Proposed IMMA Revisions

Revised DRAFT, 19 February 2014

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Introduction

Format changes—to yield IMMA version 1—are marked below in blue within Supplement C of the current IMMA (version 0) documentation. The abbreviated version of the documentation (http://icoads.noaa.gov/e-doc/imma/R2.5-imma_short.pdf) includes Supp. D, providing details on individual field configurations; whereas the complete documentation (http://icoads.noaa.gov/e-doc/imma/R2.5-imma.pdf) also provides additional background in its main text and in Supps. A-B, including more detailed comparisons between IMMA and international exchange (IMMT/IMMPC) formats.

Detailed background/discussion notes for the *Core* and attachments (attms) appear following each table below. When significant changes or additions to attm content were needed (i.e. for *Immt*, *Mod-qc*, and *Meta-vos*) a revised attm was created with a new table number and new attachment ID (*ATTI*), but the old configuration was retained as a deprecated attm. The *Nocn*, *Nocq*, *Ivad*, *Error*, and *Uida* attms are new, and the *Auto*, *Alt-qc*, *Track*, and *Hist* attms are proposed (with many details of the proposed attms, as well as some details of the planned new attms, to be finalized; including any new field abbreviations, which need to be checked for uniqueness to avoid possible overlaps with already defined field abbreviations).

The following items discuss aspects of the planned changes in greater detail:

1. Abbreviated structural element names in italics: A new IMMA documentation feature—to enhance communication—is that the *Core* and attms (e.g. *Icoads*) are all given abbreviated names in *italics*, but with only the first letter in uppercase, to distinguish them from the fully capitalized IMMA field abbreviations.

2. Switch to attm-internal field numbering: E.g. within the *Icoads* attm, the fields are now numbered 1-51 rather than 49-99. Otherwise documentation maintenance was becoming challenging, and in conjunction with the IVAD project this is viewed as a more flexible approach. However, the revised Fortran program to read/write IMMA1 ({rwimma1}[1]) still utilizes a linear field numbering approach for assigning array storage across the *Core* and all attms.

3. Operational and deprecated attms: Rather than change (i.e. add/subtract, or modify, fields) attms, a new attm version is created, with tables for the deprecated attms tentatively retained only in the last-version format documentation (and noting that by itself the item 2 field numbering switch is not considered such a change). The {rwimma1} program is able to read both the operational and deprecated attms, and the format remains fully backward compatible. Related also to item 2, the new *Ivad* and *Error* attms include both input component number (i.e. 0=*Core* or *ATTI*) (*ICNI/ICNE*) and field number (*FNI/FNE*).

[1] In this document, {braces} are used to mark the names of Fortran software, with {rwimma1} referring specifically to http://icoads.noaa.gov/software/rwimma1. With limited modifications, this program can also write IMMA1. In terms of processing new attms, the current program will process the *Nocn, Ecr, Uida, Ivad,* and *Error* attms, including processing of Subsidiary records.

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4. Additional software maintenance considerations: To make translation software adapted from {rwimma} (e.g. existing adaptations of {rwimma1} used to translate data from other formats into IMMA) more robust over the longer term, usage of field abbreviations (e.g. FTRUE(SST)) rather than hard-coded storage array locations (e.g. FTRUE(35)) appears prudent with the advantage e.g. *W2* is defined in both Tables C2 and C5.

5. Switch to multi-record "linked-report" approach: Rather than modifying the *Icoads* attm as originally proposed to include *UID* and associated release-tracking information etc., those fields are placed in a short new *Uida* attm (see Table C98), which appears both in the Main and (any optional) Subsidiary records, linking them all together, e.g.:

Main IMMA record: *Core* + *Icoads* + *Immt* + *Mod-qc* + *Meta-vos* + *Nocn* + *Uida* + *Suppl*
Subsidiary IMMA record: *Uida* + *Ivad* + *Ivad* + *Ivad* … + *Ivad*
Subsidiary IMMA record: *Uida* + *Error* + *Error* + *Error* … + *Error*

Each complete multi-record construct (i.e. Main plus Subsidiary records) is referred to below as a "linked-report." Alternatively, information such as ship metadata (*Meta-vos*) attms, or the proposed alternative QC (*Alt-qc*) attms, might be conveyed separately back to ICOADS in a file containing only Subsidiary records, i.e. to be blended with (or possibly into fields in other attms, in the case of *Alt-qc*) the Main records before provision to users:

Subsidiary IMMA record: *Uida* + *Meta-vos*
Subsidiary IMMA record: *Uida* + *Alt-qc* + *Alt-qc* + *Alt-qc* … + *Alt-qc*

Such Subsidiary-only records thus would not ordinarily be provided directly to users. The way this is being implemented is still anticipated to be fully backward compatible. The *Core* has not changed, but {rwimma1} checks the first few characters of each record to determine whether it is a Subsidiary record (i.e. starts with "9815").

6. Software constraints on linked-reports and attm composition: Processing by {rwimma1} of Main+Subsidiary records (linked-reports), and of the *Ivad* and *Error* attms, presently is being implemented with these fairly loose constraints: (i) Both Main and Subsidiary records are allowed by {rwimma1} to contain multiples of any attachment in any order; except the *Suppl* attm, if present, must be the last Main attm. (ii) In the event of repeating (except *Ivad* and *Error*) attms, the last attm takes precedence and overwrites information from all previous (e.g. Subsidiary attms take precedence over any repeating Main attms). (iii) Subsidiary records must each begin with a *Uida* attm, followed by zero or more attms of any type except *Suppl*. (iv) The maximum number of *Ivad* and *Error* attms within a linked-report is set at 100 each. In addition, while by definition of *UID* two (or more) Main records should never appear with the same *UID*, no check is envisioned as feasible at the present time for *UID* uniqueness.

7. Status of new-field content: In the revised attms (*Immt*, *Mod-qc*, and *Meta-vos*) newly defined fields generally will not be populated (i.e. in the prototype Release 2.5 dataset), with the exception of field *MDS* in the *Meta-vos* attm (see also related discussion in Annex C). In the new *Uida* attm, *UID* is set as discussed below Table C98, and the Release number fields are set as *RN1*=2, *RN2*=5, *RN3*=1, i.e. this is considered R2.5.1, to distinguish it from the original R2.5.

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Table 1 provides a summary of the development status of the IMMA components, and Table 2 outlines different record structures currently available with Release 2.5 (R2.5), the prototype Release 2.5.1 (R2.5.1), or under development for Release 3.0 (R3.0).

These Annexes provide additional background information:

- Annex A: Implementation/Unresolved Issues
- Annex B: Development of the Unique Report ID (*UID*); and Intra-record Release No. (*RN*) Tracking
- Annex C: Reprocessing Notes for Recovering Missing Field Configurations, Etc.
- Annex D: QC Flag Discussion
- Annex E: Edited Cloud Report (*Ecr*) attm
- Annex F: Author Reference Code (*ARC*) Registration and Storage
- Annex G: Discussion of ICOADS Future IMMA/IVAD Archival Structure

NOTE: ~~strikethrough~~ in Suppl. C below indicates updates are still needed, or marks material that has been moved elsewhere.

Table 1. Status of IMMA components and related information. Shaded components are deprecated.

Component	*Abbrev.*	*Status*	*Reference information*	*Length (char.)*
Core	*Core*	operational	Table C0	108
ICOADS attm	*Icoads*	operational	Table C1	65
IMMT-2/FM 13 attm	(none)	deprecated	Table C2 (sep. doc.)	76
Model quality control attm	(none)	deprecated	Table C3 (sep. doc.)	66
Ship metadata attm	(none)	deprecated	Table C4 (sep. doc.)	67
IMMT-5/FM 13 attm	*Immt*	operational	Table C5	94
Model quality control attm	*Mod-qc*	operational	Table C6	68
Ship metadata attm	*Meta-vos*	operational	Table C7	58
Near-surface oceano. attm	*Nocn*	operational	Table C8	102
Edited cloud report attm	*Ecr*	operational	Table C9 – Annex E	32
IVAD attm	*Ivad*	operational	Table C96	48
Error attm	*Error*	operational	Table C97	variable
Unique report ID attm	*Uida*	operational	Table C98	15
Supplemental data attm	*Suppl*	operational	Table C99	variable

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Automated instrument. attm	*Auto*	proposed	Table CP1	41
Near-surface oceano. QC attm	*Nocq*	proposed	Table CP2	28
Alternative QC attm	*Alt-qc*	proposed	Table CP3	TBD
Platform tracking attm	*Track*	proposed	Table CP4	TBD
Historical attm	*Hist*	proposed	Table CP5	TBD
Buoy metadata attm	*Meta-buoy*	proposed	TBD	TBD
Reanalyses QC attm	*Rean-qc*	proposed	TBD	TBD
Daily observational (Daily) attm	*Daily*	proposed	TBD	TBD

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Table 2. IMMA record structures currently operational for R2.5, R2.5.1, and the "linked-report" Main + Subsidiary (optional) record structure being implemented for R3.0. Inclusion of the attm count (*ATTC*) field in the *Core*, and of the attm ID (*ATTI*) and attm data length (*ATTL*) fields at the beginning of each attm, enables computer parsing of the records. Thus additional variations on these basic record types are implemented by inclusion or omission of attms, and new attms can be defined in the future as needed for new data or metadata requirements.[1]

Release	*Record structure*	*Len. (char.)*[2]
R2.5	*Core* + *Icoads* + *Immt*[2] + *Mod-qc*[3] + *Meta-vos*[3] [+ *Suppl*]	372
R2.5.1	*Core* + *Icoads* + *Immt* + *Mod-qc* + *Meta-vos* + *Uida* [+ *Suppl*]	408
R3.0:		
Main	*Core* + *Icoads* + *Immt* + *Mod-qc* + *Meta-vos* + *Nocn* + *Ecr* + *Uida* [+ *Suppl*]	544
Subsid.	*Uida* + *Ivad* + *Ivad* + … + *Ivad* (any number of attms; type may vary)	(var.)
(…)	(…any number of additional Subsidiary records…)	(var.)
Subsid.	*Uida* + *Error* + *Error* + … + *Error*	(var.)

1. In addition, the IMMA format is designed so that attms containing no data (not relevant to a given data source) can be omitted to reduce data volume.
2. Not counting the *Suppl* attm, which varies in length depending on data source (see Table 1).
3. Earlier, now deprecated, versions of these attms (see Table 1).

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Supplement C. Record Types

The IMMA *Core* (Table C0) forms the common front-end for all record types. By itself, the *Core*, which is divided into location and regular sections, forms a useful abbreviated record type incorporating many of the most commonly used data elements in standardized form (drawn from the fields to be agreed internationally, listed in Supp. D). Concatenating one or more "attachments" (attm) after the *Core* creates additional record types. So far, in addition to the *Core*, the following attms have been defined:

Table C0: Core (*Core*)	(108 characters)
Table C1: ICOADS (*Icoads*) attm	(65 characters)
Table C5: IMMT-5/FM 13 (*Immt*) attm	(94 characters)
Table C6: Model quality control (*Mod-qc*) attm	(68 characters)
Table C7: Ship metadata (*Meta-vos*) attm	(58 characters)
Table C8: Near-surface oceanographic (*Nocn*) attm	(102 characters)
Table C9: Edited cloud report (*Ecr*) attm (see Annex E)	(32 characters)
Table C96: ICOADS Value-added Database (*Ivad*) attm	(48 characters)
Table C97: Error (*Error*) attm	(field-dependent len.)
Table C98: Unique report ID (*Uida*) attm	(15 characters)
Table C99: Supplemental data (*Suppl*) attm	(source-dep. length)

including these deprecated attms (note: not documented here; see IMMA0 documentation):

Table C2: IMMT-2/FM 13 attm	(76 characters)
Table C3: Model quality control attm	(66 characters)
Table C4: Ship metadata attm	(57 characters)

Additionally, the following attms are proposed (CP):

Table CP1: Automated instrumentation (*Auto*) attm	(41 characters)
Table CP2: Near-surface oceanographic QC (*Nocq*) attm	(28 characters)
Table CP3. Alternative QC (*Alt-qc*) attm	(proposed)
Table CP4: Platform tracking (*Track*) attm	(proposed)
Table CP5: Historical (*Hist*) attm	(proposed)

and the following attms are envisioned as further possibilities, but without any suggested content below:

Buoy metadata (*Meta-buoy*) attm	(proposed, no table)
Reanalyses quality control (*Rean-qc*) attm	(proposed, no table)
Daily observational (*Daily*) attm	(proposed, no table)

Each table following contains these columns:

1: Field number. Field numbering is attm-internal beginning with field number 1 and ending with the last field indicated in the table.
2: Length (Len.) in characters (i.e. bytes).
3-4: Abbreviation (Abbr.) for each element (or field), and a brief description.
5-6: For fields with a bounded numeric range (either decimal or base36), the minimum (Min.) and maximum (Max.) are indicated in decimal (and/or in base36 in [square brackets]). In other cases the range and configuration are listed as: "a" for

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Deleted: are examples of the record types that can be constructed from the Core plus these attachments (where Table numbers are used to indicate the corresponding attm) (NOTE: ~~strikethrough~~ below indicates updates are still ne ... [47]

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alphabetic (A-Z), “b” for alphanumeric (strictly 0-Z with no leading blanks), “c” for alphanumeric plus other characters, or “u” for undecided form (only for fields that are currently unused). Base36 fields include “[b36]” in the Units column, and, as for decimal numeric fields, any leading missing positions are blank (vs. zero) filled (note: as a consequence, base36 is not always interpretable as alphanumeric).
7: Units of data and related WMO Codes. Information in parentheses usually relates the proposed field to a field from Supp. B, Table B1 (if applicable): WMO Code symbolic letters are listed, or “•” followed by a field number from Table B1 in the absence of symbolic letters. This information is prefixed by “Δ” to highlight field configurations that are extended in range or modified in form from presently defined WMO representations.

Table C0. IMMA *Core*.

