



# G-XXII: HRSST TT Report

Gary Corlett

**GHRSSST**  
GROUP FOR HIGH RESOLUTION  
SEA SURFACE TEMPERATURE



# HRSST Task Team - Introduction

- Satellite SST validation relies on data from drifting buoys.
- GHR SST and the JCOMM DBCP established a pilot project to define a standard for SST measurements from drifting buoys known as HRSST (high resolution sea surface temperature).
- The majority of buoys now deployed are HRSST compliant and so it is pertinent to analyse the current drifter network to confirm they meet the HRSST standard and to also revisit and refine the standard as required.
- The aims of this TT are therefore to:
  - Analyse the quality and performance of the current drifter network with a particular focus on HRSST drifters.
  - Revise the HRSST specification and also propose an initial standard for FRM drifters.

# HRSST Task Team - Activities

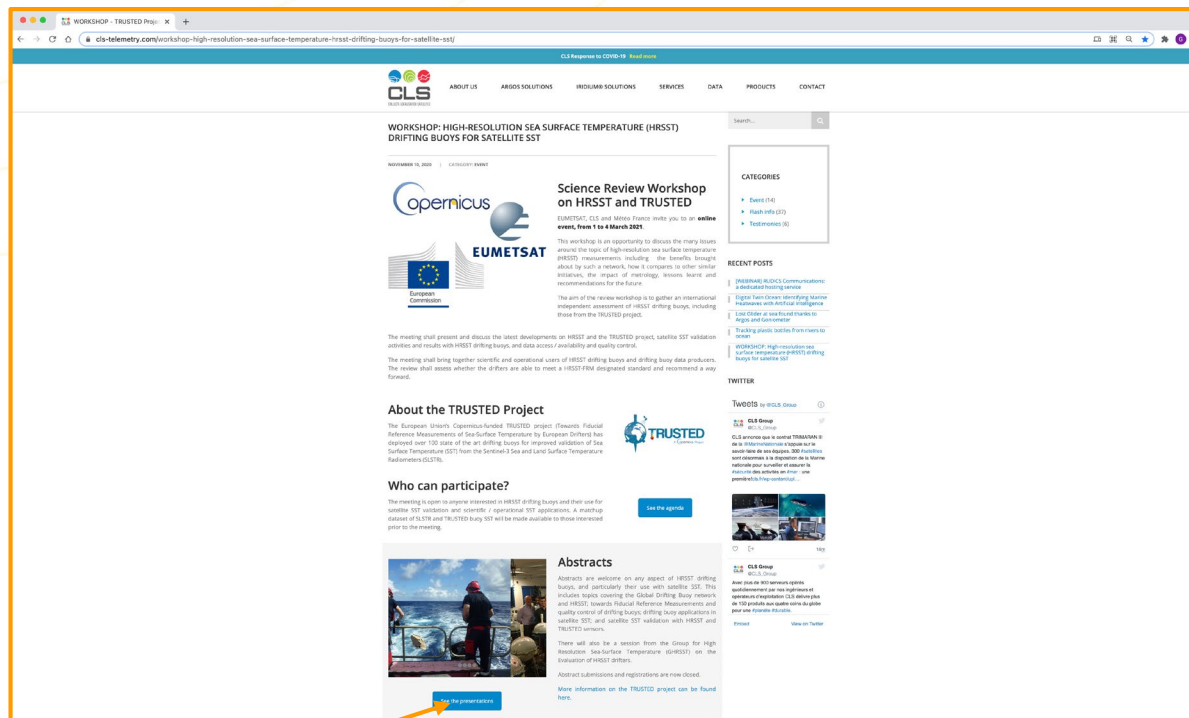
- Task T1:
  - Perform initial assessment of current drifters and their compliance with HRSST (by G-XXII)
- Task T2:
  - To propose an uncertainty model for the drifter network (by G-XXIII)
- Task T3
  - Define a protocol for real-time quality control of drifting buoys for satellite SST validation (by G-XXIII)
- Task T4
  - Revise the HRSST specification (by G-XXIII)
- Task T5
  - To propose an initial FRM specification for drifters (by G-XXIII)

# Task Team Members

- **Task Team chair**
  - Gary Corlett
- **Task Team members**
  - Anne O'Carroll, Igor Tomazic, Verena Hormann, Gary Wick, Sandra Castro, Helen Beggs, Chris Merchant, Jean-Francois Piolle, Craig Donlon and David Meldrum, Stéphane Saux Picart, Shane Elipot
- If you want to join, leave or be co-chair then let me know!

