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First Author	
First Name	Sven (1)
Last Name	Kotlarski
Submitting Author	
First Name	Sven Thomas
Last Name	Kotlarski
Correspondence	sven.kotlarski@meteoswiss.ch
Co-Authors >> E-Mails will be not listed	Steger, Christian R. (2); Bülow, Katharina (3); Teichmann, Claas (3)
Organisations	1: Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland 2: Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland 3: GERICS Climate Service Center Germany, Hamburg, Germany
Country	Switzerland
Region	Western Europe

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Abstract

Large parts of the world, including many mountain regions, have experienced a decline of surface snow cover during the last decades as a response to global warming. With climate projections indicating a progression of this warming trend, surface snow cover is generally expected to further decrease. One way to quantify the future snow cover evolution is to force dedicated physical snow pack models at local, regional or even continental scale with post-processed output from global or regional climate models. The latter, however, do incorporate interactive snow cover models as part of their land surface parameterization schemes, thus enabling the analysis of past and future snow cover variability and trends in the climate models themselves. With the advantage of being fully and interactively coupled to the simulated atmospheric state, these schemes are typically of a simplified nature and generally operate at the rather coarse grid cell resolution of the embedding climate model. However, past works have revealed the general usability of climate model-simulated snow cover.

In this contribution we exploit the most recent regional climate model ensemble for Europe as provided by the EURO-CORDEX initiative at a spatial resolution of 12 km for deriving estimates of the future snow cover evolution over Europe, including a number of high mountain ranges. A dedicated validation exercise compares several simulated snow indicators in the historical period against a range of reference datasets and mostly reveals a satisfying performance of the simulations. On a European scale mean annual snow cover duration, for instance, is well captured by the ensemble mean of the models. In regions with complex topography, winter snow water equivalent can however be distinctively overestimated and certain grid cells reveal unrealistic glaciation (i.e. year-round snow coverage). These shortcomings can be partly attributed to inaccuracies in the simulated atmospheric forcing, i.e. to biases in air temperature and/or precipitation. Snow cover scenarios for the 21st century show a distinct reduction in snow cover duration for low elevation regions, with the magnitude of this decrease depending, amongst other factors, on the emission scenario considered. Projected decreases in snow cover are typically less pronounced for medium to high-elevation regions. These results generally confirm regional assessments obtained by driving snow pack models with climate model output in an offline mode and, thereby, highlight the potential of climate model-simulated snow cover as an additional or alternative data source.