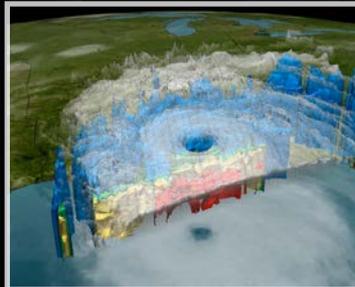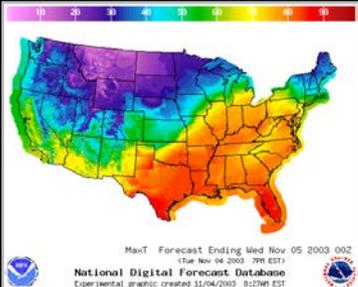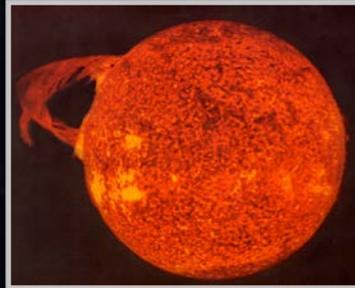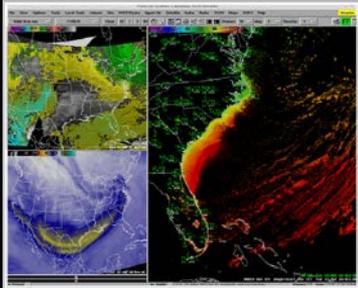# National Centers for Environmental Prediction: Building a Weather-Ready Nation

Dr. William M. Lapenta
Director, National Centers for Environmental Prediction
NOAA/National Weather Service
COPC meeting
5 November 2014

Proposed NWS HQ Organization

* Includes Office of Communications, Congressional Affairs, and Equal Opportunity & Diversity

Office of The Chief of Staff *

International Affairs

Office of the Chief Learning Officer

The Office of Assistant Administrator AA DAA

CFO/CAO

Enterprise Risk Management & Internal Audit Office

Assistant CIO

Office of Organizational Excellence

Office of Planning & Programming for Service Delivery

Office of Chief Operating Officer

Office of Facilities

Office of Observations

Office of Central Processing

Office of Dissemination

Office of Science and Technology Integration

Analyze, Forecast, and Support Office

National Centers for Environmental Prediction

Regional Offices

National Water Center

Proposed HQ Office

Field Office

Existing HQ Office

NWS National Centers for Environmental Prediction
Specialized Services – Common Mission
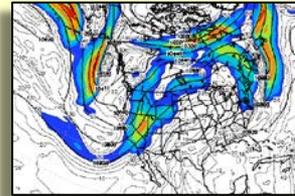
6 Corps Officers

- NHC: Brinkley
- EMC: Barry; (Ostapenko)
- OPC: Schultz (Phillips)
- AWC: Waddington
- SWPC: Hemmick
- OD: Odell

**Aviation Weather Center
Kansas City, MO**

**Climate Prediction Center
College Park, MD**

**Environmental
Modeling Center
College Park, MD**

**National Hurricane Center
Miami, FL**

**NCEP Central Operations
College Park, MD
(Supercomputers in
Reston & Orlando)**

**Ocean Prediction Center
College Park, MD**

**Space Weather
Prediction Center
Boulder, CO**

**Storm Prediction Center
Norman, OK**

**Weather Prediction Center
College Park, MD**

Mission: reliable, timely, and accurate analyses, guidance, forecasts, and warnings for the protection of life and property and the enhancement of the national economy.

