



Naval Oceanography



R&D Requirements Brief CEROS Industry Day September 14, 2009

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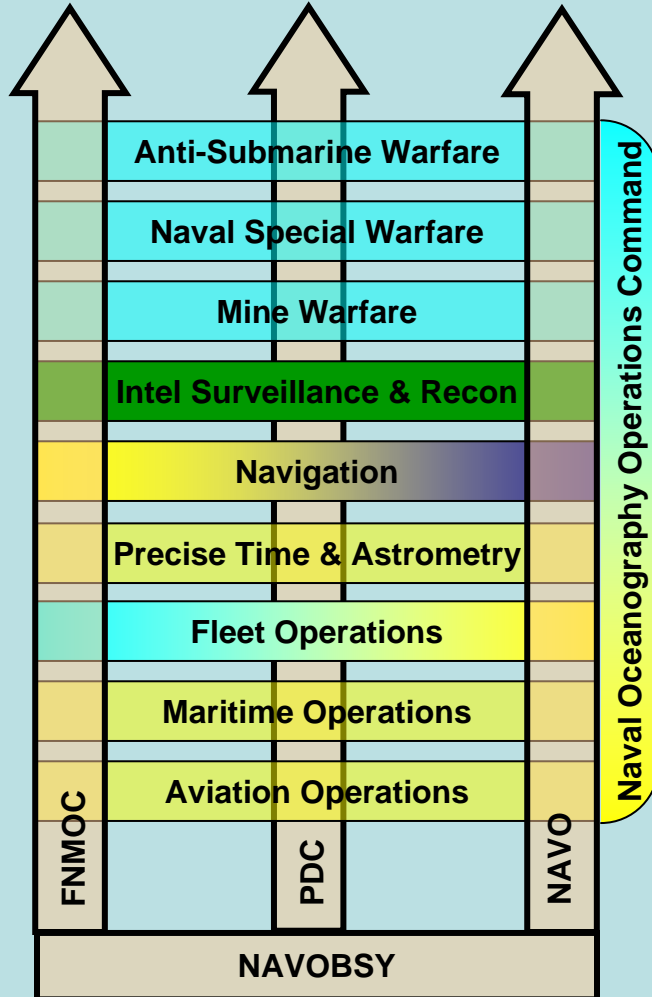
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Naval Oceanography



WARFIGHTING FOCUSED

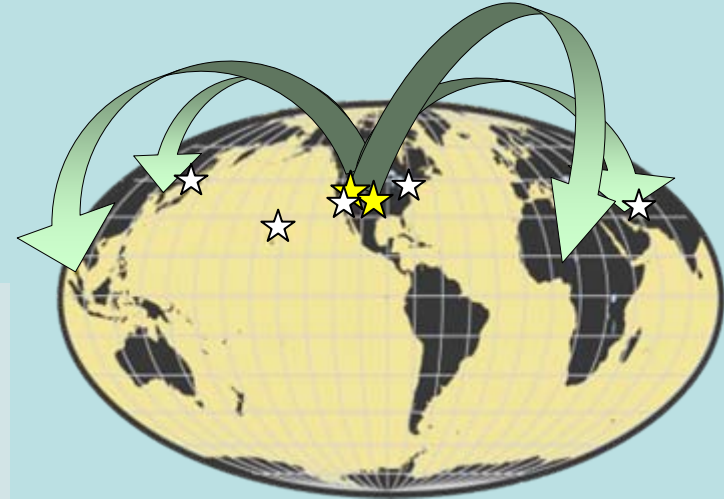


Naval Oceanography

- 7 T-AGS ships
- 1 LIDAR aircraft
- expeditionary fleet survey team
- 1,200 military
- 1,100 civilians

- Warfighting
- Safety
- Shaping

KNOWLEDGE-CENTRIC



- Teamwork
- Technical Excellence
- Clear Communications
- Manage Risk
- Measure Results
- Continuous Improvement



Battlespace On Demand

Linking Forecasts to Decisions



Decision superiority: Making better decisions faster than the adversary

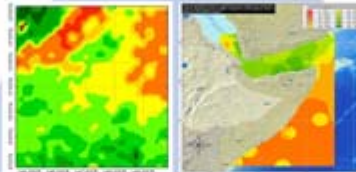
DECISION



- ▲ Options
- ▲ Courses of Action
- ▲ Sensor Employment
- ▲ Asset Allocation
- ▲ Timing
- ▲ Quantified Risk

