FNMOC

The 2nd National OPC Observational Data Workshop

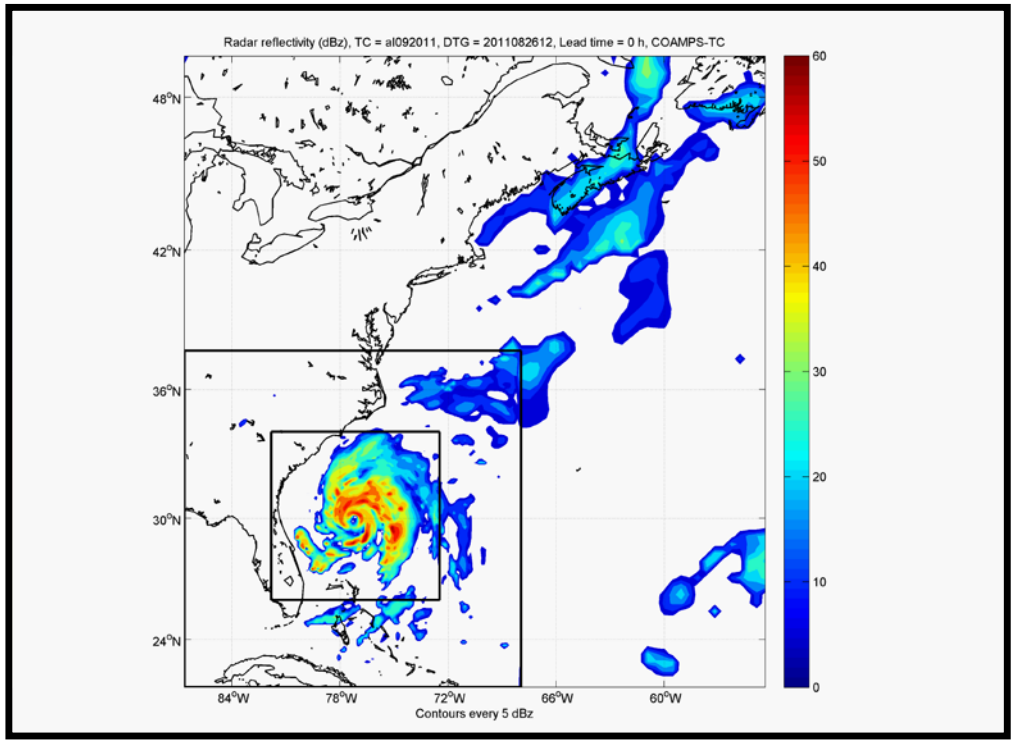
22 May 2018

The overall classification of this brief is:

Approved for Public Release; Distribution is Unlimited

Agenda

- Command Overview and Operational/Warfighter Focus
- Global Deterministic & Ensemble / Long-range Atmospheric Models
- Regional Coupled Modeling
- Global, Regional and Tactical scale Ocean Modeling
- Specialized Ocean Modeling
- Wave-Watch Modeling
- Tropical Forecasting
- GBS / Product Push



Team FNMOC

- Diverse team of highly-educated, technically proficient and warfighting-experienced Sailors, Civilians and Contractors.
  - 18 Military Officers:
    - METOC, IP, SWO, Intel
    - 25% MS Degree
    - 90% Warfare qualified
  - 150 Civilian & 30 Contractors:
    - Predominantly Physical Science and Computer Science
    - 9% PhD, 30% MS Degree, 35% BS Degree
    - 40% eligible to retire within 5 years
      - Broad and deep experience in the mission and the science
      - Succession challenges

N5 Modeling & Forecasting Department

Modeling & Forecasting Department Head (N5)

SUPV Oceanographer
Mr. Dennis Krynen

N5 Deputy Department Head

SUPV Scientist
Interdisciplinary
Dr. Mark Swenson (Acting)

Regional Ocean Modeling (N51)

SUPV Oceanographer
Ms. Kelly Wood

Ocean Forecasting (N52)

SUPV Oceanographer
Mr. Jeffery Todd Rayburn

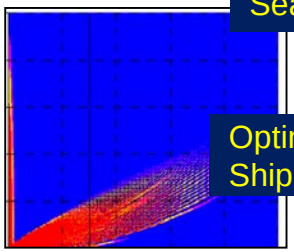
Regional Atmospheric Modeling (N53)

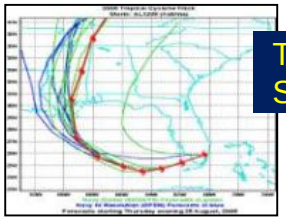
SUPV Meteorologist
Mr. Chuck Skupniewicz (Acting)

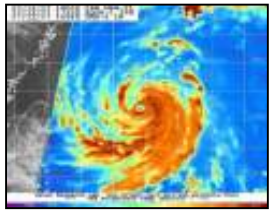
Global Modeling and ESPC (N54)

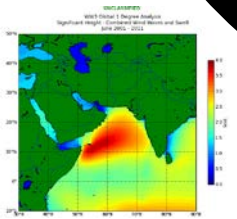
SUPV Meteorologist
Mr. Chuck Skupniewicz (Acting)

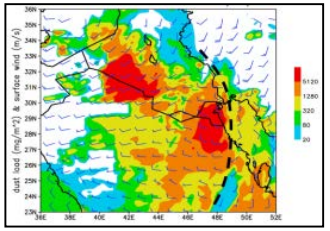
FNMOC Operational Support

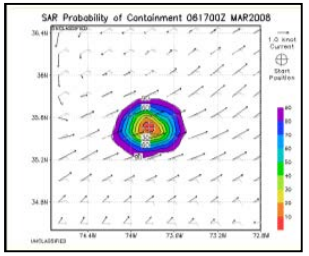


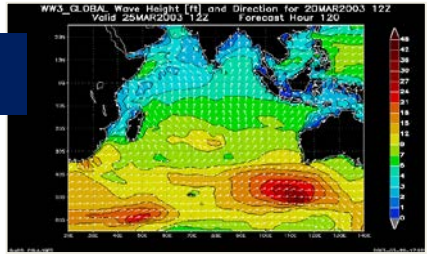








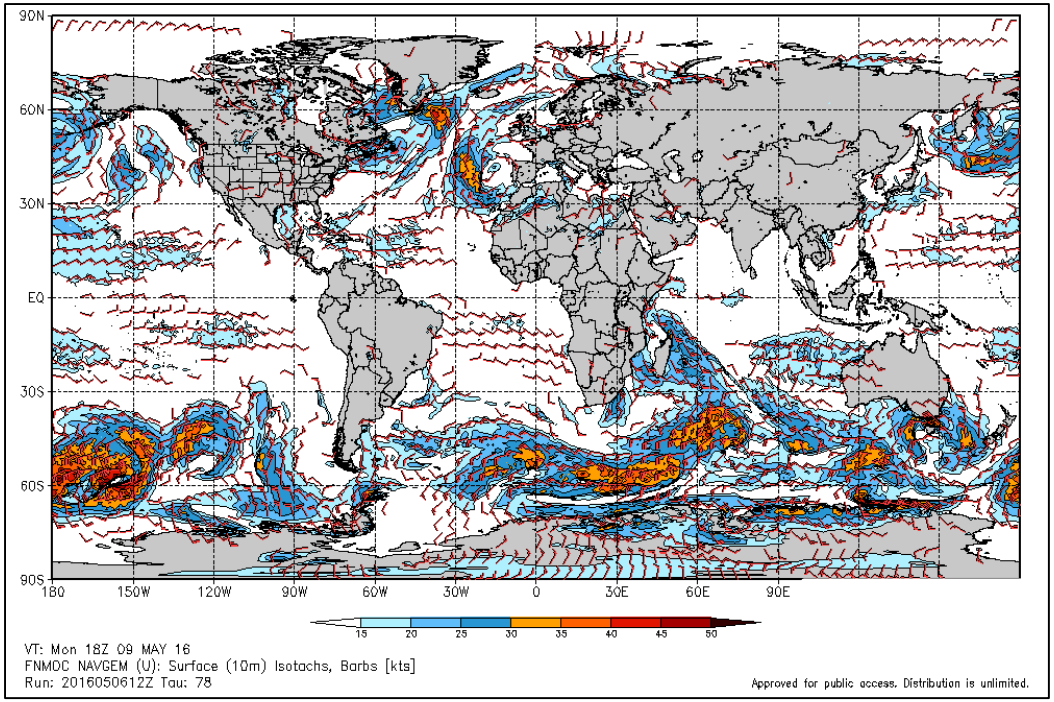




NAVGEM – Global Model

NAVal Global Environment Model - At the center of FNMOC production

- Semi-Lagrangian dynamic core model
- Operational Capability
  - NAVGEM v1.4
    - ~31 km grid spacing
    - Model top ~60 km
    - Hybrid 4D-Var Data Assimilation
    - Ozone Assimilation
- Future Capability
  - NAVGEM v2.0 [Late FY18]
    - ~19 km grid spacing
    - Model top ~80 km
  - NAVGEM v3.0 [FY19]
    - ~13 km grid spacing
    - model top ~90 km



- Next Step - Unified Modeling – National Earth System Prediction Capability (ESPC)

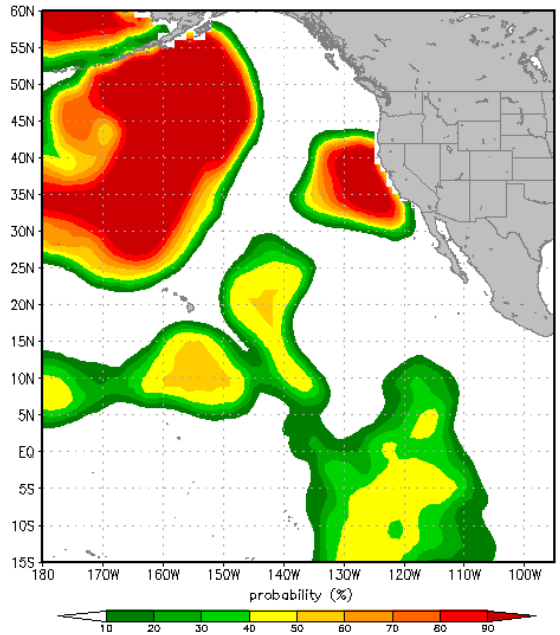
Navy Earth Science Prediction Capability

- Expecting delivery toward end of FY18
  - Global atmosphere will be NAVGEM 1.4
  - Global ocean will be 1/12th degree HYCOM
  - CICE
  - WW3
  - 1 hour of wall-clock per forecast day
- 16-day deterministic
- 45-day ensemble; 16 members

