



The NOAA Operational Numerical Guidance System:

N **C** Recent Changes and Moving Forward

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William. M. Lapenta
Acting Director
Environmental Modeling Center

NOAA/NWS/NCEP

**Geoff DiMego , John Derber , Yuejian Zhu , Hendrik Tolman , Vijay Tallapragada,
Shrinivas Moorthi , Mike Ek , Mark Iredell , Suru Saha**



Presentation Outline



- **Why NOAA Conducts Operational Numerical Weather Prediction**
- **The NOAA Operational Numerical Guidance Suite**
 - **Computational Aspects**
 - **Data Assimilation System**
 - **Global Forecast Systems**
 - **CONUS Mesoscale**
- **Moving The Suite Forward**
 - **Emphasis on global systems**
- **Questions**



NOAA Operational Numerical Guidance Supports the Agency Mission



– Numerical Weather Prediction at NOAA

➤ Related to ability to meet service-based metrics (below)

– National Weather Service GPRA* Metrics

(* Government Performance & Results Act)

➤ Hurricane Track and Intensity

➤ Winter Storm Warning

➤ Precipitation Threat

➤ Flood Warning

➤ Marine Wind Speed and Wave Height

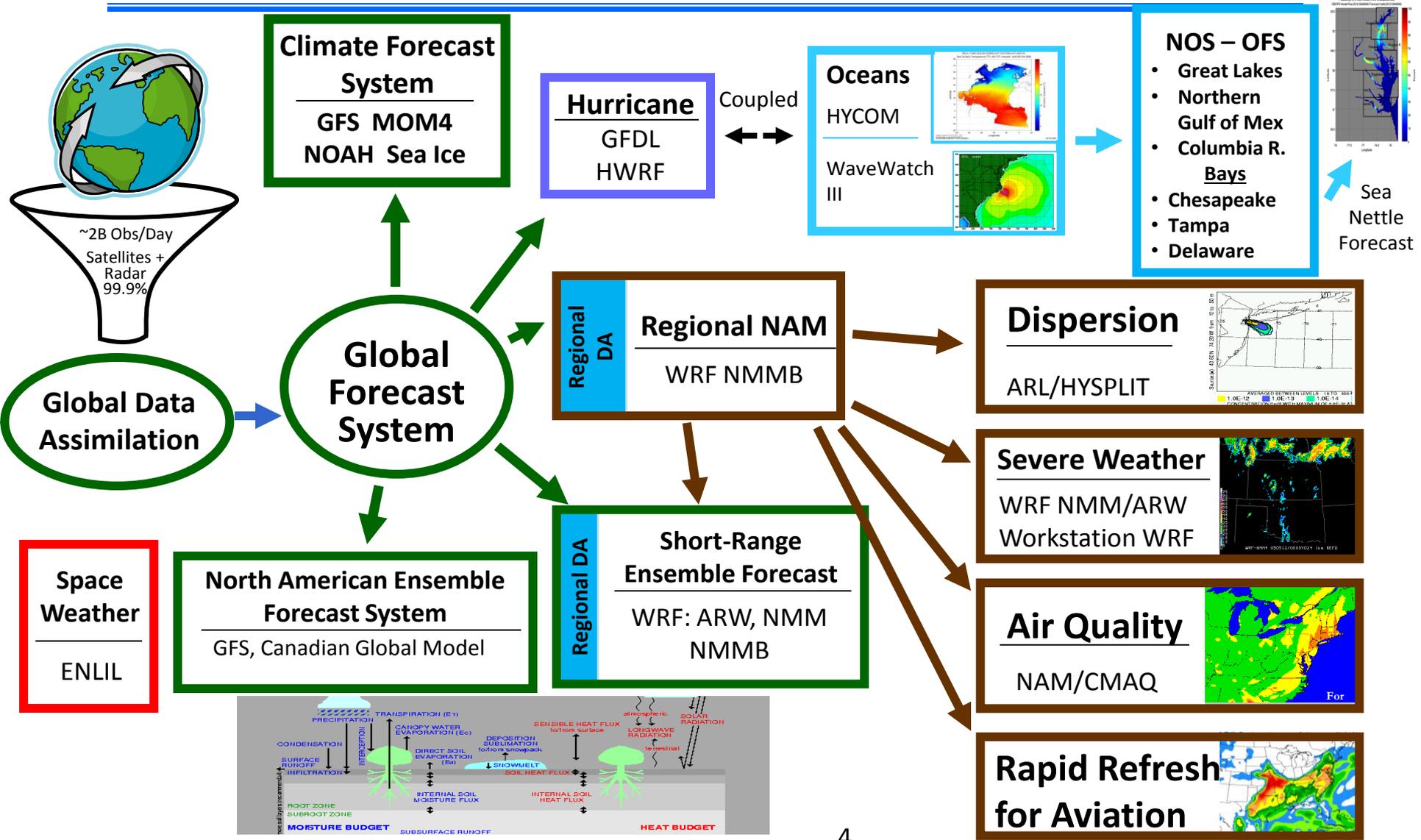
Lead Time
and
Accuracy!

