NPL

fiducial reference temperature measurements

esa

Fiducial Reference Measurements for validation of Surface Temperature from Satellites (FRM4STS)

ESA Contract No. 4000113848_15I-LG

OP-30: Scientific and Technical Meeting Report: “Towards SI Traceability for non-recoverable SST FRM Instruments”

2 MAY 2018

Reference	OFE-OP-30-V1-Iss-1-Ver-2-Draft
Issue	1
Revision	2
Date of Issue	2 May 2018
Document Type	STM

Approval/Acceptance			
ESA Craig Donlon Technical Officer	esa Digitally signed by Craig Donlon DN: cn=Craig Donlon, o=European Space Agency, ou=ESTEC, email=craig.donlon@esa.int, c=NL Location: Noordwijk, The Netherlands Date: 2018.05.13 13:24:37 +02'00'	**NPL** Andrew Brown Project Manager	Andrew Brown, NPL
	Signature		*Signature*

INTENTIONALLY BLANK

CONTENTS

INTENTIONALLY BLANK

EXECUTIVE SUMMARY

FRM4STS Option 1 comprised a body of work to examine every aspect of the reporting and management of SST originating from the global drifter fleet: past, present and future. In addition to the creation of tools to comb historical databases and platform files for metadata relating to drifter measurement of SST, and the production of a technical report that outlines best practice for the future, particularly with regard to SI traceability of drifter SST, the work stipulated that a scientific and technical workshop should be convened to bring together the drifter SST community – buoy operators, manufacturers, data analysts and the satellite end-users – to examine the issues around the creation and maintenance of a drifter SST database traceable to SI and agree best practice for the future.

In the event, the workshop was held in October 2016 at the Scripps Institution for Oceanography (SIO), La Jolla, just ahead of the annual session of the Data Buoy Co-operation Panel (DBCP). The venue and date were chosen in order to maximise the participation of the data buoy community, and to ensure that the workshop outcomes might be taken forward to the DBCP for their endorsement and long-term support.

As a result of a no-cost extension of the project, pushing the end date to early 2018, a further workshop was convened at IFREMER, Brest, in November 2017, again just ahead of the annual DBCP session. Both workshops elicited participation of about 25 experts in the field of drifter SST and its application to satellite SST retrievals.

The principal outcomes of both workshops were as follows:

- Acceptance in principle of the GHRSST Standard (Annex A Table 1) for global drifter SST implementation and reporting, subject to the eventual validation of its usefulness;
- Critically, recognition (through a preliminary study by Gary Corlett) that drifter HRSST reports were indeed driving down the uncertainty in satellite SST retrievals;
- Acknowledgement that the space component and the drifter array are elements of a composite network and that both are required for different but complementary purposes;
- Acceptance of the requirement for SI traceability of drifter SST;
- Endorsement of the efforts to harmonize and publish available drifter metadata in a global dataset;
- Agreement that mechanisms must be found to maintain the harmonized metadata dataset in the future;
- Agreement that the routine reporting of diagnostic data (e.g. drifter internal temperature) and access to collateral information (e.g. wave spectral estimates) are important components of best practice for developing drifter capability in general and SI traceability in particular;
- Agreement that a working group be established to take forward the above and to further develop standards and best practices, possibly through reactivation of the DBCP's PP-HRSST that had been disbanded in 2014.

In the subsequent DBCP sessions, the above findings were welcomed, particularly insofar as they signalled a new era of co-operation between the *in situ* and satellite communities, which might in due course lead to the development of new and better methodologies for ocean observation of variables other than SST, cross-funded by both communities.

In particular, the DBCP committed to the long-term maintenance of the drifter SST metadata database, through its Technical Co-ordinator at JCOMMOPS, and to the reinstatement of the Pilot Project for HRSST, as a practical means of overseeing the evaluation and potential future roll-out of drifter HRSST.

The remainder of this report details the two workshops and the relevant discussion and actions from the DBCP.

ANNEX A - A FIRST SCIENTIFIC AND TECHNICAL WORKSHOP ON TRACEABILITY OF DRIFTER SST MEASUREMENTS

A meeting hosted at Scripps on 13-14 October 2016 under the auspices of the ESA FRM4STS initiative

INTRODUCTION

Following the efforts of the DBCP and GHRSST in establishing a dialogue between the satellite and *in situ* communities to encourage the roll-out of better buoy SST (so-called High Resolution SST, or HRSST) measurements in support of satellite SST performance monitoring and validation, both ESA and EUMETSAT have recently taken positive steps in this direction: ESA by commissioning a wide-ranging desk study of drifter SST (FRM4STS Option 1), EUMETSAT by inviting tenders for the procurement and deployment of drifters with enhanced SST capabilities. The aim of both initiatives is to better understand and improve the uncertainty budget associated with drifter SST, and to demonstrate the value (or otherwise) of drifter HRSST as specified in the 'GHRSST Standard' (see Table 1). Of particular note is the need to establish a route to SI traceability for drifter SST measurements and to provide sufficient knowledge to quantify the stability of SST measurements reported by the global drifter array. It is important to understand in this context that early efforts by the DBCP and GHRSST in deploying and evaluating a significant number of HRSST drifters did not demonstrate a positive outcome, possibly because of the limited overlap between the HRSST drifter deployments and the availability of the high-quality AATSR satellite sensor on ENVISAT. However, with the launch of the SLSTR instrument on Sentinel-3, it is now appropriate and timely to revisit this evaluation activity.

