Author Reference Document

Beaufort Wind Corrected Records for Deck 761 within the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) Value-Added Database (IVAD)

Shawn R. Smith, Kristen Briggs, and Keqiao Li

Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee, USA

Corresponding Author: Shawn R. Smith, +1-850-644-6918, smith@coaps.fsu.edu

1. Introduction

In 2013, FSU began development of an adjustment for estimated (Beaufort) winds as a prototype for the ICOADS Value-Added Database (IVAD) project. The goal of the exercise was to apply adjustments created by Lindau (1995) to available Beaufort estimated wind in ICOADS release 2.5.1. The subsequent analysis revealed that identifying actual Beaufort winds within the ICOADS records was problematic, noting that a true Beaufort wind scale only has 13 possible values (0-12, Simpson 1906). Following a thorough examination of wind values denoted as "estimated" in ICOADS, the authors determined that they could only confidently adjust wind speed values for deck 761 - Japanese Whaling Ship Data; CDMP/MIT digitization, 1946-1984 – which had a clear designation that the original wind data were from the Beaufort scale.

2. Identifying Beaufort Winds

A graduate student, Mr. Keqiao Li, evaluated the estimated winds found in ICOADS release 2.5.1 reports for the period 1970-2007. The authors chose this period to overlap with the marine air temperature adjustments that were developed by the National Oceanography Center (NOC; Berry et al. 2004) as a second IVAD prototype. Mr. Li extracted all ICOADS records from ships that have a wind indicator (WI) that defines the wind speed as "estimated" (e.g., WI = 0, 2, 3, 5, and 6). Histograms of the wind speed (W) observations (Fig. 1) revealed that only WI=5, denoting a wind value that was known to be converted from the Beaufort scale, had wind speed values that fell into the 13 discrete bins anticipated for a Beaufort wind. All others (WI=2 and 6 not shown in Fig. 1) had much larger spread because of varying national practices for converting an estimated wind to a wind speed value (in many cases this was up to the subjectivity of the observer on the ship).

The histograms supported a decision to only create the IVAD wind prototype using those ICOADS records that are known to be converted from a Beaufort scale (WI=5) for the period 1970-2007. A search of this period only revealed two decks (761 and 792) that had records with WI=5 (Fig. 2). Since the majority of the observations are from deck 761, the Lindau (1995) adjustment was only applied to that deck for this prototype. The distribution of wind speed values for deck 761 (Fig. 3) shows the original Beaufort values to use the Code 1100 scale (Simpson 1906). For the final Beaufort wind prototype, the Lindau (1995) adjustment was applied to the entire record of deck 761 covering 1946-1984.

