I. Cruise Report

A.Cruise Narrative

A.1 Highlights

Expedition Designation

A.v.Humboldt Cruise 6-92

Chief Scientist

Leg 1-4: Eberhard Hagen, IOW

Abbrevations:

IOW: Institut fuer Ostseeforschung Warnemuende, Germany.

Ship

R/V A.V.Humboldt

Ports of Call

Leg 1: Rostock, Germany to -
Leg 2: - to Las Palmas,Canaries
Leg 3: Las Palmas to Lisboa, Portugal
Leg 4: Lisboa to Rostock

Cruise Dates

Leg 1: September 2 to September 9, 1992
Leg 2: September 9 to September 26, 1992
Leg 3: September 28 to October 6, 1992
Leg 4: October 8 to October 14, 1992

A.2 Cruise Summary

Cruise summary report and station locations - see annexed paper.
Station maps also on floppy:
\AvHumbol.692\map.bmp

Subjekt of Leg 1 and 2: WOCE : Eastern Boundary Currents 5
Subjekt of Leg 3 and 4: AMOR 92= Atlantic Measurement of Oceanic Radiation : Skin-Bulk-SST Relationship

Measurements

During the cruise a total of 171 CTD/rosette stations were occupied using a CTDO equipped with a rosette of 12*2.7 l teflon-type water sampling bottles.

.CTDO and sound speed;
.salinity and oxygen of water samples;
.temperature and pressure by reverse deep sea thermometers
.stepwise current meter profiling (0-500m) using GPS navigation system : 32 stations

.AMOR 92 - Experiment:
-skin-bulk-SST by means of Heiman KT4 radiometer (8-14 *10**-6m): 30 days
-air-pressure,-temperature,-humidity up to an average attitude of about 22 km by radiosondes: 48 starts
-underwater radiation 12 stations
-pyranometer 30 days

.meteorological standard parameters : 30 days
.chlorophyll filtration 12 stations
.flourescence down to 300 dbar 12 stations

A.3 Principal Investigators

E. Hagen	CTDO,S,O2, Current Profiles Fluorescense	IOW
R.Feistel	SST	IOW
C.Zuelicke	Meteorology	IRSA
D.v.d.Linde	Underwater radiation	IRSA
N.Hoeffner	Chlorophyll	IRSA
E.Mittelstaedt	Current (moorings)	BSH

A.4 Preliminary Results

are described in annexed paper: Wissenschaftlich-technischer Fahrtbericht...

A.5 Major Problems

At station 177 the OM-87 probe No 2 was lost during the up cast when the cable teared.
From station 178 to 235 the OM-87 probe No 3 was used.

A.7 List of Cruise Participants

Name	Responsibility	Affiliation
Leg 1 - 4		
Eberhard Hagen	Chief Scientist radiosondes starts	IOW
Rainer Feistel	Skin-Bulk-SST	IOW
Stefan Weinreben	CTD-Software	IOW
Henry Will	CTD Hardware Current Profiling	IOW
Christoph Zuelicke	Skin-Bulk-SST	IRSA
Guenter Plueschke	Salts, CTD Winch	IOW
Wolfgang Hub	Oxygen, CTD Winch	IOW
Dieter Fritsch	Precision Mechanics	S-GmbH-R
additional		
Leg 1,3,4		
Dirk van der Linde	Underwater radiation	IRSA
Leg 3		
Nicolas Hoeffner	Underwater radiation	IRSA
Wolfgang Lange	Moorings	BSH
Holger Giese	Moorings	BSH
A.J.Lakhdar Idrissi	Observer	ISPM

Abbreviations:

S-GmbH-R: S.F.Bau & Service GmbH,Rostock, Germany.
IRSA:(Joint Research Centre) Institut for Remote Sensing Applications, Marine Enviroment, Ispra, Italy.
BSH: Bundesamt fuer Seeschiffahrt und Hydrographie, Hamburg, Germany.
ISPM: Institut Scientifique des Peches Maritimes, Casablanca, Marocco.

B. Measurement Techniques and Calibrations
CTDO - Salinity - Oxygen
WOCE-Stations 128-235 only

B.1 CTDO

B.1.a Equipment and Techniques

During the cruise two CDTO probes (No2 and No3) were used.