The ESA FRM4STS Option 1 contract, being delivered by David Meldrum, includes the holding of an international workshop of both satellite and *in situ* practitioners to foster a dialogue that might lead to positive outcomes in terms of better understanding each other's needs and priorities, and in quantifying the uncertainty budget associated with drifter SST. A target outcome from the workshop is to develop best practice and a workplan for future activities, as discussed further below. The workshop was hosted by Luca Centurioni at Scripps on the 13th and 14th October 2016, and attracted 20 participants, including four out of the five current manufacturers of the SVP drifter. The only manufacturer unable to participate in person has nonetheless offered full co-operation with the aims of the project. The agenda is attached as Annex B.

1. Narrative

The workshop explored a number of issues:

- The methodology and needs of the satellite community in extracting SST from the space and *in situ* data and metadata at its disposal;
- A detailed discussion of the complexity of the SST variable and the multi-dimensional uncertainty budget and its implications for the buoy community (see Figure 1 and Table 2);
- Evolution of the 'standard' drifter design, end to end calibration, characterisation and traceability: current and historical practice in the drifter community;
- Experiences of both the satellite and drifter communities with HRSST drifter deployments and evaluation, including recalibration;
- The way forward towards better traceability, a better understanding of the value (or otherwise) of the HRSST drifter, and a better satellite SST product.

Overall, the agenda and discussion proceeded in an open and honest manner, and all agreed that the activity was worthwhile and should if possible be repeated in a year's time, when inter-comparison data from the Sentinel-3 SLSTR and from the projected EUMETSAT drifter study should be available. The meeting was also pleased to note that the pressing need for harmonization of the various drifter metadata datasets into a single searchable resource that was being actively addressed by David Meldrum, and that a comprehensive metadata dataset would be published early in 2017.

2. Main outcomes

The DBCP and GHRSST are asked to note that consensus was reached by the meeting in a number of areas:

- Acceptance in principle of the GHRSST Standard (Table 1) for global drifter SST implementation and reporting, subject to the eventual validation of its usefulness;
- Acknowledgement that the space component and the drifter array are elements of a composite network and that both are required for different but complementary purposes;
- Acceptance in principle of the requirement for SI traceability of drifter SST;
- Endorsement of the efforts to harmonize and publish available drifter metadata in a global dataset;
- Agreement that mechanisms must be found to maintain the harmonized metadata dataset in the future;
- Agreement that the routine reporting of diagnostic data (e.g. drifter internal temperature) and access to collateral information (e.g. wave spectral estimates) are important components of best practice for developing drifter capability in general and SI traceability in particular;
- Agreement that a working group be established to take forward the above and to further develop standards and best practices, possibly through reactivation of the DBCP's PP-GHRSST that had been disbanded in 2014 (see Annex C for its legacy ToRs);
- Agreement on the desirability of an online tool and access to data and metrics that would facilitate intercomparison of satellite and drifter SST: the development of such a tool to be an area for ongoing collaboration;
- Agreement to reconvene if possible in a year's time, possibly just ahead of the next DBCP session.

3. Requests to the DBCP

The DBCP is asked to:

1. Note and endorse the efforts of the workshop and its participants;
2. Advise the group as to its future workplan;
3. Consider how it might assist the work of group by, *inter alia*:
    a. Reactivating the PP-HRSST;
    b. Assigning sustained resources, possibly through JCOMMOPS, for the diligent maintenance of the drifter metadata database;
    c. Endorsing any standards and best-practice guidance that might be developed by the group;
4. Discuss whether the *modus operandi* and objectives of the group might in due course serve as a model for the timely implementation of best practice, not only for SST, but for other ECVs, particularly wave spectral data;
5. Report its deliberations with respect to all of the above to JCOMM, and seek additional resources as deemed necessary.

4. Closure of the session

All presentations made to the meeting will eventually be uploaded to the FRM4STS website (www.frm4sts.org). The Scripps team were thanked for the excellence of the local arrangements and the meeting closed at 1700 on 14 October 2016.

