Ron Brown IMET Data Quality Control Report: August 2002-September 2003

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1.0 Introduction

This report summarizes the quality of the surface meteorological data collected by the research vessel *Ronald Brown* (identifier: WTEC) IMET system during the last 3 cruises of 2002 and the first 9 cruises of 2003 for a total of 12 cruises beginning 27 August 2002 and ending 4 September 2003. The data were provided to the Florida State University – Research Vessel Surface Meteorological Data Center in ASCII format by John Shannahoff and converted to standard RVSMDC netCDF format. The data were preprocessed using an automated screening program, which adds quality control flags to the data, highlighting potential problems. Next, the data are run through a newly implemented statistical program, which checks for spikes (V), steps (X) and other suspect values (U – fails threshold test, and Y - suspect between X's) and flags them accordingly. This program was only run on the true wind speeds, the atmospheric pressure, air temperature, sea temperature, and relative humidity. Finally, the Data Quality Evaluator (DQE) reviewed the data and current flags, whereby flags were added, removed, or modified according to the judgment of the DQE and other RVSMDC personnel. Details of the quality control procedures can be found in Smith et al. (1996). The data quality control report summarizes the flags for the *Ronald Brown* IMET surface meteorological data, including those added by both the preprocessor and the DQE.

2.0 Statistical Information

The *Ronald Brown* IMET data were received as one-minute averages. Observations for the following variables were provided:

Time	(time)
Latitude	(lat)
Longitude	(lon)
Platform Heading	(PL_HD)
Platform Course	(PL_CRS)
Platform Speed over Ground	(PL_SPD)
IMET Platform-Relative Wind Direction (14.12 m)	(PL_WDIR)
IMET Platform-Relative Wind Speed (14.12 m)	(PL_WSPD)
Earth-Relative Wind Direction (14.12 m)	(DIR)
Earth-Relative Wind Speed (14.12 m)	(SPD)
Platform-Relative Wind Direction 2 (25.5 m)	(PL_WDIR2)
Platform-Relative Wind Speed 2 (25.5 m)	(PL_WSPD2)
Earth-Relative Wind Direction 2 (25.5 m)	(DIR2)
Earth-Relative Wind Speed 2 (25.5 m)	(SPD2)
Atmospheric Pressure (15.56 m)	(P)
Air Temperature (12.98 m)	(T)
Sea Temperature (5.6 m in depth)	(TS)
Relative Humidity (12.98 m)	(RH)
Short-wave Atmospheric Radiation (10.01 m) *	(RAD)
Long-wave Atmospheric Radiation (10.01 m)	(RAD2)
Precipitation *	(PRECIP)

*- Not provided in 02-L

3.0 2002 QC Results

A total of 4,647,071 values were evaluated with 249,500 flags added by the preprocessor and the DQE resulting in 5.37 % of the values being flagged for the late 2002 and early 2003 cruises of the *Ronald Brown*. A breakdown of each cruise is provided in Table 1.

Table 1: Statistical Information

Cruise Identifier*	Cruise Dates	Number of Records	Number of Values	Number of Flags	Percent Flagged
02-L	8/27 – 9/15	27,110	515,090	18,059	3.51
02-M	9/19 – 9/30	15,499	325,479	12,552	3.86
02-N	10/11 – 11/6	37,358	784,518	35,210	4.49
03-A	2/4 – 2/15	15,709	329,889	9,897	3.00
03-B	2/19 – 3/7	23,217	487,557	15,640	3.21
03-C	3/10 – 3/28	23,515	493,815	21,565	4.37
03-D	6/4 – 6/7	3,490	73,290	2,566	3.50
03-E	6/10 – 6/14	3,287	69,027	6,496	9.41
03-F	6/19 – 7/10	29,865	627,165	47,165	7.52
03-G	7/15 – 8/10	37,109	779,289	68,314	8.77
03-H	8/28 – 9/2	6,117	128,457	10,260	7.99
03-I	9/3 – 9/4	1,595	33,495	1,776	5.30

