Program Observation Requirements Document (PORD)

for

Ocean *In situ* Observation Requirements

National Weather Service (NWS)

November 7, 2012

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NOSC Endorsement

The NOSC has received the National Weather Service's Observation Requirements, with Goal Lead and Line Office concurrence, and endorses the Level-of-Validation provided for the NWS Priority-1 Ocean *In Situ* Requirements.

Dr. Kathryn Sullivan Chair, NOSC	12/7/12 Date	✓ Endorsed
Mary Kicza Vice Chair, NOSC	12/3/12 Date	✓ Endorsed
Laura K. Furgione Vice Chair, NOSC	12/4/12 Date	✓ Endorsed
RDML Mike Devany Vice Chair, NOSC	11/29/12 Date	✓ Endorsed

Goal and Line Office Concurrence

The National Weather Service's Line Office Leadership and Weather Ready Nation Lead concur with the Observation Requirements and are satisfied with the Level-of-Validation provided for the Priority-1 Ocean *In Situ* Requirements.

Laura K. Furgione Assistant Administrator (Acting), NWS	11/15/12 Date	LKF Validated
Ed Johnson Lead, Weather Ready Nation Goal	11/13/12 Date	EJ Validated
David Caldwell Director, NWS/OCWWS	11/13/12 Date	DBC Validated
Mark Paese Director, NWS/OOS	11/13/12 Date	MSP Validated

Program Membership Concurrence

Mike Angove NWS/OCWWS/MSD	11/9/2012 Date	Concurred
Kathleen O'Neil NWS/NDBC	11/7/2012 Date	Concurred
Fiona Horsfall Chief, NWS/OCWWS/CSD	11/13/12 Date	Concurred
Mark Tew Chief, NWS/OCWWS/MSD/MCWS	11/8/2012 Date	Concurred

1. Document Overview

NOAA's Ocean *In Situ* requirements validation process creates a baseline of objectively verifiable requirements based on:

- Documentation via mandates, scientific studies, or ongoing research, and/or
- Consensus among Program Members, Program Managers, Goal Leads, and Line Office AAs

With these, NOAA can better set priorities based on mission needs and stakeholder input. The validated requirements can then be the basis for justification and gap analysis of NOAA observing systems satisfying those requirements, positioning NOAA to operate the right mix of assets and options to meet at-sea sampling requirements now and in the future.

The National Weather Service (NWS) worked closely with the Technology, Planning, and Integration for Observations (TPIO) Office, Office of Marine and Aviation Operation (OMAO), and Subject Matter Experts (SMEs) to document their list of Ocean *In Situ* requirements.

TPIO, on behalf of the NOAA Observing Systems Council (NOSC), follows a standard process when documenting observation, system-independent, requirements with NOAA Line Offices. This template includes the priority of each requirement based on its importance to the group mission:

- Mission Critical (Priority-1)
- Mission Optimal (Priority-2)
- Mission Enhancing (Priority-3)

Specific attributes for each Priority-1 requirement are then documented and validated. In support of generation of the NOAA Fleet Plan in late 2012, the NOSC's Observation Requirements process was modified for application to more system specific Ocean *In Situ* requirements. The validation process for each Line Office's Ocean *In Situ* requirements has been applied to the 1) observational need; 2) geographic coverage and 3) sampling frequency. In addition, the number of Days At Sea (DAS) associated with each requirement are also provided to assist with the NOAA Fleet Plan. The requirements list and attributes are verified by the Line Offices representatives and SMEs who then provide validation documentation to support each Priority-1 requirement and its specified attributes values. Validation is important as it provides independent confirmation of the needs of the program either through the results of scientific studies, operational use, or subject matter experts. Both the Line Office representatives and TPIO assess the applicability of the documents and prepare a summary of the validation of Priority-1 requirements. The NOAA Line Office obtains their leadership concurrence and presents the requirements summary to the NOSC for their endorsement of the validation process.

2. Observation Requirements Summary

The National Weather Service (NWS) has a total of 3 Priority-1 Ocean *In Situ* requirements to address its mission. This document provides the list of requirements for the following NWS programs:

2.1 Office of Climate, Water, and Weather Services (OCWWS)

2.1.1 Program Summary

The NWS requires DAS to support the operations and maintenance of the Deep-ocean Assessment and Reporting of Tsunami (DART), Tropical Atmosphere/Ocean (TAO) and moored buoys networks. The main purpose of the NOAA buoy network is to provide reliable, accurate, and cost-effective atmospheric and oceanic observations in support of weather forecasting, especially including the issuance of marine warnings to the general public as well as all public and private coastal interests. This network also supports international agreements on climate monitoring. NWS' National Data Buoy Center (NDBC) oversees buoy development, deployment, and management.

Weather buoys are an incredibly valuable part of the hurricane warning system. Surveys of meteorologists have shown about 40% of the National Weather Service's (NWS) marine warnings and advisories are based, at least in part, on NDBC's meteorological data.

The TAO array (renamed the TAO/TRITON array on 1 January 2000) consists of approximately 70 moorings in the Tropical Pacific Ocean, telemetering oceanographic and meteorological data to shore in real-time via either the Argos or the iridium satellite systems. The array is a major component of the El Niño/Southern Oscillation (ENSO) Observing System, the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). The United States (National Oceanic and Atmospheric Administration) is responsible for 55 of the 70 moorings that are located between 95W and 165E, and Japan (Japan Agency for Marine-earth Science and TEChnology) maintains the remaining moorings west of 165E.

