Sentinel-3 SLSTR ongoing cal/val activities for sea surface temperature measurements

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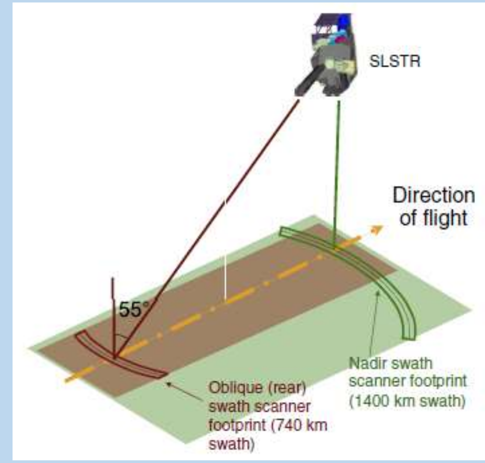
Introduction

SST is the main variable obtained from SLSTR instrument and one of the key variables in global climate monitoring. Therefore, there is a very stringent requirement on producing SST retrievals from SLSTR. Absolute accuracy should be better than 0.3 K and with a temporal stability of 0.1 K/decade. To enable and confirm such a stringent requirements, set of Cal/Val and monitoring activities are implemented for Sentinel-3/SLSTR mission on Level-0, Level-1 and Level-2 products.



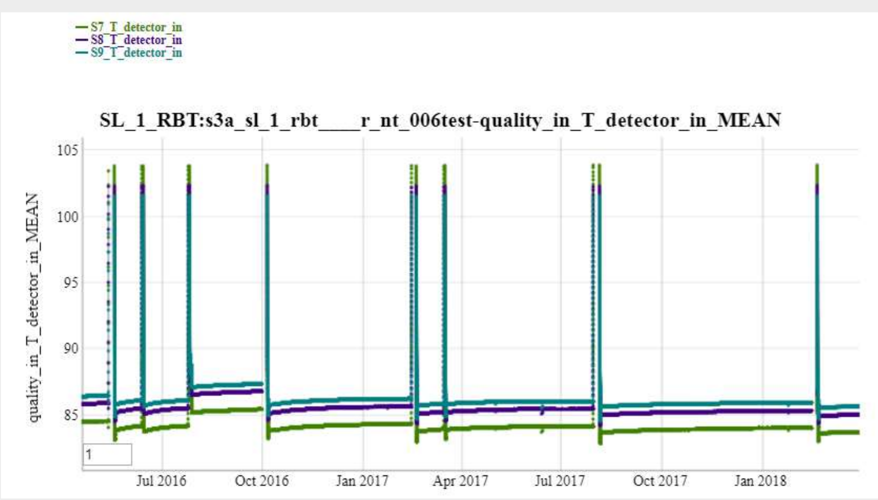
Band	λ center [μm]	Δλ [μm]	SNR/ NeΔT [mK]	Pixel size [km]
S1	0.555	0.02	10.4-14.3	0.5
S2	0.659	0.02	10.0-13.1	0.5
S3	0.865	0.02	9.7-11.5	0.5
S4	1.375	0.015	5.1-6.5	0.5
S5	1.610	0.06	3.2-3.9	0.5
S6	2.250	0.05	5.7-7.1	0.5
S7	3.74	0.38	60-67 mK	1.0
F1	3.74	0.38	225-259 mK	1.0
S8	10.85	0.9	26-37 mK	1.0
F2	10.85	0.9	40-56 mK	1.0
S9	12.0	1.0	28-40 mK	1.0

S3A Launch – 16/02/2016
SLSTR-A L1b operational data release – 17/11/2016
SLSTR-A L2 SST operational data release – 05/07/2017
Bayesian cloudmask: 04/04/2018
SLSTR-A reprocessed data (L1/L2 SST): 19/04/2016-04/04/2018

