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SMALL SCALE VARIABILITY IN SNOW ACCUMULATION AND ABLATION UNDER A HETEROGENEOUS MIXED-CONIFER CANOPY

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The spatial patterns of snow accumulation and melt in forested watersheds directly control runoff generation processes and the annual quantity and quality of available water to downstream receiving waters. In the western U.S. nearly three quarters of the annual water input into the hydrologic cycle comes from snow accumulation and melt in forested watersheds. This provision of water is one of the most important forest ecosystem services and is necessary for ecological, economic and social health. Despite our understanding of the coupling of forests and watersheds, the relationship between forest spatial patterns and snow hydrology is poorly understood. Forest canopies exhibit heterogeneity manifested as a mosaic of differing species, spatial arrangements, and canopy densities that differentially intercept incoming precipitation, alter wind patterns, and absorb, trap or reflect radiation; controlling the processes of snow accumulation and ablation. Vegetation patterns have been used as surrogates for processes where we expect that spatially recognizable structures give rise to specific ecological processes and vice versa. We investigated how spatial patterns of snow depth, density, snow water equivalent (SWE), and snow disappearance date (SDD) varied within stands of heterogeneous canopy structure. We collected 780 empirical measurements of snow depth, density, and SWE at peak accumulation on two fully georeferenced, mixed-conifer plots at Lubrecht Experimental Forest in western Montana. Throughout the 49 day melt season, we monitored SDD, snow depth, and SWE every third day with 4900 samples per campaign. In 2014, snow depth, density and SWE ranged from 0.0-67.31 cm, 5.43-49.76%, and 0.75-17.90 cm respectively. A canopy competition index ranged from 0.0-86.8 with non-forested areas averaging 11.5 cm SWE, melting around day 41 compared to mature dense canopy with average SWE of 5.1 cm and a SDD around day 9. This preliminary work suggests a strong linkage between canopy structure and accumulation and snowmelt processes. In the future we seek to link canopy patterns and the specific physical mechanisms that lead to differential snow dynamics in forested landscapes. This understanding is essential for improving process-based models and tools for forest managers to optimize forest water resources in a changing climate.