A new challenge: towards Fiducial Reference Measurements (FRM) from drifting buoys for satellite Sea-Surface Temperature Calibration and Validation

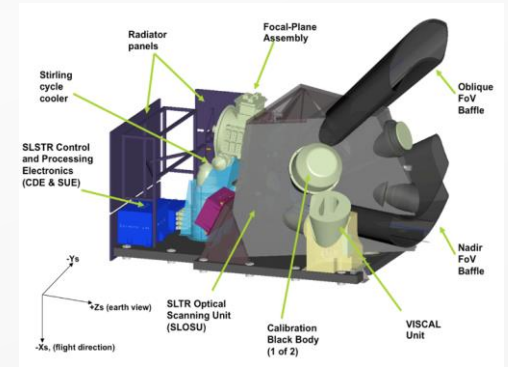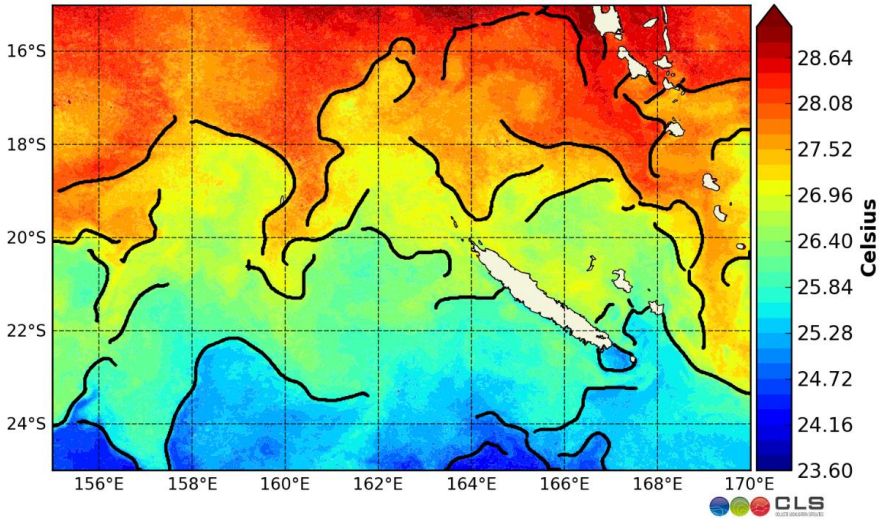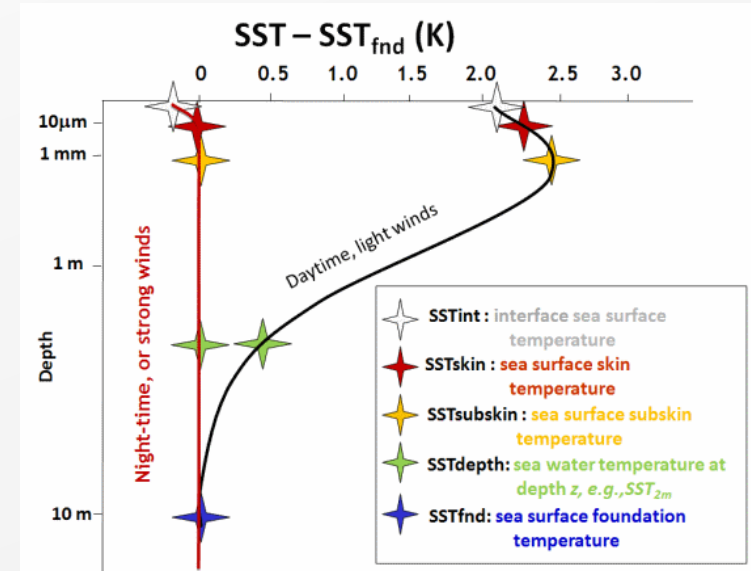Marc Lucas, CLS

Anne O'Carroll, Eumetsat

TRUSTED

Copernicus
Europe's eyes on Earth

Background: Satellite SST

CLS SST Data 20/05/2016

$SST - SST_{fnd}$ (K)

Important to put an error bar on the map thanks to In-Situ data
Complicated because of:

- atmosphere
- skin effect
- Satellite sensor footprint
- In situ sensor uncertainty
- Colocation in time & space

ESA FRM4STS: new specifications

1. Investigation of requirements for Satellite Surface Temperature calibration requirements

2. Work package dedicated to ocean surface data (led by D.Meldrum)

3. Recommendation formulated on improvements needed to Surface Velocity Profiling (SVP) buoy array

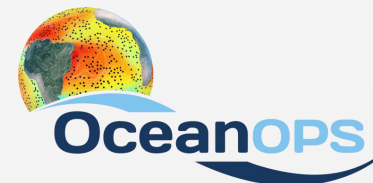4. the output report 'Towards SI traceability for non-recoverable SST FRM instruments'

