

Supplementary Information for

“Ice dynamics will remain a primary driver of Greenland ice sheet mass loss over the next century”

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Retreat calibration

Supplementary Table 1: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for SW region. Grey represents the glacier that has poorly constrained bed topography, blue shows underestimated retreat and red shows overestimated retreat.

Glacier name	Retreat distance (km)	
	Observed	Modeled
Akullersuup Sermia	-0.251	-0.0331
Avannarleq Bræ	x	x
Eqalorutsit Kangilliit	-0.224	3.41
Eqalorutsit Killiit Sermiat	x	x
Eqalorutsit Killiit Sermiat E	x	x
Kangiata Nunaata Sermia	-0.472	-0.509
Naajat	x	x
Nakkaasorsuaq	x	x
Narsap Sermia	4.22	4.23
Nigerlikasik	x	x
Qooqqup Sermia	0	0.422
Sermeq	x	x
Sermiligaarssuk Bræ	x	x
Sermilik Bræ	x	x
Ukaasorsuaq	0	0.187

Supplementary Table 2: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for CW region

Glacier name	Retreat distance (km)	
	Observed	Modeled
Alangorliup Sermia	0	0.673
Eqip Sermia	2.09	2.11
Innigia Isbræ	5.83	5.81
Jakobshavn Isbræ (N. branch)	2.83	2.57
Jakobshavn Isbræ (S. branch)	2.355	2.701
Kangerluarsuup Sermia	0.806	0.08
Kangerlussuup Sermersua	0	0.051
Kangilerngata Sermia	1.57	1.52
Kangilleq	-0.534	-0.0642
Sermeq Kujalleq	-0.701	-0.787
Lille Gletscher	0.794	0.589
Perlerfiup	3.07	3.32
Rinki Isbræ	0.612	1.62
Saqqarliup Sermia	0.842	-0.01
Sermeq Avannarleq	-0.0754	-0.011
Sermeq Silarleq	4.24	3.87
Sermilik	-0.279	-0.252
Store Gletscher	0	0.0401

Supplementary Table 3: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for NW region

Glacier name	Retreat distance (km)	
	Observed	Modeled
Alison Gletscher	3.17	3.93
Bowdoin Gletscher	1.46	0.0201
Carlos Gletscher	0.303	-0.118
Carlos Gletscher W	x	x
Cornell Gletscher	0.78	0.78
Cornell Gletscher N	0.633	0.429
Dietrich	x	x
Dietrichson Gletscher	1.81	1.68
Døcker Smith Gletscher (N.branch)	1.42	0.731
Døcker Smith Gletscher (S.branch)	0.927	2.75
Døcker Smith Gletscher W	0.502	1.24
Farquhar Gletscher	0.334	0.498
Gade Glacier	0	0.0101
Harald Moltke Bræ	1.26	-0.325
Hart Gletscher	x	x
Hayes Gletscher	1.25	0.204
South Hayes M	-0.21	0.0413
South Hayes N	-0.157	-0.0514
South Hayes NN	0.182	0.83
Hayes Gletscher N	-0.101	0.0208
South Hayes SS	2.42	2.86
Heilprin Gletscheri	0.478	0.497
Helland Gletscher	1.52	0.418
Helland Gletscher E	0.783	0.0602
Helland Gletscher W	x	x
Hubbard Gletscher	x	x
Illullip Sermia	1.07	0.197
Issuuarsuit Sermia	0.28	1.02
Kakivfaat Sermiat	3.51	3.45
Kjer Gletscher	6.61	6.5
Kjer Gletscher N	1.7	0.445
Kong Oscar Gletscher	-0.0101	0.0105
Leidy Gletscher	x	x
Melville Gletscher	0.0828	0.0828
Mohn Gletscher	0.895	0.231
Morris Jesup Gletscher	0.982	-0.0309
Nansen Gletscher	2.85	3.01
Nansen Gletscher S	0	0.531
Nordenskiöld Gletscher	4.37	4.55
Nordenskiöld Gletscher N	0.452	0.697
Nunatakassaap Sermia	0	-0.02
Oscar N	2.02	1.95

