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Supplement of

How well are hazards associated with derechos reproduced in regional climate simulations?

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Supplemental Materials

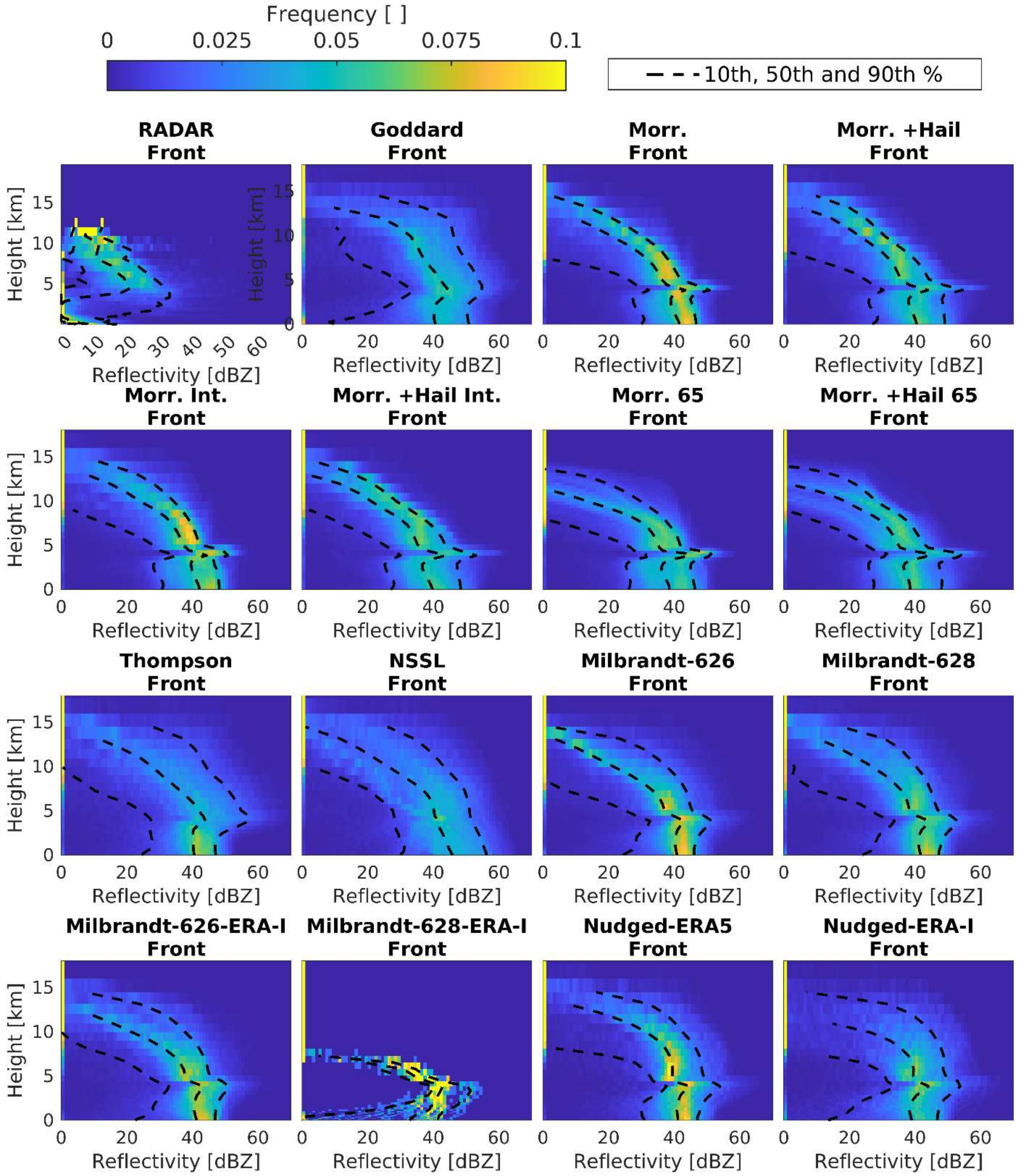

Figure S1: Probability distributions of base reflectivity from RADAR and derived RADAR reflectivity from each WRF ensemble member at each model height at t_p during the Front period. The plot shows the frequency with which a given reflectivity is observed at a given height in output for all domain d03 grid cells where cREF > 40 dBZ. Dotted lines show the 10th, 50th and 90th percentile reflectivity at each height.

