

Add Domain Boundary Rows to Regional FV3 DA

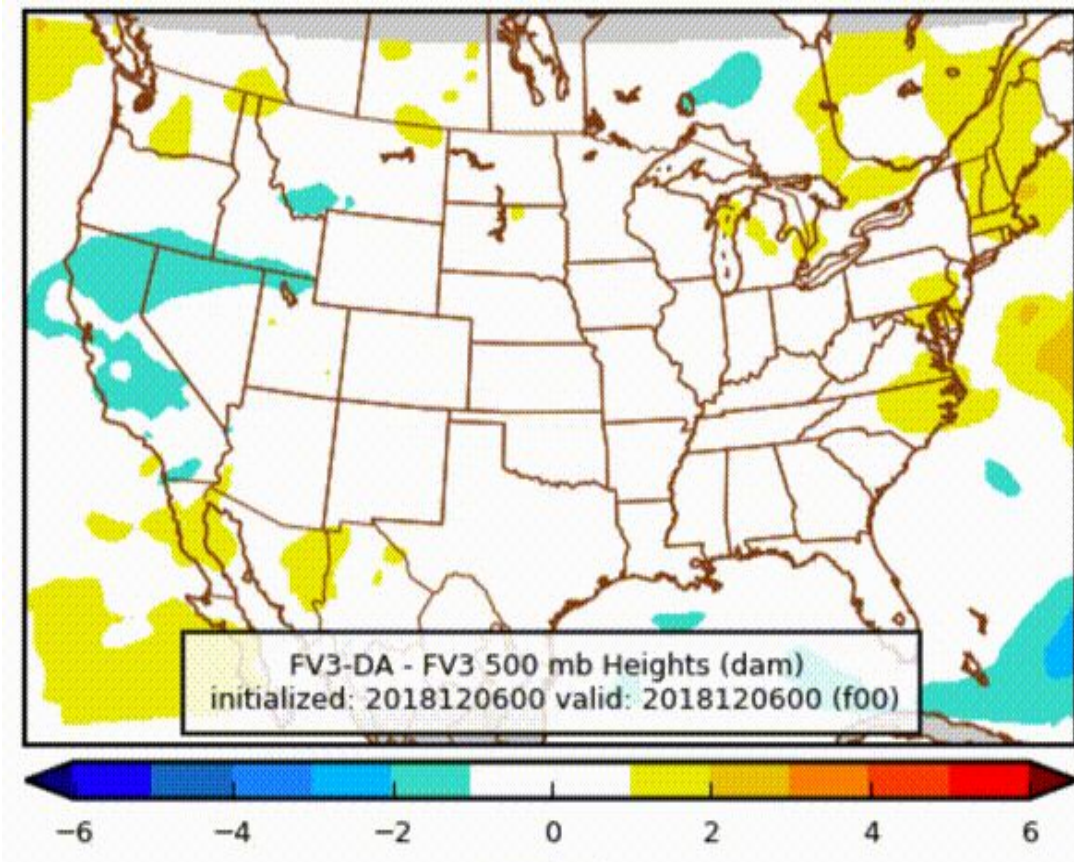
Tom Black

HFIP Teleconference

10 July 2019

Regional DA Imbalance: Hours 0 to 6

500 mb Height (dam)



Difference of cold start regional FV3 forecast from regional DA forecast with hourly spinup from tm06 to tm00.

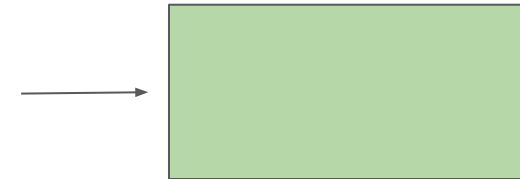
- Evidence indicates that the imbalance arises from integrating the DA-updated forecast domain with boundaries that do not see the updates during the spinup.
- Therefore include the boundary rows in the regional domain of the 'core' and 'tracers' restart files that are updated by the GSI.

Current

Model writes fields into restart files ***without the boundary***:

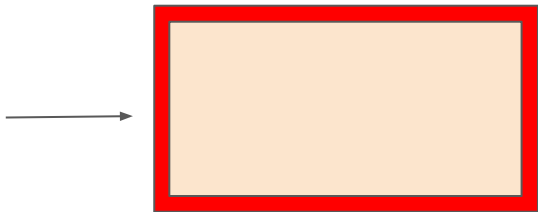


GSI updates the integration domain:

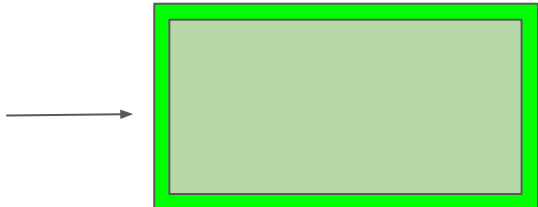


New

Model writes fields into restart files ***with the boundary***:

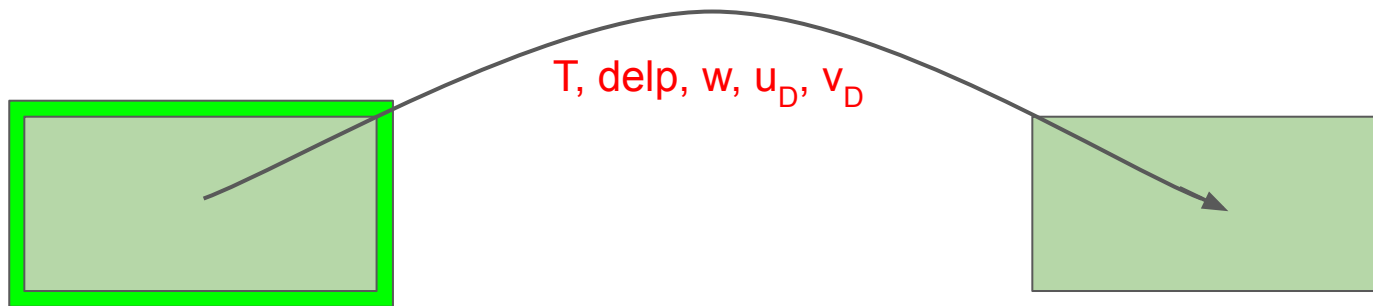


GSI updates the entire domain ***including the boundary***:

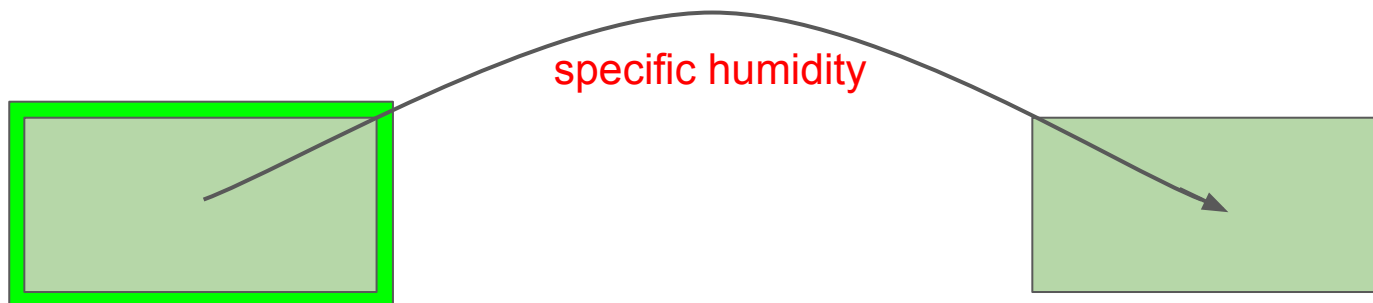


When the GSI update is complete the data in the enlarged restart files must be transferred back to the standard sized restart files and to the BC file for the forecast to use during its execution.

