Ongoing comparison between Sentinel-3A SLSTR and IASI aboard Metop-A and –B

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Introduction

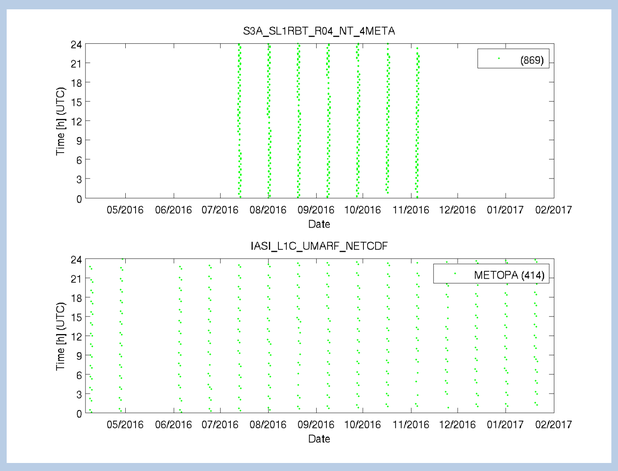
Aboard the Sentinel-3 satellite is a dual view Sea and Land Surface Temperature Radiometer (SLSTR) implemented to fulfil requirements of delivering accurate reference surface ocean, land and ice temperature and to maintain continuity with ENVISAT (A)ATSR series of instruments (Donlon et al., 2012). The Infrared Atmospheric Sounding Interferometer (IASI-A) onboard Metop-A/B is used within Global Space-based Inter-Calibration System (GSICS) as a reference instrument for inter-comparison and re-calibration of other instruments. Therefore to examine the accuracy and continuity we performed comparisons of Sentinel-3A SLSTR against Metop-A IASI measurements. Additionally, applying the same approach, we performed comparison against Metop-B IASI and using double difference method to indirectly assess the differences between Metop-A and Metop-B IASI.

Data

- **S3A SLSTR** : SL_1_RBT___ (L1B)
- **Reprocessed: Jul-Nov 2016 (PB 2.8)**

- **IASI A (B)**

Level 1C
SNOs: time range of SLSTR reprocessed data
Spectral range: 645 to 2760 cm-1 (3.62 to 15.5 microns)
Radiometric resolution : 0.2 to 0.4 K
Spectral resolution : 0.5 cm-1
Number of channels: 8700
Spatial resolution : pixel diameter of 12 km



Methodology

Crossovers (SNO/QSNO)

(Q)SNO=(quasi) simultaneous nadir overpasses

Collocations (matchups)

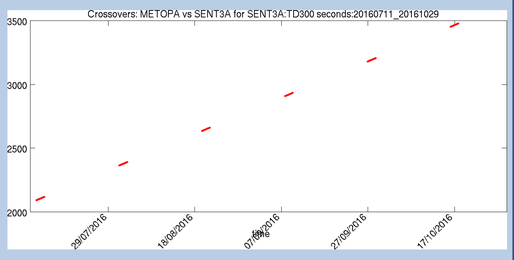
spatio/temporal/geometry

Spectral convolution

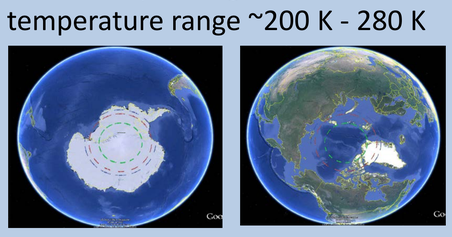
Convolve IASI radiance spectra with SLSTR SRF

Aggregate (average)

SLSTR pixels in IASI FoV



Limited to pole regions → temperature range ~200 K - 280 K

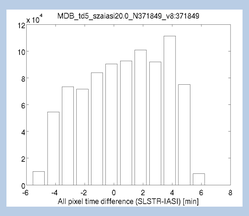


Crossovers

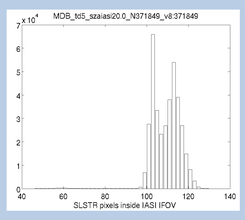
- only simultaneous nadir overpasses (SNOs):
- based on orbital model prediction
- Estimated for the period: Apr16-Jan17
- Max time difference: 5 min
- Max spatial distance:10 km
- Analysed 7 SNO (REP) events for IASI-A
- Each event last ~2 days with ~50 crossovers per SNO

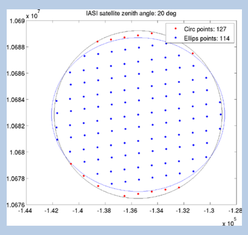
MetopA: 27-28/04; 04-06/06; 23-25/06; 12-14/07; 31/07-02/08;19-21/08; 07-09/09; 26-28/09; 16-17/10;04-05/11; …

Pixel time difference between IASI and SLSTR



Number of SLSTR pixels inside IASI IFOV





Collocations (matchups)

