2018 CAPS Spring Forecast Experiment
Program Plan

May 8, 2018

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Table of Contents

1. Overview of New Features for 2018 Season

Major features for 2018:

- **3-km** horizontal grid spacing over the CONUS domain (1620×1120, Figure 1)
- **WRF version 3.9.1.1** is used for 2018 season for 3DVAR-based core members and EnKF members, coupled with ARPS v5.4; A **3.9_GSD** WRF version is used for single-physics and stochastic-physics members
- A New **FV3** member ensemble (FV3 domain shown in Figure 2)
- Three SSEF suites:
  - A **3DVAR-based SSEF** at 3-km with **27+** ARW members, initiated with 3DVAR analysis at 0000 UTC,, with up to 60-h forecast, running on ***Stampede2*** (MIC nodes) at TACC
  - A **FV3** core **SSEF** at ~3.5 km (nested within a 13 km uniform global domain) with 12 members with different physics combination (microphysics, PBL, cumulus), running on ***Stampede2*** (SKX nodes) at TACC
  - **GSI+EnKF-based SSEF**: Up to a 40-member storm-scale ensemble background, six hours of hourly cycled GIS+EnKF (conventional data) and one hour of cycled EnKF radar DA at 15 min intervals, followed by a 10-member ensemble forecast (up to 48-h) starting at 0000 UTC, running on the same CONUS domain (see Figure 1). Ten ensemble forecasts initiated at 0000 UTC from the EnKF mean and ensemble members are produced. Running on ***Bridges*** at PSC
- A second run period with up to 15 SSEF members (ARW + FV3) in support of **HMT FFaIR-2018**

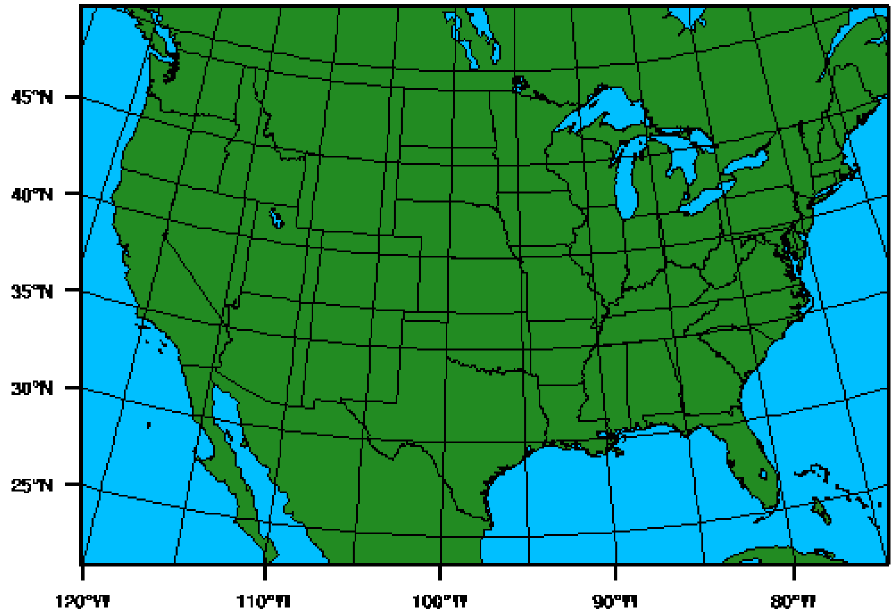

Figure 1. The computational domain for the 2018 Season. The ARW domain is at 3-km grid spacing, consisting of 1620×1120 horizontal grid points.

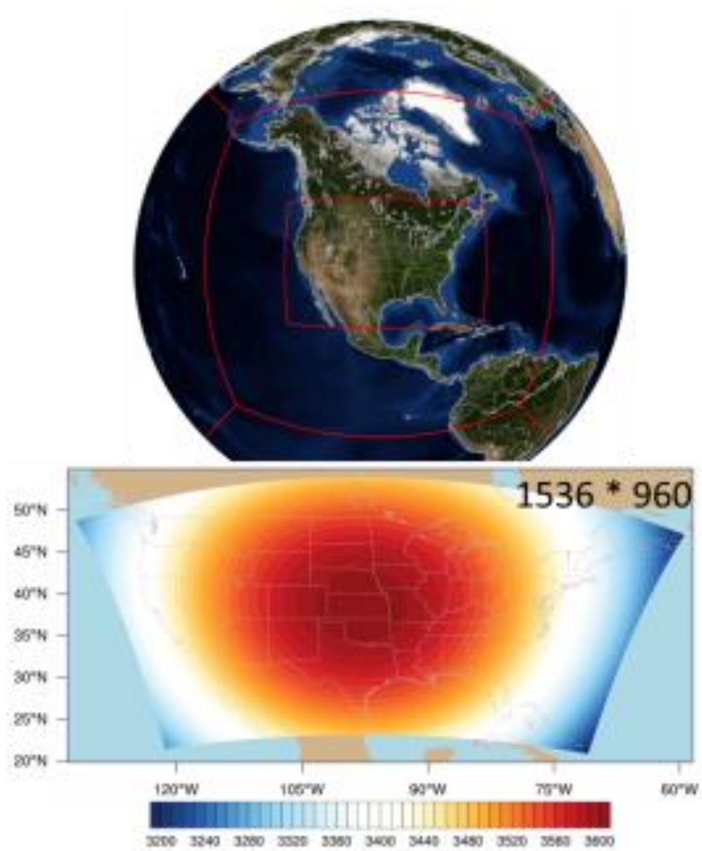

Figure 2. FV3 domain. Top: Uniform (13 km) global domain, with the innermost domain marking the fine nested domain area; Bottom: Coverage of the nested domain (~3.5 km), with color shades indicating grid spacing in meter.

2. Program Duration

HWT: From **16 April 2018** through **1 June 2018**
HMT FFaIR: From **18 June 2018** through **20 July 2018** (with one week off during 2-6 July)

The 2018 NOAA HWT Spring Forecast Experiment, a joint effort among NOAA Storm Prediction Center (SPC) and National Severe Storm Laboratory (NSSL) and the Center for Analysis and Prediction of Storms (CAPS) at University of Oklahoma, will officially **start on 30 April and end on 1 June**, with five days a week (Monday through Friday). CAPS 2018 Spring Program begins regular forecast production two weeks earlier on 16 April to identify possible issues, and remains five days a week (running forecasts on the night of Sunday through Thursday) with possible weekend runs upon SPC request according to weather circumstance.

The 2018 HMT Flash Flood and Intense Rainfall Experiment (FFaIR) will **start on 18 June and end on 20 July**, with five days a week (Monday through Friday). The July Fourth week (2-6 July) will be the off week. CAPS will produce up to 15 (ARW + FV3) members on Stampede2 to support the 2018 FFaIR Experiment.

3. SSEF Configuration

WRF-ARW and GFDL's FV3 cores are used in the 2018 Spring Forecast Experiment. All ARW forecasts use **51** vertical levels. WRF code (V3.9.1.1) was modified by CAPS to allow initial hydrometeor fields generated from 3DVAR/ARPS Cloud analysis of WRS-88D radar reflectivity to pass into WRF initial condition, and (for ARW) to write out reflectivity field every 6 min. A special V3.9_GSD version of WRF-ARW is used for single physics ensembles, including a stochastic perturbation ensemble in particular.

FV3 forecasts uses 50 vertical levels. In 2018, radar data may be assimilated with cloud analysis for FV3 runs.

3.1 3DVAR SSEF initialized at 0000 UTC

3DVAR SSEF forecasts are generated with the Weather Research and Forecast (WRF) modeling system (**Version 3.9.1.1)**, with the Advanced Research WRF (ARW) core, and the NCEP operationally used NMMB modeling system. The 00Z NAM analyses available on the 12 km grid (218) are used for initialization of control and non-perturbed members and as first guess for initialization of perturbed members with the initial condition perturbations coming directly from the NCEP Short-Range Ensemble Forecast (SREF). SREF data with Grid 132 data form are directly processed. WSR-88D data, along with available surface and upper air observations, are analyzed using ARPS 3DVAR/Cloud-analysis system. Forecast output at hourly intervals (higher time frequency output for a limited selection of 2D fields, and of 3D full dump for the visualization application) are archived at the TACC mass storage facility.

