Supplementary Material

1 VIDEO VIZUALIZING THE NEAR-SURFACE BOUNDARY LAYER DYNAMICS

The video visualizes the near-surface boundary layer dynamics by showing a slice through the LES domain. The slice is cut parallel to the flow direction in the middle of the domain (at $y = 3\,\mathrm{m}$). The video only shows the lowest $2\,\mathrm{m}$ adjacent to the snow surface. Furthermore, for a better visualization, we omit $7.5\,\mathrm{m}$ of upwind flow over bare ground.

2 NEAR-SURFACE BOUNDARY LAYER FOR LOW AND HIGH AIR TEMPERATURES

In order to study the influence of varying air temperatures on the growth of the SIBL, we perform a similar analysis as presented in Sec. 4.3. We chose the air temperature at $P = (x = 0\,\mathrm{m}, z = 0.5\,\mathrm{m})$ to select the 20% lowest air temperatures in Fig. S1a and b and the 20% highest air temperatures in Fig. S1c and d. Both

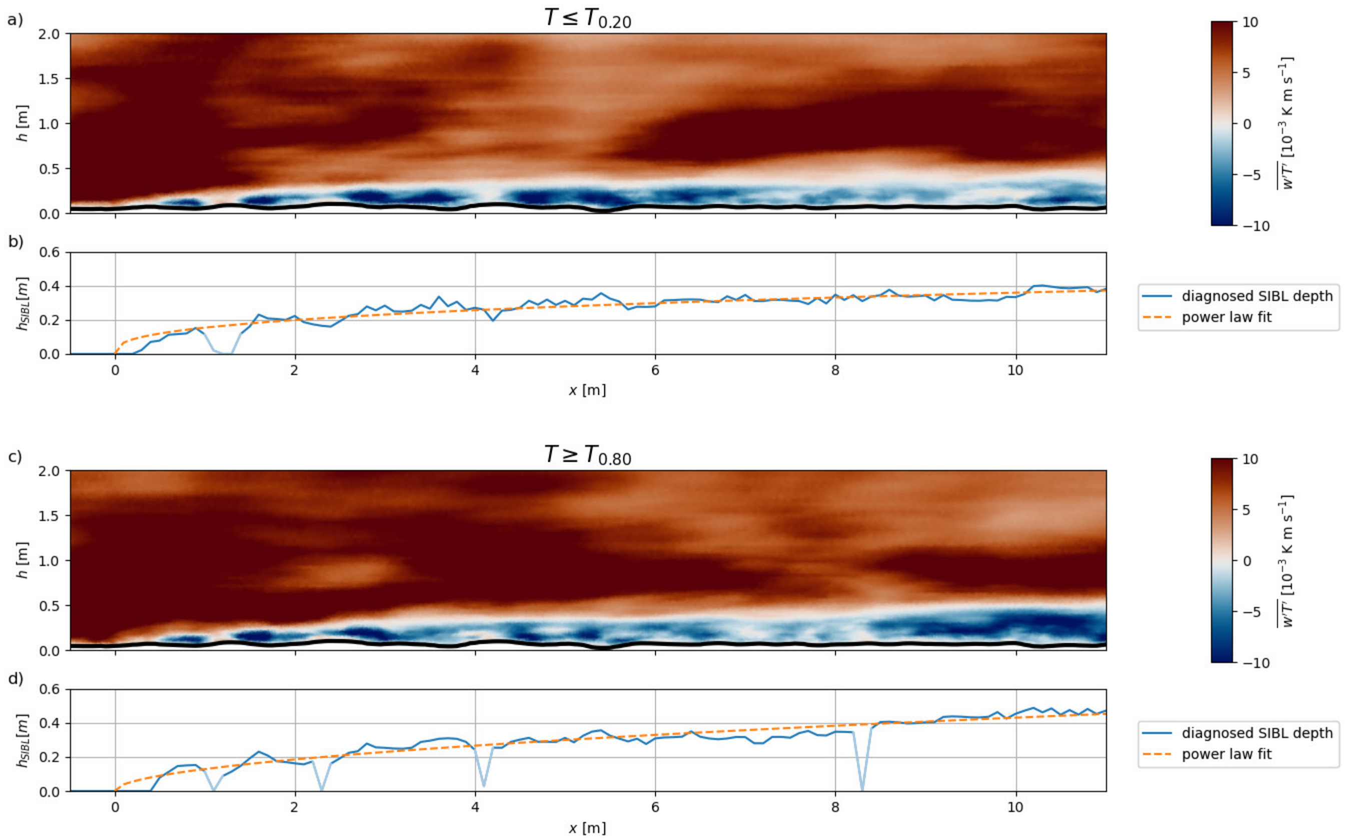

Figure S1. **a** Median buoyancy flux for the 20% lowest air temperatures at $P = (x = 0\,\mathrm{m}, z = 0.5\,\mathrm{m}$ and **b** the SIBL depth diagnosed from it together with a fit of (6). **c** Median buoyancy flux for the 80% highest air temperatures at P and **d** the SIBL depth diagnosed from it with a fit of (6). We neglected the blurred parts of the diagnosed SIBL depth similar to Fig. 5.

cases exhibit only slight differences both in the 2D overview (Fig. S1a and c) as well as in the diagnosed SIBL depths (Fig. S1b and d). Mainly, the upper boundary of the SIBL at the leading edge ($x < 4\,\mathrm{m}$) seems

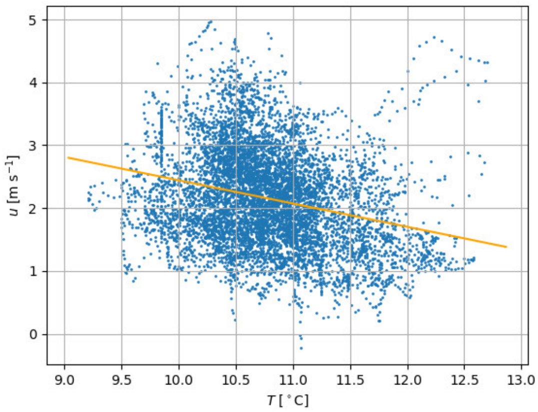

Figure S2. Scatter plot of air temperatures with horizontal wind speed. The orange line is a linear fit.

to be smoother during the colder periods. However, as Fig. S2 indicates, there is a negative correlation between air temperature and horizontal wind speed. Consequently, lower air temperatures (Fig. S1a and b) coincide with higher wind speeds. We suspect that the smoother upper boundary of the SIBL stems from higher wind speeds rather than from lower air temperatures.