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North-East Black Sea climate system decadal variability

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On the basis of the Gelendhzik coastal weather station(44.55°N, 38.05°E) long-term (1974-2010) observational data, climatic variability organization from a variety of synoptic conditions is considered. The mechanism of evolution of fields from small to large time scales is the "universal" set of wind vector variations, which due to their crucial role for the region deserves a special name "elementary cycle" (EC). Typical changes in the EC are characterized by a cyclic change in dominant wind from the south-east to north-east direction and vice versa. The similarity of temporal EC variations at different time scales is regarded as a manifestation of wind variability fractality. It is shown, that the fractality is due to recurrence of basic regional baric synoptic fields. Three long-term EC in the period 1974-2010 constitute a decadal climatic "wave" – repeated wind vector variations, which due to rather simple appearance can be traced easily with the use of progressive vector diagram without any filtration. This type of long-term EC figure can be used effectively as a reference curve for the numerous climatic “events” and processes, considered in nowdays. Meridional component of wind velocity in the climatic wave, as well as the accompanying changes in temperature of air and water, are statistically associated with the atmospheric pressure East Atlantic-West Russia dipole. Effects of North Atlantic Oscillation are revealed in the air zonal transport changes.

As follows from the estimate of linear trends over the past 30 years, the background warming is 0.072°C/year for sea water and 0.051°C/year for the air. Similar estimation for the 70-year time series yields 0.009°C/year and 0.011°C/year, respectively. During this period, 43-year temperature cycle in 1947-1990 was followed by a half-cycle (incomplete) in 1990-2005 with a shorter period, and the amplitude of temperature long-term variations since 1990 is clearly increased. For the other hydrometeorological parameters, amplitude and frequency of long-term oscillations were also changing in the time course. Thus, the duration of the low-frequency sea level cycles in the period 1995-2010 had been increased to 7 years as compared to 3 years during 1980-1995. The according amplitude was increased from 5 to 10 cm. The reverse pattern is visible in the long-term changes of atmospheric pressure and precipitation: the amplitude and period of recurrence in the second half of observations at weather station were significantly decreased. The reasons for the above changes of the oscillation modes and their relationship with atmospheric circulation indices, has not yet been clarified.

In general, the impact of winds on regional multiscale hydrophysical processes in the North-East Black Sea is rather complicated. However, for the above relatively simple wind cycles the dominant response signals of the marine hydrosystem can be separated. The response to winds is due to the air temperature advection, wind strength, direction, duration and spatial inhomogenity. Currently, it is obtained, that the "quanta" of wind cycles produces sea-level fluctuations of different time and space scales, which adapt to the equilibrium by means of various dynamical processes including inertial waves, shelf upwellings/downwellings, local jet streams and various eddies.