Rick Spinrad
Oregon State University

Co-Author: Rick Spinrad, Marine Technology Society

Co-Author: Rick Spinrad, Federal Advisory Committee on the Integrated Ocean Observing System
Stage setters/operating assumptions

1. We want to make the world a better place
2. A lot has changed in our community
THE TIMES
THEY ARE
A-CHANGIN’
BOB
DYLAN
NSF PM:

“We’ve got to be responsive to market pull…”

“Our mission includes building innovation capacity…”
THE TIMES THEY ARE A-CHANGIN’

BOB DYLAN

GODAE OceanView
OSEs and OSSEs

"Why do our ideas about the ocean circulation always have such a peculiar dream-like quality?"
Henry Stommel (1954)

Trends in (Ocean) Research

• Culture change with respect to IP (NSF talking about market pull, and building innovation capacity!)
• Private funding (Schmidt, Paul Allen, James Cameron, Verizon, BNY, The Economist World Oceans summit...): "Engaged Philanthropy"
• Predictive capacity: OSEs (Data denial) and OSSEs
• More pressure to replicate (The Economist)
• Crowdsourcing (OpenROV, ...)
• Globalization
• Millennials in the workforce (accelerated deal-flow, 'ENS to CDR')
Catching Albacore

• Dan on the F/V Amigo
2012 HIGHLIGHTS:
- 416 WINNING EFFORTS IN 98 MAJOR TOURNAMENTS
- 22 YEAR TOTAL NOW 6117
- RI STATE MAKO RECORD
- VA STATE WAHOO RECORD

- NORTH CAROLINA GOVERNOR'S CUP
- SOUTH CAROLINA GOVERNOR'S CUP
- MID- ATLANTIC $500,000
- OCEAN CITY WHITE MARLIN OPEN
- WORLD SAILFISH CHAMPIONSHIP
- TRI-STATE CANYON SHOOTOUT
- TEXAS INTERNATIONAL
- BLUE MARLIN GRAND CHAMPIONSHIP
- SOUTH JERSEY SHARK
- TEXAS BILLFISH CHAMPIONSHIP
- ORANGE BEACH BILLFISH CLASSIC
- SKA DIVISION 4 & DIVISION 6 OVERALL

PINPOINTS HOT SPOTS
Tells how many days the ocean conditions have been favorable

CATCH REPORTS
FREE UPDATES WHILE FISHING

Currents and Frontal Edges
Shows Water Color, Clarity,
Water Temperature,
Bottom Topography,
Navigational Coordinates

COMPREHENSIVE ANALYSIS
Map and Text Description

WHY GUESS WITH INTERNET IMAGES OR OTHER IMITATIONS?
New York Bight West

$65.00

Coordinates  

Date

SKU: NR05. Category: Northeastern U.S.

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- Gulf of Mexico
- International

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Areas of interest: Barnegat Inlet, Jones Inlet, Manasquan Inlet, Sandy Hook, Fire Island, Moriches
MYOCEAN INTERACTIVE CATALOGUE

Search mode: multi-criteria or full catalogue

Please note you have to register first before downloading MyOcean products.

Service commitments & licence

Access "Product Quality Accuracy Numbers"

1. AN AREA
   - All areas
   - Global Ocean
   - Arctic Ocean
   - Baltic Sea
   - Atlantic-European North West Shelf-Ocean
   - Atlantic-Iberian Biscay Irish-Ocean
   - Mediterranean Sea
   - Black Sea

2. A PARAMETER
   - All parameters
   - Ocean Temperature
   - Ocean Salinity
   - Ocean Currents
   - Sea Ice
   - Sea Level
   - Winds
   - Ocean Optics
   - Ocean Chemistry
   - Ocean Biology
   - Ocean Chlorophyll

3. A PRODUCT TYPE
   - All product types
   - Forecast Products
   - Near Real Time Products
   - Multi Year Products
   - Time Invariant Products