# TRUSTED/HRSST Workshop

- <https://www.eumetsat.int/TRUSTED>
- <https://www.cls-telemetry.com/workshop-high-resolution-sea-surface-temperature-hrsst-drifting-buoys-for-satellite-sst/>



Link to presentations





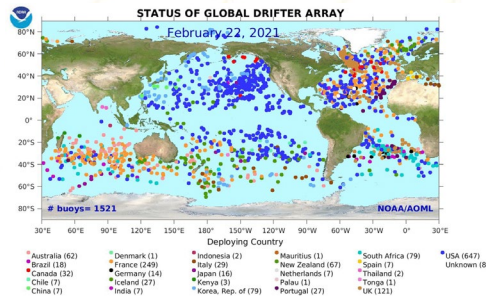
# Workshop outcomes - draft

- Priority recommendations:
  - For the GHRSSST and DBCP communities to revisit and revise the GHRSSST/DBCP HRSST specification.
  - For the GHRSSST and DBCP communities to formulate an agreed FRM standard for drifters (e.g. could be HRSST + SI + uncertainty per measurement + metadata)
- Additional recommendations:
  - Continuation of metadata repository activities are essential and should include automatic interrogation of the complete OceanOps metadata repository. Progress towards supplying complete metadata information per measurement is important.
  - High quality / FRM in situ measurements of sea-ice surface temperature are needed for satellite sea-IST development and a suitable instrument needs to be designed and deployed.
  - The continuation of FRM TRUSTED activities is recommended and should address evolutions such as further measurements at high-latitudes and others to be further assessed.

# Task T1

- Reference data, such as drifting buoys, are essential for satellite SST validation

<https://www.aoml.noaa.gov/phod/gdp/>



- Majority of drifters provided by the NOAA Global Drifter Program (GDP)
- All drifter activities are coordinated by the JCOMM DBCP
- Estimated uncertainty of drifters was 0.1 K
  - However many studies suggested drifter uncertainty was closer to 0.2 K

## GHR SST DBCP Pilot Project

- A number of drifters to be upgraded to a higher specification
  - Position accuracy and reporting to 0.01degrees (**HRSST-1**)
  - SST accuracy < 0.05K; reporting to 0.01K (**HRSST-2**)
    - Total standard uncertainty in measured SST to be < 0.05K
- Requirements
  - Hourly measurements
  - Report design depth in calm water to  $\pm 5\text{cm}$
  - Report of geographical location to  $\pm 0.5\text{km}$  or better
  - Report of time of SST measurements to  $\pm 5$  minutes
- Endorsed at GHR SST 2013
- Most drifter data now HRSST-2

**Need to clarify/define HRSST versus FRM**

# Available sources of drifter metadata

- Various sources available – each with pros and cons
- Initial source are AOML ‘databases’
  - Text files
- Fields extracted
  - Deployment date (in order to discriminate multiple WMO IDs plus age of buoy)
  - Manufacturer (9 in SLSTR-A MDB)
  - Type (23 in SLSTR-A MDB)
  - Drogue-off date



## 9



# Drogue off date

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→ ↻ 🏠

aoml.noaa.gov/phod/dac/dirall.html

LIST AND DETAILS OF ALL BUOYS IN DATABASE AS OF December 31, 2020 (Created on: Wed Mar 24 15:24:09 EDT 2021)

