Supplemental material for

"A Nationally Coherent Characterization and Quantification of Mountain Systems in Canada", by Graham McDowell and Jiaao Guo, published in *Mountain Research and Development* 41(2), 2021. (See https://bioone.org/toc/mred/41/2)

APPENDIX S1 Elaboration of analysis methods (in ArcGIS) for each research question.

How much of Canada is covered by mountainous terrain?

- Canada's official boundary:
  1. Clip Statistics Canada's national boundary (provinces/territories) file by the world K1 mountain boundaries
  2. Calculate percentage of Canada's K1 mountains area / total national terrestrial area.

- Global comparison using Word Bank's *world administrative country* file:
  1. Clip the World Bank's administrative country boundaries (under *Sovereign country* and *country* class, excluding those dispute areas) by global K1 mountain layer.
  2. "Union" the K1 mountain polygon with the world country polygon (to get the K1 mountain segmented by each country's boundary).
  3. Clip the union file again by the K1 mountain boundary.
  4. Calculate the "area" geometry of each K1 mountain polygon in the corresponding country.
  5. Use "Feature to Point" tool to convert the file in step 4 into points ("inside" feature)
  6. Using "Spatial Join" (sum) tool to get the total K1 mountain area in km2 per country.
  7. Calculate the percentage of K1 mountain areas/total land areas

What are the major mountainous regions of Canada?

1. Defining 10 major mountain classes inspired by Canada's Terrestrial Ecozones: Atlantic Maritime; Arctic Cordillera; Boreal Cordillera; Interior Hill North; Interior Hill West; Interior Hill Central; Montane Cordillera; Pacific Maritime; Taiga Cordillera; and Taiga Shield.
   - Major mountain classes are customized and may not strictly lined up with ecozones.
   - Note that Interior Hill West includes those sparsely distributed K1 mountains within Taiga Plans and Boreal Plains ecozones; Interior Hill North includes those sparsely distributed K1 mountains within Northern Arctic and Southern Arctic ecozones; and Interior Hill Central includes those K1 mountains in southern part of Boreal Shield and Taiga Shield ecozones.
2. Extract 10 pre-defined classes by Canadian K1 mountain boundaries.
3. Calculate area geometry of each major mountain classes.
4. Calculate their area percentage of total Canadian K1 mountain areas.

What land-cover types found in Canada's mountain areas?

1. Extract Government of Canada's 2015 Land Cover of Canada by mask (K1 mountains)
2. Get the cell count of the 15 classes of extracted land cover types
3. Calculate percentage of each land cover class divided by total land cover cell-count of Canada & K1 mountains
4. Repeat the process based on major mountain classes.

To what extent are Canada's protected and conserved areas associated with mountains?

1. Clip the Canadian Protected and Conserved Areas Database (CPCAD) layer by K1 mountain boundaries.
2. Calculate area geometry of CPCAD within K1 mountains and the subsets (e.g. National Park).
3. Calculate percentage of CPCAD and subsets by major mountain classes.

How many people live within and adjacent to mountain areas in Canada?

- By Statistics Canada's 2016 Dissemination Block (DB):
  1. Define selection logic: including all the DBs that have at least 50% areas within K1 mountain boundaries
  2. Select the DB data that intersected with K1 polylines (e.g. K1 mountains' outer boundaries), exported into a new DB polygon (file A). Calculate the area (in Km^2) of each of the new DB file.
  3. Clip the new DB file A by original the K1 polygon, to get file B. Calculate the remaining area of file B.
  4. Calculate the area percentages of file B/file A; re-select those polygons with over 50% in K1 mountains and exported as file C.
  5. Select the DB polygons that are completely within the K1 mountains, exported as file D.
  6. Merge file C and file D to get the complete DBs that have at least 50% areas covered by K1 mountains.