Oscar NN	0.597	0.512
Qeqertarsuup Sermia	0.918	0.854
Rink Gletscher (N.branch)	0.176	0.145
Rink Gletscher (S.branch)	0.126	0.33
Rink Gletscher S	0	0.053
Savissuaq Gletscher	4.17	1.19
Savissuaq W	1.24	0.172
Savissuaq WW	1.37	0.309
Savissuaq WWW	0.962	-0.0207
Savissuaq WWWW	2.25	2.13
Sharp Gletscher	x	x
Steenstrup Gletscher	1.71	1.31
Sverdrup Gletscher	3.52	3.49
Tracy Gletscher	2.75	2.7
Upervik Isstrøm C	2.95	2.82
Upervik Isstrøm N	3.53	1.34
Upervik Isstrøm NW	0.804	0.556
Upervik Isstrøm S	0.293	0.246
Upervik Isstrøm SS	0.896	0.633
Ussing Bræer	0.363	0.341
Ussing BræerN	-0.431	0.845
Verhoeff Gletscher	x	x
Yngvar Nielsen Bræ	3.49	0.478
Yngvar Nielsen Bræ W	0.0104	0.0104

Supplementary Table 4: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for N region

Glacier name	Retreat distance (km)	
	Observed	Modeled
Academy Gletscher	0	0.14
Adams	x	x
C.H. Ostenfeld Gletscher	1.5	1.42
Dodge	x	x
Hagen Bræ	0.57	-0.253
Harder Gletscher	0.172	0
Humboldt Gletscher	2.11	2.08
Jungersen	x	x
Marie Sophie Gletscher	-0.0601	0.201
Naravana Fjord	x	x
Newman Bugt	x	x
Petermann Gletscher	24.1	0
Ryder Gletscher	-0.505	-0.291
Steensby Gletscher	12.4	-0.153

Supplementary Table 5: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for NE region

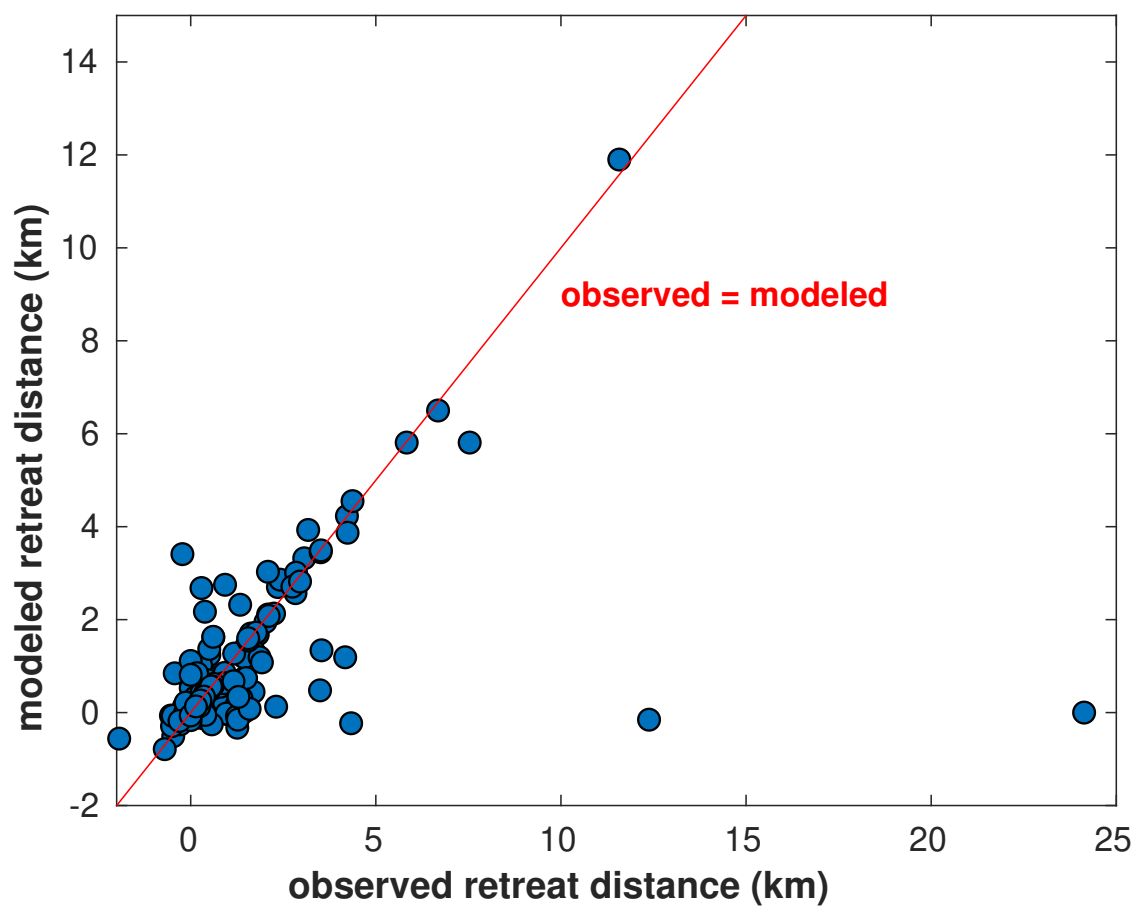
Glacier name	Retreat distance (km)	
	Observed	Modeled
Nioghalvfjerdingsfjorden (79North)	1.25	-0.0804
Charcot Gletscher	x	x
Daugaard-Jensen	1.62	1.7
Eielson Gletscher	x	x
F. Graae Gletscher	0.384	2.17
Gerard de Geer Gletscher	0	0.0825
Heinkel Gletscher	x	x
Hisinger Gletscher	x	x
Jættegletscher	x	x
Kofoed-Hansen Bræ	0.291	2.68
Nordenskiöld Gletscher	x	x
Nunatak	x	x
Rolige Gletscher	0	1.11
Soranerbræen Gletscher	x	x
Storstrømmen	4.33	-0.23
Vestfjord Gletscher	0.433	0.436
Waltershausen Gletscher	0	0
Zachariae Isstrøm	11.6	11.9

