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Arctic temperature amplification and sea-ice melt

R. G. Graversen (1), M. Kapsch (1), T. Mauritzen (2), and M. Tjernström (1)

(1) Stockholm University, Department of Meteorology, Stockholm, Sweden (rune@misu.su.se, +46 8 15 7185), (2) Max Planck Institute for Meteorology, Hamburg, Germany

In recent decades, Arctic temperatures increase more than the global average – this has become known as Arctic temperature amplification. At the same time, Arctic sea-ice extent is shrinking with a pace being largest in summer.

Reanalysis data show Arctic temperature amplification in the free troposphere above the boundary layer. In summer this warming aloft cannot be attributed to surface processes. This is because the surface-air temperature trends are modest in the Arctic during summer, since the ice-melt keeps the temperatures close to the melting point. Rather the warming in the free troposphere could be due to changes of the heat advection into the Arctic and changes of the cloudiness. The warming aloft induces an increase of the energy flux towards the surface in terms of longwave radiation and turbulent fluxes, which contributes to the sea-ice melt during summer. When the ice melts, surface-based processes start acting, among them the surface-albedo feedback where the sea-ice reduction leads to an increase of absorption of solar radiation. During summer, the excess of energy at the surface is stored in the ocean, both internally as heat, and latently due to the ice melt. This energy is released during the following autumn and winter causing positive surface-air temperature in these seasons.

The extreme ice melt in 2007 is an example of this chain of processes. During the summer of 2007 the Arctic sea ice shrank to the lowest extent ever observed. Using the state-of-the-art ERA-Interim reanalysis data, the role of the atmospheric energy transport in this extreme melt event is explored.