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Plain Language Summary: It has been recognized that the turbulent effects influence the cloud dynamics and the representation of moist process is critical for the performance of the sub-grid-scale (SGS) turbulence schemes. This note reports on the large impact of the representation of ice phase clouds in the turbulent closure scheme on the high clouds and their response to global warming, which underlines the critical nature of the treatment of SGS ice clouds which reflects a realistic ice condensation physics not only for a better representation of high clouds in the current climate but for an improved projection of changes of high clouds due to global warming.

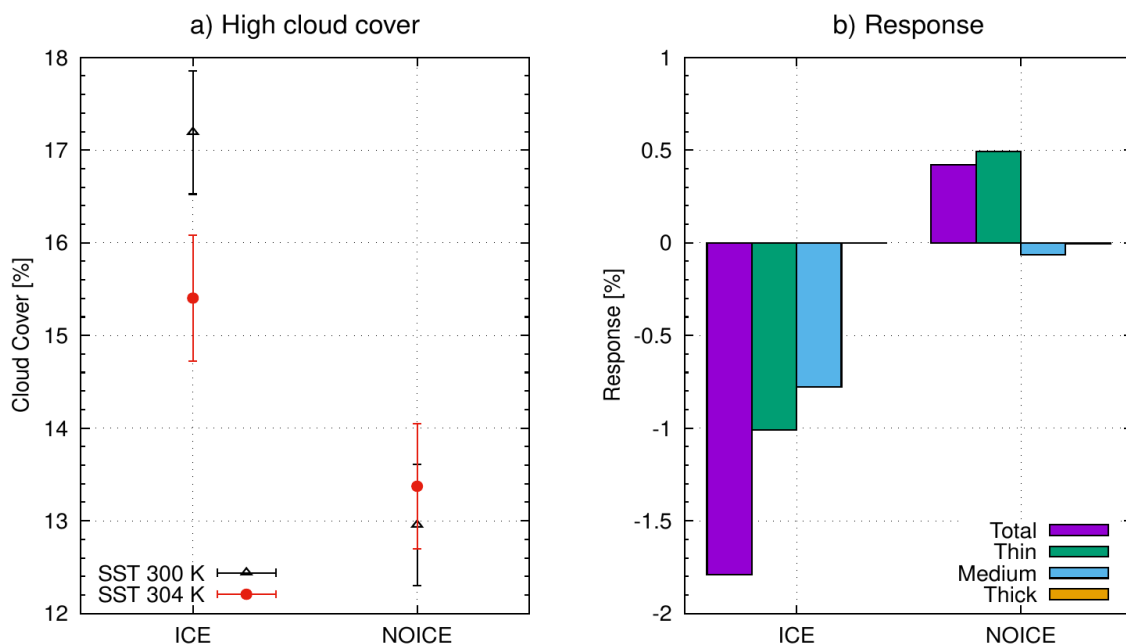


Figure 1. a) Globally averaged cloud cover for the simulations with (ICE) and without (NOICE) the saturation adjustment type SGS ice cloud scheme using sea surface temperatures (SSTs) of 300 (black) and 304 (red) K. b) Cloud cover response to increasing SST. The purple, green, blue, and orange indicate the response for the total, thin, medium, and thick high clouds, respectively.

- The impacts of the saturation adjustment type approach to sub-grid-scale (SGS) ice clouds in a turbulence scheme on the high clouds and their response to global warming were investigated.
- The SGS ice cloud scheme modulated largely the high cloud covers and caused a significantly different response of high cloud amounts to global warming.
- Since the representation of high clouds is critical for the representation of climatological fields, the improvement of the treatment of SGS ice clouds physics in the turbulence should be desirable.