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Modelling regional glacier length changes over the last millennium using the Open Global Glacier Model

David Parkes and Hugues Goosse

Correspondence to: David Parkes (david.parkes.88@gmail.com)

Supplementary material

In tables S1-4, the values of relative variance (RV), shown in main figure 6, are categorised. $0 \leq RV \leq 0.4$ is labelled 'minimal' explanation of the full variance. For $0.4 < RV \leq 0.8$ the variable provides a 'moderate' explanation of the full variance. $0.8 < RV \leq 1.2$, the bracket around the value of 1 which indicates the same variance as in the full runs, is labelled a 'full' explanation, comparable to the full run. When $RV > 1.2$, the single-variable-driven run shows greater variability than the full-climate-driven, and we consider the explanation of the full variance by that single variable to 'overshoot' the full-climate-driven output.

Region	Minimal (0 - 0.4)	Moderate (0.4 - 0.8)	Full (0.8 - 1.2)	Overshoot (1.2+)
Alaska	0	0	2	4
W. Can/US	0	1	5	0
Greenland Per.	0	0	1	5
Iceland	0	0	1	5
Svalbard	0	0	2	4
Scandinavia	0	2	2	2
Rus. Arctic	0	2	2	2
North Asia	0	1	1	4
Cen. Europe	0	1	4	1
Cauc./M.East	0	0	4	2
Cen. Asia	0	6	0	0
S Asia West	1	0	4	1
S Asia East	0	0	2	4
Low Latitudes	0	0	6	0
S Andes	0	0	5	1
New Zealand	0	1	3	2
Global	1	14	44	37

Table S1: *Explanation of variance by temperature in each region*

Region	Minimal (0 - 0.4)	Moderate (0.4 - 0.8)	Full (0.8 - 1.2)	Overshoot (1.2+)
Alaska	6	0	0	0
W. Can/US	6	0	0	0
Greenland Per.	6	0	0	0
Iceland	5	0	0	1
Svalbard	2	0	2	1
Scandinavia	4	1	0	1
Rus. Arctic	1	2	0	3
North Asia	5	1	0	0
Cen. Europe	6	0	0	0
Cauc./M.East	6	0	0	0
Cen. Asia	5	0	0	1
S Asia West	0	0	4	2
S Asia East	2	1	3	0
Low Latitudes	6	0	0	0
S Andes	6	0	0	0
New Zealand	6	0	0	0
Global	72	5	9	9

Table S2: *Explanation of variance by precipitation in each region. NOTE: Svalbard features a failure in the modelling of the constant temperature run (used to determine explanation of variance by precipitation) for BCC-CSM, resulting in one fewer result in this region.*

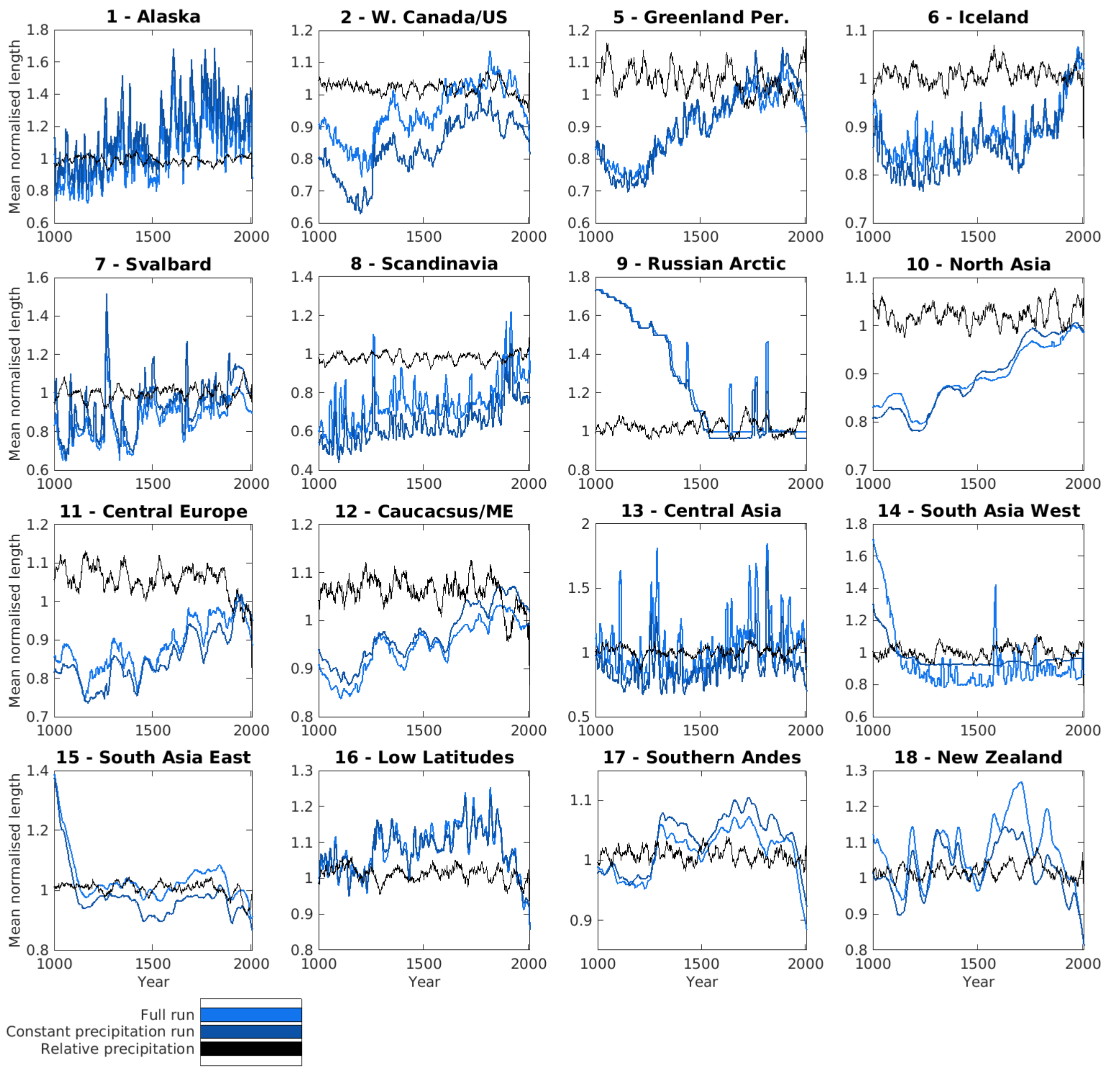
Model	Minimal (0 - 0.4)	Moderate (0.4 - 0.8)	Full (0.8 - 1.2)	Overshoot (1.2+)
CESM	1	3	6	6
IPSL	0	2	7	7
GISS	0	1	7	8
CCSM4	0	4	7	5
BCC-CSM	0	2	8	6
MPI	0	2	9	5

Table S3: *Explanation of variance by temperature in each model*

Model	Minimal (0 - 0.4)	Moderate (0.4 - 0.8)	Full (0.8 - 1.2)	Overshoot (1.2+)
CESM	12	1	3	0
IPSL	12	1	1	2
GISS	14	0	1	1
CCSM4	12	0	1	3
BCC-CSM	11	2	1	1
MPI	11	1	2	2

Table S4: *Explanation of variance by precipitation in each model. NOTE: Svalbard features a failure in the modelling of the constant temperature run (used to determine explanation of variance by precipitation) for BCC-CSM, resulting in one fewer result for this model.*