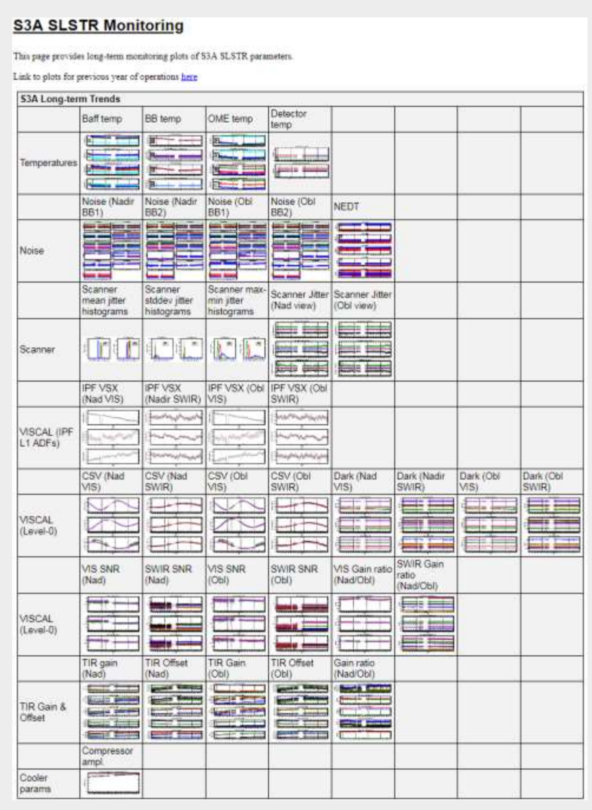
S3B Launch – 25/04/2018
SLSTR-B L1b operational data release – 12/11/2018
SLSTR-B L2 Marine operational data release – 12/03/2019

S3B/S3A tandem phase (30 sec): Jun-Oct 2018

SLSTR L0/L1 monitoring



Example of monitoring SLSTR-A detector temperatures for IR channels from Jun 2016 to April 2018. Discontinuities occur due to the scheduled decontamination or following an anomaly. The vertical lines indicate the start and end of each decontamination cycle.



