

<b>International Comprehensive Ocean-Atmosphere Data Set (ICOADS)</b>	<b>Release 2.5</b>
Total Cloudiness $N=9$ Fix for NCEP BUFR Data, Oct. 1999-May 2002	17 May 2013
Document name:	<i>R2.5-N=9Fix</i>

Global Telecommunications System (GTS) receipts from NOAA’s National Centers for Environmental Prediction (NCEP) are impacted by a problem in total cloud amount ( $N$ ) starting with March 1997 data. This problem arose from incorrect translation by NCEP into WMO’s BUFR format resulting in the omission, until approximately 6 May 2002, of  $N=9$  values, indicating “sky obscured by fog and/or other meteorological phenomena.”

Since these  $N=9$  values are important for analyses and climatological applications utilizing synoptic ship reports of cloudiness data, we corrected the problem in the **experimental** version of ICOADS Release 2.5 in IMMA1 format, R2.5.1 (including in its “intermediate” version, R2.5.1<sub>i</sub>, containing duplicates and other reports rejected from the final R2.5.1 product).

Specifically, all deck 792 (NCEP BUFR GTS: Ship Data) ship reports in the experimental new (IMMA1 format) Release 2.5.1 (including the intermediate product R2.5.1<sub>i</sub>) for Oct. 1999 through May 2002 were reprocessed to access original  $N$  values in the (first, if multiple) attached supplement FM 13 (GTS SHIP code) string, which was then used to reset  $N$  in the IMMA Core. Once again demonstrating the value of having the original GTS character string record attached to the IMMA format. Without this archiving feature this problem could not be easily addressed. The internal Release numbering was not altered, i.e. all records still indicate R2.5.1. For that period, Table 1 provides counts of the total deck 792 and corrected  $N=9$  reports, and the Appendix provides further details about the problem, including why ICOADS was impacted only starting Oct. 1999.

*Table 1.* Numbers of IMMA1 NCEP deck 792 ship reports in R2.5.1 (experimental final product) and R2.5.1<sub>i</sub> (experimental intermediate product) from Oct. 1999 through May 2002, and the subset numbers of reports in the final and intermediate products in which  $N$  changed to “9” from space (indicating missing data).

<i>Product type</i>	<i>Total deck 792 reports</i>	<i>Number of changed reports</i>
Final R2.5.1	1,223,566	51,067
Intermediate R2.5.1 <sub>i</sub>	2,684,344	92,247

<b>Document Revision Information</b>
Previous document version: none.

**APPENDIX**  
**Summary of missing VOS total cloud cover reports of N=9**  
**(“Sky obscured by fog and/or other meteorological phenomena”)**  
**impacting NOAA/NCEP BUFR ~March 1997~6 May 2002**  
**(and ICOADS ~Oct. 1999~6 May 2002)**

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*(DRAFT Revised 17 May 2013 to update dates, B/C10–SHIP information, etc.)*  
*(NOAA/NCDC and NOAA/ESRL)*

For a widely used climate research cloud data product known as the “EECRA” (Hahn et al. 1995, 1999), a total cloud ( $N$ ) ship report of  $N=9$ , together with a reported present weather ( $ww$ ) indicating precipitation or fog, is interpreted as overcast cloud cover (see Annex A for further code details about  $N$ ). However, in August 2008 Carole Hahn discovered that the ICOADS ship data used as continuing input for EECRA lacked any  $N=9$  values, beginning in October 1999.

As part of the explanation for this problem, we note that presently ICOADS (at Release 2.5) includes delayed-mode (e.g., IMMT format) VOS reports only through 2007, and subsequently relies on the GTS (FM 13 SHIP code) for VOS receipts, and specifically on data from NOAA/NCEP. BUFR data from NCEP become available starting in March 1997. NCEP’s implementation of BUFR critically preserves the originally reported GTS message strings (FM 13, FM 18 BUOY, etc.) attached to the translated BUFR data (see Annex B for further discussion). Because of a variety of data homogeneity problems when BUFR was first introduced, for ICOADS we ended up retranslating the attached FM 13 (and other) messages, rather than relying on the translated BUFR data, for March 1997–Sep. 1999 (further details available here: <http://icoads.noaa.gov/rt.html>). From Oct. 1999 forward, in contrast, we have used the translated BUFR field (see Table 1).

After examining more of the data and discussing this problem with NCEP, this appears to be the  $N=9$  situation with ICOADS and NCEP/BUFR:

- Through Sep. 1999 ICOADS properly preserves  $N=9$  because original FM 13 messages (or other data sources) were used.
- For Oct. 1999 until approximately 6 May 2002 ICOADS lacks  $N=9$ .
- Also, the omission of  $N=9$  extends back to March 1997 in NCEP/BUFR.<sup>1</sup>
- Around 00:00 6 May 2002 NCEP made a (possibly undocumented) decoder change that began storing  $N=9$  as 113%.
- Our ICOADS translation of the BUFR data converted the 113% back into  $N=9$  (i.e. no software change was required after the 113% values started appearing), but FM 13 data for Oct. 1999 through May 2002 were reprocessed to recover  $N=9$ .

Also, further research indicates that CBS (WMO 2006, p. 155) recommended such a change:

‘7. Addition of a Note under Class 20

Cloud cover (total) 0 20 010 is defined in BUFR/CREX Table B with UNIT = %. The corresponding Code table 2700 for N (Total cloud cover) in [1] allows to make a difference between N = 9 “Sky obscured by fog and/or other meteorological phenomena” and N = / (Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena,

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<sup>1</sup> The obsolete NCEP Near-Real-Time (NRT) abbreviated format (see format documentation at: <http://icoads.noaa.gov/nrt.html>), which continues to be derived by NCEP from their BUFR, also includes  $N$  since 4 Aug. 1991, but unfortunately utilizes 9 to instead indicate missing data.

or observation is not made). In the Regulations for reporting TAC data in TDCF, Cloud cover (total) 0 20 010 is recommended to be set to a missing value in both cases, which has been found not satisfactory. It is proposed to add a Note under Class 20: A cloud cover (total) value 113 shall indicate “Sky obscured by fog and/or other meteorological phenomena”.

