POMMS 3.0 WRF Configuration Report for PG&E

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May 20, 2020

Project Summary and Goals

This report describes the significant testing, validation and recommendation for the new Weather Research and Forecast (WRF) model that will be operationalized at PG&E. The goal of the project is to deploy the most accurate model possible for PG&E operations. This work includes operationalizing a 2-km deterministic weather model, an 8-member model ensemble, on-demand simulations at 0.67-km, and a 30-year reanalysis at 2-km.

Teams Involved

PG&E utilized two external numerical weather prediction experts to build out the next generation model for operational use. This configuration allows for cross-validation and testing of model results. DTN was selected as the partner to operationally run the model on the AWS cloud and has extensive experience building and running the WRF model for several partners around the world. ADS has extensive model expertise especially in California and has worked extensively with other CA utilities to build custom model solutions for their operations. ADS was selected as the vendor to perform validation and provide expertise and guidance on the optimal model configuration for testing. These vendors were also responsible for building the previous versions of POMMS.

PG&E provides a third layer of validation and has team members with deep numerical weather prediction expertise as well. Dr. Bereket Habtezion at PG&E has more than a decade of experience running the WRF model, and AJ Eiserloh built and operationalized San Jose State University's WRF model. PG&E's operational meteorology team also has deep experience utilizing high resolution model data.

Summary of Optimal WRF Configuration

After significant validation and testing, the optimal validated WRF configuration for the operational 2-km forecasts as well as the 30-year historical data set is presented below. This WRF model configuration is recommend by both external partners DTN and ADS and was approved by PG&E Meteorology. The validation and testing is discussed in detail in a subsequent section.

Note that numbers in brackets correspond to WRF namelist values. Default WRF namelist values used for parameters are not necessarily listed.

Operational 2-km WRF Configuration

WRF version 4.1.2 (released 12 July 2019) was selected for this project. Key features added or made default in version 4 of WRF include a hybrid vertical coordinate and a moist potential temperature prognostic variable. A nested grid configuration of 18-, 6-, and 2-km grids is used. The vertical grid has 51 levels and a 20 hPa top. Adaptive time stepping is used for computational efficiency.

For land use, MODIS 30 arc sec data with lakes is used on all grids (`modis_lai+modis_30s_lake+30s`). We use the GEOGRID table appropriate for Noah-MP (`GEOGRID.TBL.ARW.noahmp`). Based on verification results, we modified the roughness lengths for evergreen broadleaf forest (LUINDEX=2) and urban (13) in `MPTABLE.TBL`. This adjustment was made to adjust the bias seen over these landuse types.

We selected the RRTMG scheme for both long- and shortwave radiation [4] with a time step of 10 minutes. Shortwave is interpolated in time (`swint_opt=1`), while topographic shading and slope-dependent radiation are applied on the 2-km grid.

The NoahMP land surface model [4] was selected. The dynamic vegetation option was turned off; we instead use climatological albedo and Leaf Area Index (LAI) from geogrid files instead of table values (`dveg=8, usemonalb=True, rdlai2d=True`)

The MYNN surface layer [5] and 3rd-order PBL [5] physics schemes are used. We apply consistent mixing of scalars in PBL (`scalar_pblmix=1`) and gravitational settling of cloud droplets (`grav_settling=2`).

The Thompson microphysics [8] scheme is used. It has ice, snow and graupel processes suitable for high-resolution simulations, along with ice and rain number concentrations. The Kain-Fritsch cumulus parameterization [1] is applied on the outer grid.

The Smagorinsky first-order closure (`km_opt=4`) is used for horizontal turbulent diffusion. Vertical diffusion acts on full fields (`mix_full_fields=True`), and turbulence and mixing terms evaluated in physical space (`diff_opt=2`). Upper-level damping is applied (`damp_opt=3, dampcoef=0.2, zdamp=5000`). Finally, time off-centering for vertical sound waves is increased (`epssm=0.2`).

The forecasts are initialized using ¼° GFS forecast data and 1/12° SST analyses. 3DVAR data assimilation is applied on the outer grid at T-3 hours. Data available for assimilation is taken from the MADIS feed, and include conventional surface and upper-air observations, as well as aircraft data and satellite-derived winds. The nested grids are spawned at T=0.

Configuration used for Ensembles

Eight ensemble members are run to provide a measure of forecast uncertainty. Six of the members are stochastically perturbed, with all of the following settings applied to each member:

- Stochastically perturbed physics tendencies (SPPT) (`sppt=1`)
- Stochastic kinetic-energy backscatter scheme (SKEBS) (`skebs=1`)
- Stochastically perturbed parameter scheme (SPP) (`spp=1`)

Random perturbations (`rand_perturb=1`) are applied to all grids, and a different random seed (`nens`) use used for each member.

The remaining two ensemble members can be used for testing alternate configurations, such as alternate physical parameterizations (e.g., alternate PBL scheme) or initial conditions (e.g., ECMWF forecast data).

Configuration used for 0.67-km Runs

The on-demand runs have an additional 0.67-km nested grid that covers a smaller region of interest. Several preset regions are available, and these can be scheduled within a web-based GUI (Fig. 2). For domains covering

the Sierra Nevada, the maximum time step for adaptive time stepping on the outer grid is 120 sec. It remains 144 sec on all others. Topographic shading and slope-dependent radiation also applied on the 0.67-km grid.

Configuration used for Testing and Evaluation

WRF runs used for testing and evaluation are initialized and forced with NCEP Climate Forecast System Version 2 (CFSv2) reanalysis data. The dataset provides output at 6-hour intervals on a ½° grid for variables on pressure levels, and about 0.2° for surface variables. Time-varying sea surface temperature (SST), sea ice, vegetation fraction, and albedo were applied (`sst_update=1`), along with updated deep soil temperature (`tmn_update=1`) and calculated skin SST (`sst_skin=1`).

Configuration used for Reanalyses

The 30-year reanalyses were similarly initialized with CFSv2 data (for years 2011 and forward), or the similar NCEP Climate Forecast System Reanalysis (CFSR) data (for years prior to 2011). The reanalyses were initialized at yearly intervals beginning July 29. This allowed a 3-day "spin-up" period, which was discarded. The nominal year thus began on August 1 of each year.

The reanalyses were also forced with the NCEP data using spectral nudging (18- and 6-km grids only), with the following parameters:

- Maximum wavenumber to nudge: 6 on 18-km grid, 3 on 6-km grid (`xwavenum=6, 3, 0; ywavenum=6, 3, 0`). This corresponds to a wavelength of 807 km on the 18-km grid, 632 km on the 6-km grid.
- Reduced nudging for temperature and moisture. Coefficients (g*): U, V, height: 3E-4; T, Q: 4.5E-5.
- No nudging within PBL (`if_no_pbl_nudging_*`)
- No nudging below model level 20 (`if_zfac_*=1, k_zfac_*=20`), increasing linearly to full strength within one level (`dk_zfac_*=1`)
- Nudging ramps down linearly in final 60 minutes (`if_ramping=1, dtramp_min=60`)