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code) [base36]*
			Location section (45 characters):			
1	4	*YR*	year UTC	1600	2024	(AAAA)
2	2	*MO*	month UTC[1]	1	12	(MM)
3	2	*DY*	day UTC[1]	1	31	(YY)
4	4	*HR*	hour UTC[1]	0	23.99	0.01 hour (Δ GG)
5	5	*LAT*	latitude	–90.00	90.00	0.01°N (Δ $L_aL_aL_a$)
6	6	*LON*	longitude[1]	–179.99	359.99	0.01°E (Δ $L_oL_oL_oL_o$)
				0.00	359.99	(ICOADS convention)
				–179.99	180.00	(NCDC-variant convention)
7	2	*IM*	IMMA version	0	99	(Δ •65)
8	1	*ATTC*	attm count	0	10 [Z]	[b36]
9	1	*TI*	time indicator	0	3	
10	1	*LI*	latitude/long. indic.	0	6	
11	1	*DS*	ship course	0	9	(D_s)
12	1	*VS*	ship speed	0	9	(Δ v_s)
13	2	*NID*	national source indic.[1]	0	99	
14	2	*II*	*ID* indicator	0	10	
15	9	*ID*	identification/call sign	c	c	(Δ •42)
16	2	*C1*	country code	b	b	(Δ •43)
			Regular section (63 characters):			
17	1	*DI*	wind direction indic.	0	6	
18	3	*D*	wind direction (true)	1	362	°, 361-2 (Δ dd)
19	1	*WI*	wind speed indicator	0	8	(Δ i_W)
20	3	*W*	wind speed	0	99.9	0.1 m/s (Δ ff)
21	1	*VI*	*VV* indic.	0	2	(Δ •9)
22	2	*VV*	visibility	90	99	(VV)
23	2	*WW*	present weather	0	99	(ww)
24	1	*W1*	past weather	0	9	(W_1)
25	5	*SLP*	sea level pressure	870.0	1074.6	0.1 hPa (Δ PPPP)
26	1	*A*	characteristic of *PPP*	0	8	(a)
27	3	*PPP*	amt. pressure tend.	0	51.0	0.1 hPa (ppp)
28	1	*IT*	indic. for temperatures	0	9	(Δ i_T)

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No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
29	4	*AT*	air temperature	–99.9	99.9	0.1°C (Δ s_n, TTT)
30	1	*WBTI*	*WBT* indic.	0	3	(Δ s_w)
31	4	*WBT*	wet-bulb temperature	–99.9	99.9	0.1°C (Δ s_w, $T_bT_bT_b$)
32	1	*DPTI*	*DPT* indic.	0	3	(Δ s_t)
33	4	*DPT*	dew-point temperature	–99.9	99.9	0.1°C (Δ s_t, $T_dT_dT_d$)
34	2	*SI*	*SST* meas. method	0	12	(Δ •30)
35	4	*SST*	sea surface temp.	–99.9	99.9	0.1°C (Δ s_n, $T_wT_wT_w$)
36	1	*N*	total cloud amount	0	9	(N)
37	1	*NH*	lower cloud amount	0	9	(N_h)
38	1	*CL*	low cloud type	0	10 [A]	(Δ C_L) [b36]
39	1	*HI*	*H* indic.	0	1	(Δ •9)
40	1	*H*	cloud height	0	10 [A]	(Δ h) [b36]
41	1	*CM*	middle cloud type	0	10 [A]	(Δ C_M) [b36]
42	1	*CH*	high cloud type	0	10 [A]	(Δ C_H) [b36]
43	2	*WD*	wave direction	0	38	
44	2	*WP*	wave period	0	30, 99	seconds (P_WP_W)
45	2	*WH*	wave height	0	99	(H_WH_W)
46	2	*SD*	swell direction	0	38	($d_{W1}d_{W1}$)
47	2	*SP*	swell period	0	30, 99	seconds ($P_{W1}P_{W1}$)
48	2	*SH*	swell height	0	99	($H_{W1}H_{W1}$)

1. Fields differing from the ICOADS-standard representation in the NCDC-variant format (see Supps. D-E for further details). For *MO*, *DY*, and *HR*, the NCDC-variant format (obsolete) uses leading zeros as an exception to the "blank left-fill" aspect of the ICOADS-standard representation for numeric data.

***Core* update notes:**

No format changes, aside from an extension of the range of *ATTC* to 10 (also its representation was changed to base36), and *IM* is set to "1" in the revised format, to indicate IMMA1.

See Annex A for a discussion of NDBC moored buoy wave measurements currently translated into the ship-oriented wave fields *WD*, *WP*, and *WH*. Annex C states that the configuration of *WP* needs to be expanded to include 99, but it already does include 99 here (reason for discrepancy unclear).

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Table C1. ICOADS (*Icoads*) attm.

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=1
2	2	*ATTL*	attm length			Note: set *ATTL*=65
			Box elements (6 characters):			
3	1	*BSI*	box system indicator	u	u	(currently set to missing)
4	3	*B10*	10° box number	1	648	(ICOADS BOX10 system)
5	2	*B1*	1° box number	0	99	
			Processing elements (17 characters):			
6	3	*DCK*	deck	0	999	
7	3	*SID*	source ID	0	999	
8	2	*PT*	platform type	0	21	[Note: Max.=15 in IMMA0 documentation was error]
9	2	*DUPS*	dup status	0	14	
10	1	*DUPC*	dup check	0	2	
11	1	*TC*	track check	0	1	
12	1	*PB*	pressure bias	0	2	
13	1	*WX*	wave period indicator	1	1	
14	1	*SX*	swell period indicator	1	1	
15	2	*C2*	2nd country code	0	40	
			QC elements (38 characters):			
16-27	1×12	*SQZ-DQA*[1]	adaptive QC flags	1	35	(12 flags)[2] [b36]
28	1	*ND*	night/day flag	1	2	
29-34	1×6	*SF-RF*[1]	trimming flags	1	15	(6 flags)[2] [b36]
35-48	1×14	*ZNC-TNC*[1]	NCDC-QC flags	1	10	(14 flags)[2] [b36]
49	2	*QCE*[3]	external (e.g. MEDS)	0	63	integer encoding (6 flags)
50	1	*LZ*	landlocked flag	1	1	
51	2	*QCZ*[3]	source exclusion flags	0	31	integer encoding (5 flags)

[Note: Detailed QC flag footnotes omitted here.]

***Icoads* attm update notes:**

No changes, other than renumbering of fields.

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Table C5. IMMT-5/FM 13 (*Immt*) attm. This attm includes data fields that are widely applicable to Voluntary Observing Ship (VOS) data reported in formats other than IMMT and FM 13.

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code)* *[base36]*
1	2	*ATTI*	attm ID			Note: set *ATTI*=5
2	2	*ATTL*	attm length			Note: set *ATTL*=94
			Common for IMMT-2/3/4/5 (49 characters):			
3	1	*OS*	observation source	0	6	(•40)
4	1	*OP*	observation platform	0	9	(•41)
5	1	*FM*	FM code version	0	Z	(Δ •64) [b36]
6	1	*IMMV*	IMMT version	0	Z	[b36]
7	1	*IX*	station/weather indic.	1	7	(i_X)
8	1	*W2*	2nd past weather	0	9	(W_2)
	~~1~~	~~*SGN*~~[1]	~~significant cloud amount~~	~~0~~	~~9~~	~~(N_S; ref. Table B3)~~
	~~1~~	~~*SGT*~~[1]	~~significant cloud type~~	~~0~~	~~9, "A"~~	~~(C; ref. Table B3)~~
	~~2~~	~~*SGH*~~[1]	~~significant cloud height~~	~~0~~	~~99~~	~~(h_Sh_S; ref. Table B3)~~
9	1	*WMI*	indic. for wave meas.	0	9	(•31)
10	2	*SD2*	dir. of second. swell	0	38	($d_{W2}d_{W2}$)
11	2	*SP2*	per. of second. swell	0	30, 99	($P_{W2}P_{W2}$)
12	2	*SH2*	ht. of second. swell	0	99	($H_{W2}H_{W2}$)
13	1	*IS*	ice accretion on ship	1	5	(I_s)
14	2	*ES*	thickness of I_s	0	99	cm (E_sE_s)
15	1	*RS*	rate of I_s	0	4	(R_s)
16	1	*IC1*	concentration of sea ice	0	10 [A]	(Δ c_i) [b36]
17	1	*IC2*	stage of development	0	10 [A]	(Δ S_i) [b36]
18	1	*IC3*	ice of land origin	0	10 [A]	(Δ b_i) [b36]
19	1	*IC4*	true bearing ice edge	0	10 [A]	(Δ D_i) [b36]
20	1	*IC5*	ice situation/trend	0	10 [A]	(Δ z_i) [b36]
21	1	*IR*	indic. for precip. data	0	4	(i_R)
22	3	*RRR*	amount of precip.	0	999	(RRR)
23	1	*TR*	duration of per. *RRR*	1	9	(t_R)
24	1	*NU*	national use	c	c	(national practice)
25	1	*QCI*	quality control indic.	0	9	(•45)
26-45	1×20	*QI1-20*	QC indic. for fields	0	9	(Q_1-Q_{20})
			New for IMMT-2/3/4/5 (41 characters):			
46	1	*QI21*	MQCS version	0	9	(Q_{21})
47	3	*HDG*	ship's heading	0^2	360	0, ° (HDG)
48	3	*COG*	course over ground	0	360	0, ° (COG)
49	2	*SOG*	speed over ground	0	99	kt (SOG)
50	2	*SLL*	max.ht.>Sum. load ln.	0	99	m (SLL)
51	3	*SLHH*	dep. load ln.: sea lev.	–99	99	m ($s_L$hh)

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52	3	*RWD*	relative wind direction	1	362	°, 361-2[3] (ref. *D*)
53	3	*RWS*	relative wind speed	0	99.9	0.1 m/s (ref. *W*)
54-61	1×8	*QI22-29*	QC indic. for fields	0	9	(Q_{22}-Q_{29})[4]
62	4	*RH*	relative humidity	0.0	100.0	0.1%
63	1	*RHI*	relative humidity indic.	0	4	(RHi)
64	1	*AWSI*	AWS indicator	0	2	(AWSi)
65	7	*IMONO*	IMO number	0	9999999	(IMOno)

1. Strictly historical fields, moved to *Hist*.
2. Zero is documented to mean "no movement," but has been suggested should not be used (see Supp. D).
3. Special code 362 for "variable, or all directions" is allocated in IMMA, but IMMT does not presently contain a corresponding configuration for *RWS* (see Supp. D).
4. As from IMMT-4, usage of Q_{26} is discontinued, ref. IMMT-4 documentation: "now Q_{27} serves as the indicator for both S_L and HH."

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***Immt* attm update notes:**

Renumbering of fields. Length of *FM* reduced to one character (previously two) and Max. increased to "Z" from "8." While the IMMT-5 range of this input field is only 0-C, and the IMMA0 range of this field was tightly constrained to 0-8 (reflecting the legal range of the input data at IMMT-2), we note that the IMMA0 range was not increased to account for expansions in the range of this field associated with the intermediate IMMT-3/4 updates. Thus increasing the *FM* max. accommodates future IMMT field adjustments without requiring adjustment in the IMMA1 configuration (but conversely offers less stringent control on the legality of the *FM* data).

The current IMMA0 "IMMT-2/FM 13" attm is updated to reflect changes made in three later versions of IMMT: IMMT-3 (effective 1 Jan. 2007), IMMT-4 (1 Jan. 2011), and IMMT-5 (1 June 2012). Differences between IMMT-4 and IMMA0 are documented at http://icoads.noaa.gov/immt4.html. In conjunction with approval by JCOMM-4 of IMMT-5 (http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=8833), it was decided to discontinue roman, and strictly use (including in WMO publications) arabic, numerals for the format versioning.

A new field (*IMMV*) indicates the applicable IMMT version within the attm, which accommodates some format evolution problems, in that some IMMT fields changed meaning between IMMT-3 and IMMT-4.

For reference, the following table shows selected IMMT versus IMMA field differences outside of this attm, where IMMA generally has enhanced resolution/method:

IMMA *Core* field	IMMT	IMMA
HR	whole hour	0.01 hour
LAT and *LON*	0.1°	0.01° (in *Core*) or 0.001° (in proposed *Auto*)
W	whole kts or whole m/s	0.1 m/s (converted)
ID	7 characters	9 characters

Discussion of unresolved issues: KNMI had suggested that a QC flag for *RH* be considered for addition to IMMT so that all major elements would have an associated individual QC flag, however such a flag has not yet been defined for IMMT (nor for this revision of IMMA). Also the QC flags (*QCI* and *QI1-20*) are voluminous (occupying 30 characters total) and not optimally organized due to the way IMMT has evolved. If any further changes were made in the *Immt* attm, the option could be considered to bring all the QC flags closer together (including possibly in a separate attm, similar to the proposed *Nocq* attm, but devoted to IMMT QC information).

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Table C6. Model quality control (*Mod-qc*) attm. For reference, the Units column also includes (following any units information) the current UK Met Office BUFR element names.

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code) [base36]*

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=6
2	2	*ATTL*	attm length			Note: set *ATTL*=68
			GTS bull. header fields (10 characters):			
3	4	*CCCC*	collecting centre	a	a	COLTN_CNTR
4	6	*BUID*	bulletin ID	b	b	BLTN_IDNY
			Model comp. elements (54 characters):			
5	1	*FBSRC*	Feedback source	0	0	(0=operational; any additional values *tbd*, e.g. for reanalyses)
6	5	*BMP*	background (bckd.) *SLP*	870.0	1074.6	0.1 hPa; BCKD_MSL_PESR
7	4	*BSWU*	bckd. wind U-comp.	–99.9	99.9	0.1 m/s; BCKD_SRFC_WIND_U
8	4	*SWU*	derived wind U-comp.	–99.9	99.9	0.1 m/s; SRFC_WIND_U
9	4	*BSWV*	bckd. wind V-comp.	–99.9	99.9	0.1 m/s; BCKD_SRFC_WIND_V
10	4	*SWV*	derived wind V-comp.	–99.9	99.9	0.1 m/s; SRFC_WIND_V
11	4	*BSAT*	bckd. air temperature	–99.9	99.9	0.1°C; BCKD_SRFC_AIR_TMPR
12	3	*BSRH*	bckd. relative humidity	0	100	%; BCKD_SRFC_RLTV_HUMDY
13	3	*SRH*	(derived) relative humidity	0	100	%; SRFC_RLTV_HUMDY
	~~1~~	~~*SIX*~~	~~derived stn./wea. indic.~~	~~2~~	~~3~~	~~(subset of *IX*, field 105; unused)~~
14	5	*BSST*	bckd. *SST*	–99.99	99.99	0.01°C; BCKD_SEA_SRFC_TMPR
15	1	*MST*	model surface type	0	9	(UK 008204); MODL_SRFC_TYPE
16	4	*MSH*	model height of surface	-999	9999	m; MODL_SRFC_HGHT
17	4	*BY*	bckd. year	0	9999	year; BCKD_YEAR
18	2	*BM*	bckd. month	1	12	month; BCKD_MNTH
19	2	*BD*	bckd. day	1	31	day; BCKD_DAY
20	2	*BH*	bckd. hour	0	23	hour; BCKD_HOUR
21	2	*BFL*	bckd. forecast length (time period or displacement minute)	0	99	hours BCKD_FRCT_LNGH

***Mod-qc* attm update notes:**

Renumbering of fields.