This change was reflected in the November 2007 Suppl. to the *Manual on Codes* (WMO 2001), and now also appears in the B/C10–SHIP template as described in Table 1.

### References

- Hahn, C.J., and S.G. Warren, 1999: *Extended Edited Synoptic Cloud Reports from Ships and Land Stations Over the Globe, 1952-1996*. NDP-026C, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, TN [<http://cdiac.ornl.gov/ftp/ndp026c/ndp026c.txt>].
- Hahn, C.J., S.G. Warren and J. London, 1995: The effect of moonlight on observation of cloud cover at night, and application to cloud climatology. *J. Climate*, **8**, 1429-1446.
- JCOMM, 2008: JCOMM Data Management Coordination Group, Third Session, Ostend, Belgium, 26-28 March 2008, Final Report (JCOMM Meeting Report No. 56) [<ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-56-DMCG-3-final.pdf>].
- WMO, 1995: *Manual on Codes* WMO-No. 306, Volume I.1, Part A – Alphanumeric Codes (1995 edition, Suppl. No. 3 (VIII.2001)).
- WMO, 2001: *Manual on Codes* WMO-No. 306, Volume I.2, Part B – Binary Codes (2001 edition, Suppl. No. 3 (XI.2007)).
- WMO, 2006: Commission for Basic Systems, Extraordinary session, Seoul, Republic of Korea, 9–16 November 2006. Abridged final report with resolutions and recommendations, WMO-No. 1017.

**Table 1:** The total cloud cover BUFR representation from (a) WMO (2001), and (b) in the B/C10–SHIP template:

(a) WMO (2001), in which Note 5 (p. 72; apparently added as part of the Nov. 2007 Suppl.) states: ‘(5) A cloud cover (total) value 113 shall indicate “Sky obscured by fog and/or other meteorological phenomena”.’

(b) B/C10–SHIP (amended 7 Nov. 2012):

[http://www.wmo.int/pages/prog/www/WMOCodes/BC\\_Regulations/BC10-SHIP.pdf](http://www.wmo.int/pages/prog/www/WMOCodes/BC_Regulations/BC10-SHIP.pdf)

now including this note: “(1) Total cloud cover shall be reported as 113 when sky is obscured by fog and/or other meteorological phenomena.”

<u>Source (above)</u>	<u>Table reference</u>	<u>Element name</u>	<u>Unit, scale</u>
(a)	0 20 010	Cloud cover (total) (see Note 5)	%, 0
(b)	0 20 010	Cloud cover (total) <b>N</b>	%, 0

**Annex A:** Excerpt below from WMO (1995) for traditional alphanumeric code 2700, which includes total cloud cover (symbolic letter N). N is reported under FM 13 (ship GTS reports).

CODE TABLES

N — N<sub>m</sub>

**2700**

**N** *Total cloud cover*

**N<sub>h</sub>** *Amount of all the C<sub>L</sub> cloud present or, if no C<sub>L</sub> cloud is present, the amount of all the C<sub>M</sub> cloud present*

**N<sub>s</sub>** *Amount of individual cloud layer or mass whose genus is indicated by C*

**N'** *Amount of cloud whose base is below the level of the station*

Code figure

0	0	0
1	1 oktas or less, but not zero	1/10 or less, but not zero
2	2 oktas	2/10 – 3/10
3	3 oktas	4/10
4	4 oktas	5/10
5	5 oktas	6/10
6	6 oktas	7/10 – 8/10
7	7 oktas or more, but not 8 oktas	9/10 or more, but not 10/10
8	8 oktas	10/10
9	Sky obscured by fog and/or other meteorological phenomena	
/	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made	

Note: For use of (/), see Regulation 12.1.4.

**Annex B:** Text excerpt from JCOMM (2008), ANNEX VI, “Comparisons of NCEP BUFR with SHIP (FM 13) GTS Messages: 2006 Wind Data”:

“This note discusses how small differences between the processing of originally reported FM 13 wind data by ICOADS, versus by NCEP in their translation to BUFR, can introduce measurable differences in the output data. Such differences could for example lead to spurious data artifacts when switching data sources for climate change studies.

While preservation of original FM 13 (and other GTS) messages is not presently part of WMO’s BUFR templates, NCEP very beneficially archives these messages with the translated BUFR data. This NCEP policy remains critical because it provides one means for detection of such differences, and also allows the possibility of future correction of these and other data problems or omissions. Similarly, the IMMA format used for ICOADS has a supplementary “attachment,” which is routinely used to store a wide variety of input data (including the FM 13 and other GTS message strings retrieved from NCEP BUFR), so that those more original data can readily be tapped in the event of translation errors or omissions.

For centers archiving only translated BUFR data and not also original messages (e.g., UK Met Office), one useful criterion for the design of WMO templates could be whether each BUFR field can be certified 100% reversible to the original data (including information about original precision, if BUFR carries additional precision). Just the two field examples presented here do not fulfill that proposed requirement, which (due e.g. to the fact that some inadvertent translation differences will likely always occur due to software bugs or finite precision errors) is likely unattainable. In that case the most robust WMO policy may therefore be to simply build into BUFR templates, or into other JCOMM data management policies, features for archival of the original data (like NCEP BUFR and IMMA).”