* - Assigned by RVSMDC to ease identification

3.1 Quality Control Information

The quality of the IMET data from the research vessel *Ronald Brown* collected in late 2002 and early 2003 was good for the cruises 02-L thru 02-D and was fair for the remaining cruises. There was a significant jump in the amount of data flagged between the 03-D and 03-E cruises. There are several reasons behind this. First, the true winds from both anemometers have more than double the percentage of values flagged from 7 June onward. In fact, the true wind direction's percentage flagged for the first set of cruises (7) is 11.78 and 34.45 for the second set of cruises (5). The second anemometer's true wind direction is 8.65 for the first set and 17.08 for the second. The data for the true wind speed also follows the same trend with 9.78 flagged for the first set of cruises of the year and 59.82 for the second set, and anemometer two had the wind speed percentage of flagged data go from 7.28 for the first set to 24.86 for the second. The pressure and temperature data also had an increase in flags. The percentage of flagged pressure data went from 2.63 to 7.38 and the temperature went from 2.3 to 4.31. The reasons behind the demise of the data

quality are unknown but may be due to the alteration of the deck cargo. Inquiries are being made with the NOAA operators. Table 2 details the distribution of flags among the variables. A discussion of the flagged and removed variables follows.

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

Variable	B	E	G	H	I	K	S	U	V	X	Y	Total Number of Flags	% of Variable Flagged
TIME												0	0.00
LAT												0	0.00
LON												0	0.00
PL_HD							3					3	0.00*
PL_CRS							19					19	0.00*
PL_SPD							15					15	0.00*
PL_WDIR												0	0.00
PL_WSPD	156					17	7					180	0.08
DIR		27,043			4	16,961	47					44,055	19.68
SPD		46,798	38		7	12,618	10	1,178	96	106	56	60,907	27.21
PL_WDIR2						263						263	0.12
PL_WSPD2	30					196	7					233	0.10
DIR2		4,589			4	21,265	95					25,953	11.59
SPD2		1,048	29		7	27,700	49	985	68	62	38	29,986	13.39
P			1		7	8,655		837	32	31	24	9,587	4.28
T			47		5	6,288	3	86	14	183	88	6,714	3.00
TS			526	4		46		189	21	122	58	966	0.43
RH						1,330	3	25,864	1,692	4,395	3,352	36,636	16.36
RAD**	33,404											33,404	16.98
RAD2						431						431	0.19
PRECIP**						136	12					148	0.10
Total Number of Flags	33,590	79,478	641	4	34	95,906	270	29,139	1,923	4,899	3,616	249,500	
% of all Values Flagged	0.72	1.71	0.01	0.00*	0.00*	2.06	0.00*	0.63	0.04	0.11	0.08	5.37	

* - Percentages < 0.01%
**- Not included in 02-L

3.1.1 Deleted Data

The DQE determined that the precipitation data was in need of deletion, for the cruises 03-A thru 03-C, because the instrument recorded negative values for precipitation.

3.1.2 Missing Data

Most of the cruises in this set had a random minute or so of data missing each day that is undetectable when viewing the plots of the data. The only way to identify the missing data is to zoom in on the time or look at the raw data. There were cruises when the data went missing for extended periods of time. Cruises that had missing data include: the L, M, and N cruises from 2002; and A, B, C, G, and H cruises from 2003.

Anemometer 1, on the bow, had data missing during the 02-L, 02-N, 03-B, and 03-G cruises. During the 02-L cruise the data were missing on 28 August from 17Z until 19:34Z on the 29th and again on 1 September 12:16Z – 12:34Z. There were three cases of anemometer one missing data during the 02-N cruise; 17 October 00Z – 3Z, 27 October 19 – 21 Z, and 3 November from 00Z until 12:30Z. For the 03-B cruise, the data were missing 25 February from 6:09Z – 12:41Z. Finally, for the 03-G cruise, the data were missing on 6 August from 21:15Z – 23:06Z.

