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Independent validation of Sentinel 3A SST Products with Bayesian Cloud Mask

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Disclaimer

The work performed in the frame of this contract is carried out with funding by the European Union. The views expressed herein can in no way be taken to reflect the official opinion of either the European Union or the European Space Agency.



The work presented here is carried out as part of the Sentinel 3 Mission Performance Centre (S3MPC; prime contractor ACRI-ST, France)



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Contributors

EUMETSAT

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Ifremer

- ❖ Jean-Francois Piollé

University of Reading

- ❖ Kevin Pearson, Claire Bulgin, Owen Embury





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

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 FTP

- **WST**

- This product provides the best SST at each SLSTR location in GHRSSST L2P format.
- Available to all via FTP, EUMETCAST and CODA

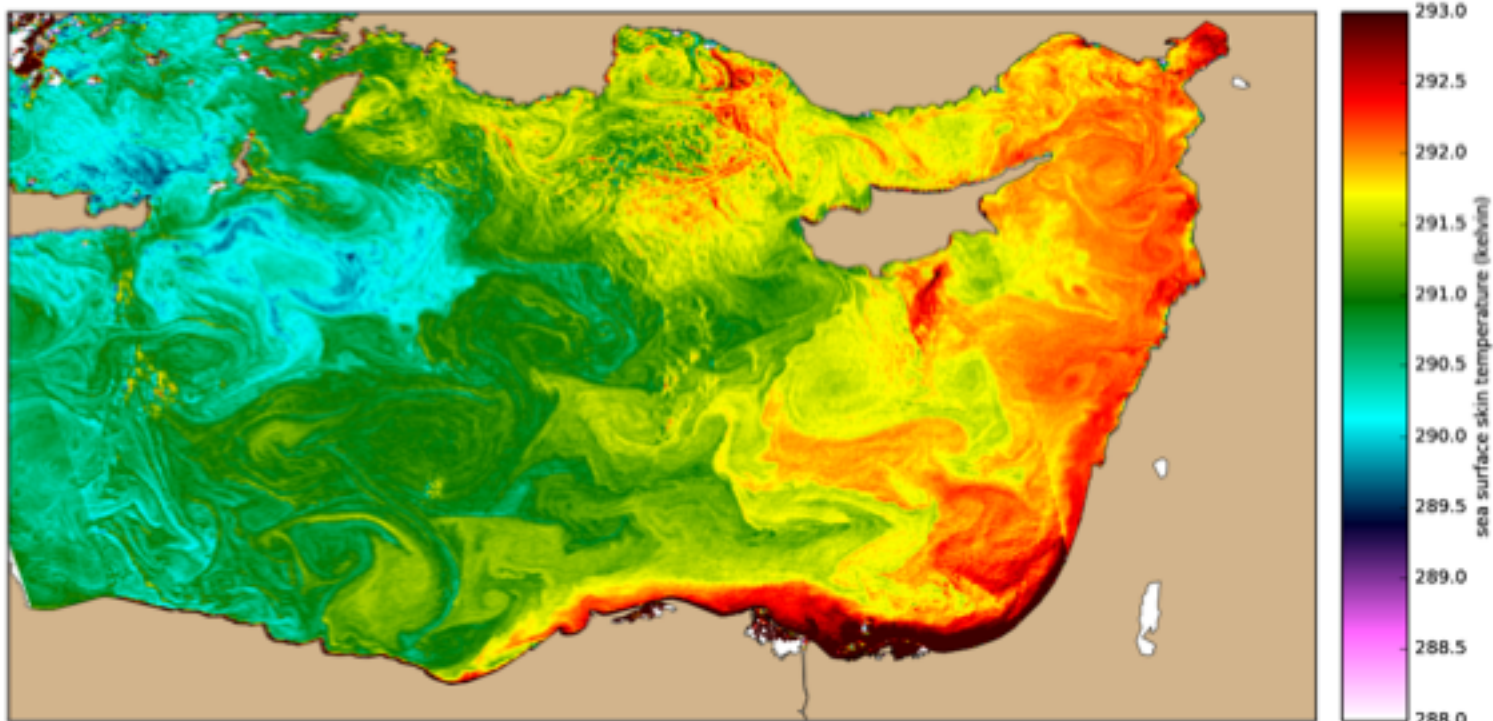


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Image Quality (1)

