



# **“First to Field” Naval Research in the 21<sup>st</sup> Century**

**Feb 21, 2019**

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# Today's Challenge

Accelerating Pace  
of Technological  
Change

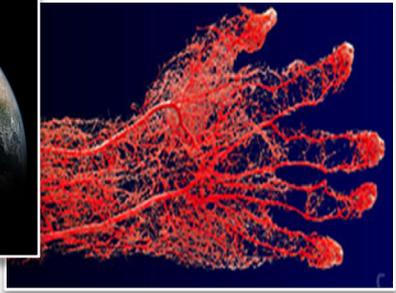
Commoditization  
and Proliferation  
of Information

Shifting  
Economic Power

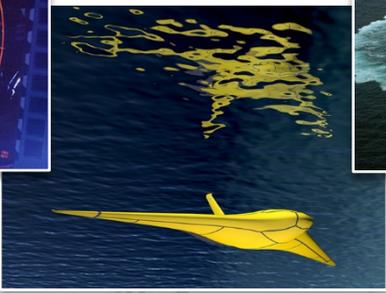
State and Non-State  
Complexity



# The Naval Research Enterprise



**4,000+ People**  
**23 Locations**  
**\$2.1B / year**  
**>1,000 Partners**



**ONR HQ**

**U.S. NAVAL  
RESEARCH  
LABORATORY  
NRL**



**ONR Global**



# The Naval Research Ecosystem c. 2018

*Global Commercial Market Driven*



# Naval Research Response



## FRAMEWORK PRIORITIES



***Augmented Warfighter***



***Integrated & Distributed Forces***



***Operational Endurance***



***Scalable Lethality***



***Sensing & Sense-Making***

***“...the tempo of modern war has reached the point where this Nation will probably never again have an opportunity to arm itself successfully after the start of hostilities....” – Forrestal***