Blackbody, baffle and OME temperatures

Noise trends

Scan jitter

Detector temperature

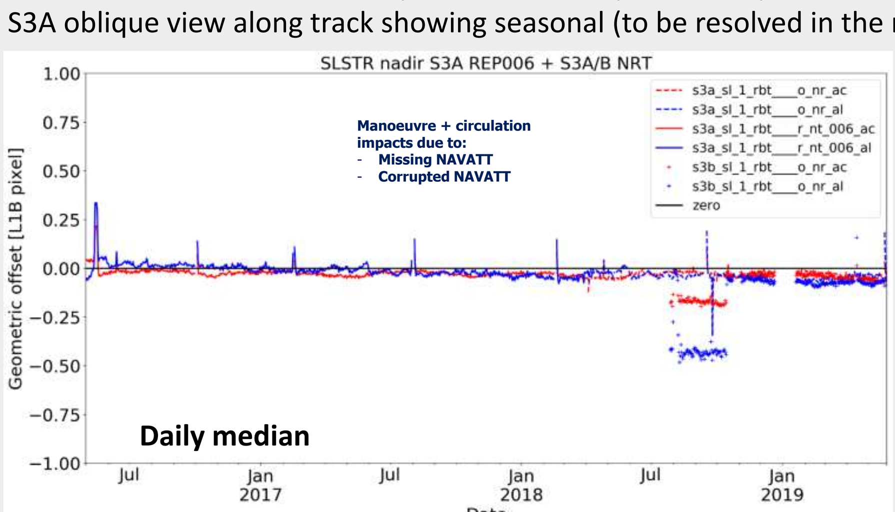
VISCAL plots
NEDT trend

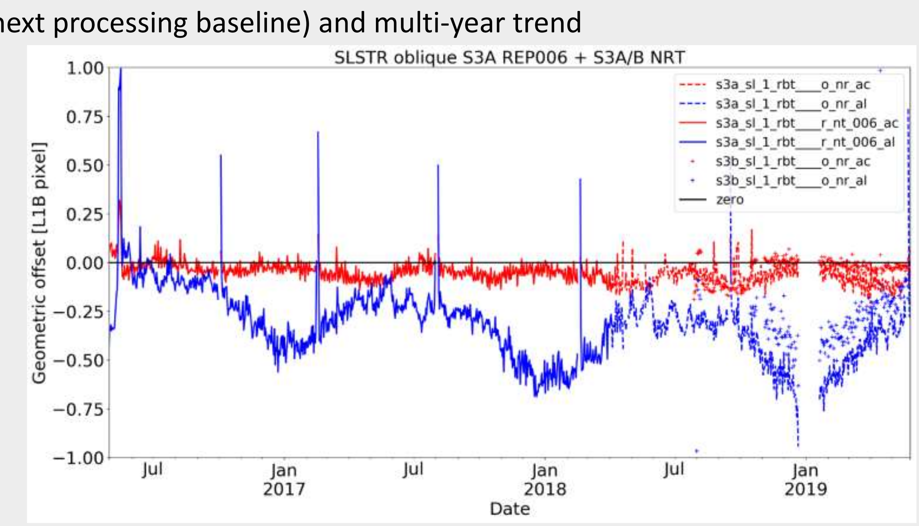
Gain/offset trend

Compressor amplitude
+ more

Geolocation verification

- SLSTR-A/B geolocation performance is monitored by performing cross correlation between image subsets and ground control points (GCPs)
- Difference between predicted and found position defines offset (in L1 500 m pixels)
- Each Level-1 product (3 min) contains several hundred GCPs - only GCPs with high signal-to-noise ratio (larger then 10) are used in analysis
- Both SLSTR-A/B nadir and oblique view currently within requirements (0.5 SSD).
- S3A oblique view along track showing seasonal (to be resolved in the next processing baseline) and multi-year trend





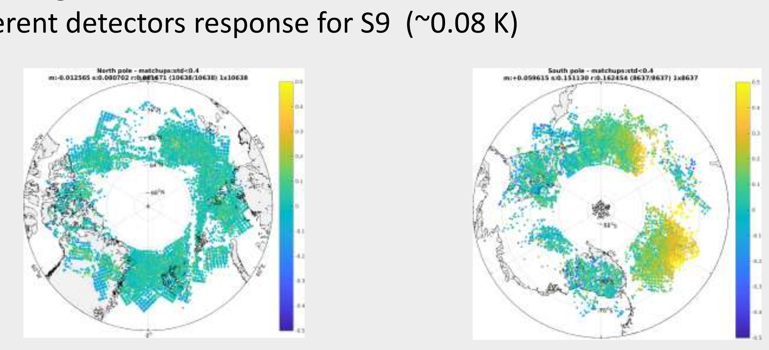
Radiometric intercomparison: SLSTR-A/B vs IASI (tandem phase)