Vision: Nation's trusted source, first alert, and preferred partner for environmental prediction services
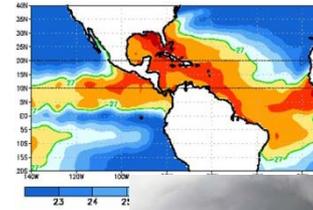
What NCEP Delivers

"Provision of Services from the Sun to the Sea"

- ➤ **Solar Monitoring, Warnings and Forecasts**
- ➤ **Climate Seasonal Forecasts**
- ➤ **El Nino – La Nina Forecast**
- ➤ **Weather Forecasts to Day 7**
- ➤ **Extreme Events (Hurricanes, Severe Weather, Snowstorms, Fire Weather)**
- ➤ **Aviation Forecasts and Warnings**
- ➤ **High Seas Forecasts and Warnings**

- ▪ **Model Development, Implementation and Applications for Global and Regional Weather, Climate, Oceans and now Space Weather**
- ▪ **International Partnerships in Ensemble Forecasts**
- ▪ **Data Assimilation including the Joint Center for Satellite Data Assimilation**
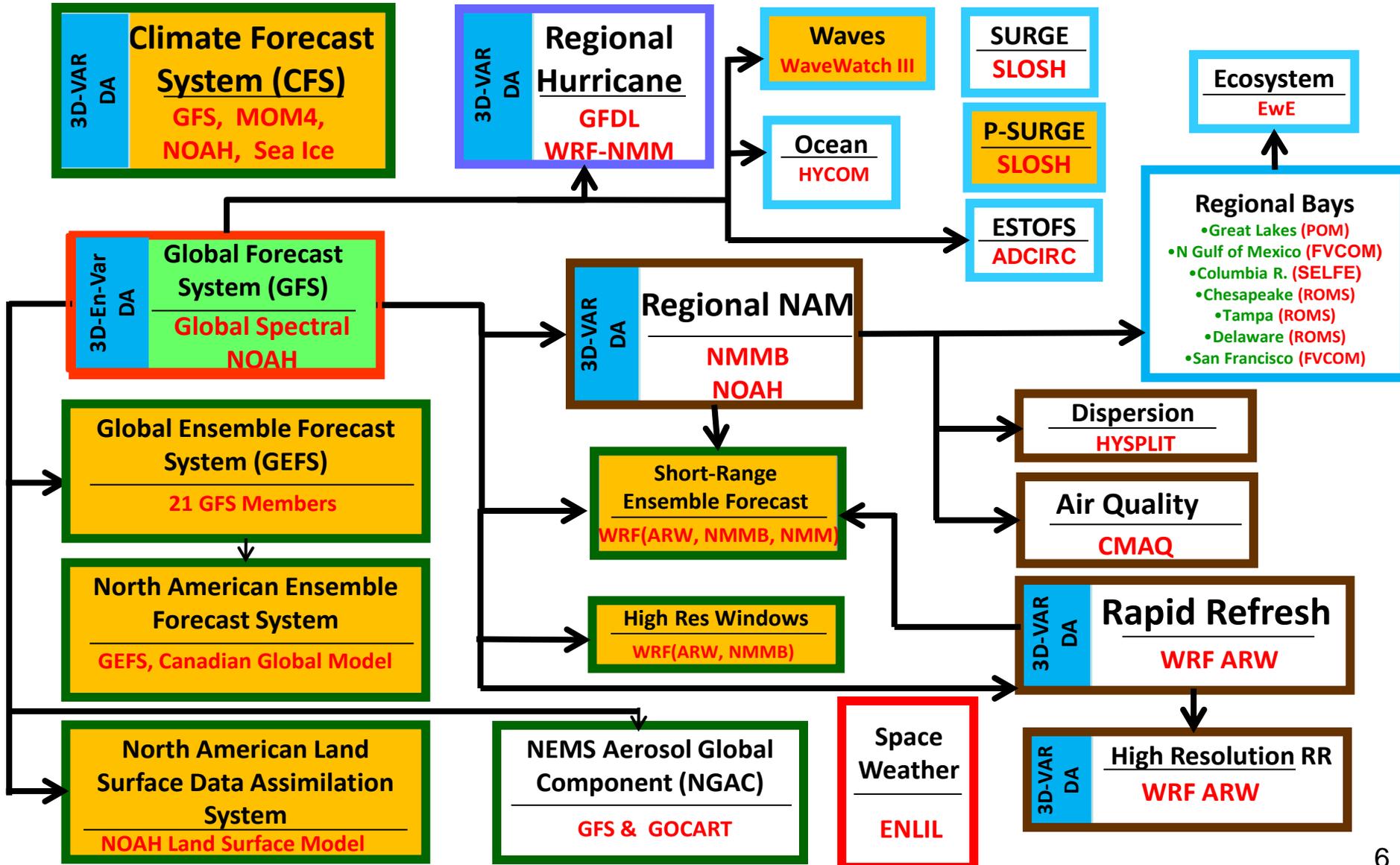- ▪ **Super Computer, Workstation and Network Operations**
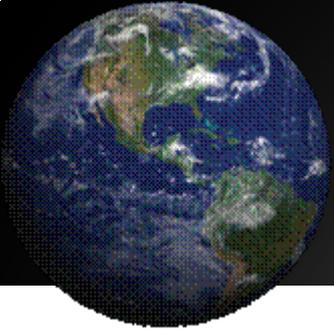
Strategic Areas for NCEP in the next 5 Years