# Research & Development Priorities

*Augmented  
Warfighter*



*Integrated &  
Distributed Forces*



*Operational  
Endurance*



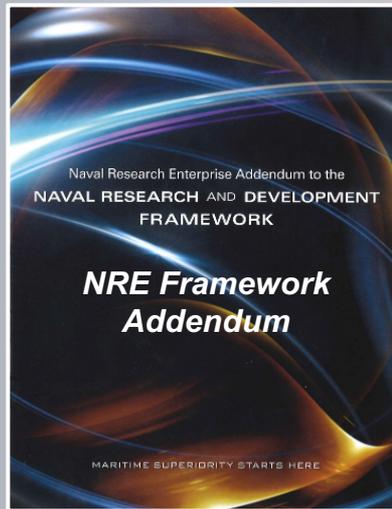
*Scalable  
Lethality*



*Sensing &  
Sense-Making*



**Five Framework Priorities  
that are Strategic and  
Warfighter-Focused...**



**...Translates to Six  
Technology-Focused  
Integrated Research Portfolios**



*Amphibious  
Expeditionary Maneuver*



*Information, Cyber &  
Spectrum Superiority*



*Undersea  
Battlespace &  
Maritime Domain  
Access*



*Mission Capable,  
Persistent &  
Survivable  
Sea Platforms*



*Warfighter  
Supremacy*



*Aviation, Force Projection  
& Integrated Defense*



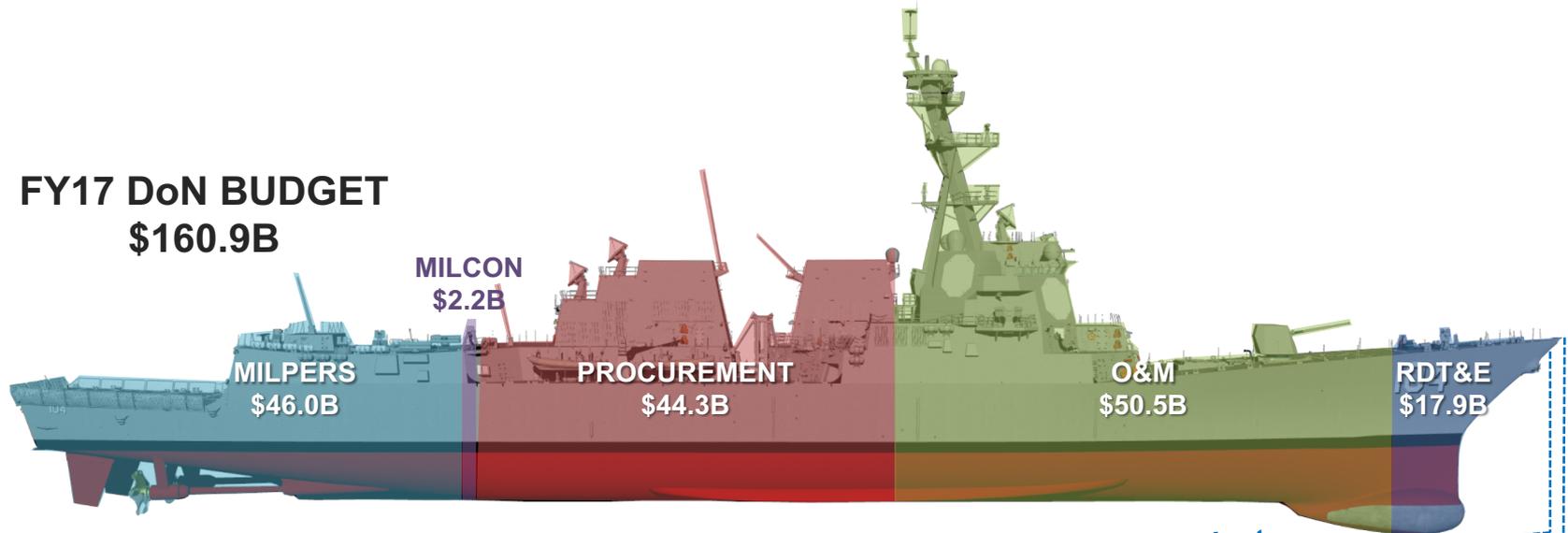
# 55 Enduring Research Responsibilities

- EXPEDITIONARY FIRES AND LETHALITY
- EXPEDITIONARY C4ISR
- HYBRID THREAT DEFEAT
- HUMAN PERFORMANCE AND PROTECTION
- AMPHIBIOUS MOBILITY
- LOGISTICS, SUSTAINMENT AND MAINTENANCE
- EXPEDITIONARY POWER AND ENERGY
- LIGHTENING THE LOAD
- ACCELERATED LEARNING/DECISION-MAKING
- INFORMATION ENVIRONMENT OPERATIONS
- DIRECTED ENERGY (DE) & COUNTER DE
- AERODYNAMICS
- FLIGHT DYNAMICS & CONTROL
- PROPULSION
- STRUCTURES AND MATERIALS
- ENERGETIC MATERIALS
- HYPERSONICS
- AUTONOMY
- ADVANCED RF ELECTRONICS & MATERIALS
- COMMUNICATIONS AND NETWORKING
- COMPUTATIONAL METHODS FOR DECISION MAKING
- DATA SCIENCE AND ANALYTICS
- ELECTRONIC WARFARE
- SENSORS AND SENSOR PROCESSING
- MACHINE LEARNING, REASONING AND INTELLIGENCE
- RESOURCE OPTIMIZATION
- PRECISION NAVIGATION & TIMEKEEPING
- UNDERSEA MEDICINE
- BIOLOGICAL SCIENCES
- BIOROBOTICS
- CAPABLE MANPOWER
- COMMAND DECISION MAKING
- FORCE HEALTH PROTECTION
- HUMAN-ROBOT INTERACTION
- NOISE-INDUCED HEARING LOSS
- TRAINING AND SIMULATION
- ARCTIC AND GLOBAL PREDICTION
- LITTORAL GEOSCIENCES AND OPTICS
- MARINE MAMMALS AND BIOLOGY
- MARINE METEOROLOGY
- MARITIME SENSING
- OCEAN ACOUSTICS
- OCEAN ENGINEERING & MARINE SYSTEMS
- PHYSICAL OCEANOGRAPHY
- RESEARCH FACILITIES
- SPACE ENVIRONMENT
- UNDERSEA SIGNAL PROCESSING
- NAVAL ENGINEERING
- ADVANCED NAVAL POWER SYSTEMS
- ADVANCED SURVIVABLE SEA PLATFORMS
- UNMANNED SEA PLATFORMS, AUTONOMY AND POWER
- ADVANCED NAVAL MATERIALS
- UNDERSEA WEAPONS, COUNTER-WEAPONS AND ENERGETICS
- SEA PLATFORM ENVIRONMENTAL QUALITY
- CORROSION CONTROL

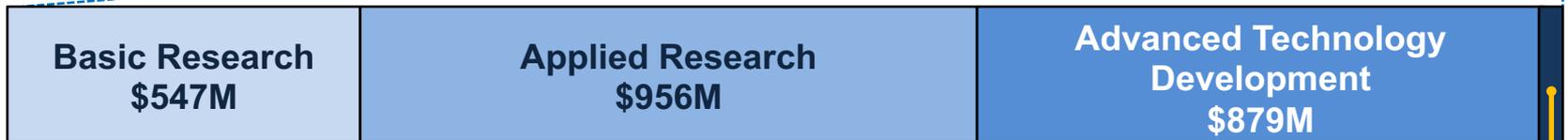


# The Portfolio Investment Relative to FY17 Navy Budget

**FY17 DoN BUDGET**  
**\$160.9B**



Naval Research Enterprise Allotted \$2.42B of FY17 RDT&E Budget



Demonstration  
and Validation  
\$37M



# Getting to Capability

*The ONR Portfolio is Broad Yet Singularly Focused on Delivering Continued Naval Superiority*



\$37M

**Demonstration and Validation**

Efforts that have moved into the development and integration of hardware for field experiments and tests.

\$879M

**Advanced Technology Development**

Evaluation of integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential.

\$956M

**Applied Research**

Research to determine the means by which a recognized and specific need may be met.