NAVGEM Ensemble - Long Range Prediction

Ensembles - Value Added Forecasting

- Increases model skill out to 12 days
- Probabilistic forecasts
- Tailored threshold products



VT: Wed 18Z 04 DEC 13
FNMOC EFS (U): Probability of Significant Wave Height > 8 ft
Run: 2013120300Z Tau: 42

Members Available: NGP 20 GFS 20 CMC 0

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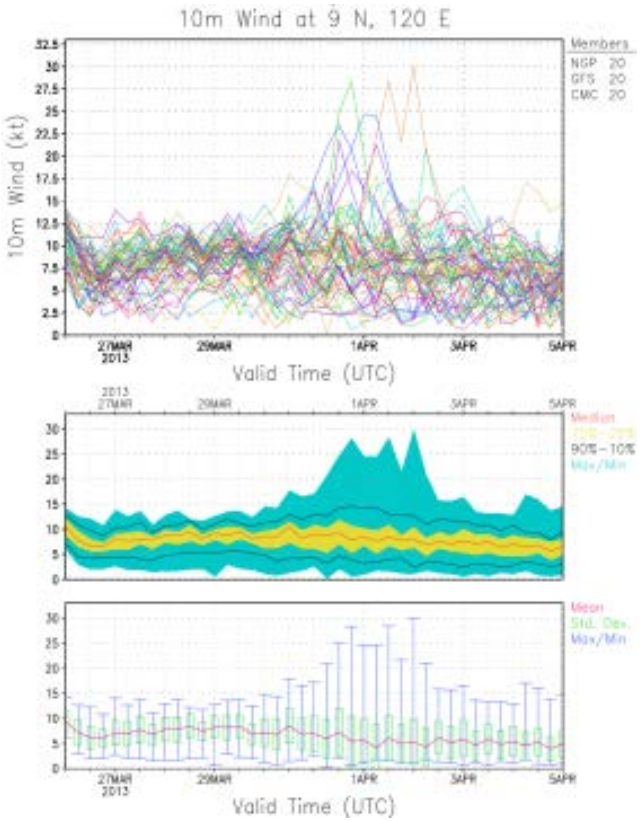
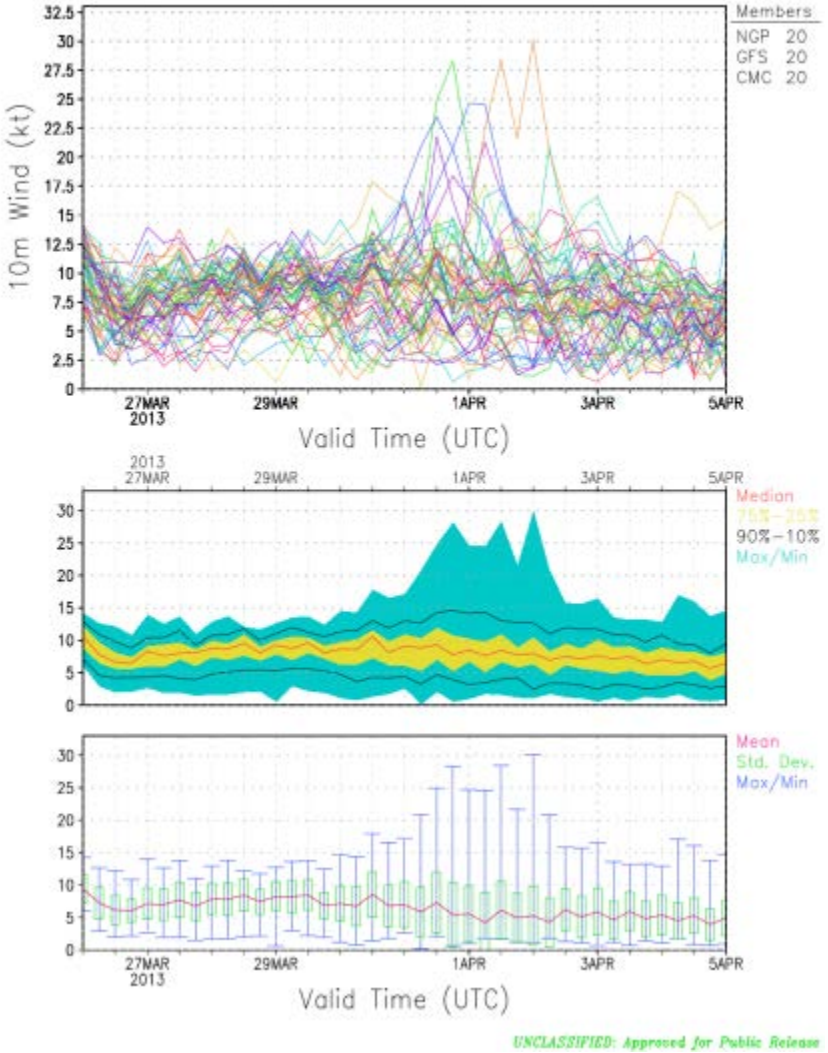


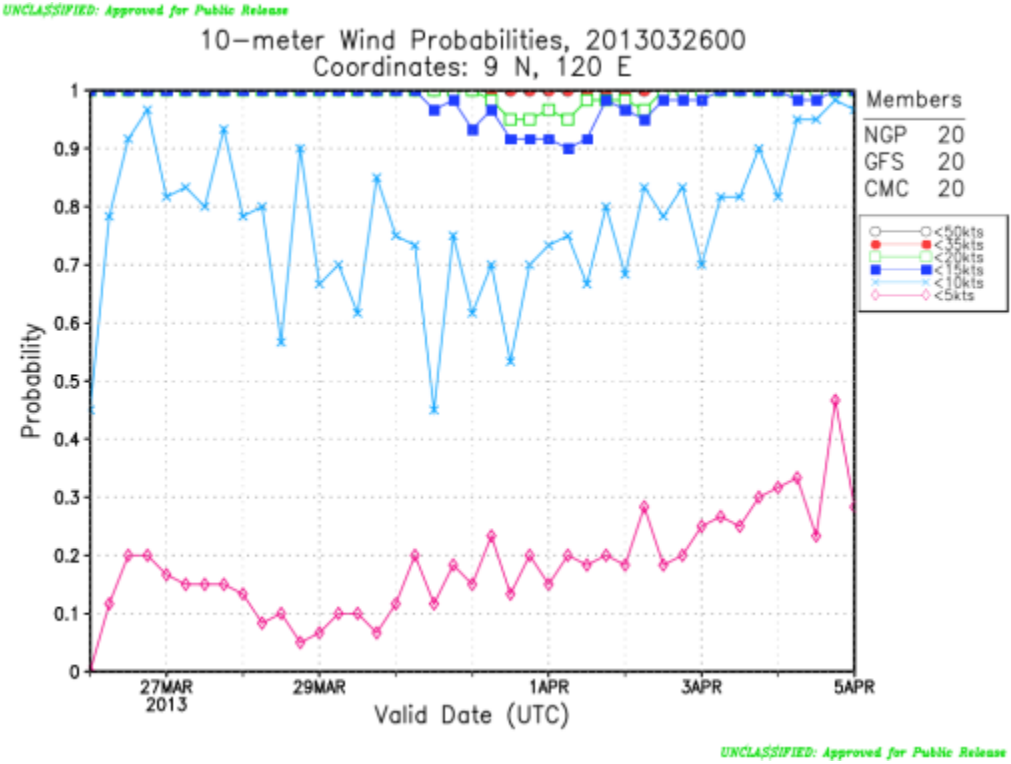
Forecast reliability can be estimated from the "spread" shown in individual model members

NUOPC = Multi-model Ensemble (USN, NCEP, Canadian Met)

60-Member Ensemble ISO Ex-USS GUARDIAN

Ensemble Mean & uncertainty for 10-m winds out to 16 days



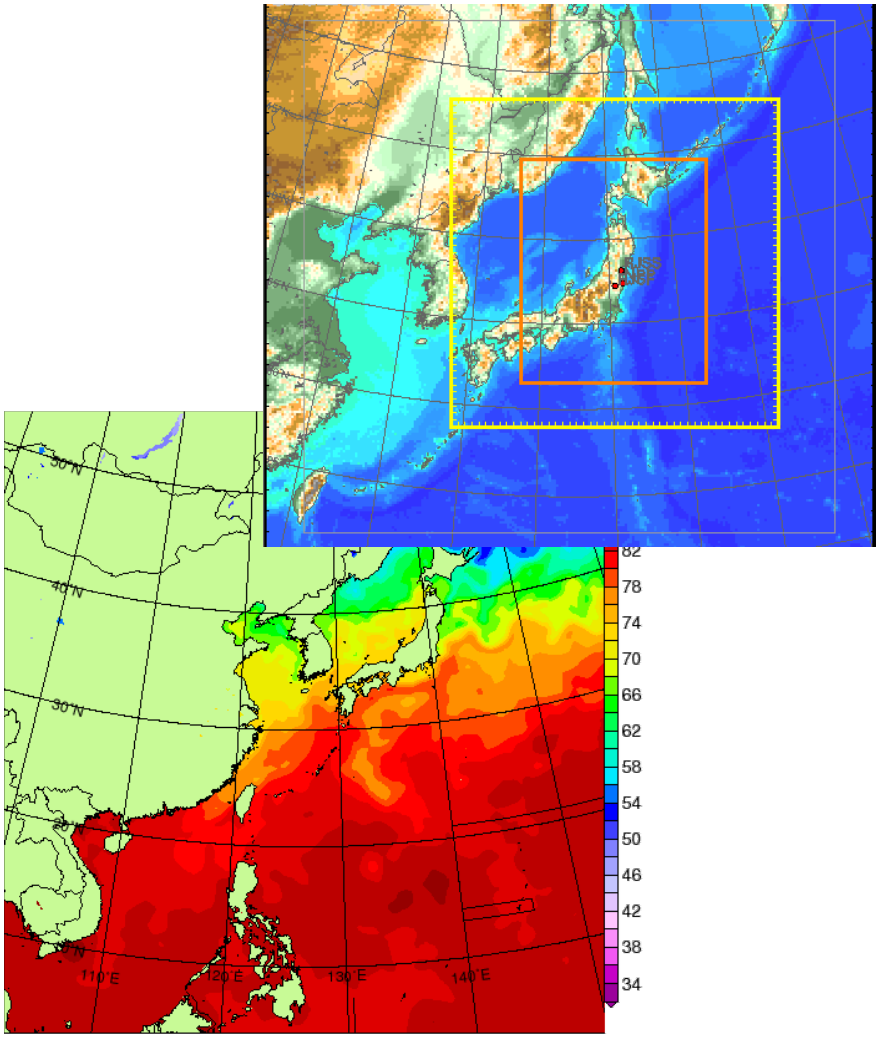


60-member Ensemble “METEOGRAM” to determine probability when 10-m winds will be less than10kts for at least 4-days.