Figures S1-5: *On the following pages: regional length changes for each of the 5 GCMs not featured in the main text figure 8 (CESM, GISS, CCSM4, BCC-CSM, and MPI, in order) comparing fully climate run and constant precipitation run, shown with relative precipitation (annual precipitation normalised to 1900-1950 mean climate). The constant precipitation run lengths are normalised to the full climate run 1950 length, to better illustrate differences.*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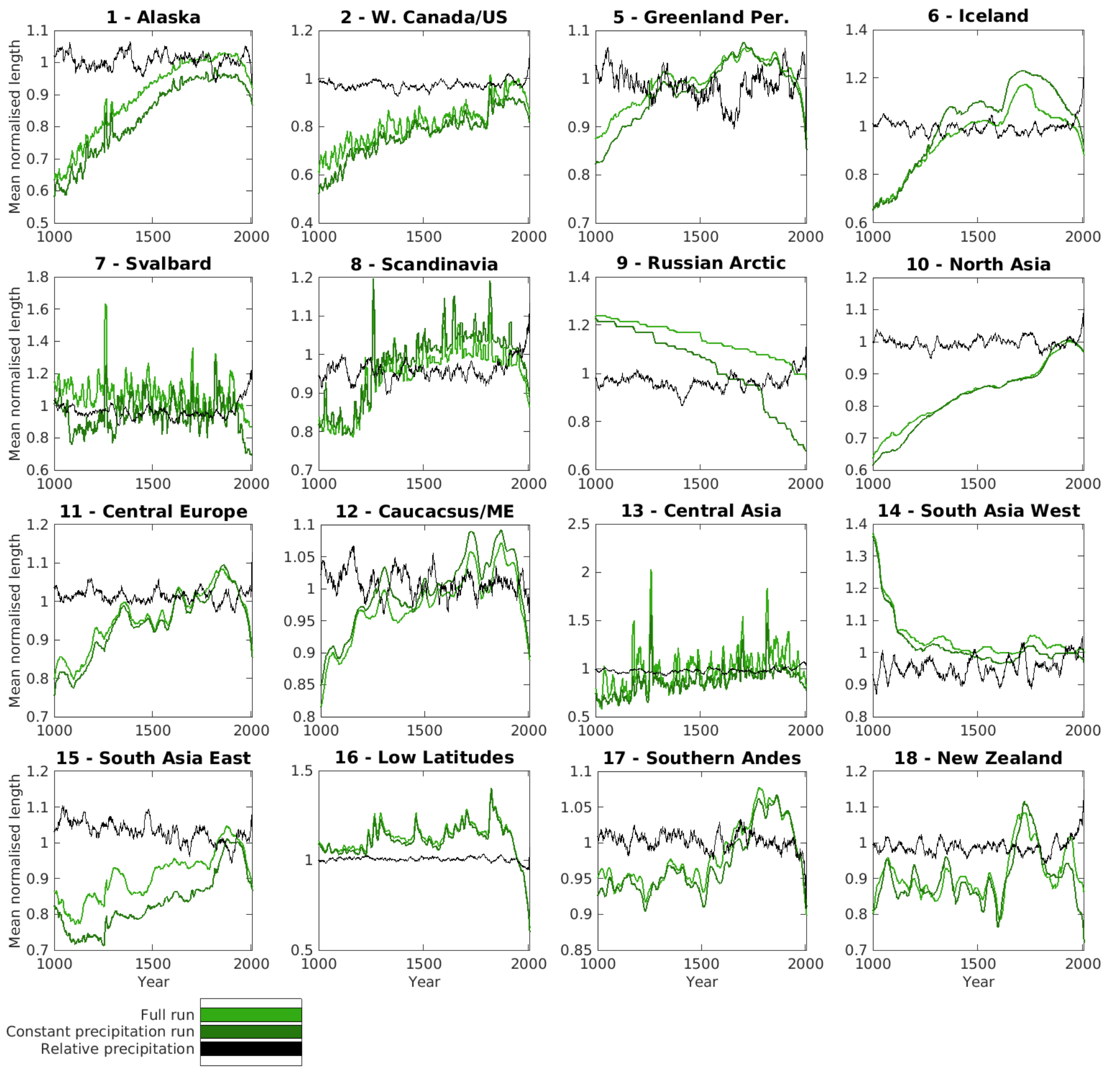
6 - Iceland
7 - Svalbard
8 - Scandinavia
9 - Russian Arctic
10 - North Asia
11 - Central Europe
12 - Caucacsus/ME
13 - Central Asia
14 - South Asia West
15 - South Asia East
16 - Low Latitudes
17 - Southern Andes
18 - New Zealand
Mean normalised length
Year
Full run
Constant precipitation run
