

# The potential for improvements to ICOADS: lessons from ship tracking

Elizabeth Kent, David Berry, Giulia Carella



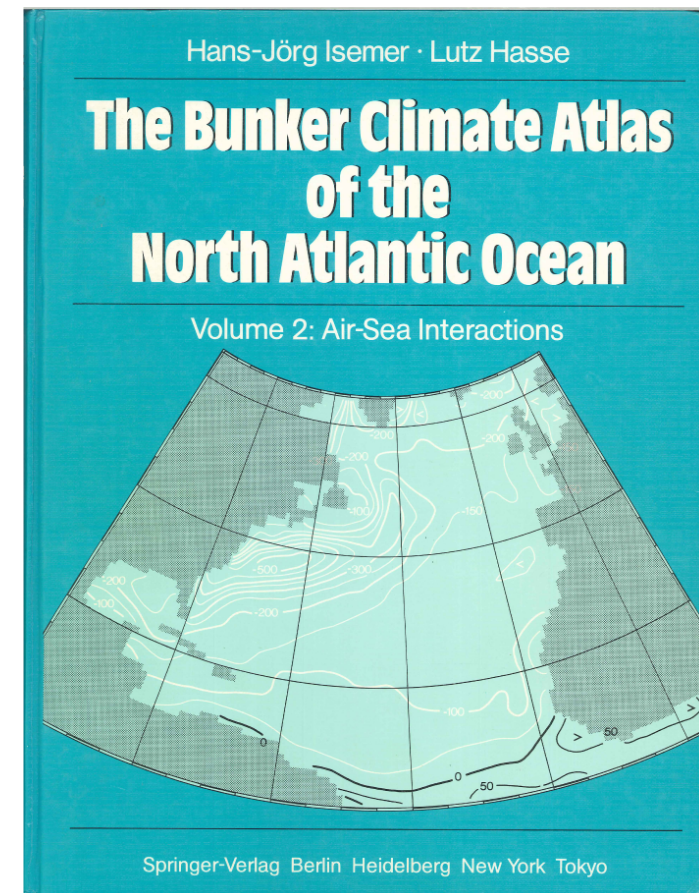
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# Marine climate data products from the 1980s & early 1990s

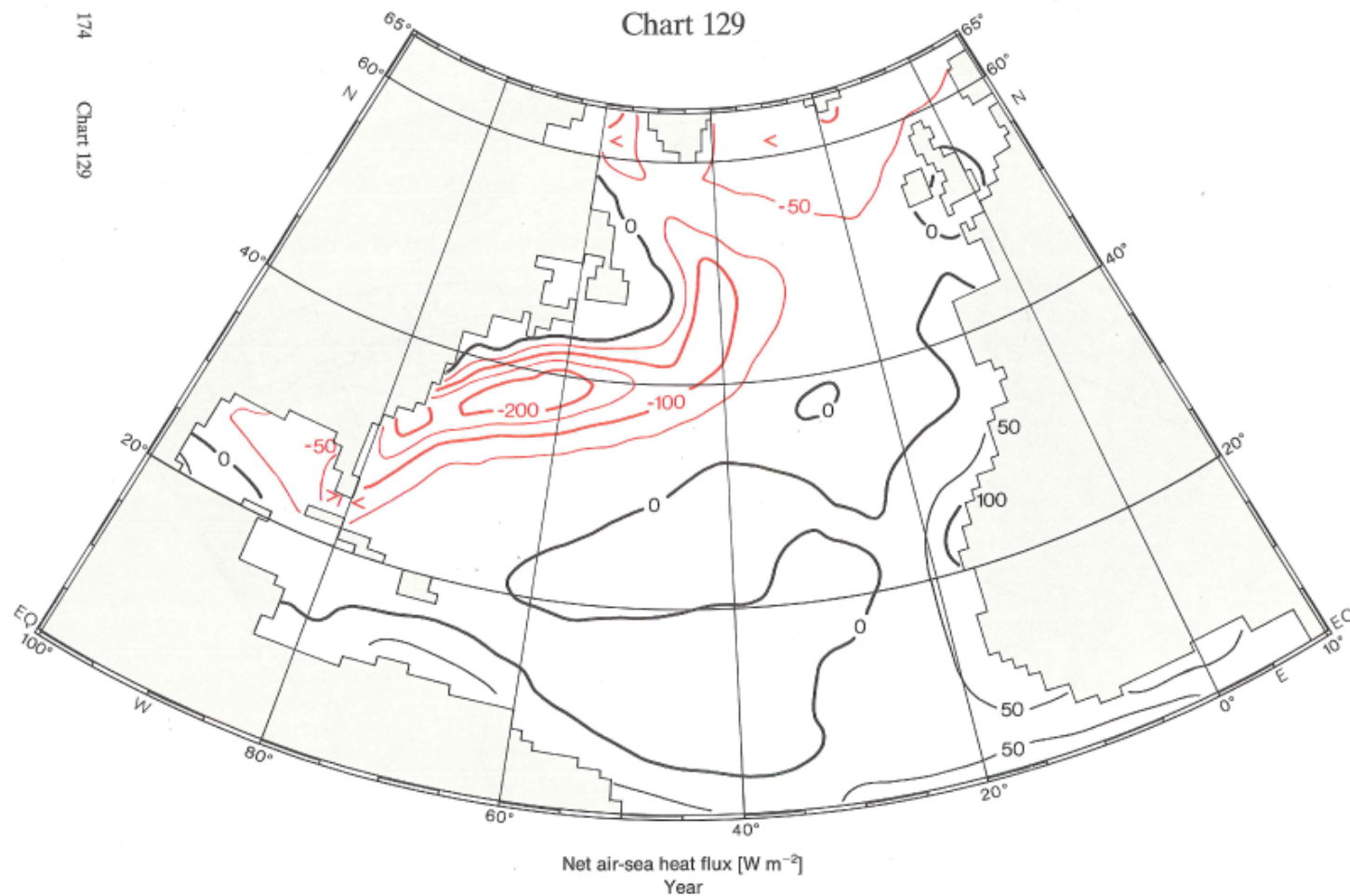
- Esbensen and Kushnir (1981) – **TDF-11**
- Isemer and Hasse (1987) – **TDF-11**
- Hsiung (1985) – **CDS - FNMOC**
- GOSTA (1990) – **UKMO MDB**
- Oberhuber (1988) – **COADS R1**



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# Air-sea fluxes: Isemer and Hasse (1987)