The *daily* ensemble forecast configuration includes the following, all of which are run on ***Stampede2***, a supercomputer system with 4200 Intel Xeon Phi 7250 KNL ("Knights Landing") computing nodes (MIC) and 1736 Intel Xeon Platinum 8160 ("Skylake") computing nodes (SKX) at TACC. CAPS SSEF forecasts may have dedicated access to the system over the project period.

- ARW V3.9.1.1: 10 member core ensemble at 3-km grid spacing initialized at 0000 UTC. Model execution begins around 0145 UTC (8:30pm CDT) and finish in 6 hours, with results being processed as they become available. **Table 1** lists the configuration and physics options for each ARW member. Members include arw_cn0, arw_cn, arw_m2 ~ arw_m10 with 60-h forecast duration,
- ARW V3.9_GSD: 17 member, including 8 single physics ensemble, 8 stochastic perturbation ensemble, and 1 Thompson stochastic member (Figure 1 in shading) are 36-h using V3.9_GSD version of WRF.

Table 1. Configurations for ARW members. NAMa and NAMf refer to 12 km NAM analysis and forecast, respectively. ARPSa refers to ARPS 3DVAR and cloud analysis.

Member	IC	BC	Radar data	Microphy	LSM	PBL

arw_cn0*	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	MYJ
arw_cn	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	MYJ
arw_m2	RAPa+3DVAR	18Z GFSf	yes	Thompson	RUC	MYNN
arw_m3	arw_cn + arw-p1_pert	21Z SREF arw-p1	yes	NSSL	Noah	YSU
arw_m4	arw_cn + arw-n1_pert	21Z SREF arw-n1	yes	NSSL	Noah	MYNN
arw_m5	arw_cn + nmmb-p1_pert	21Z SREF nmmb-p1	yes	Morrison	Noah	MYJ
arw_m6	arw_cn + nmmb-n1_pert	21Z SREF nmmb-n1	yes	P3	Noah	YSU
arw_m7	arw_cn + arw-p2_pert	21Z SREF arw-p2	yes	NSSL	Noah	MYJ
arw_m8	arw_cn + arw-n2_pert	21Z SREF arw-n2	yes	Morrison	Noah	YSU
arw_m9	arw_cn + nmmb-p2_pert	21Z SREF nmmb-p2	yes	P3	Noah	MYNN
arw_m10	arw_cn + nmmb-n2_pert	21Z SREF nmmb-n2	yes	Thompson	Noah	MYNN
arw_m11	00Z ARPSa	00Z NAMf	yes	Thompson	RUC	MYNN
~~arw_m12~~	~~RAPa+3DVAR~~	~~18Z GFSf~~	~~yes~~	~~Thompson~~	~~RUC~~	~~MYNN~~
arw_m13	arw_cn + arw-p1_pert	21Z SREF arw-p1	yes	Thompson	RUC	MYNN
arw_m14	arw_cn + arw-n1_pert	21Z SREF arw-n1	yes	Thompson	RUC	MYNN
arw_m15	arw_cn + nmmb-p1_pert	21Z SREF nmmb-p1	yes	Thompson	RUC	MYNN
arw_m16	arw_cn + nmmb-n1_pert	21Z SREF nmmb-n1	yes	Thompson	RUC	MYNN
arw_m17	arw_cn + arw-p2_pert	21Z SREF arw-p2	yes	Thompson	RUC	MYNN
arw_m18	arw_cn + arw-n2_pert	21Z SREF arw-n2	yes	Thompson	RUC	MYNN
arw_m19	00Z ARPSa	00Z NAMf	yes	Thompson	RUC	MYNN
arw_m20	RAPa+3DVAR	18Z GFSf	yes	Thompson	RUC	MYNN

arw_m21	arw_cn + arw-p1_pert	21Z SREF arw-p1	yes	Thompson	RUC	MYNN
arw_m22	arw_cn + arw-n1_pert	21Z SREF arw-n1	yes	Thompson	RUC	MYNN
arw_m23	arw_cn + nmmb-p1_pert	21Z SREF nmmb-p1	yes	Thompson	RUC	MYNN
arw_m24	arw_cn + nmmb-n1_pert	21Z SREF nmmb-n1	yes	Thompson	RUC	MYNN
arw_m25	arw_cn + arw-p2_pert	21Z SREF arw-p2	yes	Thompson	RUC	MYNN
arw_m26	arw_cn + arw-n2_pert	21Z SREF arw-n2	yes	Thompson	RUC	MYNN
arw_m27	RAPa+3DVAR	18Z GFSf	yes	Thompson	RUC	MYNN

Note 1: For all members: *ra_lw_physics*= RRTMG; *ra_sw_physics*=RRTMG; *cu_physics*=none
Note 2: arw_cn0 is the same as arw_cn, except with non-HRRR vertical levels and no smoothing
Note 3: arw_m19 ~ arw_m26 (dark shading) are with stochastic perturbation turned on (spp_mp=1,spp_pbl=1)
Note 4: arw_m27 is with Thompson stochastic setting on (spp_mp=7, spp_pbl=0)
Note 5: arw_12 is the same as arw_cn, so counted as one member

3.2 FV3 SSEF initialized at 0000 UTC

FV3: 12 member (see Table 2)

Table 2. Configurations for each individual member with FV3 core

member	IC	mp_phy	PBL	Cumulus
fv3_m01	00Z GFSa	Thompson	MYNN-SA	Tiedtke
fv3_m02	00Z GFSa	Thompson	MYNN	Tiedtke
fv3_m03	00Z GFSa	Thompson	YSU-SA	Tiedtke
fv3_m04	00Z GFSa	Thompson	YSU	Tiedtke
fv3_m05	00Z GFSa	Thompson	EDMF	Tiedtke
fv3_m06	00Z GFSa	NSSL	MYNN-SA	Tiedtke

fv3_m07	00Z GFSa	NSSL	MYNN	Tiedtke
fv3_m08	00Z GFSa	NSSL	YSU-SA	Tiedtke
fv3_m09	00Z GFSa	NSSL	YSU	Tiedtke
fv3_m10	00Z GFSa	NSSL	EDMF	Tiedtke
fv3_m11	00Z GFSa	Thompson	MYNN-SA	SA-SAS
fv3_m12	00Z GFSa	GFDL	EDMF	SA-SAS

3.3 GSI+EnKF-based SSEF initialized at 0000 UTC

The 3-km GSI+EnKF system will be initialized at 1800 UTC each day, and assimilate the RAP/HRRR GSI data stream hourly (except for restricted data) from 1900–0000 UTC over the CONUS domain. Radar data will be assimilated every 15 minutes from 2300–0000 UTC using the CAPS EnKF system. The ensemble used will consist of 40 WRF ARW members with initial perturbations and mixed physics options to provide input for the EnKF ensemble analyses. Each member uses Thompson microphysics, although with varied graupel density among members (see Table 3). A 10- member ensemble forecast (run for 48 hours) follows using the final EnKF analyses at 0000 UTC using multi-physics multi-microphysics WRF-ARW configurations (Table 4). This suite of forecasts will be run on Bridges at PSC.

