WECOMA DAS System

Two Pentium III based computers serve as the heart of the data acquisition system. A LabVIEW program is used for task management running under the Win 2000 operating system. One computer runs the DAS program, and the other machine serves as a backup. The backup machine runs a data quality checking program, which is also a LabVIEW program. There are two serial boards in each of the computers, one of which is an 8-port RS-232 card and the other is a 2-port RS-485 card.

Three of the eight RS-232 channels are used for GPS, which are P-Code, Differential and Ashtech. The barometer, GPS time, and echosounder are also collected via the RS-232 card. The RS-485 board is used to collect data from the EDO speedlog and a network of Keithley modules.

The Keithley modules are 15-bit resolution analog to digital converters, with a rated accuracy of 0.02% of full scale. There are a variety of types of these modules used. Modules implemented in the system have input ranges that handle +/- 5 volts, +/- 1volt, +/- 100 millivolts and also frequency. The modules are used to read the analog values for the anemometer, relative humidity, air temperature, par, psp, pir, pir case and hemisphere temperatures, heading, wind speed and direction from both the port and starboard sides, and the flow through fluorometer. There are also two modules meant for science party provided analog instruments. The frequency modules support SBE temperature and conductivity sensors, which are used for the sea surface temperature, and the flow through temperature and conductivity.

The sensor output values, at the modules, are sampled approximately twice a second and averaged over a period of one minute. The data in a one-minute record includes for each analog instrument the mean, minimum and maximum values, the number of samples and the mean value in engineering units. The RS-232 inputs are sampled once during the one-minute record, except for the P-Code, which contains the speed over ground and course over ground used in computing the true winds. These two factors are sampled approximately every ten seconds.

The DAS machine stores the one-minute records in one-hour files, with separate computers doing the primary record storage. The primary storage machines store not only the

one-minute records in one hour files, but also filters or cooks the data into 24 hour blocks. The cooked files contain the engineered mean values for each minute record, and format them into a comma delimited text file. The science party is given a data CD, at the end of each cruise, which contains the das, adcp, echosounder, and other applicable data such as ctd, and mocness data. The system documentation is also recorded on the disk.

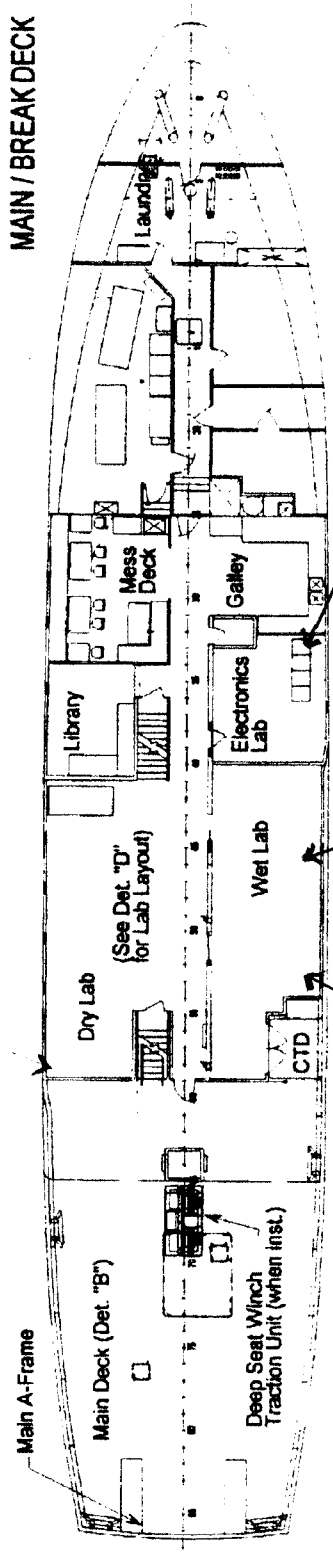
The documentation files include separate folders for calibration sheets, configuration of the das and CTD systems, and instrument documentation. The calibration folder contain separate folders for the copies of MET and CTD sensor calibrations. Each of these folders contains calibrations for both the sensors in use and any spare sensors onboard the ship. The configuration folder contains documents which have the MET and SBE sensor lists, which provides type and serial numbers for the sensors in current use and as spares. The folder also contains documents on the format of the one-minute records and the configuration file. The instrumentation documentation folder contains MET instrument specifications file, a file with some of the NMEA definitions that are used, and a file explaining how true winds are calculated by the DAS program, which is based on "Establishing more truth in true winds" by S.R. Smith, M.A. Bourassa and R.J. Sharp. There is also a file with a copy of the wind navigation definitions from the same paper.