Fields *CCCC* and *BUID* are exclusive to operational GTS data. Additional GTS bulletin header information (e.g. fields indicating whether reports are corrected on re-transmission—available from NCEP BUFR at least and now planned for retention as part of the NCDC GTS data) could possibly be useful to also incorporate somewhere in IMMA. However, separating the GTS bulletin header information, from the more specialized model QC fields, might be more

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efficient, to avoid creating attms that are largely blank. A related consideration is the possibility of composite blending of Met Office BUFR with other GTS sources.

Note: Additionally, and peripherally related to the content of this attm, NCEP has "quality marks" they set, which currently are not preserved in IMMA (ref. http://icoads.noaa.gov/rt.html).

For *BSRH* and *SRH* values appear at least as high as 107%. While actual RH can't be that high, this raises the question whether the ranges of these model-generated fields should be increased in the future e.g. to 107%. On the other hand, *MSH* is extended to a 4-character field, since values of -152.0 and others less than -99 have been detected (plus larger positive values than previously allowed).

Also, *BSST* is translated to SI units at the Met Office using constant 273.15K, whereas a lower-precision 273.1K constant is used for *BSAT*, the only other temperature field presently being made available by the Met Office. To keep its resultant higher precision, *BSST* is expanded to 5 characters. Explanation from Colin Parrett at the Met Office's Real Time Monitoring Centre (RTMC):

> "As far as I know, the conversions depend on the precision of the received data, using 273.0, 273.1 or 273.15 for 0, 1 or 2 (or more) decimal places. I've enquired with our MetDB Team for confirmation and I'll let you know if things have changed. The background SST does come from a different source, so that might explain the greater precision."

The referenced encoding constant 273.0 does not appear to apply to the temperature elements currently received from the Met Office, but in the event such data were received in the future a 4-character field configuration like that for BSAT would be sufficient (however, to accurately translate temperature data back from Kelvin to °C, it is crucial to know what constant has been used for encoding originally reported °C temperatures to Kelvin for storage in BUFR).

SIX is not reported in the original BUFR files, and there are no plans at the RTMC to begin encoding it—thus it is removed from IMMA1.

Table C7. Ship metadata (*Meta-vos*) attm. For more information, including other fields available in WMO Pub. 47 but not selected for this attm, see Berry et al. (2009).[1]

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code)* [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=7
2	2	*ATTL*	attm length			Note: set *ATTL*=58
			Ship metadata elements (54 characters):			
3	1	*MDS*	metadata source	0	1	(0=WMO Pub. 47; 1=COAPS)
4	2	*C1M*	recruiting country	a	a	(Δ •43)
5	2	*OPM*	type of ship (programme)	0	99	(code unlike *OP*)
6	2	*KOV*	kind of vessel	c	c	
7	2	*COR*	country of registry	a	a	(Δ •43)
8	3	*TOB*	type of barometer	c	c	
9	3	*TOT*	type of thermometer	c	c	
10	2	*EOT*	exposure of thermometer	c	c	
11	2	*LOT*	screen location	c	c	
12	1	*TOH*	type of hygrometer	c	c	
13	2	*EOH*	exposure of hygrometer	c	c	
14	3	*SIM*	*SST* meas. method	c	c	(code unlike *SI*)
15	3	*LOV*	length of vessel	0	999	M
16	2	*DOS*	depth of *SST* meas.	0	99	M

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No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
17	3	*HOP*	height of visual observation platform	0	999	M
18	3	*HOT*	height of *AT* sensor	0	999	M
19	3	*HOB*	height of barometer	0	999	M
20	3	*HOA*	height of anemometer	0	999	M
21	5	*SMF*	source metadata file	0	99999	e.g. "19991" 1st Q 1991
22	5	*SME*	source meta. element	0	99999	line number in file
23	2	*SMV*	source format version	0	99	(see Berry et al. 2009[1])

1. Berry, D.I., E.C. Kent, and S.D. Woodruff, 2009: *Blending ICOADS Release 2.5 and WMO Publication 47, 1966–2007* [http://icoads.noaa.gov/e-doc/imma/WMO47IMMA_1966_2007-R2.5.pdf].

Meta-vos **attm update notes:**

Renumbering of fields.

One new field, *MDS*, is added to indicate the metadata source.

Table C8. Near-surface oceanographic data (*Nocn*) attm.

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=8
2	2	*ATTL*	attm length			Note: set *ATTL*=102 [2U] [b36]
			Near-surface oceanographic data and metadata (98 characters):			
3	5	*OTV*	temperature value	-3.000	38.999	0.001°C[1]
4	4	*OTZ*	temperature depth	0.00	99.99	0.01 m
5	5	*OSV*	salinity value	0.000	40.999	0.001 (unitless)
6	4	*OSZ*	salinity depth	0.00	99.99	0.01 m
7	4	*OOV*	dissolved oxygen	0.00	12.99	0.01 milliliter/liter
8	4	*OOZ*	dissolved oxygen depth	0.00	99.99	0.01 m
9	4	*OPV*	phosphate value	0.00	30.99	0.01 micromole/liter
10	4	*OPZ*	phosphate depth	0.00	99.99	0.01 m
11	5	*OSIV*	silicate value	0.00	250.99	0.01 micromole/liter
12	4	*OSIZ*	silicate depth	0.00	99.99	0.01 m
13	5	*ONV*	nitrate value	0.00	500.99	0.01 micromole/liter
14	4	*ONZ*	nitrate depth	0.00	99.99	0.01 m
15	3	*OPHV*	pH value	6.20	9.20	0.01 (unitless)
16	4	*OPHZ*	pH depth	0.00	99.99	0.01 m
17	4	*OCV*	total chlorophyll value	0.00	50.99	0.01 micrograms/liter
18	4	*OCZ*	total chlorophyll depth	0.00	99.99	0.01 m
19	3	*OAV*	alkalinity value	0.00	3.10	0.01 milliequivalent/liter
20	4	*OAZ*	alkalinity depth	0.00	99.99	0.01 m

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No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
21	4	*OPCV*	partial pressure of carbon dioxide value	0.0	999.0	0.1 microatmosphere
22	4	*OPCZ*	partial pressure of carbon dioxide depth	0.00	99.99	0.01 m
23	2	*ODV*	dissolved inorganic carbon value	0.0	4.0	0.1 millimole/liter
24	4	*ODZ*	dissolved inorganic carbon depth	0.00	99.99	0.01 m
25	10	*PUID*[2]	provider's unique record Identification	b	b	[As defined by the data provider (e.g. WOD is numeric)]

1. The *SST* min. and max. limits in the *Core* (Table C0) are -99.0 to 99.0°C with a precision of 0.1°C, this attachment has greater precision as is appropriate for modern oceanographic profile data, with a max. value based roughly on QC limits from the GOSUD programme.
2. The size of this field is based on WOD unique cast number. NODC allows for a character string equivalent to the maximum value of an unsigned integer*4, i.e. 4294967295. For more general application we allow for 10 characters and for the string to be alphanumeric.

***Nocn* attm notes (new attm):**
Field contents tailored to the specialized requirements of capturing near-surface data deemed most relevant to marine meteorology from the World Ocean Database (e.g. WOD09; http://www.nodc.noaa.gov/OC5/WOD/pr_wod.html).

Table
C96. ICOADS Value-Added Database (*Ivad*) attm.

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI=96*
2	2	*ATTL*	attm length			Note: set *ATTL*=48
			Value-added data and metadata (44 characters):			
3	2	*ICNI*	input component number—*Ivad*	0	(*tbd*)	IMMA component number
4	2	*FNI*	field number—*Ivad*	1	(*tbd*)	IMMA field no. within *ICNI*
5	1	*JVAD*	scaling factor for *VAD*	1	Z[2]	b36
6	6	*VAD*	value-added data	(*inh.*[1])	(*inh.*[1])	(inherited from *ICNI & FNI*)
7	1	*IVAU1*	type indicator for *VAU1*	1	Z[2]	b36
8	1	*JVAU1*	scaling factor for *VAU1*	1	Z[2]	b36
9	6	*VAU1*	uncertainty of type *IVAU1*	(*inh.*[1])	(*inh.*[1])	(inherited from *ICNI & FNI*)
10	1	*IVAU2*	type indicator for *VAU2*	1	Z[2]	b36
11	1	*JVAU2*	scaling factor for *VAU2*	1	Z[2]	b36
12	6	*VAU2*	uncertainty of type *IVAU2*	(*inh.*[1])	(*inh.*[1])	(inherited from *ICNI & FNI*)
13	1	*IVAU3*	type indicator for *VAU3*	1	Z[2]	b36
14	1	*JVAU3*	scaling factor for *VAU3*	1	Z[2]	b36
15	6	*VAU3*	uncertainty of type *IVAU3*	(*inh.*[1])	(*inh.*[1])	(inherited from *ICNI & FNI*)
16	1	*VQC*	value-added QC flag	1	4, 9	(see Table C96a)

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No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
17	4	*ARCI*	author reference code–*Ivad*	b	b	(alphanumeric)
18	3	*CDNI*	creation day number—*Ivad*[3]	0	46655 [ZZZ]	[b36]
19	1	*ASII*	access status indic.—*Ivad*	0	1	0=active, 1=inactive

1. The range and other characteristics of these value-added data fields are all inherited from *ICN* & *FN*; the numeric precision is determined from the scaling factor fields (where 0=integer).
2. Indicator configurations to be fully defined during prototyping.
3. To be set by the external developer, as to when they produced the attm, numbering from day zero at 1 January 2014 (thus *CDNI* + 2456659 would equal a "Julian" day number, ref. http://www.nr.com/julian.html). ZZZ is 46655 in base36, thus the use of three characters allows almost 128 years of entries (in contrast, ZZ is 1295 in base36, thus two characters would allow only ~3.5 years of entries).

Ivad attm notes (new attm)

Bias adjusted fields will be stored in this *Ivad* attm, whereas the unadjusted data will be stored in the *Core*/other attms. Note that this is an inversion of the planned handling, after blending into ICOADS, of straightforward data corrections using the *Error* attm (see Table C97).

Rather than including these attms (of which there may be a varying number) within the main IMMA record, we are implementing a "linked-report" (Main+Subsidiary, or Main only if there are no Subsidiary records present) approach, such that Subsidiary attms can store an indefinite number of individual *Ivad* attms together in separate physical record(s), for a given *UID*. This requires that both the Main and Subsidiary record types include *UID* (together with ICOADS Release number details *RN1*+*RN2*+*RN3*) so that they can be identified (i.e. by Subsidiary record type) and linked back together with the main record. This linking is accomplished using the new *Uida* attm (see Table C98).

For *VQC*, we envision this as a mechanism for storing externally provided data QC information, such that the provider of QC information would be required to map their flags to the *VQC* configuration (Table C96a) and describe their mapping method in external documentation as linked via *ARC* (also original flags could be stored in the *Suppl* attm together with original data).

Table C96a. Configuration of the value-added QC Flag (*VQC*), following primary-level quality flag (QF) codes and definitions from IOC (2013)[1], which also recommends that any QC tests must be well documented in metadata that accompany the data. See Annex D for further discussion.

Code	*Primary level flag's short name*	*Definition*
1	Good	passed documented required QC tests
2[2]	Not evaluated, not available or unknown	used for data when no QC test performed or the information on quality is not available
3	Questionable/suspect	failed non-critical documented metric or subjective test(s)
4	Bad	failed critical documented QC test(s) or as assigned by the data producer
9	Missing data	used as placeholder when data are missing

1. IOC, 2013: Ocean Data Standards, Vol. 3: Recommendation for a Quality Flag Scheme for the Exchange of Oceanographic and Marine Meteorological Data. IOC Manuals and Guides 54, Vol. 3., 12 pp. (English.)(IOC/2013/MG/54-3). [http://www.iode.org/index.php?option=com_oe&task=viewDocumentRecord&docID=10762].
2. Explanation for the placement of flag value 2, from IOC (2013): 'The quality of verified "Good" (flag 1) is considered higher (smaller flag value) compared to "Not evaluated" (flag 2), as the latter could turn out to be

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of any quality from good to bad, once the quality checks have been performed. Consequently, the neutral "Not evaluated" (flag 2) is placed between verified "Good" and verified "Questionable/suspect".'

Table C97. Error (*Error*) attm.

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=97
2	2	*ATTL*	attm length			Note: set *ATTL*=(inh.[1])
			Corrected erroneous data and metadata:			
3	2	*ICNE*	input component number—*Error*	0	*(tbd)*	IMMA component number
4	2	*FNE*	field number—*Error*	1	*(tbd)*	IMMA field no. within *ICNE*
5	1	*CEF*	corrected/erroneous field flag	0	1	0: *ERRD* is the corrected value; 1: *ERRD* is the erroneous value
6	*(inh.*[1]*)*	*ERRD*	corrected/erroneous field value	*(inh.*[1]*)*	*(inh.*[1]*)*	(inherited from *ICNE* & *FNE*)
7	4	*ARCE*	author reference code–*Error*	b	b	(alphanumeric)
8	3	*CDNE*	creation day number—*Error*	0	46655 [ZZZ]	(as for *CDNI*, ref. Table C96) [b36]
9	1	*ASIE*	access status indic.—*Track*	0	1	0=active, 1=inactive

***Error* attm notes (new attm)**

The ICOADS group does not anticipate creating these e.g. during the "preconditioning" step of processing. *Error* attms would most likely be created by outside providers, not by the ICOADS group (e.g., bad call signs during track checking).

Implementation will be handled similarly to the *Ivad* attm (Table C96) in that any number of individual *Error* attms will be stored in one (or more) *Error* Subsidiary record(s), and linked together using the *Uida* attm (Table C98). *CEF* distinguishes between *Error* Subsidiary records as provided externally to ICOADS (*CEF*=0), in contrast to after the *Error* records are blended into ICOADS (*CEF*=1).