\$547M

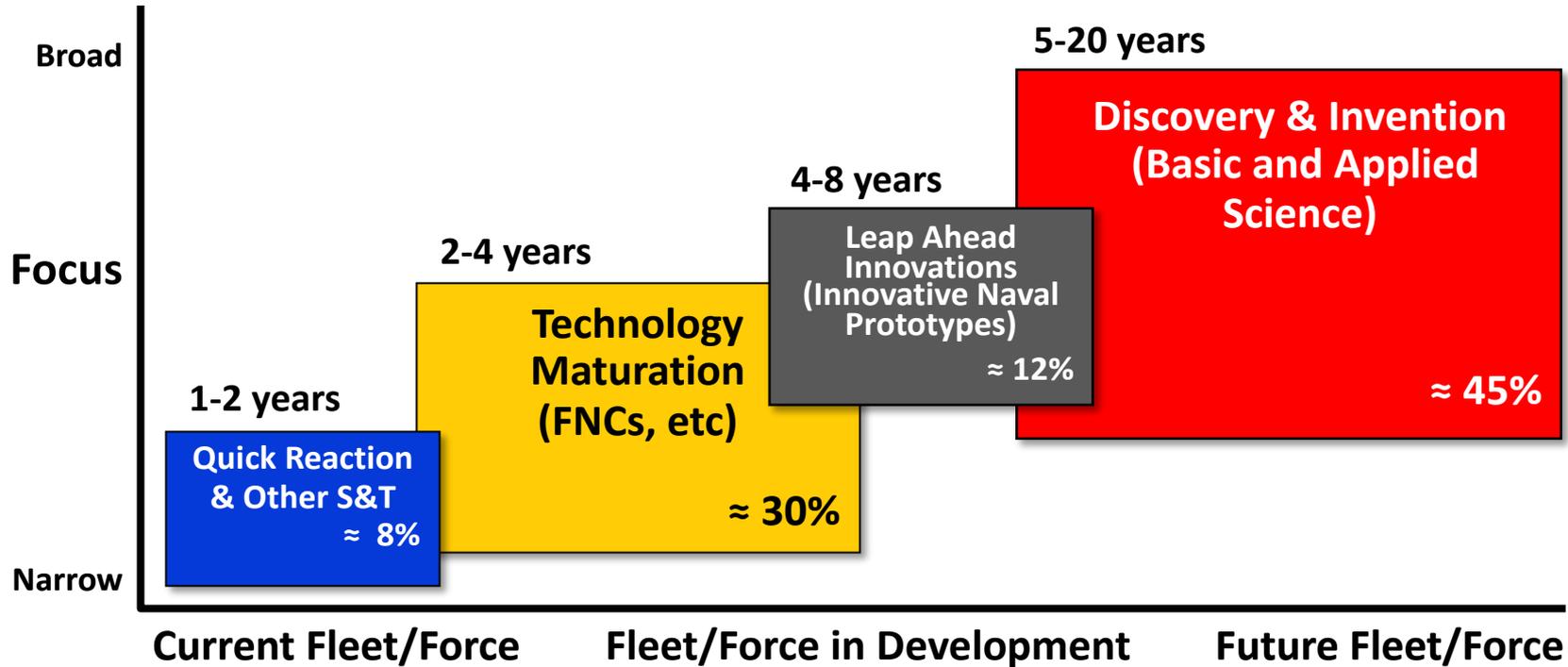
**Basic Research**

Research without specific applications toward processes or products in mind.

