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Main Parameters of the Global Climate Change Background in the Eastern Part of the Black Sea Region

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Research Goals

The main goal of this study is to develop the method to determine the regional and local parameters of the climatic background making it possible to evaluate the joint effect of the parameters of the climatic background at a specific time and in the specific area.

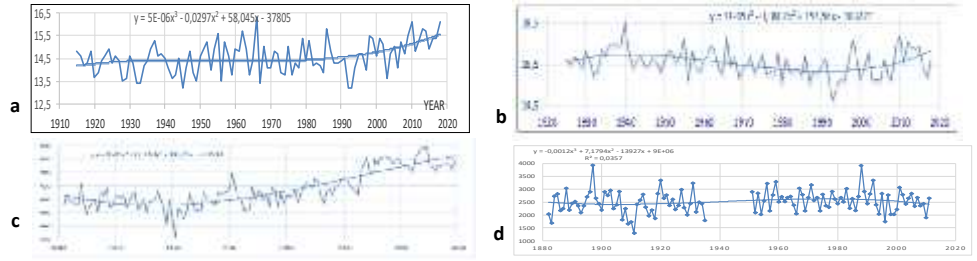
Research Methods

The study is based on the determination of the principal variation parameters of the climatic back-ground by using the statistical methods. The major climatic background elements are: air temperature (*T*), atmospheric precipitations (*p*), wind (*w*), sea level (*h*) and sea water temperature (*t*). This method can be used both, theoretically and empirically. In solving the given problem, the empirical method is preferred, as the results of monitoring allows developing "long series" of observation over meteorolo-gical and oceanographic elements. The observation data over the given elements were used to develop the time series of the data of the operating or representative monitoring centers of the study region:

$$X_1, X_2, X_3,...X_{n-1}, X_n \qquad n=1, 2, 3,...$$

where X_1 is the averaged data of observation of any element.

The following parameters of hydro-meteorological elements were selected as the background properties: mean arithmetic value (m_j), its mathematical expectation (M_j) with relevant *A* probability, extreme values and gross increase, with relevant trends (τ), with its sign showing the trend of the element development and value of annual increment. The principal property of the background is a polynomial equation of the variation of climatic elements.



*Century-long variations of air temperature (a), Sea temperature (b), Sea level (c) and atmospheric precipitations (d) in **BATUMI** coastal zone*

Conclusion

The climatic background is a joint effect of spatial-temporal dynamics of hydro-meteorological elements, generalized with A-probability for the specific time interval (σ) and area (f).

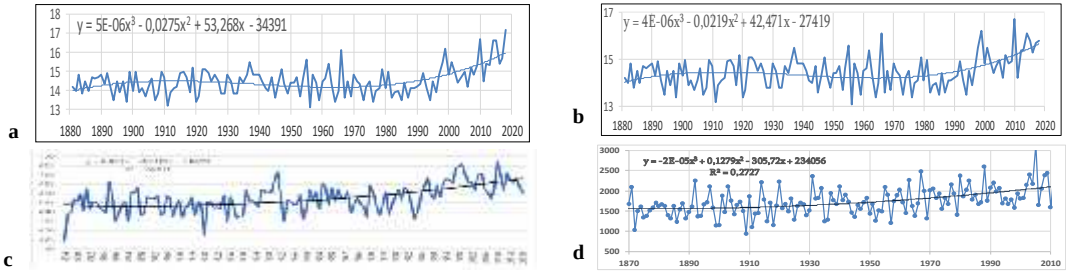
- The most reliable method to identify the assessment of water reservoir impact on the climate is to do a mathematical statistical analysis of "long series" drafted by using the data of the monitoring data of the meteorological and oceanographic posts operating in the reservoir water area. The results of the analysis must be corrected by considering the background properties of ongoing global climate changes. If no such series is available, or the series is "statistically short", an "analog" method is used; an analog, i.e. the water reservoir is selected based on the principle of similarity of the surrounding environment (air temperature, wind velocity, evaporation, etc.), but with certain corrections.
- The impact of the sea on air temperature is clearly seen in the results of monitoring of the locations distanced from the sea coast by 100 km. Two intervals of the century-long temperature variation were identified: long sinusoid and short sharp growth variations.
- Deficit of precipitation outside the breeze circulation increases sharply, which confirms the need to build water reservoirs.
- A century-long variation of the sea water change is identical to the air variation. The difference is seen in average many-year temperature values –water temperature in the coastal area is almost 2°C higher than that of the air, and sea level rise caused by global warming is 9-12 cm.

Results

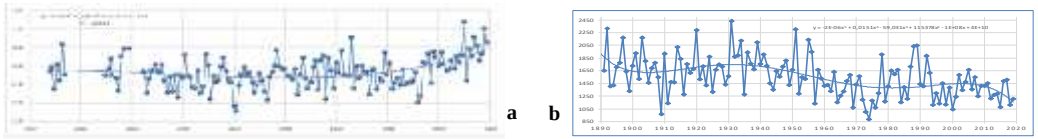
The empirical method was realized in the Black Sea eastern region – Colhic Lowland and piedmonts of the Caucasian Ridge with the height of up to 1000 m. Here, the areas, with some of them not under the reservoir impact and others with the reservoir impact occurring simultaneously with the climate variation, are found side by side. Six meteorological and two oceanographic posts were selected in Georgia-country depending on the duration and scope of the monitoring, while their results were used to develop ten statistical series, including four oceanographic ones. As per the data of a wide-scope hydrometeorological monitoring of the region, "long series" of meteorological and oceanographic elements are possible to develop and the data of their statistical analysis can be used to determine the regional and local properties of climatic background. "Long series" are the series made up of two fragments with statistically sufficient lengths, with the first fragment covering time period prior to the start-up of the reservoir ($\{X_i\}_{i=1}^{k}$) and another fragment covering the period of the reservoir operation ($\{X_i\}_{i=k+1}^{n}$):

$$\{X_i\}_{i=1}^{k}, \{X_i\}_{i=k+1}^{n}, \quad i=1,2,3,..,k,k+1,..,n$$

Site	Meteorological data		Oceanic data	
	Air temperature	Atmospheric precipitations	Sea level	Water temperature
Batumi	1897 - 2019	1881-2019	1881-2019	1881-2019
Poti	1881-2019	1869-2019	1874-2019	1874-2019
Kutaisi	1848-2019	1890-2019	-	-



Century-long variations of average annual values of air temperature (a), Sea water temperature (b), Sea level (c) and atmospheric precipitations (d) in POTI coastal zone



Century-long variations of air temperature (a) and atmospheric precipitations (b) in KUTAISI monitoring area

Acknowledgements

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