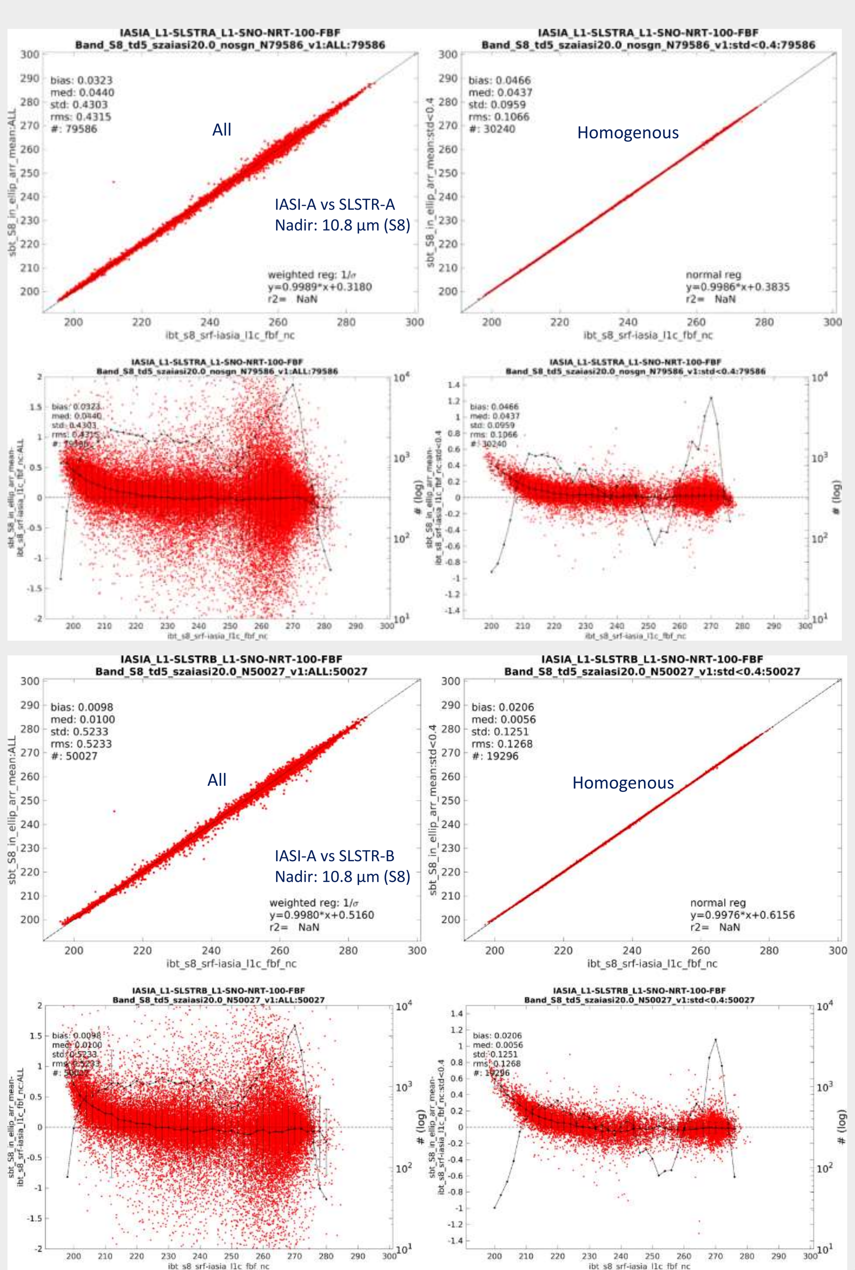
AIM
To verify if SLSTR IR is meeting performance requirements:
- The absolute radiometric accuracy of the data acquired in the IR channels shall be smaller than 0.2 K (0.1 K goal) traceable to the ITS-90.
- As a minimum, this requirement shall be met in the blackbody temperature range (~250 K - ~300 K), provided that the on-ground characterization covers the complete temperature range specified.

Objectives
- To compare against stable and characterized referent sensor: IASI – Global Space-based Inter-Calibration System (GSICS) referent sensor - due to the stability and characterisation

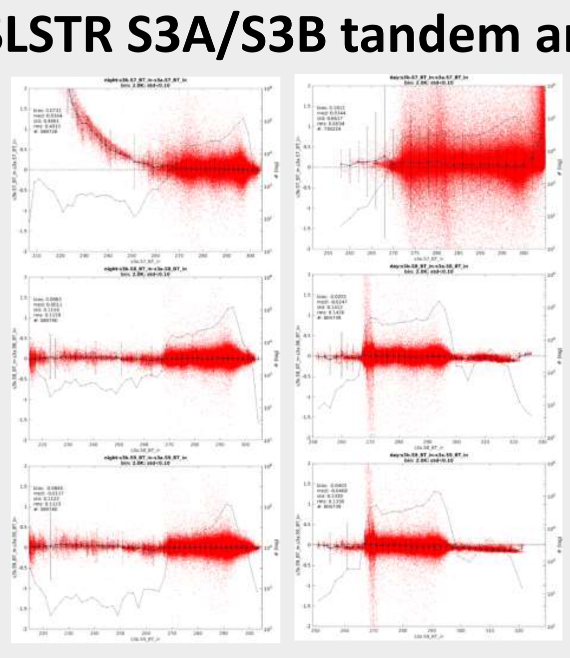
Methodology
- Crossovers (SNO), Collocations (matchups: time, space, viewing angle), Spectral convolutions; Aggregation (avg)
- SNO event (20-22.06.2018) during the S3 tandem phase (S3A/S3B 30 seconds apart)

