Supporting information for "Investigating multiscale meteorological controls and impacts of soil moisture heterogeneity on radiation fog in complex terrain using semi-idealised simulations"

This document presents sensitivity experiments on the vertical spacing used for Domain 4 (D04) of the fog simulations presented in the main manuscript. The original simulation has a vertical grid spacing of 18 m for D04, and we conducted two sets of simulations with a vertical grid spacing of 9 m and 6 m, respectively. The sensitivity experiments are presented in Section 1 and Figures S1-S6. The original simulations presented in the manuscript were conducted using the Cray FORTRAN compilers, while the sensitivity experiments presented here were conducted using the Intel FORTRAN compilers. This does not change our conclusions. To provide more confidence, the results of the homogeneous simulation with D04 of 18 m vertical grid spacing conducted using the Intel FORTRAN compilers are presented in Section 2. The figures (Figures S7-S10) in Section 2 are similar to those in Section 4 of the main manuscript.

1. SENSITIVITY EXPERIMENTS

The vertical level configurations and computation time of the sensitivity experiments are shown in Table S1. For each of the three configurations, two simulations were conducted. One contains homogeneous soil moisture (HOM), and the other contains heterogeneous soil moisture with the 12-point adjustment (HET12p). Hereafter, we denote the simulations conducted with the vertical grid spacing of 18 m, 9 m, and 6 m as HOM-18m and HET12p-18m, HOM-9m and HET12p-9m, and HOM-6m and HET12p-6m, respectively.

The fog duration for HOM-18m, HOM-9m, and HOM-6m, and the fog duration difference between each HOM simulation and HET12p simulation are shown in Figure S1. As shown in Figure S1, the finer vertical grid spacing results in an increase in fog area and fog duration. However, the comparison between each HOM and HET12p simulation still does not show a direct correlation between spatial variations in soil moisture and the changes in fog duration. To provide more evidence supporting our conclusion, Figure S2 shows the time series of liquid water mixing ratio (ql) for Hagley Park (HAP), Port Hills (PTH), Southwest of Christchurch (SWC), and

Table S1. Vertical level configurations and computation time for the sensitivity experiments.

Vertical grid spacing (dz)	Vertical grid points (nz)	Simulation hours	CPU specification	Number of CPUs	Wall clock time
18 m	36	48 hours	Intel Xeon Skylake Gold 6148 processor cores (2.4 GHz)	396	8 hours
9 m	72	36 hours	Intel Xeon Skylake Gold 6148 processor cores (2.4 GHz)	396	24 hours
6 m	108	34 hours	Intel Broadwell processer cores (2.1 GHz)	396	72 hours

Waimakariri River (WMR). The vertical profiles of wind, potential temperature, and ql are shown in Figures S3, S4, S5, and S6 for HAP, PTH, SWC, and WMR, respectively.

