Supplementary Material

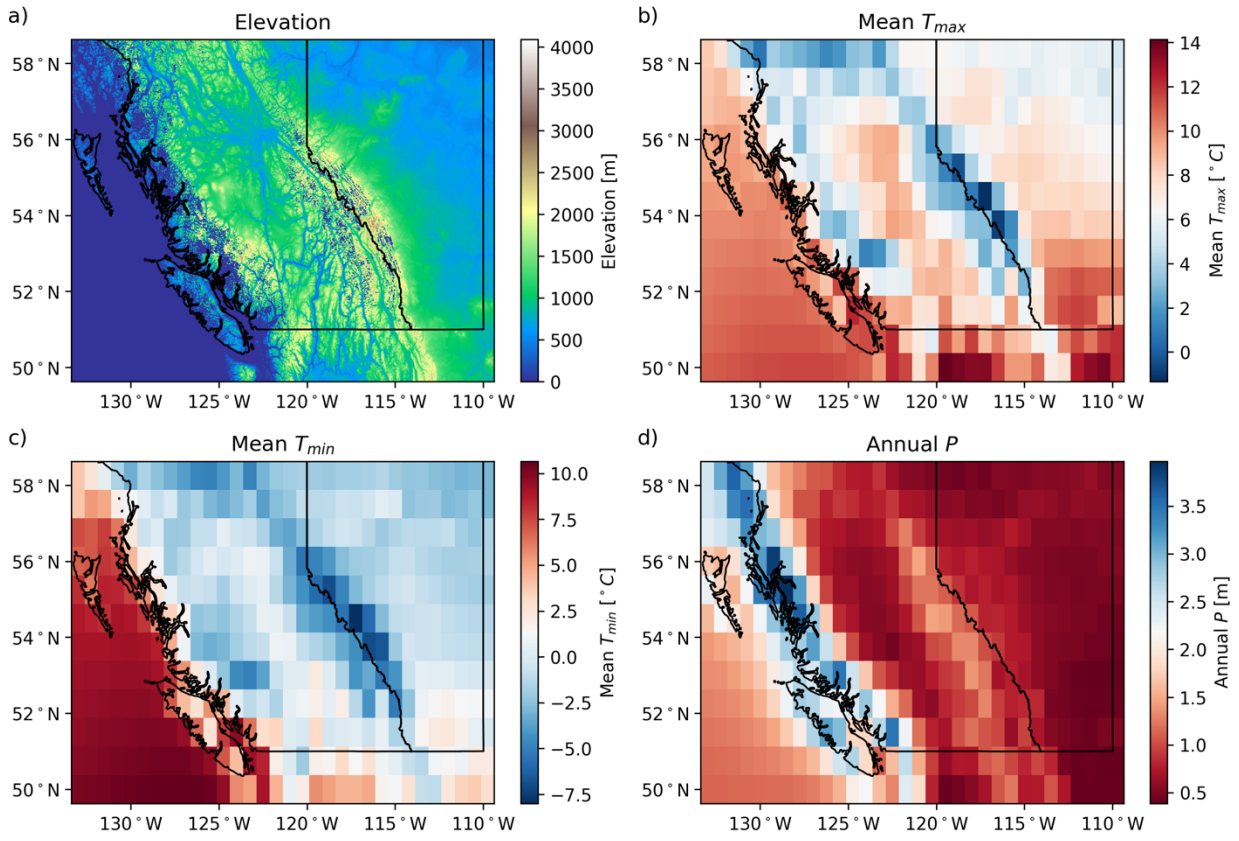
1 Supplementary Figure and Tables

1.1 Supplementary Tables

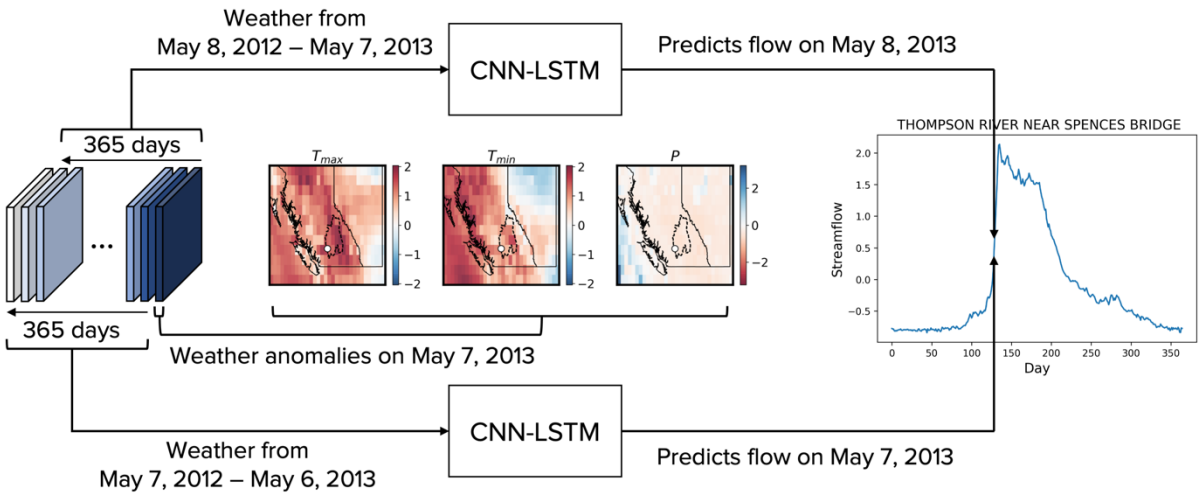
Table A1: Glacier coverage details of each geographically constrained stream gauge cluster.

