



## Supplement of

## **Representing surface heterogeneity in land–atmosphere coupling in E3SMv1 single-column model over ARM SGP during summertime**

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Table S1: Subgrid patches and the corresponding weights within the ARM SGP grid cell at ne30 resolution.

Landunit	Patch type	Weight_ne30 (%)
Vegetated	Bare ground	6.9
	Needleleaf evergreen temperate tree	2.1
	Broadleaf deciduous temperate tree	6.1
	C3 non-arctic grass	25.8
	C4 grass	16.5
	C3 crop	41.6
Lake	Lake	1.0



Figure S1: Diurnal cycle of surface temperature variance from the HOM and HET confiurations as presented in the original manuscript, as well as the sensitivity experiments with increased/decreased lake patch (labeld as lake+/lake-).



Figure S2: Profiles of (a) liquid water potential temperature  $\theta_l$ , (b) specific humidity  $\overline{q_t}$ , (c) potential temperature variance  $\overline{\theta_l'}^2$ , (d) specific humidity variance  $\overline{q_t'}^2$ , and (e) temperature humidity covariance  $\overline{\theta_l'}q_t'$  averaged over 14-16 LT for the clear-sky days.



Figure S3: Same as Fig. S2, except for (a) the buoyancy production term of  $\theta_l$ ,  $\overline{\theta'_l \theta'_v}$ , (b) the turbulent flux of liquid water potential temperature  $\overline{w' \theta'_l}$ , (c) the buoyancy flux  $\overline{w' \theta'_v}$ , (d) the vertical velocity variance  $\overline{w'^2}$ , (e) the  $q_t$  buoyancy term,  $\overline{q'_t \theta'_v}$ , (f) the turbulent flux of water specific content  $\overline{w' q'_t}$ , (g) the third-order moment of vertical velocity  $\overline{w'^3}$ , and (h) the skewness of the vertical velocity PDF  $Sk_w$ .



Figure S4: Same as Fig. S2 but for the cloudy days.



Figure S5: Same as Fig. S3 but for the cloudy days.



Figure S6: Diurnal cycle of total precipitation (convective + large-scale) averaged over precipitating days



Figure S7: Diurnal cycles of (a) near-surface temperature, (b) humidity, (c) total cloud fraction, and (d) precipitation amount from HOM, HET, and surface measurement averaged over JJA in 2015.