Storm-Scale Ensemble Forecasting during NOAA 2019 HWT and HMT using SAR-FV3 with Multiple Physics

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In 2019, CAPS continued to play major role in the NOAA Hazardous Weather Testbed (HWT) Spring Forecast Experiment, and in the Hydro-Meteorological Testbed (HMT) Flash Flood and Intensive Rainfall (FFaIR) Experiment by producing convection-allowing storm-scale ensemble forecasts (SSEF) over the entire CONUS domain at 3-km grid spacing.

As NOAA NWS proceeds to build all of its future global and regional forecasting system based on the GFDL Finite Volume Cubed-Sphere (FV3) dynamic core, CAPS ran two sets of SAR-FV3 based SSEF at CAM resolution of about 3km. SAR-FV3 is a stand alone regional version of FV3 to contribute to NOAA 2019 HWT CLUE and HMT FFaIR.

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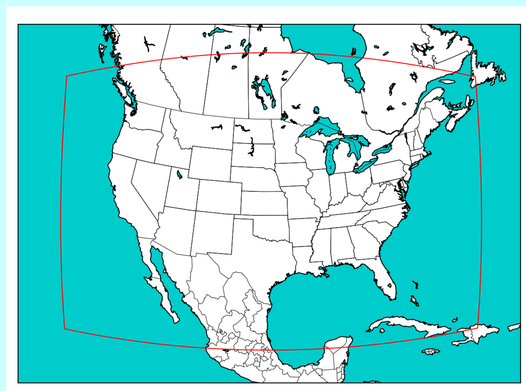
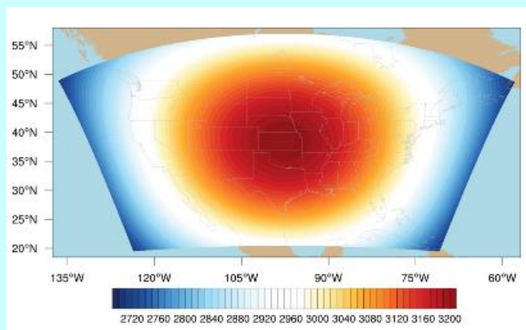
CONUS domain (1921x1297, at 3-km)





Bottom: color shades indicating grid spacing in meter.

2019 CAPS SAR-FV3 Members

One ensemble (*core* or *phys*) uses NAM as background and different PBL, microphysics, surface layer and LSM

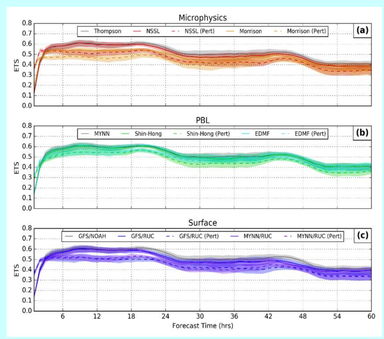
Member	IC/LBC	Microphysics	PBL	SFC layer	LSM
core-cntl	NAM	Thompson	SA-MYNN	GFS	NOAH
core-pbl1	NAM	Thompson	SA-ShinHong	GFS	NOAH
core-pbl2	NAM	Thompson	EDMF	GFS	NOAH
core-mp1	NAM	NSSL	SA-MYNN	GFS	NOAH
core-mp2	NAM	Morrison-Gettelman	SA-MYNN	GFS	NOAH
core-lsm1	NAM	Thompson	SA-MYNN	GFS	RUC
core-sfcl1	NAM	Thompson	SA-MYNN	MYNN	RUC

One ensemble (*pert*) uses NAM plus IC/LBC perturbations from EMC SREF and different physics combination

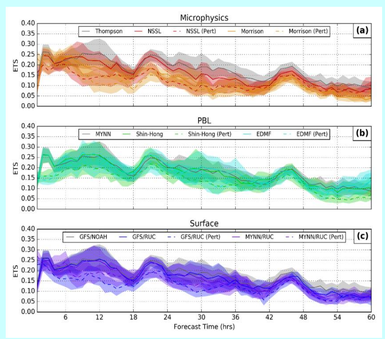
Member	IC/LBC	Microphysics	PBL	SFC layer	LSM
pert-pbl1	NAM+SREF-ARW (n1)	Thompson	SA-ShinHong	GFS	NOAH
pert-pbl2	NAM+SREF-ARW (p2)	Thompson	EDMF	GFS	NOAH
pert-mp1	NAM+SREF-ARW (p1)	NSSL	SA-MYNN	GFS	NOAH
pert-mp2	NAM+SREF-ARW (n2)	Morrison-Gettelman	SA-MYNN	GFS	NOAH
pert-lsm1	NAM+SREF-ARW (p3)	Thompson	SA-MYNN	GFS	RUC
pert-sfcl1	NAM+SREF-ARW (n3)	Thompson	SA-MYNN	MYNN	RUC

