Analysis of Snowmelt and Autumn Storm Events Along a Newfoundland and Labrador Boreal Ecosystem Longitudinal Transect

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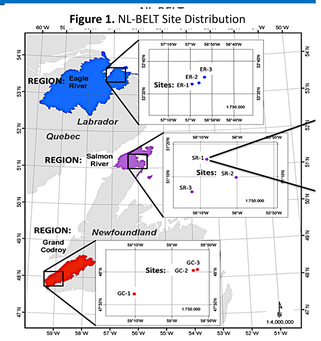
Introduction

Water flux in the boreal forest of Newfoundland and Labrador varies by location and has been changing throughout time. This study outlines characteristics of water flux in the boreal forest of Newfoundland and Labrador based on timing and magnitude of events across a longitudinal transect and with respect to time. Detailing changes in hydrological responses for this region can guide future research in understanding how dissolved organic carbon (DOC) is mobilized.

Figure 1. NL-BELT Site Distribution



(Bowering et al., 2019)

Hypotheses

H1: a.) Snowmelt peak discharge and b.) autumn peak discharge increase in magnitude from north to south along the latitudinal gradient.

H2: a.) The start dates (onset) of snowmelt and b.) the date of peak snowmelt discharge occur earlier annually for all sites.

H3: Snowmelt peak discharge is decreasing in magnitude at all sites with respect to time.

H4: The peak discharge or autumn water flux after autumn ET shutdown (to include September and October) is increasing for all sites.

Methods: Data Acquisition

Environment Canada data were obtained for stream gauges in each of the 3 locations to obtain the timing and magnitude of snowmelt and autumn peak discharges for each year (fig. 2). These data were analyzed to determine whether the timing or magnitude of each type of discharge event has changed with time. A total of 8 Environment Canada sites were selected for analysis. The gauges were located in the 3 regions of varying latitude.

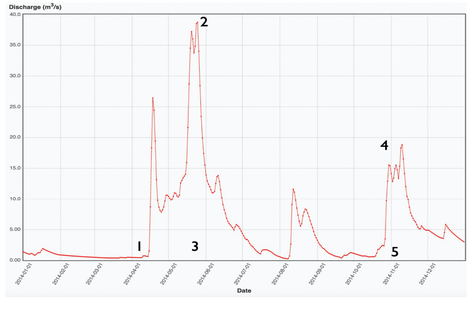


Figure 2. Discharge Vs. Time hydrograph example indicating:

1: Start date of snowmelt
2: Maximum discharge of snowmelt period
3: Date of maximum discharge of snowmelt
4: Autumn maximum discharge
5: Date of Autumn maximum discharge

Methods: Trend Analysis

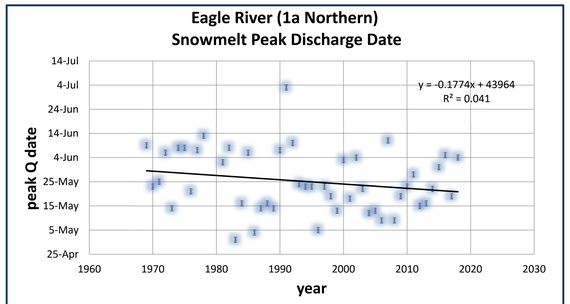


Figure 3. Trend analysis was conducted on) discharge timing and magnitude (5 parameters for each of the 8 stream gauges. Example: Timing of Snowmelt Peak Q

Results H1

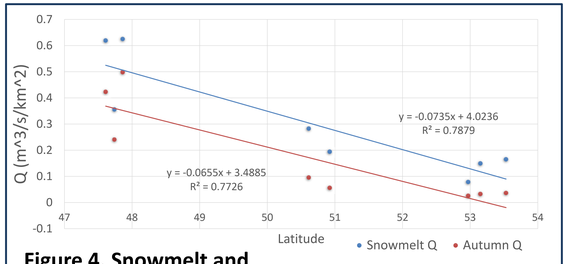


Figure 4. Snowmelt and Autumn discharge analysis shows larger discharge values in the south.

