Ronald Brown IMET Data Quality Control Report: May 2004 – March 2005

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1.0 Introduction

This report summarizes the quality of the surface meteorological data collected by the research vessel (R/V) *Ronald Brown* (identifier: WTEC) IMET system during the 12 cruises beginning 27 May 2004 and ending on 18 March 2005. The data were provided to the Florida State University – Research Vessel Surface Meteorology Data Center (RVSMDC) on compact disk by Jonathan Shannahoff. The ASCII files were converted to standard RVSMDC netCDF format. The data were preprocessed using an automated screening program, which automatically adds quality control flags to the data, high-lighting potential problems. Next, the data are run through our statistical Spike and Stair-Step Indicator (SASSI), which adds flags for spikes and steps in the data. 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 the preprocessor, SASSI, and the DQE.

2.0 Sensor Information

The *Ronald Brown* 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 (14.12m)	(PL_WDIR)
IMET Platform-Relative Wind Speed (14.12m)	(PL_WSPD)
Earth-Relative Wind Direction (14.12m)	(DIR)
Earth-Relative Wind Speed (14.12m)	(SPD)
IMET Platform-Relative Wind Direction 2 (25.5m)	(PL_WDIR2)
IMET Platform-Relative Wind Speed 2 (25.5m)	(PL_WSPD2)
Earth-Relative Wind Direction 2 (25.5m)	(DIR2)
Earth-Relative Wind Speed 2 (25.5m)	(SPD2)
Atmospheric Pressure (15.56m)	(P)
Air Temperature (12.98m)	(T)
Sea Temperature (5.6m)	(TS)
Relative Humidity (12.98m)	(RH)
Short-wave Atmospheric Radiation (10.01m)	(RAD)
Long-wave Atmospheric Radiation (10.01m)	(RAD2)
Precipitation	(PRECIP)

3.0 Results

3.1.0 Statistical Information

A total of 5,735,730 values were evaluated with 163,380 flags added by the preprocessor, SASSI, and the DQE resulting in 2.85% of the data being flagged for the 10 months of cruises of the *Ronald Brown* from May 2004 through March 2005. A breakdown of each of the cruises is provided in Table 1.

Table 1: Statistical 2004 – 2005 Cruise Information

Cruise Identifier*	Cruise Dates	Number of Records	Number of Values	Number of Flags	Percent Flagged
04G	5/27/04 – 6/12/04	22,821	479,241	5,637	1.18
04H	6/18/04 – 6/28/04	15,404	323,484	14,246	4.40
04I	7/5/04 – 7/23/04	25,580	537,180	14,447	2.69
04J	7/26/04 – 8/12/04	24,234	508,914	15,285	3.00
04K	9/22/04 – 10/3/04	16,543	347,403	12,936	3.72
04L	10/10/04 – 10/18/04	11,699	245,679	8,235	3.35
04M	10/29/04 – 11/28/04	43,665	916,965	23,734	2.59
04N	12/5/04 – 12/23/04	25,645	538,545	16,915	3.14
05A	12/29/04 – 1/5/05	10,075	211,575	3,120	1.47
05B†	1/11/05 – 2/22/05	59,973	1,259,433	39,678	3.15
05C	3/1/05 – 3/5/05	5,774	121,254	1,819	1.50
05D	3/10/05 – 3/18/05	11,717	246,057	7,328	2.98

* Assigned by RVSMDC to ease identification
† Note: Cruise 05B was conducted as part of the U.S. CLIVAR program along line A16S.

