Welcome to DEEP OCEAN OBSERVING STRATEGY

Addressing the grand societal issues of climate change prediction and adaptation, ecosystem conservation, and sustainable management in the deep ocean

• DOOS Background
• Workshop Objectives
DOOS Objective

Develop a common statement of requirements and an initial strategy for sustained global deep ocean observations; considering all Essential Ocean Variables (EOVs), regions, technologies, and societal imperatives so as to extract high priority, feasibility, and GOOS fit-for-purpose actions for the next 5-10 years.

TRANSLATION:

• Develop a coordinated plan that brings together the deep observing community to address key scientific and societal needs by measuring EOVs.
• Turn the deep ocean observing ‘strategy’ into a ‘system’

** We may also want to look beyond for the next 20-50 years
What Depths?

ARGO

DEEP ARGO

Why > 200 m?

Potential phosphate mining → Trawl fisheries

Oil & gas drilling → Climate change, pollution, & marine debris

Pelagic fisheries → Potential crust & sulfide mining

Seamount fisheries → Mean seamount depth & hydrothermal vent depth (2.2 km)

Sea Mount (4.3 km)

ABYSSAL PLAIN

Largely international jurisdiction

National & international jurisdiction

Largely national jurisdiction

CONTINENTAL SHELF

CONTINENTAL MARGIN

National & international jurisdiction

Potential manganese nodule mining

Mengerink et al. 2014

TRENCH
DOOS HISTORY


Consultative Draft Preparation
Community Feedback
Leadership Team/COL
Inventory
Scoping Workshop

IMPLEMENTATION

GLOBAL OCEAN OBSERVING MTG

SUSTAINED DEEP OCEAN OBSERVATIONS
Eric Lindstrom
(Co-Chair GOOS Steering Committee)

Original Advisory Team (Consultative Draft Preparation)

Climate and Physical Observations
- Gregory C. Johnson
- Patrick Heimbach
- Bernadette Sloyan

Carbon, Biogeochemistry
- Toste Tanhua
- Rik Wanninkhof

Biodiversity and Ecosystem Observations
- Antje Boetius
- Lisa Levin
- Myriam Sibuet

DOOS Consultative Draft: www.ioc-goos.org/deepocean
DOOS Workshop Planning Committee

- Lisa Levin*
- Antje Boetius (F. Janssen)
- Albert Fischer
- Masao Fukasawa
- Patrick Heimbeck
- Greg Johnson
- Henry Ruhl
- Bernadette Sloyan
- Sun Song
- Toste Tanhua
- Rik Wanninkhof

**Distributed Project Office:**
Andrea McCurdy (Proj. Manager)
Nicholas Rome
Kruti Desai
Kristen Yarincik
+ Leslie Smith
Guillermo Mendoza

* Project Leadership
Who Are We?

GO SHIP

SPACE OBS.
ARGO
DEEP ARGOS
BIO ARGOS
TIME SERIES

MOORINGS

SMART CABLES

GLIDERS

OBSERVATORIES

SUBMERSIBLES
ROVS

AUVS

ANIMAL TAGS

PASSIVE

ACOUSTICS

ESP

www.deepoceanobserving.org
Our Status?

• Consultative Draft
• Webpage
  • www.deepoceanobserving.org
  • format to solicit stakeholder comments.
• Deep-Ocean Inventory – 70 Responses
  • An initial picture..
• DOOS Workshop - Scoping, Terms of Reference
• Introduction: Deep-Ocean Observing
• Rationale and Scientific Drivers
• Requirements Setting: Essential Ocean Variables for the Deep Ocean
• Deployment and Maintenance: Observing Platforms and Technologies Addressing the EOVs
• Data and Information Products: Strategy for Data Management
• Strategic Roadmap
Science Challenges

**Climate and Physical Community**
- Understanding Heat & Freshwater Transports
- Understanding Mass Transports
- Closure of the Earth’s Energy Budget
- Understand the Global Fresh Water Balance
- Understand Global & Regional Sea Level
- Deep Ocean Mixing & Fluxes in Heat and Salinity

**Carbon and Biogeochemistry Community**
- Determine the Anthropogenic Carbon Load
- Determine the Strength of Ocean Ventilation
- Assess the sources and sinks for potential greenhouse gases

**Biodiversity and Ecosystems Community**
- Exploration and Observation
- Prediction of Future Biological Responses
- Understand the Functioning of Deep-Sea Ecosystems
- Understanding the Roles and Relationships of Ecosystem and Ecosystem Engineers
Ardron & Warner, in *Handbook of Ocean Resources*, Earthscan Books
Climate Change as a Criterion for Deep Marine Protected Areas

Improved model of climate change at the sea floor for assessing protection scenarios, and environmental impact assessment

BOTTOM TRAWLING

SEABED MINING

pH projection

Mid Atlantic Ridge

Dunn, Halpin et al.