- For Indigenous populations by Aboriginal Identity at the Census Subdivision (CSD) level:
  1. Clean up the Aboriginal Identity Table to only count for the "GEO_LEVEL " = 3, "DIM: Sex (3)" = "Total - sex ", "DIM: Age (20) " = "Total - Age ", "DIM: Registered or Treaty Indian status (3)" = "Total - Population by Registered or Treaty Indian status "
  2. Define selection logic: A). including all the CSDs that have at least 50% areas within K1 mountain boundaries; and B). all CSDs touching the K1 mountains, and have minimum Indigenous inhabitants of 500
  3. Repeat selecting method as the DB part, plus adding those CSDs with overall 500 Indigenous inhabitants.

- By World Gridded Population (2020):
  1. Clip gridded population raster by Canada's national boundary, and K1 mountain boundaries of Canada, respectively.
  2. Get the cell count and average cell value of national population grid and K1 mountain population grid; calculate the K1 mountain population / national population percentage
  3. Generate 100Km buffer from K1 mountain boundaries; repeat the above steps to calculate the K1 mountain population of 100Km buffer / national population.

Which Indigenous territories intersect with mountain areas in Canada?

1. Download "Territories" datasets (.json) from native-land.ca and convert them into shapefiles.
2. Select territories that are intersect with K1 mountain boundaries as Layer A; clip territories data by K1 mountain boundaries as Layer B.
3. Calculate the K1 percentages of those mountainous Indigenous territories (B/A percentage)

Which Indigenous linguistic areas intersect with mountain areas in Canada?

1. Download "Language" datasets (.json) from native-land.ca and convert them into shapefiles.
2. Clip territories data by K1 mountain boundaries; display on map with labels

What proportion of Canada's GDP originates from economic activity in Canada's mountain areas?