All data – no masking applied

sea_surface_temperature - 2018-04-05 19:36:56+00:00



Dual-view

Image from Jean Francois Piollé

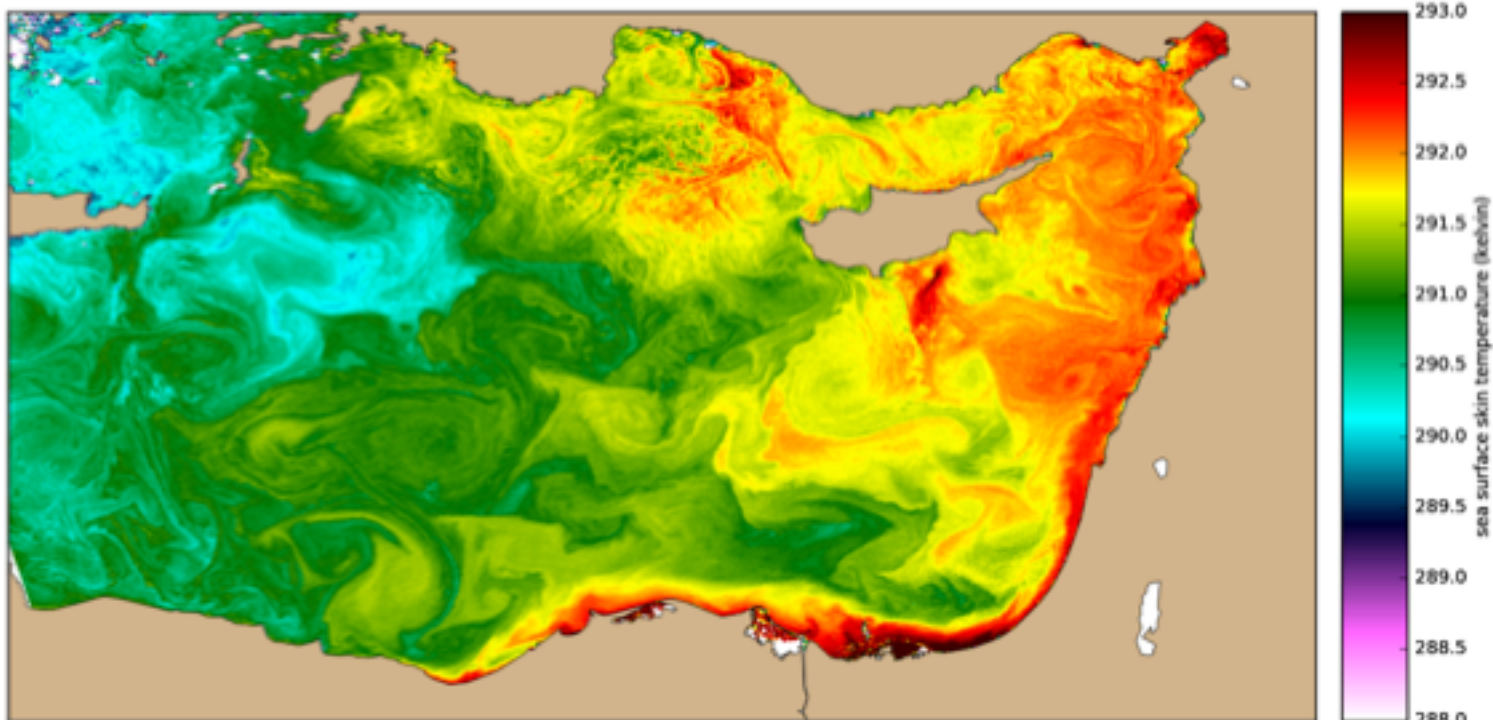


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Image Quality (2)