The SBE sensor calibrations can be found on the OSU Marine Technicians WEB site. It has the current, as well as all past, calibrations for each sensor. It is a future goal of mine to make sure all our sensor calibrations, and information, will be available on the WEB.

I don’t know, and don’t believe, that the quality of our current data is high enough to be distributed as high-resolution data. Part of the problem is, I don’t know exactly what constitutes a high-resolution data system. Funding is probably not our biggest obstacle in achieving better quality data. Lack of training and the man-hours needed, for calibrations, data quality checking and needed programming changes, are our greatest impediment to achieving a high-resolution data system. I know everyone in our group would like to raise the quality of the data we provide.

There are some simple things that would improve the data quality, ease of use and availability. To make the documentation provided with the data more user friendly, it was recently pointed out to me, that I should provide a 'read_me' file detailing folder and file content. Toby, the computer specialist within our group, is working on project that will display a subset of the data on shore in near-real time. The graphed data will eventually be available on the WEB. I am hoping to learn at this workshop whether the data should have any averaging of samples. Changing over to a system of saving every sample is doable, maybe not at two hertz though. Making these changes and changing some of the sensors should improve our data quality.

There is a request for ultrasonic wind monitors in our 2003 instrument proposal. An ultrasonic wind monitor can be placed on the highest point of our mast, so there would be an unobstructed 360-degree field. These monitors also have no dead-band, which would additionally increase the accuracy of the wind measurements. With no moving parts these monitors also don't have the problems with fouling by engine exhaust, as we have seen with the mechanical wind monitors. Having access to the sensors, such as the PIR or PSP, to perform routine cleaning is an on-going problem. Getting on top of the doghouse to perform sensor cleaning is not always possible. Although cleaning does not take much time, there are often other tasks that have a greater priority, especially since there is usually only one marine technician on-board per cruise. These problems plus the lack of time to devote to ensuring calibrations are done in a timely manner all degrade the quality of data we can provide.

