Knorr IMET Data Quality Control Report

Lauren Volkmer, David F. Zierden, and Shawn R. Smith

World Ocean Circulation Experiment

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 research vessel *Knorr* (identifier: KCEJ) IMET system during one WOCE cruise beginning 02 January 1996 and ending 22 January 1996. The data were provided to the Florida State University Data Assembly Center (DAC) in electronic format by the Woods Hole Oceanographic Institute and were converted to standard DAC netCDF format. 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, 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 *Knorr* IMET data, including those added by the preprocessor and the DQE.

Statistical Information:

The *Knorr* IMET data include observations taken every minute for the following variables:

Time	(TIME)
Latitude	(LAT)
Longitude	(LON)
Platform Heading	(PL_HD)
Platform Course	(PL_CRS)
Platform Speed Over Ground	(PL_SPD)
Platform Speed Over Water	(PL_SPD2)
Platform Relative Wind Direction	(PL_WDIR)
Platform Relative Wind Speed	(PL_WSPD)
Earth Relative Wind Direction	(DIR)
Earth Relative Wind Speed	(SPD)
Atmospheric Pressure	(P)
Air Temperature	(T)
Sea Temperature	(TS)
Relative Humidity	(RH)
Precipitation	(PRECIP)
Atmospheric Radiation	(RAD)

Details of the cruise 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 499,120 values were evaluated with 32,246 flags added by the preprocessor and the Data Quality Evaluator resulting in a total of 6.46% of the values being flagged.

Table 1: Statistical Cruise Information

CTC	Dates	Number of Records	Number of Values	Number of Flags	Percent Flagged
I__02W/00	01/02/96 – 01/22/96	29,360	499,120	32,246	6.46

Summary:

The quality of the IMET data from the research vessel *Knorr* ranged from very good to poor depending on the variable. Table 2 details the distribution of flags among the different variables.

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

Variable	B	J	K	S	Total Number of Flags	Percentage of Variable Flagged
TIME						0.00
LAT						0.00
LON						0.00
PL_HD						0.00
PL_CRS			4317	7	4324	14.73
PL_SPD						0.00
PL_SPD2	3341		1635	120	5096	17.36
PL_WDIR		498		1	499	1.70
PL_WSPD		498		1	499	1.70
DIR		498	5589	125	6212	21.16
SPD		498	7777	35	8310	28.30
P		303		1	304	1.04
T				53	53	0.18
TS				23	23	0.08
RH				2	2	0.01
PRECIP		1380		50	1430	4.87
RAD	5488			6	5494	18.71
Total Number of Flags	8829	3675	19318	424	32246	
Percentage of All Values Flagged	1.77	0.74	3.87	0.08	6.46	

Platform Course:
The Platform Course (PL_CRS) data were generally reliable except when the ship was close to stationary. The PL_CRS data were derived from a GPS sensor. PL_CRS data from this type of GPS sensor are expected to fluctuate greatly when the platform speed is less than 2 m/s. However, there were a number of occurrences where the *Knorr* PL_CRS data contained several successive data points with the same value resulting in a flat data trend. This flat trend at very slow ship speeds was highly uncharacteristic and the data were assigned the *K* flag by the DQE. Caution is advised when utilizing PL_CRS data from these periods.

Platform Speed Over Water:
Several problems were identified with the Platform Speed Over Water (PL_SPD2) variable. First, when the ship speed was less than 2 m/s, numerous negative values were recorded. These negative values were assigned the *B* flag by the preprocessor. The EDO speedlog instrument that measures the PL_SPD2 variable utilizes Doppler technology to measure the speed of the ship relative to water. Wind, waves, and ocean currents may cause realistic negative values when the ship speed is low. Therefore, the user may wish to disregard these *B* flags. Secondly, there were numerous spikes in the PL_SPD2 data. The data were extremely noisy and the *S* flag was assigned to data that deviated from the local average by more than approximately 3 m/s. Finally, the *K* flag was assigned to PL_SPD2 data that fluctuated more than 4 m/s from the mean data trend. Some degree of fluctuation caused by wave motion is expected, but these values far exceeded a reasonable amount. In general, all PL_SPD2 data should be used cautiously and the DQE recommends these data be smoothed or filtered.