Anemometer 2, on the mast, also experienced a period of missing data during the 03-C cruise for a half an hour beginning 17:34Z on 25 March.

During the 02-N cruise, the temperature and precipitation data were missing 27 October for 2 hours beginning at 19Z.

The platform-relative wind direction was missing from the 03-B cruise on 21 February from 3:21Z until 12:45Z. This cruise also had missing data in the second anemometer's platform-relative wind speed twice on 26 February from 2:38 – 3:07Z and again from 21:17 – 23:08Z.

There were many situations in which all of the data went missing at the same time. During the 02-M cruise, all of the data went missing from 11:14 – 12:12Z on 24 September. This occurred twice in the 02-N cruise; first on 13 October for one hour beginning at 00Z and the second time on 30 October from 9 – 9:30Z. The 03-A cruise had missing data on 11 February from 17:41 – 18:34Z. For the 03-C cruise, all data were missing 18 March from 11:30 – 11:44Z and again from 10:21 – 18:01Z on 24 March. Lastly, the 03-H cruise had missing data in all variables twice on 29 August, first for one hour and fifteen minutes beginning at 12:10Z and again from 14:47 – 15:10Z.

Note: for those times in which the platform-relative winds are missing, the subsequent, calculated true winds are K-flagged due to their uncertainty.

3.2.0 Variable Flagging

3.2.1 Stair Stepping

Stair stepping of the navigation variables is an inherent property of these variables due to the motion of the ship. Stair stepping of the meteorological variables in response to a change in the vessel's motion is often an indicator of questionable meteorological data values. Meteorological data, in the absence of flow distortion (See section 3.2.2), should not reflect the motion of the vessel. Therefore, such values received the cautionary K-flag. Some of the steps were caught by the newly

implemented statistics based prescreener and received the X-flag. Almost every day had X-flags added to a variable for steps.

The true winds of the *Ronald Brown* often stair step and thus received the K-flag at these times. Some of the stair steps were not flagged, as there were no visible links in other variables to the steps. Examples of steps in the true winds are noticeable in each cruise. For example, during the 02-L cruise on 14 September 2002, the true winds, the pressure, and temperature data step with changes in the vessel's platform-relative wind speed and were K-flagged. This day is also indicative of the other meteorological variables stair stepping, a fairly regular occurrence.

The stepping of the temperature is likely related to the deck heating and ventilation problem discussed in section 3.2.4. This also occurs for the relative humidity, although not as frequently as the temperature. This is because the relative humidity has its own independent sensor with a different time constant.

Another variable to step with the motion of the vessel is the pressure. The pressure stepped in each of the cruises except the 02-M and the 03-I. The steps in the pressure ranged from a tenth of a millibar to 1.5 mb, but rarely much more. Some of the pressure steps were not flagged, as they were only around a tenth of a millibar. During the 02-L cruise the pressure stepped five times: 4, 5 (2mb), and 13-15 September. Stepping occurred twice on the 02-N cruise in October on 16 (.2 mb) and 21 (1 mb). The 03-A cruise had three days in which the vessel motion influenced the pressure: 7 and 8 February (.2 mb) and also the 15th (.5mb). This was a major problem on the 03-B cruise as this was experienced from 22 February until 3 March, and then again on 5 and 7 of March. The 03-C cruise had steps in the pressure data beginning on 10 March and 18-20 (.2 mb) also. This cruise also had many days in which the pressure stepped but was not flagged. These days include 14-17 March and 27 and 28 also. The 03-D cruise had only one example of the pressure stepping, 5 June. For the 03-F cruise, this happened on 19, 21, 24 (.1 mb), and 25 June, and again in July on the 4-10th. The average step in this period is .4mb with the exception of 10 July when the pressure jumps 2 mb. The 03-G cruise also had many days in which the pressure stepped including July 18, 19 (.5 mb), 21-23 , and August 1-9. Finally, the 03-H cruise had steps in the pressure from 28 August until 31 August (.5 mb avg). The steps the pressure readings may be due to the varying wind flow over the barometer, thus creating steps.

