Lamont– Doherty Earth Observatory
Office of Marine Affairs
61 Route 9W
Palisades, NY 10969
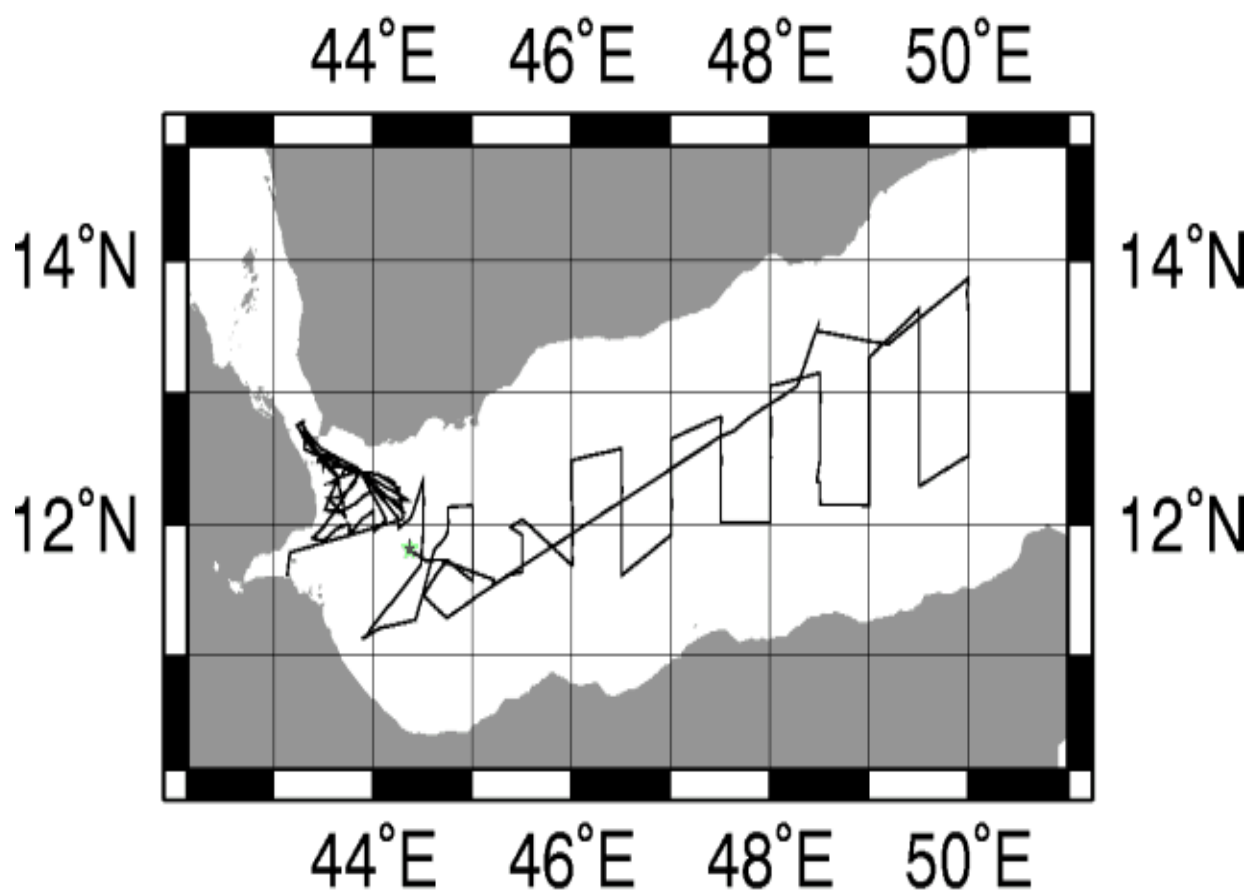
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            845 365–8677

R/V Maurice Ewing Data Reduction Summary

EW–0110 Djibouti – Djibouti

Date	Julian Date	Time	Port
August 20, 2001	232	10:06:00	Djibouti
September 12, 2001	254	23:59:00	Djibouti

GMT 2001 Sep 12 01:09:04 TO DATE

Background and Scientific Objectives

The Red Sea Outflow Experiment (REDSOX) is a joint effort between the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS) and the Woods Hole Oceanographic Institution (WHOI). The purpose of the program is to conduct measurements of the outflow of high salinity water from the Red Sea and its mixing with ambient waters in the Gulf of Aden. The program is funded by the United States National Science Foundation (NSF).

