Study of satellite observations synergy in order to improve surface temperature in NWP

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OUTLINE

- Context of the study
- Satellite Land Surface Temperature (LST) comparison
- Validation to in-situ data
- Conclusions and perspectives

Context of the study

- Importance of the Land Surface Temperature (LST) in surface analysis and limits of its modelization
- Surface schemes use modeled LST
- Realistic LST to replace modeled LST for satellite radiance assimilation

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- Importance of the Land Surface Temperature (LST) in surface analysis and limits of its modelization
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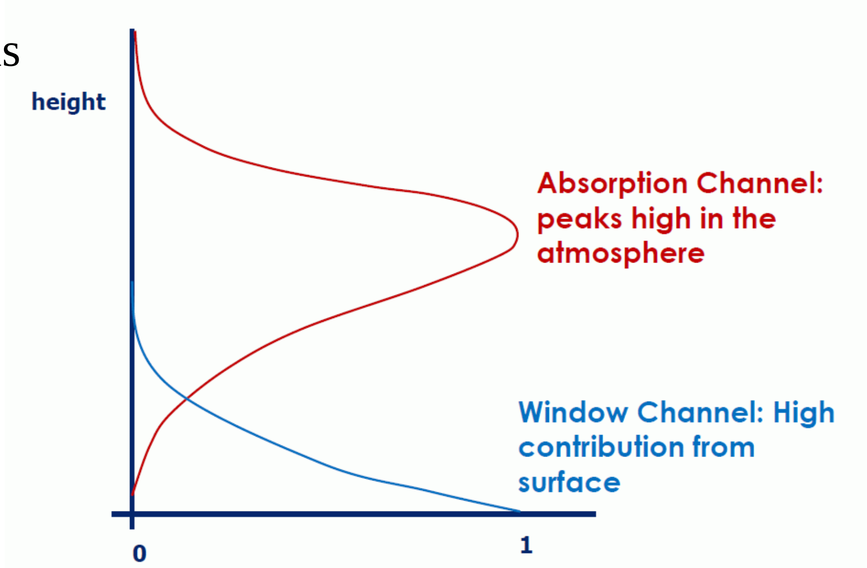
- Window channels for Satellites LST retrieval
- Further application of satellites LST in surface analysis

→ Study of agreement between different sensors



Contribution profile of a water vapour absorption channel (red) compared to a window channel (blue). Credits: eumetrain/Marianne König (EUMETSAT)

Context of the study

AROME-France 3D-Var model experiments:

→ Operational Meso-scale Non-Hydrostatic model of Météo-France

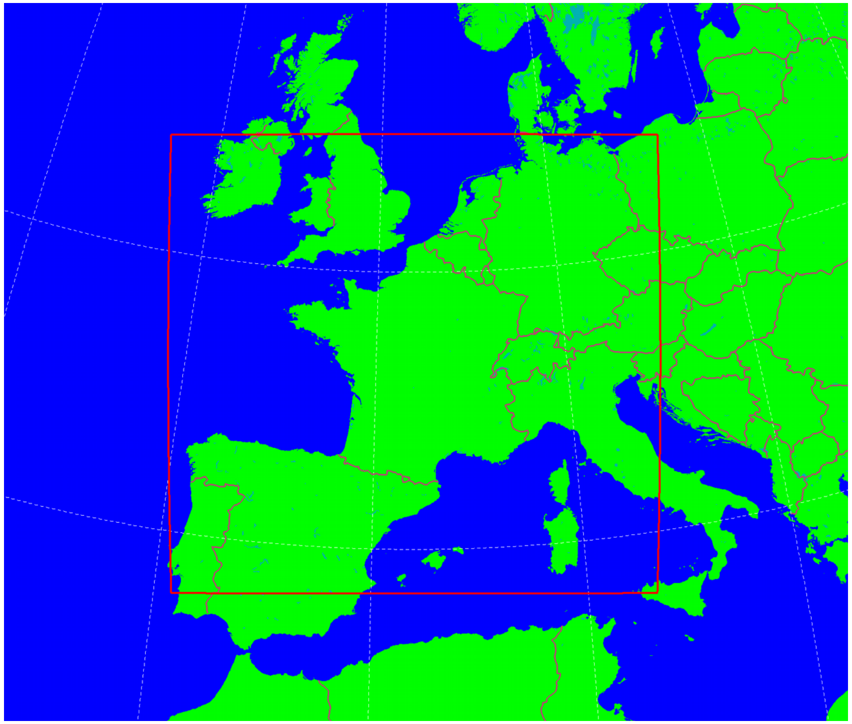
(1h 3D-Var cycle assimilating Conventional/Satellite/Radar observations)