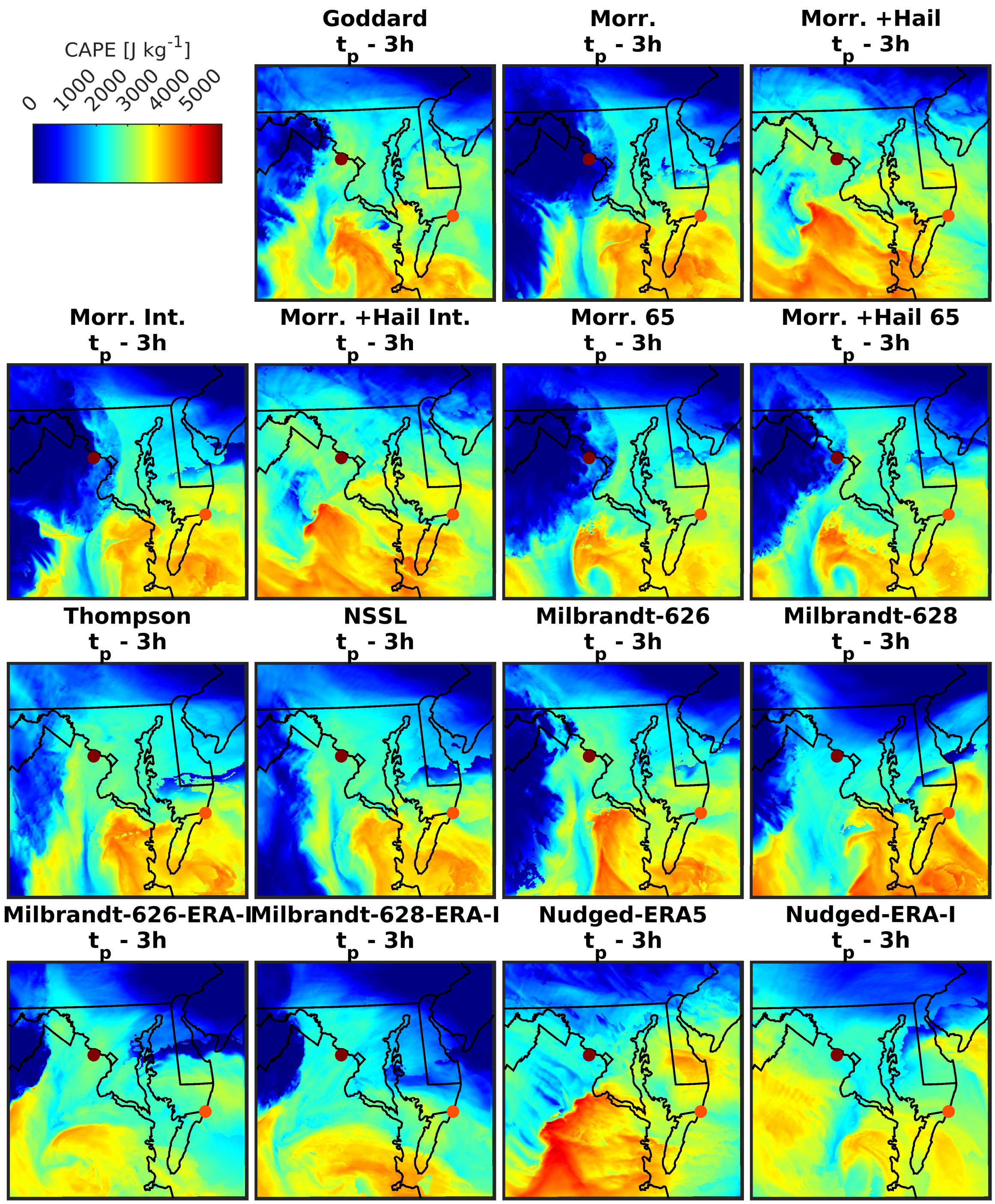

Figure S2: Spatial patterns of MU-CAPE at t_p-3 (i.e. 3 hours prior to the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) over domain d03 for all ensemble members. These panels are also shown in Figure 13 of the main text but are included again here, enlarged for visibility. MU-CAPE as computed from the SHARPpy program based on rawinsonde data at tp-3 (define from RADAR) (i.e. 0000 UTC 30 June) at KIAD (38.968N, -77.369E) and KWAL (38.018N and -75.236E) are shown by the filled circles.