Table 3. Configuration for the EnKF ensemble

Member	IC	BC	BMP – Thomp (ρg)	LSM	PBL
enk_m1	18Z NAMa	18Z NAMf	500	Noah	MYJ
enk_m2	enk_m1 + arw_n1-p1	15Z SREF arw_n1	500	Noah	YSU
enk_m3	enk_m1 + arw_n2-p2	15Z SREF arw_n2	673	Noah	MYJ
enk_m4	enk_m1 + arw_n3-p3	15Z SREF arw_n3	666	Noah	ACM2
enk_m5	enk_m1 + arw_n4-p4	15Z SREF arw_n4	659	Noah	ACM2
enk_m6	enk_m1 + arw_n5-p5	15Z SREF arw_n5	652	Noah	MYNN
enk_m7	enk_m1 + arw_n6-p6	15Z SREF arw_n6	645	Noah	MYJ

enk_m8	enk_m1 + arw_p1-n1	15Z SREF arw_p1	638	Noah	YSU
enk_m9	enk_m1 + arw_p2-n2	15Z SREF arw_p2	631	Noah	MYJ
enk_m10	enk_m1 + arw_p3-n3	15Z SREF arw_p3	624	Noah	MYNN
enk_m11	enk_m1 + arw_p4-n4	15Z SREF arw_p4	617	Noah	MYJ
enk_m12	enk_m1 + arw_p5-n5	15Z SREF arw_p5	610	Noah	YSU
enk_m13	enk_m1 + arw_p6-n6	15Z SREF arw_p6	603	Noah	ACM2
enk_m14	enk_m1 + nmb_n1-p1	15Z SREF nmb_n1	596	Noah	MYNN
enk_m15	enk_m1 + nmb_n2-p2	15Z SREF nmb_n2	589	Noah	MYNN
enk_m16	enk_m1 + nmb_n3-p3	15Z SREF nnb_n3	582	Noah	ACM2
enk_m17	enk_m1 + nmb_n4-p4	15Z SREF nmb_n4	575	Noah	MYJ
enk_m18	enk_m1 + nmb_n5-p5	15Z SREF nmb_n5	568	Noah	ACM2
enk_m19	enk_m1 + nmb_n6-p6	15Z SREF nmb_n6	561	Noah	MYJ
enk_m20	enk_m1 + nmb_p1-n1	15Z SREF nmb_p1	554	Noah	ACM2
enk_m21	enk_m1 + nmb_p2-n2	15Z SREF nmb_p2	547	Noah	MYJ
enk_m22	enk_m1 + nmb_p3-n3	15Z SREF emb_p3	540	Noah	MYJ
enk_m23	enk_m1 + nmb_p4-n4	15Z SREF nmb_p4	533	Noah	YSU
enk_m24	enk_m1 + nmb_p5-n5	15Z SREF nmb_p5	526	Noah	MYNN
enk_m25	enk_m1 + nmb_p6-n6	15Z SREF nmb_p6	519	Noah	MYNN
enk_m26	enk_m1 + arw_n1-n2	15Z SREF arw_n1	512	Noah	MYJ
enk_m27	enk_m1 + arw_n3-n4	15Z SREF arw_n3	505	Noah	YSU
enk_m28	enk_m1 + arw_n5-n6	15Z SREF arw_n5	498	Noah	ACM2
enk_m29	enk_m1 + arw_p1-p2	15Z SREF arw-p1	491	Noah	MYNN

enk_m30	enk_m1 + arw_p3-p4	15Z SREF arw_p3	484	Noah	MYJ
enk_m31	enk_m1 + arw_p5-p6	15Z SREF arw_p5	477	Noah	YSU
enk_m32	enk_m1 + arw_n2-n1	15Z SREF arw_n2	470	Noah	MYNN
enk_m33	enk_m1 + arw_n4-n3	15Z SREF arw_n4	463	Noah	MYJ
enk_m34	enk_m1 + arw_n6-n5	15Z SREF arw_n6	456	Noah	YSU
enk_m35	enk_m1 + arw_p2-p1	15Z SREF arw_p2	449	Noah	ACM2
enk_m36	enk_m1 + arw_p4-p3	15Z SREF arw_p4	442	Noah	MYNN
enk_m37	enk_m1 + arw_p6-p5	15Z SREF arw_p6	435	Noah	MYNN
enk_m38	enk_m1 + nmb_n-n2	15Z SREF nmb_n1	428	Noah	MYJ
enk_m39	enk_m1 + nmb_n3-n4	15Z SREF nmb_n3	421	Noah	YSU
enk_m40	enk_m1 + nmb_n5-n6	15Z SREF nmb_n5	414	Noah	MYJ

Table 4. Configuration for the EnKF member ensemble forecasts

Member	IC	BC	Microphysics	LSM	PBL
enkf_m01	enk_m01a	00Z NAMf	Thompson	Noah	MYJ
enkf_m02	enk_m02a	21Z SREF arw-p1	NSSL	Noah	YSU
enkf_m03	enk_m15a	21Z SREF arw-n1	NSSL	Noah	MYNN
enkf_m04	enk_m40a	21Z SREF nmmb-p1	Morrison	Noah	MYJ
enkf_m05	enk_m8a	21Z SREF nmmb-n1	P3	Noah	YSU
enkf_m06	enk_m26a	21Z SREF arw-p2	NSSL	Noah	MYJ
enkf_m07	enk_m39a	21Z SREF arw-n2	Morrison	Noah	YSU
enkf_m08	enk_m12a	21Z SREF nmmb-p2	P3	Noah	MYNN

enkf_m09	enk_mn	00Z NAMf	Thompson	Noah	MYJ
enkf_m10	enk_mn	00Z NAMf	NSSL	Noah	MYJ
~~enkf_m11~~	~~enk_m25a~~	~~21Z SREF nmmb-n2~~	~~Thompson~~	~~Noah~~	~~MYNN~~
~~enkf_m12~~	~~3dvar~~	~~00Z NAMf~~	~~Thompson~~	~~Noah~~	~~MYJ~~

4. Forecast Product and Deliverables to HWT/HMT

4.1 Products available to HWT and HMT (NSSL/SPC, WPC) in GRIB2

The 123 forecast fields for 2018 HWT Spring Forecast Experiment are listed in Table 5. The NCEP Unified Post Processing System (UPP, Version 3.2) is used to post-process WRF-ARW to generate them in GRIB2 format.

A complete set of extracted 2D fields in hdf4 format (Table 8) over the full CONUS domain are archived by CAPS for post-analysis and external collaborations.

Table 5. 2D fields of each member for HWT/HMT

Number	Level/Layer	Parameter	Description
001	entire atmosphere	REFC	Composite reflectivity [dB]
002	cloud top	RETOP	Echo Top [m]
003	entire atmosphere	VIL	Radar-Simulated Vertically Integrated Liquid [kg/m^2]
004	surface	VIS	Visibility [m]
005	1000 m above ground	REFD	Reflectivity [dB]
006	4000 m above ground	REFD	Reflectivity [dB]
007	surface	GUST	Wind Speed (Gust) [m/s]
008	500 mb	HGT	Geopotential Height [gpm]
009	500 mb	TMP	Temperature [K]
010	500 mb	DPT	Dew Point Temperature [K]
011	500 mb	UGRD	U-Component of Wind [m/s]
012	500 mb	VGRD	V-Component of Wind [m/s]
013	700 mb	HGT	Geopotential Height [gpm]
014	700 mb	TMP	Temperature [K]
015	700 mb	DPT	Dew Point Temperature [K]
016	700 mb	UGRD	U-Component of Wind [m/s]
017	700 mb	VGRD	V-Component of Wind [m/s]
018	850 mb	HGT	Geopotential Height [gpm]

