NAEFS Status and Future Plan

Yuejian Zhu

Ensemble team leader
Environmental Modeling Center
NCEP/NWS/NOAA

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North American Ensemble Forecast System (NAEFS)

International project to produce operational multi-center ensemble products

Bias correction and combines global ensemble forecasts from Canada & USA

Generates products for:
Weather forecasters
Specialized users
End users

Operational outlet for THORPEX research using TIGGE archive

The National Oceanic and Atmospheric Administration
of the United States,

The Meteorological Service of Canada and

The National Meteorological Service
of Mexico

Recognizing the importance of scientific and technical international cooperation in the field of meteorology for the development of improved global forecast models;

Considering the great potential of model diversity to increase the accuracy of one to fourteen day probabilistic forecasts;

Noting the significant international cooperation undertaken to develop and implement an operational ensemble forecast system for the benefit of North America and surrounding territories;

The signatories, hereby inaugurate the North American Ensemble Forecast System at Camp Springs, Maryland, USA, on this 16th Day of November 2004.

Statement

The North American Ensemble Forecast System (NAEFS) combines state of the art weather forecast tools, called ensemble forecasts, developed at the US National Weather Service (NWS) and the Meteorological Service of Canada (MSC). When combined, these tools (a) provide weather forecast guidance for the 1-14 day period that is of higher quality than the currently available operational guidance based on either of the two sets of tools separately; and (b) make a set of forecasts that are seamless across the national boundaries over North America, between Mexico and the US, and between the US and Canada. As a first step in the development of the NAEFS system, the two ensemble generating centers, the National Centers for Environmental Prediction (NCEP) of NWS and the Canadian Meteorological Center (CMC) of MSC started exchanging their ensemble forecast data on the operational basis in September 2004. First NAEFS probabilistic products have been implemented at NCEP in February 2006. The enhanced weather forecast products are generated based on the joint ensemble which has been undergone a statistical post-processing to reduce their systematic errors.

NAEFS Current Status

Updated: February 13 2013

	NCEP	CMC	NAEFS
Model	GFS	GEM	NCEP+CMC
Initial uncertainty	ETR	EnKF	ETR + EnKF
Model uncertainty/Stochastic	Yes (Stochastic Pert)	Yes (multi-physics and stochastic)	Yes
Tropical storm	Relocation	None	
Daily frequency	00,06,12 and 18UTC	00 and 12UTC	00 and 12UTC
Resolution	T254L42 (d0-d8)~55km T190L42 (d8-16)~70km	600*300 (66km) L72	1*1 degree
Control	Yes	Yes	Yes (2)
Ensemble members	20 for each cycle	20 for each cycle	40 for each cycle
Forecast length	16 days (384 hours)	16 days (384 hours)	16 days
Post-process	Bias correction (same bias for all members)	Bias correction for each member	Yes
Last implementation	February 14th 2012	February 13 2013	