➢ **A major player in building and sustaining a Weather Ready Nation**

➢ **Strategically expand science/service areas based on user requirements:**
  - **3-4 weeks forecasts (closing the gap between weather and climate)**
  - **Extending lead time for high impact events**
  - **Incorporate a full earth system science approach**
  - **Strategically transition research into operations**

➢ **Deliver (with partners) the WRN integrated field structure**

➢ **Deliver world class operational numerical guidance required to support the WRN**

➢ **Deliver timely, reliable and accurate products and services**

➢ **Deliver high capacity IT infrastructure support, high performance computing and technical management services**

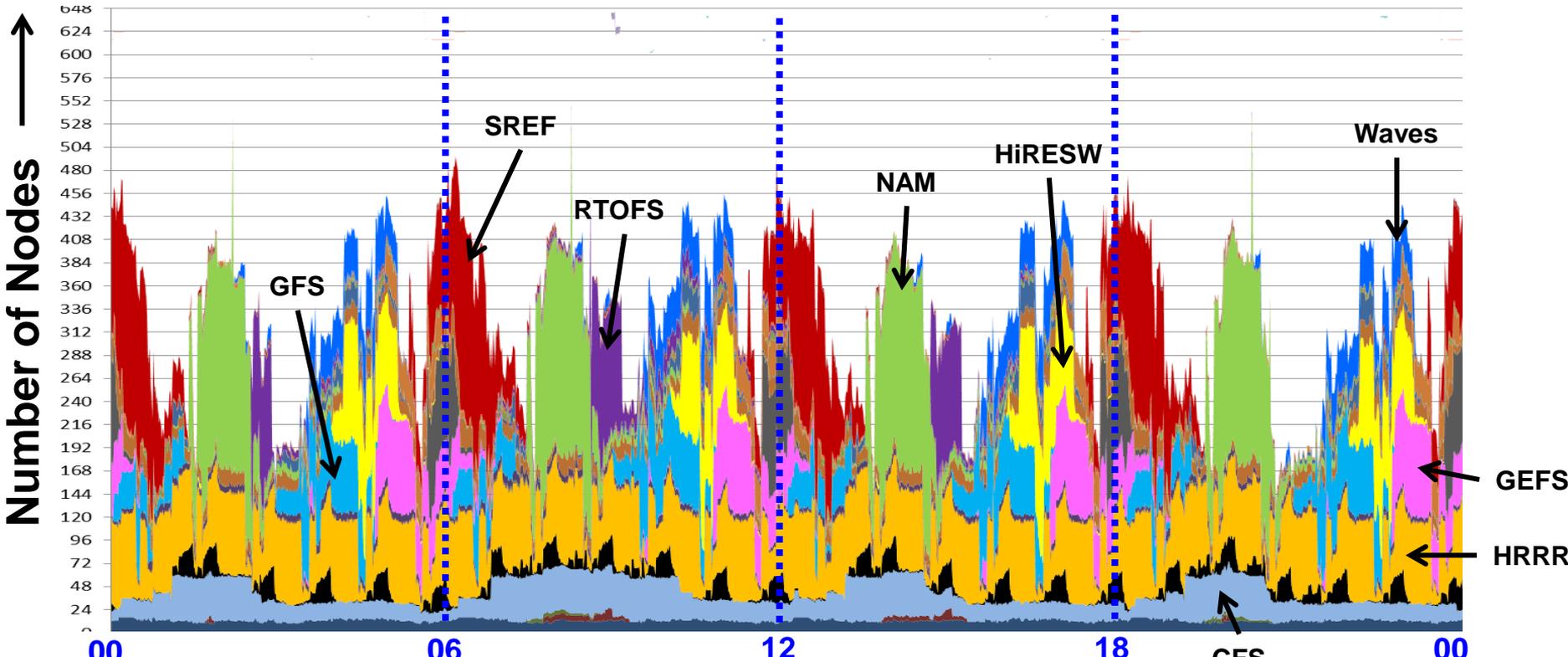# NOAA's Operational Numerical Guidance Suite (December 2014)

