

# Sea-Bird University

MODULE LIST

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## MODULE 0 – Introduction, Course Plan and Syllabus

- SBE Training Introduction
- Modules by the numbers
- Topics We Will Cover
- Resources

## MODULE 0 –Introduction to Data Collection in the Ocean

- Overview
- Sensors, Instruments and Systems
- Nomenclature
- Ocean Profiling
- Oceanographic Terms
- Oceanographic Parameters
- Activity: Install Seasoft and Course Data

## MODULE 1 – Introduction to Profiling Equipment

- Overview
- Profiling Systems
- SBE 19, 19plus and 19plus V2: Sensor Placement
- Autonomous Profiling Instruments
- Specialty Profiling Systems
- Real-time Profiling
- Cabling the 9plus to the 11plus
- SBE 9plus/11plus Data Telemetry
- Internally Recorded Profiling
- Real-time Options for Internally Recording Instruments
- Modular Sensors
- Water Sampling Equipment
- Real-Time Water Sampling with SBE 9plus
- Real-Time Water Sampling with Internally Recording Instruments
- Autonomous Water Sampling with Internally Recording Instruments
- Autonomous Water Sampling with SBE 9plus
- Activity: Cable your Computer to SBE 19plus V2

## Module 2 – Setup and Acquiring Data with Internally Recording Profiling Instruments

- Overview
- Sea-Bird Software for Recording and Processing Data
- Seaterm V2: User Interface for Internally Recording Instruments
- Seaterm 232: User Interface for RS-232 Instruments
- Calculating Memory Capacity
- Calculating Battery Endurance
- Activity: Setup SBE 19*plus* V2 and Collect Some Data
- Transferring Stored Data
- Activity: Transfer Data from CTD to Computer
- Capturing Real-Time ASCII Data
- Using Internally Recording Instruments for Real-Time Applications

## Module 3 – Setup and Acquiring Data with Real-Time Profiling Systems

- Overview
- Sea-Bird Software for Recording and Processing Data
- Seasave: Setup for Real-Time Data Acquisition
- Seasave: Instrument Configuration
- Activity: Create Configuration File
- Seasave: Default Display
- Seasave: Configuring Inputs and Outputs
- Seasave: Configuring Serial Ports
- Seasave: Configuring Water Sampling
- Seasave: Configuring TCP/IP Ports
- Seasave: Defining Miscellaneous Parameters
- Seasave: Pump Control
- Seasave: Configuring Serial Data Output
- Seasave: Configuring Shared File Output
- Seasave: Configuring Mark Variables
- Seasave: Configuring TCP/IP Output
- Seasave: Configuring SBE 11*plus* Alarms
- Seasave: Configuring SBE 14 Remote Display
- Cabling a Remote Display
- Seasave: Configuring PC Alarms
- Seasave: Configuring Cast Headers

- Seasave: Saving Your Setup
- Seasave: Acquiring Real-Time Data
- Activity: Take a Bench Cast and Collect Real-Time Data
- Seasave: Output File Types
- Seasave: Header Files
- Seasave: Mark Files
- Seasave: Mark Files
- Seasave: Bottle Data Files
- Seasave: Displaying Archived Data
- Activity: Display Bench Cast in Seasave

## Module 4: Introduction to SBE Data Processing, Data Conversion and Plotting

- Overview
- Basic Data Processing: Example Data Sets
- Activity: View Example Data in Seasave
- Data Processing: Flow Chart
- Data Conversion: Software
- Data Conversion: File Headers Revealed
- Data Conversion: What files does the software output?
- Data Conversion: Output File Formats
- Activity: Convert Example Data in SBE Data Processing
- Sea Plot: Display Converted Data
- Sea Plot: Plotting Multiple Files with Overlay Plots
- Sea Plot: TS Plots
- Activity: Plot Example Data in SBE Data Processing with Sea Plot

## Module 5: Water Sampling with Internally Recording Instruments

- Overview
- Water Sampling Components
- Autonomous Water Sampling with Internally Recording Instruments
- Setting up Water Sampling Equipment with Seaterm AF
- SeatermAF V2: Setting Up CTD Communications
- Seaterm AF V2: Setting up Sampling Protocol
- Data Recorded in Auto Fire Instruments
- Real-Time Data and Water Samples from an Internally Recording Instrument
- Correlating CTD Data with Water Samples
- Extracting CTD Data for Water Samples with Data Conversion
- Bottle Summary: Summarizing Water Sample Data
- Activity: Create .ros and .btl Files