Relative precipitation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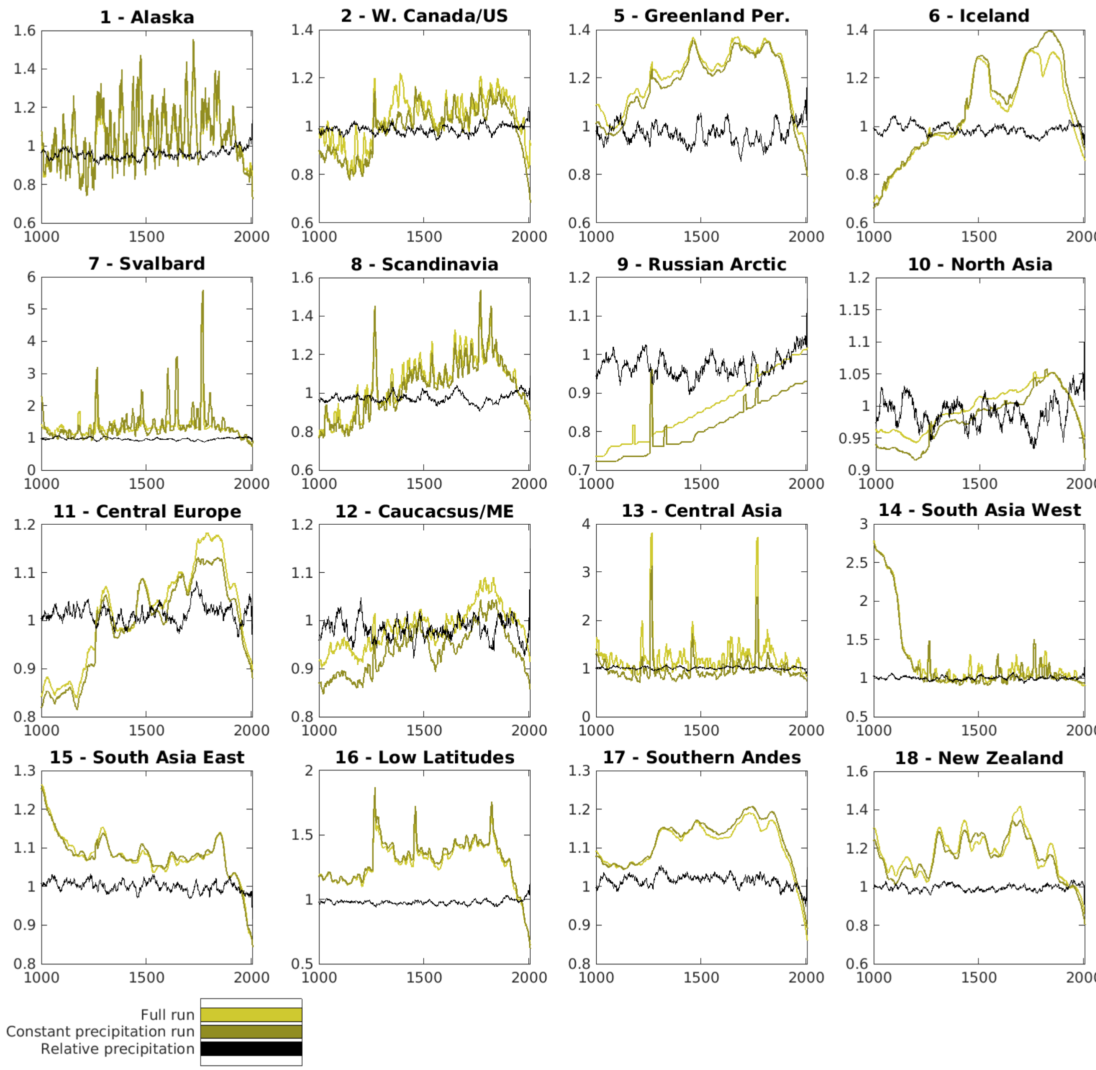
Mean normalised length
Year
Full run
Constant precipitation run
Relative precipitation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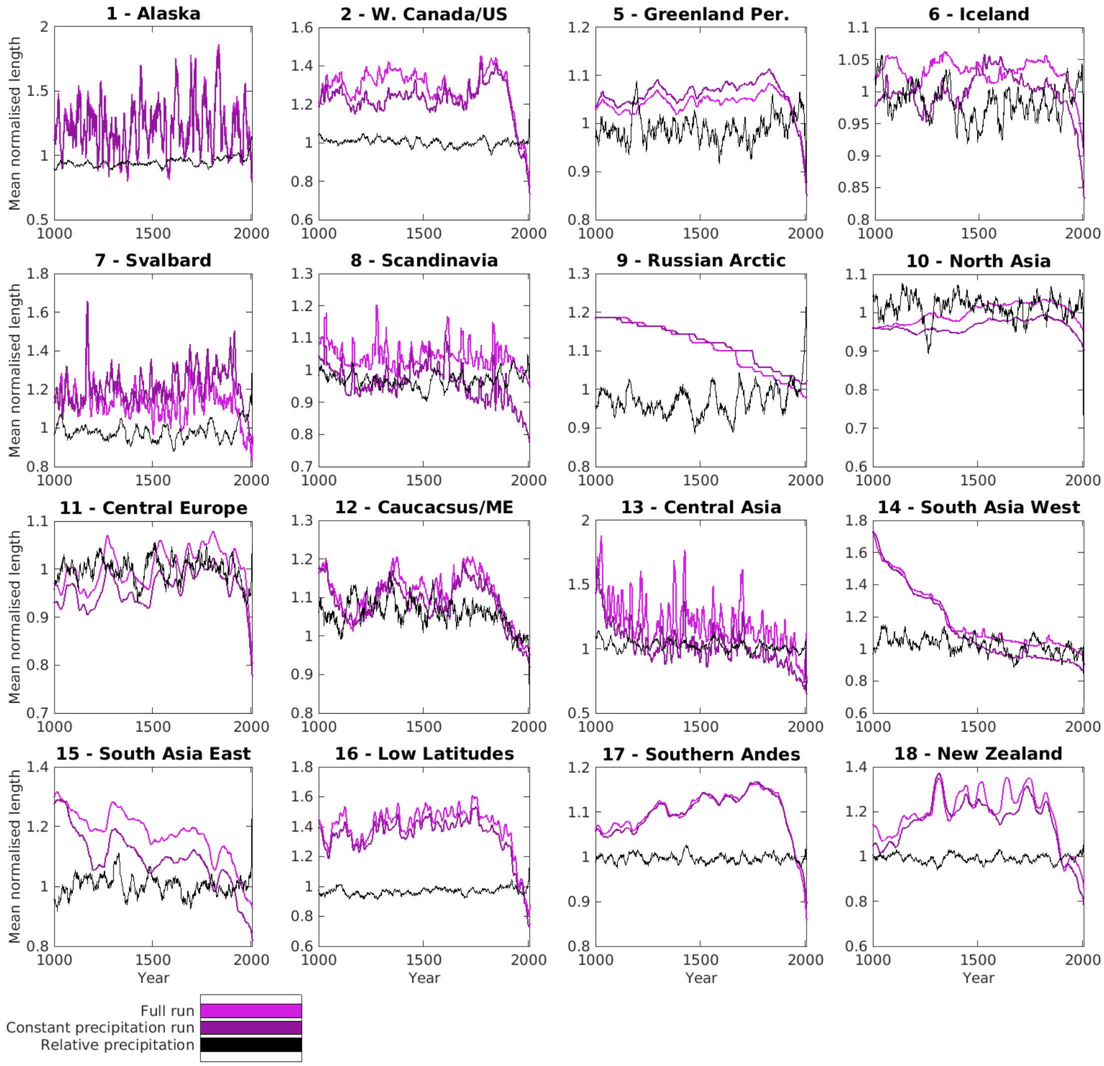
18 - New Zealand
Full run
Constant precipitation run
Relative precipitation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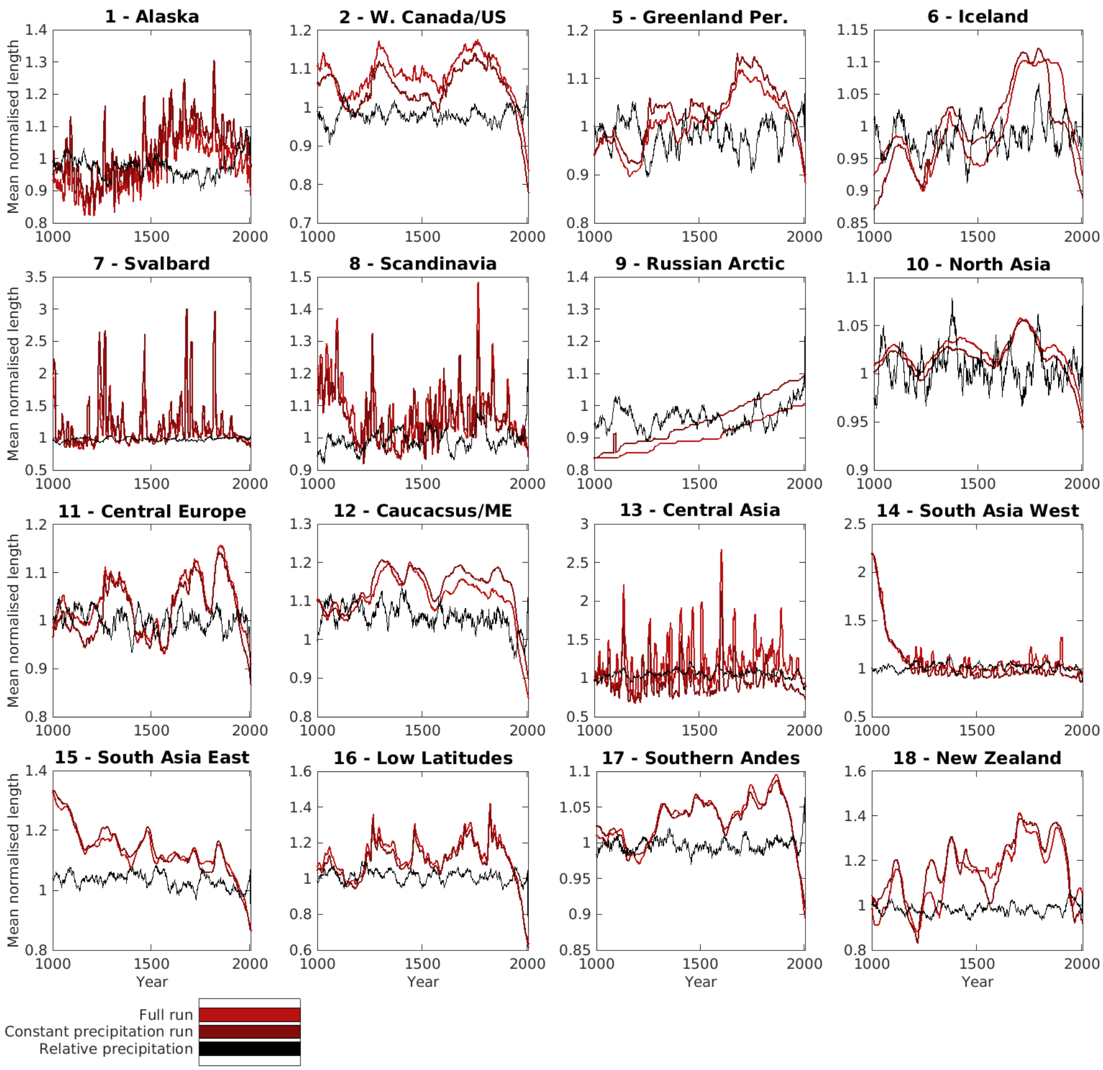
Mean normalised length
Year
Full run
Constant precipitation run
Relative precipitation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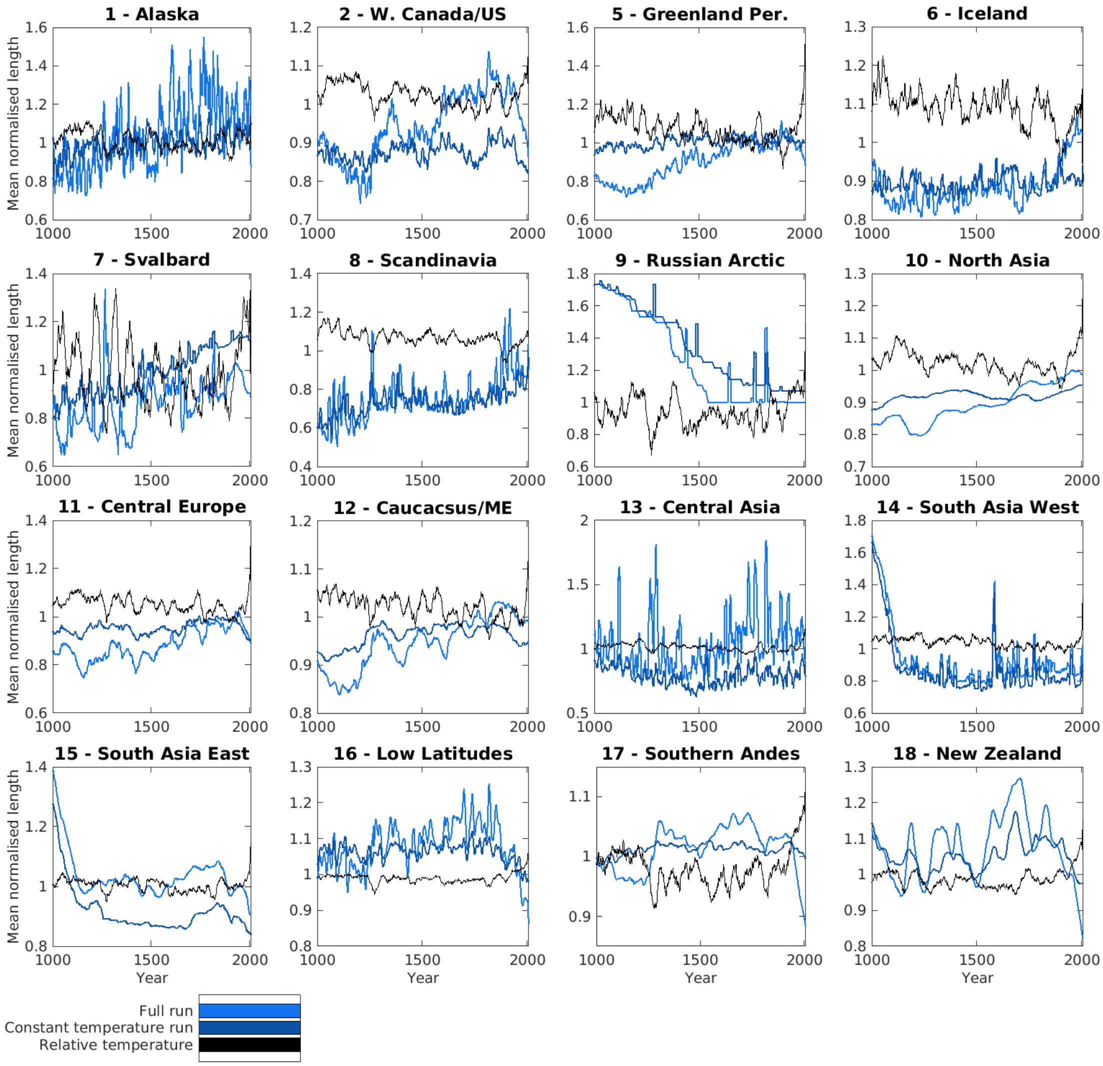
12 - Caucacsus/ME
13 - Central Asia
14 - South Asia West
15 - South Asia East
16 - Low Latitudes
17 - Southern Andes
18 - New Zealand
Mean normalised length
Year
Full run
Constant precipitation run
Relative precipitation