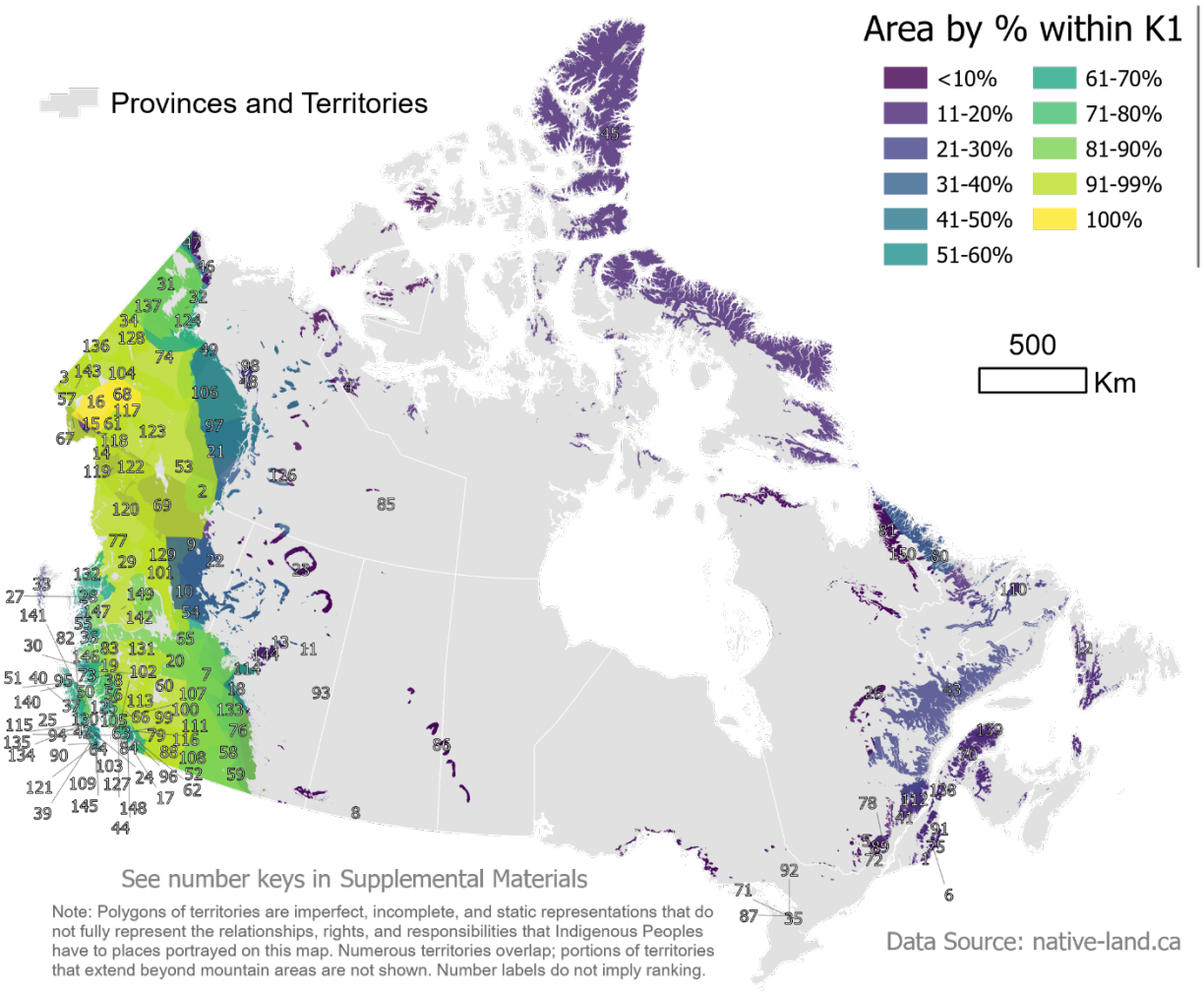
1. Linear transformation logic: Canada's 2010 and 2019 gross domestic product, current prices, by "Purchasing power parity; international dollars", were 1,353.06 and 1,925.58 billion, respectively. The equivalent GDP (PPP) growth would be +42.3%
2. Clip World Bank's 2010 gridded GDP raster by Canada's national boundary, and K1 mountain boundaries of Canada, respectively.
3. Using "raster calculator", multiplies the GDP value for Canada and K1 mountain by 1.423 (to match with IMF's growth rate from 2010 to 2019)
4. Get the cell count and average cell value of national GDP grid and K1 mountain GDP grid.
5. Calculate the K1 mountain GDP / national GDP percentage

What are the main economic sectors in Canada's mountain areas?

- N/A

All maps based on these analyses use datum and projections information of NAD83 Canada Atlas Lambert. Its European Petroleum Survey Group (ESPG) code is 3978.

APPENDIX S2 Figure 5 with labels and annotations.



Number	Territory Name
1	Abenaki / Abénaquis
2	Acho Dene Koe
3	Ahtna Nenn’
4	Akaitcho
5	Anishinabewaki ᐊᓂᔑᓇᐯᒧᐊᑭ
6	Arosaguntacook
7	Aseniwuche Winewak (Rocky Mountain)
8	Assiniboine
9	Beaver
10	Beaver
11	Beaver Lake Cree
12	Beothuk
13	Big Stone Cree
14	Carcross/Tagish First Nation (BC)

15	Carcross/Tagish First Nation (Yukon)
16	Champagne & Aishihik
17	Coast Salish
18	Cree
19	Da’naxda’xw Awaetlatla
20	Dakeł Keyoh (ᑕᗷᒃ ᕫᘐʰ)
21	Dehcho Dene
22	Dene Tha'
23	Denendeh (Dënësųłinḗ Nëné)
24	Ditidaht
25	ditidaqiiċaq disiḃaʔk (Ditidaht)
26	Eeyou Istchee
27	Gitga’at
28	Gitga’at Lax Yuup
29	Gitx̲san Lax̲yip
30	Gwa’Sala-‘Nakwaxda’xw
31	Gwich'in Nành
32	Gwitch'in Settlement Region
33	Haida Gwaii
34	Hän
35	Haudenosaunee
36	Heiltsuk
37	Hesquiaht
38	Homalco
39	Hul’qumi’num Treaty Group
40	Hupacasath
41	Huron-Wendat
42	Huu-ay-aht
43	Innus (Montagnais)
44	In-SHUCK-ch
45	Inuit
46	Inupiat
47	Inuvialuit
48	K’áálǫ Got’ine
49	K’asho Got’ine
50	K’ómoks
51	Ka:’yu:’k’t’h’/Che:k’tles7et’h’
52	Kalispel
53	Kaska Dena Kayeh
54	Kelly Lake Metis Settlement Society
55	Kitasoo/Xai'xais
56	Klahoose