NAEFS (FNMOC) Grid Exchange Variables

Update: July 12 2010

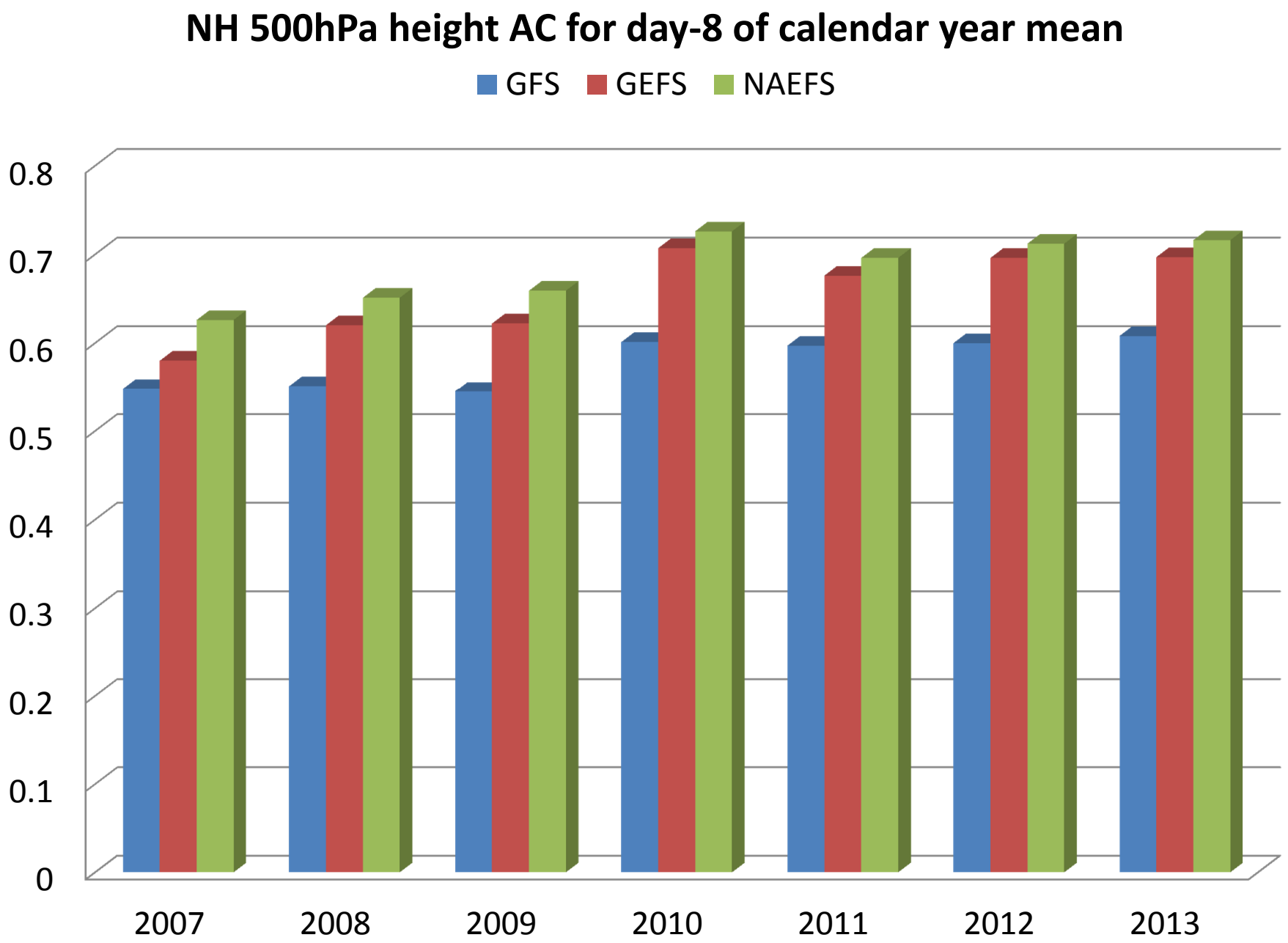
Variables	Pgrba file	Total 80/73
GHT	Surface, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	11/(11)
TMP	2m, 2mMax, 2mMin, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	13/(13)
RH	2m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	11/(11)
UGRD	10m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	11/(11)
VGRD	10m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	11/(11)
PRES	Surface, PRMSL	2/(2)
PRCP	APCP, CRAIN, CSNOW, CFRZR, CICEP	5/(4)
FLUX (surface)	LHTFL, SHTFL, DSWRF, DLWRF, USWRF, ULWRF	6/(2)
FLUX (top)	ULWRF (OLR)	1/(1)
PWAT	Total precipitable water at atmospheric column	1/(1)
TCDC	Total cloud cover at atmospheric column	1/(1)
CAPE	Convective available potential energy, Convective Inhibition	2/(2)
SOIL/SNOW	SOILW(0-10cm) , TMP(0-10cm down), WEASD(water equiv. of accum. Snow depth), SNOD(surface)	4/(1)
Other	850 hPa vertical velocity	1/(1)
Notes	Original NAEFS grids currently being sent to NCEP by FNMOC, Require model change to add. (future plan) Not available	FNMOC=72