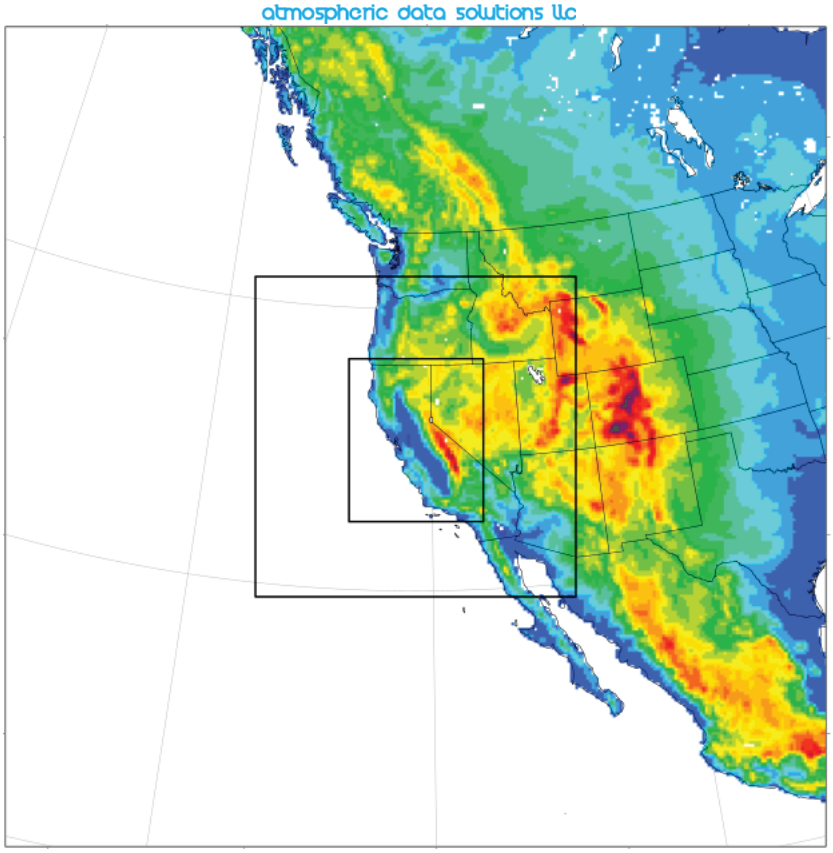

Figure 1: Operational WRF domain configuration.

Grid number	Grid spacing (km)	Grid extent (nx x ny, staggered)	Width x height (km)
1	18	270 x 270	4842 x 4842
2	6	316 x 316	1890 x 1890
3	2	397 x 481	1188 x 1440
4	0.67	322 x 322	214 x 214

Table 1: WRF grid details.

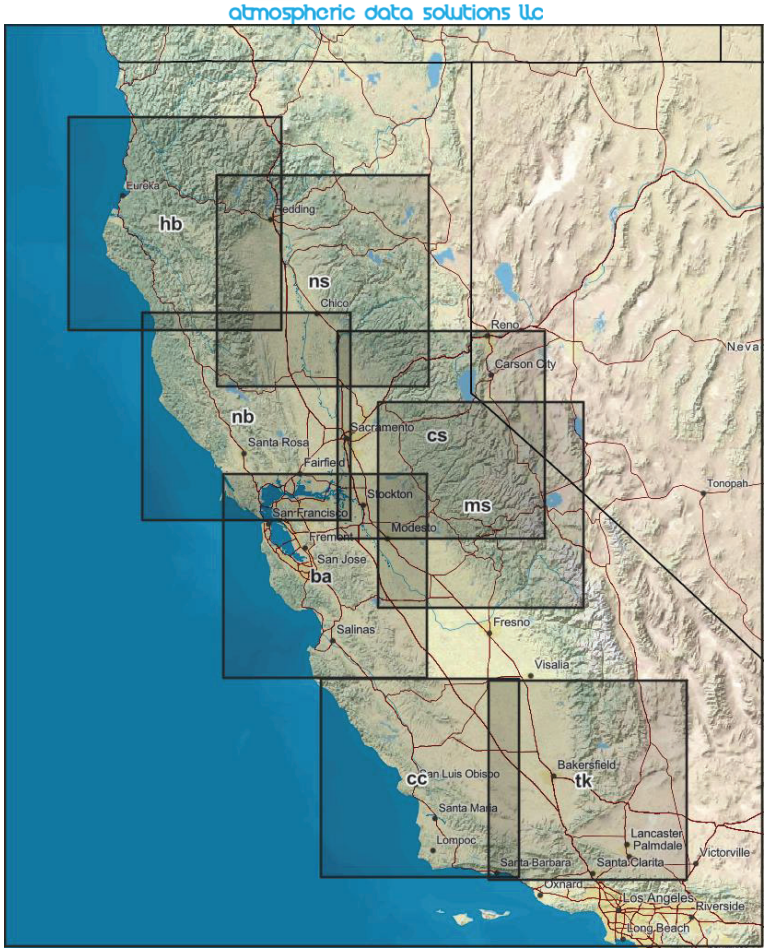

Figure 2: Available 0.67-km on-demand domains.

Tests and Results

Nearly 20 model configurations of WRF were run on a variety of test cases covering high wind and precipitation events. Model output from each case were validated against the hundreds of weather stations now available in the PG&E territory, including the hundreds of stations PG&E has deployed since 2018 (Fig. 3). The ultimate goal was to find the optimal WRF model configuration that produced the most accurate simulations over a range of high impact events for a range of meteorological parameters.

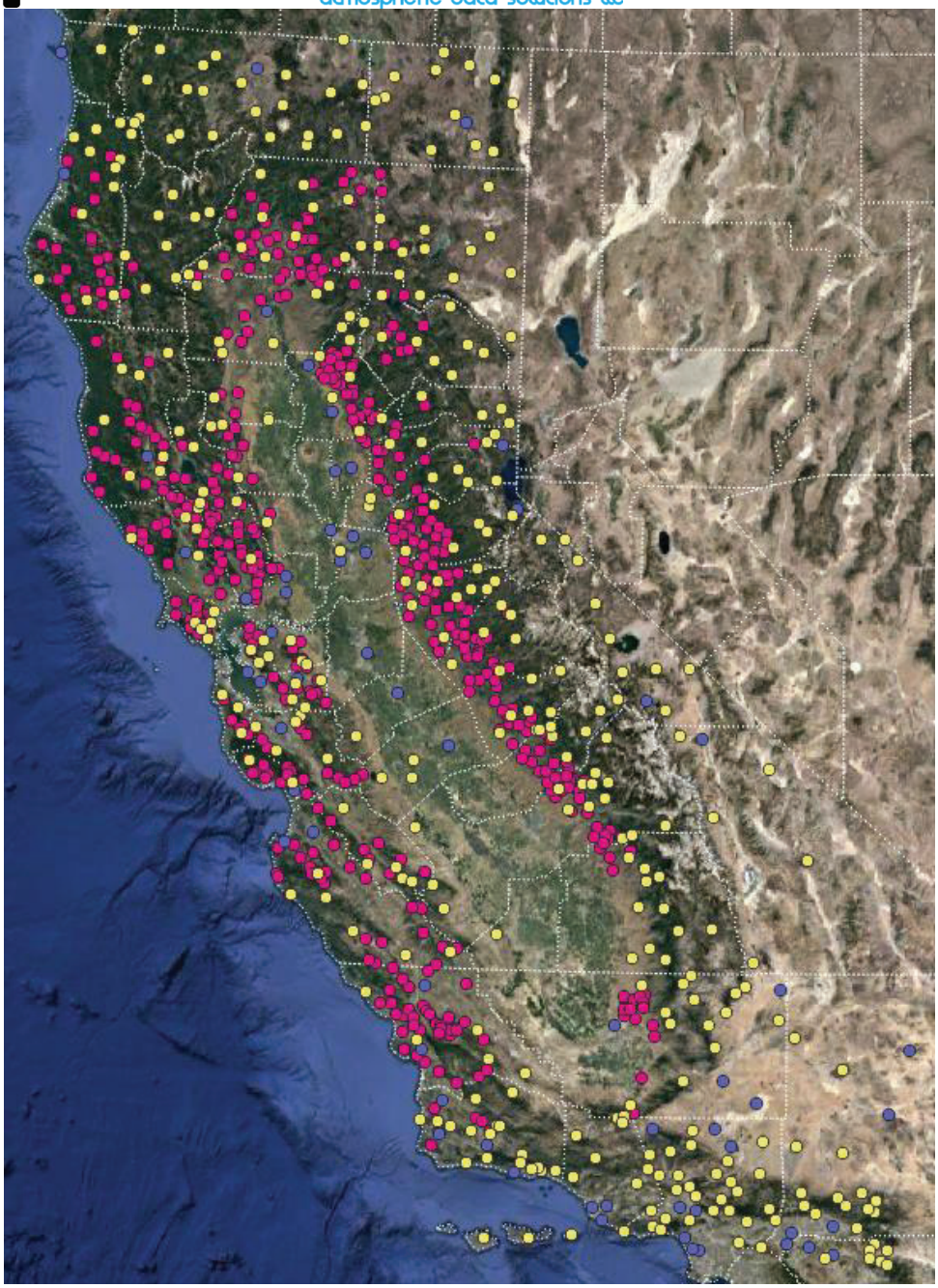

Figure 3. Weather stations used for validation. ASOS – Blue, PG&E – Red, RAWS – Yellow.

