Supplementary Information for "Trajectory-enhancement of low-earth orbiter thermodynamic retrievals to predict convection: a simulation experiment"

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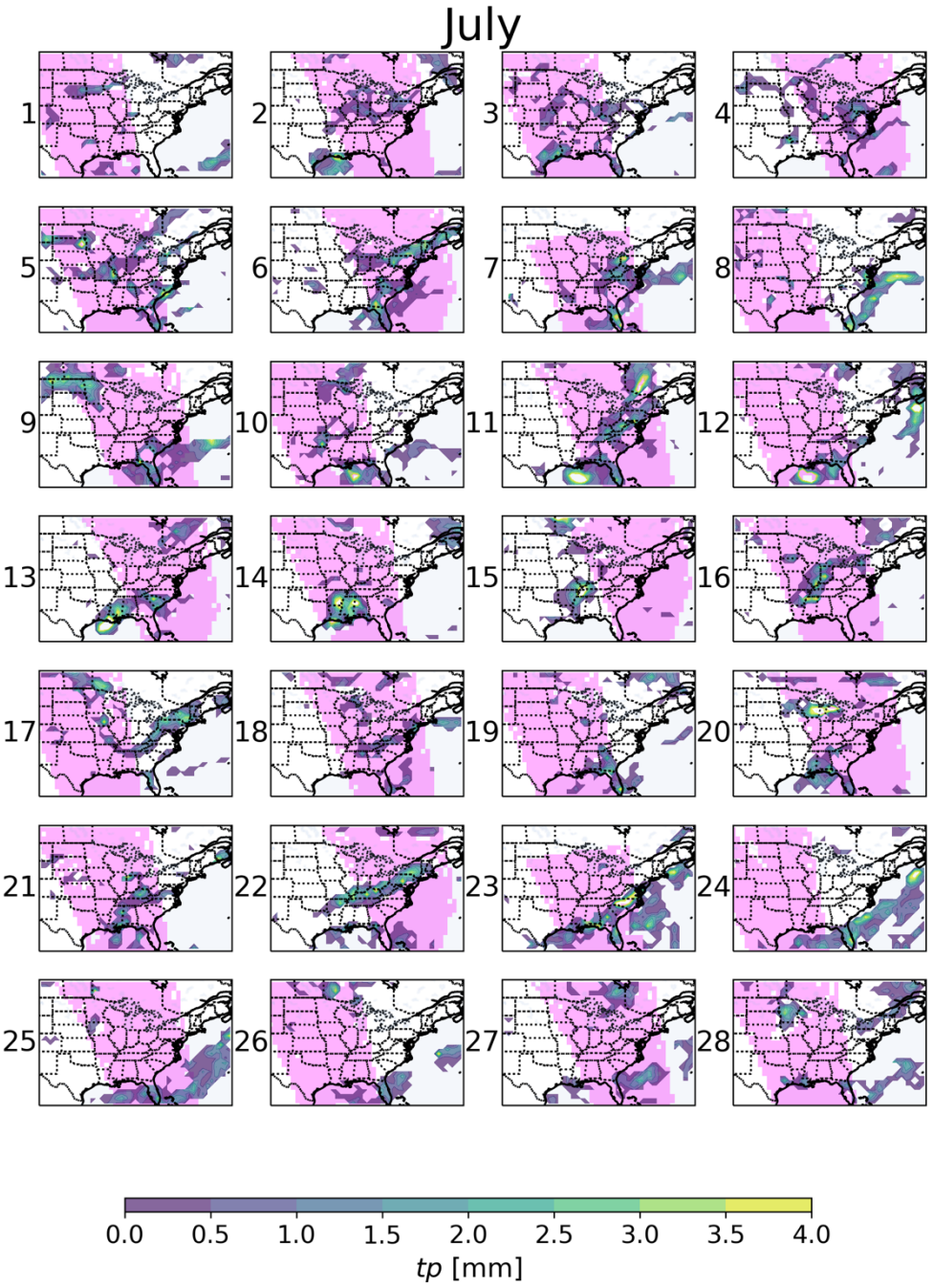
1 Introduction

