Sentinel-3 SLSTR SST Validation using a Fiducial Reference Measurements (FRM) Service

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1 Introduction

Sea Surface Temperature (*SST*) measurement is one of the most easily obtainable climate variables. However, it is challenging to meet the required absolute accuracy and long term stability whether the data are derived by, *in situ*, or satellite measurements. In order to be able to make such an assessment, the uncertainty of each measurement has to be known, but also all the measurements have to be traceable to the same standard.

2 Fiducial reference measurement data

Fiducial Reference Measurement (FRM) data for *SST* is mainly acquired with Infrared Shipborne Radiometers (ISRs), such as Infrared Sea surface temperature Autonomous Radiometer (ISAR) [1,2], Scanning Infrared Sea Surface Temperature Radiometer (SISTeR) and Marine Atmospheric Emitted Radiance Interferometer (M-AERI). The ships4sst project provides a platform to coordinate the collection and storage of FRM data sets in a standardised netcdf format. Fig. 1 shows a map of the shisp4sst archive data.

In order to make ISR data a FRM, the instruments are calibrated before and after each deployment with the NIST and NPL traceable infrared (IR) black body source (e.g. CASOTS II [3]). Furthermore each measurement has its individual uncertainty assigned. All ISR in the ships4sst archive produce the uncertainty based on a uncertainty model (e.g. [1]) which is derived from first principles by analysing each instrument component, and assigning an uncertainty to each component. These uncertainties are then fed through the ISR *SST* processor to estimate an uncertainty for each Sea Surface Temperature at the Skin interface (SST_{skin}) measurement.

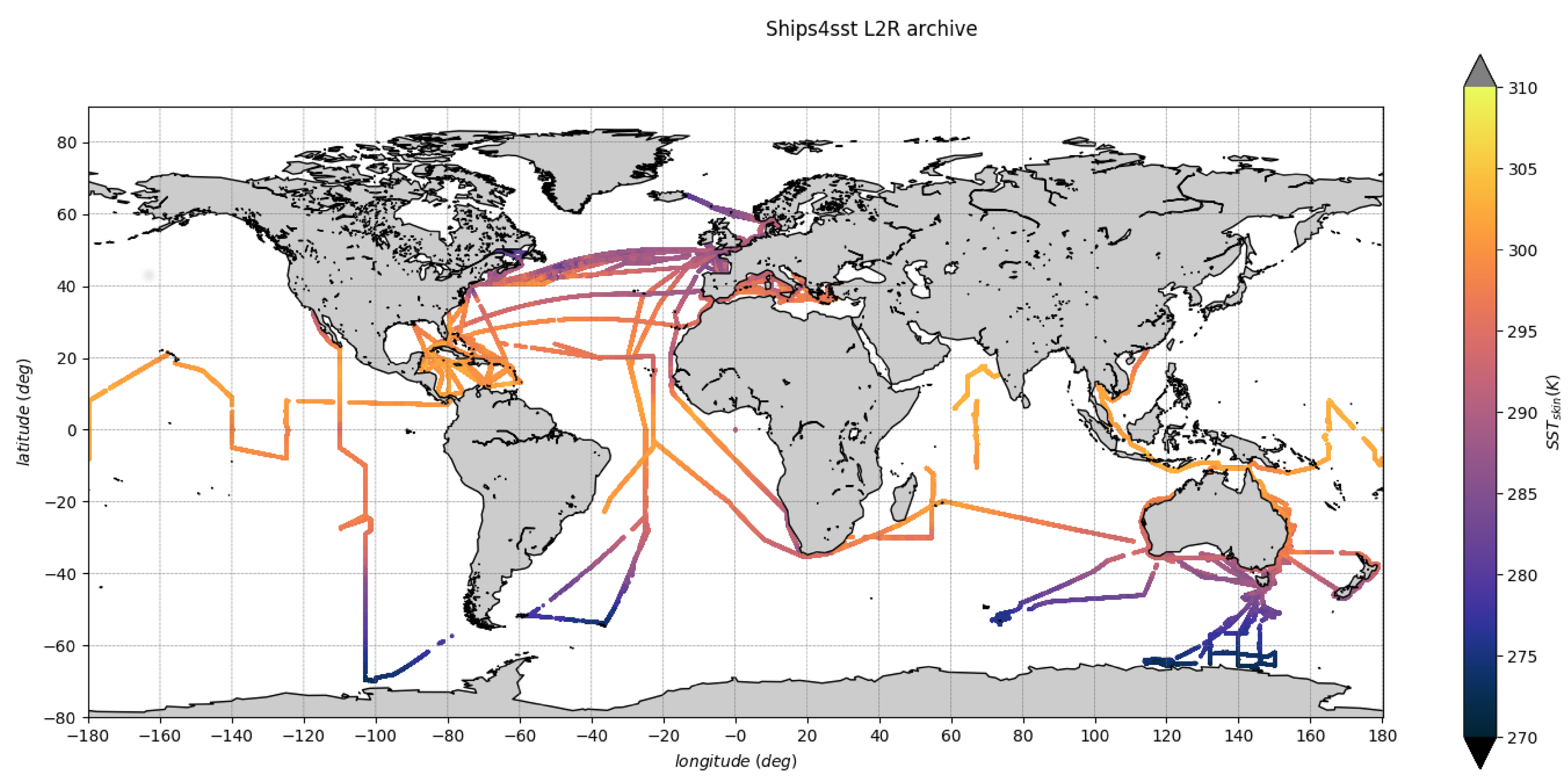

Fig. 1: Map of the FRM data in the ships4sst archive.

