Table S1. Statistics of the 10 m wind speed, 2 m temperature, and rain rate in July 2016. The top statistics are presented in bold.

	rCTL	rRSL
10 m wind speed		
Mean bias (m s^{-1})	2.10	**2.01**
Root mean square error (m s^{-1})	2.74	**2.69**
2 m temperature		
Mean bias (K)	**-1.35**	-1.68
Root mean square error (K)	2.37	**2.55**
Rain rate		
Mean bias (mm hr^{-1})	**0.122**	0.150
Root-mean-square error (mm hr^{-1})	2.964	**2.948**
Pattern correlation	0.884	**0.889**

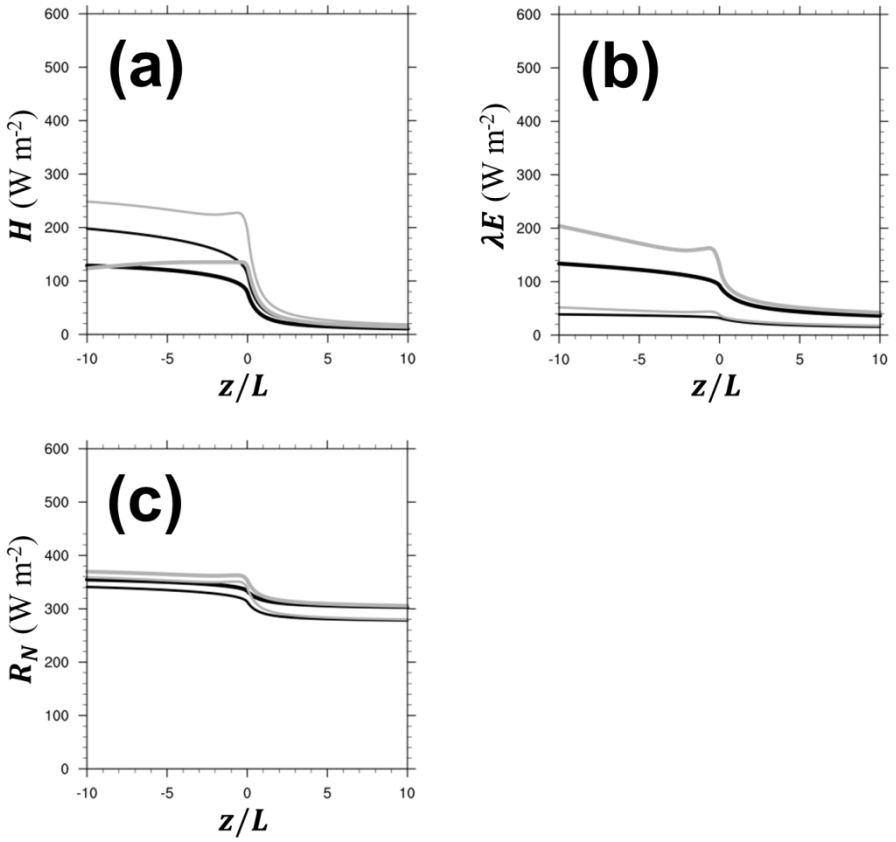


Figure S1. (a) sensible heat flux (W m^{-2}), (b) latent heat flux (W m^{-2}), and (c) net radiation (W m^{-2}) at a given atmospheric stability (z/L). The black lines denote offCTL, while the gray lines denote offRSL. Thin and thick lines correspond to soil moisture of 0.15 m^3 m^{-3} and 0.15 m^3 m^{-3}, respectively.