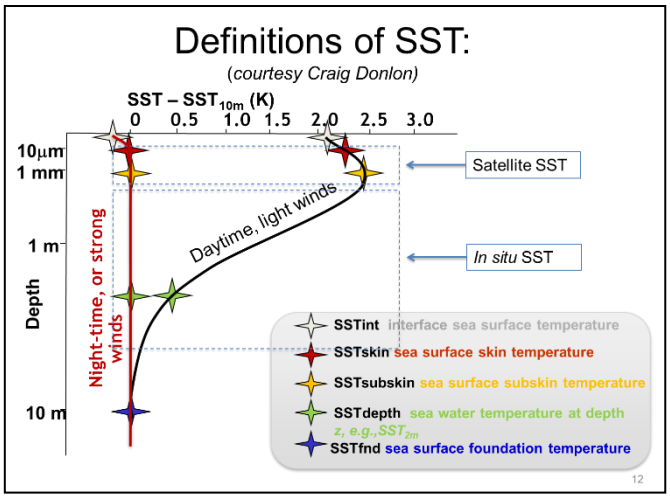

Figure 1: *A representation of the variation of SST with depth in calm and windy conditions*

- Hourly measurements
- Report design depth in calm water to ± 5 cm
- Report geographical location to ± 0.5 km or better
- SST total standard uncertainty ± 0.05K or better, resolution 0.01K
- Report time of SST measurements to ± 5 minutes

Table 1: *The GHRSST 'standard' for drifter HRSST reports*

- Sensor accuracy/characterisation
  - Calibrated or batch-qualified?
    - Before or after integration into drifter?
    - What errors are introduced in signal processing and message formatting?
  - Traceability to national standards
  - Sensor drift
    - Target obs system stability of 3 mK per year
    - What should be target for drifters?
  - Post-calibration seldom possible
- Positional and temporal accuracy
  - Errors in the above look like sensor errors to the analyst
- Depth uncertainty
  - 'SST' is a function of depth
  - How does the depth of the sensor vary?
  - Drogue on/off
  - How is the sensor output sampled/averaged?
- Metadata
  - Collection, distribution, archival
- What errors are introduced in downstream processing and archival?

Table 2: *Measurement uncertainty and traceability: issues to consider*

ANNEX B - AGENDA: A SCIENTIFIC AND TECHNICAL WORKSHOP ON TRACEABILITY OF DRIFTER SST MEASUREMENTS

Sea Cave Room, Scripps Institution for Oceanography, La Jolla, California: 13-14 October 2016

OBJECTIVE

To review scientific needs and historical practice in drifter SST measurement and **agree best practice** for the future, for adoption and ratification by the DBCP and the satellite SST community.

AGENDA

Day 1		
0900-0930	*Registration and coffee*	
0930-0945	Welcome by Scripps, NOAA and the DBCP	Luca Centurioni, Sidney Thurston and Jon Turton
0945-1015	Introduction, background to the workshop, its purposes and scope	David Meldrum, DMLtd
Session 1	**How the satellite community uses *in situ* SST: future needs**	
1015-1045	Contributions of drifter temperature measurements to satellite SST retrievals	Peter Minnett, U of Miami
1045-1115	Use of drifter measurements in satellite climate data records of SST	Chris Merchant, U of Reading
1115-1145	*Morning break*	
1145-1215	NOAA satellite SST products and harmonization with in situ data	Alexander Ignatov, NOAA
1215-1245	GHRSST and satellite SST uncertainty validation, early results from HRSST deployments	Gary Corlett, GHRSST PO
1245-1400	*Lunch*	
Session 2	**How the satellite community is progressing**	
1400-1430	ESA initiatives in support of Sentinel-3 and GHRSST	Craig Donlon, ESA
1430-1500	EUMETSAT initiatives: improving drifting buoy SST for Copernicus satellite validation	Anne O'Carroll, EUMETSAT
1500-1530	Discussion - satellite community priorities	Peter Minnett (facilitator)
1530-1600	*Afternoon break*	
Session 3	**Drifter SST background**	
1600-1630	Drifter SST – current and historical practice	David Meldrum
1630-1700	The Global Drifter Program: Observations of Sea Surface Temperature in the World's Oceans	Luca Centurioni, Scripps
1700-1730	Review of day's activities and objectives for Day 2	David Meldrum (facilitator)
1830-	*Ice-breaker and Hosted Dinner (partners welcome)*	
Day 2		
0900-0915	Introduction to Day 2: do we understand what we need to achieve!	David Meldrum
Session 4	**Practical progress with implementing HRSST**	
0915-0945	The Metocean HRSST sensor and its implementation	Bernie Petolas, Joubeh
0945-1015	Météo-France/E-SURFMAR practical experience with HRSST buoys	Gilbert Emzivat, Météo France
1015-1045	Météo-France/E-SURFMAR HRSST calibration and recalibration exercises	Paul Poli, Météo France
1045-1115	The evolution of the Pacific Gyre SST sensor: our view of the future	Andy Sybrandy, Pacific Gyre
1115-1145	*Morning Break*	