SEARCH

KEYWORD SEARCH
Too much? Too soon?
Aanderaa Instruments
About.com Weather
AccuWeather
Advanced Designs Corporation
Advanced Distributed Sensor Systems, Inc.
Advanced Forecasting Corporation
AER, Inc.
Aerocomp
Aerology & Ink
AFC Risk - Advanced Forecasting Corporation
AIR, WEATHER & SEA CONDITIONS, INC.
Alert FM
Alert Weather Services, Inc.
AmbientWeather
Aerospace & Marine International Corporation
Agricultural Weather Information Information Service (AWIS), Inc.
Air Science Consultants, Inc.
Allivan Marketing
Ambient Software
America's Weather
AnythingWeather.com
Applied Modeling, Inc.
Applied Weather Technology
APR Weather
Armcandy Sailor
ASAI/Weather 2000
Associated Science Experts
AtmosForecast
Atmospheric Information Services
Automated Weather Source
Aviation Weather dot Com
Aviation Weather - Windows Phone 7 Aviation Weather Application
Aviation Weather, Inc.
Avtec Systems, Inc.
Baja Weather Service
Baron Services
Big Bend Weather
Big Country Stormchasers Group
Big Country Weather
Big Country Weather and Aviation
Big Country Weather Observer
Birail
Blue Diamond Books - Hurricanes and the Middle Atlantic States
Bruce F. Watson
Burk Weather Center
Cable News Network (CNN)
Clear Weather Solutions
  Clearwest
  ClimaData Corp.
  Climate Logic
  Climate-Charts.com
  Climatological Consulting Corporation
  Climatronics Corporation
  Climet Systems
  Coastal Environmental Systems
  Columbia Weather Systems, Inc.
  Commanders' Weather Corporation
  Commercial Weather Services Association
  Compu-Weather, Inc.
  Comptus,Inc.
  Connecticut Weather Center, Inc.
  Consumer Lightning Products, Inc.
  Continental Weather & Earth Sciences, Inc.
  Continental Weather Corporation
  Convective Development
  Cox Weather Services
  Crown Weather Services
  CustomWeather, Inc.
  Data Acquisition Systems Manufacturers
  Davis Instruments
  DayWeather Inc.
  DBS Weather Impact Corp.
  Degree Days.net
  Demico Inc.
  DesktopDoppler
  DeTect, Inc.
  Digital RF Technology, Inc.
  The Disaster Center
  Disaster Warning Network, Inc.
  doityourselfWEATHER
  E-Alert USA
  Early Alert, Inc.
  Earth Satellite Corporation (EarthSat)
  East Coast Weather
  East End Weather
  Echo of Thunder Weather
  Ed Roy, Ltd
  EJS Weather
  Eltek Specialist Data Loggers
  Emergency Communications Network
  ENSCO, Inc.
  Enterprise Electronics Corporation
  EnviroTech Sensors, Inc.
  Expert Weather Investigations (EWI)
  Extreme Tornado Research, Inc. (ETRI)
FleetWeather, Inc.
  FM DX Antenna Co (NOAA Weather Radio Antennas)
  Forensic Meteorology Associates, Inc.
  Forensic Weather Consultants
  Fort Phantom Weather
  Fotosearch Weather Photography
  Fox Weather, LLC
  Franklin Time and Weather
  Freese-Notis
  General Dynamics - Automated Observation System
  Geonor, Inc.
  Global Weather Dynamics, Inc.
  Golden Gate Weather Services
  Great Lakes Weather Service
  HailTrax
  Hawaii Weather Today
  Hazardous Weather Preparedness Institute
  Henz Meteorological Services (HMS)
  HOTWEATHER
  How the Weatherworks
  Hunters Weather Photography
  Hurricane by Kitty Code
  Hurricane Consulting, Inc.
  Hurricane Headquarters
  Hurricane Hollow Weather
  Hurricanecity
  Hurricanestorm
  Hurricaneville
  InstantWeatherMaps.com
  Intellischade
  InterMet Systems
  iWindsurf.com
  I*ON Weather, Inc.
  Jenifer Clark's Gulfstream
  Jeppesen
  Jersey Weather Service
  Kestrel Wind/Weather Instruments
  Landfall Navigation
  Las Vegas Weather
  Life Shield Step Shelters
  LightningStorm.com
  Locus Weather
  LRC Weather LLC
  Marine Computer Systems
  Marine Weather Center
  Marine Weather dot Com
  Marta Systems
  Meridian Environmental Technology Inc.
  MeteoGroup
NUMBER OF CAR MANUFACTURERS (GLOBALLY)

1896 - 1930

Today
Commercial Ocean Services
Users

Data acquirers
OOI, ARGO, IOOS, ...

Product and Service developers/providers

“End users”
Shipping, Fishing, Energy, ...

THIS IS THE MOST IMPORTANT SLIDE
Food Security
Public Health
Commerce
Energy Security
National Security
Personal Security
Improving hazard responses
Improving the global economy
- Improving fisheries management
“This ... Strategic Direction implies a priority shift ... to maintaining capabilities in which the United States has maintained technological superiority, e.g. survivable maritime and aviation platforms, dominant intelligence, surveillance and reconnaissance (ISR) ...”

“The United States cannot predict when or where aggression against an ally or a nation of interest could occur. It cannot station forces everywhere, so it must be prepared to wage war anywhere with limited warning.”