Description of the CTDO (WLOST 1993):
The CTDOs and the sensors are manufactured at the Institut fuer Meereskunde Warnemuende (IfMW), Germany. The CTDO is an OM-87 = Oceanological Measuring System, consisting of an expandable

dividing CTDO-probe, interfaced through a special designed slave-computer, a meteorological subsystem interfaced by a second slave-computer and a master-PC. The IfMW began to develope oceanological measuring systems in the 60th. The first computer controlled CTD-system, OM-75 (MOECKEL 1980) was taken into service in 1976. The new generation: OM-87 has been used since 1988.

The CTD is equipped with frequency-analogous sensors at standard ports, developed and manufactured by IfMW; the oxygen sensor together with FSI "Kurt Schwabe",Meinsberg,Germany.

CTDO - Sensor Configuration List

CTD No/ Stat.No.	parameter	sensor	resolution	precision
2/ 128-177	pressure	P600	0.2 dbar	5 dbar
3/ 178-235		P082	0.14dbar	2 dbar
2/ 128-177	temperature	T103	0.0015 K	0.01 K
3/ 178-235		T124	0.0015 K	0.01 K
2/ 128-177	conductivity	C884	0.0008mS/cm	
3/ 178-235		C857	0.0008mS/cm	
2/ 128-177	oxygen	O024	demaged	
3/ 178-235		O023	0.01 ml/l	0.1ml/l
2/ 128-159	sound speed	V218	0.025 m/s	0.3m/s
2/ 160		V218	demaged	
2/ 161-168		V111	0.025 m/s	0.3m/s
2/ 169		V111	demaged	
2/ 170-177		V212	0.025 m/s	0.3m/s
3/ 178-180		V210	0.025 m/s	0.3m/s
3/ 181-235		V218	0.025 m/s	0.3m/s

B.1.b CTDO Sampling procedure and data processing

Sampling procedure

CTDO was recorded on hard disk during the down casts.

sampling rate : 1 record in 1.2 s = 0.83 Hz.
integration time of sensors :1 s
lowering speed of CTD: 1.0 m/s
time constants: pressure and temperature sensors = 0.1 s
conductivity sensor = 0.1 s at 1 m/s lowering speed

The precalibration constants of pressure
temperature
conductivity
sound speed sensors and
the recalibration constants of the oxygen sensors
were used over the whole cruise.
The check mesurements of CTDO and water sample data (in situ comparisions)were used for calculating the post-cruise corrections.

Post-Cruise CTD Data Processing

The raw data are digitized frequencies, which had been converted to physical units of pressure, temperature, conductivity, oxygen and sound speed.

A validation routine was applied to the CTDO down cast data (LASS et.al. 1983), to eleminate:
- data values, which are not physically realizable
- random errors by recursive low-pass filtering(ACHESON 1975)
- systematic errors: caused by the effect of ship's rolling and pitching on the lowering rate of CTD. Records aquired while CTD is moving down too slowly have been discarded to enforce a strict monotonic sequence in pressure.

The so called eddy-algorithm in connected view with the values of sensor integration time and lowering rate reduse the effect of different time lags of the sensors to minor importance.

The calculation of salinity from conductivity and convertion of dissolved oxygen from volumetric to weight concentration were done last after correcting the data as described below. Dissolved oxygen was converted according to WOCE O.M.(1991).

The data have *not* been averaged finally in 2 dbar increments because of the low sampling rate of the CTD and a great amount of discarded records in the course of data processing - up to 50 pc on average.