- Under clear-sky conditions
- Blacklisting cloud contaminated observations
- LST retrieved with the Mono-channel and known emissivity
- RTTOV 11 and emissivity atlas
- Three covered periods of a month each:

Summer: 16/06/2017 - 16/07/2017

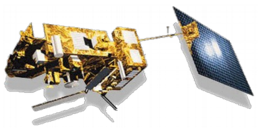
Autumn: 01/10/2017 - 31/10/2017

Winter: 15/01/2018 - 14/02/2018



AROME-France domain (1.3 km)

Satellite LST comparison



Spinning Enhanced Visible and Infrared Imager SEVIRI

- On board MSG satellites
- Geostationary, 8 thermal Infrared channels
- 3km of spatial resolution at nadir
- Emissivity Land-SAF atlas

→ Channel 9 (10.8 µm) [*Guedj et al. , 2011*]

Infrared Atmospheric Sounding Interferometer IASI

- On board Metop-A and Metop-B
- Polar orbit, 8461 channels
- 12Km of spatial resolution at nadir
- Emissivity atlas from University of Wisconsin

→ Channel 1194 (10.6 µm) [*Boukachaba, 2017*]

Advanced Microwave Sounding Unit AMSU-A

- On board Metop-A/B and NOAA satellites
- Polar orbit
- 15 microwave channels
- 48km of spatial resolution at nadir
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→ Channel 3 (50.3 GHz) [*Karbou et al., 2006*]

Advanced Microwave Sounding Unit AMSU-B

- On board Metop-A/B and NOAA satellites
- Polar orbit
- 5 microwave channels
- 16km of spatial resolution at nadir
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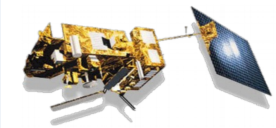
→ Channel 1 (89 GHz) [*Karbou et al., 2006*]

Satellite LST comparison



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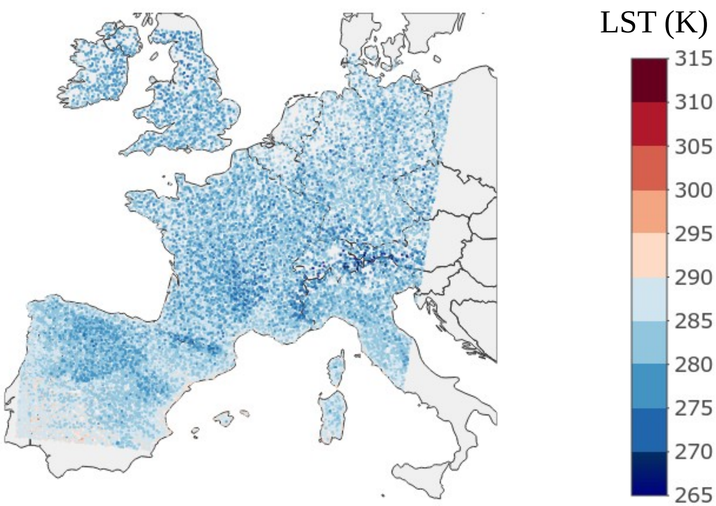
Different sensors LST compared to SEVIRI mean LST within 4.5 Km