ETS & BIAS in Neighborhood (60km radius)

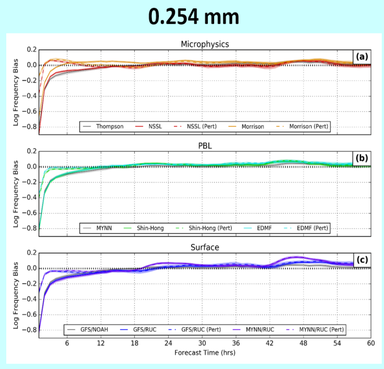
0.254 mm



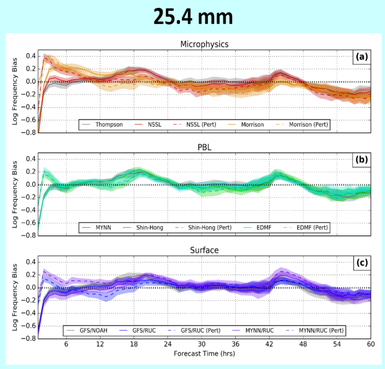
25.4 mm



0.254 mm



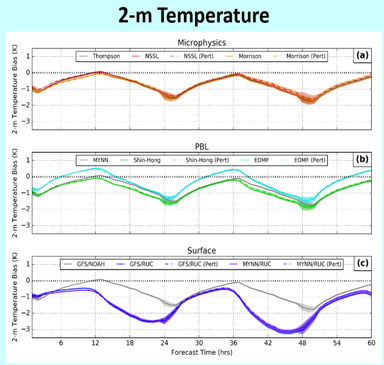
25.4 mm



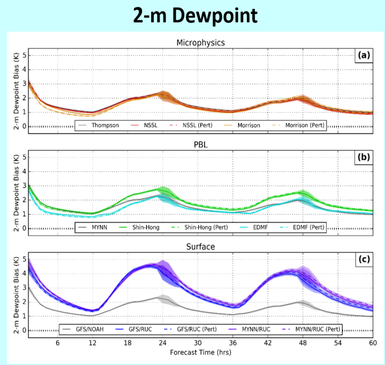
Verification for 1-h accumulated precipitation over a 60km neighborhood radius, with 5-95th percentile bootstrapping. Top: ETS (GSS); Bottom: Frequency Bias.

2m Temperature/Dewpoint bias

2-m Temperature

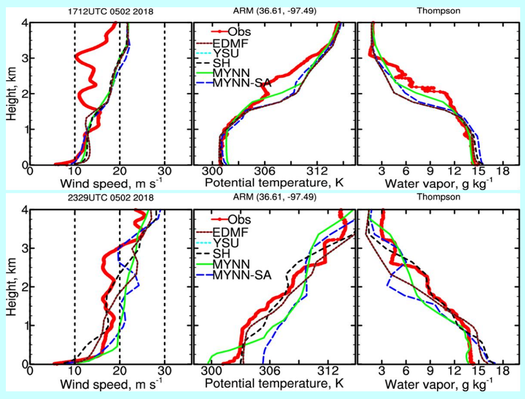


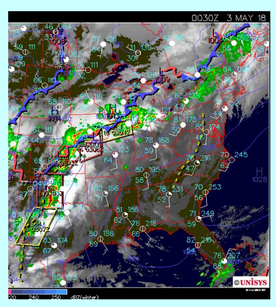
2-m Dewpoint



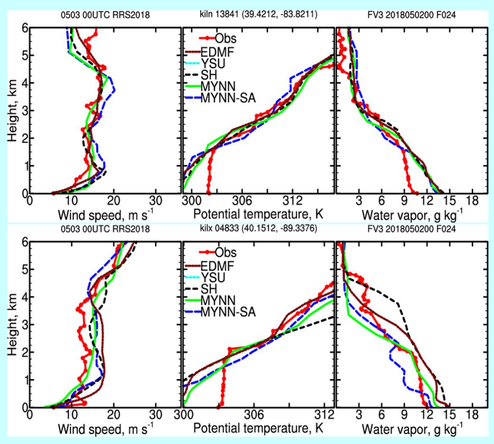
Temperature is generally cold-biased, and dewpoint is moist-biased.