3

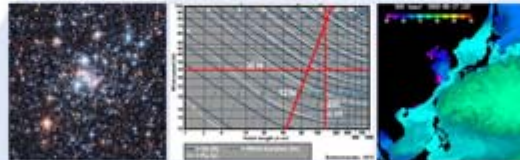
PERFORMANCE



- ▲ How the predicted environment affects the Fleet and Joint Forces

2

ENVIRONMENT



- ▲ The predicted environment

1

DATA



- ▲ Observations, measurements, satellites, gliders, buoys, etc.

0

INITIAL AND BOUNDARY CONDITIONS



Naval Oceanography Operations Command



Operational arm of the Naval Oceanography Program

- Provides an asymmetric advantage by exploiting current/future state of the environment.*
- 24/7 reachback to production centers*



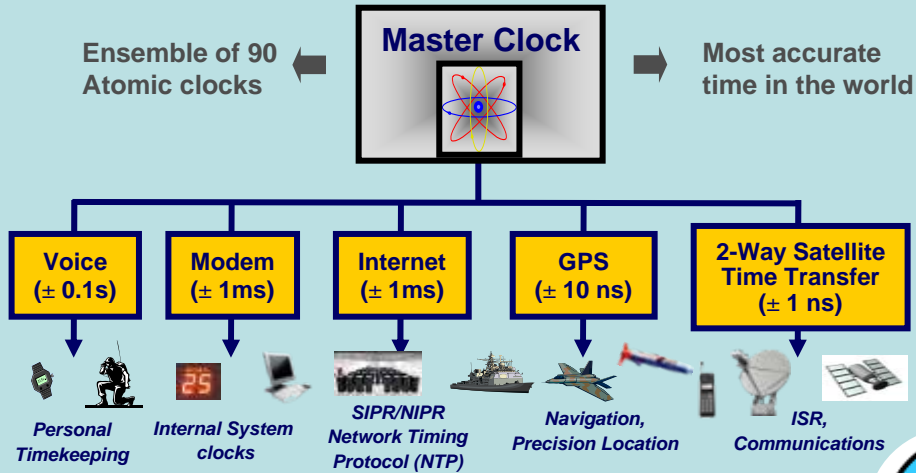
- **Five Warfighting-focused Directorates:**
 - ASW, NSW, MIW, FLT OPS, and ISR
- **Four Warfighting-enabling Directorates:**
 - NAV, PTA, AVN, and MAR
- **Integrated civilian / military team leveraging expertise and experience**



U.S. Naval Observatory



Precise Time

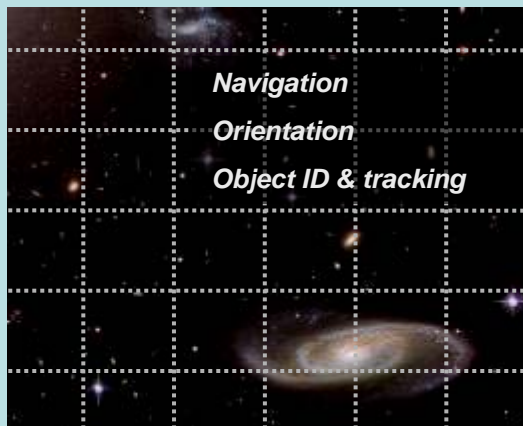


Earth Orientation Parameters

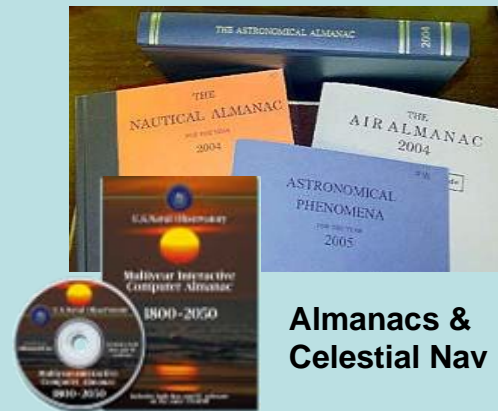
- ★ Departures from “pure” rotation
- ★ Synchs the earth and its orbiting space platforms
- ★ GPS Error = 2 meters w/in 1 week & 400 meters at 6 months w/o EOP



