Statistical analysis of long-term dynamics of atmospheric precipitation in Central Siberia

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The precipitation in the cold period of the year is part of the hydrological cycle and is studied in different scientific disciplines. This study presents the results of studying the dynamics of atmospheric precipitation in the cold period of the year in the town of Bratsk and compared the 21-23 solar cycles with the Wolf numbers using methods of mathematical statistics.

Generally it may be noted that the local minimums of precipitation occur during periods of solar activity in 21-23 solar cycles (the maximum of Wolf numbers), while the local maximums of precipitation amount correlate with the period of solar activity decline in 21-23 solar cycles.
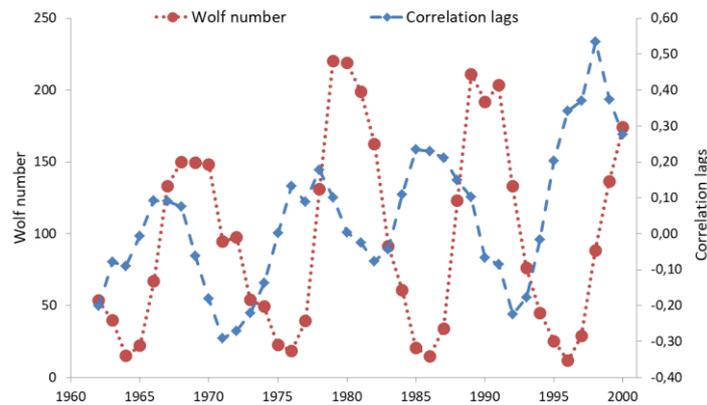

Figure 1. Diagram of correlation lags of precipitation in the cold period (October-April) in Bratsk and Wolf numbers.

The diagram of the lag coefficients for the correlation of the amount of precipitation in the cold period of the year (October-April) and the Wolf numbers (Fig.1) reflects a stable cyclic dependence of these quantities. A lag correlation can reveal the existence of a delay when the influence of one indicator (solar activity) on another (precipitation amount) is manifested through a certain time interval.

Local maximums of Wolf numbers during the observed period fall on 1968, 1979, 1989, 2000; the cycle length averages 10.7 years. The average duration of the periods of increase is 3.3 years. Local maximums of correlation lags during the observed period fall on 1968, 1979, 1989, 2000, the cycle length also averages 10.7 years. Practically in the same years, the maximum values of the amount of precipitation are recorded: 1966 (183 mm), 1978 (142 mm), 1985 (138 mm), 1997 (163 mm). The average duration of the periods of increase is 5 years. The average lag for the maximum values is 8.3 years.

Local minimums of Wolf numbers during the observed period fall on 1964, 1976, 1986, 1996; the cycle length averages 10.7 years. The average duration of the periods of decrease is 7.3 years. Local minimums of correlation lags during the observed period fall on 1962, 1971, 1982, 1992; the cycle length averages 10 years. Practically in the same years, the minimum values of the amount of precipitation are recorded: 1963 (115 mm), 1972 (71 mm), 1982 (103 mm), 1993 (85 mm). The average duration of the periods of decrease is 5.3 years. The average lag for the minimum values is 6.3 years.
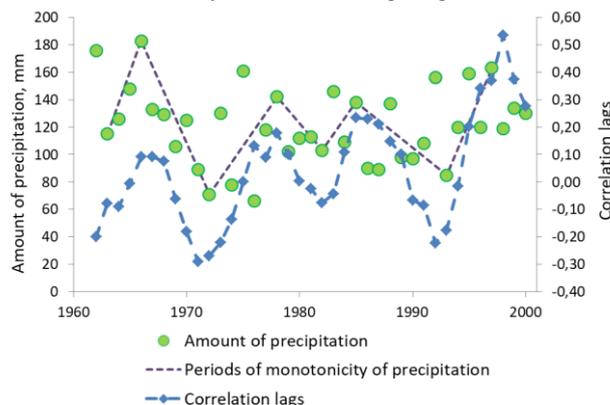

Figure 2. Diagram of correlation lags of precipitation in the cold period of the year and amount of precipitation.

Comparison of the correlation lags with the amount of precipitation in the cold period of the year suggests the existence of monotonicity periods of changes in the amount of precipitation about 6 years (Fig. 2). In those periods when the sign of the correlation lags changes from plus to minus, the amount of precipitation decreases. And almost always for a year, which corresponds to the largest absolute value of the negative value of the correlation lags, it has its local minimum. In those periods when the sign of the correlation lags changes from minus to plus, there is an increase in the amount of precipitation. And also almost always for a year, which corresponds to the largest absolute value of the positive value of the correlation lags, it has its local maximum.