



On the applicability of Copernicus Sentinel-3A and -3B Sea and Land Surface Temperature Radiometers as reference sensors

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Introduction

- Sea surface temperature (SST) is a fundamental physical variable for understanding the ocean/atmosphere interface.
- Operational services rely on daily SST analyses, which provide a spatially complete best guess from available daily measurements.
- The Advanced Along Track Scanning Radiometer (AATSR) demonstrated the capability of using a dual-view IR radiometer as a reference sensor so underpin the daily analyses.
- In this presentation we assess if the Sea and Land Surface Temperature Radiometer (SLSTR) can provide such data.
- We will do this by (1) assessing the quality of SLSTR, (2) comparing SLSTR to other satellite sensors and (3) looking at the quality of current SST analyses.
 - We will use the SLSTR MDB (see poster 013 by Igor Tomazic for further details)



Copernicus Sentinel 3 SST

- The Sea and Land Surface Temperature Radiometer (SLSTR) is a dual-view self-calibrating IR radiometer following the ATSR class of sensors

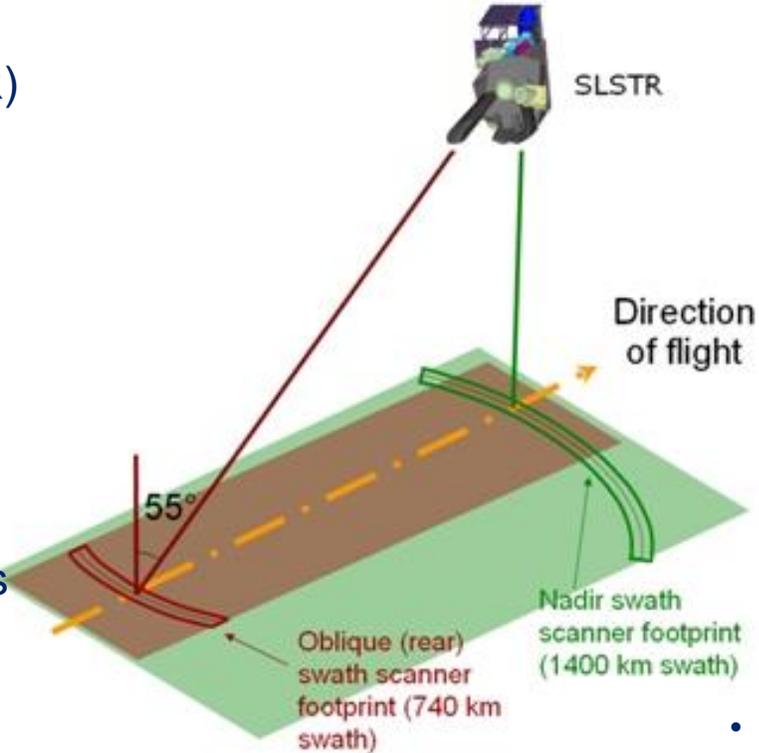
- SST Retrievals by radiative transfer modelling of the form:

$$a_0 + \sum_1^n a_n BT_n$$

where n is the number of channels

- For SLSTR we use 2 channels during day and 3 during night
 - 3.7 μm not used during day owing to solar contamination
 - We have two views, so we have four SST retrievals in total

SLSTR provides SST_{skin}



SLSTR-A

Operational since 05/07/2017
Reprocessed data from 19/04/2016 to 04/04/2018 available via CODA REP

SLSTR-B

Harmonized to SLSTR-A using SSES
Operational since 12/03/2019

| Nominal Channel Centre | Primary Application |
|------------------------|---------------------|
| S7: 3.7 μm | SST Retrieval |
| S8: 11 μm | SST/LST Retrieval |
| S9: 12 μm | SST/LST Retrieval |

Four Possible Retrievals:

Nadir 2-channel N2
Nadir 3-channel N3
Dual 2-channel D2
Dual 3-channel D3

WCT

- This product provides sea surface temperature for all offered retrieval algorithms.
- Only available to Cal/Val users via ODA (FTP) and Data Centre (Archive)

