2010 CAPS Spring Forecast Experiment Program Plan

(A Brief Version)

May 17, 2010

Table of Content

Table of Content 2
1. Overview of New Features for 2010 Season 3
2. Program Duration 4
3. Forecast System Configuration 5
4. Logistics 8
5. Forecast Product Generation and Delivery to the SPC 8

1. Overview of New Features for 2010 Season

<u>Major changes from 2009:</u>

- **Expanding domains to cover full CONUS**. All three domains from 2009 season are enlarged to cover the full continental US (see Figure 1). This change will increase total computing grid points by ~30%.
- **WRF version 3.1.1** (released July 31, 2009) is used for 2010 season. As a result, and for NMM core supporting, the ARPS-WRF interface package, *arps4wrf* , *wrf2arps*, and *nmm2arps*, and the real_nmm (to allow hydrometeor variables to pass into WRF IC file) have to be updated to be consistent with the new WRF version.
- **New set of physics configuration** with the newly available physics options in WRFV3.1.1
- **There are 26 4-km members.**
- **Physics-perturbation-only members:** Six 4-km members will contain only physics differences to allow for unambiguous evaluation and comparison of new PBL and (two-moment) microphysics schemes available in WRF 3.1.1.
- **Perturbed-IC-only runs for predictability studies.** Storm-scale random Gaussian perturbations, and recursively-filtered mesoscale perturbations are included in two IC-perturbation only members, respectively.
- Consistent with new SREF system update in late 2009, **WRF SREF members (3 ARW, 4 NMM, 2 EtaKF, 2 EtaBMJ, 1 RSM-SAS) will provide perturbed IC/LBCs**, all using ET (Ensemble Transform) technique. **Hourly LBC update are used**, as SREF now provide hourly output for the first 39 hours.
- **Add 3-hourly update forecasts over a smaller domain** (as part of VORTEX II project), initiated at 09, 12, 15, and 18 UTC, one run is 3DVAR initialized (with radar data) and the other one is NAM 12 km initialized (without radar data). All are 18 h forecasts, running on ***Sooner***.
- 2D fields of summary ensemble product (such as probability matched reflectivity, ensemble probabilities, neighborhood probability, etc.) are added to the GEMPAK files
- Experiment ending date is shifted to the third week into mid June, to focus more on aviation impact associated with Aviation Weather Testbed.
- CONUS-scale forecasts are run on NICS/University of Tennessee Athena system, a Cray XT4 with over 18,000 cores in dedicated mode.

