Pronounced anomalies of air, water, ice conditions in the Barents and Kara Seas, and the Sea of Azov

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Abstract

This paper analyses the anomalous hydrometeorological situation that occurred at the beginning of 2012 in the seas of the Russian Arctic and Russian South. Atmospheric blocking in the temperate zone and the extension of the Siberian High to the Iberian Peninsula (known as the Voeikov et al. axis) led to a positive anomaly of air and water temperatures and a decrease in the ice extent in the Barents and Kara Seas. At the same time a prolonged negative air temperature anomaly was recorded in central and southern Europe and led to anomalously severe ice conditions in the Sea of Azov. Winter hydrographic conditions in the Barents and Kara Seas are illustrated by a unique set of observations made using expendable bathythermosalinographs (XCTD).

1. Introduction

Problems relating to thermal regimes and sea ice extent changes at the global and local scale have been discussed at length in the recent scientific literature (Matishov & Dzhenyuk 2012, Levermann et al. 2012, Matishov et al. 2012a,b). Usually, it is the deviations of climatic norms and long-term hydrometeorological trends, which often do not go beyond the bounds of statistical errors, that are analysed. Meanwhile, economic activities in seas and coastal areas as well as the stability of terrestrial and marine ecosystems depend first of all on large and prolonged oceanological anomalies, which do not always coincide with the sign of long-term trends (Matishov 2008).

Strong warming has been recorded in the Arctic Ocean and its shelf seas since the beginning of the 21st century (Matishov et al. 2009, Alekseev et al. 2010, Kattsov & Porfiryev 2011). The positive water temperature anomaly in Atlantic water masses has remained in the Barents Sea for no less than ten years (Matishov et al. 2009, 2012).

The Arctic ice area in summer and autumn has decreased significantly in recent years; as a result, navigation on the Northern Sea Route has taken place without icebreaker support. Parts of the Pechora and Kara Seas were ice-free in the winter of 2011/12, whereas the probability of that condition based on long-term data is close to zero. Meanwhile, at the beginning of 2012 (January and February) the air temperature on Franz Josef Land reached values that were close to the absolute maximum (+1–2°C). The position of the ice edge in the Barents Sea was close to its climatic minimum with 1% probability. In the Kara Sea significant areas of water remained open until February. No such climatic data had previously been recorded (*Atlas of the oceans* ... 1980).

Some researchers believe that the decrease in the ice extent in the Arctic basin in summer and autumn is caused by a change in the large-scale atmospheric circulation (Overland & Wang 2010), which results in an increase of blocking situations and precipitation in Europe in winter (Liu et al. 2012).

At the same time anomalously cold weather in the second half of winter has become a typical phenomenon in central and southern Europe and the adjacent seas (the Sea of Azov, the north-eastern Black Sea, the northern Caspian Sea) (Matishov et al. 2012a, Moore & Renfrew 2012, Tourpali & Zanis 2013). The anomalies in January and February of 2006 and 2012 were especially pronounced. The air temperature in the south of European Russia decreased in January 2006 to −32–33°C; the average monthly values were about −15°C, that is, 12–15°C below the climatic norms. Similar conditions were recorded in January and February 2012. At that period the influence of the Siberian High reached as far as the English Channel and