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NOAA Ship *Okeanos Explorer*

FY20 Data Management Plan

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I. Document Purpose

The NOAA Ship *Okeanos Explorer* (EX), owned and maintained by the NOAA Office of Marine and Aviation Operations (OMAO) and operated by the NOAA Office of Ocean Exploration and Research (OER) and the Global Foundation for Ocean Exploration (GFOE), is NOAA's only vessel solely dedicated to exploration of the deep ocean. This document outlines a plan for managing data and information recorded, collected, or otherwise generated by EX during its missions in Fiscal Year 2020 (See Appendix A for Details). This plan is intended to support a comprehensive and standardized approach to identifying, acquiring, displaying, archiving, and publishing EX mission data and information.

Date	Author	Version	Comments
2/14/2012	S. Gottfried	1.0	Initial Draft
3/23/2012	S. Gottfried	1.1	Updated Video Pipeline
2/6/2013	S. Gottfried	1.2	FY13 Updates
11/20/2013	S. Gottfried	1.3	FY14 Updates
11/17/2014	S. Gottfried	1.4	FY15 Updates
7/29/2015	S. Gottfried	2.0	Added Sampling Operations
3/18/2016	S. Gottfried	3.0	New Video data management procedures; PARR Compliance; Updated data pipelines
3/3/2017	M. Cromwell		FY17 Draft
8/23/2017	S. Gottfried	3.0	Added Appendix of Expeditions
1/31/2019	M. Cromwell/S. Gottfried	4.0	FY19 Updates including network overhaul, transfer of responsibilities
7/13/2020	Megan Cromwell (with contributions from NCEI, OER, & GFOE)	4.1	FY20 Updates

II. Document Authority

NOAA environmental and geospatial data are maintained in accordance with applicable Office of Management and Budget (OMB) regulations, including OMB Circulars A-16 and A-130; International Organization for Standardization (ISO) approved data standards; the Geospatial Profile of the Federal Enterprise Architecture; federal law related to records management within federal agencies – Sections 3101-3107 of Title 44 of the United States Code (44 U.S.C. 3101-3107); the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.); and the National Archives and Records Administration (NARA) Records Management Regulations – Parts 1220-1238 of Title 36 of the Code of Federal Regulations (36 CFR 1220-1238); NOAA Administrative Issuance NAO 205-17 and NAO 212-15; and

the Federal Rules of Civil Procedure (28 U.S.C. § 2072). NOAA Information Access and Dissemination establishes policy for distributing scientific and technical publications and ensuring compliance with NOAA's mission to provide environmental information to its user communities. NOAA Management of Environmental and Geospatial Data and Information provides high-level direction that guides procedures, decisions, and actions regarding environmental data and information management throughout NOAA.

III. Scope of Plan

This plan sets forth a comprehensive and standardized approach to identifying, acquiring, displaying, archiving, and publishing EX data. The scope of this plan addresses EX data in its current state and custody arrangement and provides for management throughout the remainder of its lifecycle. It is designed to work in part or in whole to accomplish NOAA's primary data management objectives and may be executed for one data type or all of EX data and information.

IV. Data Management Plan Overview

The data collected and products generated, as a result of a mission on the EX, will be managed by a collaborative group of individuals from the Global Foundation for Ocean Exploration (GFOE), the OMAO, and the NOAA National Centers for Environmental Information (NCEI). The GFOE team is responsible for the maintenance and operation of OER's two submersible vehicles, ROV *Deep Discoverer* and Camera Platform *Seirios*; as well as, the architecture, maintenance and operations of the onboard network systems and processes, and the network systems and processes at a shoreside location at the University of Rhode Island (URI) Innerspace Center (ISC). OMAO is responsible for the data management of the hull-mounted sensors, except the multibeam sensor suite, which is handled separately. The NCEI team is responsible for the database supporting onboard sampling operations and for the stewardship of the data once the cruise is complete.

For this document, this collaborative group will be referred to as the OER Data Management Team (DMT). Because the EX is NOAA's first vessel dedicated solely to exploration, all data recorded, products generated, and discoveries made during a mission will be made discoverable and accessible to the general public in as close to real-time as possible. Exceptions to this will be noted in the individual mission Data Management Plans (DMP) when data are protected due to submerged cultural resources, in foreign waters, or other reasons. Public access of these data will be achieved through a variety of discovery and access points, including secure FTP servers, account controlled content management sites, metadata search engines, public access websites, and customized geospatial applications.

v. EX Instrument and Data Type Inventory

Meteorological/Oceanographic/Navigational (METOC/NAV/VEHICLES): The EX is equipped with an integrated suite of oceanographic/navigational/meteorological instrumentation which is monitored by OMAO's Scientific Computing System (SCS) and recorded on the GFOE network by a set of custom GFOE applications collectively known as CORVID. The EX also has an over-the-side deployable CTD / Rosette instrument for collecting water column profile data and water samples and an Underway CTD which can be used to collect CTD and sound velocity data continually while underway. Flowthrough thermosalinographs and two Acoustic Doppler Current Profilers are also utilized. The OER maintains an inventory of eXpendable BathyThermographs (XBTs) for collecting water column temperature and depth. Asynchronous sound velocity profiles (asvp) are a derived file from the CTDs or XBTs. These data are typically archived at NCEI.

Bathymetry and Water Column Backscatter (GEO): The EX has a state-of-the-art multibeam sonar system, the Kongsberg EM 302 (EM 304 as of spring 2020), complementary bottom-looking sensors, and calibrating instrumentation. The EX also has a suite of Simrad EK split beam sonars at varying frequencies for detecting features in the water column. Specifically, these include EK 60/EK 80 split-beam split-frequency systems operating at 18kHz, 38kHz, 70kHz, 120kHz, and 200kHz. The sonar suite also includes a Knudsen Chirp 3260 Sub-Bottom Profiler. These data and the products that result are typically archived at NCEI. Note that the 38kHz transducer is considered compromised and has not been successfully calibrated and is therefore not typically collected. Due to interference, the 38kHz cannot be run concurrently with the 30kHz EM 304 Multibeam; therefore, 38kHz data is more sparse than the other frequencies. The 18kHz is run through the SCS as the ship's depth reading.

Multimedia (MUL): OER has a dedicated, two-vehicle submersible system which will be used for in situ observations and physical sample collection during the FY20 field season. The main vehicle, Deep Discoverer, is a custom-designed 6,000 meter-rated ROV. *Deep Discoverer* is accompanied by a smaller, secondary vehicle, *Seirios*, which is a custom-designed camera sled. Each vehicle will record broadcast quality video in addition to environmental and navigational data. These vehicles will be operated under OER's Ocean Explorer Model that utilizes telepresence to connect shore-side scientists in real time to the operations for collaborative deep-water exploration. As part of the standard processing procedures, still images will also be extracted from the high-resolution recorded video. Video and images are archived at NCEI; these data are discoverable and accessible through a customized OER Video Portal and through a partnership with Ocean Networks Canada's cloud-based annotation tool, SeaTube.

Documentation, Reports, and Publications: Planning documents, summary reports, and scientific publications are published in the NOAA Central Library catalog.

NASA Aerosol Data: The EX is a ship of opportunity for NASA's Maritime Aerosol Network (MAN) which provides ship-borne aerosol optical depth measurements from Microtops II sun photometers. The collaboration began in FY12. Information about the program can be found at http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html. Data access from EX cruises can be found at http://aeronet.gsfc.nasa.gov/new_web/cruises_new/OkExplorer_yy_#.html

A complete list of EX data and products that are managed by NCEI's DMT is viewable in Table 1.

Table 1. EX Instrument/Data Type Inventory.

Data Class	Instrument	Data Type	Data Format
ASVP	Derived	Asynchronous Sound Velocity Profile	.asvp
GEO	Kongsberg EM302/EM304 (30 kHz)	Multibeam Bathymetry, Bottom Backscatter, Water Column Backscatter (proprietary format read into MBSystem)	.all, .wcd (proprietary), .txt (ASCII full resolution XYZ bathymetry), .sd (Fledermaus object), .tif (gridded bathymetry, GeoTIF image), .kml
GEO	Simrad EK80	Water Column Backscatter	.raw, .bot, .idx
GEO	Knudsen CHIRP 3260 (3.5 kHz)	Sub-bottom profile	.sgy, .kea, .keb (proprietary).
GEO	GP170	Science GPS data	
MET	RM Young 61202V	Barometric Pressure (mB)	.raw (ASCII)
MET	RM Young 05106/RM Young 05306B	Relative Wind Speed (knots)/Relative Wind Direction (degrees)	.raw (ASCII)
MET	Derived	True Wind Speed/Direction	.raw (ASCII)
MET	Epply PSP and PIR	Solar Radiation (kWh/m2)	.raw (ASCII)
MET	Vaisala HMP49A	Air temperature and humidity sensor	.raw (ASCII)
MET	SeaBird 45 Micro-TSG	Thermosalinograph	
MET	SBE 38 Temperature Probe	Temperature	
MET	Turner Designs 10-Au Fluorometer	Fluorescence	.raw (ASCII)
NAV	Applanix POS/MV 320, Version 5	Location, Heading, Attitude (Decimal degrees, degrees, degrees)	.raw (ASCII)

NAV	Fugro MarineStar DGPS/C-NAV 2000	Global Position (Decimal degrees)	.raw (ASCII)
NAV	Meridian TSS Gyro Compass	Compass Readings	.raw (ASCII)
OCN	Teledyne Ocean Surveyor	Acoustic Doppler Current Profiler (ADCP) 38 KHz	
OCN	Teledyne Workhorse Mariner	Acoustic Doppler Current Profiler (ADCP) 300 KHz	
OCN	SeaBird SBE-911plus	Conductivity, Temperature, Depth, Light Scattering, Oxidation-Reduction Potential, Dissolved Oxygen, Altimeter	.hex, .xmlcon (proprietary); .cnv (processed), .hdr, .jpg (processed)
OCN	Teledyne Ocean Science Underway CTD	Conductivity, Temperature, Depth (CTD) or Sound Velocity measurements while underway	
OCN	SeaBird SBE-38	Surface seawater temperature probe	
OCN	Sippican MK-21 eXpendable BathyThermograph	Temperature, Depth, Sound Velocity (deg C, meters, m/s)	.edf (ASCII)
OCN	RESON SVP 70	Sound Velocity Profile	.asvp (ASCII)
MUL	Insite Pacific Inc., Zeus Plus High-Definition 3-CCD Color Zoom Camera	Color Video Clips, Framegrabs (ROV and Camera Sled)	h.264 high-definition (for dive trailers) & h.264 low- resolution; ProRes 422 Resolution
MUL	Insite Pacific Inc., Mini Zeus High-Definition Color Zoom Camera	Color Video Clips, Framegrabs (Camera Sled)	h.264 high-definition (for dive trailers) & h.264 low-resolution

VI. Data Flow Strategies and Procedures

Data recorded and/or products generated as a result of an EX mission will be managed first by the strict enforcement of Standard Operating Procedures (SOPs) followed by specified crew members, mission specific onboard personnel, and by a team of data managers both onboard and ashore. The OER Data Management Team will follow established SOPs to ensure data and metadata are archived correctly and made accessible through data discovery tools.

A. Synchronization Procedures from Shipboard Repository Server to Shoreside Repository Server

To facilitate near real-time data access from shore during operations, GFOE manages a ship to shore data synchronization system and complementary data server exdata.tgfoe.org Shoreside Repository Server (SRS) located at the Inner Space Center. For an outline of how the cruise data is organized on exdata.tgfoe.org please see below. It should be noted that only a subset of the complete data set is available in real-time due to the amount of data collected versus limitations of the available satellite bandwidth. Following the completion of each cruise, two complete copies of all data are physically transported by two GFOE Data Team members travelling on separate flights. One copy is mailed to NCEI for ingest and another copy is kept on GFOE managed storage until NCEI's ingest process has been verified.