Figures S6-10: *On the following pages: regional length changes for each of the 5 GCMs not featured in the main text figure 9 (CESM, GISS, CCSM4, BCC-CSM, and MPI, in order) comparing fully climate run and constant temperature run, shown with relative melt-relevant temperature (annual degree-day sum normalised to 1900-1950 mean climate). Relative temperature is inverted, so that the direction of any trend corresponds to the expected impact on glacier length. The constant temperature run lengths are normalised to the full climate run 1950 length, to better illustrate differences.*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12 - Caucacsus/ME
13 - Central Asia
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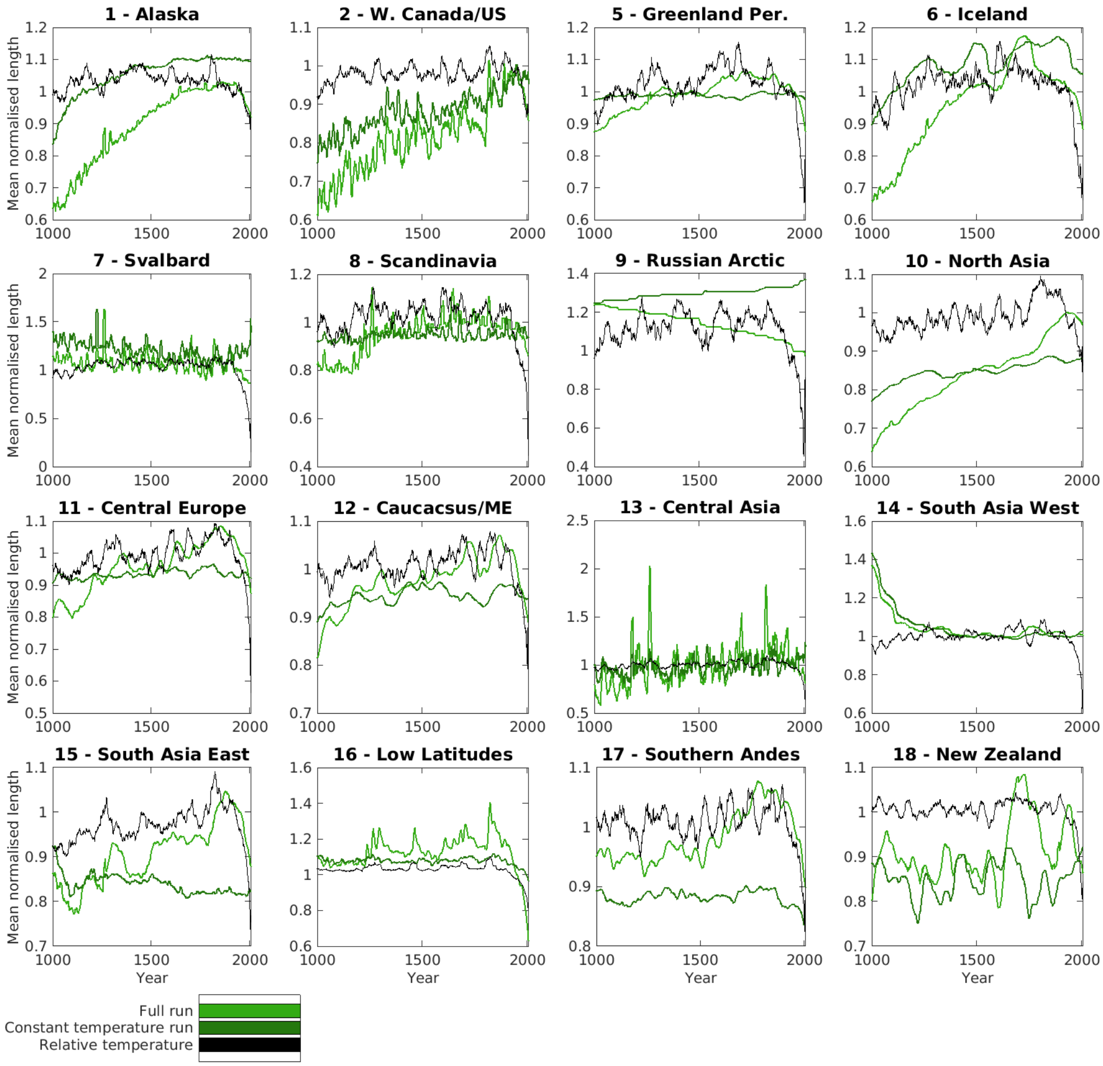
16 - Low Latitudes
17 - Southern Andes
18 - New Zealand
Mean normalised length
Year
Full run
Constant temperature run
Relative temperature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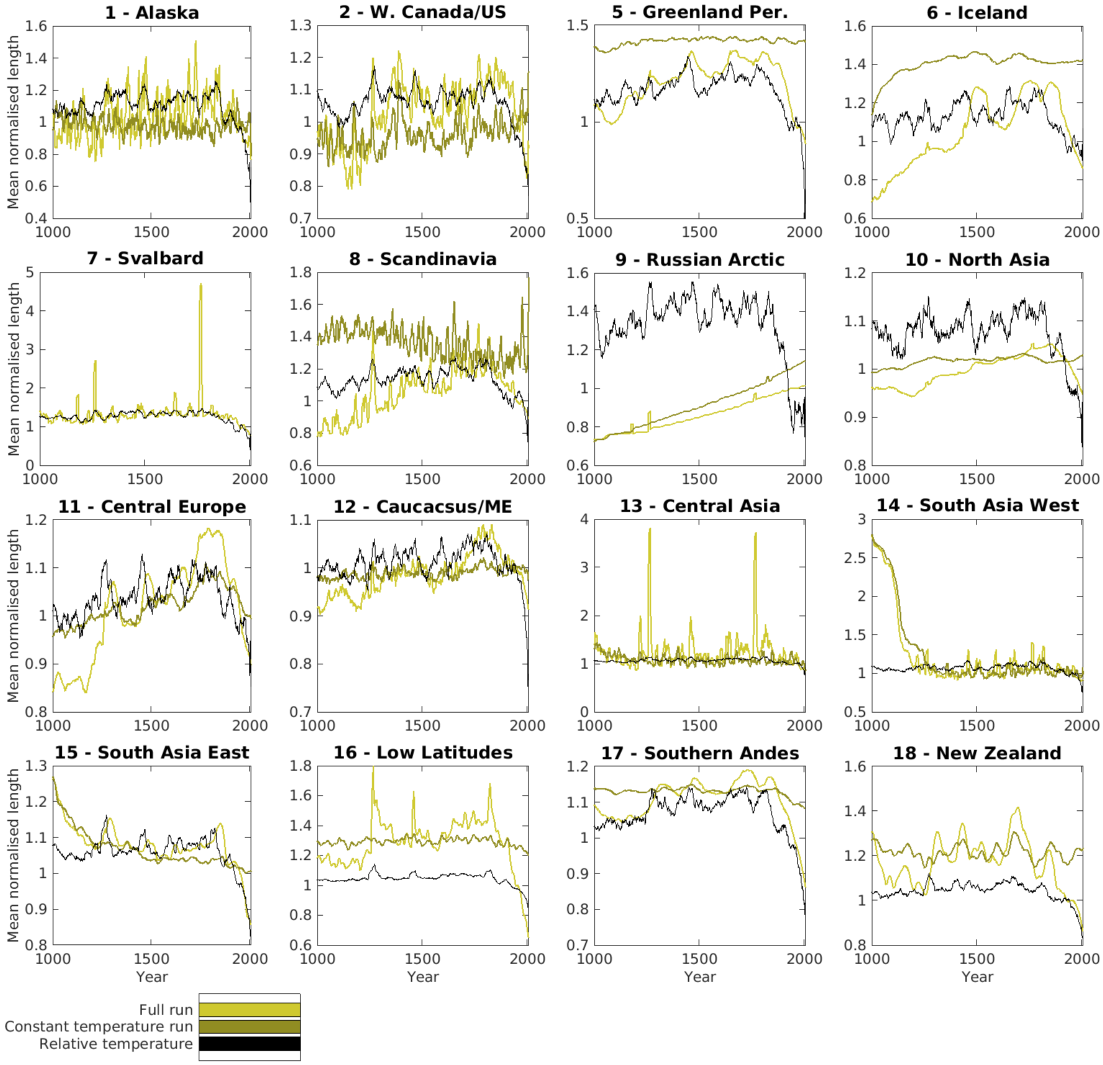
18 - New Zealand
Mean normalised length
Year
Full run
Constant temperature run
Relative temperature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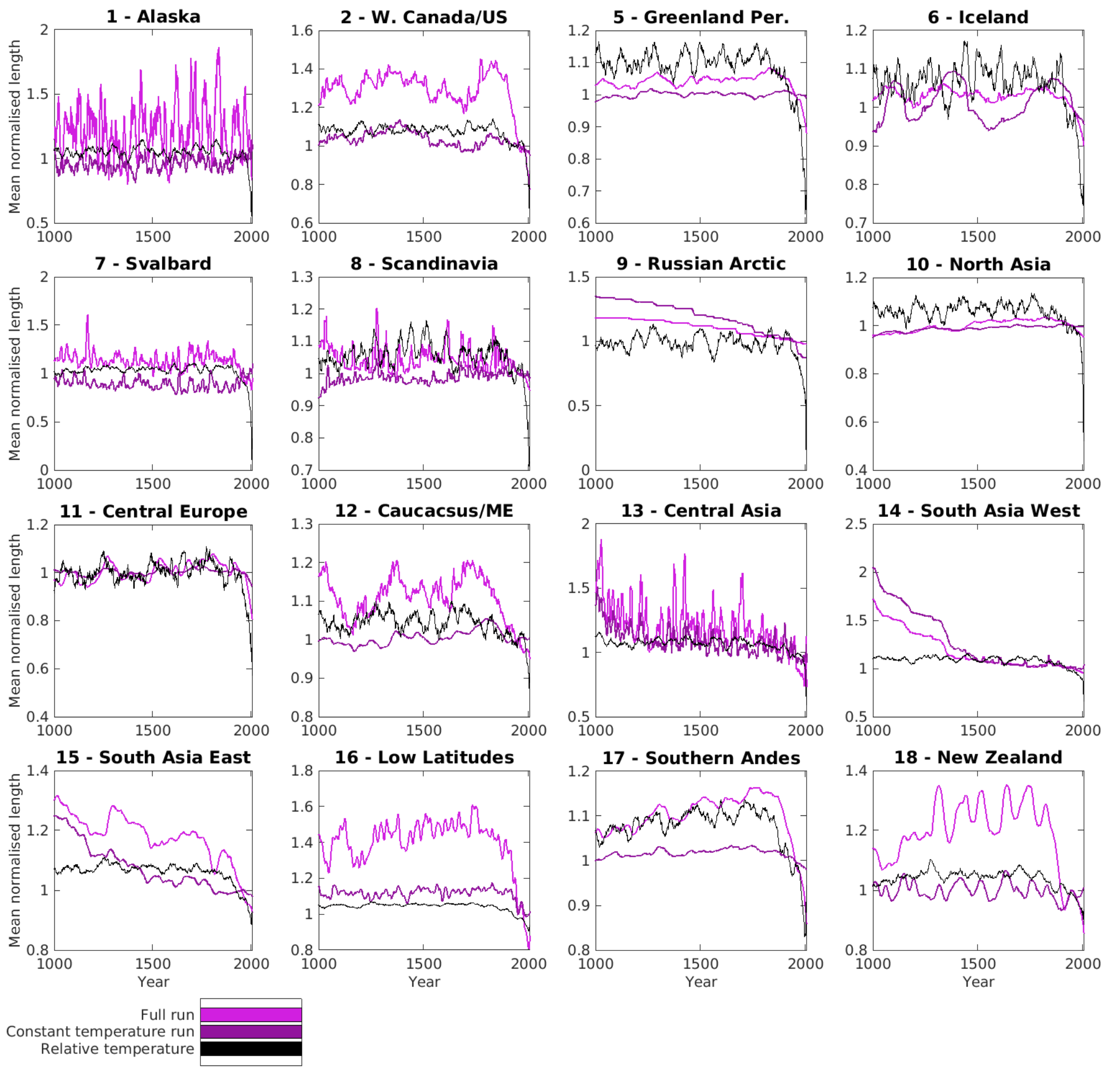
18 - New Zealand
Mean normalised length
Year
Full run
Constant temperature run
Relative temperature