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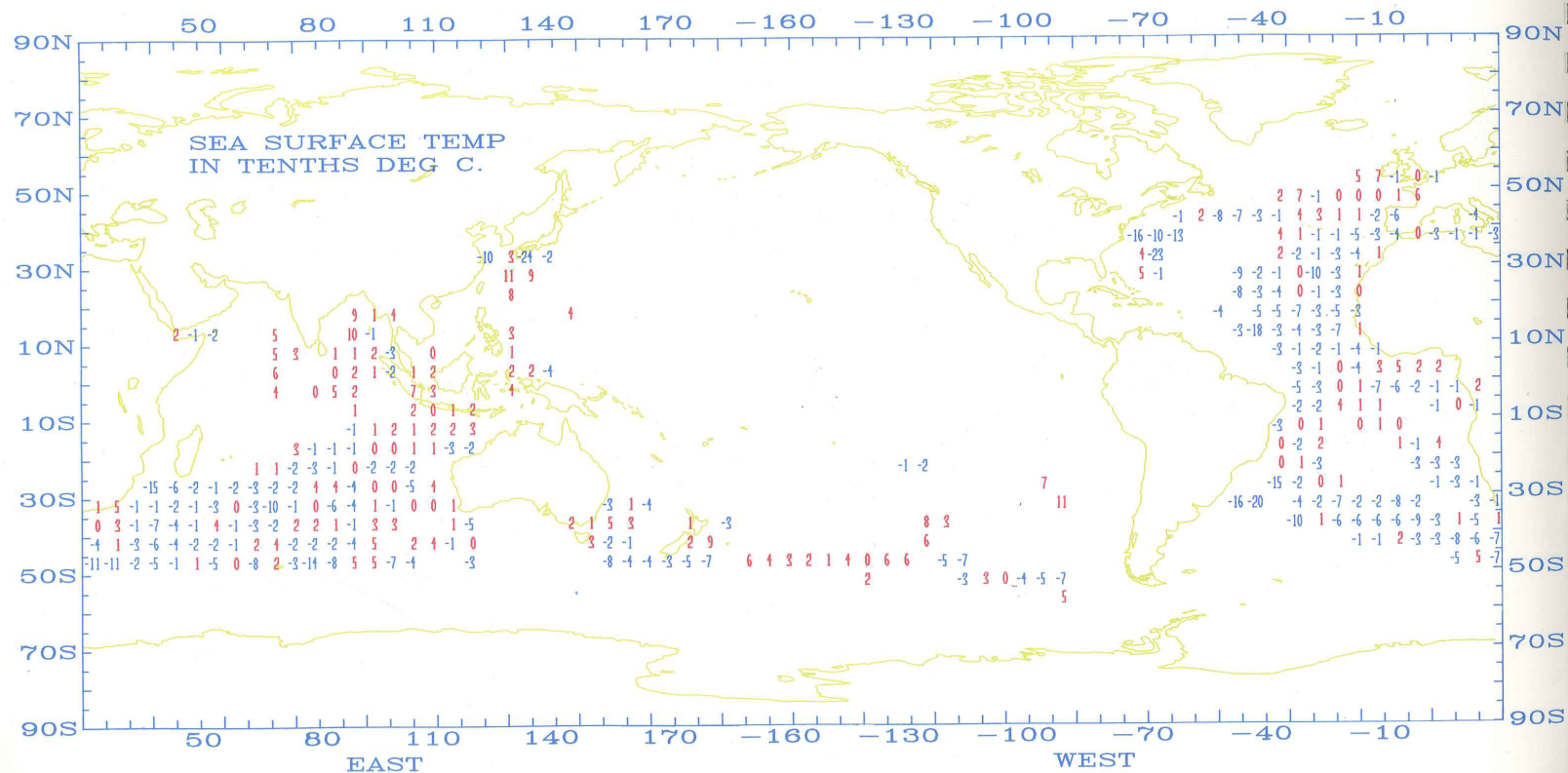
The Bunker Climate Atlas of the North Atlantic Ocean



# GOSTA Atlas SST and MAT (1990)

PLATE NUMBER 244

SEASONALLY AVERAGED SST ANOMALIES, JANUARY – MARCH FROM 1866 TO 1875



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[illegible]

## Punch card typists keying ship logbooks at KNMI in ~1950s



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Wallbrink and Koek (2010) Data Acquisition And Key punching Codes For Marine Met. Observations

# TDF-11 manual (1968)

TAPE DECK		PAGE NO.
TDF-11	SURFACE MARINE OBSERVATIONS	i
<p style="text-align: center;"><u>INTRODUCTION</u></p> <p><u>SOURCE</u></p> <p>Tape Data Family - 11 was derived from a variety of punched card decks. Observations were obtained from Ship Logs, Ship Weather Reporting Forms, published Ship Observations, Automatic Observing Bouys, Teletype Reports, and on cards purchased from several foreign Meteorological Services.</p> <p>The quality of instruments ranges from those found aboard a 19th century Whaling Ship to the most sophisticated electronic equipment used on today's Ocean Weather Ships. Observer qualifications vary from Deck Hand to trained Meteorologist.</p> <p>From this conglomeration, an effort was made to bring to the researcher of oceanic weather patterns and sea conditions, a common observational format, designed for use with modern electronic data processing equipment. The International Marine punched card (Deck 128), established in 1963, was used as the basic input format to Tape Data Family - 11. Some modifications were made so that previously recorded observations could become an integral part of this Family.</p> <p><u>QUALITY CONTROL AND CODE CONVERSIONS</u></p> <p>The starting point for programming was the individual card deck. No attempt was made to</p>		





# TDF-11: standard and supplemental data

## STANDARD FORMAT

CARD DECK	MAR SQ	SUB SQ	Q	LAT	LONG	YEAR	MO	DA	HR	WIND DIR	WIND SPD	VIS	WX	W	PRESS	T I	AIR TMP	WET BLB	DEW PT	SEA TMP	A-S DIF
xxx	xxx	xx	x	xxx	xxxx	xxxx	xx	xx	xx	ixx	ixxx	ixx	xx	x	xxxxxx	i	xxx	xxx	xxx	xxx	xxx
FIELD NUMBER	001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021

CLOUDS							WAVE	P	WAVE	SWL	P	SWL	OSV	C	S																			
N	N <sub>h</sub>	C <sub>L</sub>	I	h	C <sub>M</sub>	C <sub>H</sub>	DIR	E	HGT	DIR	E	HGT	NO.	D	H	P	A	I	ICE	A	C	A	D	S	a	ppp	A	SIG	SIG	SIG	I	SHIP		
x	x	x	i	x	x	x	xx	x	xx	xx	x	xx	xx	x	x		D	C	THK	C	C		D	I	P		D	N	T	HGT	C	NO.		
x	x	x	i	x	x	x	xx	x	xx	xx	x	xx	xx	x	x		l	x	xx	x	ΔΔ		6	x	x	x	xxx	8	x	x	xx	Δ Δ	x	xxxx
FIELD NUMBER	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048	049	050	051	052	053		

