Discovery Multimet Data Quality Control Report

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INTRODUCTION:

This report summarizes the quality of surface meteorological data collected by the research vessel *Discovery* (identifier: GLNE) during two cruises completed in 1997 and 1998. The data were provided to the Florida State University Data Assembly Center (DAC) in multimet electronic format by D. M. Gould (BODC) and were converted to standard DAC netCDF format. The data arrived from the British Oceanographic Data Center (BODC) already quality controlled and comprised of the BODC's own unique set of flags (e.g. G-good data, B-bad data, I-interpolated value which is assumed to be good, S-suspect data, N-null or absent value). Upon arrival, these flags were converted to WOCEMET's quality control guidelines (e.g. Z-good data, J-bad data, R-interpolated value which is assumed to be good, Q-suspect data previously quality controlled, Z-null or absent value (good data)). The data were then processed using an automated screening program, which added quality control flags to the data, highlighting potential problems. Finally, the Data Quality Evaluator (DQE) reviewed the data and current flags (both DAC and BODC), whereby flags were added, removed, or modified according to the judgment of the DQE and other DAC personnel. Details of the quality control procedures can be found in Smith et al. (1994). The data quality control report summarizes the flags for the *Discovery* meteorological data, including those added by the BODC, the WOCEMET preprocessor, and the DQE.

DATA VARIABLES:

The *Discovery* data are expected to include observations averaged once every minute on these cruises. Values for the following variables were collected:

Time	(TIME)
Latitude	(LAT)
Longitude	(LON)
Platform Heading	(PL_HD)
Platform Course	(PL_CRS)
Platform Speed	(PL_SPD)
Earth Relative Wind Direction	(DIR)
Earth Relative Wind Speed	(SPD)
Sea Temperature	(TS)
Atmospheric Pressure	(P)
Air Temperature	(T)
Wet Bulb Temperature	(TW)
Downwelling Long Wave Radiation *	* (RAD)
Downwelling Short Wave Radiation *	* (RAD2)
Photosynthetically Available Radiation *	* (RAD3)

* The variable, downwelling long wave radiation (RAD), was not observed in the 1998 *Discovery* cruise, AR_21_/03. As a result, downwelling short wave radiation is actually RAD and photosynthetically available radiation is RAD2.

1997 FLAG SUMMARY

Statistical Information:

Details of the 1997 cruise are listed in Table 1 and include the cruise dates, number of records, number of values, number of flags, and total percentage of data flagged. A total of 864,000 values were evaluated with 54,820 flags added by both the preprocessor and the DQE resulting in a total of 6.34% of the values being flagged.

Table 1: Statistical Cruise Information

Cruise Identifier	Cruise Dates	Number of Records	Number of Values	Number of Flags	Percent Flagged
A__25_/00	08/07/97 – 09/15/97	57,600	864,000	54,800	6.34

Summary:

The 1997 multimet data from the *Discovery* proves to be of fair quality with 6.34% of the reported values flagged for potential problems. The distribution of flags for each variable are detailed in Table 2.

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

Variable	B	D	J	K	Q	R	S	Total Number of Flags	Percentage of Variable Flagged
TIME								0	0.00
LAT						24		24	0.04
LON						24		24	0.04
PL_HD			37,454					37,454	65.02
PL_CRS								0	0.00
PL_SPD							1	1	0.00*
DIR					527			527	0.91
SPD					22			22	0.04
TS					207			207	0.36
P				2,570				2,570	4.46
T		93		119	1		3	216	0.38
TW		93		119				212	0.37
RAD							5	5	0.01
RAD2	13,540							13,540	23.51
RAD3								0	0.00
Total Number of Flags	13,540	186	37,454	2,808	757	48	9	54,800	
Percent of All Values Flagged	1.57	0.02	4.33	0.33	0.09	0.01	0.00*	6.34	

*Percentages < 0.01

<u>*B-flags*</u>:

Atmospheric (short wave) radiation (RAD2) received a total 13,540 B-flags on the A__25_/00 cruise. These values were between 0 and -3.2 Wm^{-2}. Physically unrealistic negative radiation values are likely the result of the instrument not tuned to low radiation values.

D-Flags:

Temperature (T) and wet bulb temperature (TW) were assessed a total of 186 D-flags by the automated preprocessor. D-flags are applied to both variables if TW is greater than T, a physically unrealistic occurrence. During the A__25_/00 cruise, TW followed closely the pattern of T and occasionally TW was equal to or slightly greater than T. At these times, D-flags were applied to both variables.

J-Flag:

Platform heading (PL_HD) was assessed one J-flag due to a negative data value being recorded. This negative data value, -1.0 degree (clockwise from true north), is unrealistic and should not be used.

On 08/18/97 at 23:33, PL_HD dropped to zero and maintained there for the remainder of the A__25_/00 cruise. The 37,453 J-flags that were assessed to PL_HD, were likely the result of an instrument failure, however, this information was unknown to the DQE at the time of processing. Subsequently, J-flags were applied.

K-flags:

Pressure (P) was assessed 2,570 K-flags for ½ millibar increases that occurred with a change in forward speed or motion. This relationship should not occur in earth relative data so the data were consequently flagged as cautionary.