Coupled Ocean / Atmosphere Mesoscale Prediction System (COAMPS): Regional Model

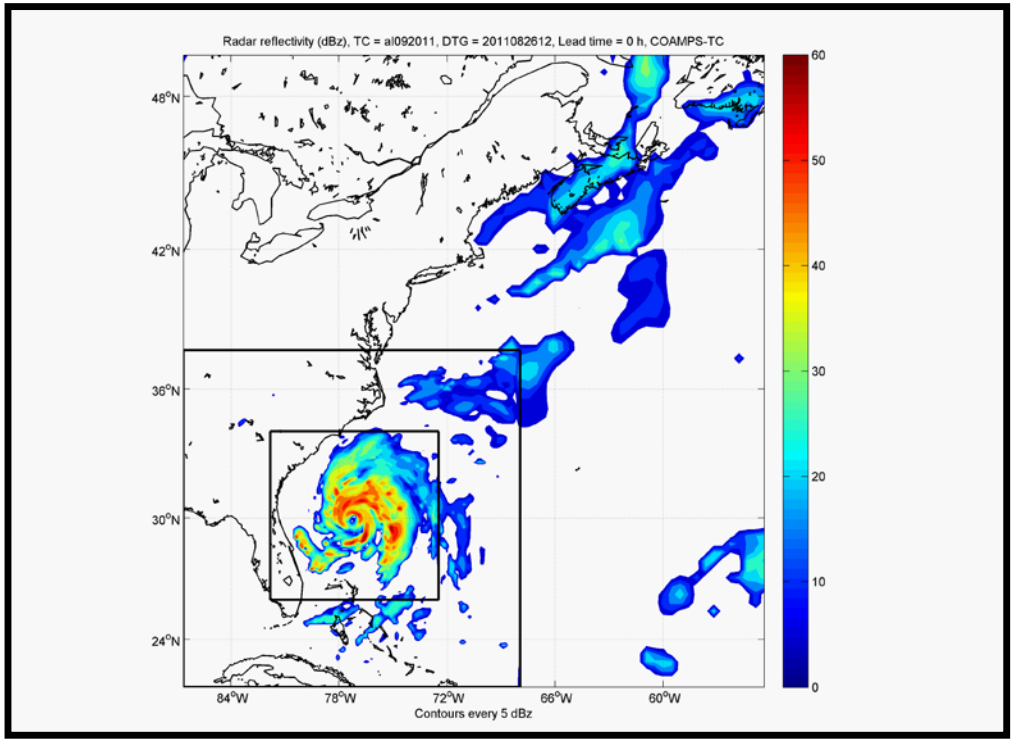
COAMPS - Regional to Tactical Scale Rapid Response Support

- Customizable on-demand support for land, littoral, or open ocean operations
- Resolutions available: 15/5/1.67-km
- Available all classification levels (NIPR/SIPR/JWICS)
- Forecasts out to 72 hours (can do 96)
- Rapid Environmental Assessment (REA) Nowcast based on NEXRAD or SPS-48
- Ship-Following COAMPS



COAMPS-TC System Overview

- Analysis
  - Synthetic Observations
- Atmosphere
  - Non-Hydrostatic
  - Moving nests
  - TC Physics
- Coupled Ocean
  - 3D-Var (NCODA), ocean (RNCOM)
- Nests
  - NAVGEM boundary conditions
  - Atmosphere: 36/12/4 km
  - Ocean: 7.5 km
- Ensemble
  - Uncoupled, COAMPS-TC with perturbed boundary conditions: 36/12/4 km



IRENE (2011)
Simulated Radar Reflectivity

COAMPS Rapid Environmental Assessment (REA)

- Navy's tactical-scale NWP model
- 45/15/5/1.67-km grid spacing
- Assimilate NEXRAD and other radar hourly
- 9-12 hour forecast run every hour
- Latency <1 hour

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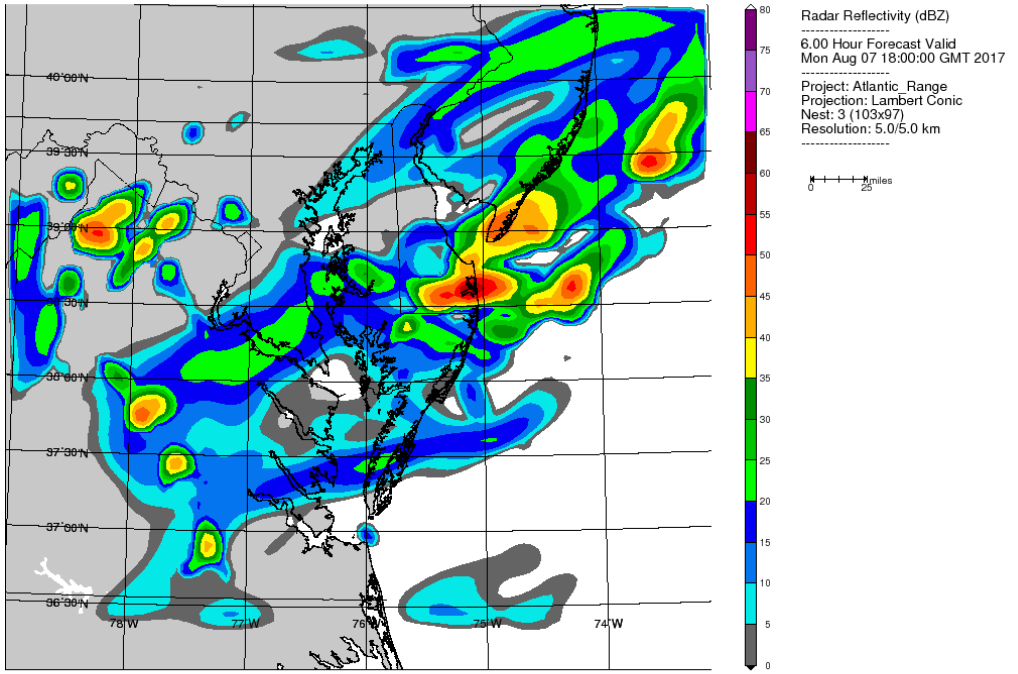

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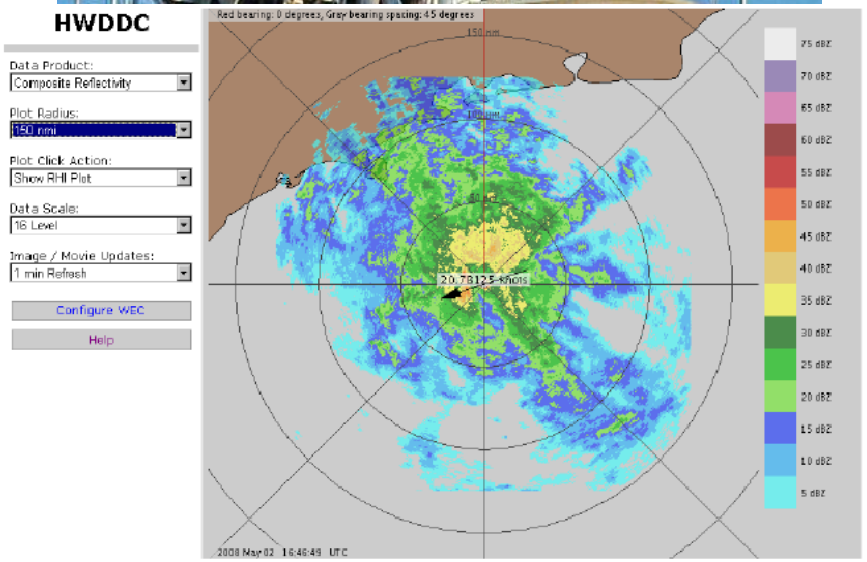
SPS-48 Hazardous Weather Detection and Display Capability (HWDDC)

- SPS-48 shipborne weather radar
- E and F band (2 to 4 GHz)
- 250 nmi range
- Data ingested into onboard Hazardous Weather Detection and Display Capability (HWDDC)
- Data assimilated into COAMPS
- Increased safety of flight and safety of navigation

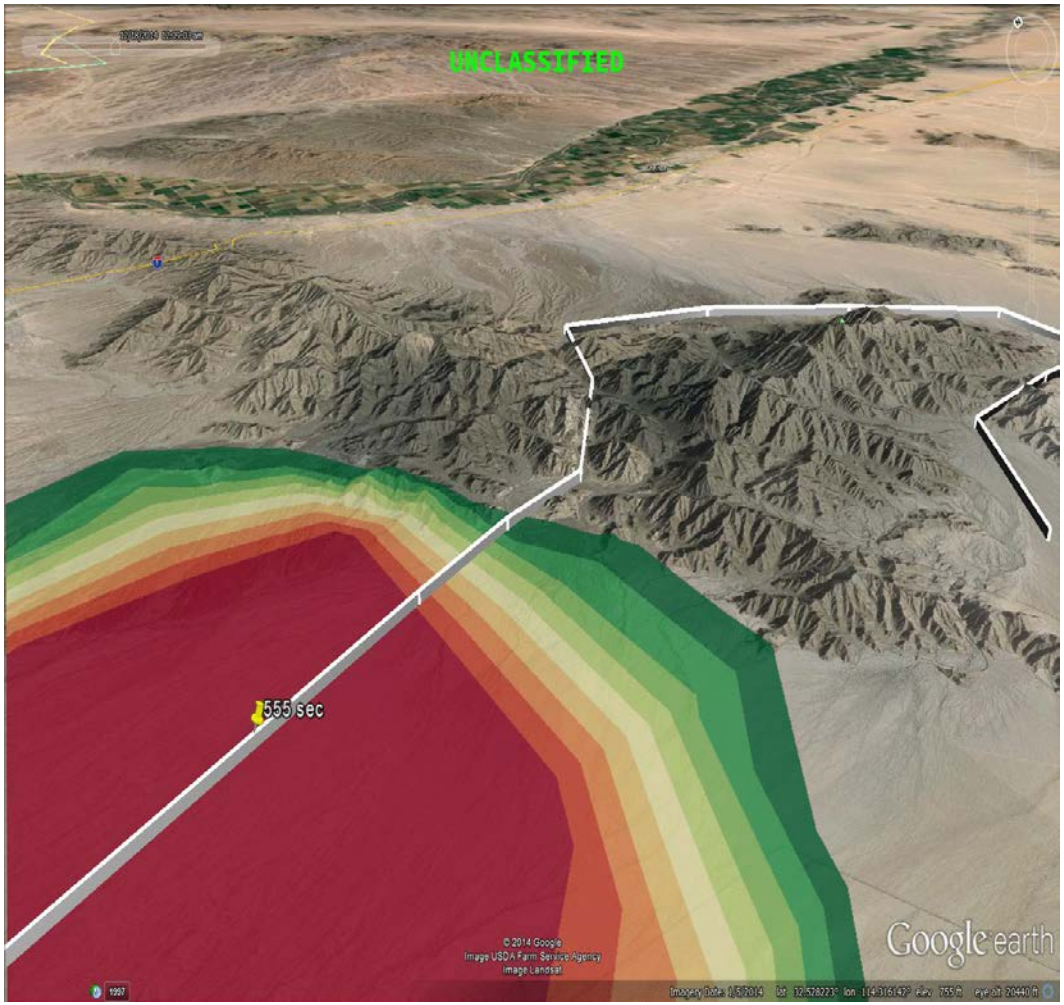


Ship-Following COAMPS

- Provides automated moving boxes for tactical-scale COAMPS support for ships at sea
- 45/15/5-km grid spacing
- Uses ship position provided by HWDDC, Joint Observations (J-OBS), Movement Report (MOVREP), etc.
- Supports SPS-48 HWDDC radar data assimilation
- Utilizes REA forecasting mode
- Right: USS JOHN C. STENNIS (CVN 74) deployment 00Z 09 OCT 2012 – 00Z 19 OCT 2012