## SUPPLEMENTAL DATA FIELDS

WAVES	SHIP CLASS	S K	P C	P H	O B	I C	DIR CUR	SPD CUR	SPEC PHEN	22 BLANK CHARACTERS																			
xxxxxx	xxxxxxxx	x	x	x	x	x	xx	xx	xxxx																				
FIELD NUMBER	051	052	053	054	055	056	057	058	059	060	061	062	063	064	065	066	067	068	069	070	071	072	073	074	075	076	077	078	079



# TDF-11: some data not kept

In cases where it was felt that elements were acceptable for conversion without significant loss of resolution, the new values were placed in the common portion of the observation. Elements or meteorological phenomena which did not lend themselves to conversion were retained in the supplemental portion of the observation.

During the taping, additional quality control checks were made. These checks flagged or rejected observations that did not meet specified conditions or limits. Extreme temperatures were established for each Marsden Square and individual observations were compared against these limits. Pressures were also checked against a set of extreme values. Ship positions had to be in ocean, sea, or lake areas. Wind directions, visibility, weather, sea conditions etc. had to be valid punches as defined by each card deck.



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# Lessons from ship tracking

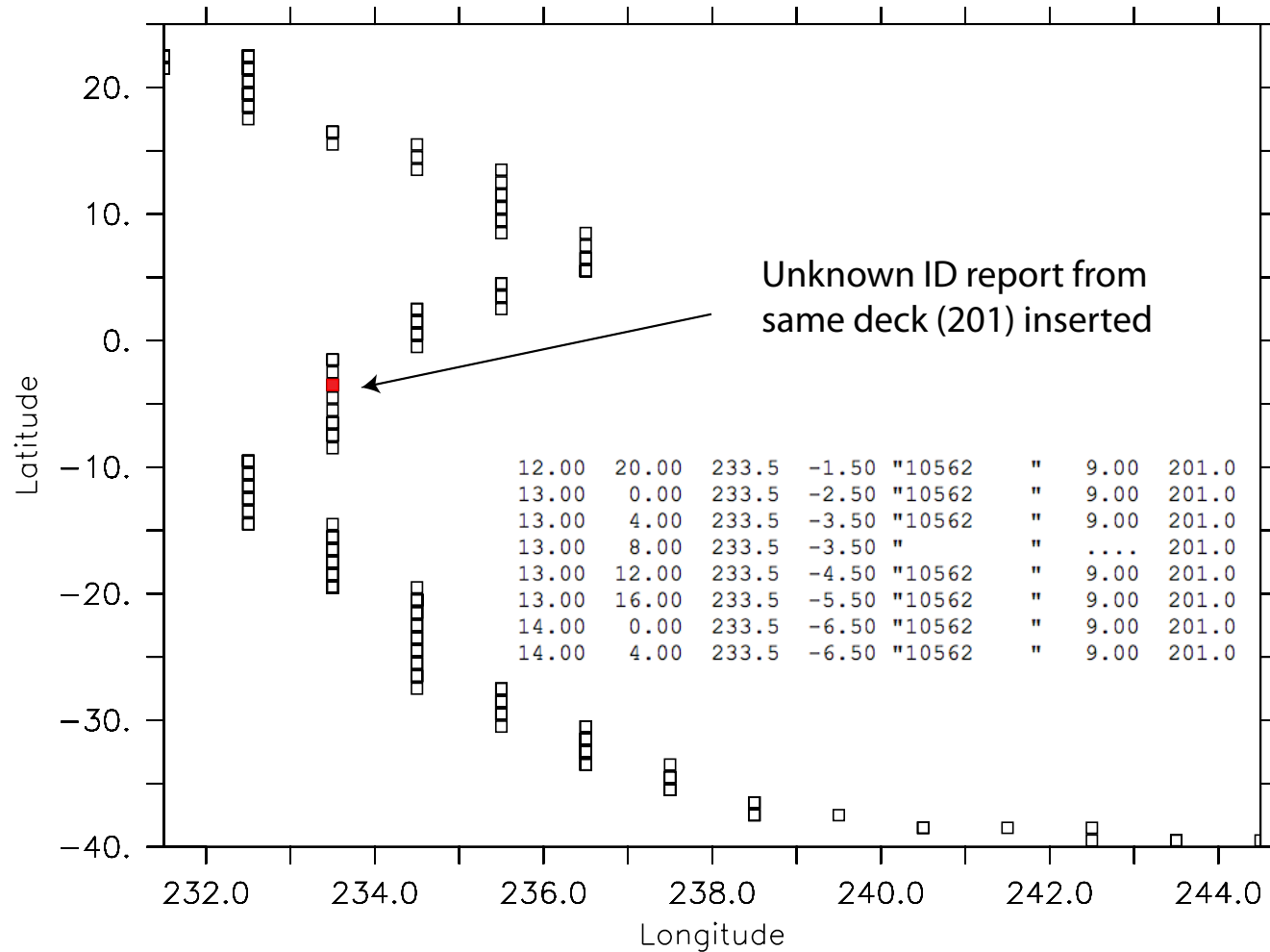


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# Ship tracking - January 1900