3 FRM4STS

Because FRM play an important part of *SST* validation, it is important that ISR, such as ISAR, SISTeR and MAERI, comply with FRM protocols and standards a number of inter-comparisons were carried out in 2016 and 2017 organised by European Space Agency (ESA) and National Physical Laboratory, Teddington, UK (NPL). The results showed good agreement between the instruments in the laboratory tests and the field experiments (Greenland - ICE, Wraysbury - SST, Namibia - LST) and can be seen at the FRM4STS webpage (www.frm4sts.org).

Fig. 2: FRM4STS comparison at Wraysbury

4 Satellite *SST* validation

Satellite validation is carried out over a number of temporal and spatial *matchup* windows ranging form 6.5 h and 25 km to 0.5h and 1km. Her we show the results of a *matchup* window of 2h and 1km. The Sea and Land Surface Temperature Radiometer (SLSTR) validation was performed with Felyx MDB v6.0 (August 2016 - April 2018) for Group for High Resolution Sea Surface Temperature (GHRSST) quality level 5 and water surface temperature (WST) data.

Global SLSTR FRM validation

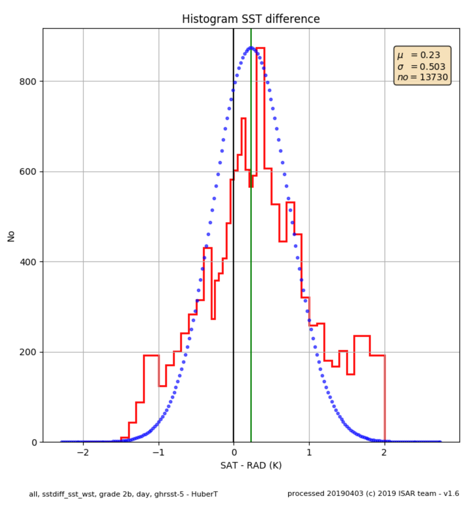

Fig. 3: Histogram for global day time data.

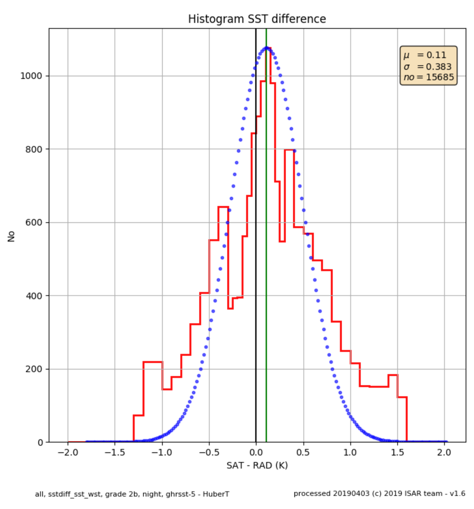

Fig. 4: Histogram for global night time data.