Atmospheric Acoustic Propagation

- NASA code adapted to Navy requirements by NRL MMD
- Combines weather & terrain
- Web GIS interface
- Multiple output formats: KML, Shapefile, PNG
- Initial OPTEST and OPEVAL completed
- Future:
  - Additional airframes
  - Multi-platform capability
  - Optimum path routing
  - Threat avoidance routing

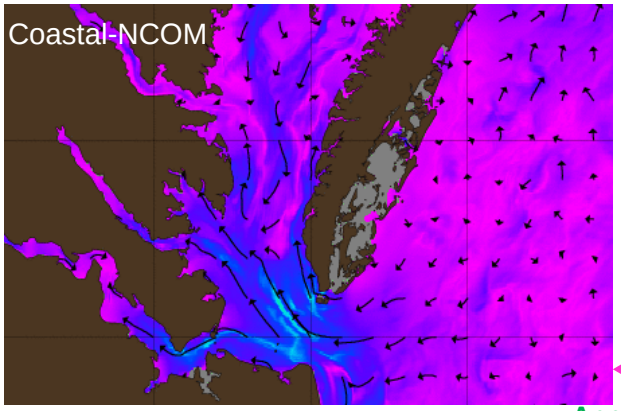


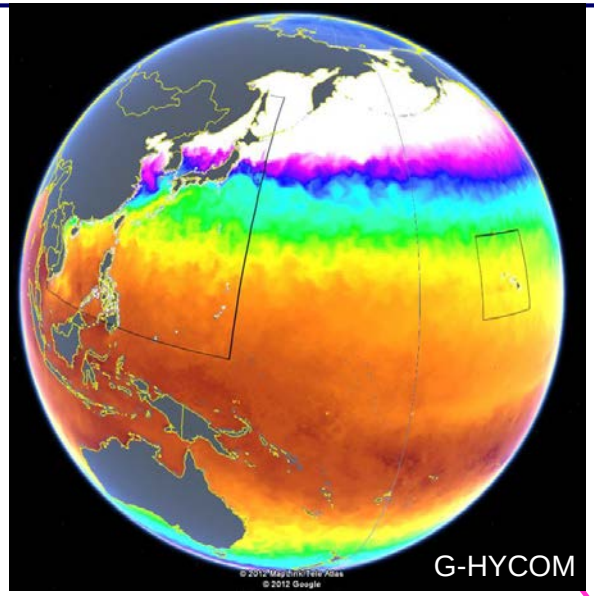
Green = 10-40% detection, Red = 90-100%

Global, Regional, and Coastal Ocean Models

Global-HYCOM

- Operational Capability:
  - Forecasts 3D Temp., Sal., Currents, Elevation out to 168 hours in 3-hr increments
  - NAVGEM wind forcing
  - 1/12 deg (~9 km)
  - 40+ vertical layers
  - Pressure, depth, sigma coordinates as needed
- Future Capability:
  - 1/25 deg (3.8-km)



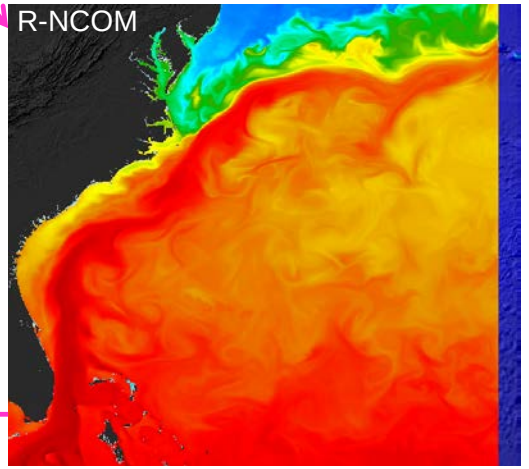


Coastal-NCOM

- Operational Capability:
  - Forecasts out to 72 or 96 hours in 1-hr increments
  - COAMPS wind forcing
  - BC from R-NCOM
  - 300 – 500 m
  - Provides BC to higher resolution nests (10 – 100 meter)

Regional-NCOM

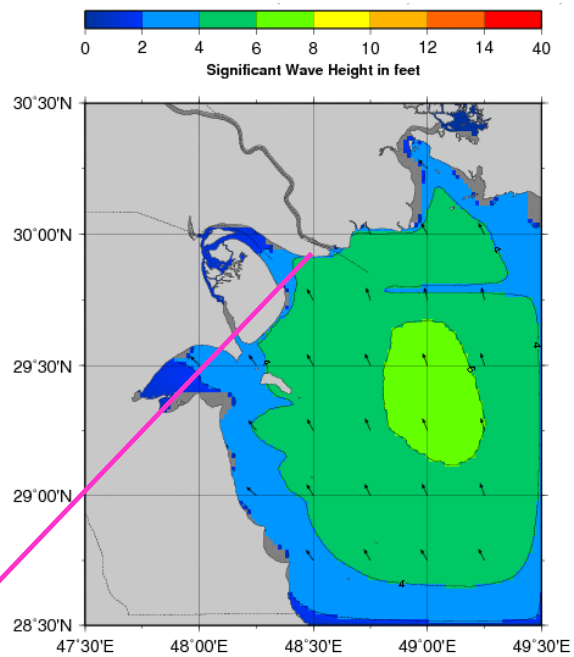
- Operational Capability:
  - Forecasts out to 96 hours in 3-hr increments
  - COAMPS wind forcing
  - Boundary conditions (BC) from G-HYCOM
  - 3.7-km (~1/30 deg)
  - Provides BC to higher resolution nests (300 – 500 meter)



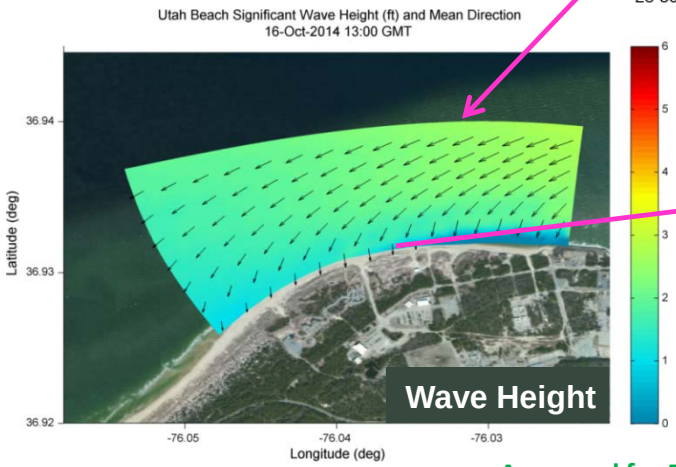
Coastal / Near-Shore Wave Forecasting

- Small boat operations
- Planning diver / vehicle operations
- Surf forecasting for amphibious operations
- 2 weeks to 1 month turn-around time

