



# Atlantic Oceanographic & Meteorological Laboratory

National Oceanic & Atmospheric Administration



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**September 2008**

## **Cruise Plan – AX7**

**Ship Name:** *M/V Hapag Lloyd Rome Express*

**Project Title:** Atlantic Climate Change Program  
Volunteer Observing Ship High Resolution XBT Line AX7

**Beginning date:** On or about 25 September 2008 from Barcelona, Spain

**Ending date:** Arriving Fort Lauderdale, Florida on or about 7 October 2008

**Loading date:** 2 September 2008, Port Everglades, Florida, USA

**Scientific Ship Rider:** Jim Farrington, NOAA/AOML

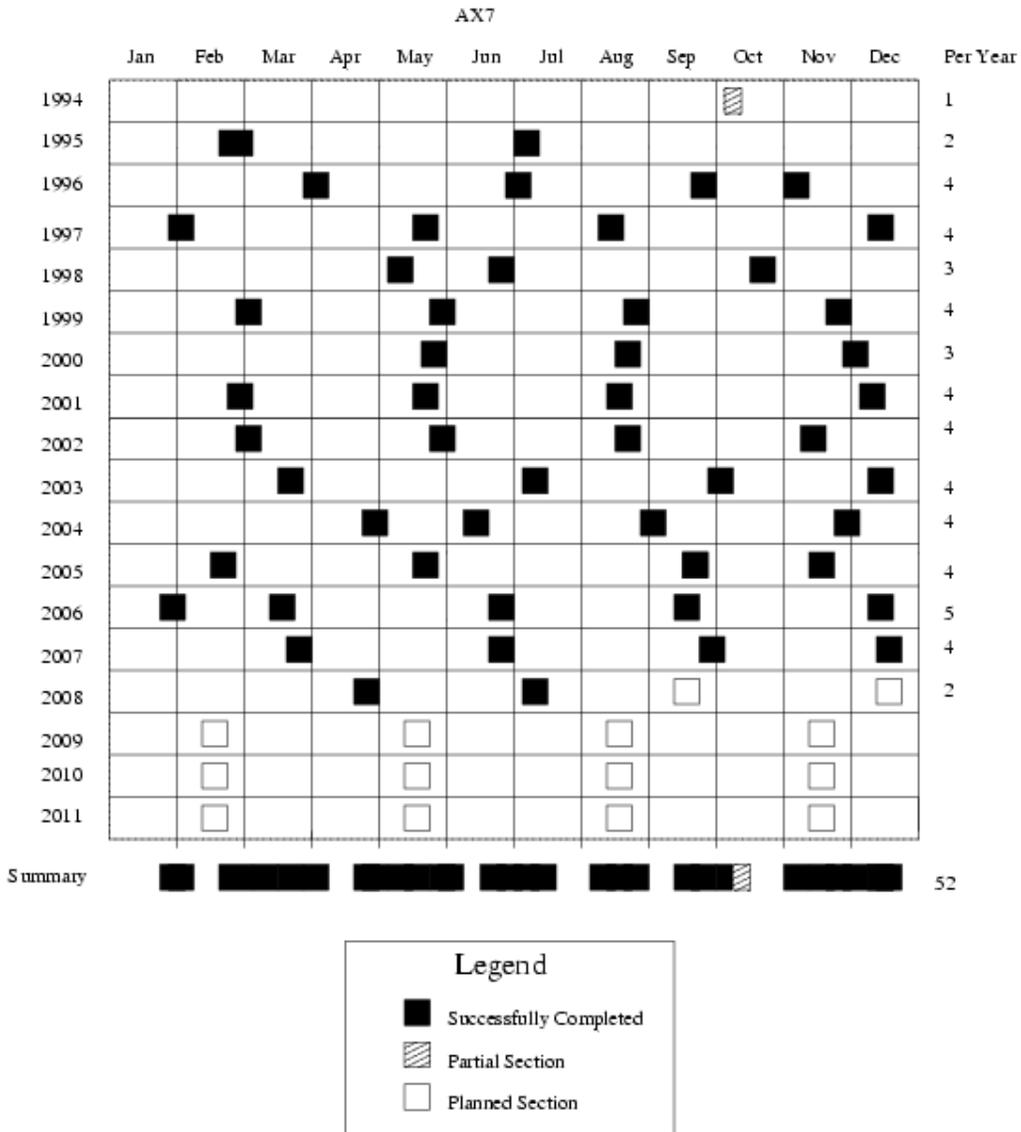
## **Description of the Scientific Program**