Astrometry – star positions & motions



Astronomical Applications



Solar/Lunar Illumination





Naval Oceanographic Office

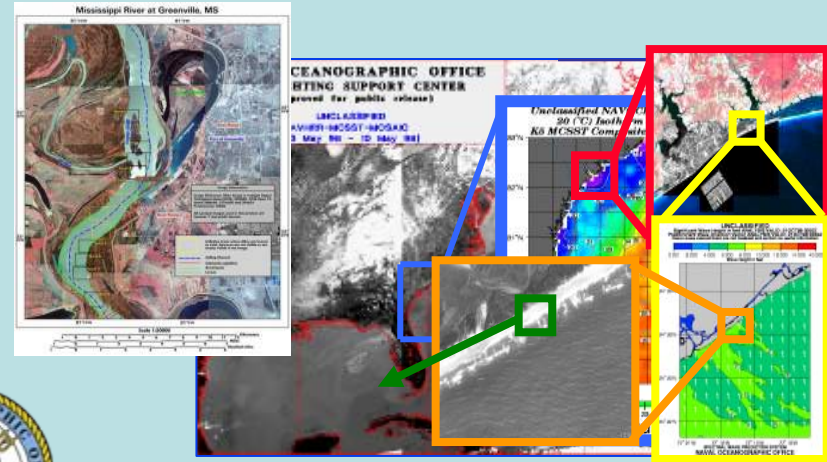


Collection Assets

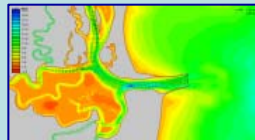
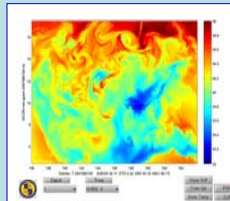
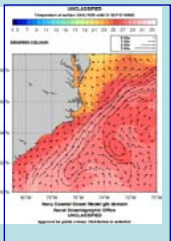
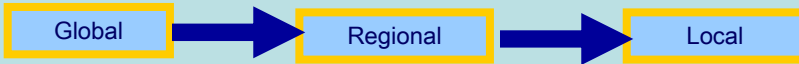
- Military Survey Ships
- Fleet Survey Team
- Airborne LIDAR
- UAVs
- Tethered Vehicles



Annotated Imagery



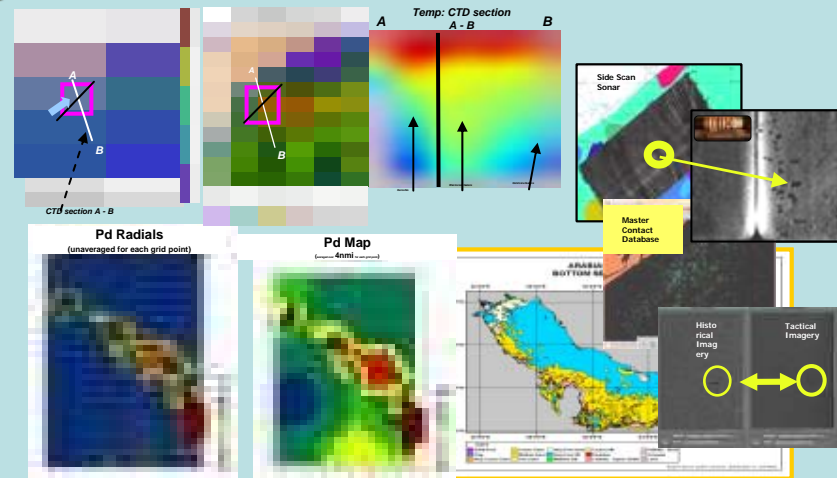
Ocean Circulation Modeling



- Navy Layered Ocean Model
- Global Navy Coastal Ocean Model (NCOM)

- - Shallow Water Analysis & Forecast System
- - East Asian Seas NCOM
- - Relocatable-NCOM

