Simulation of snow transport and sublimation in an agricultural river catchment, southern Québec, Canada

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Background and Introduction

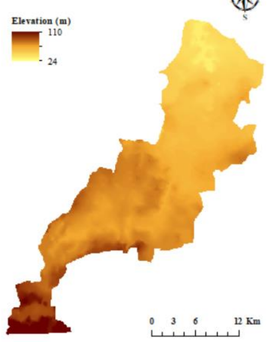
In catchments dominated by windswept, exposed landscapes, blowing snow redistribution and sublimation can be critical in determining the snow accumulation and snow water equivalent (SWE). Since SWE strongly impacts the magnitude and timing of the snowmelt contribution to streamflow, there is a need to better understand and represent blowing snow processes within hydrological models.

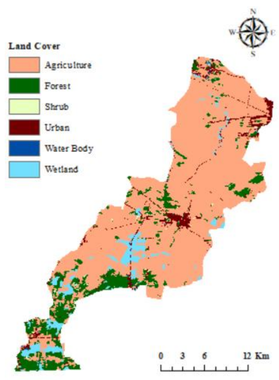
Objectives:

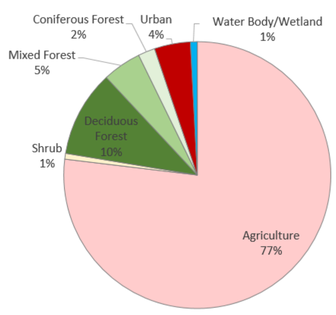
- To simulate blowing snow processes including snow transport, snow interception in canopies and sublimation.
- To compare the resulted snow water equivalent (SWE) values among different landscape units.

Study Site

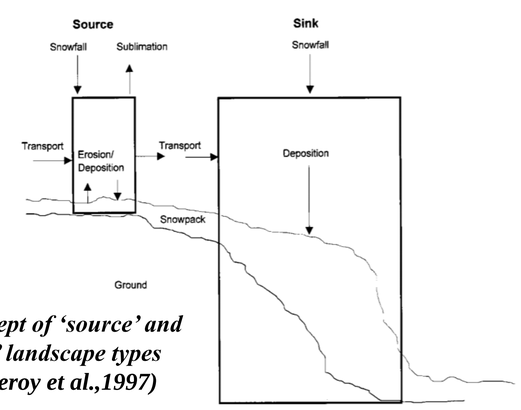
Acadie River catchment







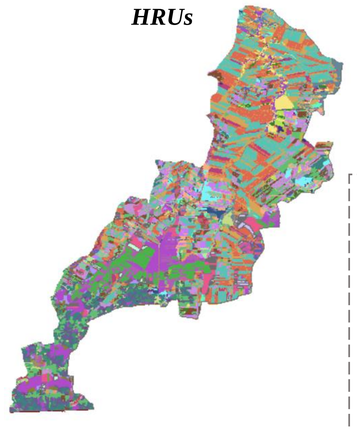
Method

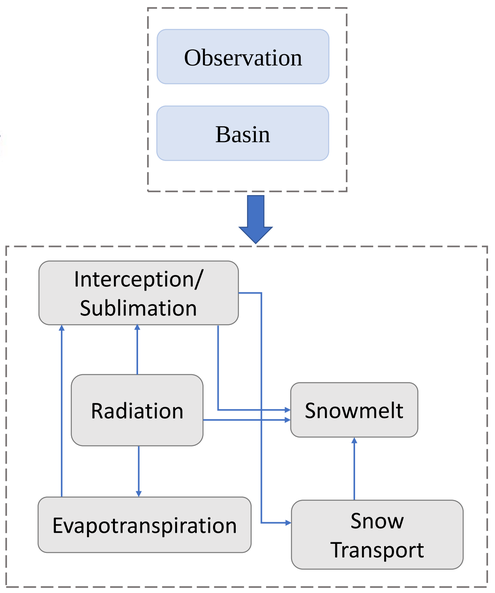


Concept of 'source' and 'sink' landscape types (Pomeroy et al.,1997)

Cold Regions Hydrological Model (CRHM)