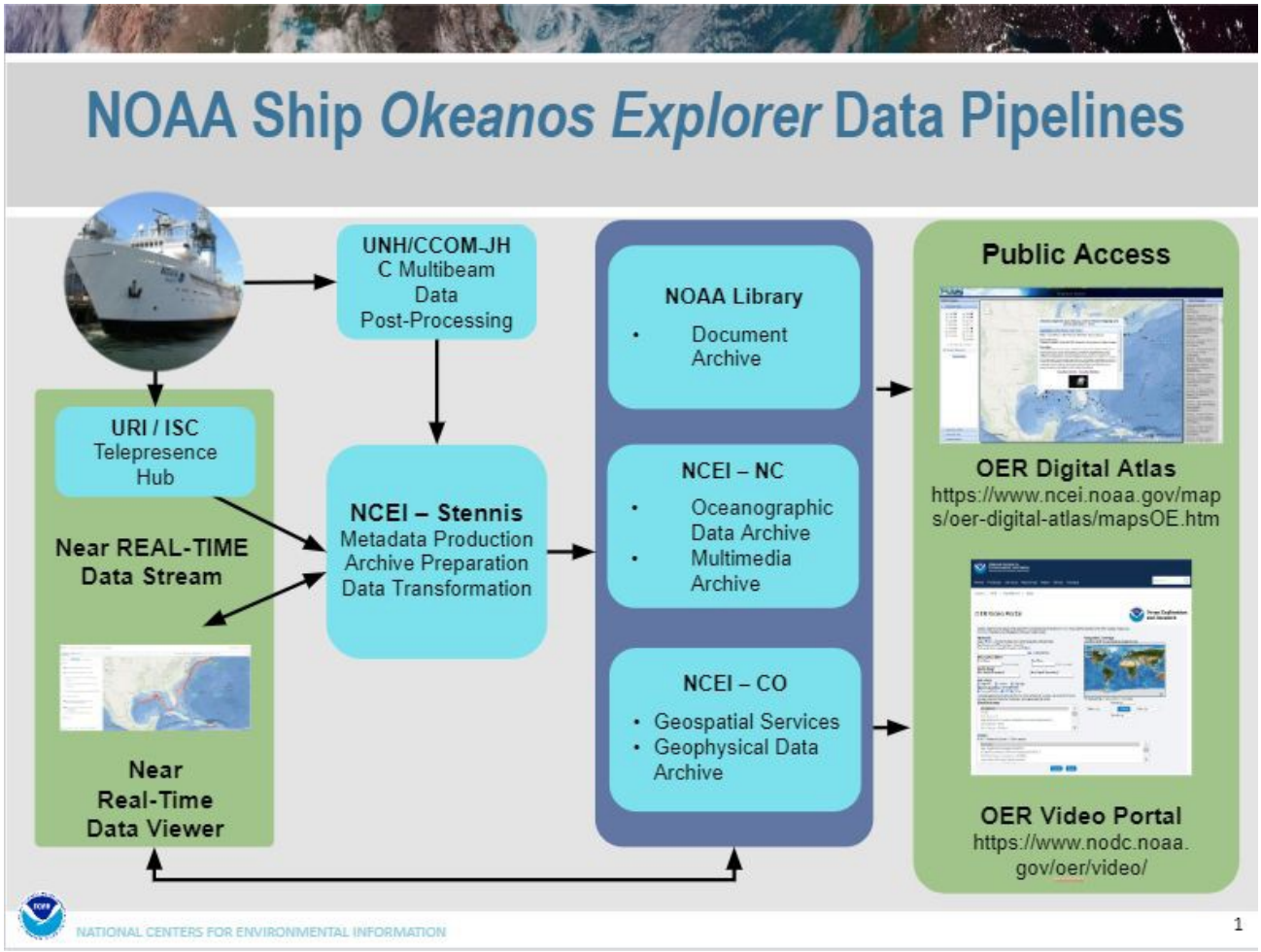


Figure 1. EX Data Management Pipeline.

B. Repository Folder Structure, File Naming Conventions and Standards

exdata.tgfoe.org Shoreside Repository Server (SRS)

The success of the data management strategy is highly-dependent upon the compliance of the onboard systems and personnel to ensure output files follow a defined folder organization and file naming convention. The following describes the current defined conventions.

[ ] = optional input; { } = choice input; yyyymmddThh[mmss]Z = ISO8601 Standard

OkeanosCruises

- EXyynn[L#] (ex. EX1504L2)
  - CTD
    - asvp
    - CPCTD
    - ROVCTD
    - SHIPCTD
    - XBT
  - EK60
  - Eventlogs
  - EXyynn[L#].manifest
  - EXyynn[L#]_SCSData.md5deep.diff
  - EXyynn[L#]_shipboard_SCSData.md5deep
  - EXyynn[L#]_shore_SCSData.md5deep
  - ex_to_isc_comparison.txt
  - Imagery
    - EXyynn[L#]_DIVE###_yyyymmdd
  - Multibeam
    - EXyynn[L#]_MB_###m_WGS{###}_yyyymmdd
  - Multibeam_Raw
  - Products
    - HighlightImagery
    - HighlightVideo
      - Compressed
      - ShotList
      - Web
    - ROV
      - EXyynn[L#]_DIVE###_yyyymmdd
      - TOPSIDE
    - ROVDiveSummaries
  - Sample
    - EXyynn[L#]_DIVE###_yyyymmdd
      - Imagery
      - Video
  - SBP
  - SCSData
    - METOC
    - NAV
    - VEHICLES
  - UPLOAD
  - Video
    - EXyynn[L#]_DIVE###_yyyymmdd
    - TOPSIDE

CTD

This directory contains water column profiles made by different instruments during the expedition. It is divided into 5 subfolders: asvp, CPCTD, ROVCTD, SHIPCTD and XBT.

CTD/asvp

It contains Active Sound Velocity Profiles (ASVP) made by the mapping team. They are derived from files in the XBT folder or CTD files in CPCTD, ROVCTD or SHIPCTD folders. Every ASVP has the same name as the file used to create it except for the extension which changes to .asvp. Files follow this filename conventions:

EXyynn[L#]_{AXBT|CTD|SSM|XBT}###_yyyymmddThhmmssZ.asvp

EXyynn[L#]_DIVE##_yyyymmdd_{CPCTD|ROVCTD}.asvp

CTD/ CPCTD

This folder contains CTD casts from Seirios SBE 911 plus CTD. All raw files without any filtering or processing are organized in dive subfolders. If the device is restarted for any reason during the dive a number is appended to the end of the filename for all subsequent files to avoid overwriting data.

Header files: include software version, serial number, configuration, etc. and follow this

Name convention: EXyynn[L#]_DIVE##_yyyymmdd_CPCTD_{#}.hdr

Data files: hexadecimal raw data created by Seasave from a real-time data stream and follow this
Name convention: EXyynn[L#]_DIVE##_yyyymmdd_CPCTD_{#}.hex

Instrument configuration files: contain the number, type and calibration coefficients of every sensor.

Name convention: EXyynn[L#]_DIVE##_yyyymmdd_CPCTD_{#}.XMLCON

CTD/ROVCTD

This directory contains CTD casts from Deep Discoverer SBE 911 plus CTD. All raw files without any filtering or processing are organized in dive subfolders name. If the device is restarted for any reason during the dive a number is appended to the end of the filename for all subsequent files to avoid overwriting data.

Header files: include software version, serial number, configuration, etc.

Name convention: EXyynn[L#]_DIVE##_yyyymmdd_ROVCTD_{#}.hdr

Data files: hexadecimal raw data created by Seasave from a real-time data stream.
Name convention: EXyynn[L#]_DIVE##_yyyymmdd_ROVCTD_{#}.hex

Instrument configuration files: contain the number, type and calibration coefficients of every sensor.
Name convention: EXyynn[L#]_DIVE##_yyyymmdd_ROVCTD_{#}.XMLCON

CTD/SHIPCTD

It contains CTD casts from the ships SBE 911 plus CTD. All files are not processed or filtered in any way.

Header files: include software version, serial number, configuration, etc.
Name convention: EXyynn[L#]_CTD###_ddmmyy.hdr

Data files: hexadecimal raw data created by Seasave from a real-time data stream.
Name convention: EXyynn[L#]_CTD###_ddmmyy.hex

Instrument configuration files: contain the number, type and calibration coefficients of every sensor.
Name convention: EXyynn[L#]_CTD###_ddmmyy.xmlcon

Converted data files: created from hexadecimal files and contain the same data in a human-readable format. Name convention: EXyynn[L#]_CTD###_ddmmyy.cnv

CTD/XBT

Expendable Bathythermograph files are saved in this directory and they are also used to produce ASVP files.
Name convention: EXyynn[L#]_{A}XBT###_yymmdd.{EDF|RDF|txt}

EK60

This folder contains files produced by the hull-mounted single-beam EK60/EK80 sonar. During the FY18 off-season the system was upgraded and the new file format is much larger than before, for this reason the folder is only synchronized to shore during non-ROV expeditions.
Name convention: EXyynn[L#]_EK60-Dyyyymmdd-Thhmmss.{raw|idx}.

Eventlogs

Transcripts of the chat room used during ROV dives and SeaTube annotations are kept in this

directory.

Annotations name convention: EXyynn[L#]_DIVE##_ANNOTATIONS.csv.

Transcripts name convention: EXyynn[L#]_EVT_yyyymmdd.txt

Imagery

This directory is divided into dive subdirectories. After every dive video editors go through all video footage and create “frame grabs” of any interesting or scientifically significant subject. There is always at least one image created per video file.

Name conventions:

EXyynn[L#]_IMG_yyyymmddThhmmssZ_{camera}_[descriptor].jpg

EXyynn[L#]_IMG_yyyymmddThhmmssZ_D##_##{B|G}_##.jpg

Imagery/TOPSIDE

Video editors take images during operations during the entire expedition and place those in this folder.

Name convention: EXyynn[L#]_IMG_yyyymmdd_[descriptor].jpg

Multibeam

This directory contains the multibeam daily products created by the mapping team. Data is presented in various formats and divided with each day underway in a different subfolder.

Name conventions:

EXyynn[L#]_MB_###m_WGS{###}_yyyymmdd.{kmz|sd|tif|xyz}

EXyynn[L#]_MB_###m_WGS{###}_yyyymmdd_fp.tif

Multibeam_Raw

Files from the Kongsberg EM302 hull-mounted multibeam sonar are saved here. Similar to the EK60, these are only synchronized to shore during non-ROV expeditions.

Name convention: ####_yyyymmdd_hhmmss_EXyynn[L#]_MB.{all|wcd}

Products/HighlightImagery

A few images are selected and color corrected per dive as representative examples of that exploration for engagement and outreach purposes.

Name conventions:

EXyynn[L#]_IMG_yyyymmddThhmmssZ_{camera}_[descriptor]_CC.jpg

EXyynn[L#]_IMG_yyyymmddThhmmssZ_D##_##{B|G}_##_CC.jpg

Products/HighlightVideo

At least one short highlight video is produced per dive for engagement and outreach purposes. Each video editor also creates a longer video with a theme that relates to the current expedition. These videos are encoded into three different video formats with each saved to a different subfolder.

Products/HighlightVideo/Compressed

This format is a lower resolution mp4 file with a bit rate of 1.5Mbps.

Name convention: EXyynn[L#]_VID_yyyymmdd_[DIVE##]_[descriptor]_Low.mp4

Products/HighlightVideo/ShotList

These are csv files containing a list of all media (videos and images) used in the creation of each highlight video.

Name convention: EXyynn[L#]_VID_yyyymmdd_[DIVE##]_[descriptor].csv

Products/HighlightVideo/Web

This is the lowest resolution format produced by the program. Files are mp4 with a bit rate of 8 Mbps.