1900 1

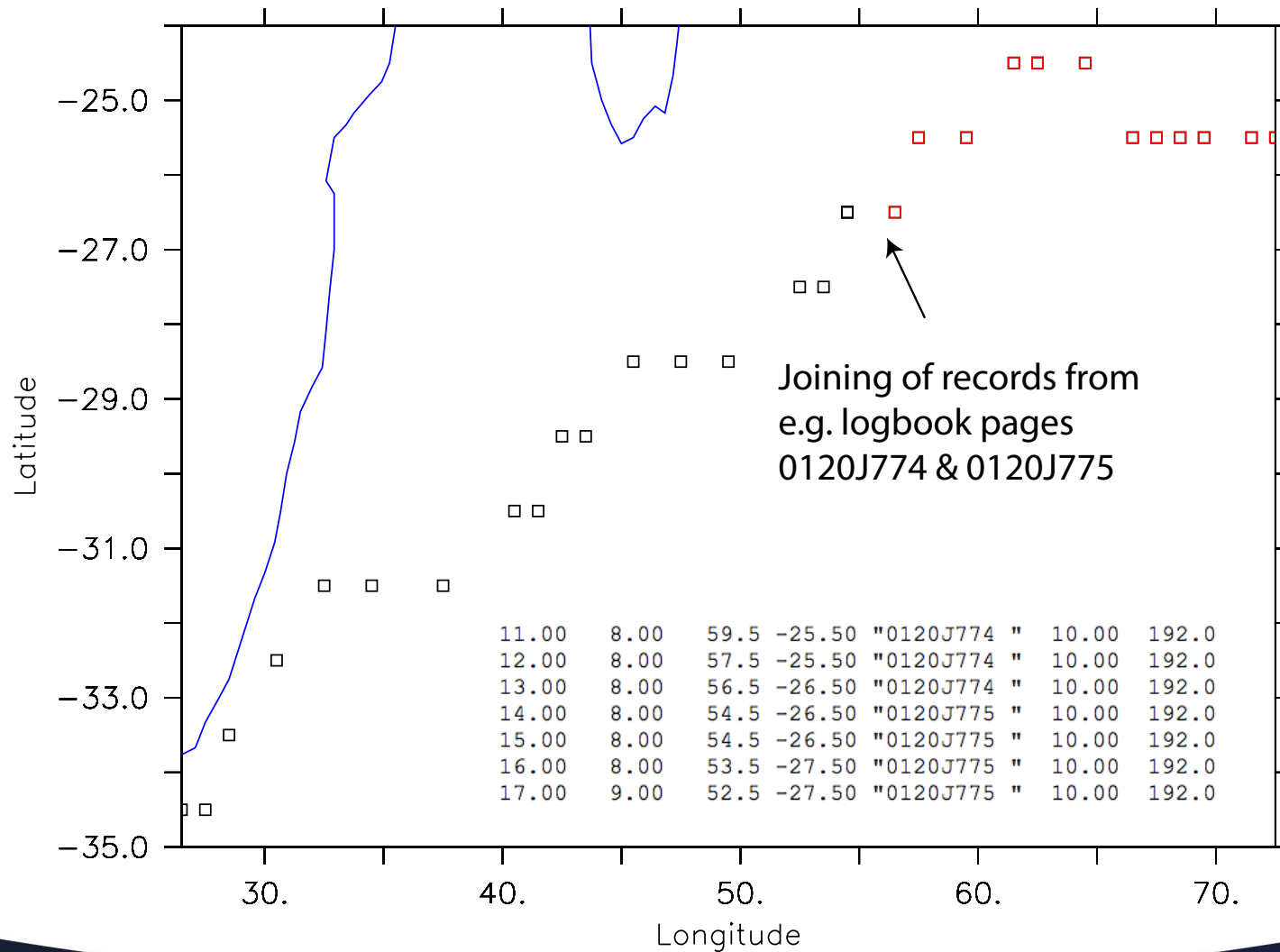


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# Ship tracking – January 1900



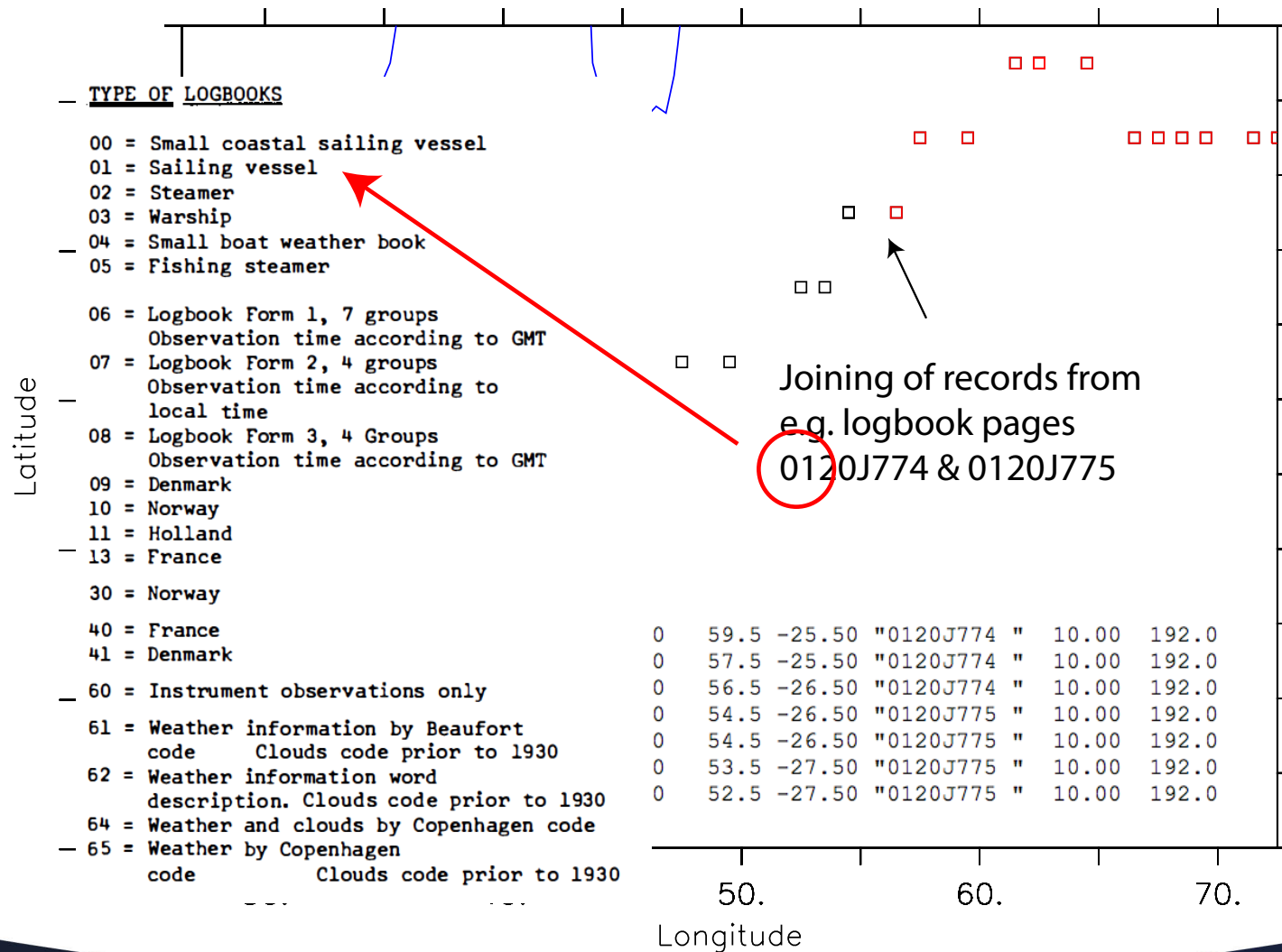
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# January 1900 – adding info. from TDF-11 doc.