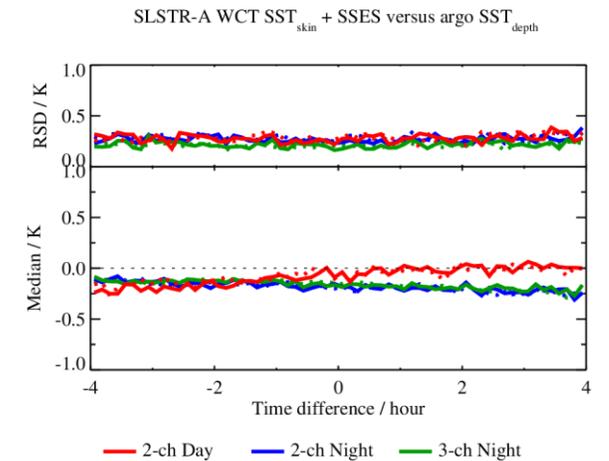
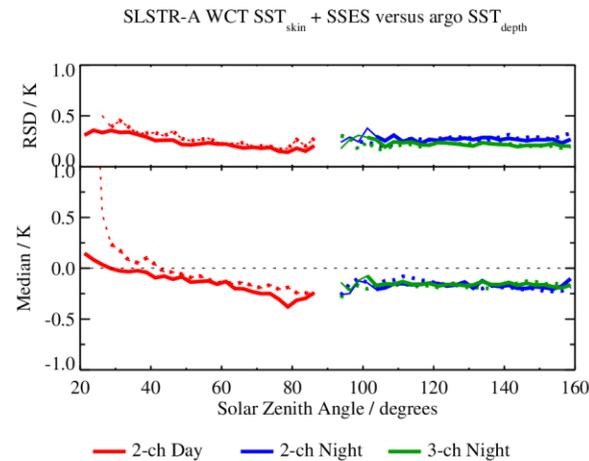
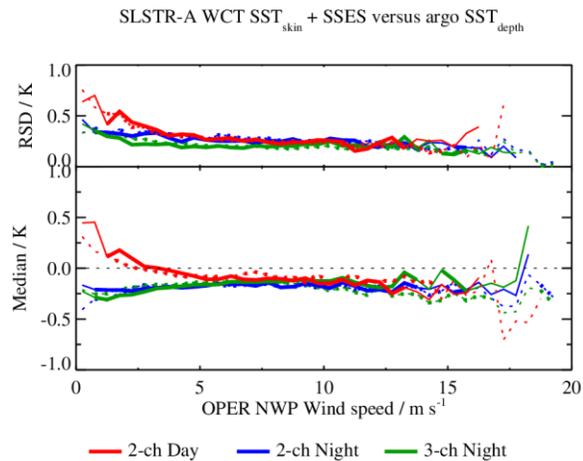
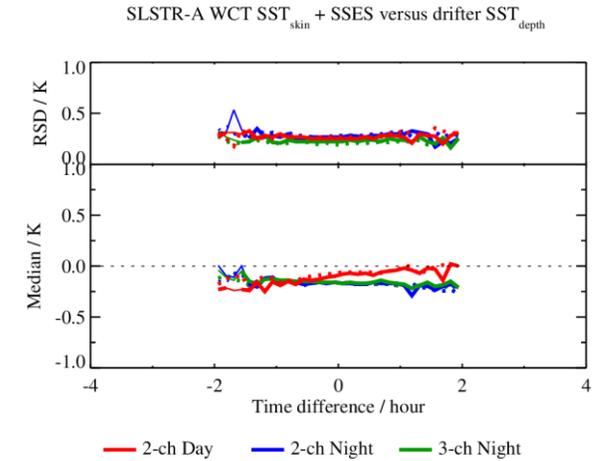
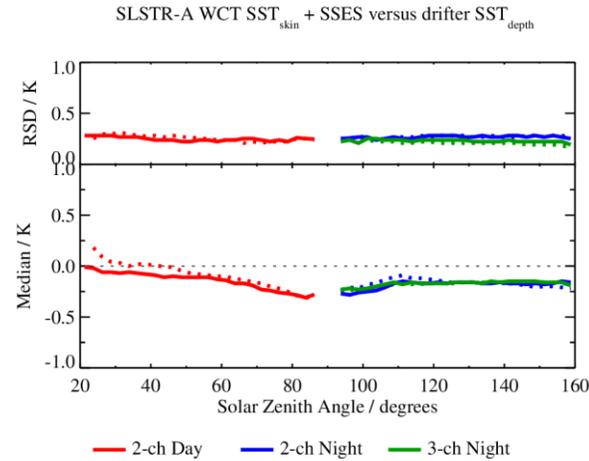
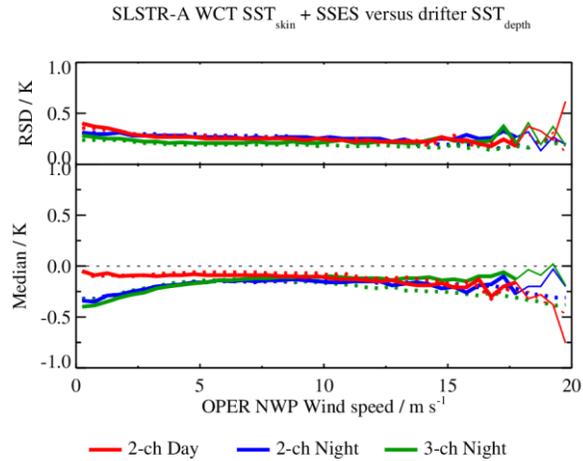
WST