Other variables that had influence from the vessel motion are the sea temperature and the long-wave radiation. The frequency of the steps in these variables is much less than the variables mentioned above. The sea temperature stepped over 3° C on 3 September 2002 and the long-wave radiation stepped on 14 September 2002. The sea temperature step may be due to the vessel passing through a current. The step in the long-wave radiation matches the steps in the navigation data, and steps in the pressure, temperature and true winds and may be due to the steps in temperature affecting the receiving sensor of the radiometer.

3.2.2 Flow Distortion

Flow distortion was a major problem on the late 2002 and early 2003 cruises of the *Ronald Brown*. Some flow distortion is inevitable. Flow distortion is the result of the wind flowing over and around the cargo on the deck and the superstructure of the vessel relative to the location of the instruments. Since the cargo varies from cruise to cruise, it is very difficult to identify the source of the flow distortion problem. With two sets of anemometers, occurrences of flow distortion can be identified by the differences in platform-relative wind speeds and directions between the two different anemometers and, also, the differences between the calculated true wind speeds and directions of the anemometers. Another factor in identifying flow distortion is by the time series of the data, the trace will be different between the different anemometers at the same times. Flow distortion occurred on every cruise in the set and was apparent in almost every day of the cruises. This resulted in a high level of uncertainty of the true winds for the cruises. The difference in the platform-relative wind directions is about 20° between the two anemometers and about the same for the calculated true-wind direction, although greater differences do exist in the data for each set of variables. The difference in the platform-relative wind speeds is usually around 2 m/s and can range up to 5 m/s. For the true wind speeds the difference is normally only around 1.5 m/s, yet greater differences are in the data. Examples of flow distortion can be found 10 September 2002, 2 November 2002, 31 July 2003.

3.2.3 Winds

The quality of the wind data for this set of cruises varies from cruise to cruise as well as from anemometer to anemometer. There were winds of good quality recorded on the 02-M cruise for both anemometers, 03-D cruise for the true wind speed at 14.12 m and also for the 25.5 m anemometer's direction, and finally, the 03-E cruise's 25.5 m anemometer. Fair quality winds were taken from the 02-L cruise's 25.5 m anemometer, 02-N for both anemometers, 03-A for the 14.12 m anemometer, 03-B for both anemometers' speeds, and 03-D 25.5 m speed. The remaining true winds; 02-L, 03-A 25.5 m anemometer data, 03-B both directional data, 03-C all wind data, 03-D 14.12 m true wind direction and 25.5 m true wind speed data, 03-F all wind data, and 03-G through 03-I all wind data are of poor quality. In particular, the 03-E cruise had more than 90% of the 14.12 m anemometer's data flagged with E-flags by the preprocessor. Most of the flagging was due to stair stepping of the winds with the motion of the vessel and flow distortion. Almost every day has flags added due to stair stepping. The use of the true winds should be done with caution.

3.2.4 Ventilation

An insufficiently ventilated thermometer can experience steep rises in the temperature in a relatively short period of time when the platform-relative winds speeds are light

or when the flow over the instrument is blocked. Not all of the occasions of the ventilation problem reflected in the temperature are reflected in the relative humidity data since the relative humidity has its own independent sensor with a different time constant. The main pattern used to identify the ventilation problem is a relative temperature maximum during a period of platform-relative wind speed minimum. Ventilation problems are more pronounced when the atmospheric radiation is at or near the daily maximum. Ventilation issues, when identifiable, were K-flagged by the DQE or had X-flags added marking the steps.

