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European snow cover in a changing climate: An analysis of the EURO-CORDEX regional climate model ensemble

Sven Kotlarski (1), Claas Teichmann (2), Andreas Gobiet (2), and the EURO-CORDEX Team

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland, (2) Climate Service Center 2.0 (CS2), Hamburg, Germany, (3) Central Office for Meteorology and Geodynamics (ZAMG), Graz, Austria

Surface snow cover plays an important and interactive role in global and regional climate systems. For this reason, state-of-the-art climate models employ snow parameterization schemes of differing complexity that simulate the snow cover response to climate change and climate variability and that allow for an approximate representation of snow-atmosphere feedbacks. A dedicated validation of snow cover characteristics simulated by climate models can provide valuable insight in the accuracy of the feedback representation and in the origin of, for instance, near-surface temperature biases. The analysis of scenario simulations provides estimates of future snow cover changes on continental and sub-continental scales as a response to rising greenhouse gas concentrations, complementing smaller-scale snow cover scenarios obtained from dedicated cryospheric impact models.

We here present a first analysis of surface snow cover characteristics in the recently established EURO-CORDEX regional climate model (RCM) ensemble, considering simulations with grid spacings of both 12 and 50 km. The analysis covers snow cover validation in ERA-Interim-driven hindcast simulations as well as the assessment of 21st century snow cover changes over different parts of Europe. A particular focus is on the European Alps, a region with a high economic vulnerability with respect to the anticipated snow cover reduction.

Model evaluation against satellite-derived and surface-based observational datasets reveals an approximate reproduction of spatio-temporal snow cover variability over Europe by the RCMs. In the Alps, however, high-elevation snow mass can be considerably overestimated by individual models. This feature is likely connected to cold high-elevation temperature biases. 21st century snow cover scenarios show an almost complete loss of snow cover in low-elevation regions, largely confirming previous works. The rate of snow cover decrease strongly depends on the warming magnitude and, consequently, on the choice of the emission scenario. Percentage snow cover reductions are less pronounced at medium to high-elevations.