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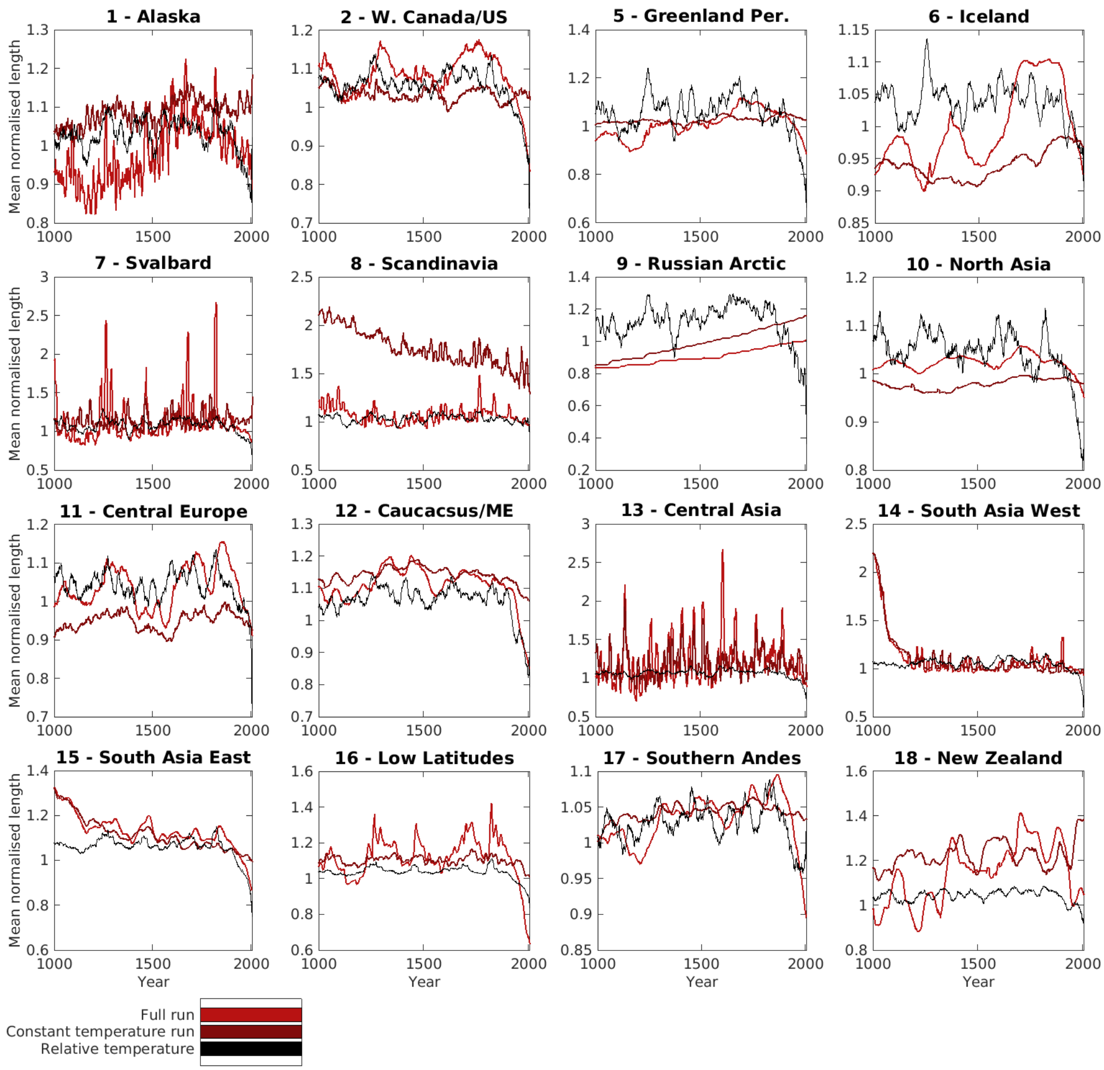
17 - Southern Andes
18 - New Zealand
Mean normalised length
Year
Full run
Constant temperature run
Relative temperature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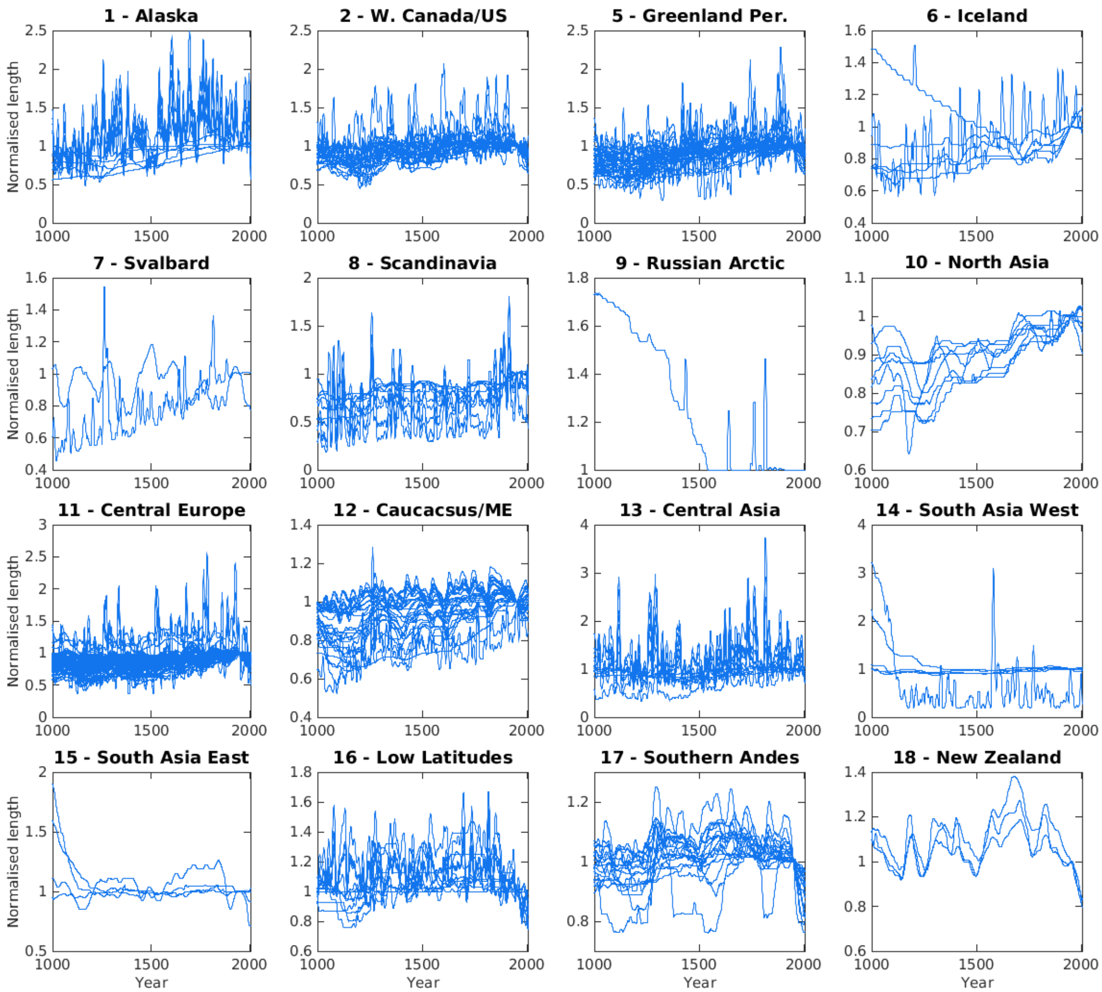
13 - Central Asia
14 - South Asia West
15 - South Asia East
16 - Low Latitudes
17 - Southern Andes
18 - New Zealand
Mean normalised length
Year
Full run
Constant temperature run
Relative temperature