019	850 mb	TMP	Temperature [K]
020	850 mb	DPT	Dew Point Temperature [K]
021	850 mb	UGRD	U-Component of Wind [m/s]
022	850 mb	VGRD	V-Component of Wind [m/s]
023	925 mb	TMP	Temperature [K]
024	925 mb	DPT	Dew Point Temperature [K]
025	925 mb	UGRD	U-Component of Wind [m/s]
026	925 mb	VGRD	V-Component of Wind [m/s]
027	1000 mb	TMP	Temperature [K]
028	1000 mb	DPT	Dew Point Temperature [K]
029	1000 mb	UGRD	U-Component of Wind [m/s]
030	1000 mb	VGRD	V-Component of Wind [m/s]
031	100-1000 mb above ground	MAXUVV	Hourly Max upward Vertical Velocity - lowest 100hPa [m/s]
032	100-1000 mb above ground	MAXDVV	Hrly Max downward Vertical Velocity - lowest 100hPa [m/s]
033	0.5-0.8 sigma layer	DZDT	Vertical Velocity (Geometric) [m/s]
034	mean sea level	PRMSL	Pressure Reduced to MSL [Pa]
035	1000 mb	HGT	Geopotential Height [gpm]
036	1000 m above ground	MAXREF	Hourly Max of Simulated Reflectivity at 1 km AGL [dB]
037	5000-2000 m above ground	MXUPHL	Hrly Max Updraft Helicity - 2km to 5 km AGL [m^2/s^2]
038	entire column	TCOLG	Total Column Integrated Graupel [kg/m^2]
039	surface	LTNG	Lightning [non-dim]
040	80 m above ground	UGRD	U-Component of Wind [m/s]
041	80 m above ground	VGRD	V-Component of Wind [m/s]
042	surface	PRES	Pressure [Pa]
043	surface	HGT	Geopotential Height [gpm]
044	surface	TMP	Temperature [K]
045	0 m underground	MSTAV	Moisture Availability [%]
046	surface	WEASD	Water Equivalent of Accumulated Snow Depth [kg/m^2]
047	surface	SNOWC	Snow Cover [%]
048	surface	SNOD	Snow Depth [m]
049	2 m above ground	TMP	Temperature [K]
050	2 m above ground	SPFH	Specific Humidity [kg/kg]
051	2 m above ground	DPT	Dew Point Temperature [K]
052	10 m above ground	UGRD	U-Component of Wind [m/s]
053	10 m above ground	VGRD	V-Component of Wind [m/s]

054	10 m above ground	WIND	Wind Speed [m/s]
055	surface	CPOFP	Percent frozen precipitation [%]
056	surface	PRATE	Precipitation Rate [kg/m^2/s]
057	surface	APCP	Total Precipitation [kg/m^2]
058	surface	WEASD	Water Equivalent of Accumulated Snow Depth [kg/m^2]
059	surface	APCP	Precipitation [kg/m^2] – hourly total
060	surface	WEASD	Water Equivalent of Accumulated Snow Depth [kg/m^2]
061	surface	CSNOW	Categorical Snow [-]
062	surface	CICEP	Categorical Ice Pellets [-]
063	surface	CFRZR	Categorical Freezing Rain [-]
064	surface	CRAIN	Categorical Rain [-]
065	surface	VGTYP	Vegetation Type [Integer(0- 13)]
066	500-1000 mb	LFTX	Surface Lifted Index [K]
067	surface	CAPE	Convective Available Potential Energy [J/kg]
068	surface	CIN	Convective Inhibition [J/kg]
069	entire column	PWAT	Precipitable Water [kg/m^2]
070	low cloud layer	LCDC	Low Cloud Cover [%]
071	middle cloud layer	MCDC	Medium Cloud Cover [%]
072	high cloud layer	HCDC	High Cloud Cover [%]
073	entire atmosphere	TCDC	Total Cloud Cover [%]
074	cloud base	PRES	Pressure [Pa]
075	cloud base	HGT	Geopotential Height [gpm]
076	cloud ceiling	HGT	Geopotential Height [gpm]
077	cloud top	PRES	Pressure [Pa]
078	cloud top	HGT	Geopotential Height [gpm]
079	top of atmosphere	ULWRF	Upward Long-Wave Rad. Flux [W/m^2]
080	surface	DSWRF	Downward Short-Wave Radiation Flux [W/m^2]
081	3000-0 m above ground	HLCY	Storm Relative Helicity [m^2/s^2]
082	1000-0 m above ground	HLCY	Storm Relative Helicity [m^2/s^2]
083	0-6000 m above ground	USTM	U-Component Storm Motion [m/s]
084	0-6000 m above ground	VSTM	V-Component Storm Motion [m/s]
085	0-1000 m above ground	VUCSH	Vertical U-Component Shear [1/s]
086	0-1000 m above ground	VVCSH	Vertical V-Component Shear [1/s]
087	0-6000 m above ground	VUCSH	Vertical U-Component Shear [1/s]
088	0-6000 m above ground	VVCSH	Vertical V-Component Shear [1/s]
089	180-0 mb above ground	4LFTX	Best (4 layer) Lifted Index [K]

090	180-0 mb above ground	CAPE	Convective Available Potential Energy [J/kg]
091	180-0 mb above ground	CIN	Convective Inhibition [J/kg]
092	surface	HPBL	Planetary Boundary Layer Height [m]
093	lifted condensation level	HGT	Geopotential Height [gpm]
094	90-0 mb above ground	CAPE	Convective Available Potential Energy [J/kg]
095	90-0 mb above ground	CIN	Convective Inhibition [J/kg]
096	255-0 mb above ground	CAPE	Convective Available Potential Energy [J/kg]
097	255-0 mb above ground	CIN	Convective Inhibition [J/kg]
098	equilibrium level	HGT	Geopotential Height [gpm]
099	255-0 mb above ground	PLPL	Pressure of level from which parcel was lifted [Pa]
100	surface	LAND	Land Cover (0=sea, 1=land) [Proportion]
101	surface	ICEC	Ice Cover [Proportion]
102	250 mb	UGRD	U-component of wind [m/s]
103	250 mb	VGRD	V-component of wind [m/s]
104	250 mb	HGT	Geopotential Height [gpm]
105	250 mb	TMP	Temperature [K]
106	700 mb	VVEL	Vertical Velocity [m/s]
107	-10 C	REFD	Reflectivity [dB]
108	-10 C	REFD	Hourly maximum of -10C reflectivity
109	5000-2000 m above ground	MNUPHL	Hrly Min Updraft Helicity - 2km to 5 km AGL [m^2/s^2]
110	2000-0 m above ground	MXUPHL	Hrly Max Updraft Helicity - 0km to 2 km AGL [m^2/s^2]
111	2000-0 m above ground	MNUPHL	Hrly Min Updraft Helicity - 0km to 2 km AGL [m^2/s^2]
112	3000-0 m above ground	MXUPHL	Hrly Max Updraft Helicity - 0km to 3 km AGL [m^2/s^2]
113	3000-0 m above ground	MNUPHL	Hrly Min Updraft Helicity - 0km to 3 km AGL [m^2/s^2]
114	2000-0 m above ground	RELV	Hrly Max Rel. Vort. – 0km to 2km AGL [1/s]
115	1000-0 m above ground	RELV	Hrly Max Rel. Vort. – 0km to 1km AGL [1/s]
116	entire column	HAIL	Hrly Max of Hail/Graupel Diameter [m]
117	0.1 sigma	HAIL	Hrly Max of Hail/Graupel Diameter [m]
118	5000-2000m AGL	UPHL	Updraft Helicity (instantaneous)
119	6000-1000m AGL	UPHL	Updraft Helicity (instantaneous)
120	top of atmos	SBT123	Simulated Brightness T for GOES 12 Ch. 3
121	top of atmos	SBT124	Simulated Brightness T for GOES 12 Ch. 4
122	top of atmos	SBT113	Simulated Brightness T for GOES 11 Ch. 3
123	top of atmos	SBT114	Simulated Brightness T for GOES 11 Ch. 4

4.2 Post-processed ensemble products in GEMPAK for HMT FFaIR

A list of post-processed ensemble products are produced in the 2018 Spring Experiment (see Table 7). 15 ensemble members are contributed to the products.

During HMT FFaIR, a slightly different membership is configured to reflect the desire to examine microphysics impact on QPF. Table 6 is the ARW membership during the NMT FFaIR, all will run 60 h except for FV3 membrs which will run for 84 h. The 4 shaded members in Table 6 are designed to evaluate microphysics impact on QPF.