Session 5	**Agreeing what needs to be done**	
1145-1215	Manufacturer viewpoints	Craig Donlon and Paul Poli (facilitators)
1215-1245	Discussion, review and tabulation of requirements	David Meldrum (facilitator)
1245-1400	*Lunch*	
1400-1430	Traceability: how to meet requirements for T	Peter Minnett (facilitator)
1430-1500	Traceability: how to meet requirements for (x,y,z,t)	Bernie Petolas (facilitator)
1500-1530	Traceability: downstream processing, data and metadata dissemination and archival	Luca Centurioni (facilitator)
1530-1600	*Afternoon break*	
Session 6	**A model for best practice for adoption by DBCP**	
1600-1730	Discussion - a strawman proposal for endorsement by the DBCP	David Meldrum and Jon Turton
	Meeting close	

ANNEX C - PARTICIPANT LIST 2016

Participant		Affiliation	e-mail
Braasch	Lance	SIO	lbraasch@ucsd.edu
Centurioni	Luca	SIO	lcenturioni@ucsd.edu
Corlett	Gary	GHRSST	gkc1@le.ac.uk
Donlon	Craig	ESA	craig.donlon@esa.int
Emzivat	Gilbert	CMM	gilbert.emzivat@meteo.fr
Hormann	Verena	SIO	vhormann@ucsd.edu
Ignatov	Alexander	NOAA	alex.ignatov@noaa.gov
Le Garrec	Marc	CMM	marc.legarrec@meteo.fr
Meldrum	David	DML	davidmeldrumltd@gmail.com
Merchant	Chris	U of Reading	c.j.merchant@reading.ac.uk
Minnett	Peter	U of Miami	pminnett@rsmas.miami.edu
Montgomery	Glen	Pacific Gyre	gmontgomery@pacificgyre.com
O'Carroll	Anne	EUMETSAT	anne.ocarroll@eumetsat.int
Petolas	Bernie	Joubeh	bernie.petolas@joubeh.com
Poli	Paul	CMM	paul.poli@meteo.fr
Sybrandy	Andy	Pacific Gyre	asybrandy@pacificgyre.com
Thurston	Sidney	NOAA	sidney.thurston@noaa.gov
Turton	Jon	DBCP/JCOMM	jon.turton@metoffice.gov.uk
Watson	Connor	SIO	cwatson@ucsd.edu
Wingenroth	Jeff	DBI	jlwing55@gmail.com

ANNEX D - OUTCOMES FROM DBCP-32, LA JOLLA, 17-21 OCTOBER 2016

1. Introduction.

The drifter SST traceability workshop was intentionally held just in advance of DBCP-32 so that DBCP participants might be made aware of this new collaboration between the space and *in situ* sectors, and the Panel could if it wished endorse the recommendations flowing from the workshop and help build them into best-practice protocols for the future. A key recommendation, accepted by the Panel, was the reinstatement of the DBCP-GHRSST Pilot Project for HRSST as a practical means of ensuring that the value of HRSST drifters might be demonstrated and that they might eventually become the default option for the global drifter fleet. The relevant sections from the DBCP-32 Meeting Report are appended below. The full text of the report is at
http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=18436

2. Extract from the DBCP-32 Meeting Report

Evaluation of Need for Task Team for High resolution drifter SST measurements

Under this agenda item, Prof D Meldrum reported on the main outcomes of the ESA-supported drifter SST workshop that had been held at Scripps immediately prior to the current session, with the principal objective of improving the quality of drifter SST for use by the satellite community. Prof Meldrum reminded the Panel that it had initiated a dialogue with the satellite community in 2009 through interaction with the Group for High Resolution Sea Surface Temperature (GHRSST), and that in due course it had created the DBCP-GHRSST Pilot Project for HRSST (PP-HRSST). A significant number of HRSST drifters had been deployed under the auspices of this project, principally by E-SURFMAR and the UK Met Office, but a proper evaluation of the results had been hampered by the loss of ENVISAT and the high quality radiometer (AATSR) that it carried. Indeed the limited suite of intercomparison studies undertaken had failed to demonstrate any advantage in deploying HRSST sensors. Nonetheless, the advent of Iridium communications and the BUFR GTS code had led to a gradual migration towards HRSST, in terms of higher reported resolution if not absolute accuracy, being the default in drifter manufacture.

The Panel was pleased to note the new and strong interest of the space community in funding appropriate activities in the in situ sector, and thanked ESA and EUMETSAT for their commitment in this regard. In so doing, it invited the space sector to work closely with the Panel in defining and developing new opportunities for collaboration.