Name convention: EXyynn[L#]_VID_yyyymmdd_[DIVE##]_[descriptor]_Web.mp4

Products/ROV

Files are divided in dive subfolders and contain navigation and vehicle information.

Summary file: contains timestamps and location for the start, bottom and end of dive. It also contains duration, time at bottom and maximum depth reach during the exploration.

Name convention: EXyynn[L#]_DIVE##.txt

Targets file: contains hypack targets in kml format.

Name convention: EXyynn[L#]_DIVE##_HypackTargets_converted.kml

Path file: contains the 2-D ROV trajectory in kml format.

Name convention: EXyynn[L#]_DIVE##_Path.kml

Sensor list file: contains serial number and model of sensors mounted on both ROVs in csv format.

Name convention: EXyynn[L#]_DIVE##_RovSensorList.csv

Track files: contain timestamped ROV position information during the dive in csv format.

Name conventions:

EXyynn[L#]_DIVE##_RovTrack1Hz.csv

EXyynn[L#]_DIVE##_ RovTrack.csv

Products/ROVDiveSummaries

Comprehensive dive summaries created by the expedition coordinator containing general information, participants, bathymetry, specimen imagery and collected sample's data.

Name convention: EXyynn[L#]_DIVE##_yyyymmdd_ROVDiveSummary_Final.docx

File Name Format: EXYYZZLR_DiveXX_Summary_Final

Title Format: Okeanos Explorer ROV Dive Summary: EX-YY-ZZ Leg R, Dive XX, Month DD, YYYY

Sample

This directory contains all sample-related products created by the onboard sample data manager (SDM). The top-level folder is divided in dive subdirectories and also contains the samples database and files listing all sample imagery and video.

Name conventions:

EX_SODA_FYnn_EXyynn.accdb

EXyynn[L#]_ImageFilesBySpecimen.csv

EXyynn[L#]_VideoFilesBySpecimen.csv

Sample/Dive/Imagery

This directory is divided into specimen subfolders, which contain all wet-lab images taken by the SDM and symbolic links to the subsea sample "frame grabs" taken by the ROV. Starting in FY19, the name convention for sample-related imagery was shortened. The new descriptor after the date/time stamp is D##_##{B|G}_##, where the numbers refer to the dive, specimen collected and camera number respectively (see See Table 2 for ROV camera number codes).

Name conventions:

EXyynn[L#]_IMG_yyyymmddThhmmssZ_D##_##{B|G}_##.jpg

EXyynn[L#]_IMG_yyyymmddThhmmssZ_SMPSTL_D##_##{B|G}_L##.{CR2|JPG}

EXyynn[L#]_IMG_{yyyymmddThhmmssZ_SMPSTL_D##_##{B|G}_(S|A##)_L##.{CR2|JPG}

EXyynn[L#]_IMG_yyyymmddThhmmssZ_SMPSTL_D##_##{B|G}_COLOR_PALETTE.{CR2|JPG}

EXyynn[L#]_IMG_yyyymmddThhmmssZ_MICRO_D##_##{B|G}_(M|A|S##)_(M##).{CR2|JPG}

Sample/Dive/Video

This directory is divided into specimen subfolders, which contain symbolic links to the subsea low-resolution videos recorded by the ROV. Starting in FY19, the name convention for

sample-related videos was shortened. The new descriptor after the date/time stamp is D##_##{B|G}_##, where the numbers refer to the dive, specimen collected and camera number respectively (see See Table 2 for ROV camera number codes).

Name convention:

EXyynn[L#]_VID_yyyymmddThhmmssZ_D##_##{B|G}_##_Low.mp4

SBP

Files created by the Knudsen hull-mounted sub-bottom profiling sonar are saved in this folder.

Name conventions:

EXyynn[L#]_SBP_####_yyyy_###_####_###.{kea|keb}

EXyynn[L#]_SBP_####_yyyy_###_####_#####_CHP3.5_FLT_###.sgy

SCSData/METOC

These are files containing oceanographic and meteorological data from different ship sensors. Data is continuously recorded into csv files, which are split at midnight UTC.

SCSData/NAV

Navigational data from different ship sensors is continuously recorded into this directory. Files are split at midnight UTC and saved in csv format.

SCSData/VEHICLES

Data coming from multiple sensors onboard both ROVs is recorded into this directory. Files are split at midnight UTC and saved in csv format.

UPLOAD

These are various files related to the expedition that do not belong in any other directory. There is no type, structure or name conventions set for these files. This folder is primarily used by shipboard personnel to transfer large files to shore.

Video

This directory contains all video footage recorded subsea by the ROVs. Files and organized into dive folders and further divided into format subfolders.

Video/DIVE/Compressed

This is the low-resolution copy of the original footage. Videos are split into 5 minute files in mp4 format.

Name convention:

EXyynn[L#]_VID_yyyymmddThhmmssZ_{camera code}_[descriptor]_Low.mp4

EXyynn[L#]_VID_yyyymmddThhmmssZ_D##_##{B|G}_##_Low.mp4

A complete table of camera codes is included below.

Video/TOPSIDE

This directory is divided into Video Imagery and Audio subfolders. Video editors place here files that have been used for highlights but are not part of the official expedition products in any other folders.

Name convention:

EXyynn[L#]_VID_yyyymmdd_[descriptor].{wav|WAV}

EXyynn[L#]_VID_yyyymmdd_[descriptor].{png|PNG|jpg|JPG|jpeg|JPEG}

EXyynn[L#]_VID_yyyymmdd_[descriptor].{mov|MOV|mp4|MP4}

Table 2. Camera Codes for Naming Conventions.

Camera Placement	Camera Description	Camera Code
ROV	Main HD Camera (Zeus+) Primary Camera	ROVHD (01)
ROV	HD Camera (Mini-Zeus) Secondary Camera	ROVHD2 (02)
ROV	HD Color Camera on the Front port side, primary purpose viewing manipulator arm of ROV (Aurora)	PTMAN (04)
ROV	HD Color Camera on the front starboard side, primary purpose viewing manipulator arm of ROV (Aurora)	SBMAN (05)
ROV	Umbilical SD Camera (Kongsberg PTZ)	AFTPTZ (09)
ROV	Pilot SD Camera (Titan) PTZ camera, primary purpose birds eye view in front of ROV	ROVPLT (03)
ROV	SD b/w camera on Port side of ROV (Aurora)	ROVPT (06)
ROV	SD b/w camera on Starboard side of ROV (Aurora)	ROVSB (07)
ROV	SD camera on the aft side of the ROV (Aurora)	ROVAFT (08)
ROV	SD camera view of the suction sampler jar	ROVJAR (11)
Camera Platform	Main HD Camera (Zeus+) Primary Camera	CPHD
Camera Platform	Second HD camera on camera platform used to telescope downwards allowing Co-Pilot to PTZ around (Mini-Zeus)	CP2HD
Camera Platform	Umbilical SD Camera Rear Facing Camera viewing umbilical tether(Nova)	CPUMB
Camera Platform	Pilot SD Camera Front Facing above Main Camera(Aurora)	CPPLT
Camera Platform	SD Camera on bottom of camera platform (Cyclops)	CPSDWN

Starboard Side of Fantail	Starboard HD Video Camera	SBROBO
Post Side of Fantail	Port HD Video Camera	PTROBO
Front of ROV/Mapping Control Room	Control Room Front HD Video Camera	CRROBO
Back of ROV/Mapping Control Room	Control Room Rear HD Video Camera	CR2ROBO
Dry Lab	Dry Lab HD Video Camera	DLROBO
Portable	HD video from the ship Sony EX3 handheld camera	EX3
Computer Feed	Pulled from DVI-HDSDI scan converters	DVI
Multi-Display	HD Video	MULTI
Bridge Mast	Closed-Circuit Television Camera	MASTCCTV
Port Bridge Wing	Closed-Circuit Television Camera	PTBRDGCCTV
Starboard Bridge Wing	Closed-Circuit Television Camera	SBBRDGCCTV
Starboard Working Deck (CTD Launch)	Closed-Circuit Television Camera	SBDECKCCTV
Aft Deck	Closed-Circuit Television Camera	AFTDECKCCTV
ROV/Mapping Control Room	Closed-Circuit Television Camera	CRCCTV
Generator Room	Closed-Circuit Television Camera	GENCCTV
Upper Motor Room	Closed-Circuit Television Camera	MOTORCCTV
Winch Room Looking at Traction Winch and Storage Drum	Closed-Circuit Television Camera	WINCHCCTV
	Composite of First 9 CCTVs	3X3CCTV
Fantail Looking at Transom	Closed-Circuit Television Camera	WIRECCTV
Winch Room Looking at Traction Winch Sheave	Closed-Circuit Television Camera	SHEAVECCTV
ROV Hangar	Closed-Circuit Television Camera	HANGARCCTV
Bow Thruster Room	Closed-Circuit Television Camera	BOWTHRUSTCCTV
	Black & White Scuba Diver inspection camera	MicroBWSD
Portable	HD GoPro Camera	GPHD
Portable	Time elapse video from GoPro Camera	GPTL
Portable	HD Video from handheld camera (NOT the ship's Sony EX3)	HH
Portable	Digital Still Camera	DSLR

NOTE: where camera codes have a parenthetical number, the number should be considered a condensed form of the code. Condensed codes are only used with physical sample related video (and derivative still images) to accommodate filename length restrictions of the video recording system.

VII. Data and Product Pipelines

A. Oceanographic/Meteorological/Navigational Data Archive Pipeline

Data from hull-mounted oceanographic and meteorological (METOC) sensors, integrated oceanographic sensors from the submersibles, and navigational instrumentation on both the vessel and its submersibles are monitored and recorded by redundant systems on two physically separate networks. Historically, the ship's Scientific Computer System (SCS) operated and managed by OMAO personnel on the OMAO network was the only system performing this function. Starting FY18 an alternate system was deployed on the GFOE network managed by GFOE personnel. GFOE uses a suite of custom developed software, collectively known as CORVID, to perform the same function as SCS with some improvements that better serve the Okeanos environment (native support for underwater cultural heritage operations and a descriptive header added to each file). These two systems receive the exact same data input via a GFOE developed active serial splitting matrix. Both systems timestamp data as it arrives and write the results in Comma Separated Value format though they use the "RAW" file extension. Both systems create separate data files for each UTC day.

Data is recorded 24/7 while underway and continuously synchronized to the SCSData folder in CruiseData, the onboard repository where all expedition data is gathered before sending it to shore. Some of these data will be used in a near real-time mode to update the live EX ship track geospatial service. All of these data will be archived by NCEI. A cruise-level and several collection-level metadata records describing the data inventory will be included with the data submission.