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# TDF-11 additional information

- 0 = Weather
- 1 = University Scientific Expedition
- 2 = Maritime or Governmental Agency
- 3 = Naval
- 4 = Privately owned Merchant or Cargo
- 5 = Privately owned fishing boat

deck 118 – Japanese ship obs # 1 “Ship class”

- 0 = Netherlands
- 1 = Norway
- 2 = U.S.A.
- 3 = United Kingdom
- 4 = France
- 5 = Denmark
- 6 = Italy
- 7 = India
- 8 = Hong Kong
- 9 = New Zealand
- 0 = Ireland
- 1 = Philippines
- 2 = Egypt
- 3 = Canada
- 4 = Belgium
- 5 = South
- 6 = Austr

deck 184 – GB Marine  
Obs. “Country of origin”

deck 196 – German marine “Ship  
class”

- 50 = Commercial ships
- 51 = Fishing ships
- 52 = Commercial ships-shortened code
- 53 = Fishing ships
- 54 = Commercial ships-short code
- 55 = Fishing ships
- 67 = Research ship-with Meteorologist
- 69 = Research ship-no Meteorologist
- 70 = Light ships

deck 197 – Danish (and other)  
polar obs “code sheet page #

- 000-499 = Danish source
- 500-797 = British Expedition RRS Discovery  
1925-1927 and RRS Wm. Scoresby
- 798 = French Antarctic Expedition  
Pourquoi Pas 1908-1910
- 799 = Scottish Expedition RRS Scotia  
1902-1904
- 800-999 = Russian Expedition F.J. Sedov  
1912-1914

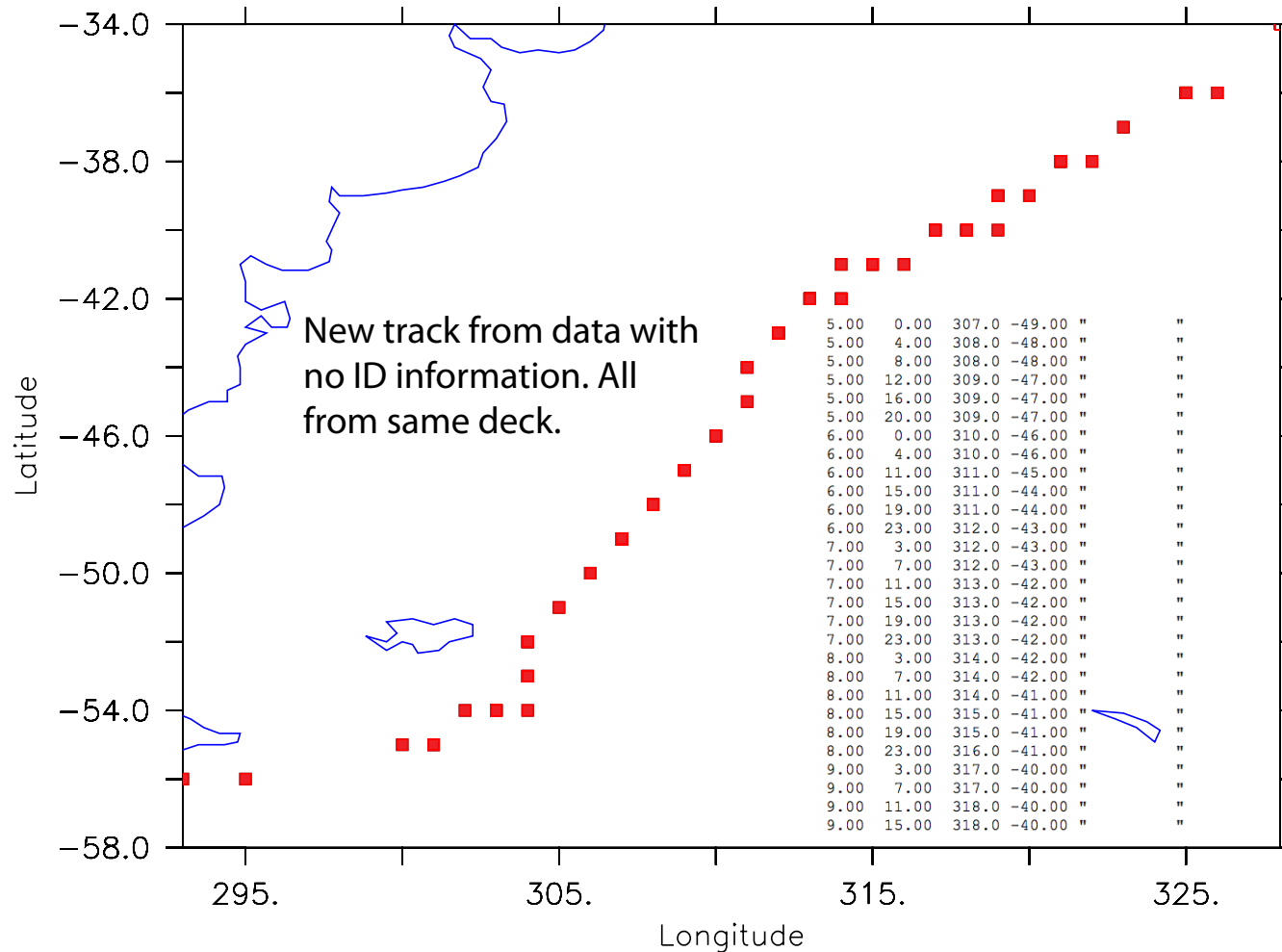


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# Ship tracking January 1895



