ships4sst

shipborne radiometers for sea surface temperature

Satellite Validation AATSR to SLSTR

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Space ConneXions

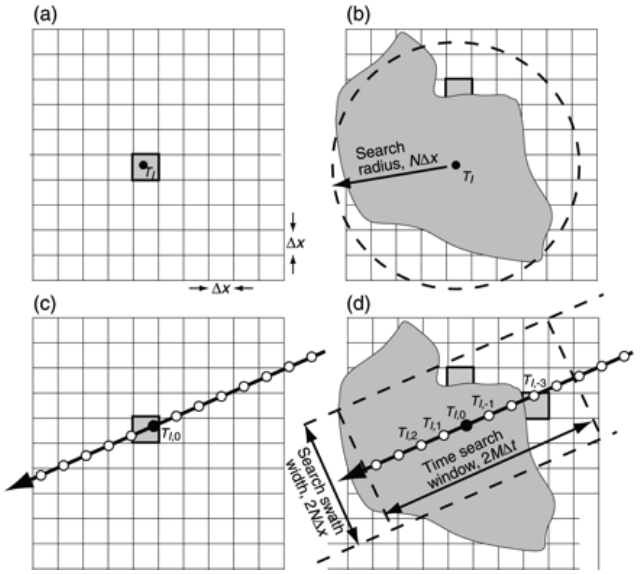
Overview

- Validation principle
- AATSR validation
- An updated matchup process
- SLSTR validation

Matching the data

- $E = T - V$
- $E = V_S - V_I$

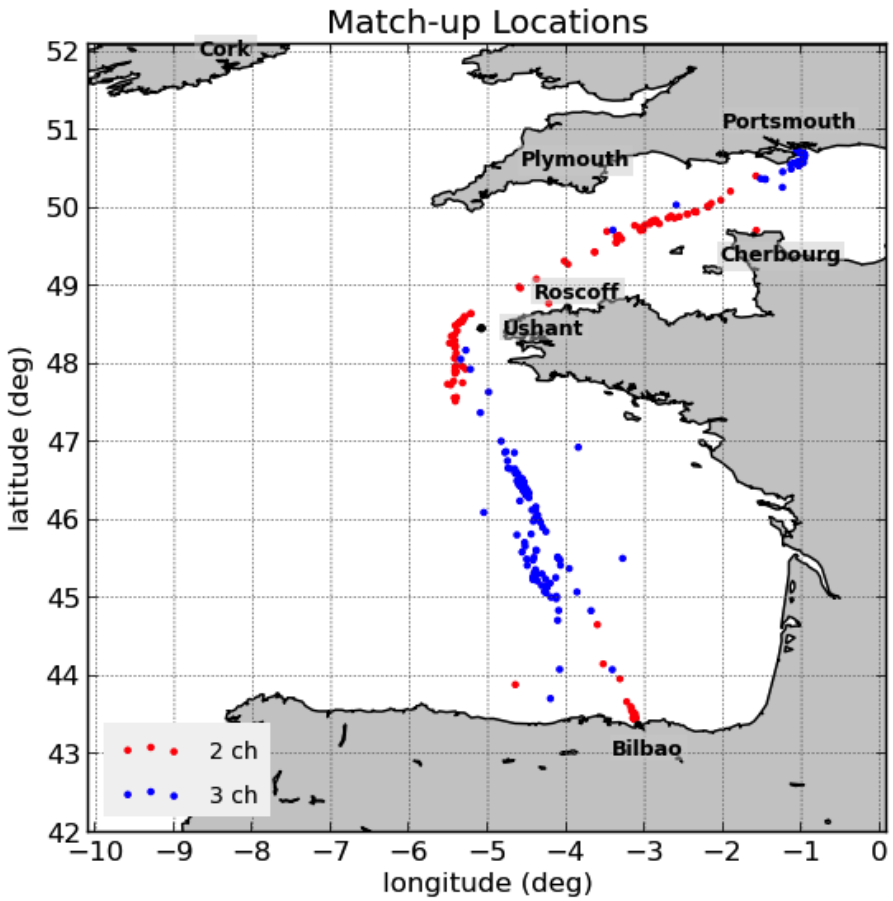
- The MDB files are produced by Felyx
  - SLSTR L1b and L2 data within 400x400 pixels of matchup
  - L2R data within 6hrs of matchup
- MDB files analysed ISFRN
  - Follow the Wimmer et.al 2012 approach