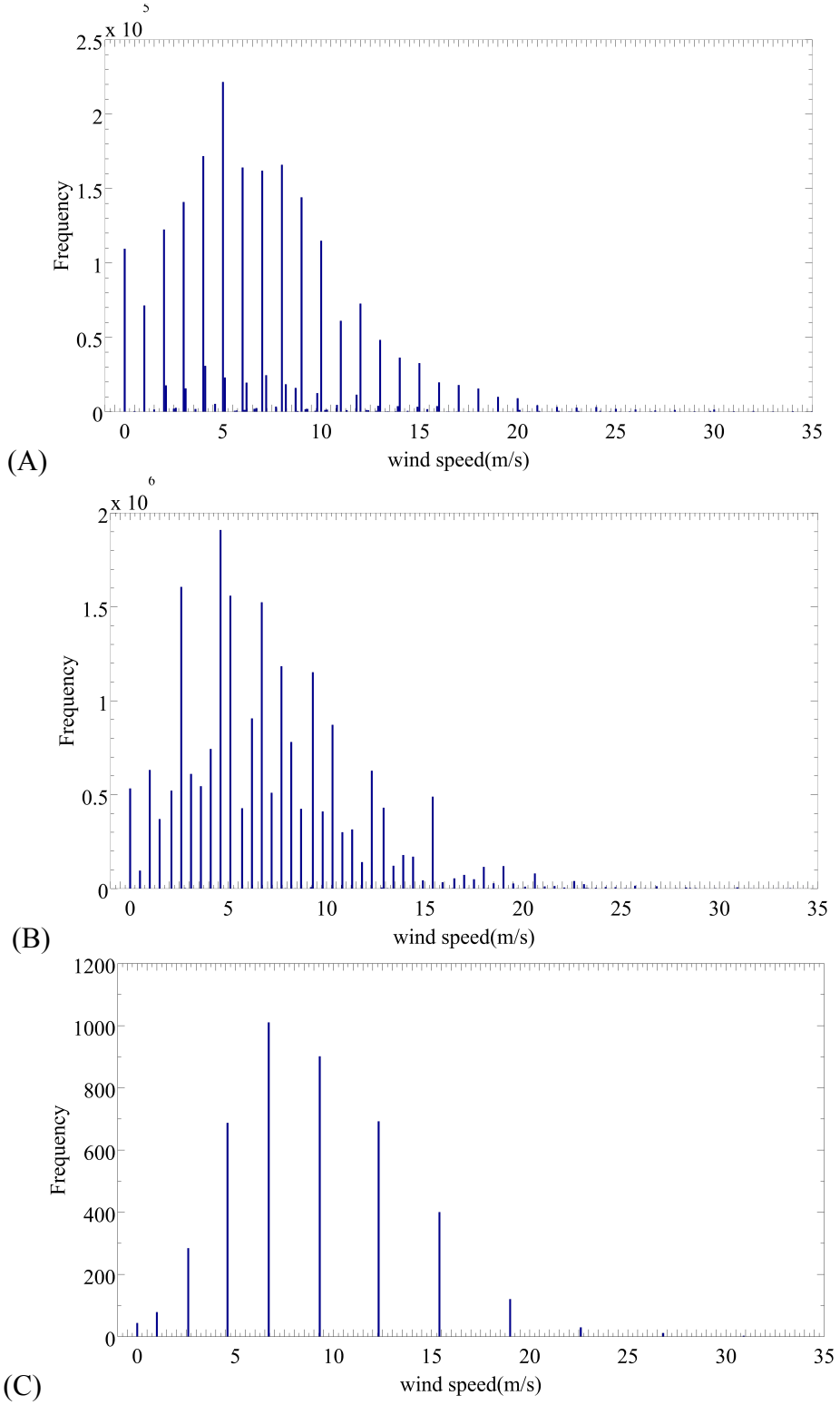

Figure 1: Histograms of estimated wind speeds from ICOADS release 2.5.1 categorized by wind indicator for the period 1970-2007. (a) Meter per second, estimated (WI=0), (b) knot, estimated (WI=3), and (c) Beaufort force based on documentation (WI=5). All wind speeds are plotted in meters per second as read from the ICOADS data files.

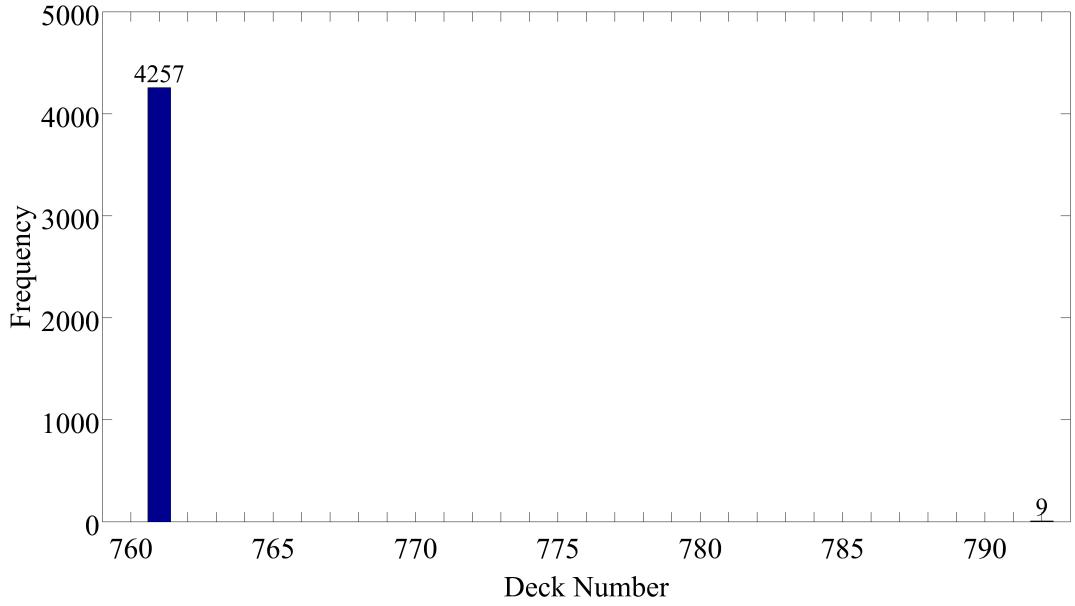

Figure 2: Histogram of deck numbers with WI=5 for the period 1970-2007. Only decks 761 and 792 had records marked as Beaufort winds.