## Module 6: Miscellaneous Applications

- Overview
- Fresh water Applications
- Specific Conductance
- Sound Velocity
- Adding RS-232 Serial Output Interface to 911*plus*
- Adding Navigational Information to Your Data

## Module 7: Thermosalinographs

- Overview
- Thermosalinographs
- SBE 21: Installation and Setup
- SBE 45: Installation and Setup (continued)
- Calibration
- Maintenance
- Healthy Data
- More Challenging Data: Bubbles
- Salinity Drift
- Troubleshooting Opto/NMEA Boxes

## Module 8: Making Measurements in the Ocean

- Overview
- Basics of Sensor Measurements
- Temperature Sensors
- Conductivity Sensors
- Pressure Sensors
- CTD sampling Rates
- Resolution and Sampling Theory: Sampling and Profiling Rates
- Activity: Compare Resolution
- Coordinating Measurements
- Aligning Data
- Coordinating Measurements: An Example
- Sensor Response to Step Changes

## Module 9: Getting the Highest Accuracy Data: CTD Care and Calibrations

- Overview
- Care of thermometers in the field
- Sensor Drift Characteristics
- Care of Conductivity Sensors in the field
- Conductivity Drift Characteristics
- Pressure Sensor Drift Characteristics
- Converting Sensor Output to Scientific Units
- Converting to Scientific Units: Calibration
- Using Calibrations to Improve your Data
- Temperature: Using Calibrations to Improve your Data
- Activity: Correct T via Pre/Post-Cruise Calibrations
- Conductivity: Using Calibrations to Improve your Data
- Calculating Parameters with SeaCalc III
- Activity: Correct C via Pre/Post-Cruise Calibration

## Module 10: Getting the Highest Accuracy Data: Field Calibrations

- Overview
- Field Calibrations
- Field Calibrations: Pressure
- Field Calibrations: Temperature
- Field Calibrations: Discrete Sampling
- Field Calibrations: Conductivity
- Activity: Correct CTD Conductivity with Water Samples

## Module 11: Advanced Data Processing: Dynamic Errors in CTDs

- Overview
- Why worry about absolute accuracy?
- Errors in CTD data
- Dependent versus Independent Variables
- Dynamic Errors in Temperature
- Dynamic Errors in Conductivity
- Dynamic Errors in Salinity
- Reducing Dynamic Errors

## Module 12: Advanced Data Processing: Dynamic Corrections for CTDs

- Overview
- Data Processing Software
- Key Data Processing Modules
- Additional Data Processing Modules
- File Manipulation Modules
- Data Processing Notes
- Activity: Convert Data
- Filtering Data
- Illustrating Sensor Alignment
- Demonstration of Misalignment Effects
- Removing Misalignment
- Activity: Align Data and Derive
- Conductivity Cell Thermal Mass
- Activity: Remove Conductivity Cell Thermal Mass Effect

## Module 13: Advanced Data Processing – Ship Heave and Data Reduction

- Overview
- Data Artifacts Induced By Ship Heave
- Activity: Remove Loops
- Bin Averaging
- Bin Averaging: Algorithm
- Bin Averaging: Surface Bins
- Bin Averaging: File Selection and Data Setup
- Bin Averaging: Output Data
- Activity: Bin Average
- Recommended SBE 911 plus Profiling CTD Data Processing Steps
- Recommended SBE 19plus V2 Profiling CTD Data Processing Steps
- Recommended SBE 25plus Profiling CTD Data Processing Steps

## Module 14: Advanced Data Processing – Batch Processing

- Overview
- Data Processing Large Numbers of Files
- Writing Batch Processing Scripts
- Running SBEBatch
- Nuances of SBEBatch
- Activity: Use Batch Scripting to Process Data



## Module 15: Introduction to Moored Equipment

- Overview
- Introduction to the SBE 16 SeaCAT Family
- Introduction to the SBE 37 MicroCAT Family
- Introduction to the SeapHOX Family
- Introduction to the SBE 39 and 56 Families
- Inductive Modem Telemetry
- Inductive Modem Instruments
- Clock Drift
- Memory Capacity
- Battery Endurance
- Battery Endurance by Instrument
- Battery Endurance Issues
- Battery Endurance: Alkaline Battery Capacity
- Battery Endurance: Lithium Battery Capacity
- Calculating Battery Endurance
- Activity: Calculate Battery Endurance
- Measuring Periodic Signals