The GHRSST workshop, attended by 20 participants encompassing a wide range of interests in both the satellite and drifter SST communities, reached consensus on a number of issues, as listed below:

- Acceptance in principle of the GHRSST Standard (Table 1) for global drifter SST implementation and reporting, subject to the eventual validation of its usefulness;
- Acknowledgement that the space component and the drifter array are elements of a composite network and that both are required for different but complementary purposes;
- Acceptance in principle of the requirement for SI traceability of drifter SST;
- Endorsement of the efforts by Prof Meldrum to harmonize and publish available drifter metadata in a global dataset;
- Agreement that mechanisms must be found to maintain the harmonized metadata dataset in the future;
- Agreement that the routine reporting of diagnostic data (e.g. drifter internal temperature) and access to collateral information (e.g. wave spectral estimates) are important components of best practice for developing drifter capability in general and SI traceability in particular;

- Agreement that a working group be established to take forward the above and to further develop standards and best practices, possibly through reactivation of the DBCP's PP-GHRSST that had been disbanded in 2014;
- Agreement on the desirability of an online tool and access to data and metrics that would facilitate intercomparison of satellite and drifter SST: the development of such a tool to be an area for ongoing collaboration;
- Agreement to reconvene if possible in a year's time, possibly just ahead of the next DBCP session.

▪ Hourly measurements ▪ Report design depth in calm water to ± 5 cm ▪ Report geographical location to ± 0.5 km or better ▪ SST total standard uncertainty ± 0.05K or better, resolution 0.01K ▪ Report time of SST measurements to ± 5 minutes

Table 1: *The GHRSST 'standard' for drifter HRSST reports*

Following further discussion at the workshop, it was agreed to request a number of actions from the DBCP at its current session, namely:

- Note and endorse the efforts of the workshop and its participants;
- Advise the group as to its future workplan;
- Consider how it might assist the work of group by, inter alia:
  a. Reactivating the PP-HRSST;
  b. Assigning sustained resources, possibly through JCOMMOPS, for the diligent maintenance of the drifter metadata database;
  c. Endorsing any standards and best-practice guidance that might be developed by the group;
- Discuss whether the *modus operandi* and objectives of the group might in due course serve as a model for the timely implementation of best practice, not only for SST, but for other ECVs, particularly wave spectral data;
- Report its deliberations with respect to all of the above to JCOMM, and seek additional resources as deemed necessary.

These requests were discussed both at the DBCP Executive Board and during open session and were broadly approved. In particular it was agreed to reinstate PP-HRSST with immediate effect (but without a budget), and Prof Meldrum was asked to act as interim chair, to revise the ToRs, suggest PP membership and draft a workplan and budget as soon as possible, for consideration at the next meeting of the Executive Board. (Action: Prof Meldrum).

The Panel strongly endorsed the concept of a global drifter metadata database, a concept that already formed part of the mission and workplan for JCOMMOPS, and agreed that it should receive heightened priority and visibility within the JCOMMOPS operating principles. (Action: JCOMMOPS).

The Panel agreed to highlight its activities and aspirations with regard to Pilot Projects, through the OCG, to the next JCOMM session and to seek their guidance for further developing these activities.

In closing this agenda item, the Panel thanked Drs Centurioni and Donlon and Prof Meldrum for their efforts in bringing the space and in situ communities closer together, and asked to kept closely informed of future developments and opportunities. The complete report of the workshop is available as DBCP-32-Ref Report on SST : Scientific and Technical Workshop on Traceability of Drifter SST Measurements,
http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=17897

ANNEX E - A SECOND SCIENTIFIC AND TECHNICAL WORKSHOP ON TRACEABILITY OF DRIFTER SST MEASUREMENTS

A meeting hosted at IFREMER on 13 November 2017 under the auspices of the ESA FRM4STS initiative

Report by David Meldrum

1. Narrative

As at the previous workshop (Scripps, October 2016, Annex A *et seq*), the workshop explored a number of issues:

- The methodology and needs of the satellite community in extracting SST from the space and *in situ* data and metadata at its disposal;
- A detailed discussion of the complexity of the SST variable and the multi-dimensional uncertainty budget and its implications for the buoy community (see Figure 1 and Table 2);
- Evolution of the 'standard' drifter design, end to end calibration, characterisation and traceability: current and historical practice in the drifter community;
- Experiences of both the satellite and drifter communities with HRSST drifter deployments and evaluation, including recalibration;
- The way forward towards better traceability, a better understanding of the value (or otherwise) of the HRSST drifter, and a better satellite SST product;
- The sustained support for better drifter SST, through continued practical evaluation and the maintenance of the metadata database to better inform climate studies;
- The development of best practice for drifter SST.

2. Main outcomes

The DBCP and GHRSST were asked to note that consensus was reached by the meeting in a number of areas:

- Acceptance in principle of the GHRSST Standard (Table 1) for global drifter SST implementation and reporting, subject to the eventual validation of its usefulness;
- Recognition (through a preliminary study by Gary Corlett) that drifter HRSST reports were indeed driving down the uncertainty in satellite SST retrievals;
- Acknowledgement that the space component and the drifter array are elements of a composite network and that both are required for different but complementary purposes;
- Acceptance in principle of the requirement for SI traceability of drifter SST;
- Endorsement of the efforts to harmonize and publish available drifter metadata in a global dataset;
- Agreement that mechanisms must be found to maintain the harmonized metadata dataset in the future;
- Agreement that the routine reporting of diagnostic data (e.g. drifter internal temperature) and access to collateral information (e.g. wave spectral estimates) are important components of best practice for developing drifter capability in general and SI traceability in particular;
- Agreement that a working group be established to take forward the above and to further develop standards and best practices, possibly through reactivation of the DBCP's PP-GHRSST that had been disbanded in 2014 (see Annex F for its ToRs);