3.1.1 Quality Control Information

The quality of the data for the second half of 2004 and early 2005 collected on the *R/V Ronald Brown* varied between cruises and parameters. The data was of good quality, 1 – 5% flagged, for all of the quality controlled cruises discussed in this data set. When all of the cruises were combined, the total amount of data flagged was only 2.85%, a dramatic improvement from the last set of *Ronald Brown* data (11 June 2003 – 4 May 2004) that underwent quality control (8.80%). The earth relative wind direction data was typically of fair (5 – 10% flagged) to poor (>10% flagged) quality for both anemometers, although the 04G and 05A cruise were of good quality for both anemometers as was the data for the anemometer at 25.5m for the 05C cruise. The earth relative wind speed data was also typically fair to poor quality for both anemometers, although both were of good quality for the 04G, 05A, and 05C cruises. The anemometer at 14.12m had good quality earth relative wind speeds during the 04N cruise and the anemometer at 25.5m had good quality earth relative wind speeds during the 05B cruise. The atmospheric pressure was usually of excellent (0 – 1%) to good quality with the exception of the 05D cruise as it was of fair quality with 6.33% of the data having flags added. The air temperature was mostly good quality data although the 05C cruise recorded excellent quality data and the 04K, L, 05A and 05D cruises logged fair quality data. The sea temperature was of excellent to good quality for the majority of the cruises although the 04I and J cruises were of poor and fair quality respectively. The relative humidity was typically of fair to poor quality with the exception being the 04G cruise having recorded good quality data. The short and long-wave radiation data were of excellent quality other than the short-wave radiation during the 04N cruise when it was of fair quality. The precipitation data will be removed from the data before it is publicly released. The low number of flags applied to the precipitation data was the result of early identification of significant issues with the data requiring elimination from the data. A discussion of the flagged and removed variables follows.

NOTE: SASSI only applied to scalar variables. These variables include the earth-relative wind speeds, sea temperature, air temperature, atmospheric pressure, and relative humidity.

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

Variable	B	E	G	H	I	K	N	S	U	V	X	Y	Total Number of Flags	Total % of Data Flagged
TIME													0	0.00
LAT							53						53	0.02
LON							53						53	0.02
PL_HD													0	0.00
PL_CRS													0	0.00
PL_SPD								1					1	0.00*
PL_WDIR						1,585		2,878					4,463	1.63
PL_WSPD						1,760		710					2,470	0.90
DIR		1,741			7	21,450		2,342					25,540	9.35
SPD		177	160		8	21,641		1,120	1,323	206	133	62	24,830	9.09
PL_WDIR2								1,903					1,903	0.70
PL_WSPD2						106		497					603	0.22
DIR2		3,873		2	7	21,005		2,145					27,032	9.90
SPD2		545	11		8	16,196		1,848	965	95	64	37	19,769	7.24
P					8	5,661		4	66	8	10	5	5,762	2.11
T			144		7	5,847		9	611	115	561	253	7,547	2.76
TS	172		54			138		5	3,925	446	1,528	904	7,172	2.63
RH	3		348		4	1,229		41	20,190	1,376	5,075	3,611	31,877	11.67
RAD	1,840				1								1,841	0.67
RAD2	129				1			279					409	0.15
PRECIP				8		1,955		92					2,055	0.75
Total Number of Flags	2,144	6,336	717	10	51	98,573	106	13,874	27,080	2,246	7,371	4,872	163,380	
Percentage of All Variables Flagged	0.04	0.11	0.01	0.00*	0.00*	1.72	0.00*	0.24	0.47	0.04	0.13	0.08		

* Percentages < 0.01%

3.1.2 Deleted Data

The DQE determined that some of the 2004 – 2005 *Ronald Brown* IMET data were unusable due to extensive missing, highly suspect, or erroneous data. As a result, these data were removed from the final quality controlled data set.

The precipitation data from all of the cruises discussed were removed after visual quality control due to the lack of confidence in the data collected. The R.M. Young self-siphoning rain gauge typically leaked and would often record negative values of accumulated precipitation. Other suspect events include draining before expected. For example, on 24 June 2004, it had been registering roughly 24.7 mm of precipitation and then went to 29.4mm in one minute and maintained about that value for just over an hour until it drained back to the previous level.