**Academic Sweet Spot**

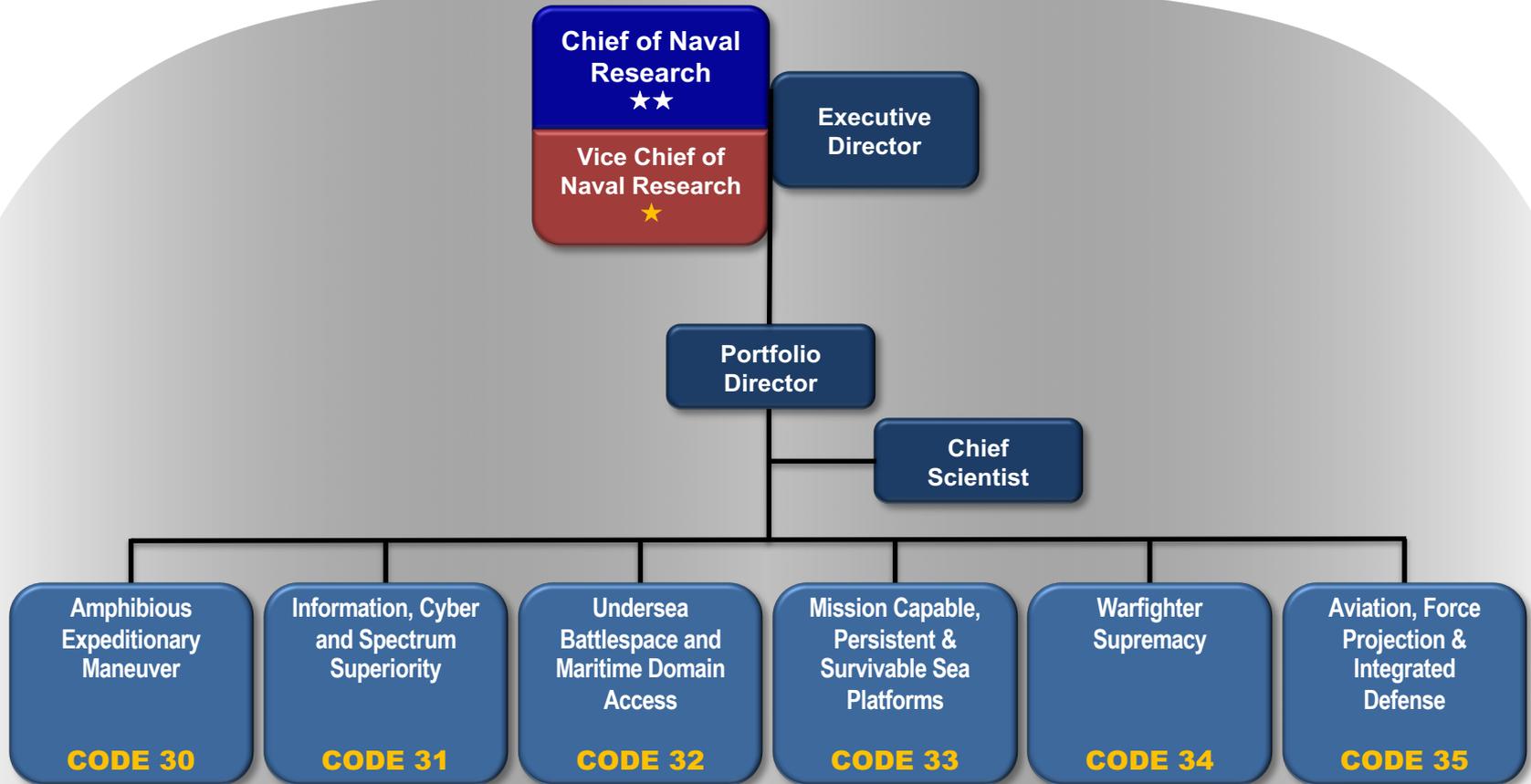
FY17 Funding

# Warfighting Capabilities Enabled by S&T Investments





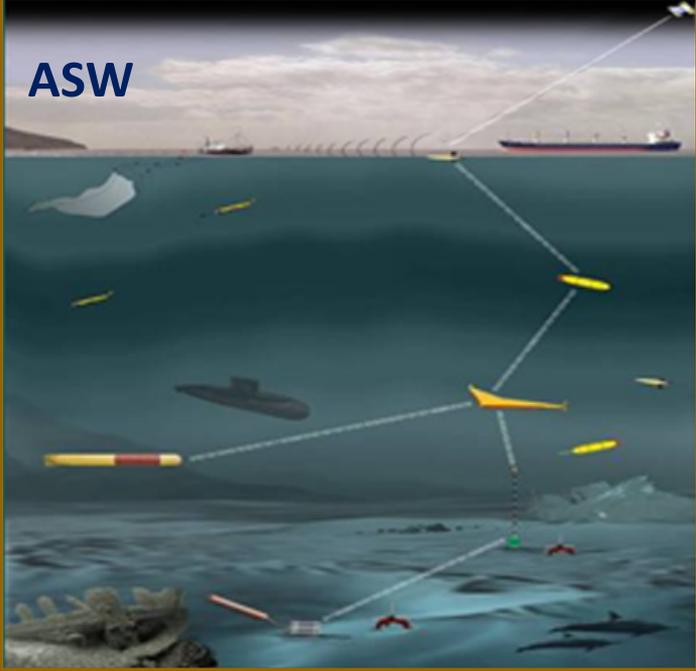
# ONR Headquarters



*Managing the Portfolio*



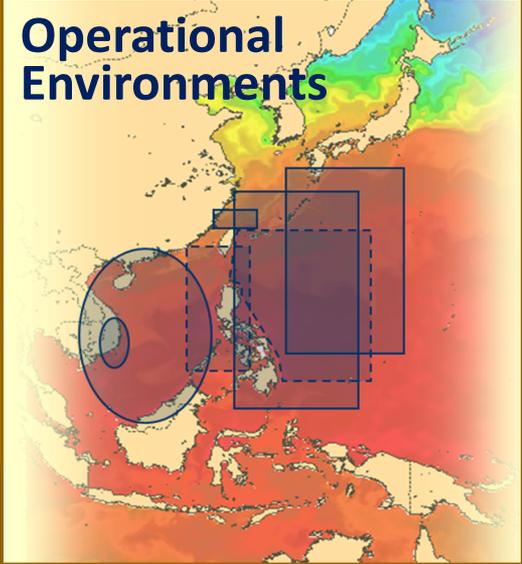
# Code 32 Areas of Responsibility



ASW

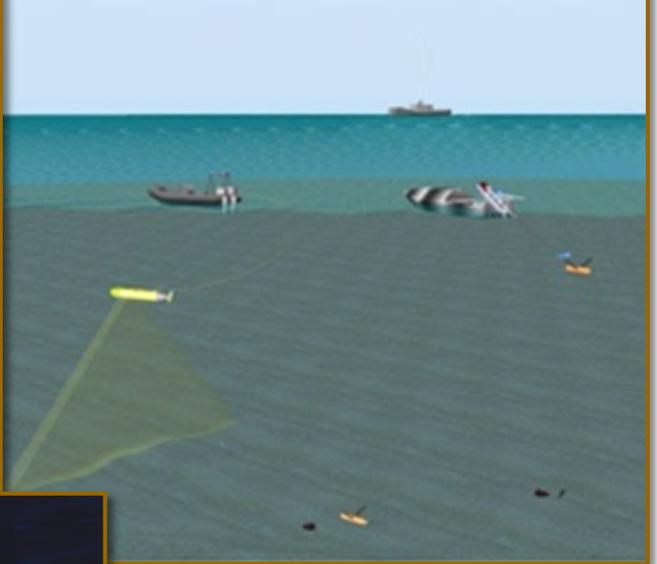


SPACE



Operational Environments

MCM



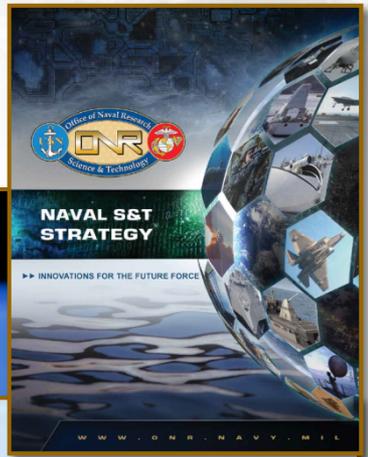
Marine Mammals



UUVs



Research Vessels





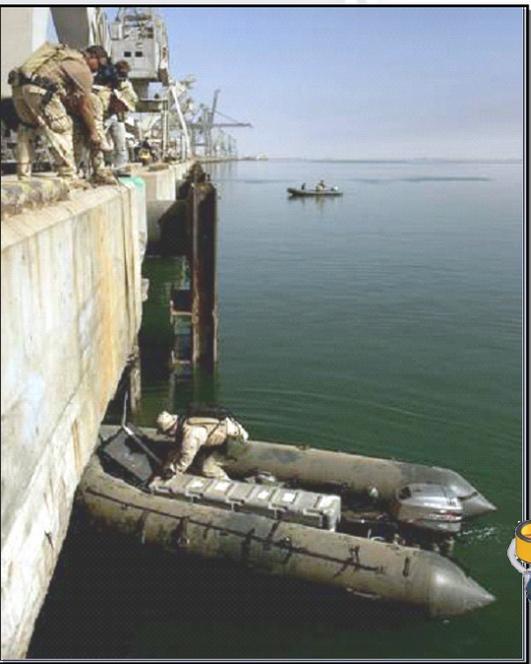
# Investment topics determined from imperatives of Naval Missions (“Use inspired research”)

- **ASW** → **Ocean Acoustics, Physical Oceanography, Arctic, Marine Mammals**
- **MIW** → **Ocean Acoustics, Littoral Geoscience, Physical Oceanography**
- **Strike** → **Marine Meteorology**
- **NSW** → **Littoral Geoscience, Physical Oceanography**
- **Amphibious Ops** → **Littoral Geoscience, Marine Meteorology**