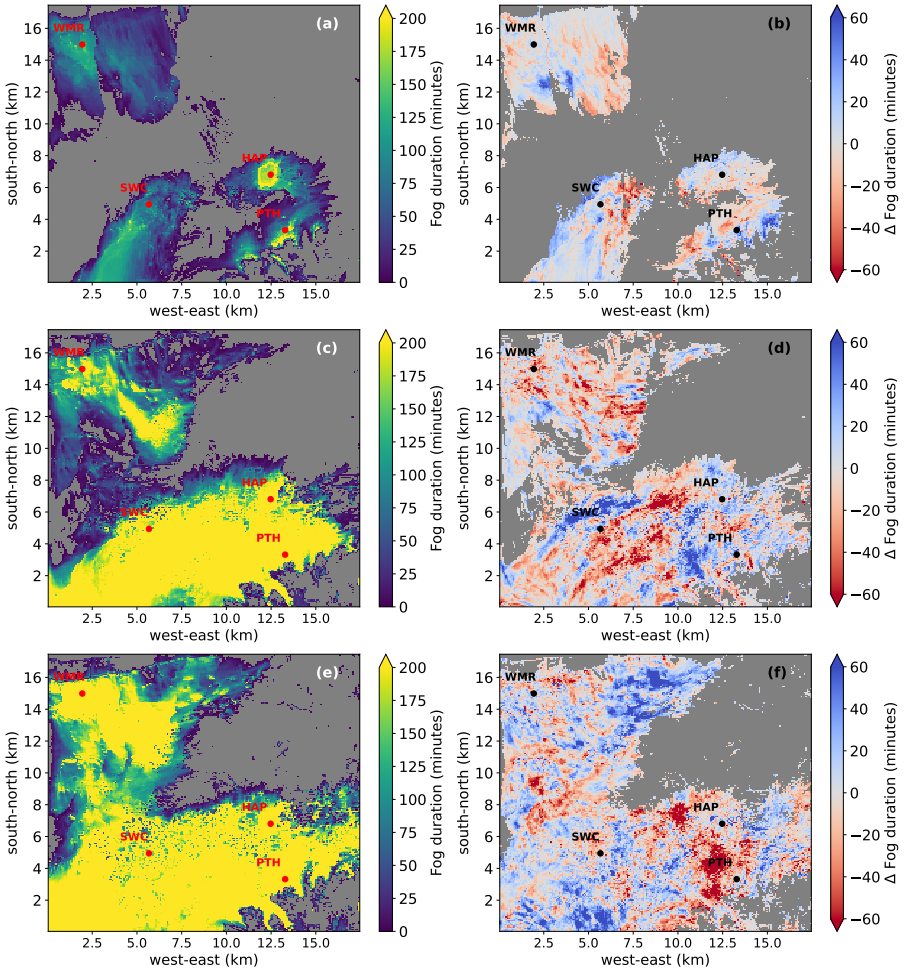

Fig. S1. (a), (b), (c), and (d) show fog duration in minutes for HOM-18m, HOM-9m, and HOM-6m, respectively. (b), (d), and (f) are fog duration differences in minutes between each HOM and HET12p simulation for the simulations with a vertical grid spacing of 18 m, 9 m, and 6 m, respectively. Hagley Park (HAP), Port Hills (PTH), Southwest of Christchurch (SWC), and Waimakariri River (WMR) are marked by dots in each panel.

2. RESULTS FOR THE HOMOGENEOUS SOIL MOISTURE SIMULATION WITH THE INTEL FORTRAN COMPILER

Figures S7, S8, S9, and S10 show the results for HOM-18m simulated using the Intel FORTRAN compiler.

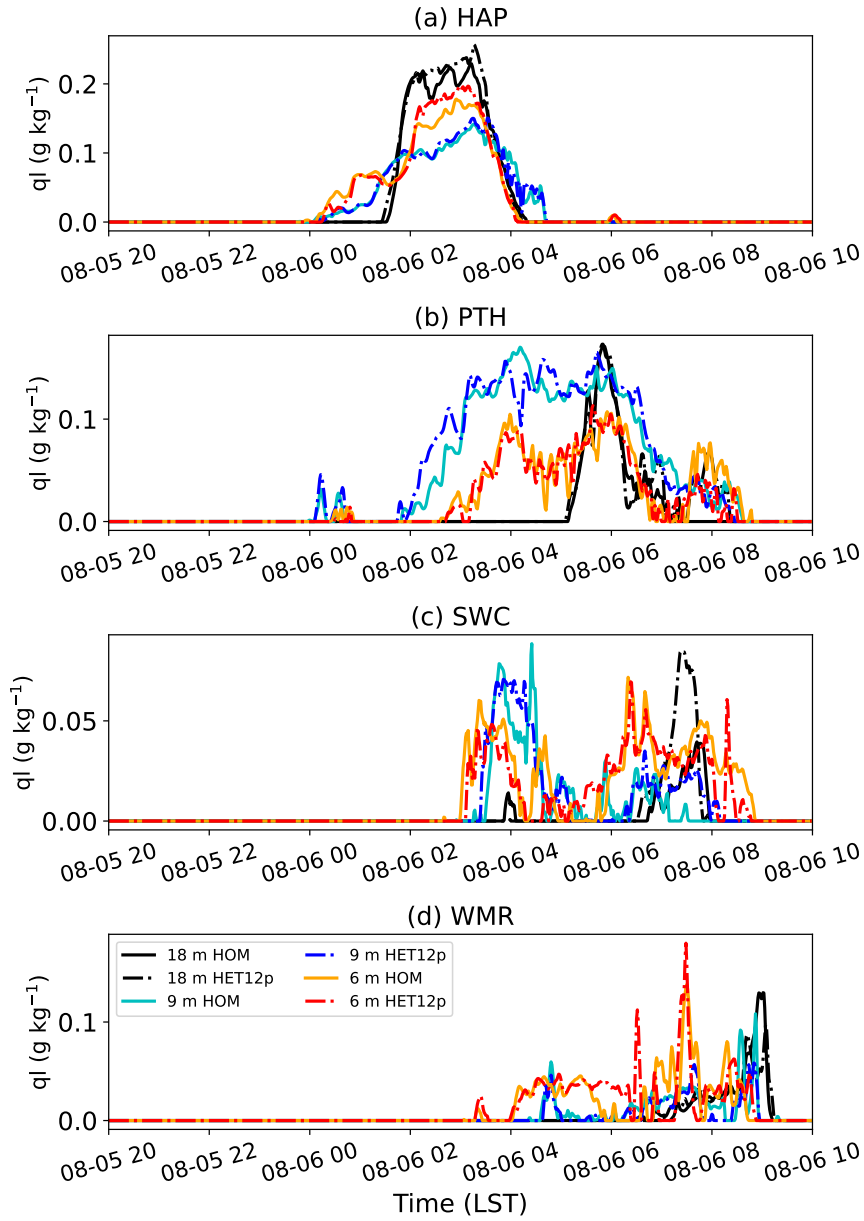

Fig. S2. Time series of liquid water mixing ratio (ql) for (a) HAP, (b) PTH, (c) SWC, and (d) WMR.