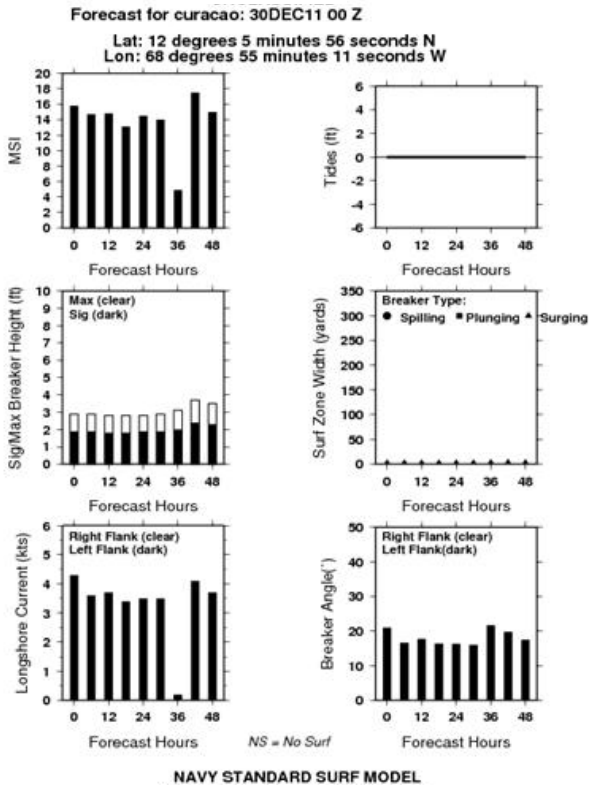
Coastal Wave Height



Near-Shore Wave Height

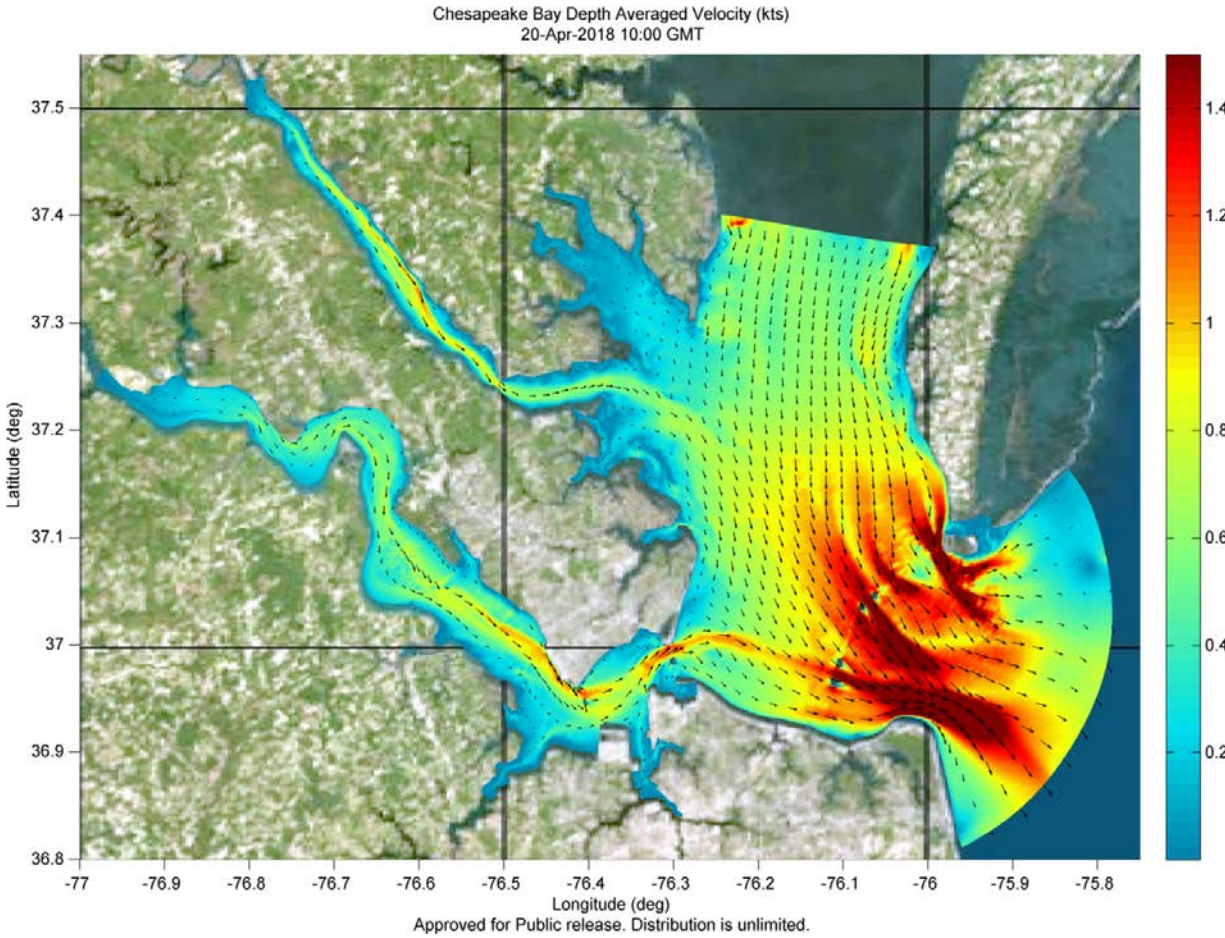


Surf Forecasts



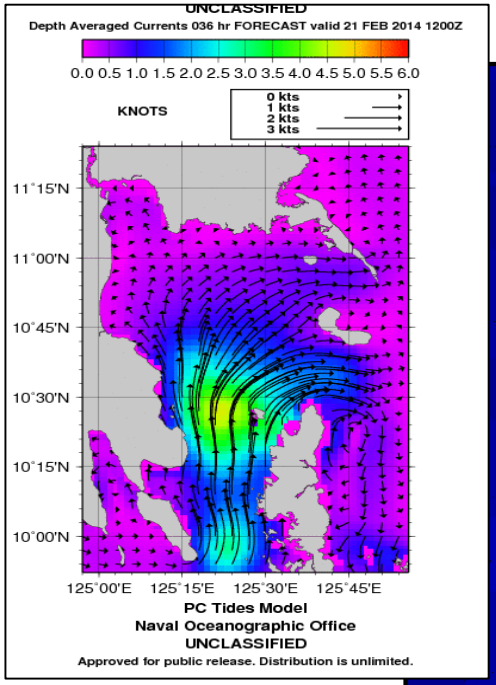
High Resolution Coastal Modeling – Delft3D

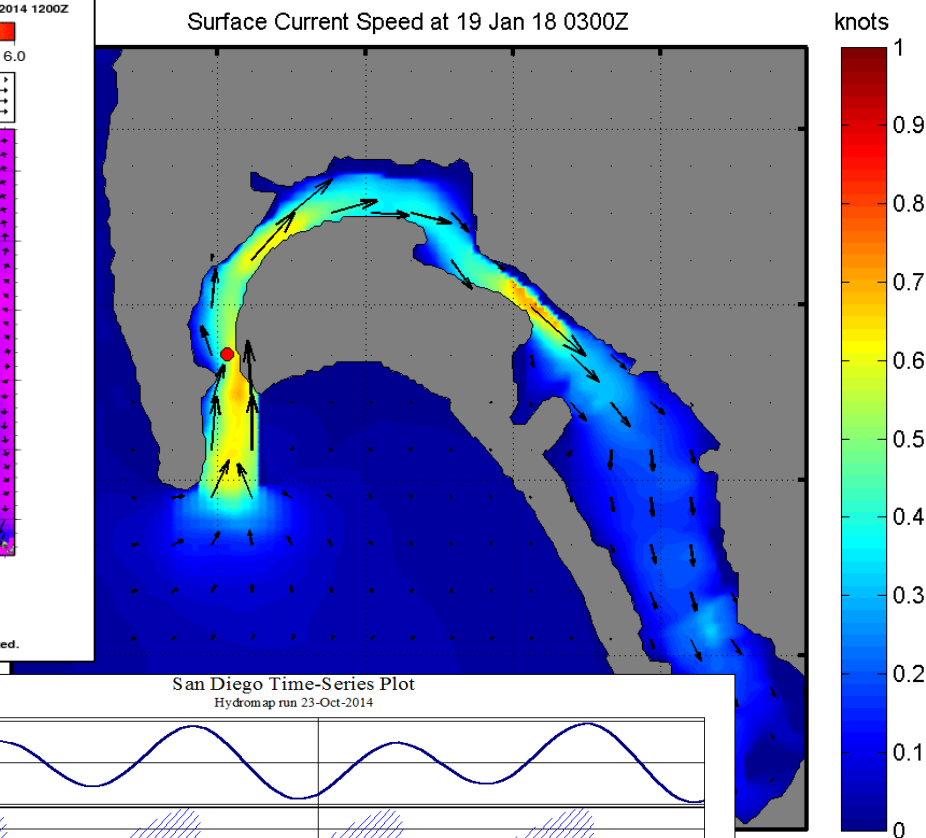
- Variable resolution model grids, 10m – 100m
- Mainly used for Maritime Homeland Defense Support, some Expeditionary Warfare Support
- Approx. 40 Delft3D domains running daily, most on NIPR DSRC
- High-resolution bathymetry
- 48 or 72 hour forecasts
- One month turn-around time

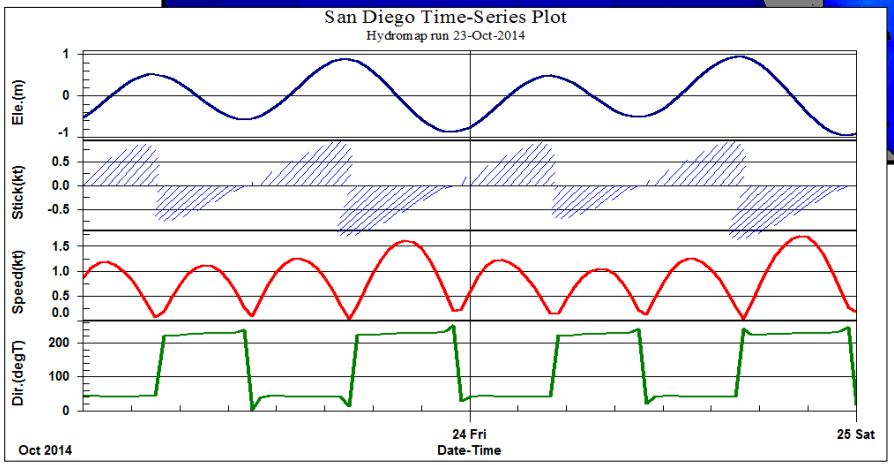


Tidal Currents Models

- 2D graphics, time-series, constituent table outputs
- Nest to needed resolution
- Provides a first guess - rapid implementation (<24 hours)
- Can run in daily forecast mode with wind forcing or can run tide-only for any time period