Supplementary Table 6: Observed and modeled ice front retreat (in km along a center-line) during the calibration period (2007-2017) for SE region

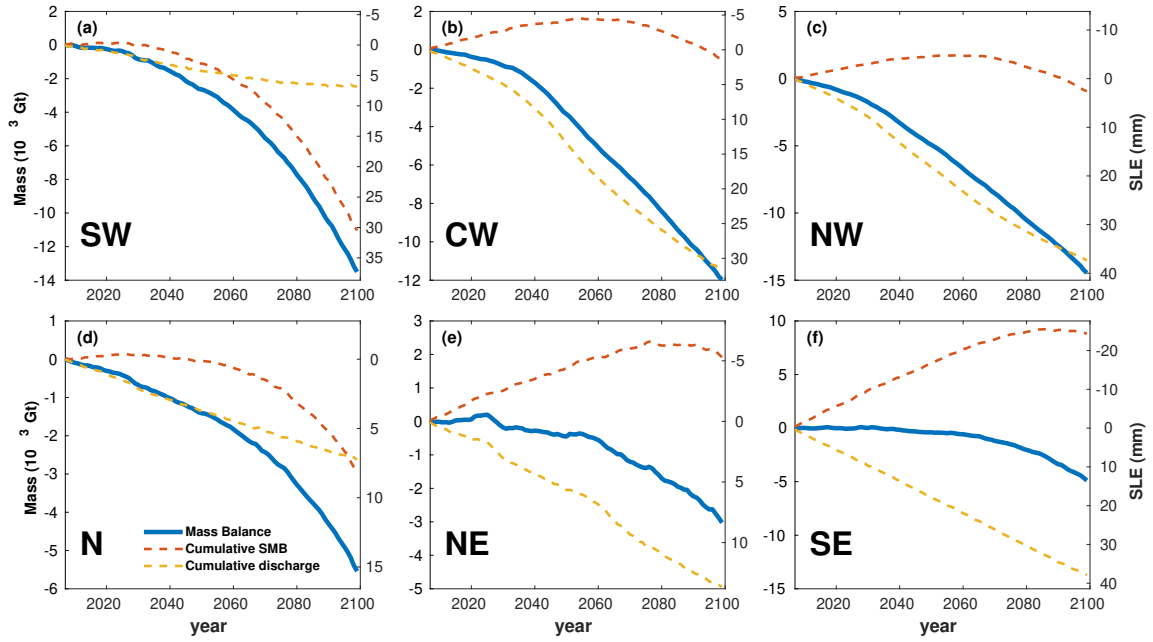
Glacier name	Retreat distance (km)	
	Observed	Modeled
A.P. Bernstorff Gletscher	0.623	0.618
Anorituup Kangerlua	0.159	0.254
Anorituup Kangerlua S	0	0.0212
Apuseeq	1.27	-0.152
Apuseeq N	x	x
Apuseerajik	1.59	0.0802
Borggraven	x	x
Bredeletscher	x	x
Courtauld Gletscher	x	x
Danell Fjord	0	0.0651
South Danell Fjord	0.584	0.561
South Danell Fjord SS	0.394	-0.0511
South Danell Fjord SSS	x	x
Deception Ø CN	1.44	1.19
Deception Ø CS	0.29	0.416
Dendritgletscher	1.17	1.27
Dendritgletscher S	1.49	0.742
Fimbulgletscher	x	x
Frederiksborg Gletscher	0.298	0.294