The test dates were:

Date (PT)	WRF Run (UTC)	Description
11/7/2018 2300 – 11/8/2018 2300	11/7 00Z – 11/9 00Z (72 h)	Camp Fire
10/13/2018 2200 – 10/15/2018 0900	10/13 12Z – 10/16 00Z (60 h)	PSPS
2/8/2019 1200 – 2/10/2019 2300	2/8 06Z – 2/11 00Z (54 h)	Storm
3/5/2019 1000 – 3/7/2019 0600	3/5 06Z – 3/7 06Z (48 h)	Storm
6/8-9/2019	6/8 00Z – 6/10 00Z (48 h)	PSPS
9/23/2019	9/23 12Z – 9/24 12Z (24 h)	PSPS
10/9-10/2019	10/9 00Z – 10/11 00Z (48 h)	PSPS
10/23-24/2019	10/23 00Z – 10/25 00Z (48 h)	PSPS
10/26-27/2019	6/26 00Z – 6/28 12Z (60 h)	PSPS

Table 2: Weather event dates, WRF start and end dates and event descriptions.

Testing began using a baseline configuration somewhat similar to the final operational configuration with the exception of resolution and a new land surface model. This baseline used RRTMG radiation scheme, NoahMP land model and the MYNN 2.5-order planetary boundary layer scheme. Each run was scored against the PG&E and RAWS wind speed, temperature, and dew point observations. Results of various tests are qualitatively described below. Numbers in braces refer to tests performed (ens_cfsr_{NNN}).

Land Use Data

A test similar to the 3-km (POMMS 2.0) configuration (Noah LSM, YSU PBL scheme), but using the increased roughness lengths (z_0) of Cao and Fovell (2018) was performed (modified LANDUSE.TBL and VEGPARM.TBL). The high wind speed bias was significantly reduced, confirming that z_0 was a strong driver of wind speed bias.

With the use of the new NoahMP land model, z_0 changed across the WRF domain (see MPTABLE.TBL for roughness lengths). Our validation analytics guided us to decrease z_0 for evergreen broadleaf forest (index 2) from 1.1 to 0.7 m, and for urban (13) from 1.0 to 0.6 m resulting in wind speed improvements. {010, 011, 012, 016}

We also tested the 15-arc second MODIS data with lakes. This is a newer land use data set built over a different time period using different temporal aggregations. However, our validation analytics indicated that WRF did not compare as well to observations as the 30-arc second MODIS land use data set.

The Kishne (2017) SOILPARM.TBL changes were tested in hopes it would improve near-surface dew point, though it actually degraded the results {019}.

Physics Parameterizations

We were not able to test the Goddard radiation [5] and microphysics [7] schemes for this version of WRF due to incompatibilities.

We tested various PBL schemes:

- MYJ {005} and YSU {006} did not perform as well as MYNN.
- ACM2 PBL with the Pleim-Xu surface layer scheme performed well, but was suitable only for hindcasts {007}.
- Modifying certain MYNN-2.5 PBL parameters did not yield an improvement {011, 018}.
- The 2.5-order version of MYNN performed slightly better than the 3rd-order {011, 012, 016, 017} only for winds. MYNN 3rd-order resulted in an improvement in the near-surface dewpoint validation.

Given the greater improvement in dewpoint which more than offsets the slight degradation in wind speed comparison, we are recommending the configuration with the MYNN 3rd-order scheme {012} as the operational and historical POMMS3 configuration. This decision is motivated by our need to skillfully capture wildfire potential which is a function of near-surface winds, temperature and moisture, but also wildfire fuel moisture including:

- Dead fuel moisture - A long-memory variable which is a function of the following weather output integrated over many months:
  - Incoming solar radiation.
  - Near-surface temperature.
  - Near-surface relative humidity.
  - Precipitation.
- Live fuel moisture - A long-memory variable which is a function of the following weather output integrated over many months:
  - Precipitation.
  - Temperature.
  - Relative humidity.

WRF Validation Summary

All validation statistics reported for wind speed > 2 MPH

MAE, RMSE calcuated as integration period average of hourly network MAE and RMSE

		Wind Speed				Temperature				Dewpoint			
		Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE
ens_cfsr_001	pge2r - Baseline	0.97	-0.20	3.76	5.16	0.99	0.14	4.33	5.57	0.97	-6.01	8.29	10.64
ens_cfsr_009	m15 - sst_skin, sst_update, tmn_update	0.97	-0.20	3.76	5.16	0.99	0.08	4.32	5.56	0.97	-5.76	8.07	10.39
ens_cfsr_013	et - m15/MYNN 2.5 mods	0.97	-0.17	3.77	5.16	0.99	0.09	4.32	5.56	0.97	-5.75	8.06	10.40
ens_cfsr_010	zmp - m15/z0 for LUINDEX 2(0.95) and 13(0.80)	0.97	-0.19	3.76	5.16	0.99	0.07	4.32	5.56	0.97	-5.76	8.07	10.39
ens_cfsr_011	z15b2 - m15/z0 for LUINDEX 2(0.70) and 13(0.60)	0.97	-0.16	3.77	5.15	0.99	0.07	4.32	5.56	0.97	-5.75	8.07	10.39
ens_cfsr_012	z15b3 - z15b2/MYNN3	0.96	-0.24	3.77	5.18	0.98	-0.27	4.33	5.53	0.98	-4.63	7.58	9.89
ens_cfsr_002	N - m15/Noah LSM	0.97	2.70	5.04	6.70	0.98	0.03	4.64	5.90	0.99	-5.93	8.11	10.64
ens_cfsr_004	b3 - m15/MYNN3	0.96	-0.28	3.77	5.19	0.98	-0.27	4.33	5.53	0.98	-4.64	7.58	9.89
ens_cfsr_005	bj - m15/MYJ	0.95	-0.70	3.83	5.28	0.97	-0.15	4.61	5.88	0.99	-4.21	7.13	9.41
ens_cfsr_006	by - m15/YSU	0.97	-0.40	3.79	5.23	0.99	-0.15	4.25	5.47	0.97	-5.23	7.85	10.19
ens_cfsr_007	px - m15/PX sfc layer scheme/ACM2 PBL	0.97	-0.49	3.82	5.24	0.99	0.05	4.22	5.46	0.97	-6.20	8.44	10.91
ens_cfsr_014	m009 - MODIS 15s	0.97	0.24	3.85	5.22	0.99	0.05	4.32	5.55	0.97	-5.93	8.11	10.45
ens_cfsr_015	m013 - m009/MYNN 2.5 mods	0.97	0.24	3.85	5.22	0.98	0.06	4.32	5.55	0.97	-5.94	8.11	10.46
ens_cfsr_016	m011 - m009/z0 for LUINDEX 2(0.70) and 13(0.60)	0.97	0.27	3.86	5.23	0.99	0.05	4.32	5.55	0.97	-5.93	8.12	10.46
ens_cfsr_017	m012 - m011/MYNN3	0.97	0.18	3.86	5.25	0.98	-0.29	4.33	5.54	0.98	-4.82	7.6	9.94
ens_cfsr_018	a011 - m011/et	0.97	0.27	3.86	5.23	0.98	0.06	4.32	5.55	0.97	-5.92	8.11	10.46
ens_cfsr_019	Kishne soil paramaters	0.97	-0.17	3.76	5.16	0.99	0.24	4.31	5.56	0.97	-6.31	8.40	10.76

