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Variability in space and time of water and solute delivery to the stream network

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The spatial and temporal variability of water delivery mechanisms to the stream network was examined in the Cotton Creek Experimental Watershed (CCEW), a 17 km2 snow-dominated watershed located in south-eastern British Columbia, Canada. Our objectives were 1) to determine the first order controls on water delivery mechanisms from the scale of the hillslope to that of the whole watershed and 2) to highlight the shift in nature of these controls as the flow regime evolves from peak flow to low flow.

Following a scale connecting approach, we conceptualized the watershed as an aggregation of elementary contributing areas (ECA), each representing the incremental addition of drainage area along a stream reach. Cotton Creek's stream network was divided into 54 reaches, with ECA's ranging from 1.5 to 146 ha in size. Discharge and electric conductivity measurements at both ends of each reach were carried out in order to compute the net budget over the length of the reach. Streamflow gauging campaigns were repeated from freshet to baseflow periods for years 2006-2008. Preliminary investigations showed that delivery from ECA was poorly explained by contributing area only. Incremental discharge measurements were then regressed against topographic variables, spatially distributed input data (snowmelt and rain), forest cover and geological information. Water delivery mechanisms were mostly controlled by the spatial variability of water input during the freshet seasons. Topographic controls became dominant as the flow receded. Controls on water delivery during low flows were difficult to identify, probably due to a greater uncertainty characterizing discharge measurements and resulting discharge increments.

This approach is aimed at identifying emergent behaviors between the ECA and watershed scales. It also offers a temporally dynamic definition of first order controls on water delivery to the stream network, which can help refine hydrological models.