Graulv	0.353	0.321
Graulv E	x	x
Gyldenløve Fjord N	1.76	1.72
Gyldenløve Fjord S	1.86	1.19
Heimdal Gletscher	-0.0101	-0.0227
Helheim Gletscher	0.414	0.434
Herluf Trolle N	-0.184	0.131
Herluf Trolle S	0.501	1.37
Ikertivaq M	0.173	0.848
Ikertivaq N	0.441	0.492
Ikertivaq NN	1.16	0.674
Ikertivaq S	0.395	0.419
K.I.V. Steenstrup	0.549	0.561
Kaarale Gletscher	x	x
Kangerluluk	x	x
Kangerlussuaq Gletscher	2.06	3.03
Kangertivala	x	x
Kangertsivala	x	x
Kista Dan Gletscher	-0.486	-0.0709
Kista Dan Gletscher W	0.232	0.131
Knud Rasmussen Gletscher	x	x
Knud Rasmussen Gletscher W	x	x
Køge Bugt C	1.29	0.338
Køge Bugt N	-0.173	-0.0873
Køge Bugt S	-0.158	-0.0105
Køge Bugt SS	x	x
Kong Christian IV Gletscher	0	0.802
Kronborg Gletscher	x	x
Kruuse Fjord	0	-0.162
Laube Gletscher	x	x
Laube Gletscher N	x	x
Laube Gletscher S	x	x
Mælkevejen	x	x
Magga Dan Gletscher	0	0.0306
Mogens Heinesen C	0.608	1.63
MogensHeinesenN	1.56	1.55
Mogens Heinesen S	1.92	1.08
Mogens Heinesen SS	x	x
Mogens Heinesen SSS	0.351	0.343
Mone	x	x
Nakkaagajik	x	x
Napasorsuaq C	x	x
Napasorsuaq N	0	0.103
Napasorsuaq S	x	x
Napasorsuaq SS	x	x
Nigertiip	7.54	5.81
Nordfjord Gletscher	x	x
Ostre Borg	x	x
Polaric	-0.138	0.214
Polaric Gletscher S	x	x