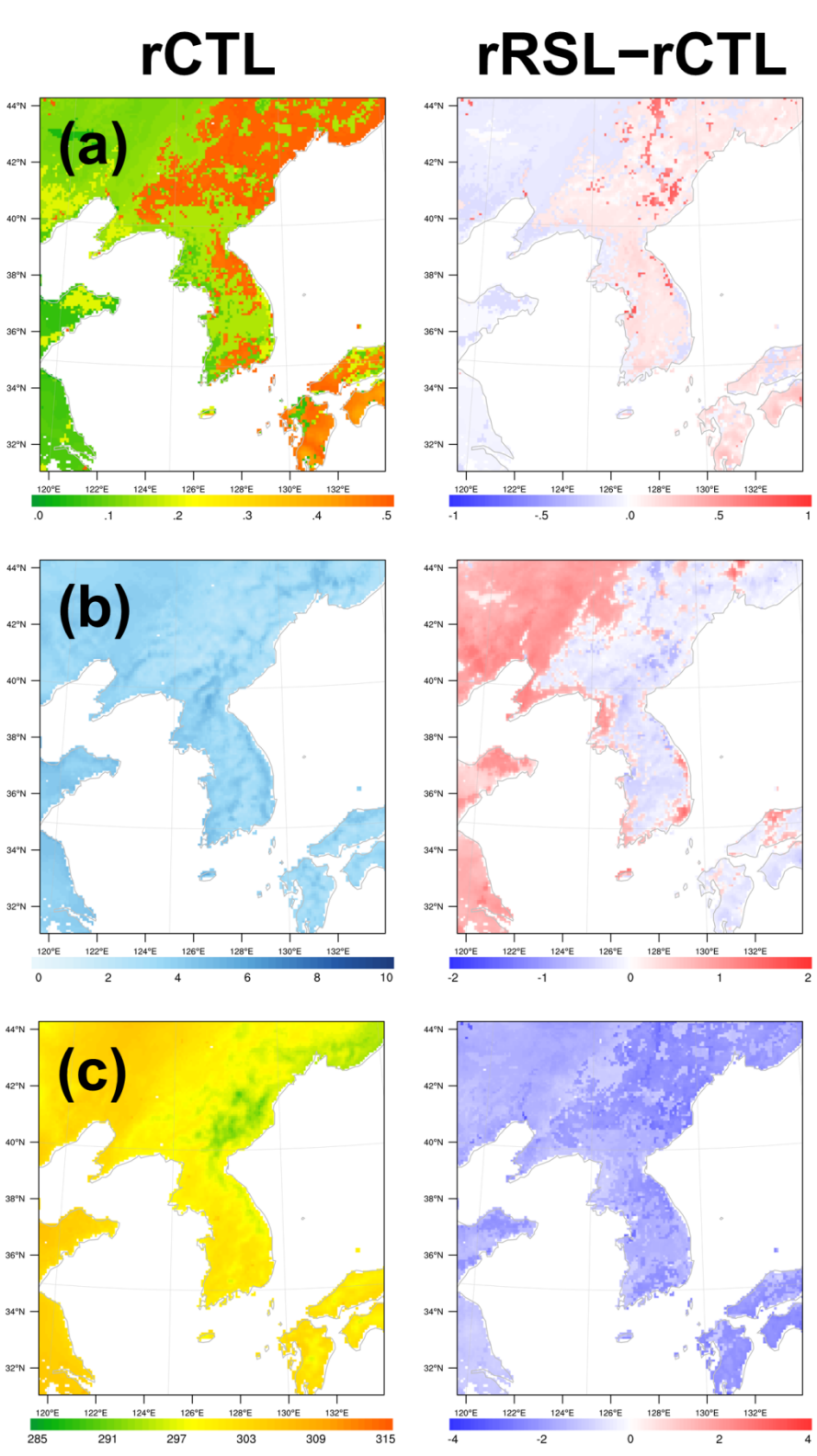
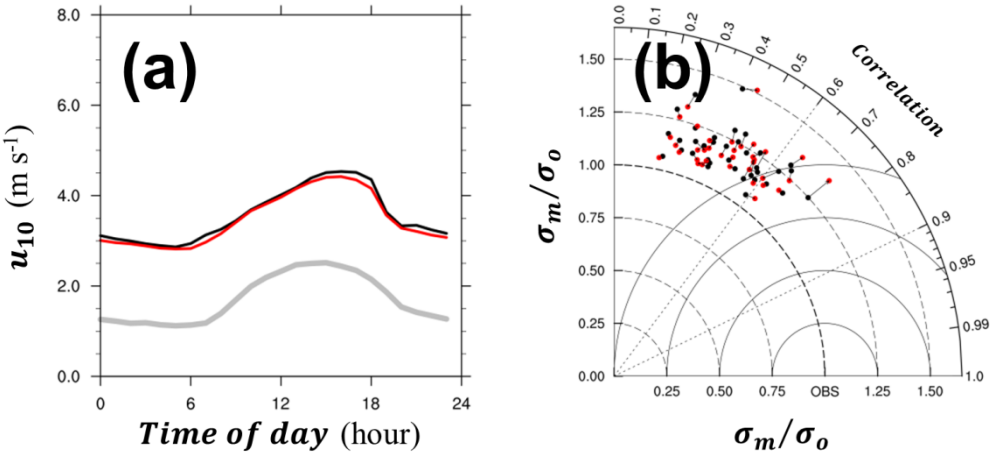

rCTL
rRSL−rCTL
(a)
(b)
(c)
44°N
42°N
40°N
38°N
36°N
34°N
32°N
120°E 122°E 124°E 126°E 128°E 130°E 132°E
.0 .1 .2 .3 .4 .5
-1 -.5 .0 .5 1
0 2 4 6 8 10
-2 -1 0 1 2
285 291 297 303 309 315
-4 -2 0 2 4

Figure S2. (a) Roughness length (m), (b) 10 m wind speed (m s^{-1}), and (c) daytime 2 m temperature (K) of the (left) rCTL experiment and (right) the difference (rRSL − rCTL). The results are averaged over a period of one month in July 2016 and masked out over the ocean.