To simplify the user interface, the tentative plan is that corrections for straightforward errors (e.g. callsign garbling) will ultimately be stored by ICOADS in the *Core*/other attms, whereas uncorrected data will be stored in this *Error* attm—this is an inversion of the planned handling of bias adjustments using the *Ivad* attm. The swapping of the information in the provided *Error* attms, to final inverted storage in IMMA (i.e. from *CEF*=0 to *CEF*=1, and interchanging the data fields), will probably be handled centrally; however, the *CEF* flag settings should allow this inversion to be handled externally instead if desired (i.e. through the provision of both Main and Subsidiary records).

Although some reduction in data volume is achieved by having the width of the data field vary (i.e. inherited from the referenced field configuration), this remains a relatively voluminous approach to storing error information for individual fields owing to the attm overhead. Alternatively, similar to the old LMR "error attachment" (ref. discussion in red at the end of http://icoads.noaa.gov/Release_1/suppF.html regarding "Attachment 5") this could potentially be a variable-length attm of the following form: *FN*, *ERRD*, *NREP* number of repetitions (i.e. 1/more repetitions of *FN*+*ERRD*, …, all falling under one *ARCE*).

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Table C98. Unique report ID (*Uida*) attm.

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=98
2	2	*ATTL*	attm length			Note: set *ATTL*=15
			Processing elements (10 characters):			
3	6	*UID*	Unique report ID	b	b	(alphanumeric[1])
4	1	*RN1*	Release no.: primary	0	[Z]	e.g. 2 [b36]
5	1	*RN2*	Release no.: secondary	0	[Z]	e.g. 5 [b36]
6	1	*RN3*	Release no.: tertiary	0	[Z]	e.g. 0 (thus 2.5.0 together) [b36]
7	1	*RSA*	Release status indicator	0	2	0=Prelim., 1=Aux., 2=Full
8	1	*IRF*	intermediate reject flag	0	1	0=Reject, 1=Retained

1. While it represents a base36 number, this field is handled by {rwimma1} as strictly (i.e. without leading spaces, e.g. 35=00000Z) alphanumeric, and thus is not fully translated into an integer or floating-point (REAL) number (ref. {rwimma1} comments: "For character […] fields, note that ITRUE and FTRUE contain the ICHAR of the first character of the field…"). Separate from {rwimma1} however, this Fortran library is available to transform *UID* into an integer (and vice versa): http://icoads.noaa.gov/software/base36.f. Users interested in handling *UID* as a number should be aware of possible finite precision issues arising in the representation of large numbers on computers:

- In the integer case, the largest 6-character base36 number is ZZZZZZ (2,176,782,335); however, if one bit is reserved for sign, the largest positive integer representable in 32 bits is only 2^{31}–1 (2,147,483,647; ZIK0ZJ in base36). However as noted below the current maximum of *UID* is $m_{R2.5i}$ (~295M) and thus well below this threshold.
- Whereas, in the floating-point case it is not even possible to accurately represent $m_{R2.5i}$ as a 32-bit single precision REAL number.

Uida attm notes (new attm):

The *intermediate* Release 2.5 product (R2.5*i*), containing available duplicates and other reports excluded from the normal user product (R2.5), was used as the starting point for assigning *UID* and these other new fields, and generally prototyping IMMA1. The Release number fields were set to indicate R2.5.1 (i.e. *RN1*=2, *RN2*=5, *RN3*=1), and *IRF* to indicate whether each report is to be rejected or retained during construction of a final user product R2.5.1, from the prototype intermediate product R2.5.1*i* (note: both the intermediate R2.5.1*i* and the final R2.5.1 data are available to interested users).

R2.5*i* contains ~295M (specifically: 294,725,525) reports ($m_{R2.5i}$), so all those records (in predefined temporal archive sequence) had *UID* assigned from 1,…,$m_{R2.5i}$. In preparation for processing the next Release, we anticipate that all new and historical records will be numbered starting from $m_{R2.5i}$+1. After blending the old and new records into the new Release, all the *UIDs* will no longer be sequential (i.e. new *UIDs* will be interleaved into the old purely numeric sequence; see Annex B for further discussion).

One additional idea that came up in ETMC-III (2010) discussion was to allow for the possibility as well for a national *UID*, e.g. *UIDN*, as opposed to the main international *UID*. This should be kept under consideration as a possibility for the future, but we do not recommend expanding the *Uida* attm with that information (which would seem to fit better elsewhere).

In addition to operationalizing the setting of *UIDs* in the "preliminary" near-real-time (NRT) data, we need to decide how to set *RSA* and *IRF* for the upcoming new (i.e. merged NCDC-NCEP GTS) NRT data—which, like full Releases, will have both intermediate and final files.

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Table C99. Supplemental data (*Suppl*) attm. This attm stores the original input data string, with recommended settings *ATTL*=0 (unspecified length) and *ATTE*=missing (Ascii). For processing via {rwimma1}, this attm must appear at the end of the record, and the record must terminate with a line feed.

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code)* [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=99
2	2	*ATTL*	attm length			Note: set *ATTL*=0[1]
3	1	*ATTE*	attm encoding	0	1	Note: set *ATTE*=missing[2]
			Supplemental data (format determined by data source):			
4		*SUPD*[1]	supplemental data	c	c	

1. The length of the supplemental data is unspecified if *ATTL*=0, and may be variable.
2. Thus far, *ATTE*=1 (hexadecimal) has been used only for MORMET (deck 732) data (to represent binary input). This printable representation, which {rwimma1} treats identically to Ascii, is undocumented in available (i.e. IMMA0) Suppl. D information. In addition, while the *ATTE*=0 (base64 encoding; unprintable) representation is documented in Suppl. D, currently it is unused and not fully implemented in {rwimma1}.

***Suppl* attm update notes:**

No changes, other than renumbering of fields, and regarding the range of *ATTE*. Also, this table's number was changed to match *ATTI*.

Table CP1. Automated instrumentation (*Auto*) attm (proposed)

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code)* [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI=(tbd)*
2	2	*ATTL*	attm length			Note: set *ATTL*=41
			Automated instrumental metadata (37 characters):			
3	8	*ALAT*	latitude	–90.000	90.000	0.001°N
4	9	*ALON*	longitude	0.000	359.999	0.001°E (ICOADS conv.)
5	1	*INAV*	navigation system indicator	0	9	(controlled vocabulary *tbd*, e.g. 0=GPS, 1=POSMV, 2=INS)
6	6	*APRS*	atmospheric pressure	870.00	1074.60	at barometer height (*HOB*)
7	6	*ARSW*	shortwave radiation	0.00	1600.00	Wm^{-2}
8	1	*IARSW*	shortwave radiation indicator	0	9	(controlled vocabulary *tbd*, e.g. 0=down-, 1=upwelling)
9	5	*ARLW*	longwave radiation	200.00?	800.00?	Wm^{-2}
10	1	*IARLW*	longwave radiation indicator	0	9	(controlled vocabulary *tbd*, e.g. 0=down-, 1=upwelling)

***Auto* attm notes:**

This attm was designed to provide a location to capture meteorological and underway ocean data that are not routinely reported by VOS or in historical ship reports. These values would be derived from automated instrumentation.

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This attm could be expanded to include all possible parameters that could be derived at high precision from automated instrumentation. Candidate fields that are included elsewhere in IMMA0 are: Ship's course and speed (*DS*/*VS*, in the *Core*; or *COG*/*SOG* for the over ground elements, in *Immt*), and ship's heading (*HDG* in *Immt*), wind direction and speed (true *D*/*W*, in the *Core*; or relative *RWD*/*RWS* in *Immt*), *AT*, *WBT*, *DPT* (*Core*), and *RH* and precipitation (*Immt*). Other possible fields for this table include visibility and cloud height derived from automated sensors, but they are currently very rare on ships or moorings, or possibly surface velocity data (not presently part of ICOADS).

For *ARSW*, we need to decide if we want to allow for negative values. They are common due to sensor calibration issues (and flagged e.g. by SAMOS), but are not physical.

Storing *APRS* is proposed for two reasons (a) there is no place in IMMA to store atmospheric pressure values not converted to sea level and (b) precision automated barometers can easily record *SLP* (or *APRS*) to 2 or 3 decimal places. However, if the field serves two purposes, an associated indicator may be needed to flag the high-resolution pressure type (i.e. *SLP* or *APRS*)

Radiation could be handled in different ways. The idea above provides for separate shortwave/longwave total radiation variables. If we added a signed range, this could also allow for net radiation. Another other option would allow for multiple radiation values each with an indicator stating whether it is shortwave, longwave, PAR, UV, etc. This may result in a variable-length attachment or one of fixed-length with many empty fields. Also, some indicator of the time period over which the radiation was integrated may be needed. The draft E-SURFMAR Dataformat#100 (http://esurfmar.meteo.fr/doc/o/vos/E-SURFMAR_VOS_formats_v011.pdf) suggests "over the past hour." More discussion is needed on these issues.

Table CP2. Near-surface oceanographic QC (*Nocq*) attm (proposed)

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code)* [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=9
2	2	*ATTL*	attm length			Note: set *ATTL*=28
			Near-surface oceanographic QC and calibration information (24 characters):			
1	1	*OQCI*	quality control indic.[1]	0	9	(Same as *QCI* in Table C5)
2	1	*OQCFL*	QC flag list[2]	u	u	*(tbd)*
3	1	*OTQC*	*OTV* (temp.) QC flag	0	9	*(tbd)*
4	1	*OTCI*	*OTV* calibration indic.	0	9?	*(tbd)*[3]
5	1	*OSQC*	*OSV* (salinity) QC flag	0	9	*(tbd)*
6	1	*OSCI*	*OSV* calibration indic.	0	9?	*(tbd)*
7	1	*OOQC*	*OOV* (oxygen) QC flag	0	9	*(tbd)*
8	1	*OOCI*	*OOV* calibration indic.	0	9?	*(tbd)*
9	1	*OPQC*	*OPV* (phosphate) QC flag	0	9	*(tbd)*
10	1	*OPCI*	*OPV* calibration indic.	0	9?	*(tbd)*
11	1	*OSIQC*	*OSIV* (silicate) QC flag	0	9	*(tbd)*
12	1	*OSICI*	*OSIV* calibration indic.	0	9?	*(tbd)*
13	1	*ONQC*	*ONV* (nitrate) QC flag	0	9	*(tbd)*
14	1	*ONCI*	*ONV* calibration indic.	0	9?	*(tbd)*
15	1	*OPHQC*	*OPHV* (pH) QC flag	0	9	*(tbd)*
16	1	*OPHCI*	*OPHV* calibration indic.	0	9?	*(tbd)*

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17	1	*OCQC*	*OCV* (total chlor.) QC flag	0	9	*(tbd)*
18	1	*OCCI*	*OCV* calibration indic.	0	9?	*(tbd)*
19	1	*OAQC*	*OAV* (alkalinity) QC flag	0	9	*(tbd)*
20	1	*OACI*	*OAV* calibration indic.	0	9?	*(tbd)*
21	1	*OPCQC*	*OPCV* (PaC02) QC flag	0	9	*(tbd)*
22	1	*OPCCI*	*OPCV* calibration indic.	0	9?	*(tbd)*
23	1	*ODQC*	*ODV* (DIC) QC flag	0	9	*(tbd)*
24	1	*ODCCI*	*ODV* indic.	0	9?	*(tbd)*

1. Proposed as an overall QC method flag, the same as *QCI* in the *Immt* attm, which has this configuration:
   0 - No quality control (QC)
   1 - Manual QC only
   2 - Automated QC only /MQC (no time-sequence checks)
   3 - Automated QC only (inc. time sequence checks)
   4 - Manual and automated QC (superficial; no automated time-sequence checks)
   5 - Manual and automated QC (superficial; including time-sequence checks)
   6 - Manual and automated QC (intensive, including automated time-sequence checks)
   7 & 8 - Not used
   9 - National system of QC (information to be furnished to WMO)
2. Proposed indicator that points to different QC flag schemes (e.g. the ODS-based scheme as listed in Table C96a).
3. As agreed at the April 2013 UK EarthTemp meetings, it appears we need at least 4 configurations: (0) not calibrated, (1) calibrated, (2) bottle calibrated, (3) others.

***Nocq* attm notes:**

QC flags and calibration information paralleling the data value (and accompanying depth) fields in the *Nocn* attm (Table C8).

Table CP3. Alternative QC (*Alt-qc*) attm (proposed).

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code) [base36]*
1	2	*ATTI*	attm ID			Note: set *ATTI=(tbd)*
2	2	*ATTL*	attm length			Note: set *ATTL*=18
			Alternative QC information (14 characters):			
3	2	*JCNQ*	input component number–*Alt-qc*	0	*(tbd)*	IMMA component number
4	6	*FNQ*	field number–*Alt-qc*	1	*(tbd)*	IMMA field no. within *JCNQ*
5	1	*AQCFL*[1]	QC flag list	u	u	(*tbd*; possibly [b36])
6	1	*QCFV*	QC flag value	0	9	(tbd; possibly [b36])
7	4	*ARCQ*	author reference code–*Alt-qc*	b	b	(alphanumeric)

1. See *OQCFL* in the *Nocq* attm (Table CP2).

***Alt-qc* attm notes:**

Envisioned as a means by which data providers could provide QC flag information on a flexible basis, akin to the *Error* attm, but for additional quality control flags for any field number in

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any attm. The intent of the QC flag list is to allow users to submit data using a range of QC flagging schemes (e.g., 0-9, A-Z, etc). This could be supported by using base36 representation. May also want to consider need for length>1 for the *QCFV*.

Table CP4. Platform tracking (*Track*) attm (proposed).

No.	*Len.*	*Abbr.*	*Element description*	*Min.*	*Max.*	*Units (Code) [base36]*
1	2	*ATTI*	attm ID			Note: set *ATTI=(tbd)*
2	2	*ATTL*	attm length			Note: set *ATTL*=(tbd)
			Platform track information (~25 characters):			
3	1?	*UIDT*	UID type			(*tbd*; e.g. 1=ICOADS-standard, 2=collection/*SID*-specific,3=platform/voyage-specific)
4	6	*UID1*	UID of previous report	1	*(tbd)*	
5	6	*UID2*	UID of this report	1	*(tbd)*	
6	6	*UID3*	UID of next report	0	*(tbd)*	
7	4	*ARCT*	author reference code–*Track*	b	b	(alphanumeric)
8	2	*CDNT*	creation day number—*Track*	0	ZZ	(as for *CDNI*, ref. Table C96) [b36]
8	1	*ASIT*	access status indic.—*Track*	0	1	0=active, 1=inactive

***Track* attm notes:**

Sets aside space for "pointer" fields indicating the UID of the previous (*UID1*) and next (*UID3*) report, with respect to this report (*UID2*), in ship/buoy track sequence (i.e. both forward, and backward, in time and space). If indicated by *UIDT*, this attm could contain collection- (or source ID, *SID*) specific, or even platform/voyage-specific, rather than ICOADS-standard, *UID* information (which thus in a sense can be considered value-added information, if assembled externally).