- Time difference (pixel time): 5 min (SNO)
- Spatial difference: within pixel (central)
- Viewing angle:
  - $|\Delta\sec(\vartheta)/\sec(\vartheta)|<1\%$ or
  - **|IASI SZA| < 20°**
- All matchups included
- IASI IFOV estimated as ellipse $f(\vartheta)$

Spectral convolution

- Convolution of SLSTR SRF over IASI radiances → synthetic SLSTR S8 and S9 bands
- SLSTR SRF v2014
- Assesing band 7 (3.7 µm) requires gap filling

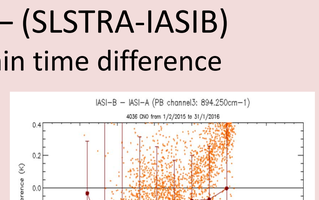
approach due to the incomplete spectral coverage by IASI (tbd)

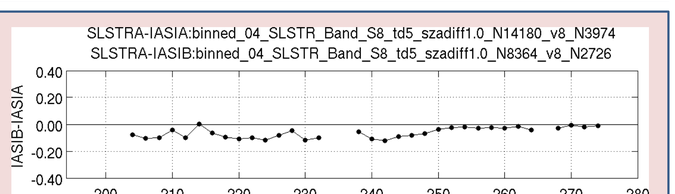
Double differences:

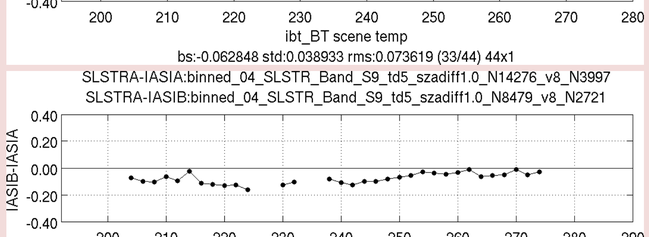
IASI B – IASI A (over SLSTR A)

SLSTR A vs IASI A/B:
(SLSTRA – IASIA) – (SLSTRA-IASIB)
|IASI SZA|<20°; 5 min time difference

Double differences:
MSG/SEVIRI vs IASI A/B
After Hewison, 2016 (IASI WG 2106)