There were nine of the cruises to experience a notable ventilation problem: 02-L, 02-M, 02-N, 03-A, 03-B, 03-C, 03-F, 03-G, and 03-H. The average increase in temperature for the vessel was about 1.3° C and the average change in relative humidity was around 10% when the hygrometer was affected. For the 02-L cruise, the problem occurred twice, 4 and 14 September. The 02-M cruise had two occurrences also, 21 and 23 of September with the relative humidity showing signs of vessel influence on the 21st. The 02-N cruise had several days in which there was an identifiable ventilation problem with the temperature: 12, 14, 16, 18, 21, 23, and 27-29 October. The only day in which the relative humidity displayed the steps was 14 October. There were six days that ventilation affected the temperature data in the 03-A cruise: 5, 8, 9, 11, 12, and 13 of February with the fifth and 12th having relative humidity steps. The 03-B cruise also had five days with stepping of the temperature data and include: 26-28 February and 2 and 5 March. On 5 March, the relative humidity steps with the temperature and platform-relative wind speed. Two days during the 03-C cruise, 10 and 12 March, had the ventilation problem. Several days of the 03-F cruise had this problem: 21, 22, 24, and 26 June and 5-8 July. The 24th of June was the only day to have steps in the relative humidity. The days experiencing ventilation problems during the 03-G were 17-20 July and August 1, 5, 7, and 9. Finally, during the 03-H cruise, three days of the cruise had ventilation problems: 28 and 30 August and September 1. For example, on 12 March 2003, the platform-relative wind speed dropped 9 m/s in four minutes and the temperature rose just over 1.25° C to a relative maximum in the same period.

3.2.5 Navigation Data

The navigation data for the vessel experienced very few problems for the available data. There were several occasions in which the platform-relative speed over ground was recorded as –500m/s and were appropriately S-flagged. These extreme values negatively affect the calculations of the true winds since the platform-relative speed over ground is used in their calculations. These situations took place during the 02-L, 02-N, 03-A, B, F, and G cruises. This occurred during the 02-L cruise on 30 August. This happened twice during the 02-N cruise, once on 14 October and again on 5 November. For the 03-A cruise, it was on 9 February, for the 03-B cruise it was 22 and 25 February, the 03-F cruise had this happen on 20 June, twice on 28 June, and once on 29 June. This cruise, 02-F, also had two instances on 6 July in which the platform-relative speed was S-flagged although it was not recorded as –500 m/s. This

day, 6 July, also had 4 S-flags placed on the course of the platform. For the 03-G cruise, the course was S-flagged on 17 July and the platform-relative speed over ground was flagged again for the negative value problem on 28 and 31 July and 9 August.

The latitude and longitude had L-flags removed from the data during the 03-I cruise on 4 September as the preprocessor flagged the data in error as the vessel was in Tampa Bay.

3.2.6 B Flag

The B-flag is assigned to those values falling outside of a realistic, acceptable range by the preprocessor. In rare cases, the bounds flag highlights extreme natural events. There were B-flags added to at least one point in all of these cruises. The flags were added to the platform-relative wind speeds for extreme values and to the short-wave radiation for negative values. The radiometer most likely detected negative values because the instrument was not tuned to detect low values of radiation.

The 02-L cruise had one day with B-flags added, 28 August, to the platform-relative wind speed as it spiked to over 50 m/s. During the 02-M cruise, the short-wave radiation received these flags every day. The same is true for the 02-N cruise, with the exception of 11 October, as no bounds flags were added. The 03-A cruise had B-flags added on 6, 8, 9, and 11-15 February totaling 217 B-flags. The 03-B cruise had a total of 639 B-flags added to each day except for 19 February. The 03-C cruise had B-flags everyday except 15, 18, and 22 March. This cruise, 03-C, also had 30 B-flags on the 25.5 m platform-relative wind speed during 25 March. On 26 March there were an additional 46 B-flags added to the 14.12 m platform-relative wind speed. The 03-D cruise had B-flags added to the short-wave radiation on 5, 6, and 7 June totaling 687 flags. The 03-E cruise had two days of B-flags added to the short-wave radiation, 11 and 13 June, totaling 42 flags. For the 03-F cruise, the short-wave radiation had bounds flags added by the preprocessor for negative values. This occurred on 22, 26, 28-30 June and also 1, 3-10 July. Every day of the 03-G cruise had B-flags added to the radiation and on 6 August, they were added to the platform-relative wind speed as well. The 03-H and I cruises had bounds flags added each day of the cruise.