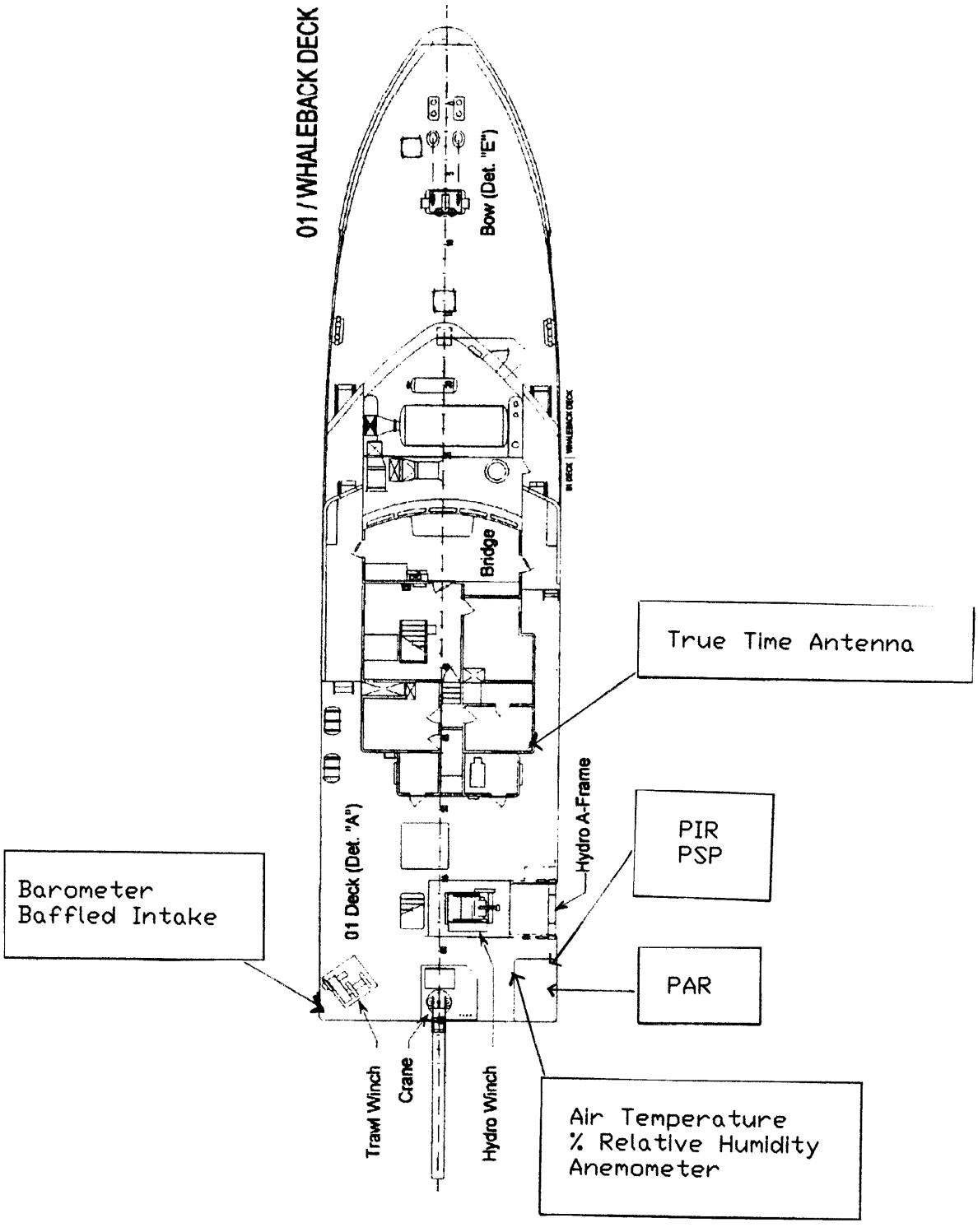


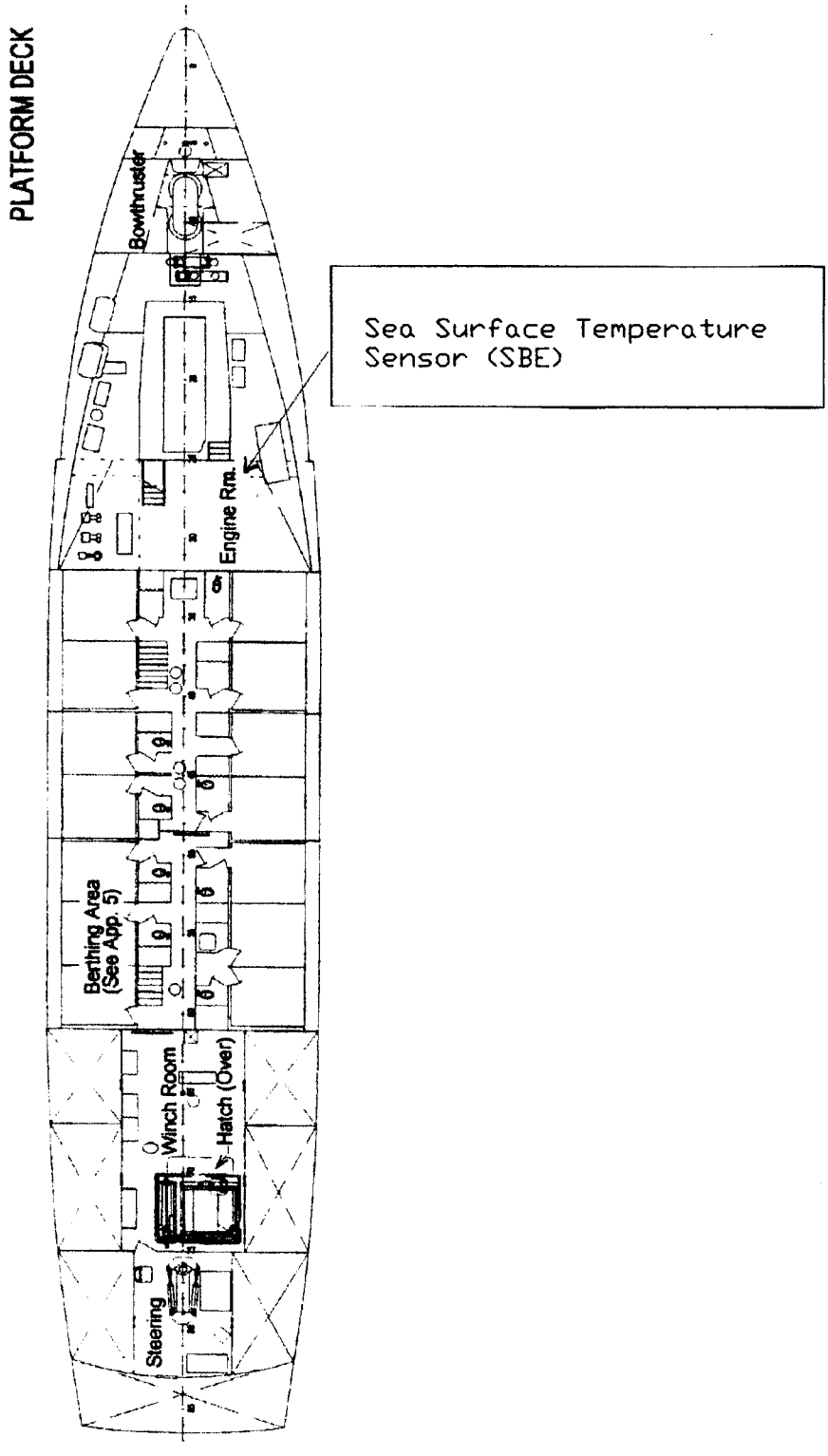
2 RACK MOUNT PIII 1GHz 512MB RAM
WIN 2000 Operating System
National Instrument 2 Port RS485
& 8 Port RS232 Serial Cards
program in LABView