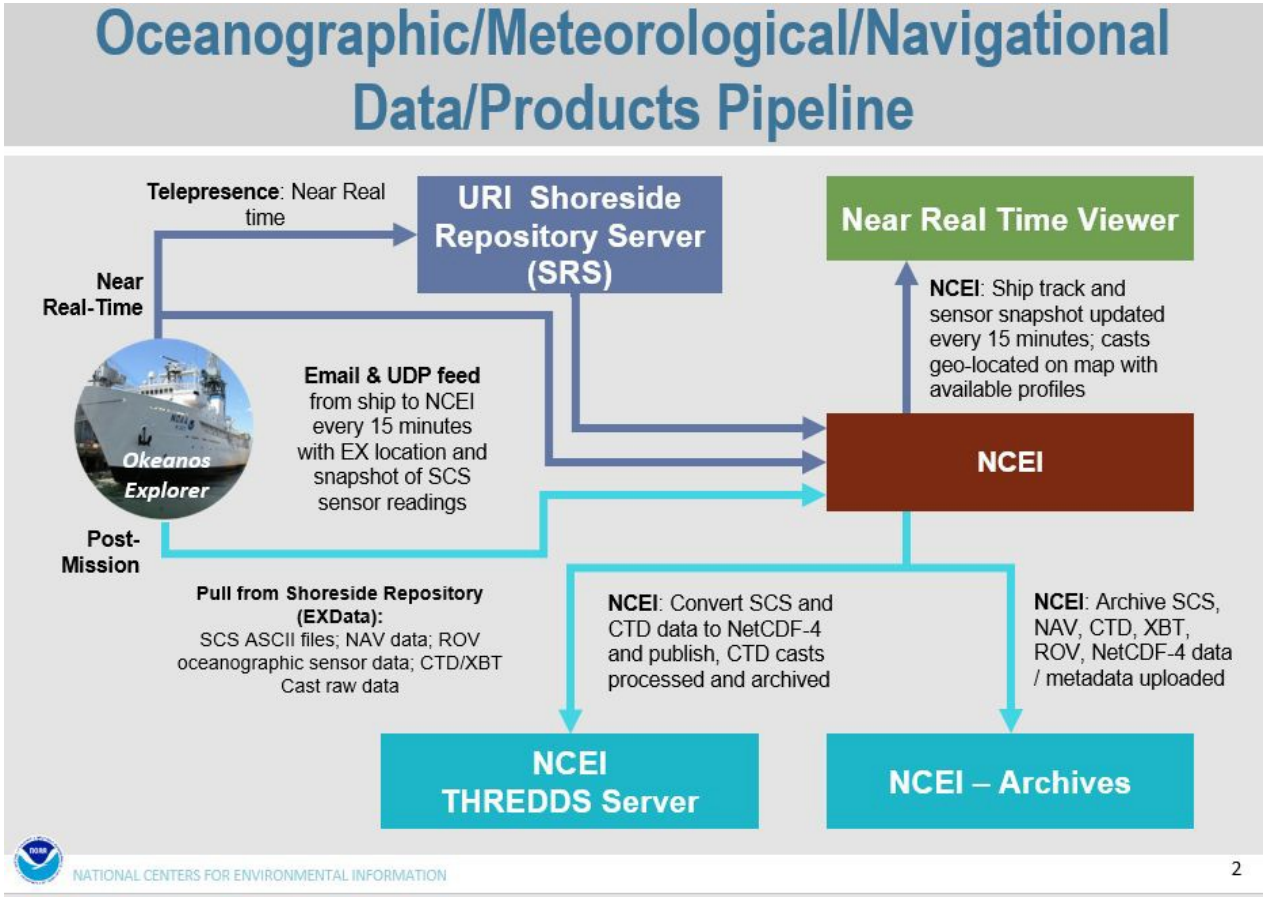


Figure 2. *Okeanos Explorer* Oceanographic Data Pipeline.

Near-Real-Time:

At periodic (currently fifteen minute) intervals, an email containing the ship's position and a snapshot of SCS data are delivered to NCEI.

Data are streamed near-real-time to the shoreside server. It is usually available to participating scientists within a few hours of original recording.

A UDP feed is sent from the ship that is processed to populate a live EX ship track geospatial service of the near-real-time EX location. The ship's position is updated at 15-min intervals for optimal visualization. This live service does not operate when EX is in port or when the ship is performing restricted operations.

Additionally, GFOE maintains a chatroom, available from shore, for operation discussions that provides a real-time vehicle position and CTD data update. Transcripts of the chatroom are made available via the exdata.tgfoe.org SRS.

Post-Dive

Post dive, several ROV data streams are combined, interpolated and filtered to create an ROV navigation dive track and a down sampled 1Hz ROV navigation dive track. Position data from the vehicle USBL navigation system is converted from decimal minutes to decimal degrees, is filtered using a rolling median filter to remove bad position fixes, and is indexed by the sample time. The vehicle DVL altitude and Paroscientific pressure sensor data are indexed by sample time and any altitude value greater than 100m is considered a bad value and removed. The navigation, depth and altitude are then combined and interpolated using a time-based interpolation. To create the 1Hz track this data is then downsampled using the pad method where the last good data point is used.

In addition to the ROV navigation track and the 1Hz version of that file, we also create a KML version of the dive track. The ROV navigation dive track is downsampled until it contains only 2000 points to meet limits set by Google Earth. These points are then converted to the KML format. The Hypack target file waypoints are also converted to the KML format.

For every dive a csv file is created containing a list of all cameras and sensors installed on both ROVs. This file includes model, serial number and placement on the vehicles for each item listed. This information is reviewed at the beginning of each expedition to ensure it is up to date and updated throughout the expedition as equipment is replaced. Every morning during pre dives one more check is performed to confirm all sensors onboard have not changed without being documented.

A dive summary report detailing time and location for notable dive events; in/out of the water, on/off bottom, etc, is also created. These times are determined by button presses made throughout the dive by the navigator on a simple GUI which logs dive stage change times, e.g. in water, descent, bottom, ascent, out of water. The locations for each stage are then pulled from the ROV dive track based on these times.

Post-Mission

All SCS data, including navigation and CTD/XBT cast data are delivered to NCEI via ftp.

SCS navigation data are used to apply a thinning algorithm and return an optimized thinned navigation track, which is added to the GeoDatabase for GIS applications.

All of the SCS data files are used to generate netCDF-4 files (using netCDF-3 “classic” internal organization) which is compliant with the NODC netCDF templates, version 2.

The CTD cast raw data are used to generate a second NetCDF-3 formatted file.

ISO metadata records are generated for the NetCDF-3 files, and ISO metadata records are generated for the SCS ASCII files, the NAV data set, and the CTD and XBT data sets.

All data sets and the corresponding metadata are accessioned and archived.

The NetCDF3 file will be ingested into an NCEI hosted Thematic Real-time Environmental Distributed Data Services (THREDDS) server for user discoverability and access.

Table 3. Oceanographic/Meteorological/Navigational Metadata Granularity and Target Archive.

Data Class	Instrument	Data Type	Format	Metadata Granularity	Archive Center
METOC	All SCS monitored sensors	Meteorological and Oceanographic data sensors	ASCII	1 meta rec	NCEI
NAV	DGPS, CNAV	EX, ROV, and sled navigation	ASCII	1 meta rec	NCEI
ALL	All	Archive Ready	NetCDF-4	1 meta rec	NCEI

B. Multibeam Survey Data Archive Pipeline

The multibeam survey data collected by bottom-looking and complementary sensors, data from the calibration instruments, and the products generated after the data are returned to and post-processed at UNH. Data are then sent to NCEI for archival. Data will be accompanied with a collection level metadata record for the multibeam collection. Additionally, individual metadata records will accompany each raw (level-0) file, each edited (level-1) file, each data product (level-2), and report (level-3). Furthermore, the submission to NCEI will include the following:

a. raw (level-0) mapping survey and water column data files,
b. CTD and/or XBT profile data used for calibration in multibeam survey,
c. post-processed, quality assured, and edited (level-1) data files in .gsf format,
d. specific data products (level-2) including cumulative cleaned and gridded bathymetry data in the following formats: GeoTIFF and floating point geotiffs,, ASCII xyz files, KMZ files, and Fledermaus .sd files.
e. comprehensive mapping data report (level-3).

For more information about mapping operations and associated reporting, refer to the NOAA OER Deepwater Exploration Mapping Procedures Manual.

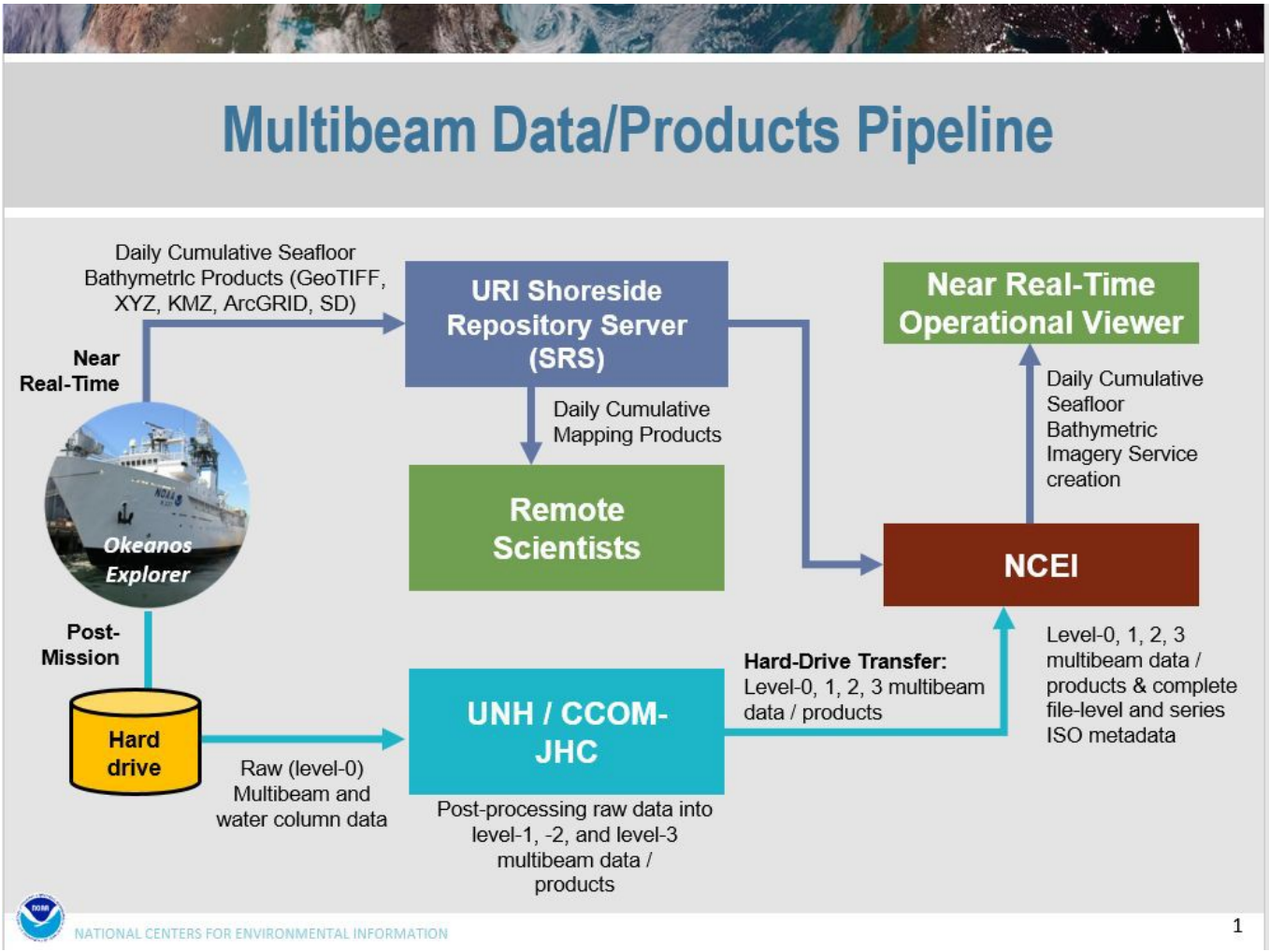


Figure 3. Okeanos Explorer Multibeam Data Pipeline.

Near-Real-Time

If the remote science team has requested that some raw multibeam data be transferred in near-real-time to the SRS, then the raw data and a current copy of the processing spreadsheet will be transmitted during the Rsync process. This occurs during telepresence-based mapping cruises, when the mapping lead remains onshore and mapping watchstanders monitor the collection of the multibeam data onboard.

As operational GeoTIFF images are created, these will also be transmitted to the SRS by the Rsync process.

The data management team at NCEI will pull the GeoTIFF images and the operational bathymetry

processing spreadsheet for near real-time metadata generation. Participating scientists wanting access to the raw multibeam in near real-time can pull the individual files with the metadata that provides operational and provisional processing steps and a disclaimer for non-QC status of the data.