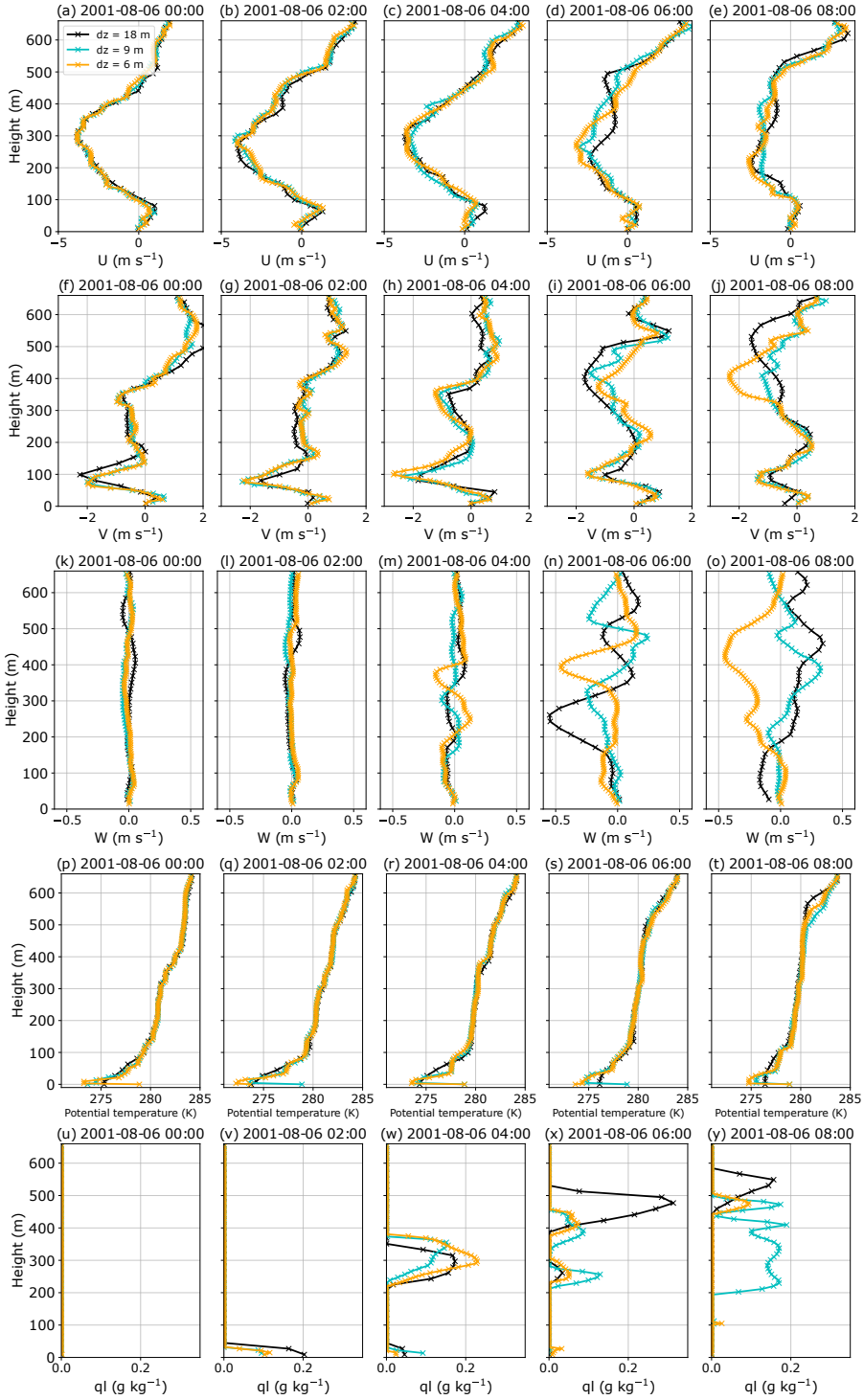

Fig. S3. Vertical profiles of the u component of winds (a–e), v component of winds (f–j), w component of winds (k–o), potential temperature (p-t), and *ql* (u-y) for HAP taken from HOM-18m, HOM-9m, and HOM-6m at the times indicated in the figures.