3D-VAR DA — Climate Forecast System (CFS)
GFS, MOM4, NOAH, Sea Ice

3D-VAR DA — Regional Hurricane
GFDL
WRF-NMM

Waves
WaveWatch III

SURGE
SLOSH

Ocean
HYCOM

P-SURGE
SLOSH

Ecosystem
EwE

ESTOFS
ADCIRC

3D-En-Var DA — Global Forecast System (GFS)
Global Spectral
NOAH

3D-VAR DA — Regional NAM
NMMB
NOAH

Regional Bays
• Great Lakes (POM)
• N Gulf of Mexico (FVCOM)
• Columbia R. (SELFE)
• Chesapeake (ROMS)
• Tampa (ROMS)
• Delaware (ROMS)
• San Francisco (FVCOM)

Dispersion
HYSPLIT

Global Ensemble Forecast System (GEFS)
21 GFS Members

Short-Range Ensemble Forecast
WRF(ARW, NMMB, NMM)

Air Quality
CMAQ

North American Ensemble Forecast System
GEFS, Canadian Global Model

High Res Windows
WRF(ARW, NMMB)

3D-VAR DA — Rapid Refresh
WRF ARW

North American Land Surface Data Assimilation System
NOAH Land Surface Model

NEMS Aerosol Global Component (NGAC)
GFS & GOCART

Space Weather
ENLIL

3D-VAR DA — High Resolution RR
WRF ARW

Numerical Guidance On Supercomputer

Phase 1 (Capacity ~ 0.208Pf)
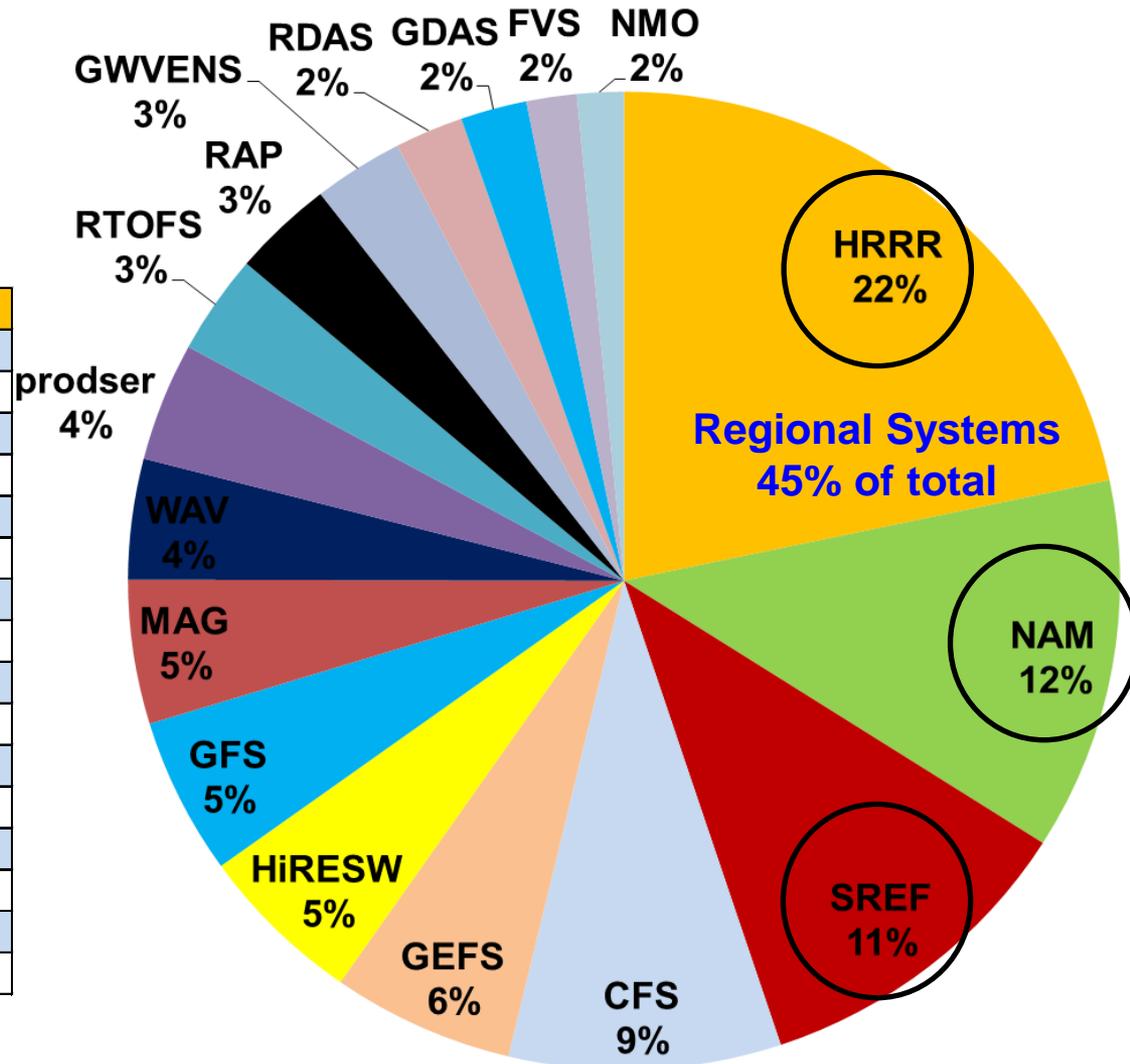

24-h Cycle   **29 December 2014**

Computational Cost of Production Suite Components

% utilization based on the number of nodes used in a 24 hour period

Acronym	Component
HRRR	High Resolution Rapid Refresh
NAM	North American Model
