

# MB-System Developers Workshop

## Agenda

February 18-20, 2014

Monterey Bay Aquarium Research Institute

Moss Landing, CA, USA

Hosted by David Caress

---

Version 7

20 February 2014

---

### Day 1 - Tuesday February 18

#### Schedule

- 0830 Breakfast available
- 0900 Welcome and Organizational Details
- 0915 Caress starts talking about: ***Writing an MB-System I/O Module***
- 1030ish Break
- 1045ish Caress resumes talking
- noonish Lunch served
- 1300ish Caress resumes talking
- 1430ish Break
- 1445ish Caress resumes talking
- 1600 Caress stops talking

- 1601 MBARI tour
- 1700ish Done with tour
- 1830ish Meet for dinner somewhere in the Cannery Row Area of Monterey

## Day 2 - Wednesday February 19

### Schedule

- 0830 Breakfast available
- 0900 Organizational Details
- 0915 Caress starts talking about: ***Writing an MB-System Application***
- 1030ish Break
- 1045ish Caress resumes talking
- noonish Lunch served
- 1300ish Caress resumes talking
- 1430 Break to recast room and prepare for seminar
- 1500 MBARI Seminar by Dale Chayes: ***Airborne seawater sampling through Arctic sea ice***
- 1600ish Chayes stops talking
- 1600-1700 Time for informal discussion & interactions with MBARI staff
- 1830ish Meet for dinner somewhere in the Cannery Row Area of Monterey

## Day 3 - Thursday February 20

### Schedule

- 0830 Breakfast available
- 0900 Organizational Details
- 0915 Caress presents: ***MB-System 6: The Current Plan***
- 1030ish Break
- 1045ish Discussion regarding what we really ought to do
  - Presentations are welcome, including priorities for IEDA, MARUM, USGS, etc
  - What's involved in integrating with GDAL and GMT5?
  - Are the planned supported data types expansive enough for the future?

- Are we missing anything important in the planned data products?
  - noonish Lunch served
  - 1300ish Resume discussions
    - End with revisiting the development priority rankings from 2011
  - 1700ish We all stop talking
  - 1830ish Meet for dinner somewhere in the Cannery Row Area of Monterey
- 

## **Coveners**

- David Caress (MBARI)
- Dale Chayes (LDEO)
- Ferreira Christian (MARUM)
- Krystle Anderson (MBARI)

## **Attendees**

- Vicki Ferrini (LDEO)
  - David Finlayson (USGS)
  - Marcus Hammond (Stanford)
  - Rich Henthorn (MBARI)
  - Gordon Keith (CSIRO)
  - Peter Lemmond (WHOI)
  - Mike McCann (MBARI)
  - Suzanne O'Hara (LDEO)
  - Jose Padiá (Stanford)
  - Jenny Paduan (MBARI)
  - Evan Robertson (NOAA)
  - Kurt Schwehr (Google Earth/Google Oceans)
  - Mathias Weinrebe (MANIDA/PANGEA)
- 

## **Topic of Day 1: Writing an MB-System I/O Module**

- **Introduction**
- **Diversity of Seafloor Mapping Data**
- **Modular Structure of MBIO**
- **Common API to read and write data in all supported formats**
  - Level 1 reading
  - Level 2 reading and writing
  - Format id numbers and information
  - Verbosity
  - Status and error values
  - Organizing data files with datalists
  - MB-System memory management tools
  - Dynamic memory management for data arrays
  - On-the-Fly Merging of Asynchronous Navigation and Attitude
  - Optimized File Reading and Writing
- **Organization of MB-System Source Code**
- **Example of a New MB-System I/O Module**
  - I/O Module Source Files
  - I/O Module Template Files
  - Overview of Coding an I/O Module
  - Step 1: Select the Data System Name and Data Format Names and ID's
  - Step 2: Prepare the Source Files from the Templates

- Step 3: Define Data Structures Required to Store the New Data
- Step 4(a): Write the Initialization Functions in `mbr_wasspunl.c`
- Step 4(b): Write the Reading and Writing Functions in `mbr_wasspunl.c`
  - Basic Behavior of `mbr_rt*()` and `mbr_wt*()` Functions
  - The Structure of `mb_rt_*` Functions: Simple Reading vs Multiple Functions
  - Reading by `mbr_rt_wasspenl()` and Subordinate Functions
  - On-The-Fly Interpolation of Asynchronous Values (Not Needed for WASSP)
  - Writing by `mbr_wt_wasspenl()` and Subordinate Functions
- Step 5. Write the Data Access Functions in `mbsys_wassp.c`
- Step 6. Integrate the New I/O module Into MBIO
- Step 7: Update the MB-System Build
- Step 8: Test the New I/O Module

---

## Topic of Day 2: Writing an MB-System Application

- **Architecture of MB-System**
  - Summary of the MBIO API
  - Example 1 - Simple program to read and write a single file
    - Accessing desired record types
  - Example 2 - Add some common complexities
    - Handling recursive datalists
    - Using ancilliary files (e.g. `fnv`, `inf`, `fbt`)
    - Working with beamflags