All data – no masking applied

sea_surface_temperature - 2018-04-05 19:36:56+00:00



Nadir-only

Image from Jean Francois Piollé

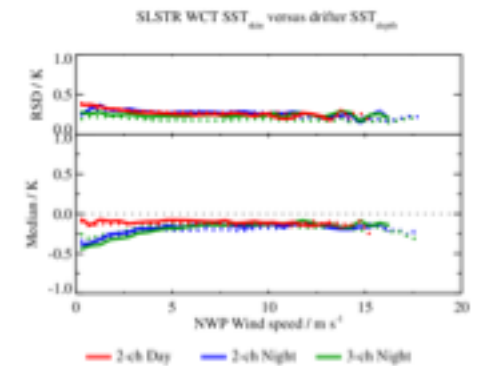
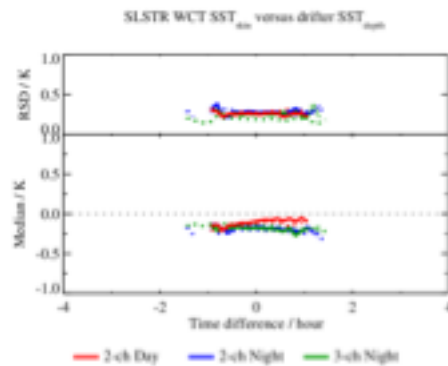
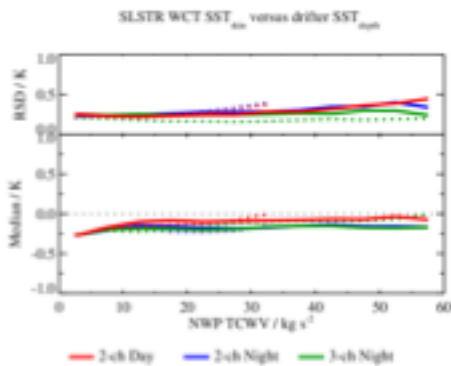
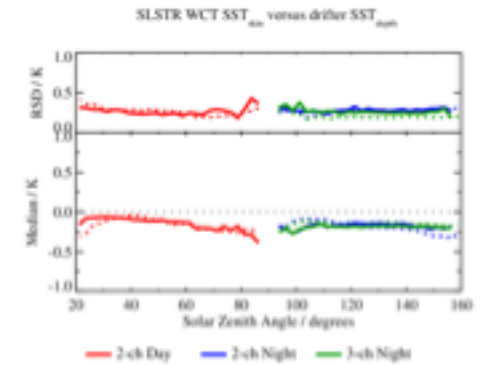
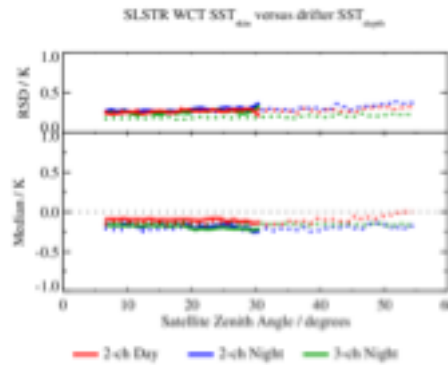
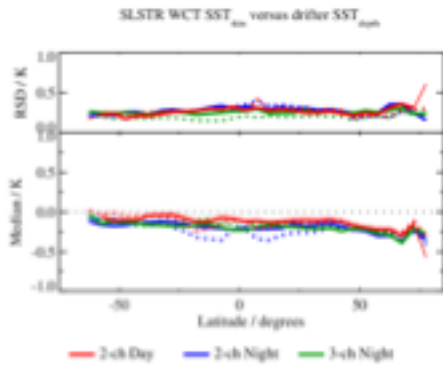


- **Matchup generation**
 - Matchups between SLSTR and CMEMS *in situ* data generated using Felyx
 - Radiometer data provided by PIs
- **Matchup Databases**
 - Reprocessing v4: July 2016 to November 2016
 - Reprocessing v5: November 2016 to March 2017
 - OSI-SAF NRT: March 2017 onwards
 - **Bayesian operational from 04/04/2018**
- **Post processing**
 - Consistent SST processor
 - Offline Bayesian clear-sky calculation
 - Fairall/Kantha-Clayson (FKC) model runs for skin-depth adjustment