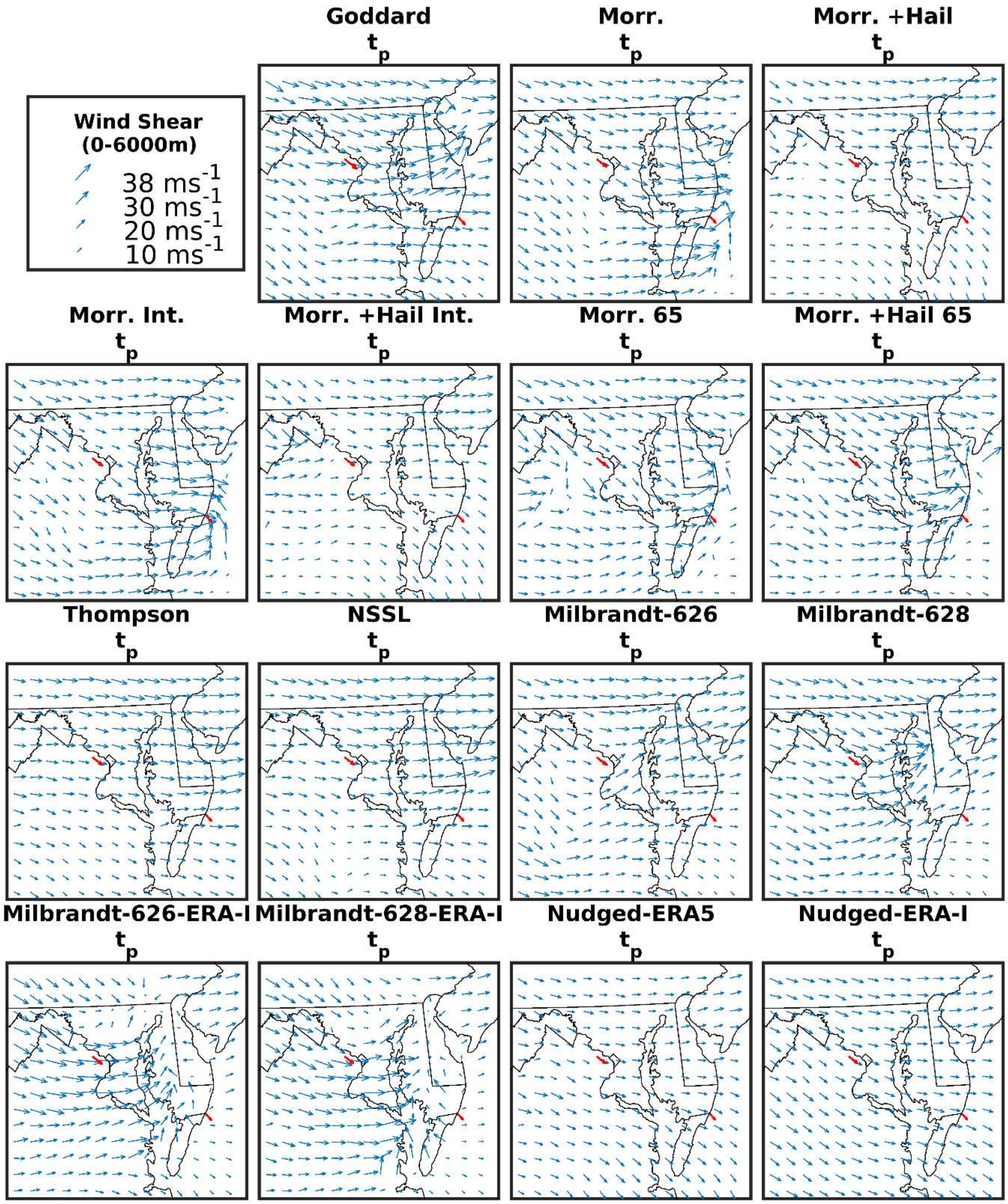

Figure S3: Total wind shear between the ground and 6000 m (S6, see definition in section 2.3) at t_p (the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) for each ensemble member. These panels are also shown in Figure 13 of the main text but are included again here, enlarged for visibility. Observed shear from the surface to 6 km at the KIAD (38.968N, -77.369E) and KWAL (38.018N and -75.236E) stations are shown by the red arrows.