57	Kluane
58	Ktunaxa
59	Ktunaxa ʔamakʔis
60	Kwakwaka’wakw
61	Kwanlin Dün
62	Kwantlen
63	Kwikwetlem
64	Lekwungen/Songhees
65	Lheidli T'enneh
66	Lil'wat
67	Lingít Aaní (Tlingit)
68	Little Salmon/Carmacks
69	Métis
70	Mi’kmaq
71	Mississauga
72	Mohawk
73	Musgamagw Dzawada'enuxw
74	Na-cho Nyak Dun
75	Nanrantsouak
76	Niitsítpiis-stahkoii ᓇᐟᒧ·ᑐᑯ· ᓴᐦᓴᐟ (Blackfoot / Niitsítapi ᓇᐟᒧ·ᒣᑯ)
77	Nisga'a
78	Nitaskinan (Atikamekw / Nehirowisi Aski)
79	Nłeʔkepmx Tmíxʷ (Nlaka'pamux)
80	Nunatsiavut
81	Nunavik
82	nuučaaṅuuɬʔatḥ nisṁa (Nuu-chah-nulth)
83	Nuxalk
84	Nuxwsa'7aq (Nooksack)
85	NWT Métis Nation
86	Očeti Šakówiŋ (Sioux)
87	Odawa
88	Okanagan
89	Omàmìwininìwag (Algonquin)
90	Pacheedaht
91	Penobscot
92	Petun
93	Plains Cree
94	Qayqayt
95	Quatsino
96	S’ólh Téméxw (Stó:lō)
97	Sahtu Dene and Metis
98	Sahtú Got’ine

99	sc̓əwaθenaʔɬ təməxʷ (Tsawwassen)
100	Secwépemc (Secwépemcúl’ecw)
101	Sekani
102	səl̓ilwətaʔɬ təməxʷ (Tsleil-Waututh)
103	səl̓ilwətaʔɬ təməxʷ (Tsleil-Waututh)
104	Selkirk
105	Shíshálh
106	Shita Got’ine
107	Skwxwú7mesh-ulh Temíx̱w (Squamish)
108	sngaytskstx tum-ula7xw (Sinixt)
109	Snuneymuxw
110	Southern Inuit (NunatuKavut)
111	sq̓əc̓iy̓aʔɬ təməxʷ (Katzie)
112	St. Lawrence Iroquoians
113	St̓át̓imc Tmicw (St'at'imc)
114	Stoney
115	Stz'uminus
116	Syilx tmixʷ (Okanagan)
117	Ta’an Kwäch’än
118	Tagish
119	Taku River Tlingit
120	Tāłtān Konelīne (Tahltan)
121	Te’mexw Treaty Association
122	Teslin Tlingit Council (BC)
123	Teslin Tlingit Council (Yukon)
124	Tetlit Gwich’in
125	Tla’amin Nation (Sliammon)
126	Tłı̨chǫ Ndè
127	Toquaht
128	Tr’ondëk Hwëch’in
129	Tse’khene
130	Tseshaht
131	Tsilhqot'in Nen
132	Ts'msyen La̱xyuup (Tsimshian)
133	Tsuu T'ina
134	Uchucklesaht
135	Ucluelet
136	Upper Tanana
137	Vuntut Gwitchin
138	Wðlastðkwiyik (Maliseet)
139	Wabanaki Confederacy
140	We Wai Kai

141	We Wai Kum
142	Wet’suwet’en
143	White River-Kluane
144	Woodland Cree
145	W̱SÁNEĆ
146	Wuikinuxv (Oweekeno)
147	x̣à’isla w̓áwís (Haisla)
148	xʷməθkʷəy̓əm
149	Yekooche
150	ᒋᑦ ᐊᔾᒋᓄᐤ St'aschinuw (Naskapi)

APPENDIX S3 Figure 6 with labels and annotations.