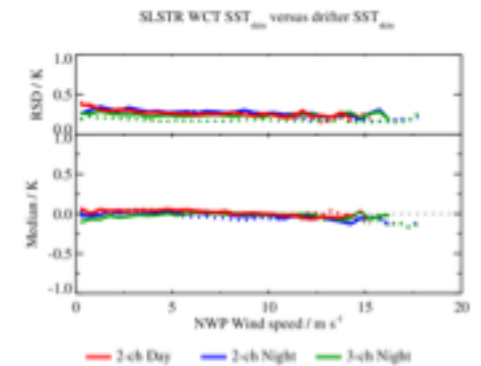
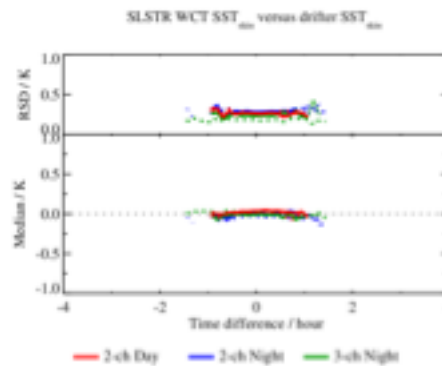
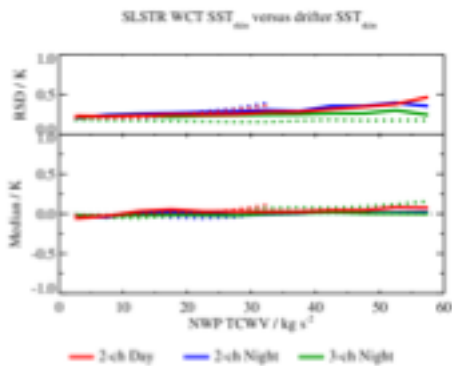
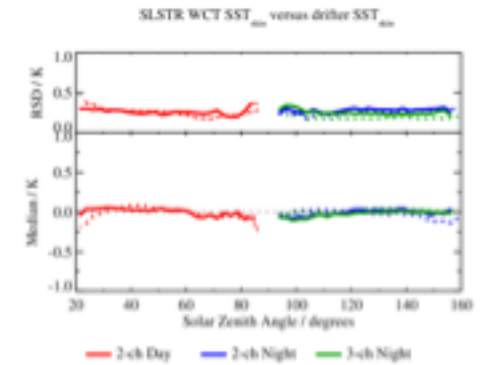
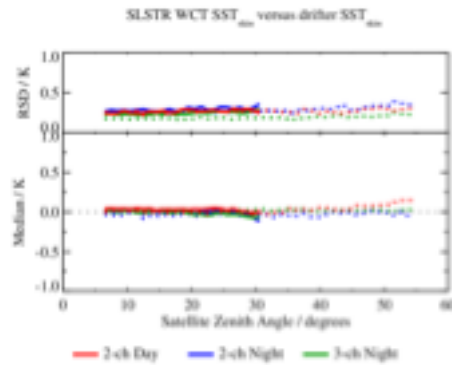
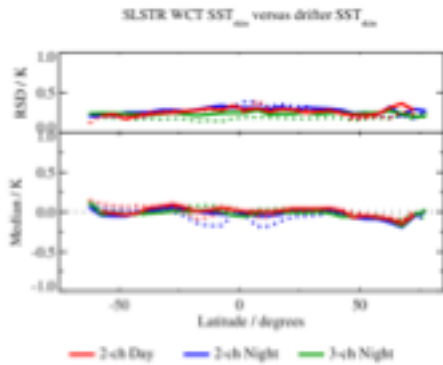
- **QL scheme updated to use scheme from SST_CCI (O. Embury)**