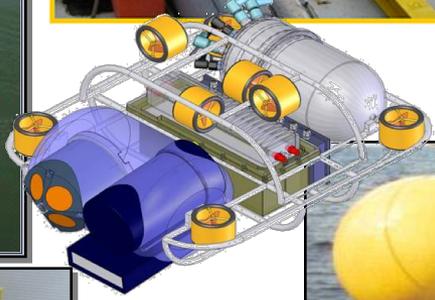
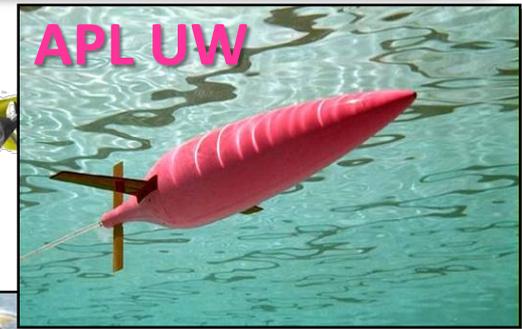
## Transition POC's:

- **Close relationships with N2N6E, CNMOC (NAVOCEANO, FNMOC), N45, N975, N95, N99, N97, UWDC, PEO LCS, PEO IWS5**
- **Fleet relationships with NSW, SUBPAC, 7<sup>th</sup> Fleet, PACFLT, 5<sup>th</sup> Fleet**

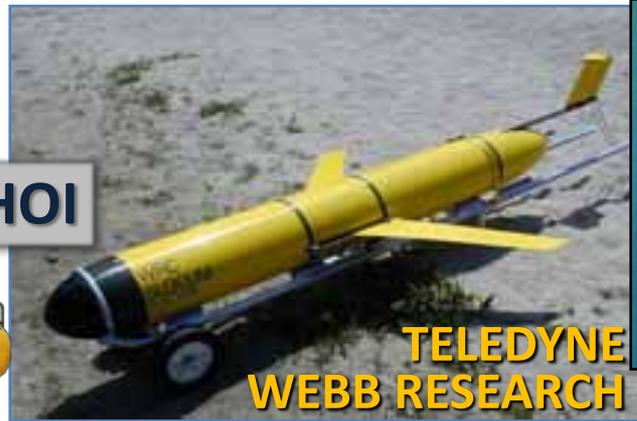
# Autonomous Sensing



- Networked, mobile, persistent, scalable
- Intelligence Preparation of the Battlespace – before all platforms