Post-Cruise CTD Data Corrections

In order to get the CTDO to match the water sample data, following fits were applied to CTDO:

CTDO-Stat.No.	Sensor	Fitting Param.		Fitting Polynoms
	pressure:	linear fit:		$PRES_{fitted}$=A0+A1*PRES
		A0	A1	
128-130	P600	-13.5	1.0	
131-160	P600	- 1.43	1.01821	
161-169	P600	13.74	1.02355	
170-177	P600	- 1.87	1.02233	
178-235	P082	- 0.7	1.0	

CTDO-Stat.No.	Sensor	Fitting Param.	Fitting Polynoms
	temperature: linear fit ; $TEMP_{fitted}$=A0+A1*TEMP		
		A0	A1
128-177	T103	0.02373	0.990516
	temperature: time dependend correction		$TEMP_{corr.}$=TEMP+A0+A1*TIME
TIME/hours=Beginning time of cast(in continuously caunted hours of the year: January 1; 0 o'clock: TIME=0 hours)			
		A0	A1
178-253	T124	-1.47842	2.45E-4
	conductivity: linear fit ; $COND_{fitted}$=A0+A1*COND		
		A0	A1
128-177	C884	4.009E-2	0.991363
178-235	C857	0.1816	0.993873
	oxygen: data discarded		
128-177	O024		
	oxygen: linear fit:		$OXYG_{fitted}$=A0+A1*OXYG
	(ml/l)	A0	A1
178-235	O023	0.0	0.133876
	oxygen: pressure correction		$OXYG_{corr.}$=$OXYG_{fitted}$+A0+A1*PRES
	(ml/l)	A0	A1
178-235	O023	-0.525	6.89E-4
	sound speed: no fit		
128-235	all used sensors		

B.1.c Calibration

All sensors were precalibrated at the calibration labority of IOW.
Each oxygen sensor was recalibrated with water samples during the cruise at the first station when it was taken in use . The calibration constants of all sensors were checked up by in situ comparisions of p, T, C, O2.

B.1.e Errors and Noise

During the cruise located faulty sensors were replaced as listed above in the CTD sensor configuration list.

After the cruise following sensor failures were detected and the data were discarded:

	oxygen	from station 128-177

B.2 Water Sampling for In Situ Comparisions

B.2.a,b Techniques and sampling procedures

After finishing the down cast (CTDO-recording),the CTD was liftet and stopped within well mixed layers. After 10 minutes waiting to let the deep-sea thermometers adapt to the surrounding temperature two water bottles were tripped while a short time CTDO recording. The deep sea thermometers (2 protected and 2 unprotected) were reversed simultaneously with the first bottle tripping.

When the first bottle of each sampling depth tripped correctly the water samples (3 dissolved oxygen and 3 salinity) were drawn from these bottles, otherwise from the second ones.

The S and O data of the water samples so as the reverse temperature and -pressure data were used for the post-cruise corrections of CTDO data.

Salinity

The water sample salinities were measured with a Guildline Autosal Modell 8400A salinometer, manufactured by Guildline Instruments Ltd.,Smiths Falls,Canada. The salinometer was standardized weekly with I.A.P.S.O. Standard Seawater (SSW) Batch P 115. Differences in standardization readings were less than 3.

The salinometer manufacturer claims a precision of 0.0002 and an accuracy of better than 0.003;better than 0.001 when the laboratory temperature is constant (+-1 K) and about 1-2 K below the bath temperature of the salinometer.

Oxygen

The dissoloved oxygen samples were analysed by the Winkler Titration Method modificated by CARRITT and CARPENTER (1966).

Temperature (reverse thermometers)

The following reverse thermometers were used:
manufactured by: VEB Thermometerwerk Geraberg,Germany

	scale	graduated in
pressure protected	-2...+30degC	0.1K
unprotected	-2...+30degC	0.1K

manufactured by Gohla-Precision, Kiel,Germany :

	scale	graduated in
pressure protected	-1...+35degC	0.1K

Duplicate Water Samples

Two or three duplicate salinity and oxygen samples were drawn from a bottle usually.
The differences between the salinity and oxygen measurements of the duplicate water samples and the standard deviation of the differences are shown in the following table:

	average differenz between samples	maximum diff.	standard deviation of all differences
salinity	0.0012 PSU	0.014 PSU	0.0023
oxygen	0.023 ml/l	0.1 ml/l	0.0153

B.2.f Laboratory and Sample Temperatures

The laboratory was temperature controlled :24...26 degC.
The bath temperature of the Autosal salinometer was set to 27 degC.
Salinity and oxygen samples had been tempered at room temperature when measured.

B.2.i Standards used

I.A.P.S.O Standard Seawater ,Batch P115, 6.2.91
During the cruise this batch was used only.

C. References

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