ID	WMO	EXP	1st DATE	1st LAT	1st LON	END DATE	END LAT	END LON	DROG OFF	DOFF	LT DOFF	LN DEATH	MANUF.	TYPE
CODES														
68340580	6102774	21312	12 28 2020	-61.03	173.15	01 01 2021	-61.78	173.30	00 00	0	99 99	999 99	0	SIO SVP
68340670	6102777	21312	12 28 2020	-63.02	173.19	12 31 2020	-63.62	175.32	00 00	0	99 99	999 99	0	SIO SVP
65513430	3301570	21312	12 27 2020	-60.00	296.65	01 01 2021	-60.07	297.49	00 00	0	99 99	999 99	0	SIO SVBP
68340620	6102775	21312	12 27 2020	-56.02	172.85	12 31 2020	-56.14	172.67	00 00	0	99 99	999 99	0	SIO SVP
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68340700	6102778	21312	12 27 2020	-57.03	173.02	12 31 2020	-57.49	171.61	00 00	0	99 99	999 99	0	SIO SVP
67548130	1501722	21312	12 15 2020	30.22	281.26	12 28 2020	29.39	281.43	00 00	0	99 99	999 99	0	DBI SVP
67548140	1501723	21312	12 15 2020	31.35	308.92	12 31 2020	31.05	311.21	00 00	0	99 99	999 99	0	DBI SVP
67548150	1501724	21312	12 15 2020	38.69	319.91	01 01 2021	36.93	318.86	00 00	0	99 99	999 99	0	DBI SVP
67548160	1501725	21312	12 15 2020	24.27	302.48	01 01 2021	24.66	303.83	00 00	0	99 99	999 99	0	DBI SVP
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60714510	5601686	21312	12 10 2020	-57.47	61.44	01 01 2021	-56.77	63.39	00 00	0	99 99	999 99	0	DBI SVBP
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NOTE: Longitudes are expressed in 0-360 E longitude

Droge off date of 1-1-19 indicates we were unable to interpret the droge status from the droge sensor readings

Droge off date equal to deployment time means droge was off since deployment

Droge off date equal to ending time, buoy ended with its droge attached.

Droge off date equal 0 = 0 Indicates droge still attached and buoy is alive

DEATH CODES:  
0 = buoy still reporting as of last update  
1 = buoy ran aground  
2 = buoy was picked up  
3 = buoy self-transmitting  
4 = in-lab data transmissions at end of trajectory  
5 = Bad battery voltage  
6 = Place to indicate status while transmitting good position

BUOY TYPES:  
SVP Standard drifters carrying only SVP, Droge and Voltage sensors  
SVBP SVP with barometer  
SVBP SVP with barometer and salinity sensors  
SVBP SVP with barometer and wind sensors  
SVBP SVP with GPS  
SVBP SVP with optical sensor  
SVBP SVP with salinity sensor  
SVBP SVP with wind sensor  
SVBP SVP with wind sensor  
SVBP SVP with barometer and sea sensor  
SVBP SVP with barometer and sea sensor

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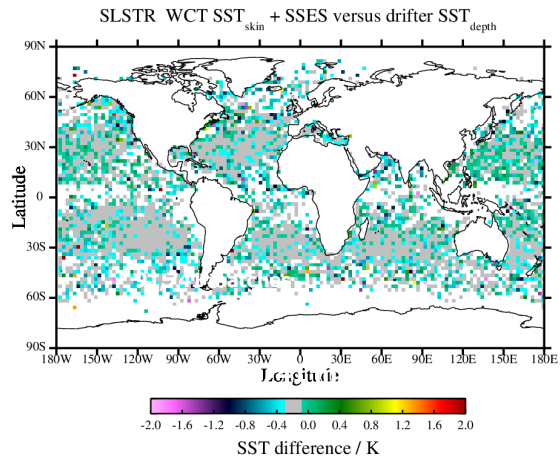
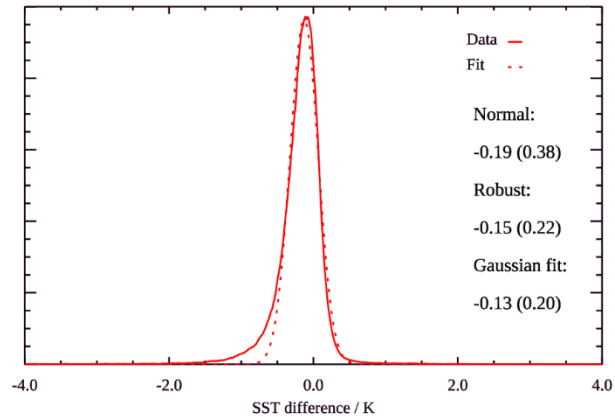
# HR SST drifters - identification

- Drifter activities coordinated by the JCOMM DBCP
- Most drifters are deployed by the NOAA Global Drifter Program (GDP)
  - Luca Centurioni (SCRIPPS)
- Preliminary list of HR SST defined in collaboration with GDP
  - Iridium AND NOT DBi in AOML list
  - Note DBi not included as calibration not confirmed to be  $< 0.05$  K