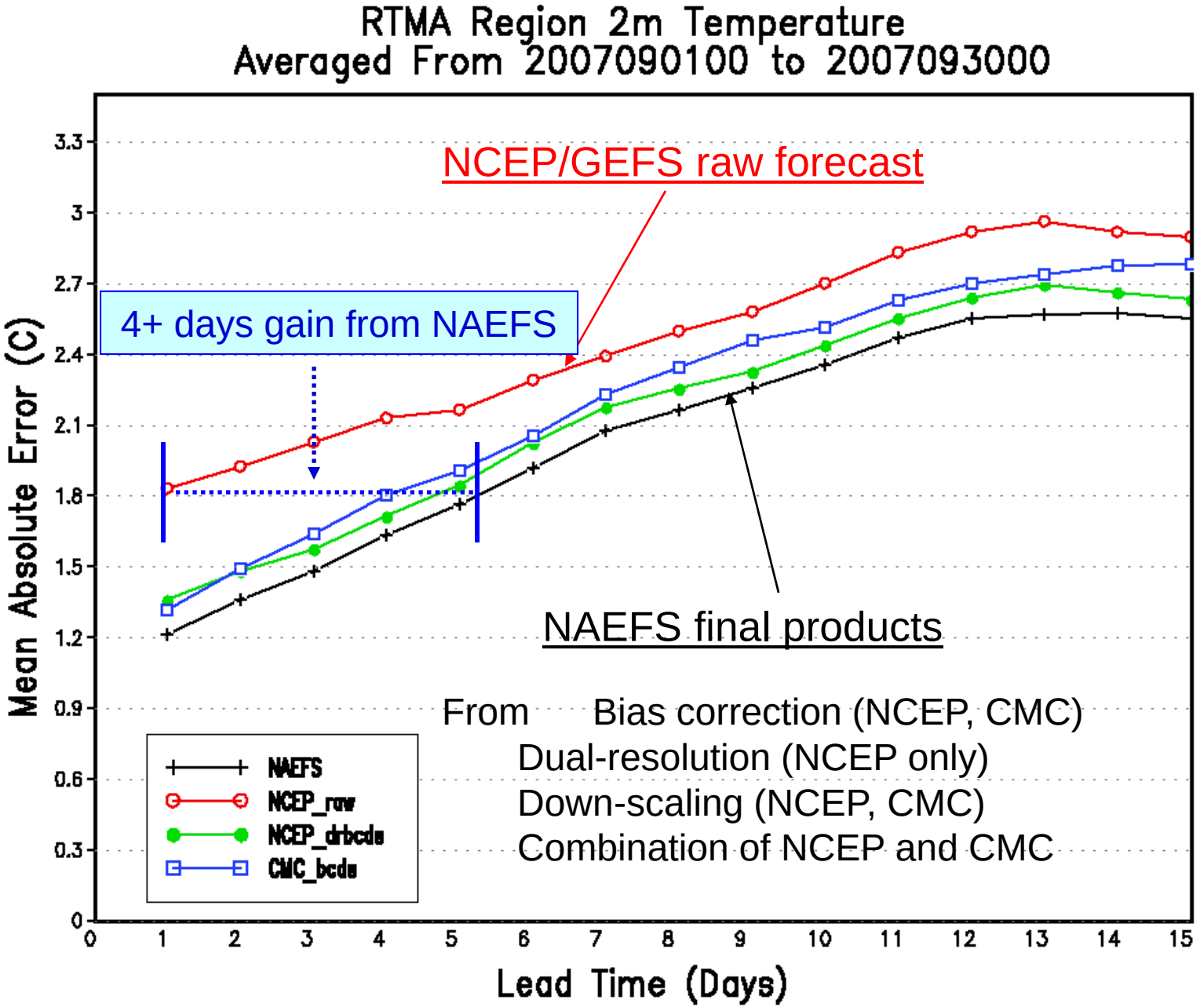
NAEFS Bias Correction Variables

Variables	pgrba_bc file	Total 49
GHT	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000hPa	10
TMP	2m, 2mMax, 2mMin, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000hPa	13
UGRD	10m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000hPa	11
VGRD	10m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000hPa	11
VVEL	850hPa	1
PRES	Surface, PRMSL	2
FLUX (top)	ULWRF (toa - OLR)	1

