Geneva, 01/11/22

DBCP-38 S&T workshop

Uncertainty traceability diagrams for improving the metrology of Fiducial Reference Measurements drifting buoys for satellite validation

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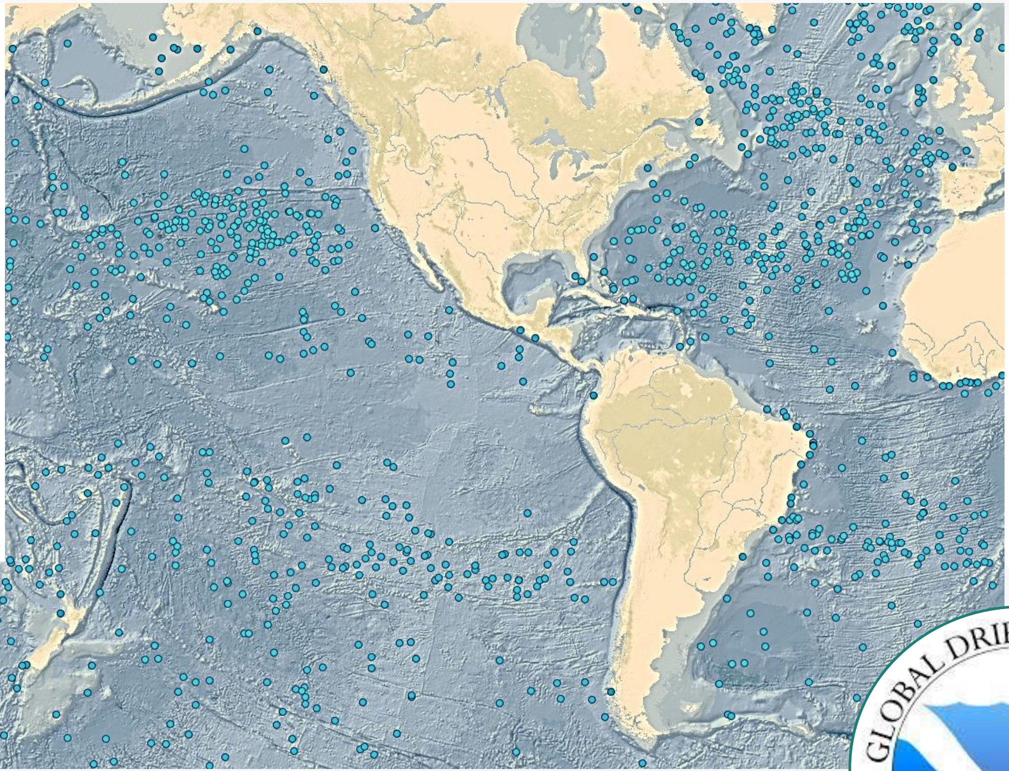
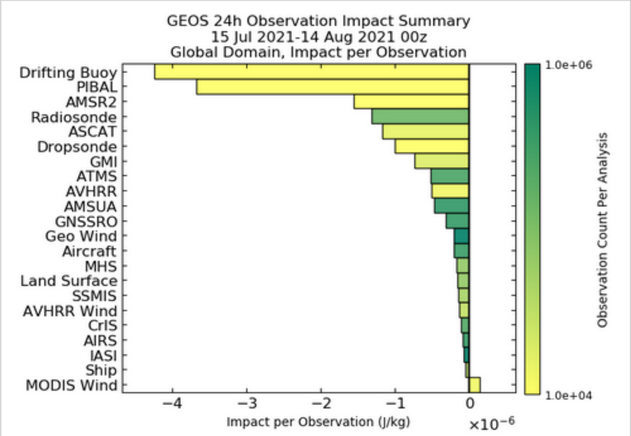
TRUSTED