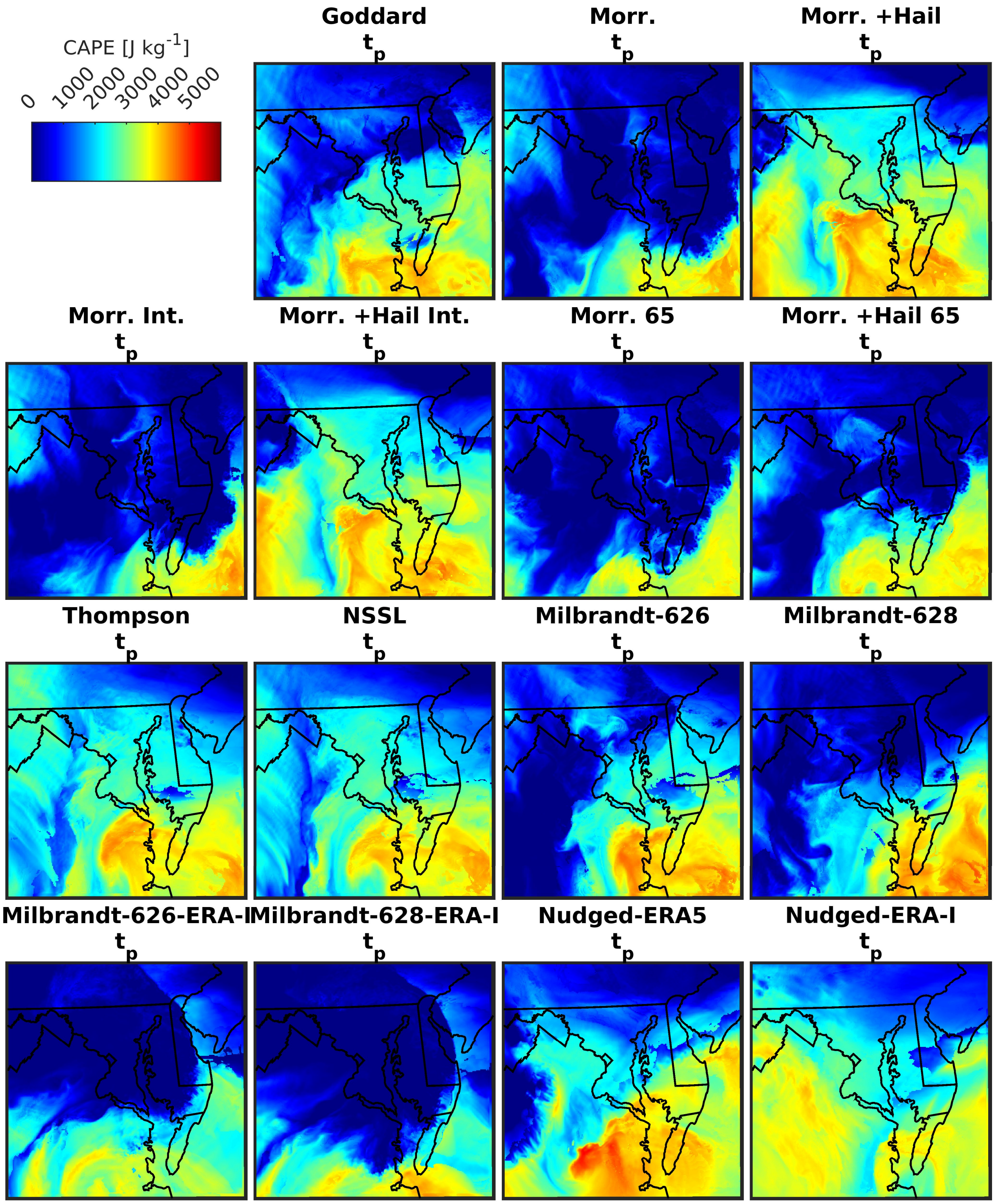

Figure S4: Spatial patterns of MU-CAPE at t_p (i.e. the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) over domain d03 for all ensemble members. These panels are also shown in Figure 13 of the main text but are included again here, enlarged for visibility.

