COPC
May 2016

CAPT Russ Smith
Commanding Officer

Mr. Bill Kerr
Technical Director

CAPT (sel.) Sean Robinson
Executive Officer

Mission

Enable fleet safety and warfighting effectiveness of Naval, Joint and Coalition forces by developing and providing assured global and regional numerical environmental prediction and applied decision-making services

Vision

DoD's Premier Numerical Modeling Center - the Lead for Physical Battlespace Awareness and Operational Advantage
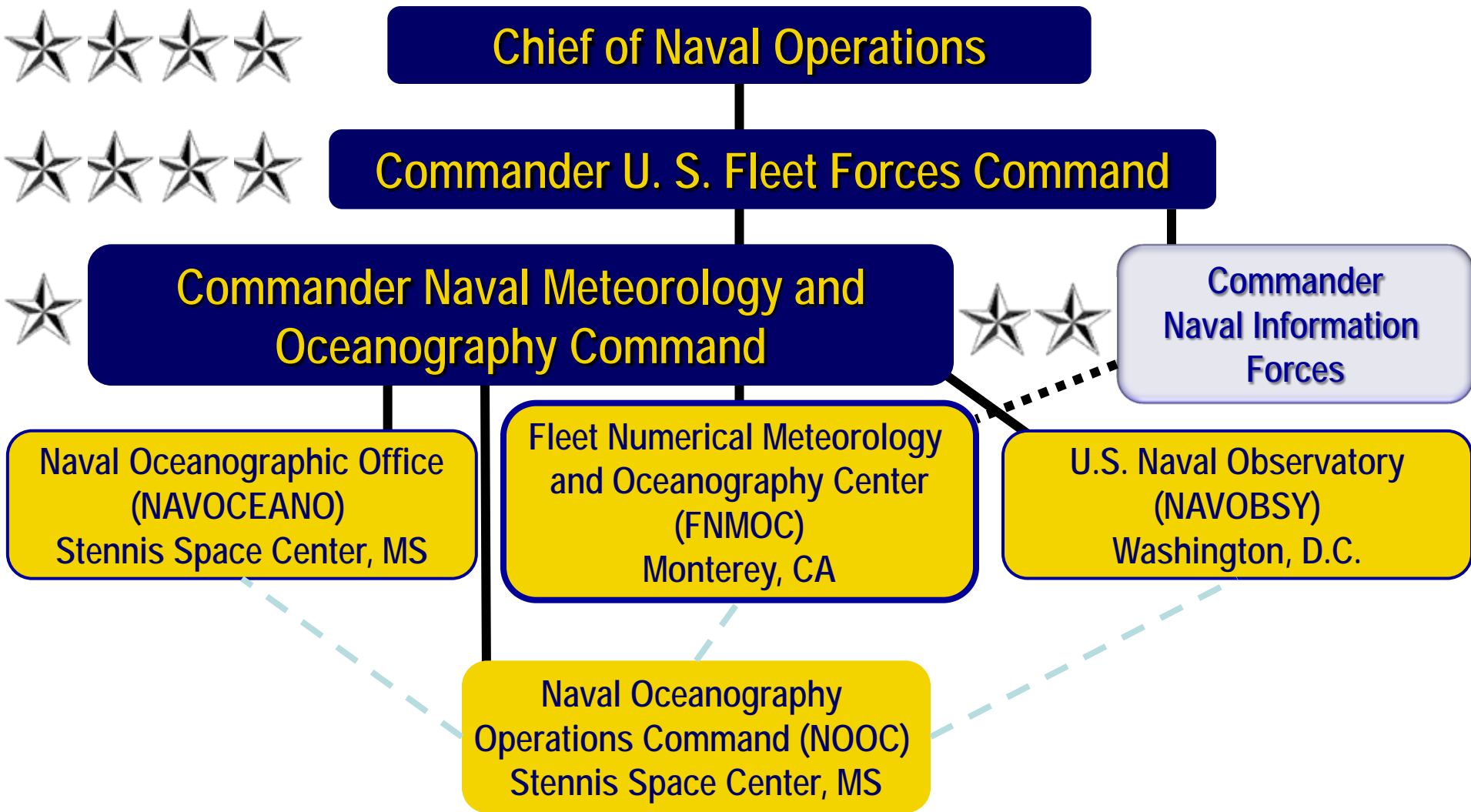
Functions