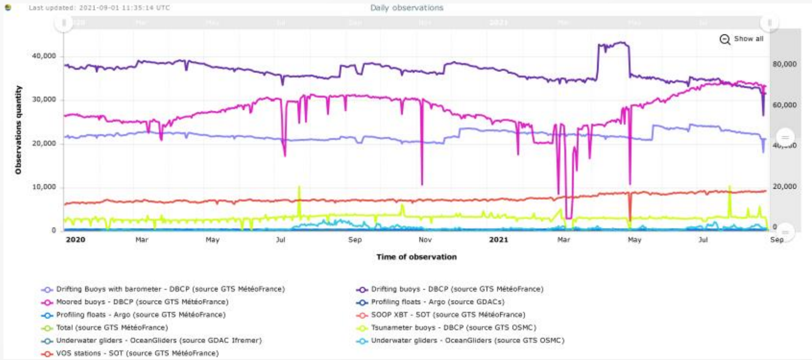
Copernicus
Europe's eyes on Earth

DBCP SVP network: a unique resource





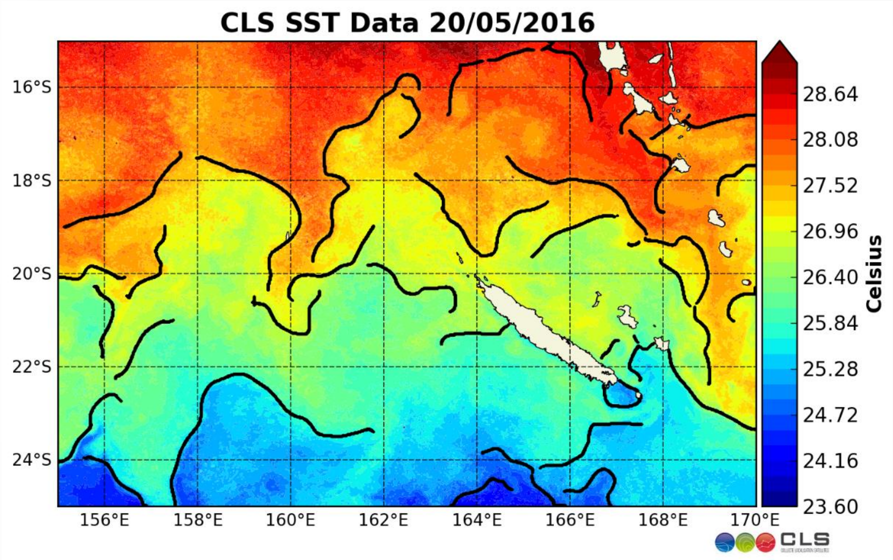
Sea Level Pressure (SLP) Observations
Impact on Improving Numerical Weather Predictions (NWP

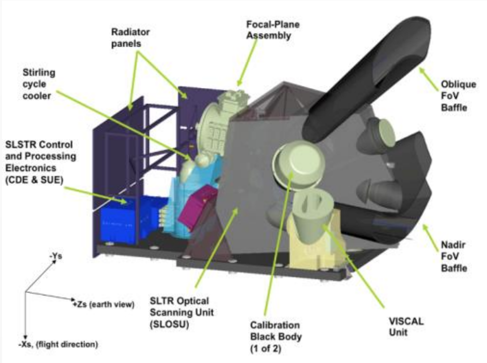


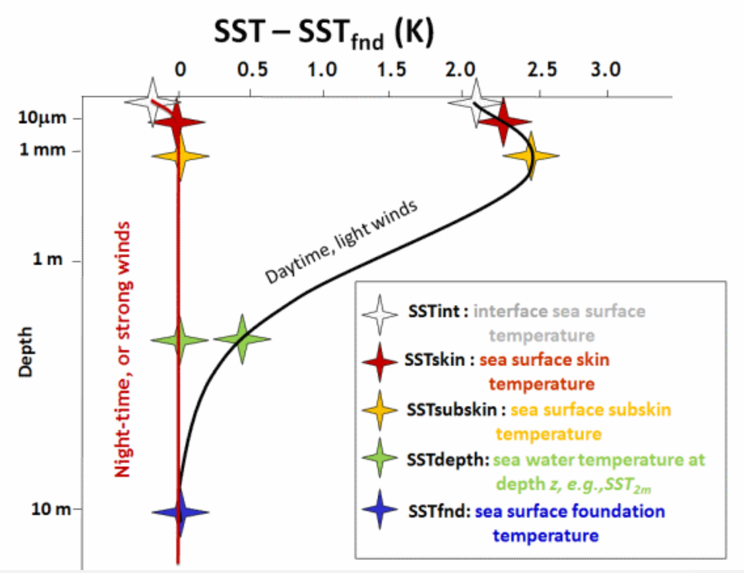
GLOBAL DRIFTER PROGRAM
National Oceanic and Atmospheric Administration

DBCP WMO - IOC DATA BUOY COOPERATION PANEL

Background: Satellite SST







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

TRUSTED: mission brief

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

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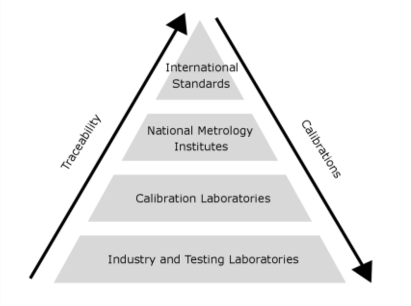
FRM specification:

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 those 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 activities managed by EUMETSAT):

- DBCP/GHRSST 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 included in TRUSTED phase 2 activities.
- EUMETSAT analysis continues TRUSTED / FRM.