The main objectives of REDSOX are:

1. To describe the pathways and downstream evolution of the descending outflow plumes of Red Sea Water in the western Gulf of Aden

2. To quantify the processes that control the final depth of the equilibrated Red Sea Outflow Water, and

3. To identify the transport processes and mechanisms that advect Red Sea Outflow Water and its properties through the Gulf of Aden and into the Indian Ocean.

In order to achieve these objectives, fieldwork has been carried out during two cruises. This report describes the scientific research conducted during the second project cruise from 21 August to 12 September 2001 aboard the R/V Maurice Ewing (REDSOX–2). This cruise was timed to take place during the climatological period of minimum deep outflow from the Red Sea, which occurs in boreal summer. The shipboard scientific activities consisted of three main components. First, a high–resolution hydrographic and direct current survey of the Gulf of Aden was conducted to describe the three–dimensional water property distributions and circulation characteristics. Second, direct measurements of turbulent mixing were made to study the bottom stress and mixing processes in the descending plumes. Third, acoustically–tracked RAFOS floats were launched to observe the rates and pathways of Red Sea Outflow Water spreading, including some floats that were deployed in delayed release mode.

REDSOX is intended to provide the first comprehensive description of the pathways, structure, and variability of the descending outflow plumes from the Red Sea and the equilibrated Red Sea Water mass as it enters the western Indian Ocean.   Analysis of the experimental data will lead to a better understanding of mixing and spreading processes in dense overflows and a more detailed knowledge of the factors that control the final watermass characteristics of these outflows.

Cruise Members

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All data in this report is logged using GMT time and Julian days in order to avoid confusion with local time changes.

This is the first cruise to run the newly overhauled data logging and reduction system. As a general note, the UNIX environment variable "EWING_DATA_SYSTEM" must be set for accounts that will use the system. The old system is in standby, still installed, but was not used at all during the cruise. The logging system ran reasonably smoothly given the extent of the modifications to the system. The problems detailed below are thought to be unrelated to the software upgrade, to which we are now more or less committed for the long term. This upgrade will vastly improve the managability and maintainability of the data system for the next several years, and hopefully reduce the large number of version control problems that we have encountered in the past.

On J246, Walrus (logging console) was logged out and all the data had to be restarted. There were some problems getting a couple logging processes running smoothly again, which are noted further along in this document.

Official data logging ended at midnight on September 11, J254 in anticipation of radical schedule changes due to the terrorist attacks on the U.S.

Hydrosweep

Hydrosweep acquisition was somewhat iffy. There is an offset problem of about 7–15 meters between the port and starbord sides. The outside beams may also be unreliable.

At 10:45UTC on j237 (Aug 25), a Sound Velocity Profile called "Mean Aden SVP" calculated from a number of CTD casts was entered into the Hydrosweep Online system.

The centerbeam logging process flipped out at the time of the data restart and started logging spurious dates and depths. Probably 99% of these bad records did **not** corrupt the main data logging because the spurious data forced the process to create new, ridiculously named files. All the bad data files were removed, and the bad data records in the good files are thought to be completely removed both in the raw and processed output. This mess caused major errors in the reduction process, which is how it was caught. The logging process has been updated to discard such records in the future, but the cause is not yet known. The centerbeam logfiles should be clear of the broken records.

The restart also clogged the serial port for logging the POSMV, so a couple days worth of POSMV data was lost. This was probably data that would have been useful for debugging the centerbeam issue.

Supposedly the patch from Atlas will fix the offset problem. A new disk with a full installation for the Hydromap Online machine is on its way to Djibouti, so the now failing hard drive inside that machine will be replaced as well. Hopefully this will solve a number of problems with the Hydromap machine.

On J252 (Sept9) the supposed patch from Atlas for the Hydrosweep IPS wrecked the system. The IPS device was brought back online with a backup flash RAM installation after roughly 12 hours of downtime.

Meteorology

On J245 (Sept 2), the automated meteorology+ct+sg data merging was brought online. All daily data since has been merged, and all previous days have been retroactively processed.

The weatherpack flipped around 1030 on J248 and logged random temperatures for about an hour until it was caught and the logging reset.

Thermosalinograph

The TSG ran throughout most of the cruise, except for the period for which it was accidentally turned off. Data before 0600 on J235 should be discarded.

Pirates

A pirate attack was logged off the coast of Somalia on J243 (Aug 31). All data systems ran smoothly and the turbocharger was successfully operated. Standard shipboard data was successfully collected with very little noise, and the salient features of the incident are visible in the daily graphs. As a result of the attack, the focus of the cruise was shifted to the middle channel of the Gulf in keeping with the newly imposed 50–mile limit.