Summary
- Stable calibration within requirements (220-280 K): Near zero nadir view bias (<0.1 K) in S8 and S9 (220 K – 280 K)
- Cold temperature (<220 K) bias (~>0.2 K) (nonlinearity?)
- Small negative bias for >280 K
- Different detectors response for S9 (~0.08 K)



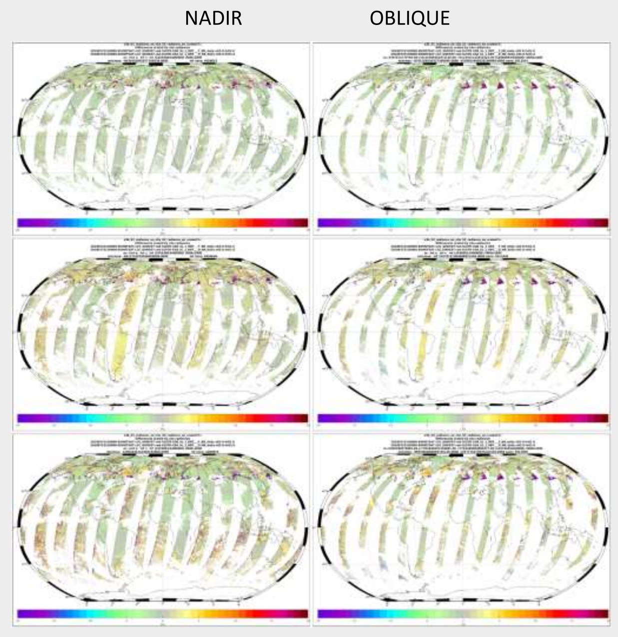


SLSTR S3A/S3B tandem analysis



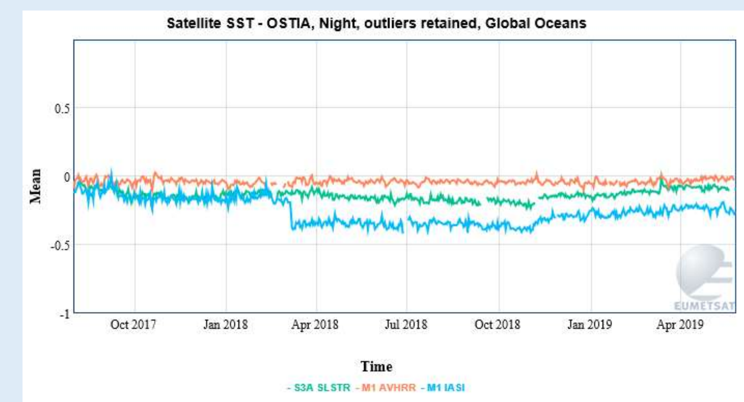
- L3 binning of L1 data (VIS/SWIR/IR)
- 0.1 deg resolution
- Day/night
- Cloud free (using standard cloud mask)
- IR: absolute differences