Turner 10-AU Fluorometer
Vortex Debubbler

Flow-Through System
SBE Temperature &
Conductivity Sensor
Vortex Debubbler

Barometer
RS232 output


01 / WHALEBACK DECK
Bow (Det. "E")
Bridge
01 Deck (Det. "A")
Hydro A-Frame
Trawl Winch
Crane
Hydro Winch
True Time Antenna
PIR
PSP
PAR
Barometer
Baffled Intake
Air Temperature
% Relative Humidity
Anemometer


PLATFORM DECK
Bowthruster
Engine Rm.
Berthing Area (See App. 5)
Winch Room
Hatch (Over)
Steering
Sea Surface Temperature Sensor (SBE)

M1000 Module DAQ Addressing

ASCII VALUE	HEX VALUE	MODULE TYPE	SET-UP	ASSOCIATED SENSOR
0	30	frequency	300200C0	Sea Surface Temperature TSE001
1	31	frequency	310200C0	Flo-thru Temperature TSF001
2	32	frequency	320200C0	Flo-thru Conductivity CSF001
3	33	frequency	330200C0	spare (on ship)
4	34	frequency	340200C0	spare (on ship)
A	41	voltage +/-5V	410200C0	Anemometer WSD001
B	42	voltage +/-5V	420200C0	PIR Case Temperature LCD001
C	43	voltage +/-5V	430200C0	PIR HemiTemperature LHD001
D	44	voltage +/-5V	440200C0	PAR DPD001
E	45	voltage +/-5V	450200C0	SPX001 UserDefined
F	46	voltage +/-5V	460200C0	SPX002 UserDefined
G	47	voltage +/-5V	470200C0	spare (on ship)
H	48	voltage +/-5V	480200C0	Fluorometer FVB001
I	49	voltage +/-5V	490200C0	Snychro HEA001
J	4A	voltage +/-5V	4A0200C0	Wind Speed Port WSP001
K	4B	voltage +/-5V	4B0200C0	Wind Heading Port WHP001
L	4C	voltage +/-5V	4C0200C0	Wind Speed STBD WSS001
M	4D	voltage +/-5V	4D0200C0	Wind Heading STBD WHS001
N	4E	voltage +/-5V	4E0200C0	spare (at shop)
O	4F	voltage +/-5V	4F0200C0	Speedlog
P	50	voltage +/-5V	500200C0	unknown location
a	61	voltage +/-1V	610200C0	Vaisala Humidity HVD001
b	62	voltage +/-1V	620200C0	RM Young Humidity HYD001
c	63	voltage +/-1V	630200C0	RM Young Air Temperature AYD001
d	64	voltage +/-100mV	640200C0	spare (at shop)
e	65	voltage +/-100mV	650200C0	spare (on ship)
f	66	voltage +/-100mV	660200C0	PIR DLD001
g	67	voltage +/-1V	670200C0	PSP DSD001
h	68	voltage +/-1V	680200C0	spare (at shop)
I	69	voltage +/-1V	690200C0	spare (on ship)