Tactical Products

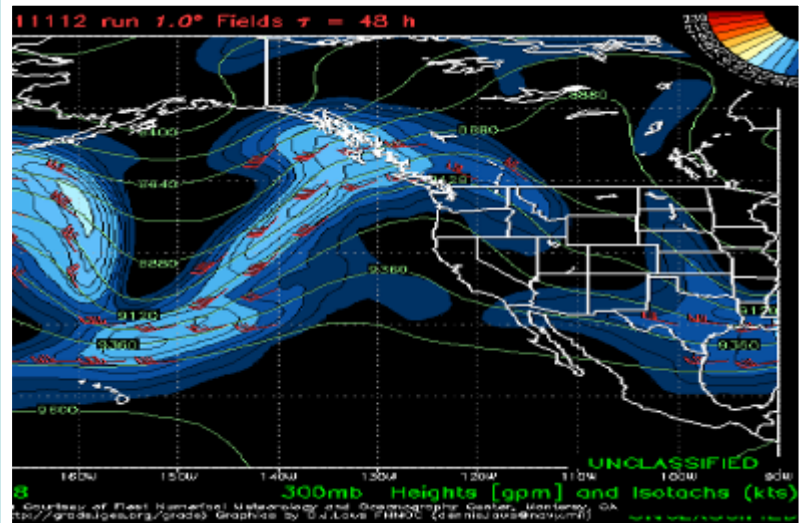




Fleet Numerical Meteorology and Oceanography Center



- DoD's only global numerical weather prediction capability
- 24x7 Operational Reachback Center (serves as CNMOC's operational watch)
- Collocated with Naval Research Laboratory and Naval Postgraduate School





How R&D Transitions to NAVMETOC



- **Leverage Commander of Naval Research (CNR) 6.1 - > 6.3 S&T/R&D**
- **Transitioned via 6.4 R&D**
 - **CNO N84 (Oceanographer of the Navy) is the 6.4 Resource Sponsor**
 - **METOC ACT and non-ACAT Programs Executed by PEO C4I, PMW-120**
- **Primary Performers for non-ACAT 6.4 R&D are Naval Research Labs (Stennis Space Center, MS and Monterey, CA)**
- **If you have ideas that can help, we will encourage you to contact the PEO/PM/Lab**



R&D Needs – General Topics



- *Decision Support*
 - *Integrating Environment/Commander's Intent/Intel into Actionable Decisions*
- *Quantifying and Communicating Uncertainty*
- *Data Visualization*
- *UUV Technology*
- *Coupled Ocean/Atmospheric Modeling*



R&D Focus Areas Decision Support



- *Develop METOC decision support products applicable to ASW, MIW, EXW, and ship safety*
- *Develop/Improve Performance Surface products supporting ASW, MIW, EXW, and Weather Services*
- *Develop Smart Climatology methodology and products*
- *Develop Sampling Guidance methodology*
 - *Where do we deploy sensors in time and space to reduce model / product error?*



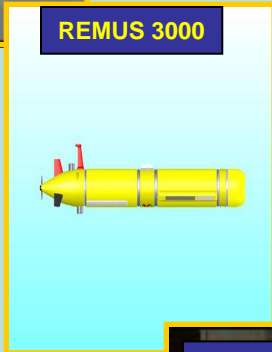
R&D Focus Areas Visualization



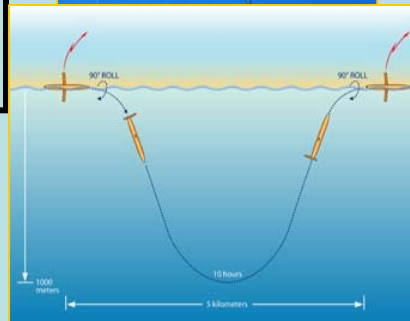
- *Enhanced visualization of large, time-varying METOC datasets*
- *Tools for assessing model output by ocean forecasters*