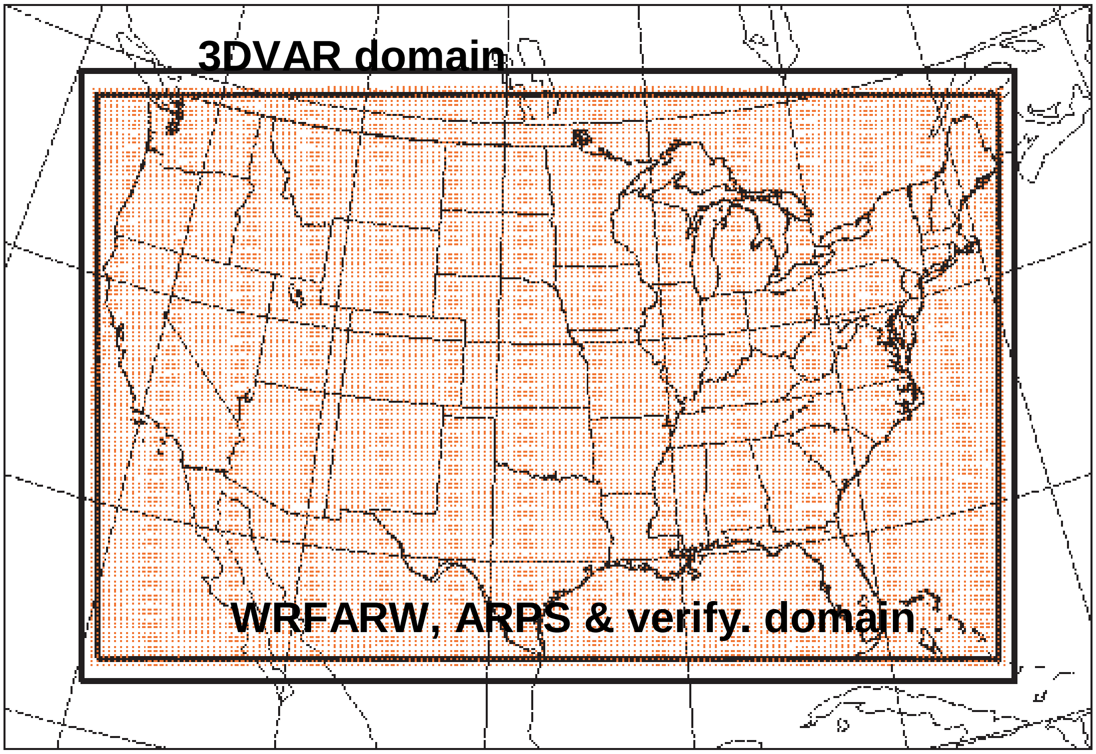

*Figure 1. Computational domains for the 2010 Season. The outer thick rectangular box represents the domain for performing 3DVAR (**Grid 1** – 1200×780). The red dot area represents the WRF-NMM domain (**Grid 2** – 790×999). The inner thick box is the domain for WRF-ARW and ARPS and also for common verification (**Grid3** - 1160×720 at 4 km grid spacing; 4640×2880 at 1 km grid spacing).*

2. Program Duration

From **26 April 2010** through **18 June 2010**

The 2010 SPC/NSSL HWT Spring 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 17 May and end on 18 June**, with four days a week (Monday through Thursday). CAPS 2010 Spring Program begins regular forecast production three weeks earlier on 26 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.

Related program
VORTEX-II:

- VORTEX-2: Four forecasts over the central Great plans initialized at 0900, 1200, 1500, and 1800 UTC every day are run to serve the special needs for VORTEX-2 field experiment. Forecasts are run on OU OSCER Sooner. Forecasts are available on CAPS's realtime forecast web site.

Starting from May 1, 2010, lasting 6 weeks

CASA:

Starting March 15, lasting …

3. Forecast System Configuration

<u>4-km-resolution Storm-Scale Ensemble Forecast System:</u>

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_cn	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	MYJ
arw_c0	00Z NAMa	00Z NAMf	no	Thompson	Noah	MYJ
arw_m3	arw_cn + random pert	00Z NAMf	yes	Thompson	Noah	MYJ
arw_m4	arw_cn + RF-smoothed pert	00Z NAMf	yes	Thompson	Noah	MYJ
arw_m5	arw_cn + em-p1 + recur pert	21Z SREF em-p1	yes	Morrison	RUC	YSU
arw_m6	arw_cn + em-p1_pert	21Z SREF em-p1	yes	Morrison	RUC	YSU
arw_m7	arw_cn + em-p2_pert	21Z SREF em-p2	yes	Thompson	Noah	QNSE
arw_m8	arw_cn – nmm-p1_pert	21Z SREF nmm-p1	yes	WSM6	RUC	QNSE
arw_m9	arw_cn + nmm-p2_pert	21Z SREF nmm-p2	yes	WDM6	Noah	MYNN
arw_m10	arw_cn + rsmSAS-n1_pert	21Z SREF rsmSAS-n1	yes	Ferrier	RUC	YSU
arw_m11	arw_cn – etaKF-n1_pert	21Z SREF etaKF-n1	yes	Ferrier	Noah	YSU

arw_m12	arw_cn + etaKF-p1_pert	21Z SREF etaKF-p1	yes	WDM6	RUC	QNSE
arw_m13	arw_cn – etaBMJ-n1_pert	21Z SREF etaBMJ-n1	yes	WSM6	Noah	MYNN
arw_m14	arw_cn + etaBMJ-p1_pert	21Z SREF etaBMJ-p1	yes	Thompson	RUC	MYNN
arw_m15	00Z ARPSa	00Z NAMf	yes	WDM6	Noah	MYJ
arw_m16	00Z ARPSa	00Z NAMf	yes	WSM6	Noah	MYJ
arw_m17	00Z ARPSa	00Z NAMf	yes	Morrison	Noah	MYJ
arw_m18	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	QNSE
arw_m19	00Z ARPSa	00Z NAMf	yes	Thompson	Noah	MYNN

* For all members: *ra_lw_physics*= RRTM; *ra_sw_physics*=Goddard; *cu_physics*=none