The volunteer ship, *M/V ROME EXPRESS*, will be involved in a study of the upper ocean thermal structure of the subtropical North Atlantic Ocean within the context of the Atlantic Volunteer Observing Ship Program. Repeat crossings of the center of the subtropical gyre, every 3 months, will be conducted with the intent of determining and monitoring the seasonal-to-interannual variability of the upper ocean. This particular line along nominally 30° N, designated as AX7, is ideal for monitoring heat flux variability in the Atlantic because it lies near the center of the subtropical gyre which has been shown to be the latitude of the maximum heat flux in the ocean. The upper ocean thermal structure obtained by the voluntary observing ship (VOS) using the expendable temperature probes (XBTs) will be used to correlate the subtropical gyre intensity with atmospheric forcing as well as determining the heat transport. XBT data along this latitude will be compared and combined with several ongoing and historical studies including estimates of the Florida Current and Deep Western Boundary Current Transports and several full water column historical surveys completed near the same latitude. The new higher resolution for this line should help determine the correct sampling strategies for lower resolution XBT lines as well as providing resolution of the

eddy structure so necessary to incorporate into the atmospheric-ocean forecast models now being implemented at the National Meteorological Center.

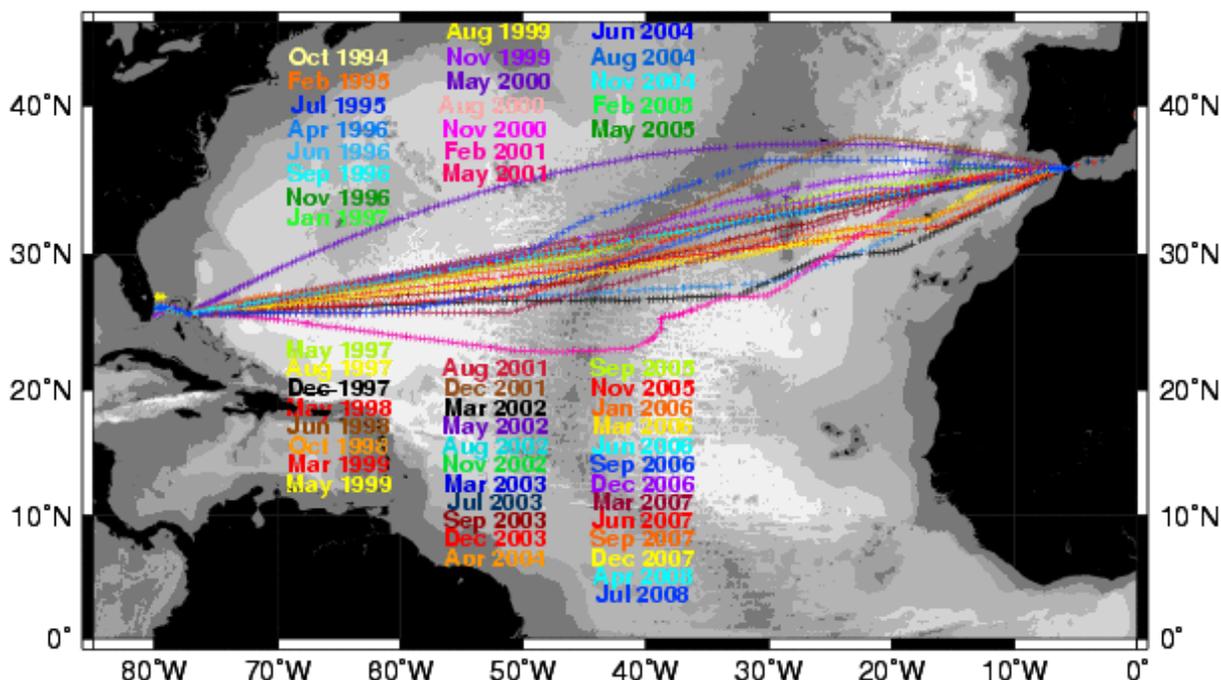
**Implementation**

The first crossing of this VOS line (designated AX7) began on September 30, 1994 (Figure 1). We have more or less proceeded on the same route since that time (Figure 2). This VOS line will meet WOCE criterion for high-resolution deployment providing temperature profiles every 50 km in the open ocean and between 10-30 km near boundary currents down to a depth of about 800 m. This section emphasizes consistent horizontal spacing of XBT probes: clusters in space or time are of little value.



**Figure 1:** Table of times of all section occupations since the program began in 1994.

## AX7 XBT Positions



**Figure 2:** Map of station locations of all XBT sections taken along AX7 since the program began in 1994.

**PLEASE NOTE: IT IS THE RESPONSIBILITY OF THE RIDER TO ENTER THE SHIP'S LLOYDS NUMBER AND CALLSIGN INTO THE SEAS METADATA SETUP.**

The overall plan for the ship track is as follows:

- From Barcelona, Spain to 5°20' W, 36° N: Set up and test XBT launcher as desired. No planned sampling.
- From near 5°20' W, 36° N to near 7° W, 36° N: High resolution sampling every 10 km: i.e., 15 probes over 150 km deployed every 22 minutes.
- From near 7° W, 36° N to near 70° W, 26°30' N: Standard sampling every 50 km: i.e., 120 probes over 5990 km deployed every 1 hour and 48 minutes.
- From near 70° W, 26°30' N to near 76°20' W, 26° N: Medium resolution every 30 km: i.e., 21 probes over 635 km deployed every 1 hour and 5 minutes.
- From (76°20' W, 26° N) to Hole in the Wall, Abaco (near 77°20' W, 25°40' N) : High resolution sampling every 10 km: i.e., probes over 107 km deployed every 22 minutes.
- Northwest Providence Channel: From Hole in the Wall, Abaco (near 77°07' W, 25°48' N) to the Western end of the Providence Channel (near 79°05' W, 26°10' N): Medium resolution sampling every 30 km: i.e., 6 probes over 176 km deployed every 1 hour and 5 minutes.
- Florida Straits: From the end of the Providence Channel (near Great Isaccs, Bahamas, 79°12' W, 26°10' N) to 80°00' W, High resolution sampling every 12 nautical miles (8 probes), then 1 final drop between 80°02' W and 80°01' W.

The above sampling time-interval time interval estimates are based on a ship traveling at 15 knots. If the ship is traveling at a different speed it will be necessary to adjust the launch times (see table 1 as a quick guide).

Ship Speed knots	Desired Sample Spacing			
	10 km	15 km	30 km	50 km
10	32 min	49 min	1 hr 37 min	2 hr 42 min
11	29 min	44 min	1 hr 28 min	2 hr 27 min
12	27 min	41 min	1 hr 21 min	2 hr 15 min
13	25 min	37 min	1 hr 15 min	2 hr 4 min
14	23 min	35 min	1 hr 10 min	1 hr 55 min
15	22 min	32 min	1 hr 5 min	1 hr 48 min
16	20 min	30 min	1 hr	1 hr 41 min
17	19 min	29 min	57 min	1 hr 35 min
18	18 min	27 min	54 min	1 hr 30 min
19	17 min	26 min	51 min	1 hr 25 min
20	16 min	24 min	49 min	1 hr 21 min

**Table 1.** Time interval between XBT launches based on ship speed and desired sampling spacing.

If the planned cruise track deviates significantly from the outline above please notify Molly Baringer at (305)361-4345 or (305)710-9240.