M1000 Module DAQ Addressing

ASCII VALUE	HEX VALUE	MODULE TYPE	SET-UP	ASSOCIATED SENSOR
0	30	frequency	300200C0	Sea Surface Temperature TSE001
1	31	frequency	310200C0	Flo-thru Temperature TSF001
2	32	frequency	320200C0	Flo-thru Conductivity CSF001
3	33	frequency	330200C0	spare (on ship)
4	34	frequency	340200C0	spare (on ship)
A	41	voltage +/-5V	410200C0	Anemometer WSD001
B	42	voltage +/-5V	420200C0	PIR Case Temperature LCD001
C	43	voltage +/-5V	430200C0	PIR HemiTemperature LHD001
D	44	voltage +/-5V	440200C0	PAR DPD001
E	45	voltage +/-5V	450200C0	SPX001 UserDefined
F	46	voltage +/-5V	460200C0	SPX002 UserDefined
G	47	voltage +/-5V	470200C0	spare (on ship)
H	48	voltage +/-5V	480200C0	Fluorometer FVB001
I	49	voltage +/-5V	490200C0	Snychro HEA001
J	4A	voltage +/-5V	4A0200C0	Wind Speed Port WSP001
K	4B	voltage +/-5V	4B0200C0	Wind Heading Port WHP001
L	4C	voltage +/-5V	4C0200C0	Wind Speed STBD WSS001
M	4D	voltage +/-5V	4D0200C0	Wind Heading STBD WHS001
N	4E	voltage +/-5V	4E0200C0	spare (at shop)
O	4F	voltage +/-5V	4F0200C0	Speedlog
P	50	voltage +/-5V	500200C0	unknown location
a	61	voltage +/-1V	610200C0	Vaisala Humidity HVD001
b	62	voltage +/-1V	620200C0	RM Young Humidity HYD001
c	63	voltage +/-1V	630200C0	RM Young Air Temperature AYD001
d	64	voltage +/-100mV	640200C0	spare (at shop)
e	65	voltage +/-100mV	650200C0	spare (on ship)
f	66	voltage +/-100mV	660200C0	PIR DLD001
g	67	voltage +/-1V	670200C0	PSP DSD001
h	68	voltage +/-1V	680200C0	spare (at shop)
I	69	voltage +/-1V	690200C0	spare (on ship)

Data Acquisition Record Explanation

```
$PSTA,1200, 02141635.cfg, 04614.txt, DAQ V 15
$ZAZDA,046:14:01:44
$PASHR,ATT,568916.0,267.70,-002.00,+009.59,0.0022,0.0207,0*2C
$GPGGA,140142.060,4439.1299,N,12544.6636,W,1,08,1.0,009.5,M,024.0,M,,*73
$GPVTG,269.9,T,251.3,M,011.5,N,021.3,K*4A
$PDGPS,GPGGA,140059,4439.1393,N,12544.4249,W,2,08,1.00,0,M,,,234,0270*11
$PKEL99,15022003,140041,HF,00.00,0,LF,00.00,0,44 39.138897N,125 44.411695W
$WIXDR,1005.95
$VDVBW,02.12,00.88,A,02.12,00.88,V*B4
$PVOLT,WSD001,531.3600,222.6400,357.5708,126,4.4301
$PVOLT,AYD001,602.4400,601.6000,601.8333,126,10.1833
$PVOLT,HYD001,893.0800,885.9600,888.6994,126,88.8699
$PVOLT,DSD001,-2.6800,-2.8600,-2.7749,126,-8.1139
$PVOLT,DPD001,1.8400,1.3600,1.5949,126,164.9349E+12
$PVOLT,DLD001,50.5200,50.1300,50.3029,126,324.1686
$PVOLT,LCD001,3503.3600,3502.2400,3502.8483,126,9.5688
$PVOLT,LHD001,3509.4400,3505.7600,3507.7854,126,9.6345
$PVOLT,HEA001,-2304.0800,-2447.9200,-2366.4148,126,265.1909
$PVOLT,WHS001,4920.8800,4572.0800,471.5074,126,223.6973
$PVOLT,WSS001,1141.6000,894.2400,1032.6895,126,11.4160
$PFREQ,TSF001,7951.2000,7948.8000,7949.8121,126,11.5633
$PFREQ,CSF001,8605.7600,8603.8400,8604.5460,126,3.6927
$PUNIT,SAF001,126,32.3945
$PFREQ,TSE001,7447.6800,7445.4400,7446.3314,126,11.1839
$PVOLT,FVB001,2.7200,2.5600,2.6578,126,2.6578
$PVOLT,WHP001,4937.2000,4577.2000,471.7606,126,222.6493
$PVOLT,WSP001,1102.4000,868.8000,996.0356,126,10.7058
$PVOLT,VSL001,-1015.6800,-3043.1200,-2211.3860,126,8.8455E+0
$PVOLT,SPX001,298.0800,295.2000,296.5917,126,296.5917E+0
$PVOLT,SPX002,65.2800,56.8800,61.9130,126,61.9130E+0
$VTG,COG001,276.5000,260.0000,266.8623,126,266.8623E+0
$VTG,SOG001,11.4000,9.9000,10.7214,126,10.7214E+0
$PEND,1200
```

