L'Atalante Automated Weather System Data Quality Control Report

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Introduction:

The data referenced in this report are automated weather system (AWS) observations collected by the research vessel L'Atalante (identifier: FNCM). The data were gathered during six WOCE cruises occurring in the years 1991, 1992, 1993, and 1995. C. Maillard and E. Moussat provided the data to Florida State University in electronic format. They were modified according to Appendix A and converted to the standard FSU format. The data were then processed using an automated data screening program. Next, the Data Quality Evaluator reviewed, modified, and added appropriate quality control (QC) flags to the data. Details of the WOCE quality control procedures can be found in Smith et al (1996). This data quality control report summarizes the flags for the L'Atalante AWS surface meteorology data, including those added by both the preprocessor and the Data Quality Evaluator.

Statistical Information:

The L'Atalante data were expected to include observations collected every ten minutes on cruise AR_15_/05 and every minute on cruises AR_15_/09, A__07_/00, A__06_/00, A__14_/00 and A__13_/00. Values for each of the following variables were collected on all six of the WOCE cruises:

Time	(TIME)
Latitude	(LAT)
Longitude	(LON)
Sea Temperature	(TS)
Atmospheric Pressure	(P)
Air Temperature	(T)
Relative Humidity	(RH)
Precipitation	(PRECIP)
Atmospheric Radiation	(RAD)

Values were also collected for the following variables on WOCE cruise A__07_/00 from 01/14/93 through 02/09/93:

Platform Course	(PL_CRS)
Platform Speed	(PL_SPD)
Earth Relative Wind Direction	(DIR)

Earth Relative Wind Speed (SPD)

A second set of wind data was also collected on cruise A__07_/00 from 01/14/93 through 01/16/93, although there are large gaps where this data was either zero or nonexistent. Platform relative wind direction and speed were also measured on all cruises except for A__06_/00 and A__07_/00 from 01/02/93 through 01/13/93 and can be made available upon request. Details of each cruise including start and end date, number of values, number of records, number of flags and percentage flagged are listed in Table 1. A total of 2,293,062 values were evaluated with 169,789 flags added by the preprocessor and Data Quality Evaluator for a total of 7.41 percent of the values being flagged. The distribution of these flags for each variable is detailed in Table 2.

Table 1: Statistical Cruise Information

CTC	Dates	Number of Records	Number of Values	Number of Flags	Percentage Flagged
AR_15_/05	08/10/91 - 09/07/91	3,904	35,136	4,142	11.79
AR_15_/09	11/14/92 - 11/30/92	23,988	215,892	21,645	10.02
A__07_/00	01/02/93 - 02/10/93	51,828	673,764*	68,919*	10.23
A__06_/00	02/13/93 - 03/19/93	44,809	403,281	42,028	10.42
A__14_/00	01/13/95 - 02/16/95	49,620	446,580	14,899	3.34
A__13_/00	02/21/95 - 04/02/95	57,601	518,409	18,156	3.50

* Not including the second set of wind data, due to their incomplete nature

Summary:

The automated weather system observations from the research vessel L'Atalante demonstrated significant problems with the air temperature and relative humidity on all of the cruises. Atmospheric radiation data appeared to have a scaling problem on four of the cruises. The wind data on cruise A__07_/00 also demonstrated a systematic error. These major problems and other minor problems are listed below along with explanations of the corresponding flags that were

assigned.

Table 2: Number of Flags and Percentage Flagged for each variable *

Variable	B	G	H	I	J	K	S	Total Number of Flags	Percentage of Variable Flagged
LAT									0.00
LON									0.00
PL_CRS									0.00
PL_SPD									0.00
DIR					15,304		3	15,307	43.79
SPD							1	1	0.00
TS		102				4,355	3	4,460	1.92
P			2	2		25	3	32	0.01
T		151	2	6		4,205	3	4,367	1.88
RH	506	9		5		3,536	3	4,059	1.75
PRECIP							3	3	0.00
RAD	29,574					111,986		141,560	61.08
Total Number of Flags	30,080	262	4	13	15,304	124,107	19	169,789	7.41
Percentage of Flags used	1.29	0.01	0.00	0.00	0.67	5.41	0.00	7.41	

* Not including the second set of wind data

Major Problems (Cruise A__07_/00):

- The reported earth relative wind direction is influenced by the ship's course and speed. In particular, the DIR values fluctuated over 50 degrees whenever the ship's speed was less than 2.5 m/s. For earth relative true wind this should not occur; consequently, all values of DIR were assigned the "J" flag when PL_SPD was less than 2.5 m/s. Since the flagging was done graphically (Smith, et al. 1996), some such points may not have been flagged. Also, the transition zones between higher speeds and those less than 2.5 m/s

sometimes had acceptable DIR values and were not flagged. As noted in the final comments, the authors recommend that ALL wind data be used with caution.

- PL_SPD was only measured to the nearest m/s, therefore the precision of the calculated values of SPD and SPD2 were only to the nearest m/s.
- On the 3 days when a second set of wind data was recorded, gaps occurred in DIR2 and SPD2 where all values were zero. These zero values were assigned the "J" flag.