FRM4STS

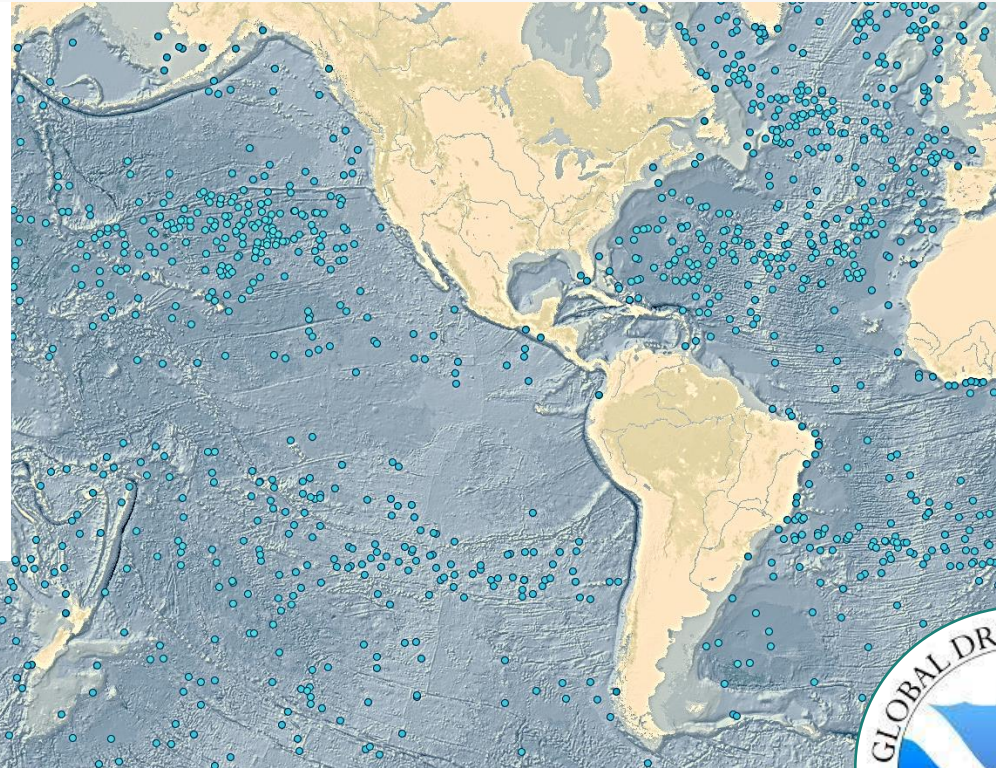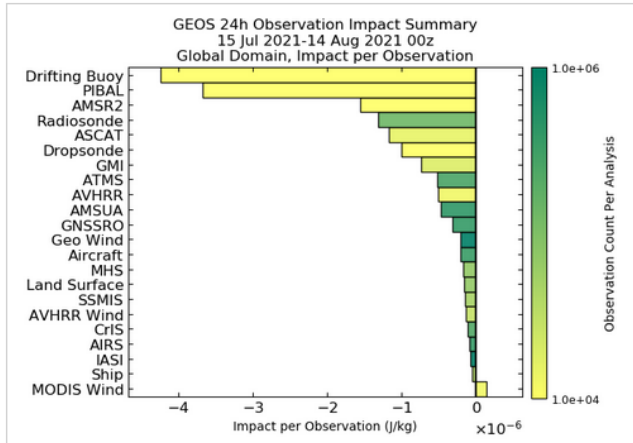# TRUSTED: towards FRM and achievements from 2018-2021

1. Deploy sensors with higher sensitivity and reduced response time

2. Use the highest GNSS positioning accuracy

3. Include 2 sensors for Dual temperature measurement

4. Use of the Bennet/Hoge-2 equation to convert resistance to temperature

5. Include temperature depth measurement though the use of an HP sensor

6. Use Higher sampling frequency (1 second)

7. Improve the metrology procedure for sensor calibration and verification

8. Improve metadata traceability and storage

DBCP-37 S&T workshop

Significant Improvements in DBCP SVP network

GEOS 24h Observation Impact Summary
15 Jul 2021-14 Aug 2021 00z
Global Domain, Impact per Observation

