G-XXII: HRSST TT Report

Gary Corlett

HRSST Task Team - Introduction

- Satellite SST validation relies on data from drifting buoys.

- GHRSST 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.

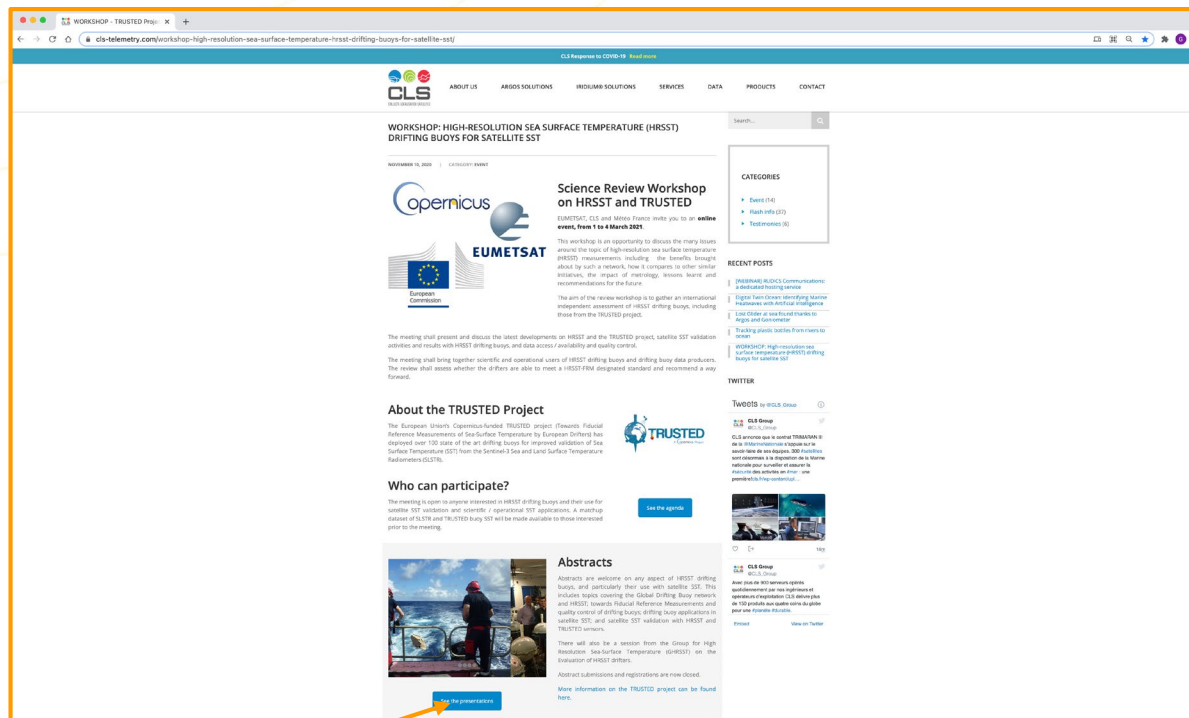# HRSST Task Team - Activities

- 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 GHRSST and DBCP communities to revisit and revise the GHRSST/DBCP HRSST specification.

  - For the GHRSST 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/

STATUS OF GLOBAL DRIFTER ARRAY
February 22, 2021
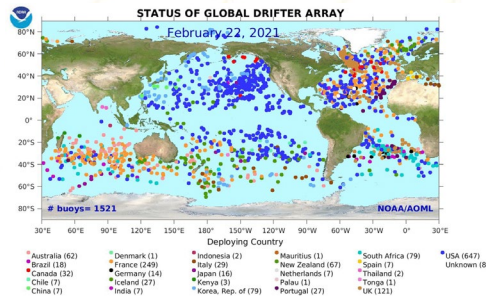
- Majority of drifters provided by the NOAA Global Drifter Program (GDP)

- 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

GHRSST 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 ±5cm
    - Report of geographical location to ±0.5km or better
    - Report of time of SST measurements to ±5 minutes
- Endorsed at GHRSST 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

