**Predicting changes in stream temperatures using LiDAR-derived simulations associated with harvesting of forest buffers**

Riparian zones are the corridor of vegetation between a stream network and the upland forest. Sustainable forest management of riparian zones is essential to maintaining the key ecosystem services they provide to stream systems and mitigating potentially harmful effects of forest harvesting on stream processes. Riparian buffers are the primary tool used to protect stream habitat for anadromous salmonids, which are ecologically, economically, and culturally important keystone species in North America. In British Columbia, Canada, riparian buffers consist of a nested harvesting/retention scheme, in which a total Riparian Management Area (RMA) can have varying levels of harvesting, from partial thinning to a clearcut.

Critically, riparian buffers provide shade to a stream by attenuating solar insolation and therefore regulating temperature, as insolation at the stream surface is the primary driver of stream thermal regimes. Harvesting of near-stream vegetation and removal of stream shading can increase stream temperatures by more than 10° C, raising stream temperatures to levels potentially lethal for salmon and other aquatic species. Changes in climate have the potential to directly contribute to warming stream temperatures and drought conditions in watersheds, thereby emphasizing the importance of the management of riparian buffers.

While light detection and ranging (LiDAR) data from Remotely Piloted Aircraft Systems (RPAS) have previously been utilized to create models of insolation and shading from canopy height models (CHMs), few studies have linked these models to stream temperatures. To determine the effects of different management strategies, we also used solar insolation models with simulations of varying forest harvesting intensities to estimate the increase in stream temperature associated with removal of riparian forest stands.

RPAS data were acquired over five stream segments in a watershed on Vancouver Island, Canada. The resulting CHMs were used to create insolation models, which in turn were used as an explanatory variable in a quadratic regression with water temperature as the response variable. Models revealed that solar insolation modeled from RPAS point clouds explained up to 90% of the variation in stream temperature.

Harvesting simulations were created by using an individual tree detection (ITD) algorithm to identify tree crowns and remove a certain percentage of trees (25% and 50%, respectively) from the CHM. These “thinned” CHMs were then added to a bare-earth digital elevation model (DEM) and input to the insolation model. A full bare-earth DEM was used to simulate a complete harvest of the RMA. The regressions were then used to generate predictions of stream temperatures using these simulated insolation values as the explanatory variables.

Simulations of riparian forest thinning predicted an increase in stream temperatures by an average of 1°C, with clearcutting of the RMA corresponding to a predicted increase of approximately 6°C. While harvesting of streamside stands is known to increase stream temperatures, RPAS-acquired LiDAR data can be used to gauge the potential impact of riparian forest harvesting on stream temperatures at high spatial resolutions before forest operations begin. These predictions could be crucial to preserving the populations of aquatic species such as salmonids in the face of a changing climate.