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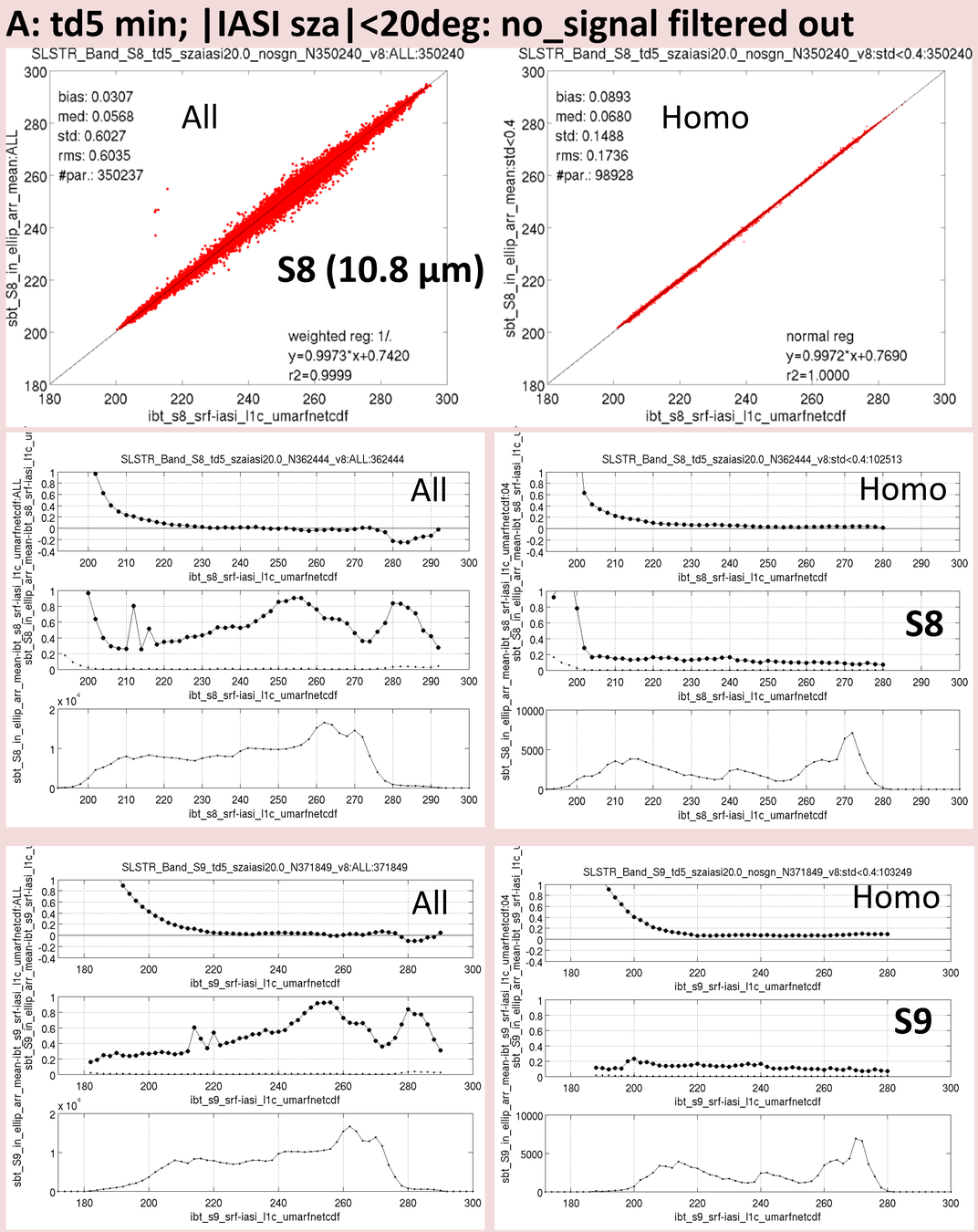
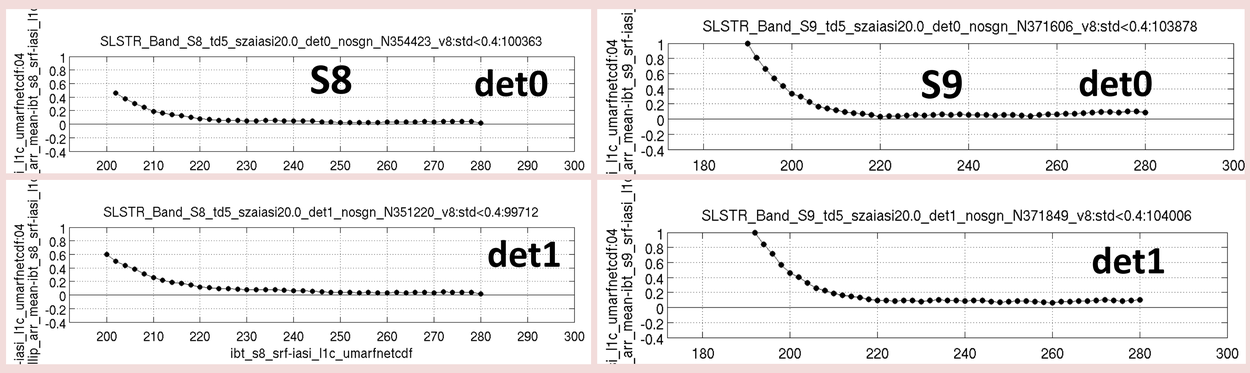
Results

- Scatter and scene temperature dependance plots
- All and homogenous (homo) pixels (std within IASI IFOV < 0.4 K)
- Detector 0 vs detector 1
- Removed all collocations containing slstr pixels flagged with no_signal
- Checkeboard pattern around ~200 K → related to different response of det0 and det1 (will be resolved)

IASI A: td5 min; |IASI sza|<20deg: no_signal filtered out

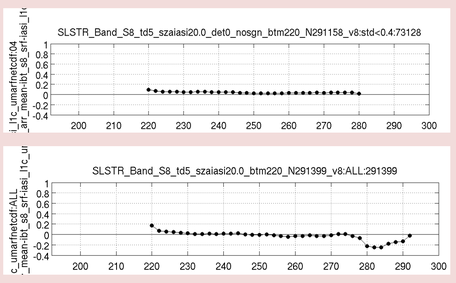


IASI A: det0/det1:



Statistics for BT>220 K: IASI A: det0/det1/all: homo/all:S8/S9

	All/det0/ det1	homo	ALL
S8	all	0.05+-0.11 (72863)	0.00+-0.64 (291396)
	det0	0.04+-0.12 (73128)	-0.01+-0.66 (291155)
	det1	0.05+-0.12 (73291)	0.00+-0.65 (291488)
S9	all	0.08+-0.11 (73606)	0.03+-0.66 (287830)
	det0	0.07+-0.12 (73963)	0.02+-0.67 (287570)
	det1	0.09+-0.11 (74056)	0.04+-0.67 (287900)



Summary

- Stable calibration
- Near zero bias (<0.1 K) in S8 and S9 nadir (220 K – 280 K) → very good!
- Cold temperature bias (~>0.2 K): nonlinearity (BB 250-300)?
- "no_signal" flagging issues ~200 K for S8 → to be resolved
- Negative bias in >280 K → QSNO (on-going work)
- Detectors response: S8 – OK, S9 small offset (~0.08 K)
- SLSTR → 2 radiometers
- IASI double differences: small bias ~ 0.05 K – F(SNO event/season) → similar results as for MSG/SEVIRI

Acknowledgements

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