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A watershed classification approach that looks beyond hydrology: application to a semi-arid, agricultural region in Canada

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Supplementary Data

Table S1 – Criteria and steps applied to select a study set of watersheds.

Variable	Threshold Criterion	Rationale	# watersheds after selection
Canadian watersheds within the prairie ecozone	Dataset constrained to watersheds completely contained within the prairie ecozone.	Focus candidate watersheds to the study region.	4729
Watershed area	Removed watershed with area greater than 4000 km^2 and less than 5 km^2.	Remove large and small watersheds to constrain the area of the watersheds included in analysis.	4359
Urban area	Removed watersheds where area of urban land greater than 40%.	Restrict candidate watersheds to those not highly impacted by urban development and infrastructure.	4329
Lake	Removed watersheds designated as entirely lake or reservoir (from HydroSHEDs dataset).	A binary variable coded in original dataset. We focused our analysis on terrestrial systems and thus removed those designated as lakes.	4180
Water area	Removed watershed where water area greater than 90%.	Second cleaning step to remove watersheds where a majority of area was inundated but not coded explicitly (as lake or reservoir) in the dataset.	4175

Table S2 – Types and sources of data used in cluster analysis.

Data	Dataset	Agency	Reference
Watersheds	HydroSHEDs	Academic	Lehner and Grill (2013)
Climate	CANGRID	Government	ECCC (2017)
Flow data	HYDAT stations, Water Survey of Canada	Government	ECCC (2016)
Water extent	Global Surface Water	Academic	Pekel et al. (2016)
Streams	Canvec series	Government	NRC (2016)
Surficial geology	-	Government (Provincial)	Atkinson et al. (2017), Matile et al. (2006), Simpson (2008)
Soil particle size classes, zone	Detailed Soil Survey	Government	AAFC (2013, 2015)
Land cover	Annual Crop Inventory 2016	Government	AAFC (2016)
Tillage practice	Census of Agriculture (2011, 2016)	Government	Statistics Canada (2016)

Table S3 – Components of compositional datasets. The physiographic dataset is shown in addition to the various classifications and components considered.

Dataset	Components
Surficial geology	Alluvial deposits
	Colluvial deposits
	Eolian deposits
	Glacial till deposits
	Glaciolacustrine deposits
	Glaciofluvial deposits
	Organic deposits
	Rock deposits
Soil zone	Dark grey
	Grey
	Black
	Dark brown
	Brown
Surface landform	Dissected
	Level
	Hummocky
	Rolling
	Undulating
Land cover	Forest
	Shrubland
	Grassland
	Pasture
	Cropland
	Fallow land

Table S4 – Mean and range of agreement of watersheds in the resampling and re-classifying analysis to the classification in Fig. 5. The minimum and maximum percent agreement are shown in parentheses.

Class	Percent agreement
1	84.0 (50.0-100)
2	97.4 (12.5-100)
3	86.5 (22.2-100)
4	53.4 (0.0-83.3)
5	96.5 (22.2-100)
6	98.7 (33.3-100)
7	97.8 (55.6-100)