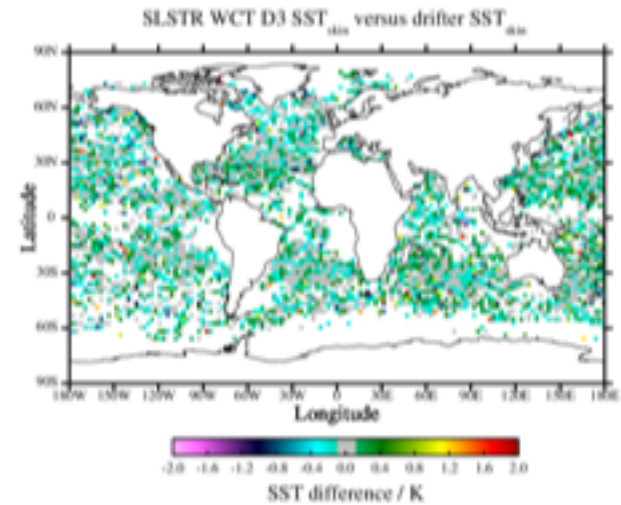
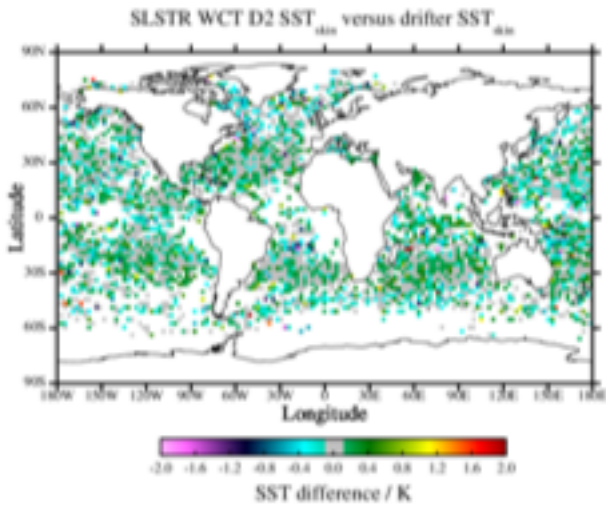
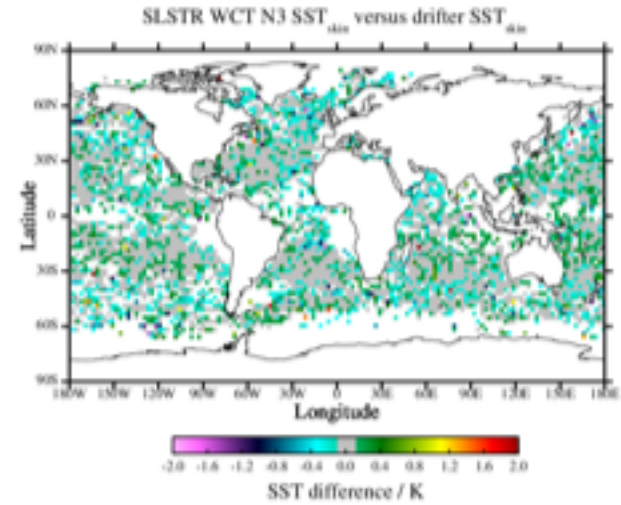
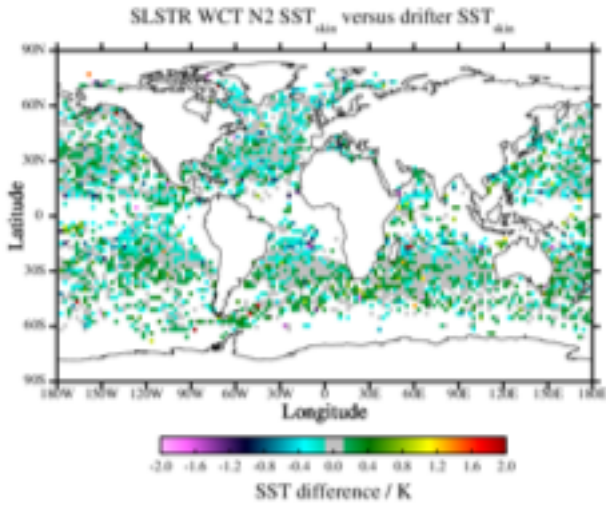
level	meaning	P(clear)	Other
0	no_data	< 0	No data; land
1	bad_data	< 0.5	T ₁₁ < 260; SST < 271.15; ice detected; NWP missing
2	worst_quality	< 0.8	$\theta_{\text{sat}} > 55$
3	low_quality	< 0.9	Twilight ($87.5 < \theta_{\text{sol}} < 92.5$)
4	acceptable_quality		Aerosol detected: $\text{abs}(\text{ASDI}) > 0.2$
5	best_quality		