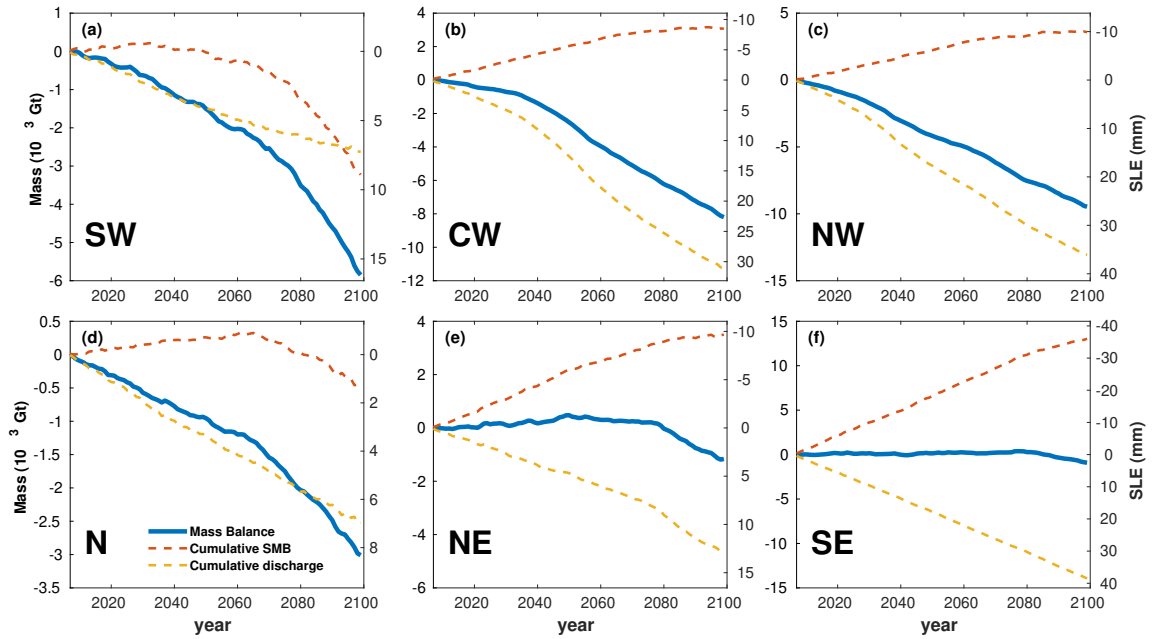
Puisortoq C	-1.93	-0.56
Puisortoq N	0.262	0.26
Puisortoq S	1.34	2.32
Rimfaxe	-0.303	-0.18
Rosenborg Gletscher	x	x
Skinfaxe	0	-0.0623
Søndre Bræ	x	x
Sorgenfri Glacier	0.141	0.133
Sortebræ	x	x
Styrtegletscher	x	x
Sydbæ	x	x
Thrym Gletscher	x	x
Tingmiarmiut Fjord	1.55	1.6
Tingmiarmiut Fjord S	x	x
Torvgletscher S	x	x
Torvgletscher SS	x	x
Uunartit Islands	2.31	0.127



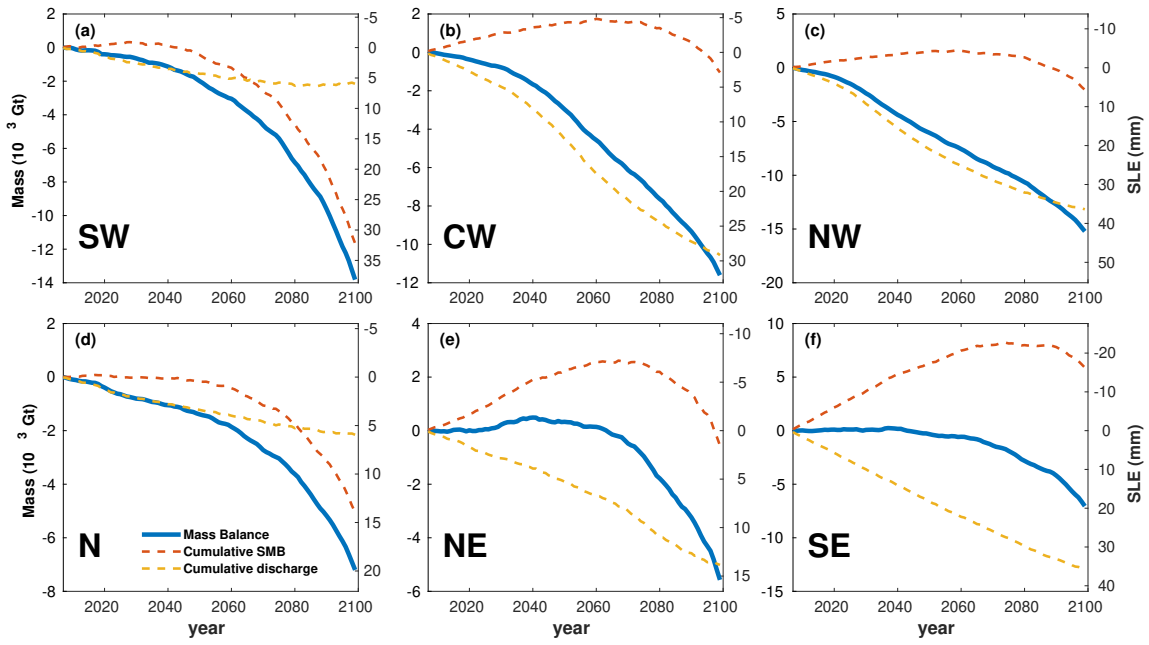
Supplementary Figure 1: Comparison between observed and modeled retreat distance. Observed retreat versus modeled retreat between 2007 and 2017 for the 148 glaciers modeled without poorly-known bathymetry.



