The Experimental Regional Ensemble Forecast (ExREF) System

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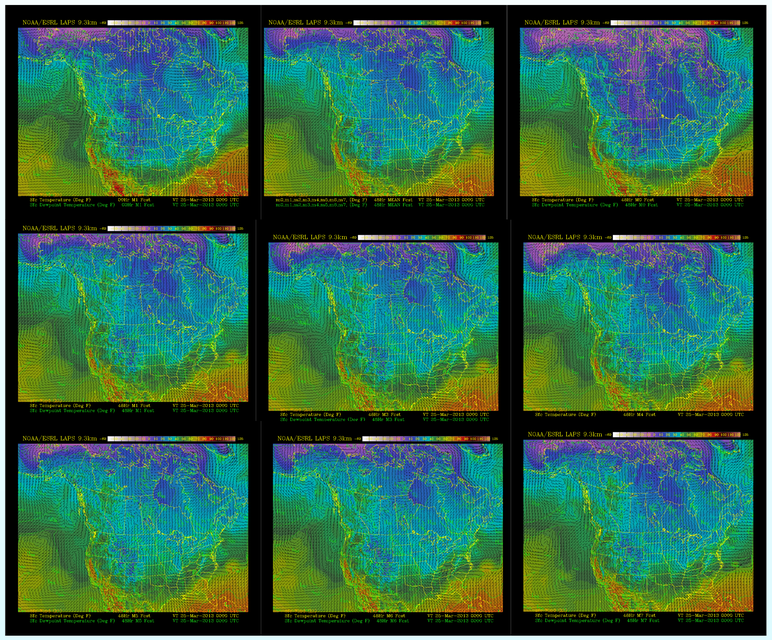
Overview

http://www.esrl.noaa.gov/exref/hmt.html

- ExREF is a near-real time experimental ensemble used as a proving ground for development and testing of new ensemble methodologies.
- If successful, these techniques can be transitioned to operations.



Surface temperature, dewpoint, and winds analysis and 48-h forecasts (mean and members)

Ensemble Configuration

- 9-km grid spacing over most of North America
- Forecast length 84 h
- Initialized four times a day using
  - Global Forecast System (GFS)
  - Local Analysis and Prediction System (LAPS; laps.noaa.gov)
  - Dynamically Downscaled (DD) perturbations of GEFS
- Boundary Conditions: Global Ensemble Forecast System (GEFS)
- Microphysics: Thompson, Ferrier, WSM6

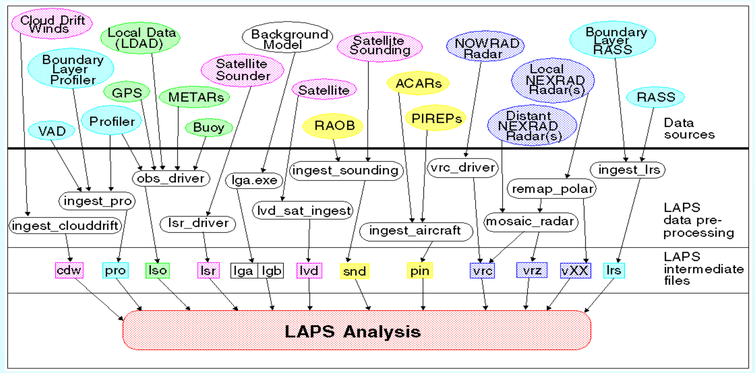
	IC	BC	MP
m0	GFS	GFS	Thompson
m1	TLAPS	GFS	Thompson
m2	DD_1	$GEFS_1$	Ferrier
m3	DD_2	$GEFS_2$	WSM6
m4	DD_3	$GEFS_3$	Thompson
m5	DD_4	$GEFS_4$	Ferrier
m6	DD_5	$GEFS_5$	WSM6
m7	VLAPS	GFS	Thompson

The ensemble uses a variety of initial and boundary conditions to represent uncertainty in the large scale fields.

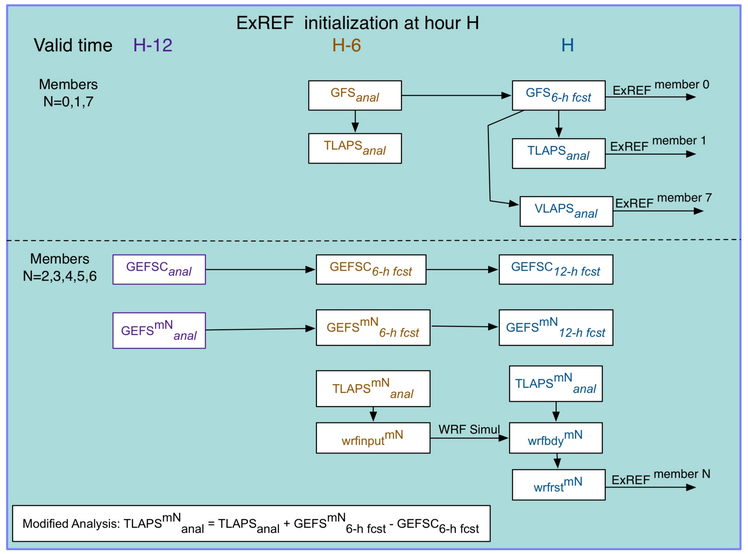
Microphysics diversity is also used as QPF is very sensitive to this parameterization.

