Command Overview

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10 March 2010

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Operations Department
Watch Presence

• Global and 24x7
  – Coordinates and provides support for all time sensitive METOC RFIs

• Fleet Ops Reachback
  – Tailored Products: AREPS, TAWS, Staff Daily Briefs, Northern WX, Evaporative duct’s for COMSUBFOR, MOCC VP det
  – Other Support: USSTRATCOM, NOPF Whidbey, NSW MSC, Special Support Pages, JMFU/CMFU supporting C2X/JTFEX
  – Supporting forward SGOTs and METs as required

• ISR Reachback (Strike component)
  – TAM and JFCC ISR

• Submarine Weather (SUBWEAX) Direct Support
Models Overview

- **NOGAPS** – Navy Operational Global Atmospheric Prediction System; T319L42 global spectral model, at the center of FNMOC production.

- **COAMPS/CAAPS** – Coupled Ocean/Atmosphere Mesoscale Prediction System; regional mesoscale model, multi-nested to ~2 km resolution within NOGAPS.

- **NAVDAS** – Navy Atmospheric Variational Data Assimilation System; 3D-VAR data assimilation for NOGAPS and COAMPS. **NAVDAS-AR** 4D-VAR Weak Constraint now operational.

- **GFDN** – Navy implementation of the GFDL TC model; only moveable-nest TC model operational in all ocean basins (critical part of 4-member CONW and 5-member CONU for extended TC forecasts). Nested within NOGAPS.

- **WW3** – WaveWatch III spectral ocean wave model; global and regional implementations, driven by NOGAPS and COAMPS.

- **EFS** – NOGAPS-based global 18-member 10-day Ensemble Forecast System (part of NAEFS and JEFS collaborations); includes 18-member global WW3 ensemble.

- **NAAPS** – Navy Atmospheric Aerosol Prediction System; only operational global aerosol model. Atmospheric optical properties output feeds Target Acquisition Weapons Software (TAWS). Driven by NOGAPS.
Models and Applications

- Ocean Acoustic Forecasting
- Automated High Seas / Wind Warnings
- Optimum Track Ship Routing
- Target Weapon Systems
- Ocean Models
- Ensemble Models
- Tropical Cyclone Forecasts
- Ballistic Wind Computations
- Mesoscale Models
- Long-Range Planning
- WRIP
- Aerosol Modeling
- Aircraft Routing
- Visibility/Dust Forecasts
- Electro-Optical Forecasts
- Search and Rescue
- CEEMS

Supercomputing Excellence for Fleet Safety and Warfighter Decision Superiority
NOGAPS:
- Global spectral model
- Only global weather model protected to DoD Information Assurance (IA) standards
- Run 4 times per day with forecasts to 180 hours
- Provides lateral boundary conditions for COAMPS/COAMPS-OS
- Was the leading tropical cyclone track forecast model in the world for 2006
- Developed and supported by NRL
Battlespace On Demand

Forecast Battlespace

Tier 3 - the Decision Layer
• Options / Courses of Action
• Search Patterns
• Asset Allocation / Timing
• Quantify Risk

Tier 2 - the Performance Layer

Tier 1 - the (forecast) Environment Layer

Initial and Boundary Conditions

Fleet Numerical... Supercomputing Excellence for Fleet Safety and Warfighter Decision Superiority...
Battlespace On Demand

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Initial and Boundary Conditions

Model Products
Smart Climatology
Satellite Products

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Regional Capabilities

Centralized Atmospheric Analysis and Prediction System (CAAPS)

- CAAPS is a relocatable, higher-resolution modeling implementation of COAMPS-OS [Linux Cluster based]
  - User configurable areas and model resolutions
- Rapid area implementation permits repositioning in near real-time to support critical Naval operations
- Incorporates a Vapor-Liquid-Solid (VLS) Track Dispersion Model for WMD plume forecasts
- Multiple CAAPS areas currently running to support classified Naval and Joint operations

CAAPS delivers on-demand support within 20 minutes
COAMPS On Scene

• Local-scale on-demand implementation of COAMPS via the Centralized Atmospheric Analysis and Prediction System (CAAPS)

• Rapid and on-demand initiation of high-resolution multi-nested model runs down to a ~1 km resolution

• Fully integrated with the VLSTrack atmospheric transport and dispersion model

• Soon to include coupled ocean models (WW3, SWAN, NCOM)

• With HPC capability added to the SCIF, we now have TS level of high-res. model support
Specialized products related to both the vertical distribution and particle-size distribution of water are required for the WRIP planning tool.

