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Anomalous Arctic Warming Linked with Severe Winter Weather in Northern Hemisphere Continents

Judah Cohen[1,2], Jennifer Francis[3], and Karl Pfeiffer[1]
[1]AER, Inc., Lexington, MA, United States of America (jcohen@aer.com)
[2]Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA, United States of America
[3]3Woodwell Climate Research Center, Falmouth, MA, United States of America

We have extended a recently developed index of accumulated winter season severity index (AWSSI), originally based on temperature and snowfall observations from weather stations in the United States only, to the entire Northern Hemisphere using reanalysis output. The expanded index (rAWSSI) is analyzed to reveal relationships between Arctic air temperatures/geopotential heights and the probability of severe winter weather across the midlatitudes. Cold temperatures dominate the index, while snowfall contributes mainly over high elevations. We find a direct and linear relationship between anomalously high Arctic temperatures/geopotential heights and increased severe winter weather, especially in northern and eastern continental regions. Positive temperature trends in specific Arctic regions are associated with increasing trends in severe winter weather in particular midlatitude areas. These trends are more robust during recent decades when Arctic warming has accelerated, exceeding the pace of global-average warming by a factor of two to four. We also explore trends in the variability of daily rAWSSI. During the era of rapid Arctic warming, variability has decreased over the Arctic Ocean and Europe – suggesting less volatile winter weather -- while it has increased along the United States (US)/Canadian border, western Canada, and northeast Asia, indicating more pronounced shifts in weather conditions. This finding suggests an increased tendency for volatile weather swings known as weather whiplash. Finally, we find that when the stratospheric polar vortex is weak (anomalously warm stratosphere), the rAWSSI tends to increase, suggesting an association between disruptions in the polar vortex and severe winter weather across certain regions of the Northern Hemisphere continents.