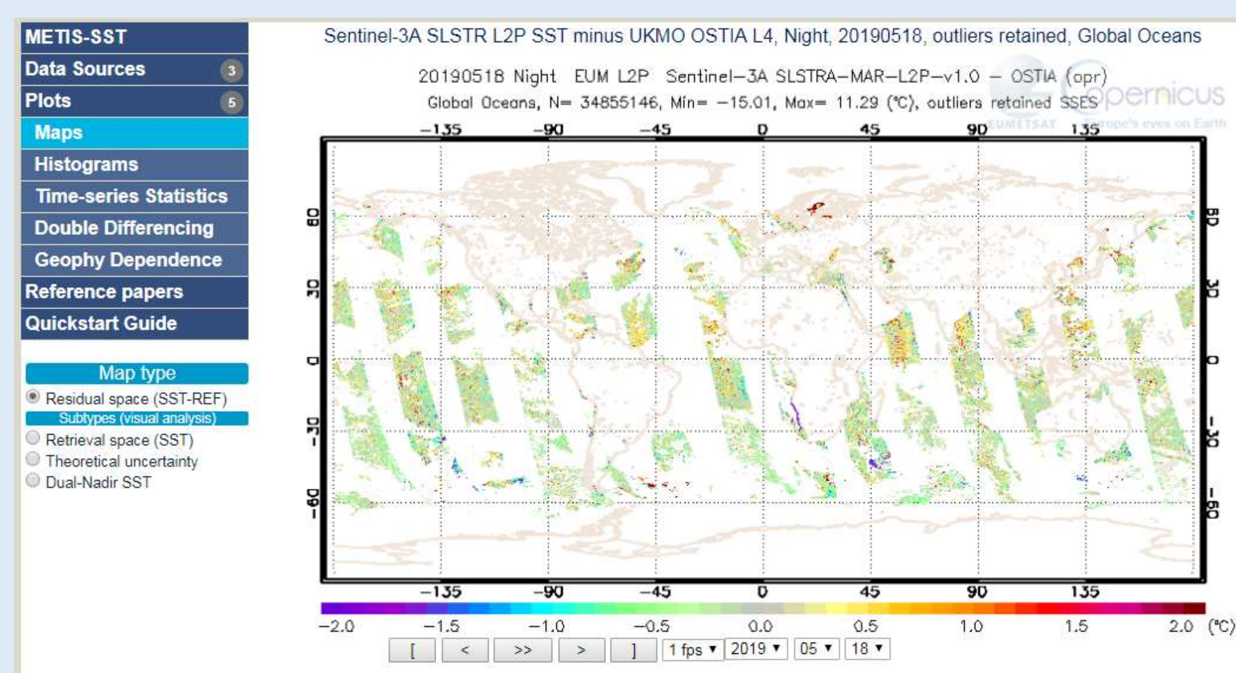
Summary for S7/S8/S9
- Nadir: very good agreement (near zero bias); Small increase in bias for higher BTs (>300 K)
- Oblique: negative bias (up to 0.5 K) for cold BTs
- possible straylight in S3A

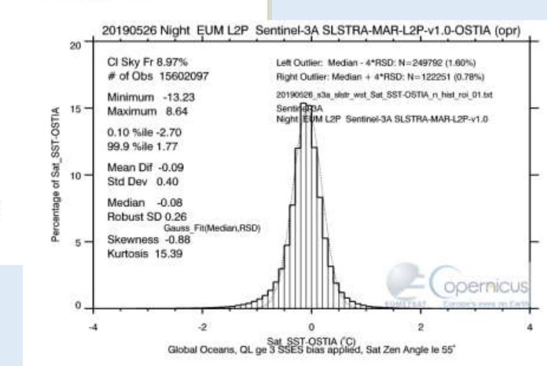


SST Bias Characterisation: Inter-satellite and inter-algorithm comparisons

- Satellite comparison with OSI-SAF and CMEMS products
- SST L2: SLSTR-A/B; AVHRR-B; IASI-B
- SST L4: OSTIA, CMC 10 km, OSTIA climatology (m)
- Analysing algorithms and instrument characteristics
- Global and regional routine analysis
- Daily, monthly plots, maps, time-series, histograms, ...
- **METIS**: http://metis.eumetsat.int/sst/