Grade	Time	Spatial
1	±0.5 h	±1km
2a	±0.5 h	±20km
2b	±2 h	±1km
3	±2 h	±20km
4	±6 h	±25km

Wimmer, W., Robinson, I. S., & Donlon, C. J. (2012). Long-term validation of AATSR SST data products using shipborne radiometry in the Bay of Biscay and English Channel. *Remote Sensing of Environment*, *116*, 17-31. DOI: 10.1016/j.rse.2011.03.022

Locations of AATSR-ISAR matchups (grade 2b) 2004 - 2012



Grade 2b:

2996 night match-ups

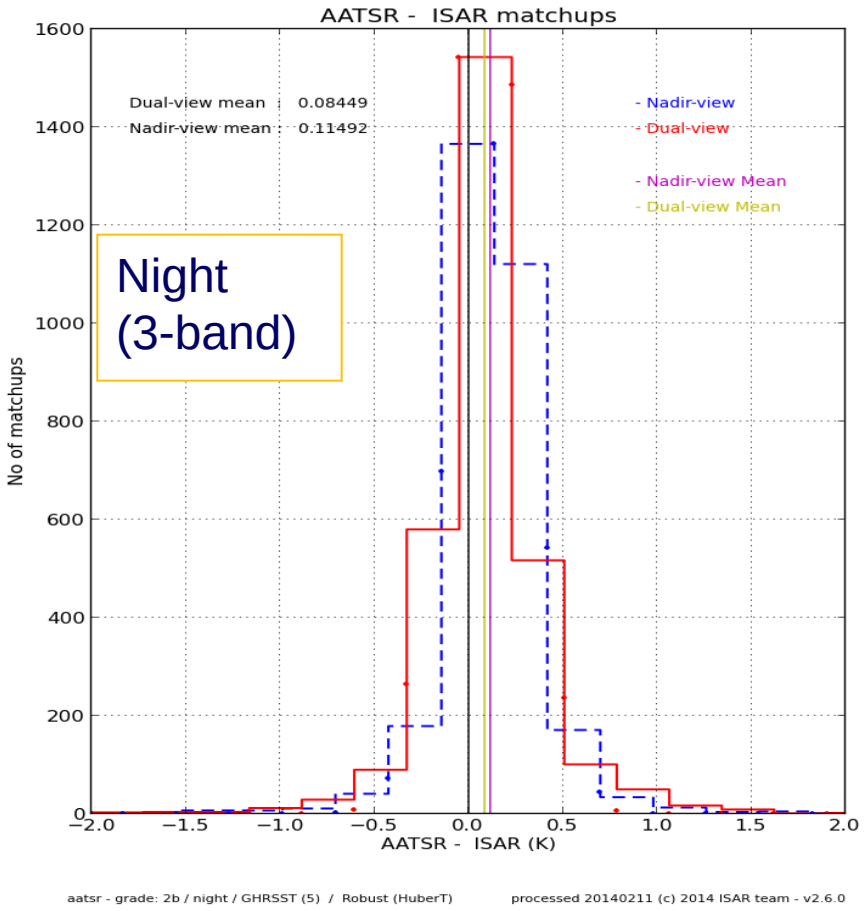
1153 day match-ups

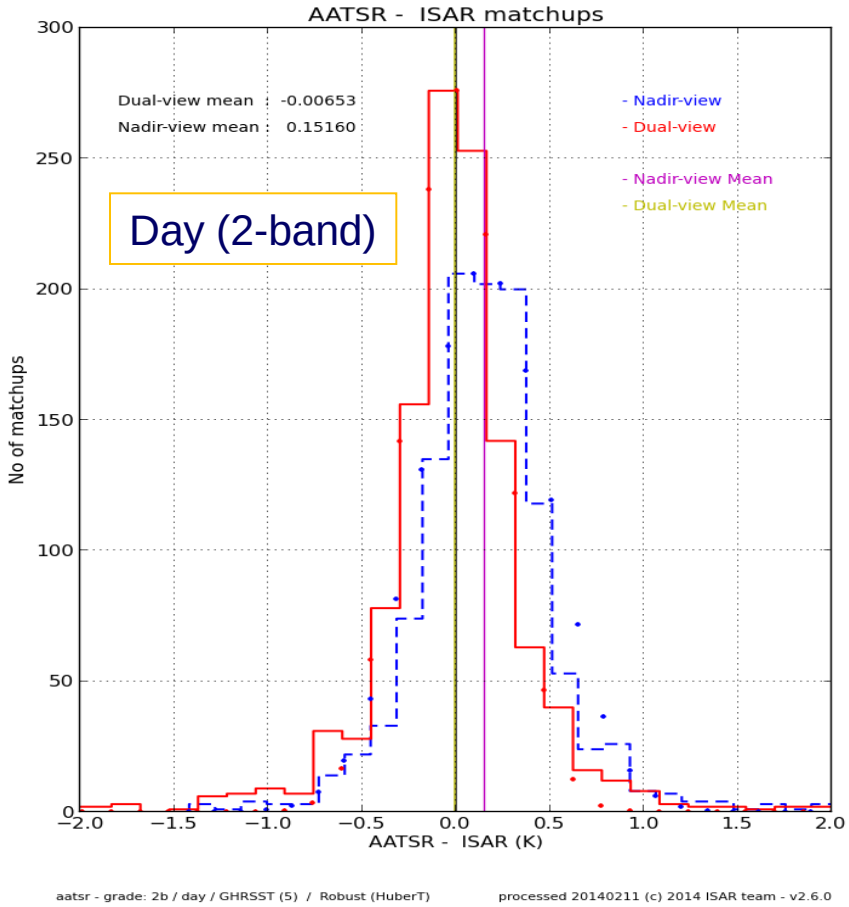
AATSR – ISAR Match-ups, July 2004-April 2012 Dual view (CV=5)

Grade 2b matches AATSR and ISAR samples within 1 km and 2 hrs

Grade of coincidence	Mean estimated difference	Robust standard deviation	No. of Matches	Overpass numbers	Min temp, °C	Max temp, °C
2 waveband algorithm (D2)						
1	0.00	0.19	302	50	5.9	18.9
2a	-0.08	0.34	692	94	5.9	19.9
2b	**-0.01**	**0.25**	**1153**	**101**	**5.5**	**24.2**
3	-0.08	0.37	2575	152	4.5	24.7
4	-0.08	0.43	7956	264	3.6	25.1
3 waveband algorithm (D3)						
1	0.09	0.21	836	96	5.3	22.1
2a	0.09	0.28	1582	146	5.3	22.1
2b	**0.08**	**0.21**	**2996**	**138**	**5.3**	**22.8**
3	0.09	0.30	5603	194	5.3	22.8
4	0.06	0.34	18082	314	0.5	24.5

Histogram of AATSR – ISAR ΔSST distribution for 2004-12