15 **Figure S3. (a) One month mean diurnal variation of 10 m wind speed and (b) the Taylor diagram showing the correlation coefficient, normalized centered root–mean–square differences (RMSD), and standard deviations of the models (σ_m) normalized by that of observation (σ_o) from observation (gray), rCTL experiment (black), and rRSL experiment (red) in July 2016. The vectors indicate the changes of the statistics from rCTL to rRSL. The arrows indicate those from rCTL to rRSL. Every vector shows the movement toward the observation, thereby suggesting the model improvement.**

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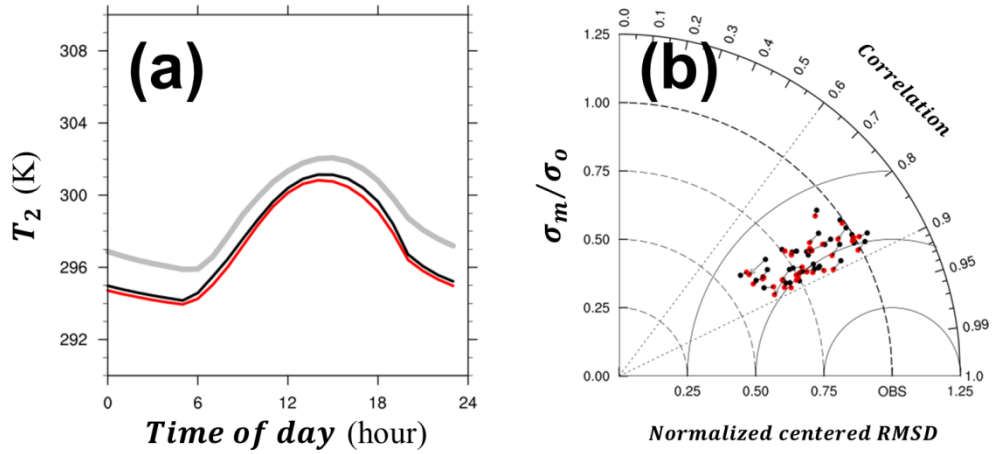

Figure S4. Same as in Fig. S3 but for 2 m temperature in July, 2016.

