precipitation; the occurrence of *veranicos* in the rainy season is greater in the second fortnight of each month.

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