CTD + Floats + Bottom Lander

Most of the troubles with the CTD were solved during 0109, and operations were reasonably smooth. The first bottom lander experiment came back with no data. All floats were launched successfully.

Gravity

No notes.

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Data Logging

The R/V Maurice Ewing data logging system is run on a Sparc Ultra Enterprise Server. Attached are 48 serial ports via 3 16–port Digi International SCSI Terminal Servers. Generally, all data logged by the Ewing Data Acquisition System (DAS) is time stamped with the CPU time of the server, and broadcast to the Ewing network using UDP packet broadcasts. The CPU time of the server is synchronized once every half hour to a Datum UTC gps time clock.

GPS times are also time–tagged with cpu time, although the time of the GPS position is from the GPS fix itself.

The following tables describe the data instruments which performed logging during this cruise. The tables associated with the instruments describe logging periods and data losses for that instrument.

Time Reference

Datum StarTime 9390–1000

logging interval: 30 minutes
file id: tr2

Used as the CPU synchronization clock. This clock is polled once every half hour to synchronize the CPU clock of the data logger to UTC time. The logger (octopus) is responsible for updating the times of the other CPUs.

This clock was running and synchronizing the system the entire cruise.

Interruption s greater than 30 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+232:20:47:30.068		Logging officially started
2001+254:23:53:29.727		Logging officially ends

GPS Receivers

GPS data is usually logged at 10 second intervals. The NMEA strings GPGGA and GPVTG are logged for position, speed, and heading fixes. This data was logged constantly throughout the cruise.

The Tasmon GPS was the primary GPS for this cruise.

Trimble Tasmon P/Y Code Receiver

logging interval: 10 seconds
file id: gp1

The Tasmon is the primary GPS receiver for the Ewing Logging system and the primary GPS for Spectra fixes. The accuracy is around 15 meters. There were no interruptions during this

cruise.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+232:20:38:16.870		Logging officially started
2001+254:23:59:57.534		Logging officially ends

Trimble NT200D

logging interval: 10 seconds
file id: gp2

The Trimble is the secondary receiver for GPS data. Data is logged at 10 second intervals and is also used as an input to Spectra, although it is weighed at a lower value than the Tasmon receiver.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+232:20:38:27.063		Logging officially started
2001+233:07:44:38.180	2001+233:07:56:38.263	
2001+237:17:39:41.798	2001+237:18:23:22.137	
2001+237:18:25:47.631	2001+237:18:37:45.764	
2001+239:21:18:15.899	2001+240:06:40:37.892	
2001+240:12:05:57.777	2001+240:12:36:07.833	
2001+246:06:24:39.788	2001+246:06:39:35.875	
2001+254:23:59:51.984		Logging Ends

Tailbuoy Garmin GP8

logging interval: 10 seconds
file id: tb1

The tailbuoy was not used.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
		Tailbuoy logging starts
		Tailbuoy logging officially ends

Speed and Heading

Furuno CI–30 Dual Axis Speed Log
Sperry MK–27 Gyro

logging interval: 6 seconds
file id: fu

The Furuno and Gyro are combined to output speed, heading and course information to a raw Furuno file, as well as an NMEA VDVHW signal used as an input to various systems including steering and Spectra.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
2001+232:20:38:48.836		Official start date
2001+254:23:59:57.514		Official end date

Gravity

Bell Aerospace BGM–3 Marine Gravity Meter System

logging interval:	1 second
file id:	vc. (raw), vt. (processed)
drift per day:	0.035

The BGM consists of a forced feedback accelerometer mounted on a gyro stabilized platform. The gravity meter outputs raw counts approximately once per second which are logged and processed to provide real–time gravity displays during the course of the cruise as well as adjusted gravity data at the end of the cruise.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	Log Date	Comment
2001+232:20:39:02.459		Official start date
2001+254:23:59:59.354		Official end time

Bathymetry

Krupp Atlas Hydrosweep–DS2

logging interval:	variable based on water depth
file id:	hb (centerbeam), hs (swath)

The hydrosweep full swath data is continuously logged for every cruise, and centerbeam data is extracted and processed separately. The centerbeam operates at a logging frequency dependent on the water depth.

The full swath data is not routinely processed, but can be processed with the MB–System software which can be downloaded for free. For instructions, use the website: http://www.ldeo.columbia.edu/MB–System.