The Deep-ocean Assessment and Reporting of Tsunami (DART) is an operational observing component of the U.S. National Tsunami Hazard Mitigation Program (NTHMP). The NTHMP is a comprehensive, joint Federal/State effort to reduce the loss of life and property due to tsunami inundation of U.S. coastlines. Cooperating U.S. agencies include NOAA, the Federal Emergency Management Agency, the U.S. Geological Survey and the Emergency Management organizations of the states and US territories. (see www.pmel.noaa.gov/tsunami-hazard). DART is a deep ocean network of 39 real-time reporting tsunami measurement systems in the Pacific Ocean, the Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico that provides early detection and direct measurement of tsunamis generated in those source regions that pose the most direct threat to U.S. coastal communities, including the Alaska-Aleutian Subduction Zone (AASZ), the Cascadia Subduction Zone (CSZ), the South American Seismic Zone (SASZ), and the Subduction Zones of the Atlantic

and the Caribbean. The DART system, developed by NOAA's Pacific Marine Environmental Laboratory and operated by the NWS National Data Buoy Center, consists of an anchored seafloor bottom pressure recorder (BPR) and a companion moored surface buoy for real-time communications (Gonzalez et al., 1998). An acoustic link transmits data from the BPR on the seafloor to the surface buoy.

Moored buoys are the weather sentinels of the sea. They are deployed in the coastal and offshore waters from the western Atlantic to the Pacific Ocean around Hawaii, and from the Bering Sea to the South Pacific. NDBC's moored buoys measure and transmit barometric pressure; wind direction, speed, and gust; air and sea temperature; and wave energy spectra from which significant wave height, dominant wave period, and average wave period are derived. Even the direction of wave propagation is measured on many moored buoys. NDBC's fleet of moored buoys includes several types: 3-m, 10-m, and 12-m discus hulls and a 6-m boat-shaped hulls. The choice of hull type used usually depends on its intended deployment location and measurement requirements. To assure optimum performance, a specific mooring design is produced based on hull type, location, and water depth. For example, a smaller buoy in shallow coastal waters may be moored using an all-chain mooring. On the other hand, a large discus buoy deployed in the deep ocean may require a combination of chain, nylon, and buoyant polypropylene materials designed for many years of service. In addition to their use in operational forecasting, warnings, and atmospheric models, moored buoy data are used for scientific and research programs, emergency response to chemical spills, legal proceedings, and engineering design.

2.1.2 Validation Assessment for Priority-1 Requirements

NWS representatives worked jointly with TPIO to review the submitted documentation, and identify the "level of validation" for NWS/OCWWS's Ocean *In Situ* Priority 1 Observation Requirements.

Table 1: OCWWS Validation Assessment for Priority-1 Requirements

#	Validation Assessment	Observation Requirement	Geo Coverage	Samp-ling	DAS	Validation Docs
NWS.DBC.001	Validated	Operations and Maintenance of DART Network	Coastal US	1 yr	300	1, 2, 3, 4, 5
NWS.DBC.002	Validated	Operations and Maintenance of TAO and Production of Key Data Sets	Global	1 yr	285	6
NWS.DBC.003	Validated	Operations and Maintenance of moored buoys	Coastal US	1 yr	466	7, 8

Note: DAS numbers were not validated but were submitted by programs to indicated needed days at sea for each survey.

Legend: Level of Validation

- Validated
- Validated with SME Statement
- Not Validated (insufficient documentation)

2.1.3 Validation Documents Submitted

NWS representatives worked jointly with TPIO to identify references to validate both the need for an observation requirement and its specific measurement attributes. These validation documents support one or more of the Priority-1 Requirements as shown in Table 1 above. For occurrences where validation documents could not be identified, program Subject Matter Experts (SME) justifications are provided.

The following Validation Documents have been submitted in support of NWS/OCWWS's Ocean *In Situ* Priority 1 Observation Requirements.

Table 2: OCWWS Validation Documents provided to support Priority-1 Requirements

Doc #	Document Title
1	Improving tsunami forecast skill using deep ocean observations. Bernard, E.N., and V.V. Titov (2007), Mar. Tech. Soc. J., 40(3), 23–26.
2	History and future of deep-ocean tsunami measurements. Bernard, E., and C. Meinig (2011), In Proceedings of Oceans' 11 MTS/IEEE, Kona, IEEE, Piscataway, NJ, 19–22 September 2011, No. 6106894, 7 pp.
3	Direct energy estimation of the 2011 Japan tsunami using deep-ocean pressure measurements. Tang, L., V.V. Titov, E. Bernard, Y. Wei, C. Chamberlin, J.C. Newman, H. Mofjeld, D. Arcas, M. Eble, C. Moore, B. Uslu, C. Pells, M.C. Spillane, L.M. Wright, and E. Gica (2012), J. Geophys. Res., 117, C08008, doi: 10.1029/2011JC007635.
4	Public law 109-479, the Tsunami Warning and Education Act, Section 804 (g) (codified at 33 U.S.C. § 3203(g))
5	THE NEED FOR 15 SECOND DART DATA DURING REAL-TIME TSUNAMI ASSESSMENT
6	Requirements for the TAO/TRITON Array, September 2011
7	National Data Buoy Center (NDBC) National Backbone Contributions to the Integrated Ocean Observation System (IOOS), OCEANS 2006, 18-21 Sept. 2006, Crout, R.L., NOAA Nat. Data Buoy Center, Stennis Space Center, MS Conlee, D.T. ; Bernard, L.J., Page(s): 1 – 3
8	A National Operational Wave Observation Plan, March 2009