- This product provides the best SST at each SLSTR location in GHRSSST L2P format.**
- Available to all via ODA (FTP), EUMETCAST (DVP), CODA(REP) (http) and Data Centre (Archive)**

<http://eoportal.eumetsat.int/> (only simple registration is needed)

Validation results – “raw” drifter and Argo

Drifter matchups (top row) and Argo matchups (bottom row)

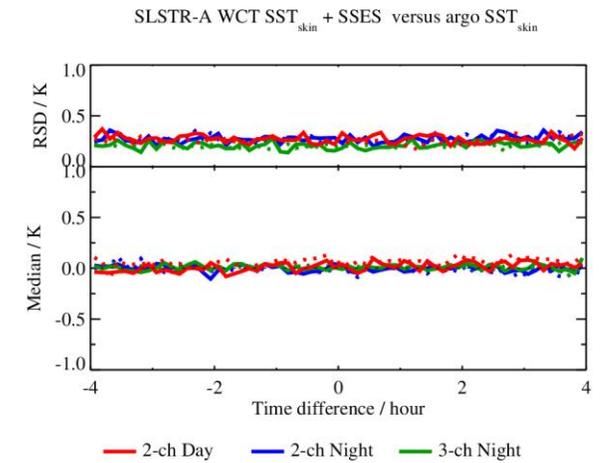
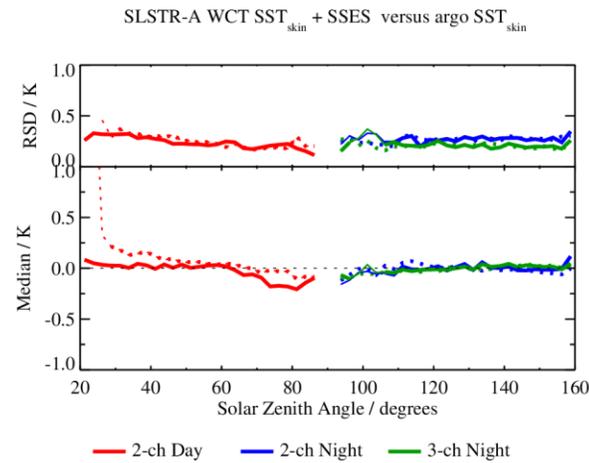
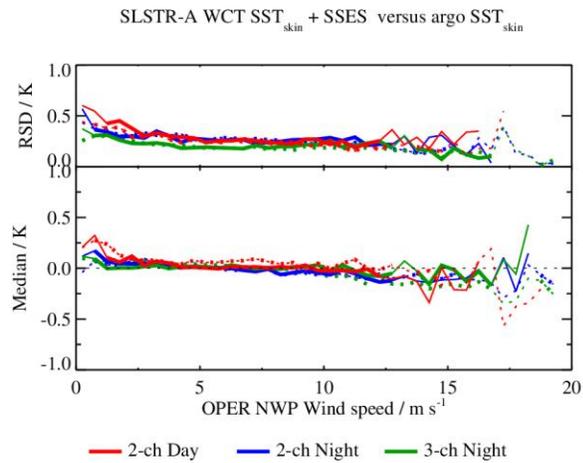
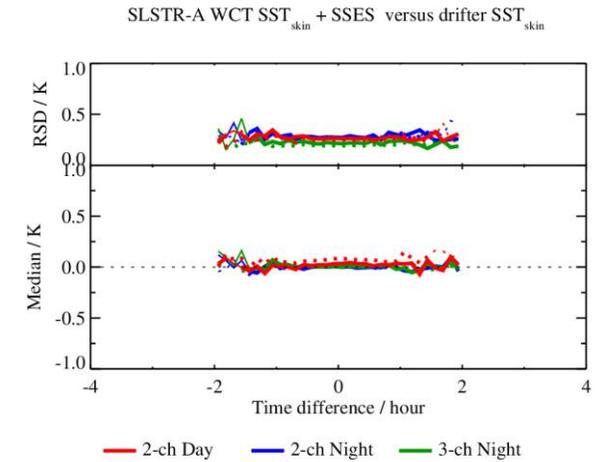
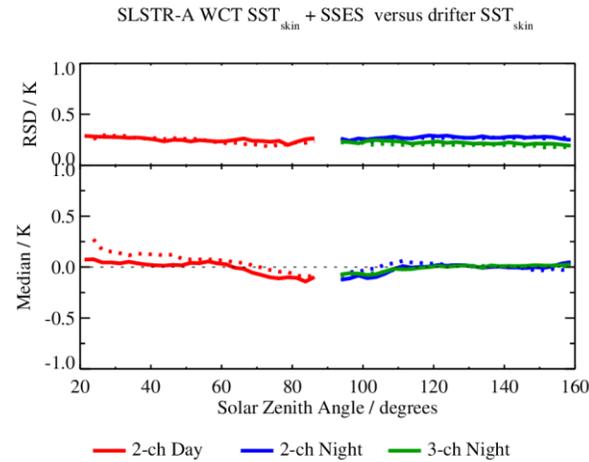
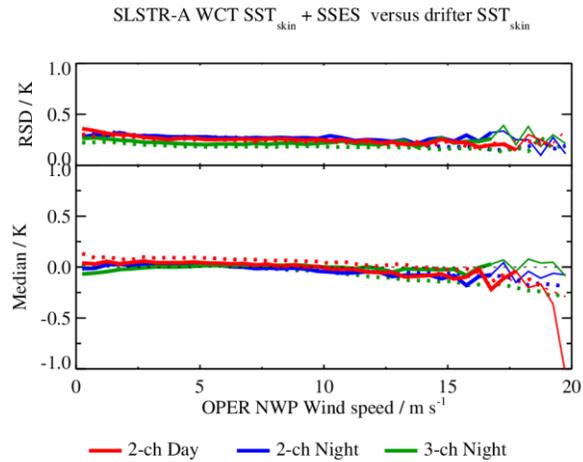