3.1.3 Missing Data

There was only one cruise to have a prolonged period of missing data for the data set described in this report, the 05B cruise. In this example the data from the anemometer at 14.12m failed to record beginning at 18:50 UTC 6 February 2005 until 13:54 UTC on 7 February. This resulted in the loss of platform-relative wind speed and direction data used with the platform heading, course, and speed to calculate earth-relative winds. It is suspected that platform-relative wind data were used in the calculation of the true winds but the data logger failed to record them. This is assumed because there is no discontinuity in the time series for the earth-relative winds at 14.12m. The earth-relative wind values, lacking recorded platform-relative wind data, were left unflagged as historical QuikScat data was used to validate that the calculated earth-relative.

There were several random minutes of data missing during each of the cruises with the exception of the 04L cruise. This was noted using the daily statistics generated by the countflags routine; it revealed missing data when there were less than 1440 of the expected one-minute observations in the day. In these cases, the data from all instruments was not recorded. The cause is unknown, but may be the result of instrument system maintenance or the rebooting of the data logger.

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 vessel. Stair stepping of the meteorological variables in response to a change in the vessel's motion, course, speed or heading, 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 SASSI, the statistics based prescreener, and received the X-flag, usually in conjunction with the other flags used by the program. There were 39,323 U, X, and Y flags added by SASSI. Almost everyday of the cruises had a suspect step in one of the variables' time series. There were steps in every cruise evaluated. This resulted in the application of 98,573 K-flags to the data, although not all of them were added for stair stepping. Note: some of the steps in the winds have had E-flags applied to the data by the prescreener, prior to visual inspection, for failing the true winds recalculation test. The earth relative winds, air temperature, relative humidity, atmospheric pressure, and sea temperature are the meteorological variables that had steps in the data corresponding to the motion of the vessel.

There were 128 days in which the earth-relative wind direction from the anemometer at 14.12m had K-flags added for steps in the data. 11 August 2004, during the 04J cruise, is an example of the earth-relative wind direction stepping with changes in the platform's heading and course. The step occurred just after 5 UTC and the winds shifted from about 165° to around 195° as the heading and course went from 290° to around 110°. As the vessel reverted its track to the previous trend, the winds also returned to roughly the same values.

The earth-relative wind speed from the anemometer at 14.12m had steps during steps during 113 days during the cruises discussed. An example of the 14.12m earth-relative wind speed took also place on 11 August 2004 at about 4:56 UTC. Here the platform speed dropped from 4.5 m/s to about 2.6 m/s and the earth-relative wind speed went from 7.5 m/s to 6.5 m/s and less. As the platform speed increased, so did the earth-relative wind speed, back to the original trend of about 7.5 m/s.

The earth-relative wind direction calculated from the anemometer from 25.5m also had steps in the data corresponding to steps in the motion of the vessel. This took place on 114 days of the cruises, such as 13 October 2004. Here the course was steady at 170° and changed to about 355° and the heading went from a consistent 95° to 355° and the direction went from about 95° to 200° and leveled off at about 130°. As the vessel went back to a steady track, the earth-relative wind direction returned to the previous trend of about 100°.

The true wind speed at 25.5m had steps in 95 days of the cruises. 15 December 2004 is an example of the 25.5m earth-relative wind speed stepping with the motion of the vessel, in this case the speed. The platform speed was very low, less than 0.5m/s, and increased about 0.5m/s resulting in the earth-relative wind speed decreasing about 6m/s from around 10m/s to about 4m/s.

The air temperature had steps during 42 days of the cruises. Most of the steps were likely due to steps in the platform-relative wind speed related to ventilation issues (See section 3.2.4). Some of the steps were identified by SASSI. 26 September 2004 is an example of the temperature data having been influenced by the motion of the vessel. Here the platform-relative wind speed decreased from about 10m/s to about 7m/s. This resulted in the temperature increasing about 2°C from 25°C to 27°C. As the platform-relative wind speed slowly returned to 10m/s, the air temperature also cooled to about 25°C. Occasionally, the relative humidity would fluctuate due to a change in temperature, decreasing as the air temperature increased. SASSI was able to identify such situations. 29 September is an example. In this situation, the platform-relative wind speed decreased about 2m/s and the air temperature rose 1°C and the relative humidity fell roughly 3%. SASSI identified these steps with U and V flags for suspect data and spikes.