This could be very useful e.g. for reanalyses to resolve the problem of connecting ship/buoy voyages within ICOADS. Due to effects of dupelim, tracks may consist of records interspersed from a variety of sources, with possibly varying *IDs* for records in track sequence. This proposed attm would provide the storage mechanism for this information, but populating the attm seems likely to be challenging and is not presently resourced. Therefore as with the *Ivad* attm, we might consider this to be metadata we would consider ingesting if somebody else had the resources to implement the ship tracking. [Note: Meanwhile a related improvement would be to try to fill in more ship callsigns etc., e.g. through substitution of information among duplicates.]

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Table CP5. Historical attm *(Hist)* (proposed). *ATTI* to be assigned, and *ATTL* and field numbering to be decided (*tbd*).

No.	Len.	Abbr.	Element description	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI=(tbd)*
2	2	*ATTL*	attm length			Note: set *ATTL=(tbd)*
			Historical data fields (>19 characters):			
3	?	*SN*	ship's name	u	u	[Note: either the full name, or possibly abbreviated with reference to a separately maintained list, to same space?]
4	5	*LCR*	longitude by chronometer	0.00	359.99	0.01°E[1] (ICOADS conv.)
5	5	*LMG*	longitude made good[2]	0.00	359.99	0.01°E[1] (ICOADS conv.)
6	5	*LDR*	longitude by account[3]	0.00	359.99	0.01°E[1] (ICOADS conv.)
7	1	*WFI*	*WF* indic.	u	u	
8	2	*WF*	wind force	0	12	
9	1	*XWI*	*XW* indic.	u	u	
10	3	*XW*	wind speed (ext. *W*)	0	99.9	0.1 m/s
11	1	*XDI*	*XD* indic.	u	u	
12	2	*XD*	wind dir. (ext. *D*)	u	u	
14	1	*SLPI*	*SLP* indic.	u	u	[Note: This or another indicator needed to indicate the presence or absence of *SLP* adjustment (ref. *PB*)?]
15	1	*TAI*	*TA* indic.	u	u	
16	4	*TA*	*SLP* att. thermometer	–99.9	99.9	ref. *AT*
17	5	*SMPR*	sympiesometric pressure	25.000	32.000	0.001 inches of mercury[4]
18	1	*XNI*	*XN* indic.	u	u	
19	2	*XN*	cloud amt. (ext. *N*)	u	u	
20	1	*SGN*	significant cloud amount	0	9	(N_S; ref. Table B3)
21	1	*SGT*	significant cloud type	0	9, "A"	(C; ref. Table B3)
22	2	*SGH*	significant cloud height	0	99	(h_Sh_S; ref. Table B3)
(plus additional elements tbd)						

1. A possible alternative approach for storing these longitudes, such as from the EEIC collection, would be to keep the DDD.MM.SS original format, noting however that original data configurations should be preserved anyway in the *Suppl* attm. Also storing decimal points would violate the standard IMMA representation for numeric data (unless these fields were stored as character strings).
2. With reference to Greenwich Meridian.
3. As calculated by dead reckoning.
4. Due to the erratic nature of the sympiesometer measurements such as observed in the EIC Collection, these values might fall well out of the range specified here.

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***Hist* attm update notes:**

Fields *SGN*, *SGT*, and *SGH*, which are believed to be purely historical (1960s or earlier), are moved here from the *Immt* attm. Refer to the complete version of the IMMA0 documentation for Table B3 (http://icoads.noaa.gov/e-doc/imma/R2.5-imma.pdf). Among potential additional elements: dead reckoning positions (if preserved additionally to observed positions) and surface current movement (derivable from dead reckoning positions), Leeway, magnetic deviation and variation, etc.

Other examples from recent work on the C19th German Maury Collection:

Cloud form:

Cirrus	CI	Cirrocumulus	CC	Cirrostratus	CS
Altocumulus	AC	Altostratus	AS		
Stratocumulus	SC	Stratus	ST	Nimbostratus	NS
Cumulus	CU	Cumulonimbus	CB		

Present Weather indicated by combinations of the following Beaufort Codes:

b	blue sky	p	passing showers
c	cloudy sky	q	squally
d	drizzle	r	rain, rainy
f	fog	s	snow
g	gloomy	t	thunder
h	hail	u	ugly threatening sky
l	lightning	v	exceptional visibility
m	mist	w	dew
o	overcast, overcast skies	z	haze

Additional historical fields, such as the following, will have to be investigated much further to determine the feasibility of incorporating them in IMMA. Historically, these are largely non-standardized recordings, recorded in comments possibly embedded in large amounts of text (e.g. >1500 unique state of sea and weather comments in the EEIC collection).

Historic sea state
Historic sea ice

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Annex A: Implementation/Unresolved Issues

(a) Handling higher-resolution SST

New requirements to store higher resolution SST data (e.g. to hundredths of a degree) are emerging e.g. from buoys and C-MAN stations. Future options to handle these data could include: (i) extending the precision of *SST* by one decimal place in the *Core* (plus probably requiring additional indicator settings); (ii) storing the data together with subsurface ocean temperatures within the *Nocn* attm; (iii) through an expansion of the *Auto* attachment. At this stage however, no further changes are viewed as practical in IMMA1 either to the *Core* or the *Nocn* attm, so any such changes would need to be reserved until a future format upgrade.

In a revised *Core*, *IT* (indicator for temperatures) could in theory hold the precision information, but since it refers to all temperature values in a single report (multiple temperatures in a single record could be to different precisions), this raises the question whether a precision indicator for each individual temperature field (*SST*, *AT*, *WBT*, and *DPT*) would be more useful (e.g. in new attm(s)). Past OISST work at NCDC has encountered problems using the existing *IT* information, but because it can be ambiguous the information has not been considered generally very useful.

(b) Questions about mixing ship and buoy wave data (or other fields)

Some NDBC wave data currently are transformed for storage in Table C2 fields (potentially inappropriate). Specifically, ICOADS contains increasing amounts of measured wave data from NOAA National Data Buoy Center (NDBC) moored buoys in the vicinity of the US coastline. Specifically, these variables in the NCDC TD-1171 format (NCDC 2003; note: no longer produced, since NDBC and NODC have adopted a netCDF format going forward from ~2012) have been translated into IMMA variables (with a loss of data resolution, at least in the case of *WD*, which is represented in degrees in TD-1171 (e.g. 0-360) as compared to coded units of ten degrees in IMMA, e.g. 0-36):

WD = principal wave direction (pos. 84-86)
WH = significant wave height (pos. 75-77)
WP = dominant wave period (pos. 78-80)

In the future, ICOADS should consider adding additional sources of measured wave data, e.g. Canadian and E-SURFMAR.

(c) Mod-qc alternative implementation ideas (probably for envisioned Rean attm)

Possibly in a future IMMA upgrade this could be generalized, or another attm developed to handle model QC/feedback information akin to the generalized *Ivad* attm approach (i.e. keyed to *FNI*). In IMMA1, we are configuring the *Mod-qc* attm (Table C6) only to handle the more specialized existing VOSClim requirements. This idea hinges on the suggestion that reanalysis feedback information would probably be field-number-specific, and has fields for background value, estimated value, and then a reference indicator (e.g. UK VOSCLIM, ERA-40, etc.) to cover operational and reanalysis model feedback.).

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(d) Gathering Requirements for Future VOS Delayed Data Format (from 2010)

Future/additional requirements (ref. e-mail 2 April 2010 from Frits Koek and Martin Stam)

"It is very difficult to think about the future usage of VOS data. Nevertheless we gave it a go.
Extra elements we could think of and would like to add are:

- Wind speed at anemometer height;
- Wind speed reduced to 10m;
- Anemometer height;
- Method of reduction of the wind speed to 10m;
- Depth of SST measurement below water level;
- Air pressure at instrument level;
- Air pressure at sea level;
- Height of barometer above sea level;
- Correction method for reduction to sea level.

Further, in general, it would be ideal if per element at least the following information is available:

- Actual measurement/reading;
- Method (instrument/visual/calculated);
- Precision (thousandths, hundredths, tenths, whole, etc.);
- Sample size (1s, 1min, 5min, 10min, etc.);
- Average/median/instantaneous;
- Make and model of instrument;
- Location of instrument;
- Exposure of instrument;
- Height of instrument above sea level;
- Units."

Eric Freeman 8 April 2010 e-mail: In addition to the elements that Frits and Martin have recommended, here are a few more that may be handy in the future:

- One major topic that has been mentioned a few times is the removal of the quadrant field and the addition of positions in the latitude and longitude fields to account for higher precision as well as a minus (-) sign for the hemisphere.
- Salinity
- Depth of sfc salinity reading.
- Radiation (sw & lw)
- Current (sfc or near sfc)
- Depth of current reading

Many of these should help with flux calculations and satellite calibration/validation. There may also need to be additional metadata/qc fields associated with these.

Annex B: *Development of the Unique Report ID (UID); and Intra-record Release No. (RN) Tracking*[3]

IMMA format improvements related to the IVAD project include adding to each IMMA record a Unique Report ID (*UID*), together with Release number (*RN*) tracking fields. Both improvements are being implemented in the *Uida* attm (see Table C98). Prototype implementation is being coordinated with reanalysis projects and other centers to solicit any additional ideas or technical considerations. The prospect has also been raised whether other developing or planned in situ international “comprehensive” archives (e.g. upper-air and land surface) should consider potentially interoperable (as applicable) or at least technically similar schemes.

Initial assignment of the UID number to the archive
The *UID* has been initiated in ICOADS starting with a numbering from 1, …, ~295M ($m_{R2.5}$) of all the records (in predefined temporal archive sequence) in the R2.5 intermediate product (see Table C98 and notes following). The intermediate product contains all currently blended duplicates and other questionable reports, and from it a smaller finalized product (261M reports) without the dups etc. was constructed for most users (although the intermediate product is also publicly available, in the event advanced users wish to study the duplicate matching etc.).

Plan for handling new records introduced during Releases/updates
We plan to number these from $m_{R2.5}$ + 1 to $m_{R2.k}$ (*k* = new Release increment, for an additional set of records to be blended). When these data are blended into e.g. R2.5 data (i.e. records numbered 1, …, ~295M ($m_{R2.5}$), in the resulting blended data it is important to note that the *UID*s will no longer be sequential (i.e. new *UID*s will be interleaved into the old purely numeric sequence).

Possibility of merged (multi-source) reports in the future
Data sources such as the VOS Climate (VOSClim) project, in which unique data fields flow from up to three distinct data streams: GTS, delayed-mode, and NWP model comparison (see Table C6) could benefit from merged records in the future. However, blending records could potentially be used more widely to improve the quality and completeness of the data more generally (e.g. GTS vs. delayed-mode). Probably blended records should receive a new *UID* (and DCK, SID).

UID format considerations (database and IMMA)
Base36 encoding is being used to store *UID* (Table C98), so as to achieve a ~50% reduction in storage size. ICOADS has software available for base36 encoding/decoding (http://icoads.noaa.gov/software/base36.f), and Dave Berry (UK NOC) has implemented similar software. Different implementations appear possible either to maximize space savings, at the expense of CPU time, or vice versa.

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[3] Adapted from material provided in 2010 to the Data Provenance working group of the International Surface Temperature Initiative (http://www.surfacetemperatures.org).

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Annex C: Reprocessing Notes for Recovering Missing Field Configurations, Etc.

Following are excerpts from the current IMMA0 documentation (http://icoads.noaa.gov/e-doc/imma/R2.5-imma_short.pdf) for individual fields discussing proposed, or potential additional, field configuration modifications. For expanded field configurations (e.g. *WP*=99 currently missing in IMMA), this raises the question whether data (e.g. attached supplemental data, if available) should be reprocessed as resources permit to populate the missing configurations (generally these aspects are highlighted in gray below).

In addition, we note that newly defined fields in the revised *Immt*, *Mod-qc*, and *Meta-vos* attms generally will not be populated in the prototype IMMA (intermediate) dataset (R2.5.1*i* and R2.5.1), with the exception of field *MDS* in the *Meta-vos* attm.

As an important related issue however, a translation software update to IMMA1 from IMMA0 will be desirable, as resources permit (and probably subsequent to the prototyping phase, to ensure the finality of IMMA1 details), for newly available historical data sources, as well as operational contemporary data sources (e.g. GTS datastreams, and IMMT/IMMA data flowing regularly from the GCCs).

30) *WBTI* — *WBT* indicator
32) *DPTI* — *DPT* indicator […]

Background: *WBTI* and *DPTI* are derived from sign positions s_w and s_t in IMMT-4. [Note: For data originally translated into LMR from IMMT formats, the predecessor LMR field *T2* preserved only a subset of information derived from s_w and s_t, coupled with whether *DPT* was computed during ICOADS processing. Future work should seek to recover more complete information for data that were translated to IMMA from LMR, and consider new configurations to separately document ICOADS processing. WMO (2009a) Reg. 12.2.3.3.1 specifies when (e.g. owing to instrument failure) relative humidity (RH) is available and may be reported in FM 13 instead of *DPT* in an alternative group 29UUU. Thus far such RH data have generally not been recovered into ICOADS).]

Discussion: Since Jan. 2005 for NCEP GTS data, *RH*, when available instead of *DPT*, was translated from BUFR and converted to *DPT* for storage in IMMA0. Appendix A in http://icoads.noaa.gov/merge.html provides more details on this and other changes in the handling of recent GTS humidity data.

