EGU24-6297, updated on 08 Feb 2025
https://doi.org/10.5194/egusphere-egu24-6297
EGU General Assembly 2024

Investigating the usage of physically modeled snow cover vs. webcam-based snow cover for driving plant species distribution models

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Snow is a crucial factor determining plant species distributions in alpine and arctic environments. Therefore, metrics like the duration of snow cover are important predictors to model plant distributions. Many studies employed snow cover metrics derived from optical satellite image time series. Such satellite-derived observations are easily accessible and highly consistent, making them a viable choice for current and past conditions. However, an inherent limitation is their applicability for future projections of snow cover, which is only possible by establishing statistical relationships to ancillary data sets. Snow cover simulated by a physically-based snow model could circumvent these constraints, but it was rarely employed for predicting alpine plant species distributions. Increasing availability of input data, computational power and data sets for validation nowadays allow for modeling at reasonably high resolutions.

To this end, we report first results of several modeling experiments, to quantify the differences of using snow cover metrics derived from webcam time series and modeled snow data for a study site of approximately 5 km² in the Stubaier Alps (Tyrol, Austria). Melt-out date is one of most commonly used snow metrics in species distribution models. Hence, we derive the melt-out dates from two seasons (2022 and 2023) of webcam-based and modeled snow cover. Subsequently, we modeled the distribution of 79 plant species with the melt-out dates as predictors along with several proxies for topographic heterogeneity at spatial resolutions of 1 m and 20 m in order to account for the small-scale variability of snow cover in alpine landscapes. The study demonstrates how the usage of modeled and observed snow data affects modeling of high-alpine vegetation distribution. These insights are important for appropriately designing species distribution modeling studies based on modeled rather than observed snow data.

Acknowledgements: This work has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 883669).