Table 3: Single-event WRF validation statistics for all configurations tested. Cor=Correlation, MAE=Mean Absolute Error and RMSE=Root-Mean Squared Error. Results shown above are validating against weather stations obs from the 10/26 – 10/27/2019 strong offshore wind event.

ensID	sst_skin,sst_update,tmn_update	LSM	Modified Z0	LUDATA	PBL	SFCLAY	Radiation	MPHYS	Kishne Soil Param
ens_cfsr_001	No	NoahMP	No	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_009	Yes	NoahMP	No	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_013	Yes	NoahMP	No	MODIS30s/Lake	MYNN2 - tkeadvect, edmf=0	MYNN	RRTMG	Thompson	No
ens_cfsr_010	Yes	NoahMP	Yes - 2=0.95/13=0.80	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_011	Yes	NoahMP	Yes - 2=0.70/13=0.60	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_012	Yes	NoahMP	Yes - 2=0.70/13=0.60	MODIS30s/Lake	MYNN3	MYNN	RRTMG	Thompson	No
ens_cfsr_002	Yes	Noah	No	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_004	Yes	NoahMP	No	MODIS30s/Lake	MYNN3	MYNN	RRTMG	Thompson	No
ens_cfsr_005	Yes	NoahMP	No	MODIS30s/Lake	MYJ	M-O	RRTMG	Thompson	No
ens_cfsr_006	Yes	NoahMP	No	MODIS30s/Lake	YSU	Rev M-O	RRTMG	Thompson	No
ens_cfsr_007	Yes	NoahMP	No	MODIS30s/Lake	ACM2	PX	RRTMG	Thompson	No
ens_cfsr_014	Yes	NoahMP	No	MODIS15s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_015	Yes	NoahMP	No	MODIS15s/Lake	MYNN2 - tkeadvect, edmf=0	MYNN	RRTMG	Thompson	No
ens_cfsr_016	Yes	NoahMP	Yes - 2=0.70/13=0.60	MODIS15s/Lake	MYNN2	MYNN	RRTMG	Thompson	No
ens_cfsr_017	Yes	NoahMP	Yes - 2=0.70/13=0.60	MODIS15s/Lake	MYNN3	MYNN	RRTMG	Thompson	No
ens_cfsr_018	Yes	NoahMP	No	MODIS15s/Lake	MYNN2 - tkeadvect, edmf=0	MYNN	RRTMG	Thompson	No
ens_cfsr_019	Yes	NoahMP	No	MODIS30s/Lake	MYNN2	MYNN	RRTMG	Thompson	Yes

Table 4: Summary of WRF configuration parameters for each tested configuration.

Wind Speed (MPH)												
ens_cfsr_011								**ens_cfsr_012**				
		Type	Event	Cor	Bias	MAE	RMSE		Cor	Bias	MAE	RMSE
		PG&E	2018-10-13 to 2018-10-15	0.90	**-0.61**	4.05	6.04		0.90	-0.81	**4.02**	**6.02**
		RAWS		0.95	0.11	4.08	5.74		0.95	**-0.06**	**4.03**	**5.70**
		PG&E	2018-11-07 to 2018-11-08	0.73	**-0.01**	4.19	**6.05**		**0.79**	-0.29	**4.16**	6.06
		RAWS		0.90	**0.09**	4.19	5.84		0.90	-0.10	**4.16**	**5.83**
		PG&E	2019-02-07 to 2019-02-10	0.98	-0.70	**2.90**	3.94		0.98	-0.70	2.91	**3.93**
		RAWS		0.97	**-0.14**	3.22	4.39		0.97	-0.22	**3.20**	**4.35**
		PG&E	2019-03-04 to 2019-03-06	**0.93**	**-1.02**	**3.95**	**5.30**		0.92	-1.22	3.97	5.35
		RAWS		**0.95**	**-0.44**	**4.31**	**5.83**		0.93	-0.46	4.36	5.91
		PG&E	2019-06-08 to 2019-06-09	0.66	0.17	3.27	4.45		**0.72**	**-0.10**	**3.22**	**4.41**
		RAWS		0.50	0.55	3.47	4.64		**0.73**	**0.40**	**3.43**	**4.62**
		PG&E	2019-09-22 to 2019-09-23	**0.89**	**-0.65**	2.52	3.43		0.87	-0.75	2.52	3.43
		RAWS		**0.90**	**-0.62**	**2.70**	**3.53**		0.88	-0.72	2.71	3.56
		PG&E	2019-10-09 to 2019-10-10	**0.85**	**-0.14**	3.35	4.68		0.81	-0.25	3.34	4.68
		RAWS		**0.82**	0.37	3.82	5.32		0.79	**0.29**	**3.80**	**5.29**
		PG&E	2019-10-23 to 2019-10-24	**0.86**	**-0.54**	3.39	**4.66**		0.84	-0.61	3.39	4.67
		RAWS		**0.91**	0.35	3.85	5.26		0.89	**0.19**	**3.78**	**5.20**
		PG&E	2019-10-26 to 2019-10-27	**0.96**	**-0.48**	**3.62**	**4.95**		0.95	-0.57	3.63	4.98
		RAWS		0.97	0.35	**3.97**	**5.40**		0.97	**0.28**	3.98	5.43
			AVERAGE:	0.87	-0.19	3.60	4.97		0.88	-0.32	3.59	4.97

Table 5: WRF ens_cfsr_011 and ens_cfsr_012 wind speed validation statistics for each weather event compared against PG&E mesonet and RAWS.

Temperature (F)												
ens_cfsr_011								ens_cfsr_012				
	Type	Event	Cor	Bias	MAE	RMSE		Cor	Bias	MAE	RMSE
	PG&E	2018-10-13 to 2018-10-15	0.96	0.63	4.26	5.61		0.96	**0.16**	**4.22**	**5.53**
	RAWS		**0.99**	1.08	4.18	5.53		0.98	**0.68**	**4.15**	**5.47**
	PG&E	2018-11-07 to 2018-11-08	0.98	1.00	4.16	5.61		0.98	**0.86**	**4.14**	**5.60**
	RAWS		0.99	0.91	4.14	5.59		0.99	**0.74**	**4.12**	**5.56**
	PG&E	2019-02-07 to 2019-02-10	0.92	**-1.06**	2.51	3.11		0.92	-1.24	**2.46**	**3.04**
	RAWS		0.95	**-1.32**	**3.12**	**4.05**		0.95	-1.47	3.13	4.06
	PG&E	2019-03-04 to 2019-03-06	**0.91**	**-0.49**	**2.23**	**2.80**		0.90	-0.88	2.31	2.88
	RAWS		**0.91**	**-0.98**	**2.91**	**3.76**		0.88	-1.21	2.95	3.82
	PG&E	2019-06-08 to 2019-06-09	0.99	**0.16**	3.75	4.91		0.99	-0.58	**3.73**	**4.85**
	RAWS		0.99	**-1.26**	**4.08**	**5.42**		0.99	-1.88	4.37	5.67
	PG&E	2019-09-22 to 2019-09-23	1.00	0.88	3.26	4.29		1.00	**0.55**	**3.24**	**4.23**
	RAWS		0.98	0.28	**4.11**	5.34		0.98	**0.01**	4.14	**5.33**
	PG&E	2019-10-09 to 2019-10-10	0.99	0.65	3.81	4.95		0.99	**0.22**	**3.71**	**4.79**
	RAWS		0.99	**-0.46**	**4.03**	**5.33**		0.99	-0.85	4.07	5.34
	PG&E	2019-10-23 to 2019-10-24	0.98	**-0.41**	**4.28**	**5.41**		0.98	-0.92	4.48	5.57
	RAWS		0.98	**-0.94**	**4.74**	**6.00**		0.98	-1.43	4.95	6.18
	PG&E	2019-10-26 to 2019-10-27	0.98	**0.14**	4.39	5.54		0.98	-0.19	**4.37**	**5.47**
	RAWS		**0.98**	**-0.05**	**4.22**	**5.51**		0.97	-0.40	4.27	5.53
		AVERAGE:	0.97	-0.07	3.79	4.93		0.97	-0.44	3.82	4.94

Table 6: WRF ens_cfsr_011 and ens_cfsr_012 near-surface temperature validation statistics for each weather event compared against PG&E mesonet and RAWS.