Transfer the updated core restart file fields to the original file.

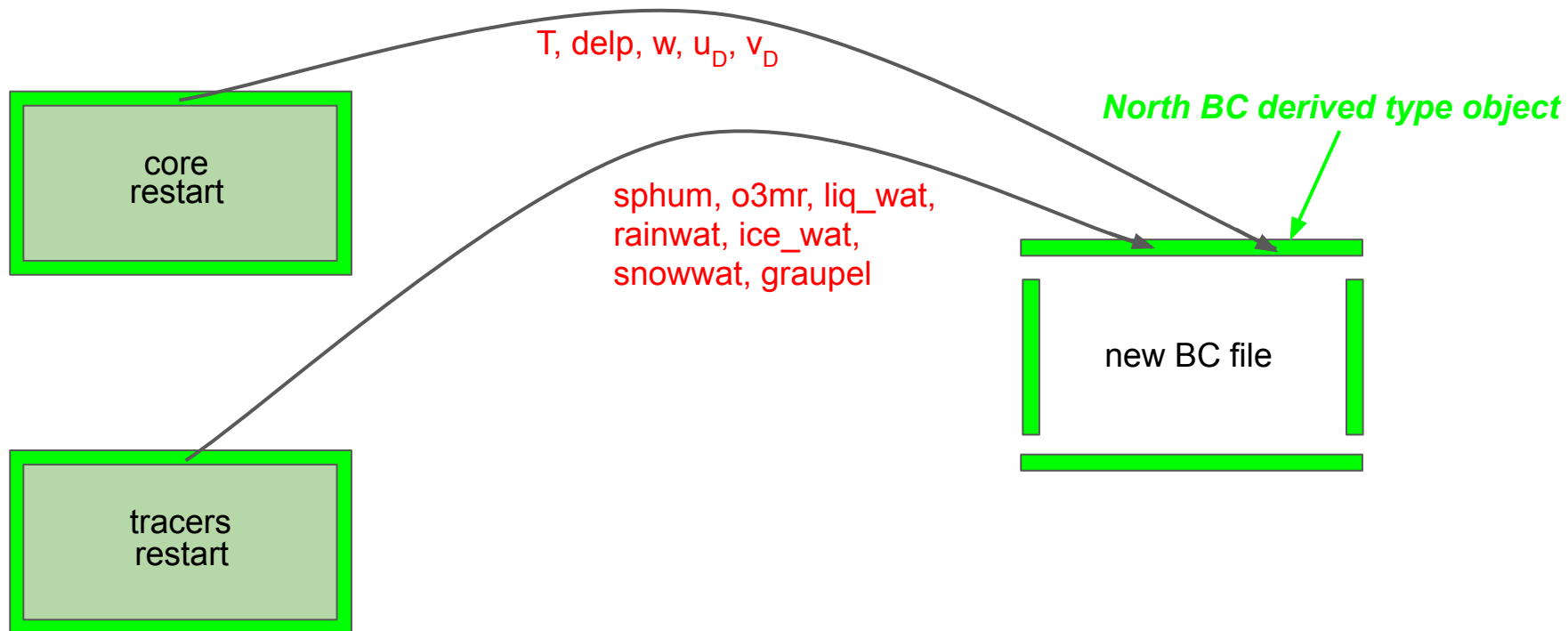


Transfer the updated tracers restart file field to the original file.



The original BC files from chgres hold data on the external forecast levels with winds oriented to geographic latitude/longitude. These are remapped to the model levels and winds are rotated to the integration grid each time new BC data is read in.

Since data in the restart files is already on the model levels and oriented to the model grid do a direct transfer of all BC file variables to a new BC file. Then tell the model not to remap and rotate that data.



More BC File Variables



*BC file variables **not** in the updated restart files:*

p_{sfc}

layer delta z

C-grid wind components

Vertically sum the updated delta p's. \Rightarrow p_{sfc}

Integrate the hydrostatic eqn upward using the updated T, delta p, and specific humidity. \Rightarrow layer delta z

Interpolate from the updated D-grid winds. \Rightarrow C-grid wind components

Develop SAR specific scripts to aid model testing
without using the regional workflow

Jim Abeles

HFIP Teleconference

10 July 2019

Batch scripts are system specific

- `run_regional_driver_grid.{theia,dell,cray}`
 - creates grid, orography and static surface data files at model resolution
- `run_regional_chgres.{theia,dell,cray}`
- `run_regional_chgres_forBC.{theia,dell,cray}`
 - The chgres scripts run the new `chgres_cube` code developed by George Gayno

FV3-CAM Verification Available from EMC

- Comparison of EMC's FV3-CAM configurations (FV3 Nest, SAR, and SARX) against HRRR, NAM Nest, and FV3-based GFS
- Scorecards, performance diagrams, and series plots for upper air and surface variables, precipitation, and CAPE

https://www.emc.ncep.noaa.gov/users/Logan.Dawson/fv3cam_verif/

FV3SAR and FV3NEST Have Largely Similar Performance

FV3NEST vs. FV3SAR Scorecard – Upper Air
for FV3NEST and FV3SAR

2019-05-11 12:00:00 – 2019-06-10 12:00:00

			CONUS					
			F00	F12	F24	F36	F48	F60
Bias	Geopotential Height	250 mb						
		500 mb						
		700 mb						
		850 mb						
	Temperature	250 mb						
		500 mb	▼					
		700 mb						
		850 mb	▲	▲				
	Specific Humidity	300 mb						
		500 mb	▲					
		700 mb						
		850 mb						
BCRMSE	Geopotential Height	250 mb						
		500 mb						
		700 mb						
		850 mb						
	Temperature	250 mb						
		500 mb						
		700 mb						
		850 mb						
	Specific Humidity	300 mb						
		500 mb						
		700 mb						
		850 mb						
Bias	Vector Wind	250 mb						
		500 mb						
		700 mb						
		850 mb						
RMSE	Vector Wind	250 mb						
		500 mb						
		700 mb						
		850 mb						

FV3NEST vs. FV3SAR Scorecard – Surface

for FV3NEST and FV3SAR

2019-05-11 12:00:00 – 2019-06-10 12:00:00

			CONUS																					
			F00	F03	F06	F09	F12	F15	F18	F21	F24	F27	F30	F33	F36	F39	F42	F45	F48	F51	F54	F57	F60	
Bias	Temperature	2-m	▲	▲		▼	▲	▲	▲	▲		▲	▼	▲	▼	▲	▲	▲		▲	▼	▼	▲	
	Dewpoint Temperature	2-m	▲	▲	▼	▲															▼	▼	▲	
	Wind Speed	10-m		▲	▲		▲			▲														
	Wind Gust		▼	▲																				
	Sea Level Pressure			▲	▲	▲				▼			▼	▲	▲		▼	▲			▲		▲	
BCRMSE	Temperature	2-m	▲	▲			▲	▲											▲					
	Dewpoint Temperature	2-m									▲													
	Wind Speed	10-m														▲	▲						▲	
	Wind Gust																▲							
	Sea Level Pressure							▲	▲	▲														