Major Problems (All Cruises):

- The air temperature often experienced jumps of over 2 degrees C at times of low platform relative wind speed and high atmospheric radiation. The temperature readings were probably higher than expected because of inadequate ventilation. Radiational heating of the ship by direct sunlight may cause a buildup of heat around the instrument. When the wind was over 2 m/s this buildup did not occur. All values within these jumps were assigned the "K" flag and should be used with caution.
- Lower relative humidity values occured in response to the increases in air temperature described above. These values were also given the "K" flag.
- Negative values for RAD were present during nighttime hours. Based on the radiation profiles, RAD is assumed to be a measure of incoming solar radiation and negative values would be physically meaningless. Therefore, these negative values were assigned "B" flags by the prescreener.
- RAD values on cruises AR_15_/05, AR_15_/09, A__07_/00, and A__06_/00 were all less than 150 watt per meters squared while actual values of incoming solar radiation should be on the order of 1,000 watts per meters squared. The data are likely in error by a factor of 0.1, but this assumption could not be confirmed. Therefore, all non-negative RAD values were given the "K" flag during these cruises and should be used with caution.

Minor Problems

- On cruise AR_15_/09 the sea surface temperature dropped more than 2 degrees C for short periods during 01/02/93 and 01/03/93 when the ship was near the shore. No clear physical explanation for these variations was available, so all TS values on these days received the "K" flag.
- The sea surface temperature was 2 degrees C less than the surrounding values for over 4 hours on 02/05/95 pm cruise A__14_/00. The ship was far from any land mass or ocean current that may cause such a drop, so this feature was given the "K" flag.
- A small block of sea surface temperature received "G" flags by the prescreener for temperatures more than four standard deviations above climatology on 02/13/95 of cruise A__14_/00.
- The sea surface temperature changed nearly 10 degrees C when the ship entered and exited a cold water port near the southern tip of Africa. This occured from 02/16/95 through 02/22/95 during cruise A__14_/00. The water surface temperature data is likely accurate, although is does not reflect the ocean surface temperature in this area. The TS values were not flagged, but should be used with caution.
- Sea surface temperature showed unusually high diurnal heating on 03/22/95 of cruise A__14_/00 . These values were flagged with "K".
- The surface pressure values on cruise AR_15_/05 sometimes echoed the fluctuations in T and RH corresponding to periods of low winds and high radiation. These P values were also given the "K" flag.
- On 03/29/95 of cruise A__13_/00 the variables TS, T, P, RH, and PRECIP all experienced a spike at the same time, followed by a period with no values recorded. These variables were all assigned the "S" flag. RH values prior to this spike were greater than 100 and were given the "B" flag by the prescreener. T and P showed a discontinuity

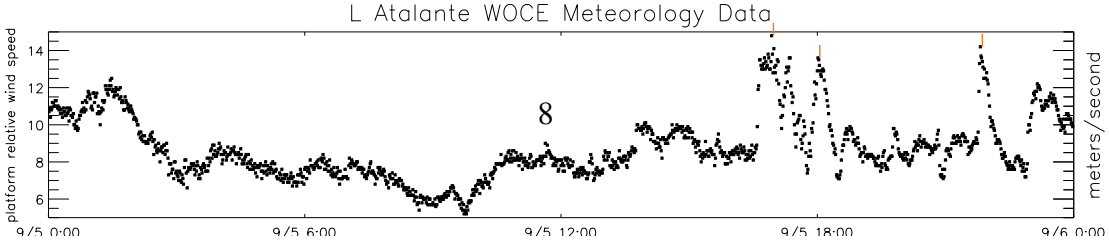
after values resumed and were given the "H" flag.

- On four occasions the air temperature experienced a sudden drop of several degrees C. These drops were accompained by a sudden increase of wind speed, increased relative humidity, changes in surface pressure, and sharply decreased atmospheric radiation. Some precipitation occurred during these events. The changes in these variables likely marked the passage of a tropical wave, cold front or squall line. Figure 1 shows a typical event (likely a tropical wave leaving Africa) on 09/05/91 and the position of "I" flags marking points of interest in the T and P variables.
- During one of these meteorological events on cruise A__13_/00 the air temperature and sea surface temperature dropped below four standard deviations from climatology. These values were assigned "G" flags by the prescreener.

Final Note:

The L'Atalante wind data, on the cruise they were available, have serious problems. If the values calculated for DIR are supposed to represent earth relative wind direction, then they were calculated incorrectly. Correct values for DIR would reflect no trace of the ship's movement. The earth relative wind speed may also have this problem, but with such poor resolution it is impossible to determine. All wind data should be used with caution, even if there are no flags present. The temperature and relative humidity data should also be used with caution, specifically during periods of light winds and strong atmospheric radiation. The negative values for atmospheric radiation during nighttime hours should be discarded. Sea surface temperatures on the open ocean seem reliable, but caution should be used when the ship is near the shore. Otherwise, the data are in good condition.

Figure 1: Typical Meteorological Event



Appendix A: Modifications to FNCM Data

Some modifications were made to the L'Atalante data before they were prescreened and quality controlled by the Data Quality Evaluator. The latitude and longitude data, meteorological data, and wind data were provided in three separate formats. The following modifications had to be made in order to time synchronize the data and are summarized below:

- LAT and LON data were taken on every 0, 20, and 40 seconds of each minute and were averaged to obtain a single value for that minute.
- The times at which the meteorological data were recorded were rounded to the nearest minute.
- The times at which the wind data were recorded were rounded to the nearest minute.

The three sets of data were then combined together by matching observations with identical minute time stamps.

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 32301999