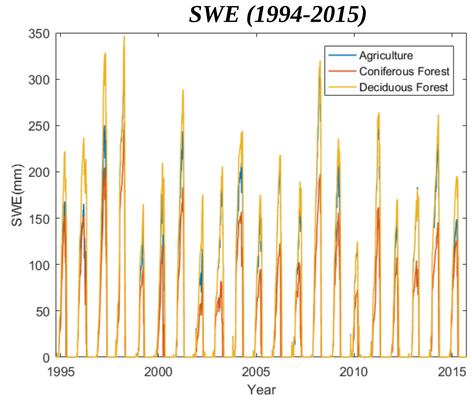
HRUs



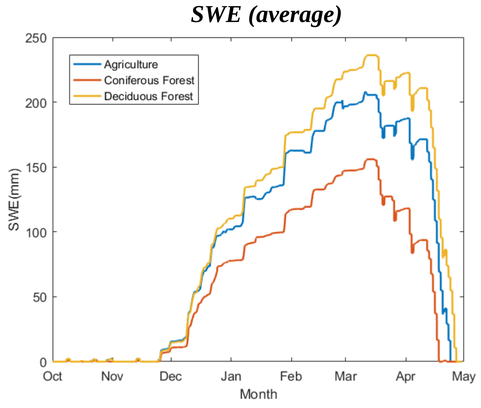


Results

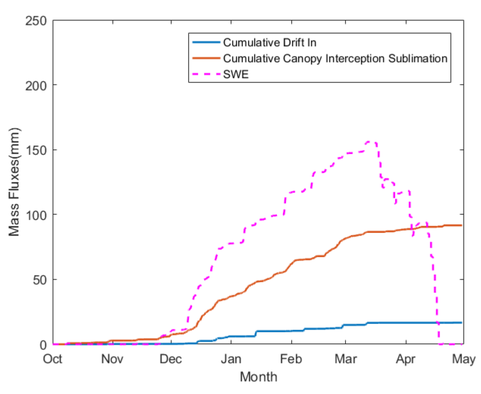
SWE (1994-2015)



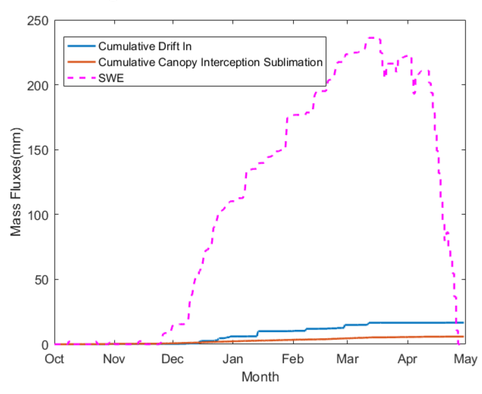
SWE (average)



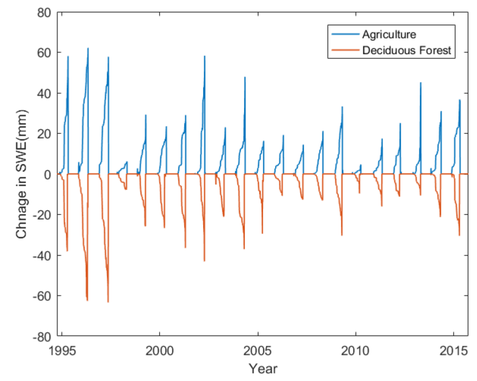
Average Mass Fluxes in Coniferous Forest



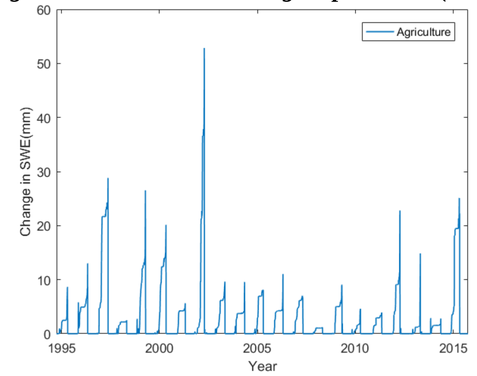
Average Mass Fluxes in Deciduous Forest



Change in SWE with inhibiting blowing snow



Change in SWE with maintaining crop residues (50cm)



Conclusions

Snow accumulation and associated SWE were found to be higher in deciduous forests than in agricultural sites. Snow erosion of agricultural fields and snow deposition in deciduous forests seem to compensate canopy losses. On the contrary, great amounts of snow interception in canopies and its sublimation before reaching the ground were responsible for lower SWE in coniferous forests.

In addition, the maintenance of the crop residues (conservation tillage practice) resulted in higher SWE in the agricultural sites compared to the case where all the residues are removed (conventional tillage practice). This outcome indicates that a change towards conservation tillage practice would be critical in managing and conserving snow water for use in agricultural production.

Taken together, it is shown that land use type and the associated roughness exert a critical control on snow distributions in this type of landscape, and perhaps on possible implications for future snow hydrology of the catchment.

References

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Pomeroy, J. W., Marsh, P., & Gray, D. M. (1997). Application of a distributed blowing snow model to the Arctic. *Hydrological processes*, *11*(11), 1451-1464.

Pomeroy, J., D. Gray, T. Brown, N. Hedstrom, W. Quinton, R. Granger, and S. Carey (2007), The cold regions hydrological model: a platform for basing process representation and model structure on physical evidence, Hydrological processes, 21(19), 2650-2667.