If the planned sampling is interrupted for any reason (such as an autolauncher failure) the procedure will be to drop another probe as close as possible to the planned drop and continue with the desired spacing of the XBTs for that section of the cruise track (according to the above guide). If a serious malfunction of the autolauncher occurs then manually deploy the XBTs from the stern of the ship using the hand launcher.

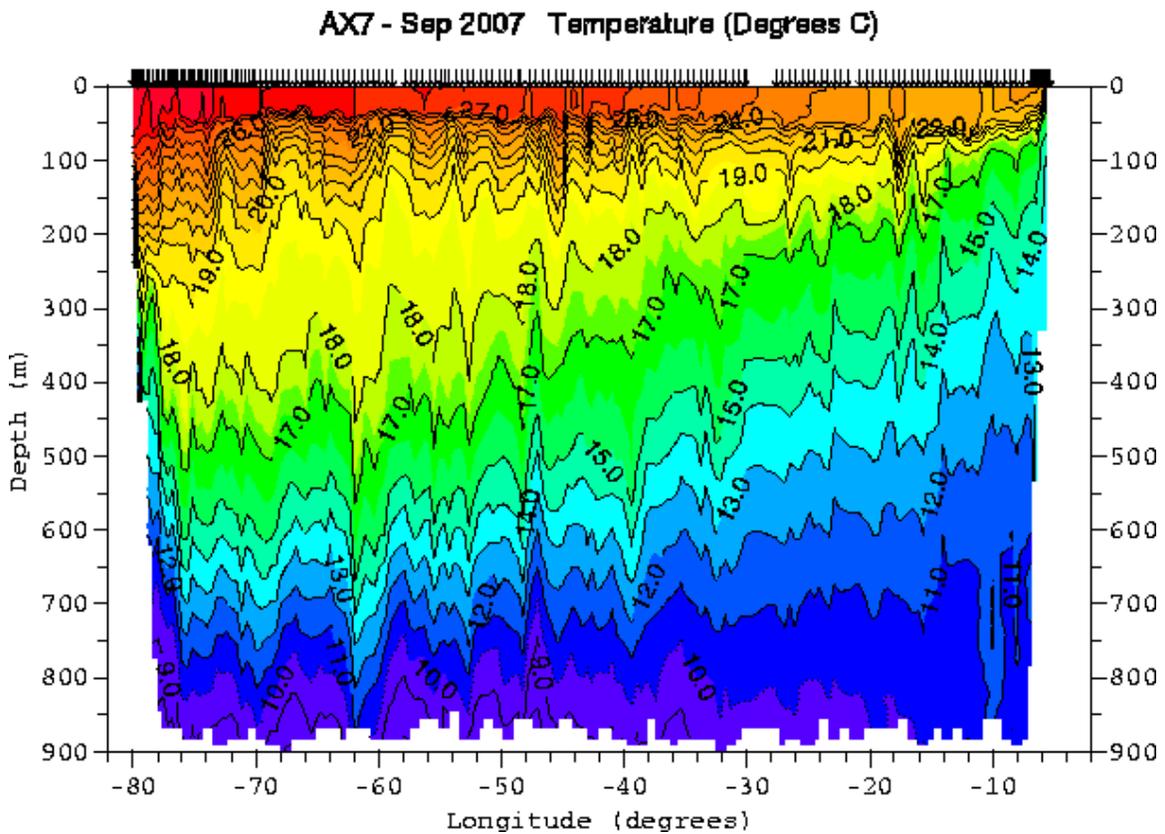
The ship-rider will work as needed around the clock to:

- 1) Check and load the auto-launcher;
- 2) Check that the system is logging data correctly; and
- 3) Deploy ARGO profiling floats and surface drifting buoys as necessary.

In addition to the above, four (4) surface drifting buoys were loaded aboard the ship. Deployment positions for the floats will be determined at a later date.

### **Summary**

This high resolution XBT line will require 240 probes plus an anticipated 10% failure rate of 24 probes for each Atlantic crossing. This requires a total of 264 probes per crossing. Drifting buoys will also be deployed during the cruise. ARGO floats will not be deployed during this cruise.