3. Requests to the DBCP

The DBCP is asked to:

- Note and endorse the efforts of the workshop and its participants;
- Advise the group as to its future workplan;
- Consider how it might assist the work of group by, *inter alia*:
    - Reactivating the PP-HRSST;
    - Assigning sustained resources through JCOMMOPS for the diligent maintenance of the drifter metadata database;
    - Endorsing any standards and best-practice guidance that might be developed by the group;
- Discuss whether the *modus operandi* and objectives of the group might in due course serve as a model for the timely implementation of best practice, not only for SST, but for other ECVs, particularly wave spectral data;
- Report its deliberations with respect to all of the above to JCOMM, and seek additional resources as deemed necessary.

4. Closure of the session

All presentations made to the meeting have been uploaded to the FRM4STS website (www.frm4sts.org). The IFREMER team were thanked for the excellence of the local arrangements and the meeting closed at 1800 on 13 November 2017.

ANNEX F - AGENDA: A SCIENTIFIC AND TECHNICAL WORKSHOP ON TRACEABILITY OF DRIFTER SST MEASUREMENTS

Salon de l'Océan, Ifremer, Brest, France: 13 November 2017

OBJECTIVE

To review scientific needs and historical practice in drifter SST measurement and agree best practice for the future, for adoption and ratification by the DBCP and the satellite SST community.

DRAFT AGENDA

Timings	Title	Speaker
0900-0930	*Registration*	
0930-0945	Welcome by JCOMMOPS, the DBCP and ESA	Mathieu Belbéoch, Jon Turton, Craig Donlon
0945-1015	Introduction, background to the workshop, its purposes and scope, review of the La Jolla workshop, expected outcomes	David Meldrum (DMLtd)
Session 1	**How the satellite community uses *in situ* SST: its needs for the future**	Chair: Anne O'Carroll (EUMETSAT)
1015-1030	Contributions of drifter temperature measurements to satellite SST retrievals and to the climate record	Chris Merchant (U of Reading) Peter Minnett (U of Miami)
1030-1045	Usage of *in situ* SST measurements in match-up databases and Sentinel-3 SLSTR cal/val	Jean-François Piollé (Ifremer)
1045-1100	GHRSST and satellite SST uncertainty validation, results from HRSST deployments, the need for traceability	Gary Corlett (GHRSST PO)
1100-1130	*Coffee*	
Session 2	**How the satellite community is progressing**	Chair: Jean-François Piollé (Ifremer)
1130-1145	ESA initiatives in support of Sentinel-3 and GHRSST	Craig Donlon (ESA)
1145-1200	EUMETSAT initiatives: improving drifting buoy SST for Copernicus satellite validation: outcomes of the ITT exercise	Anne O'Carroll (EUMETSAT)
1200-1215	Discussion - satellite community priorities	Craig Donlon (facilitator)
Session 3	**Drifter SST background**	Chair: Pierre Blouch
1215-1230	Drifter SST – current and historical practice, the roll-out of HRSST	David Meldrum (DMLtd)
1230-1245	The Global Drifter Program: current and future plans, latest HRSST results	Lance Braasch and Verena Hormann (Scripps)
1245-1345	*Lunch*	
Session 4	**Practical progress with implementing traceable HRSST**	Chair: Bernie Petolas
1415-1430	HRSST-2 recalibration: results from serendipitous recoveries	Paul Poli (Météo France), David Meldrum (DMLtd)
1430-1500	HRSST implementations by other manufacturers: an open forum discussion	Jeff Wingenroth (DBI), Bernie Petolas (Metocean), Luca Centurioni (Scripps), Yves Degrés (NKE)
Session 5	**Progress with ESA Fiducial Reference Measurements activities**	Chair: Gary Corlett (GHRSST PO)
1500-1515	Report on progress with FRM4STS Option 1 – drifter SST	David Meldrum (DMLtd)
1515-1530	Mining the archive for drifter SST metadata	Lovro Valcic (Bruncin)
1530-1600	*Coffee*	
1600-1615	ESA FRM activities: extending FRM to other drifter observations	Craig Donlon (ESA)
Session 6	**Agreeing what needs to be done**	
1615-1630	Manufacturer and end-user viewpoints	Craig Donlon and Jeff Wingenroth (facilitators)
1630-1645	Reactivation of the DBCP-GHRSST Pilot Project	David Meldrum (facilitator)
1645-1715	Discussion – best practice, a strawman proposal for endorsement by the DBCP	David Meldrum and Jon Turton (facilitators)
	Meeting close	
TBA	*Self-funded Dinner at La Maison de l'Océan*	

