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What drives the rapid sub-Arctic continental warming during summer?

Debashis Nath
Institute of Atmospheric Physics, Chinese Academy of Sciences, Center For Monsoon System Research, Beijing, China (debashis@mail.iap.ac.cn)

In the last three decades, rapid surface warming is observed in the land areas of northern high-latitudes during boreal summer months. The warming trend exceeds 0.5°C per decade was mainly located over eastern Siberia, northern Canada and Greenland. Although the warming trend is thought to be driven by early snowmelt, however, the exact causes, especially its relationship with atmospheric circulation changes remains a subject of debate. By analyzing the ERA-Interim data, this study examines the possible factors for rapid sub-Arctic warming. Our analysis indicates that the changes in the configuration of SLP trend are resulting from an enhanced blocking activity and an associated positive trend in the geopotential height around the Greenland region. This configuration of SLP trend caused by the positive trend in geopotential height around the Greenland region, not only affecting the land warming by transport of more warm and moist air, but also accelerating the sea ice loss in summer through ice transport out of the central Arctic Ocean through Fram Strait. It is found that more than half of the warming trend over whole sub-Arctic and 80% over Northern Canada and Eastern Siberia (regions with maximum amplification) can be explained by an enhanced downward infrared radiation (IR). Downward IR is largely drives by horizontal atmospheric moisture flux convergence and warm air advection. The positive trend in geopotential height over the Greenland region is the key for moisture fluxes convergence over northern Canada and over eastern Siberia through changes in the storm tracks. An enhanced summertime blocking activity in the Greenland region seems responsible for the positive trend in the geopotential height.