– Customer Service Provider

➤ Operational numerical guidance provides foundational tools used by Government, public and private industry to improve public safety, quality of life and make business decisions that drive US economic growth



NOAA's Operational Numerical Guidance Suite

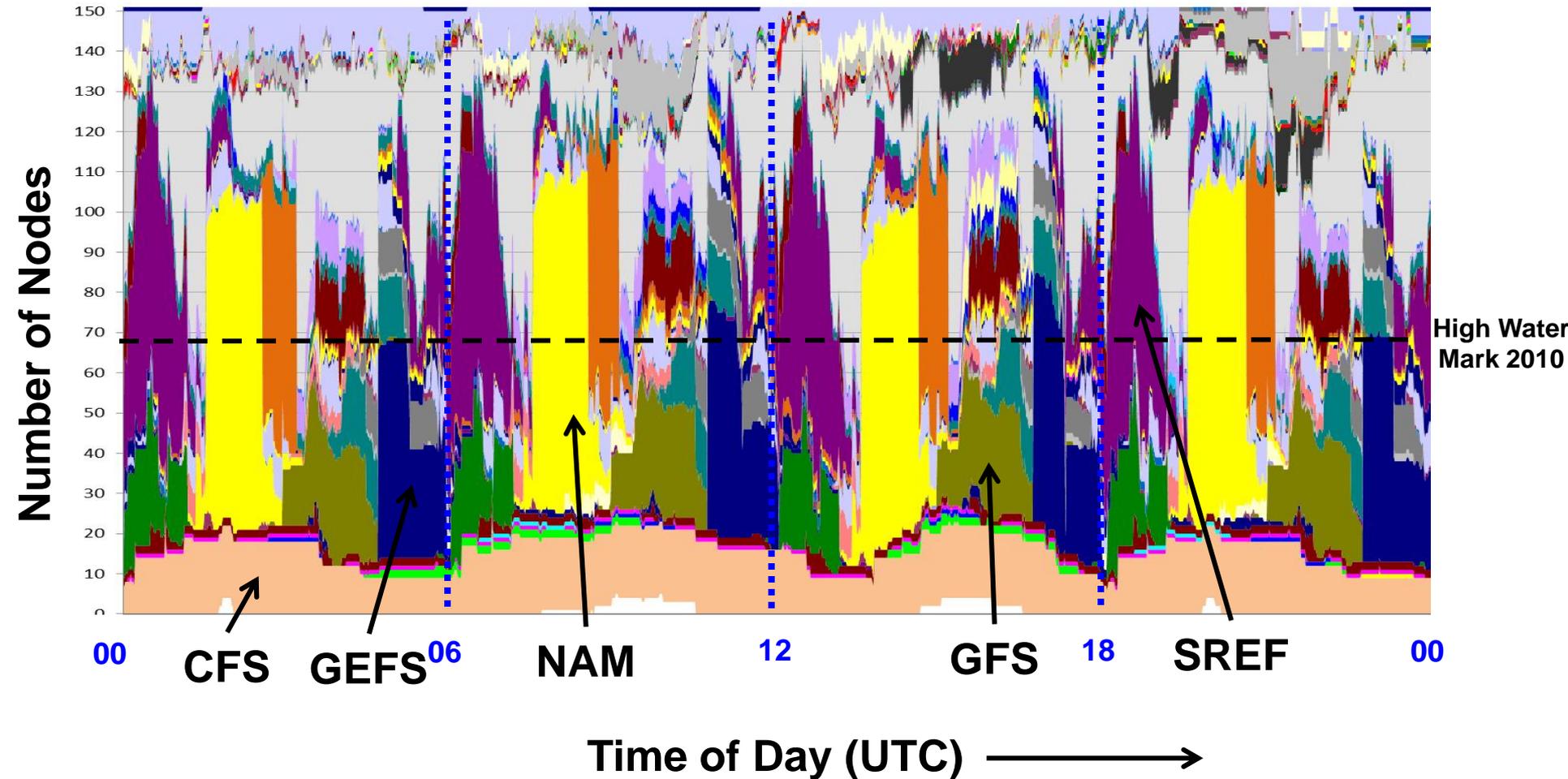




Numerical Guidance Suite Execution on the Operational NOAA Supercomputer



24-h Snapshot 20 August 2012

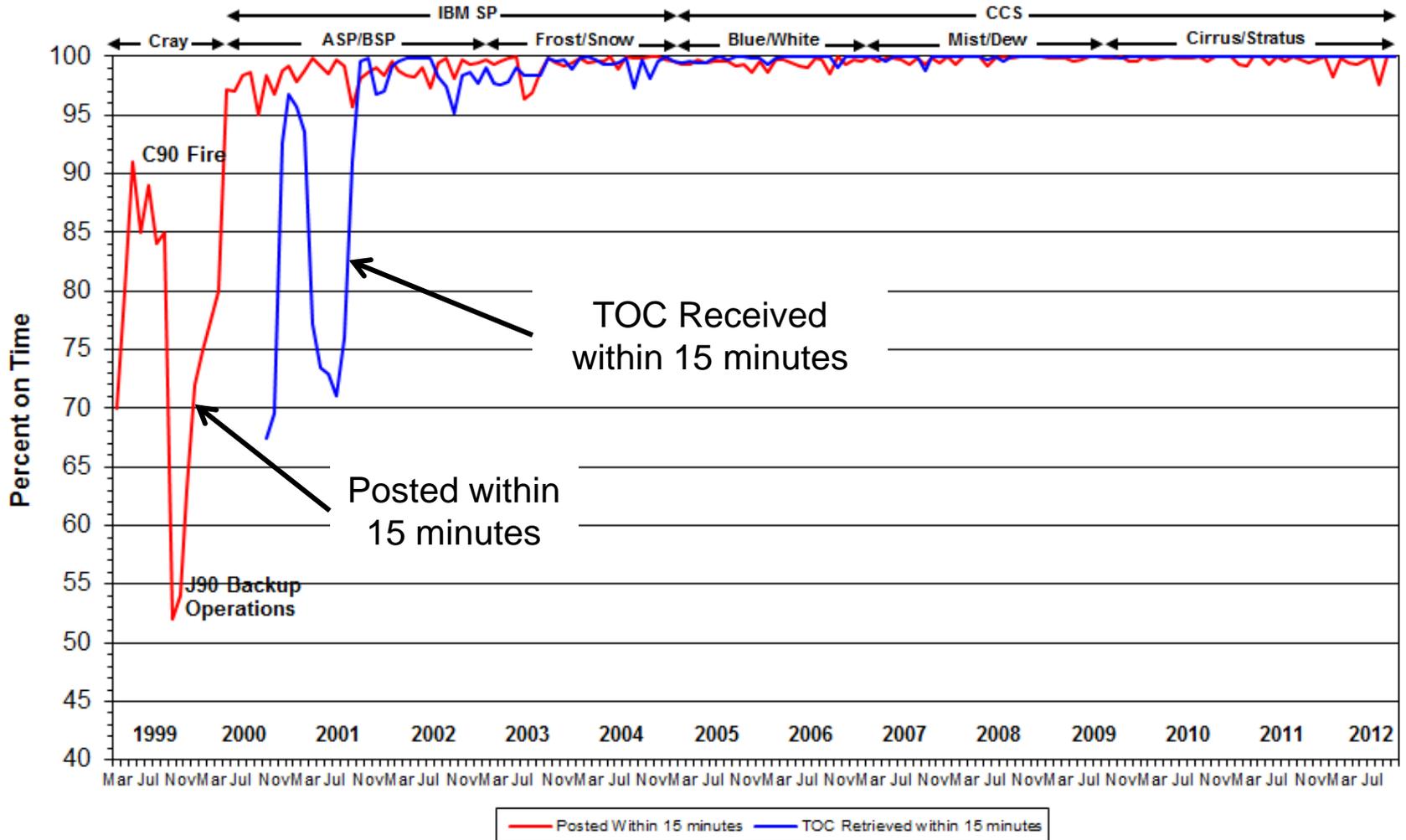




NOAA Operational Product Delivery: Reliable, Timely and Accurate....