Table 2. Configurations for each individual member with NMM core

member	IC	BC	Radar data	mp_phy	lw_phy	sw-phy	sf_phy
nmm_cn	00Z ARPSa	00Z NAMf	yes	Ferrier	GFDL	GFDL	Noah
nmm_c0	00Z NAMa	00Z NAMf	no	Ferrier	GFDL	GFDL	Noah
nmm_m3	nmm_cn + nmm-n1_pert	21Z SREF nmm-n1	yes	Thompson	RRTM	Dudhia	Noah
nmm_m4	nmm_cn + nmm-n2_pert	21Z SREF nmm-n2	yes	WSM 6-class	RRTM	Dudhia	RUC
nmm_m5	nmm_cn + em-n1_pert	21Z SREF em-n1	yes	Ferrier	GFDL	GFDL	RUC

* For all members: *pbl_physics*=MYJ; *cu_physics*= NONE

Table 3. Configurations for each individual member with ARPS

member	IC	BC	Radar data	Microphy.	radiation	sf_phy
arps_cn	00Z ARPSa	00Z NAMf	yes	Lin	Chou/Suarez	Force-restore
arps_c0	00Z NAMa	00Z NAMf	no	Lin	Chou/Suarez	Force-restore

* For all members: no cumulus parameterization

High-resolution (1 km) deterministic forecast:

One 1 km grid spacing forecast over the same ARW domain as the 4 km ensemble (**Grid 3**) is produced using the same physics configuration as the control member *arw_cn*. The forecast is initialized from 00 UTC and last 30 h. The ARPS 3DVAR and cloud analysis is performed separately at the 1 km grid with available radar data (radar radial velocity and reflectivity). NAM 00 UTC analysis is used as the background and its forecasts are used to provide the LBC.

The 1 km forecast uses up to 12,800 cores, plus 320 cores for post-processing, on Athena.

0900, 1200, 1500, and 1800 UTC rapid update forecasts:

Four update forecasts initiated at 0900, 1200, 1500, and 1800 UTC are generated over a smaller VORTEX II domain (Figure 2), one 3DVAR initialized (with radar data analysis) and another one NAM 12 km initialized (without radar data). WRF-ARW model is used to generate the two 18 h forecasts for each update time. The physics options are the same as ARW control member, *arw_cn* (see Table 1). These two forecasts are performed locally on OSCER's ***Sooner*** system.

Figure 2. Model domain used for the 09, 12, 15, and 18 UTC update forecasts, with 440×480 horizontal grid points at 4 km grid spacing.

4. Logistics

All forecasts, except the Vortex2-scale 3-hourly update forecasts, are performed on NICS's 18,000 core CRAY XT4 supercomputing system at University of Tennessee. The Vortex2-scale 3-hourly update forecasts and CASA wind analysis and rapid-update fine scale forecasts are performed on OSCER's Sooner at University of Oklahoma.

5. Forecast Product Generation and Delivery to the SPC

Products available to NSSL/SPC, DTC, HPC in GEMPAK:

The NSSL/SPC required list of forecast fields for 2010 HWT Spring Experiment is a subset of total 2D fields extracted (see Table 3). The number of fields is 27 for each 4 km ensemble member, and 15 (shaded) for the 1 km forecast. Six fields (with field name underlined) are hourly maximum. This dataset is also available to DTC.

In order to keep realtime data flow into SPC server low, the NSSL/SPC GEMPAK fields are over a sub-domain emphasizing the east part of the CONUS. Figure 3 is the desired sub-domain (860×690 grid points in horizontal). A complete set of extracted 2D fields (Table 5) over the full CONUS domain are archived by CAPS for post-analysis and external collaborations.