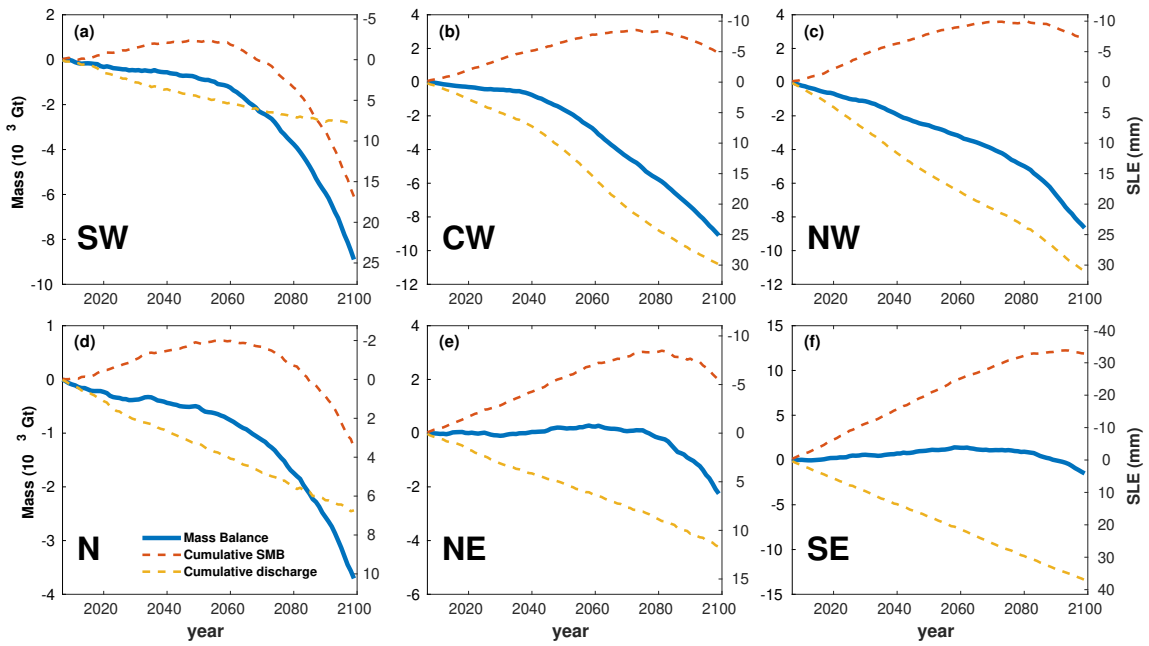
Supplementary Figure 2: Regional projections of cumulative SMB, ice discharge, and ice mass. Cumulative SMB, ice discharge and changes in ice mass from 2007 to 2100 for the six regions of Greenland under CanESM2 RCP8.5