Figures S11-16: *On the following pages: the spread of 1950-normalised length changes for all glaciers in each region for each of the 6 GCMs (CESM, IPSL, GISS, CCSM4, BCC-CSM, and MPI, in order).*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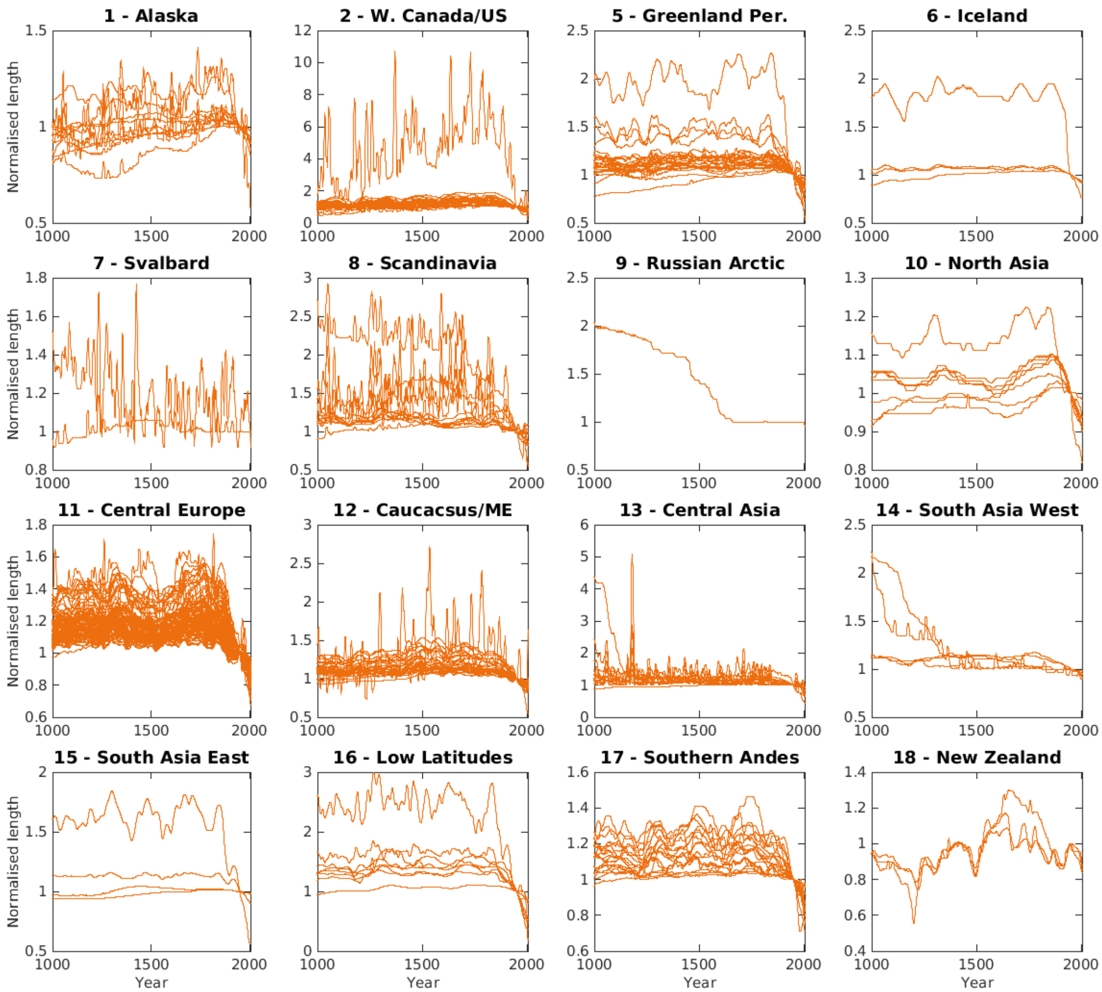
18 - New Zealand
Normalised length
Year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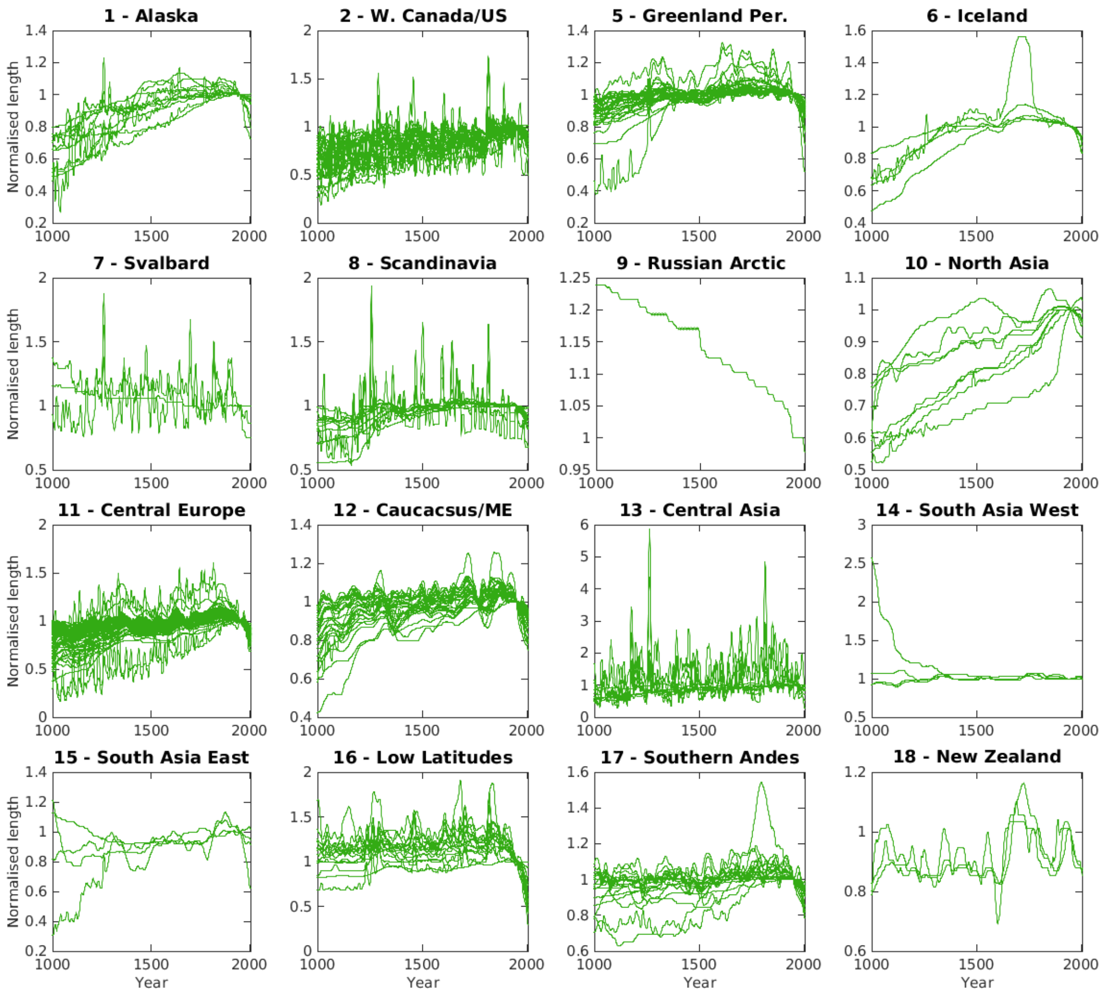
Normalised length
Year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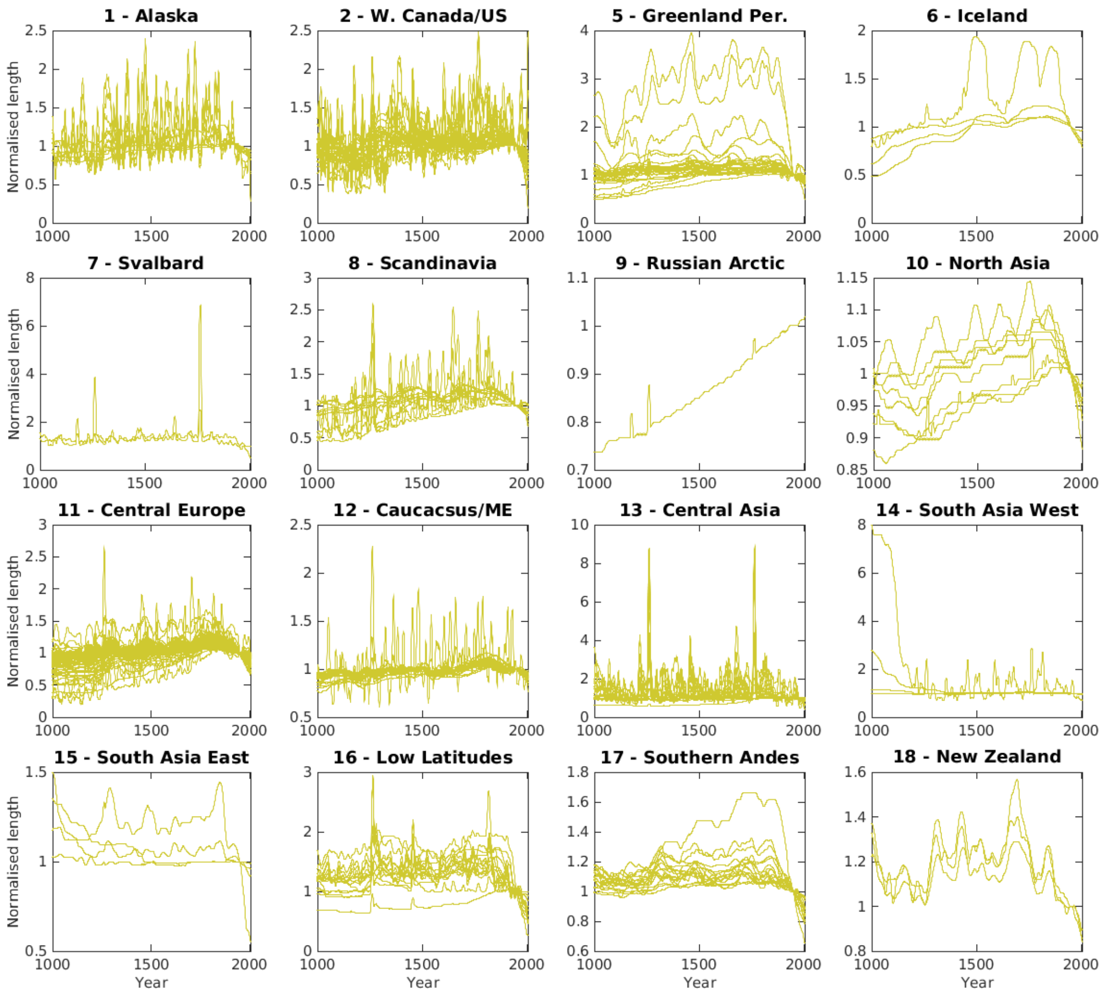
18 - New Zealand
Normalised length
Year