▲	FV3NEST is better than FV3SAR at the 99% significance level
▲	FV3NEST is better than FV3SAR at the 95% significance level
	No statistically significant difference between FV3NEST and FV3SAR
▼	FV3NEST is worse than FV3SAR at the 95% significance level
▼	FV3NEST is worse than FV3SAR at the 99% significance level
	Data missing

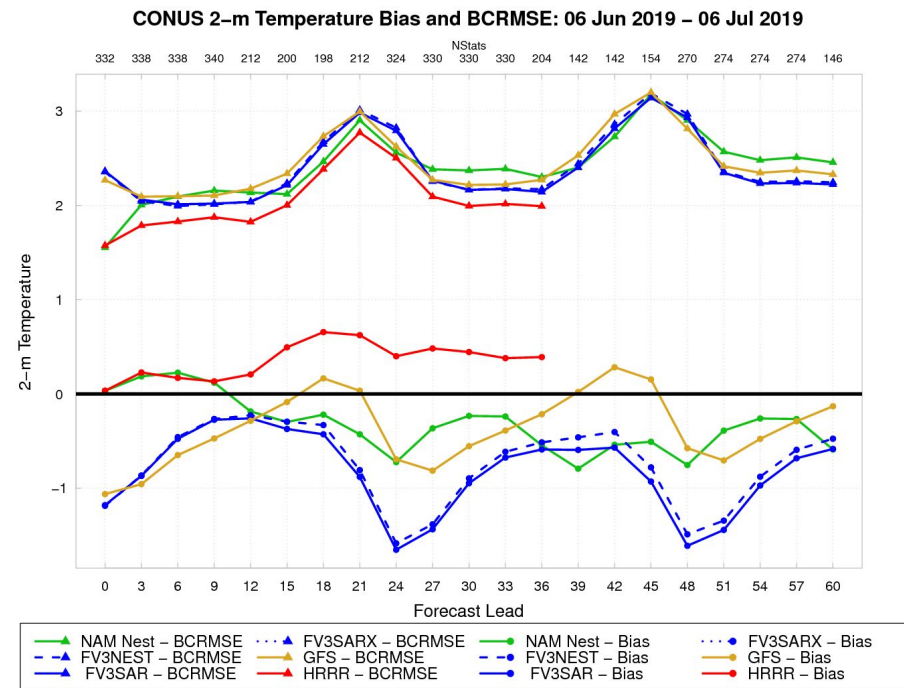
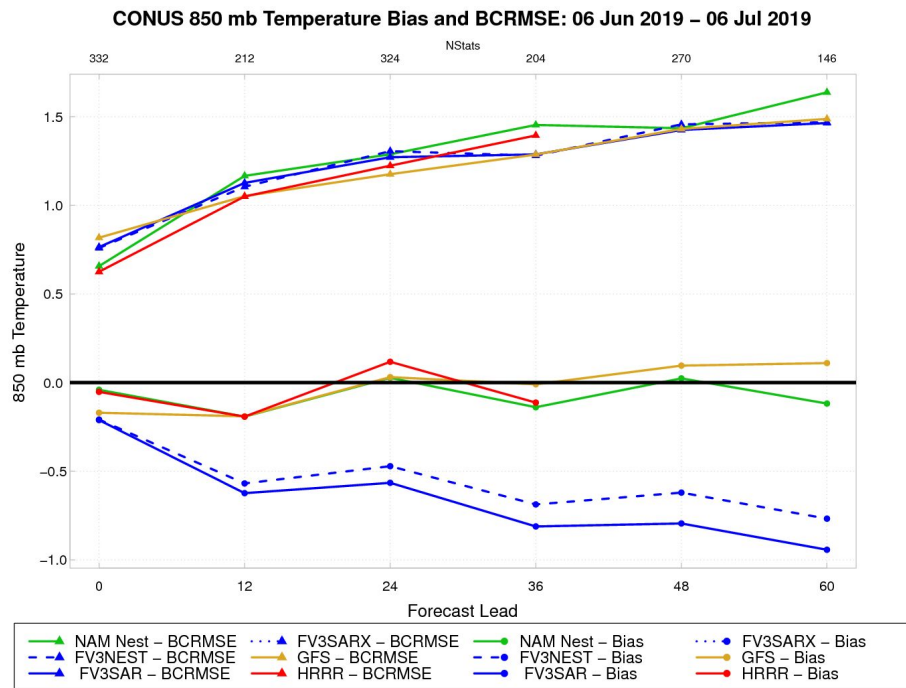
Greys denote no statistically significant differences, which is good to see

FV3NEST vs. FV3SAR Scorecard – 24-h Precipitation
for FV3NEST and FV3SAR

2019-06-05 12:00:00 – 2019-07-05 12:00:00

			CONUS	
			F36	F60
ETS	24-h Precip.	> .01 in.		
		> .10 in.		
		> .25 in.		
		> .50 in.		
		> .75 in.		
		> 1.0 in.		
		> 1.5 in.		
		> 2.0 in.		
		> 3.0 in.		
		> 4.0 in.	▼	
FBIAS	24-h Precip.	> .01 in.		
		> .10 in.		
		> .25 in.		
		> .50 in.		
		> .75 in.		
		> 1.0 in.		
		> 1.5 in.	▲	
		> 2.0 in.	▲	
		> 3.0 in.		
		> 4.0 in.		

FV3-CAMs Suffer from Low-Level Cold Bias Seen in GFSv15



- Low-level cold bias seen in GFSv15 is also apparent in the FV3-CAMs
- Low-level cold bias in GFSv15 was expected to be less serious in the summer months

FV3-CAM Precipitation Forecasts Are Comparable to Operational CAMs

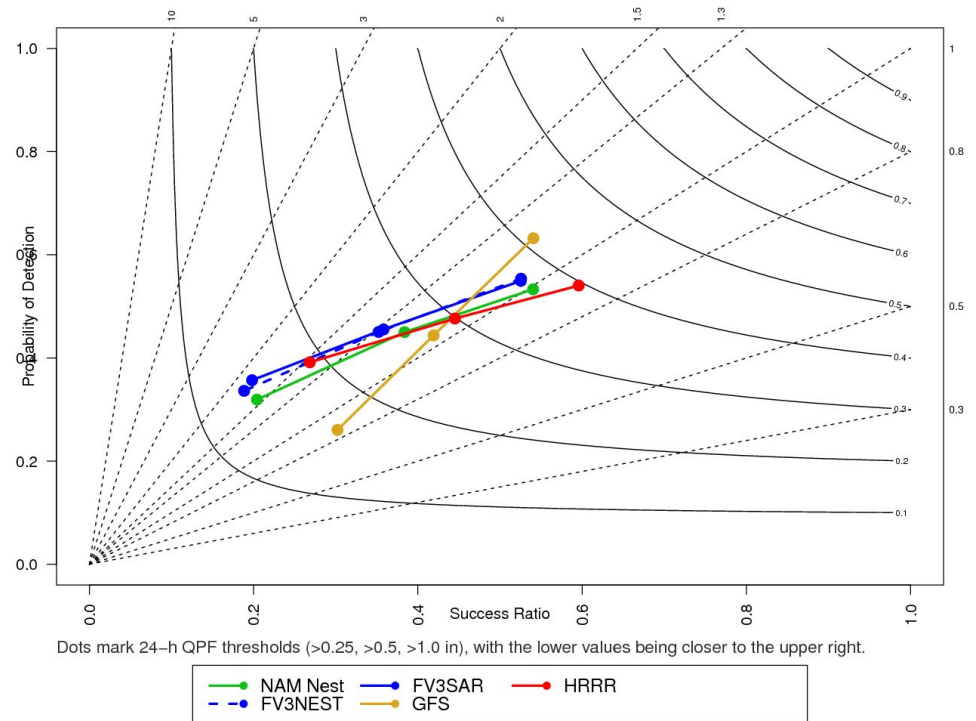
FV3SAR vs. NAM Nest Scorecard – 6-h Precipitation
for FV3SAR and NAM Nest