Daily cumulative GeoTIFF images of the seafloor imagery will be geo-located and added to the *Okeanos Explorer* Bathymetric Grids (Provisional Daily Updates) web services which is hosted on Esri's ArcGIS Online. This GIS Service is restarted at the beginning of each new cruise. This service, along with all other OER-related bathymetric map services, is maintained by the GIS team at NCEI-CO.

Post-Mission

All bottom-looking sensor data and complementary data (water column and sound velocity) are saved to a hard-drive. This hard-drive will be brought back to the University of New Hampshire Center for Coastal and Ocean Mapping (UNH CCOM) for post-processing.

A full complement of multibeam data from a 30-day EX cruise on which the Kongsberg EM302 multibeam system runs continuously will produce 200-300 Gigabytes of raw multibeam (37.5% of total volume) and water column data (62.5% of total volume). At UNH, the mapping team will post-process the multibeam data through the following steps:

f. The raw (level-0) data will be saved to the CCOM file servers, where they will be quality checked and post-processed.
g. The edited level-0 data is saved as level-1 full resolution data files in a non-proprietary format – .gsf files (cleaned not gridded).
h. The post-processing steps used to produce the level-1 data will be documented.
i. Level-2 products will be generated from the level-1 data files.
j. The post-processing steps used to produce the level-2 data products will be documented.
k. The level-1 data, level-2 products, post-processing steps, and working data processing spreadsheets will be copied to the hard drive in a new folder. A processing spreadsheet will contain the temporal and spatial limits of each file and any supplemental information documenting problems or issues that affected the quality of the data in that file.

At NCEI, all multibeam related files will be post-processed through metadata generation procedures. Metadata will be generated for each individual survey track file (level-0 and -1), for accompanying CTD/XBT profile data sets, for composite xyz files, KMZs, GeoTIFFs, png images, and Fledermaus output (level-2), and a set of data products and reports (level-3). Finalized data/metadata will be compressed and bundled using the Bagit software and delivered to the geophysical archive via hard drive or ftp protocol.

Table 4. Multibeam Survey Metadata Granularity and Target Archive.

Data Class	Instrument	Data Type	Format	Metadata Granularity	Archive Center
GEO	Kongsberg EM304(30 kHz)	Multibeam Bathymetry, Bottom Backscatter, Water Column Backscatter (proprietary format read into MBSystem)	.KMall, .KMwcd (proprietary)	1 meta rec per .KMall and KMwcd file in Multibeam Data folder and subfolders	NCEI
GEO	Simrad EK60/EK80	split-beam water column sonar	.idx .raw (proprietary)	1 meta rec per file	NCEI
GEO	Knudsen CHIRP 3260 (3.5 kHz)	Sub-bottom profile	.sgy, .kea, .keb (proprietary)	1 meta rec = Subbottom Profile Data folder	NCEI
OCN	SeaBird SBE-911plus	CTD Cast	.hex, .con (Proprietary); .cnv, .hdr, .bl, .jpg (processed)	1 meta rec = CTD folder	NCEI
OCN	Sippican MK-21 eXpendable BathyThermograph (XBT)	XBT	.txt	1 meta rec = XBT folder	NCEI
OCN	Calculated	Sound Velocity (m/s)	.asvp (ASCII)	1 meta rec = Profile_Data/SVP or Profile_Data/ASVP	NCEI

C. Video Data Archive Pipeline

Video data from the EX is managed according to the results of the Video Data Management Modernization Initiative (VDMMI) project. Full-resolution (source video) and low-resolution video analogues, high-resolution, and full-resolution (source) highlight video products will be archived via the NCEI CLASS archive and made discoverable through a customized self-service video portal, OER Video Portal, which uses the NCEI metadata search system or Geoportal in the background.

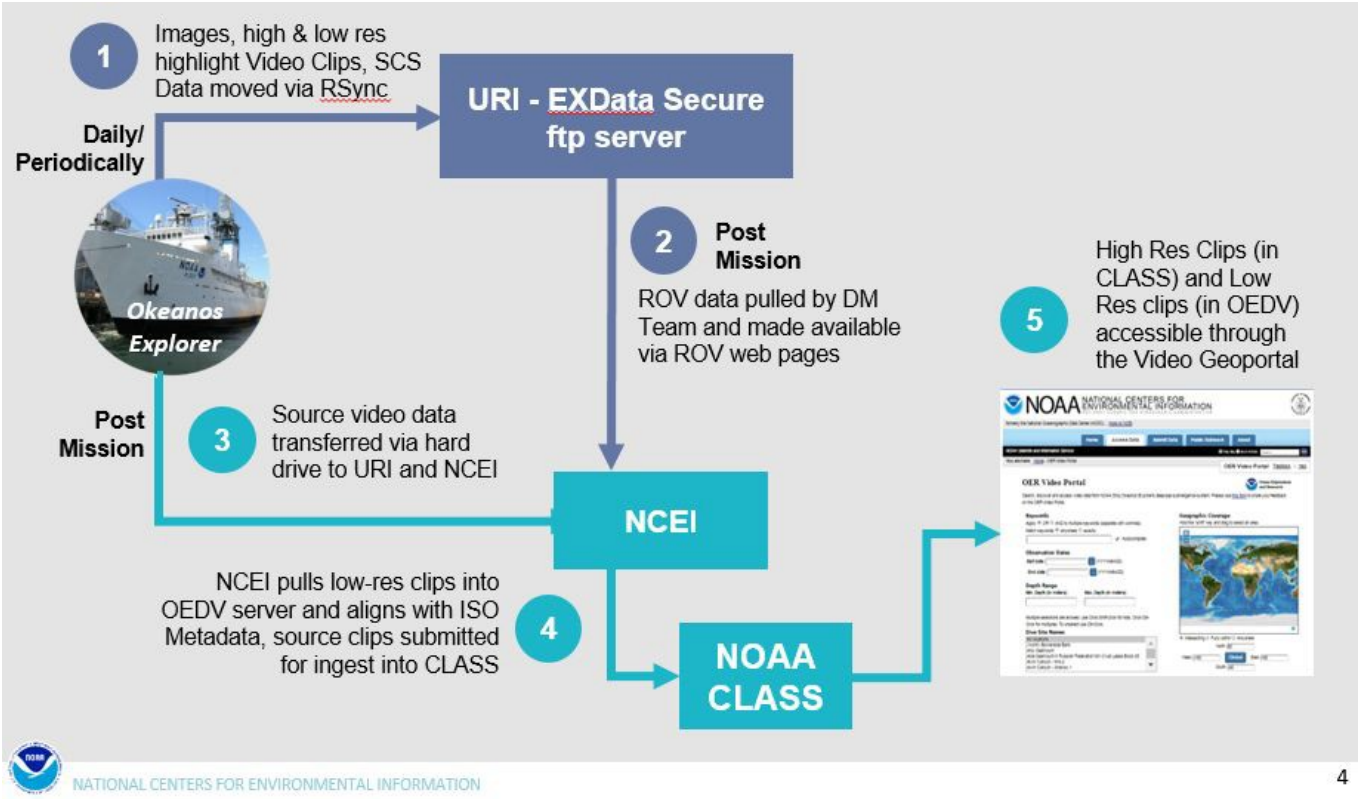


Figure 4. NOAA Ship *Okeanos Explorer* Video Data Pipeline.

Near Real-Time

The EX runs the EVS system which captures video from the *Deep Discoverer* HD Camera in full-resolution (1080i, 147 Mbps, ProRes 422) from "deck-to-deck" (i.e., from the start of ROV launch to the end of ROV recovery) during a dive operation. The system also captures deck-to-deck video from *Seirios* HD Camera in full-resolution (1080i, 33Mbps, ProRes 422 Proxy). The video data is programmatically divided into 5 minute segments for ease of transport and archiving. The vehicles have multiple secondary cameras that record high-definition video and high-resolution cameras are installed at strategic locations onboard the ship.

EX has onboard videographers who work to preserve video segments during the dive operations from the secondary cameras and the ship deck cameras. Video segments to be preserved will be marked and saved onboard the EX using the EVS Instant Replay System through collaboration and guidance via the onboard and remote science team leads. These segments will be saved with a strict file naming convention including cruise ID, date/time, camera ID, and abbreviated video annotation.

The video segments from all sources are transcoded to a web-streaming quality (640x360p360p 1.5 Mbps MPEG-4 H.264). The low-resolution files are saved to the Ship Board Repository Server (SBRS) and then transferred via rsync to the Shoreside Repository Server (SRS). The original-source video files are transferred via hard drive at the conclusion of the cruise.

Additionally, the videographer creates a dive highlight video or dive trailer using the most interesting video footage available. An Editor Decision List (EDL) is made for each video product generated; this list identifies audio and video segments used for product creation. These dive trailers, or dive highlight videos, are saved in three different resolutions: 1) full-resolution (1080i, 147 Mbps, ProRes 422), 2) low-resolution (640x360p, 1.5Mbps, MPEG-4 H.264) and 3) web-resolution (720p, 8Mbps, MPEG-4 H.264) for preservation and use.. All source material used to produce highlight videos is collected and saved with the highlights.

Two streams of video footage are delivered via telepresence to be distributed over Internet 2 to the Exploration Command Centers - where participating shore-side scientists can actively participate with the mission. These video streams are also distributed over Internet 1 for passive public expedition participation.

A real-time video annotations system (SeaTube V2) developed by Ocean Network Canada (ONC) is used during dive operations to tag date/time markers of 1) significant events (i.e., on bottom, off bottom, sampling operation start, sampling operation end, etc.) and 2) video annotations provided by participating scientists both onboard and ashore. Video annotation files are exported from ONC's annotation system and from the chat room using a prescribed list of words. These timestamped annotations are then used to populate the video metadata records during post-mission procedures.

Post-Mission

Metadata extraction routines are run on the SRS to extrapolate geospatial information from the SCS data, the scientific annotation system (SeaTube V2), the scientific chatlog, and other available resources to build a comma-delimited file of metadata fields for each individual video file. Extrapolated metadata information within this comma-delimited files are used to programmatically populate a ISO metadata template to produce ISO metadata records for each individual video segment (low- and full-res). ISO metadata records are also produced for highlight videos in all resolutions. These ISO metadata records are then published in two Geoportals maintained by NCEI.

The OER Video Portal has a front-end user interface that allows the public to enter specific filtering criteria which searches through the video metadata records to return relevant video files. The OER Video Portal allows users to preview/download the streaming (low-res) quality video and/or place an order for the full-res video.

Table 5. Video Metadata and Target Archive.

Data Class	Instrument	Data Type	Format	Metadata Granularity	Archive Center
MUL	ROV/Sled Cameras	Full- and Low-res video segments	ProRes 422 (full 147 Mbps) h.264 (low l.5 Mbps)	1 ISO meta rec per each dive; 1 ISO meta rec per segment	NCEI
MUL	ROV/Sled Cameras	Video streams from each vehicle to the ECCs	h.264 (5 Mbps)	1 ISO meta rec per stream	NCEI
MUL	ROV/Sled Cameras	Dive highlight videos	ProRes 422 (full 147 Mbps) h.264 (low 1.5 Mbps, high 8 Mbps)	1 ISO meta rec per dive	NCEI
MUL	ROV/Sled Cameras	Framegrab images	.jpg	1 ISO meta rec per dive	NCEI

D. Sampling Operations Pipeline

Biological and geophysical specimens may be collected during scientific ROV dives. Sample Data Managers from NCEI will participate onboard all scientific ROV missions and assist science leads during sampling operations and web-lab processing/preservation procedures. SOPs define onboard responsibilities of the Sample Data Manager, and a user's manual details what data must be recorded in the Microsoft Access Sampling Operations Database Application (SODA). The SODA MS Database catalogs all collected specimens.

