Naval Meteorology and Oceanography
Oceans In Action 2014
Decision Superiority: Making better decisions faster than the adversary

Decision

Performance

Environment

Data

INITIAL AND BOUNDARY CONDITIONS

Options
Courses of Action
Sensor Employment
Asset Allocation
Timing
Quantified Risk

How the predicted environment affects the Fleet and Joint Forces

The predicted environment

Observations, measurements, satellites, gliders, buoys, etc.
# Tier 0 UUV Roadmap

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Program Type</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Autonomous Underwater Vehicles</strong></td>
<td></td>
<td></td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
<td>G4</td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
</tr>
<tr>
<td>LBS-AUV (Remus 600)</td>
<td>POR (PMV 120)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mk-18 Mod 1 (Remus 100)</td>
<td>POR (PMVS 400)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mk-10 Mod 2 (Remus 600)</td>
<td>POR( PMVS 400) “Fastlane”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Projects (Remus 25000)</td>
<td>NAVO Reimbursable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Projects (Remus 60000)</td>
<td>NAVO Reimbursable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Displacement UUV</td>
<td>Development/POR (PMVS 400)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent Littoral Undersea Surv. (PMVS 100)</td>
<td>Development/POR (PMVS 400)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX/VNSW (Luer) - NDCC</td>
<td>Development/POR (PMVS 400)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBS/G (Teledyne-Webb Slocum)</td>
<td>POR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prolifere (Iridium Based) - NAVO</td>
<td>Internal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unmanned Surface Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmanned Hydrographic Survey Launch</td>
<td>NAVO Hydrography</td>
<td>Internal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHARC (LRI Waveglider)</td>
<td>NAVO METOC</td>
<td>Internal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ready Fleet … Global Reach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: United States Fleet Forces

Approved for Public Release, Distribution Unlimited
# Tier 0 Atmospheric Sensor Roadmap

## Key
- **Operational Capability**
- 6.2 / 6.3
- 6.4 / BTP Non-ACAT
- ACAT NOR Development
- Other Money (internal/external)
- Unknown
- Risky

## Roadmap

<table>
<thead>
<tr>
<th>Capability</th>
<th>Sub Level</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASOS</td>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>AVOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis-Like</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site-Based ATM Profiler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Protection Sensors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASO</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moriah</td>
<td>FOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>METMF(R)</td>
<td>FOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEXGEN Local METMF(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEXGEN Satellite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMQ 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMQ-11</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXW Sensors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buoy/Drifter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual Obs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Collection of Atmospheric State Data

<table>
<thead>
<tr>
<th>Capability</th>
<th>Sub Level</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASOS</td>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>AVOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site-Based ATM Profiler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Protection Sensors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASO</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moriah</td>
<td>FOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>METMF(R)</td>
<td>FOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEXGEN Local METMF(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEXGEN Satellite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMQ 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMQ-11</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXW Sensors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buoy/Drifter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual Obs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Approved for Public Release, Distribution Unlimited
Naval Ocean Glider Program

Wave Glider (SHARC) – AUV Hydrography

Wave Glider
Liquid Robotics

USNS BOWDITCH (TAGS-62)
Survey depth >300m

Hydrographic Survey Launch
Survey depth 10-50m

SHARC
(Sensor Hosting Autonomous Remote Craft)

Underwater Transponder Positioning (UTP – 3000m)

Littoral Battlespace Sensing-AUV
Operating Depth 50-500m

AUV (via SHARC) C2 conducted from LBS van onboard BOWDITCH

From the Glider Operations Center at NAVOCEANO

Naval Oceanographic Office Stennis Space Center, MS

Approved for Public Release, Distribution Unlimited
Duties
- Manned 24/7/365 at NAVO
- DOD Iridium C2 via RUDICS
- Data QA - Produces near real-time oceanographic data for assimilation into dynamic ocean models.

Challenges:
- Information Assurance – All data required to be encrypted (FIPS-120).
- Varied CONOPS depending on mission (MIW, ASW, etc.)
- Manning – Automation where possible.
- Multiple systems types (gliders, floats, etc.)
Tier 1 Ocean Modeling Roadmap

United States Fleet Forces

Ready Fleet ... Global Reach

Approved for Public Release, Distribution Unlimited
Total CNMOC Modeling Requirements

Includes N-ESPC

DSRC Peak TFLOPS

1300
675
350-380
140

Global Atmos Ensemble
Global Atmos Forecast
Global Atmos DA
Atmos Ensemble (R)
Total Regional Atmos Forecast
Regional Atmos DA
Global Ocean Ensemble
Global Ocean Forecast
Global Ocean DA
Ocean DA (R)
Wave Ensemble (R)
Wave Forecast (R)
Tropical Cyclone Forecast (R)
Wave Models (R)
Tide Models (R)
Ocean Ensembles (R)
Ocean Ensembles (G)
Coastal High res
Ocean Model Deterministic (R)
Ocean Model Deterministic (G)
Ocean Model Assimilation (G)
Infrastructure
iMETOC

- Based on NSA’s Ozone Widget Framework (OWF)
- Platform independent
- Scales from HPC to tablet to smart phones
- Consistent with future Navy C2 architectures being deployed

iMETOC enables the vision of BonD with rapid geospatially enablement of our data, products and services.

- Visualization tools
- Forecaster tools
- METOC decision aids
- Tactical decision aids
- BonD Tier 2/3 services
Center Of Excellence for Unmanned Systems (COEUS) @ Stennis

Providing the operations, maintenance, logistics, training and expertise of unmanned systems and Command and Control Centers.

**NOAA @ Stennis**
- **Mission Control Center** – Providing the unclassified Common Operational Picture (COP) for NOAA, IOOS, other Government and International agencies
- NDBC provides command and control to deployed NOAA and IOOS platforms
- Unclassified locations pushed to U.S. Navy MCC
- COP software shared between NDBC and Navy

**U.S. Navy @ Stennis**
- **Glider Operations Center** – Providing the classified Common Operational Picture (COP) for U.S. Navy, U.S. Army, and other agencies
- Navy survey ships provides deployment opportunities for NOAA and other agencies
- Navy survey ships provide all-ocean surveillance, command and control and communications to deployed platforms
- COP software shared between NDBC and Navy

**STENNIS**
- **NASA** – Provides test and evaluation, validation and verification of unmanned airborne platforms deployed from Stennis airport
- **Private Industry** – Builds up and maintains large Unmanned Systems inventory (similar to TAO buoy inventory) – cleaning, calibrating and “renting” systems for deployment
- **Universities** – Provides training on deploying and operating unmanned systems (ocean and aerial), creates first of a kind degree program in unmanned systems engineering, provides trained pool of students
Thank you!
Questions?