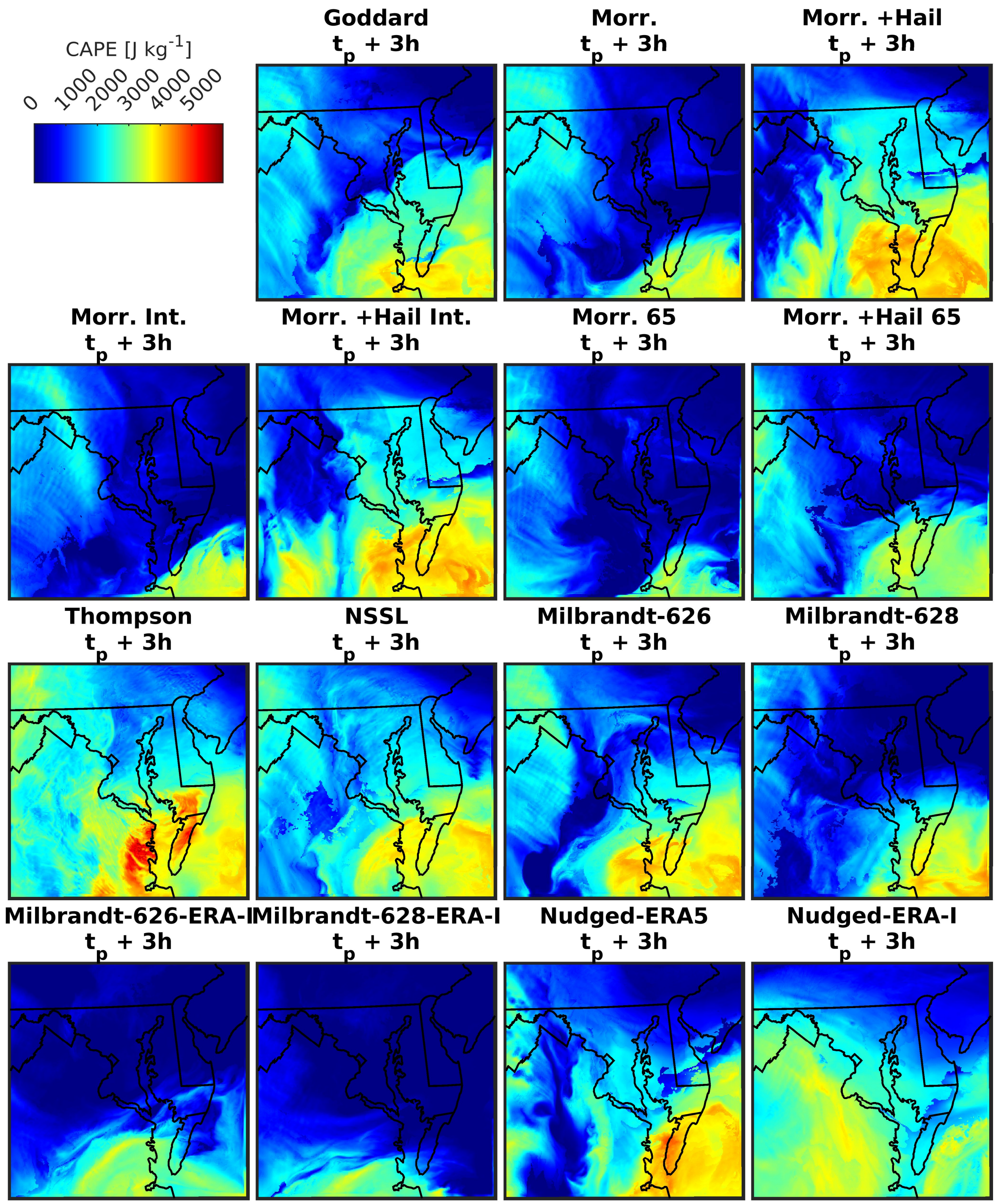

Figure S5: Spatial pattern of MU-CAPE at t_p + 3 hours (i.e. 3 hours after the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) over domain d03 for all ensemble members. These panels are also shown in Figure 13 of the main text but are included again here, enlarged for visibility.