This required original R&D by NRL and operational production and distribution of unique parameters.

Operational support of WRIP parameters available from all COAMPS areas on Opal.

2x/daily 48hr forecasts @ 00 & 12Z for the 14 WRIP areas
GFDN

- Navy’s version of the Geophysical Fluid Dynamics Lab tropical cyclone model
- GFDN is run for tropical cyclones in any basin
- Uses NOGAPS lateral boundary vice GFS fields used by GFDL
- Two nested configuration
  - 75°x75° fixed outer nest at 1/2°
  - 11°x11° moving inner nest at 1/6°
- 42 vertical sigma levels
Navy Coupled Ocean Data Assimilation

- Provides sea boundary conditions to COAMPS and NOGAPS
- 3D Ocean Analysis based on Multi-Variant Optimum Interpolation (MVOI) technique
- Computes SST, ice concentration, and 3-D temperature and salinity analyses
- Part of Analysis/Forecast cycle with WW3 to assimilate satellite wave height data
- Current back-up and future replacement for MODAS
• Recent Upgrades
  - Running under OPS control on A2 Linux Cluster
  - Implemented WW3 v3.12 on A2

• Planned Upgrades
  - Implement WW3 v3.14, including assimilation of wave height data from satellite altimeters, on A2 (FY09)
  - Create a joint global WW3 ensemble with NCEP, assembled at FNMOC (FY09)
  - Interactive “virtual buoy” wave forecast bulletins on SIPR/JWICS (FY09)
  - Integrated WW3 into COAMPS-OS v2.0 (FY09)

New WW3 Ensemble Global Wave Height Mean and Variability graphic
WAVEWATCH III (WW3)

SIGNIFICANT WAVE HEIGHT WW3 GLOBAL (Feet) 12 Hr. Fcst. Valid 28APR2009 1200Z
WAVEWATCH III (WW3)

• Recent Improvements
  - Operational implementation of Wave Data Assimilation [Sep 09]

• Plans
  - Create a joint global WW3 ensemble with NCEP, assembled at FNMOC [FY10]
Ensemble Forecast System (EFS)

- Based on NOGAPS and WW3
- 18 Members; 10 day forecasts
Ensemble Forecast System (EFS)

- 18 NOGAPS forecasts at approximately 1-degree resolution and 30 vertical levels (T119L30)

- Forecast period: 0 to 240 hours at 6 hr intervals, run once per day at 00Z

- Grids available through CAGIPS at approx 0530Z (include parameter values for individual members, ensemble means, and gale wind probability)

- Web graphical products include:
  - gale wind probability
  - precipitation probability
  - spaghetti plots, plume plots
  - ensemble mean temperature
  - 500 mb height mean and standard deviation
Ensemble Probability Plot

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FNMOC EFS 2008102900 run 1.0° Fields τ = 48 h (18 members)
NAAPS

- Global atmospheric aerosol prediction system
- Includes smoke, dust, sea salt, sulfate, volcanic
- Use real-time data streams
- Driven by NOGAPS
- Provides direct feed to the Forecast of Atmospheric and Optical Radiative Properties (FAROP) and the Target Acquisition Weather Software (TAWS) for BonD Tier 2 Applications
- Developed and supported by NRL
NAAPPS Specialized Products

