The impact of future Arctic sea ice loss on the atmospheric circulation and surface climate is investigated using the Whole Atmosphere Community Climate Model (WACCM), NCAR’s “high-top” atmospheric model.

The tropospheric circulation response to late 21st century Arctic sea ice loss is characterized by a negative phase of the Northern annular mode (NAM), with maximum amplitude in winter consistent with previous studies. The less well-known stratospheric response transitions from a weakening of the polar vortex in winter to a strengthening of the vortex in spring. The stratospheric circulation response can be understood as a consequence of largely canceling effects from sea ice loss in the central Arctic and marginal ice zones, which drive opposite-signed changes in tropospheric wave driving.

The winter surface climate response to Arctic sea ice loss shows strong warming over the high-latitude continents. In the mid-latitudes, North America warms but central Eurasia cools slightly due to circulation effects. These seasonal mean changes are accompanied by a reduction in daily temperature variance. As a result, the risk of cold extremes over North America decreases due to Arctic sea ice loss, contradicting recent speculation.