Long period trends in time series for study of climate variability and extremality

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The approach to study climate trends, that is used in the paper, unlike the traditional trend estimation, envisages simultaneous research on the long-period trends for the change in all the portions of the range of possible values of climate characteristics. It is evident that the necessary condition for the implementation of this approach is data containing high time-resolution observations of climatic system parameters. The implementation of this approach provides for detailed investigation on changes of the entire distribution of meteorological values, including extremes and values close to extremes ("tails of distributions"). The mechanism is considered to study long-period climate changes that appear in the entire range of quantile values for the primary observational data. This mechanism is implemented by authors using statistical tools that are referred to as "quantile regression".

Examples are given of using the above-mentioned tools to conduct simultaneous analysis of long-period trends in all the portions of the quantile range from 0 to 1. Trends for quantile values close to 0 or close to 1 make it possible to estimate the trends for the climate extremality change. Trends for the other portions of the quantile range are also of interest and allow content interpretation.

The paper contains patterns of spatial distribution for trends in different parts of quantile range for the surface temperature over the territory of Russia. A dataset of daily minimal, daily maximal and daily mean temperature values for 600 stations is used for the study. For trends in median values, the patterns are shown to be similar to those calculated by traditional method. However, trends for the parts of quantile range different from median (including those for quantiles located in "tails of distributions"), demonstrate the patterns of spatial distribution that are just different. The interpretation of results is provided.