- Example 3 - Program that impacts processing of data
  - Altering the processing parameters in the \*.par files

---

## Topic of Day 3: MB-System 6: The Current Plan

- **Review Why MB-System is What it is....**
  - Why Open Source?
  - Why go to so much trouble to support formats as they exist?
  - Why are some (problematic) formats not supported
- **Review of the priorities listed in the NSF proposal**
- **What's changed since we wrote the NSF proposal**
  - Clear that we need to expand the kinds of data supported
    - Lidar
    - Photographic imagery
    - Photogrammetric bathymetry
    - Others?
  - GMT 5 - very different from GMT 4.
  - Preprocessing needs to be part of the normal processing flow
- **Proposed changes to the processing architecture**
  - Preprocessing becomes a normal step
    - Replace mb7kpreprocess, etc. with mbpreprocess
    - Embed existing metadata at the start
      - Platform
      - Event
      - Need to adopt existing standards - what are they?
      - No metadata will be mandatory
  - Recast basic MBIO API to use many insert/extract calls instead of "catch-all" functions like the existing mb\_get() or mb\_read()
    - Have one extract and one insert function for each data type, as

defined below

- For formats that do not support derived data types (e.g. sidescan laid out on the seafloor), use ancillary files for storage and export.
  - Allows simultaneous access to raw, laid-out, corrected, corrected and filtered sidescan regardless of the data format
- Handle sensor offsets properly and comprehensively
  - Define existing sensor suite and sensor offsets as part of preprocessing (mbpreprocess)
  - Allow arbitrary offset changes as part of processing (mbprocess)
- Versioning of edit save files
- Add uncertainties in soundings to the supported data types
  - Include sounding uncertainties in fbt files
- Integrate with GDAL and GMT5
- Create an MB-System CHRT tool that integrates with CHRT server applications made available by Brian Calder at CCOM
- Expand the options for data products
  - BAG files
  - Google Earth integration
- Broader range of data types supported for processing and display
  - Currently only bathymetry, amplitude, sidescan
  - Expand to a larger list, each of which can be processed differently:
    - Navigation
    - Attitude
    - Singlebeam sonar
      - Per-beam topography
        - Ranges and angles
        - Topography
        - Topography uncertainty
      - Per-beam backscatter (amplitude)
        - Uncorrected

- Corrected
- Corrected and filtered
- Multiple single beam sonar (sweep rather than multibeam)
  - Per-beam topography
    - Ranges and angles
    - Topography
    - Topography uncertainty
  - Per-beam backscatter (amplitude)
    - Uncorrected
    - Corrected
    - Corrected and filtered
- Multibeam sonar
  - Per-beam topography
    - Ranges and angles
    - Topography
    - Topography uncertainty
  - Per-beam backscatter (amplitude)
    - Uncorrected
    - Corrected
    - Corrected and filtered
  - Per-sample backscatter (pseudo-sidescan)
    - Time series
    - Resampled onto seafloor, uncorrected
    - Resampled onto seafloor, corrected
    - Resampled onto seafloor, corrected and filtered
- Interferometric sonar
  - Per-sample topography
    - Ranges and angles
    - Topography
    - Topography uncertainty

- Per-sample backscatter (sidescan)
  - Time series
  - Resampled onto seafloor, uncorrected
  - Resampled onto seafloor, corrected
  - Resampled onto seafloor, corrected and filtered
  
- Sidescan sonar
  - Nadir topography
    - Range and angle
    - Topography
    - Topography uncertainty
  
  - Per-sample backscatter (sidescan)
    - Time series
    - Resampled onto seafloor
    - Corrected
    - Corrected and filtered
  
- Lidar topography
  - Lidar ranges and angles
  - Lidar topography
  - Lidar topography uncertainty
  - Lidar intensity
  
- Photographs
  - Raw
  - Resampled onto seafloor, uncorrected
  - Resampled onto seafloor, corrected
  
- Stereo photographs
  - Raw
  - Resampled onto seafloor, uncorrected
  - Resampled onto seafloor, corrected
  - Photogrammetric topography
  - Photogrammetric topography uncertainty

- Gridded topography
  - Gridded topography
  - Gridded topography uncertainty
- Mosaiced backscatter
- Mosaiced photographs
- Synthetic Aperture Radar (airborne, satellite)

*NOTE from Gordon* Difference between backscatter that is "corrected" for mosaicing and backscatter that is quantitatively corrected to get at actual backscatter coefficients What is the right term for Lidar intensity or backscatter? What about structured light?

- **Priorities and comments by others (IEDA, MARUM, USGS, etc)**
- **Discussion**
  - Presentations are welcome, including priorities for IEDA, MARUM, USGS, etc
  - What's involved in integrating with GDAL and GMT5?
  - Are the planned supported data types expansive enough for the future?
  - Are we missing anything important in the planned data products?
- **Revisit the development priority rankings from 2011**
- **Future MB-System Workshops**
  - How was this workshop? Suggestions, criticisms, etc.
  - Should we do another workshop next year?
    - User's Workshop or Developer's Workshop?
    - MBARI, Lamont, UNH?