Satellite LST comparison – IASI vs SEVIRI

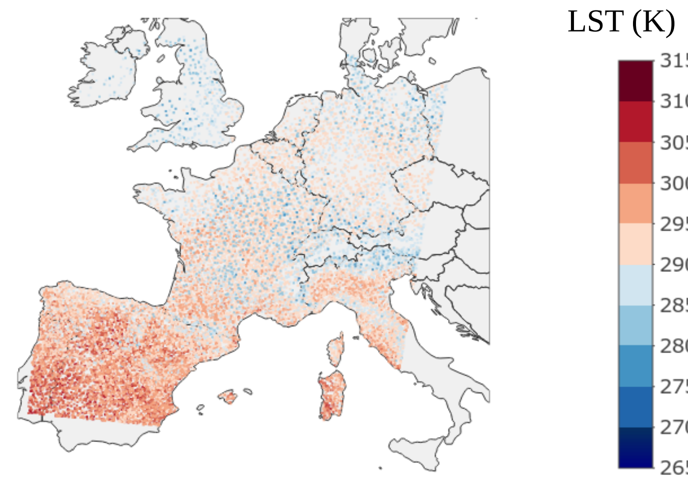
IASI LST – Night-time (October 2017)

a



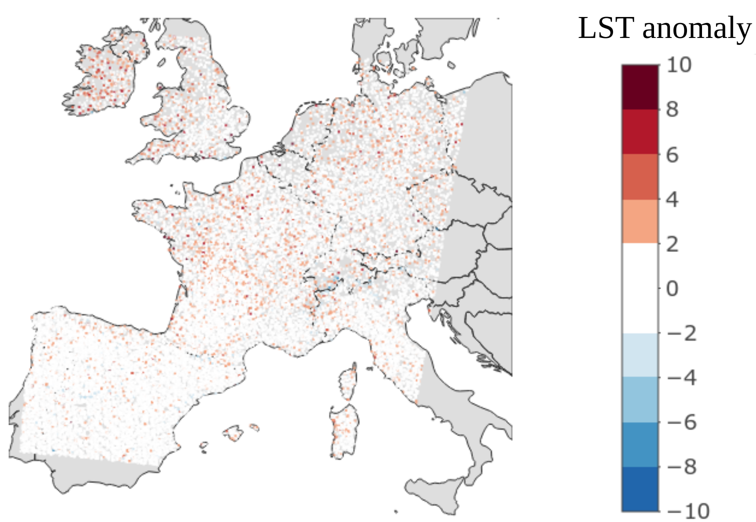
IASI LST – Daytime (October 2017)

b



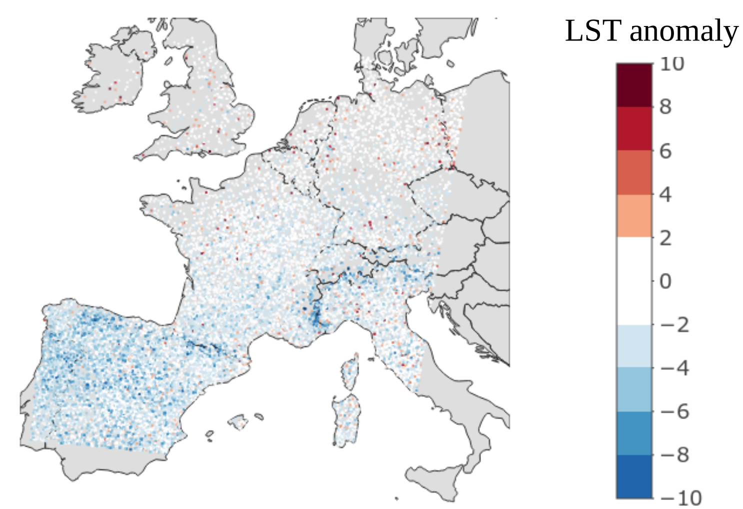
IASI - SEVIRI LST anomaly – Night-time (October 2017)