- Produce a variety of METOC products tailored to the mission requirements of DoD, to include:
  - **optimum path flight plans, specific ocean state data, custom (high resolution) weather prediction areas, operational climatology support, go/no-go decision tools, tactical decision aids (TDA), weapon system inputs proven to improve performance and accuracy, and a variety of other mission-critical METOC data, products, and services**
- Serve as DISA Node for 12 DoD organizations on central California coast
- Strategic deterrence support

Tasks

- Operate a High Performance Computing Center (HPCC) with capabilities at every classification level
- Collaborate with NAVO, USNO, NRL, NCEP, NESDIS, and 557th Weather Wing (WW)
- Primary host of Navy Enterprise Portal-Oceanography (NEP-Oc) and alternate host of Flight Weather Briefer (FWB) servers

★★★★ **Chief of Naval Operations**

★★★★ **Commander U. S. Fleet Forces Command**

★ **Commander Naval Meteorology and Oceanography Command**

★★ **Commander Naval Information Forces**

Naval Oceanographic Office (NAVOCEANO) Stennis Space Center, MS

Fleet Numerical Meteorology and Oceanography Center (FNMOC) Monterey, CA

U.S. Naval Observatory (NAVOBSY) Washington, D.C.

Naval Oceanography Operations Command (NOOC) Stennis Space Center, MS

Fleet Numerical & Information Warfare

- *One of seven internationally recognized Global Numerical Weather Prediction (NWP) Centers*
- *DoD "IA-compliant" Global NWP center with secondary mission as DISA node*
- *Center of Excellence for Environmental Modeling within Naval Oceanography Enterprise, aligned with long-standing strategic partners in order to effectively execute the three-pillar strategy of Information Warfare*

NWP High Performance Computing (HPC) on all Classification Domains

Data output in multiple OGC-compliant formats – providing METOC modeling, services, products and data for Fleet Safety, Resource Protection and Operational forecast and climatology production supporting Naval, Joint and Allied forces – over multiple C2 systems, networks, COPS, Tools and TDAs

Our Data touches:
NIPRNET - SIPRNET – JWICS - CENTRIX - GCCS - C2RPC - Geo-Server - Google Earth - Navy Tactical Cloud (NTC) - NITES (NITES Next) - NEP-Oc – Intellink - Global Broadcast Service (GBS) - ArcGIS – Falcon View – PFPS – JMPS – Flight Weather Briefer – AREPS – TAWS - AND MORE!

Our U.S. customers and partners:
USN, USMC, USAF, USA, USCG, NGA, DIA, CIA, NRO, ONI, NAVO, 557th WW , NOAA, ONR/NRL

Global and Tailored Regional Atmospheric & Oceanographic Prediction…

Fleet Numerical…

Atmospheric & Oceanographic Prediction Enabling Fleet Safety and Decision Superiority…

1. Operationally Reliable: Assured Global and Regional Numerical Atmospheric and Oceanographic Prediction at all classification levels

2. Climatology support to Naval and DoD Operations and Exercises at all classification levels

3. Produce and disseminate METOC products tailored to mission requirements

FNMOC delivers Physical Battlespace Awareness (PBA) and directly supports Integrated Fires (IF)

Cybersecurity-compliant systems and communications (DISA) paths directly support Assured Command and Control (AC2)

Models Overview

- **NAVGEM 1.3.1** – <u>NAV</u>al <u>G</u>lobal <u>E</u>nvironment <u>M</u>odel; (T425L60) ~ 31 km, 60 vertical levels; Semi-Lagrangian dynamic core model. ***At the center of FNMOC production***.