Manufacturer and type ID

Drogue off date

HRSST 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 HRSST 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_{skin} + SSES versus drifter SST_{depth}
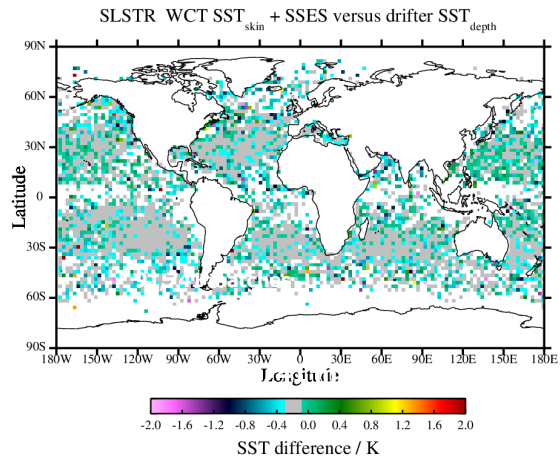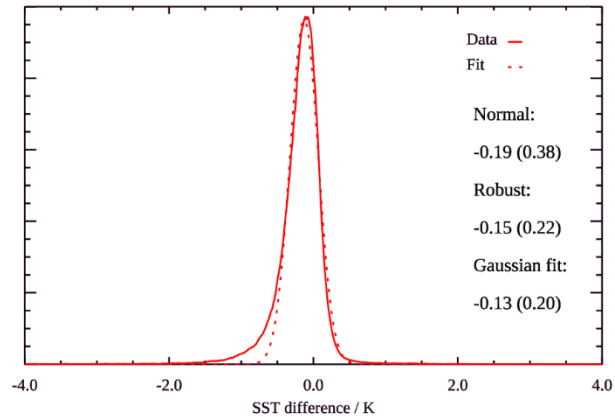
Data —
Fit - -

Normal:
-0.19 (0.38)
Robust:
-0.15 (0.22)
Gaussian fit:
-0.13 (0.20)

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}

HRSST

SLSTR WCT N3 nighttime SST_{skin} + SSES versus drifter SST_{depth}

Data —
Fit - -

Normal:
-0.21 (0.40)
Robust:
-0.17 (0.19)
Gaussian fit:
-0.15 (0.18)

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}
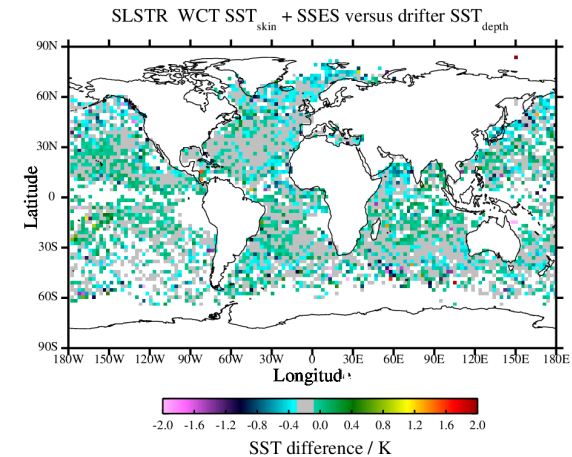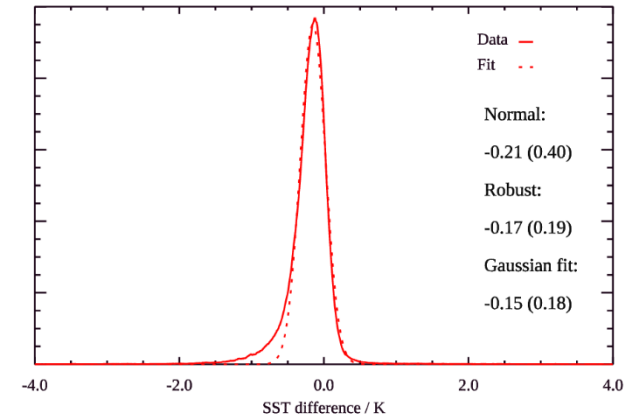
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments

Drogue-on versus drogue-off

Drogue-on

SLSTR WCT N3 nighttime SST_{skin} + SSES versus drifter SST_{depth}

Data —
Fit · ·

Normal:
-0.16 (0.36)
Robust:
-0.13 (0.21)
Gaussian fit:
-0.11 (0.19)