Colours show number of channels; solid lines indicate dual-view; dashed lines indicate nadir-only.



Validation results – drifter and Argo with FKC adjustments

Drifter matchups (top row) and Argo matchups (bottom row)



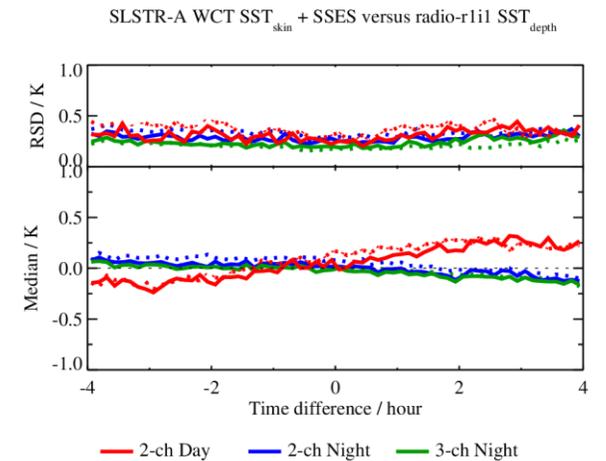
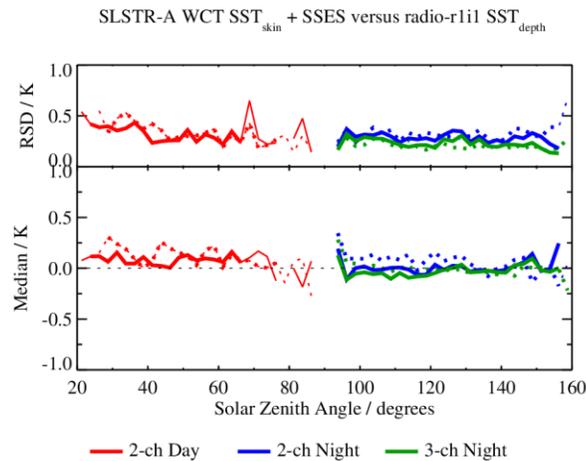
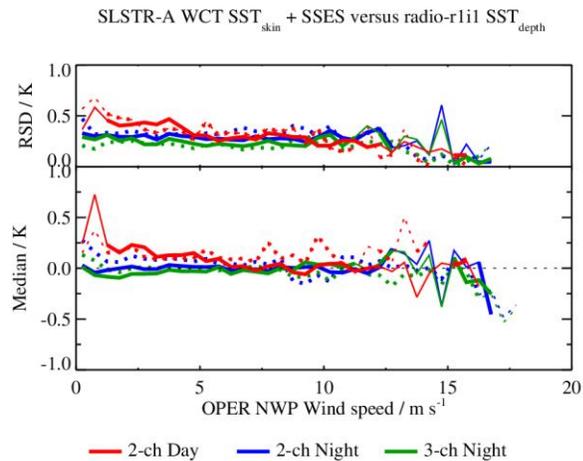
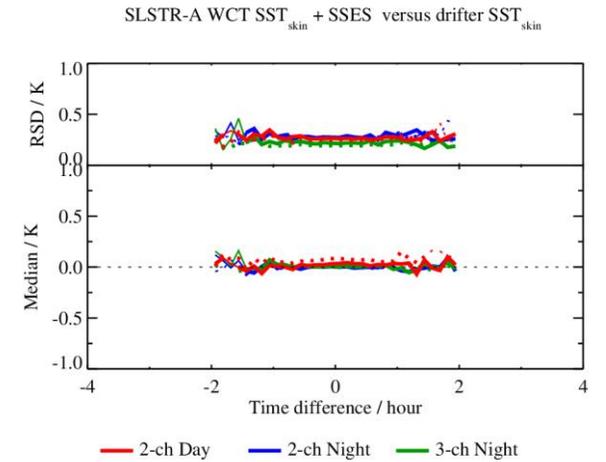
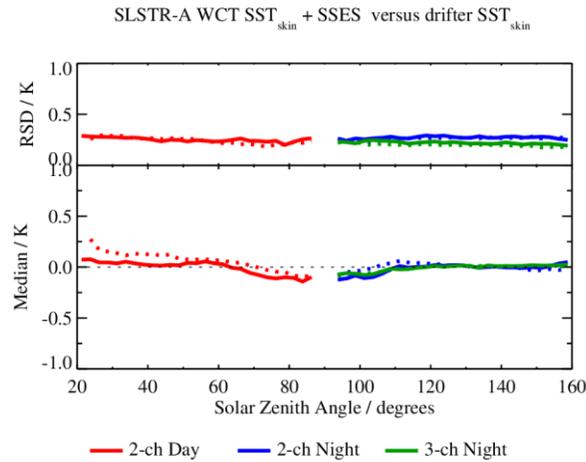
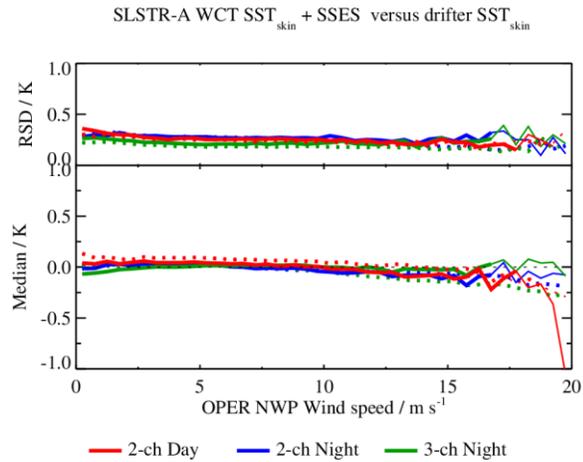
Colours show number of channels; solid lines indicate dual-view; dashed lines indicate nadir-only.