A Strategy-Based Framework for Accommodating Reductions in the Defense Budget

RAND
National Defense Research Institute, October 2012
NOAA Operational Forecast System

Gulf of Mexico, Demonstration since Sep 1999; Operational since Sep 2004:

An Operational forecast of impact: 0-3 days
and a prediction of likelihood of a bloom for mgmt

Goal is to help other U.S. HAB areas

http://www.csc.noaa.gov/crs/habf

- Improving public health
Saved lives
Protected property
Preserved national security
AND
Saved Christmas
Imagine a world where…

- Two month lead on prediction of two months of ice-free Arctic
- HAB forecast of 3-5 days
- Hi-res OA predictions
- Optimized renewables integration (and utilization by forward deployed forces)
We need to think like an industry not a research community

- What’s the market?
- Where’s the capital?
  - Angels? VCs?
  - Public/private commingling
- What are the risks?
- What are the exit strategies for investors?
- What are the gaps in the supply stream?
- What are the workforce requirements?
What will it take?

CHARTING THE COURSE FOR OCEAN SCIENCE IN THE UNITED STATES FOR THE NEXT DECADE

AN OCEAN RESEARCH PRIORITIES PLAN AND IMPLEMENTATION STRATEGY

NSTC JOINT SUBCOMMITTEE ON OCEAN SCIENCE AND TECHNOLOGY JANUARY 26, 2007
The Challenge

I. Operationally reliable
   Deliver accurate data consistently

O. Financially sustainable
   Diversify funding and increase leveraging

O. Politically defensible
   Prepare consistent answers about value

S. Technologically extensible and evolvable
   Flex to include new data sources
The Vision

Independent Cost Estimate of the U.S. Integrated Ocean Observing System (IOOS®)

Volume I-Summary

Prepared for:
The National Aeronautics and Space Administration Science Mission Directorate (NASA SMD)

and

The Interagency Ocean Observation Committee (IOOC)

Prepared by:
The Jet Propulsion Laboratory Earth Science and Technology Directorate

May 4, 2012

Independent
Cost Estimate
$3.6B per year...
~ 3:1 ROI

Public Value
Concept of operations

The ocean observing enterprise will be expressed through a new structure of governance and operations.

A wholly different concept will have to emerge, including ...

- Public/private partnerships
- Cooperative R&D Agreements
- Gov’t Owned / Contractor Operated principles
- Indefinite Delivery / Indefinite Quantity tools
- Legalized commingling of resources
BENEFITS FROM OCEAN INFORMATION IN THE SMARTPHONE ERA

The U.S. Integrated Ocean Observing System (IOOS®) is an investment of tremendous national value and significant importance. As an enterprise among federal, regional, and institutional observing programs, IOOS links ocean sensing information together to provide important real-time data to enhance our nation’s predictive capability and decision support infrastructure. IOOS has proven effective in protecting lives, property, and the environment and provides a foundation from which expanded partnerships can continue to generate valuable private, public, and national opportunities.

In the last ten years, Americans have felt over $100B of financial impact due to tsunamis, hurricanes, and fisheries collapses. The impacts of natural hazards, in particular, are large. Lives are lost and people displaced. Property is damaged - sometimes irreparably. Jobs are eliminated or set back, and environmental damage is significant - sometimes permanent. IOOS is now relevant in every major ocean event, enabling us to reduce these losses by supporting day-to-day decision making through a decision support system based upon ocean science and technology advances.

U.S. IOOS Data and Products were used to forecast and prepare for Superstorm Sandy

Just before Superstorm Sandy, IOOS information allowed vessels in the ports of NY and NJ to be diverted to other east coast ports. Over 23,000 cargo vans were safely delivered and then trucked or shipped via rail to the NY-NJ metropolitan region. This action ensured the critical 2012 Christmas shopping season occurred without disruption.

In Hoboken, NJ, 1,700 buildings were severely flooded, impacting up to 34,000 people. Advanced warnings provided by IOOS-derived storm surge forecasts reduced more extensive damage to property, allowed for timely evacuation, and spared discomfort, injury, or worse. The mayor’s decision to order the evacuation of thousands of ground floor apartments by midnight the day before landfall saved a significant number of lives.

The Navy’s Atlantic Fleet Headquarters sent 80 ships out of Hampton Roads ports and shipyards three days prior to the onset of the storm at a cost of $10M. All safely exited with no damage or loss of life. Based on historic damage to the fleet from past hurricanes, a storm of Sandy’s magnitude otherwise could have caused $500M in damage to ships.

U.S. IOOS works, but is incomplete. Imagine the power of a comprehensive IOOS!

1 The word “ocean” is used in this document to denote oceans, coasts, and the Great Lakes.
U.S. IOOS Vision

IOOS is an innovative public/private enterprise of integrated national and regional ocean, coastal, and Great Lakes observations that equips the nation to face natural and manmade risks to economic growth, prosperity, and survivability, and to ensure a safe, productive, and resilient ocean and coastal zone.