- **COAMPS v5.2** – <u>C</u>oupled <u>O</u>cean/<u>A</u>tmosphere <u>M</u>esoscale <u>P</u>rediction <u>S</u>ystem; high resolution model for quick response to warfighter support requests(< 1 day); multi-nested to less than 1 km; 60 vertical levels. Special support for tropical cyclones, dust, EM and acoustic propagation. Driven by NAVGEM. Run at all classification levels ***At the center of FNMOC production.*** ***50/40/16***

- **WW3 v4.18** – <u>W</u>ave<u>W</u>atch <u>III</u>; ocean wave model; global (~35KM) and regional (5KM) implementations. Driven by NAVGEM and COAMPS. Model bias can be "tuned".

- **COAMPS - TC** – COAMPS centered on JTWC official forecast.

- **WW3 TC-OFCL** – WW3 forced by JTWC official forecast (as inserted into NAVGEM)

- **NAVGEM Ensemble 1.2.3** – Global 21-member, 16-day forecast, T239L50; supports 20-member global WW3 ensemble. Uses customized ensemble transform method to match member perturbations to model error. With the NCEP and CMC global ensembles, forms the National Unified Operational Prediction Capability (NUOPC) 60 member multi-model ensemble.

- **GFDN** – Navy implementation of the GFDL TC model; ~10 km resolution; the only moveable-nest TC model operational in <u>ALL</u> ocean basins and a critical model for extended TC forecasts. Driven by NAVGEM.

    - *2015 upgrade in testing: ~6km resolution and improved intensity forecasts.*

- **NAAPS** – <u>N</u>avy <u>A</u>tmospheric <u>A</u>erosol <u>P</u>rediction <u>S</u>ystem; the only operational global aerosol model. Atmospheric optical properties output feeds Target Acquisition Weapons Software (TAWS). Driven by NAVGEM.

- **AAP** – Atmospheric Acoustic Propagation; is a system for predicting the probability that a human ear will detect a helicopter in theater. System is a part of COAMPS-OS, atmospheric forecast from COAMPS.

Fleet Numerical…

Atmospheric & Oceanographic Prediction Enabling Fleet Safety and Decision Superiority…

- **Recent Events**
  - NAVGEM v1.3.1
    - T425L60 (~31 km grid spacing; model top ~60 km)
    - Data assimilation upgrades

- **Plans**
  - NAVGEM v1.4 [3QFY16]
    - T425L60 (~31 km grid spacing; model top ~60 km)
    - Hybrid DA
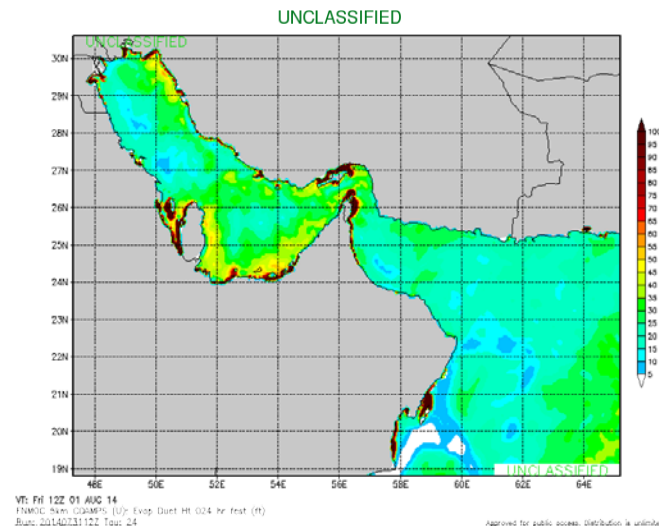   - Ozone Assimilation
  - NAVGEM v2.0 [3QFY17]
    - T681L80 (~19 km grid spacing; model top ~80 km)
  - NAVGEM v3.0 [4QFY18]
    - T1025L100 (~13 km grid spacing; model top ~90 km)

COAMPS: Regional to Tactical Scale Rapid Response Support

- Limited Area model /globally relocatable nested grid / ocean model coupling
- Data Assimilation
  - Atmosphere: analyzed winds, heights, temperature, moisture (NAVDAS)
  - Ocean: analyzed SST and ice (NCODA)
- COAMPS "On-Demand System" Framework (COAMPS_OS)
  - Ship Following COAMPS
  - Rapid Environmental Assessment (REA)
    - HWDDC (Hazardous Weather Detection & Display Capability)
  - Interfaces to WW3, NCODA, RNCOM
- Atmospheric Forecast Model
  - Nonhydrostatic dynamics
  - Explicit moist physics; Cumulus parameterization for resolution > 10 km
  - High resolution boundary layer; level 2.5 TKE closure; surface and radiation physics
  - Prognostic dust
  - Moving nests for tropical cyclones