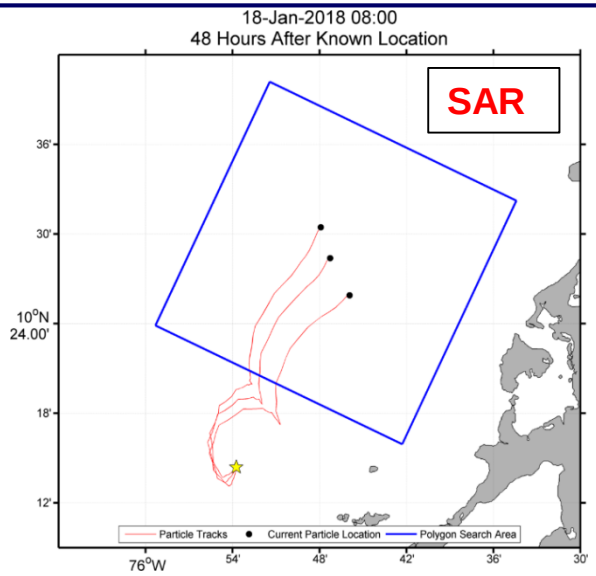


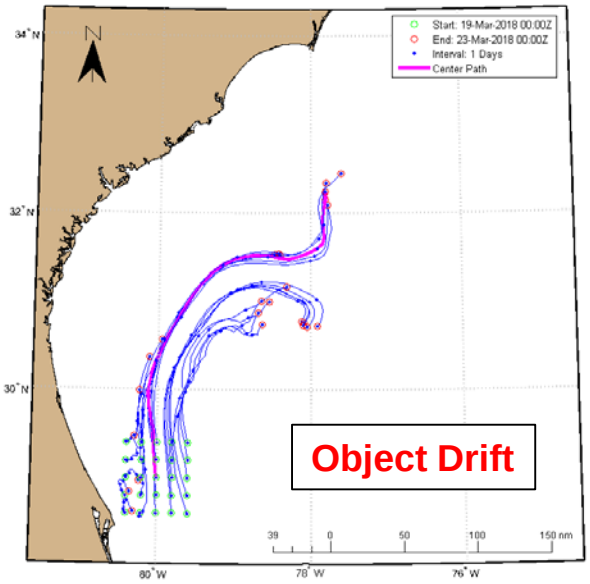


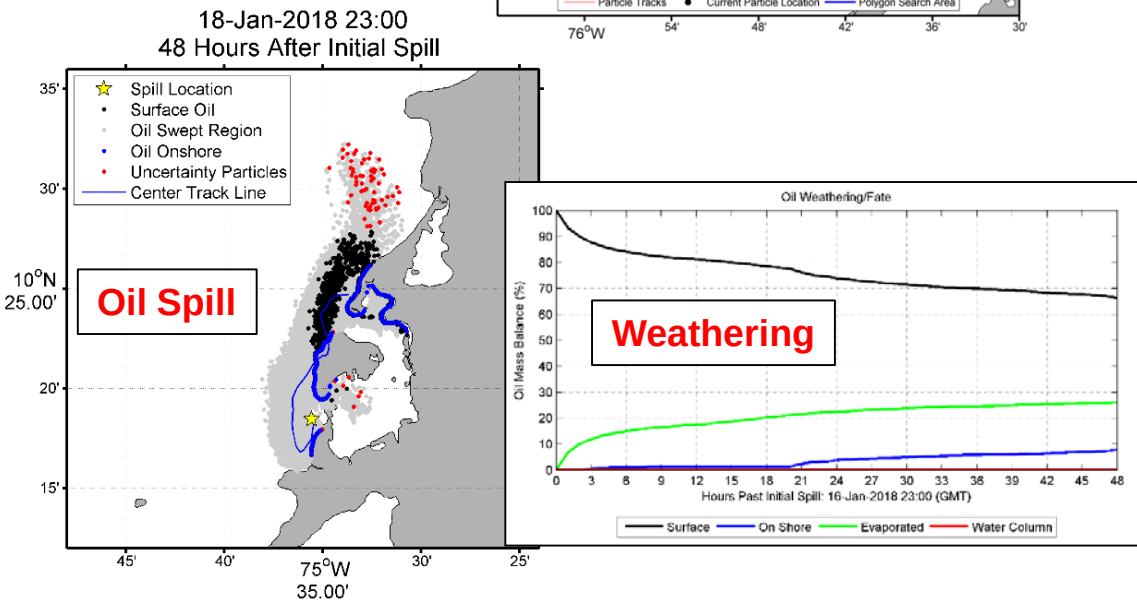


Ocean Drift Forecasting

- Drift forecasts / hindcasts for objects in water
- Need start time/date and location
- Used for Search and Rescue, Mine-Like Objects, Oil Spills
- 2 – 3 hour turn-around time





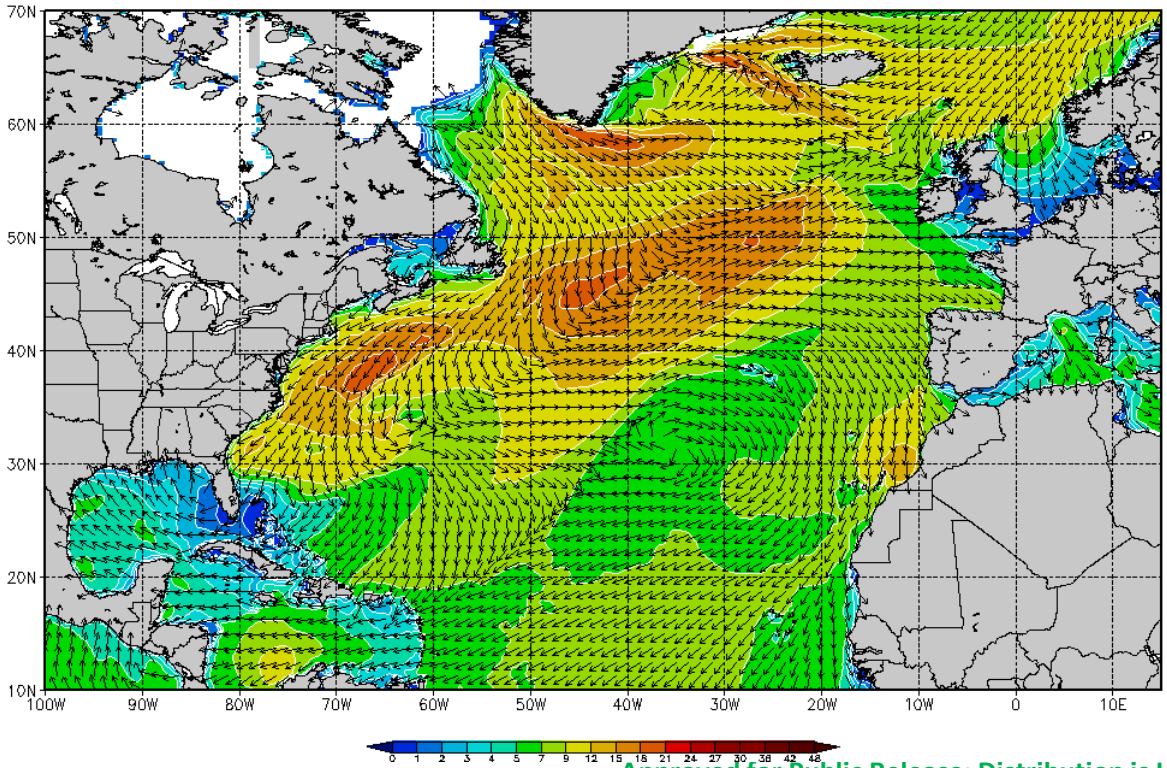


WW3 – Ocean Waves

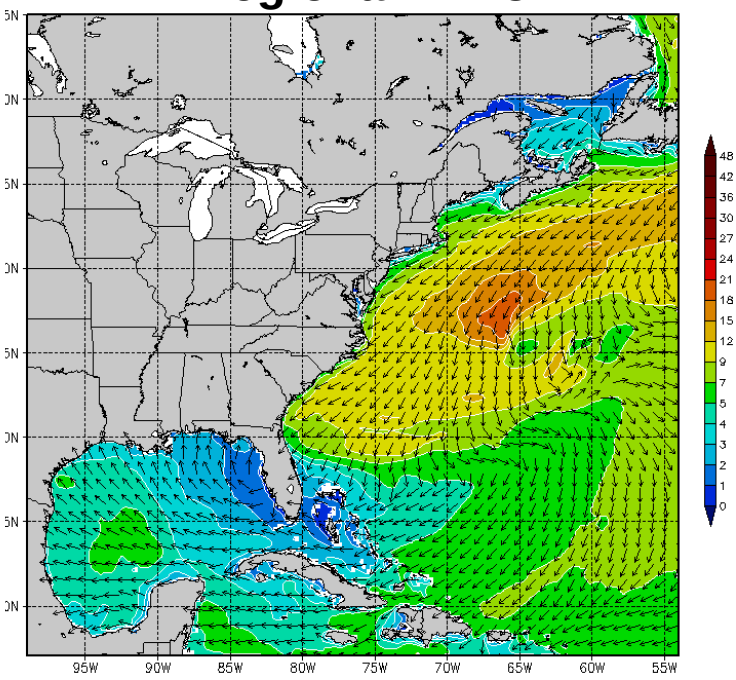
Wave Watch 3rd Generation – Ocean Waves from Global to Tactical Scales

- Global (~35-km) and high resolution implementations, 36 frequencies/36 directions
- Driven by NAVGEM and COAMPS, model bias can be "tuned"
- Includes assimilation of altimeter and buoy data