2019-06-05 12:00:00 – 2019-07-05 12:00:00

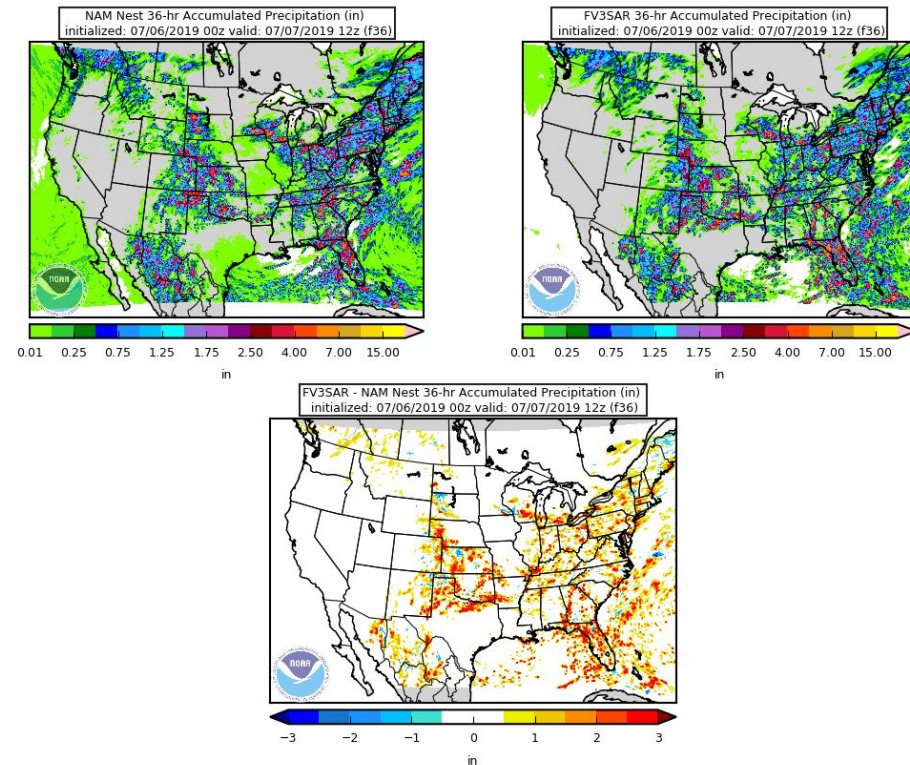
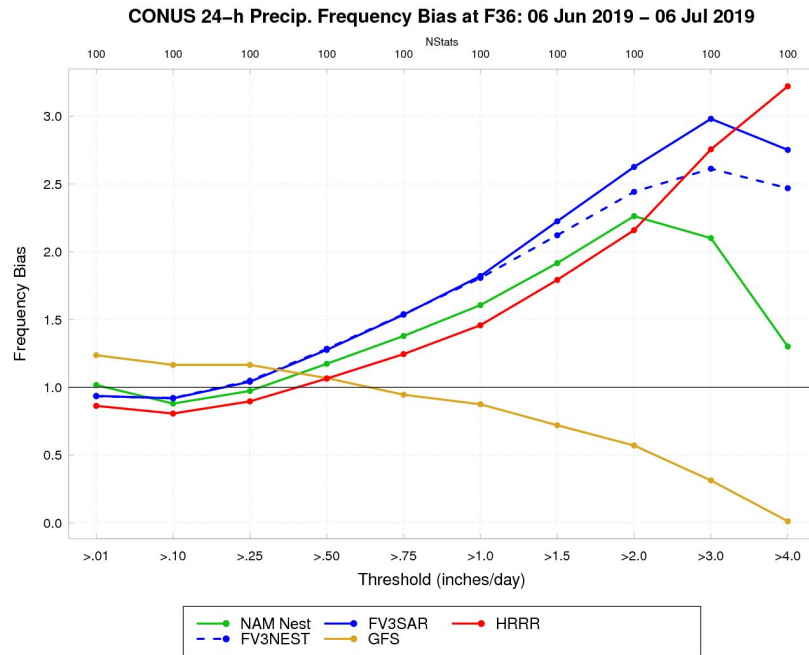
		CONUS									
		F06	F12	F18	F24	F30	F36	F42	F48	F54	F60
6-h Precip. > 1 mm	< 5 km	▲	▲	▲				▲			
	< 24 km	▲	▲	▲				▲			
	< 52 km	▲	▲	▲				▲			
	< 100 km	▲	▲	▲				▲			
6-h Precip. > 2 mm	< 5 km	▲	▲	▲				▲			
	< 24 km	▲	▲	▲				▲			
	< 52 km	▲	▲	▲				▲			
	< 100 km	▲	▲	▲				▲			
6-h Precip. > 5 mm	< 5 km							▲			
	< 24 km							▲			
	< 52 km							▲			
	< 100 km							▲			
6-h Precip. > 10 mm	< 5 km	▼	▲					▲			
	< 24 km	▼	▲					▲			
	< 52 km	▼	▲					▲			
	< 100 km	▼	▲					▲			
6-h Precip. > 20 mm	< 5 km	▼	▲					▲			
	< 24 km	▼	▲					▲			
	< 52 km	▼	▲					▲			
	< 100 km	▼	▲					▲			
6-h Precip. > 50 mm	< 5 km								▲		
	< 24 km								▲		
	< 52 km								▲		
	< 100 km								▲		

▲	FV3SAR is better than NAM Nest at the 99% significance level
▲	FV3SAR is better than NAM Nest at the 95% significance level
	No statistically significant difference between FV3SAR and NAM Nest
▼	FV3SAR is worse than NAM Nest at the 95% significance level
▼	FV3SAR is worse than NAM Nest at the 99% significance level
	Data missing

CONUS 24-h Precip. Performance Diagram at F36: 06 Jun 2019 – 06 Jul 2019



High QPF Bias in FV3-CAMs Is Apparent in Stats and Forecast Maps



- 36-h accumulations are shown on the right
- Clear that FV3SAR has more precip than NAM Nest

Varying Vertical Grid Resolution and Diffusion in 3-km Standalone Regional (SAR)