FKC = Combined Fairall & Kantha/Clayson skin-effect/diurnal-variability model driven by ERA-interim fluxes



Validation results – Compare drifter/FKC and radiometer

Drifter matchups (top row) and radiometer matchups (bottom row)



Colours show number of channels; solid lines indicate dual-view; dashed lines indicate nadir-only.

Radiometer data provided by ISFRN (<http://www.shipborne-radiometer.org/>)

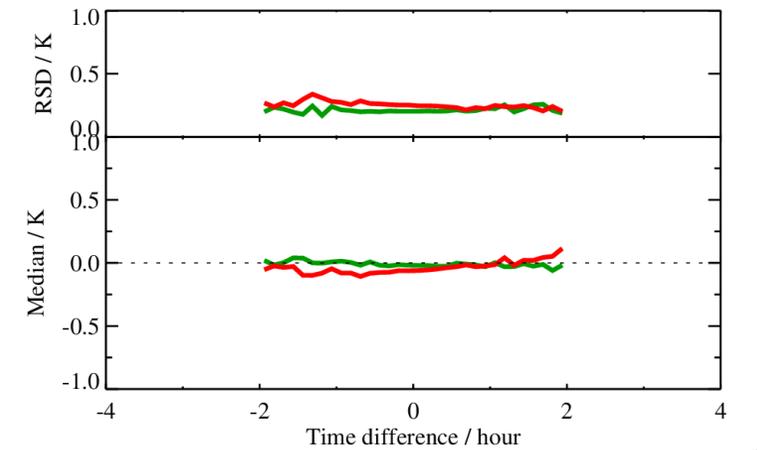
