Meteor DVS Data Quality Control Report

Jesse Enloe and Shawn R. Smith

World Ocean Circulation Experiment (WOCE)

Surface Meteorological Data Assembly Center

Center for Ocean-Atmospheric Prediction Studies

Florida State University

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Introduction:

This report summarizes the quality of surface meteorological data collected by the *Meteor* (identifier: DBBH) DVS system during five WOCE cruises beginning 28 December 1996 and ending 14 September 1997. The data were provided to the Florida State University Data Assembly Center (DAC) on CD-ROM by K. Motamedi at the Bundesamt für Seeschiffahrt und Hydrographie, Germany. They were then converted to standard DAC net CDF format and then processed using an automated screening program, which adds quality control flags to the data, highlighting potential problems. Finally, the Data Quality Evaluator (DQE) reviewed the data and current flags, whereby flags were added, removed, or modified according to the judgement of the DQE and other DAC personnel. Details of the WOCE quality control procedures can be found in Smith et al. (1996). The data quality control report summarizes the flags for the *Meteor* DVS surface meteorological data, including those added by both the preprocessor and the DQE.

Statistical Information:

The *Meteor* DVS data are expected to include observations taken every minute on all five WOCE cruises. Values for the following variables were collected:

Time	TIME
Latitude	LAT
Longitude	LON
Platform Heading (gyrocompass)	PL_HD
Platform Course (Ins)	PL_CRS
Platform Speed (Ins)	PL_SPD
Platform Speed (EDD Log)	PL_SPD2
Port Platform Relative Wind Direction	PL_WDIR
Port Platform Relative Wind Speed	PL_WSPD
Starboard Platform Relative Wind Direction	PL_WDIR2
Starboard Platform Relative Wind Speed	PL_WSPD2
Port Earth Relative Wind Direction	DIR
Port Earth Relative Wind Speed	SPD
Starboard Earth Relative Wind Direction	DIR2
Starboard Earth Relative Wind Speed	SPD2
Port Sea Temperature	TS
Starboard Sea Temperature	TS2
Atmospheric Pressure	P
Port Air Temperature	T
Starboard Air Temperature	T2
Port Dewpoint Temperature	TD
Starboard Dewpoint Temperature	TD2
Port Relative Humidity	RH
Starboard Relative Humidity	RH2
Atmospheric Radiation	RAD

Details of the cruises are listed in Table 1 and include cruise dates, number of records, number of values, number of flags, and total percentage of data flagged. A total of 4,243,177 values were evaluated with 215,530 flags added by the preprocessor and the DQE for a total of 5.08% of the values being flagged. Note that the EDD Log platform speed data on three of the cruises were found to be of poor quality and are not included in the statistical results. These values will not be released (discussion below).

Table 1: Statistical Cruise Information

CTC	Dates	Number of Records	Number of Values	Number of Flags	Percentage Flagged
AR_26_/01	12/28/96 – 01/22/97	26,822	670,550	23,906	3.57
AR_12_/08	05/15/97 – 06/01/97	24,163	579,912	15,265	2.63*
A__02_/04	06/11/97 – 07/02/97	30,275	756,875	51,913	6.86
AR_27_/01	07/06/97 – 08/12/97	52,181	1,252,344	57,373	4.58*
AR_07E/07	08/16/97 – 09/14/97	40,979	983,496	67,073	6.82*

*PL_SPD2 removed due to poor quality

Summary:

The overall quality of the data collected by the *Meteor* is fair, with 5.08% of the reported values being flagged for potential problems. However, the overall quality of the meteorological data varies greatly from variable to variable. The placement of the instruments for T, T2, TD, TD2, RH, and RH2 on the superstructure in the proximity of the exhaust stack caused a major problem, resulting in extensive flagging of these variables. Moreover, the EDD Log platform speed (PL_SPD2) on the three cruises AR_12_/08, AR_27_/01, and AR_07E/07 were found to be of extremely poor quality and were not included in the public release. Table 2 details the distribution of flags among the remaining variables.

(Table on following page)

Table 2: Number of Flags and Percentage Flagged for Each Variable

Variable	B	D	E	F	G	H	J	K	S	Total Number of Flags	Percentage of Variable Flagged
TIME										0	0.00
LAT				33					1	34	0.02
LON	1			33					1	35	0.02
PL_HD										0	0.00
PL_CRS										0	0.00
PL_SPD									1	1	0.00*
PL_SPD2	2							6,704	44	6,750	3.87
PL_WDIR									1	1	0.00*
PL_WSPD									1	1	0.00*
PL_WDIR2										0	0.00
PL_WSPD2										0	0.00
DIR			403					1,533	101	2,037	1.17
SPD			1		18			2,324	177	2,520	1.44
DIR2			284					1,468	84	1,836	1.05
SPD2			1		64			2,030	169	2,264	1.30
TS						16		2,246	1	2,263	1.30
TS2						16		2,157	6	2,179	1.25
P									345	345	0.20
T		18,122						13,354	122	31,598	18.12
T2		14,455			37			11,587	159	26,238	15.04
TD		16,355						15,854	129	32,338	18.54
TD2		14,414						22,727	55	37,196	21.33
RH					59			21,716	123	21,898	12.55
RH2								25,786	64	25,850	14.82
RAD	12,544						6,938	656	8	20,146	11.55
Total Number of Flags	12,547	63,346	689	66	178	32	6,938	130,142	1,592	215,530	
Percentage of All Values Flagged	0.30	1.49	0.02	0.00*	0.00*	0.00*	0.16	3.07	0.04	5.08	