ANNEX G - PARTICIPANT LIST 2017

A scientific and technical workshop on traceability of drifter SST measurements

Salon de l'Océan, Ifremer, Brest, France: 13 November 2017

Name	e-mail
Mathieu BELBÉOCH	belbeoch@jcommops.org
Christophe BILLON	christophe.billon@meteo.fr
Pierre BLOUCH	Pierre.Blouch@e-surfmar.eu
Lance BRAASCH	lbraasch@ucsd.edu
Luca CENTURIONI	lcenturion@ucsd.edu
Gary CORLETT	gkc1@le.ac.uk
Yves DEGRÉS	ydegres@nke.fr
Craig DONLON	craig.donlon@esa.int
Gilbert EMZIVAT	gilbert.emzivat@meteo.fr
Dan HAYES	hayesdan@cyprus-subsea.com
Verena HORMANN	vhormann@ucsd.edu
Long JIANG	ljiang@wmo.int
Marc LE GARREC	marc.le.garrec@shom.fr
David MELDRUM	dtm@sams.ac.uk
Nolwenn NANO-ASCIONE	nolwenn.nano-ascione@meteo.fr
Anne O'CARROLL	anne.ocarroll@eumetsat.int
Bernie PETOLAS	bpetolas@ns.sympatico.ca
Jean-François PIOLLÉ	Jean.francois.piolle@ifremer.fr
Pierre-Marie POULAIN	ppoulain@inogs.it
Brice ROBERT	brobert@cls.fr
Stéphane SAUX PICART	stephane.sauxpicart@meteo.fr
Sidney THURSTON	sidney.thurston@noaa.gov
Jon TURTON	jon.turton@metoffice.gov.uk
Lovro VALCIC	lovro.valcic@gmail.com
Jeff WINGENROTH	jlwing55@gmail.com

ANNEX H - DISCUSSIONS AND ACTIONS STEMMING FROM THE DBCP SESSION AT BREST, NOVEMBER 2017

EXTRACT FROM THE DBCP MEETING REPORT

7.1 Pilot Project on High Resolution Sea Surface Temperature (PP-HRSST)

7.1.1 Prof David Meldrum reported on the history and recent developments of the DBCP Pilot Project on High Resolution Sea Surface Temperature (PP-HRSST). He informed the Panel regarding a dialogue between the DBCP and the Group for High Resolution Sea Surface Temperature (GHRSST). At the 26th session of the DBCP, 27 - 30 September 2010, Oban, United Kingdom, it was recognized that drifter SST was critical for the validation of satellite-derived SST, and that the resolution and accuracy of currently reported drifter SST was inadequate.

7.1.2 The Panel decided to establish a Pilot Project for HRSST, overseen by a Steering Group (SG), and with a defined workplan and a three-year duration. Despite considerable investment by the Panel, ESURFMAR and the Met Office, initial deployments of HRSST drifters did not demonstrate a significant improvement in satellite SST retrievals, largely because of the failure of ENVISAT during the evaluation phase. Furthermore, the satellite community proved unable to contribute to the exercise. Consequently, the Panel suspended PP-HRSST's activities at its 30th DBCP session, Weihai, China 27 – 31 October 2014.

7.1.3 The Panel noted that more recently, the European satellite community has become proactive in supporting the rollout and evaluation of HRSST drifters through specific funded actions by ESA and EUMETSAT.

7.1.4 The Panel was requested to reactivate the PP-HRSST, and that a revised ToR for membership and workplan be approved. DBCP Panel approved the work plan and ToR[1] and, Prof David Meldrum was appointed as Chair of PP-HRSST.

Action 7.1/1: Provide a list of PP-HRSST members. Chair will relate with David Meldrun and send letters out to the EUMETSAT and ESA ***(David Meldrum/Chair; Feb 2018)***
Action 7.1/2: Approve PP-HRSST budget request for travel support ***(DBCP-EXB; March 2018)***
Action 7.1/3: Integrate the metadata database from HRSST to the JCOMMOPS database ***(JCOMMOPS/TC; DBCP-34)***

OUTCOMES FROM THE DBCP EXECUTIVE BOARD, 22 FEBRUARY 2018

7.1.1 The draft membership of the PP-HRSST SG was approved, and the DBCP chair will write formal letters of invitation as required. Currently the membership is as follows:

Chair: D Meldrum appointed *pro tem* by the Panel
Vice chair (DBCP appointee, TBA)
DBCP chair (ex officio) - *Jon Turton*
DBCP TC (ex officio) - *Long Jiang*
Buoy programme manager(s) - *Sidney Thurston*
Representatives from the satellite community - *Craig Donlon*
Buoy data analyst(s) - *Rick Lumpkin*
Buoy manufacturer(s) - *Bernie Petolas*
WMO CIMO representative(s)
GHRSST representative(s) - *Anne O'Carroll*
Oceanographic user(s) - *Luca Centurioni*
Secretariat (ex officio)

