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Impact of energy transport by planetary waves on Arctic climate variables

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The atmospheric transport of energy into the Arctic region is important in determining the Arctic climate and contribute to the Arctic amplification of global warming. The atmospheric energy transport can be split into a dry static part and a latent part, where the latter is associated with a flux of water vapor. In recent studies, a new approach has been suggested to study the underlying mechanisms behind the energy transport into the Arctic. By applying a Fourier transform to the transport of heat and moisture and decomposing the resulting energy transport with respect to zonal wavenumbers, the wavenumbers can be divided in groups reflecting the relative contributions from planetary and synoptic-scale waves. Following this approach, it has been shown that the Arctic near surface temperature is more influenced by the latent energy transported into the region than dry static energy, and more by energy transported by planetary scale waves, than synoptic scale waves. The latent energy transport has a greater effect on Arctic climate because it affects the climate not only by latent energy released during condensation, but additionally through the radiative effects of the water vapor and condensed (cloud) water itself. Estimates of future energy transport show that the latent part may increase on account of the dry static part during the twenty first century. This shift in the energy balance has been estimated to cause an increased effect on Arctic amplification, despite an overall decrease in energy transport. Here, we extend the analysis to further investigate the effect of atmospheric latent energy transport on Arctic climate. Following the same approach, we decompose the northward transport of latent energy into wave parts, to identify systematic changes in the latent energy transport over recent decades, and to identify specific regions and seasons that are sensitive to latent energy transport. Results show that in addition to temperature, transport of latent heat also impact the Arctic sea ice extent by enhancing the local greenhouse effect. Strong impact on sea ice is confined to certain areas within the Arctic region, and is particularly strong in winter. The analysis also includes effects on variables such as cloud water and the surface energy budget.