Emphasis on Customer Service





Global Data Assimilation System Upgrade



Implemented 22 May 2012

- **Hybrid system**
 - Most of the impact comes from this change
 - Uses ensemble forecasts to help define background error
- **NPP (ATMS) assimilated**
 - Quick use of data 7 months after launch
- **Use of GPSRO Bending Angle rather than refractivity**
 - Allows use of more data (especially higher in atmos.)
 - Small positive impacts
- **Satellite radiance monitoring code**
 - Allows quicker awareness of problems (run every cycle)
 - Monitoring software can automatically detect many problems
- **Partnership between research and operations**
 - (NASA/GMAO, NOAA/ESRL, Univ OK, and NOAA/NCEP)
- **Consolidation across systems**
 - Unify operational data assimilation system for global, regional and hurricane applications
 - Cost effective—O&M
 - Configuration management



NCEP Closing the International Gap

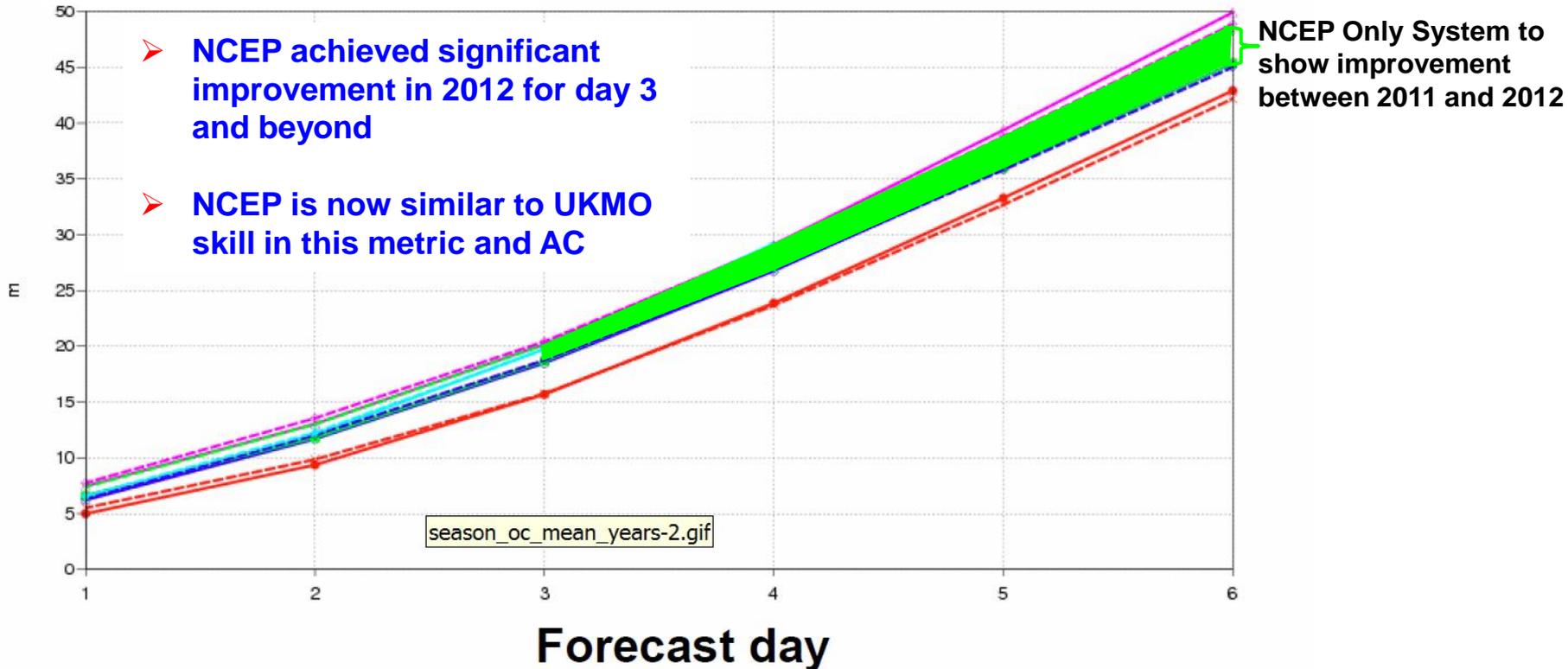
June, July, August 500hPa Geopotential RMSE