The following is an explanation of the DAS, data acquisition system, and record format. The example record used is from the file 04614.txt, indicating the file was started on the 46th Julian day, or February 15th, at 14:00 UTC. Each file contains an hour of data, records being made each minute.

$PSTA :Start of record, record number, configuration file name, file name, DAS program version

$ZAZDA :Satellite time, True Time system, output in DDD:HH:MM:SS format

$PASHR :Ashtech GPS output string in NMEA format

$GPGGA :P-Code GPS output string in NMEA format

$GPVTG :P-Code GPS output string in NMEA format

$PDGPS: :Differential GPS output string in NMEA format

$PKEL99 :Knudsen Echosounder output string, $PKEL99 Knudsen proprietary address, Date, Time hhmmss, HF, high frequency depth to surface, HF valid flag (1=valid),LF, low frequency to surface, LF valid flag, position(latitude and longitude)

$WIXDR :Barometer output string in millibars

$VDVBW :Speed Log output string in NMEA format

$PVOLT :Proprietary address indicating the sensor output is a voltage. The code for Meteorological instruments can be found in the WECOMA Meteorological Suite documentation. Next are the maximum, minimum

and mean values for that one minute period, number of loops (samples) made during that period. The last value is in calculated engineering units using the mean value, except for SPX001 and SPX002. The last value for SPX001 and SPX002 are a repeat of the associated mean value and are not in engineering units.

$PFREQ :Proprietary address indicating the sensor output is a frequency, from the Sea-Bird Electronics sensors, for the Flo-Thru system and Sea Surface Temperature. The values are maximum, minimum, mean, number of loops, and engineering units.

$PUNIT :Proprietary address indicating the output is in dimensionless unit, SAF001 is the calculated salinity for the Flow-Thru system using the mean values for temperature and conductivity.

$VTG, COG :Proprietary address for vessel course over ground extracted from the GPS string, $GPVTG, used in calculating true winds

$VTG, S0G :Proprietary address for vessel speed over ground extracted from the GPS string, $GPVTG, used in calculating true winds