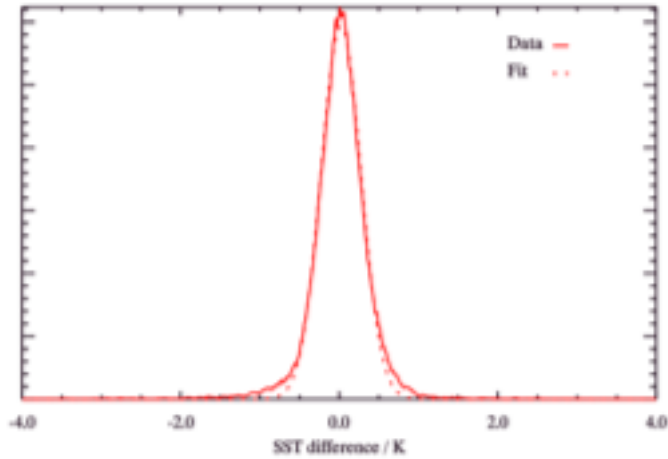
Dependence – drifters QL=5 FKC



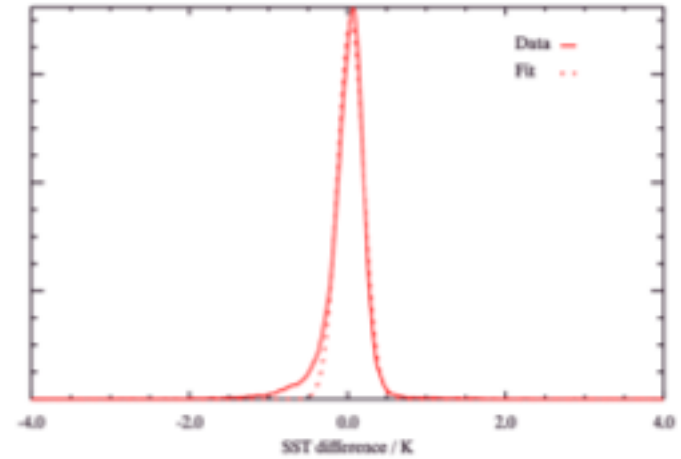




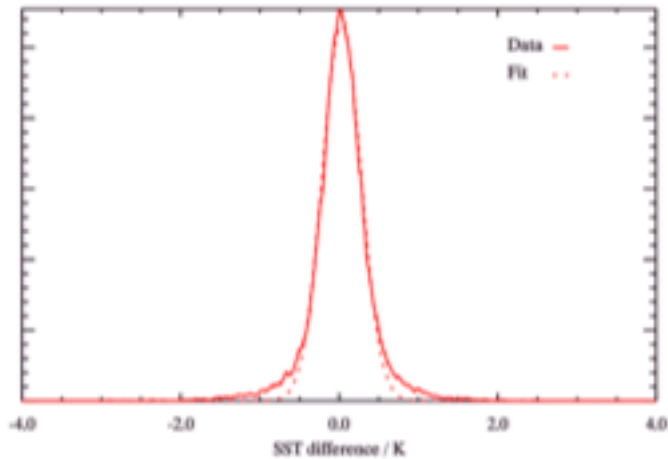
SLSTR WCT N2 SST_{skin} versus drifter SST_{skin}



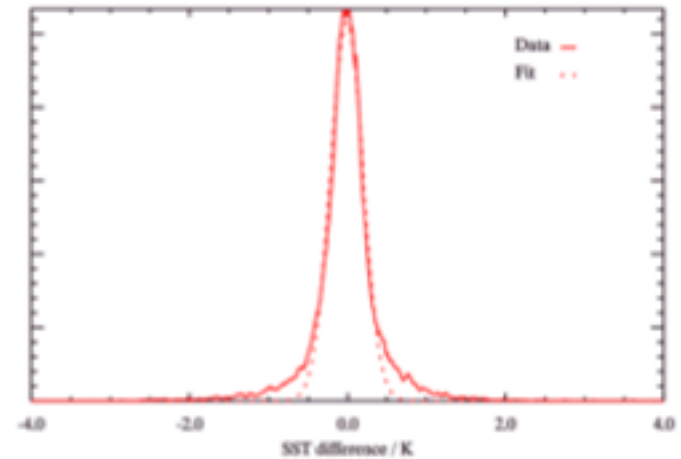
SLSTR WCT N3 SST_{skin} versus drifter SST_{skin}



SLSTR WCT D2 SST_{skin} versus drifter SST_{skin}



SLSTR WCT D3 SST_{skin} versus drifter SST_{skin}





QL=2 (SatZA)

Daytime

N2: 2464 -0.08 (0.46)
D2: 764 +0.01 (0.50)

Night time

N2: 3598 -0.16 (0.49)
N3: 4175 -0.10 (0.34)
D2: 1472 +0.03 (0.66)
D3: 1472 +0.06 (0.63)

QL=3 (Twilight)

Daytime

N2: 2566 -0.05 (0.46)
D2: 482 -0.01 (0.41)

Night time

N2: 1866 -0.17 (0.40)
N3: 2049 -0.07 (0.28)
D2: 1173 +0.04 (0.47)
D3: 1174 +0.03 (0.45)

QL=4 (SDI)

Daytime

N2: 9134 +0.01 (0.37)
D2: 267 -0.67 (1.88)

Night time

N2: 4885 +0.24 (0.45)
N3: 976 +0.06 (0.28)
D2: 159 -0.47 (0.97)
D3: 159 -0.38 (0.73)

QL=5

Daytime

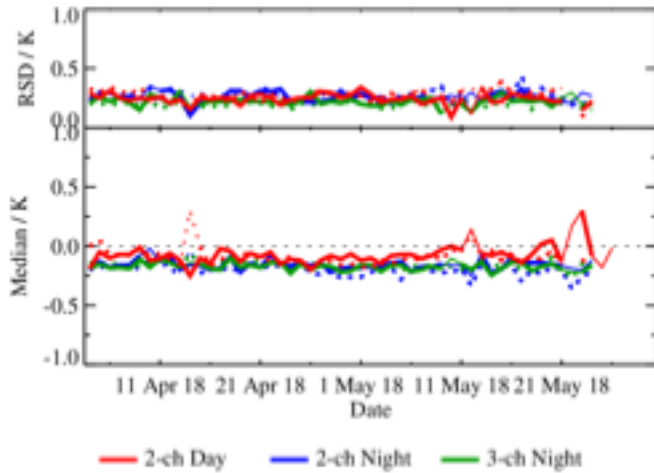
N2: 11394 +0.06 (0.27)
D2: 10249 +0.06 (0.26)