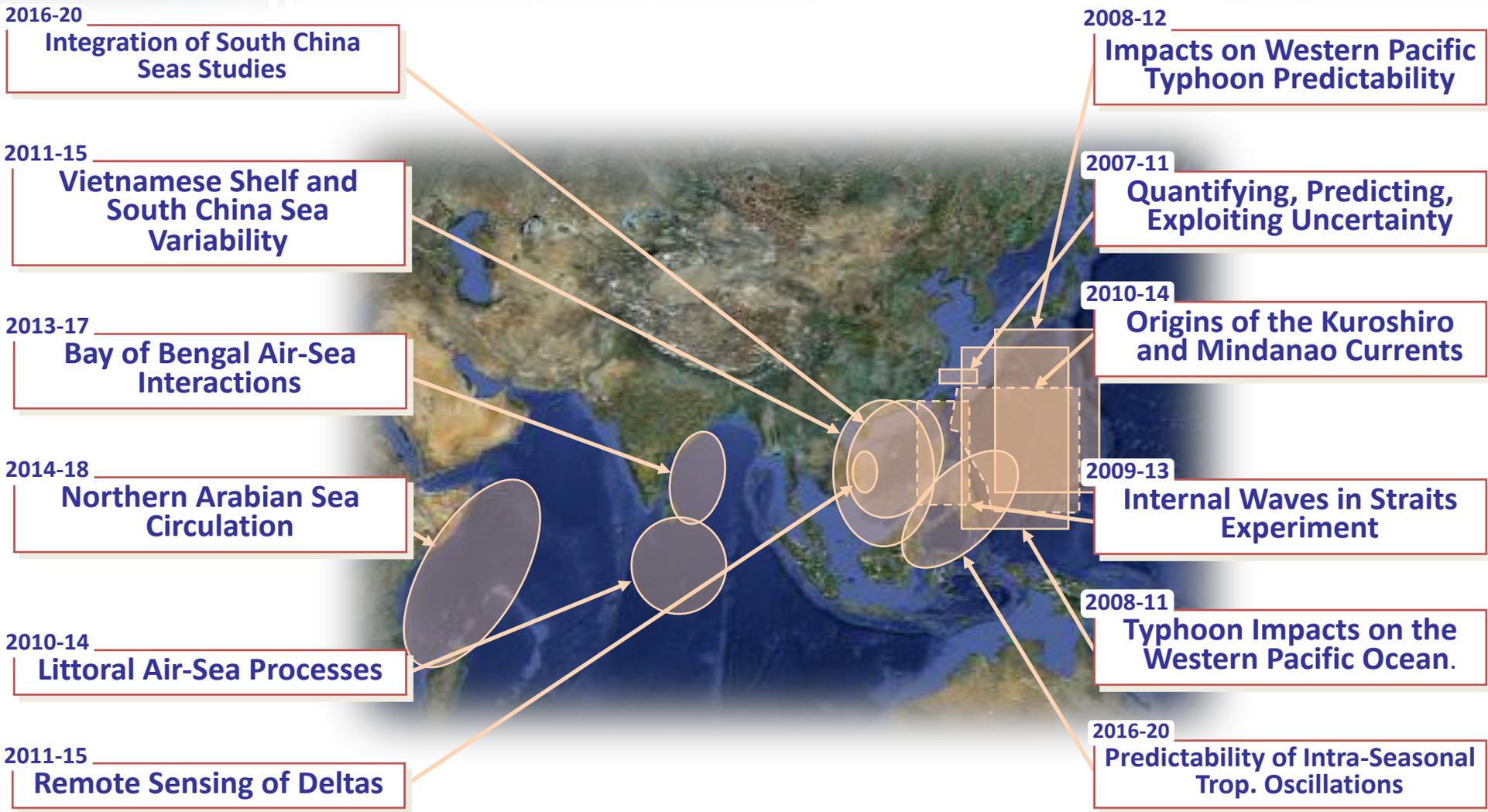


WHOI





# DRIs in the WESTPAC & IO Operational Environment



**55 Five-Year Department Research Initiative (DRI) Studies Completed Since 1995** (through end FY15)



# Department Research Initiatives (DRIs)

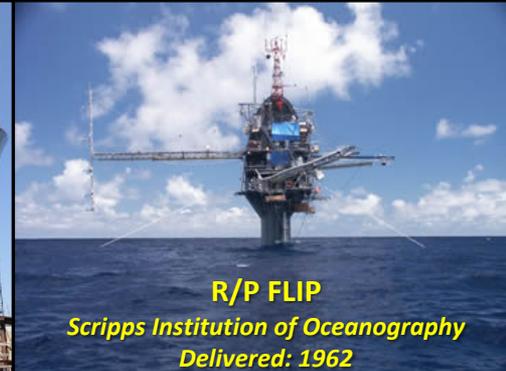
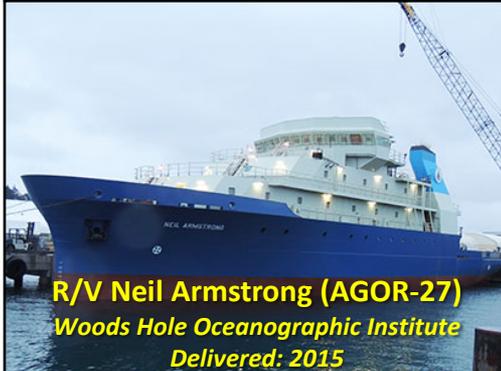
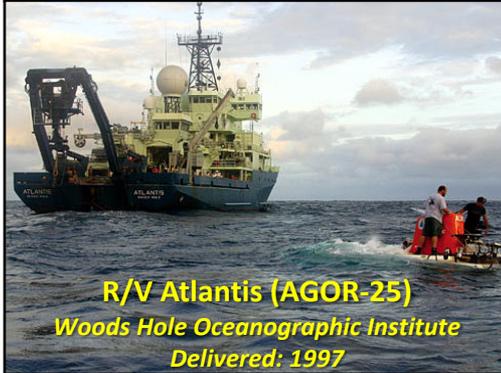
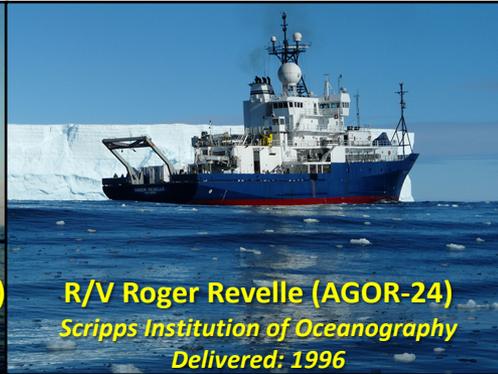
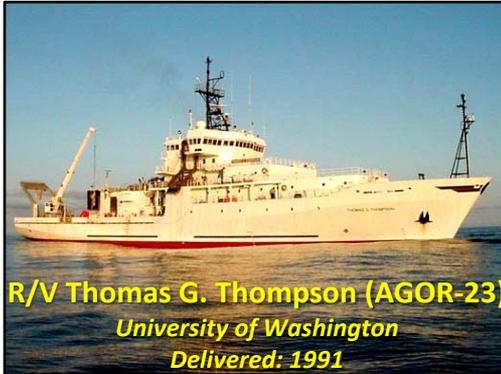
Since 1995, 55 Five Year Studies Completed (through end FY15)

DRIs by FY	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Origins of Kuroshiro and Mindanao Currents																		
Inlet and River Mouth Dynamics																		
Littoral Air-Sea Processes																		
Vietnamese Shelf Variability																		
Parameterizations for Seasonal Predictions																		
Active Transfer Learning																		
Predictability of Seasonal and Intraseasonal Oscillations																		
Emerging Dynamics of the Marginal ice Zone																		
Remote Sensing of Deltas																		
Bay of Bengal Freshwater Flux																		
Fluxes Through the Ocean Boundary Layer																		
Increasing Open Water in the Arctic Ocean																		
Impact of Outflow on Tropical Cyclone Intensification and Structure																		
Northern Arabian Sea Circulation - autonomous research (NASCar)																		
Flow Encountering Abrupt Topography																		
The Inner Shelf																		
Integration of South China Sea Studies (ISCSS)																		
Stratified Ocean Dynamics in the Arctic (SODA)																		
Predictability of Intra-Seasonal Tropical Oscillations (PISTON)																		
Monsoon Intra-Seasonal Oscillations in the Tropical Indian Ocean																		
Arctic Mobile Observing System																		
Undersea Remote Sensors																		

- DRIs allow programs to mount field/infrastructure intensive efforts beyond reach of individual core environmental science disciplines
- Responsive to top down guidance representing department strategic direction



# The ONR Research Fleet



- Global reach – two year missions
- Ships operate 280-300 days/year
- Science teams rotate to ship for 18-25 day projects
- Daily operations costs paid by research agency (National Science Foundation, Navy, NOAA, USGS, DOE)
- Crewed by professional mariners & university employees



# Investment Planning at the Project Level

- **Program Officers given responsibility for individual projects within strategic guidance**
  - Independent initiative with quality review by Department and BOV's
  - DRI competition refreshes topics and allows budget evolution
  - Work with NRL (especially on ocean/atmospheric modeling)
  - Makeup of teams and budgets evolve to fit naval needs
- **Sea-going experimentation a key element of the investment**
  - Detailed studies target understanding of process priorities for specific phenomena – hypothesis based
  - Department D&I is roughly 80% observational - 20% other
  - Department encourages \$14-18M/yr of ship time (order 700 days/yr) provided from Department for team projects
  - CNR a "Type" commander of 6 research oceanographic ships



# Supporting the Next Generation



- Data supplied by PIs as part of Annual Report archival process
- In Basic and Applied Sciences
- In Physical Oceanography, Marine Meteorology, Ocean Modeling, Acoustics, Ocean Engineering, Coastal Geosciences, Signal Processing, Sensors, etc.
- note: Graduate and Post Docs are counted only if funded  $\geq 50\%$