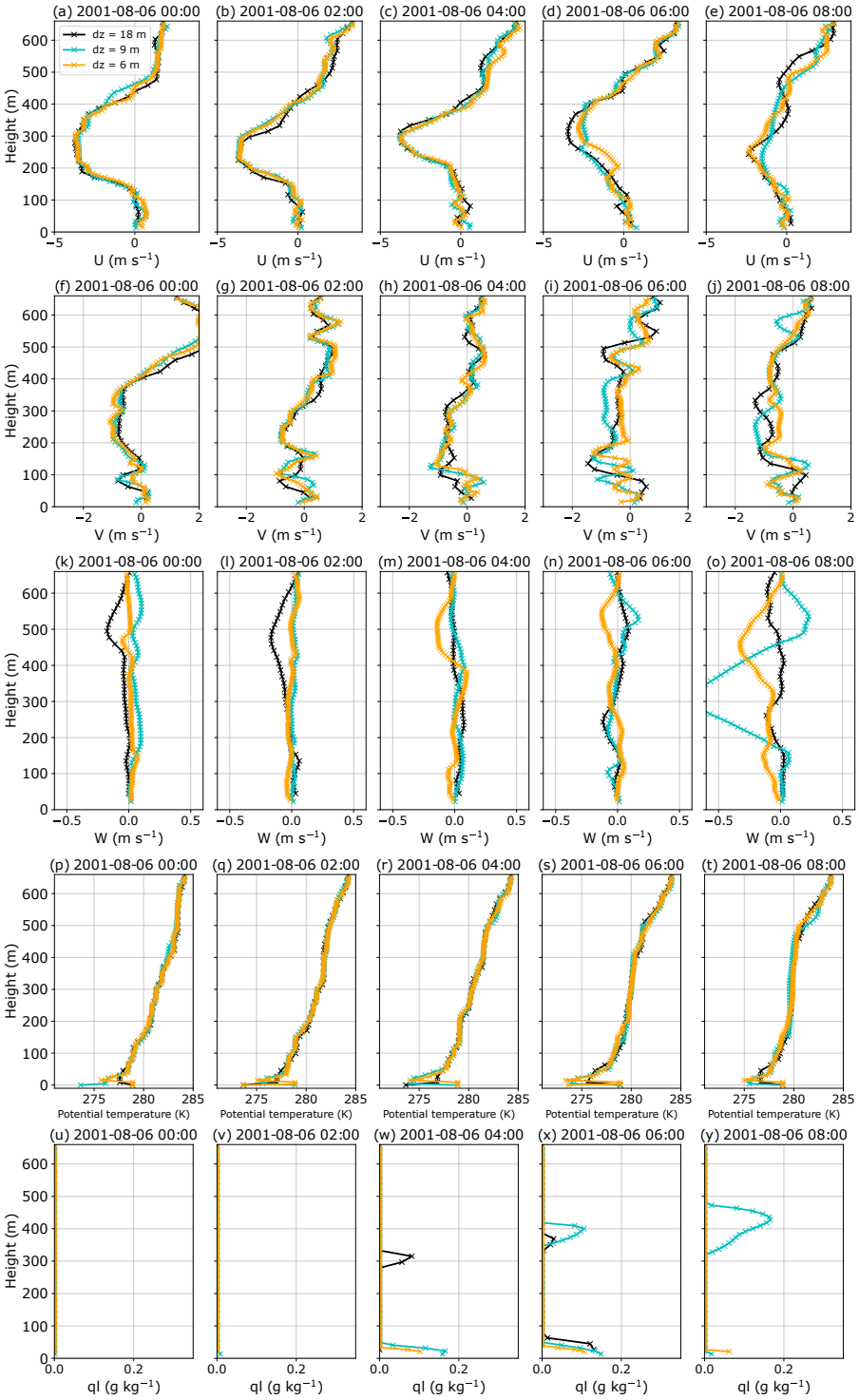

Fig. S4. Similar to S3, but for PTH.