- **Recent Events**
  - All planned areas converted to Hi-Top (30 to 60 levels) [Jan 2016]
  - Operational testing of 550m inner nest
  - Original delivery schedule changed for major code restructure of v5.3
    - Includes wave coupling w/ ESMF v7.1
  - Current operational configuration (v5.2) w/ new Schmidt microphysics
    - Schmidt microphysics originally scheduled for v5.4

- **Plans**
  - v5.2 will be used for coupled atmosphere/ocean TC forecasts [3QFY16]
    - Originally scheduled for v5.6
  - v5.5 (4DVAR) [1QFY17]
    - Seeks initial conditions such to forecast best fit most recent OBS w/ assimilation interval
    - Direct radiance assimilation

- ## **Recent Events**
  - Operational implementation of COAMPS-OS v2.5.5 [Mar 2016]
    - Atmospheric Acoustic Propagation (AAP) improvements
      - Multi-helicopter mission
      - Streamlined mission route entry
      - RunNow capability for high-res COAMPS data

- ## **Plans**
  - V2.6 [3QFY16]
    - Ship following COAMPS nests
  - v2.6.1 [4QFY16]
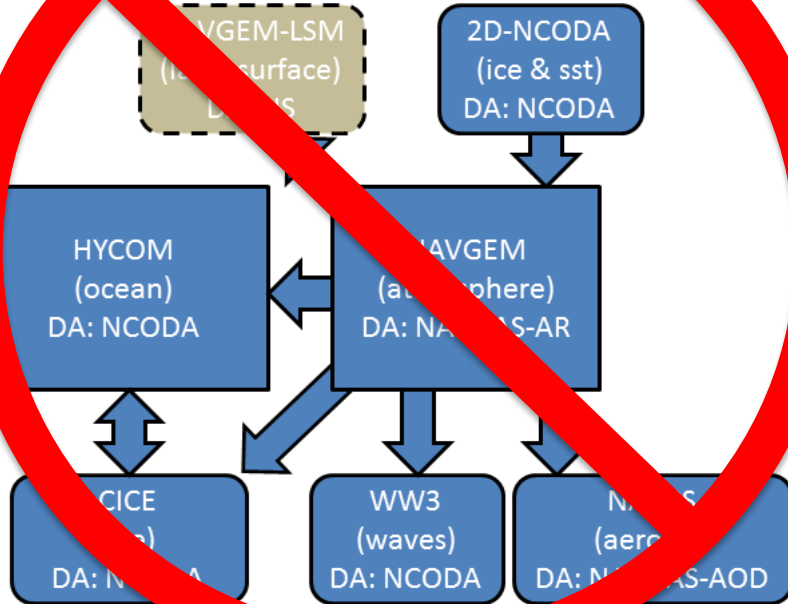   - Supports ESMF coupled COAMPS-TC, 4DVAR