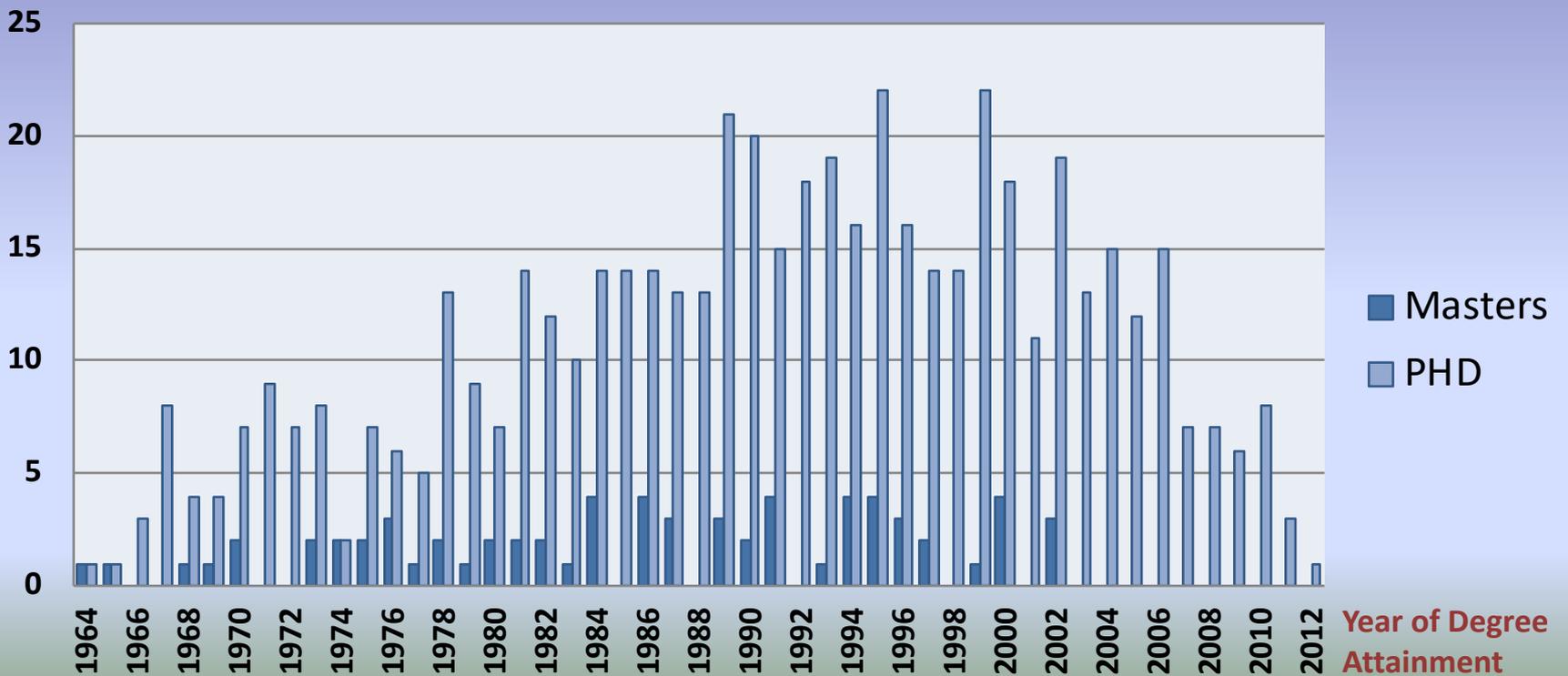
	Under-Grads total	Under-Grads women	Under-Grads minority	Grads total	Grads women	Grads minority	PD total	PD women	PD minority
2010	390	150	39	563	175	43	188	46	16
2011	389	145	53	695	211	40	188	55	20
2012	384	178	55	637	238	53	220	68	17
2013	515	281	63	583	229	27	252	76	9
2014	342	168	43	500	191	23	210	65	10
2015	359	186	41	428	159	25	203	68	12





# PI Educational Background

**Ocean Battlespace Sensing S&T Department  
PIs funded in FY11\***



\* In response to a request from OSD for information to judge the health of sciences and engineering in government sponsored research



# Naval Research Laboratory

- *The Navy's Corporate Laboratory*
- *World Class Research Team*
- *Basic and Applied Research and Advanced Technology Development for Anticipated Navy and Marine Corps Needs*



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## U.S. NAVAL RESEARCH LABORATORY

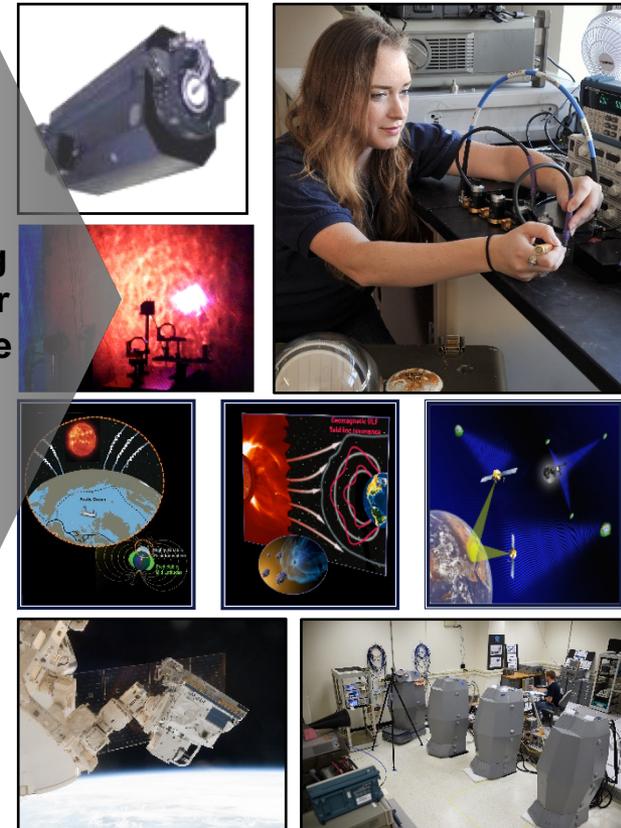
### Research Focus Areas



### NRL Basic & Applied Research

### Delivering Warfighter Advantage

### NRL Products & Prototypes



Directly Funded Work

Integrated Research Portfolio



# ONR Global

## Washington, D.C. Region / ONR HQ

### ONR Global Arlington

Executive Officer  
 International S&T Engagement Advisors  
 FCC/C10F ★★ ★  
 N81 ★★ ★