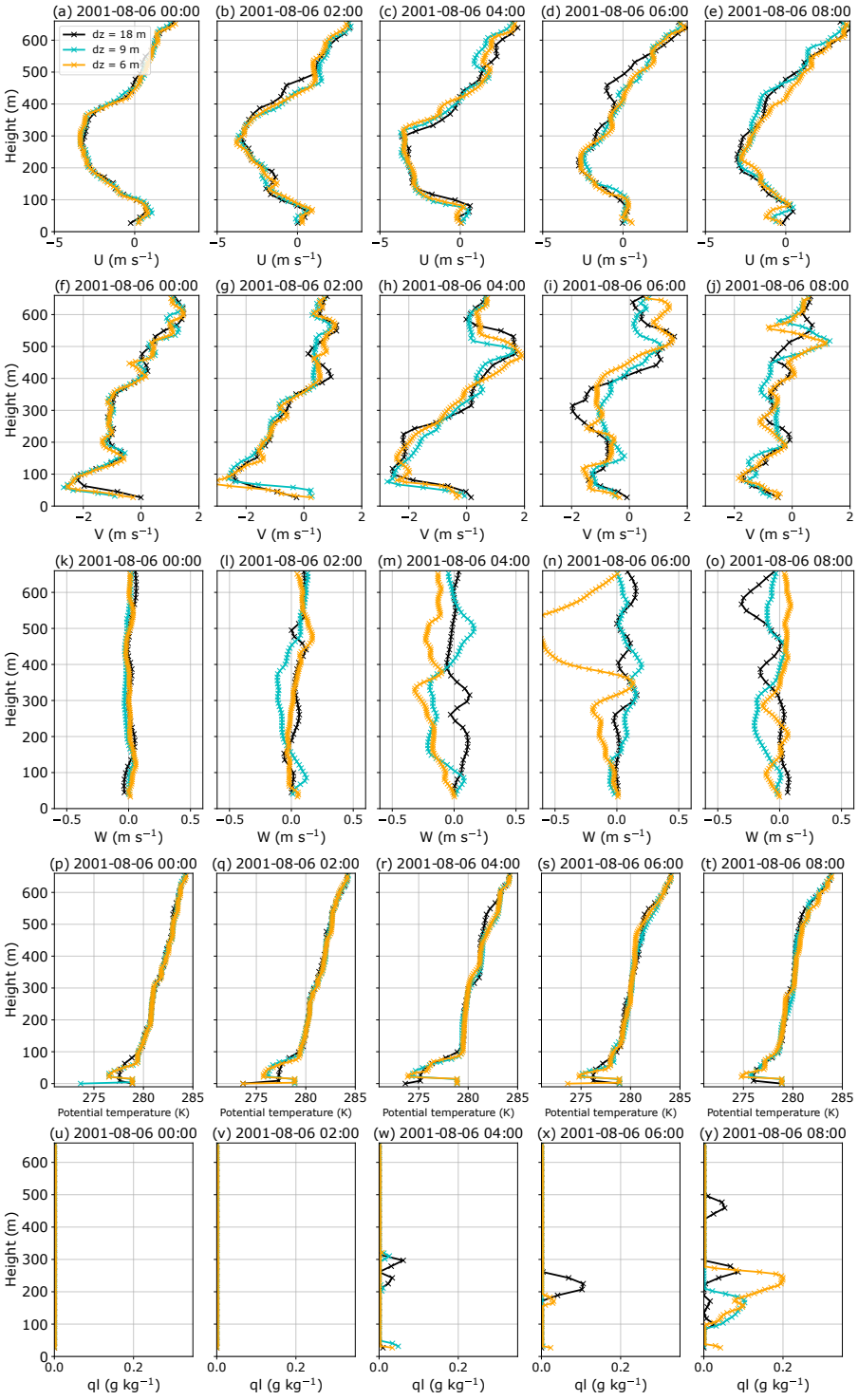

Fig. S5. Similar to S3, but for SWC.