AATSR – ISAR Match-ups, July 2004--April 2012 seasonal analysis - dual view (CV=5)

Grade 2b matches AATSR and ISAR samples within 1 km and 2 hrs

Season	Mean estimated difference	Robust standard deviation	No. of Matches	Overpass numbers	Min temp, ° C	Max temp, ° C
2 waveband algorithm (D2)						
Winter	-0.06	0.16	86	10	7.7	14.7
Spring	-0.10	0.21	401	28	5.5	17.7
Summer	0.06	0.34	483	45	10.0	24.2
Autumn	0.08	0.24	183	18	11.1	21.2
3 waveband algorithm (D3)						
Winter	0.24	0.31	187	16	5.3	15.0
Spring	0.06	0.18	1075	44	6.9	16.8
Summer	0.07	0.25	822	42	12.4	22.8
Autumn	0.10	0.21	912	36	12.6	21.6

A different approach

- Calculate the errors:
  - $E = V_S - V_I$
  - $E = E_S + E_T + E_M + E_P$

E_S .. Spatial mismatch
E_T .. Temporal mismatch
E_M .. Instrument error
E_P .. Point in sampling area

  - $Q = \mathrm{Min}\{Q_{P1}, Q_{P2}, Q_T, Q_S, Q_{Sky}\}$

A different approach

A Quality flag Q_x of 0, 3, 4 or 5 is set according to the value of five indicators I_x as follows:

- Q_P:
  - Q_{P1} ~ I_{P1} = variance (9x9 non cloud AATSR) * chi2 (95% conf.)
  - Q_{P2} ~ I_{P2} = variance (1h ISAR data) * chi2 (95% confidence)
- Q_T ~ I_T = time trend over 1 h of ISAR data * time_diff
- Q_S ~ I_S = spatial trend (9x9 non cloud AATSR) * distance_diff
- Q_{Sky} ~ I_{Sky} = BT_{Sky} [related to cloudiness]