Extinction Coefficient @ 0.3 µm
Extinction Coefficient @ 0.55 µm
Extinction Coefficient @ 1.06 µm
Extinction Coefficient @ 3-5 µm (band-averaged)
Extinction Coefficient @ 8-12 µm (band-averaged)
Scattering Coefficient @ 0.3 µm
Scattering Coefficient @ 0.55 µm
Scattering Coefficient @ 1.06 µm
Asymmetry Parameter @ 0.3 µm
Asymmetry Parameter @ 0.55 µm
Asymmetry Parameter @ 1.06 µm
Phase Function @ 0.3 µm [Phase 2]
Phase Function @ 0.55 µm [Phase 2]
Phase Function @ 1.06 µm [Phase 2]

Target Acquisition Weapons Software
Weapons sensor-specific lock in ranges displayed in FalconView
Battlespace On Demand

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Tier 2 - the Performance Layer

Tier 1 - the (forecast) Environment Layer

Initial and Boundary Conditions

Visualization of METOC Impacts
Tier 2 Applications

- AREPS (Advanced Refractive Effects Prediction System)
- Target Acquisition Weather Software (TAWS)
- FAROP (Forecast of Atmos. and Optical Radiative Properties)
- ATCF (Automated Tropical Cyclone Forecast System)
- APS (Atmospheric Performance Surface)
- EVIS (Environmental Visualization)

Example of Radar Performance Prediction
Battlespace On Demand

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Tactical Decision Aids (TDAs)
Tier 3 Applications

- AOTSR (Automated Optimum Track Ship Routing)
- OPARS (Optimum Path Aircraft Routing System)
- Web SAR (Web-Based Search and Rescue)
- VLSTrack/HPAC (Atmospheric Transport and Dispersion)
- CEEMS (Contribution of Environmental Effects on Missile Systems)
Situational Awareness

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CAYAAT, FOUO
USNS ZEUS (NVTM)
OCT 27, 18:00

Wind speed: 10.4 kts
Wind dir.: 090°T
Swell height: 6.6 ft
Swell period: 7.6 s
Swell dir.: 077°T
Sea height: 2.7 ft
Sea period: 4.6 s

SIG. wave height: 7.1 ft
Current speed: 0.2 kts
Current dir.: 343°T
Ship speed: 9.9 kts
Ship dir.: 245°T
Location: 24.6N, 152.5W

Toggle track display

Wind: NCOAPS-2009102100
Wave: WAVG_GLOBAL-2009102100
Current: TOPS_GLOBAL-2009102100

Ship observation
- Lead indicates course
- "Now"
- MOVREP-derived ship position
- Green

Sea ice
- Ice edge
- 100% ice pack
- Arctic only

Tropicals
- > 63 kts
- > 53 kts

Winds
- > 35 kts
- > 25 kts
- > 12 kts

Seas
- > 50 kts
- > 34 kts
- > 18 kts

Forecast areas
- Valid time: 271200Z OCT 09
- No forecasts available

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- FNMOC produces a wide variety of on-demand satellite imagery products from meteorological satellites (including NASA platforms)
- Complements the CAAPS/COAMPS-OS on-demand modeling capability
- Includes unique capability to pull out dust plumes from Moderate Resolution Imaging Spectroradiometer (MODIS) imagery
- Developed and supported by NRL
SSM/I and SSMI/S Products

- FNMOC serves as the primary national production facility for SSMI and SSMI/S products
- Important supporting data set for NWP models and maritime forecasters
MODIS on Aqua & Terra

03W.RAMMASUN 11 MAY 2008

Terra, 1Km, Water Vapor

Aqua, 1Km, Nighttime IR

Aqua, 1Km, VIS
Tropical Cyclone Web Page

- Multi-Sensor satellite data fusion page
- Complements the FNMOC TC forecast model products
- Heavily used by both military and civil forecasters
- Available to the public
Summary

• Fleet Numerical is a 24x7 Global Operational Command, with direct support relationships and connectivity to Fleet, Joint, and Coalition Forces.

• Fleet Numerical’s Core NWP Mission is aligned, resourced, and continues to maintain a World-Class reputation.

• Fleet Numerical is leaning forward in innovative and effective supercomputing combined with high-quality and pioneering METOC models and applications to deliver timely and relevant information to Forces.

Supercomputing Excellence for Fleet Safety And Warfighter Decision Superiority”
Questions?