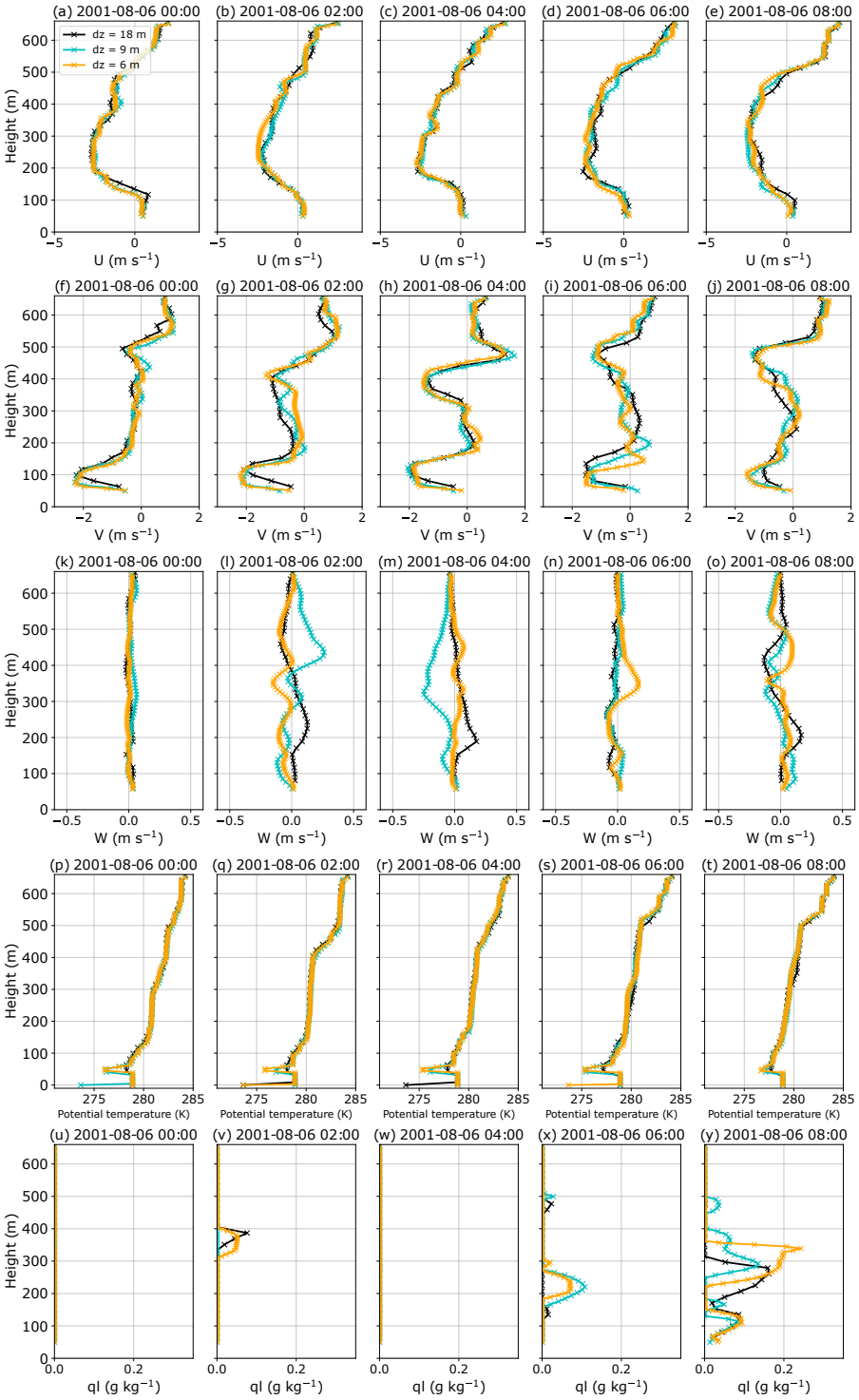

Fig. S6. Similar to S3, but for WMR.

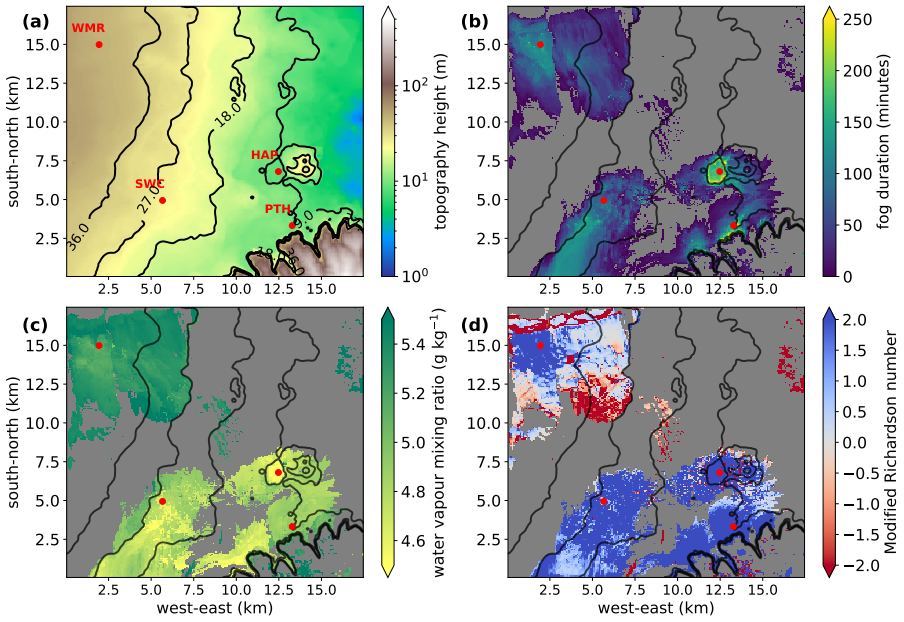

Fig. S7. Similar to Figure 3 in the main manuscript, but for HOM-18m simulated using the Intel FORTRAN compiler.