Eric Aligo

HFIP Teleconference

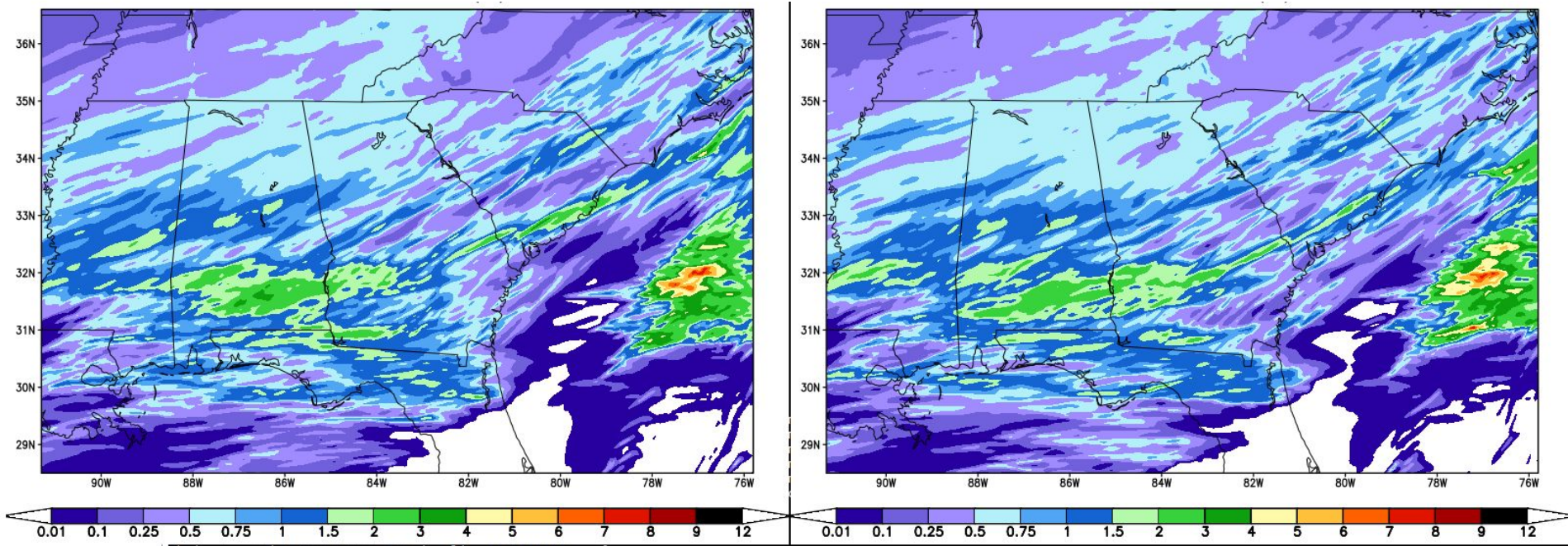
10 July 2019

Vertical Grid Resolution (VGR)

FV3GFS VGR

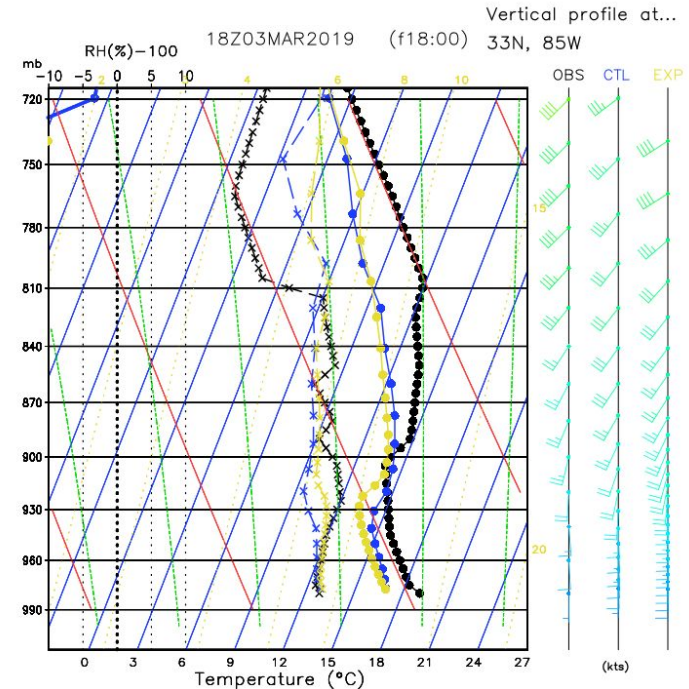
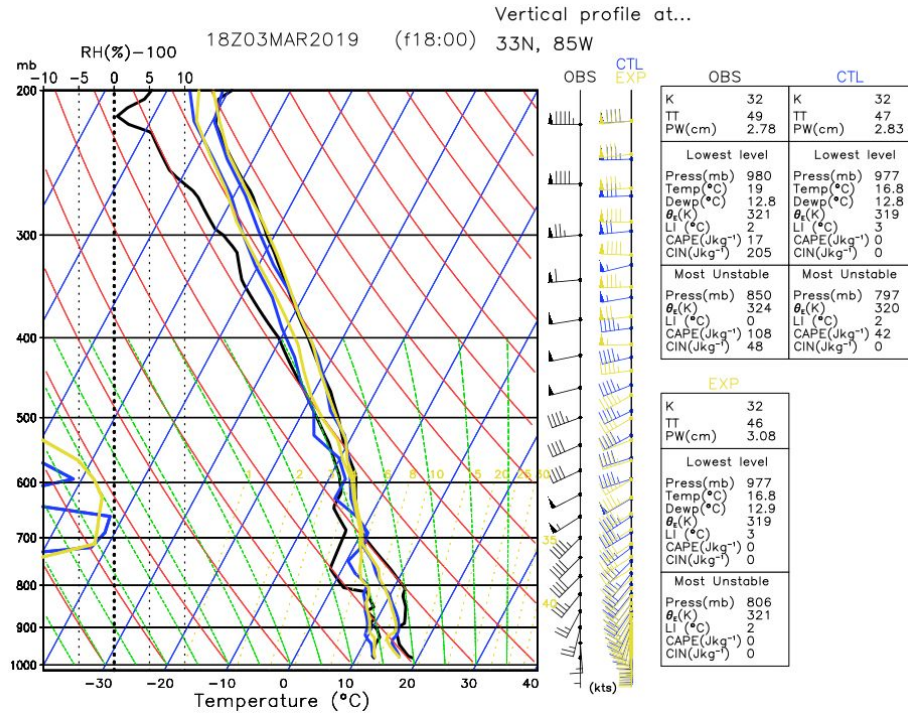
NAM VGR

30H RUN TOTAL PRECIP (IN) 06Z/04 MAR 2019



Rainfall peaks slightly lower in
NAM VGR run.

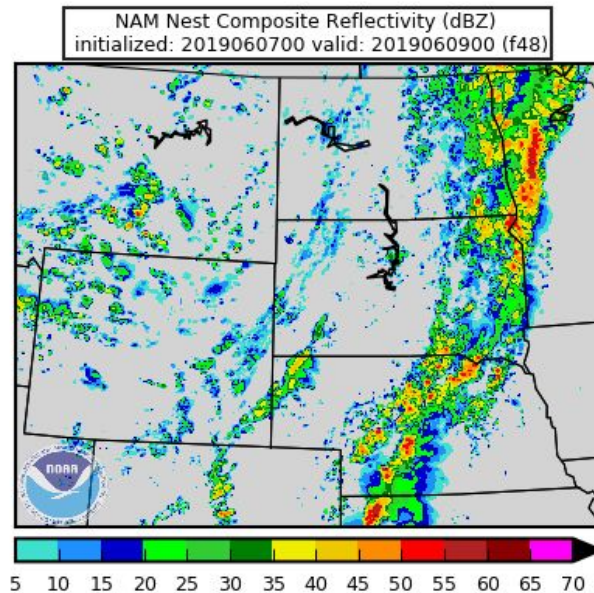
Observed, Control and Experiment Soundings