Each of the five indicators is capable of being calculated individually for each match-up data pair

Quality indicator design

A Quality flag Q_x of 0, 3, 4 or 5 is set according to the value of five indicators I_x as follows:

- Q_P:
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- Q_T ~ I_T = time trend over 1 h of ISAR data * time_diff
- Q_S ~ I_S = spatial trend (9x9 non cloud AATSR) * distance_diff
- Q_{Sky} ~ I_{Sky} = BT_{Sky} [related to cloudiness]

Each of the five indicators is capable of being calculated individually for each match-up data pair

Indicator threshold for assigning Quality levels

For each match-up, the five Q_x are set according to the I_x by reference to the following table of thresholds:

Quality	0	3	4	5
Q_{P1}	all data	0.3	0.1	0.035
Q_{P2}	all data	0.3	0.1	0.035
Q_T	all data	0.6	0.2	0.05
Q_S	all data	0.25	0.07	0.025
Q_{SKY}	all data	280	260	240

The overall Q is set as the minimum of the five Q_x :-

$$Q = \text{Min}\{Q_{P1}, Q_{P2}, Q_T, Q_S, Q_{Sky}\}$$

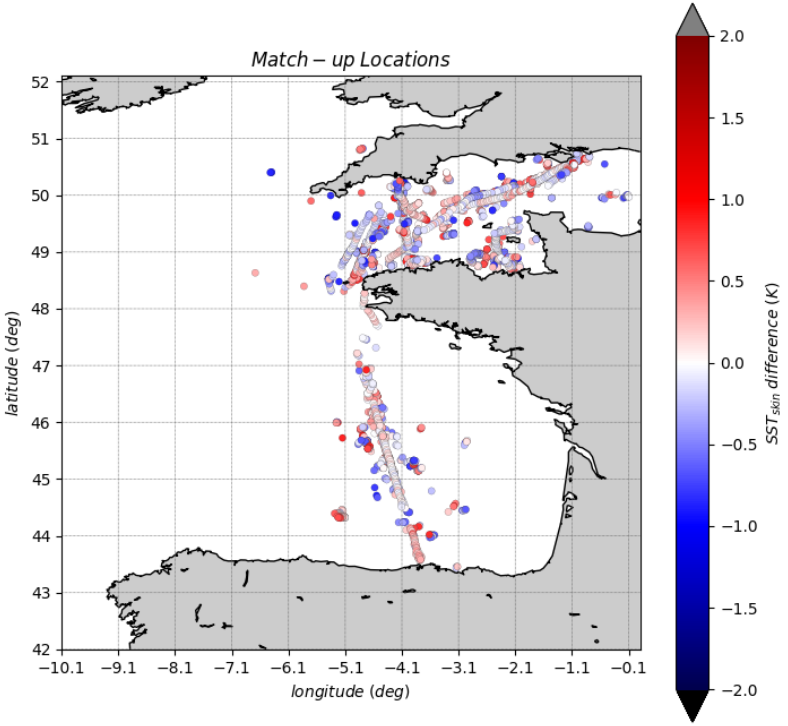
AATSR dual view – ISAR. 2004-2012
Validation stratified by match-up quality (Q)

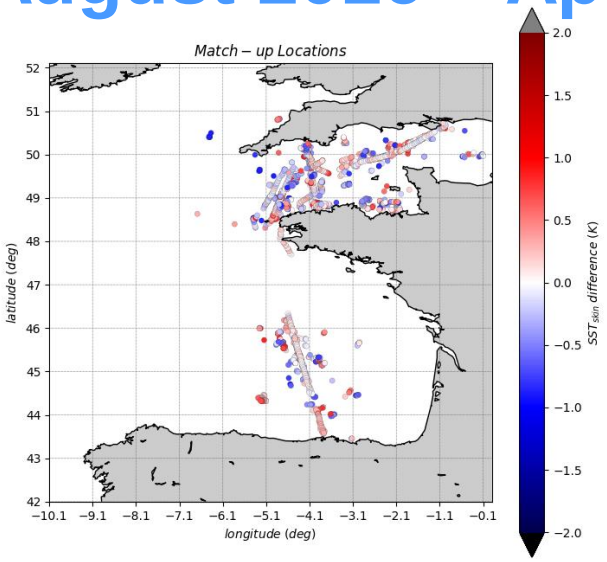
Match-up quality factor	Mean estimated difference	Robust standard deviation	No. of match-ups
2 channel			
All matches	-0.08	0.43	7956
Q3	-0.03	0.25	1202
Q4	-0.01	0.21	560
Q5	**0.01**	**0.16**	**117**
3 channel			
All matches	0.06	0.34	18082
Q3	0.07	0.24	3163
Q4	0.05	0.18	1418
Q5	**0.06**	**0.13**	**434**