# Non-HRSST versus HRSST

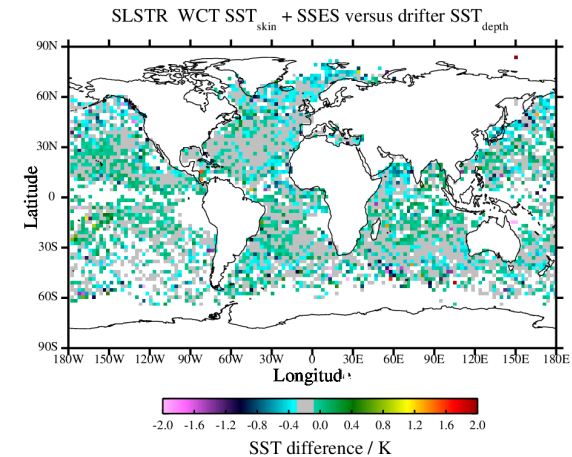
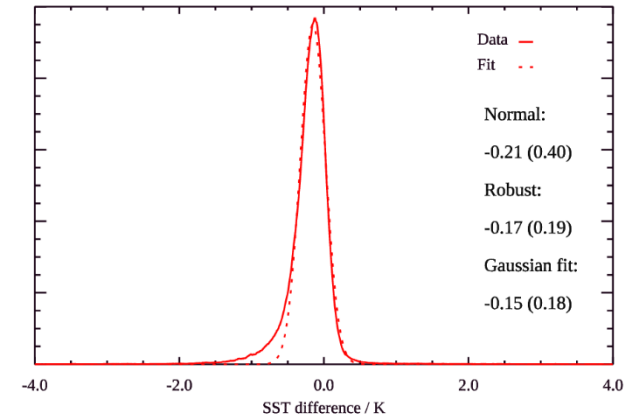
## Non-HRSST

SLSTR WCT N3 nighttime SST<sub>skin</sub> + SSES versus drifter SST<sub>depth</sub>



## HRSST

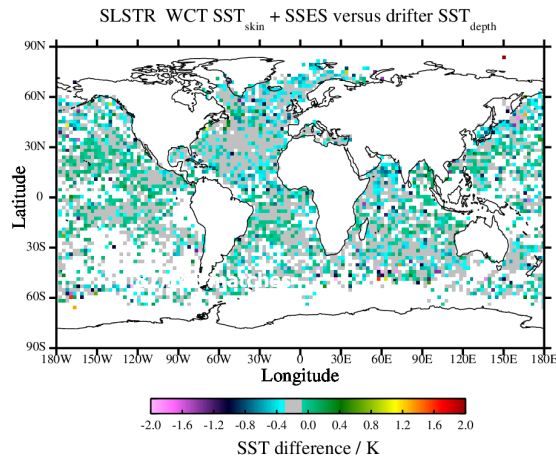
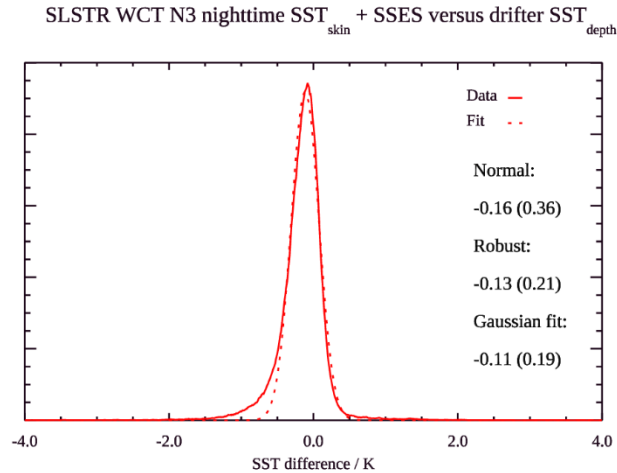
SLSTR WCT N3 nighttime SST<sub>skin</sub> + SSES versus drifter SST<sub>depth</sub>