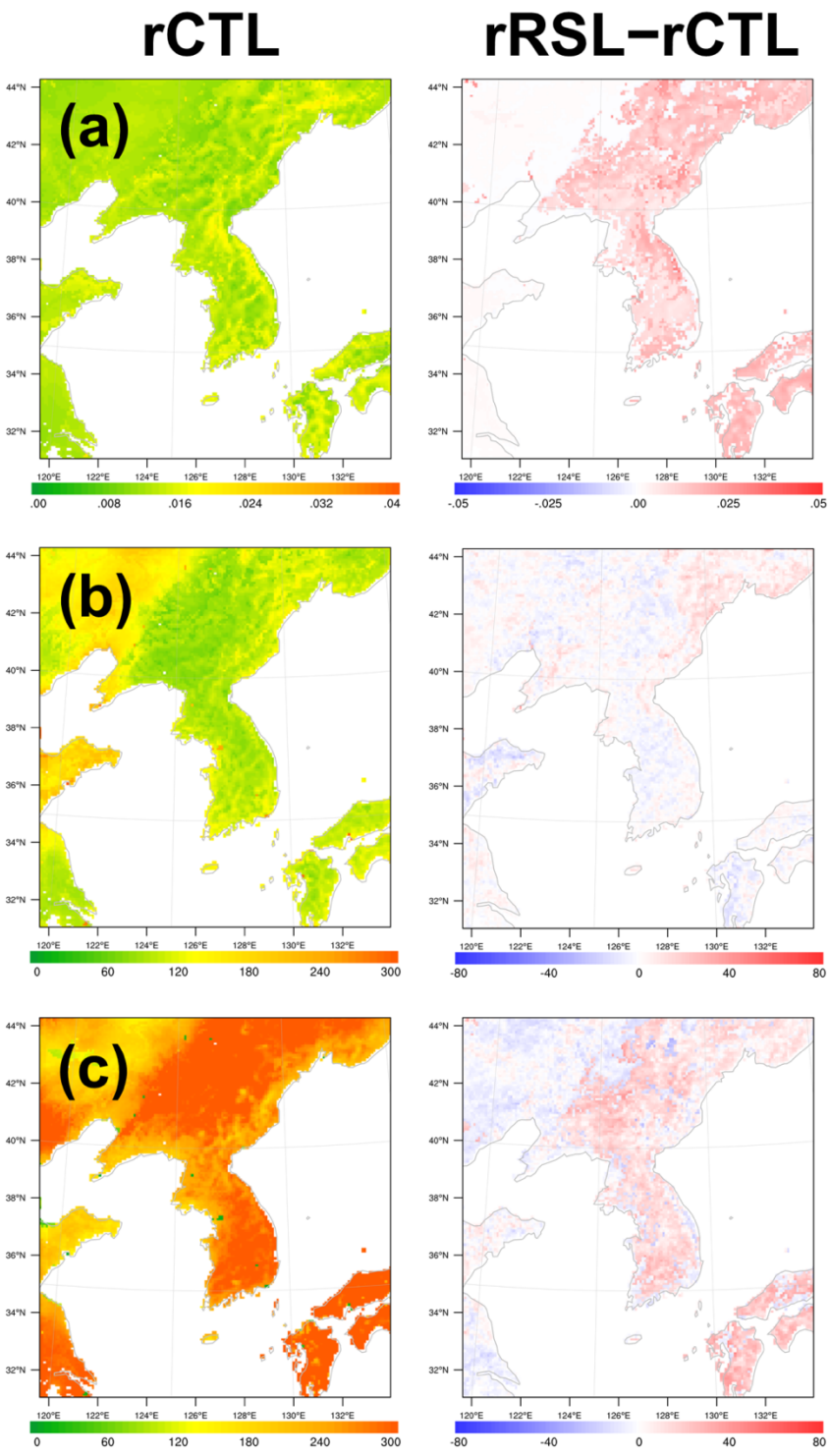
rCTL
rRSL−rCTL
(a)
(b)
(c)
44°N
42°N
40°N
38°N
36°N
34°N
32°N
120°E
122°E
124°E
126°E
128°E
130°E
132°E
.00
.008
.016
.024
.032
.04
-.05
-.025
.00
.025
.05
0
60
120
180
240
300
-80
-40
0
40
80

Figure S5. (a) Aerodynamic conductance (m s^{-1}), (b) daytime sensible heat flux (W m^{-2}), and (c) daytime latent heat flux (W m^{-2}) of the (left) rCTL experiment and (right) the difference (rRSL − rCTL). The results are averaged over a period of one month in July 2016 and masked out over the ocean.

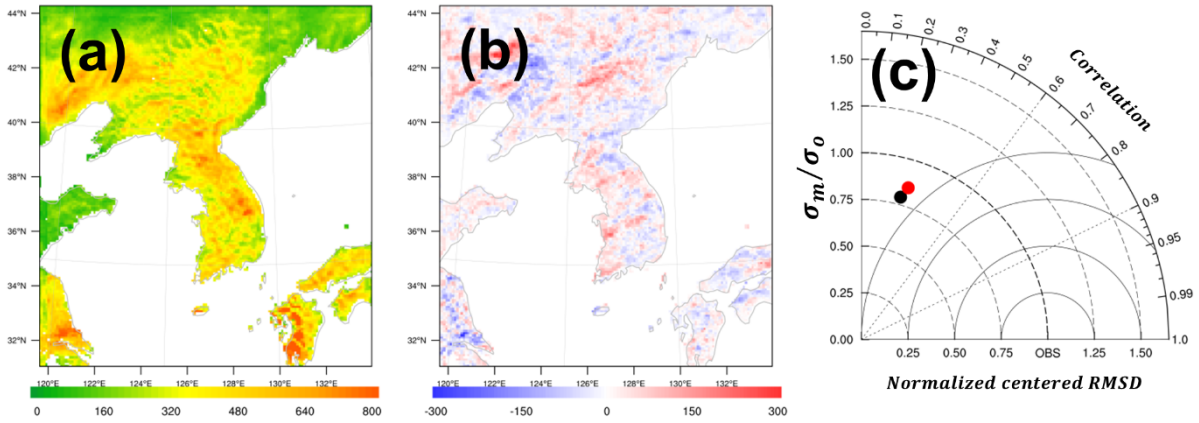

Figure S6. (a) One month accumulated precipitation of the rCTL experiment (mm) and (b) difference (rRSL − rCTL) in July 2016. (c) Taylor diagram showing the correlation coefficient, normalized centered root–mean–square difference (RMSD), and the standard deviations of models (σ_m) normalized by that of the observation (σ_o) and from the rain rate (mm h^{-1}) of the rCTL experiment (black) and the rRSL experiment (red) during one month at 656 rain gauges.