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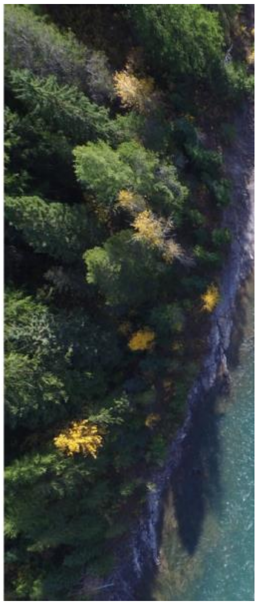
Informing Land & Resource Management

Axel Anderson

Identifying high-runoff areas during peak streamflow on the Eastern Slopes of the southern Canadian Rocky Mountains

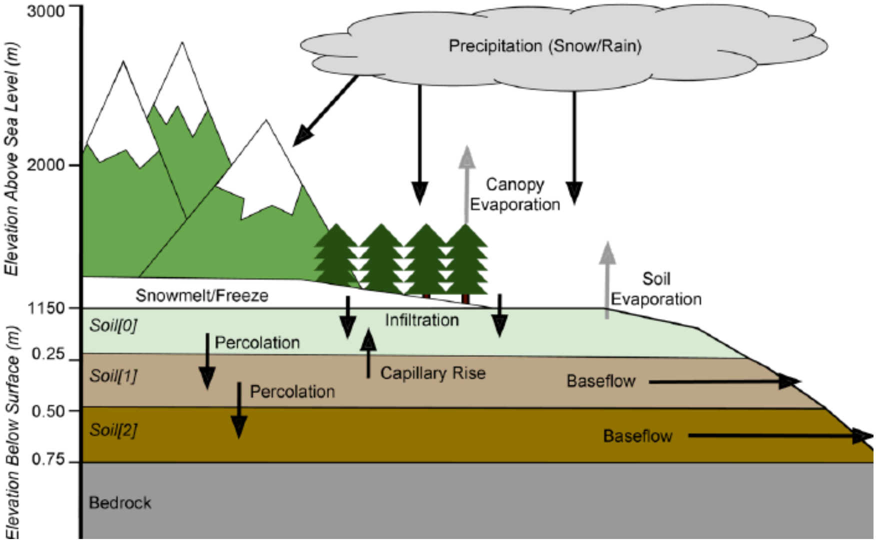


In forested landscapes, vegetation has high potential to modify the timing and quantity of water delivery from these systems, most notably peak streamflow. Changes to the quantity and timing of peak streamflow can alter stream channel morphology and sediment transport characteristics in watersheds, ultimately affecting downstream water users and aquatic ecosystem function and structure. Removal of forest vegetation generally increases snow accumulation and melt rates, and consequently increases the average and peak streamflow originating from forested watersheds. Several studies have also identified that certain elevation zones contribute disproportionately to peak streamflow. Lower elevation areas typically contribute less total runoff, and this runoff also primarily occurs prior to freshet. By comparison, higher elevation areas receive more precipitation, generate substantially greater runoff, and snowmelt coincides with peak streamflow.

This study identifies and maps areas that contribute the greatest amount of runoff to peak flow periods for watersheds across the Eastern Slopes of the southern Canadian Rocky Mountains in Alberta, Canada. This work relates to current techniques for watershed assessment combined with hydrological modelling and seeks to improve our understanding and evaluation of risks to water resources as a result of forest management in Alberta's Eastern Slopes. Identification of the zone of greatest runoff generation during peak streamflow will allow forest managers to evaluate the potential impacts of management activities in these sensitive areas based on recent advances in forest hydrology and watershed science.

Results

Peak annual streamflow in the study area generally occurred during late-May to early July in high-elevation sub-basins, coinciding with spring snowmelt, and throughout the ice-free season in low-relief sub-basins, where a lower snowpack led to a more rainfall-dominated peak streamflow signal. Areas of the highest runoff during the peak flow period were generally located between 2000 m and 2500 m in high-elevation sub-basins, and at the highest attainable elevations in low-elevation sub-basins (1800 m to 2200 m).



