Persistent shift of the Arctic polar vortex towards the Eurasian continent in recent decades



Background

• A better understanding of the Arctic polar vortex is helpful to improve forecast ability on mid-latitude extreme weather events (e.g., Baldwin and Dunkerton, 2001; Cohen et al.,2014).

• Previous studies have found that the Arctic polar vortex has weakened over the past decades (e.g., Alexeev et al., 2011; Kim et al., 2014).

• Whether the location of the polar vortex has experienced a persistent change in response to Arctic climate change?

Shift of the Arctic polar vortex





latitude and (bottom) longitude.

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Mechanisms



Fig. 3. (a) Differences in 6-month (Sep.-Feb.) mean sea-ice cover (SIC) over the northern polar cap between the 2000s and the 1980s. (b) Composited mean differences in February mean PV between the low and high Barents-Kara SIC years averaged between the isentropic layers 430-600 K. The February mean vortex edges during the low Barents-Kara SIC years (red line) and the high Barents-Kara SIC years (blue line). (c) Difference in February mean PV between model simulations R2 and R1 and February mean vortex edge in R1 (blue line) and R2 (red line). (d) Difference in February mean **PV** between simulations **R5** and **R1** and February mean vortex edge in R1 (blue line) and R5 (red line) averaged between the isentropic layer 430-600 K.

Table 1 Model and Simulations

Simulation (WACCM3)	
R1	With a second the de
R2	The SST SIC force the SIC d
R5	The SIC R1, excep Eurasian higher th

Description

easonal cycle of SIC and SST based ecadal of SIC and SST in the 1980s

is the same as in R1, except that the ing represents the decadal mean of during the 2000s.

and SSTs are the same as those in pt that the surface albedo over the during autumn and winter is 5% nan that in R1.



Fig. 4. (Left) Composite differences in geopotential height at 500 hPa (a,c) and surface temperature (b,d) in February and March between high and low February-mean SPV index. (Right) CMIP 5 models results.

Summary

•Since the 1980s the polar vortex in late winter (February) exhibits a persistent shift towards the Eurasian continent and away from North America (Figs. 1, 2).

•The BKS have lost significant areas of sea-ice concentration (SIC) during autumn and winter in the 2000s. Which causes the polar vortex shifts towards the Eurasian continent and away from North America. The increased Eurasian snow cover also has a contribution (Fig.3).

•The stratospheric polar vortex shift can cause a cooling over some parts of the continent in the past three decades (Fig.4).

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Influence on Mid-Latitude Climate