Dewpoint (F)												
ens_cfsr_011								ens_cfsr_012				
	Type	Event	Cor	Bias	MAE	RMSE		Cor	Bias	MAE	RMSE
	PG&E	2018-10-13 to 2018-10-15	0.95	-1.05	**6.04**	8.26		0.95	**0.86**	6.12	**8.14**
	RAWS		0.98	-1.59	**6.66**	9.35		0.98	**0.06**	6.75	**9.19**
	PG&E	2018-11-07 to 2018-11-08	**0.88**	-3.86	6.13	8.21		0.83	**-2.54**	**5.75**	**7.68**
	RAWS		**0.99**	-0.95	**6.86**	9.17		0.98	**0.38**	7.04	9.17
	PG&E	2019-02-07 to 2019-02-10	0.92	-1.36	2.62	3.41		0.92	**-1.17**	**2.56**	**3.31**
	RAWS		**0.95**	-1.92	3.59	4.79		0.94	**-1.53**	**3.51**	**4.72**
	PG&E	2019-03-04 to 2019-03-06	0.93	**-0.79**	**2.42**	**3.09**		0.93	-0.92	2.49	3.18
	RAWS		0.97	**-0.83**	**3.47**	**4.97**		0.97	-0.91	3.49	5.01
	PG&E	2019-06-08 to 2019-06-09	0.76	-2.11	5.27	6.59		**0.79**	**-0.11**	**4.95**	**6.24**
	RAWS		0.15	-0.92	**5.78**	**7.47**		**0.27**	0.92	6.02	7.69
	PG&E	2019-09-22 to 2019-09-23	0.78	-6.19	6.72	8.06		**0.81**	**-5.87**	**6.45**	**7.78**
	RAWS		0.91	-6.55	7.34	9.04		**0.92**	**-6.12**	**7.01**	**8.67**
	PG&E	2019-10-09 to 2019-10-10	0.97	-7.43	8.77	11.11		**0.98**	**-5.54**	**7.55**	**9.75**
	RAWS		0.97	-3.59	7.17	9.68		0.97	**-1.99**	**6.73**	**9.02**
	PG&E	2019-10-23 to 2019-10-24	0.96	-2.44	6.65	8.58		0.96	**-1.78**	**6.55**	**8.46**
	RAWS		0.95	**0.23**	**6.82**	**8.85**		**0.96**	1.03	7.10	9.17
	PG&E	2019-10-26 to 2019-10-27	0.98	-7.15	8.58	10.85		0.98	**-5.97**	**7.93**	**10.16**
	RAWS		0.92	-3.74	7.33	9.69		0.92	**-2.72**	**7.09**	**9.47**
		AVERAGE:	0.88	-2.90	6.01	7.84		0.89	-1.88	5.84	7.60

Table 7: WRF ens_cfsr_011 and ens_cfsr_012 near-surface dewpoint validation statistics for each weather event compared against PG&E mesonet and RAWS.

One final major validation effort was completed to the WRF simulation to confirm proper nudging parameters. After commencing the historical simulation for the most recent year, the final WRF configuration was validated using PG&E stations and RAWS for six events occurring well into the year-long integration:

- 2018-10-13 to 2018-10-15
- 2018-11-07 to 2018-11-08
- 2019-02-07 to 2019-02-10
- 2019-06-08 to 2019-06-09
- 2019-10-26 to 2019-11-22
- 2019-11-19 to 2019-11-22

The validation results confirmed lack of model drift throughout the period. Further, the spectral nudging parameters resulted in improved model skill for most events and stations (see tables 8, 9 and 10).

Wind Speed (MPH)

		ens_cfsr_011				ens_cfsr_012				ens_cfsr_012 – Nudged			
Type	Event	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE
PG&E	2018-10-13 to 2018-10-15	**0.90**	-0.61	4.05	6.04	**0.90**	-0.81	4.02	6.02	0.78	**-0.09**	**3.96**	**5.72**
RAWS		0.95	0.11	4.08	5.74	0.95	-0.06	4.03	5.70	**0.96**	**0.01**	**3.97**	**5.67**
PG&E	2018-11-07 to 2018-11-08	0.73	**-0.01**	4.19	6.05	0.79	-0.29	4.16	6.06	**0.90**	-0.16	**4.03**	**5.77**
RAWS		**0.90**	**0.09**	4.19	5.84	**0.90**	-0.10	**4.16**	**5.83**	**0.94**	-0.19	4.22	5.92
PG&E	2019-02-07 to 2019-02-10	0.98	**-0.70**	2.90	3.94	0.98	**-0.70**	2.91	3.93	**0.99**	-0.88	**2.86**	**3.86**
RAWS		**0.97**	**-0.14**	3.22	4.39	**0.97**	-0.22	3.20	**4.35**	**0.97**	-0.46	**3.15**	**4.35**
PG&E	2019-03-04 to 2019-03-06	0.93	-1.02	3.95	5.30	0.92	-1.22	3.97	5.35				
RAWS		0.95	-0.44	4.31	5.83	0.93	-0.46	4.36	5.91				
PG&E	2019-06-08 to 2019-06-09	0.66	0.17	3.27	4.45	0.72	**-0.10**	3.22	4.41	**0.93**	-0.49	**2.95**	**4.07**
RAWS		0.50	0.55	3.47	4.64	0.73	0.40	3.43	4.62	**0.91**	**-0.15**	**3.18**	**4.32**
PG&E	2019-09-22 to 2019-09-23	0.89	-0.65	2.52	3.43	0.87	-0.75	2.52	3.43				
RAWS		0.90	-0.62	2.70	3.53	0.88	-0.72	2.71	3.56				
PG&E	2019-10-09 to 2019-10-10	0.85	-0.14	3.35	4.68	0.81	-0.25	3.34	4.68				
RAWS		0.82	0.37	3.82	5.32	0.79	0.29	3.80	5.29				
PG&E	2019-10-23 to 2019-10-24	0.86	-0.54	3.39	4.66	0.84	-0.61	3.39	4.67				
RAWS		0.91	0.35	3.85	5.26	0.89	0.19	3.78	5.20				
PG&E	2019-10-26 to 2019-10-27	0.96	**-0.48**	3.62	4.95	0.95	-0.57	3.63	4.98	**0.97**	-0.58	**3.44**	**4.71**
RAWS		0.97	0.35	3.97	5.40	0.97	0.28	3.98	5.43	**0.98**	**0.34**	**3.88**	**5.28**
PG&E	2019-11-19 to 2019-11-22	0.90	**-0.23**	2.85	3.86					**0.95**	-0.56	**2.68**	**3.64**
RAWS		0.93	**0.24**	3.05	4.05					**0.97**	-0.26	**2.91**	**3.92**

Table 8: WRF ens_cfsr_011, ens_cfsr_012 and ens_cfsr_012-Nudged wind speed validation statistics for each weather event compared against PG&E mesonet and RAWS. Bolded green text indicates best validation statistic among the three configurations.