The relative humidity also had steps in the data that did not always occur with changes in the motion of the vessel or the air temperature, as mentioned above. On 8 July 2004, the relative humidity was consistently 95.25% except for 2 unexplained steps in which the relative humidity dropped up to 4.5% to values around 91%. This is not a significant change in magnitude, but, given the consistency of the relative humidity before and after the steps, the data were flagged as suspect. In this example, however, there were no significant changes in platform speed or air temperature during the steps.

There were also steps in the sea temperature data. Most of the steps in the sea temperature were the legitimate result of the vessel crossing strong thermal gradients in the ocean. The vessel was in the vicinity of the Gulf Stream off New England during the 04G – J cruises, and within islands of southern Argentina during the 04N – 05B cruises. 22 December 2004 was an example of severe sea temperature stepping. The sea temperature was steady at about 16.6°C off the central Chilean coast, and then, at 18 UTC, the values fluctuated between 5°C and 41°C, even dropping to -4°C. This was likely a malfunction in the sensor although the data were K-flagged by the DQE, B-flagged by the prescreener, and X and V-flagged by SASSI.

3.2.2 Flow Distortion

Flow distortion was suspected to be a problem for the late 2004 and early 2005 cruises of the *Ronald Brown* detailed in this report. Flow distortion is the result of the wind flowing over and around the cargo on the deck and superstructure of the vessel relative to the location of the instrument sensors. Since the cargo varies from cruise to cruise, it is often very difficult to identify the source of the flow distortion problem. Some flow distortion is inevitable. 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 two anemometers. The *Ronald Brown* has multiple wind sensors, although at differing heights, enabling easier identification of flow distortion problems. Flow distortion often results in a high degree of uncertainty in the winds. Nearly every day had some degree of flow distortion taking place.

An example of flow distortion in the platform-relative and earth-relative wind direction data took place at the end of the day 1 August 2004. In this example, the platform-relative wind direction values from the anemometer at 14.12m went from about 75° to around 300° while the anemometer at 25.5m recorded values consistently at about 95°. The same is true for the earth-relative wind direction data. The 14.12m anemometer recorded data at about 210° with two steps to 250° and 260°. The anemometer at 25.5m recorded data at about 225° with two steps to 215°. This identifies a difference between the anemometers, likely the result of flow distortion.

Flow distortion was evident in the platform-relative wind speed data 16 December 2004. In this case the anemometer at 14.12m recorded values of about 4-6m/s and the anemometer at 25.5m recorded data for the same period that was only about 1m/s. There were also steps in the lower anemometer's data that were not recorded by the higher one indicating flow distortion issues. These differences were carried over into the earth-relative wind speed data. The anemometer at 25.5m had steps in the time series that were not in apparent in the 14.12m time series. The values also differed. The 14.12m earth-relative wind speed data were about 8m/s and the 25.5m values were about 5.5m/s, again indicating a flow distortion problem. Differences in velocity would be expected at different heights due to differing amounts of friction, although these are suspect since the lower anemometer recorded higher wind speeds.

Improved documentation of the sensor locations and their surrounding environment (i.e., digital photos of sensor sites) will improve our understanding of flow distortion affects on individual sensors.

3.2.3 Winds

The quality of the IMET wind data for the late 2004 and early 2005 cruises from the R/V *Ronald Brown* was fairly consistent as the majority of the cruises recorded fair quality data. Historical QuikScat data was used to verify the winds during visual inspection of the current data. This method of comparison may have reduced the number of flags applied to the data, resulting in the lower percentage of data flagged. When all of the cruises' wind data were considered as a whole, the quality is much improved compared to the last sets of data having been quality evaluated at COAPS. There was a dramatic improvement in the wind data compared to the data from September – November 2003. 36.48% and 48.72% of the earth-relative wind direction and speed from the anemometer at 14.12m had flags added for the previous data and only 9.35% and 9.09% of the wind data were flagged for the current cruises. The quality of the wind data recorded by the anemometer at 25.5m was only slightly better for the current data. The earth-relative wind direction and speed for the recent data had 9.90% and 7.24% of the data flagged compared to 10.21% and 10.54% of the previous data flagged.