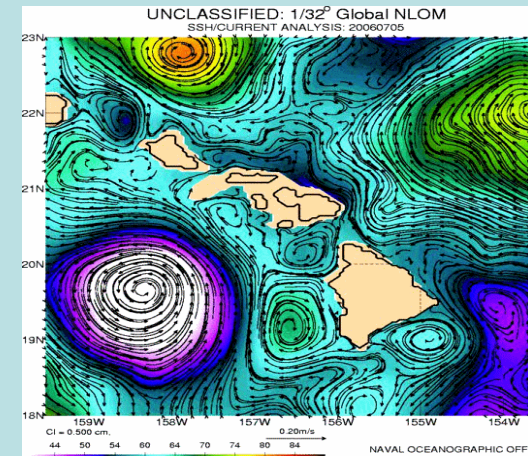
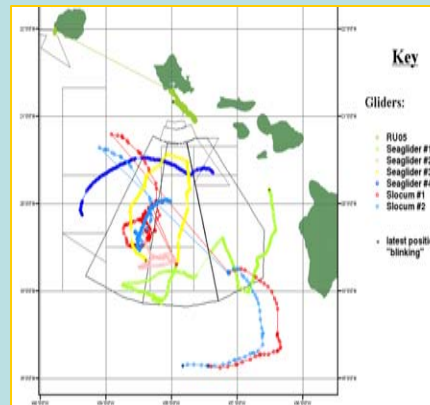
Autonomous Underwater Vehicles (AUVs)



- ### UUVs
- Side Scan Sonar
 - Sub-Bottom Profiler
 - Cameras
 - Conductivity, Temperature, Depth
 - Acoustic Doppler Current Profiler
 - Full Ocean Depths



- ### Ocean Gliders
- | | |
|---------------|------------------------|
| Weight | 110 lb |
| Hull Dia. | 30 cm |
| Length | 2.8 m (w/1-m antenna) |
| Speed | 0.6 knots (horizontal) |
| Max Depth | 1000 m |
| Theoretical - | |
| Endurance | 6 months |
| Range | 4000 km |
| Power | Lithium |
| Comms | Iridium |
| Sensors | Temp-Salinity-Optics |



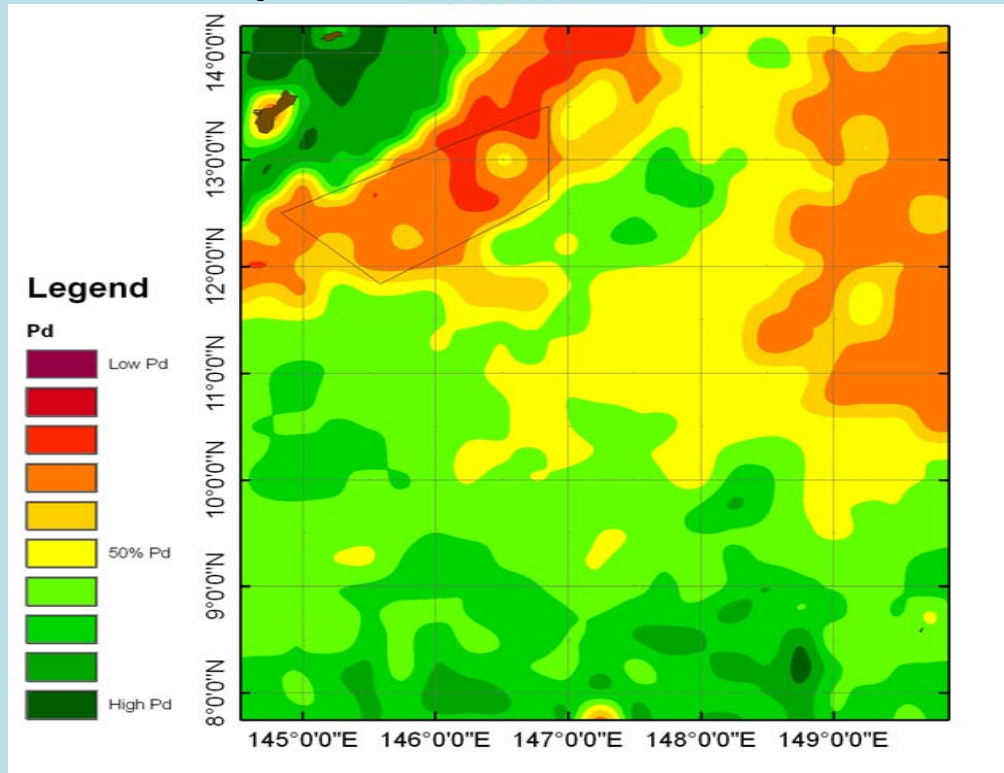


What is a Performance Surface?