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Metrology: quantification of uncertainties

- **A calibration in two steps:**
  - MoSens HRSST Sensors Calibration with an uncertainty budget.
  - Verification within the buoys with a final uncertainty budget.

$$U_C = 2\sqrt{u_{tref}^2 + (S_{rep} + u_{bath})^2 + S^2}$$

Uncertainty budget of MoSens calibration	N° 4656 (mK)	N° 4658 (mK)
Reference temperature (u_{tref})	0.9	0.9
Bath stability (u_{Bath})	0.3	0.3
MoSens reproducibility (S)	1.7	0.9
MoSens repeatability (S_{rep})	0.3	0.3
Expended uncertainty (U_C)	4.0	2.8

Uncertainty budget of HRSST measurements	N° Y17-07 (mK)	N° Y18-24 (mK)
Reference temperature (u_{tref})	0.9	0.9
Bath stability (u_{Bath})	0.3	0.3
Buoy HRSST reproducibility (S)	2.5	3.4
Buoy HRSST repeatability (S_{rep})	0.5	0.5
Expended uncertainty (U_C)	5.5	7.2

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Metrology: Post Deployment Calibration

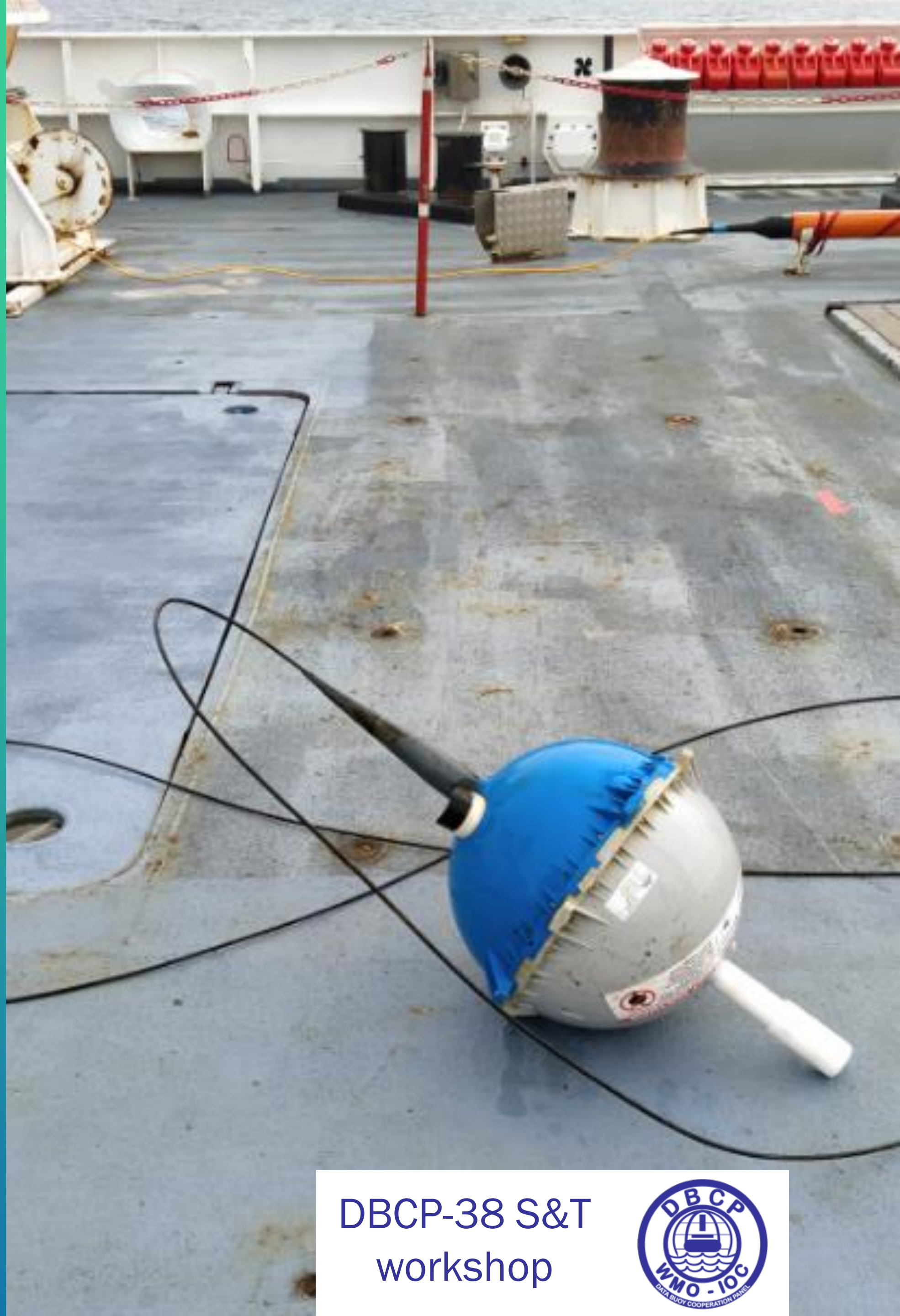
- 3 buoys recovered:
  - 1 onshore Iceland (damaged)
  - 1 east of Iceland (intact)
  - 1 moored in the North Sea