SST difference / K

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}

SST difference / K

Drogue-off

SLSTR WCT N3 nighttime SST_{skin} + SSES versus drifter SST_{depth}

Data —
Fit · ·

Normal:
-0.18 (0.35)
Robust:
-0.14 (0.22)
Gaussian fit:
-0.12 (0.20)

SST difference / K

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}

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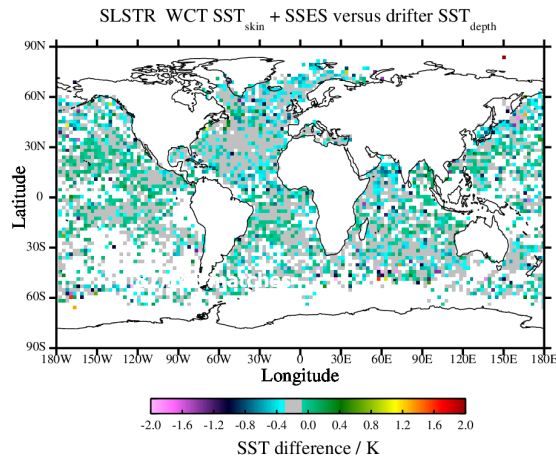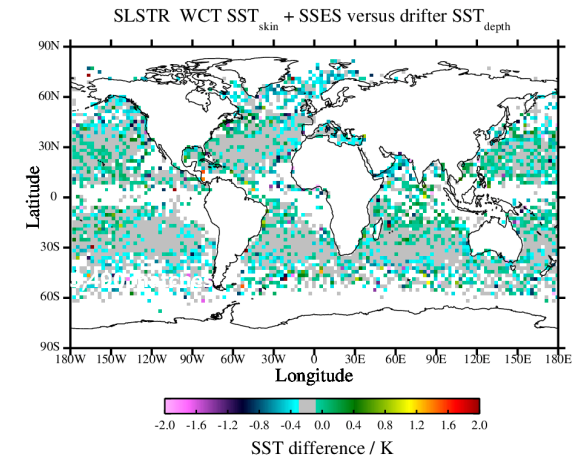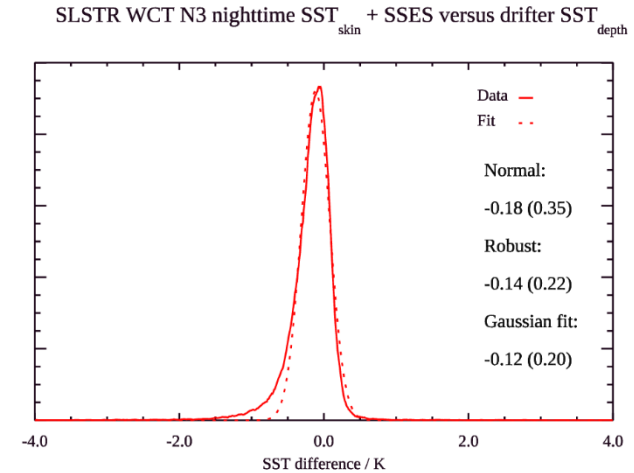
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments

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**

DBi

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}

SIO

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}

Pacific Gyre

SLSTR WCT SST_{skin} + SSES versus drifter SST_{depth}
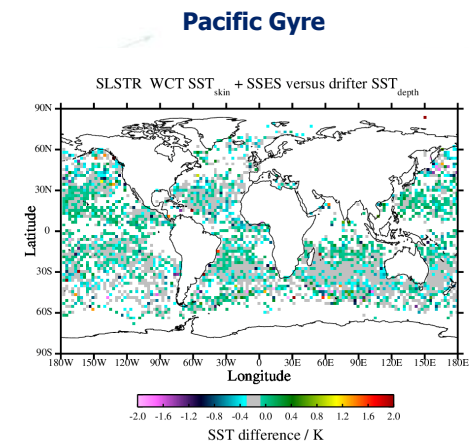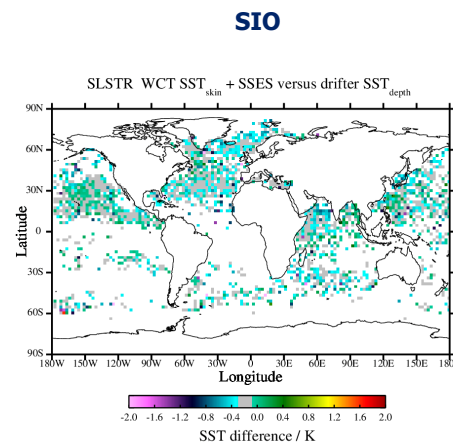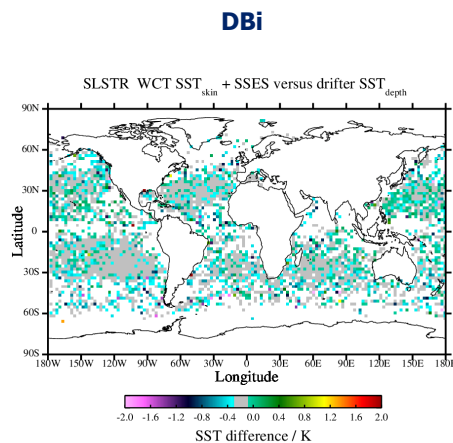
Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments

By type

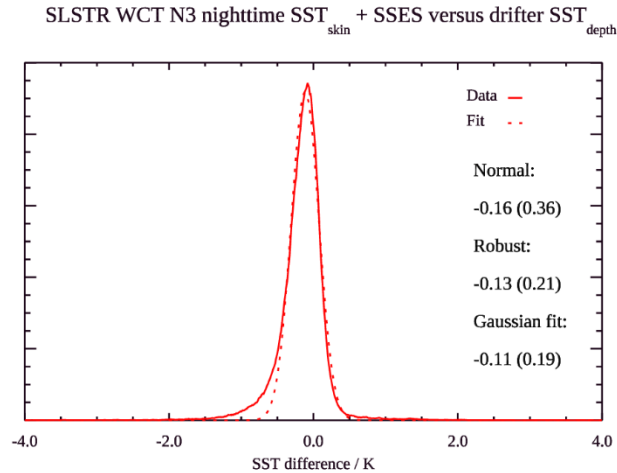|			
BD2A3	12207	-0.16	0.18
BD2GHI	16483	-0.21	0.24
BD2GI	72227	-0.16	0.21
BD2WHI	236	-0.09	0.28
BDGA3	20	+0.12	1.00
SVGSHI	1334	-0.08	0.15
SVP	9026	-0.21	0.25
SVP3	3572	-0.19	0.19
SVP3A3	19842	-0.14	0.19
SVP3GI	44021	-0.12	0.19
SVPDWD2	494	-0.06	0.19
SVPGHI	16893	-0.18	0.22
SVPGSHI	108	+0.02	0.16
SVPVHI	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

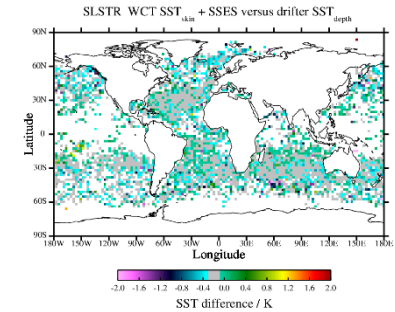**Results shown for SLSTR-A N3 retrieval only; no skin/depth or time adjustments**
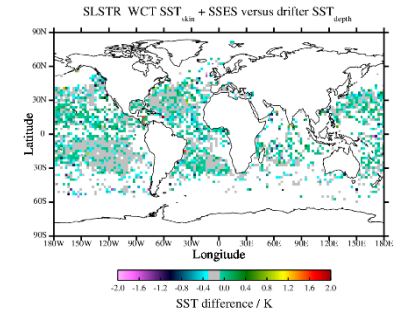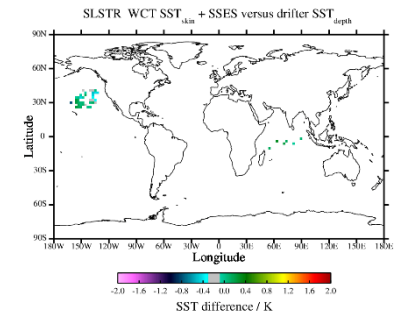
Task T2

- 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

- Changes to TT membership?

- Updates to HRSST specification?

- Development of drifter FRM specification?

- Additions to minimal metadata record?

- Should the TT continue?