**Figure 3.** This figure shows a temperature section of a typical crossing along the AX7 route. Temperature contours shown on the figure are in  $^{\circ}\text{C}$ . This section was taken aboard the *BARCELONA EXPRESS* in September of 2007.

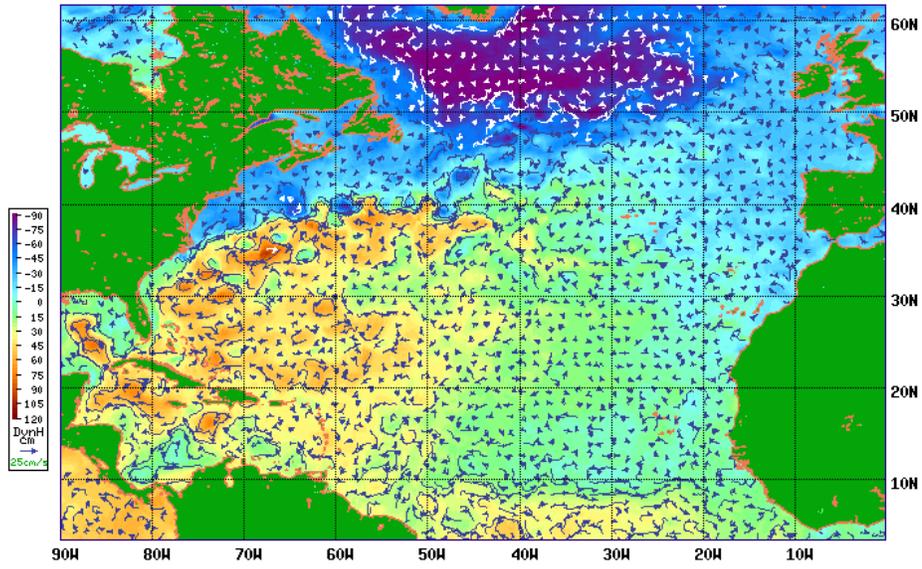
Figure 3 shows a typical temperature section across the subtropical Atlantic. Some features in these sections include:

- Increase depth of isotherms (constant temperature surfaces) towards the west (e.g.,  $15^{\circ}\text{C}$  isotherm starts near 100m in the east and deepens to over 650m in the west).
- A rapid decrease in the depth of isotherms near the western boundary (where the Florida Current and Azores current bring warm water northward).
- Warmest surface water is found in the west (near the Gulf Stream/Florida Current and the subtropical gyre recirculation).
- Large fluctuations in the depth of temperature surfaces between  $20\text{-}30^{\circ}\text{W}$  where the Azores current crosses the section.

Typical currents expected in the region are shown in Figure 4. The XBTs deployed will identify the vertical structure of the mesoscale features present in the region.

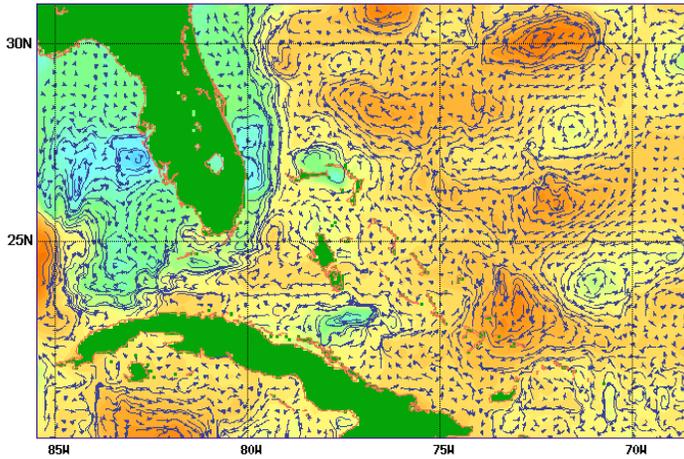
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CoastWatch NOAA/AOML  
Altimeter/GTS Interface