In order to save disk space, the HMT GEMPAK data are trimmed off 100 grid points in west and south edges, 50 grid points in east edge, and 80 grid points in north edge (see Figure 2). This reduces the GEMPAK file sizes by 23%.

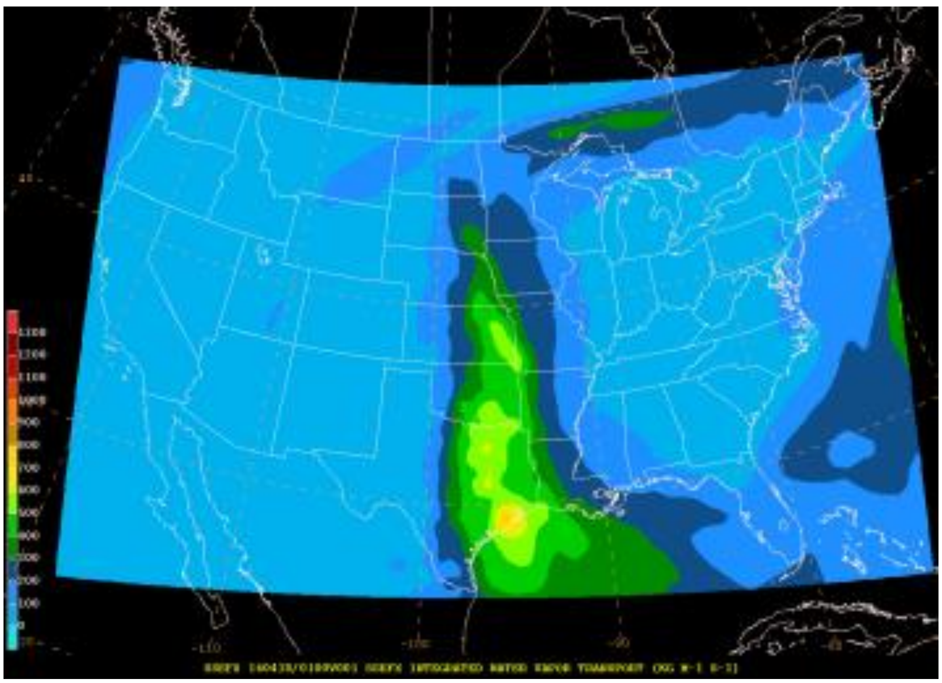

Figure 3. Sub-domain for the GEMPAK data for HMT.

Table 6. Ensemble members for HMT during FFaIR

Member	IC	BC	Radar data	Microphy	LSM	PBL
arw_cn	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	MYJ
arw_m2	arw_cn + arw-p1_pert	21Z SREF arw-p1	yes	NSSL	Noah	YSU
arw_m3	arw_cn + arw-n1_pert	21Z SREF arw-n1	yes	NSSL	Noah	MYNN

arw_m4	arw_cn + arw-p2_pert	21Z SREF arw-p2	yes	NSSL	Noah	MYJ
arw_m5	arw_cn + arw-n2_pert	21Z SREF arw-n2	yes	Morrison	Noah	YSU
arw_m6	arw_cn + nmmb-p1_pert	21Z SREF nmmb-p1	yes	Morrison	Noah	MYJ
arw_m7	arw_cn + nmmb-n1_pert	21Z SREF nmmb-n1	yes	P3	Noah	YSU
arw_m8	arw_cn + nmmb-p2_pert	21Z SREF nmmb-p2	yes	P3	Noah	MYNN
arw_m9	arw_cn + nmmb-n2_pert	21Z SREF nmmb-n2	yes	Thompson	Noah	MYNN
arw_m10	arw_cn + arw-n3_pert	21Z SREF arw-n3	yes	Thompson	Noah	MYJ
arw_m11	00Z ARPSa	00Z NAMf	yes	Morrison	Noah	MYJ
arw_m12	00Z ARPSa	00Z NAMf	yes	P3	Noah	MYJ
arw_m13	00Z ARPSa	00Z NAMf	yes	NSSL	Noah	MYJ
fv3_m14	GFS	-	no	Thompson	Noah	MYNN
fv3_m15	GFS	-	no	NSSL	Noah	MYNN

* For all ARW members: ra_lw_physics= RRTMG; ra_sw_physics=RRTMG; cu_physics=none

Table 7. Ensemble post-processed products for HMT

Field	GEMPAK name	Unit	Type	Ens type
Sea level pressure	PMSL	hPa	Surface/single layer	Mean
Sea Level pressure Spread	MSLS	hPa	Surface/single layer	STDEV
850 hPa Z	HGHT850	m	Surface/single layer	Mean
500 hPa Z	HGHT500	m	Surface/single layer	Mean
250 hPa Z	HGHT250	m	Surface/single layer	Mean
500 hPa Z Spread	H500S	m	Surface/single layer	Mean
850 hPa u-wind	UREL850	m/s	Surface/single layer	Mean
850 hPa v-wind	VREL850	m/s	Surface/single layer	Mean

250 hPa u-wind	UREL250	m/s	Surface/single layer	Mean
250 hPa v-wind	VREL250	m/s	Surface/single layer	Mean
500 hPa u-wind	UREL500	m/s	Surface/single layer	Mean
500 hPa v-wind	VREL500	m/s	Surface/single layer	Mean
850-300 hPa mean u-wind	UREL850_300	m/s	Surface/single layer	Mean
850-300 hPa mean v-wind	VREL850_300	m/s	Surface/single layer	Mean
IVTu	IVTU	kg/m/s	Surface/single layer	Mean
IVTv	IVTV	kg/m/s	Surface/single layer	Mean
500 hPa absolute vorticity	AVORT500	1/s	Surface/single layer	Mean
1-h precip	P01M_PM	mm	Surface/single layer	PM-mean
1-h precip	P01M_LPM	mm	Surface/single layer	LPM-mean
1-h precip	P01M_M	mm	Surface/single layer	Mean
1-h precip	P01M_MX	mm	Surface/single layer	Max
1-h precip $\geq$ 0.50 in	PR01MTH2_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
1-h precip $\geq$ 1.00 in	PR01MTH3_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
1-h precip > 2.00 in	PR01MTH4_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
3-h precip	P03M_PM	mm	Surface/single layer	PM-mean
3-h precip	P03M_LPM	mm	Surface/single layer	LPM-mean
3-h precip > 0.50 in	PR03MTH2_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
3-h precip > 1.00 in	PR03MTH3_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
3-h precip > 2.00 in	PR03MTH4_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
6-h precip	P06M_PM	mm	Surface/single layer	PM-mean
6-h precip	P06M_LPM	mm	Surface/single layer	LPM-mean
6-h precip	P06M_M	mm	Surface/single layer	Mean
6-h precip	P06M_MX	mm	Surface/single layer	Max