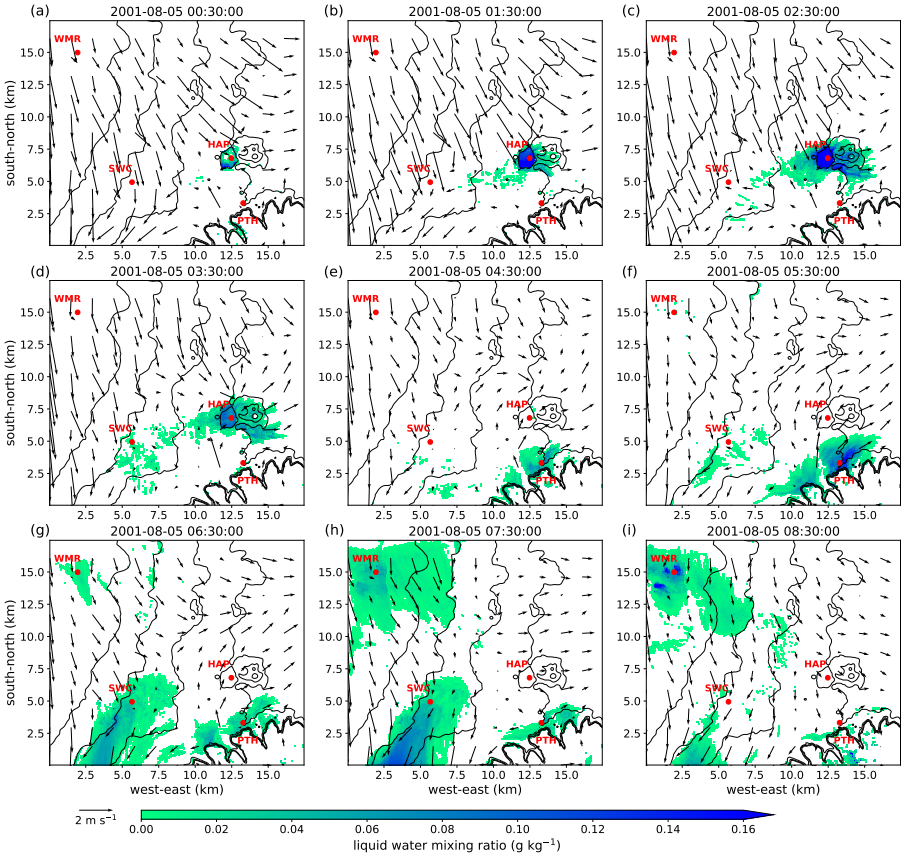

Fig. S8. Similar to Figure 4 in the main manuscript, but for HOM-18m simulated using the Intel FORTRAN compiler.

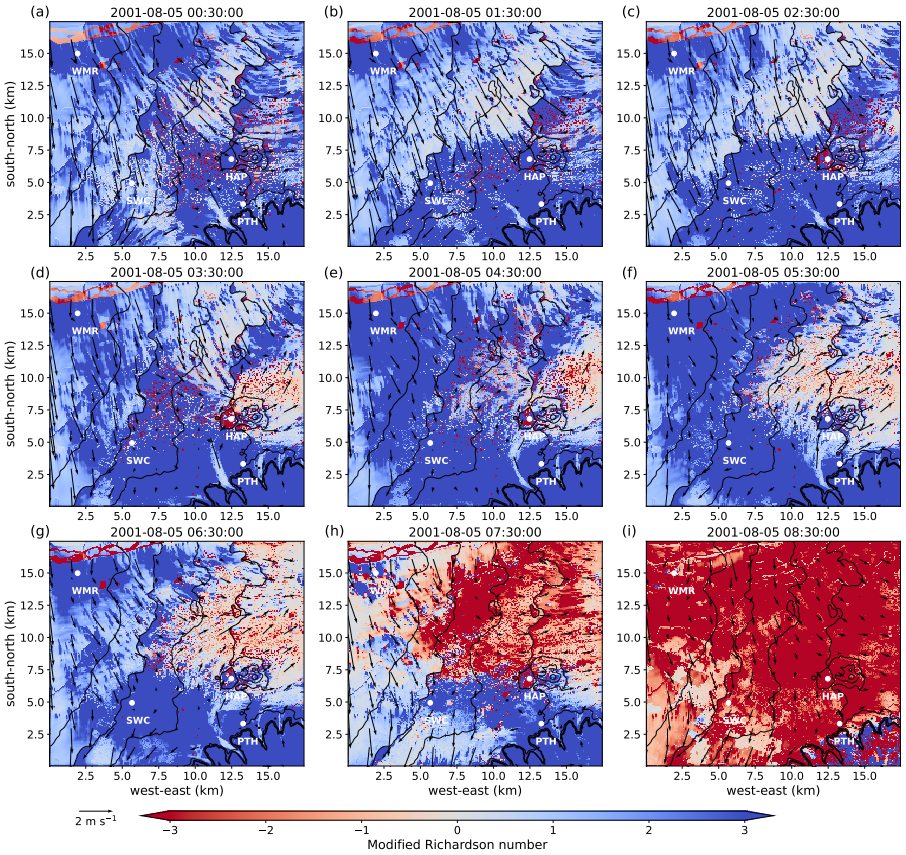

Fig. S9. Similar to Figure 5 in the main manuscript, but for HOM-18m simulated using the Intel FORTRAN compiler.