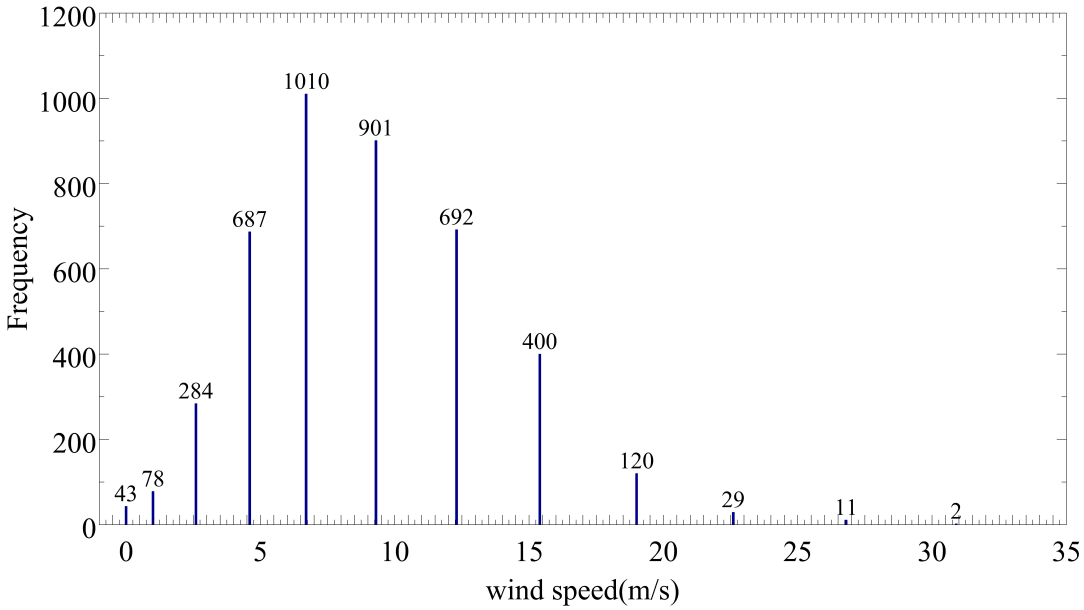

Figure 3: Histogram of wind speed values for deck 761 (Japanese Whaling Ship Data [CDMP/MIT digitization, 1946-1984]) with WI=5 for the period 1970-1984. Note that the wind speeds fall in the 13 bins associated with the Simpson (1906) Beaufort scale.

3. Applying the Lindau Correction

Adjusting the wind speed values in Deck 761 is a straightforward process. For each record, the original wind speed is read and the value is mapped to the Lindau (1995) adjusted value as shown in Table 1. To ensure that adjustments are only applied to the correct records, the code verifies that the record is from a ship (PT between 0 and 5), the deck (DCK) is equal to 761, and

the WI = 5. The adjusted value is provided in an *ivad* attachment of the International Marine Meteorological Archive (IMMA) format for each ICOADS record that matches these criteria, while the original wind speed value is retained in the core of the ICOADS record. A sample of the original *ivad* records submitted to the ICOADS project is shown in Table 2.

The total number of records adjusted in each year reaches a maximum in the 1960s (Table 3). The records generally occur during the Austral summer (October – May) as this would be the period when this fleet was in operations around Antarctica.

Table 1: Conversion of wind speed in Deck 761 to Lindau (1995) values. Lindau (1995) values in knots from his Figure 8 are converted to ms-1 by multiplying by 0.5144 and rounding to one decimal place. Deck 761 contained no wind speeds associated with Beaufort force 12.

Beaufort Force	Deck 761 Wind Speed (ms^{-1})	Lindau (1995) Wind Speed (ms^{-1}) at 10m
0	0.0	0.0
1	1.0	1.2
2	2.6	2.7
3	4.6	4.6
4	6.7	7.2
5	9.3	9.7
6	12.3	12.1
7	15.4	14.6
8	19.0	17.2
9	22.6	20.2
10	26.8	23.4
11	30.9	27.1
12	--	31.4

Table 2: Sample of *ivad* attachments containing Beaufort wind adjustments using the Lindau (1995) approach for April 1983. The format of the data includes the unique record identifier attachment followed by the *ivad* attachment. Details of the attachment format is available from http://icoads.noaa.gov/ivad/IMMA-Rev.pdf.

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981528S9NS251219653 0201    27                    FS01201412160
981528SG8Y251219653 0201    12                    FS01201412160
981528SMX6251219653 0201    97                    FS01201412160
981528STW2251219653 0201     0                    FS01201412160
981528T0L7251219653 0201    97                    FS01201412160
981528T7C7251219653 0201    27                    FS01201412160
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Table 3: Number of records per year in Deck 761 with Lindau (1995) adjusted values.

Year	Records	Year	Records
1946	88	1966	778
1947	290	1967	520
1948	270	1968	396
1949	310	1969	450
1950	302	1970	450
1951	388	1971	465
1952	337	1972	576
1953	308	1973	528
1954	350	1974	471
1955	458	1975	136
1956	568	1976	253
1957	852	1977	266
1958	942	1978	182
1959	930	1979	155
1960	1087	1980	163
1961	1212	1981	182
1962	1223	1982	179
1963	1167	1983	167
1964	1234	1984	84
1965	1136		

4. Acknowledgements

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5. References

Berry, D.I., E. C. Kent, and P. K. Taylor, 2004: An analytical model of heating errors in marine air temperatures from ships. *J. Atmos. Oceanic Technol*., **21**, 1198–1215. DOI: 10.1002/joc.1178.

Lindau R., 1995: A new Beaufort equivalent scale. *International COADS Winds Workshop*, Institut fur Meereskunde, Kiel, and National Oceanic and Atmospheric Administration: Kiel, Germany; 232–252.

Simpson, C.G., 1906: The Beaufort Scale of Wind Force. Report of the Director of the Meteorological Office, Official No. 180, London.