MBSystem, version 5.0beta3 is necessary to process data after June 1, 2001.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2001+232:21:00:50.000		Official start logging

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Log Date	LogDate	Comment
2001+246:00:14:42	2001+246:00:26:41	
2001+251:22:03:42	2001+252:09:40:15	
2001+254:23:59:55.000		Official end logging

Weather Station

RM Young Precision Meteorological Instruments, 26700 series

logging interval: 1 minute
file id: wx

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. We log this information at 1–minute intervals.

Log Date	LogDate	Comment
2001+232:20:39:27.61		Official start logging
2001+254:23:59:00.400		Official end logging

Magnetics

Varian Magnetometer

logging interval: 12 seconds
file id: mg

The following table shows the times the magnetometer was logging

Start Log Date	End LogDate	Comment

Gravity Ties

EW0108 Piraeus, Greece

Pier/Ship	Latitude	Longitude
	37 56.297N	23 38.160E

At the east corner of the pier in front of the Piraeus Port Authority building

Reference	Latitude	Longitude
	37 56.46N	23 38.40E

At the Lat/Lon reported by Andrew's handheld GPS, near the customs gate exit

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0104	104	04/14/2001	8.99	0.08	8.25
Post Cruise	EW0108	213	08/01/2001	22.69	0.126	8.99
Total Days			109.00	13.70		

Time	Entry	Value	
09:25	CDeck Level BELOW Pier	0.00	
10:13	Pier 1 L&R Value	3636.55	L&R
10:45	Reference L&R Value	3637.11	L&R
11:08	Pier 2 L&R Value	3636.55	L&R
	Reference Gravity	980048.20	mGals
	Gravity Meter Value (BGM Reading)	980072.00	mGals
	Potsdam Corrected	0	1 if corrected

*Gravity meter is **5.5** meters below CDeck*

	Difference in meters between Gravity Meter and Pier			5.50	meters
Height Cor =	Pier Height*	FAA Constant			
	5.50	0.31		1.71	mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) –	Reference	*1.06 L&R/mGal		Delta L&R	
3636.55	3637.11	1.06		–0.60	mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Pier Gravity	
980048.20	–0.60	0.00		980047.60	mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter	
980047.60	1.71			980049.31	mGals

Current Mistie

BGM Reading	Calculated Gravity			Current Mistie	
980072.00	980049.31			22.69	mGals

File Formats

For all formats, a **–** in the time field means an invalid value for some reason.

Streamer Compass/Bird Data   cb.r

```
This data is not processed, but can still be found in the "processed" data directory.

Shot Time              Line    Shot    Latitude     Longitude

2000+079:00:08:40.085 strike1 000296  N 15 49.6217 W 060 19.8019

2nd GPS Position                      Tailbuoy Position
Latitude    Longitude                 Latitude    Longitude

N 15 49.6189 W 060 19.8101    N 15 47.1234 W 060 20.1901

Furuno   Streamer
Gyro     Compasses & Heading

344.1       C01 2.3 C02 1.7  ...
```

Gun Depths   dg

```
Gun depths in tenths of meters.  There will always be 20 gundepths even if only one gun
was configured and shooting.

                       Gun Depths
Shot Time              1   2   3   4   5   6   7   8   9 ...  20

2001+089:06:47:05.909 189 068 005 005 096 005 060 054 005 ... 6
```

Raw Furuno Log   fu.s

```
This data has been smoothed and output 1 fix per minute.

CPU Time Stamp         Track Speed Hdg   Gyro

2000+166:00:01:53.091 –     4.4   140.5 148.3
```

Hydrosweep Centerbeam   hb.n

```
Hydrosweep data merged with navigation

                        Centerbeam
CPU Time Stamp         Latitude Longitude        Depth

2000+074:09:55:00.000 N 13 6.6206    W 59 39.3908   134.9
```

Merged Data   m

```
                                             GPS
CPU Time Stamp         Latitude     Longitude     Used  Set  Drift Depth

2000+200:12:25:00.000 N 45 54.1583 W 42 47.1770    gp1  0.0  0.0

Magnetic               Gravity
Total Intensity  Anomaly   FAA  GRV      EOTVOS  Drift   Shift

49464.7          55.5      22.2 980735.0  –8.4    –0.1    2.8

Temperature Salinity Conductivity

0.0       0.0       0.0
```

The gravity drift and shift are values that have been added to the raw gravity to make up for drift in the meter that has been lost in accordance with a gravity check at each port stop.

Temperature,Salinity and Conductivity will only be valid while logging a
Thermosalinograph, which is not usually the case.