## ONR Global Headquarters London

Commanding Officer  
 Technical Director  
 Science Directors

### San Diego

C3F ★★ ★  
 AIRFOR ★★ ★  
 SURFOR ★★ ★  
 I MEF ★★ ★  
 UWDC ★  
 SMWDC ★

## ONR Global Prague

Science Director

### ONR Global Tokyo

Science Directors

### Hawaii

PACOM ★★ ★  
 PACFLT ★★ ★  
 MARFORPAC ★★ ★

### Mayport

C4F ★★

### Norfolk

FLTFOR ★★ ★  
 SUBFOR ★★ ★  
 MARFORCOM ★★ ★  
 NAVIFOR ★★ ★  
 SPECWAR ★★  
 NECC ★  
 NWDC ★

### Naples

NAVAF/NAVEUR/  
 C6F ★★ ★

### Bahrain

NAVCENT/C5F ★★ ★

### Yokosuka

C7F ★★ ★

### Okinawa

III MEF ★★ ★

### India

## ONR Global Singapore

Science Directors

## ONR Global Santiago

Science Director

## ONR Global São Paulo

Science Directors

**Science Directors**

- London
- Prague
- Tokyo
- Santiago
- Singapore
- Sao Paulo

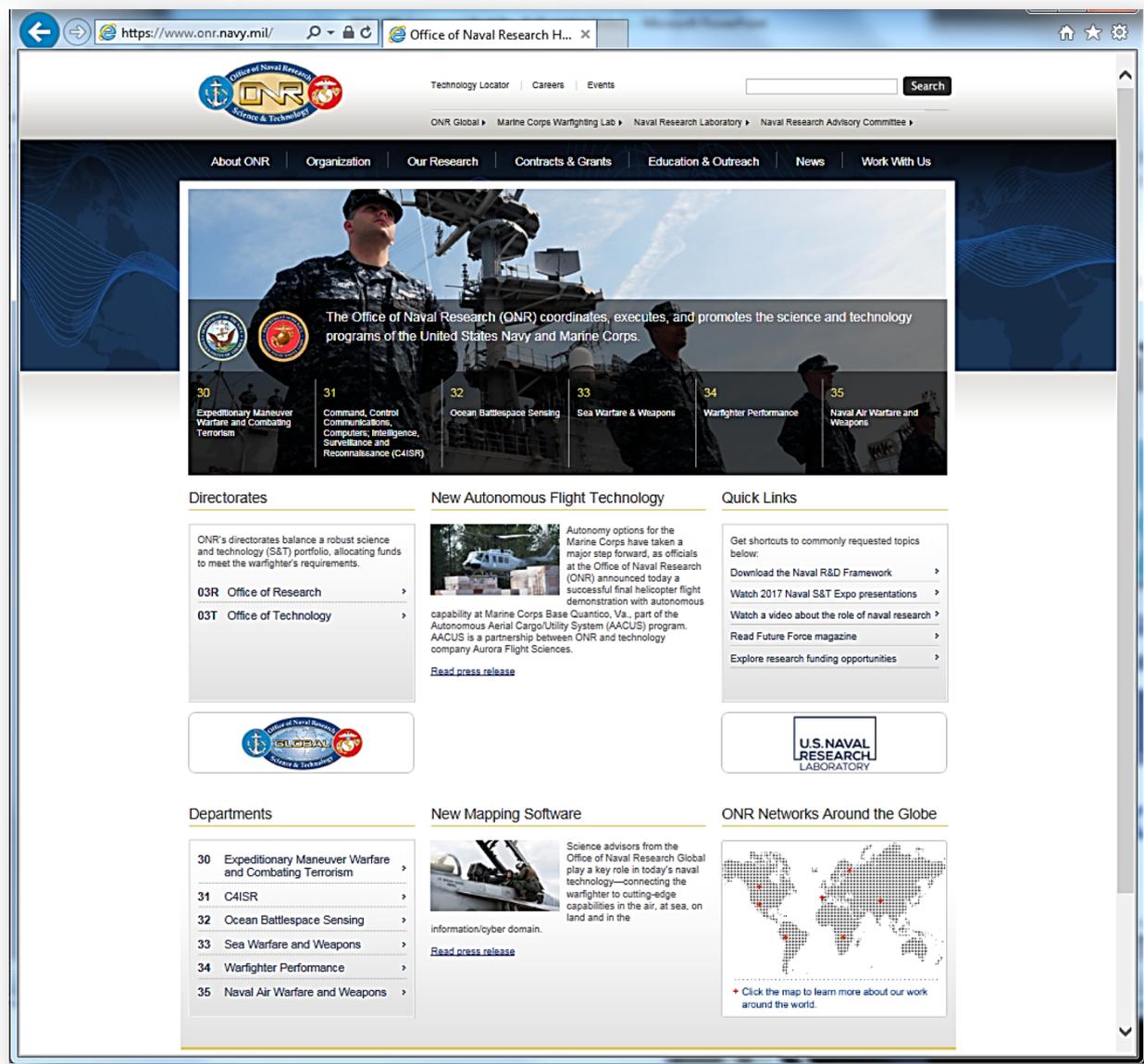
**Science Advisors**

- ★ Joint Command
- ★ Navy Command
- ★ Marine Corps Command

**ONR's Global Offices are the Bridge to International Partnership;  
 Naval R&D Diplomacy in More than 60 Countries**



# Staying In Touch



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