Supplementary material of the paper by Niwano et al. entitled as " NHM-SMAP: Spatially and temporally high resolution non-hydrostatic atmospheric model coupled with detailed snow process model for Greenland Ice Sheet"

Table S1. Model performance in terms of simulating hourly 2 m water vapor pressure (in hPa) at each AWS on the GrIS (Figure 1). Note that the evaluation were conducted at only SIGMA and PROMICE sites. ME, RMSE, and R^2 are the mean error (the average of the difference between simulated values and observed values), and the coefficient of determination, respectively. Number of observations (OBS) employed for the comparison are also listed.

Sites	ME (hPa)	RMSE (hPa)	R^2	Number of observations
SIGMA-A	0.07	0.36	0.95	18998
SIGMA-B	0.21	0.48	0.94	18541
KPC_U	−0.01	0.44	0.95	26139
SCO_U	−0.16	0.62	0.90	25786
TAS_U	−0.33	0.76	0.84	23263
QAS_L	−0.53	0.88	0.89	23483
QAS_A	−0.42	0.77	0.89	8678
NUK_L	−0.23	0.67	0.92	21933
NUK_U	−0.30	0.63	0.92	20908
NUK_N	−0.23	0.56	0.93	19955
KAN_L	−0.02	0.52	0.94	25518
KAN_M	−0.15	0.59	0.92	20379
KAN_U	−0.05	0.46	0.93	22925
UPE_L	−0.27	0.69	0.92	25409
UPE_U	−0.27	0.56	0.95	23036

Table S2. Model performance in terms of simulating hourly surface pressure (in hPa) at each AWS on the GrIS (Figure 1). Elevation differences between the reality and NHM-SMAP are indicated together.

Sites	ME (hPa)	RMSE (hPa)	R^2	Number of observations	Elevation difference (m)
SIGMA-A	-2.8	2.9	0.99	18998	4
SIGMA-B	17.4	17.4	0.99	18550	-165
Summit	-7.6	8.9	0.86	13064	44
S-Dome	-4.3	4.4	1.00	11161	20
KPC_U	-5.5	5.6	0.99	26304	23
SCO_U	-23.1	23.2	0.98	26249	176
TAS_U	-2.3	2.6	0.99	23330	1
QAS_L	-12.5	12.6	0.99	26302	85
QAS_A	-13.9	13.9	1.00	9267	104
NUK_L	-7.5	7.6	0.99	26296	26
NUK_U	-13.0	13.1	0.98	20933	85
NUK_N	-8.4	8.5	0.99	23570	46
KAN_L	5.6	5.7	0.99	26303	-74
KAN_M	-7.8	8.0	0.98	21208	49
KAN_U	-3.7	3.7	0.99	24084	20
UPE_L	-7.2	7.3	0.98	25743	34
UPE_U	-8.6	8.7	0.99	26300	77

Table S3. Model performance in terms of simulating hourly 10 m wind speed (in m s^{-1}) at each AWS on the GrIS (Figure 1).

Sites	ME (m s^{-1})	RMSE (m s^{-1})	R^2	Number of observations
SIGMA-A	−0.5	2.6	0.40	17846
SIGMA-B	1.0	3.2	0.14	17851
Summit	−0.7	2.5	0.54	18825
S-Dome	−2.0	4.0	0.76	10624
KPC_U	0.4	1.7	0.65	25921
SCO_U	−0.2	2.3	0.13	25774
TAS_U	2.5	4.3	0.68	22977
QAS_L	0.2	2.8	0.51	23423
QAS_A	−0.6	2.5	0.59	8481
NUK_L	0.4	2.3	0.52	21808
NUK_U	2.2	3.2	0.64	20807
NUK_N	−0.3	2.4	0.65	19773
KAN_L	0.8	2.4	0.54	25432
KAN_M	−0.1	2.3	0.72	21047
KAN_U	−1.4	2.8	0.78	22660
UPE_L	1.3	3.1	0.44	25051
UPE_U	0.6	2.5	0.69	22906

Table S4. Model performance in terms of simulating hourly downward shortwave radiant flux (in W m^{-2}) at each AWS on the GrIS (Figure 1).

Sites	ME (W m^{-2})	RMSE (W m^{-2})	R^2	Number of observations
SIGMA-A	−13.5	60.2	0.86	8077
SIGMA-B	−9.4	72.6	0.80	8069
Summit	−9.1	75.9	0.88	10945
S-Dome	52.6	112.3	0.82	10556
KPC_U	−28.6	56.0	0.90	11443
SCO_U	0.6	69.0	0.88	10972
TAS_U	−9.6	88.9	0.81	8588
QAS_L	16.6	96.5	0.83	11229
QAS_A	−3.8	103.7	0.81	3962
NUK_L	2.2	90.8	0.83	8384
NUK_U	−10.5	82.8	0.87	8341
NUK_N	4.4	84.5	0.86	9534
KAN_L	−17.1	127.3	0.70	10837
KAN_M	−16.4	73.0	0.88	8510
KAN_U	−39.4	81.3	0.91	10467
UPE_L	−0.7	78.5	0.83	11007
UPE_U	−7.0	65.0	0.88	11061

Table S5. Model performance in terms of simulating hourly downward longwaveradiant flux (in W m^{-2}) at each AWS on the GrIS (Figure 1). Note that the evaluation were conducted at only SIGMA and PROMICE sites.