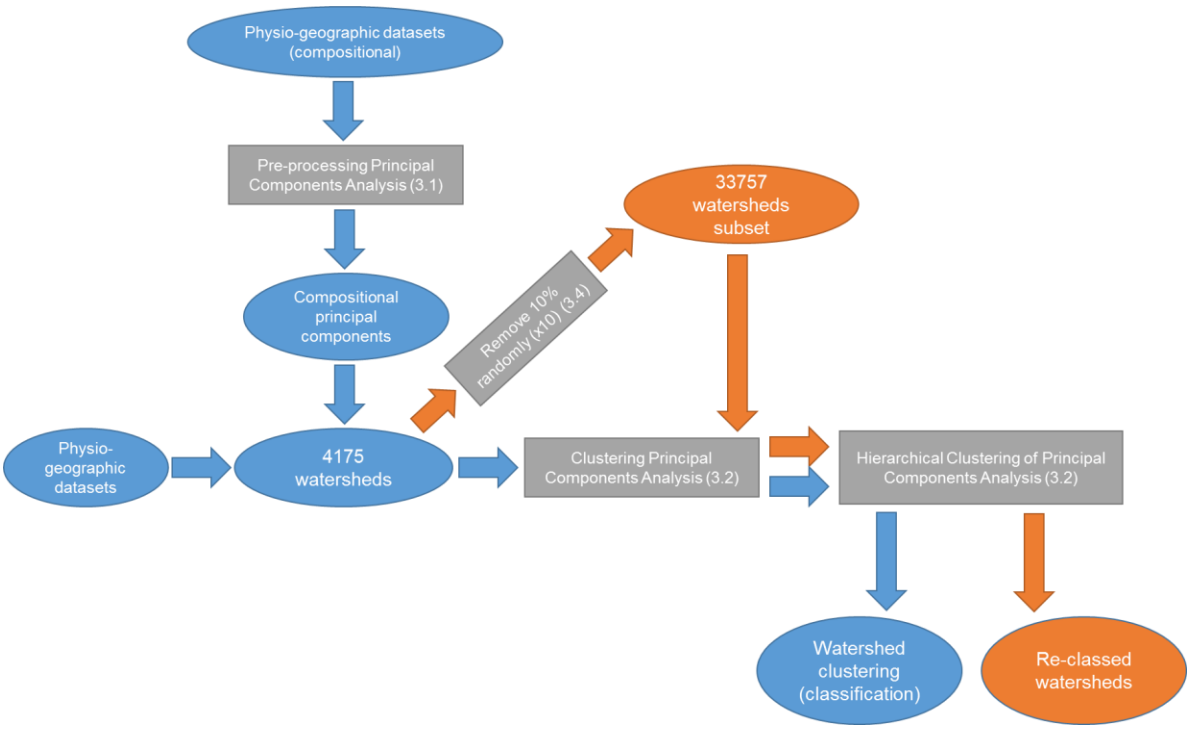

Figure S1 – Workflow diagram of the clustering and classification of watersheds procedure. Diagram depicts the transformation and incorporation of watershed physio-geographic characteristic into the Hierarchical clustering analysis and the identification of classes. Circles depict datasets, and squares show the analysis steps. The numbers in parentheses indicate sections of main text describing the analysis procedure. Blue shows the flow of the clustering and classification of the complete watershed dataset. Orange shows the flow of the re-classifying procedure on the subsets of watersheds, which was repeated ten times.

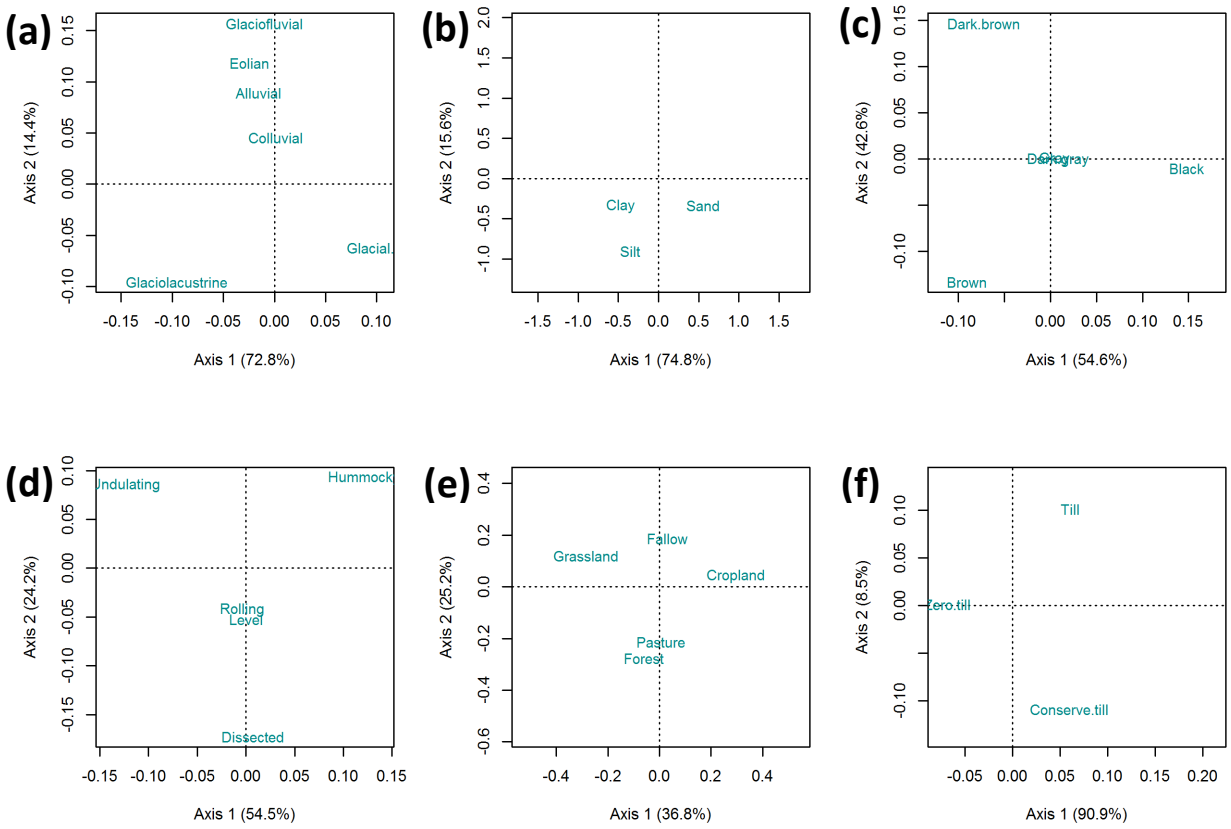

Figure S2 – Principal components analysis ordinations of compositional datasets: (a) surficial geology, (b) particle size class, (c) soil zone, (d) surface land form, (e) land cover, and (f) tillage practice. The percentage of variation explained by each axis is shown. Note that the variables at the centre of plot (c) are "dark gray" and "gray" soil zones and are not well represented by Axis 1 and Axis 2.