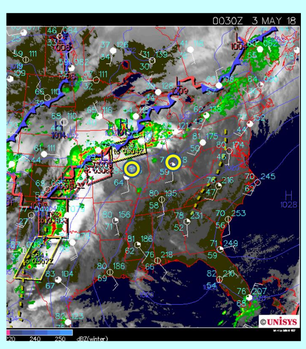
Bias vs ARM & RRS sounding





Compare with ARM, good under clear sky. In presence of cloud and precipitation, large discrepancy between different member

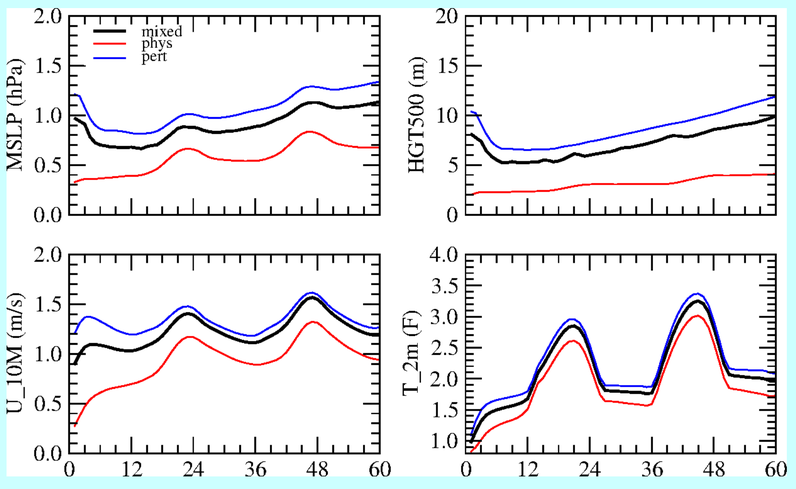




KILN and KILX are marked using circles

Cold bias at 00z (lead time 24 hr) shows up in the Mid-west

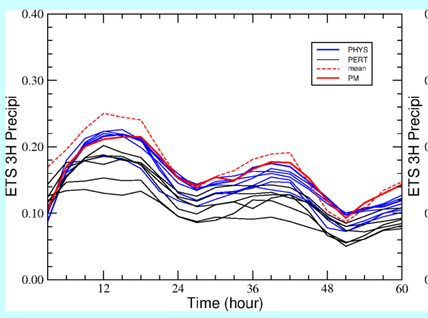
SAR-FV3 Ensemble Spread



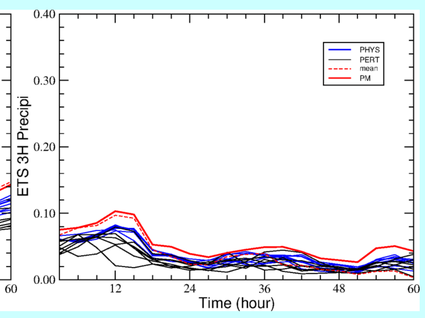
- *'pert' sub-ensemble has larger spread than 'phys' sub-ensemble*
- *The spread of the Combined ('mixed') ensemble is in between*

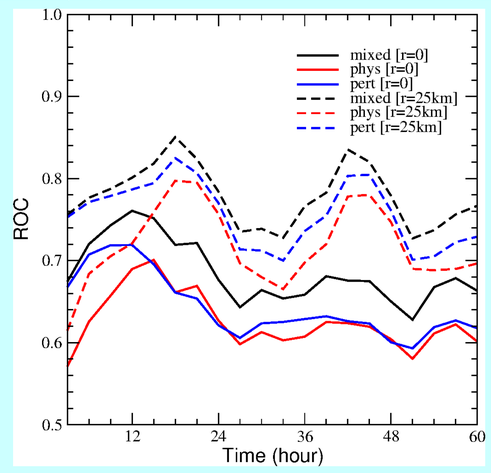
'*pert*' ensemble generally underscores the '*phys*' ensemble in ETS of 3-h precip, but scores better than the later in AUROC. The '*mixed*' has the highest AUROC

0.01"

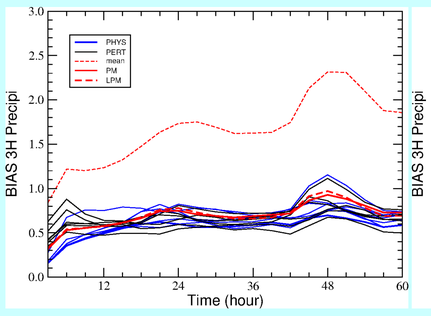


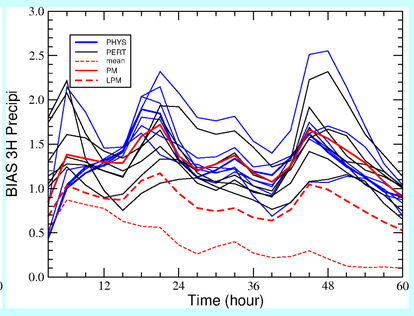
0.5"





Frequency Bias – 3-h rainfall





BIAS of 3-h accumulated precipitation ≥0.01 (left), and ≥0.5 inch (right).

Summery

- **SAR-FV3 2m temperature cold-biased, and dewpoint moist-biased, esp. in presence of cloud and precipitation**
- **Ensemble with IC/LBC perturbations show larger spread than physics-only ensemble**
- **'pert' members have lower ETS, but higher AUROC than 'phys' members**
- **Morrison micrphysics in current SAR-FV3 version has the lowest ETS, may suggest implementation problem**