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Variability in the general atmospheric circulation, precipitation and runoff in Eastern Europe

Sergiy Ivanov (1), Alexander Svetlitchnyi (2), Alexander Matygin (3), Galina Ivus (1), and Julia Palamarchuk (1)

(1) Odessa Environmental University, Ukraine (svvivo@te.net.ua), (2) Odessa National Mechnikov University, Ukraine (svetl@matrix.odessa.ua), (3) Ukrainian Scientific Center of Ecology of Seas (acm32alex@mail.ru)

Using different databases, changes of atmospheric circulation, regional precipitation, and runoff in Eastern Europe are analysed. The focus of the study is to search relationships between large-scale atmospheric flow characteristics and wet days as well as subsequent runoff in major rivers of the region. Unfortunately, various precipitation datasets developed in the last decades show significant differences in spatial and temporal distribution of available information that is difficult to reconcile. Nevertheless, results indicate that regional precipitation changes can be attributed to changes in large-scale atmospheric circulation. In particular, the zonal shift in storm tracks and associated atmospheric water vapor transfer changes cause a decrease in precipitation over the southern part of Eastern Europe, in particular, over the Danube River Basin. On the other hand, precipitation over the northern half of Eastern Europe increases, with largest increases over the Eastern European Plateau and the Dnepr River Basin. Thermodynamic changes also contribute to precipitation changes, mainly due to an increase in atmospheric precipitable water in the cold season (and, thus, increase in snowfall) in response to rising temperatures.

Runoff of the major rivers in Eastern Europe correlates with precipitation over their basins less than it may be expected. Moreover, for the last decades the opposite tendencies in precipitation and runoff for Danube have been observed. This can be explained by the anthropogenic impact on the runoff for which the dynamics do not coincide with the tendencies in the natural factors responsible for runoff formation. In 1990, the fresh water withdrawal in the Ukraine was around 30 km3 that is comparable to local runoff resources of the nation. At the same time, the water consumption was around 11 km3. For socio-economic reasons, in the 1990s the water withdrawal and consumption sharply decreased when their minimums were reached only in 2004, being equal to 10 and 2 km3 respectively. The main reduction in water use had occurred in agriculture and industry sectors of the economy. The decrease in water use in the 1990s was reported in other East European countries as well. In these years, substantial changes took place in runoff formation due to reformation of agriculture in these countries. Appearance of numerous small individual instead of large collective farms, changes in plant types grew and subsequent changes in land use technologies, and growth of the area of eroded lands are the factors, which affected all components of watersheds' water budget, including, certainly, the river runoff.