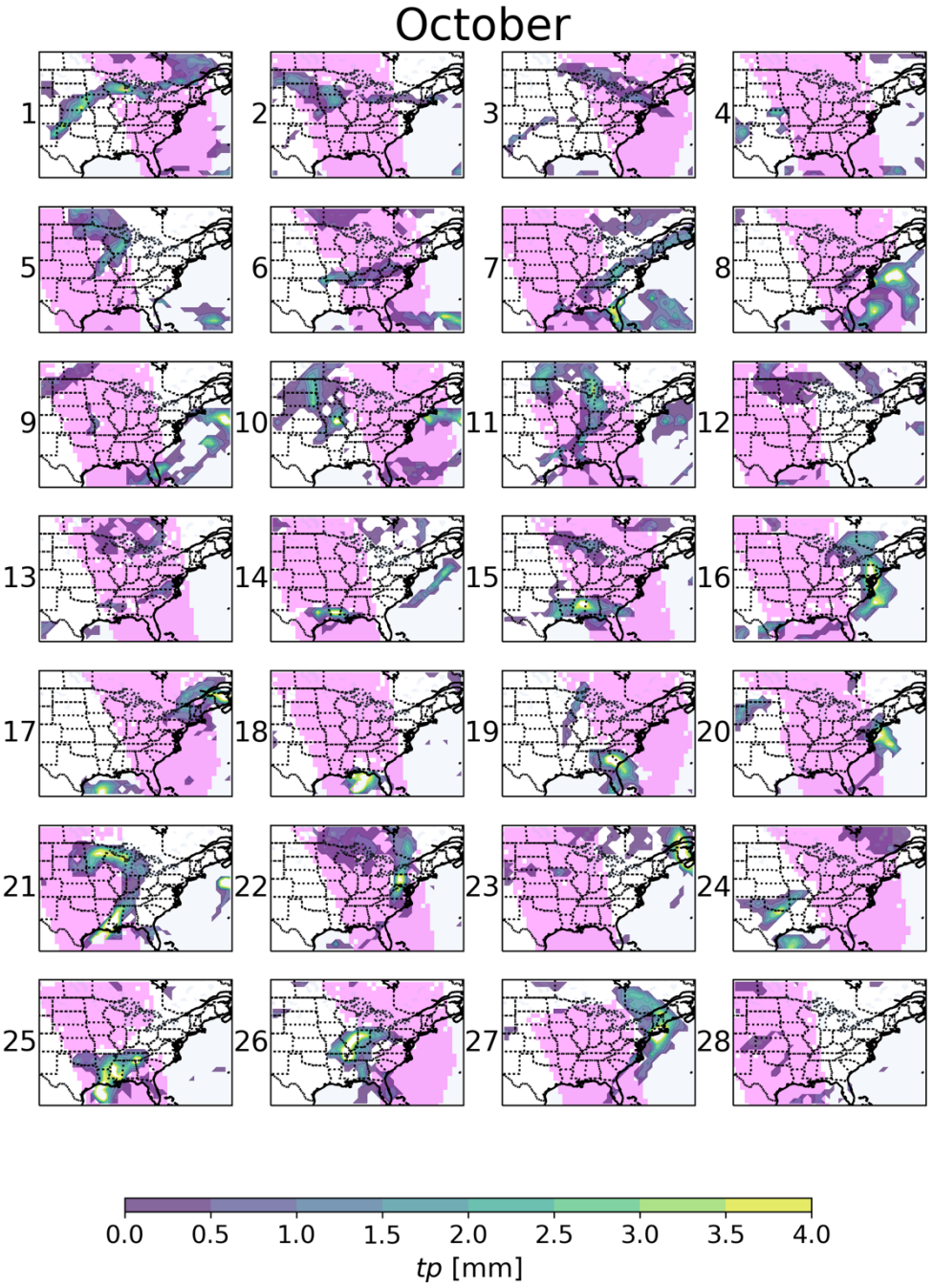
This supplement contains Supplementary Table 1 and Supplementary Figures 1—5.

Supplementary Table 1. Total precipitation (*tp*) statistics for ERA5-FCST grid cells where CAPE>99.5th percentile and CIN<70th percentile. Each row represents the values calculated from a different combination of parcel and whether the absolute or enhanced parameters were used. MU = most unstable, MML = mean mixed layer, entries beginning with "d" (e.g. dMU) represent the enhanced values where each grid cell has had the daily mean subtracted. Left-most data column is the mean precipitation in that CAPE-CIN bin, and the next 3 columns are the frequencies calculated for precipitation rate thresholds of 3, 4 and 5 mm hr^{-1}. The bottom row are those same statistics calculated for all grid cells with valid CAPE and CIN in all ERA5-FCST timesteps.