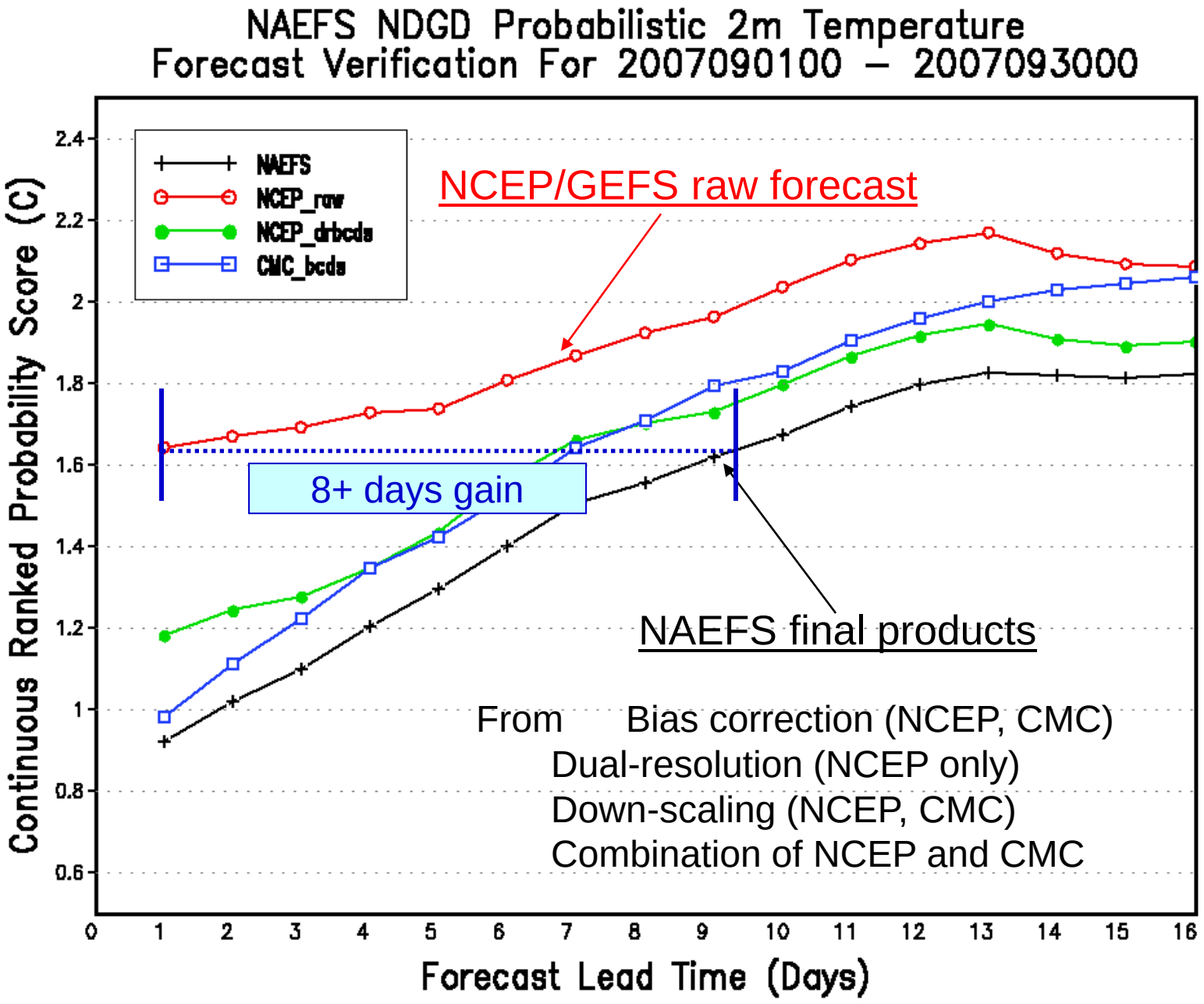
NAEFS Downscaled Variables

Variables	Domains	Resolutions	Total 10/8
Surface Pressure	CONUS/Alaska	5km/6km	1/1
2-m temperature	CONUS/Alaska	5km/6km	1/1
10-m U component	CONUS/Alaska	5km/6km	1/1
10-m V component	CONUS/Alaska	5km/6km	1/1
2-m maximum T	CONUS/Alaska	5km/6km	1/1
2-m minimum T	CONUS/Alaska	5km/6km	1/1
10-m wind speed	CONUS/Alaska	5km/6km	1/1
10-m wind direction	CONUS/Alaska	5km/6km	1/1
2-m dew-point T	CONUS/Alaska	5km/6km	1/1
2-m relative humidity	CONUS/Alaska	5km/6km	1/1