SREF	Short Range Ensemble Forecast
CFS	Climate Forecast System
GEFS	Global Ensemble Forecast System
HiRESW	High Resolution Windows
GFS	Global Forecast System
MAG	Model & Analysis Graphics
WAV	WAVEWATCH III
prodser	COMMS Overhead
RTOFS	Real Time Ocean Forecast System
RAP	Rapid Refresh
GWVENS	Global Wave Ensemble
RDAS	Reagional Data Assimilation System
GDAS	Global Data Assimilation System
FVS	Forecast Verification System

Pie chart — Computational cost by component:
- HRRR 22%
- NAM 12%
- SREF 11%
- CFS 9%
- GEFS 6%
- HiRESW 5%
- GFS 5%
- MAG 5%
- WAV 4%
- prodser 4%
- RTOFS 3%
- RAP 3%
- GWVENS 3%
- RDAS 2%
- GDAS 2%
- FVS 2%
- NMO 2%

Regional Systems 45% of total

The NOAA Operational Modeling Strategy…High Level Perspective

➢ **Moving away from the "model of the day"**
  - **Ensemble based numerical guidance**
  - **Ensemble system only as good as the modeling system it is built from**

➢ **Priorities for end-to-end model development:**
  1. **Data assimilation (methodology and observations)**
  2. **Resolution—horizontal and vertical**
  3. **Physics**
     - **Clouds, microphysics, radiation, land, ocean, ice, aerosols….includes coupling**
  4. **Post processing techniques**
  5. **Dynamic core**

➢ **Must consider advanced HPC technologies but don't forget about the science**