## Module 16: Setup and Acquiring Data with Moored Instruments - Software

- Overview
- SeatermV2 and Seaterm: User Interface
- Check Calibration Coefficients
- Checking Status Report
- Setting Date and Time
- Pump Settings
- Upload Files
- SeatermV2: Upload Types
- Activity: Setting Up, Logging, Uploading MicroCAT Data
- Converting Sensor Output to Scientific Units
- SBE 39 and older SBE 37 Data Conversion Utilities
- SBE 16plus V2 Headers
- Data Formats
- Activity: Converting and Plotting Time Series Data
- Preparing for Deployment: Inductive Modem Systems

## Module 17: Setup and Acquiring Data with Moored Instruments - Hardware

- Overview
- Anti-foulant Paints
- Changing Batteries
- Checking Cables and Connectors
- Clean Data Collection
- Plumbing
- Preparing for Deployment
- Preparing for Deployment: Sensor Check
- Preparing for Deployment: Check Zero Conductivity Frequency
- Activity: Check Zero Conductivity for SBE 37-SM
- Removing Air from Plumbing
- Starting Logging

## Module 18: Getting the Highest Accuracy Data – Moored Applications

- Overview
- Static Errors
- Instrument Malfunction
- Care of Sensors in the Field
- Care of Sensors in the Field: Conductivity
- Sensor Drift Characteristics
- Correcting Data with Pre- and Post-Deployment Calibrations
- Temperature Drift from Pre- and Post-Deployment Calibrations
- Field Validation of Conductivity
- Correcting Conductivity and Temperature Data: Example
- Lab Validation
- Activity: Validate and T and C against Reference Standards

## Module 19: Waves and Tides: Theory and Setup

- Overview
- SBE 26 Wave and Tide Recorder
- SBE *26plus* Wave and Tide Recorder
- Measuring Tides
- Measuring Waves
- Wave Frequency Spectrum
- Measuring Waves: Background
- Deployment Planning
- Setting up the SBE 26
- SBE 26 Measurement Sequence
- Setting up the SBE *26plus*
- SBE *26plus* Measurement Sequence
- Adding Conductivity
- Battery and Memory Summary
- Deployment Summary
- Recovery Summary
- Removing Barometric Pressure from Tide Data
- Troubleshooting an SBE 26
- Troubleshooting an SBE *26plus*

## Module 20: Wave and Tides: Data Processing

- Overview
- Separating into Wave Data and Tide Data: Convert Hex
- Separating into Wave Data and Tide Data: .tid File Format
- Separating into Wave Data and Tide Data: .wb File Format
- Activity: Convert Wave and Tide Data
- Processing Wave Measurements: Process Wave Burst Data
- Processing Wave Measurements: .was File Format
- Processing Wave Measurements: .rpt File Format
- Processing Wave Measurements: .wt File Format
- Processing Wave Measurements: .wts File Format
- Activity: Process Wave Burst Data
- Tabulating Wave Data: Create Reports
- Activity: Create Wave Data Report
- Removing Barometric Pressure from Tide Data: Merge Barometric Pressure
- Graphing Wave and Tide Data
- A Wave and Tide Example
- A Wave and Tide Example, Processing Errors
- A Wave and Tide Example, Sampling Setup Errors
- A Wave and Tide Example, Correcting Processing Errors
- Processing Wave Data: Reality Check
- Activity: Plot wave auto-spectrum and time series

## Module 21: Troubleshooting

- Overview
- Troubleshooting: The Basics
- Checklist for Real-Time Systems
- Troubleshooting: 911*plus*
- Activity: Troubleshooting
- Troubleshooting: NMEA Problems
- Troubleshooting: Carousel Water Sampler
- Troubleshooting: SBE 33 or SBE 36
- Troubleshooting: Internally Recording Instruments
- Troubleshooting: Auto Fire Module (AFM)
- Troubleshooting: Data Problems
- Activity: Examine Bad Data