6-h precip ≥ 1.0-in	PR06MTH3_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
6-h precip ≥ 2.0-in	PR06MTH4_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
6-h precip ≥ 3.0-in	PR06MTH5_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
12-h precip	P12M_PM	mm	Surface/single layer	PM-mean
12-h precip	P12M_LPM	mm	Surface/single layer	LPM-mean
12-h precip > 1.00 in	PR12MTH3_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
12-h precip > 2.00 in	PR12MTH4_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
12-h precip > 3.00 in	PR12MTH5_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
24-h precip	P24M_PM	mm	Surface/single layer	PM-mean
24-h precip	P24M_LPM	mm	Surface/single layer	LPM-mean
24-h precip > 1.00 in	PR24MTH3_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
24-h precip > 2.00 in	PR24MTH4_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
24-h precip > 3.00 in	PR24MTH5_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 3-h FFG	FFG03_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h FFG	FFG06_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 12-h FFG	FFG12_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h FFG	FFG24_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h 2-y RI	RI06_002_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h 5-y RI	RI06_005_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h 10-y RI	RI06_010_PN	%	Surface/single layer	Prob-neighbor (ROI=25,

				sigma=5)
Exceeding 6-h 25-y RI	RI06_025_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h 50-y RI	RI06_050_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 6-h 100-y RI	RI06_100_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 2-y RI	RI24_002_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 5-y RI	RI24_005_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 10-y RI	RI24_010_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 25-y RI	RI24_025_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 50-y RI	RI24_050_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Exceeding 24-h 100-y RI	RI24_100_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Lowest model level temp	TMPF	F	Surface/single layer	Mean
Lowest model level dew point	DWPF	F	Surface/single layer	Mean
precipitable water	PWAT	mm	Surface/single layer	Mean
10 m U	UREL	m/s	Surface/single layer	Mean
10 m V	VREL	m/s	Surface/single layer	Mean
1 km AGL reflectivity	REFL1KM	dBZ	Surface/single layer	PM-mean
1 km refl ≥ 40 dBZ	REFL1KMTH1_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Composite reflectivity	REFLCMP	dBZ	Surface/single layer	PM-mean
Comp refl ≥ 40 dBZ	REFLCMPTH1_PN	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Surface-based CAPE	CAPE	J/kg	Surface/single layer	Mean
Surface-based CIN	CIN	J/kg	Surface/single layer	Mean
Surface-based LCL	HLCL	m	Surface/single layer	Mean

Max Updraft helicity	VHEL	m^2/s^2	Surface/single layer	Max
Max sfc-100 hPa W	VVELMAX	m/s	Surface/single layer	Max
Max sfc-100 hPa W ≥ 10 m/s	VVELMAX10	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Max sfc-100 hPa W ≥ 20 m/s	VVELMAX20	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
mlCAPE	MLCAPE	J/kg	Surface/single layer	Mean
mlCIN	MLCIN	J/kg	Surface/single layer	Mean
muCAPE	MUCAPE	J/kg	Surface/single layer	Mean
muCIN	MUCIN	J/kg	Surface/single layer	Mean
0 – 3 km AGL lapse rate	LLLR	K/km	Surface/single layer	Mean
700-500 mb lapse rate	LR75	K/km	Surface/single layer	Mean
0-1 km AGL wind shear	SHR01	1/s	Surface/single layer	Mean
0-6 km AGL wind shear	SHR06	1/s	Surface/single layer	Mean
Vertical-integrated Qg	COLQG	kg/ m^2	Surface/single layer	Max
Vertical-integrated Qg ≥ 40	COLQG40	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Surface wind speed (10-m)	WMAGSFC	m/s	Surface/single layer	Max
Surface wind speed (10-m) ≥ 15 m/s	WMAGSFC15	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)
Surface wind speed (10-m) ≥ 25 m/s	WMAGSFC25	%	Surface/single layer	Prob-neighbor (ROI=25, sigma=5)

4.3 Products that will be extracted and archived as 2D HDF4 files

Table 8 lists the 2D fields that are produced and archived in HDF4 format over the full domain for each ensemble member.

Table 8. 2D fields archived for CAPS post-analysis

Field	Variable name	Variable ID	Unit	Type	Level
Surface pressure	PRES	sfpres	hPa	Surface/single layer	0
Sea level pressure	PMSL	mspres	hPa	Surface/single layer	0

1-h precipitation	P01M	accppt	mm	Surface/single layer	0
Precipitable water	PWAT	pwat__	mm	Surface/single layer	0
2 m temperature	TMPF	temp2m	F	Surface/single layer	0
2 m dew point	DWPF	dewp2m	F	Surface/single layer	0
2 m mixing ratio	MIXR	qv2m__	g/kg	Surface/single layer	0
1st level temperature	TMPF	tempk2	F	Surface/single layer	0
1st level dew point	DWPF	dewpk2	F	Surface/single layer	0
1st level mixing ratio	MIXR	qvk2__	g/kg	Surface/single layer	0
1st level wind speed	WMAGM	wsp2mx	m/s	Surface/single layer	0
10 m U	UREL	u10m__	m/s	Surface/single layer	0
10 m V	VREL	v10m__	m/s	Surface/single layer	0
Surface wind speed (10-m)	WMAGSFC	wspmax	m/s	Surface/single layer	0
Wind speed (1-km)	WMAG1KM	wsp1km	m/s	Surface/single layer	0
Surface geo- height	HGHT	hgtsfc	m	Surface/single layer	0
1 km AGL reflectivity	REFL1KM	ref1km	dBZ	Surface/single layer	0
1 km AGL reflectivity	REFL1KM_HM	refmax	dBZ	Surface/single layer	0
4 km AGL reflectivity	REFL4KM	ref4km	dBZ	Surface/single layer	0
Composite reflectivity	REFLCMP	cmpref	dBZ	Surface/single layer	0
Composite reflectivity	REFLCMP_HM	crefmx	dBZ	Surface/single layer	0
Reflectivity at -10C	REFLMTR	r10cmx	dBZ	Surface/single layer	0
Surface-based CAPE	CAPE	sbcape	J/kg	Surface/single layer	0
Moist unstable CAPE	MUCAPE	mucape	J/kg	Surface/single layer	0
Mixed-layer CAPE	MLCAPE	mlcape	J/kg	Surface/single layer	0
Surface-based CIN	CINS	sbcins	J/kg	Surface/single layer	0
Moist unstable CIN	MUCINS	mucins	J/kg	Surface/single layer	0
Mixed-layer CIN	MLCINS	mlcins	J/kg	Surface/single layer	0
Surface-based LCL	HLCL	sblcl_	m	Surface/single layer	0

0-1 km AGL SRH	SRH01	srh01_	m^2/s^2	Surface/single layer	0
0-3 km AGL SRH	SRH03	srh03_	m^2/s^2	Surface/single layer	0
Updraft helicity max	VHELMAX	uh_max	m2/s2	Surface/single layer	0
Updraft helicity min	VHELMIN	uh_min	m2/s2	Surface/single layer	0
Updraft helicity - E	VHELE	uhemax	m2/s2	Surface/single layer	0
Updraft helicity - P	VHELF	uhpmax	m^2/s^2	Surface/single layer	0
0-3km Updraft helicity	VHEL3KM	uh03mx	m^2/s^2	Surface/single layer	0
Sfc-400hPa max W	VVELMAX	wupmax	m/s	Surface/single layer	0
Sfc-400hPa min W	VVELMIN	wdnmax	m/s	Surface/single layer	0
0-1 km AGL wind shear	SHR01	shr01_	1/s	Surface/single layer	0
0-6 km AGL wind shera	SHR06	shr06_	1/s	Surface/single layer	0
1-h accumulated snow	SNOW	snow01	mm	Surface/single layer	0
1-h accumulated graupel	GRAUP	grpl01	mm	Surface/single layer	0
1-h accumulated hail	HAIL	hail01	mm	Surface/single layer	0
Bunkers right-moving U	BKU	bku___	m/s	Surface/single layer	0
Bunkers right-moving V	BKV	bkv___	m/s	Surface/single layer	0
IVT - U	IVTU	ivtu__	kg /m s	Surface/single layer	0
IVT - V	IVTV	ivtv__	kg /m s	Surface/single layer	0
Echo top (>= 18 dBZ)	ECHOTOP	Echotp	km	Surface/single layer	0
Vertical-integrated Qs	COLQS	cqsmax	kg/ m2	Surface/single layer	0
Vertical-integrated Qg	COLQG	cqgmax	kg/ m2	Surface/single layer	0
Vertical-integrated Qg (0-5km)	LLQG	llqg05	kg/ m^2	Surface/single layer	0
0-3km lapse rate	LLLR	lllr__	K/km	Surface/single layer	0
700-500hPa lapse rate	LR75	lr75__	K/km	Surface/single layer	0
80 m U	U80M	u80m__	m/s	Surface/single layer	0
80 m V	V80M	v80m__	m/s	Surface/single layer	0
Sfc total downward radiation flux	RADDN	raddn_	W/ m^2	Surface/single layer	0