3.2.7 G Flag

There were G-flags assigned by the preprocessor to values greater than four standard deviations from climatological mean (da Silva et al., 1994). The flagged values were typically just greater than the limit and may represent extreme, realistic values. There were G-flags assigned to the following cruises: 02-M, 02-N, 03-A, and 03-F. During the 02-M cruise there were three days with G-flags added: 22, 25, and 29 September. On 22 September, both the 14.12 m true wind speed (7 flags) and the 25.5 m true

wind speed (1 flag) were G-flagged along with the air temperature (26 flags). On 25 September, the 25.5 m true wind speed had 2 G-flags added while the air temperature had 10. The 29th had the same variables receiving the flags, 11 for the air temperature and 8 for the 25.5 m true wind speed.

The 02-N cruise also had three days of the journey have G-flags added, 19 October, 2 and 3 November. 19 October had 1 G-flag on the pressure when it was at approximately 1006.75 mb, just out of the acceptable range, yet a valid and extreme value. On 2 November, G-flags were added to the true wind speeds from both anemometers. The 14.12 m anemometer had 31 added G-flags and the 25.5 m anemometer had 13. For the third of November there were 2 flags added to the 25.5 m true wind speed.

During the 03-A cruise, 12 February had 526 flags added to the sea temperature, in the Bahamas, as it was around 30° C, an extreme high, yet realistic temperature for the ocean near the Gulf Stream.

On 29 June, during the 03-F cruise, there were 3 G-flags added to the 25.5 m true wind speed.

3.2.8 H Flags

The H-flag is used to identify discontinuities, large and sudden shifts in the data time series. These occur for several reasons, such as electrical interference, although a return of the data values to their original trend may not take place. There were a total of four discontinuity flags among the cruises. They occurred during the 03-A and 03-C cruises in the sea temperature. The 03-A cruise had this happen on 12 February as the sea temperature fell 8° C in just 2 minutes, again in the Bahamas, which is highly unlikely given the specific heat of water and the speed of the vessel.

The second occurrence of the sea temperature having a discontinuity was on 26 March 2003. In this example, the sea temperature drops 1.9° C in 3 minutes, again in the waters off the Bahamas.

3.2.9 I Flags

The I-flag represents an interesting feature or event that has taken place in the environment and was recorded by the instruments and identifiable in the data. These can be used when identifying fronts and tropical cyclones for example. There were three cruises in which I-flags were added, 02-L, 02-M, and 02-N. The validation of the tropical events was aided by data provided by the National Hurricane Center and Storm Prediction Center information was used in other cases. Maps and satellite information were helpful in these determinations. During the 02-L cruise, there were two instances of interesting features. These took place on 28 and 30 August. The

event on 28 August was a frontal passage off the coast of Florida with a large wind shift, local pressure and wind speed minimum, and a drop in air temperature. In fact, the air temperature fell nearly 4° C in just 30 minutes. This event had the true wind speed and direction for both anemometers, the atmospheric pressure and air temperature receiving the I-flag. It was identified with the aid of Storm Prediction Center archival data, primarily satellite and upper air data. The event on 30 August, as the vessel was northeast of Cape Hatteras, was most likely the same system or a related thunderstorm passing as there was a gradual return of the data to the previous environmental conditions. For example, the temperature fell 3.5 ° C in a half an hour again, only to return to the prior temperature an hour and a half later. The true wind speed and direction, atmospheric pressure and air temperature were I-flagged this day as well. The use of SPC data was used in identifying this scenario as well.