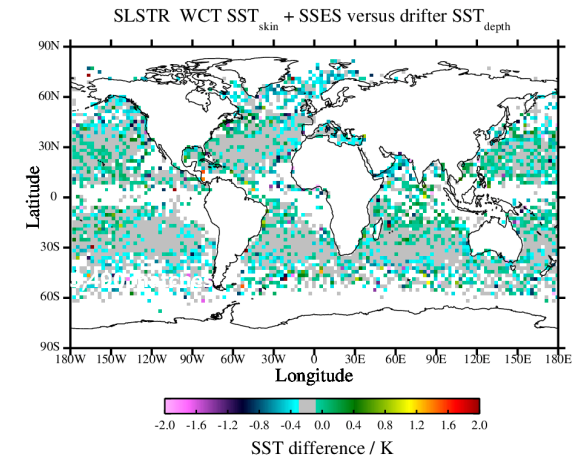
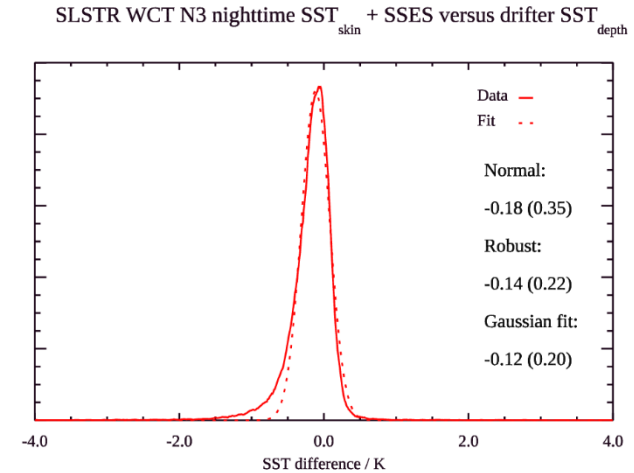
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments

# Drogue-on versus drogue-off

## Drogue-on



## Drogue-off



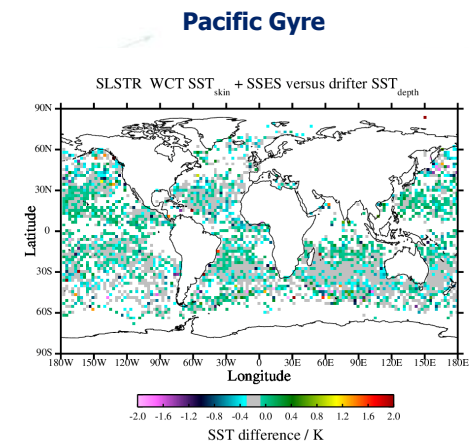
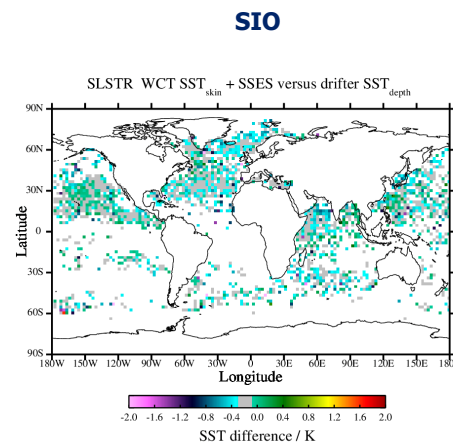
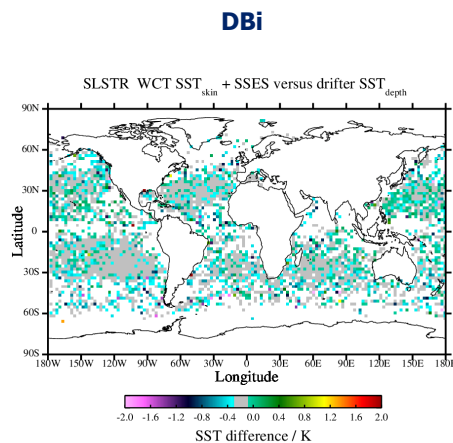
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments



# By manufacturer

Manufacturer	Num matches	Median / K	RSD / K
AOML/Bitte	2965	-0.18	0.26
Clearwater	614	-0.10	0.24
DBi	60390	-0.17	0.19
Marlin-Yug	259	-0.12	0.31
Metocean	35106	-0.14	0.22
NKE	2515	-0.09	0.25
Pacific Gyre	55248	-0.13	0.19
SIO	37514	-0.19	0.22
Technocean	102	-0.17	0.19