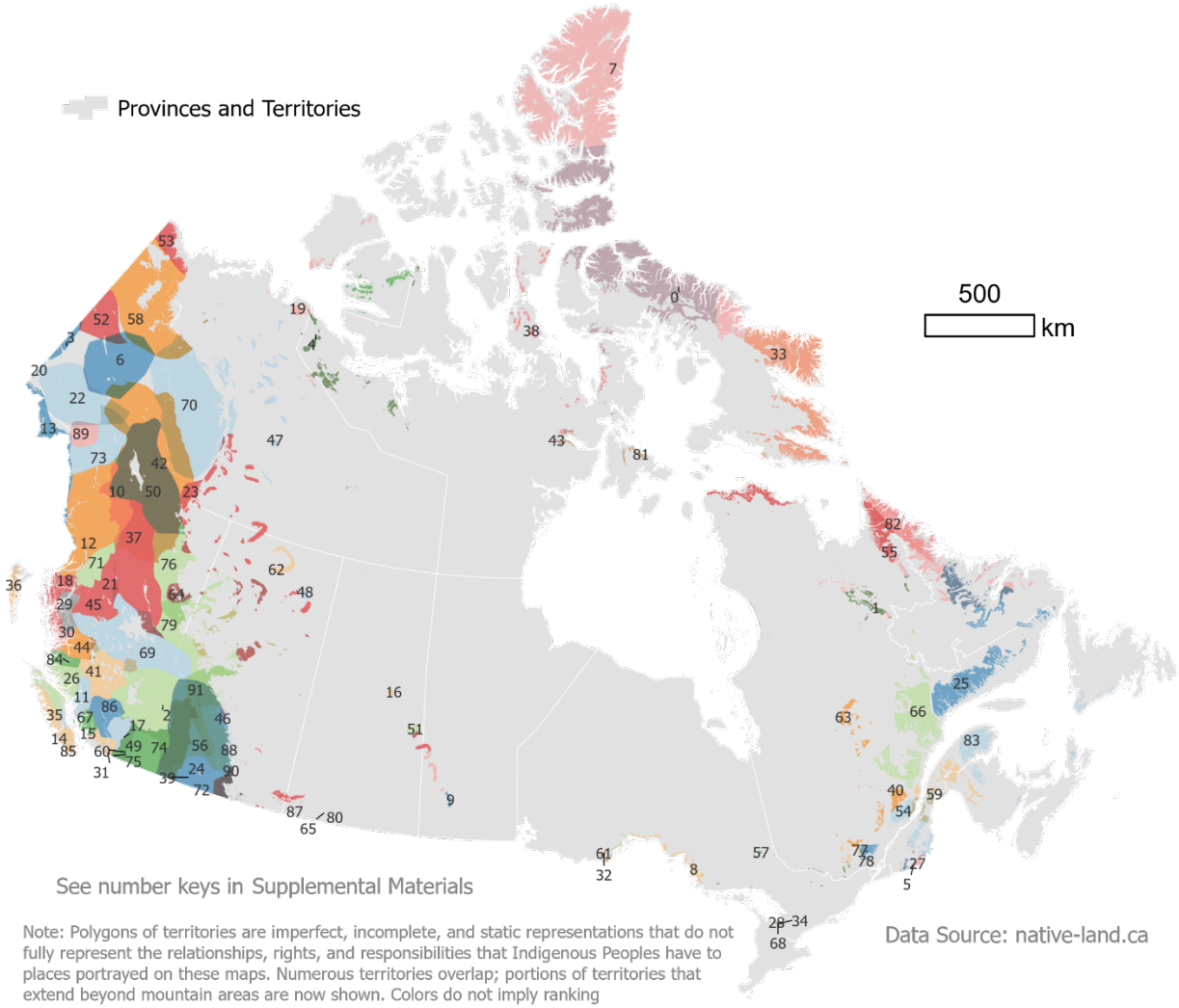


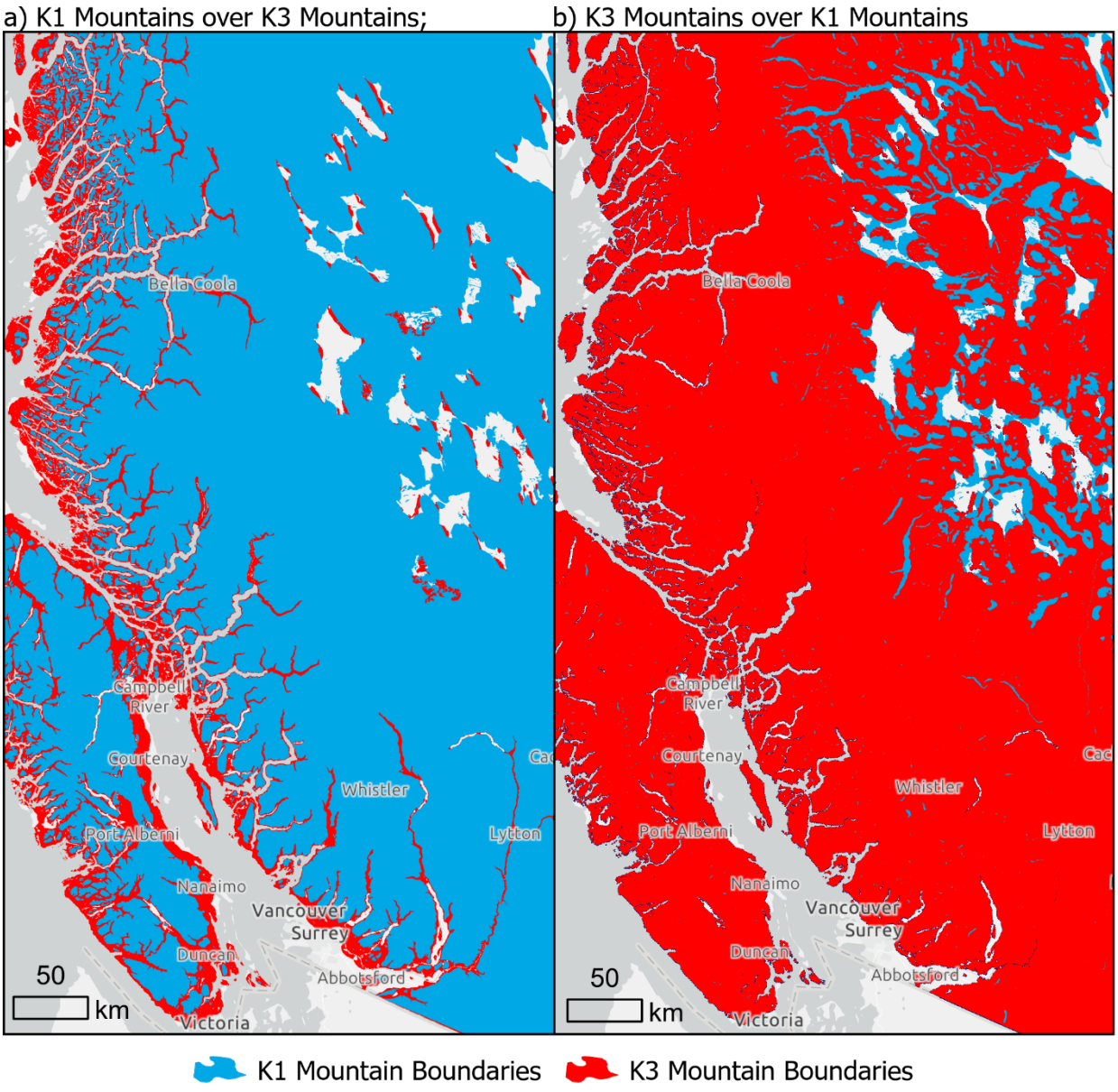
Figure 6: Number keys

Number	Language Name
0	North Baffin Qikiqtaluk uannangani
1	Naskapi
2	Secwepemcstin
3	Upper Tanana
4	Inuinnaqtun
5	Laurentian
6	Northern Tutchone
7	Inuktitut
8	Central Anishinaabe (Ojibwa)
9	Dakota
10	Tāłtān

11	Éy7á7juuthem
12	Nisg̲a’a
13	Łingít
14	Diitiidʔaatx̣
15	Sk̲wx̲wú7mesh sníchim
16	Woods and Rocky Cree
17	Nłeʔkepmxcín
18	Sm'algyax̲
19	Siglitun
20	Ahtna
21	Nedut’en
22	Southern Tutchone
23	Dene K’e
24	Nəxʷsƛ̓aɁəmúcən
25	Innu Montagnais de l’Est
26	Kwak̓wala
27	Pennacook
28	Odawa
29	Xenaksialak̓ala / Xa’’islak̓ala
30	Hailhzaqvla
31	Thompson