Sfc downward sw radiation flux	RADSW	radsw_	W/ m2	Surface/single layer	0
Qs above surface	QSSFC	qsk2__	g/kg	Surface/single layer	0
Qg above surface	QGSFC	qgk2__	g/kg	Surface/single layer	0
Qh above surface	QHSFC	qhk2__	g/kg	Surface/single layer	0
Ns above surface	QNSSFC	qnsk2_	g/kg	Surface/single layer	0
Ng above surface	QNGSFC	qngk2_	g/kg	Surface/single layer	0
Nh above surface	QNHSFC	qnhk2_	g/kg	Surface/single layer	0
Qt above surface	QTSFC	qtsfc_	g/kg	Surface/single layer	0
Hail size	HAILSIZE	hailsz	mm	Surface/single layer	0
GT Hail size at k1	HAILSIZE_k1	hailk1	mm	Surface/single layer	0
GT Hail size in column	HAILSIZE_2d	hail2d	mm	Surface/single layer	0
MAXHAILW	MAXHAILW	hailw_	mm	Surface/single layer	0
500 hPa absolute vorticity	VORT500	vrt500	1/s	Surface/single layer	0
Lightning flash rate	LTG_MAX	Lg_max	Flashes/km^2/5 min	Surface/single layer	0
LFC height	LFCH	lfch__	m	Surface/single layer	0
PBL height	PBLH	pblh__	m	Surface/single layer	0
W at PBL top	WPBL	wpbl__	m/s	Surface/single layer	0
Simulated GOES-16 BT Ch 6.14 CRTM	SIMSAT1	btch01	K	Surface/single layer	0
Simulated GOES-16 BT Ch 6.93 CRTM	SIMSAT2	btch02	K	Surface/single layer	0
Simulated GOES-16 BT Ch 7.34 CRTM	SIMSAT3	btch03	K	Surface/single layer	0
Simulated GOES-16 BT Ch 8.49 CRTM	SIMSAT4	btch04	K	Surface/single layer	0
Simulated GOES-16 BT Ch 9.60 CRTM	SIMSAT5	btch05	K	Surface/single layer	0
Simulated GOES-16 BT Ch 10.35 CRTM	SIMSAT6	btch06	K	Surface/single layer	0
Simulated GOES-16 BT Ch 11.22 CRTM	SIMSAT7	btch07	K	Surface/single layer	0
Geopotential height 925	HGHT	hgt925	m	pressure	925 hPa
Geopotential height 850	HGHT	hgt850	m	pressure	850 hPa
Geopotential height 700	HGHT	hgt700	m	pressure	700 hPa

Geopotential height 500	HGHT	hgt500	m	pressure	500 hPa
Geopotential height 250	HGHT	hgt250	m	pressure	250 hPa
925 hPa U	UREL	u925__	m/s	pressure	925 hPa
850 hPa U	UREL	u850__	m/s	pressure	850 hPa
700 hPa U	UREL	u700__	m/s	pressure	700 hPa
500 hPa U	UREL	u500__	m/s	pressure	500 hPa
250 hPa U	UREL	u250__	m/s	pressure	250 hPa
925 hPa V	VREL	v925__	m/s	pressure	925 hPa
850 hPa V	VREL	v850__	m/s	pressure	850 hPa
700 hPa V	VREL	v700__	m/s	pressure	700 hPa
500 hPa V	VREL	v500__	m/s	pressure	500 hPa
250 hPa V	VREL	v250__	m/s	pressure	250 hPa
925 hPa W	VVEL	w925__	m/s	pressure	925 hPa
850 hPa W	VVEL	w850__	m/s	pressure	850 hPa
700 hPa W	VVEL	w700__	m/s	pressure	700 hPa
500 hPa W	VVEL	w500__	m/s	pressure	500 hPa
250 hPa W	VVEL	w250__	m/s	pressure	250 hPa
925 hPa T	TMPC	tmp925	C	pressure	925 hPa
850 hPa T	TMPC	tmp850	C	pressure	850 hPa
700 hPa T	TMPC	tmp700	C	pressure	700 hPa
500 hPa T	TMPC	tmp500	C	pressure	500 hPa
250 hPa T	TMPC	tmp250	C	pressure	250 hPa
925 hPa mixing ratio	MIXR	sph925	g/kg	pressure	925 hPa
850 hPa mixing ratio	MIXR	sph850	g/kg	pressure	850 hPa
700 hPa mixing ratio	MIXR	sph700	g/kg	pressure	700 hPa
500 hPa mixing ratio	MIXR	sph500	g/kg	pressure	500 hPa
250 hPa mixing ratio	MIXR	sph250	g/kg	pressure	250 hPa

4.4 Name convention

SPC/NSSL file name	*CAPS web name*
<u>ARW members (3DVAR based):</u>	
ssef_s3cn_arw_2015032500	SPC3-EF CN WRFARW Fcst
ssef_s3c0_arw_2015032500	SPC3-EF C0 WRFARW Fcst
ssef_s3m3_arw_2015032500	SPC3-EF M3 WRFARW Fcst
ssef_s3m4_arw_2015032500	SPC3-EF M4 WRFARW Fcst
ssef_s3m5_arw_2015032500	SPC3-EF M5 WRFARW Fcst
ssef_s3m6_arw_2015032500	SPC3-EF M6 WRFARW Fcst
ssef_s3m7_arw_2015032500	SPC3-EF M7 WRFARW Fcst
ssef_s3m8_arw_2015032500	SPC3-EF M8 WRFARW Fcst
ssef_s3m9_arw_2015032500	SPC3-EF M9 WRFARW Fcst
ssef_s3m10_arw_2015032500	SPC3-EF M10 WRFARW Fcst
ssef_s3m11_arw_2015032500	SPC3-EF M11 WRFARW Fcst
ssef_s3m12_arw_2015032500	SPC3-EF M12 WRFARW Fcst
ssef_s3m13_arw_2015032500	SPC3-EF M13 WRFARW Fcst
ssef_s3m14_arw_2015032500	SPC3-EF M14 WRFARW Fcst
ssef_s3m15_arw_2015032500	SPC3-EF M15 WRFARW Fcst
ssef_s3m16_arw_2015032500	SPC3-EF M16 WRFARW Fcst
ssef_s3m17_arw_2015032500	SPC3-EF M17 WRFARW Fcst
ssef_s3m18_arw_2015032500	SPC3-EF M18 WRFARW Fcst
ssef_s3m19_arw_2015032500	SPC3-EF M19 WRFARW Fcst
ssef_s3m20_arw_2015032500	SPC3-EF M20 WRFARW Fcst

<u>ARW members (ENKF based):</u>

enkf_s3cn_arw_2015032500 ENKF3 CN WRFARW Fcst

enkf_s3m2_arw_2015032500 ENKF3 M2 WRFARW Fcst

enkf_s3m3_arw_2015032500 ENKF3 M3 WRFARW Fcst

…

FV3 members:

ssef_s3m01_fv3_2015032500 SPC3-EF M01 FV3 Fcst

ssef_s3m02_fv3_2015032500 SPC3-EF M02 FV3 Fcst

…

Ensemble summary product:

ssef_s3ens_2015032500 (12-member)

enkf_s3ens_2015032500

5. 3D Visualization

3D fields from the 00Z control run covering a 200x200 grid-point area (600 km x 600 km) region will be extracted from the CONUS domain and shipped to the NWC in real-time. The domain will be centered on the SPC-determined daily area of interest as set on the NSSL HWT web site the previous afternoon. Expected arrival of all 3D files will be by 0800 CDT. Workflow for the 3D data processing is shown in Figure 3.