- No clear differences between manufacturers
- Low match-ups for some (statistical significance)
- Limited by current SLSTR N3 accuracy and match-up process



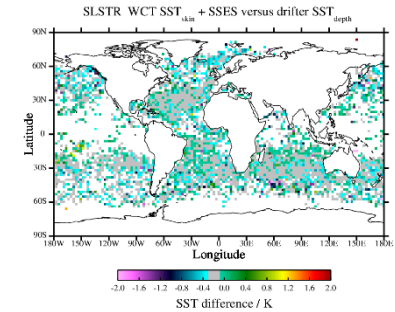
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments

# By type

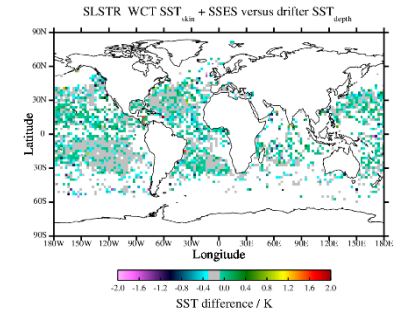
BD2A3	12207	-0.16	0.18
BD2GHI	16483	-0.21	0.24
BD2GI	72227	-0.16	0.21
BD2WHI	236	-0.09	0.28
BDGA3	20	+0.12	1.00
SVGSHI	1334	-0.08	0.15
SVP	9026	-0.21	0.25
SVP3	3572	-0.19	0.19
SVP3A3	19842	-0.14	0.19
SVP3GI	44021	-0.12	0.19
SVPDWD2	494	-0.06	0.19
SVPGHI	16893	-0.18	0.22
SVPGSHI	108	+0.02	0.16
SVPVHI	1087	-0.16	0.24
BD2VHI	360	+0.06	0.16
SVGHA3	5	-0.12	0.06
SVPB2	119	-0.43	0.30
SVPBD	2	-0.44	0.05
SVPBWD	46	-0.26	0.14
SVPG	17	-0.15	0.10
SVPGS	492	-0.16	0.16
SVPGS3	102	-0.17	0.19
SVPBD2	2183	-0.21	0.21

- Some clear differences
- Low match-ups for some (statistical significance)
- Limited by current SLSTR N3 accuracy and match-up process
- Regional effects?
- Simplification needed

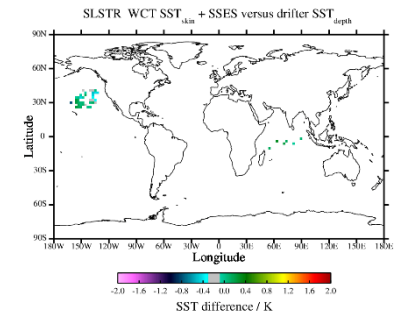
**BD2GI**



**SVP3GI**



**BD2VHI**



# Task T2

- Related activity led by Chris Merchant
  - Luca Centurioni, Verena Hormann, Shane Elipot, Gary Corlett
- Uncertainty of the ensemble of sea surface temperature measurements from global drifting buoys
  - To formulate a simple model of the ensemble SST uncertainty from drifters, as a function of parameters available from manufacturers/expert judgement and drifter databases
  - To collect information about the evolution of these parameters over time
  - To evaluate the uncertainty evolution over time
  - To compare the evaluated uncertainty with an independent estimate from satellite-drifter matches

# Updated metadata

- Minimal list of drifter metadata – proposal from the GDP
  - WMO #
  - Sat ID #
  - Drifter type (a simplified version)
  - Manufacturer
  - Date of production
  - Date of deployment
  - Satellite telemetry system
  - Date of drogue off (estimated)
  - Thermometer manufacturer
  - SST reporting resolution
  - GPS reporting resolution
  - SST accuracy
  - SST calibration traceability
  - T sensor drift
  - Buoy firmware version

# Summary

- Most drifters now conform to HRSST-2
  - Most deployments through the NOAA GDP
- Initial classification defined
  - *Iridium but not DBi*
  - Revision ongoing
- Issues with metadata availability
- Activities started to define an uncertainty model for drifters from first principles



# Questions

- Changes to TT membership?
- Updates to HRSST specification?
- Development of drifter FRM specification?
- Additions to minimal metadata record?
- Should the TT continue?