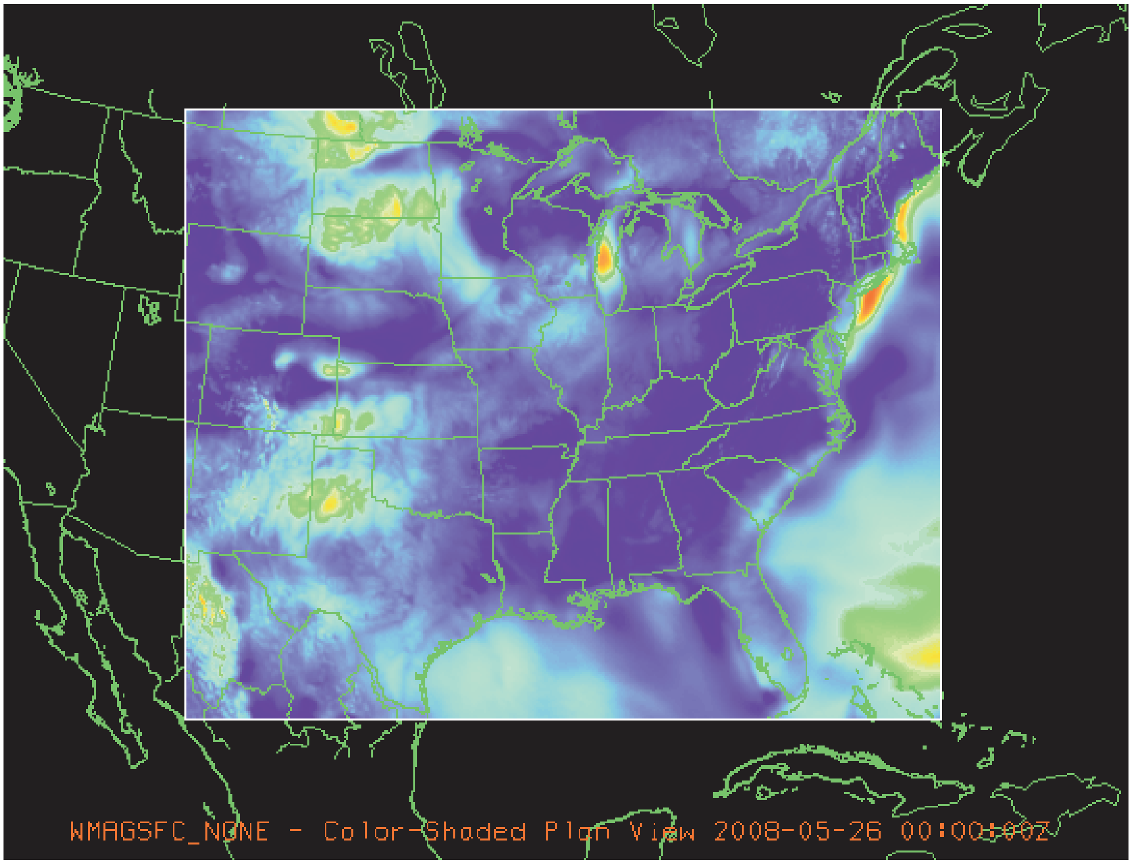

Figure 3. NSSL/SPC sub-domain for the GEMPAK dataset (850×690).

Table 3. 2D fields of each member for NSSL/SPC

Field	GEMPAK name	Unit	Type	Level
Surface pressure	PRES	hPa	Surface/single layer	0
Sea level pressure	PMSL	hPa	Surface/single layer	0
1-h precipitation	P01M	mm	Surface/single layer	0
Precipitable water	PWAT	mm	Surface/single layer	0
2 m temperature	TMPF	F	Surface/single layer	0
2 m dew point	DWPF	F	Surface/single layer	0
10 m U	UREL	m/s	Surface/single layer	0
10 m V	VREL	m/s	Surface/single layer	0

Surface wind speed (10-m)	WMAGSFC	m/s	Surface/single layer	0
1 km AGL reflectivity	REFL1KM	dBZ	Surface/single layer	0
1 km AGL reflectivity	REFL1KM_HM	dBZ	Surface/single layer	0
4 km AGL reflectivity	REFL4KM	dBZ	Surface/single layer	0
Composite reflectivity	REFLCMP	dBZ	Surface/single layer	0
Surface-based CAPE	CAPE	J/kg	Surface/single layer	0
Moist unstable CAPE	MUCAPE	J/kg	Surface/single layer	0
Surface-based CIN	CINS	J/kg	Surface/single layer	0
Moist unstable CIN	MUCINS	J/kg	Surface/single layer	0
Surface-based LCL	HLCL	m	Surface/single layer	0
0-1 km AGL SRH	SRH01	m^2/s^2	Surface/single layer	0
0-3 km AGL SRH	SRH03	m^2/s^2	Surface/single layer	0
Updraft helicity	VHEL	m^2/s^2	Surface/single layer	0
3-6 km max W	VVELMAX	m/s	Surface/single layer	0
3-6 km min W	VVELMIN	m/s	Surface/single layer	0
0-1 km AGL wind shear	SHR01	1/s	Surface/single layer	0
0-6 km AGL wind shera	SHR06	1/s	Surface/single layer	0
Echo top (>= 18 dBZ)	ETOP	Kft	Surface/single layer	0
Vertical-integrated Qg	COLQG	kg/ m^2	Surface/single layer	0

Post-processed ensemble products in GEMPAK:

A list of post-processed ensemble products are produced for NSSL/SPC for the 2010 HWT Spring Experiment (see Table 4). 15 ensemble members (arw_cn, arw_m6~m14, nmm_cn, nmm_m3~m5, arps_cn) contribute to the products. The underlined fields refer to hourly maximum. This dataset is also available to DTC and HPC.