Comparison with other forecasting centres

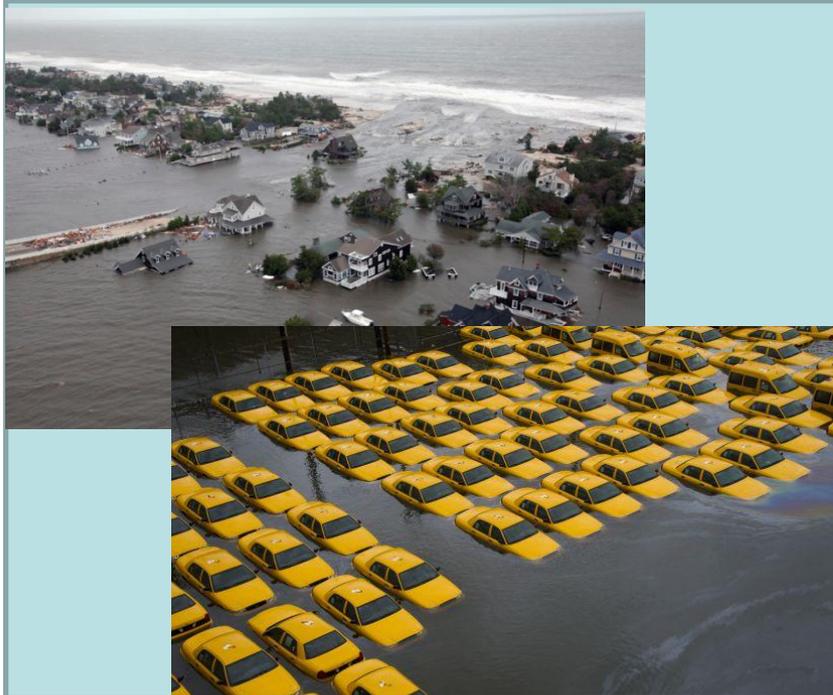
500hPa geopotential
Root mean square error
NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)

	2011	2012	
Meteo-Fr			Solid line lower than dashed indicates improvement between 2011 and 2012
CMC			
NCEP			
UKMO			
ECMWF			