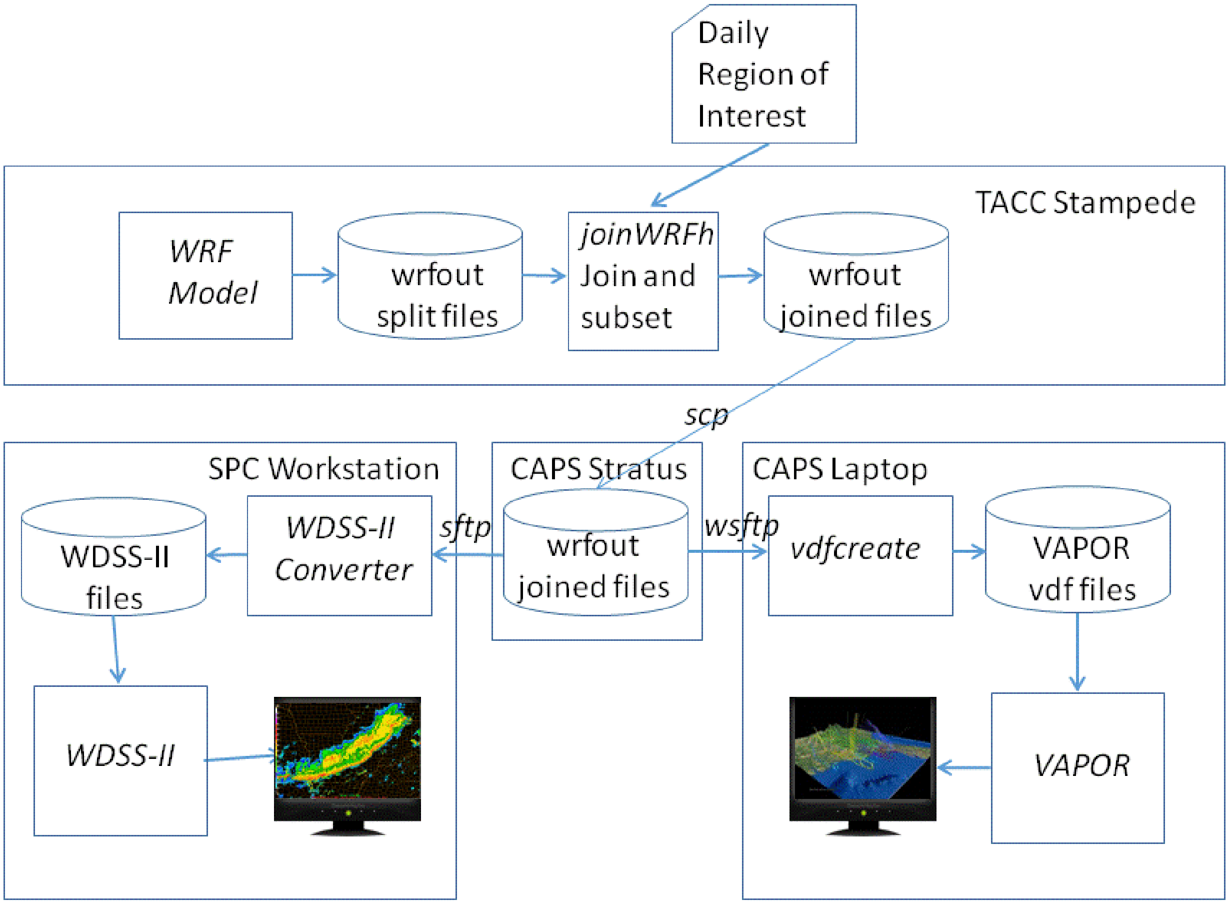

Figure 3. Workflow for 3D data extraction, transmission and 3D visualization processing.

The realtime system will create 10-minute output for 3D visualization from 1800 UTC to 0600 UTC (forecast hours 18-30) on TACC Stampede for the following members: control, m17, m18, m19, m20. The WRF subsetting and join program, joinwrfh, will be queued on Stampede at 0530 CDT each morning to create joined wrfout files of a 600 x 600 km domain centered on the HWT centerpoint of the day. The joinwrf script will include copying of files to Norman where they will be staged on the CAPS cluster (stratus). CAPS personnel, Keith Brewster or Derek Stratman, will copy the wrfout files from there to a laptop to process the 3D fields into vdf files using the VDCWizard tool . Then they will then use the NCAR VAPOR software to display relevant fields of the day for one or more members and present these to the forecast teams and at the HWT briefing at 11am CDT. A sample static VAPOR field from the 03 June 2014 is shown in Figure 4. A question about the utility of the 3D visualization and suggestion for additional fields will again be included in the HWT forecast questionnaire. The joined wrfout files and the image and movies shown in the briefings will be archived on an external harddrive for post-realtime analysis.

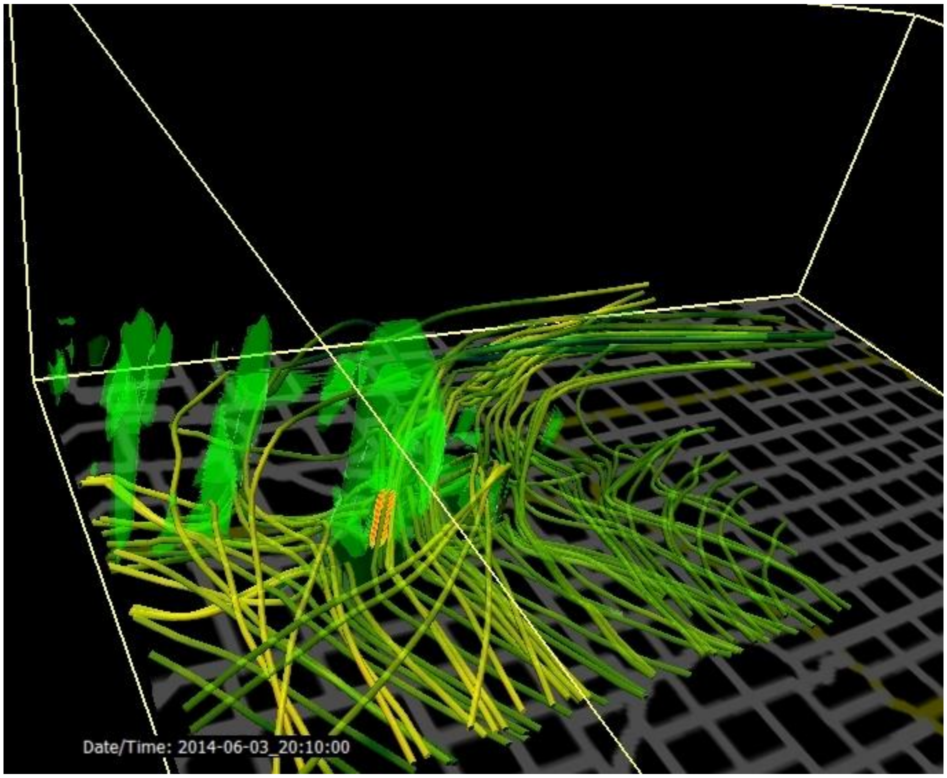

Figure 4. Sample VAPOR visualization from 03 June 2014 showing low-level parcel trajectories, envelope of reflectivity > 35 dBZ and updraft helicity (orange to red shading).

Appendix

A.1 WRF-ARW timing

A.2 FV3 timing

A.3 List of SREF members

24 perturbed SREF members:
sref_arw_n1
sref_arw_n2
sref_arw_n3
sref_arw_n4
sref_arw_n5
sref_arw_n6
sref_arw_p1
sref_arw_p2
sref_arw_p3
sref_arw_p4
sref_arw_p5
sref_arw_p6
sref_nmb_n1
sref_nmb_n2
sref_nmb_n3
sref_nmb_n4
sref_nmb_n5
sref_nmb_n6
sref_nmb_p1
sref_nmb_p2
sref_nmb_p3
sref_nmb_p4
sref_nmb_p5
sref_nmb_p6