Sites	ME (W m^{-2})	RMSE (W m^{-2})	R^2	Number of observations
SIGMA-A	−25.1	37.3	0.70	18936
SIGMA-B	−14.7	31.9	0.71	18551
KPC_U	−14.5	28.4	0.74	26192
SCO_U	−17.0	28.4	0.78	26246
TAS_U	−20.5	32.7	0.66	23184
QAS_L	−19.8	30.2	0.80	26274
QAS_A	−21.5	32.5	0.76	9238
NUK_L	−21.8	32.1	0.80	21871
NUK_U	−13.7	28.7	0.78	20885
NUK_N	−21.3	32.3	0.77	23501
KAN_L	−13.1	28.2	0.76	26216
KAN_M	−10.8	28.6	0.75	21194
KAN_U	−11.8	29.9	0.71	24058
UPE_L	−22.2	35.8	0.72	25627
UPE_U	−14.0	29.9	0.77	26265

Table S6. Model performance in terms of simulating hourly snow/firn/ice surface temperature (in ºC) at each AWS on the GrIS (Figure 1). Note that the evaluation were conducted at only SIGMA and PROMICE sites.

Sites	ME (ºC)	RMSE (ºC)	R^2	Number of observations
SIGMA-A	2.3	4.7	0.91	19007
SIGMA-B	3.2	4.9	0.91	18551
KPC_U	2.6	4.8	0.93	26139
SCO_U	1.1	4.3	0.82	26235
TAS_U	1.7	3.2	0.82	23316
QAS_L	0.4	2.2	0.87	26301
QAS_A	0.0	2.6	0.90	9264
NUK_L	0.4	2.7	0.88	21944
NUK_U	−0.3	2.7	0.90	20920
NUK_N	0.1	2.8	0.89	22793
KAN_L	1.1	3.2	0.90	26284
KAN_M	1.0	3.5	0.91	21184
KAN_U	0.9	3.3	0.93	24039
UPE_L	2.0	4.5	0.85	25747
UPE_U	1.0	3.3	0.92	26291

Table S7. Model performance in terms of simulating hourly snow and ice albedo at each AWS on the GrIS (Figure 1). Note that the evaluation were conducted at only SIGMA and PROMICE sites.

Sites	ME	RMSE	R^2	Number of observations
SIGMA-A	0.02	0.07	0.04	3150
SIGMA-B	0.07	0.15	0.06	3250
KPC_U	0.09	0.13	0.06	4451
SCO_U	0.22	0.27	0.09	5297
TAS_U	0.15	0.24	0.10	3627
QAS_L	0.32	0.41	0.12	6415
QAS_A	0.15	0.25	0.03	2252
NUK_L	0.27	0.32	0.13	4501
NUK_U	0.20	0.25	0.09	4752
NUK_N	0.23	0.33	0.12	5352
KAN_L	0.19	0.23	0.16	6003
KAN_M	0.17	0.25	0.12	4571
KAN_U	0.08	0.11	0.07	5967
UPE_L	0.11	0.17	0.19	5136
UPE_U	0.15	0.22	0.10	5243

Supplementary material of the paper by Niwano et al. entitled as " NHM-SMAP: Spatially and temporally high resolution non-hydrostatic atmospheric model coupled with detailed snow process model for Greenland Ice Sheet"

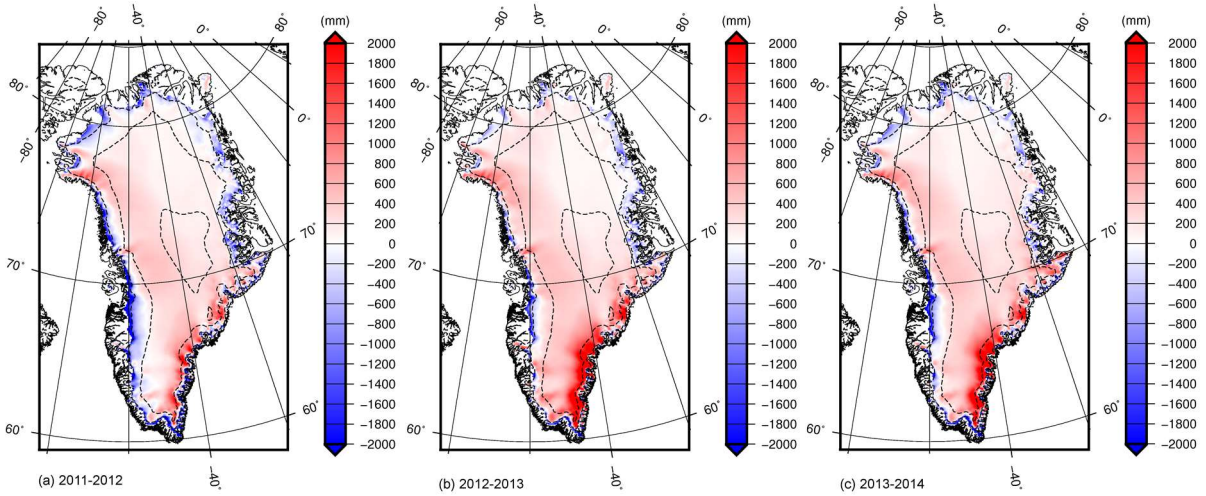

Figure S1: The NHM-SMAP simulated accumulated GrIS SMB (in mm) during the (a) 2011-2012, (b) 2012-2013, and (c) 2013-2014 mass balance years (September to August).