1895 1



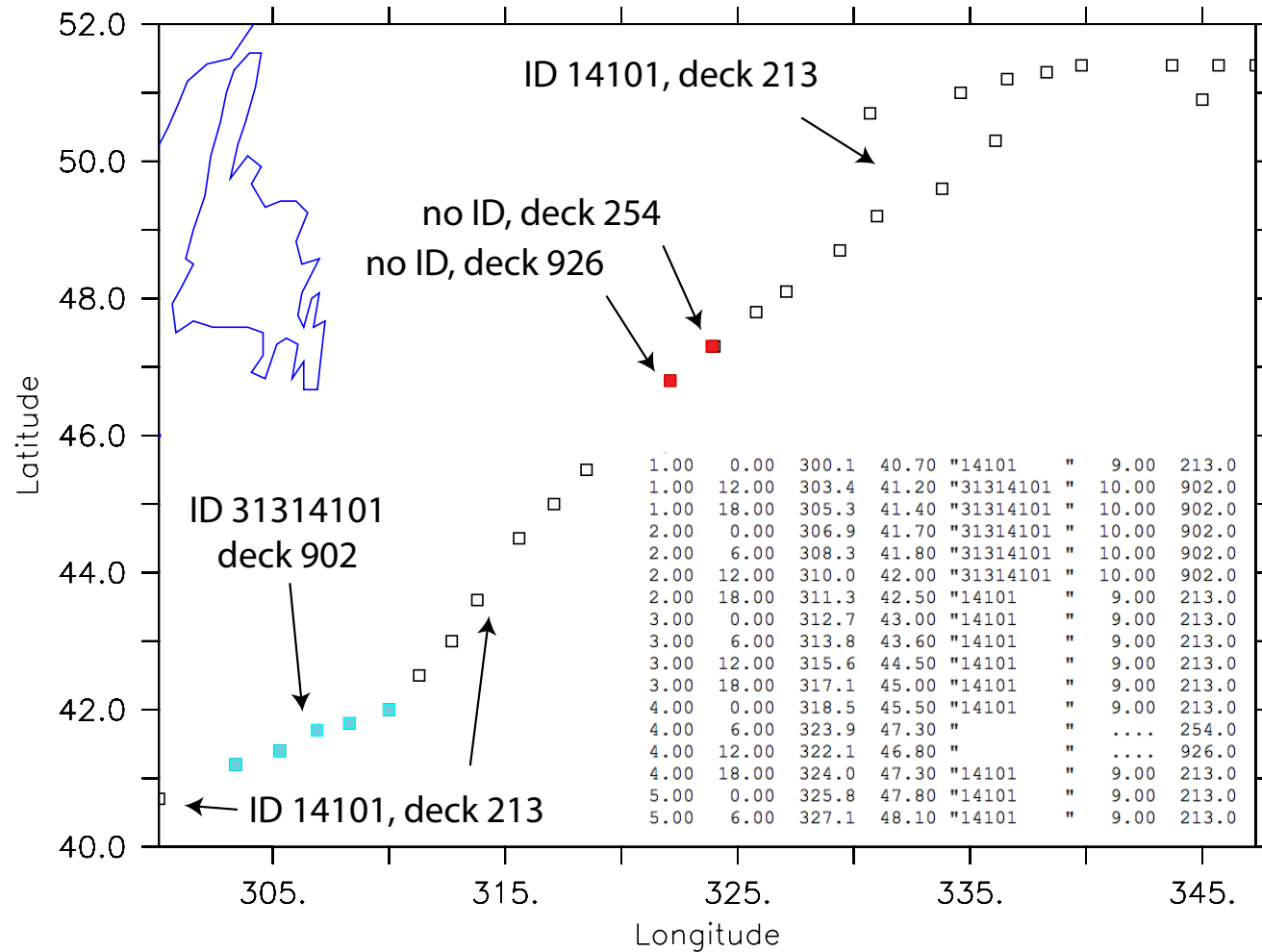
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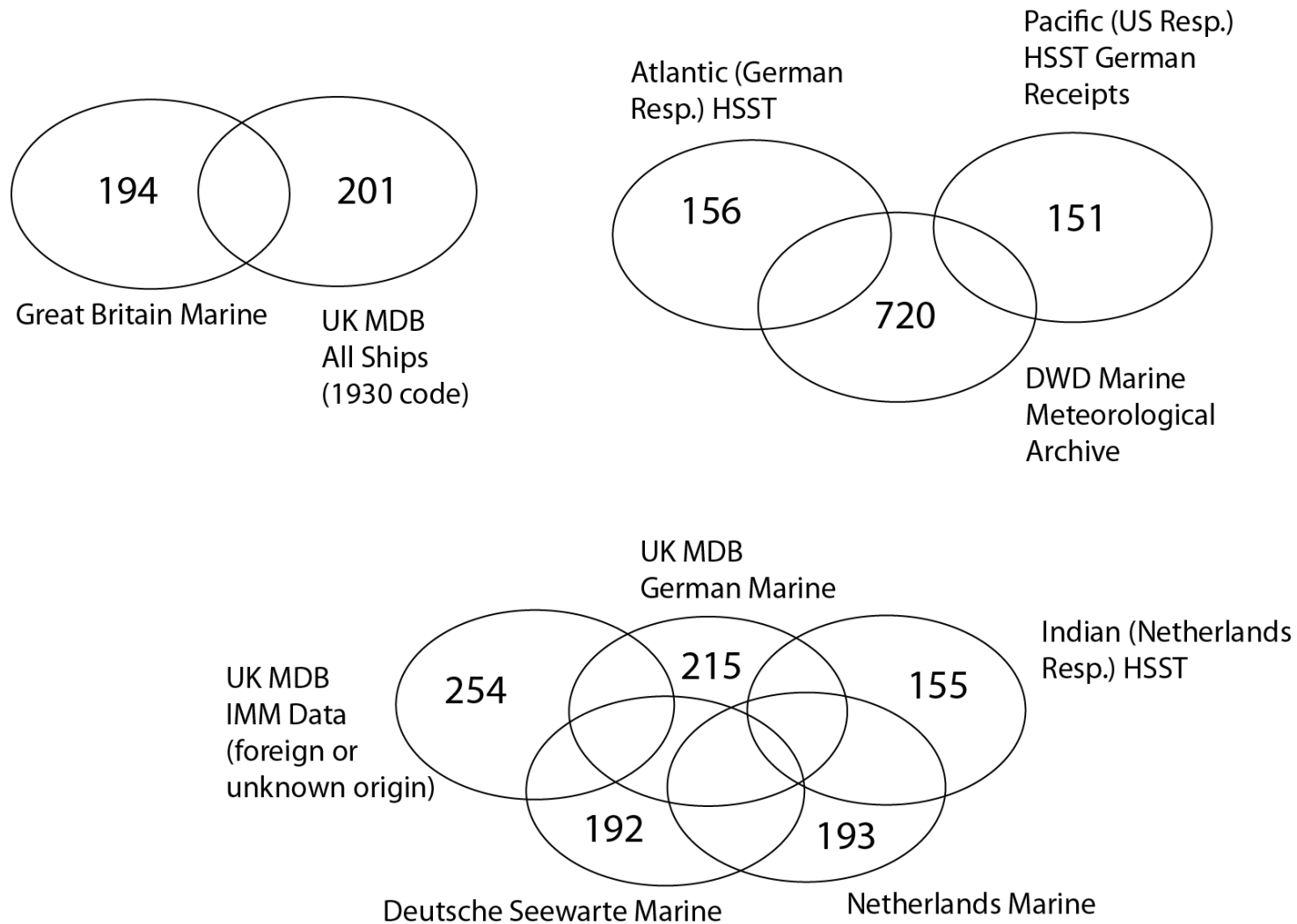
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# Ship tracking – January 1960



# Decks containing common data



# Eltanin

## Deck 897 in ICOADS

- platform type = missing
- ID = missing



### UNITED STATES RESEARCH SHIP *ELTANIN*

[Summarized from information provided by the National Science Foundation, Washington 25, D.C.]

