Abstract

The Arctic sea ice cover has declined rapidly in recent years. The sea ice loss is primarily ascribed to anthropogenic global warming, which has been observed to be stronger in the Arctic than anywhere else. This increased warming is termed *Arctic amplification*, and is arising from the combined effect of several climatic feedback processes. Investigation of the mechanisms behind the amplification has resulted in a scientific debate on the relative importance of remote and local sources of warming – in practice often meaning the relative warming contributions from changed atmospheric heat transport and surface-based, sea ice related processes. The vertical profile of warming has been widely used as an indicator of the relative contributions, as the warming signals from local and remote sources are expected to be seen near the surface and aloft respectively. Such an analysis of the vertical structure of Arctic warming, performed by *Chung and Räisänen* [2011], has been used to argue that climate models tend to over-estimate the warming from atmospheric heat transport, as the warming aloft in the models exceeds what is seen in reanalysis data. This finding has been contested in this thesis, which contributes to the Arctic amplification debate with an assessment of the effect of a reduced Arctic sea ice cover on the vertical profile of warming.

This analysis is based on simulations with the atmospheric general circulation model CAM3, which was used to simulate the atmospheric response to a reduced Arctic sea ice cover. Two different approaches has been used to induce the diminished sea ice cover: The first experiment uses prescribed, fixed sea ice conditions from the ERA Interim reanalysis, while the second incorporates an active upper ocean and sea ice cover, and induce the sea ice reduction through an albedo change.

The results show that, the sea ice reduction causes substantial surface-based warming, which exceeds the warming aloft. This indicates that, the basis for the conclusion by *Chung and Räisänen* [2011] is invalid, while the results presented here still indicate the need for further investigation of the simulated atmospheric heat transport in general circulation models. The incorporation of an active upper ocean and sea ice cover includes additional feedbacks in the simulation, which improves the estimated vertical warming profile in the model compared to the reanalysis data. The improvement is found to be linked to changes in the atmospheric circulation, and in line with results from similar studies it seems that the sea ice cover somehow is linked to the large-scale atmospheric circulation. Consequently, changes in the sea ice cover have impacts for the climate both within and beyond the Arctic. The details of the coupling remain unclear, while the results here suggest that the crucial factors lie in the feedback processes involving the sea ice and the upper ocean.