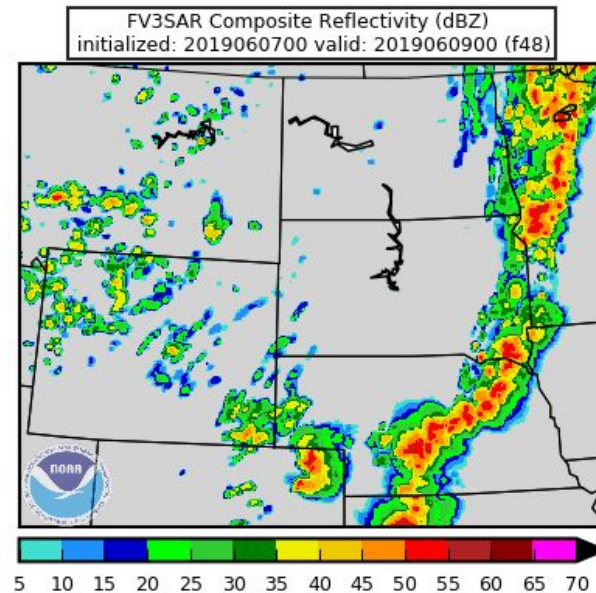
- GUI allows forecast soundings to be plotted anywhere in domain.
- Shell script allows profiles for specific lat and lon points for multiple times.
- GrADS scripts can overlay obs, a control run and experimental run.
- Soundings zoomed into the PBL can also be plotted.

Running with Less Horizontal Diffusion

NAM NEST



FV3 SAR



- NAM nest produces more small-scale details than FV3 SAR.
- SPC and HWT Spring Experiment: Features too broad in FV3 SAR
- Attempt to reduce horizontal diffusion has resulted in unstable runs.
 - Via choosing a less diffusive advection option
 - hord_*=5 instead of the more diffusive 6 option

Note: hord_*=5 is an unlimited (linear) “fifth-order” operator, hord_*=6 is an unlimited operator with 2dx filter, and hord_*=8 is a monotone Lin 2004 operator.