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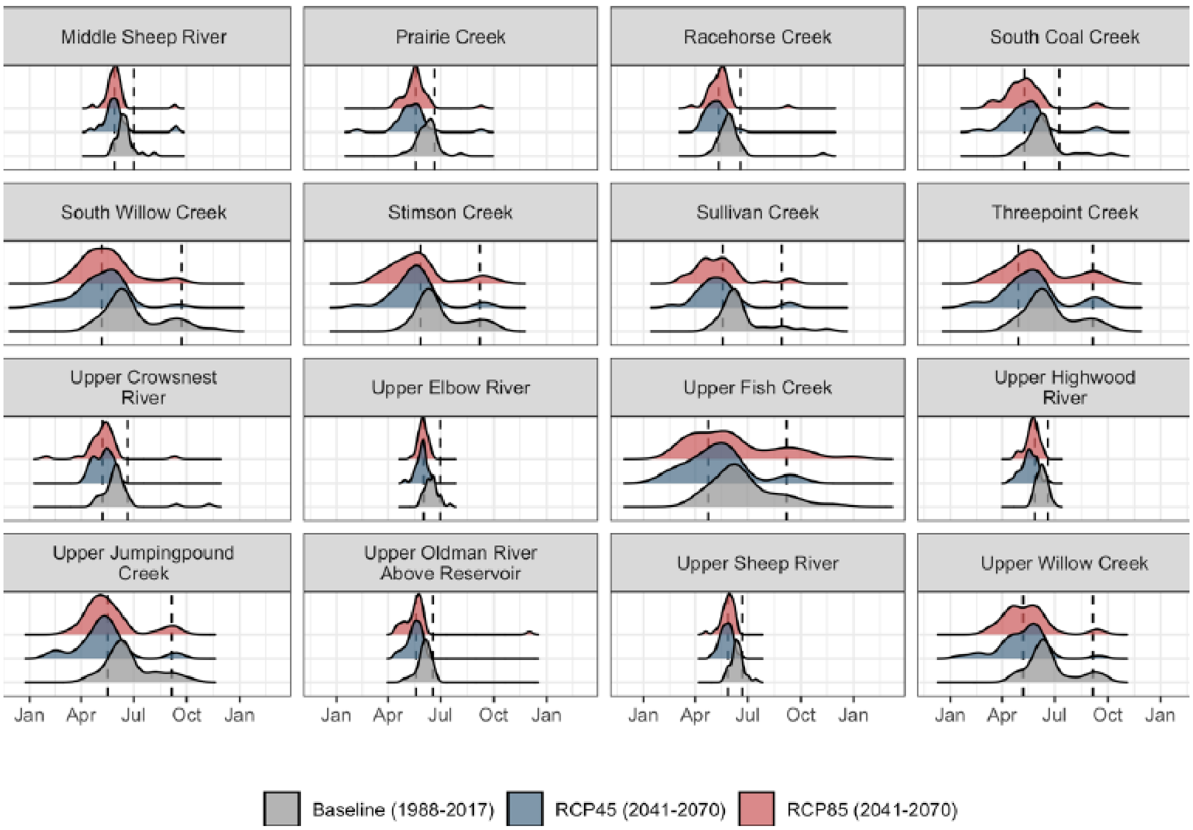
Runoff during the peak flow period was highest along more westerly portions of the study area where precipitation, particularly during winter, was higher.

Under climate change scenarios, runoff during the peak flow period generally increased at higher elevations and decreased at lower elevations, but there was marked variability in this response between sub-basins. In general, runoff increased at all elevations in high-precipitation streams and sub-basins, while drier and warmer areas generally experienced less runoff at higher elevations during the peak flow period.

In the future, we project that runoff during the peak flow period will increase due to higher air temperatures and higher winter precipitation leading to a synchronized and more rapid snowmelt period, particularly in high-elevation sub-basins. This suggests that these environments will become even more hydrologically sensitive to forest disturbance in the future. Results from hydrological modelling suggest that harvest in areas further east and at lowest elevations where runoff is lower could minimize the effect of forest disturbance on streamflow during the peak flow period.



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