

Toward improved initial conditions for NCAR's real-time convection-allowing ensemble

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Can an EnKF be used to initialize a convectionallowing ensemble to produce skillful next-day predictions of convection?

Different than other storm-scale ensemble designs Ensemble analysis (DART), continuously cycled (WRF) Large nest domain to 'push' lateral boundary condition uncertainty away from area of forecast interest Single WRF physics suite with explicit representation of

convection (identify and mitigate model errors)



$$\mathbf{X}_{\mathsf{a}} = \mathbf{X}_{\mathsf{f}} + \mathbf{K}[\mathbf{y}^{\mathsf{0}} - \mathbf{H}\mathbf{X}_{\mathsf{f}}]$$





NCAR ensemble domains



GFS + perturbations

Lower boundary: free forecast land surface, fixed sea state during integration

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Observations used in the analysis system



 ^{50°N} Routine observations from a variety of
^{45°N} sources, not uniformly distributed in type or
^{40°N} time.

Simplified observation
suite compared to
operational prediction
centers.

No radiances are



Accessible ensemble forecast information

http://ensemble.ucar.edu

Upper-Air

Surface / Precip

CAR

0.00 0.01

NCAR Ensemble Forecasts Initialized: 00 UTC Thu 24 Dec 2015

Ens Mean 48-hr Precip Ens Mean 48-hr Snowfall

Ens Mean 48-hr Sleet

System

webpage

every 30th grid point



Severe

Winter

0.75 1.00 1.25 1.50 2.00 3.00 4.00 5.00 6.00

Hourly-Max

Domains

7.00 8.00 9.00 10.00 11.00 12.00

Forecasts sponsored by the National Science Foundation, National Center for Atmospheric Research/Mesoscale and Microscale Meteorology Laboratory, and Computational Information Systems Laboratory About these Forecasts II Analysis System Statistics II Verification II System Status II FAQ II Contact us: ensemble (at) ucar (dot) edu

0.50

0.05 0.10 0.25



Forecast reliability (2013 system): 12-36 hour precipitation





Forecast reliability (2015 system): 12-36 hour precipitation





Ensemble forecast verification

Init: Mon 2016-05-16 00 UTC Day 1 prob. of UH > 75 m2/s2 w/ NWS warnings Valid: Mon 2016-05-16 12 UTC - Tue 2016-05-17 12 UTC de tra Harl 8 1 SCV G. 0.02 0.05 0.10 0.15 0.20 0.25 0.35 0.45 0.60 ensemble.ucar.edu



Ensemble forecast verification

Forecast reliability (2013 system): Severe weather events





How can we improve reliability of forecasts?

1. Post-processing methods

Need large sample of past cases for rare events

2. Improvements to analysis system

Examine impact of inflation settings Test alternative inflation algorithms Do different spread techniques produce different patterns of uncertainty?



Multiplicative inflation experiments

Type of Inflation	Prior or Posterior Inflation
Anderson et al. (2009)	Prior (SD=0.7; damp=0.9)
Anderson et al. (2009)	Posterior (SD=0.7; damp=0.9)
Anderson et al. (2009)	Prior+Posterior (SD=0.7; damp=0.9)
Whitaker and Hamill RTPS	Posterior ($\alpha = 1.24$ and 1.0)

Retrospective testing with cycled EnKF system from 27 April – 31 May 2015





















Ongoing work to improve analysis system (2016)

Inflation experiments: better tuning for inflation settings Assess impact on 12-36 hour ensemble forecast skill.

EnKF cloud analysis (dx ~ 3 km) on the current prediction grid (2017 and beyond)

- 1-12 h prediction window, multiple times per day
- More frequent analyses (at least hourly)
- Utilize radar, satellite, lightning, mesonet observations
- Awaiting next supercomputer: Cheyenne



Analysis system ensemble size increased from 50 to 80 members.

Introduction of spread restoration – to be discussed

Began assimilating GPS RO datasets

Real-time analysis mean innovations

August 2015 mean analysis innovations (O-F) for 00 UTC



Classic MYJ bias across plains and southeast US, opposite of this in other areas.

Real-time analysis mean innovations

December 2015 mean analysis innovations (O-F) for 00 UTC



Slight cool bias in December but regional variability, dry along Gulf Coast







Fractions skill score: Severe weather events