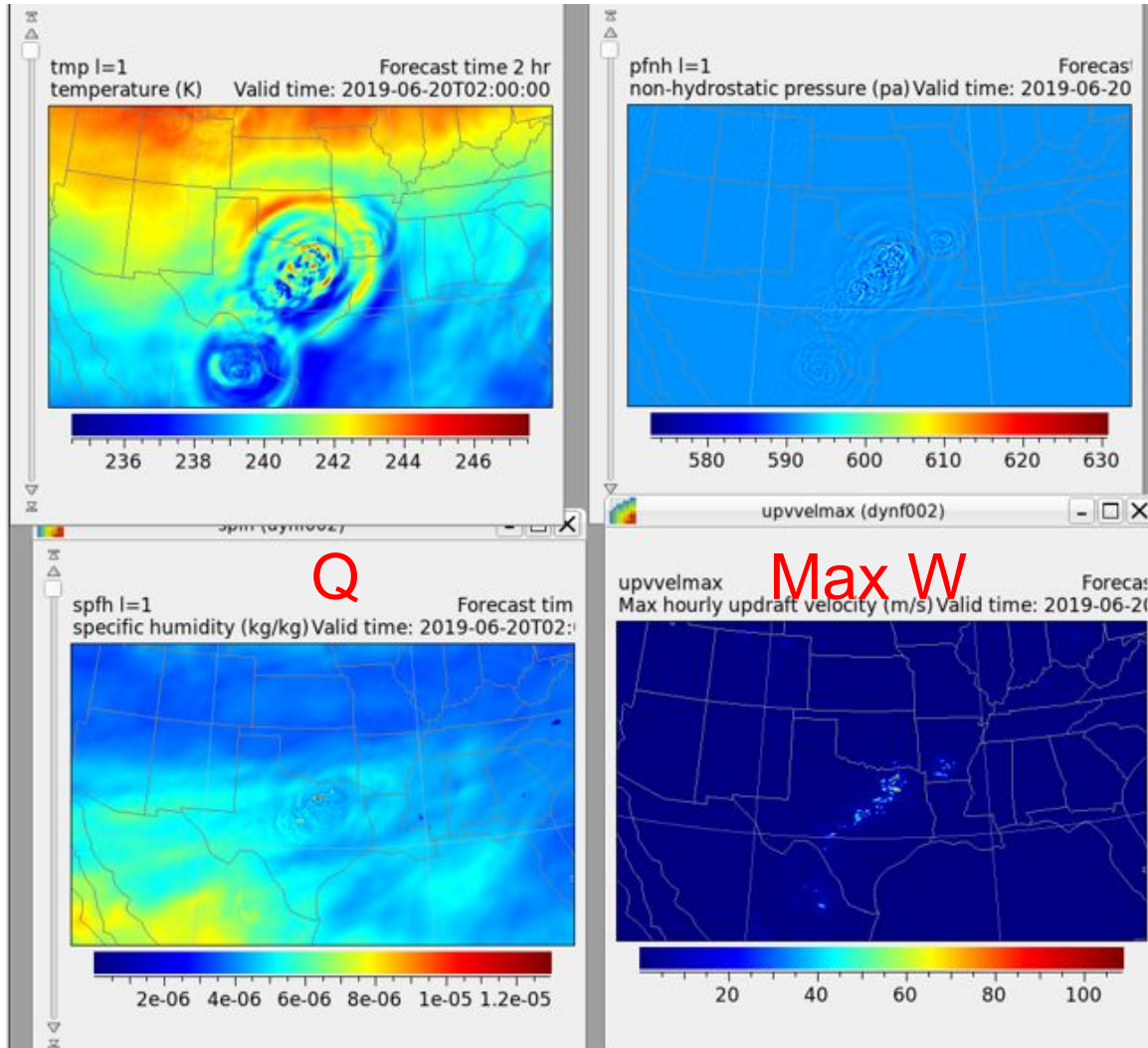
Running with Less Horizontal Diffusion

T

L = 1

P

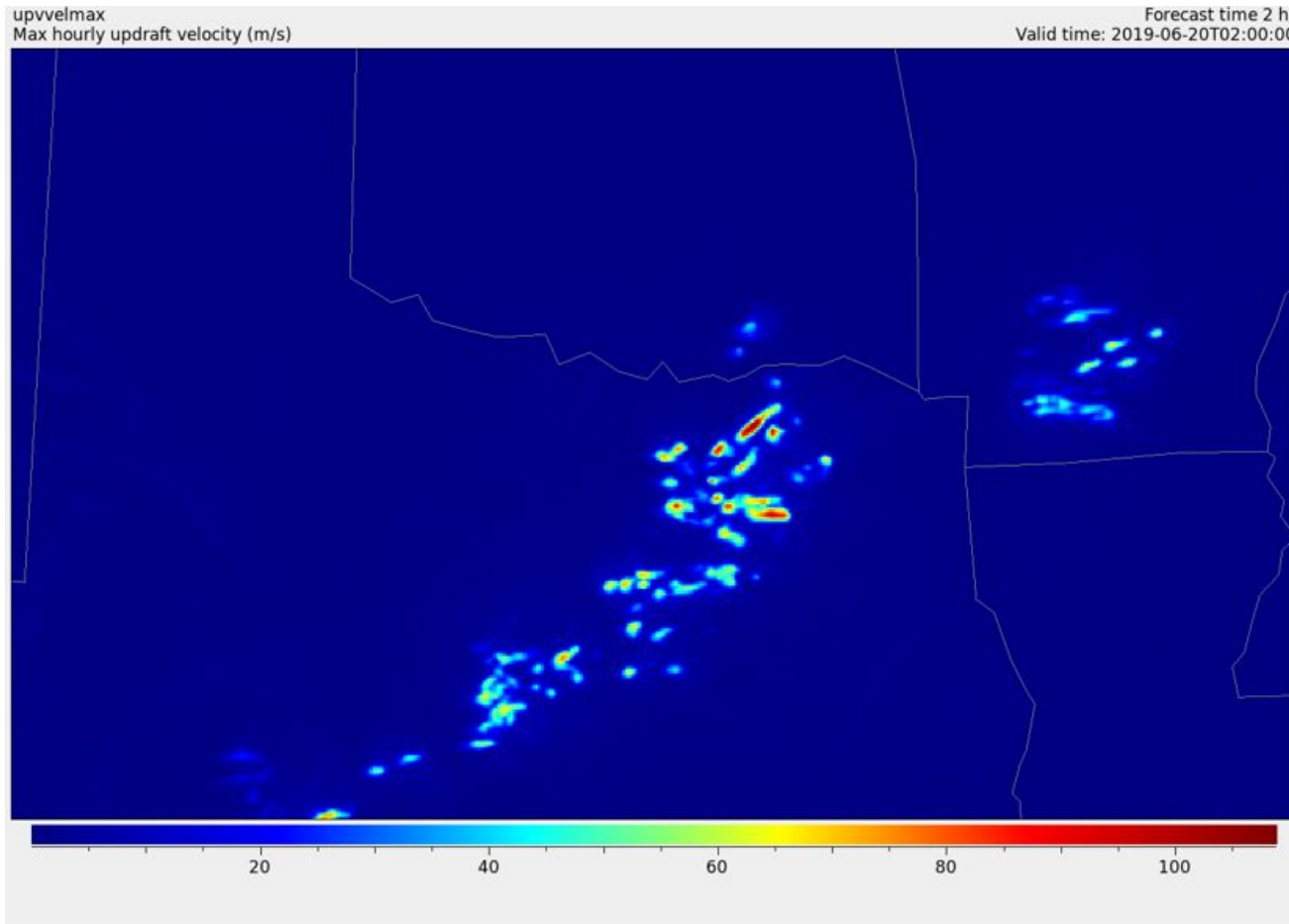
June 20 2019 @f02



- Hourly max upward vertical velocities > 100 m/s in last output time before model failure.
- Strong upward motions associated with deep convection in NE TX
- Deep convection impacts can be seen in T, q and p.

Running with Less Horizontal Diffusion

June 20 2019 @f02

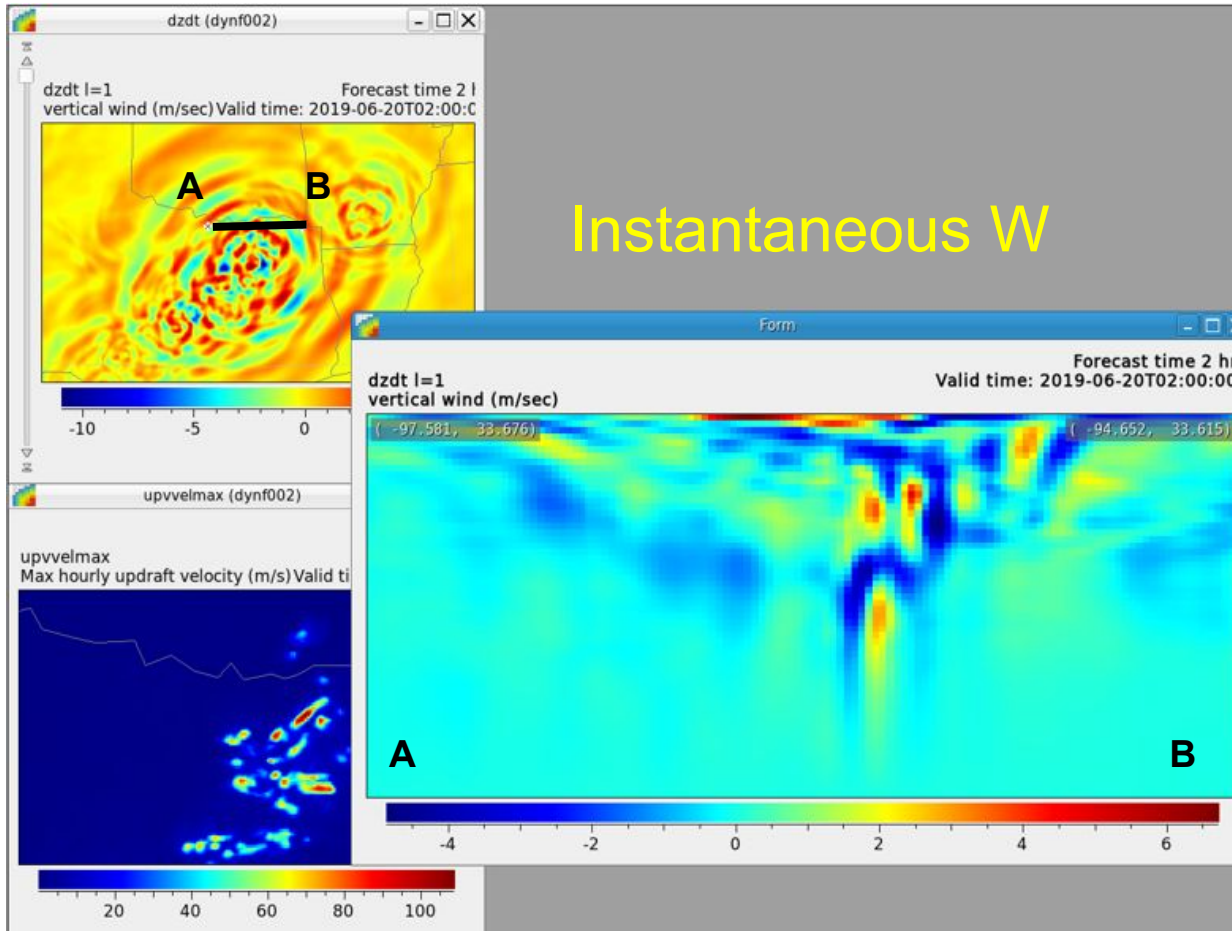


- Zoomed in plot of hourly max updrafts shows values near 110 m/s in NE TX.

