LETTER

Importance of autumn Arctic sea ice to northern winter snowfall

In their contribution to PNAS, Liu et al. (1) suggested that the recent decline of Arctic sea ice has played a critical role in recent cold and snowy winters in the Northern Hemisphere (NH). This study is very interesting, but we believe it deserves several clarifications.

First, in 2010, Wu et al. (2) discovered the importance of autumn Arctic sea ice in triggering regional cold extremes; for example, the 2007–2008 winter, when the NH (particularly East Asia) was struck by severe, record-breaking snowstorms. Liu et al. (1) applied the same idea to East Asia, Europe, and North America. In an interpretation of the Arctic low boundary effect, Wu et al. (2) used a simplified general circulation model to show that the reduced Arctic sea ice forcing induces high anomalies over high latitudes, which may favor the development and maintenance of blocking highs, and vice versa. Liu et al. (1) obtained a similar result in their numerical experiments with the Community Atmospheric Model version 3.1, although these authors did not cite Wu et al. (2).

Second, regarding seasonal predictions, Liu et al. (1) only mentioned that the autumn Arctic might be of practical use in seasonal forecasting of snow and temperature anomalies over northern continents. However, Wu et al. (2) had already examined the contribution of the autumn Arctic to seasonal predictions of extreme winter conditions, such as the 2007–2008 winter, and had established an empirical seasonal prediction model with promising prediction skill for cold extremes in East Asia (figures 9 and 10 in ref. 2).

Finally, Liu et al. (1) argued that the atmospheric pattern linked to the reduced autumn Arctic sea ice is different from the classic winter Arctic oscillation (AO) (3), because the detrended autumn Arctic sea ice and winter AO indices have a weak correlation (0.28). However, this conclusion needs to be treated with caution and may well be invalid, for the following reasons. First, the sea ice area index used by Liu et al. (figure 1 in ref. 1) is based on sea ice extent rather than sea ice area (4), although they referred to "sea ice area" throughout their article. Second, the correlation coefficient between the detrended autumn Arctic sea ice area and winter AO index is in fact as high as 0.47 (Fig. 1), exceeding the 99% confidence level (Student's t test). This result indicates that the reduced autumn Arctic sea ice significantly correlates with the classic winter AO [see also Cohen et al. (5)].

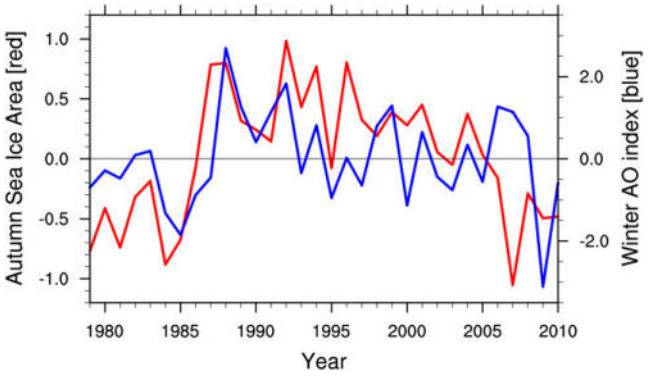

Fig. 1. Time series of detrended autumn Arctic sea ice area anomaly ($\times 10^6$ km^2; black curve) and winter AO index (blue curve).

In conclusion, the concept of the impact of Arctic sea ice on winter snowfall, as suggested by Liu et al. (1), is basically consistent with the findings of Wu et al. (2) published 2 y earlier. Wu et al. (2) had already demonstrated that the autumn Arctic sea ice is an important predictor for northern continental-scale winter climate. Moreover, the reduced autumn sea ice is closely linked to the classic winter AO rather than to the nonclassic winter AO.

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