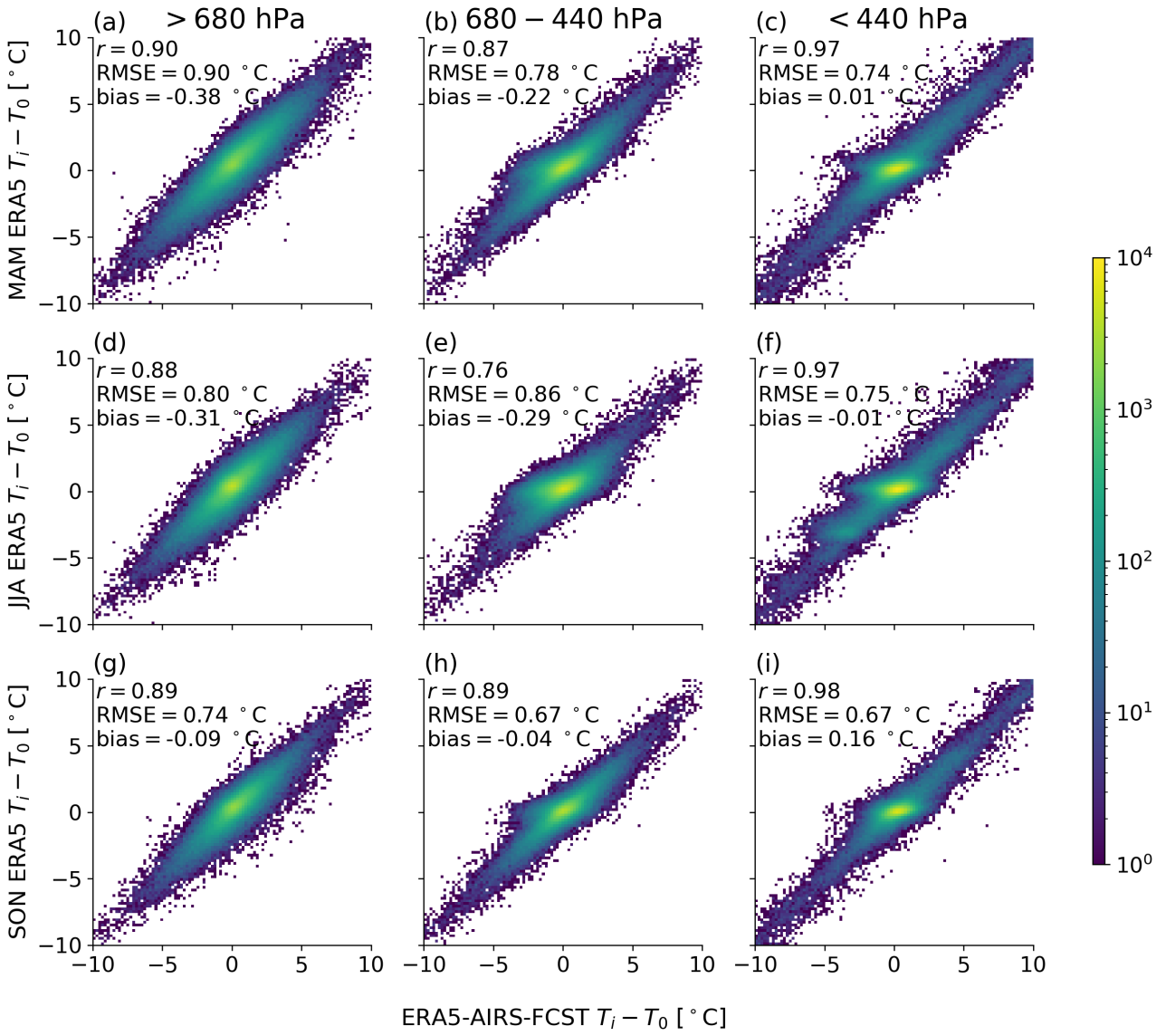
		Frequency [%]		
Parcel	Mean *tp* [mm hr^{-1}]	*tp* > 3 mm hr^{-1}	*tp* > 4 mm hr^{-1}	*tp* > 5 mm hr^{-1}
dMU	1.00	10.44	6.4	3.55
MU	0.92	9.11	5.67	3.04
dMML	1.00	9.92	6.66	3.97
MML	1.04	10.41	6.46	3.95
Full sample	0.09	0.29	0.12	0.05