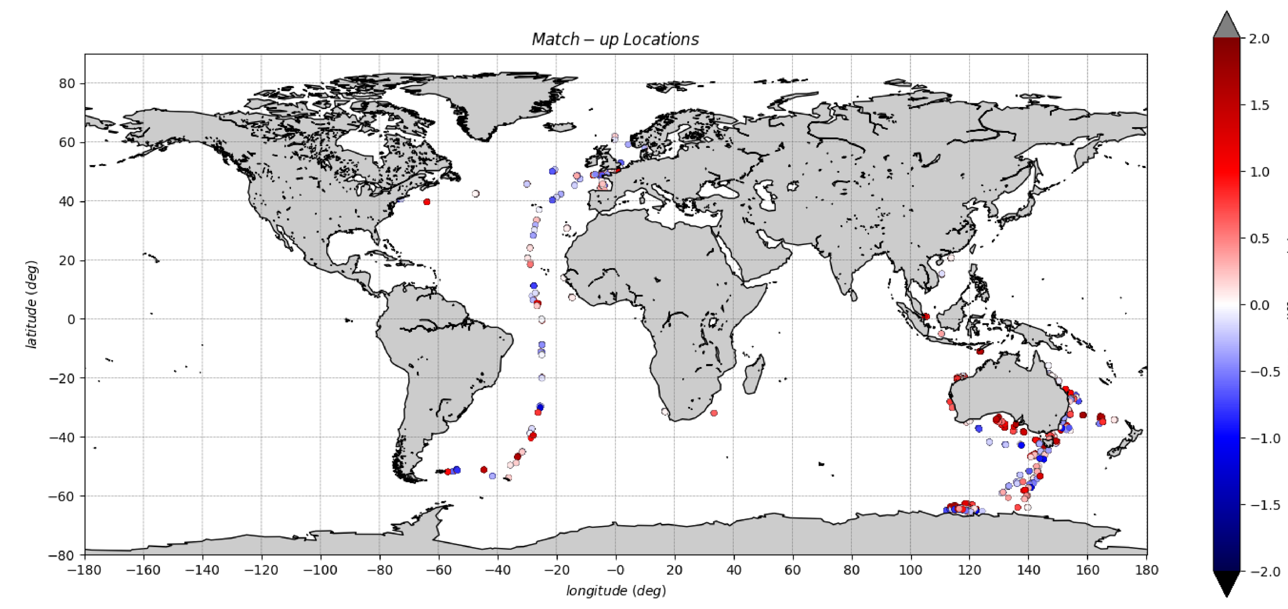

Fig. 5: Map of the match-up locations.

Regional SLSTR FRM validation example

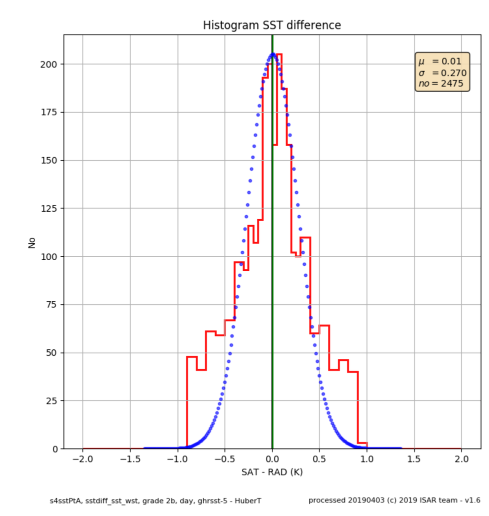

Fig. 6: Histogram for regional day time data.

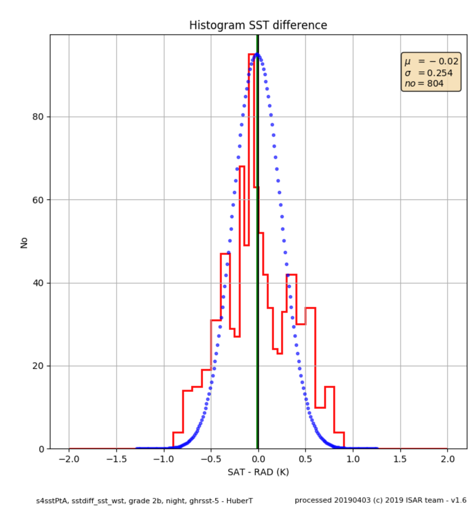

Fig. 7: Histogram for regional night time data.

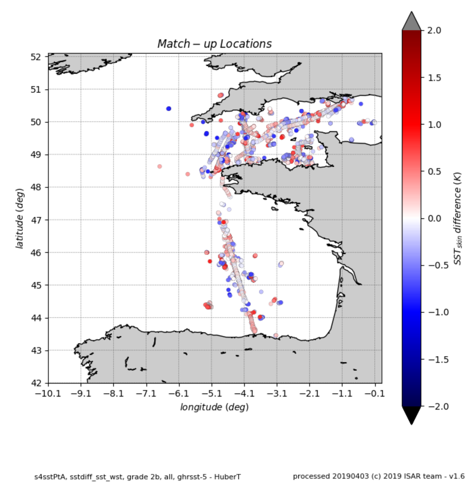

Fig. 8: Map of the match-up locations.

5 Conclusion

- SLSTR validation results for the reprocessed August 2016 to April 2018 show good agreement globally, a mean difference of 0.23 and an robust standard deviation (RSD) of 0.5 K for day time WST data and a mean difference of 0.11 and an RSD of 0.38 K for night time WST data.
- SLSTR validation results for the English Channel and Bay of Biscay region show a mean difference of 0.01 and an RSD of 0.27 K for day time WST data and a mean difference of 0.02 and an RSD of 0.25 K for night time WST data.
- The accuracy and stability assessment of SLSTR requires a traceable reference measurement, which is at least as stable and accurate as SLSTR, such as ISR.
- Still need to validate the SLSTR D3, D2, N3 N2products, waiting for Felyx MDB update to include those products.
- The ISR performance is regularly tested against a NIST and NPL through projects like FRM4STS.
- ISR *SST* measurement uncertainties are essential to classify *matchup* pairs, and identify uncertainty sources, so they are not attributed to the satellite *SST* uncertainty.

References

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International Ship-borne Fiducial Radiometer Network (ISFRN)

Group for ship-borne IR measurements:
- Common data format (netcdf) and protocols
- **data archive** at IFREMER with automatic ingestion into the ESA Felyx MDB.
- web access via **www.ships4sst.org**
- **New members and contributors are always welcome.**

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More information at www.ships4sst.org