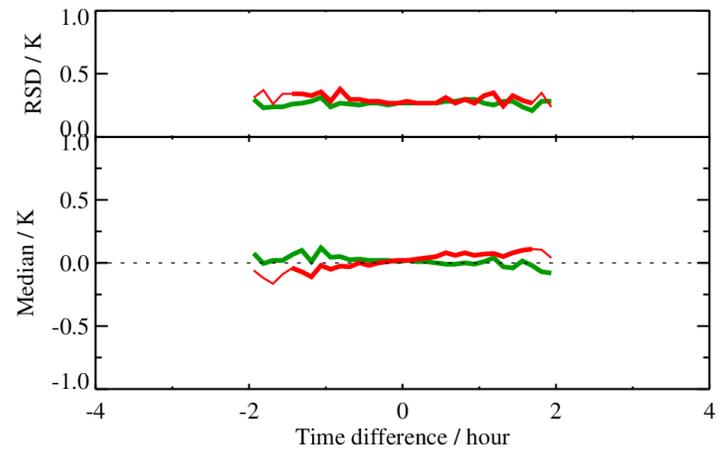
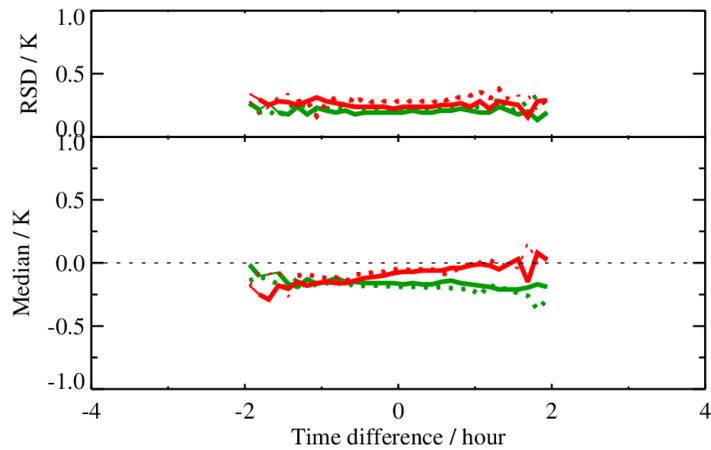
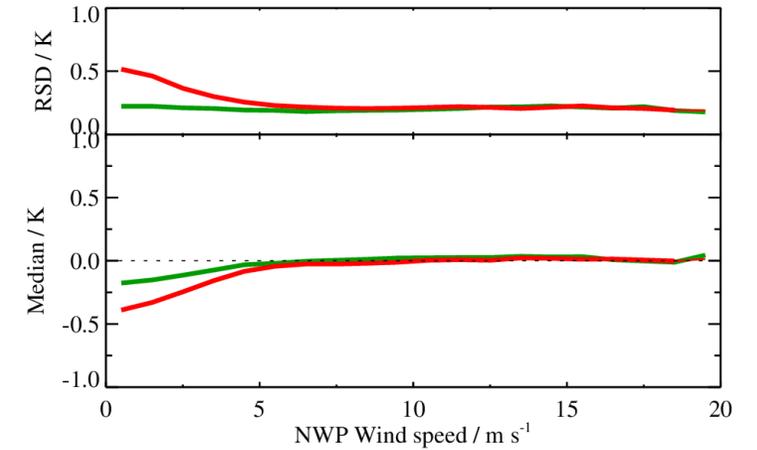
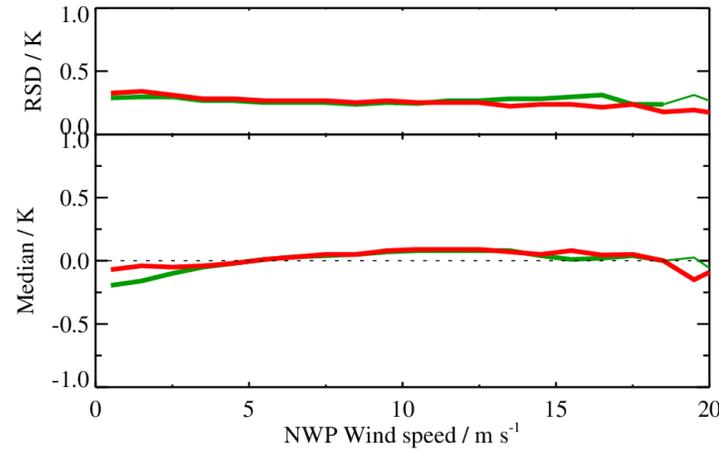
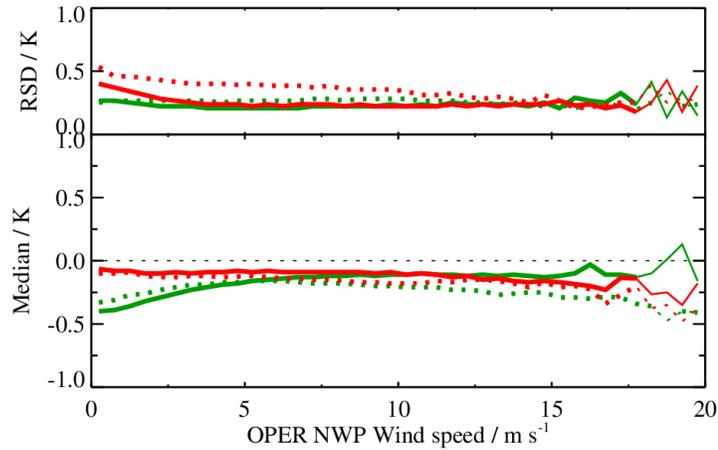


Validation results – Compare SLSTR with VIIRS and AVHRR

SLSTR

AVHRR

VIIRS



Drifter match-ups: wind-speed (top row) and time difference to in situ (bottom row)
Colours show daytime (red) and nighttime (green) results.

