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Surface air temperature sensitibily to changes in land surface model thermodynamics and hydrology

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The Arctic region is particularly sensitive to global warming due to snow and sea ice dynamics, as well as to the strong positive feedback mechanisms that amplify Arctic warming response to forcing, such as ice-snow-albedo feedback or lapse-rate feedback. The presence of permafrost makes the Arctic also relevant for global climate, since Arctic soils contain large quantities of carbon with radiative feedback implications. Improved representation of the physical processes in frozen soils and considering different model variants allows for assesing uncertainties in permafrost related processes. In this study several experiments with different set-ups of the Arctic thermo-hydrodynamics will be analyzed in order to understand how different parametrizations in permafrost areas affect Earth's climate and in particular the surface temperature in the Arctic. Those set-ups also account for different vertical discretizations of the land model. The different model configurations lead to relatively different climate background states in the Arctic, with the different vertical discretization set-ups playing a minor role. A positive sea-ice-snow-albedo feedback is shown to enhance the warming signal under a climate change scenario. The magnitude of the feedback depends on the background state and available snow and sea-ice. By assessing the Arctic amplification ratio (AA) we conclude that all configurations show considerable (internal) AA variabillity in the 20th and the first quarter of the 21st century, but end up converging to a factor of 2-3 times larger warming in the Arctic regions than globally by the end of the century. This suggests that high AA values recently found in observations are related to internal variability.