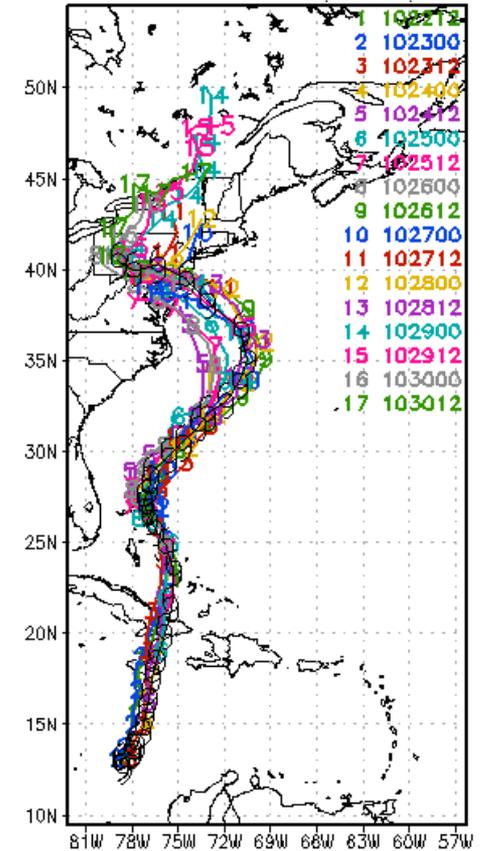
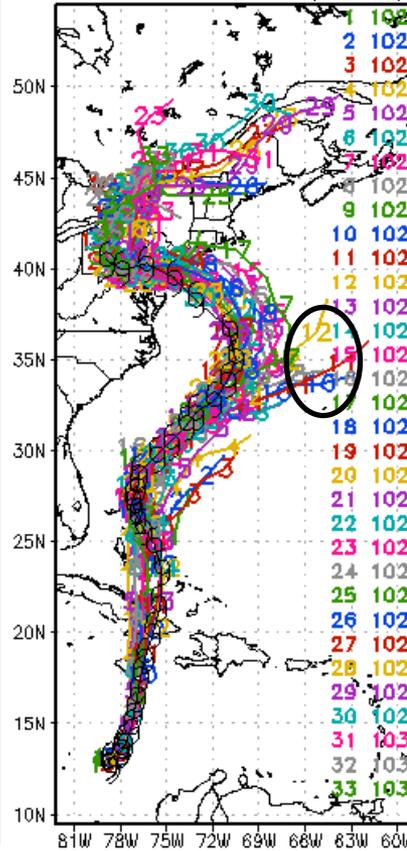
Global Model Track Guidance for Hurricane Sandy



Sequence of 5-day forecasts 22 October to 30 October 2012

NCEP GFS

ECMWF





Planned GFS/GDAS 2014 Operational Upgrade



- **Next window of opportunity for GDAS/GFS upgrade**
 - **Nov 2013 to May 2014**
 - **Follows WCOSS Moratorium**
- **Model configuration**
 - **T1148 Semi-Lagrangian, L64 (~16km)**
 - **Physics upgrades for the radiation and precipitation parameterizations**
- **Data assimilation upgrade**
 - **3D-En-Var Dual Resolution**
 - **80-member ensemble at 27-km and a 16-km analysis with 64 vertical levels**
 - **New and enhanced observations**
 - **Cloudy Radiance**
 - **Satellite winds**
 - **CrIS from NPP**
 - **METOP-B**
 - **SSM/I/S GPS-RO enhancements**
 - **New integrated bias correction**
 - **Water Vapour analysis enhancements**
 - **Climatological CO₂, Methane, Nitrous Oxide and CO for input in CRTM**
 - **Consistent cloud water retrieval in quality control**



Global Ensemble Systems and Multi-Ensemble Systems



Parameter	NCEP	CMC	NAEFS
Model	GFS	GEM	NCEP+CMC
Initial uncertainty	ETR	EnKF	ETR + EnKF
Model uncertainty/Stochastic	Yes (Stochastic Pert)	Yes (multi-physics)	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	(d0-d16) ~ 66km	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 Upgrade	February 14 th 2012	August 17 th 2011	