Snowmelt Q:
t stat = -10.8
crit value = 1.98

Autumn Q:
t stat = -16.1
crit value = 1.66

Results H2

Figure 5. Temporal Trend Snowmelt Start Date

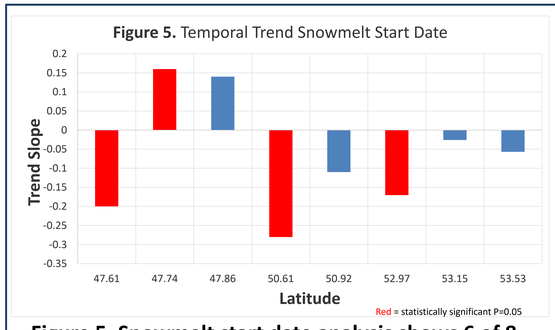


Figure 5. Snowmelt start date analysis shows 6 of 8 sites experienced an earlier start date.

Figure 6. Temporal Trend of Snowmelt Peak Date

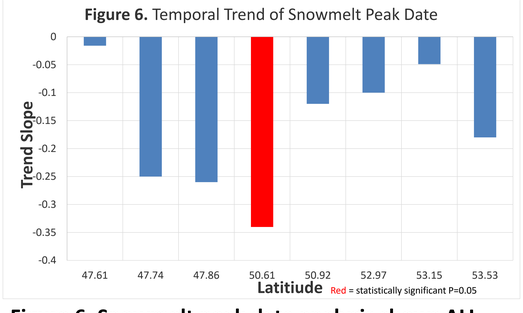


Figure 6. Snowmelt peak date analysis shows ALL sites experienced an earlier peak date.

Results H3

Figure 7. Temporal Trend of Snowmelt Qp/Basin Area

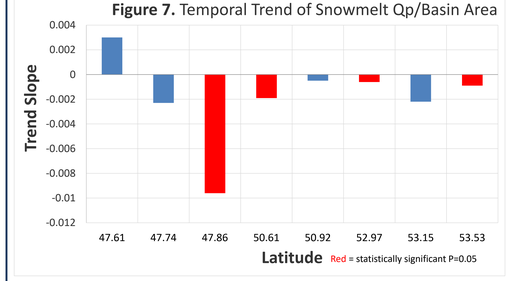


Figure 7. Snowmelt discharge analysis shows 7 of 8 sites expressed a decrease in magnitude.

Results H4

Figure 8. Temporal Trend of Autumn Qp/Basin Area

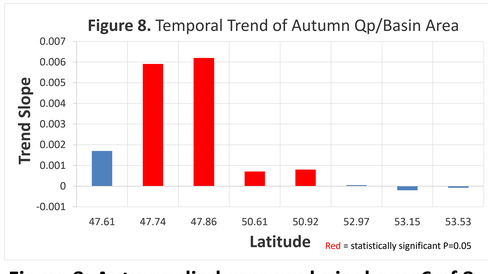
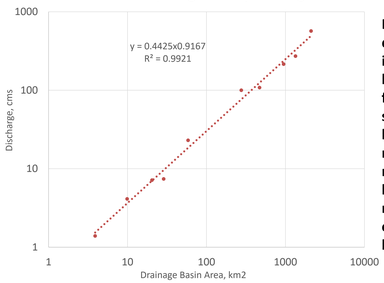


Figure 8. Autumn discharge analysis shows 6 of 8 sites expressed an increase. A stronger increase trending south.

Scaling Relationships

Figure 9. Average Peak Snowmelt for Sites in the same Hydrogeomorphic Region



Future work:

Figure 9. demonstrates there is attenuation as the basin area increases for sites from the same hydrogeomorphic region. There is a need for outlining hydrogeomorphic regions to enable comparison across basin sizes

Conclusions

Hypotheses

- H1. The magnitude of snowmelt and autumn discharge is higher at lower latitudes. Supported
- H2. All sites, with the exception of two, experienced earlier start dates of snowmelt. Supported for 3 of 4 significant sites.
- H2. All sites experienced earlier dates of maximum snowmelt discharge. Supported for 1 of 1 significant site.
- H3. Snowmelt discharge peaks are decreasing as warming occurs, most noticeable at lower latitudes. Supported for 4 of 4 significant sites.
- H4. Autumn peaks tend to be increasing. Supported for 4 of 4 significant sites.

This is one of the first studies observing changes in autumn discharge peaks, finding that southernmost autumn peak discharge is significantly increasing.

Significant results and presence of trends demonstrate changes to hydrologic characteristics for Newfoundland and Labrador.

The observed trends, by location and by timing, will be useful to future research on carbon flux in this region.

Acknowledgements and References

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