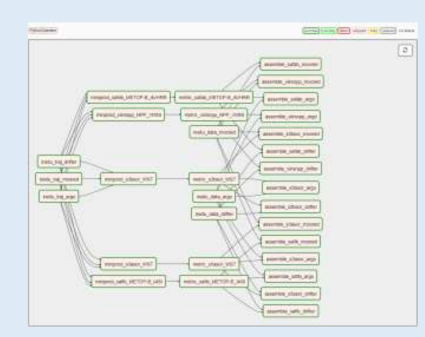


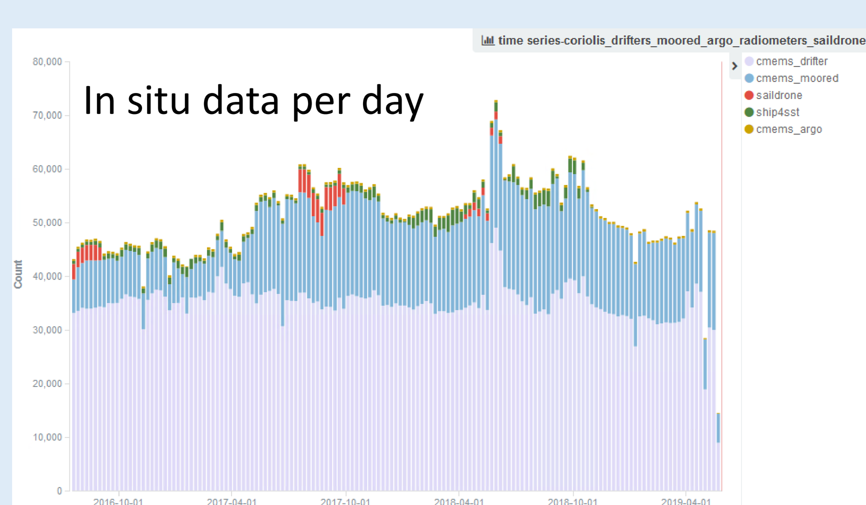




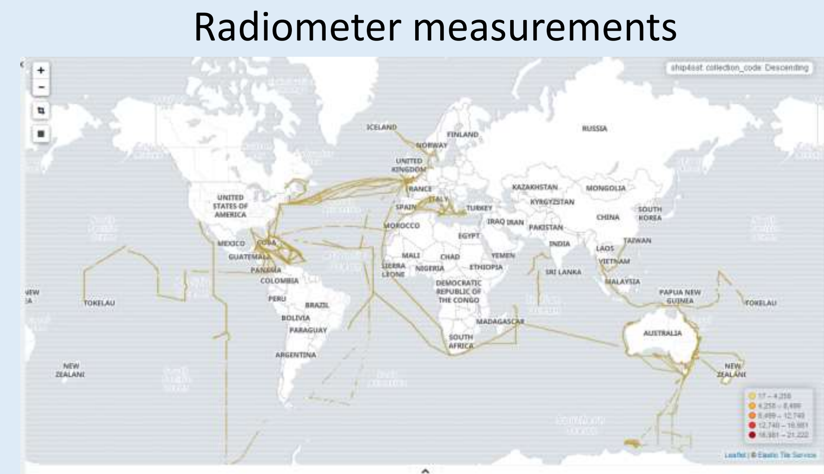
SST Bias Characterisation: Comparisons with in-situ measurements