Night time

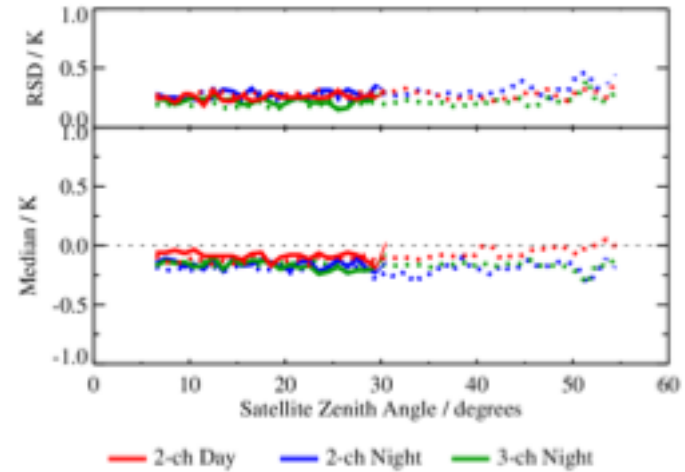
N2: 14039 -0.01 (0.27)
N3: 18307 +0.04 (0.18)
D2: 9144 +0.02 (0.27)
D3: 9145 +0.01 (0.22)

NRT – 04/04/2018 onwards (1)

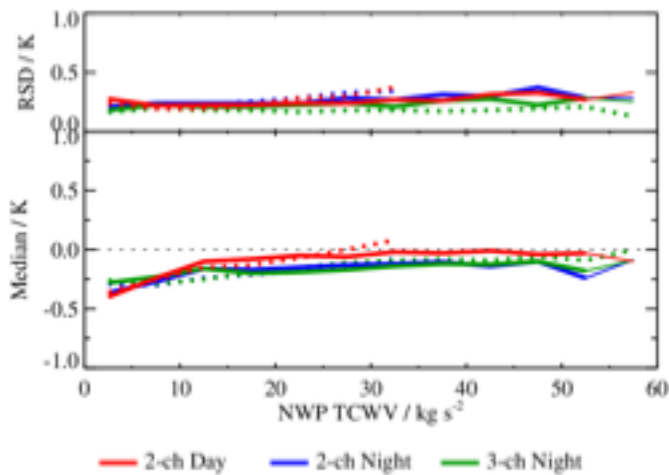
SLSTR WCT SST_{skin} versus drifter SST_{depth}



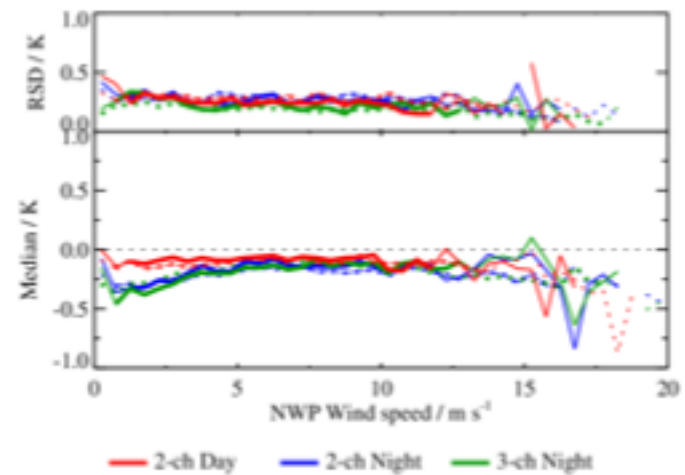
SLSTR WCT SST_{skin} versus drifter SST_{depth}



SLSTR WCT SST_{skin} versus drifter SST_{depth}



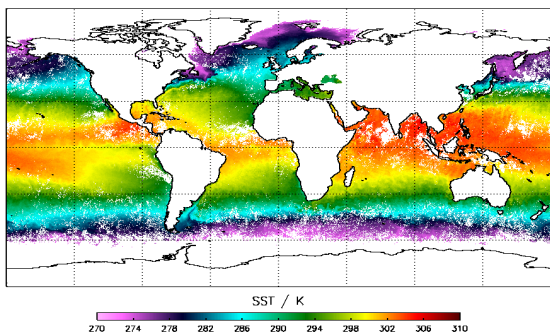
SLSTR WCT SST_{skin} versus drifter SST_{depth}