National ESPC
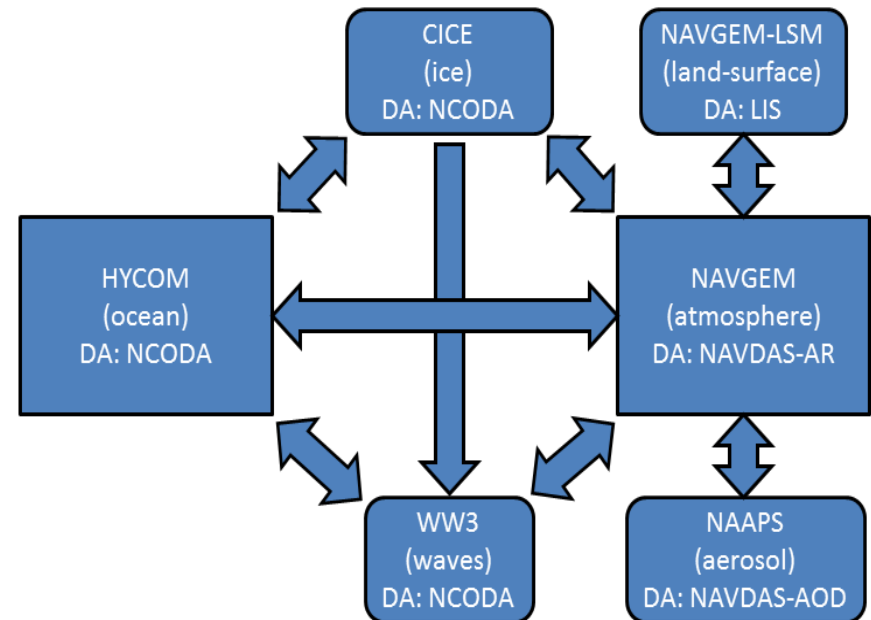### EARTH SYSTEM PREDICTION CAPABILITY

Existing Uncoupled System

- NAVGEM-LSM (land-surface) DA: LIS
- 2D-NCODA (ice & sst) DA: NCODA
- HYCOM (ocean) DA: NCODA
- NAVGEM (atmosphere) DA: NAVDAS-AR
- CICE (ice) DA: NCODA
- WW3 (waves) DA: NCODA
- NAAPS (aerosol) DA: NAVDAS-AOD

Future ESPC Coupled System

- CICE (ice) DA: NCODA
- NAVGEM-LSM (land-surface) DA: LIS
- HYCOM (ocean) DA: NCODA
- NAVGEM (atmosphere) DA: NAVDAS-AR
- WW3 (waves) DA: NCODA
- NAAPS (aerosol) DA: NAVDAS-AOD

Ongoing Exchanges w/ COPC Partners

- **To NCEP**
  - Global ensemble to NOMADS for NUOPC
  - NAVGEM for verification
  - WW3 ensemble
  - Tropical Aids to NHC
  - * Reliable data transmission challenges

- **To 557th WW**
  - NAVGEM for legacy applications
  - Global WW3 for visualization w/in AF-Webs
  - NAAPS aerosol products
  - DMSP UPP radiances, WINDSAT xDRs

- **To NESDIS**
  - DMSP & WINDSAT microwave xDRs
  - JPSS Program NAVGEM & NAAPS NWP fields for IDPS processing

- **To NAVO**
  - DMSP & WINDSAT microwave xDRs
  - NAVGEM/COAMPS NWP fields
  - NAVDAS-AR DA input fields for DSRC NAVGEM processing

- **From NCEP**
  - GFS for verification, MetCast & WxMap
  - Global ensemble from NOMADS for NUOPC
  - WW3 ensemble

- **From 557th WW**
  - CDFS-II for NUOPC cloud verification (in development)
  - Satellite winds, Mark IVB, DMSP, foreign geostationary, S-NPP xDRs via NESDIS
  - LIS/LSM Land Surface fields (snow, soil moisture/temps, vegetative index)
  - NEXRAD (assimilated into COAMPS)
  - JMPLAT (station information)
  - Predator UAV

- **From NESDIS**
  - NOAA & foreign polar/geostationary data of all shapes & sizes via DAPEGATEWAY server

- **From NAVO**
  - SSTs, Altimetry SSH/SWH
  - HYCOM NWP fields
  - Miscellaneous Conventional Oceanographic OBS

Fleet Numerical…

Atmospheric & Oceanographic Prediction Enabling Fleet Safety and Decision Superiority…

- Archives/Updates ocean surface (i.e. wind and swell waves) and atmospheric numerical model fields.

- Maintains the Advanced Climate Analysis and Forecasting (ACAF) system on the NEP-Oc.