$PEND :End of record and record number

INSTRUMENT	CODE	SENSOR SERIAL No.	Back up Sensors	OUTPUT FORM/CALIBRATION FACTORS
Barometric Pressure	WIXDR	9G1158		Pressure in millibars
Anemometer/Wind Speed	WSD001	AN-001	AN-002	m\s = (0.01183 x mV) + 0.2,
				knots = (0.02297 x mV) + 0.4
R.M. Young Air Temperature	AYD001	TS 04137	TS 04135	degrees Centigrade = (0.1 x mV) - 50
R.M. Young Relative Humidity	HYD001	TS 04137	TS 04135	value in millivolts (mV) *0.1 = % Relative Humidity
PSP	DSD001	29098F3	29099F3	8.70E-6/(watt*m^-2)*39.31 (amplification factor) Note 3
PAR	DPD001	QSR-2200		divide output voltage by 9.67E-18 V/(quanta/cm^2sec), Note 2
PIR	DLD001	28958F3	28957F3	3.75E-6 volts/(watt*m^-2) * 41.38 (amplification factor) Note 4
PIR Case Temperature	LCD001	28958F3		see calibration Bd1_Cha
PIR Hemisphere Temperature	LHD001	28958F3		see calibration Bd1_Chb
Heading (synchro)	HEA001			Degrees = 180-(0.036 x {mV/(pi/5000)}) if<0 then +360
Wind Heading Stbd	WHS001	10288		Degrees = 0.072 x mV
Wind Speed Stbd	WSS001	10288		Knots = 0.02 x mV
Flo-Thru Temperature	TSF001	Note 1		output is a frequency, see SBE temperature calculation
Flo-Thru Conductivity	CSF001	Note 1		output is a frequency, see SBE conductivity calculation
Sea Surface Temperature	TSE001	Note 1		output is a frequency, see SBE temperature calculation
Fluorometer	FVB001	10-AU-005		0-5000mV relative reading
Wind Heading Port	WHP001	10290		Degrees = 0.072 x mV
Wind Speed Port	WSP001	10290		Knots = 0.02 x mV
Vessel Speed Longitudinal	VSL001	Note 5		Velocity Forward knots = mV/-250
NOTES:				
1. See SBE Sensor List				
2. The output may also be determined by dividing output voltage				
by 5.82E+00 V/(uE/cm^2sec)				
3. See calibration amp_65096				
4. See calibration amp_65097				
5. Analog output from the EDO speedlog				

MET EQUIPMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	MODEL	POWER REQ.	Range	OUTPUT	ACCURACY
Wind Speed & Direction	R. M. Young Co.	5103	15 Vdc 20mA	0-100knots, 0-360 degrees	0-5Vdc, 0-5Vdc	Direction 0.25% linearity, Speed 2%
Air Temperature RTD	RM Young	41372VC	8-24 Vdc, 9mA @ 12Vdc	-50 to 50 degree C	0- 1.00 Vdc	+/- 0.5 for 0-20 deg. C
Relative Humidity Cap. Hygrometer	RM Young	41372VC	8-24 Vdc, 9mA @ 12Vdc	0-100% RH	0-1.00 Vdc	+/-3% for 10-90%RH, +/- 4% for 0-10% & 90-100%
3-cup Anemometer	R. M. Young Co.	12102	self powered	0-50 m/s	.0839 Vdc/ 1m/s	2%
Precipitation Gauge Siphon/Capacitance	R. M. Young Co.	50202	8-30Vdc <=3mA	0 - 50 mm	0 - 5 Vdc	+/- 2mm with 1mm threshold
Precipitation Gauge Optical/Long Path	Scientific Technology, Inc.	ORG-700	+/-12.. +/-15Vdc 10-60W	0.1 mm/h 3000mm/h	0 - 5 Vdc	1% for 10 -100 mm/hr, 4% for 1-500 mm/hr, 10% 0.1-1000mm/hr
Hemispherical Irradiance Sensor (PAR)	Biospherical Instruments Inc.	QSR-240 QSR-250	120Vac, 10W	400-700nm	0-5Vdc	+/- 1-1.5%
Pyrgeometer - Infrared Radiometer (long wave)	The Eppley Laboratory, Inc.	PIR	12 Vdc	700 watts/m^2	5uV per W/m^2 *	+/-2% for -20 to 40 deg. C , with linearity +/- 1% 0-700 W/m^2
Pyranometer - Infrared Radiometer (short wave)	The Eppley Laboratory, Inc.	PSP	12 Vdc	2800 watts/m^2	9uV per W/m^2 *	+/-1% for -20 to 40 deg. C , with linearity +/- 0.5% 0-2800 W/m^2
Barometer	Atmospheric Instrumentation Research, Inc.	AIR-DB-1B	+/-12 Vdc 14.5mA	600-1100 mb	RS232C	+/- 0.5 mb
Precipitation Gauge Optical/Short Path	Scientific Technology, Inc.	ORG-100	+12Vdc 660mA	0.1 mm/h 500mm/h	RS-232 ASCII	1% for 10 -100 mm/hr, 4% for 1-500 mm/hr, 10% 0.5-1600mm/hr

This read me file details which files each of the folders contains, and what information can be found in the individual files within the folders. Folder names will be bracketed within `[ ]' and the file names will be found within `{}' brackets.