Table 4. Ensemble post-processed products for NSSL/SPC

Field	GEMPAK name	Unit	Type	Ens type
Sea level pressure	PMSL	hPa	Surface/single layer	Mean
1-h precip	P01M_PM	mm	Surface/single layer	PM-mean
1-h precip	P01M_M	mm	Surface/single layer	Mean
1-h precip	P01M_MX	mm	Surface/single layer	Max
1-h precip ≥ 0.25 in	PR01MTH1_P	%	Surface/single layer	Prob
1-h precip ≥ 0.50 in	PR01MTH2_P	%	Surface/single layer	Prob
1-h precip ≥ 1.00 in	PR01MTH3_P	%	Surface/single layer	Prob
1-h precip ≥ 0.25 in	PR01MTH1_PN	mm	Surface/single layer	Prob-neighbor
1-h precip ≥ 0.50 in	PR01MTH2_PN	mm	Surface/single layer	Prob-neighbor
1-h precip ≥ 1.00 in	PR01MTH3_PN	mm	Surface/single layer	Prob-neighbor
3-h precip	P03M_PM	mm	Surface/single layer	PM-mean
3-h precip	P03M_M	mm	Surface/single layer	Mean
3-h precip	P03M_MN	mm	Surface/single layer	Max
3-h precip ≥ 0.5-in	PR03MTH2_P	%	Surface/single layer	Prob
3-h precip ≥ 1.0-in	PR03MTH3_P	%	Surface/single layer	Prob
3-h precip ≥ 2.0-in	PR03MTH4_P	%	Surface/single layer	Prob
3-h precip ≥ 0.5-in	PR03MTH2_PN	%	Surface/single layer	Prob-neighbor
3-h precip ≥ 1.0-in	PR03MTH3_PN	%	Surface/single layer	Prob-neighbor
3-h precip ≥ 2.0-in	PR03MTH4_PN	%	Surface/single layer	Prob-neighbor
6-h precip	P06M_PM	mm	Surface/single layer	PM-mean
6-h precip	P06M_M	mm	Surface/single layer	Mean
6-h precip	P06M_MX	mm	Surface/single layer	Max
6-h precip ≥ 0.5-in	PR06MTH2_P	%	Surface/single layer	Prob

6-h precip ≥ 1.0-in	PR06MTH3_P	%	Surface/single layer	Prob
6-h precip ≥ 2.0-in	PR06MTH4_P	%	Surface/single layer	Prob
6-h precip ≥ 0.5-in	PR06MTH2_PN	%	Surface/single layer	Prob-neighbor
6-h precip ≥ 1.0-in	PR06MTH3_PN	%	Surface/single layer	Prob-neighbor
6-h precip ≥ 2.0-in	PR06MTH4_PN	%	Surface/single layer	Prob-neighbor
2 m temp	TMPF	F	Surface/single layer	Mean
2 m dew point	DWPF	F	Surface/single layer	Mean
2m specific humidity	SPFH	g/kg	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
Max 1 km AGL reflectivity	REFL1KM_MX	dBZ	Surface/single layer	Max
1 km refl ≥ 40 dBZ	REFL1KMTH1_PN	%	Surface/single layer	Prob-neighbor
4 km AGL reflectivity	REFL4KM	dBZ	Surface/single layer	PM-mean
4 km refl ≥ 40 dBZ	REFL4KMTH1_PN	%	Surface/single layer	Prob-neighbor
Composite reflectivity	REFLCMP	dBZ	Surface/single layer	PM-mean
Comp refl ≥ 40 dBZ	REFLCMPTH1_PN	%	Surface/single layer	Prob-neighbor
Surface-based CAPE	CAPE	J/kg	Surface/single layer	Mean
sbCAPE ≥ 500	CAPE05	%	Surface/single layer	Prob
sbCAPE ≥ 1500	CAPE15	%	Surface/single layer	Prob
sbCAPE ≥ 3000	CAPE30	%	Surface/single layer	Prob
Surface-based CIN	CIN	J/kg	Surface/single layer	Mean
sbCIN < -100	CIN100	%	Surface/single layer	Prob
sbCIN < -50	CIN050	%	Surface/single layer	Prob
sbCIN < -25	CIN025	%	Surface/single layer	Prob
Surface-based LCL	HLCL	m	Surface/single layer	Mean
Max Updraft helicity	VHEL	m^2/s^2	Surface/single layer	Max
Updraft helicity ≥ 25 m^2/s^2	VHEL25	%	Surface/single layer	Prob-neighbor

