

**Arctic sea ice reduction and the extreme cold winters in Europe revisited**

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Northern Hemisphere (NH) averaged surface air temperature (SAT) has risen by about 1 K during the twentieth century. This warming trend is particularly strong in the Arctic during the winter half of the year, exceeding NH changes by a factor of two, and it has been accompanied by a rapid decrease in sea ice cover in recent decades. Yet a number of severely cold winters in Europe have also occurred in the recent years despite the overall warming trend and sea ice decline. Indeed the past two winters, 2009-2010 and 2010-2011, were unusually cold in large parts of northern and central Europe, while the globally averaged as well as the arctic SAT showed positive anomalies. Another recent extreme winter was the winter 2005-2006 which was the coldest winter in large parts of western Europe for over a decade. Several studies have focused on understanding the possible processes responsible for the SAT and, in particular, the abnormally cold winters in Europe. Scaife and Knight (2008) carried out a number of general circulation model experiments to investigate the importance of both the Atlantic Ocean and stratospheric circulation. They found that both Atlantic SSTs and the January 2006 sudden stratospheric warming are likely to have contributed to the cold 2005-2006 European winter. In a more recent study, Petoukhov and Semenov (2010) examined the response in ECHAM5 to various degrees of reduction of Barents-Kara (B-K) sea ice. They showed that anomalous decrease of winter sea ice concentration in the B-K area could result in European extreme cold events similar to the 2005-2006 winter, implying that several severe winters do not conflict the global warming picture. Our current study re-examines the impact of the Arctic sea ice reduction on the wintertime atmospheric circulation and the resulting SAT over the Eurasian continent using the global climate model EC-Earth. Following the strategy used by Petoukhov and Semenov (2010), we perform a set of simulations using the atmospheric component of the EC-Earth forced with climatological sea surface temperatures and reduced arctic sea ice distributions at different reduction levels with respect to the climatology. The model is configured with different combinations of horizontal and stratospheric vertical resolution for each sea ice forcing, to assess the sensitivity of the response to model resolution. The role of both the arctic sea ice and stratospheric circulation in these experiments are investigated. We analyse to which extent the response of the abnormal SAT in Europe-Asia are resulting from an insufficient model resolution. Reference Petoukhov, V., and V. Semenov (2010): A link between reduced Barents-Kara sea ice and cold winter extremes over northern continents. *J. Geophys. Res.*, 115, D21111, doi:10.1029/2009JD013568. Scaife, A. A. and Knight, J. R. (2008), Ensemble simulations of the cold European winter of 2005-2006. *Quarterly Journal of the Royal Meteorological Society*, 134: 1647-1659. doi: 10.1002/qj.312.