There were still issues with flow distortion contaminating the wind data, although not as severe as prior cruises. This is apparent in the difference in the amount of data flagged. The amount of E-flags applied to the data dramatically decreased as well. The data for September – November 2004 had a total of 56,192 E-flags whereas the current data had only 6,336 despite the fact that the current data also had 3.6 times as much data collected.

The platform-relative winds from the anemometer at 14.12m were, overall, of good quality for the direction and excellent quality for the speed while both the direction and speed at 25.5m were of excellent quality. The 05C platform-relative wind direction data at 14.12m had the highest percentage of data flagged with 7.15% of the data having flags applied (fair quality). The majority of the flags added to the platform-relative winds were for spikes (S) and suspect data (K). The S flags were typically added for acceleration spikes (See section 3.2.12).

3.2.4 Ventilation

An insufficiently ventilated thermometer can experience steep rises in temperature in a relatively short period of time when the platform-relative wind speeds are light or when the flow over the instrument is blocked. The ventilation issue can also affect the relative humidity values. If the amount of moisture in the atmosphere remains the same and the temperature increases due to poor ventilation, the relative humidity will decrease. However, not all of the occasions of the ventilation problems 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 ventilation problems is a relative maximum in air temperature, or dew point temperature, or a relative humidity minimum during a relative minimum period in platform-relative wind speed. Note: when the relative humidity is derived from temperature sensor data, the relative humidity could decrease if the air temperature rose due to ventilation issues. 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 U, X, and/or Y-flags added by SASSI to identify the steps. Not all of the values that were K-flagged in the air temperature and the relative humidity data were the result of ventilation issues. There were cases where there were no identifiable causes of the temperature changes.

The magnitude of the steps varied from about 0.5°C - 7°C. An example of the ventilation problem affecting the air temperature and relative humidity took place on 29 September 2004 during the 04K cruise and was identified by SASSI with U, and V-flags. In this example, the platform-relative wind speed dropped from about 1.5m/s to 0m/s in 5 minutes and the temperature gradually increased from 27.5°C to 28.4°C, and the relative humidity decreased from 72% to 70% all during the same period. The only cruise without identifiable cases of ventilation issues was the 05C cruise.

3.2.5 Navigation Data

The navigation variables only experienced one problem during the 04G cruise on 7 June. The vessel was nearly stationary for a while, as noted using the latitude and longitude and platform-speed data, off the New England coast and the platform-speed value spiked from 0-2m/s out of the trend of the surrounding data.

3.2.6 B Flags

The B-flag is assigned to those values falling outside of a realistic, acceptable range by the preprocessor. On rare cases, the bounds flag highlights extreme, natural events. There were B-flags added to the sea temperature (172), the relative humidity (3), the short-wave atmospheric radiation (1,840), and the long-wave atmospheric radiation (129).

The B-flags added to the radiation parameters were due to the instruments having observed negative values or values greater than 1400W/m^2. There were flags added to the short-wave atmospheric radiation during the 04J (1 day of 18 day cruise), 04K (5/12 days), 04L (3/9 days), 04M (24/31 days, 77%), 04N (9/19 days), 05A (1/8 days), 05B (7/43 days), 05C (3/5 days), and 05D (7/9 days) cruise. The long-wave atmospheric radiation had flags applied during the 04L (2/9 days), 04M (6/31 days), 05B (32/43 days), 05C (1/5 days), and the 05D (2/9 days) cruise. Considering the two different radiation instruments, it seems as though a problem first developed in the short-wave sensor and then the long-wave-sensor. These problems may have been fixed or the instruments recalibrated in late 2004 as the frequency of the instruments recording odd values decreased and then gradually becomes more consistent during the early cruises of 2005. The long-wave radiation sensor may have also been recalibrated after the 05B cruise.

All of the B-flags added to the sea temperature were added during the 04N cruise on 22 December 2004 as the vessel was off the central South American coast near Peru and Argentina heading south through 30S. The flagged values were over 40° C and fluctuated below 0°C, in error. The remaining data collected that day seemed reasonable and were not flagged.