Global WW3

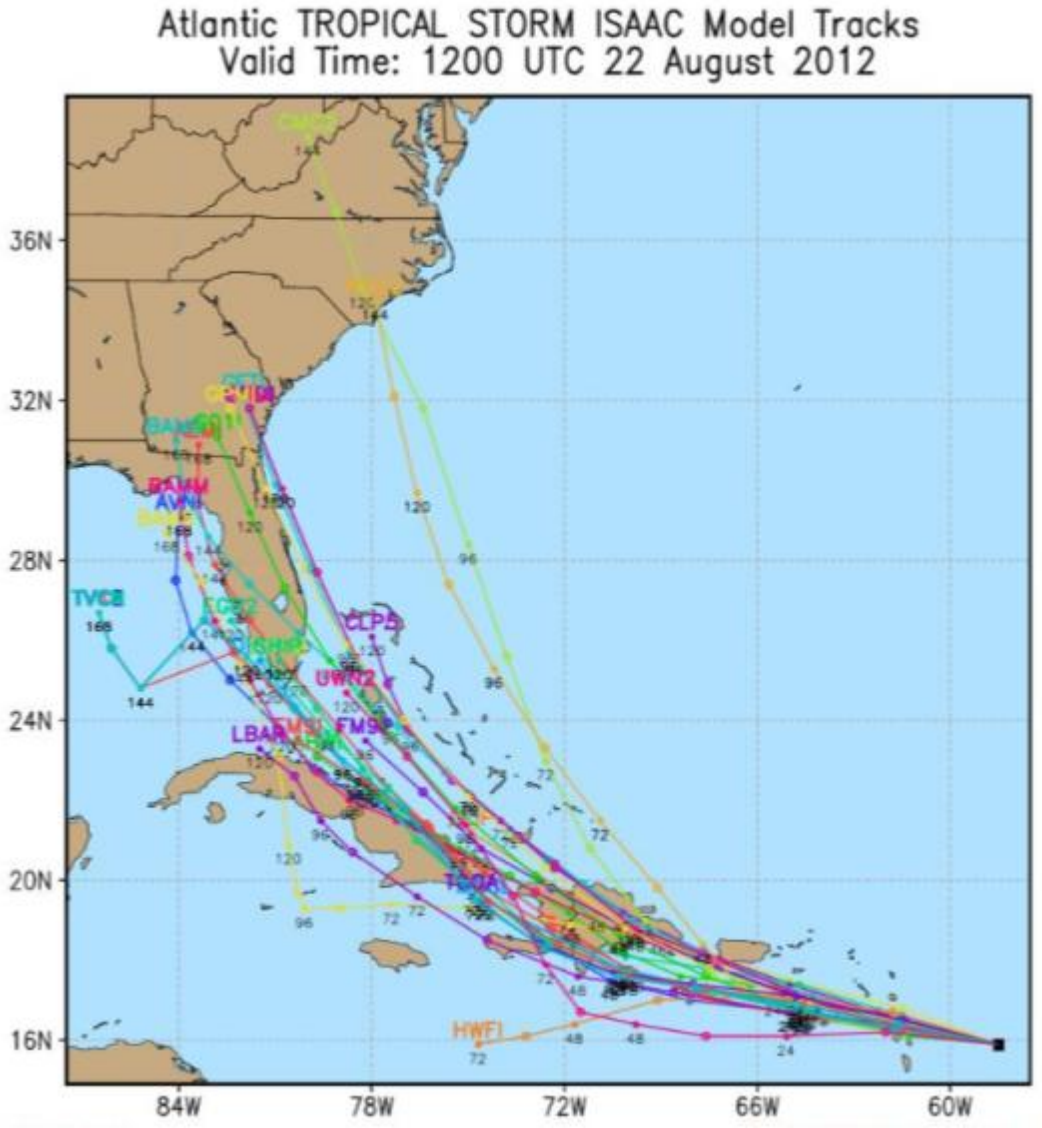


Regional WW3



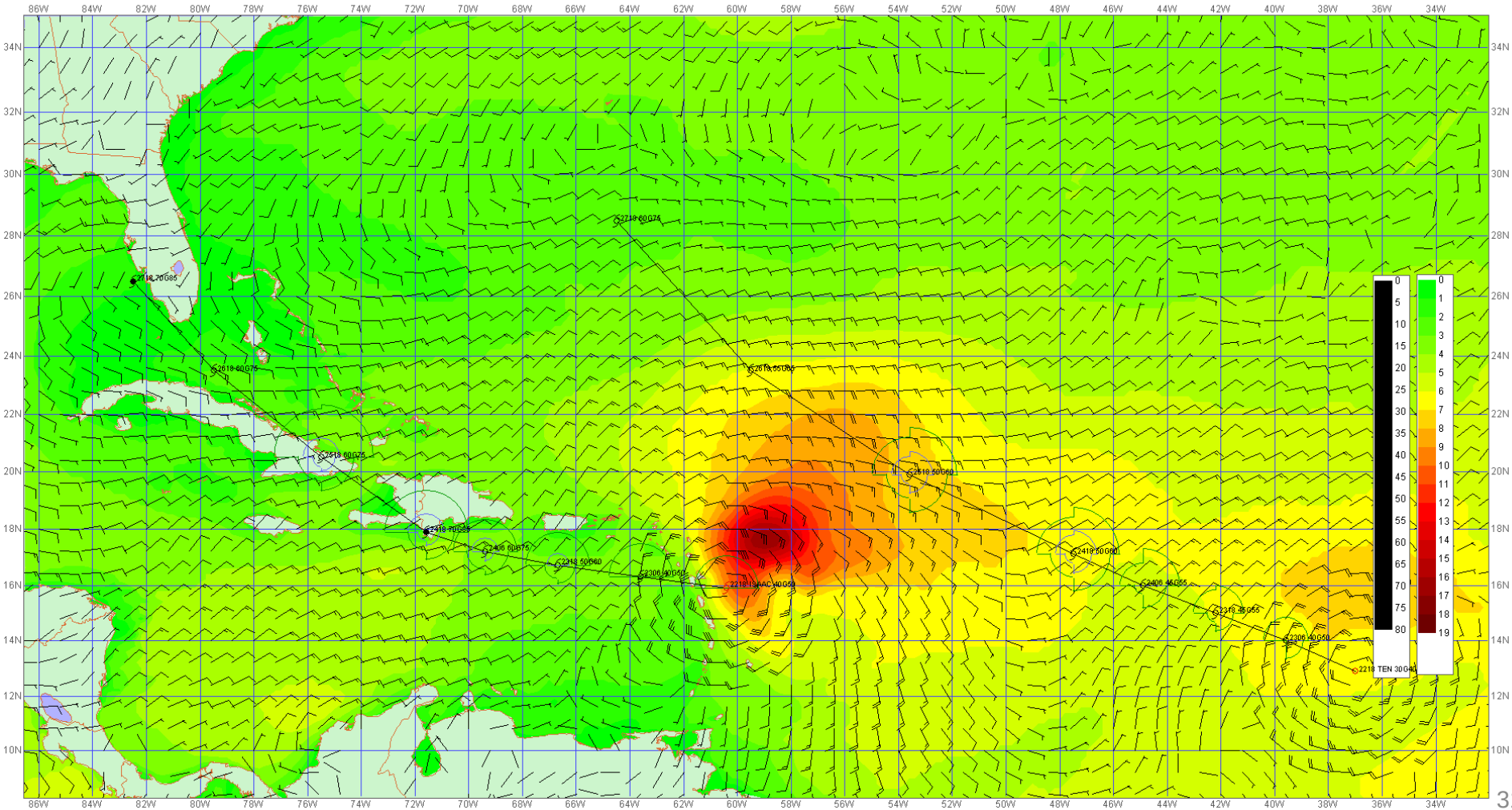
Model Tracks… Which one is right?

- NWP Centers
  - ECMWF
  - NCEP (NWS)
  - UKMET
  - JMA
- All have different forecasted track and intensity.
- Do I need to Sortie the Fleet?
  - If so where and when?



WW3 based on Official TC Warning from JTWC / NHC

- Remove the NAVGEM tropical circulation
- Insert a synthetic vortex based on the JTWC (or NHC) Forecast track and wind intensity.
- Use the modified sfc wind field to drive the WW3



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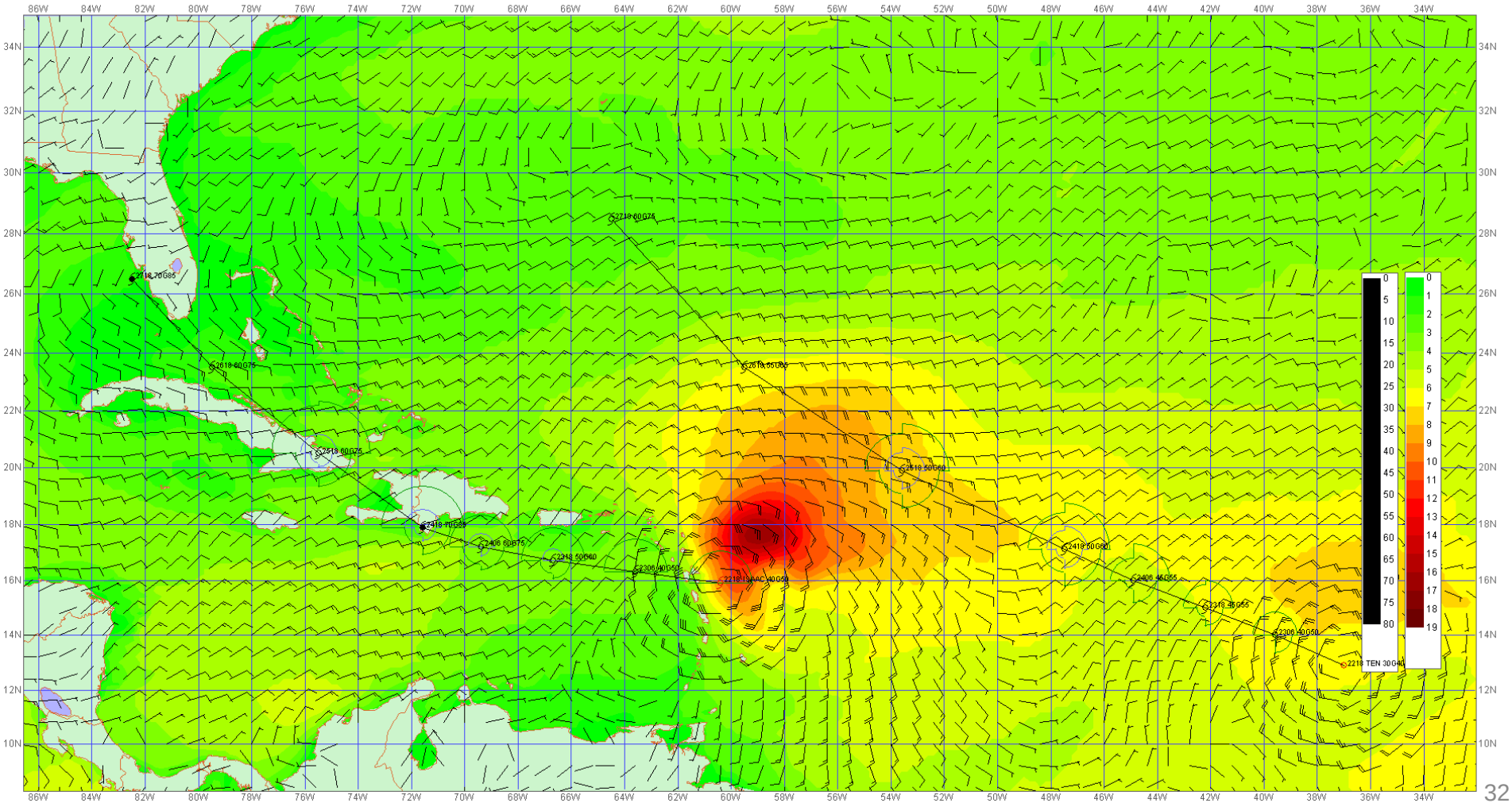
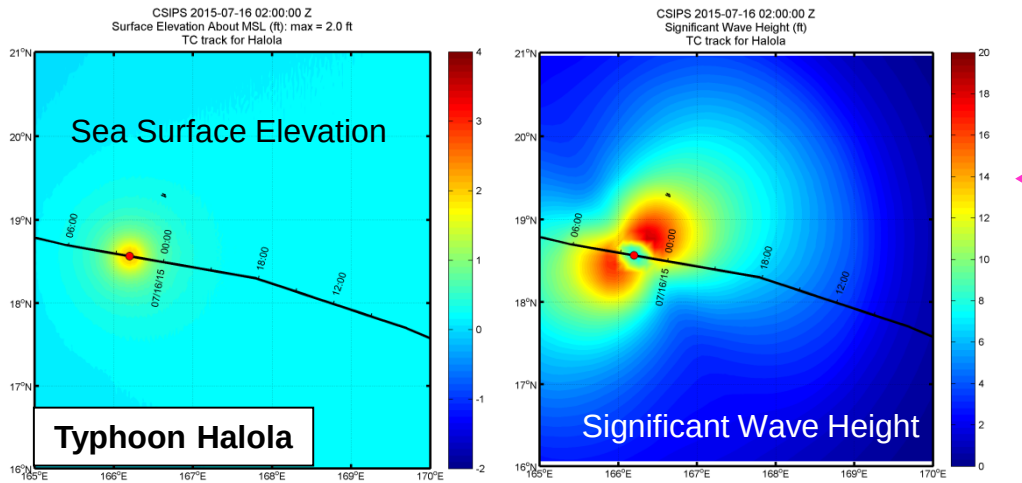
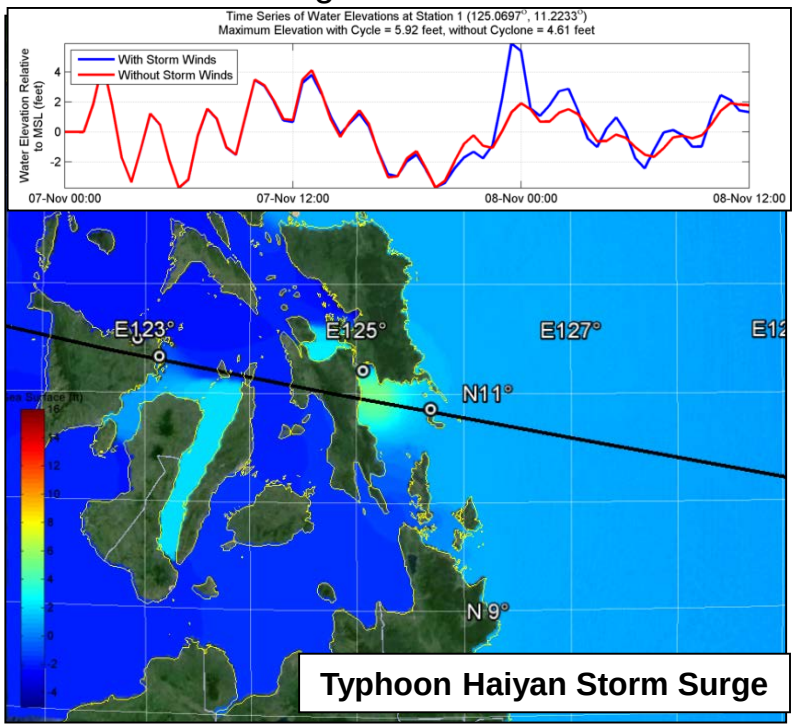