SLSTR

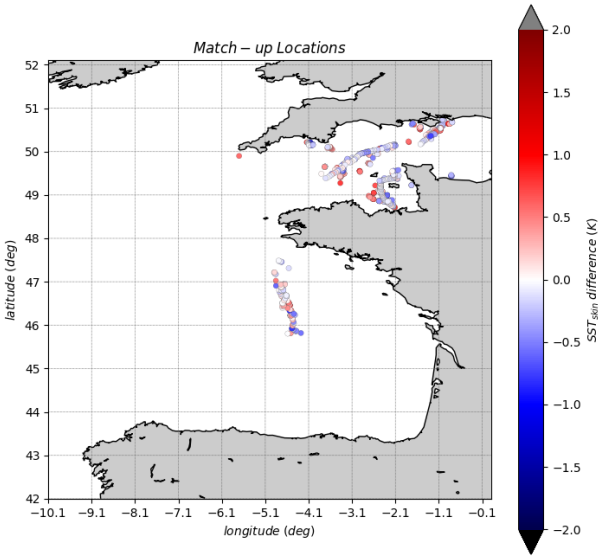
- Changes to AATSR
  - Data comes through Felyx
    - AATSR was direct download of N1 files
  - MDB are pre-matched, we just extract the best match.
    - AATSR we did the matching
  - Plotting more of the paramters
- Same as AATSR
  - Matchup process
    - We process the 400x400 pixel fields with our match-up procedure
  - Statistics
    - 3sd filter, robust

SLSTR matchup location – August 2016 – April 2018 - CV 5





Day



Night

s4sstPtA, sstdiff_sst_wst, grade 2b, night, ghrsst-5 - HuberT processed 20190123 (c) 2019 ISAR team - v1.4

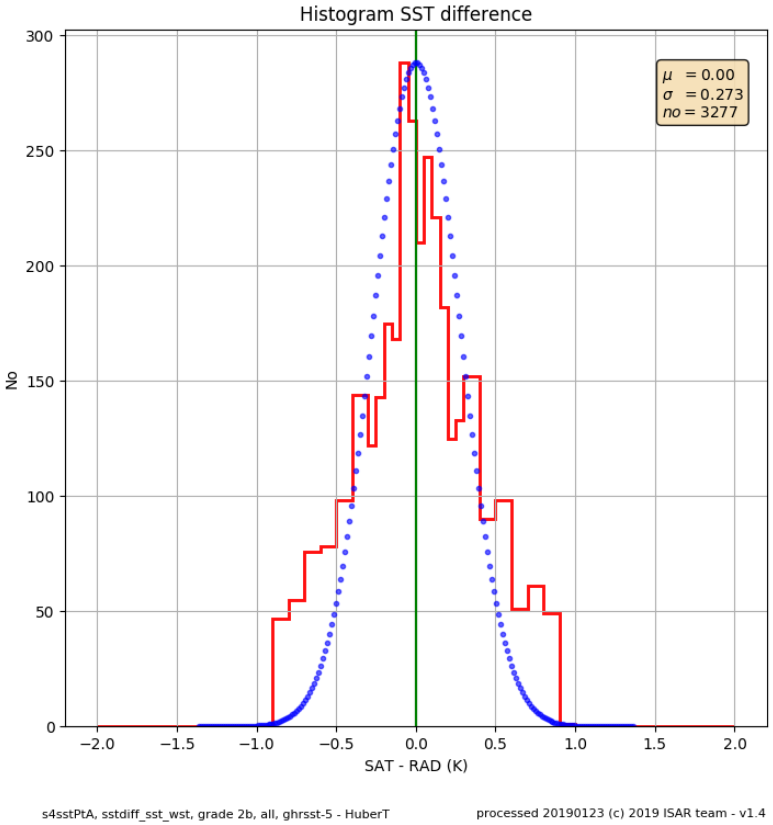
SLSTR statistics – August 2016 – April 2018