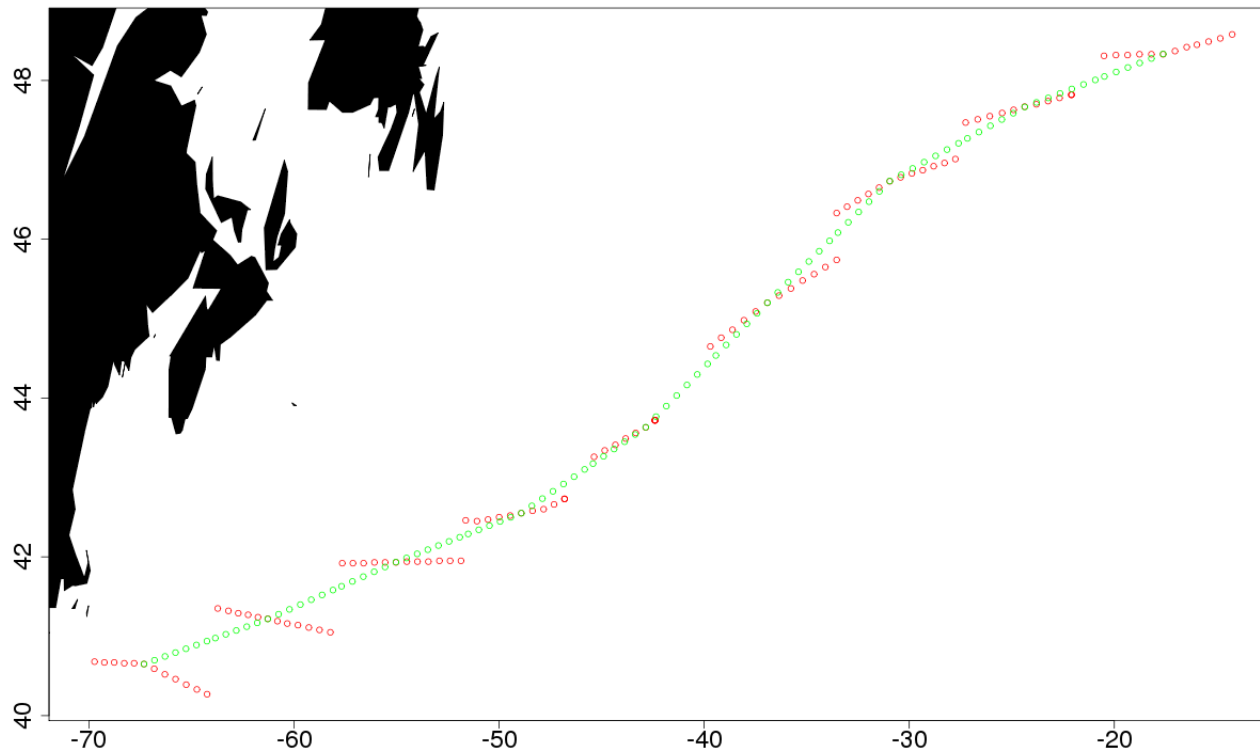
Under an agreement between the National Science Foundation and the Military Sea Transportation Service, the ice-strengthened cargo ship *Eltanin* has been converted into an Antarctic research ship and is due to make her first voyage in April 1962.

Principal dimensions of the *Eltanin* are: length 81 m. (266 ft.), beam 15.6 m. (51 ft.), draft 5.6 m. (19 ft.), displacement 3,800 tons. The vessel is propelled by diesel-electric engines of 2,700 shp, driving twin screws, and has an endurance of about 10,000 miles at a speed of 15 knots.

Built in 1957 as an Arctic supply ship, conversion of the *Eltanin* to her new role entailed substantial rearrangement of both interior and deck spaces. Cargo holds have been turned into laboratories and aft a combined helicopter and weather balloon launching deck has been added. The ship has been equipped for the investigation of numerous disciplines which include meteorology, upper atmosphere studies, marine biology, physical oceanography, submarine geology and geomagnetic studies. A scientific staff numbering 32 will be carried in addition to the civilian crew of 47.

On her first cruise the *Eltanin* will operate off Cape Horn and will be based in Valparaiso, Chile.

# ICOADS Supplemental data SS Illinois, January 1880



Red circles =  
original ICOADS  
locations

Green circles =  
locations  
interpolated  
between midday  
fixes using ICOADS  
supplemental data



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# A reprocessing of ICOADS?

New, sophisticated, dataset construction methods need more information:

- platform identifiers
- information on quality, metadata, observation types

ICOADS (and TDF-11 before that) kept most of the available information

- information may have been lost at many stages before this

What would we gain from revisiting the earlier data?

- prior to Release 2.5 “worse duplicates” were not kept
- but input data to dupelim retained (now available by deck in lmr format)
- Duplicate elimination and land masking could be rerun
- More information extracted from supplemental fields
- Examination of inconsistencies between decks -> improved quality