Stream gauge cluster	Total within-basin glacier area [km^2]	Minimum G	Mean G	Maximum G
Central	7474.5	0	0.05	0.59
Southern	93.7	0	<0.01	0.02
Eastern	0	0	0	0
Coastal	0.6	0	<0.01	<0.01
North-western	2142.4	0	0.01	0.09
North-eastern	328.2	0	<0.01	<0.01

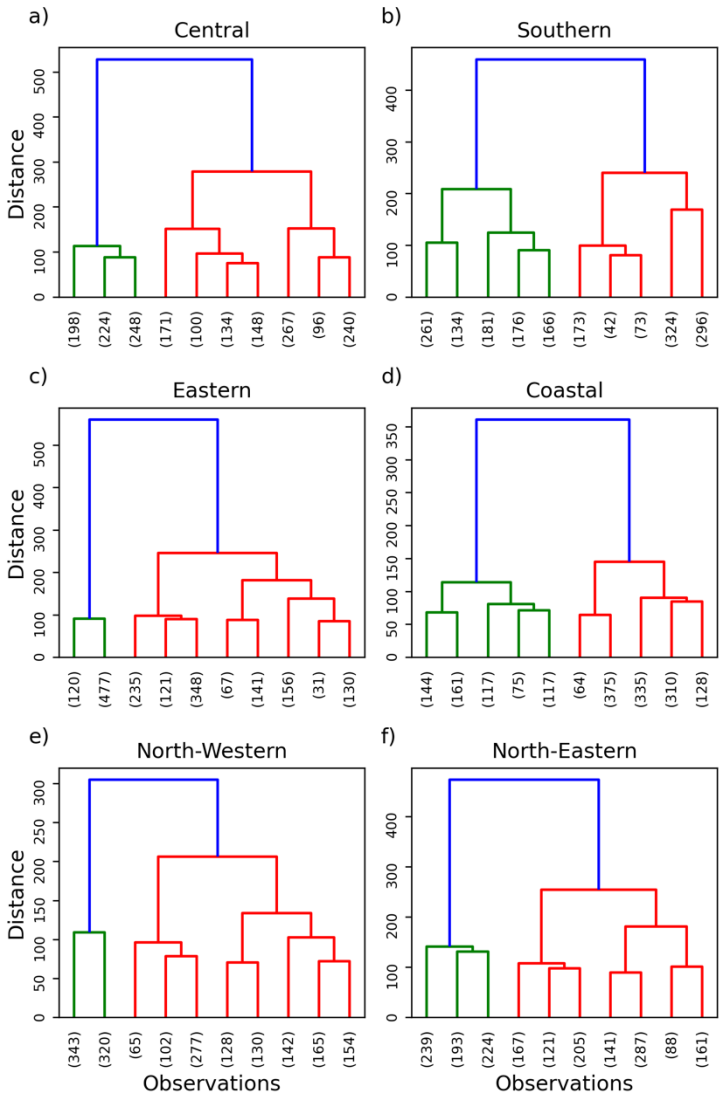
1.2 Supplementary Figures



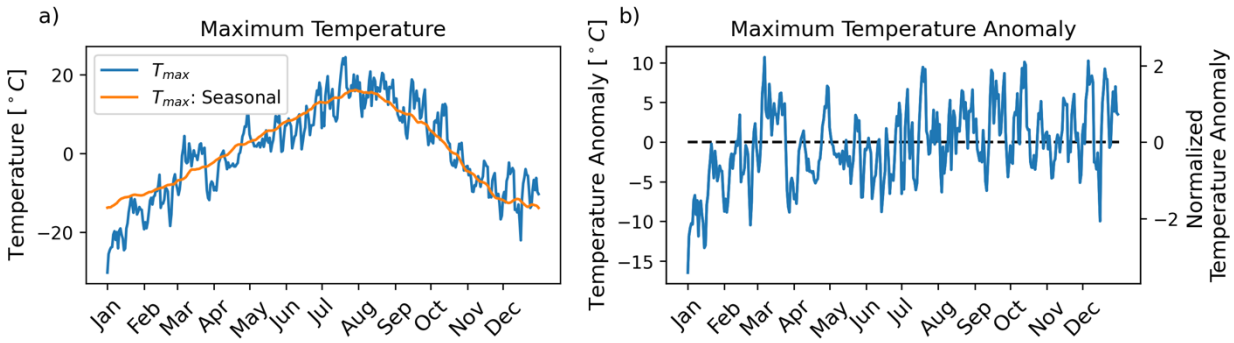
Supplementary Figure 1: Summary of the study region climate and topography. a) Topography of the study region as determined by the Shuttle Radar Topography Mission at 90 m spatial resolution (Farr et al., 2007). b) Mean annual maximum temperature, c) mean annual minimum temperature, and d) total annual precipitation, all for the period 1979 – 2015, from ERA5 climate reanalysis (Hersbach et al., 2020).



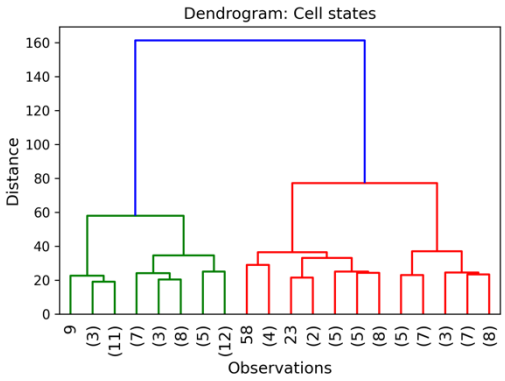
Supplementary Figure 2: Schematic outline demonstrating how antecedent flow-generating weather anomalies are determined. In this example, there is a substantial increase of modelled flow between May 7-8, 2013 at the Thompson River Near Spences Bridge. Weather from May 7, 2012 through May 6, 2013 is used to predict flow on May 7, 2013, while weather from May 8, 2012 through May 7, 2013 is used to predict flow on May 8, 2013. Temperature and precipitation on May 7, 2013, is new information to the model that causes the model to decide that flow should increase as compared to the previous day. Temperature on May 7, 2013 is warmer than normal within the basin, while precipitation is drier than normal within the basin.