- Quantification of the temperature sensor's drift:

  ≈ 4 mK/year

Tref standard uncertainty :	0.001	°C
Bath stability standard uncertainty :	0.000	°C
Reproducibility buoy n° 025 :	0.006	°C
Repeatability buoy n° 025 :	0.001	°C
Verification expanded uncertainty:	0.012	°C

Tref standard uncertainty :	0.001	°C
Bath stability standard uncertainty :	0.000	°C
Reproducibility buoy n° 017 :	0.005	°C
Repeatability buoy n° 017 :	0.001	°C
Verification expanded uncertainty:	0.011	°C



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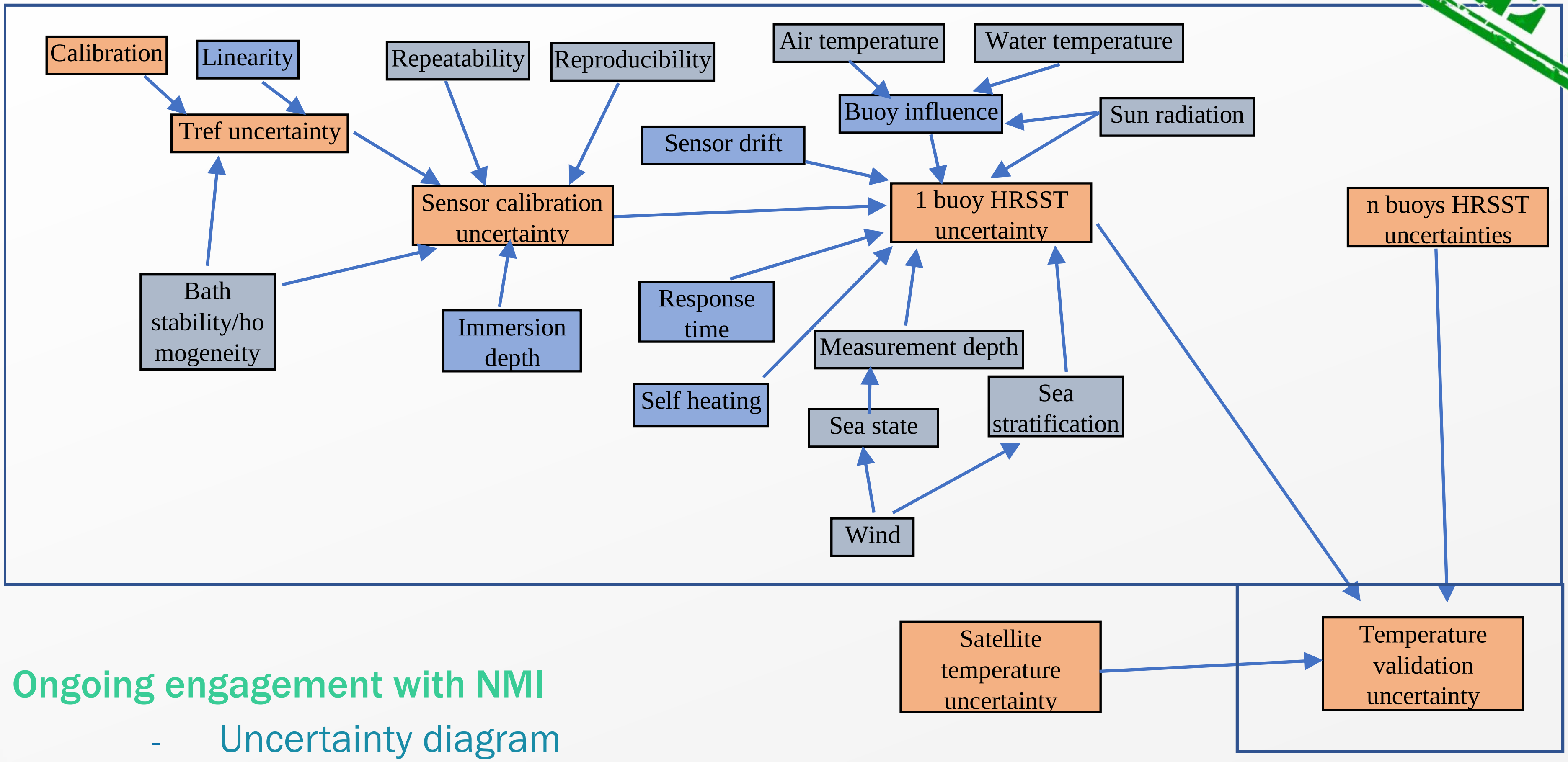
Metrology: traceability Diagram & engagement

