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DROUGHT IN THE EAST EUROPEAN PLAIN ACCORDING TO HYDROMETEOROLOGICAL AND SATELLITE DATA

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In various studies the evidence was obtained that the Atlantic Ocean is the key driver of multidecadal variations of the European climate (Cherenkova 2017; Cherenkova and Semenov 2017; Robson et al. 2012; Semenov and Cherenkova 2018; Sutton and Hodson 2005; Sutton and Dong 2012). This study presents the spatio-temporal analysis of regional climate and spring and summer drought peculiarities in the East European Plain (EEP) during the periods of positive anomalies of North Atlantic sea surface temperature and positive phase of Atlantic Multidecadal Oscillation (AMO) (1926-1962 and 1995-2012) as compared with the period of its negative anomalies and negative phase of AMO (1963-1994). In spring the observed low frequency of cyclones centers over the study territory in comparison with norm is associated with drier climate when the North Atlantic Ocean was in the cold phase. The decrease of total precipitation in spring (the difference was on average 10%) in EEP was observed in the period 1963-1994 to the period 1995-2012. The largest reduction in total precipitation (25-30%) was found in the central and in the south-east of the East European Plain. The change of the North Atlantic warm phase to the cold phase is expected in the upcoming decades, what can result to the spring limits of water supply in the agricultural regions in the south of European Russia.

In contrast, in summer, the various drought indices, such as Standardized Precipitation Index (SPI), Standardized Precipitation Evapotranspiration Index (SPEI) show the growth of severe meteorological drought frequency and increasing aridity of climate in the main grain regions of the European part of Russia during the periods of warm North Atlantic as compared with its cold period: in the Volga region (1-2 event / 10 years), in the Central Black Earth region and the Sea of Azov region (1 event / 10 years) (Figure 1). At the same time according to the Satellite Climatic Extremes Index (SCEI), based on the MODIS data of albedo, surface temperature and vegetation index (NDVI), the rise of drought frequency was observed in drysteppe and in the regions of semidesert pastures on the southeast of the European part of Russia in the period 2005–2014.

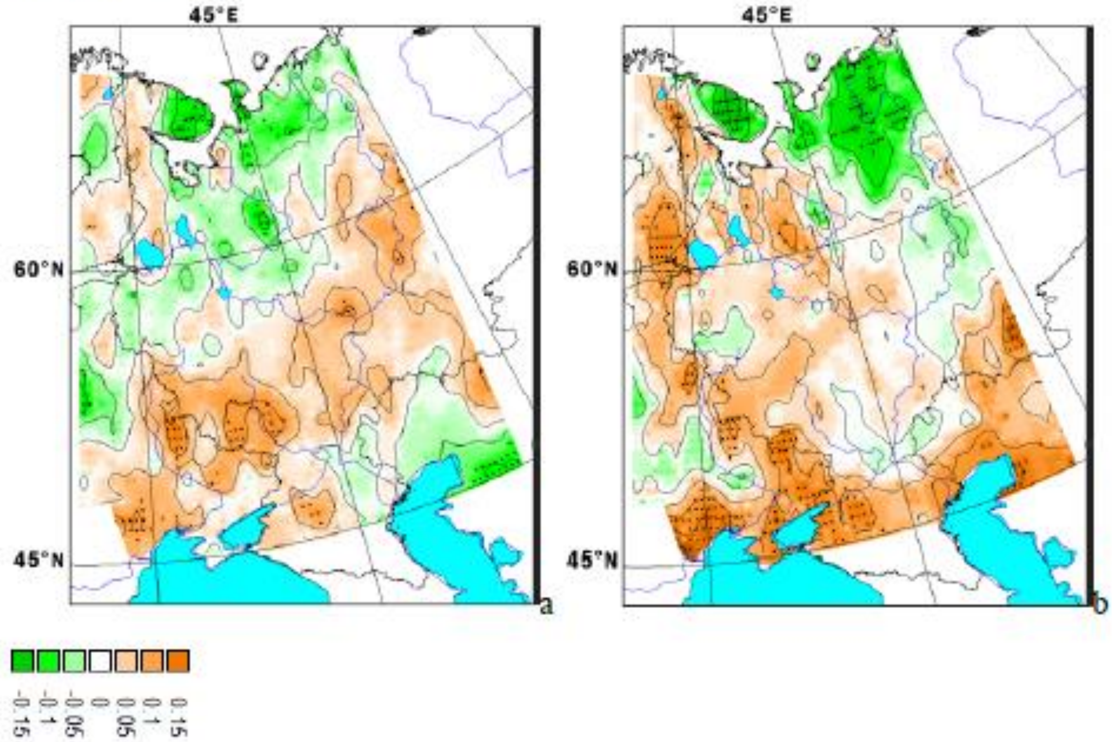

Fig. 1. Difference of severe drought frequency in the period of 1926-1962 (a) and 1995-2012 (b) compared with 1963-1994 according to the SPEI data.

Differences of the spring and summer climate in the opposite phases of AMO are explained by differences in circulation patterns. The results of analysis of the structure of the internal variability in the link between the ocean and atmosphere indicate the influence of the AMO on the atmospheric circulation in the Atlantic-European region. In spring, the AMO-related SST anomalies impact not only North Atlantic Oscillation, but also are associated with the fluctuation of a center of action over Scandinavia. The positive (negative) phase of AMO is characterized by the prevalence of negative (positive) values of NAO and Scand teleconnection indices. On the other hand, in summer, the positive (negative) phase of AMO is characterized by the predominance of negative (positive) values of NAO and EAWR indices. While the variability of NAO during the summer season is mainly related to the anomalies of regional circulation in Western Europe, EAWR is associated with a center of action located over European Russia, which can have a significant influence on regional climate in region.

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Keywords: drought, Standardized Precipitation Index, Standardized Precipitation Evapotranspiration Index, Atlantic Multidecadal Oscillation, teleconnection indices, East European Plain.

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