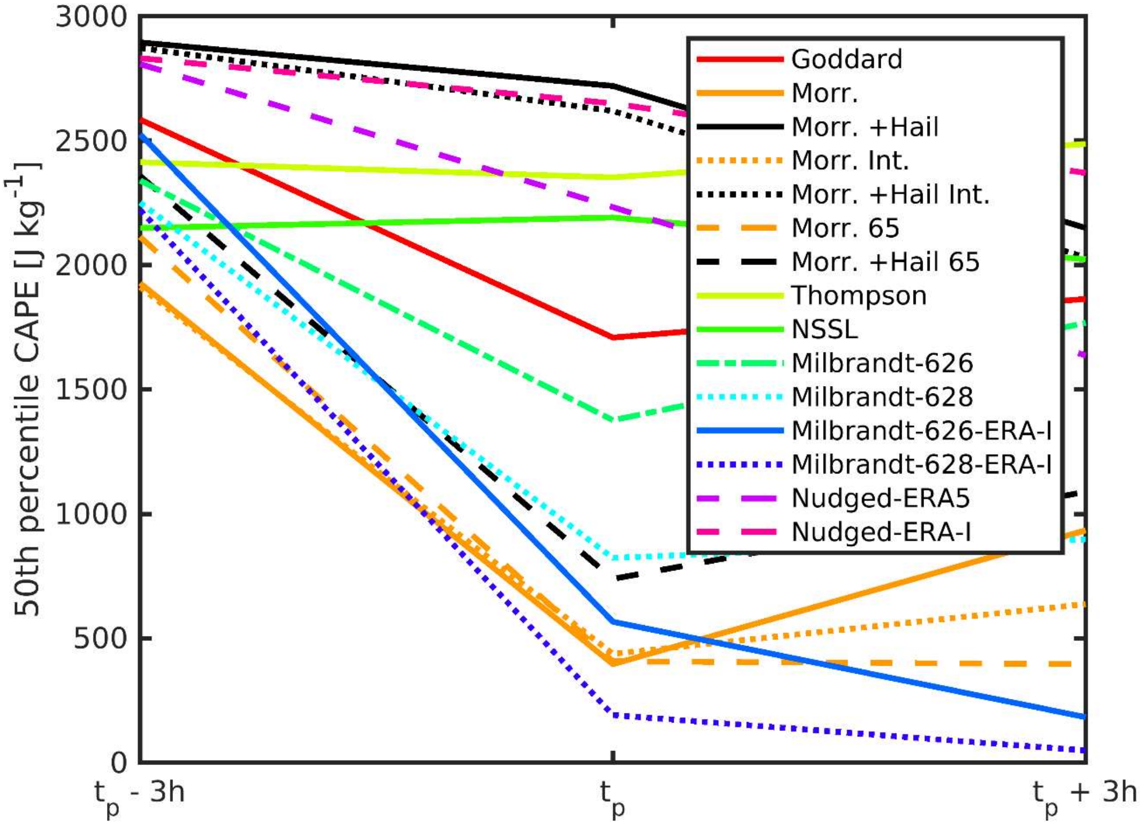

Figure S6: The spatial average (median) MU-CAPE in domain d03 cells in the six hours surrounding t_p (the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) for each ensemble member.

