JOINT ENSEMBLE FORECAST SYSTEM (JEFS) PROJECT UPDATE

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1. Introduction

The Air Force Weather Agency (AFWA) in conjunction with the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and other organizations have embarked on a joint venture to explore the feasibility of providing robust stochastic weather forecasts through ensemble forecasting systems to their respective Department of Defense (DoD) customers (Condray and Addison 2006). This venture, called the Joint Ensemble Forecast System (JEFS) project, is designed to test the value, utility, and operational feasibility of ensemble forecasting to DoD operations. A major component of JEFS prototype is the Joint Mesoscale Ensemble (JME), which consists of both Weather Research and Forecasting - Advanced Research WRF (WRF-ARW) members and the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) members. This abstract provides an overview of how the JEFS project incorporates WRF into a prototype mesoscale ensemble forecast system and serves as an update to last year's WRF Users' Workshop presentation.

2. Joint Mesoscale Ensemble (JME) Description

a. *Overview*

For the last few years, AFWA has partnered with the National Center for Atmospheric Research (NCAR) to develop AFWA JME members. AFWA began running and post-processing the JME in real-time during the Fall of 2007.

b. *JME Theater Design*

Currently AFWA operates two JME theaters (East Asia and Southwest Asia). East Asia (Figure 1) was chosen as the primary geographic area of study, since it contains challenging weather and a wide assortment of DoD assets. It is an excellent region to prove the value of ensembles to DoD operations. As part of JEFS, FNMOC and AFWA are generating 10 JME members each (10 WRF-ARW and 10 COAMPS, respectively) for the East Asian domain. AFWA is working to combine members from each center to create a 20 member JME.

Southwest Asia (SWA), also, remains an area of interest for DoD operations. AFWA is running 10 WRF-ARW JME members over the SWA theater (Figure 2).

c. AFWA's JME *Member Configuration*

To account for model uncertainty, AFWA JME members consist of various model versions (i.e., different combinations of physics packages), and perturbations to surface boundary parameters (e.g. sea surface temperature, soil moisture, soil temperature, roughness length, and albedo – see Table 1). To account for initial condition uncertainty, AFWA JME members cycle WRF-VAR and the ETKF every 12 hours on the 45-km domain.

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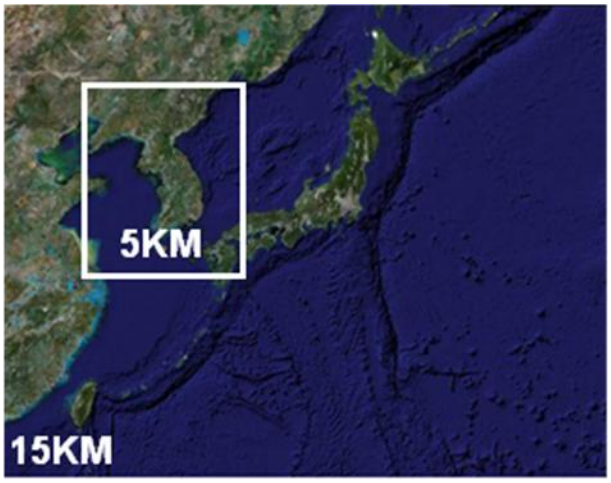

Figure 1. Nested domains of the JME over East Asia: 15-km over East Asia the 5-km inner nest over the Korean Peninsula (45-km nest not shown).

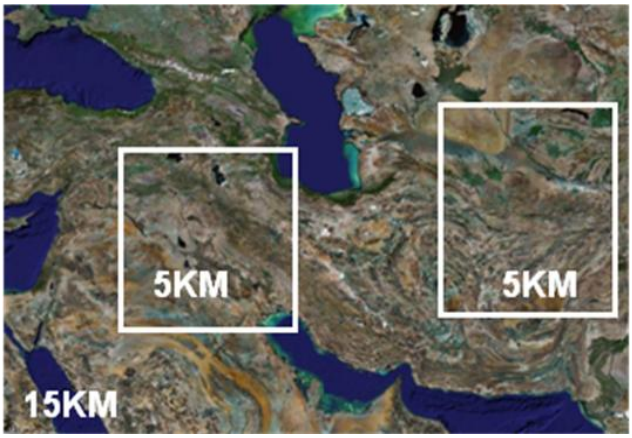

Figure 2. Nested domains of the JME over Southwest Asia: 15-km over Southwest Asia and two 5-km inner nests over the Iraq and Afghanistan (45-km nest not shown).

d. *Calibration & Verification*

AFWA continues to work towards employing post-processing calibration techniques with JME output. Techniques will address both the first moment (bias) and second moment (spread) of the estimated probability density function (PDF). In particular, the observation based gridded bias correction and Bayesian Model Averaging (BMA) techniques, developed by University of Washington through NCAR will be applied to JME output as soon as time permits (Raftery, et al. 2005). AFWA is currently verifying AFWA JME output at point locations using typical ensemble verification tools, such as: reliability diagrams, verification rank histograms, brier skill score, and etc.

4. Military Application

By far, the most practical purpose of the JEFS project will be the testing and evaluation of ensemble forecasting on military applications. Several operational forecasting units have begun analyzing JME forecasts in both forecast decision processes and operational decision making. This ongoing analysis will continue through the end of 2008. The lessons learned will have profound impacts on the future direction of Air Force Weather and likely benefit the greater weather community, as well.

5. Summary

AFWA is taking large steps towards understanding how to make mesoscale ensembles a reality to forecasters and forecast users. WRF, as a major component of the JME, is making this happen.

6. References

Condray, M. and V. Addison, 27 September 2006: *Joint Ensemble Forecast System (JEFS) Memorandum of Agreement (MOA).*

Raftery, E. T. Gneiting, F. Baladaoui, and M. Polakowski, 2005: Using Bayesian Model Averaging to Calibrate Forecast Ensembles. *Monthly Weather Review*, **133**, 1155-1174.

Member	Surface	Microphysics	PBL	Cumulus	LW_RA	SW_RA	SST Pert	Landuse Pert
1	Thermal	WSM3	MRF	Grell	CAM	Dudhia	SST_pert03	LANDUSE01.TBL
2	Thermal	Eta	YSU	Grell	CAM	CAM	SST_pert04	LANDUSE10.TBL
3	Thermal	WSM6	MYJ	KF	RRTM	CAM	SST_pert05	LANDUSE03.TBL
4	Noah	Lin	MRF	KF	RRTM	CAM	SST_pert09	LANDUSE09.TBL
5	Noah	WSM5	YSU	KF	RRTM	Dudhia	SST_pert10	LANDUSE10.TBL
6	Noah	WSM5	MYJ	Grell	RRTM	Dudhia	SST_pert11	LANDUSE11.TBL
7	RUC	Lin	YSU	BM	CAM	Dudhia	SST_pert15	LANDUSE15.TBL
8	RUC	Eta	MYJ	KF	RRTM	Dudhia	SST_pert16	LANDUSE16.TBL
9	RUC	Eta	YSU	BM	RRTM	CAM	SST_pert17	LANDUSE17.TBL
10	RUC	WSM6	YSU	Grell	CAM	CAM	SST_pert18	LANDUSE18.TBL

Table 1. AFWA JME Member Configurations.