[**Calibration Sheets**] folder contains individual calibrations for sensors on the CTD, flow-thru and MET systems

[**CTD**] folder contains individual sensor calibrations for the CTD and flow-thru systems

[**other**] folder contains calibrations for PAR, transmissometer and fluorometer sensors used on the CTD and flow-thru system

[**spares**] folder contains calibrations for spare PAR, transmissometer and fluorometer sensors

[**Sea Bird**] folder contains calibrations for temperature, conductivity, and oxygen sensors used on the CTD

[**spares**] folder contains calibrations for spare temperature, conductivity, and oxygen

[**Configuration**] folder contains files which explain the structure of the configuration and data files, the sensors which make up the MET suite, and the Sea Bird sensor list which list sensors are on the ship, and the system they are in

{**Configuration File Explanation.doc or .pdf**} file explains the structure of configuration file, which is sent out at the start of the MET system

{**File Explanation.doc or .pdf**} file explains the format of a MET record

{**Filter List Explanation.txt**} file expands abbreviations used in the cooked (.ck) files

{**MET Suite.pdf or .xls**} file lists the sensors in use, and spares, for MET system

{**SBE sensor list.pdf or .xls**} file lists Sea Bird sensors which are in the CTD, Flow-Thru systems, and spares

[**Instrument Documentation**] folder contains files with specifications and general information for sensors in the MET and CTD systems, file explaining how true winds are determined and file with definitions of terms used in determining the true winds

{**Humidity_Air Temperature.pdf**} file contains a copy of the RM Young specifications for the relative humidity/air temperature sensor used in the MET system

{**MET Instrument Specifications.pdf or .xls**} file contains a list of all the sensors used in MET system and their associated specifications

{**NMEA 0183 defn.pdf**} file contains a copy of the definitions within the 0183 standard that is used to determine data strings, such as the GPS

{**PAR_info.pdf**} file with general information about, and how to use, underwater PAR

{**SBE11plus.pdf**}general manual for SBE 11 deckunit

{**SBE 9plus.pdf**} general manual for SBE 9 underwater unit

{**True Wind Calculation.doc or .pdf**} file explains the manner in which true winds are calculated

{**wind_nav_defn.pdf**} definitions from the paper "Establishing more truth in true winds" by S.R. Smith, M.A. Bourassa and R.J. Sharp

R/V Wecoma

Ships Underway Data System

Data Selection

Last [72] hours of

Channel	Lines	Points	Both	None
Record Number	○	○	○	◉
EchoSounder High Freq	○	○	○	◉
Barometer	○	○	○	◉
Gyro Compass	○	○	○	◉
Wind Heading Starboard	○	○	○	◉
Wind Speed Starboard	○	◉	○	○
Wind Heading Port	○	○	○	◉
Wind Speed Port	○	◉	○	○
Water Temperature Flothru	○	○	○	◉
Conductivity Flothru	○	○	○	◉
Computed Salinity Flothru	○	○	○	◉
Water Temerature Engineroom	○	○	○	◉
Fluorometer	○	○	○	◉
Speed Log Longitude	○	○	○	◉
Speed Log Transverse	○	○	○	◉

Y-Range: min [0], max [30]

Refresh increment: [60] minute. [submit]

More information on:

How the graphs are generated: HMSC, SUDS.

A description of the R/V Wecoma Ships Underway Data System (SUDS).

Last modifed: 26 Sept 2002 by Toby Martin toby@oce.orst.edu

Workshop on High-Resolution Marine Meteorology

Vessel Name: WECOMA
Vessel Call Sign: WSD7079
Onboard Logging System: DAS (Data Acquisition System)
Present Configuration in operation since February 1999
First Underway System installed 1984
First MET System installed 1989
Primary Parameters Observed: show MET sheet
Underway System:

- Sea Surface Temperature
- Sea Surface Salinity (Temperature & Conductivity)
- Sea Surface Fluorescence
- Bathymetry (3.5 & 12 KHz)
- ADCP 150 KHz Narrowband
  75KHz Wideband

Data is provided to PI at end of cruise on a CD, along with DAS system Documentation