The only other parameter to have B-flags applied to the data was the relative humidity. They were added during the 04J cruise on 31 July 2004. The values were just over 100% north of Cape Cod in the western Atlantic.

3.2.7 E Flags

E-flags are added by the preprocessor to calculated earth-relative wind values that fail the true winds recalculation test. The values must have more than a 20° difference in direction and the speed difference must be more than 2.5m/s in order to have the E-flag applied. There were a total of 6,336 E-flags applied to the data from the two different anemometers. The true winds from the anemometer at 14.12m had 1,741 and 177 E flags applied to the calculated true wind direction and speed respectively. The 25.5m anemometer had 3,873 and 545 E-flags applied. The pattern of flags was atypical for the true wind data collected aboard the *Ronald Brown*. The anemometer at 14.12m usually has more of the data flagged, likely due to flow distortion and/or frictional issues related to the superstructure and foredeck cargo on the vessel. There were 2,820 values E-flagged by the preprocessor that were modified by the DQE or SASSI.

3.2.8 G Flags

There were G-flags assigned by the preprocessor to values greater than four standard deviations from the climatological mean (da Silva, et al., 1994). The flagged values were typically just greater than the four standard deviation limit and may represent extreme, realistic values. There were a total of 717 G-flags added to 5 of the cruises: 04G (169), 04H (36), 04I (312), 04K (11), and 05B (189). The G-flags added to the 04G cruise were added to the true wind speed data (20 – 25 m/s) from both anemometers during a period of low pressure, with the anemometer at 14.12m having 158 of the flags. The 04H cruise had all of the flags applied to relative humidity data 20 June 2004 to values less than 40% off the New England coast. The 04I cruise had the G-flags added to the relative humidity data as well. In this cruise, the flags were applied on 20 and 21 July, close to the New England coast, to values that were less than about 43%, although there were values on 20 July that were lower and left unflagged. The values were left unflagged due to the proximity to shore where lower values of relative humidity can exist and the vessel was near a climatology bound. The 04K had flags applied 27 September 2004 to sea temperature values northeast of the central Bahamas of 24.4°C to 24.1°C, although there were lower values recorded and not flagged. The 05B cruise had G-flags applied to the earth-relative wind speed (22 February), air (8 February) and sea temperature (24 January). The G-flags added to the earth-relative wind speed on 22 February, as the vessel was just south of the equator and east of Brazil, were for values greater than 15m/s. The vessel was likely near a storm as the temperature dropped and the relative humidity increased and the wind shifted, although there was no precipitation recorded. The flags were added on 8 February to air temperature data that was less than 21°C as the vessel was heading north in the central south Atlantic. The flags added to the sea temperature 24 January were for values of about 10.5°C, greater than 4 standard deviations from the climatological mean, near the island of South Georgia in the south Atlantic.

3.2.9 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 10 discontinuity flags added among the cruises. They took place during the 04H (6), 04J (2), and 05B (2) cruises. The earth-relative wind direction from the anemometer at 25.5m had H-flags applied during the 05B cruise on 23 January. In this example the direction shifted about 20° out of the trend of the data.

3.2.10 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 a total of 51 I flags applied to the 04G, J, L, M, N, and 05A cruises. For example, 3 August 2004, as the vessel was off the coast of Portland, ME, Hurricane Alex passed the vessel to the southeast resulting in a earth-relative wind direction shift, an earth-relative wind speed max, a pressure min, a temperature max, and a relative humidity min with precipitation recorded resulting in the application of the I-flags by the DQE. Several of the other cases when I flags were applied (04J, L, M cruises during the summer), were due to the passage of tropical waves as the vessel was in the Caribbean and western Atlantic.

