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On the linkage between Arctic warming and the change of the atmospheric meridional energy transport

Rune Grand Graversen and Mattias Burtu
Stockholm University, Department of Meteorology, Stockholm, Sweden (rune@misu.su.se, +46 8 15 7185)

Climate models show that the surface in the Arctic region warms faster than the global-mean surface warming, when the climate system is attributed to a radiative forcing. This Arctic temperature amplification is believed to be caused by several processes, such as the surface-albedo feedback and the lapse-rate feedback. The surface-albedo feedback is associated with retreating snow and ice cover leading to an increase in absorption of incoming solar radiation, and the lapse-rate feedback is associated with the Arctic lower atmosphere often being stably stratified, which hampers vertical mixing of the energy input at the surface leading to a stronger surface warming.

Another process that may contribute to Arctic amplification is the change of the meridional atmospheric energy transport. The role of this transport for the Arctic amplification has been widely discussed in literature. Radiative-forcing experiments with climate models tend to agree that the dry-static part of the transport decreases whereas the latent part increases. The total transport remains almost unchanged, with a small increase in some models and a small decrease in others. The fact that the total transport remains almost unchanged has led to the argument that the atmospheric meridional energy transport does not contribute to the Arctic warming. Here we challenge this argument.

We split the total atmospheric meridional energy transport into dry-static and latent parts as well as into parts associated with Rossby waves and meso-scale waves. We study the contribution to the Arctic warming from each of these parts.