BIODIVERSITY
A new treaty in ABNJ
Climate Policy

Mitigation and Adaptation

Consensus on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) writes an Assessment Report (AR) that represents the international consensus on climate change.

- 1990 First AR (FAR)
- 1995 Second AR (SAR)
- 2001 Third AR (TAR)
- 2007 Fourth AR (AR4)
- 2014 Fifth AR (AR5)

Source: United Nations Framework Convention on Climate Change (UNFCCC).
Biodiversity – a sampling challenge

Webb et al. 2010
Articulation of EOVs and Measurement Requirements

Physical and Climate Science EOVs:
- Sea Level
- Temperature
- Salinity
- Transient Tracers: CFC, SF, C14
- Velocity/Ocean Currents
- Transient Tracer: Argon-39
- Ocean Bottom Pressure
- Geothermal flux

Carbon and Biogeochemistry Science EOVs:
- Inorganic: C of Dissolved Inorganic Carbon (Alkalinity, PCO2, pH)
- Inorganic Nutrients
- Dissolved Oxygen
- Organic: DOM, POM, DOC

Biodiversity and Ecosystem Science EOVs:
- Chlorophyll/Surface Productivity
- Element fluxes
- Remineralization Rates
- Secondary Productivity
- Abundance and diversity of organisms
- Trophic Interactions
- Physiological Adaptation
- Functional Diversity
- Community Turnover
- Habitat Dimension
- Evolutionary Context
- Community Structure

Requirements

- Mature
  - Sustained implementation at regional and/or global scales
  - Capable of being sustained or mission qualified
  - Consensus on observation impact and best-practices

- Pilot
  - Deployment in an operational environment
  - Verification of the spatial and temporal sampling strategy
  - Measurement strategy verified by sea trial

- Concept
  - Proof-of-concept determined via feasibility study
  - Measurement strategy documented
  - Environment information identified

Lowest Readiness Level

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Creation of Data and Information Products

Data Policy
• Delivery/Dissemination (Near Real-time)
• Quality (QA/QC Requirements)
• Archives
• Products

Physical and Climate EOVs
Carbon and Biogeochemistry EOVs
Biodiversity and Ecosystem EOVs

Observations
• Ship-based
• Moorings
• Deep Argo
• Deep Gliders
• ROVs/Submersibles
• Cabled Observatories
• Habitat Laboratories
• Periodical Biological Sampling
  • Satellites
  • Models/
  • Models/ Data Assimilation

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High-Level Workshop Goals

• Encourage increased partnerships across the deep-ocean research community.

• Align, assess and improve the readiness levels of requirements, technologies, platforms, and data products that address societal imperatives.

• Expand Global Ocean Observing System (GOOS) communities to include diverse deep-ocean stakeholders.
Specific Workshop Goals

- **Determine - WHAT IS DOOS?**
- Identify societal and scientific drivers for a Deep-Ocean Observing Strategy – *What have we missed?*
- Define the key scientific questions that should be addressed with deep observations and what measurements are needed.
- Characterize observing systems that meet these scientific and functional requirements, and identify gaps, inefficiencies and vulnerabilities.
- Review the status of deep observing: platforms, sensors, technology.
- Review and prioritize existing and potential Essential Ocean Variables in deep waters.
- Evaluate logistical requirements for implementation of a recommended Deep Ocean Observing System.
  - Interest, Collaborators, Strategies, Funding
- Evaluate requirements for delivery of data, and derived products and information; evaluate the existing data systems for fitness for purpose.
DOOS Workshop Agenda

- Day 1: Intro
  - Deep-sea Themes and Case Studies
  - DOOS Scientific Goals
  - State of Deep Observing (Consultative Draft, Inventory, National Programs)

- Day 2.
  - DOOS EOVs
  - Technology Development (Platforms and Sensors)
  - Geographic Requirements
  - **Interdisciplinary task team breakouts/plenary**

- Day 3
  - Funding opportunities
  - Data management
  - Terms of reference
  - DOOS next steps and deliverables

**APPROACH: LOTS OF DISCUSSION!!**

*Please represent your discipline, national needs, as well as your own science*
• A clear answer to: What is DOOS?
• Solid recommendations for the scope, goals, duration, and structure of DOOS.
• A structure for DOOS leadership.
• Definition of DOOS projects with task team leaders.
• Guidance on a roadmap for EOV, technology, and data information product maturation.
• Linkages to specific societal needs and organizations.
• Plans for Ocean Obs. 2019 (White Papers, Messages, Teams).