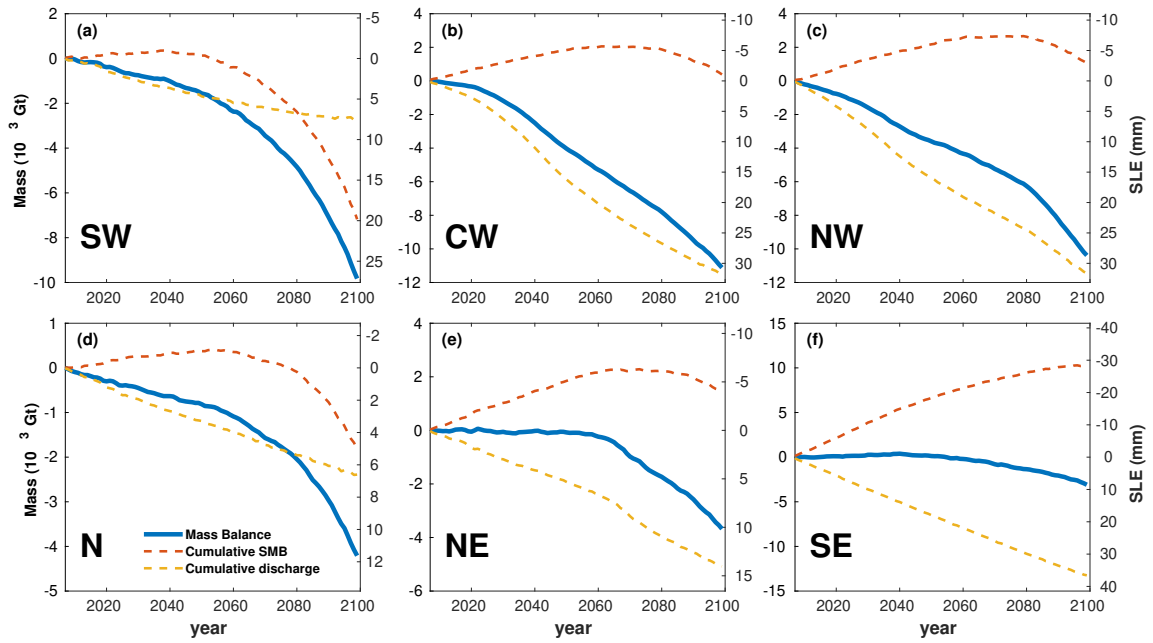
Supplementary Figure 3: Same as Supplementary Figure 2 but under NorESM1 RCP8.5



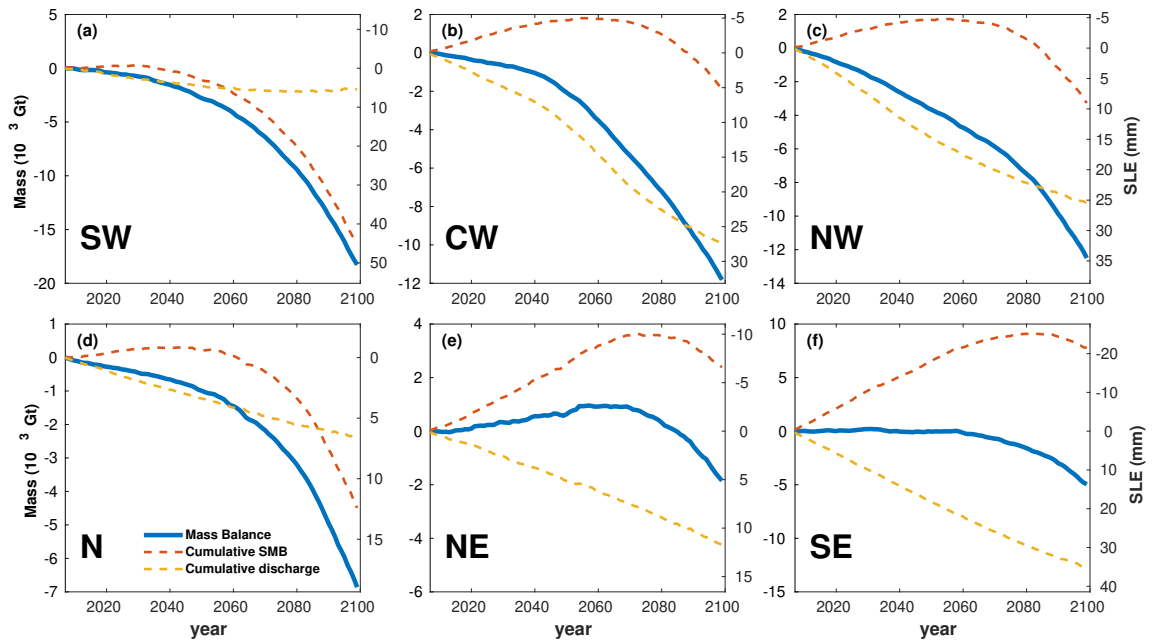
Supplementary Figure 4: Same as Supplementary Figure 2 but under CESM2 SSP585



Supplementary Figure 5: Same as Supplementary Figure 2 but under CNRM-CM6 SSP585



Supplementary Figure 6: Same as Supplementary Figure 2 but under CNRM-ESM2 SSP585



Supplementary Figure 7: Same as Supplementary Figure 2 but under UKESM1-CM6 SSP585