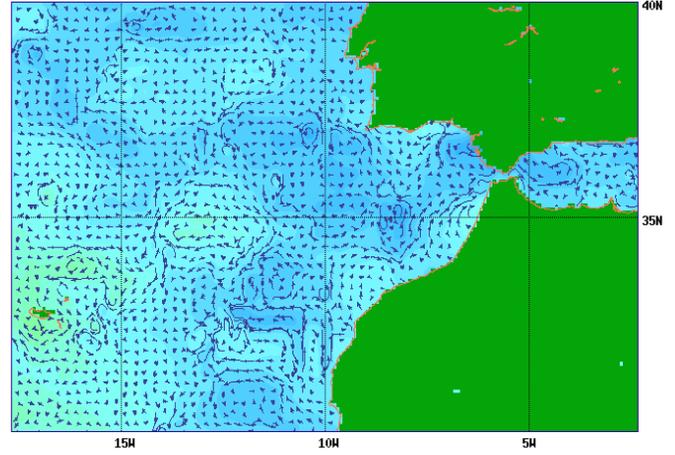
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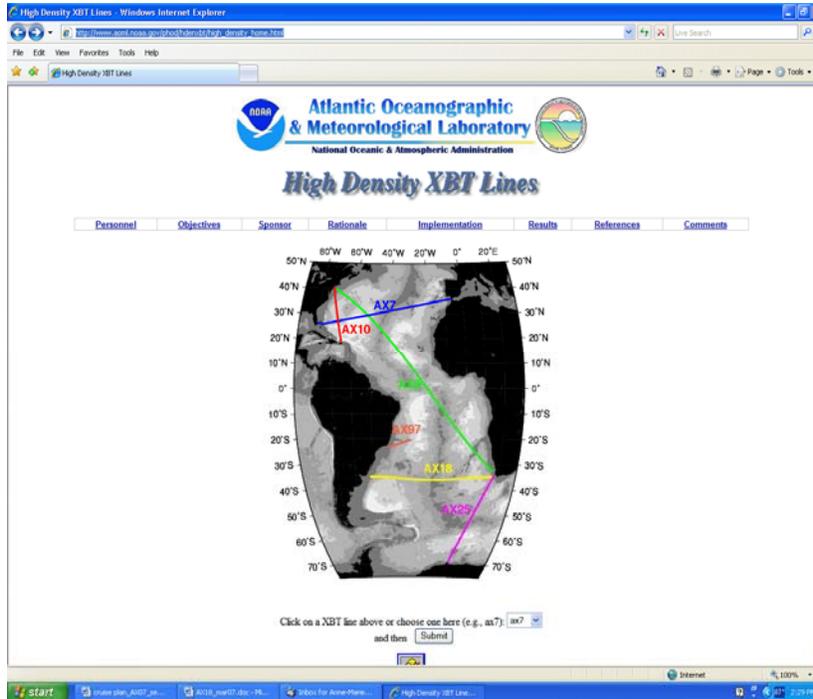


**Figure 3.** Satellite altimetry-derived surface currents and dynamic height in the North Atlantic for 12 September 2007.