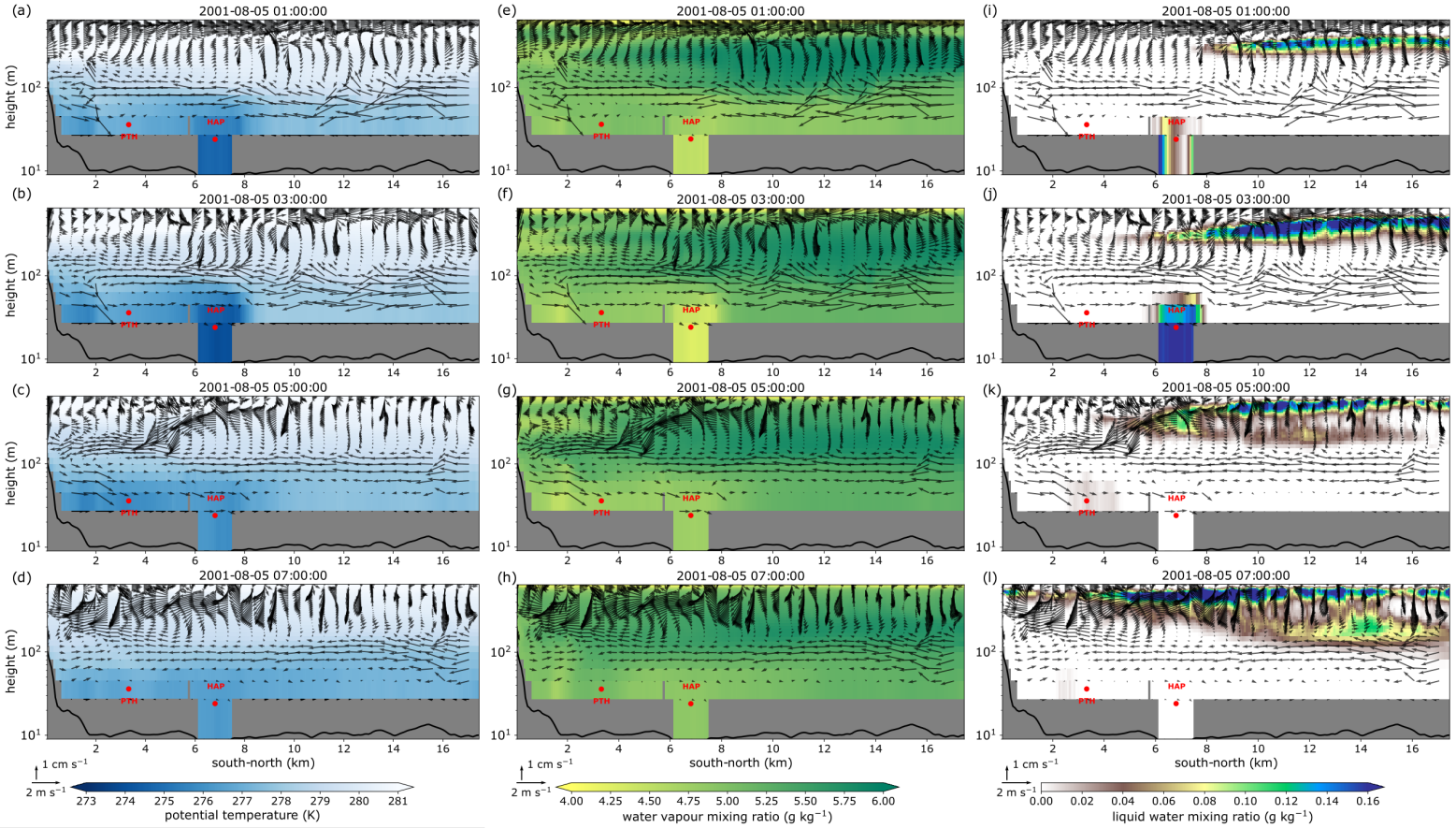

Fig. S10. Similar to Figure 6 in the main manuscript, but for HOM-18m simulated using the Intel FORTRAN compiler.