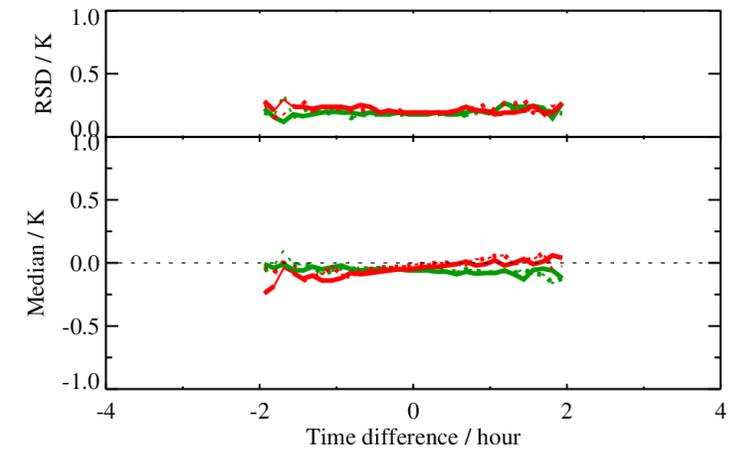
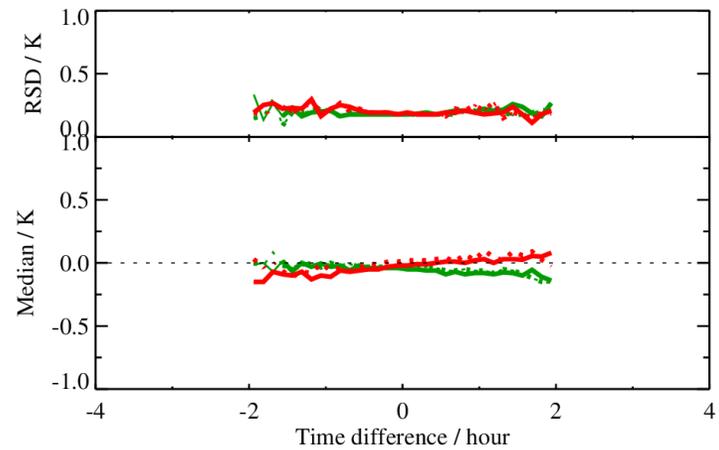
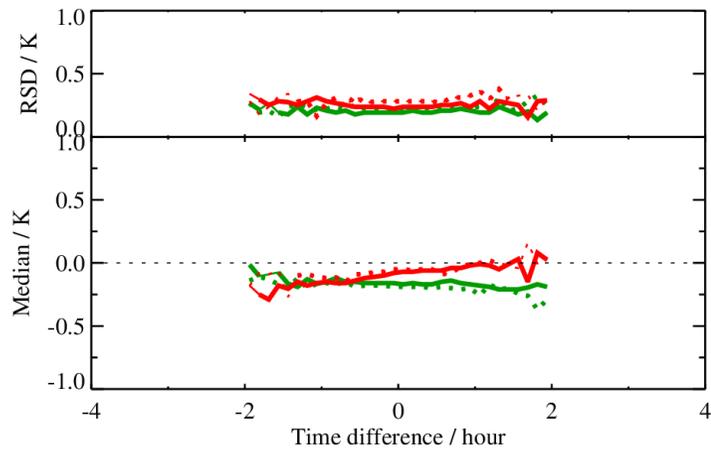
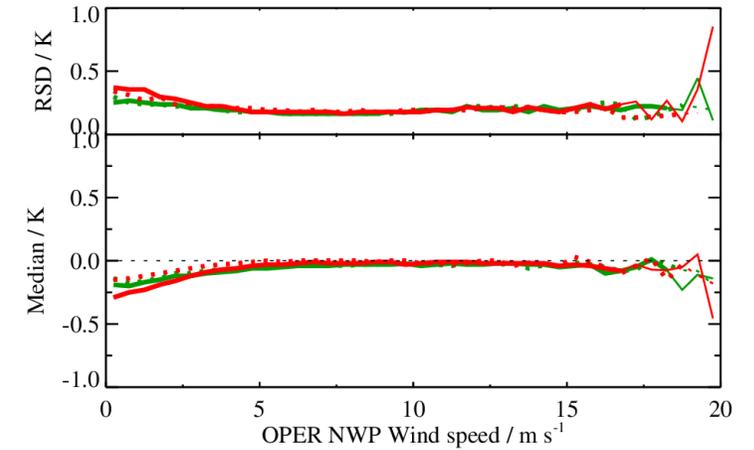
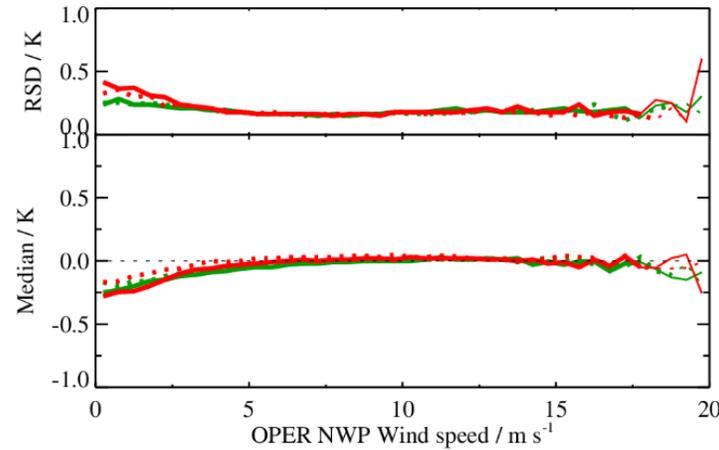
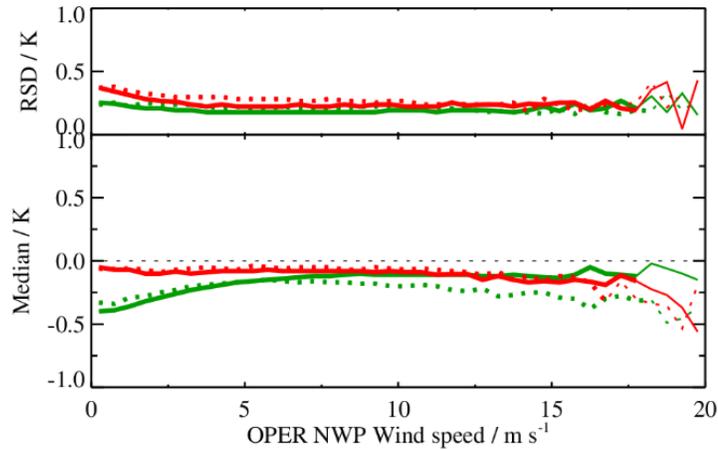