Platform Relative Wind Direction and Wind Speed:
The overall quality of the Platform Relative Wind Direction (PL_WDIR) and Platform Wind Speed (PL_WSPD) data was good. The only major problem occurred on 96/01/03 when the PL_WDIR and PL_WSPD data dropped zero and remained at that level from 0256Z to 1115Z. These erroneous values were flagged *J* by the DQE. Following this event, the data returned to a normal trend.

Earth Relative Wind:
Overall, the quality of the earth relative wind data were highly suspect with several major problems identified by the DQE. The true wind variables, Earth Relative Wind Direction (DIR) and Earth Relative Wind Speed (SPD) were calculated at the DAC. Details of the true wind calculation can be found in Smith et al. (1999). The first problem was directly related to the flat-line errors associated with the PL_CRS data as noted above. Platform course is one of the parameters involved in calculating the true wind. Therefore, when the PL_CRS data flat-lined, the corresponding DIR and SPD data were flagged *K*. There were also numerous occurrences when the ship movement was reflected in the DIR and SPD data. True wind data should not indicate ship movement. When this occurred, *K* flags were assigned to the DIR and SPD data while the ship speed was less than 2 m/s. Tests have shown that errors in calculated earth relative winds are much smaller when the ship has a steady forward motion (Smith et al. 1999). Another problem with the true wind data occurred on 96/01/03 where the PL_WDIR and PL_WSPD variables contained erroneous data as described above. Because the PL_WDIR and PL_WSPD data are used to calculate the true wind, the corresponding DIR and SPD data were flagged *J*. Finally,

ship movement involving a sudden change in speed caused numerous spikes in the DIR and SPD data and were flagged *S* by the DQE. The overall quality on the SPD and DIR data was highly suspect and the user is advised to use extreme caution when utilizing DIR and SPD data.

Pressure:
Overall, the pressure data were good except for the data recorded on 96/01/21 at 2341Z through 96/01/22 at 0444Z. During this time, the pressure values dropped to zero and were flagged *J* by the DQE. Following this event, the pressure data returned to normal. The pressure data were also noisy at times and the most significant spikes were flagged *S* by the DQE.

Precipitation:
The self-siphoning rain gauge utilized on this cruise experienced a number of problems and the data should be used with caution. The self-siphoning rain gauge is designed to fill to 50 mm, and then rapidly drain back to 0 mm. On 96/01/03 at 1235Z, the rain gauge level reached 30.6 mm and remained steady through 1252Z. After this point, the gauge appeared to leak as the precipitation slowly drained at a rate of approximately 1 mm per hour. At approximately 1440Z, the gauge drained at a much higher rate and dropped to the 0.2 mm level by 1715Z. The gauge apparently experienced a leakage problem or other malfunction and the precipitation data during this occurrence were flagged *J* by the DQE. The gauge also experienced this type of problem on 96/01/05 when precipitation amounts did not exceed 1 mm because the gauge did not maintain the current level of rainfall. The erroneous data values were flagged *J*. Throughout the cruise, the gauge drained to 0.2 mm level following each precipitation event. However, on 96/01/20, the data suddenly dropped to zero and remained at that level from 2145Z through the end of the day. The data did not return to the 0.2 mm level until 96/01/21 at 0508Z. At this time, the data spiked to 0.3 mm then leveled off at 0.2 mm. All data during this occurrence were flagged *J*. There were also a number of spikes throughout the precipitation data which were flagged *S* by the DQE.

Atmospheric Radiation:
The Atmospheric Radiation (RAD) variable recorded numerous negative values during the overnight hours. There were also several values above 1400 Watts per meter squared recorded during the daylight hours. These values were outside of realistic range assigned the *B* flag by the preprocessor.

Data Spikes:
Data spikes occurred in the majority of the variables throughout the cruise and were flagged *S* by the DQE. Spikes are common to electronic data and may be associated with power surges or ship movement.

Final Comments:
The overall quality of the data ranged from very good to poor depending on the variable. The PL_SPD2 data were very noisy and the user is advised to use a filter or smoother on the data. The true wind variables, earth relative wind direction and earth relative wind speed, were highly questionable with thirty-three percent of the data being flagged. The true wind data exhibited a variety of problems as detailed above and should be used with

extreme caution. It is also recommended that the precipitation data be used with caution as the gauge experienced several leakage and/or malfunction problems.

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

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