36) *N* — total cloud amount (cover)
37) *NH* — lower cloud amount […]
38) *CL* — low cloud type […]
39) *HI* — cloud height indicator […]
40) *H* — cloud height […]
41) *CM* — middle cloud type […]
42) *CH* — high cloud type […]

Background: Configurations for *CL*, *H*, *CM*, and *CH* are as in IMMT-4, except for use of "A" (10 in base36) in place of "/" (LMR used 10 in place of "/"). Analyses of cloud types may be impacted by a 1 Jan. 1982 GTS code change: When *N*=0, the types *CM*, *CH*, and *CL* were reported as missing (i.e. the FM 13 $8NhC_LC_MC_H$ group was omitted), whereas previously these types may have been reported zero (see Hahn et al. 1992). However, to improve climatological data quality, starting 2 Nov. 1994 FM 13 was again modified so that all cloud observations at sea including no cloud observation shall be reported (see WMO 2009a, Reg. 12.2.7.1). [Note: For historical reasons (see background under *NH*, field 37), an

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inconsistency exists in IMMA in how solidus ("/") is translated for *N* and *NH* (i.e. to missing data) versus for *CL*, *H*, *CM*, and *CH* (i.e. to "A"). A related complication (i.e. in terms of preserving information about whether data were explicitly reported as "/" versus omitted from transmission) is that group Nddff in FM 13 is mandatory, whereas $8NhC_LC_MC_H$ can be omitted (Reg. 12.2.7.1).]

44) *WP* wave period […]

Background: Historically, the (wind) wave and swell codes have been subject to complex changes. Prior to 1949 both sets of fields were apparently reported descriptively in the SHIP code, and thus are expected to be missing (and the swell fields are expected to be missing prior to 1 July 1963, as discussed below). Codes 37-38 arise from earlier historical codes (see Met Office 1948). Starting in 1968, *WD* was no longer reported and *WP* was reported in seconds. [Note: *WP*=99, indicating a confused sea, is not presently defined in IMMA. Future work should seek to recover this information from original formats, and consider an expanded IMMA configuration.]

Discussion: The current configuration of *WP* in IMMA0 includes *WP*=99, so the above highlighted note may no longer fully apply (further investigation needed).

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103) *OP* observation platform

For International Maritime Meteorological (IMM) logbook data, *OP* shows the observation platform:

- 0 – unknown
- 1 – Selected ship
- 2 – Supplementary ship
- 3 – Auxiliary ship
- 4 – automated station/data buoy
- 5 – fixed sea station
- 6 – coastal station
- 7 – aircraft
- 8 – satellite
- 9 – others

For IMMT-4 this modified configuration is planned:

- 0 – unknown
- 1 – Selected ship
- 2 – Supplementary ship
- 3 – Auxiliary ship
- 4 – registered VOSClim ship
- 5 – fixed sea station (e.g. rig or platform)
- 6 – coastal station
- 7 – *[reserved]*
- 8 – *[reserved]*
- 9 – others/data buoy

Background: Because the modified IMMT-4 configuration (developed because of deficiencies in the existing configuration) is not backward compatible, IMMT version (see Supp. B, Table B1; not presently available as a regular field in IMMA) will be required to properly interpret the revised information, if stored in this same field.

Discussion: *IMMV* (IMMT version) has been added to IMMA1, thus raising the still unresolved question of whether some IMMT receipts should be reprocessed under the R3.0 Workplan to recover *OP* values deliberately made missing (not translated) to avoid making public *OP*=4 data with the old/new meaning impossible to determine.

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105) *IX* station/weather indicator […]

Background: Starting 1 Jan. 1982, the procedure for reporting present (*WW*) and past (*W1*, *W2*) weather in FM 13 was altered significantly by adding *IX*, which allowed the "7 group" ($7wwW_1W_2$ for manual stations, and usually $7w_aw_aWa_1Wa_2$ for automatic stations) to be omitted when there was no significant present or past weather to report (see Hahn et al. 1992). However, to improve climatological data quality, starting 2 Nov. 1994 FM 13 was again modified so that any present and past weather including phenomena without significance shall be reported (see WMO 2009a, Reg. 12.2.6.2). [Note: Refer to the LMR documentation for more information regarding use of *IX* with present and past weather data, and unforeseen complications attending its introduction in 1982 (e.g. *IX* was not included in IMMT until 1 March 1985). *IX*=4 was initially defined (WMO 1981) without the Code references (hence brackets above), and *IX*=7 was introduced at a later date. The *IX*=7 value was not included in LMR, thus future work should seek to recover this information for data that were translated to IMMA from LMR.]

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107) *SGN* significant cloud amount
108) *SGT* significant cloud type
109) *SGH* significant cloud height […]

Background: These significant cloud fields are listed in Met Office (1948), but appear to have been omitted from regular IMM fields (see Table B3) and the current FM 13 code; in presently available ICOADS data they should always be missing [Note: Since these appear to be strictly historical fields, deletion from this attachment and possible repositioning within Table C5 is suggested for future consideration).]

Discussion: For IMMA1, these fields have been moved into the (proposed) *Hist* attm.

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110) *WMI* indicator for wave measurement […]

Background: [Note: Field not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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111) *SD2* swell direction (2nd)
112) *SP2* swell period (2nd)
113) *SH2* swell height (2nd) […]

Background: [Note: Fields not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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117) *IC1* concentration of sea ice
118) *IC2* stage of development
119) *IC3* ice of land origin
120) *IC4* true bearing ice edge
121) *IC5* ice situation/trend […]

Background: Separate fields (or an Code indicator) could be considered in the future. Earlier historical ice codes might also need to be researched for possible consideration. Met Office (1948) lists an Ice Group (c_2KD_ire) that may be similar or identical to the above pre-1982 code (see also Table B3 of Supp. B). [Note: Fields not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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122) *IR* indicator for precipitation data
123) *RRR* amount of precipitation

124) *TR* duration of period of reference for amount of precipitation […]

Background: [Note: Fields not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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125) *QCI* quality control (QC) indicator […]

Background: Prior to IMMT-4, values 7-8 were instead termed "not used." [Note: Field not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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126) *QI1* QC indicator for height of clouds […]

145) *QI20* QC indicator for ship's position […]

Background: [Note: Fields not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR, plus additional QC indicators available in IMMT-3/-4.]

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146) *QI21* MQCS version […]

Background: [Note: Field not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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147) *HDG* ship's heading […]

148) *COG* course over ground […]

149) *SOG* speed over ground […]

150) *SLL* max.ht.>Sum. load ln. […]

151) *SLHH* departure of Summer max. load line from actual sea level […]

152) *RWD* relative wind direction […]

153) *RWS* relative wind speed […]

Background: Fields added to IMMT-2 for VOSClim. [Note: Fields 147-153 were not included in the LMR regular section, thus future work should seek to recover this information for data that were translated into IMMA from LMR.]

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158) *BMP* background (bckd.) *SLP*

159) *BSWU* bckd. wind U-component

160) *SWU* derived wind U-component

161) *BSWV* bckd. wind V-component

162) *SWV* derived wind V-component

163) *BSAT* bckd. air temperature

164) *BSRH* bckd. relative humidity

165) *SRH* (derived) relative humidity

166) *SIX* derived stn./wea. indic. ~~(unused)~~

167) *BSST* bckd. *SST*

168) *MST* model surface type

169) *MSH* model height of surface

170) *BY* bckd. year

171) *BM* bckd. month

172) *BD* bckd. day

173) *BH* bckd. hour

174) *BFL* bckd. forecast length (do not use; erroneous in R2.5 data)

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Deleted: [Additional information: This 'do not use; erroneous in R2.5 data' label will need to be removed prior to R2.6.0 as all data will be reprocessed and erroneous '99' values removed.]

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Model quality control feedback information.

Background: Upon receipt of each GTS report from a VOSClim ship, the VOSClim Real Time Monitoring Centre (RTMC; at the UK Met Office) appends co-located parameters (and related information) from the Met Office forecast model for six variables—*SLP*, wind U- and V-component, air temperature, relative humidity, and *SST*—to a selection (translated into BUFR) of the originally reported GTS data. These augmented ship reports are made available in BUFR format to the VOSClim Data Assembly Center (DAC; at NOAA/NCDC), which converts them into IMMA format, including this attachment. Presently *SIX* is unused (should always be missing) because it is not among the fields in the input UK BUFR format. [Note: In R2.5 data, *BFL* was recently discovered to be subject to a conversion error and should not be used. Additionally, the original BUFR field that provides *BFL* is in minutes, thus future consideration should be given to the possibility, if appropriate, of changing the representation of *BFL* to an improved form.]

Discussion: The problem with *BFL* (bckd. forecast length) arose because NCDC was incorrectly translating "-9999999.0" values into "99". In IMMA1, the units of *BFL* have been changed to hours, and the impacted data receipts will be reprocessed for R3.0. Also in IMMA1, the unused field *SIX* (derived stn./wea. indic.) was removed. Beginning in June 2011, the RTMC extended the model feedback information provided to the DAC to the full VOS fleet, plus moored and drifting buoys. The DAC continues to parse the VOSClim fleet from the larger VOS set and makes these observations available (http://www.ncdc.noaa.gov/oa/climate/vosclim/vosclimdata.html). Similarly, a backlog of the VOS and buoy observations extends back to 2000 and plans are in place to receive and process those files.

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Moved up [30]: [Note: In R2.5 data, *BFL* was recently discovered to be subject to a conversion error and should not be used. Additionally, the original BUFR field that provides *BFL* is in minutes, thus future consideration should be given to the possibility, if appropriate, of changing the representation of *BFL* to an improved form.]

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Deleted: [Additional information: NCDC was not reading the -9999999.0 values correctly and this field was populated as '99'. This wasn't due to the transmissions.]

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Annex D: QC Flag Discussion: Oceanographic and Marine Meteorological Quality Control Schemes; Adoption in IMMA of a Common Value-Added QC (*VQC*) Flag

Background: We surveyed a variety of existing quality control (QC) flag (QF) schemes utilized in oceanographic and marine meteorological datasets, as summarized in this Annex, to decide on an implementation for the value-added QC (*VQC*) flag in the *Ivad* attm (Table C96). For this purpose, we settled on a "primary level" QF scheme recently adopted through the IODE-JCOMM Ocean Data Standards (ODS) process (IOC 2013).

Existing Oceanographic and Marine Meteorological QC Flag Schemes: DMPA (2008) reviewed two QF schemes currently used within ICOADS processing: (i) NOAA National Climatic Data Center (NCDC) QC (NCDC-QC) and (ii) "trimming." DMPA (2008) also reviewed three QF schemes external to ICOADS processing: (iii) the JCOMM Minimum Quality Control Standard (MQCS-6) (Table D1), (iv) Shipboard Automated Meteorological and Oceanographic System (SAMOS), and (v) Global Ocean Surface Underway Data (GOSUD).

Table D1. Minimum Quality Control Standard (current version: MQCS-7[1]) configuration for flags Q_1-Q_{29} as stored in the International Maritime Meteorological Tape (current version IMMT-5[2]) format (and also stored, when available, in fields *Q1-Q29* in the *Immt* attm, see Table C5).

Flag	*Data quality indicators*
0	No QC has been performed on this element
1	QC has been performed; element appears to be correct
2	QC has been performed; element appears to be inconsistent with other elements
3	QC has been performed; element appears to be doubtful
4	QC has been performed; element appears to be erroneous
5	The value has been changed as a result of QC
6	The flag as received by the GCCs was set to "1" (correct), but the element was judged by their MQCS as either inconsistent, dubious, erroneous, or missing
7	The flag as received by the GCCs was set to "5" (amended) but the element was judged by their MQCS as inconsistent, dubious, erroneous, or missing
8	Reserved
9	The value of the element is missing

1. Ref. https://www.wmo.int/pages/prog/amp/mmop/documents/MQCS-7-JCOMM-4.pdf
2. Ref.: https://www.wmo.int/pages/prog/amp/mmop/documents/IMMT-5-JCOMM-4.pdf. MQCS flag values 6-7 are specialized to Global Collection Centre (GCC) functions. The remaining flag value meanings are nearly identical to those defined in IOC (2010) for the Global Temperature-Salinity Profile Programme (GTSPP) (wherein 6-7 are reserved), except value 2 means: "The element appears to be probably good."

The following QF schemes managed by other data management organizations and programs were also reviewed in developing this Annex: (a) OceanSITES (2010); (b) NOAA National Data Buoy Center (NDBC) buoy and C-MAN (NDBC 2009); (c) SeaDataNet (2010); (d) Global Temperature-Salinity Profile Programme (IOC 2010); and (e) Integrated Science Data Management (ISDM) Drifting Buoys (ref. *TBD*).

Other published work comparing various existing QC procedures and QF schemes includes Cummings (2010) and IODE (2010). In addition, the Ocean Data View (ODV) group compared 16 widely used oceanographic flagging schemes as well as the

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mappings between them as implemented in their software (ODV 2011).[4] We agree with these conclusions from Reiner Schlitzer[5] about the current situation:

- Too many QC schemes currently exist
- Ranging from simple to very detailed
- Many schemes have flags that describe data history rather than data quality
- Mapping between schemes is sometimes difficult.

Following the First IODE Workshop on Quality Control of Chemical Oceanographic Data Collections (IODE 2010), a proposal (Konovalov et al. 2011) was submitted to ODS, and subsequently adopted as a formal international recommendation (IOC 2013). The recommendation outlines a two-level QF scheme including these characteristics:

- The first or primary level defines five quality codes (Table C96a). From IOC (2013): 'The primary level flags are such that increasing flag values indicate decreasing data quality. This is an important property that facilitates data quality filtering and/or processing, including inheritance of quality flag values for derived variables. The quality of a calculated value inherits the lowest quality qualifier of the variables used in the calculation. For example, when we calculate density from temperature (T) and salinity (S), then if T is of "good" quality and S is of "unknown" quality, then density should inherit the "unknown quality".'
- Flags at the secondary level complement the primary level flags by reporting the results of specific QC tests performed and data processing history. Further information from IOC (2013): 'The secondary level content varies in number and description and is chosen by those who implement the scheme, representing information on the applied quality tests (e.g., excessive spike check, regional data range check) and data processing history (e.g., interpolated values, corrected values).'

IOC (2013) lists these advantages for adopting the primary level scheme:

- Small and fixed number of unambiguous flags at the primary level that can be justified by the details in the second level;
- Primary level flag values are numeric and ordered such that increasing quality flag values indicate a decreasing level of quality. This supports the identification of all data that meet a minimum quality level and assignment of quality flags to calculated parameters;
- The scheme is universal; it can be applied to all types of data enabling exchange and integration of multi-disciplinary data;
- Existing QF schemes can be mapped to the proposed scheme with no information loss. This is specifically true when information on the applied tests is delivered by data providers;
- Data sets with different QF schemes can be merged into one data set, preserving all existing QFs and making it possible to apply new quality tests and add the results.