## Module 22: The Cruise - Before, During and After

- Overview
- Pre-Cruise Equipment Checks
- Pre-Cruise Equipment Checks - Connectors
- Pre-Cruise Equipment Checks - Cables and Dummy Plugs
- Pre-Cruise Equipment Checks – Plumbing
- Pre-Cruise Equipment Checks – Pressure Capillary
- Pre-Cruise Equipment Checks – Batteries
- Pre-Cruise Equipment Checks – Inductive Instruments
- Pre-Cruise Equipment Checks – Verify Functionality
- Shipping Precautions
- Tools and Spare Parts
- Activity: Troubleshooting
- Deployment: Instrument Plumbing
- Deployment: Pump Operation
- Deployment: Failed Underwater Connections...Be Neat!
- Deployment: Using your CTD in Very Cold Places
- Deployment: Final Preparation
- Care and Maintenance during Cruise
- Care of Conductivity Sensors in the Field
- Care and Maintenance of Water Samplers
- Flooded Instruments
- Care and Maintenance after Cruise
- Sensor Storage

## Module 23: Maintenance

- Overview
- Annual Maintenance
- Lubricating Hardware
- Electrostatic Discharge Precautions
- O-Rings and Seals
- O-Rings and Seals – Opening Instruments
- O-Rings and Seals – Cleaning Surfaces
- O-Rings and Seals – Inspecting
- O-Rings and Seals – Typical Flaws
- O-Rings and Seals – Lubrication
- O-Rings and Seals – Closing Instruments
- Pump Maintenance
- Replacing Bulkhead Connectors
- SBE 9plus Bulkhead Connector Wiring
- SBE 16plus and 19plus Bulkhead Connector Wiring
- Replacing Bulkhead Connectors

## Module 24: Introduction to Biogeochemical Sensors

- Overview
- Introduction to Biogeochemical Sensors
- Introduction to Oxygen Sensors
- Electrochemical Dissolved Oxygen Sensors
- Optical Dissolved oxygen Sensor
- Optical Fluorescence and Backscatter Sensors
- How Optical Fluorescence and Backscatter Work
- Measuring Fluorescence
- Measuring Backscatter
- Introduction to Optical Transmissometers
- How Transmissometers Work

## Module 25: Setup and Acquiring Data with Biogeochemical Sensors

- Overview
- Introduction to Modular Sensors
- Integrating Modular Sensors
- Biogeochemical Sensors: WET Labs ECO Example
- Integrating Transmissometers
- Adding Surface PAR
- Supporting Custom Auxiliary Sensors
- Adding 9600 Baud Data Channel to 911plus
- Integrating Dissolved Oxygen
- Preparing for Moored Deployment

## Module 26: Care of Biogeochemical Sensors

- Overview
- Care of Oxygen Sensors in the Field
- Cleaning Dissolved Oxygen Sensors in the Field
- Dissolved Oxygen Sensor Storage

## Module 27: Introduction to Biogeochemical Data Processing

- Overview
- Dissolved Oxygen Calibration
- SBE 43 Dissolved Oxygen Sensor Drift
- Field Calibrations for Dissolved Oxygen
- Dissolved Oxygen Calibration Equation
- Sample Validation Procedure for Dissolved Oxygen Sensor
- Dissolved Oxygen Sensor Response
- Processing Dissolved Oxygen
- Removing Misalignment in Dissolved Oxygen
- Tau Correction for Dissolved Oxygen
- Activity: Align DO Data and Derive
- Biogeochemical Data Processing Software
- Using Factory Calibrations to Process Biogeochemical Data
- Example using a Wetlabs Product

## Module 28: Advanced Data Processing – Biogeochemical Sensors

- Overview
- Dissolved Oxygen Deep Ocean Hysteresis
- Adjusting E in the Calibration Equation
- Validation in the Field
- Field Calibrations – Dissolved Oxygen
- Activity: Compute Correction Factor for Soc
- Correcting Oxygen Data: SBE 63 Optical DO Sensor
- Computing Rate of Change for Soc
- Correcting Oxygen Data for Drift
- Oxygen: Using Calibrations to Improve your Data
- Activity: Compute Rate of Change for Soc

## Module 29: Returning Instruments to Sea-Bird for Service

- Overview
- Sea-Bird Contact Information
- Information Needed by Sea-Bird
- Information Needed by Sea-Bird to Diagnose Problems
- Battery Shipping Regulations
- Service Scheduling
- Service Work Authorization
- Service Work Quotes
- Service Package
- Service Package Disc
- Service Scheduling