c

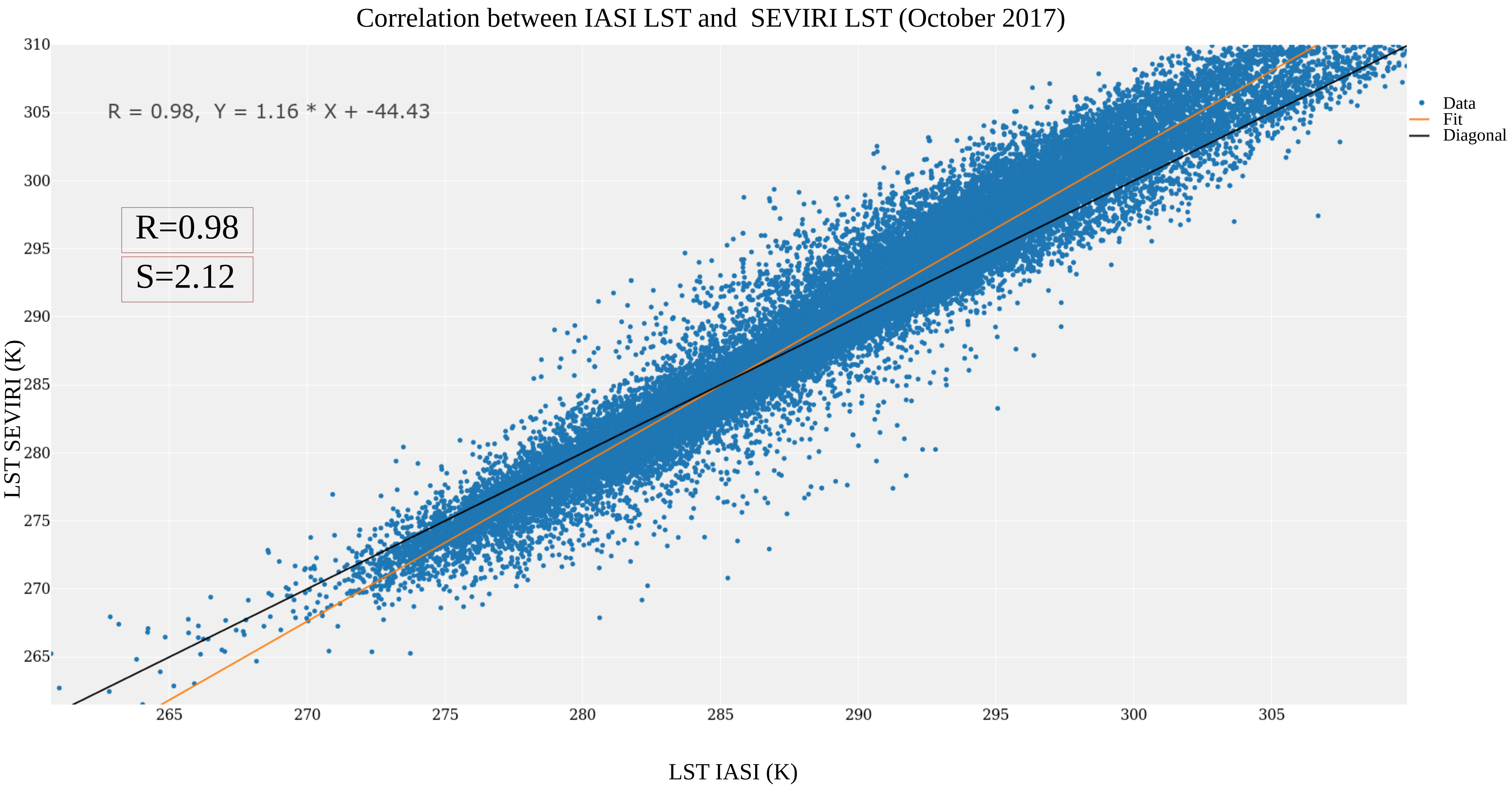


IASI - SEVIRI LST anomaly – Daytime (October 2017)