## Available Data Products

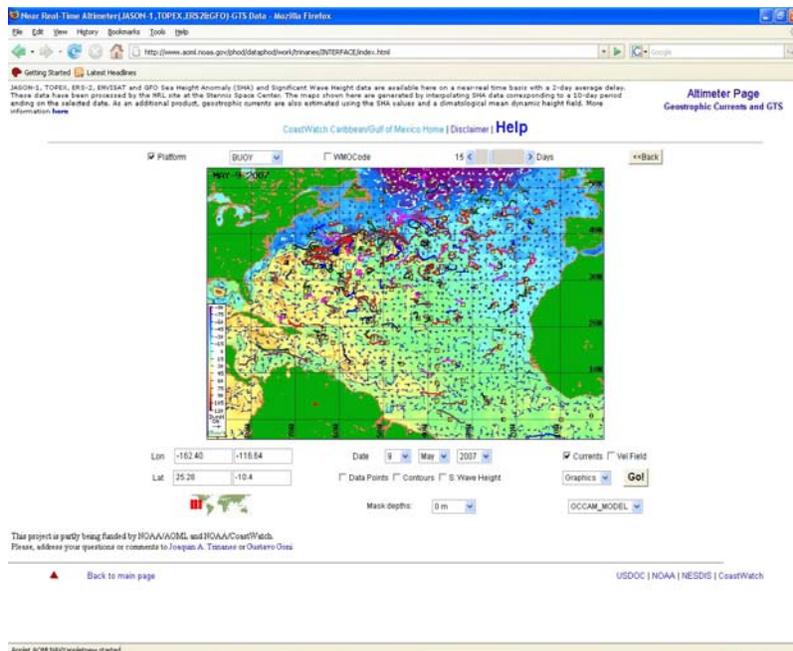
Temperature sections and information on XBT deployments can be found on the following web page:

[http://www.aoml.noaa.gov/phod/hdenxbt/high\\_density\\_home.html](http://www.aoml.noaa.gov/phod/hdenxbt/high_density_home.html)



Real-time surface winds and ocean surface currents can be found at:

<http://www.aoml.noaa.gov/phod/dataphod/work/trinanes/INTERFACE/index.html>



**High Density Check-out list for the Ship Rider**

Date Completed

*Data to be copied to CD or other means of transportable memory* \_\_\_\_\_

1. All XBT data in .BIN, .NDC and electronic XBT drop log sheet.
2. HistoryAllAttempts.txt – found at c:\ProgramFiles\AMVERSEAS\XBT\ARCHIVE
3. Cruise webpage summary, cruise report, drifting buoy log sheet and ARGO float log sheet

*XBT data and HistoryAllAttempts.txt CD to each of the following:*

Robert Roddy \_\_\_\_\_

Qi Yao \_\_\_\_\_

Sommyr Pochan \_\_\_\_\_

*Argo deployment information while underway:*

e-mailed to: [aoml.argo@noaa.gov](mailto:aoml.argo@noaa.gov) and [robert.i.rodny@noaa.gov](mailto:robert.i.rodny@noaa.gov) \_\_\_\_\_

*Drifting buoy deployment information while underway:*

[shaun.dolk@noaa.gov](mailto:shaun.dolk@noaa.gov) \_\_\_\_\_

*Cruise webpage summary.* This information goes on the webpage including number XBTs dropped, drifters/floats deployed, any data affecting issues. Send an email to each of the following:

Gustavo Goni	<a href="mailto:gustavo.goni@noaa.gov">gustavo.goni@noaa.gov</a>	_____
Molly Baringer	<a href="mailto:molly.baringer@noaa.gov">molly.baringer@noaa.gov</a>	_____
Qi Yao (XBTs)	<a href="mailto:qi.yao@noaa.gov">qi.yao@noaa.gov</a>	_____
Silvia Garzoli	<a href="mailto:silvia.garzoli@noaa.gov">silvia.garzoli@noaa.gov</a>	_____
Shaun Dolk	<a href="mailto:shaun.dolk@noaa.gov">shaun.dolk@noaa.gov</a>	_____
Sommyr Pochan	<a href="mailto:sommyr.pochan@noaa.gov">sommyr.pochan@noaa.gov</a>	_____

*Please email a Cruise Report to Molly Baringer, Silvia Garzoli and Gustavo Goni stating the following:*

- XBTs deployed
- Drifters deployed (ID, date, time, latitude, longitude)
- Profiling floats deployed (start time, deployment time, latitude, longitude)
- GTS transmission (Real-time, twice a day, problems)
- Additional equipment, tools, supplies needed
- Problems
- Recommendations
- Other narrative

*At the end of the cruise please send an e-mail to Sommyr Pochan [sommyr.pochan@noaa.gov](mailto:sommyr.pochan@noaa.gov) notifying her that cruise is over so that a thank you note can be forwarded to the captain and crew. List any special thanks or comments that you would like included in the note.*