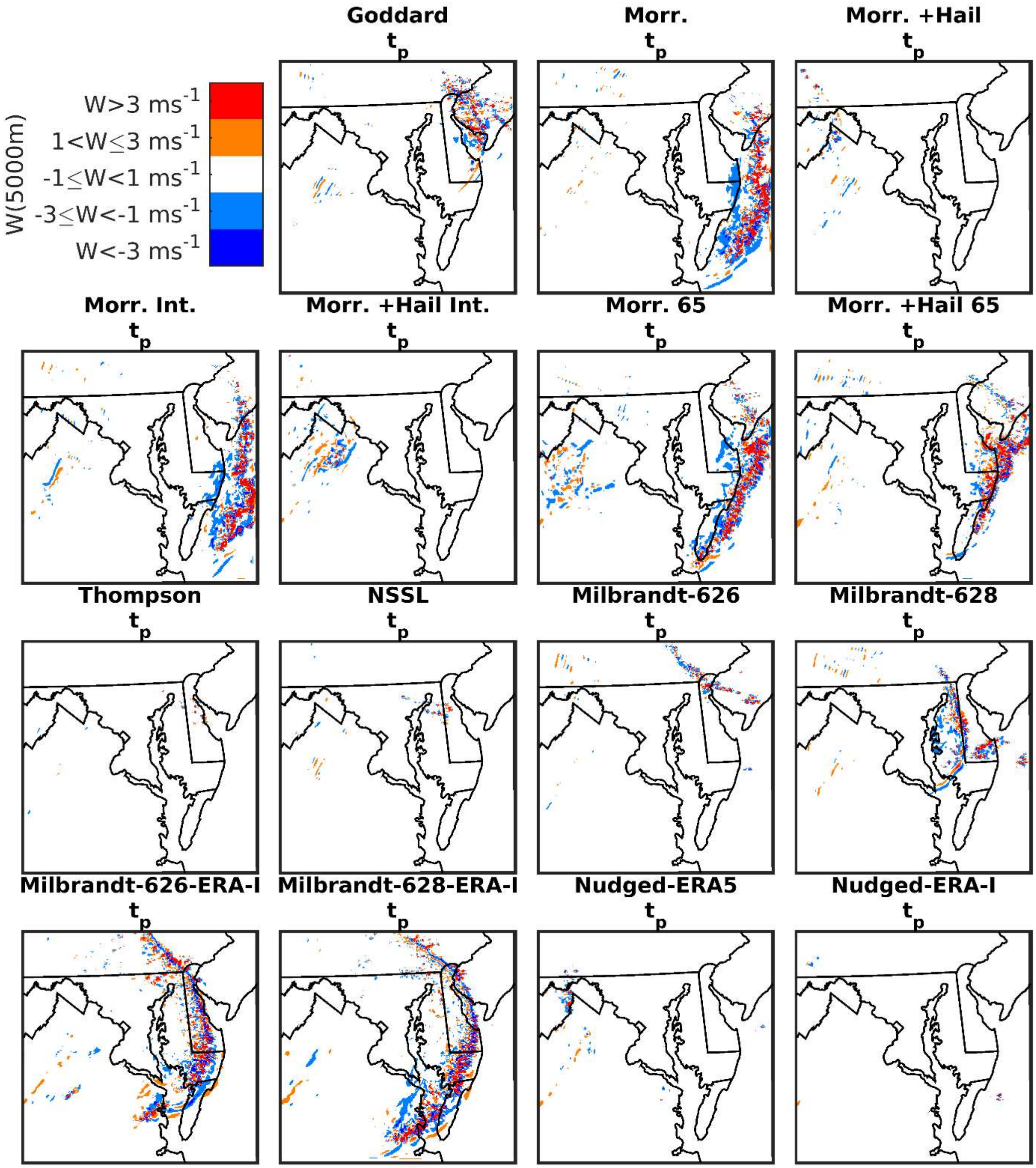

Figure S7: Vertical velocity (W) at 5000 m and t_p (the time of peak spatial extent of cREF > 40 dBZ during the Derecho period) for each ensemble member. $|W| > 1$ ms^{-1} are shown in four colored classes. These vertical velocities are also shown in Figure 13 of the main text but are included again here, enlarged for visibility.