The 02-M cruise had three days with I-flags added: 22, 29, and 30 September. The National Hurricane Center data was primarily used in the evaluation of these events. On 22 September, the *Ronald Brown* passed through part of TS Kyle east of Florida and the Bahamas. This is the reason for the I-flags. There was a large true wind maxima for both anemometers and a slight wind shift as well. The pressure did have a local minimum, and so did the temperature at the time of passage. The true wind speeds and directions, atmospheric pressure, and air temperature were all I-flagged for the event. The situation on 29 September was that the vessel was on the east-northeast side of Tropical Storm Lili and northeast of Puerto Rico. This would explain the large wind maxima and slight wind shift accompanied by the large amount of precipitation the vessel collected. There was also a pressure minimum at the time as well. The flagged variables in this case were both of the true wind speeds, as well as the temperature and pressure. On 30 September, the vessel was in between TS Kyle and TS Lili north of Puerto Rico placing the vessel in an area of a tight pressure gradient, resulting in the intensity of the winds. There was also a wind shift and falling pressure. This is the reason for the I-flags.

The 02-N cruise had an event take place on 13 October. There were two sets of I-flags added to the day's event within hours of each other due to the proximity of a strong system in the Equatorial Pacific. This produced high winds and falling temperatures as well as wind shifts. There were 2 wind maxima and wind shifts accompanied by two local pressure minima. The temperature rose about 2° C just before the approach of the system and then fell rapidly about 7° C, presumably due to the associated rainfall. Both true wind speeds and the atmospheric pressure were the variables flagged during this event.

3.2.10 Data Spikes

Isolated spikes commonly occur with automated data and can be caused by various factors such as electrical interference. Isolated spikes occurred in most of the variables in the data set. These points were assigned the S-flag. Spikes were added in all of the variables except time, latitude, longitude, both platform-relative wind

directions, atmospheric pressure, sea temperature, and the radiation data. All of the cruises had the spike flag added to some of the data. The only cruises without spikes added by the DQE were the 02-M, 03-D and E, and 03-H and I. The majority of the flags added by the prescreener were for the relative humidity data, although the pressure, sea and air temperature received flags as well.

There were also acceleration spikes in the data as well. Acceleration spikes are due to the movement of the vessel and therefore the instrument. They are often found as the vessel is changing speed and/or direction (Smith et al., 1999). They are visible as spikes where the time series levels off, yielding continued accelerating motion, i.e. turning, speeding up or slowing down. The main variables with acceleration spikes are the platform speed, platform heading, platform course, and platform-relative winds. The true winds do exhibit acceleration spikes, but to a lesser degree. The spikes are propagated into the true winds since they are calculated from the navigation data and platform-relative winds, which often have acceleration spikes.

3.3.0 Final Comments

3.3.1 Winds and Overall Quality

The majority of the flagging of the cruises of this *Ronald Brown* data set was due to the significant amount of stair stepping done by the meteorological data, flow distortion, and the negative values recorded for short-wave radiation, demonstrated by the high number of E and K-flags for the winds and B-flags for the radiation. Even though all of the meteorological data experienced stair stepping, the entire set as a whole was of fair quality. The true winds were of particularly poor quality with the anemometer at 14.12 m having at least 20% of each variable being flagged. The anemometer at 25.5 m true data was also of poor quality but the true wind speed was only 13.4 % flagged and the true wind direction was only 11.59 % flagged, almost twice as good as the bow anemometer. The true winds were of much better quality for the cruises through 03-D, possibly attributed to different deck cargo.

3.3.2 Insufficient Data

In parts of each of the cruises, the DQE would like to note that some of the data may have been left unflagged, as in the pressure data for example, due to insufficient meteorological backing because of the lack of other data. In some cases, there was not enough evidence to say whether certain questionable data should have been flagged. It is very possible that some of the data left unflagged on these cruises are suspect and should be used with caution.

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