Local Analysis and Prediction System (LAPS)

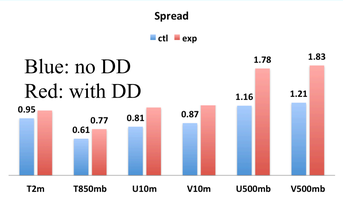
- Data assimilation system with two options provided
  - Traditional (Barnes analysis; TLAPS)
  - Variational (Multi-scale variational minimization; VLAPS)
- Employs a large-scale analysis as a first guess (for ExREF, uses GFS)
- Blends a variety of in-situ and remotely sensed data
- Has *hot start* capability to add clouds and vertical motion at t = 0

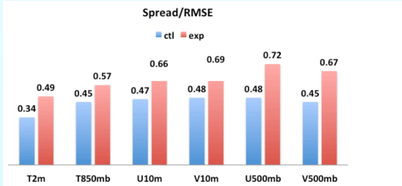


Dynamic Downscaling of Global Perturbations



Impact – Sept. 20 to Oct. 4, 2013



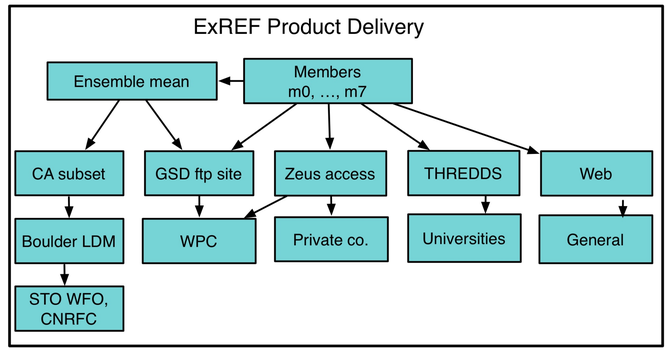


- Spread same or increased for all variables with DD
  - Increases more at upper levels where GEFS perturbations are larger
- Spread/RMSE improved about 40% for all variables and levels

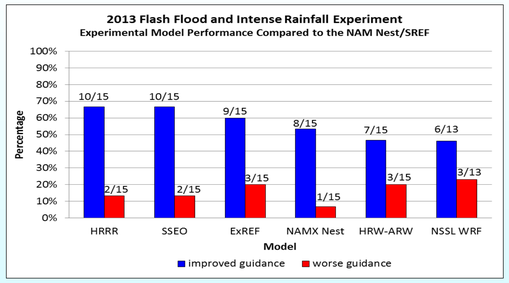
ExREF Collaborators

- NOAA ESRL/GSD
  - Runs ExREF in near-realtime
  - Develops new methods (e.g., dynamic downscaling of perturbations)
- NOAA Weather Prediction Center (WPC)
  - Tests at experiments (Flash Flood and Winter Weather)
- NOAA Hydrometeorology Testbed (HMT)
  - Uses ExREF for numerical guidance of extreme pcp events
- National Weather Service WFOs & CNRFC (Sacramento, CA)
  - Uses ExREF in AWIPS as forecaster tool
- NOAA Hazardous Weather Testbed
  - Evaluates relocatable domain (Spring Experiment 2014)

ExREF Distribution



Results from 2013 HMT-WPC Flash Flood Experiment



ExREF mean QPF was shown to consistently provide better forecast guidance than the operational SREF.

Future Work: HIRES

High-Impact Relocatable Ensemble System

- One- to three-km ensemble will be nested within ExREF and relocated daily according to the weather of interest.
- Initial deployment: relocatable single domain will be used during 2014 HWT spring experiment

Acknowledgments, References, and Contact

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Xie, Y., S. Koch, J. McGinley, S. Albers, P. E. Bieringer, M. Wolfson, and M. Chan, 2011. A space-time multi- scale analysis system: A sequential variational analysis approach. *Mon. Wea. Rev.*, **139**, 1224–1240.

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This work was partially supported by the US Weather Research Program.
Thank you to NASA SPORT for assisting in getting the EXREF into AWIPS I and AWIPS II for STO and CNRFC.