Temperature (F)

		ens_cfsr_011				ens_cfsr_012				ens_cfsr_012 – Nudged			
Type	Event	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE
PG&E	2018-10-13 to 2018-10-15	0.96	0.63	4.26	5.61	0.96	**0.16**	**4.22**	**5.53**	0.94	**-0.02**	4.50	5.91
RAWS		**0.99**	1.08	4.18	5.53	0.98	0.68	4.15	5.47	**0.99**	**0.12**	**4.04**	**5.29**
PG&E	2018-11-07 to 2018-11-08	0.98	1.00	4.16	5.61	0.98	**0.86**	**4.14**	**5.60**	0.97	1.50	4.53	6.03
RAWS		**0.99**	0.91	4.14	5.59	**0.99**	**0.74**	**4.12**	**5.56**	**0.99**	1.14	**4.11**	5.57
PG&E	2019-02-07 to 2019-02-10	0.92	**-1.06**	2.51	3.11	0.92	-1.24	2.46	3.04	**0.97**	-1.25	**2.29**	**2.96**
RAWS		0.95	-1.32	3.12	4.05	0.95	-1.47	3.13	4.06	**0.97**	-1.43	**3.03**	**3.91**
PG&E	2019-03-04 to 2019-03-06	**0.91**	**-0.49**	**2.23**	**2.80**	0.90	-0.88	2.31	2.88				
RAWS		**0.91**	**-0.98**	**2.91**	**3.76**	0.88	-1.21	2.95	3.82				
PG&E	2019-06-08 to 2019-06-09	0.99	**0.16**	3.75	4.91	0.99	-0.58	**3.73**	**4.85**	0.99	2.16	4.04	5.24
RAWS		0.99	-1.26	4.08	5.42	0.99	-1.88	4.37	5.67	**0.99**	**0.78**	**3.82**	**5.35**
PG&E	2019-09-22 to 2019-09-23	1.00	0.88	3.26	4.29	1.00	**0.55**	**3.24**	**4.23**				
RAWS		0.98	0.28	**4.11**	5.34	0.98	**0.01**	4.14	**5.33**				
PG&E	2019-10-09 to 2019-10-10	0.99	0.65	3.81	4.95	0.99	**0.22**	**3.71**	**4.79**				
RAWS		0.99	**-0.46**	**4.03**	**5.33**	0.99	-0.85	4.07	5.34				
PG&E	2019-10-23 to 2019-10-24	0.98	**-0.41**	**4.28**	**5.41**	0.98	-0.92	4.48	5.57				
RAWS		0.98	**-0.94**	**4.74**	**6.00**	0.98	-1.43	4.95	6.18				
PG&E	2019-10-26 to 2019-10-27	0.98	**0.14**	4.39	5.54	0.98	-0.19	4.37	5.47	0.97	0.36	**4.30**	**5.45**
RAWS		**0.98**	**-0.05**	4.22	5.51	0.97	-0.40	4.27	5.53	**0.98**	-0.10	**3.99**	**5.23**
PG&E	2019-11-19 to 2019-11-22	0.95	0.96	3.21	4.12					**0.96**	**0.62**	**3.04**	**3.92**
RAWS		0.98	**0.42**	3.38	4.33					**0.98**	0.56	**3.22**	**4.16**

Table 9: WRF ens_cfsr_011, ens_cfsr_012 and ens_cfsr_012-Nudged near-surface temperature validation statistics for each weather event compared against PG&E mesonet and RAWS. Bolded green text indicates best validation statistic among the three configurations.

Dewpoint (F)															
ens_cfsr_011			ens_cfsr_012				ens_cfsr_012 – Nudged								
	Type	Event	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE	Cor	Bias	MAE	RMSE
	PG&E	2018-10-13 to 2018-10-15	0.95	-1.05	**6.04**	8.26	0.95	**0.86**	6.12	**8.14**	0.91	-2.19	6.37	8.60
	RAWS		0.98	-1.59	6.66	9.35	0.98	**0.06**	6.75	9.19	0.97	-0.51	**6.23**	**8.61**
	PG&E	2018-11-07 to 2018-11-08	**0.88**	-3.86	6.13	8.21	0.83	**-2.54**	**5.75**	**7.68**	0.84	-3.24	**5.75**	**7.60**
	RAWS		**0.99**	-0.95	6.86	9.17	0.98	**0.38**	7.04	9.17	**0.99**	0.52	**6.21**	**8.19**
	PG&E	2019-02-07 to 2019-02-10	0.92	-1.36	2.62	3.41	0.92	**-1.17**	2.56	3.31	**0.98**	-1.33	**2.33**	**3.19**
	RAWS		0.95	-1.92	3.59	4.79	0.94	**-1.53**	**3.51**	**4.72**	**0.96**	-2.72	3.82	5.12
	PG&E	2019-03-04 to 2019-03-06	0.93	**-0.79**	**2.42**	**3.09**	0.93	-0.92	2.49	3.18				
	RAWS		0.97	**-0.83**	**3.47**	**4.97**	0.97	-0.91	3.49	5.01				
	PG&E	2019-06-08 to 2019-06-09	0.76	-2.11	5.27	6.59	0.79	**-0.11**	**4.95**	**6.24**	**0.84**	-6.39	7.51	9.07
	RAWS		0.15	**-0.92**	**5.78**	**7.47**	0.27	**0.92**	6.02	7.69	**0.46**	-3.65	6.14	7.98
	PG&E	2019-09-22 to 2019-09-23	0.78	-6.19	6.72	8.06	**0.81**	**-5.87**	**6.45**	**7.78**				
	RAWS		0.91	-6.55	7.34	9.04	**0.92**	**-6.12**	**7.01**	**8.67**				
	PG&E	2019-10-09 to 2019-10-10	0.97	-7.43	8.77	11.11	**0.98**	**-5.54**	**7.55**	**9.75**				
	RAWS		0.97	-3.59	7.17	9.68	0.97	**-1.99**	**6.73**	**9.02**				
	PG&E	2019-10-23 to 2019-10-24	0.96	-2.44	6.65	8.58	0.96	**-1.78**	**6.55**	**8.46**				
	RAWS		0.95	**0.23**	**6.82**	**8.85**	**0.96**	1.03	7.10	9.17				
	PG&E	2019-10-26 to 2019-10-27	0.98	-7.15	8.58	10.85	0.98	-5.97	7.93	10.16	**0.98**	**-4.36**	**6.58**	**8.11**
	RAWS		0.92	-3.74	7.33	9.69	0.92	-2.72	7.09	9.47	**0.92**	**-0.35**	**6.04**	**8.05**
	PG&E	2019-11-19 to 2019-11-22	0.69	-5.29	6.13	7.80					**0.95**	**0.06**	**2.48**	**3.42**
	RAWS		0.64	-3.89	5.56	7.20					**0.90**	**0.35**	**2.96**	**4.00**

Table 10: WRF ens_cfsr_011, ens_cfsr_012 and ens_cfsr_012-Nudged near-surface dewpoint validation statistics for each weather event compared against PG&E mesonet and RAWS. Bolded green text indicates best validation statistic among the three configurations.