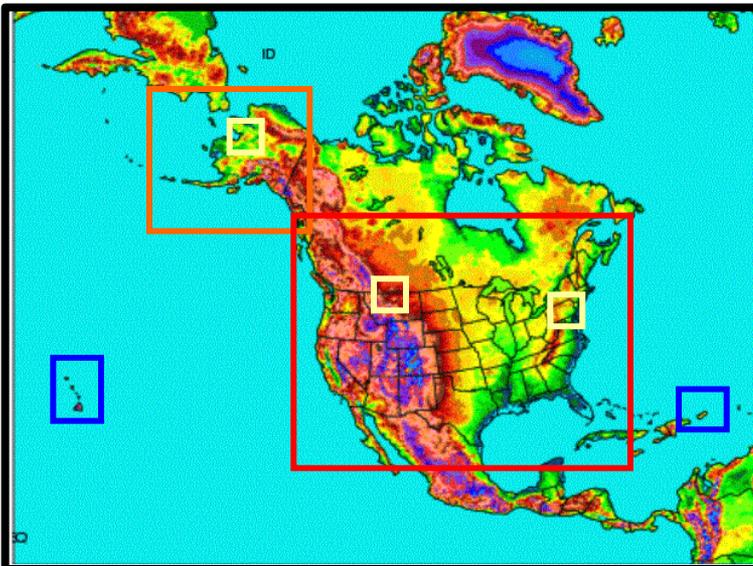


Operational Mesoscale Modeling for CONUS:



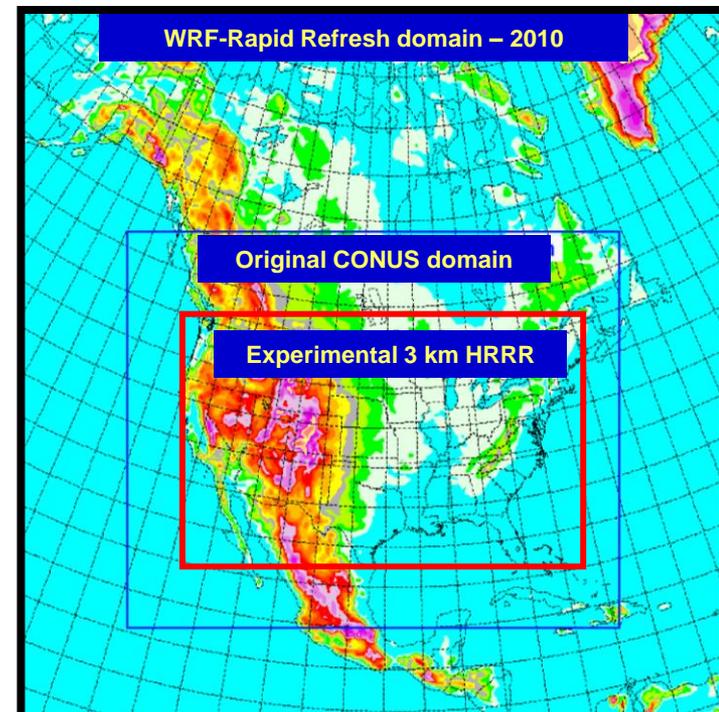
North America Model (NAM)

- *Implemented 18 October 2011*
- NEMS based NMM
- Outer grid at 12 km to 84hr
- Multiple Nests Run to ~48hr
 - 4 km CONUS nest
 - 6 km Alaska nest
 - 3 km HI & PR nests
 - 1.3km DHS/FireWeather/IMET



Rapid Refresh (RAP)

- *Implemented 1 May 2012*
- WRF-based ARW
- Use of GSI analysis
- Expanded 13 km Domain to include Alaska
- Experimental 3 km HRRR





NOAA Center for Weather and Climate Prediction: “A Game Changer”



A.K.A.—the new building....

- **Four-story, 268,762 square foot building in Riverdale, MD will house 800+ Federal employees, and contractors**
 - **5 NCEP Centers (NCO, EMC, HPC, OPC, CPC)**
 - **NESDIS Center for Satellite Applications and Research (STAR)**
 - **NESDIS Satellite Analysis Branch (SAB)**
 - **OAR Air Resources Laboratory**
- **Includes 465 seat auditorium & conference center, library, deli, fitness center and health unit**
- **Includes 40 spaces for visiting scientists**
- **Represents a “Game Changer” in our ability to do business**