Representation of a given **SONAR System's Relative Performance** within the complex, spatially and temporally, varying undersea environment. Specifically, the *ASW Performance Surface* is a scalar field of performance estimates of conditional, joint and marginal probabilities of detection

Probability of Detection for a Target Within Fixed Range



$$P(D,T) = P(D|T) * P(T)$$

	T	T'
D	(D,T) True Detection: Detection called, Target Present	(D,T') False Alarm: Detection called, Target Not Present
D'	(D',T) False Dismissal: Detection not called, Target Present	(D',T') Correct Dismissal: No Detection, No Target

where;

D= Detection

D'= No Detection

T= Target Present

T'= Target Not Present



R&D Focus Areas

UUV - Near Term



- *Improved On-Board Processing*
 - *Reduce Data Transmission Bandwidth*
- *Improved Battery Technology*
 - *Increased Mission Duration*
- *Improved Vehicle Speed*
 - *Overcome High Current Environments*
- *Improved/Integrated Mission Planning*
 - *Common Mission Planning for all Systems*
- *Adaptive Sampling*
 - *Effective sampling with Limited Assets*



R&D Focus Areas UUV - Long Term



- *Cooperative Behavior*
- *Low Cost*
 - *Expendable*
 - *Reduced Manning Requirements*
- *Hybrid Vehicles*
 - *Low Power Consumption to Objective*
 - *Dormant Operations*
- *Alternative Deployment methods*
 - *Multi-Platform Delivery*
 - *Air, Surface, Subsurface, Remote*



R&D Focus Areas



Coupled Ocean/Atmospheric Modeling

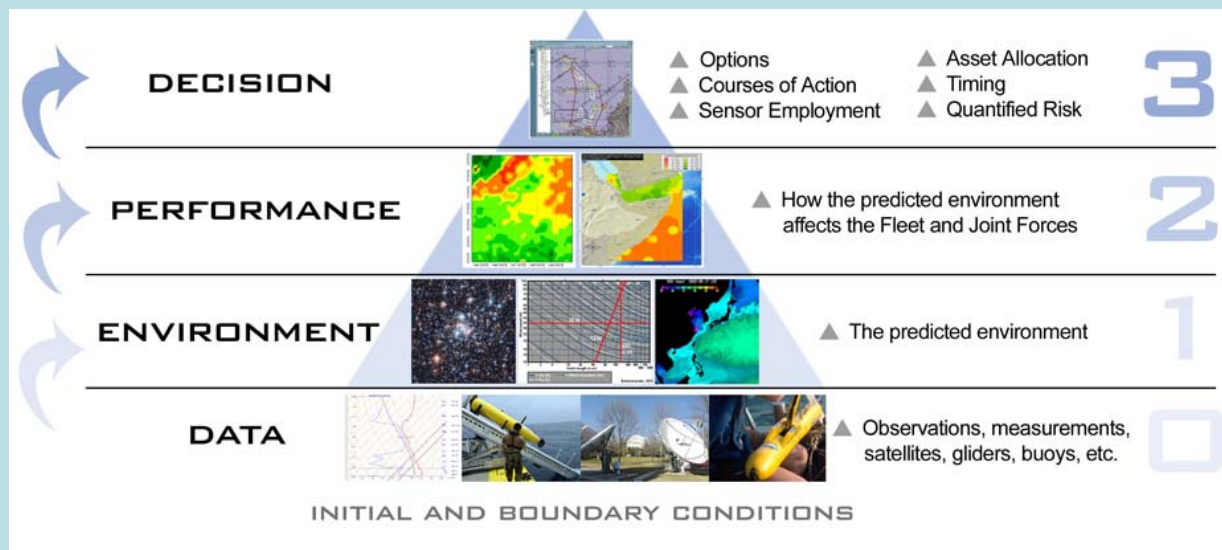
- *Ocean Modeling:*
 - *Improved Regional, Coastal, Riverine models*
 - *Predictive models for forecasting optical properties*
- *Atmospheric Modeling:*
 - *Improved Tropical Cyclone prediction (genesis, track and intensity)*



R&D Needs – Strategy



- **Move from:**
 - Tier 0 (Collection) & Tier 1 (Assimilation and Modeling)
- **To:**
 - Tier 2 (Sensor/System Performance) and Tier 3 (Decision Space)





Questions?