*Percentage < 0.01

Deleted Data:

Platform Speed (EDD Log):
The *Meteor* measured two platform speeds: a speed over the ground (PL_SPD) from the Inertial Navigation System (Ins) and a speed with respect to the water (PL_SPD2). On the AR_26_/01 cruise, PL_SPD2 proved to be accurate, having speeds similar to that of PL_SPD. Beginning with the AR_12__/08 cruise, PL_SPD2 began recording highly variable and very noisy data that were dissimilar to PL_SPD, and continued throughout the entire cruise. On the A__02_/04 cruise, PL_SPD2 data started off as the AR_12_/08 cruise had ended. However, on the morning of 17 June, it appears that the problem with the instrument corrected and the EDD log subsequently recorded accurate data for the remainder of the cruise. From the first day of the AR_27_/01 cruise to the last day of the AR_07E/07 cruise, PL_SPD2 showed problems similar to the AR_12_/08 cruise. In the cruises where PL_SPD2 recorded highly questionable data throughout the entire cruise, it was determined that the variable should be removed completely, and not be included in the public release. In the case where the problem was apparently corrected during the cruise, the variable remained, with the suspect data appropriately assessed the K flag by the DQE.

Major Problems:

Exhaust:
As stated previously, the placement of the instruments used to measure air temperature, relative humidity, and dewpoint temperature with respect to the exhaust stack caused major problems. These instruments are located on a tower just in front of and at a height just above the top of the exhaust stack. In due course, whenever there is a ship relative wind in proximity of 180 degrees (from stern to bow), the rising exhaust is carried directly to the instruments. The exhaust, being warm and moist, increases the measured air and dewpoint temperatures from one to five ºC, or more, and relative humidity as much as 10-15% and higher. After a change in ship-relative wind direction, the exhaust clears from the instruments and variables return to normal. The data are affected anywhere from a few minutes to several hours. The response to this trend is not uniform for any of these variables. The DQE attempted to flag all such events as suspect (K). But the user may want to employ a filter based on the ship relative wind direction.

Flow Distortion and Ventilation:
The ship's winds experienced flow distortion with a related ventilation problem. When there was a ship relative wind direction in the proximity of 90 degrees (from the starboard side) the ship's port-side instruments, being now partially blocked from the wind by the tower on which they are mounted, sometimes recorded highly variable wind direction and wind speed, noticeably anomalous to the trend. During such occurrences, the temperature and relative humidity instruments, inadequately ventilated, demonstrated an increase in temperature, and, consequently, a decrease in relative humidity. The problem also occurred on the starboard side instruments when the ship relative wind direction was in the proximity of 270 degrees (from the port side). In the earth relative wind, the problem was more notable in the wind speed than in the wind direction. Sometimes, only the wind speed was affected. The temperature and relative humidity aberrations were not consistent with the wind changes, and at times, occurred when the earth relative wind was not affected and didn't occur when the earth relative wind was affected.

This problem was flagged by the DQE as suspect (K) where possible, and spikes (S) where only a few values needed to be flagged. The flow distortion problem was not as easily identifiable and not always able to be flagged. The user may want to consider a smoother for the wind data when the ship relative wind is in the proximity of 90 and 270 degrees.

Dewpoint Temperature:
Both the port and starboard dewpoint temperature sensors experienced anomalously high readings sporadically throughout all five cruises. This caused the preprocessor to flag the temperature and dewpoint with the D flag, indicating the dewpoint temperature as greater than the air temperature. When such an incident transpired, the dewpoint was flagged as suspect (K) and the D flag was subsequently removed from the corresponding temperature values. The relative humidity was sometimes affected as well. Where the DQE determined the relative humidity readings as suspect, it too received the K flag.

Other Problems:

Sea Temperature:
In the final cruise, both the port and starboard sea temperature sensors experienced abrupt changes of one to two degrees C. These episodes were flagged at the beginning and end of each discontinuity with the discontinuity flag (H).

Radiation:
The radiation data were plagued by the preprocessor-assessed bounds flag (B) throughout the entire first cruise during non-daylight hours. The problem is likely due to a calibration error. During the fourth cruise, in the early morning hours of 8 July, the data demonstrated an oscillation before sunrise. The oscillation, between about zero and 20 $W \cdot m^{-2}$, was flagged as suspect and thought to be an instrument malfunction. On the final cruise, on 9 September, 9:33 a.m., the instrument suffered a severe malfunction, recording values of -200 $W \cdot m^{-2}$. The instrument never recovers from this, recording bad data for the remainder of the cruise and was assessed the J flag (indicating data of poor quality, and are not to be used) by the DQE.

Spikes:
Isolated spikes occurred in most of the variables throughout the data. Spikes are relatively common occurrences in automated data, caused by such factors as electrical interference and ship accelerations. These individual points were assigned the S flag.

Final Comments:

The DQE recommends that the user employ a filter on the air and dewpoint temperatures, as well as the relative humidity sensor when the ship relative wind is anywhere in proximity of 180º (± ~30º) due to the problem of exhaust.

A smoother may also be needed for the earth relative wind when the port relative wind direction is in propinquity of 270º (± ~30º) and/or the starboard relative wind direction in propinquity of 90º (± ~30º) due to the flow distortion/ventilation problem.

References:

Smith, S.R., C. Harvey, and D.M. Legler, 1996: *Handbook of Quality Control Procedures and Methods for Surface Meteorology Data*. WOCE Report No. 141/96, Report WOCEMET 96-1, Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee FL 32306-2840