Magnetics Data   mg.n

- A minus sign in the time stamp is flagged as a spike point, probably noise...

- Anomaly is based on the International Geomagnetic Reference Field revision 2000

CPU Time Stamp   Latitude   Longitude   Raw Value Anomaly

200+077:00:23:00.000 N 16 11.2918 W 59 47.8258 36752.2   -166.8

Navigation File   n

CPU Time Stamp   Latitude   Longitude   Used Set Drift

2000+074:00:03:00.000 N 13 6.2214 W 59 37.9399   gp1   0.0   0.0

Raw Gravity Counts   vc.r

sample BGM-3 gravity count record (without time tag):

pp:dddddd ss

```
|   |    |_____ status: 00 = No DNV error; 01 = Platform DNV
|   |                        02 = Sensor DNV;   03 = Both DNV's
|   |_____ count typically 025000 or 250000
|_____ counting interval, 01 or 10
                    The input of data can be at 1 or 10 seconds.
```

Gravity Data   vt.n

* A minus sign in the time stamp is flagged as a spike point

* m_grv3 calculates the Eotvos correction as:

  eotvos_corr = 7.5038 * vel_east * cos(lat) + .004154 * vel*vel

* The theoretical gravity value is based upon different models for the earth's shape.

        1930 = 1930 International Gravity Formula

        1967 = 1967 Geodetic Reference System Formula

        1980 = 1980 Gravity Formula

* The FAA is computed as:

  faa = corrected_grv - theoretical_grv

* Velocity smoothing is performed w/ a 5 point window

CPU Time Stamp   Latitude   Longitude   Model FAA   RAW

2000+148:00:10:00.000 N 09 34.7255 W 085 38.5826 1980 9.48   978264.16

Eotvos	Drift	DC	Raw Velocity		Smooth Velocity	
Smooth	Total	Shift	North	East	North	East
-74.78	0.06	4.16	1.875	-10.373	1.927	\10.166

Datum Time   ts2.r

CPU Time   Datum Time   Time Reference

2001+069:00:15:29.727 069 00 15 29.378 datum

Raw GPS is in NMEA Format.

Meteorological Data   wx

```
                          True
CPU Time Stamp          Spd Dir

2001+045:00:00:00.967   7.8  22

Bird1:                                        Bird 2
Speed                   Direction             Speed                   Direction
Inst  60sA    60mA   60sM  Inst 60sA 60mA     Inst   60sA   60mA   60sM   Inst 60sA 60mA

7.8   6.6    8.5    16.8  277  291  5         0.0   0.0   0.0   0.0    0    0    0

Temperature                   Humidity
Inst  60mA  60mm   60mM       Inst 60mm 60mM          Barometer

15.0  14.2  14.3   15.1       92   90   93            1027.5

Inst:        Current

60sA:        60 second average

60mA:        60 minute average

60sM:        60 second maximum

60mm:        60 minute minimum

60mM:        60 minute maximum
```


Merged Meteorological Data   mmet

```
TSG, WX, CT merged with Nav at 1 minute fixes
date        time        lat       lon       gpu head spd
2001+244:00:00:00.000 12.14071 44.98469 gp1 10.2 83.0


tws   twd    temp hum  press   cti  cte   con sal   ct
26.5 228.0 30.6 87.0 1000.8 28.8 28.8 5.9 36.3 28.8


gpu  = gps unit in use

head = ship's heading

spd  = ship's speed in knots

tws  = true wind speed

twd  = true wind direction

temp = air temp (celcius)

hum  = relative humidity (%)

press= pressure in mb

cti  = sea temp from the internal TSG sensor

cte  = sea temp from the external TSG sensor

con  = conductivity, Siemens/meter

sal  = salinity, practical salinity units

ct   = sea temp from the C-keel sensor (to tenths of a degree)
```

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Tape Contents

```
EW0110/
        EW0110.pdf              this document
        ew0110.cdf              NetCDF database file of this cruise
        ew0110.cdf_nav          NetCDF database file of this cruise' navigation
        docs/                   File Formats, etc.
        processed/              Processed datafiles merged with navigation
                trackplots/             daily cruise track plots (postscript)
        raw/                    Raw data directly from logger
            •   0110ds2.d*      Hydrosweep Bathymetry in mb183 format
        reduction/              Reduced data files
                clean/                  daily processing directory, includes daily
                                        postscript plots of the data.
        mbsystem/               Mbsystem 5.0b3 SPARC + source
    •   raw−shipboard−ADCP/
    •
```