Supplemental Data:

WRF 2km Resolution Validation Configuration Details

ADS ID: ens_cfsr_001 - New baseline configuration

Summary:

WRFv4.1.2
18, 6, 2km resolution nested grids
CFSRv2 Reanalysis Data Downscaled
20mb model top pressure level
MODIS30s land use data with lakes (modis_landuse_20class_30s_with_lakes)
MODIS LAI/GVF Climatology
NoahMP LSM
RRTMG Radiation Schemes
Thompson Microphysics
MYNN2.5 PBL Scheme
MYNN surface layer scheme
Kain-Fritsch cumulus scheme for outer domain only
Topo shading for innermost domain
Slope-dependent radiation for innermost domain
No nudging

Dates initialized (UTC):

- 20181013_1200
- 20181107_0000
- 20190608_0000
- 20190922_1200
- 20191009_0000
- 20191023_0000
- 20191026_0000
- 20191119_0000
- 20191119_1200

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-11_00:00:00', '2019-10-09_00:00:00', '2019-10-09_00:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-09_00:00:00', '2019-10-09_00:00:00', '2019-10-09_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
```

```
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 11, 11, 11
 end_hour = 0, 0, 0
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 2, 2, 2
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 48
 run_minutes = 0
 run_seconds = 0
 start_day = 9, 9, 9
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
```

```
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 io_form_auxhist4 = 2
 frames_per_auxhist4 = 1, 1, 1
 ignore_iofields_warning = .FALSE.
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 surface_input_source = 3
 sf_sfclay_physics = 5, 5, 5
 num_soil_layers = 4
 bl_pbl_physics = 5, 5, 5
 radt = 10, 10, 10
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
```

```
 sst_update = 0
 sf_surface_physics = 4, 4, 4
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
```

/

```
&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_002 - Noah LSM
DTN ID: N

Changes from baseline:

Noah LSM instead of NoahMP
sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191009_0000
- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-11_00:00:00', '2019-10-11_00:00:00', '2019-10-11_00:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-09_00:00:00', '2019-10-09_00:00:00', '2019-10-09_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 11, 11, 11
 end_hour = 0, 0, 0
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 48
 run_minutes = 0
 run_seconds = 0
 start_day = 9, 9, 9
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
```

```
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 2, 2, 2
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
```

```
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
```

```
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_004 - MYNN 3rd order
DTN ID: b3

Changes from baseline:

MYNN 3rd order instead of MYNN 2.5 order PBL
sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
```

```
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 6, 6, 6
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
```

```
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
```

```
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_csr_005 - MYJ PBL
DTN ID: bj

Changes from baseline:

MYJ instead of MYNN2.5 PBL
Monin-Obukhov surface layer scheme instead of MYNN surface layer scheme
sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
```

```
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 2, 2, 2
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 2, 2, 2
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
```

```
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
```

/

```
&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_006 - YSU PBL
DTN ID: by

Changes from baseline:

YSU instead of MYNN2.5 PBL
Revised MM5 Monin-Obukhov surface layer instead of MYNN surface layer scheme
sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
```

```
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 1, 1, 1
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 1, 1, 1
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 ysu_topdown_pblmix = 1
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
```

```
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
```

```
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_007 - PX-ACM2
DTN ID: px

Changes from baseline:

PX surface layer scheme instead of MYNN surface layer scheme
ACM2 PBL instead of MYNN2.5 PBL scheme
sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
```

```
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 7, 7, 7
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 7, 7, 7
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
```

```
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
```

/

```
&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_009 - SST_SKIN, TMN_UPDATE, SST_UPDATE
DTN ID: m15

Changes from baseline:

sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
```

```
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
```

```
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
```

```
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
```

```
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_010 - Modified z0 for LU_INDEX 2 and 13
DTN ID: zmp

Changes from baseline:

sst_skin, tmn_update and sst_update

MPTABLE.TBL modified:

LU_INDEX=2 reduced to 0.95

LU_INDEX=13 reduced to 0.80

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s', 'modis_lai+modis_30s_with_lakes+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
```

```
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
```

```
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
```

```
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_011 - Modified z0 for LU_INDEX 2 and 13
DTN ID: z15b2

Changes from baseline:

sst_skin, tmn_update and sst_update

MPTABLE.TBL modified:

LU_INDEX=2 reduced to 0.70

LU_INDEX=13 reduced to 0.60

Dates initialized (UTC):

- 20181013_1200
- 20181107_0000
- 20190208_0600
- 20190305_0600
- 20190608_0000
- 20191009_0000
- 20191023_0000
- 20191026_0000
- 20191119_1200

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '/home/rcarpenter/wrf-model/config/v4.1.2/wps'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/
```

```
&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
```

```
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
```

```
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
```

```
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_012 - Modified z0 for LU_INDEX 2 and 13/MYNN 3rd order
DTN ID: z15b3

Changes from baseline:

sst_skin, tmn_update and sst_update
MYNN 3rd order PBL scheme
MPTABLE.TBL modified:
LU_INDEX=2 reduced to 0.70
LU_INDEX=13 reduced to 0.60

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '/home/rcarpenter/wrf-model/config/v4.1.2/wps'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
```

/

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
```

```
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 6, 6, 6
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
```

```
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
```

```
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_013 - MYNN2.5 modifications
DTN ID: et

Changes from baseline:

sst_skin, tmn_update and sst_update

MYNN2.5 PBL changes:

bl_mynn_tkeadvect = .TRUE. Activate TKE advection (outermost domain only)

bl_mynn_edmf = 0 Deactivate mass-flux (outermost domain only)

Dates initialized (UTC):

- 20191026_0000

Namelist.wps

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
```

```
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 bl_mynn_tkeadvect = .TRUE.
 bl_mynn_edmf = 0
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
```

```
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/
```

```
&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_014 - MODIS15s
DTN ID: m009

Changes from baseline:

sst_skin, tmn_update and sst_update
MODIS15s land use

Dates initialized (UTC):

- 20191026_0000

Namelist.wps

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist,input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
```

```
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
```

```
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/
```

```
&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_015 - MYNN2.5 modifications
DTN ID: m013

Changes from baseline:

sst_skin, tmn_update and sst_update

MODIS15s land use

MYNN2.5 PBL changes:

bl_mynn_tkeadvect = .TRUE. Activate TKE advection (outermost domain only)

bl_mynn_edmf = 0 Deactivate mass-flux (outermost domain only)

Dates initialized (UTC):

- 20191026_0000

Namelist.wps

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
```

/

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
```

```
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 bl_mynn_tkeadvect = .TRUE.
 bl_mynn_edmf = 0
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
```

```
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/
```

```
&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_016 - Modified z0 for LU_INDEX 2 and 13
DTN ID: m011

Changes from baseline:

sst_skin, tmn_update and sst_update

MODIS15s

MPTABLE.TBL modified:

LU_INDEX=2 reduced to 0.70

LU_INDEX=13 reduced to 0.60

Dates initialized (UTC):

- 20191026_0000

Namelist.wps

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
```

/

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
```

```
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
```

```
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
```

```
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_017 - Modified z0 for LU_INDEX 2 and 13/MYNN 3rd order
DTN ID: m012

Changes from baseline:

sst_skin, tmn_update and sst_update
MODIS15s
MYNN 3rd order PBL scheme
MPTABLE.TBL modified:
LU_INDEX=2 reduced to 0.70
LU_INDEX=13 reduced to 0.60

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
```

```
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
```

```
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 6, 6, 6
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
```

```
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
```

```
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_018 - MYNN2.5 modifications
DTN ID: a011

Changes from baseline:

sst_skin, tmn_update and sst_update

MODIS15s

MYNN2.5 PBL changes:

bl_mynn_tkeadvect = .TRUE. Activate TKE advection (outermost domain only)

bl_mynn_edmf = 0 Deactivate mass-flux (outermost domain only)

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s', 'modis_lai+modis_15s_lake+30s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
```

/

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
```

```
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 bl_mynn_tkeadvect = .TRUE.
 bl_mynn_edmf = 0
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
```

```
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_q = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 dk_zfac_ph = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
 if_zfac_ph = 1, 1, 1
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/
```

```
&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```

ADS ID: ens_cfsr_019 - Kishne Soil Parameters
DTN ID: k

Changes from baseline:

sst_skin, tmn_update and sst_update

Dates initialized (UTC):