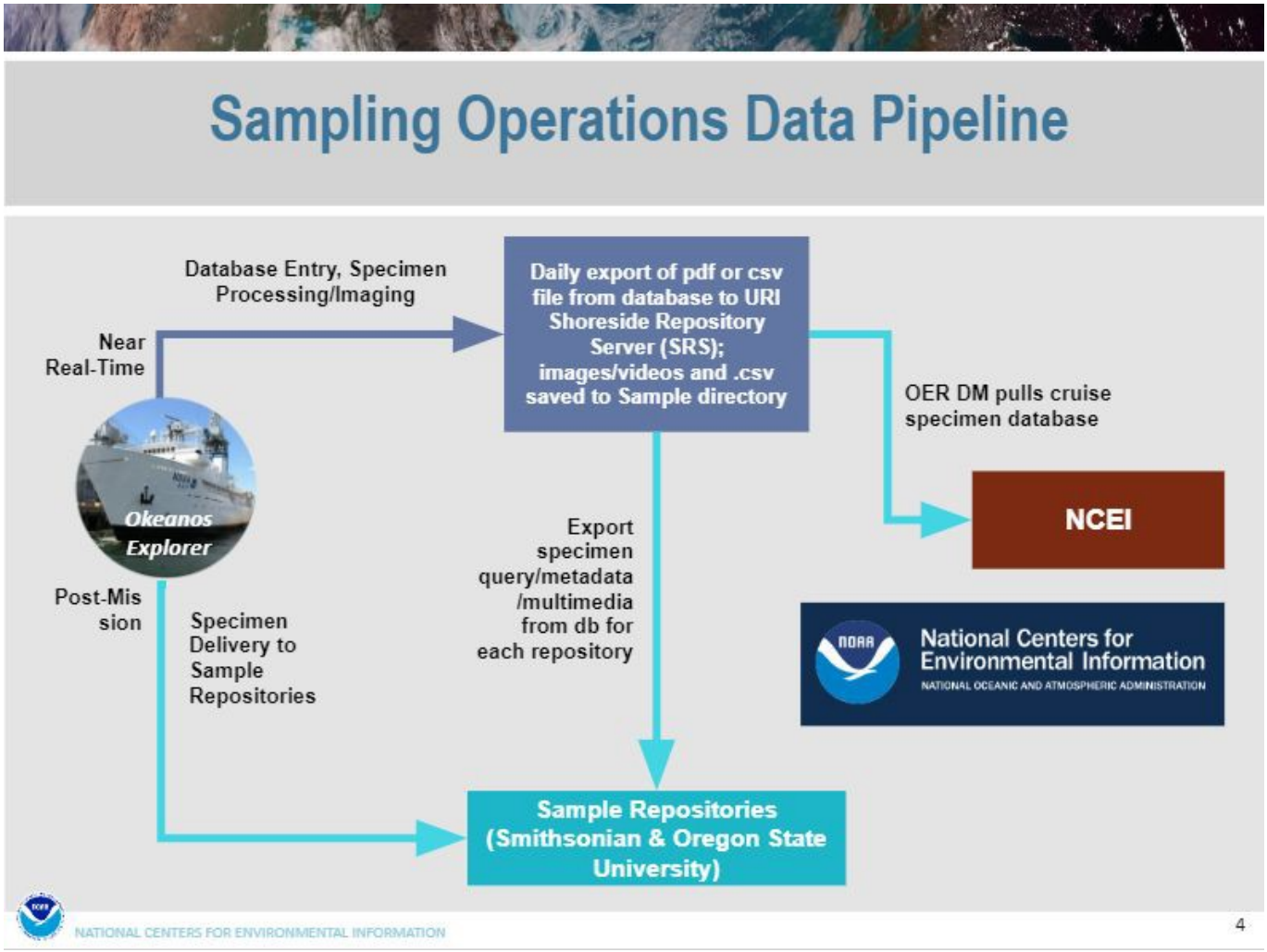


Figure 5. *Okeanos Explorer* Sampling Operations Data Pipeline.

Near-Real-Time

When a specimen is identified for collection, the videographer clips out a wide shot of the specimen and surrounding environment - this clip starts as the ROV approaches the specimen, includes laser placement on specimen, and ends after collection. During the collection of a sample collected using the manipulator arm, the manipulator arm holds the specimen in front of the main ROV camera. The videographer also clips video from secondary cameras as needed to fully document the specimen and its surrounding environment. Zoomed in still images detailing the specimen and the environment are extracted from the video. All these media files captured by the ROV are collectively known as subsea products. Starting in FY19, the name conventions for all sample-related subsea products were shortened (see Shoreside Repository Server (SRS) Folder Structure and File Naming Conventions and Standards for details). A snapshot of the environmental parameters, location, and vehicle depth are captured in the EX control room upon successful sample retrieval. This data collection is triggered by the science leads submitting an onboard sampling web form. Additionally, the start and end times of the sampling operation are noted in SeaTube, the ONC annotation software.

As the ROV ascends to the surface, specimen information collected in the control room is entered into the SODA database. The Sample Data Manager then uses a SODA database routine to print labels in preparation for specimen processing in the EX wet-lab.

Once the ROV is situated on deck, specimens are recovered and moved into the wet-lab. The order in which the specimens are processed is determined by which specimen is more likely to degrade in room temperature seawater. One specimen will be removed at a time from a bucket, placed and positioned on the photo stand with the appropriate label, ruler, and color scale where a "wet-lab" image is taken. Associated organisms found on the primary biological or geological specimens (e.g. small crustaceans and brittle stars) will be removed, photographed, and placed in small containers with duplicate labels from their host rocks, corals, or sponges.

OER has developed a sample SOP that outlines various best practices by onboard personal as well as necessary operational guidance for sampling. The document is subject to periodic updates, but a link to the most up to date version is provided here.

After all preservation procedures have been completed, the Sample Data Manager organizes the wet-lab images, reports, summary files and database in a directory structure following standard procedures and name conventions. This directory is synchronized to the Sample folder in CruiseData, the onboard repository where all expedition data is gathered before sending it to shore. In order to avoid duplicating data, symbolic links to all sample-related subsea video and imagery are also created in the Sample folder.

Post-Mission

During the cruise, the onboard science team has custody of all samples, the sample database, and the sample photographs. The primary objective after the cruise will be secure and safely transfer the samples to their appropriate archival location. Samples will be evaluated as to whether additional fluid changes are necessary and if so, perform those changes. Samples will then be inventoried and prepared for transport (according to IOTA or HAZMAT standards, if applicable)..

Selected fields in the database collection records, particularly final preservatives, will be collated into an inventory, printed out and shipped with the specimens. For biological samples, OER completes a memorandum to officially donate the specimens to the Smithsonian.

The final repositories will be the Smithsonian National Museum of Natural History (NMNH, for biological specimens and DNA) and Oregon State University (OSU, for geological specimens). Accession, cataloguing, and subsequent access to the samples by other researchers will be under the direction of Dr. Allen Collins (NOAA National Systematics Lab) and Dr. Anthony Koppers (OSU). Upon arrival at the repositories, an assessment of specimens is conducted at intake as well as a QA/QC of all samples received and corresponding data.

VIII. Data Exchange Agreements and Archive Strategies

During data management discussions at cruise planning meetings before any EX mission, an agreement shall be made as to the data types and formats that would be exchanged between the EX and any visiting scientists or international partners, if such is the case. These data management details will be included in the Cruise Plan appendix for Data Management and will include data formats, data exchange methods, and agreed upon time frames.

IX. Underwater Cultural Heritage (UCH) Data Responsibilities

In the course of **acquiring** or **post-processing** bathymetric data, features on the seafloor may be unexpectedly discovered which are of potential cultural or historical significance. These discoveries may include wrecks of ships or aircraft, the recognizable debris from wrecks, or other items which may appear anthropogenic in origin and have some associated cultural or historical significance. If such a situation arises, these data will require special consideration in data management.

The Expedition Coordinator will consult with OER's Marine Archaeologist, who will contact other relevant entities to notify them of the discovery and consult with them regarding the significance of the discovery.

If the discovery is determined to be historically significant, OER's marine archaeologist and the Expedition Coordinator will coordinate with the appropriate management authorities to discuss next steps and any data restrictions. Once an area has been designated as part of Underwater Cultural Heritage by the Expedition Coordinator, the onboard data manager changes the "cruise variables" to trigger a set of automated workflows that segregate data containing location information into special "Restricted" directories. These programs have been developed over time by the GFOE data team and currently segregate Multibeam products, CTDs, XBTs, ASVPs, ROV products and SCSData.

If it is determined that the discovery is not historically significant or it is determined that no harm will result by disclosing position information, no change to standard data management procedures is required.

Table 6. Iconographic Products/Reports.

Product	Public Release?	Archive?	Format/Size	Archive Center	Originator
Daily Situation Report	No	No	.doc/ <500K	n/a	Expedition Coordinator
Daily Web Logs with Corresponding Images or Video Clip*	Yes	No	.doc	n/a	Expedition Coordinator/ Comm/Web Team
Daily (during survey) Cumulative GeoTIFF, Fledermaus .sd, ASCII text file, .png with polygon of daily progress and .kmz of Seafloor Bathymetry	No	No	GeoTIF, .sd, .txt, .png, .kmz	n/a	Mapping Team Lead
Short and longformHighlight Videos*	Yes	Yes	.mov	NCEI	GFOE Video team
Post-Mission Final Cruise Report*	Yes	Yes	.pdf	NCL	Expedition Coordinator
Post-Mission Final Cruise Mapping Data Report*	Yes	Yes	.pdf	NCL, NCEI	Mapping Team Lead
Post-Mission Final Gridded Mapping Data Products*	Yes	Yes	GeoTIF (.tif), xyz grids (.txt), Fleder-maus objects (.sd), .png of drapped imagery .kmz of daily GeoTIF	NCEI	Mapping Team Lead
Summary Fact Sheet*	yes	yes	.pdf	OER	Comm/Web Team

*Approval Process required before publishing

Table 6 describes the current understanding of the reports and products that are expected to be generated as a result of an EX mission. These iconographic products will be vetted through an SOP to ensure the products are approved for public release or archive, if applicable. The products will be delivered via hard-drive or google drive several weeks (within 90 days) post-cruise

x. Data Discovery and Access

A. OER Video Data Portal

The OER Video Portal provides access to all archived, non-restricted OER videos. The web interface allows users to specify search parameters which query the video's metadata records. Users can then preview low-res video search results, download low-res and high-res versions of video, and access metadata, ROV dive summaries, and any other to associated web coverage.