3.2.11 N Flag, Port Data

It is possible, while the vessel is in port, for some of the meteorological variables to experience data values quite different than those over the open ocean, especially the sea temperature. When the values recorded in port are relatively out of trend with the data recorded at sea, the values may be representative of real conditions in the port and thus are not K-flagged. The N-flag is applied to latitude and longitude data to identify these situations. This was the case during the last day of the 04I cruise, 23 July, as the vessel was around Portsmouth, ME. The sea temperature dropped several degrees and began to slowly increase the further into the waterway the vessel progressed. The air temperature rose considerably and the relative humidity decreased in response to the warmer air temperatures with little change in moisture content. The earth-relative winds also fluctuated out of the trend of the data as well. The suspect nature of the fluctuations of the aforementioned variables inspired the application of 53 N-flags each to the latitude and longitude.

3.2.12 S Flags, Data Spikes

Isolated data spikes often occur with automated data and can be caused by various factors such as electrical interference. Acceleration spikes are also common when data is collected on moving vessels (Smith, 1999). These often appear as 'noisy' data. Spikes occurred in most of the variables in this data set. These points were assigned the S-flag when they were visually identified using VIDAT. There were also spikes flagged as V-flags added by the automated QC program SASSI. Spike flags (S) were added during visual inspection to the platform-speed over water and all of the meteorological variables, with the exception of the short-wave atmospheric radiation. SASSI applied spike flags (V) to the earth-relative wind speed calculated from both anemometers, the atmospheric pressure, air temperature, sea temperature, and the relative humidity.

The majority (96.9%) of the manually applied spike flags were due to acceleration spikes in the platform-relative and earth-relative wind direction and speed from both anemometers. Acceleration spikes propagate from the measured platform-relative winds to the calculated earth-relative winds since the platform-relative winds are used in their calculation. Nearly everyday of every cruise had acceleration spikes in the wind data. The long-wave atmospheric radiation had 63% of the spike flags applied during the 04M cruise indicating there may have been natural events, such as passing clouds, in which the radiation values quickly modified and returned to previous trends or there was an issue with the instrument or data logger during the cruise.

Examples of spikes took place during the 04N cruise 20 December 2004. In this example, the relative humidity was fluctuating about 10% and then there were single values that dropped an additional 5% resulting in the spike flags. The long-wave atmospheric radiation and the precipitation both spiked 29 October 2004. The radiation was fairly consistent at just over 400W/m^2 and then there were 2 different spikes, the first to a value of just less than 230W/m^2 and the second to a value of 360W/m^2. The precipitation spiked at the same time as the second spike in the radiation, about 11:30 UTC. The rain gauge was recording values of about 14.8mm and then spiked to 17.5mm for one observation.

3.3.0 Final Comments

3.3.1 Winds and Overall Quality

The data collected during the cruises of the *Ronald Brown* for late 2004 and early 2005 were of much better quality than the previously evaluated data from the vessel. The total percentage of data flagged was 5.37%, 7.87%, 8.80%, for the previously evaluated data and 2.85% for the last data set quality evaluated for the *Ron Brown*, a definite improvement. The wind data experienced dramatic improvements in quality. The earth-relative wind direction at 14.12m had 19.68%, 36.48%, and 43.06% of the data flagged for the previous three evaluated data sets and only 9.35% for the current data. The earth-relative wind speed for the same anemometer improved from 27.21%, 48.72%, and 52.86% to 9.09% for the current cruises. The wind data from the anemometer at 25.5m is typically of better quality than that of the 14.12m anemometer. This is reflected in the amount of data flagged for the last several cruises. The earth-relative wind direction at 25.5m had 11.59%, 10.21%, and 5.35% for the previous data sets evaluated and 9.90% of the data flagged for the current data. The percentage of true wind speed data recorded at 25.5m was 13.39%, 10.54%, and 7.34% for earlier data and 7.24% for the current data. All of these are trending to better quality with the exception of the 25.5m earth-relative wind direction. This is likely related to the use of historical QuikScat data used to validate the wind data from the vessel. This comparison may have prevented the application of flags, resulting in a lower percentage of flagged data. There were many flags applied to the relative humidity by SASSI that were removed at the discretion of the DQE.

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 due to insufficient meteorological backing because of the lack of data. In some cases there was not enough evidence to say whether or not certain questionable data should have been flagged.

References:

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