Enabling the Vision

IOOS’s utility will enable people through access to technology and information to connect quickly to support decisions in response to our society's greatest needs across individual to community to global scales.

IOOS’s importance will help drive the definition of innovative products and services and will ensure they are integrated into operations in numerous sectors.

IOOS’s effectiveness will be measured by positive impact on the lives and quality of life of our citizens, the efficiency of our commerce and the health of our environment.

IOOS will be nimble to ensure responsiveness to the demands of an increasingly diverse set of customers and partners.

IOOS will be innovative to promote exciting opportunities for new research and technology implementation by industry, academia, NGOs and government agencies.

Action and a commitment to a comprehensive IOOS will require leadership from a broad range of users and contributors that will empower the enterprise, encourage engagement, and lead us to expect excellence.

Empower IOOS to promote the growth and development of the enterprise, products and services, not simply to manage a system.

Encourage increased interagency governmental and non-governmental activity and trusted involvement in the enterprise.

Expect excellence and participation from collaborators and stakeholders to ensure maximum value and return on investment.
IOOS is an innovative public/private enterprise of integrated national and regional ocean, coastal and Great Lakes observations that equips the nation to face natural and manmade risks to economic growth, prosperity and survivability, and to ensure a safe, productive and resilient ocean and coastal zone.
Thank you
A vision for the future

Hank Stommel’s 1989 vision
WWHD now?
Coastal communities around the world are growing.
Driver: Commerce and Economy

99% by volume and 62% by value of U.S. foreign trade enters or leaves by ship.

New sectors are investing in ocean resources and will need ocean data.
Cloud computing is the new normal.
OOI Subsystems

Buoys, Power, Telemetry

Platform Control, DCL

Moorings

Sensors

Benthic Nodes

AUV/Dock

Shore Station

Profiler
Endurance Array

Multi-platform, multi-scale
Fixed and mobile assets
Cross-shelf arrays at
Newport and Grays Harbor
Oregon Line cabled to
Regional Scale Node
GEOSS

GOOS

CalCoFi
NEPTUNE
ARGO
OceanSITES

IOOS
US Coastal Ocean Observing Systems

OOI
HOTS
EuroSITES
EU Ocean Observing Systems

MARS
TAO
BATS
Satellites

• Connectivity
• Standards
• Coordination
Drivers and Influencers: Politics, Policy and Governance

“It is now obvious that enhanced and integrated observing systems are a key element underlying a robust ocean and climate science strategy.” – Admiral James D. Watkins

National Ocean Council

“Federal agencies will work to advance and sustain the infrastructure of ocean observing systems, such as the Integrated Ocean Observing System and the Ocean Observatories Initiative …”

National Ocean Policy Implementation Plan, April 2013

NOAA FY14 Budget ...
...IOOS Regional Observations UP 50%

New Ocean Legislation

Sequestration
The Vision

The ocean observation services that are provided will be “full spectrum.”

The enterprise of services dependent on ocean information will demand that the full array of relevant observations be operationalized.

– Draft IOOS Summit Report
Data free and available to everyone!
Tonight: Patchy fog. Otherwise, mostly cloudy, with a low around 42. North wind 7 to 15 mph, with gusts as high as 23 mph.

Friday: Patchy fog before 11am. Otherwise, mostly cloudy, with a high near 57. North wind 5 to 7 mph becoming west southwest in the morning.

Friday Night: Mostly cloudy, with a low around 44. West southwest wind 5 to 11 mph.

Saturday: Mostly cloudy, with a high near 54. West southwest wind 6 to 10 mph.

Saturday Night: A 30 percent chance of showers, mainly after 11pm. Cloudy, with a low around 46. West southwest wind 5 to 10 mph.

Sunday: A 30 percent chance of rain, mainly before 11am. Mostly cloudy, with a high near 58.

Sunday Night: A 50 percent chance of rain, mainly after 11pm. Mostly cloudy, with a low around 46.

Monday: A chance of rain. Mostly cloudy, with a high near 52.

Monday Night: A slight chance of showers. Mostly cloudy, with a low around 43.

Tuesday: A slight chance of showers. Partly sunny, with a high near 54.

Tuesday Night: Partly cloudy, with a low around 38.

Wednesday: Mostly sunny, with a high near 58.

Wednesday Night: Partly cloudy, with a low around 43.

Thursday: A slight chance of showers. Mostly sunny, with a high near 59.
The ocean observing system will promote the establishment of new models for workforce development.
Ultimately, we foresee a capability utilizing and delivering **products** from ocean observations that are fully **integrated** into the culture of our society, and is considered a non-negotiable component of our ability to enhance the **lives**, **livelihoods** and **quality of life** of future generations.
Imagine …