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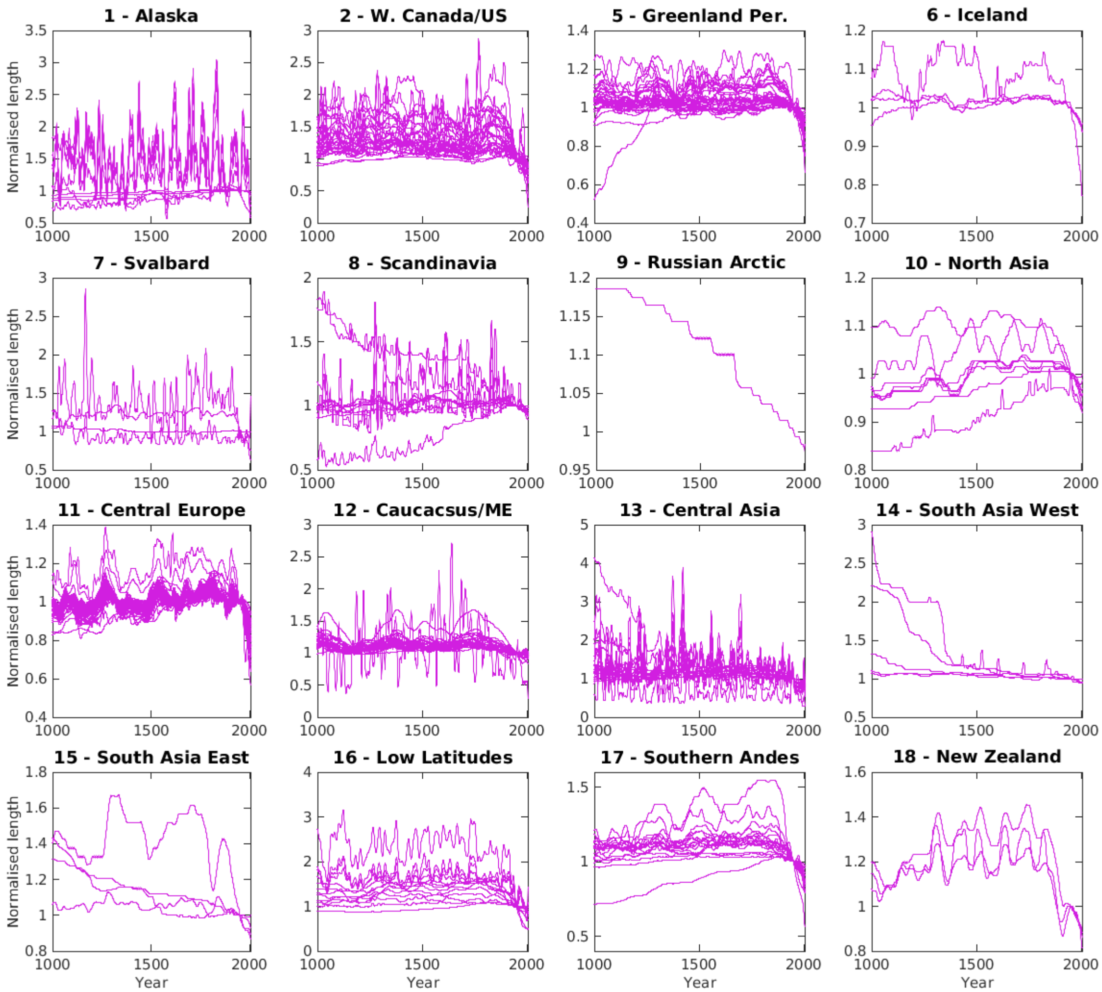
Normalised length
Year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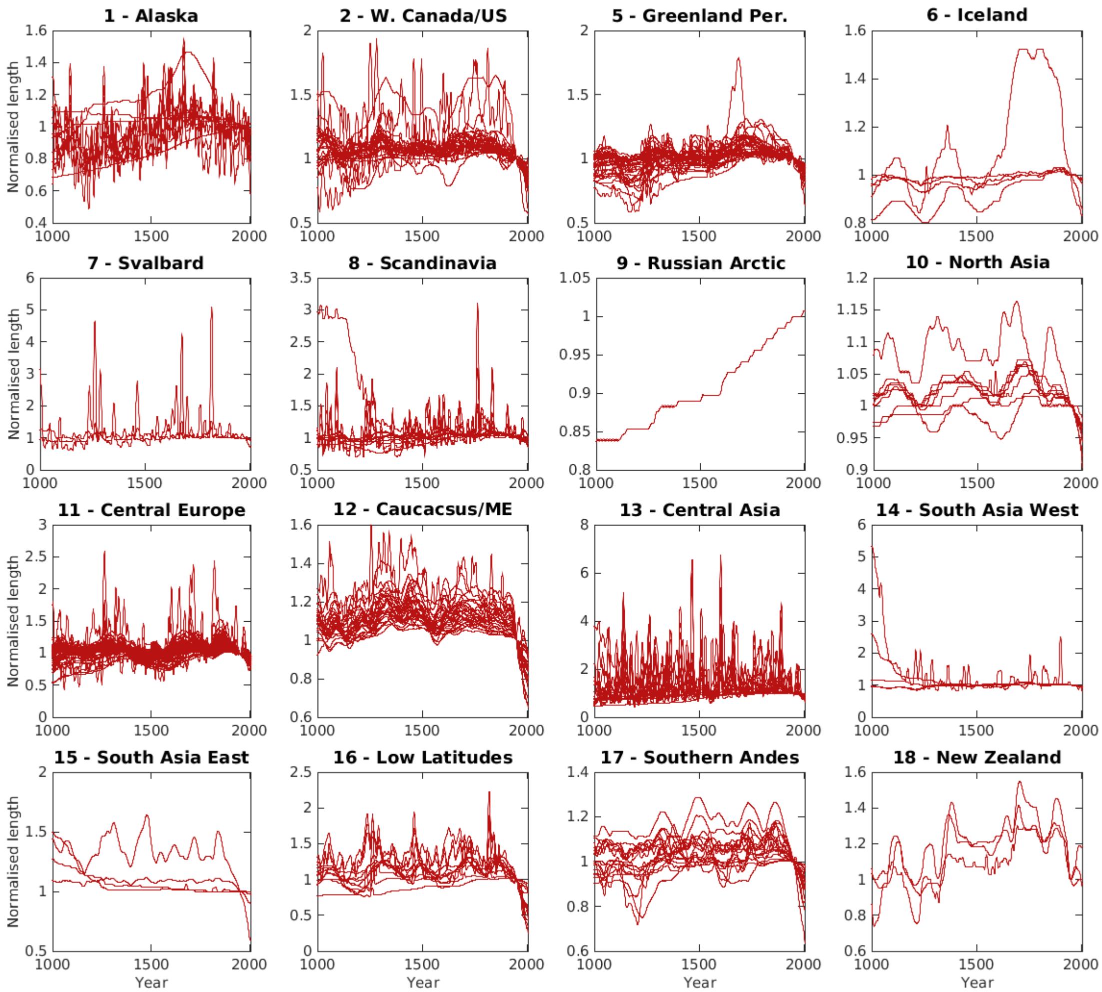
Normalised length
Year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16 - Low Latitudes
17 - Southern Andes
18 - New Zealand
Normalised length
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