NH 500hPa height AC for day-8 of calendar year mean
GFS
GEFS
NAEFS
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007
2008
2009
2010
2011
2012
2013



BO CUI, GCWMB/EMC/NCEP/NOAA



BO CUI, GCWMB/EMC/NCEP/NOAA

Future Plans

- Improving numerical forecast system
  - Resolutions
  - Initial perturbations
  - Model uncertainties (include surface perturbations)
- NAEFS extension
  - Increasing memberships (and models)
  - Extended to 30 days to cover week 3&4
  - Coupling ocean-atmosphere
- Post processing
  - Real time reforecast
  - Improving methodologies
  - Higher moment calibration
- International collaboration
  - WMO/WCRP and THORPEX legacy project - S2S, HIW
  - Other centers

North American Climate Services Partnership

Strategic Work Plan, 2013 – 2016

- **FOCUS AREA 1: Rio Grande-Rio Bravo (RGB) Regional Pilot Area**
- **FOCUS AREA 2: Great Lakes Regional Pilot Area**
- **FOCUS AREA 3: North American Ensemble Forecast System (NAEFS)**
- **FOCUS AREA 4: North American Seasonal Forecast System (NASFS)**
- **FOCUS AREA 5: North America Drought Monitor (NADM)**

FOCUS AREA 3: North American Ensemble Forecast System (NAEFS)

- To improve Operational day 1-16 predictions for North America by combining different Ensemble Prediction Systems into a super Ensemble.
  - Objective 3.1. Ensemble forecast system comparison
  - Objective 3.2. Exchange higher resolution (0.5 degree) ensemble forecast data
  - Objective 3.3 Development/improvement of common post process for multi-model ensemble
  - Objective 3.4. Development and assessment specialized products useful for decision makers (e.g. probabilistic forecasts)
  - Objective 3.5. Expand the Data exchange to the Regional Ensemble Systems

MSC-NWS Engagement Strategy

- Data exchange (radar, satellite and model output)
  - NAEFS expansion of data exchange to regional ensemble systems
- Monitoring systems (radar, upper air)
- Modeling (taking NAEFS to longer term forecasts)
  - NAEFS expansion to 30 day forecasts
  - NAEFS expansion of regional ensemble systems

7th NAEFS workshop

- 1st NAEFS workshop
  - May 1-2, 2003, Montreal, Canada
- 2nd NAEFS workshop
  - Nov 16-18, 2004, Camp Springs, MD
- 3rd NAEFS workshop
  - May 24-25, 2006, Montreal, Canada
- 4th NAEFS workshop
  - Oct 6-8, 2008, Camp Springs, MD
- 5th NAEFS workshop
  - May 17-19, 2010, Jiutepec, Morelos, México
- 6th NAEFS workshop
  - May 1-3, 2012, Monterey CA
- 7th NAEFS workshop (plan)
  - June 17-19, 2014, Montreal Canada

Summary of 6th NAEFS workshop

1-3 May, 2012 Monterey, CA

6th NAEFS workshop was held in Monterey, CA during 1-3 May 2012. There were about 50 scientists to attend this workshop whose are from Meteorological Service of Canada, Mexico Meteorological Service, UKMet, NAVY, AFWA and NOAA.

Following topics have been presented and discussed during workshop:

- Review the current status of the contribution of each NWP center to NAEFS
- For each NWP center, present plans for future model and product updates, for both the base models and ensemble system (including regional ensembles)
- Decide on coordination of plans for the overall future NAEFS ensemble and products (added variables, data transfer for increased resolution grids, FNMOC ensemble added to NAEFS, especially for mesoscale ensemble-NAEFS-LAM)
- Learn about current operational uses of ensemble forecast guidance, including military and civilian applications.