[4] ODV (2011) compared QC flag schemes (and mappings between them as implemented in ODV software) for: ODV, GTSPP, ARGO, SEADATANET, ESEAS, WOD, WODSTATION, WOCEBOTTLE, WOCECTD, WOCESAMPLE, Qartod, BODC, PANGAEA, SMHI and OceanSITES.

[5] From presentation available at: http://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxnZWJpY2h3aWtpfGd4OjdhMDljMGI5NjdlMjUwNDI&pli=1

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Planned value-added QC flag (*VQC*) implementation for IVAD: *VQC* (Table C96a) within the *Ivad* attm (Table C96) is intended to store externally provided data QC information. Specifically, the information provider is requested to map their flags to *VQC* (e.g. Table D2), and then describe methods in external documentation as linked via *ARC*. (In addition, we note that the IMMA format more generally can help satisfy an ODS goal of minimizing information loss during QF mapping, through the preservation of original input supplementary data, including original QFs.)

Table D2. Trimming flag values (left) and possible mappings to *VQC* (right). Some mapping decisions, such as where to draw the boundaries between Good, Questionable, and Bad data, are subjective.

Trimming flag values	*Proposed mapping to VQC (Table C96a)*
(missing trimming flag)	(*VQC* is missing; blank in IMMA format)
1: within 2.8σ limits	1: Good – passed documented required QC tests
2: <2.8σ sigma lower limit […][1]	"
3: >2.8σ upper limit […][1]	"
4: <3.5σ lower limit […][1]	3: Questionable/suspect – failed non-critical documented metric or subjective test(s)
5: >3.5σ upper limit […][1]	"
6: <4.5σ lower limit	4: Bad – fairly critical documented QC test(s) or as assigned by the data producer
7: >4.5σ upper limit	"
(8-10 unused)	(N/A)
11: limits missing (ocean/coastal box) […][2]	(N/A; flag relates to independent QC process results)
12: limits missing (ocean/coastal box)	2: No evaluated, not available or unknown – used for data when no QC test performed or the information on quality is not available
13: landlocked 2-degree box	(N/A; there is no landlocked flag in Table C96a)
14: data unusable (*SF*, *AF*, and *PF*, only)	4: Bad – fairly critical documented QC test(s) or as assigned by the data producer
15: data missing or not computable	9: Missing data – used as a placeholder when data are missing

1. More precisely, "<2.8σ sigma lower limit" means: $g - 3.5{*}s_1 \le a_1 < g - 2.8{*}s_1$, where a_1 is the individual observation under scrutiny, g is the smoothed median, and s_1 and s_5 are the smoothed lower and upper median deviation (similarly for the other trimming flag values footnoted).
2. Special value for buoy data QC'd by Integrated Science Data Management (ISDM), such that ISDM flagged the data as correct (for *SST* and *SLP* only).

Since the goals and general advantages as described above for the primary level (IOC 2013) QF scheme seem appropriate, we decided to use that internationally recognized configuration for *VQC*, also in hopes of improved future interoperability with other marine-meteorological and oceanographic datasets. A reorganized and expanded version of the IOC (2013) primary level scheme was also discussed as an alternative approach to configuring *VQC* possibly more appropriate for some ICOADS requirements, but abandoned because it is not internationally standardized (Table D3).

Table D3. Possible reorganization and expansion of the primary level ODS scheme (IOC 2013) being adopted for *VQC* (Table C96a).

Code	*Primary level flag's short name*	*Definition*
1	Good	passed documented required QC tests
2	Questionable/suspect	failed non-critical documented metric or subjective test(s)

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3	Bad	failed critical documented QC test(s) or as assigned by the data producer
4	Unphysical value	*(note: not part of ODS proposal)*
7	Landlocked[1]	*(note: not part of ODS proposal)*
8	Not evaluated, not available or unknown	used for data when no QC test performed or the information on quality is not available *(note: positioned instead between good and questionable/suspect in ODS proposal)*
9	Missing data	used as placeholder when data are missing

1. One possible argument against such a flag value, which might be raised e.g. by proposers to ODS, is that setting this flag then precludes performing other standard QC tests on the data value and then assigning a value 1-4. As one related consideration in the early historical data context, reported ship positions could be far less accurate than modern navigation allows, thus near-coastal reports might be recorded in logbooks at positions that are over land according to modern standards—but the data might be usable if repositioned.

References

Cummings, J., G. Brassington, R. Keeley, M. Martin, and T. Carval, 2010: GODAE Ocean Data Quality Control Intercomparison Project. In *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society* (Annex), Venice, Italy, 21-25 September 2009, Hall, J., D.E. Harrison, & D. Stammer, Eds., ESA Publication WPP-306 (doi:10.5270/OceanObs09) [http://www.oceanobs09.net/proceedings/ac/FCXNL-09A02-1656379-1-AC_4C_cummings.pdf].

DMPA, 2008: Common Issues of Quality Control of Surface Marine Data (Draft, 7 March 2008; Chairs: ETMC, DMCG, SAMOS, GOSUD, et al.). Doc 5.3 rev1 for *DMCG-III, Ostend, Belgium, 26-28 March 2008* [http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=1838].

IOC, 2010: GTSPP Real-Time Quality Control Manual, First Revised Edition. IOC Manuals and Guides No. 22 (IOC/2010/MG/22Rev.) [http://www.iode.org/index.php?option=com_oe&task=viewDocumentRecord&docID=6437].

IOC, 2013: Ocean Data Standards, Vol. 3: Recommendation for a Quality Flag Scheme for the Exchange of Oceanographic and Marine Meteorological Data. IOC Manuals and Guides 54, Vol. 3., 12 pp. (English.)(IOC/2013/MG/54-3). [http://www.iode.org/index.php?option=com_oe&task=viewDocumentRecord&docID=10762].

IODE, 2010: First IODE Workshop on Quality Control of Chemical Oceanographic Data Collections. Workshop Report No. 228. *5th Session of the IODE Group of Experts on Biological and Chemical Data Management and Exchange Practices, Oostende, Belgium, 8-11 February 2010* [http://www.iode.org/index.php?option=com_oe&task=viewDocumentRecord&docID=5109].

ISDM (Reference *To Be Determined*).

Johnson, D.R., T.P. Boyer, H.E. Garcia, R.A. Locarnini, O.K. Baranova, and M.M. Zweng, 2009: *World Ocean Database 2009 Documentation*. S. Levitus, Ed. NODC Internal Report 20, NOAA Printing Office, Silver Spring, MD, 175 pp. [http://www.nodc.noaa.gov/OC5/WOD09/pr_wod09.html].

Konovalov, S., H. Garcia, R. Schlitzer, L. Devine, C. Chandler, G. Moncoiffé, T. Suzuki, A. Kozyr, 2011: Proposal to adopt a quality flag scheme standard for oceanographic and marine meteorological data exchange, Version 1.1. Submitted 11 February 2011, currently under Community Review [available from http://www.oceandatastandards.org/index.php?option=com_content&task=view&id=46&Itemid=0].

NDBC, 2009: Handbook of Automated Data Quality Control Checks and Procedures, NDBC Technical Document 09-02 [http://www.ndbc.noaa.gov/NDBCHandbookofAutomatedDataQualityControl2009.pdf].

OceanSITES, 2010: OceanSITES User's Manual – NetCDF Conventions and Reference Tables, Version 1.2 [http://www.whoi.edu/virtual/oceansites/docs/oceansites_user_manual_version1.2.pdf].

ODV, 2011: Ocean Data View – Oceanographic quality flag schemes and mappings between them, Version 1.4 [http://odv.awi.de/fileadmin/user_upload/odv/misc/ODV4_QualityFlagSets.pdf].

SeaDataNet, 2010: SeaDataNet Data Quality Control Procedures (Version 2.0, May 2010) [http://www.seadatanet.org/content/download/18414/119624/file/SeaDataNet_QC_procedures_V2_(May_2010).pdf]

WMO, 2011: *Manual on Codes*, International Codes, Vol. I.2. WMO-No. 306 [http://www.wmo.int/pages/prog/www/WMOCodes/VolumeI2.html - VolumeI2].

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Annex E: Edited Cloud Report (*Ecr*) attm

Background: Based on information from Carole Hahn ("cjh draft 080717+ Patterned after ICOADS IMMA0 documentation"). Additional background information is available but not included here. Among the modifications and updates: variable names have been changed to be unique, the missing data representation was changed to be consistent with IMMA; Table C9c was reformatted, and Tables C9d and C9e are new (for convenient reference).

Table C9. *Ecr* attm ("Edited Cloud Report" as outlined originally in {H99}). Cloud variables *Ne*, *NHe*, *He*, *CLe*, *CMe*, and *CHe* correspond (i.e. abbreviations without trailing "e") to variables in the IMMA *Core*, but may be "edited" as described in this documentation.

No.	Len	Abbr.	Element description*	Min.	Max.	Units (Code) [base36]
1	2	*ATTI*	attm ID			Note: set *ATTI*=10
2	2	*ATTL*	attm length			Note: set *ATTL*=32

EECR Basic Cloud Elements (15 characters):

No.	Len	Abbr.	Element description	Min.	Max.	Units (Code)
3	1	*CCe*	change code	0	13	[b36]
4	2	*WWe*	present weather	0	99	(*WW*)
5	1	*Ne*	total cloud amount	0	8	(*N*; *N*=9 edited)
6	1	*NHe*	lower cloud amount	0	8	(*NH*; *NH*=9 edited)
7	1	He	lower cloud base height	0	9	(*H*)
8	2	*CLe*	low cloud type	0	11	(*CL* edited)
9	2	*CMe*	middle cloud type	0	12	(*CM* edited)
10	1	*CHe*	high cloud type	0	9	(*CH* edited)

EECR Derived Cloud Elements (8 characters):

No.	Len	Abbr.	Element description	Min.	Max.	Units (Code)
11	3	*AM*	middle cloud amount	0	8.00	0.01 oktas
12	3	*AH*	high cloud amount	0	8.00	0.01 oktas
13	1	*UM*	NOL middle amount	0	8	oktas
14	1	*UH*	NOL high amount	0	8	oktas

EECR Sky Brightness Elements (9 characters):

No.	Len	Abbr.	Element description	Min.	Max.	Units (Code)
15	1	*SBI*	sky-brightness indicator	0	1	
16	4	*SA*	solar altitude	-90.0	90.0	0.1 degrees
17	4	*RI*	relative lunar illuminance	-1.10	1.17	hundredths

* Brief description of ECR variables (see {H99} or {H95} for details):

WWe, *Ne*, *NHe*, *He*, *CLe*, *CMe*, *CHe*: These weather and cloud variables are coded as specified by WMO except that *CLe* and *CMe* have been "extended" as indicated in Table C9a. Also, cases of *N*=9 with fog or precipitation have been converted to *N*=8. Any such conversion is recorded in the change code (*CCe*). NOTE: An ECR attachment is provided only if *N* is given in the original report.

CCe: This change code indicates whether the original report was changed (edited) during processing. Code values are defined in Table C9b (and previously in sec. 3.3 of {H99}).

AM, *AH*: These variables give the "actual" cloud amounts of middle and high clouds, derived from *N* and *NH* with use of the random overlap equation if necessary (see sec. 3.5 of {H99}).

UM, *UH*: These variables, derived from *N* and *NH*, give the "non-overlapped" (NOL) amounts of middle and high clouds; i.e. the amounts visible from below (see sec. 3.5 of {H99}).

SBI: The sky-brightness indicator has a value of "1" (light) if the illuminance criterion described in {H95} was satisfied at the time and place of the report, suggesting that there was adequate light for visual observation of cloud cover and cloud types (if not, then *SBI*=0; dark). This variable can be used in lieu of *SA* and *RI* if one accepts the criterion recommended in {H95}.

SA, *RI*: These variables give the solar and lunar parameters needed to determine the illuminance provided by the sun or moon for the date, time and location of the report (see sec. 3.6 of {H99}). *SA* is the altitude of the sun above the horizon. *RI* is the relative lunar illuminance, defined in {H95}, which depends on the lunar altitude and phase, and the earth-moon distance. The illuminance criterion of Hahn et al. (H95) is satisfied (*SBI*=1) when *SA*≥-9° or *RI*>0.11. A negative value of RI means the moon was below the horizon.

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Table C9a. Cloud and Weather Type Definitions Used in ECRs (modified from Table 2 of {H99}). Note that "/" has been coded in IMMA format as "A", interpreted as "10".

Level	Shorthand notation	Meaning	Synoptic codes	Extended ECR codes#
	TC	total cloud cover	N = 0-9	0-8
	Cr	completely clear sky	N = 0	
	Ppt	precipitation	WW= 50-75,77,79,80-99	
	D	drizzle	50-59	
	R	rain	60-69	
	S	snow	70-75,77,79	
	Ts	thunderstorm or shower	80-99	
Low			CL=	
	Fo	sky obscured by fog	/ with N=9 and ww=10-12,40-49	11
	St	stratus	6,7	
	Sc	stratocumulus	4,5,8	
	Cu	cumulus	1,2	
	Cb	cumulonimbus	3,9, or N=9 with ww=Ts	10
Mid			CM=	
	Ns	nimbostratus	2,7, or N=9 with ww=DRS	12,11,10
			/ with ww=DRS and CL=0,7	10
			/ with ww= RS and CL=4-8	10
	As	altostratus	1; 2 if not DRS	
	Ac	altocumulus	3,4,5,6,8,9; 7 if not DRS	
High			CH=	
	Hi	cirriform clouds	1-9	

Used in the EECRA dataset (H99). Extended codes are shown where they differ from synoptic codes. In the processing for the extended code both "/" ("A" in IMMA) and missing (blank in IMMA) are treated in the same way.

Table C9b. Change codes (*CCe*) and their associated descriptions, cases categorizations, and field changes made (from Table 3 of {H99}). The CCe ordering in this table (0-13) also reflects the order in which changes to the cloud fields must be made during processing.