Sea Level Pressure (SLP) Observations
Impact on Improving Numerical Weather Predictions (NWP)
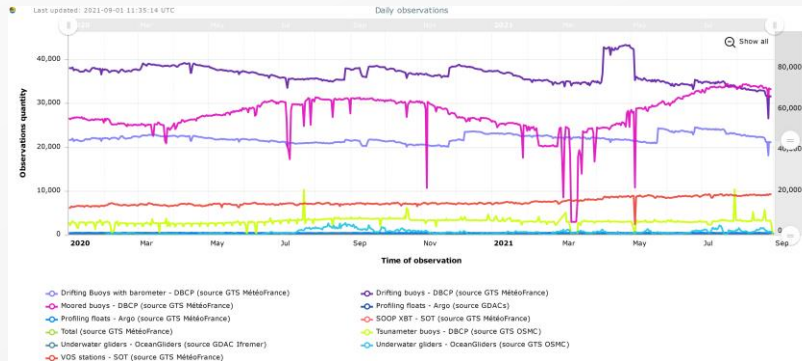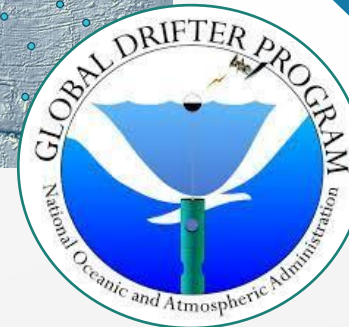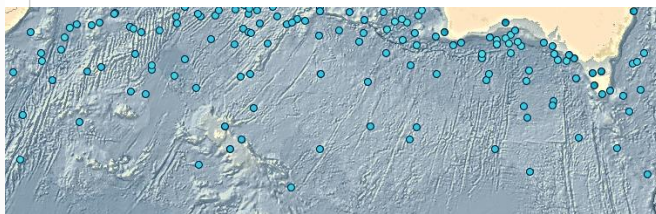
DBCP-37 S&T workshop

Moving Forward:

- Science Review workshop held in March 2021 (https://www.cls-telemetry.com/workshop-high-resolution-sea-surface-temperature-hrsst-drifting-buoys-for-satellite-sst/)

- 6 sessions with about 30 attendees per session

- Recommendations include:

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

    - for the GHRSST and DBCP communities to formulate an agreed FRM standard for drifters (e.g. could be HRSST + SI + uncertainty per buoy + metadata)

    - continuing deployments

    - Improvement on the metadata provision/distribution in coordination with Oceanops

    - Address the Ice Surface Temperature data gap

DBCP-37 S&T workshop
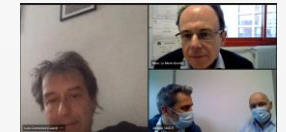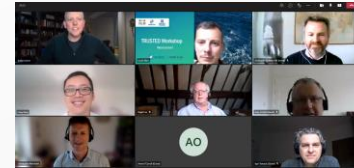
HRSST-2 specification:

- Original WMO DBCP / GHRSST pilot project (2013)

- Total standard uncertainty in measured SST < 0.05K

- Plus a request for:

- Searchable / accessible global metadata information

- GHRSST Task Team activities on HRSST continue

- Coordination with DBCP and GDP very much appreciated!

FRM specification:

FRM drifters are needed as a specific sub-set of traceable buoy SST for high-accuracy satellite validation

- › E.g. if we see a discrepancy between satellite / FRM, the use of FRM means that we should be confident that the issue is with the satellite data
- › FRM drifting buoys: smaller sub-set of buoys than HRSST drifters used by GHRSST and are funded by the EU Copernicus programme (through the TRUSTED project)

Draft specification for FRM drifters are in progress (within the Copernicus TRUSTED project managed by EUMETSAT):

- › HRSST-2 specification plus: :

  - Calibration per sensor in laboratory independent of sensor manufacture.
  - Measurement metadata and improved QC in both real time (online) and post-processing (offline) procedures.
  - Definition of uncertainty budget for the buoy measurements including a component on drift analysis.
  - Coordination with National Metrology Institutes for approval of traceability to SI and FRM standards.
  - Post-deployment calibration and analysis if opportunity.

- › Documentation on route to establishing FRM for drifters and implementation in operational procedures will be organised as part of the TRUSTED extension activities.

  EUMETSAT analysis continues on TRUSTED / FRM.
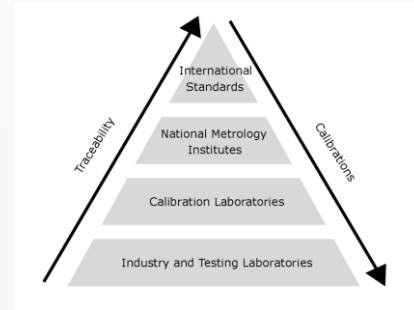
IST data Gap

- Lack of observation in sea-ice

- Harsh condition

- sea-ice in situ measurements critical for developing and validating new operational Copernicus Sentinel-3 sea-ice Surface Temperature products

- Snow effect is a big obstacle (1m thermistor pole)

- What can be done to bring down the cost to increase sampling

DBCP-37 S&T workshop

METADATA FLOW:

- improve QC and metadata information within operational buoy SST data streams and products

  - Validation by Meteo France for GTS

  - Data stored on GDAC

  - Metadata archived by OceanOps

SUMMARY & NEXT STEPS:

- HRSST and TRUSTED provide valuable data to Copernicus satellite SST validation activities.

- Excellent coordination with DBCP and GDP very welcome and should be continued.

- Continuation of TRUSTED planned for next 3 years – continuation of current service also with a focus on high-latitude SST;

- evolution of BRST to account for workshop recommendations based on DBCP drifter;

- further progress towards FRM standard and updated operational QC procedures;

- specification and development of sea-ice ST drifter.

DBCP-37 S&T workshop

Thank You

Contact: mlucas@groupcls.com

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