Temperature (T) and wet bulb temperature (TW) were both K-flagged on 09/04/97 because the data experienced ship-heating signatures. During daylight hours, when the platform speed was low, less than one ms^{-1}, T and TW increased. In this case, the increase was approximately 1½ degree Celsius. *It is important to note that during this time the platform heading was zero, therefore the DQE could not verify the adverse effect of ship orientation on the meteorological variables.

Q-flags:

Data from the A__25_/00 that were deemed suspect by the BODC were assessed Q-flags by WOCEMET.

R-flags:

Latitude (LAT) and longitude (LON) both received 24 R-flags for interpolated data values. Interpolated values are interpolated by the data provider, BODC, and are assumed to be good data.

Spikes:

The BODC evaluated several spikes. Additional spikes were identified during visual inspection by the DQE and they were assigned the S-flag. These spikes are a relatively common occurrence with automated data, caused by various factors (e.g. electrical interference, ship movement, etc.).

1998 FLAG SUMMARY

Statistical Information:

Details of the 1998 cruise are listed in Table 3 and include the cruise dates, number of records, number of values, number of flags, and total percentage of data flagged. A total of 592,482 values were evaluated with 3,019 flags added by both the preprocessor and the DQE resulting in a total of 0.51% of the values being flagged.

Table 3: Statistical Cruise Information

Cruise Identifier	Cruise Dates	Number of Records	Number of Values	Number of Flags	Percent Flagged
AR_21_/03	04/24/98 – 05/31/98	53,862	592,482	3,019	0.51

Summary:

The 1998 multimet data from the *Discovery* proves to be of excellent quality with 0.51% of the reported values flagged for potential problems. The distribution of flags for each variable are detailed in Table 4.

Table 4: Number of Flags and Percentage Flagged for Each Variable

Variable	B	D	F	K	Q	R	S	Total Number of Flags	Percentage of Variable Flagged
TIME								0	0.00
LAT			2			38		40	0.07
LON			2			38		40	0.07
DIR					389		12	401	0.74
SPD				35	7		8	50	0.09
TS								0	0.00
P								0	0.00
T		7			930		851	1,788	3.32
TW		7			45		1	53	0.10
RAD					25			25	0.05
RAD2	598			24				622	1.15
Total Number of Flags	598	14	4	59	1,396	76	872	3,019	
Percent of All Values Flagged	0.10	0.00*	0.00*	0.01	0.24	0.01	0.15	0.51	

*Percentages < 0.01

B-Flags:

Atmospheric (short wave) radiation (RAD) was assessed 598 B-flags on the AR_21_/03 cruise. The flagged values were between 0 and –9.6 Wm^{-2}. These physically unrealistic negative radiation values are likely the result of the instrument not tuned to low radiation values.

D-flags:

Temperature (T) and wet bulb temperature (TW) each received seven D-flags during the AR_21_/03 cruise. These D-flags draw attention to data values that do not meet the standard meteorological property, T is greater than or equal to TW.

F-flags:

Latitude (LAT) and longitude (LON) were assessed a total of four F-flags by the preprocessor during the 1998 *Discovery* cruise. These F-flags illustrate the platform speed computed by the preprocessor exceeds the realistic speed (15 ms^{-1}). This may have been caused by uncertainties or truncation error in the navigation data.

K-flags:

Earth relative wind speed (SPD) data were assessed 35 K-flags. The AR_21_/03 data arrived to WOCEMET already quality controlled by the British Oceanographic Data Center (BODC). During this cruise, the earth relative wind direction data were assessed many suspect flags by the BODC for data that resembled spikes. These signatures were also found in earth relative wind speed during visual inspection by the WOCEMET DQE and were subsequently flagged as suspect.

Atmospheric (short wave) radiation (RAD) received 24 K-flags on 04/25/98. These data values increased rapidly from very low radiation values (e.g. 20 Wm^{-2}) up to approximately 1200 Wm^{-2}, then were missing for nearly two hours. This may be evidence of an instrument malfunction.

Q-flags:

Data from the AR_21_/03 that were considered suspect by the BODC were assessed Q-flags by WOCEMET.

R-flags:

Latitude (LAT) and longitude (LON) both received 38 R-flags for interpolated data values. Interpolated values are interpolated by the data provider, BODC, and are assumed to be good data.

Spikes:

Additional spikes were evaluated by visual inspection by the DQE on earth relative wind direction (DIR) and earth relative wind speed (SPD).

FINAL DISSCUSSIONS:

The DQE recommends using a smoother on temperature (T) for both the A__25_/00 and AR_21_/03 cruises.

The *Discovery* data for the AR_21_/03 cruise were found to be reliable, although ship relative data (e.g. PL_HD, PL_CRS, PL_SPD) were not available to assess these meteorological variables for specific problems such as, flow distortion and ship heating. Evidence (i.e. abrupt increases) of flow distortion were found in the pressure (P), earth relative wind speed (SPD), and earth relative wind direction (DIR) data. However, these variables were NOT flagged as suspect.

REFERENCES:

Smith, S.R., C. Harvey, and D.M. Legler, 1994: *Handbook of Quality Control Procedures and Methods for Surface Meteorology Data*. Report No. 141/96, Report MET 96-1, Center for Ocean-Atmospheric Prediction Studies Florida State University, Tallahassee FL 32306-2840

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