Storm Surge Forecasting

- Storm surge forecasts in areas of Navy interest for asset protection
- Provided for humanitarian support upon request
- Dependent on Joint Typhoon Warning Center and National Hurricane Center storm warning messages
- Starting 2015 storm season, DELFT3D replaced PCTIDES as core model



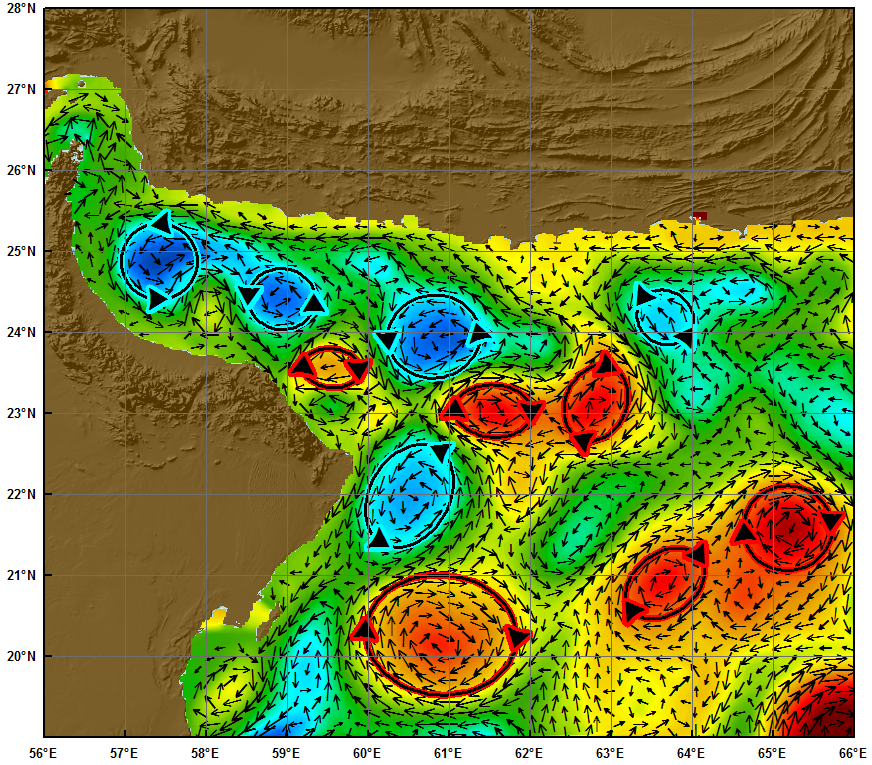
Sea Surface Height about Mean Sea Level

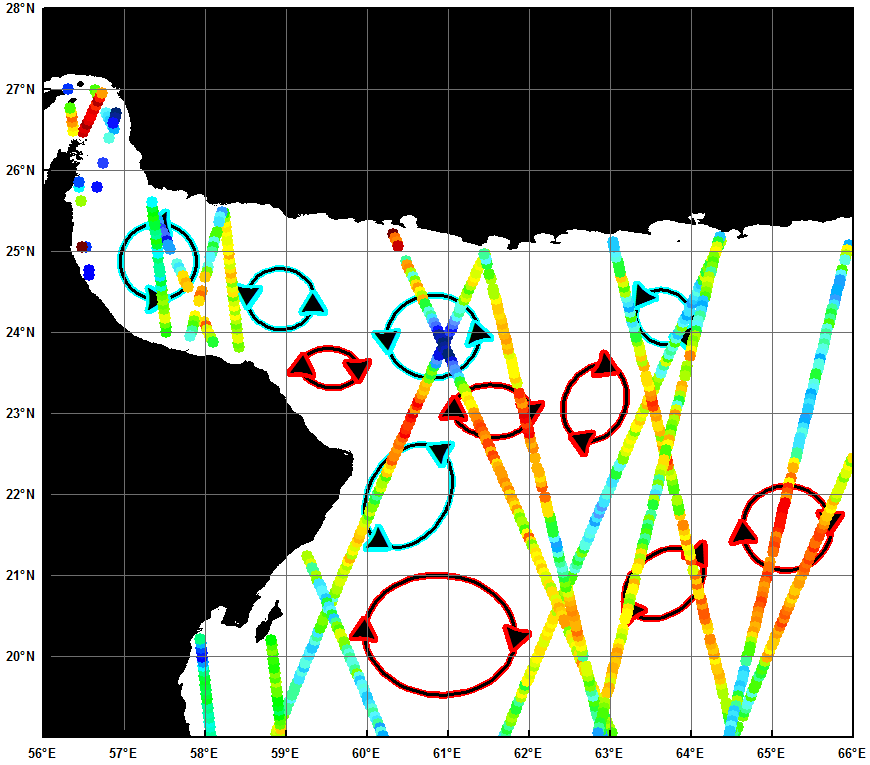


- Tropical Cyclone Halola approaching Wake Island July 14, 2015, JTWC Warning #19
- NAVOCEANO forecast indicated wave height is much higher than surge

Tactical Oceanographic Features Assessment

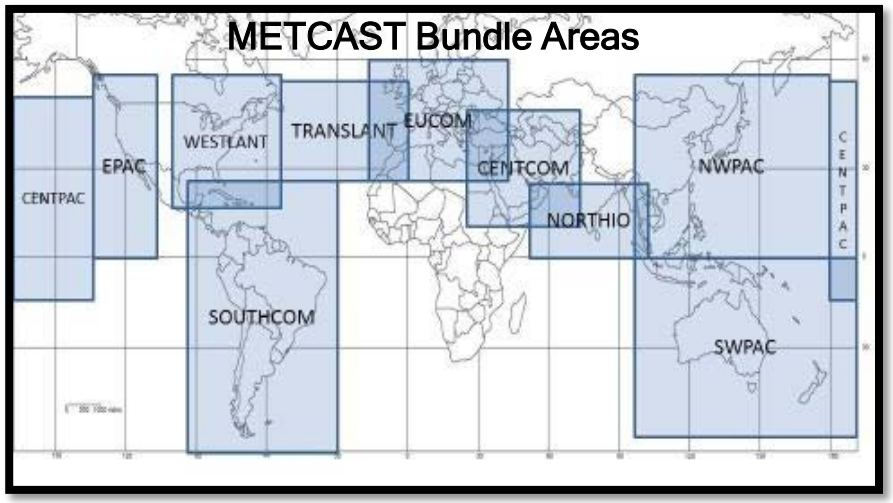
- Model predictions used to:
  - Identify acoustically significant ocean features (fronts and eddies)
  - Derive ocean acoustic parameters (e.g. sonic layer depth, etc.)
  - Input for acoustic models

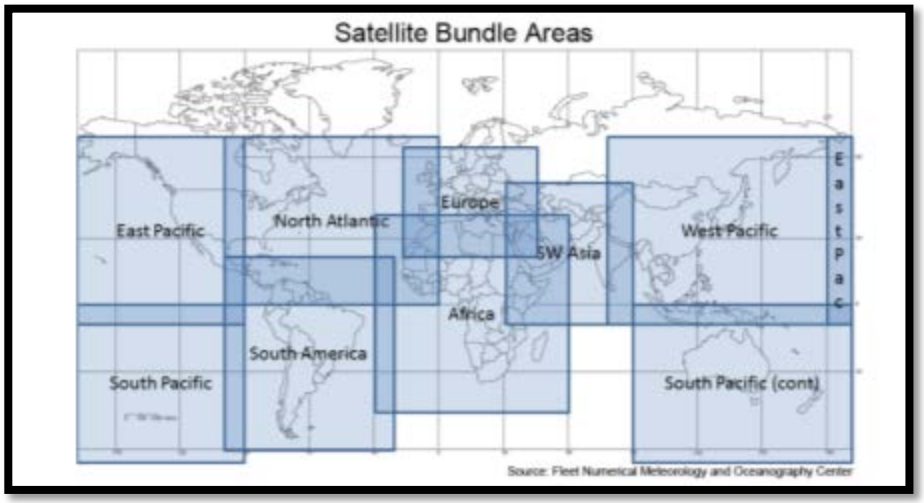




GBS Product Delivery

- GBS data feed setup
  - SOP Available and Briefed to all OA (Ship METOC) Division Officers
  - Bundle request via respective ship's Communication Officer
  - Add bundles based on geographic AOR to GMR





GBS is a passive, push data subscription service. It is most useful in a comms-limited environment on ships. For METOC, it currently enables the forecasters to receive two types of data in order to provide safety of flight and navigation. It's critical for deploying units to include GBS data delivery in their pre-planning process, to include early coordination with FNMOC / SPAWAR. Feedback on GBS during post deployment briefing is essential for improving customer support.

Questions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