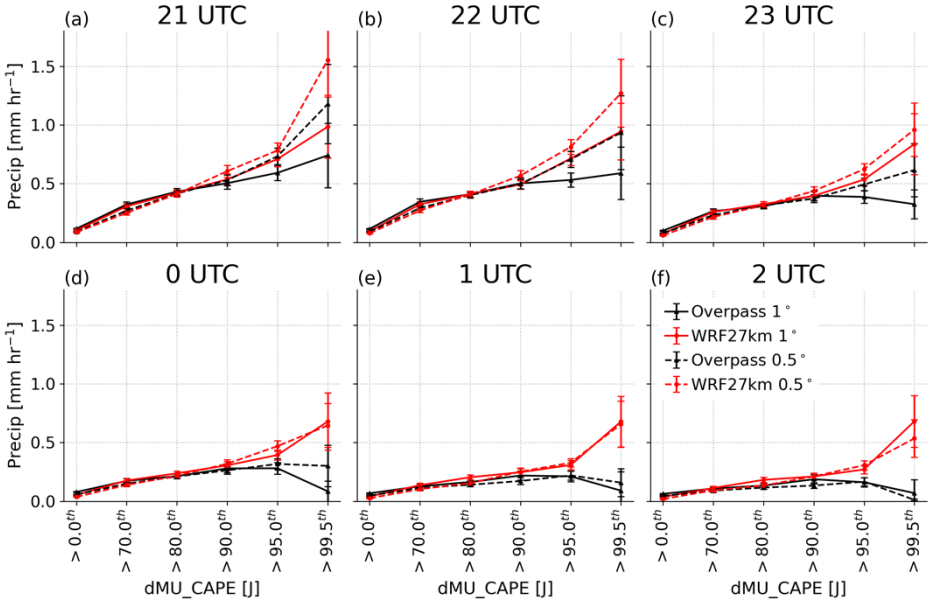
Supplementary Figure 1. ERA5 hourly precipitation rate for 1—28th July 2019 at the mean AIRS footprint time on each day. The pink shading denotes where there are sufficient valid AIRS retrievals for the ERA5-AIRS-FCST product to report a valid CAPE.



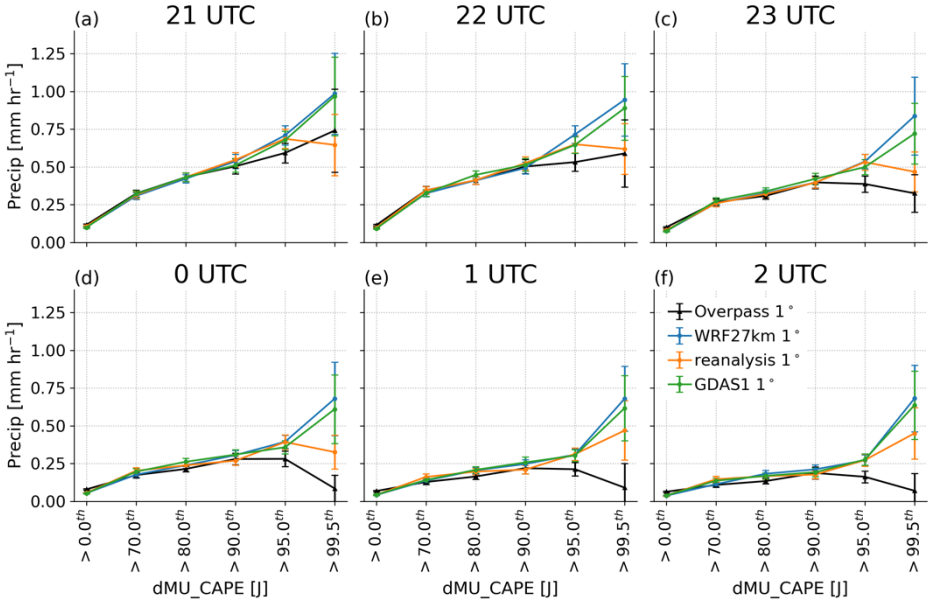
Supplementary Figure 2. ERA5 hourly precipitation rate for 1—28th October 2019 at the mean AIRS footprint time on each day. The pink shading denotes where there are sufficient valid AIRS retrievals for the ERA5-AIRS-FCST product to report a valid CAPE.



Supplementary Figure 3. 2d histograms of change in layer-mean *T* relative to overpass time, ERA5 on *y* axis and ERA5-AIRS-FCST on *x* axis. Columns are each season: (a—c) MAM, (d—f) JJA, (g—i) SON. It is expected that sub-grid convection in ERA5 causes mid- and potentially upper-layer heating relative to ERA5-AIRS-FCST and that this process explains the bulges near *y*=0 where *x*<0. Convection is most common in JJA, and its mid-layer panel (e) shows larger RMSE and smaller *r* than either (b) or (h), consistent with the *y*=0 feature being convection-driven.



Supplementary Figure 4. JJA data, mean precip in grid cells binned by percentile of dMU_CAPE. Values are for a FCST product at horizontal resolution of 1° (solid) or 0.5° (dashed). Spatial averaging smooths the *tp* distribution, so more extreme *tp* values are expected at 0.5° than 1° resolution, which may explains the higher dashed lines relative to the solid lines during 21—23 UTC.



Supplementary Figure 5. As Supplementary Figure 4 but for different NWP wind sources. Black line represents overpass time values. The coloured lines are from FCST products generated with WRF27km, reanalysis and GDAS1 NWP winds, using the products stored by ARL for HYSPLIT. Grid cells are included where all product timesteps return a valid MU_CAPE, and differences in NWP winds may therefore cause some differences in sampling between each line.