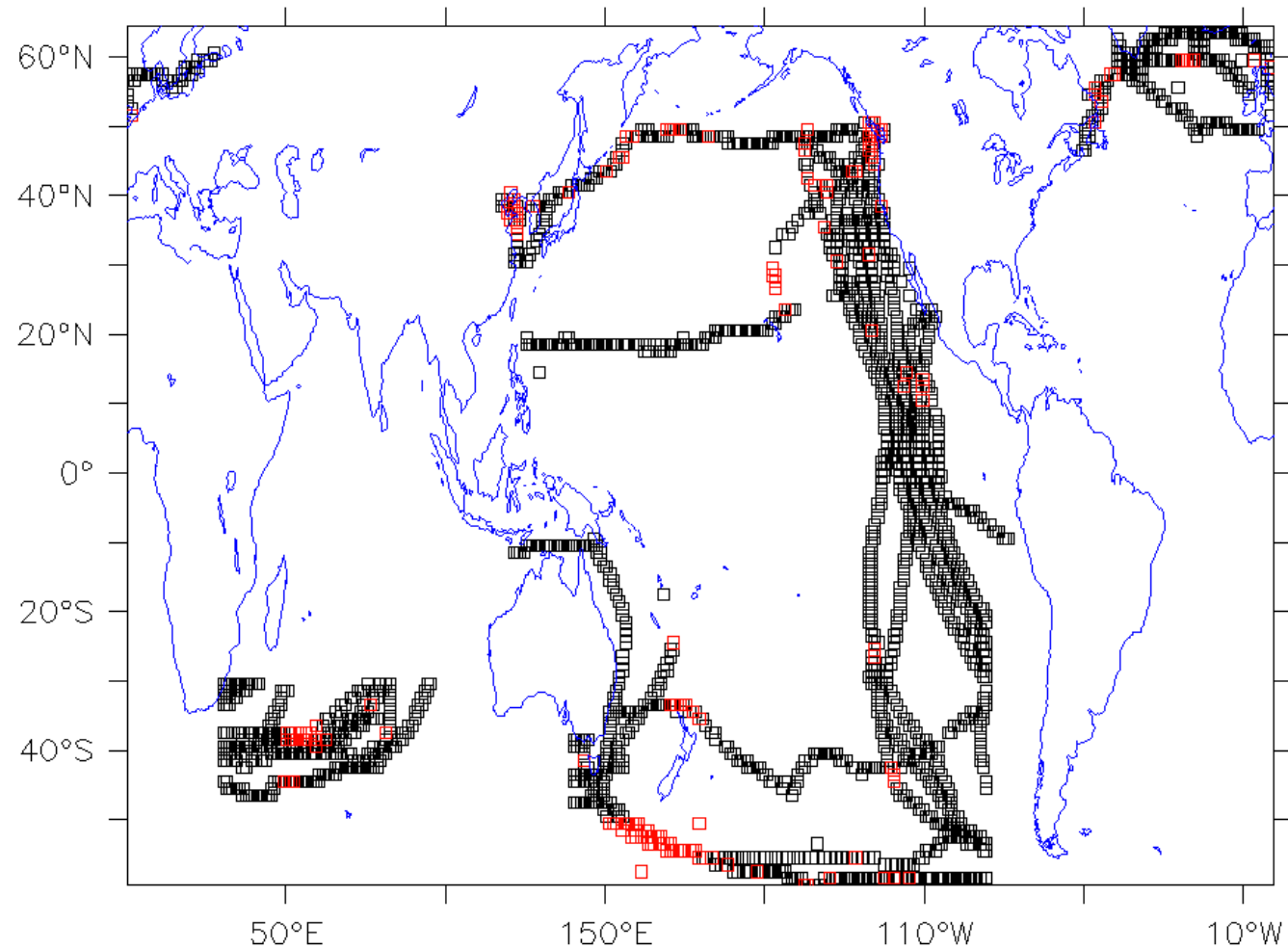
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# Deck 194/201 comparison - 1860



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# Deck 194/201 comparison - 1860

Year	Month	Day	Hour	Lon	Lat	Deck	ID	SST	Wind_spd	Dir	Cloud
1860.	3.00	8.00	3.00	188.5	-56.50	201.0	"01141"	6.70	12.30	304.0	8.000
1860.	3.00	8.00	3.00	188.5	-56.50	194.0	"101141"	6.70	12.30	304.0	....
1860.	3.00	8.00	4.00	178.5	-54.50	194.0	"101141"	6.70	12.30	259.0	....
1860.	3.00	12.00	2.00	213.5	-59.50	201.0	"01141"	4.40	9.80	11.0	8.000
1860.	3.00	12.00	2.00	213.5	-59.50	194.0	"101141"	4.40	9.30	11.0	....
1860.	3.00	15.00	16.00	237.5	-58.50	201.0	"01141"	2.80	9.80	281.0	8.000
1860.	3.00	15.00	16.00	237.5	-58.50	194.0	"101141"	2.80	9.30	281.0	....
1860.	3.00	16.00	16.00	245.5	-58.50	201.0	"01141"	3.90	9.80	236.0	8.000
1860.	3.00	16.00	16.00	245.5	-58.50	194.0	"101141"	3.90	9.30	236.0	....



# “dupelim allowances”

## d) Allowances

Ten allowances were defined for the Release 1 pre-1970s version of dupelim (see Release 1, pp. K21-K22 and K27-K29) but allowance #7 was not applicable as discussed on p. K28 of Release 1, and allowance #8 is implemented as part of preconditioning of decks 155-156 (see sec. 2.2). The remaining allowances apply to

#1 Temperatures off by less than 1 degree

#2 Present weather off by units digit (any match with the Atlas).

#3 Wind ranges used to test for equality (all decks; listed in Release 1, Table K5-4), applied to both measured and estimated wind before July 1963 (exclusive). After July 1963, the ranges are applied unless the two winds being compared both have a wind speed indicator (WT) showing wind was measured.

#2 Present weather off by units digit

for discussion of different wording compared to Release 1, p. K28, and of expanded WI values defined in LMR6 versus LMR5.]

#4 Pressure to whole millibars (deck 192 vs. HSST or MDB, deck 193 vs. HSST, or HSST vs. MDB; and any location and time match with deck 555 or 899). One of two slightly different checks is used (with the

#3 Wind ranges used to test for equality

--deck 192 vs. 150-152 or 155-156 (HSST), 0.1 hPa is added to HSST  
--deck 192 vs. 215 or 254 (MDB), 0.1 hPa is added to MDB  
--deck 193 vs. 150-152 or 155-156 (HSST), 0.1 hPa is added to HSST

and then another test for equality is made to tenths hPa. Or, for the following cases:

--deck 150-152 or 155-156 vs. 215 or 254  
--location

0.1 hPa is added  
made to whole hPa  
from the original

previously missing but is now being recovered from supplemental data, plus MDB decks of non-UK origin in which pressure differences have been identified. Deck 555 is post-1949 data.]

#5 Temperatures lost digits (deck 193 vs. HSST decks other than 192).

Air and sea surface temperature problems occur in some HSST reports (i.e., SID=2-4) that match deck 193. If air temperatures are equal between reports

is needed. When  
must be tested  
when two digits

HSST report is zero (signs must also be the same). Otherwise, they are unequal. For example, temperatures 20.3 and 0.3 would be equivalent using this scheme. [NOTE: The original wording of this allowance

#5 Temperatures lost digits

#6 A 6- or 7-hour time difference



# A reprocessing of ICOADS?

A wealth of information is available in ICOADS supplemental data

Reinstate original format data (e.g. Beaufort force)

- revisit conversions

Better tailor data formats to observation types, e.g.

- historical logbooks
- Ocean Weather Ships
- Drifting buoys

Track data within decks before merging and identifying duplicates

Improved duplicate identification, allowing for position errors

- and retain all duplicates for those that want to try themselves

Pilot project to assess value of going back to “card images”



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