NEW



Ongoing engagement with NMI

- Uncertainty diagram
- Metrology procedure approval

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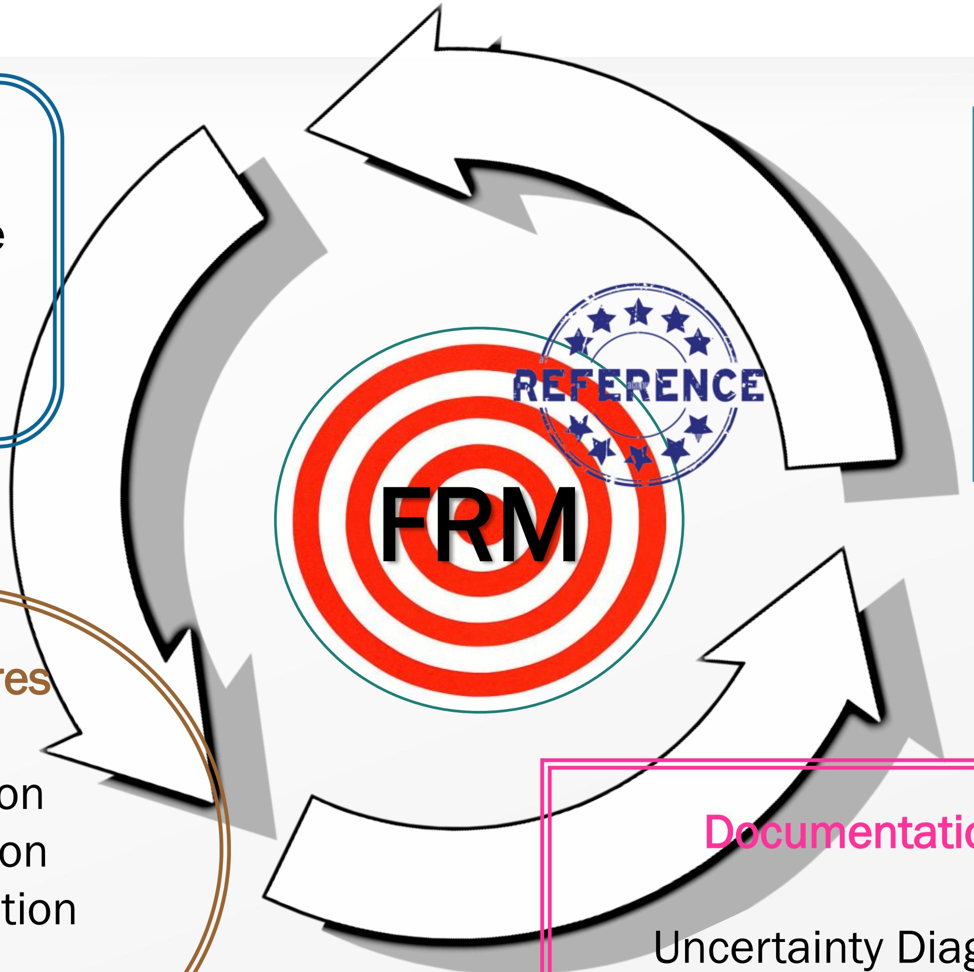
SST FRM in TRUSTED



Hardware

Low Response Time
Modular Design
High precision

Data Management

Archiving
Acessibility
Real Time metadata update

Procedures

Calibration
Verification
Re-Calibration
QC
Deployment

Documentation

Uncertainty Diagram
QC process
Calibration procedure
Sensor specification

Thank You

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