Updraft helicity ≥ 50 m^2/s^2	VHEL50	%	Surface/single layer	Prob-neighbor
Updraft helicity ≥ 100 m^2/s^2	VHEL100	%	Surface/single layer	Prob-neighbor
Max 3-6 km W	VVELMAX	m/s	Surface/single layer	Max
Min 3-6 km W	VVELMIN	m/s	Surface/single layer	Min
Max 3-6 km W ≥ 10 m/s	VVELMAX10	%	Surface/single layer	Prob-neighbor
Max 3-6 km W ≥ 15 m/s	VVELMAX15	%	Surface/single layer	Prob-neighbor
Max 3-6 km W ≥ 20 m/s	VVELMAX20	%	Surface/single layer	Prob-neighbor
Min 3-6 km W ≥ 2 m/s	VVELMIN2	%	Surface/single layer	Prob-neighbor
Min 3-6 km W ≥ 6 m/s	VVELMIN6	%	Surface/single layer	Prob-neighbor
Min 3-6 km W ≥ 10 m/s	VVELMIN10	%	Surface/single layer	Prob-neighbor
0-1 km AGL wind shear	SHR01	1/s	Surface/single layer	Mean
0-1 km AGL wind shear ≥ 10 m/s	SHR01_10	%	Surface/single layer	Prob
0-1 km AGL wind shear ≥ 15 m/s	SHR01_15	%	Surface/single layer	Prob
0-1 km AGL wind shear ≥ 20 m/s	SHR01_20	%	Surface/single layer	Prob
0-6 km AGL wind shear	SHR06	1/s	Surface/single layer	Mean
0-6 km AGL wind shear ≥ 15 m/s	SHR06_15	%	Surface/single layer	Prob
0-6 km AGL wind shear ≥ 20 m/s	SHR06_20	%	Surface/single layer	Prob
0-6 km AGL wind shear ≥ 25 m/s	SHR06_25	%	Surface/single layer	Prob
Bunkers right-moving storm motion U	BKU	m/s	Surface/single layer	Mean
Bunkers right-moving storm motion V	BKV	m/s	Surface/single layer	Mean
Bunkers right-moving storm motion speed	BKSPD	m/s	Surface/single layer	Mean
Bunkers right-moving speed ≥ 15 m/s	BKSPD15	%	Surface/single layer	Prob
Vertical-integrated Qg	COLQG	kg/ m^2	Surface/single layer	Max
Vertical-integrated Qg ≥ 20	COLQG20	%	Surface/single layer	Prob-neighbor
Vertical-integrated Qg ≥ 30	COLQG30	%	Surface/single layer	Prob-neighbor
Vertical-integrated Qg ≥ 40	COLQG40	%	Surface/single layer	Prob-neighbor
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
Surface wind speed (10-m) ≥ 20 m/s	WMAGSFC20	%	Surface/single layer	Prob-neighbor
Surface wind speed (10-m) ≥ 25 m/s	WMAGSFC25	%	Surface/single layer	Prob-neighbor
Significant Tornado Parameter[1] ≥ 1	SIGTOR1	%	Surface/single layer	Prob
Significant Tornado Parameter[1] ≥ 3	SIGTOR3	%	Surface/single layer	Prob
Significant Tornado Parameter[1] ≥ 5	SIGTOR5	%	Surface/single layer	Prob
Supercell Comp. Parameter[2] ≥ 1	SCP1	%	Surface/single layer	Prob
Supercell Comp. Parameter[2] ≥ 3	SCP3	%	Surface/single layer	Prob
Supercell Comp. Parameter[2] ≥ 9	SCP9	%	Surface/single layer	Prob
Height 18 dBZ Echo Top	ETOP	kft	Surface/single layer	Max
Height 18 dBZ Echo Top ≥ 18 kft	ETop180	%	Surface/single layer	Prob-neighbor
Height 18 dBZ Echo Top ≥ 25 kft	ETop250	%	Surface/single layer	Prob-neighbor
Height 18 dBZ Echo Top ≥ 45 kft	ETop450	%	Surface/single layer	Prob-neighbor