Example namelist for the derecho simulations

```
&time_control
 run_days                            =  6,
 run_hours                           =  0,
 run_minutes                         =  0,
 run_seconds                         =  0,
 start_year                          =  2012,  2012, 2012,
 start_month                         =  06,    06,   06,
 start_day                           =  26,    26,   26,
 start_hour                          =  00,    00,   00,
 start_minute                        =  00,    00,   00,
 start_second                        =  00,    00,   00,
 end_year                            =  2012,  2012, 2012,
 end_month                           =  07,    07,   07,
 end_day                             =  02,    02,   02,
 end_hour                            =  00,    00,   00,
 end_minute                          =  00,    00,   00,
 end_second                          =  00,    00,   00,
 interval_seconds                    =  21600
 input_from_file                     =  .true.,.true.,.true.,
 history_interval                    =  60,  10, 10,
 frames_per_outfile                  =  1,  1, 1,
 history_outname                   =  "/wrfout/wrfout_d<domain>_<date>"
 restart                             =  .false.,
 restart_interval                    =  1440,
 override_restart_timers             =  .true.,
 io_form_history                     =  11
 io_form_restart                     =  2
 io_form_input                       =  2
 io_form_boundary                    =  11
 io_form_auxinput2                   =  11
 io_form_auxhist2                    =  11
 debug_level                         =  10
 nocolons                            =  .true.,
 auxinput4_inname                    =  "wrflowinp_d<domain>",
 auxinput4_interval                  =  1440,  1440,  1440,
 io_form_auxinput4                   =  2,
 auxinput1_inname                                                          =
"/met_files/ERA5/met_em.d<domain>.<date>"
 iofields_filename                               =   "my_file_d01.txt",
"my_file_d02.txt", "my_file_d03.txt",
 ignore_iofields_warning             =  .true.,
 auxhist1_outname                  =  "/aux1/auxhist1_d<domain>_<date>"
 auxhist1_interval                   =  60,  60,  60,
 frames_per_auxhist1                 =  1,  1,  1,
 io_form_auxhist1                    =  11,
 output_diagnostics                  =  1,
 auxhist3_outname                 =  "/wrfout/wrfxtrm_d<domain>_<date>"
 auxhist3_interval                   = 60, 10, 10,
 frames_per_auxhist3                 = 1, 1, 1,
```

```
 io_form_auxhist3                    = 11,
 /

 &domains
 time_step                           = 30,
 time_step_fract_num                 = 0,
 time_step_fract_den                 = 1,
 max_dom                             = 3,
 e_we                                = 175,    262,   295,
 e_sn                                = 175,    262,   295,
 e_vert                              = 41,     41,    41,
 p_top_requested                     = 5000,
 sfcp_to_sfcp                        = .true.,
 num_metgrid_levels                  = 38,
 num_metgrid_soil_levels             = 4,
 dx                                  = 12000, 4000, 1333.33,
 dy                                  = 12000, 4000, 1333.33,
 grid_id                             = 1,     2,    3,
 parent_id                           = 1,     1,    2,
 i_parent_start                      = 1,     60,   105,
 j_parent_start                      = 1,     35,   75,
 parent_grid_ratio                   = 1,     3,    3,
 parent_time_step_ratio              = 1,     3,    3,
 feedback                            = 0,
 max_ts_locs                         = 0,
 eta_levels                         = 1.0000 , 0.9958 , 0.9916 , 0.9874
, 0.9832 ,
                                       0.9790 , 0.9749 , 0.9707 , 0.9661
, 0.9609 ,
                                       0.9549 , 0.9480 , 0.9398 , 0.9303
, 0.9189 ,
                                       0.9054 , 0.8894 , 0.8704 , 0.8481
, 0.8221 ,
                                       0.7922 , 0.7583 , 0.7205 , 0.6791
, 0.6346 ,
                                       0.5877 , 0.5393 , 0.4900 , 0.4407
, 0.3922 ,
                                       0.3450 , 0.2996 , 0.2564 , 0.2156
, 0.1773 ,
                                       0.1417 , 0.1086 , 0.0755 , 0.0475
, 0.0224 ,
                                       0.0000,
/

&physics
 mp_physics                          = 9,     9,     9,
 ra_lw_physics                       = 1,     1,     1,
 ra_sw_physics                       = 1,     1,     1,
 radt                                = 10,    10,    10,
 sf_sfclay_physics                   = 1,     1,     1,
 sf_surface_physics                  = 2,     2,     2,
 bl_pbl_physics                      = 5,     5,     5,
```

```
 bldt                              = 0,     0,     0,
 cu_physics                        = 1,     0,     0,
 cudt                              = 5,
 isfflx                            = 1,
 ifsnow                            = 1,
 icloud                            = 1,
 surface_input_source              = 3,
 num_soil_layers                   = 4,
 num_land_cat                      = 21,
 sf_urban_physics                  = 0,     0,     0,
 bl_mynn_tkebudget                 = 1,     1,     1,
 bl_mynn_tkeadvect                 = .true., .true., .true.,
 rdmaxalb                          = .false.,
 sst_update                        = 1,
 tmn_update                        = 1,
 usemonalb                         = .true.,
 lagday                            = 150,
 sst_skin                          = 1,
 slope_rad                         = 1,  1,  1,
 prec_acc_dt                       = 60., 10., 10.,
 fractional_seaice                 = 1,
 seaice_threshold                  = 0.,
 /

&noah_mp
 dveg                              = 4,
 opt_crs                           = 1,
 opt_btr                           = 2,
 opt_run                           = 3,
 opt_sfc                           = 1,
 opt_frz                           = 1,
 opt_inf                           = 1,
 opt_rad                           = 3,
 opt_alb                           = 2,
 opt_snf                           = 4,
 opt_tbot                          = 1,
 opt_stc                           = 3,
 /

 &dynamics
 w_damping                         = 1,
 diff_opt                          = 1,      1,      1,
 km_opt                            = 4,      4,      4,
 diff_6th_opt                      = 0,      0,      0,
 diff_6th_factor                   = 0.12,   0.12,   0.12,
 base_temp                         = 290.
 damp_opt                          = 0,
 zdamp                             = 5000.,  5000.,  5000.,
 dampcoef                          = 0.01,    0.01,  0.01,
 khdif                             = 0,      0,
 kvdif                             = 0,      0,
 non_hydrostatic                   = .true., .true., .true.,
```

```
/

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spec_bdy_width                       = 5,
spec_zone                            = 1,
relax_zone                           = 4,
spec_exp                             = 0.13
specified                            = .true., .false., .false.,
nested                               = .false., .true., .true.,
/

&grib2
/

&namelist_quilt
nio_tasks_per_group = 0,
nio_groups = 1,
/
```