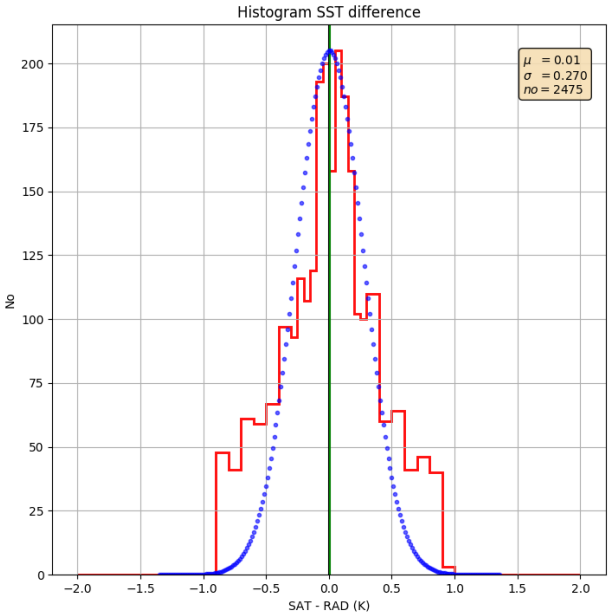
PtA	CV 5			
Grade	Mdiff	RSD	No	Overpass
1	0.00	0.24	586	67
2a	0.00	0.24	1172	67
2b	**0.00**	**0.27**	**3277**	**90**
3	0.00	0.28	5394	90
4	0.00	0.28	7533	91

Day				
Grade	Mdiff	RSD	No	Overpass
1	0.01	0.23	442	49
2a	0.01	0.23	884	49
2b	**0.01**	**0.27**	**2475**	**67**
3	0.01	0.28	4072	68
4	0.01	0.28	5664	68

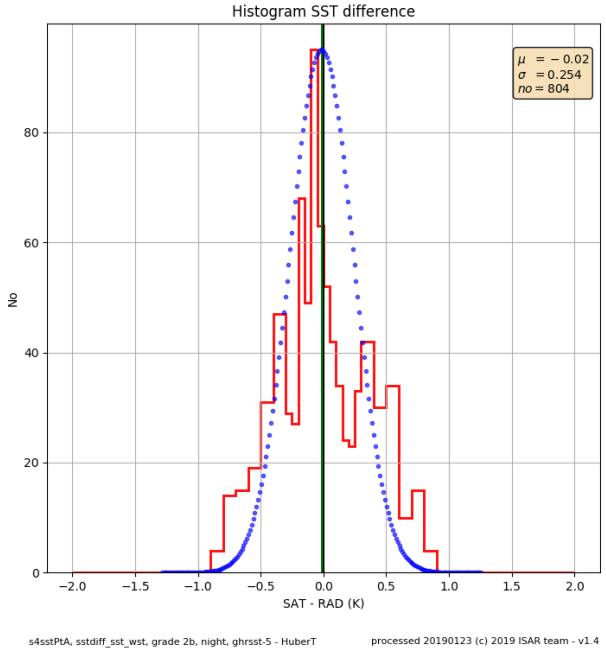
Night				
Grade	Mdiff	RSD	No	Overpass
1	-0.01	0.24	140	18
2a	-0.01	0.24	280	18
2b	**-0.02**	**0.25**	**804**	**23**
3	-0.02	0.26	1330	23
4	-0.02	0.26	1855	23

SLSTR histograms– August 2016 – April 2018





Day



Night

Conclusions

- AATSR validation
  - Day mean -0.01 K, rsd 0.25 K
  - Night mean 0.08 K, rsd 0.21 K
- Validation methods
  - Taking the matchup process uncertainties into account
  - Day mean 0.01 K, rsd 0.16 K
  - Night mean 0.06 K , rsd 0.13 K
- SLSTR Validation
  - Day mean 0.01 K, rsd 0.27 K
  - Night mean -0.02 K, rsd 0.25 K
  - WST product
- Future work
  - D3, D3, N3,N2 SLSTR validation
  - Implement AATSR matchup uncertainty methods