- 20191026_0000

Namelist.wps:

```
&share
 debug_level = 0
 end_date = '2019-10-28_12:00:00', '2019-10-28_12:00:00', '2019-10-28_12:00:00'
 interval_seconds = 21600
 io_form_geogrid = 2
 max_dom = 3
 opt_output_from_geogrid_path = '.'
 start_date = '2019-10-26_00:00:00', '2019-10-26_00:00:00', '2019-10-26_00:00:00'
 wrf_core = 'ARW'
/

&geogrid
 dx = 18000
 dy = 18000
 e_we = 271, 316, 397
 e_sn = 271, 316, 487
 geog_data_path = '/condo/brisk/wps_geog'
 geog_data_res = 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s', 'modis_lai+modis_15s_with_lakes+15s'
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 map_proj = 'lambert'
 opt_geogrid_tbl_path = '.'
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 ref_lat = 38.2
 ref_lon = -121.0
 stand_lon = -121.0
 truelat1 = 31.0
 truelat2 = 45.38
/

&ungrib
 out_format = 'WPS'
 prefix = 'FILE'
/

&metgrid
 fg_name = 'CFSR_3D', 'CFSR_SFC'
 io_form_metgrid = 2
 opt_metgrid_tbl_path = '.'
 opt_output_from_metgrid_path = '.'
/
```

Namelist.input:

```
&time_control
 adjust_output_times = .TRUE.
 debug_level = 0
 end_day = 28, 28, 28
 end_hour = 12, 12, 12
 end_minute = 0, 0, 0
 end_month = 10, 10, 10
 end_second = 0, 0, 0
 end_year = 2019, 2019, 2019
 fine_input_stream = 0, 0, 0
 frames_per_outfile = 1, 1, 1
 history_begin_m = 0, 0, 0
 history_interval = 60, 60, 60
 input_from_file = .TRUE., .TRUE., .TRUE.
 interval_seconds = 21600
 io_form_auxinput2 = 2
 io_form_boundary = 2
 io_form_history = 2
 io_form_input = 2
 io_form_restart = 2
 restart = .FALSE.
 restart_interval = 999999
 run_days = 0
 run_hours = 60
 run_minutes = 0
 run_seconds = 0
 start_day = 26, 26, 26
 start_hour = 0, 0, 0
 start_minute = 0, 0, 0
 start_month = 10, 10, 10
 start_second = 0, 0, 0
 start_year = 2019, 2019, 2019
 auxinput4_interval = 360, 360, 360
 io_form_auxhist4 = 2
 ignore_iofields_warning = .FALSE.
 auxinput4_inname = 'wrflowinp_d<domain>'
 frames_per_auxhist4 = 1, 1, 1
 io_form_auxinput4 = 2
 auxhist4_interval = 60, 60, 60
 auxhist4_outname = 'wrfsfc_d<domain>_<date>'
 iofields_filename = 'wrf_io.cfg', 'wrf_io.cfg', 'wrf_io.cfg'
/

&domains
 dx = 18000, 6000.0, 2000.0
 dy = 18000, 6000.0, 2000.0
 e_sn = 271, 316, 487
 e_vert = 51, 51, 51
 e_we = 271, 316, 397
 feedback = 0
 grid_id = 1, 2, 3
 i_parent_start = 1, 85, 89
 j_parent_start = 1, 85, 74
 max_dom = 3
 max_step_increase_pct = 5, 51, 51
 num_metgrid_levels = 38
 num_metgrid_soil_levels = 4
 p_top_requested = 2000
 parent_grid_ratio = 1, 3, 3
 parent_id = 1, 1, 2
 parent_time_step_ratio = 1, 3, 3
```

```
 smooth_option = 0
 step_to_output_time = .TRUE.
 time_step = 150
 time_step_fract_den = 1
 time_step_fract_num = 0
 tslist_unstagger_winds = .TRUE.
 use_adaptive_time_step = .TRUE.
 max_ts_locs = 58
 nproc_x = -1
 nproc_y = -1
/

&physics
 physics_suite = 'conus'
 cu_physics = 1, 0, 0
 grav_settling = 2, 2, 2
 mp_physics = 8, 8, 8
 num_land_cat = 21
 ra_lw_physics = 4, 4, 4
 ra_sw_physics = 4, 4, 4
 scalar_pblmix = 1, 1, 1
 swint_opt = 1
 prec_acc_dt = 60, 60, 60
 bl_pbl_physics = 5, 5, 5
 usemonalb = .TRUE.
 topo_shading = 0, 0, 1
 sf_sfclay_physics = 5, 5, 5
 tmn_update = 1
 sst_update = 1
 sf_surface_physics = 4, 4, 4
 num_soil_layers = 4
 slope_rad = 0, 0, 1
 rdlai2d = .TRUE.
 surface_input_source = 3
 radt = 10, 10, 10
 sst_skin = 1
/

&fdda
 obs_nudge_opt = 0, 0, 0
 fdda_end = 0, 0, 0
 fdda_start = 0, 0, 0
 max_obs = 300000
 obs_coef_mois = 0.0006, 0.0006, 0.0006
 obs_coef_temp = 0.0006, 0.0006, 0.0006
 obs_coef_wind = 0.0006, 0.0006, 0.0006
 obs_dtramp = 60.0
 obs_idynin = 1
 obs_ionf = 2
 obs_ipf_errob = .TRUE.
 obs_ipf_in4dob = .FALSE.
 obs_ipf_init = .TRUE.
 obs_ipf_nudob = .FALSE.
 obs_nudge_mois = 1, 1
 obs_nudge_temp = 1, 1
 obs_nudge_wind = 1, 1
 obs_prt_freq = 20, 20, 20
 obs_prt_max = 10
 obs_rinxy = 100
 obs_scl_neg_qv_innov = 1
 obs_sfc_scheme_horiz = 1
```

```
 obs_sfcfacr = 0.75
 obs_sfcfact = 0.75
 obs_twindo = 0.67
 gt = 4.5e-05, 4.5e-05, 4.5e-05
 if_zfac_uv = 1, 1, 1
 xwavenum = 6, 3, 0
 gq = 4.5e-05, 4.5e-05, 4.5e-05
 k_zfac_ph = 20, 20, 20
 if_no_pbl_nudging_uv = 1, 1, 1
 dk_zfac_uv = 1, 1, 1
 fgdtzero = 0, 0, 0
 ywavenum = 6, 3, 0
 dtramp_min = 60
 if_zfac_t = 1, 1, 1
 fgdt = 0, 0, 0
 gph = 0.0003, 0.0003, 0.0003
 if_zfac_ph = 1, 1, 1
 io_form_gfdda = 2
 if_ramping = 1
 dk_zfac_ph = 1, 1, 1
 grid_fdda = 0, 0, 0
 k_zfac_uv = 20, 20, 20
 if_no_pbl_nudging_ph = 1, 1, 1
 gfdda_end_h = 999999, 999999, 999999
 if_zfac_q = 1, 1, 1
 k_zfac_q = 20, 20, 20
 k_zfac_t = 20, 20, 20
 if_no_pbl_nudging_t = 1, 1, 1
 dk_zfac_t = 1, 1, 1
 gfdda_inname = 'wrffdda_d<domain>'
 if_no_pbl_nudging_q = 1, 1, 1
 guv = 0.0003, 0.0003, 0.0003
 dk_zfac_q = 1, 1, 1
 gfdda_interval_m = 360, 360, 360
/

&dynamics
 damp_opt = 3
 dampcoef = 0.2, 0.2, 0.2
 diff_opt = 2, 2, 2
 km_opt = 4, 4, 4
 mix_full_fields = .TRUE., .TRUE., .TRUE.
 w_damping = 0
 zdamp = 5000, 5000, 5000
 gwd_opt = 0
 epssm = 0.2, 0.2, 0.2
/

&bdy_control
 specified = .TRUE., .FALSE., .FALSE.
/

&grib2
/

&dfi_control
 dfi_opt = 0
 dfi_cutoff_seconds = 3600
/

&namelist_quilt
```

```
 nio_groups = 6
 nio_tasks_per_group = 2
/

&noah_mp
 dveg = 8
/
```