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The effect of latent heat transport by waves on Greenland Surface Mass Balance

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The Arctic region shows some of the world's most significant signs of climate change. The atmospheric energy transport plays an important role for the Arctic climate; the atmospheric transport contributes an amount of energy into the Arctic that is comparable to that provided directly by the sun. From recently developed Fourier and wavelet based methods it has been found that the planetary component of the latent heat transport affects that Arctic surface temperatures stronger than the decomposed dry-static energy transport and the synoptic scale component of the latent heat transport.

A large concern for humanity is that the climate change in polar regions will lead to significant melting of the ice sheets and glaciers. In fact the discharge water from the Greenland ice sheet has recently increased to the extent that this ice sheet is one of the major contributorsto sea-level rise. Here we test the hypothesis that the recent rapid increase in melt of the Greenland ice sheet is linked to a shift of planetary-scale waves transporting warm and humid air over the ice sheet.

The effect of the atmospheric energy transport is investigated by correlating the divergence of energy over the Greenland ice sheet with the surface mass balance of this ice sheet. The divergence of latent heat transport is found to correlate positively with the surface mass balance along the edges of the ice sheet, and negatively in the interior. This indicates that a convergence of latent at the edges of the ice sheet lead to a increased mass discharge from the ice sheet, whilst in the interior converging latent heat indicates an accumulation of mass to the ice sheet.

To investigate the effect of transport by planetary and synoptic scale waves on the Greenland ice sheet surface mass balance the mass flux component of the transport divergence is decomposed into wavenumbers through the application of a Fourier series. The divergences of transport contributions of each wavenumber are then correlated with the surface mass balance of the Greenland ice sheet. The correlations between the surface-mass balance and divergence of transport contributions by different wavenumbers reveals the relative impact of atmospheric circulation systems, such as Rossby waves and cyclones, on the Greenland ice sheet mass balance. Further, identifying shifts in the circulation patterns over Greenland by applying self organizing maps, or similar methods, and investigations of how these circulation patterns affect the energy transport over Greenland by atmospheric waves of different scales are also pursued.