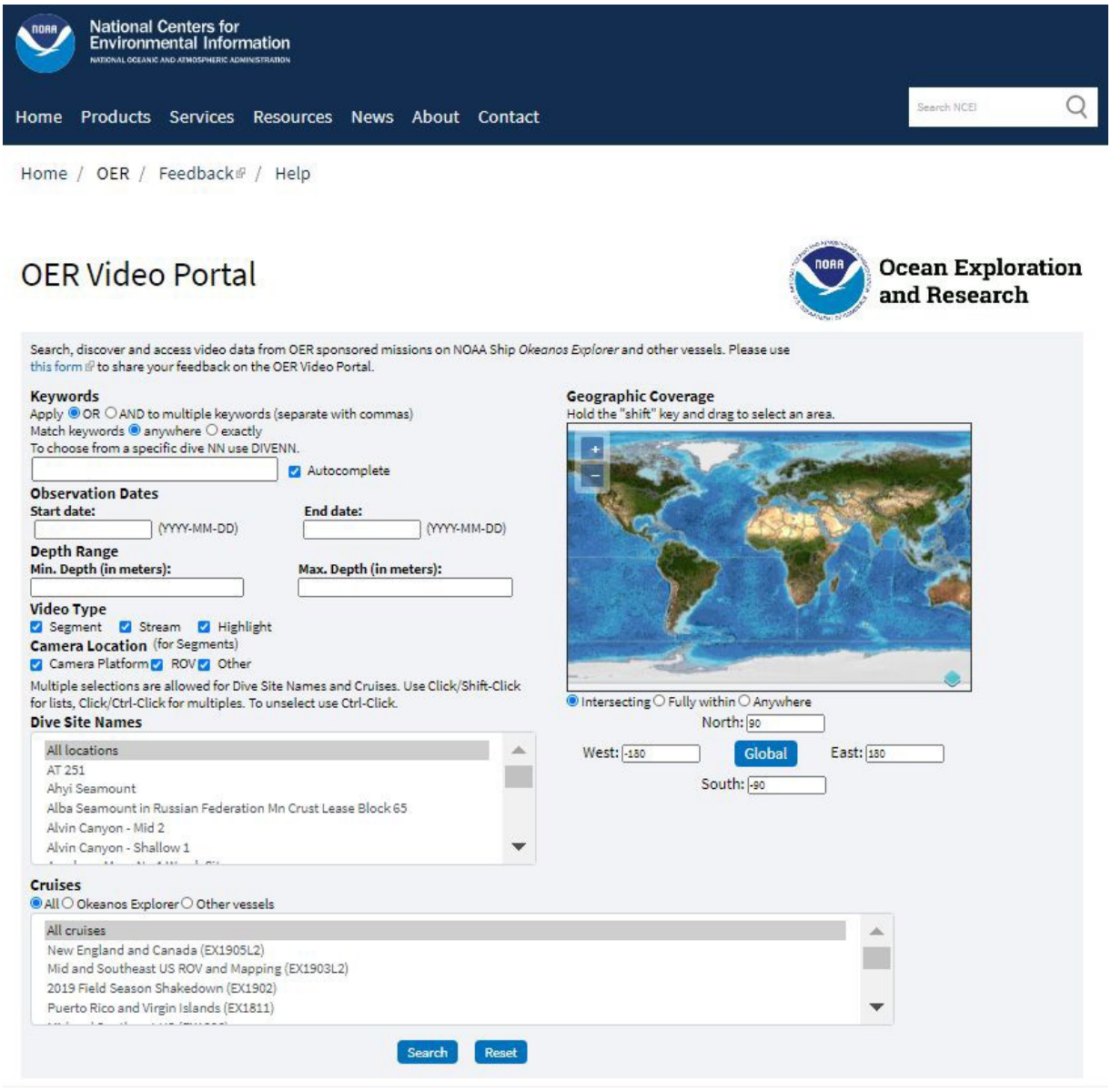


Figure 6. Screenshots of the OER Video Portal

B. NOAA OER Digital Atlas

The Digital Atlas (https://www.ncei.noaa.gov/maps/oer-digital-atlas/mapsOE.htm) is a searchable, interactive map that displays the locations of OER-sponsored expeditions from 2001 to present and provides access to directly download unique, expedition-specific scientific data from distributed repositories, including NOAA archives, NOAA Library catalogs, and special collections. Visit the Digital Atlas often for new data releases and information updates related to the completion of data quality control measures; the releasing of restricted data; and the addition of related publications, lesson plans, and additional materials.

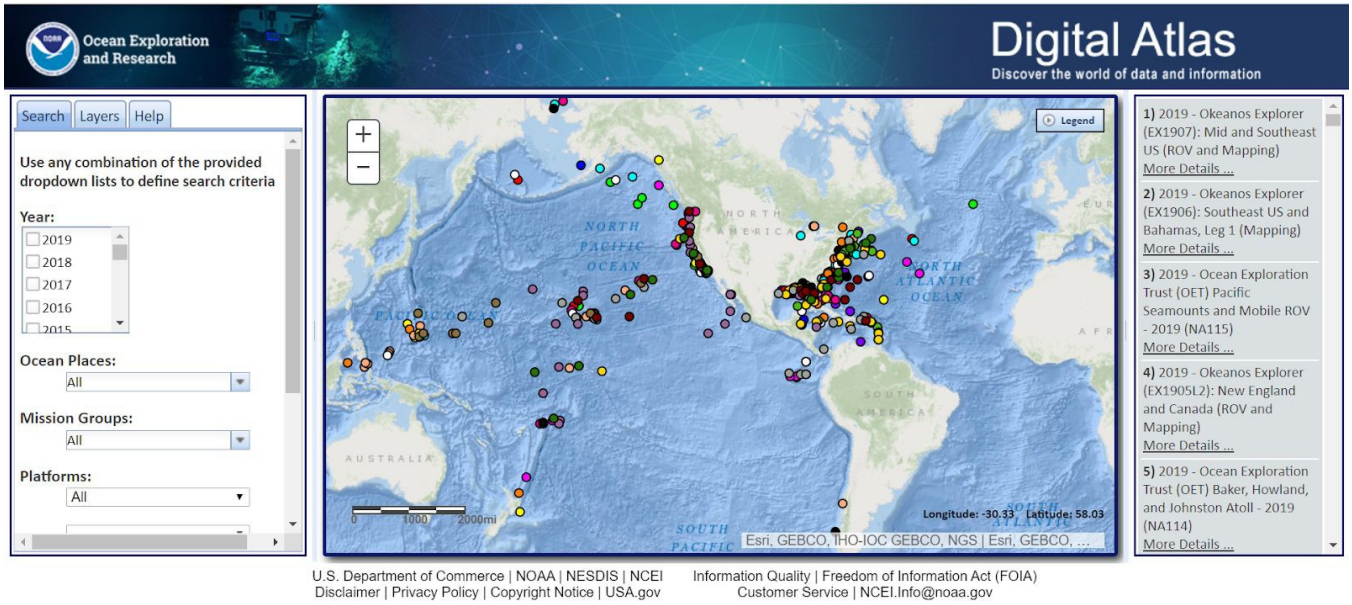


Figure 7. Screenshot of the Digital Atlas.

C. Geospatial Data Services

Near-Real-Time

Okeanos Explorer - Live Operations Webmap

Live EX ship tracking capabilities have been updated to a feature service layer on ArcGIS Online (AGOL). A subsequent AGOL webmap displays the live ship position, current cruise trackline, and provisional daily bathymetry from the current cruise. The ship's position is updated every 15mins from an email sent to NCEI. This data transfer method is expected to switch over to the User Datagram Protocol (UDP) feed by the end of FY20. Note that this live shiptrack layer is not updated when EX is in port. The live EX map viewer can be viewed here: https://noaa.maps.arcgis.com/home/item.html?id=5afb3b1849314cd4b1d768067cf98bdb.

Okeanos Explorer Bathymetric Grids (Provisional Daily Updates)

This image service provides access to provisional daily multibeam bathy products collected by EX for the current cruise. Note that this service updates automatically and is not updated when EX is in port or performing ROV operations. The service is hosted by NCEI on AGOL and is accessible here: https://noaa.maps.arcgis.com/home/item.html?id=b45f453aba7b452aad91e66a9e099a31

Post Mission

ROV Dive Pages - These data access points include a map of the dive track, information about each dive, and make select data available by each dive.

https://www.ncei.noaa.gov/waf/okeanos-rov-cruises/

EX Multibeam Bathymetric Product Suite

NCEI performs quarterly updates to include all unrestricted MB bathy data collected by EX. The suite of bathy services are hosted by NCEI on ESRI's ArcGIS Online. The *Okeanos Explorer Bathymetric Coverage Polygo*n feature layer details where EX has collected MB bathy for all cruises. The *Okeanos Explorer Bathymetric Grids* image service provides access to all multibeam bathy products collected by EX. This image service is tailored for rapid, seamless mosaic visualization and provides depth values and customizable visualization options; however, this service cannot be queried by any parameters (e.g., cruise). The *Okeanos Explorer Bathymetric Grids (Subsets)* image service provides access to gridded bathy products and supports filtering/subsetting allowing the user to display individual surveys. The *Okeanos Explorer Bathymetric Grids (Tiled Color Hillshade Visualization)* provides a seamless, tiled mosaic color hillshade visualization of EX bathy products. A 3D representation of the EX bathy products can be visualized when this tiled color hillshade visualization layer is combined with the *Okeanos Explorer Bathymetric Grids (Tiled Elevation Layer)* and set as a base map layer.

Visit the below links for more information regarding and access to these varying EX bathy products.

EX Bathy Coverage Polygon:
https://noaa.maps.arcgis.com/home/item.html?id=2447854ecfc04773a339a8ab32a98e02

EX Bathy Grids

https://noaa.maps.arcgis.com/home/item.html?id=ec1cb4fcad604cf4b3d270de6f49c586

EX Bathy Grids (Subsets)

https://noaa.maps.arcgis.com/home/item.html?id=5d072d6afd49427fa5b4b5571e13efc3

EX Bathy Grids (Tiled Color Hillshade Visualization)

https://noaa.maps.arcgis.com/home/item.html?id=f92a74d905914e59af27126972197136.

Okeanos Explorer Bathymetric Grids (Tiled Elevation Layer)
https://noaa.maps.arcgis.com/home/item.html?id=46facdf76f1047b2a3325b0fb62a473c.

D. Education Expedition Modules and Lesson Plans

OER's Education Team will develop an Exploration for Educators (EfE) and lesson plans. The Data Management team will work with the Education team to provide some or all of the following for near real-time data to be used in these Education products:

- Multibeam xyz (lat, lon, depth) gridded data
- Survey image for GIS overlay
- 3-D fly-through imagery in a movie format
- Ship navigation, meteorology, and oceanographic sensor data
- Thinned CTD cast profile data for plotting

E. SFTP/HTTPS Data Access via exdata.tgfoe.org

Near-Real-Time

During an expedition data is continuously transferred over satellite from the ship to a shore-side server (https://exdata.tgfoe.org) hosted at the Inner Space Center. It is usually available within a few hours of acquisition. This data can be accessed through SFTP or HTTPS by participating scientists and other stakeholders with a collaboration account. The data set available from shore includes ROV navigation products, water column profiles, bathymetry, imagery and full-resolution down-sampled video of ROV explorations.

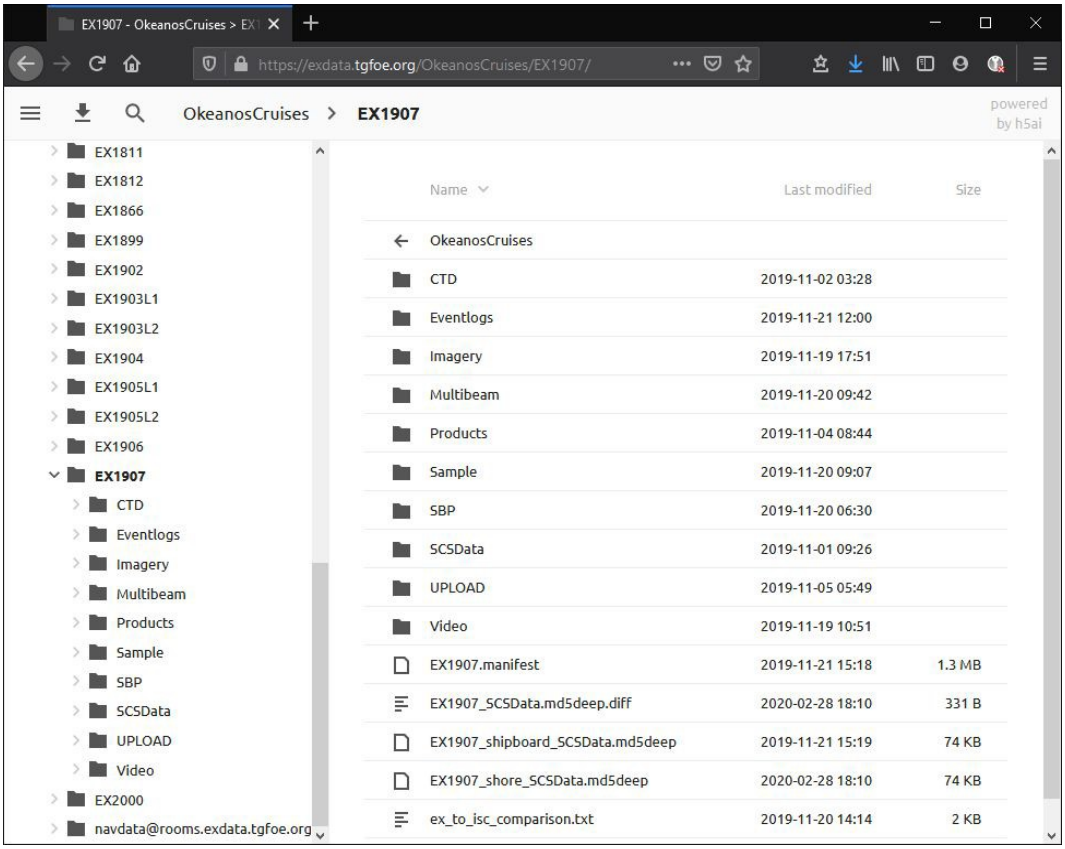


Figure 8. Screenshot of the EXData SRS

XI. Data Management Points of Contact

The following are the points of contact for the successful implementation of this Data Management Plan:

- Megan Cromwell, NCEI-MS, Okeanos Explorer Shore Side Data Management Team Lead, Megan.Cromwell@noaa.gov
- Caitlin Ruby, NCEI-CO, Okeanos Explorer GIS Team Lead Caitlin.Ruby@noaa.gov
- Global Foundation for Ocean Exploration Data Team, data@tgfoe.org

Appendix A: NOAA Ship Okeanos Explorer FY20 Expeditions

Due to COVID-19, NOAA suspended at-sea operations in March of 2020. At the time of publishing this DMP, the field season for NOAA Ship Okeanos Explorer had not resumed, though a decision was made to not pursue the Mid-Atlantic Ridge expedition. OER continues to evaluate options for the remainder of the year, should operations resume in a way that respects the health and safety guidance from federal, state, and local authorities.

October 2019 – September 2020

Throughout the year, telepresence technology will allow you to follow discoveries via the NOAA Office of Ocean Exploration and Research website, putting the unexplored ocean in front of your eyes. NOAA is currently seeking scientists and managers interested in actively participating during 2020 expeditions. For details on opportunities to get involved, please visit this page. If you are interested in providing input into expedition planning or participating as a scientist or student, please contact the Expeditions Science Advisor, Dr. Scott France, at france@louisiana.edu.

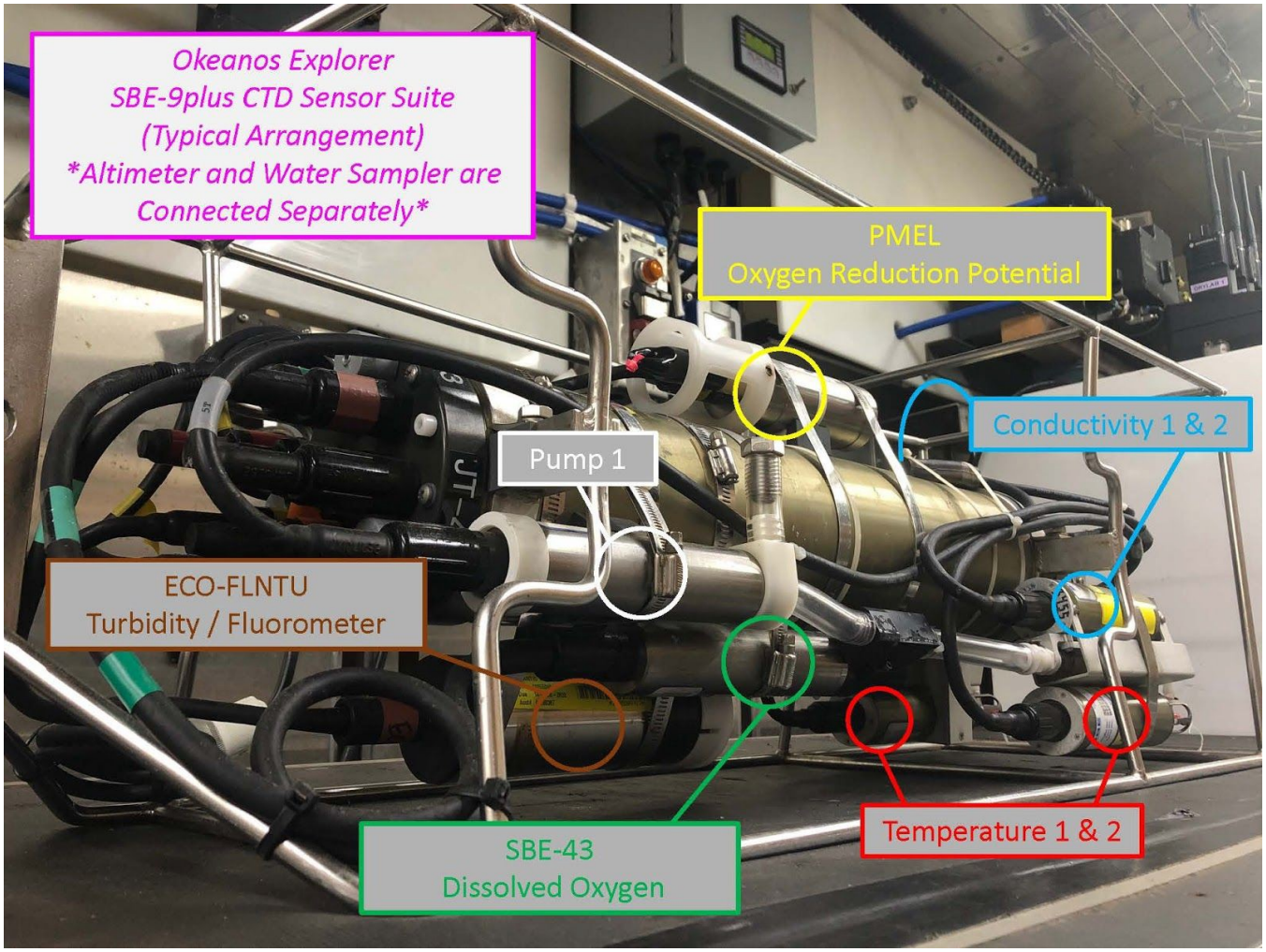
U.S. Southeast Deep-sea Exploration

In Fall 2019, OER will conduct expeditions with NOAA Ship *Okeanos Explorer* focused on mapping and exploring deep waters off the U.S. Southeastern Continental Margin and the Blake Plateau. This region has extensive, yet poorly known deep seafloor and midwater habitats, as well as unique geological features. Operations will focus on exploring the Blake Plateau, Blake Escarpment, and carbonate terraces around Florida. Specific areas to be explored include coral mounds in the Stetson-Miami Terrace Deepwater Coral Habitat Area of Particular Concern (HAPC), an area historically subject to the use of experimental deep-sea mining technologies, and areas in and around the Pourtalés Terrace Deepwater Coral HAPC. Data from this expedition will enable scientists and managers to build a better understanding of the diversity and distribution of deepwater habitats in this region, allowing for informed resource management decisions.

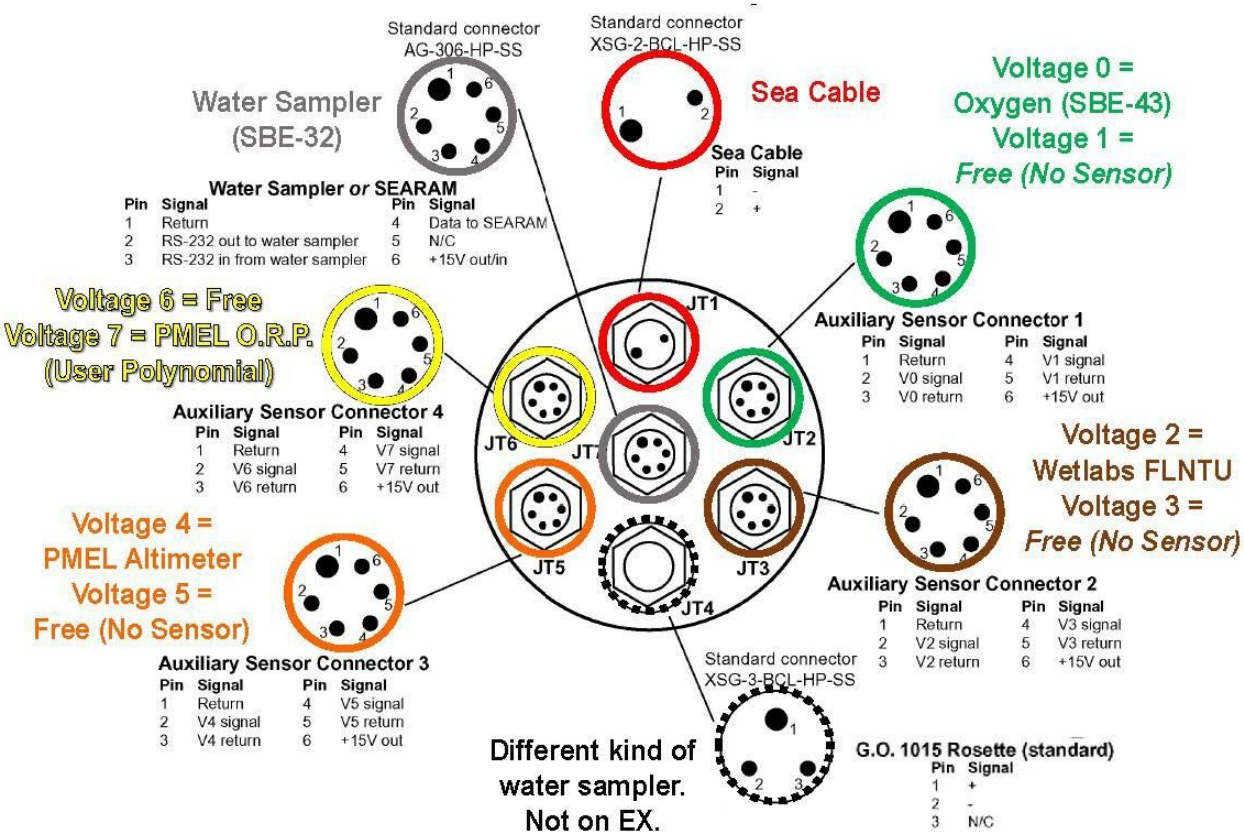
Ship Maintenance and Sea Trials

During Winter 2019/2020, NOAA Ship *Okeanos Explorer* will undergo a maintenance period to improve the material condition of the vessel and complete high-priority repairs. This will involve work on the mission spaces that house mapping and ROV systems, as well as installation of a new EM304 multibeam sonar. After work on the ship is completed, OER will commence 2020 operations with extensive testing of the mapping and ROV systems to ensure maximum reliability of the systems and high quality data collection for the rest of the field season.

Appendix B: CTD Diagrams



EX SBE-9 CTD CONNECTORS & CONFIGURATION (TOP END CAP)



Junction Top Connector & Voltage Configuration

By Connector (JT = Junction Top)	By Voltage Channel
JT1 - Sea Cable (Nuthin' else should go here)	**Voltage 0** - Oxygen (SBE-43)
JT2 - Oxygen (SBE-43)	**Voltage 1** - Free (No Sensor)
JT3 – Wetlabs FLNTU	**Voltage 2** – Wetlabs FLNTU
JT4 - Non-EX Water Sampler system. (Unused)	**Voltage 3** - Free (No Sensor)
JT5 - PMEL Altimeter	**Voltage 4** - PMEL Altimeter
JT6 - PMEL Oxygen Reduction Potential	**Voltage 5** - Free (No Sensor)
JT7 - SBE-32 Water Sampler (We use this one)	**Voltage 6** - Free (No Sensor)
	Voltage 7 - PMEL Oxygen Reduction Potential

EX SBE-9 CTD CONNECTORS & CONFIGURATION (BOTTOM END CAP)