CCe[1]	*Description*	*Case*	*Changes made*
0	No changes required		None
1	Cause of *N*=9 determined from *WW* Set *Ne*=8, *NHe*=8, and *He*=0 If *CL* missing, then set *CLe*=0 If foggy, then set *CLe*=11 If showers, then set *CLe*=10 If drizzle/rain/snow, then set *CMe*=10	*N*=9 with precipitation or fog	*Ne*=8 *NHe*=8 *He*=0 *CLe*=10,11 or *CMe*=10
2	*NH* is amount of sky covered by medium cloud if no low cloud is present. If *NH*=0 with *CM* present and *CL*=0; then if *CH* present, set *NHe* missing else, set *NHe*=N	*NH*=0 with *CM*>0 and *CL*=0 and *CH*≤0 *NH*=0 with *CM*>0 and *CL*=0 and *CH*>0	*NHe*=N *NHe*=missing

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3	If *NH*=*N* or missing and only high cloud present, set *NHe*=0	*NH*=*N* with *CH*>0 and *CL*=*CM*=0	*NHe*=0
4	If *NH*<*N* and only low cloud is present, then set *NHe*=missing	*NH*<*N* where it should be *NH*=*N*	*NHe*=missing
	If *NH*<*N* and only mid cloud is present, then set *NHe*=missing	*NH*<*N* where it should be *NH*=*N*	*NHe*=missing
	If *NH*≠*N* and only high cloud present, set *NHe*=missing	*NH*≠*N* with *CH*>0 and *CL*=*CM*=0	*NHe*=missing
5	If low cloud information (*NH* or *CL*) is missing and *CM* or *CH* present, then set *CMe*=*CHe*=missing	*CL*="/" with *CM* or *CH* not "/"	*CMe*,*CHe*=missing
6	If (*N*=*NH*=8 or *N*=*NH*=7) and *CM*=0, then set *CMe*=missing	*CM* or *CH* miscoded as 0	*CMe* or *CHe*=missing
	If (*N*=*NH*=8 or *N*=*NH*=7) and *CH*=0, then set *CHe*=missing		
7	If *CM*=7 when drizzle/rain/snow, then set *CMe*=11	*CM*=7 or 2 identified as *Ns*	*CMe*=11 or 12
	If *CM*=2 when drizzle/rain/snow, then set *CMe*=12		
8	If drizzle/rain/snow and *CM* is missing and *CL* is present; and *CL*≠1,2,3 or 9; then if either *WW*≥60 or *CL*=7 or *CL*=0; set *CMe*=10	*CM*="/" for *Ns*	*CMe*=10
9	If *CM* is missing and both *CL* and *CH* present, then set *CMe*=0	*CM* or *CH* miscoded as "/"	*CMe* or *CHe*=0
	If *N*≤4, *N*=*NH*, *CL* is present, *CM*=missing, and *CCe*=0, then *CMe*=0		
	If *N*≤4, *N*=*NH*, *CL* is present, *CH*=missing, and *CCe*=0, then set *CHe*=0		
10	*N*=9 not explainable by *WW*		all parameters set missing
11	*NH*>*N*		all parameters set missing
12	*N*=0 accompanied by precipitation		all parameters set missing
13	N>0 and *CL*=*CM*=*CH*=0		all parameters set missing

1 Also order in which changes are made, but *CCe*=9 is recorded only if no previous change occurred (this conflict can occur only with CCe=7 or 8).

Table C9c. Low cloud type (*CLe*) coding information.

Code	WMO (or EECR) Code	Description

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0	Code 0513	no stratocumulus, stratus, cumulus or cumulonimbus
1	Code 0513	cumulus with little vertical extent and seemingly flattened, or ragged cumulus, other than of bad weather, or both
2	Code 0513	cumulus of moderate or strong vertical extent, generally with protuberances in the form of domes or towers, either accompanied or not by other cumulus or stratocumulus, all having bases at the same level
3	Code 0513	cumulonimbus, the summits of which, at least partially, lack sharp outlines but are neither clearly fibrous (cirriform) nor in the form of an anvil; cumulus, stratocumulus or stratus may also be present
4	Code 0513	stratocumulus formed by the spreading out of cumulus; cumulus may also be present
5	Code 0513	stratocumulus not resulting from the spreading out of cumulus
6	Code 0513	stratus in a more or less continuous later, or in ragged shreds, or both but no stratus fractus of bad weather
7	Code 0513	stratus fractus of bad weather or cumulus fractus of bad weather, or both (pannus), usually below altostratus or nimbostratus
8	Code 0513	cumulus and stratocumulus other than that formed from the spreading out of cumulus; the base of the cumulus is at a different level from that of the stratocumulus
9	Code 0513	cumulonimbus, the upper part of which is clearly fibrous (cirriform) often in the form of an anvil; either accompanied or not by cumulonimbus without anvil or fibrous upper part, by cumulus, stratocumulus, stratus or pannus
10	(EECR code)	cumulonimbus, identified from sky obscured (*N*=9) accompanied by showery precipitation or thunderstorm (WW≥80)
11	(EECR code)	fog, identified from sky obscured (*N*=9) accompanied by *WW* indicating fog (*WW*=10-12 or 40-49)

Table C9d. Medium cloud type (CMe) coding information.

Code	*WMO (or EECR) Code*	*Description*
0	Code 0515	no altocumulus, altostratus or nimbostratus
1	Code 0515	altostratus, the greater part of which is semi-transparent; through this part the sun or moon may be weakly visible, as through ground glass
2	(EECR code)	altostratus, the greater part of which is sufficiently dense to hide the sun or moon
3	Code 0515	altocumulus, the greater part of which is semi-transparent; the various elements of the cloud change only slowly and are all at a single level
4	Code 0515	patches (often in the form of almonds or fish) of altocumulus, the greater part of which is semi-transparent; the clouds occur at one or more levels and the elements are continually changing in appearance
5	Code 0515	semi-transparent altocumulus in bands, or altocumulus, in one or more continuous layer (semi-transparent or opaque), progressively invading the sky; these generally thicken as a whole
6	Code 0515	altocumulus resulting from the spreading out of cumulus or cumulonimbus
7	(EECR code)	altocumulus in two or more layers, usually opaque in places, and not progressively invading the sky; or opaque layer of altocumulus,not progressively invading the sky; or altocumulus together with altostratus
8	Code 0515	altocumulus with sproutings in the form of small towers or battlements, or altocumulus having the appearance of cumuliform tufts
9	Code 0515	altocumulus of a chaotic sky, generally at several levels
10	(EECR code)	nimbostratus, identified from sky obscured (*N*=9) accompanied by

		drizzle, or non-showery precipitation
11	(EECR code)	nimbostratus, identified from *CM*=7 accompanied by *WW* indicating rain
12	(EECR code)	nimbostratus, identified from *CM*=2 accompanied by *WW* indicating rain

References

{H99} 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. (Also available from Data Support Section, National Center for Atmospheric Research, Boulder, CO.)

{H95} 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.

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Annex F: Author Reference Code (*ARCI*) Registration and Storage

Discussions have begun about how to register and store the 4-character Author Reference Code (*ARCI*) field stored in the *Ivad* attm (see Table C96), as well as similar *ARC* fields in other attms[8], together with accompanying IVAD author-provided documentation and possible Subsidiary data/metadata files. At this stage we envision as the basic requirement that each provider of an *Ivad* attm would submit a pdf document describing how the attm was created (with adjustment methods), which can link to published papers, etc.

At least initially, we envision allocating *ARCI* using a fairly simple mechanism similar to allocating deck (*DCK*) and source ID (*SID*) assignments, such that the values are controlled by a central authority (ICOADS). IVAD creators can then propose an *ARCI* value (e.g. BK13), which may be approved by ICOADS. All currently assigned *ARC* assignments will then be listed in an overview table tracked by NCAR (with later archive backup to NCDC) (see Fig. H1).

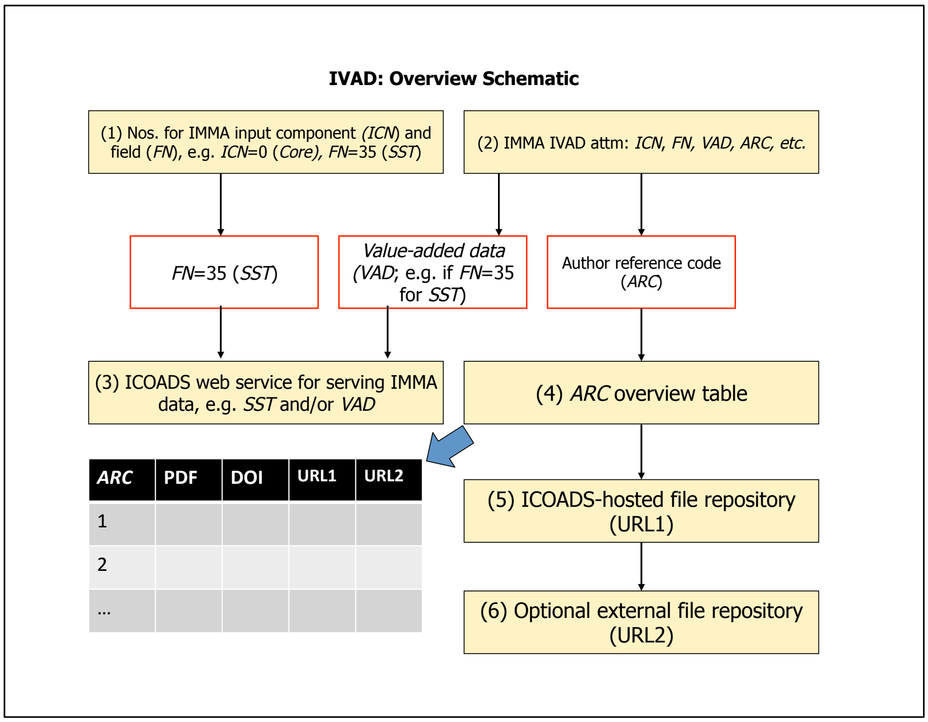

Fig. H1. Role of the Author Reference Code (*ARCI*) overview table in the IVAD system.

[8] I.e. *ARCE* in the *Error* attm (see Table C97), *ARCQ* in the proposed *Alt-qc* attm (Table CP3), and *ACRT* in the proposed *Track* attm (Table CP4).

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Annex G: Discussion of ICOADS Future IMMA/IVAD Archival Structure

Background: Future ICOADS Releases are planned to comprise different IMMA1 components as listed (together with their definitions and other characteristics) in Table G2, only some of which we anticipate would be ingested into the IVAD DBMS, with other components left separate (including Author Reference Code—*ARCI*—information, Table G1).

This raises questions about how the whole assemblage (or relevant portions) will be systematically archived at appropriate centers, including in the US both at NCDC and NCAR. Thus far the primary idea (as indicated in Table G2) has been to write out the contents of the DBMS hosted at NCAR into IMMA1 format, and then archive that.

However, to the extent information is excluded from the DBMS, those separate files then may also need to be archived. In terms of archiving timing, a brute force approach for example might be to archive the entire aggregate of files and information, whenever any "dynamic" element (see Table G2) changes.

Assignment of Digital Object Identifiers (DOIs): In keeping with recent positive standardization developments in this area, NCAR now has the capability to assign dataset DOIs (http://www.doi.org). For ICOADS, we envision that a given Release (e.g. R2.5.1) as offered publicly from NCAR would be assigned a DOI, also including the accompanying (dynamic) NRT preliminary component.

Thus possibly only the brown data components as indicated in Table G2 would be associated with the DOI (i.e. limited to those stored in the IVAD DBMS and also written out periodically from the DBMS to IMMA1 format). DOI assignment carries the responsibility of file-set reproducibility and accurate linkage to citation in publications. Opening access to new IVAD attachments has significant DOI implications, so we plan to handle this in a systematic way. If a DOI change is required, a new file-set will be created from the IVAD.

Table G1. Author Reference Code (*ARC*) table information, and its relevance to the Main, Subsidiary, and Auxiliary file types (as defined in Table G2). We anticipate that the *ARCI* information will be stored separately from the data, and will represent another "dynamic" element as described in Table G2.

Author Reference Code-*Ivad* (*ARCI*) Information		
Main	*Subsidiary*	*Auxiliary*
Relevant at least to the regular Release files (if not to the preliminary NRT data)	Relevant	Probably not relevant

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Table G2. Definitions and characteristics of Main, Subsidiary, and Auxiliary IMMA file types. Probably, only a portion (shown in brown) of the data would be made available via the IVAD DBMS, which then in turn would be written out periodically into IMMA1 format for archival.

Definitions (note: only the portion in tan is planned to be included in the IVAD DBMS)		
Main files	*Subsidiary* files	*Auxiliary* files
Stand-alone IMMA1 files (*Core* + 0 or more attms)	*Uida* + 1 or more attm(s): held separately prior to blending, but directly linked to the Main record via the *UID*.	Stand-alone IMMA1 files (*Core* + 0 or more attms): made available separately prior to blending (or possibly e.g. if offering higher-res. than deemed suitable for inclusion)
Main IMMA1 collections:	*Subsidiary* IMMA1 files (note: examples):	*Auxiliary* IMMA1 files (note: example candidates):
(a) R2.5.1$_i$ (intermediate)	*Ecr*	http://icoads.noaa.gov/maury_german.html
(b) R2.5.1 (final)	*Meta-vos*	http://icoads.noaa.gov/godar.html
(c) NCEP-NCDC NRT	*Track*	http://icoads.noaa.gov/deck117.html
	Ivad	etc.
(d) NCEP NRT (note: IMMA0 format only, to be phased out)	*Ivad-ancillary*, and other provider-defined information	
UID assignment considerations:		
Assigned; new *UIDs* required monthly for (c) (note: assuming (d) is phased out, and not upgraded to IMMA1 format)	Inherited from Main records from which derived	None assigned. Too complicated to assign *UIDs* to these sources before they are part of a formal Release, also problematic to have IVAD teams work on them outside of the regular ICOADS processing framework
Dynamic elements:		
Dynamic element: NRT files are updated monthly	Dynamic to the extent new files are added (or possibly existing files modified/upgraded)	Dynamic to the extent new collections are added (or possibly existing collections modified/upgraded)

1. An additional possibility not yet addressed in this document would be for some Subsidiary file types to not be blended into ICOADS, but only offered separately. This offering would be targeted to advanced users much like the provision of R2.5.1$_i$, i.e. not for the general user, but for those who are developing data improvement strategies and have software expertise in house. For example, what are listed in this table as *Ivad-ancillary* (and similar provider-defined information) might be more flexibly structured information such as the HOSTACE project has suggested offering alongside the uniformly structured *Ivad* atms (and for which the data providers might need to primarily support user access, e.g. through *Ivad-ancillary* read software).

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