Running with Less Horizontal Diffusion

$L = 1$

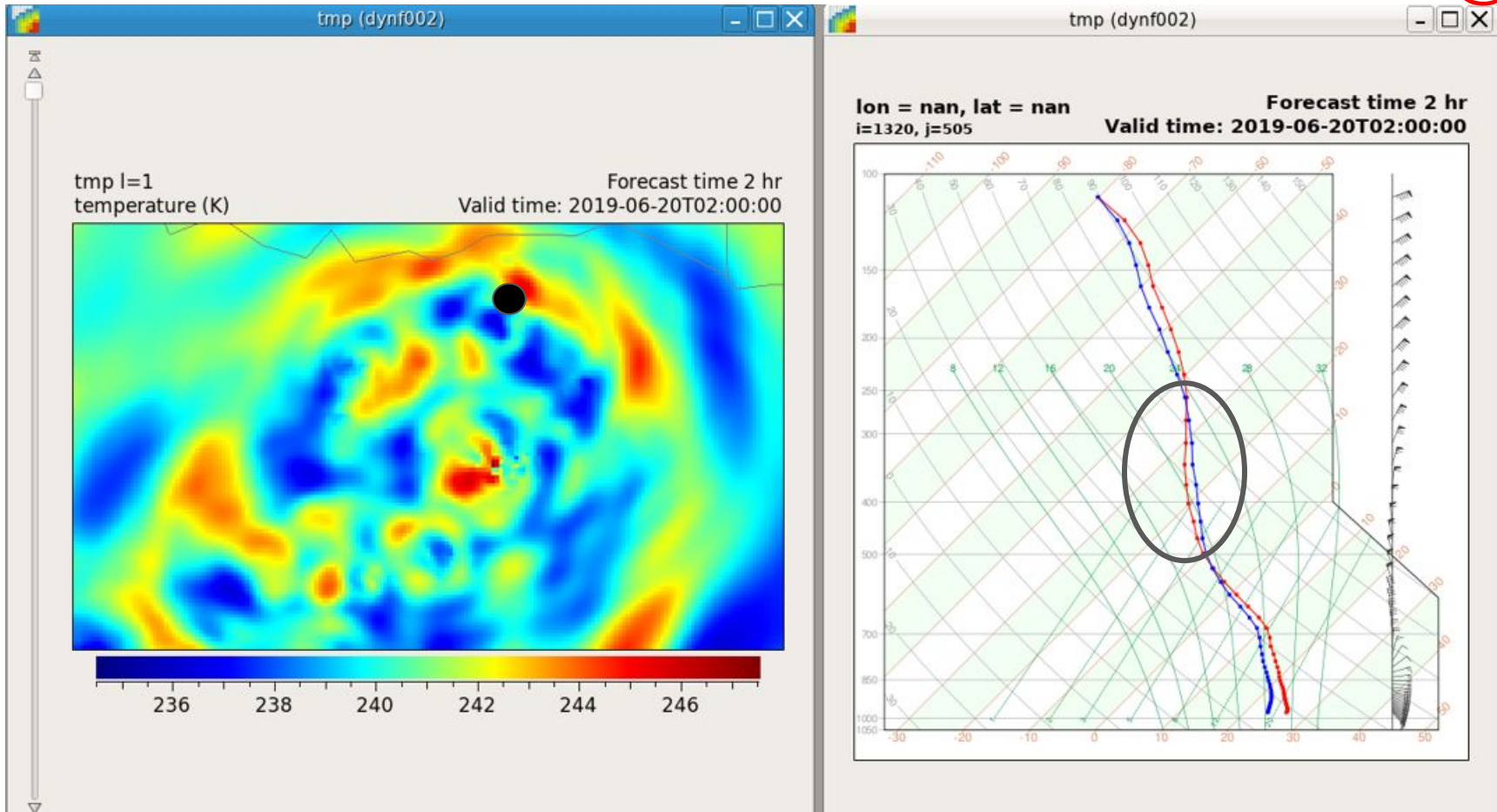
June 20 2019 @f02



- An east-west vertical cross section shows vertical velocities > 6 m/s at the very top of the model.
- Reflections?
- Changes needed to top sponge layer? More damping?

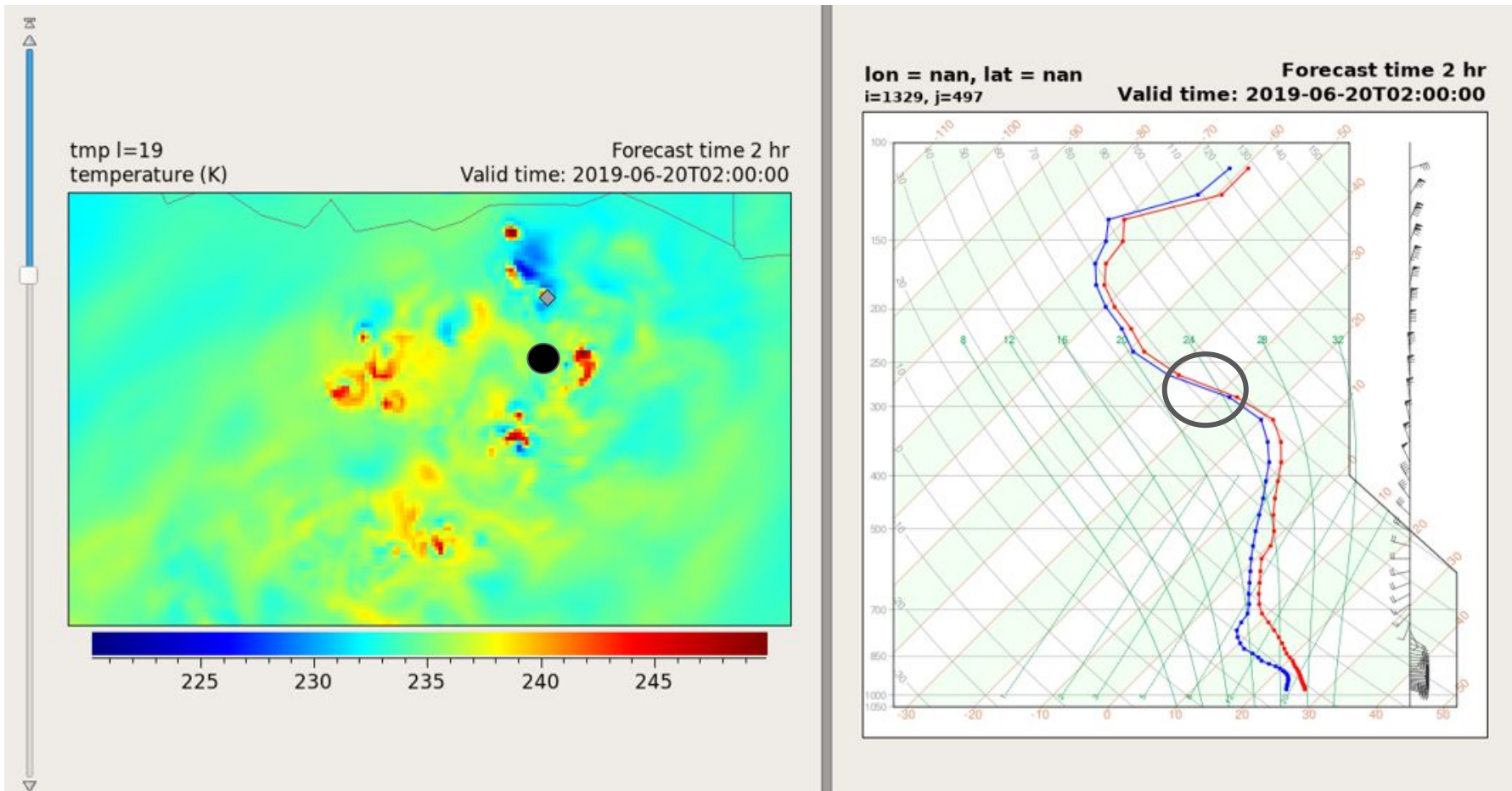
Running with Less Horizontal Diffusion

June 20 2019 @f02



- Supersaturation from 500 to 275 mb

Running with Less Horizontal Diffusion



- Moist Absolutely Unstable Profile from 300 to 250 mb?
- Stable run when vtdm4 was increased from 0.03 to 0.075, but higher value may damp the fine scale features.