- All classification levels

- Arctic

- Fastest-growing area of mission support
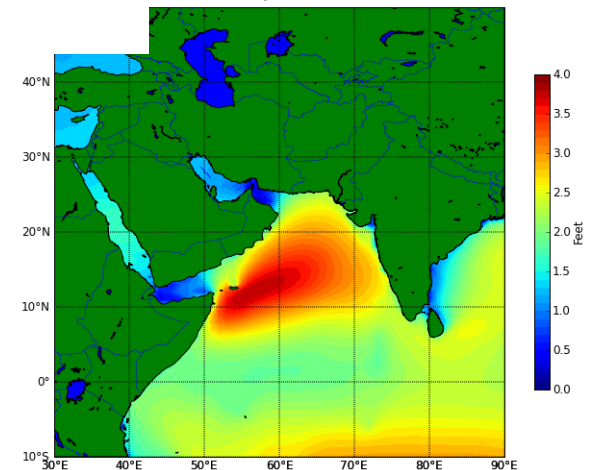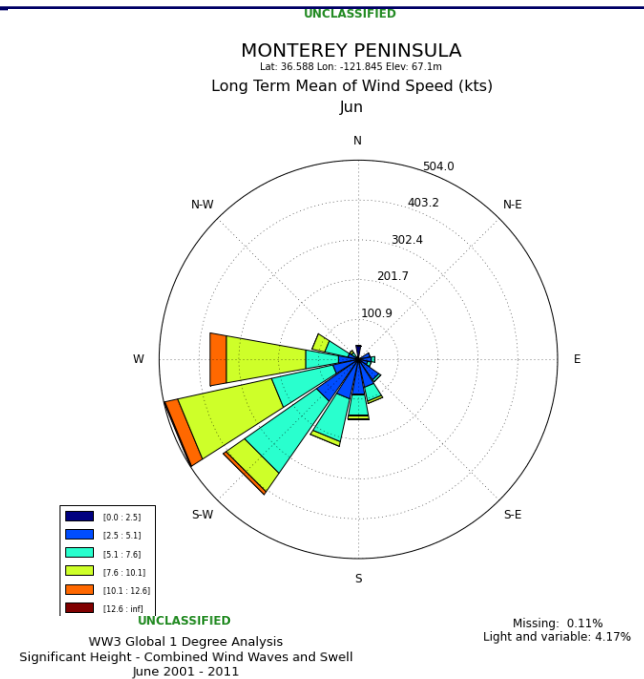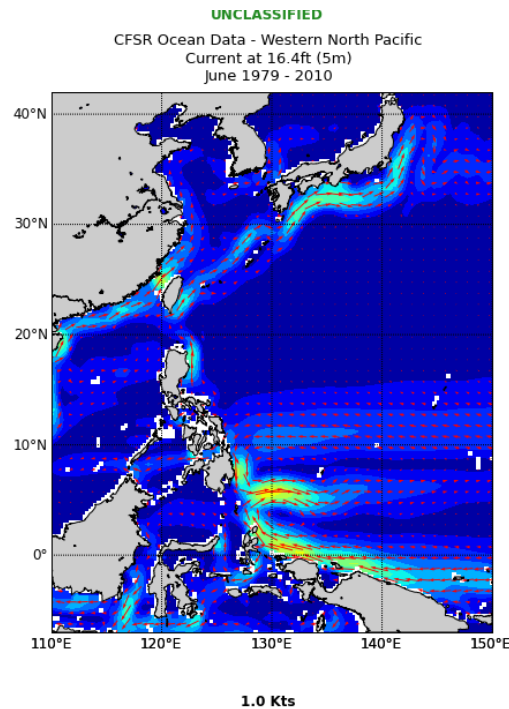
Intent:

Align Naval Oceanography Enterprise atmospheric & physical oceanographic modeling efforts to best support contingencies and operations.

End State:

Modeling resources are optimized, modeling intellectual capital is aligned, and are prepared for future operations and ESPC.

Vision

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Takeaways

FNMOC is the foundation for fleet safety

Every forecast for ships, submarines, and aircraft start with FNMOC environmental prediction & production services

FNMOC provides the foundation for Physical Battlespace Awareness and provides direct support to Integrated Fires

Cybersecure assimilation, production and delivery enabling assured C2
Only center that models the Global and Regional Atmosphere to DoD CS Standards
Provides climatological support to Joint and Naval Operations

Fleet Numerical…

Atmospheric & Oceanographic Prediction Enabling Fleet Safety and Decision Superiority…

Questions?