7.1.2 The requested travel budget of up to USD5k per year was approved.

1 http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=20424

ANNEX I - DRAFT TORS, WORKPLAN AND MEMBERSHIP OF THE RECONSTITUTED DBCP PILOT PROJECT FOR HRSST

BACKGROUND

Following a dialogue between the DBCP and the Group for High Resolution Sea Surface Temperature (GHRSST), the 26th session of the DBCP (Oban, 2010) recognised that drifter SST was critical for the validation of satellite-derived SST, and that the resolution and accuracy of currently reported drifter SST was inadequate. The Panel accordingly decided to establish a Pilot Project for HRSST, overseen by a Steering Group (SG), and with a defined workplan and a three-year duration. Despite considerable investment by the Panel, ESURFMAR and the Met Office, initial deployments of HRSST drifters did not demonstrate a significant improvement in satellite SST retrievals, largely because of the failure of ENVISAT during the evaluation phase. Furthermore, the satellite community proved unable to contribute to the exercise in material terms. Accordingly, with regret, the Panel suspended PP-HRSST's activities at its 30th session (Weihai, 2014).

More recently, the European satellite community has become proactive in supporting the rollout and evaluation of HRSST drifters through specific funded actions by ESA and EUMETSAT. The Panel therefore asked that PP-HRSST be reactivated, and that a revised SG membership and workplan be proposed for consideration by the DBCP EB in advance of its 33rd session (Brest, 2017)

1. Revised ToRs and Workplan

A draft of the Terms of Reference of the SG, its possible membership, and a workplan are listed below.

2. Terms of Reference of the SG

1. The SG will work closely with the GHRSST to:

    a. agree and review instrumentation standards and achieve consensus on best practice for drifter SST;
    b. identify optimal target ocean areas that will be likely to deliver a high number of matchups and demonstrate the impact of drifter HRSST within the project lifespan;
    c. secure sufficient funding to allow the project to proceed expeditiously;
    d. work with buoy agencies, the space community and manufacturers to allow a sufficient number of upgraded HRSST drifters to be procured and deployed in the chosen target area(s);
    e. ensure that HRSST data flow onto the GTS and are clearly identified as HRSST in associated meta-data and/or bulletin headers;
    f. assist in the analysis of the impact of the data on satellite SST retrievals;
    g. report to the Panel at its annual sessions and in the published literature.

2. The SG chair and vice chair will be appointed by the Panel, and will recruit other members of the team, drawn from the satellite community, buoy operators, manufacturers, scientists, GHRSST, end-users and other interested parties.

3. The SG chair will convene annual meetings of the SG, will communicate regularly with SG members by e-mail, and will report annually to the Panel.

Workplan

Year 1:

1. Form SG and agree on working procedures
2. Recruit additional members as required, including key players from within the GHRSST and the satellite community
3. Work closely with ESA and EUMETSAT to ensure that their emerging HRSST drifter activities are properly assimilated within DBCP aims and objectives
4. Ensure that proposed technology solutions adequately address GHRSST requirements
5. Identify the cost of an HRSST upgrade and identify buoy operators and manufacturers willing to participate in the PP
6. Present the PP to the annual GHRSST science meeting and secure GHRSST support, particularly for HRSST data evaluation activities
7. Work closely with JCOMMOPS to establish protocols for the maintenance of the drifter SST meta-data database established within the ESA initiative
8. Establish consensus for best practice for drifter SST for endorsement by the DBCP and GHRSST
9. Draw up a detailed costed implementation plan for approval by DBCP

Year 2:

1. Complete Year 1 work items
2. Work with the satellite community to identify mutually beneficial deployment areas and assist where possible with the deployment of HRSST drifters
3. Oversee calibration/recalibration protocols
4. Ensure that HRSST data are properly identified and distributed on the GTS and are appropriately archived
5. Monitor buoy deployments, data flow and data ingestion by GHRSST
6. Present at GHRSST science meeting
7. Work with the satellite community and GHRSST to identify future activities and funding opportunities
8. Make interim report to DBCP-XXXV

Year 3:

1. Continue with Year 1 and 2 work items
2. Continue deployments as far as possible
3. Attempt recovery of failed or failing buoys for analysis and sensor post-calibration
4. Review technology and data-flow performance and make recommendations as appropriate
5. Work with GHRSST to identify impacts and shortcomings of PP
6. Agree recommendations for future activities, if any
7. Report to GHRSST science meeting
8. Final report to DBCP-XXXVI
9. Work with GHRSST on a journal article
10. Disband

Membership

Chair: D Meldrum appointed *pro tem* by the Panel
Vice chair (DBCP appointee, TBA)
DBCP chair (ex officio)
DBCP TC (ex officio)
Buoy programme manager(s) - TBA

Representatives from the satellite community - TBA
Buoy data analyst(s) - TBA
Buoy manufacturer(s) - TBA
WMO CIMO representative(s)
GHRSST representative(s) - TBA
Oceanographic user(s) - TBA
Secretariat (ex officio)

-END OF DOCUMENT-