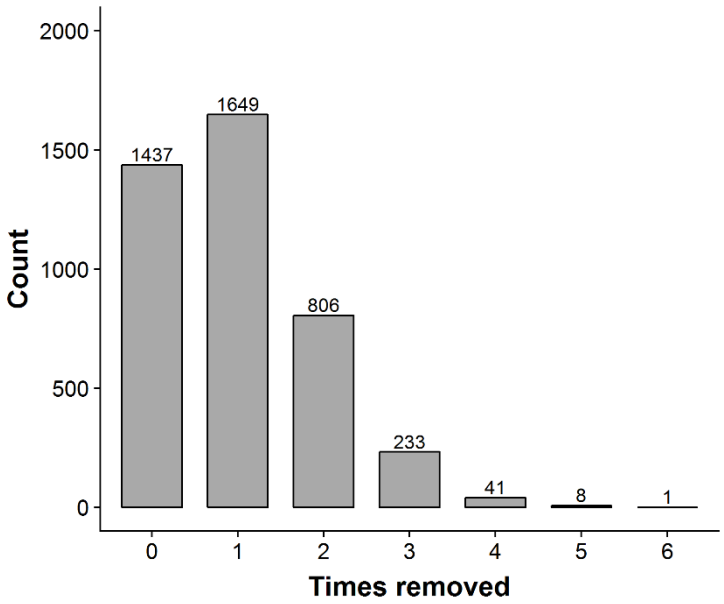

Figure S3 – Number of times an individual watershed was removed over ten iterations during the re-sampling and validation procedure. The number above bars designates the count of watersheds in each category.

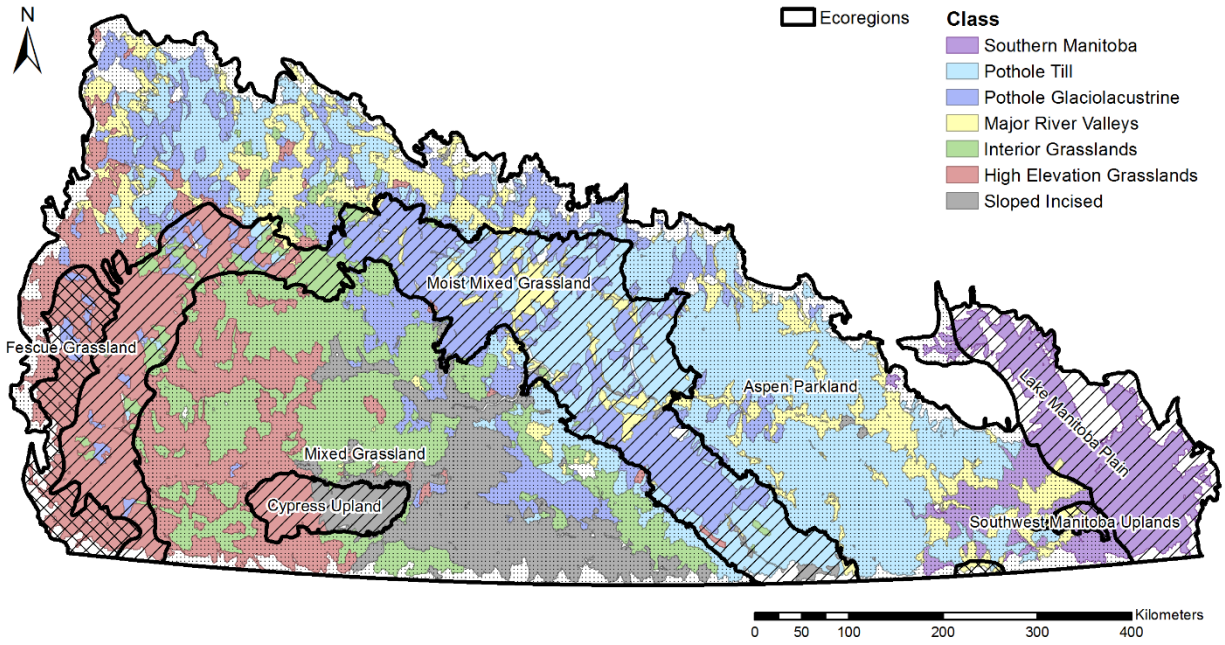

Figure S4 – Map of the study domain comparing the watershed classes to ecoregion boundaries. Delineation of ecoregions are based on those from the Ecological Working Group (1995) of Canada.