Canadian Rockies Hydrological Observatory Process and Aerial UAV Measurements 2022

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The Canadian Rockies Hydrological Observatory (CRHO) is a network of seven alpine research catchments that are instrumented with 30 hydrometeorological and hydrometric stations and regular snow survey transects. Some of the basins (Marmot Creek, Peyto Glacier) have been instrumented since the early 1960s, and some (Fortress Mountain, Helen Creek, Burstall Creek, Athabasca Glacier) were instrumented about 10 years ago. CRHO aims to improve the understanding of and capacity to predict the changes in water yield from headwater basins where cold climate processes predominate. CRHO advances mountain headwater hydrological prediction capability by serving as a generator of information that advances hydrological understanding, a test bed for hydrological process and climate downscaling algorithms, and a validation site for models. Recent applications of UAV-borne LiDAR and structure from motion remote sensing have provided unprecedented detail on the retreat of Peyto Glacier, the accumulation, redistribution and ablation of snowpacks in complex terrain, near shrubs and under needleleaf forest canopies. Peyto Glacier has retreated 329 m from 2019-2022 with ablation of 6.5 m per year near the toe. The glacier is not flowing near the toe and so is functioning as an ice reservoir as it nears the end of its existence. Modelling its hydrological response to the anomalous Western North American heat wave of 2021 with CRHM shows record melt and a substantial increase in streamflow generation. In the last winter a comprehensive snow interception, unloading, redistribution, sublimation and ablation study was initiated on a forested subalpine ridgetop in Fortress Mountain Research Basin. A 15 m canopy access tower was used to support an eddy correlation system to measure above canopy, sensible and latent heat fluxes, a net radiometer and a weighed, suspended full size fir tree. Below the canopy, three suspended, weighed 'horse-watering troughs' were used to measure sub-canopy throughfall and unloading; a network of rain gauges measured sub-canopy rainfall and drip and an eddy correlation system and net radiometer measured sub-canopy sensible and latent heat fluxes and short and longwave radiation 3 m above the ground. This site had frequent and intensive snow surveys and UAV-born LiDAR flights to measure the sub-canopy snow surface. Initial findings suggest that the concept of canopy snow interception capacity is challenging to quantify, even in a heavy snowfall environment, that wind redistribution of snow from the canopy and from the snowpack can be an important process in sub-alpine environments