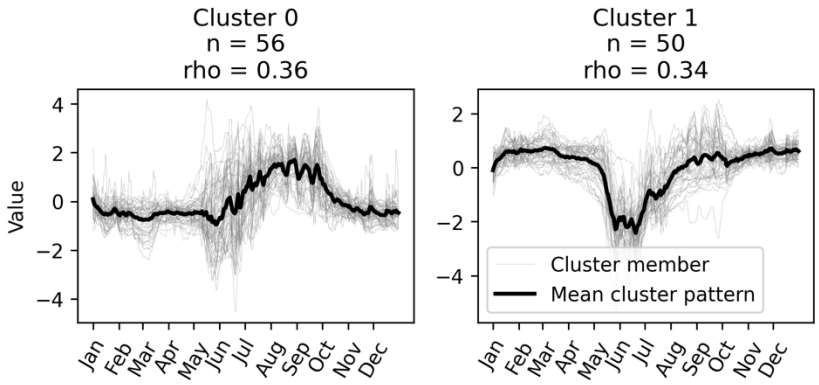
Supplementary Figure 3: The dendrograms for clustering the spatial patterns of sensitivity for each regional cluster of streamflow. The number in parentheses on the x-axis indicates the number of observations in each lower branch of the dendrogram. All regions can reasonably be divided into two clusters each, as indicated by the large vertical distance connecting the uppermost two branches.



Supplementary Figure 4: An example calculation of normalized temperature anomalies. a) One year of maximum daily temperature at one grid cell (x_1, y_1) and the seasonal cycle of $T_{max}(x_1, y_1, t)$ as calculated over 1979 – 2015. b) Maximum temperature anomalies are calculated by subtracting the seasonal cycle from the daily series of maximum temperature for this year and grid cell. The normalized temperature anomalies are scaled to have unit variance (right axis).



Supplementary Figure 5: The dendrogram used to cluster the set of cells states that are most strongly connected to basin glacier coverage. We choose to divide the set of cell states into two clusters.



Supplementary Figure 6: The clusters of cell states that are most connected to glacier coverage. We further investigate Cluster 0 because it most clearly resembles the expected shape of glacier runoff, with low values through winter, a gradual increase through spring and early summer, maximum values in July and August, and a decline through fall. Note that all cell states are normalized to have a mean of zero and unit variance before clustering.