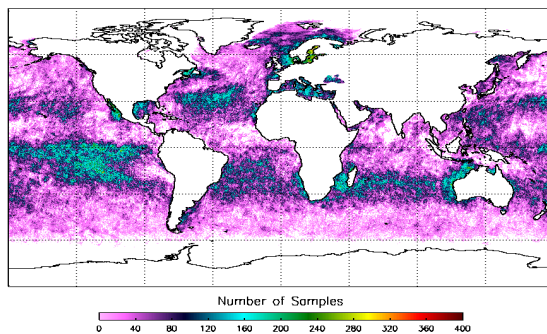


Cycle #31

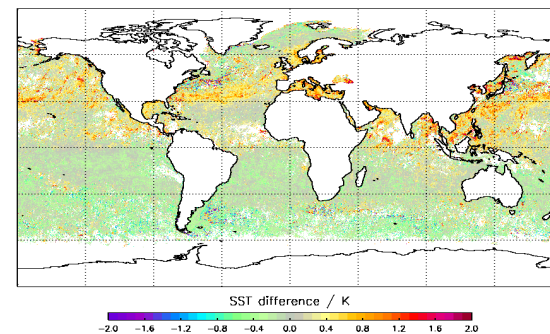
SLSTRA Daytime SST: Cycle #031



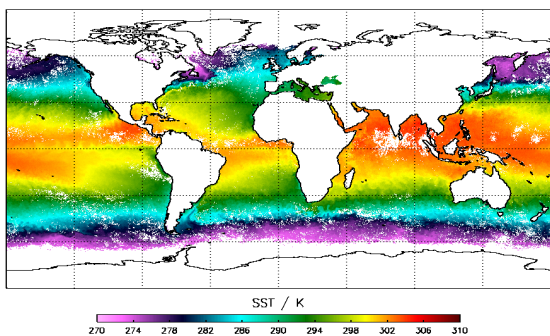
SLSTRA Daytime SST Number of Samples: Cycle #031



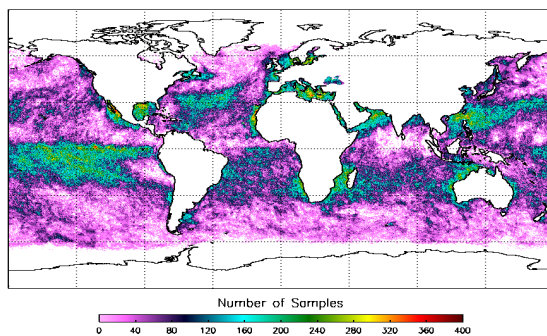
SLSTRA Daytime dt_analysis (OSTIA): Cycle #031



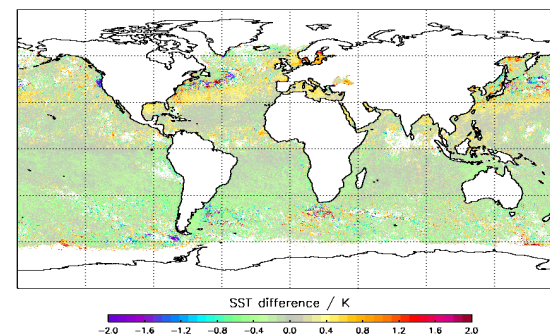
SLSTRA Nighttime SST: Cycle #031



SLSTRA Nighttime SST Number of Samples: Cycle #031



SLSTRA Nighttime dt_analysis (OSTIA): Cycle #031





- **Independent validation of SLSTR SSTs**
 - Drifting buoys, moored buoys, Argo floats, ship-borne radiometers
 - **SLSTR data are SST_{skin}**
 - Requires use of FKC model in validation
- **Updated QL scheme based on SST_CCI implemented**
 - Results in non-standard QL (e.g. 4 is worst quality for D2 and D3)
 - Use of two single view masks versus combined view mask requires further investigation
 - More match-ups needed
 - Use of full REP MDB is required
 - SST coefficients will be refined
- **Bayesian mask significantly improves SLSTR SST data quality**
 - Little, if any, residual cloud remains
 - **Climatological cut-off no longer applied so SLSTR data is now independent and suitable for use as a reference sensor**
 - Minor issues with ECMWF data found



- **Recommend using QL=5 data only**
 - SSES for QL2, 3 and 4 are **very** preliminary
- **Recommend using dual-view (D2 and D3) retrievals for reference sensor**
- **Do not use D2 or D3 QL=4 even for non-reference work**



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Acknowledgements

ACRI-ST / Deimos Space

- ❖ Claire Henocq, Amaia de Miguel, Frederic Rouffi



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- ❖ Support for visiting scientist



STFC-RAL

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