Comparison of in situ and drone-based lidar snow depth measurements in a forested subalpine region

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An existing research gap in hydrological research is the remote capture of snow accumulation and interception dynamics in forested regions, as remote sensing approaches still struggle to resolve sub-canopy snow distributions. The goal of this research is to assess the utility of high-resolution, drone-based lidar for the study of snow accumulation and redistribution in a forested subalpine region. The study specifically examined how various parameters such as canopy coverage, snow-on-trees and subsampling resolution influenced the agreement between lidar and in situ observed snow depth. In situ and drone measurements of snow depth were captured approximately every two weeks over a calendar year on a subalpine ridgetop. In situ snow depth measurements were taken at fixed locations between-trees and within tree-wells across the study site. High-resolution drone-based lidar (~1000 pts m-2) was collected each day and subsampled into a range of DEM resolutions. Lidar snow depths are consistently biased lower than in situ snow depths for both areas in between trees (mean bias: - 7 cm) and within tree wells (mean bias: - 8 cm). Subsampling resolution has minimal impact on lidar snow height bias and RMSE between 1 cm and 50 cm subsampling resolutions, after which snow depth RSME begins to increase. The prospects for estimating canopy intercepted snow load from LiDAR and expanding the existing research into snow water equivalent mapping are discussed.