32	Northwestern Anishinaabe (Ojibwa)
33	South Baffin Qikiqtaluk nigiani
34	Mississauga/Eastern Anishinaabe (Ojibwa)
35	NuučaaɁuɬ
36	X̲aad Kil / X̲aaydaa Kil (Haida)
37	Tse’khene
38	Natsilingmiutut
39	Kalispel
40	Cri-Attikamek
41	Tsilhqot’in
42	Kaska
43	Kivallirmiutut
44	Nuxalk
45	Witsuwit’en
46	Western Anishinaabe (Ojibwe)
47	Tłı̨chǫ Yatıì
48	Dëne Sųłı̨né Yatıé (Chipewyan)
49	Wenatch
50	Danezāgé’
51	Swampy Cree
52	Han

53	Inupiatun
54	Abenaki
55	Nunavimmiutitut
56	Ktunaxa
57	Western Algonquin
58	Dinjii Zhu’ Ginjik (Gwich'in)
59	Maliseet-Passamaquoddy
60	Lhéchalosem (Nooksack)
61	Southern Anishinaabe (Ojibwa)
62	Rocky Cree
63	Inland East Cree
64	Plains Cree
65	Lakota
66	Innu-Montagnais Central
67	She shashishalhem
68	Anishinaabe
69	Dakelh (ᑕᗷᒡ)
70	Sahtúot’ı̨nę Yatı̨́
71	Gitsenimx̱
72	Flathead
73	Inland Łingít
74	Nsyilxcən
75	Hul’q’umi’num’ / Halq’eméylem / hən̓q̓əmin̓əm̓
76	Dane-Zaa (ᑕᓇ ᓂ)
77	Nipissing-Algonquin
78	Mohawk
79	ᓇᐦᐃᔭᐁᐧᐃᐧᐣ (Nēhiyawēwin)
80	Assiniboin
81	Aivilimmiutut
82	Nunatsiavummiutut
83	Mi’kmaw
84	Oowekyala / ’Uik̓ala
85	SENĆOŦEN / Malchosen / Lkwungen / Semiahmoo / T’Sou-ke
86	St̓át̓imcets
87	Gros Ventre
88	Sarcee
89	Den k’e
90	Blackfoot
91	Nakota

Appendix S4 Differences in mountain areas according to K1 vs K3: Focus on Coastal British Columbia for illustrative purposes.



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