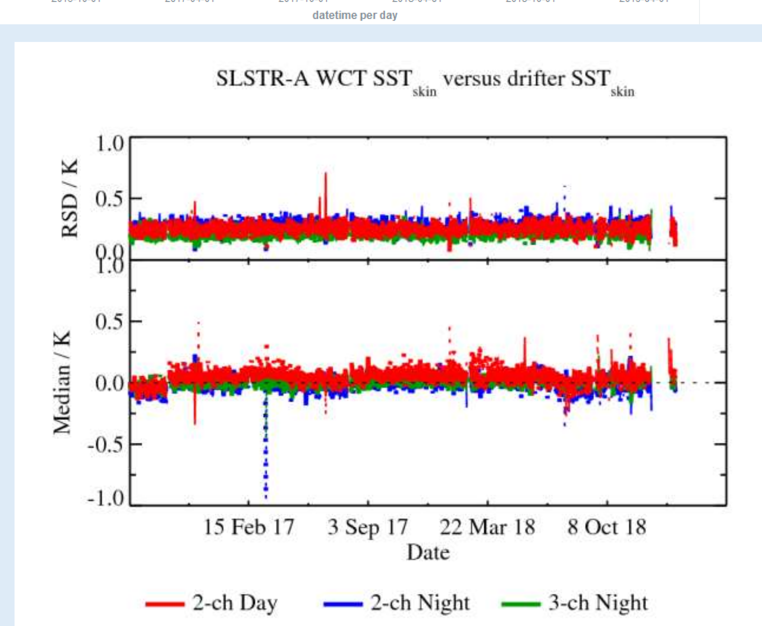
- **Copernicus Coriolis in situ service:** drifting buoys, Argo, moored buoys
- **Radiometers FRM:** Ship4sst (ISAR, M-AERI, SISTeR)
- **Saildrones** (experimental)
- **HR-SST insitu FRM**: **TRUSTED** (in progress to be ingested in felyx MDB)
- **Satellite**: SLSTR-A/B SST+L1, AVHRR-B SST, IASI-B SST, VIIRS SST(experimental)
- **Felyx**: Routine and automatic collocations of satellite and in situ measurements
- **SST MDB**: SLSTR-A/B MDB, IASI-B MDB, AVHRR-B MDB, VIIRS MDB (exp)
- Post processing: Fairall/Kantha-Clayson (FKC) model for skin-depth adjustment
- Current status: NRT@OPE (04/2018-) + S3A NTC@REPRO (08/2016-04/2018) SLSTR MDB available to S3VT
- **Update**: SLSTR MDB (L1/L2 WCT/WST) is now **split** in base MDB (WST) + WCT, MET, RBT-i, RBT-a and RTM aux



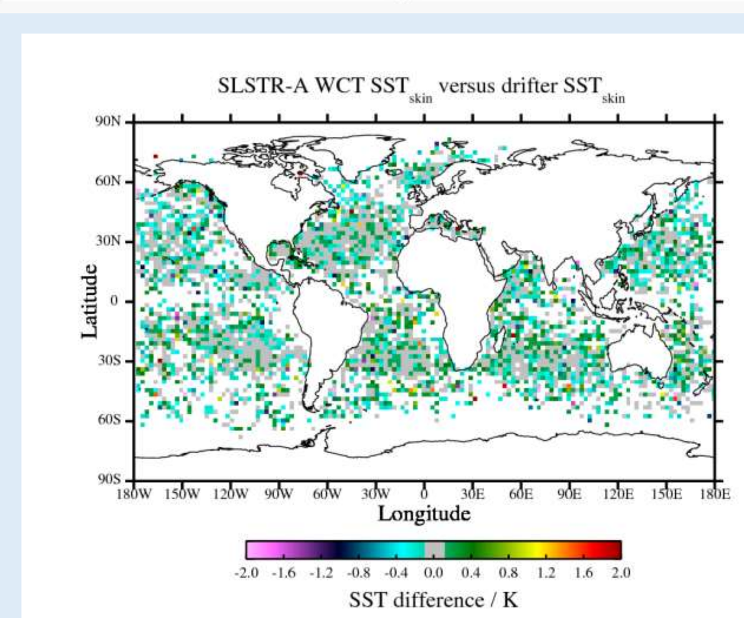


Radiometer measurements





Drifter matchup time series



Drifter matchups (measurements and location)

SLSTR data are SST_{skin} Use only QL=5 data Use dual-view (D2 and D3) retrievals for reference sensor

See poster #12: Gary Corlett, Independent Validation of Sentinel 3 SLSTR Sea Surface Temperature Products
See poster #33: Marc Lucas, Copernicus TRUSTED: HRS-SST in situ datasets
See poster #34: Bingkun Luo, Comparison Of Sentinel-3A/SLSTR Derived SST With MAERI
See poster #55: Wimmer Werenfrid, Sentinel-3 SLSTR SST Validation using a FRM Service

Acknowledgements
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Radiometric intercomparisons of AATSR and IASI, 2013, C. Whyte, D. Moore, J. Remedios