Validation results – Compare SLSTR with OSTIA and CMC

SLSTR

OSTIA

CMC



Drifter match-ups: wind-speed (top row) and time difference to in situ (bottom row)
Colours show daytime (red) and nighttime (green) results.



Summary

- SLSTR is providing data of a quality to be used as a reference sensor for the GHRSSST community
 - Issues observed with Bayesian cloud mask, especially in coastal areas, are being addressed
- SLSTR provides a measure of SST_{skin}
 - Confirmed through independent validation using data from multiple depths
- Sub-skin SSTs derived from IR sensors have a residual cool-skin effect if no explicit wind speed dependence is included
 - Could be minimised using SSES
- Daily SST analyses provide an SST closer to a daily mean than a foundation temperature
 - A residual cool-skin effect may also be present



A reminder about SLSTR

- SLSTR provides a measure of SST_{skin}
- The SL_2_WST (GHRSSST L2P) format product contains both dual-view (D2, D3) and nadir-only (N2, N3) retrievals
- Use only dual-view retrievals for reference sensor
- Use only QL=5 data
 - Never use D2 or D3 QL=4 data
- Users must apply the SSES bias adjustments
 - SLSTR-B is harmonised to SLSTR-A through SSES
- Please read Product Notices – they provide a lot of useful information (available from EUMETSAT Sea Surface Temperature Services webpage):

<https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Sentinel3/SeaSurfaceTemperatureServices/index.html>



Sentinel-3 Product Notice – SLSTR Level-2 Sea Surface Temperature

| | | |
|--------------------------|--|---------------------|
| Mission | Sentinel-3A & Sentinel-3B | |
| Sensor | SLSTR-A & SLSTR-B | |
| Product | Level 2 Sea Surface Temperature | |
| Product Notice ID | EUM/OPS-SEN3/DOC/19/1063159 | S3.PN-SLSTR-L2M.002 |
| Issue/Rev Date | 15/01/2020 | |
| Version | 1.1 | |
| Preparation | This Product Notice was prepared by EUMETSAT with assistance from the S3 Mission Performance Centre. | |
| Approval | EUMETSAT Mission Management | |

Summary

This is a Product Notice (PN) for Sentinel-3A and -3B Sea and Land Surface Temperature Radiometer (SLSTR-A and SLSTR-B) Level-2 Sea Surface Temperature (SST) products generated with Processing Baseline (PB) 2.61 (-A) and 1.33 (-B) deployed on 15/01/2020. It is applicable to both Near Real Time (NRT) and Non Time Critical (NTC) timeliness.

The Notice describes the Level-2 current status, the processing baseline, the product quality and known limitations for both SLSTR-A and SLSTR-B.

The main changes are an update to the quality level assignment to flag data affected by spacecraft manoeuvres and an adjustment to the per pixel time in the SL_2_WST product to account for the offset of the first valid pixel within a scan.

Note: A major change to the SLSTR Level-1 Processing Baseline accompanies this update to Level-2. The overall quality of the Level-2 SST is not affected by the changes at Level-1.

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