d



Satellite LST comparison – IASI vs SEVIRI



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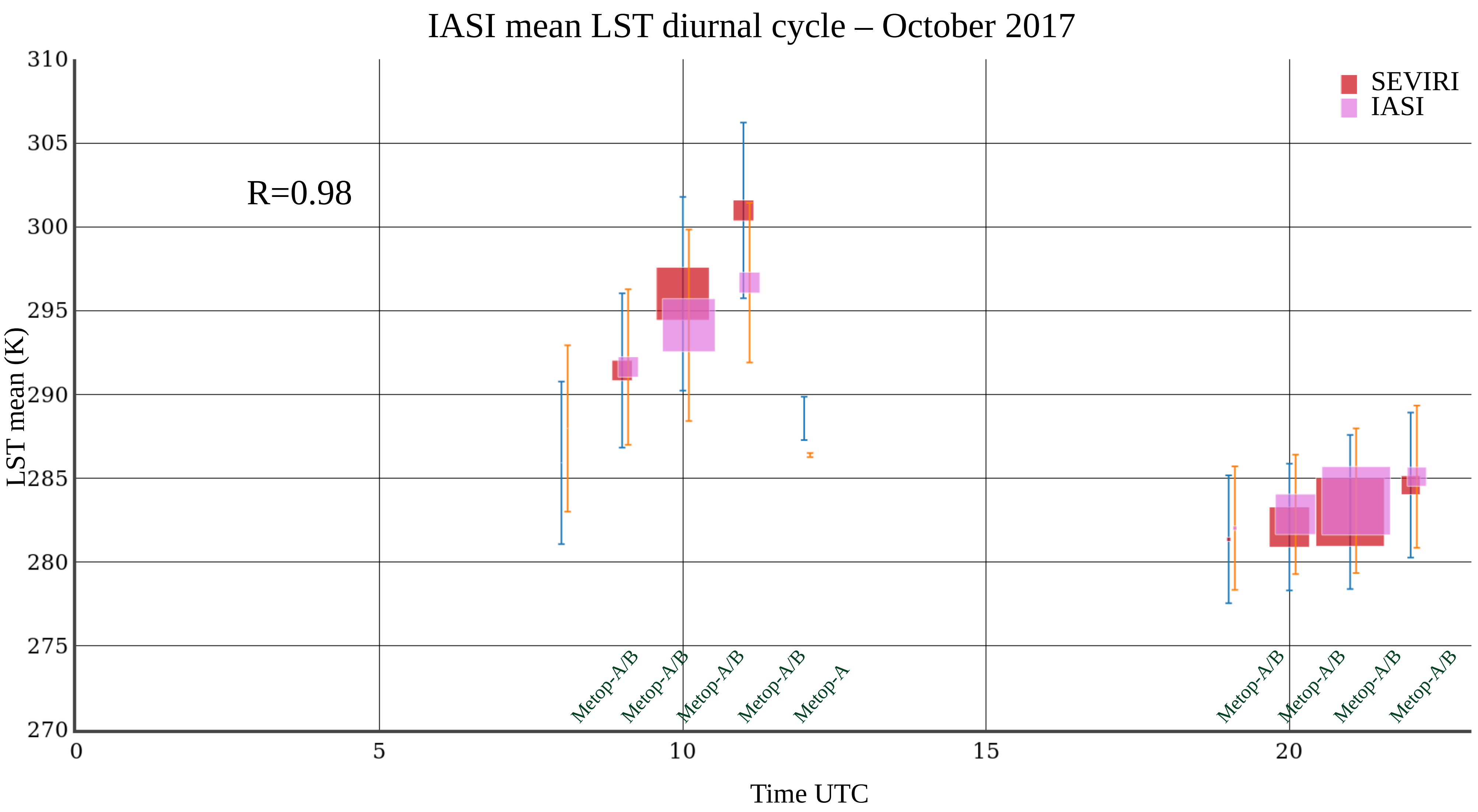

Satellite LST comparison - IASI vs SEVIRI

Bias and standard deviation of IASI to SEVIRI LST comparison

	ALL (K)			Night-time (K)			Daytime (K)		
	Bias	S	N° obs	Bias	S	N° obs	Bias	S	N° obs
90 days	0.117	2.027	142715	0.690	1.026	68237	-0.409	2.516	74478
Autumn	-0.418	2.123	55331	0.676	1.091	32252	-1.946	2.266	23079
Summer	0.803	1.958	53122	0.785	0.954	14113	0.809	2.212	39009
Winter	-0.008	1.630	34262	0.651	0.966	21872	-1.381	1.750	12390

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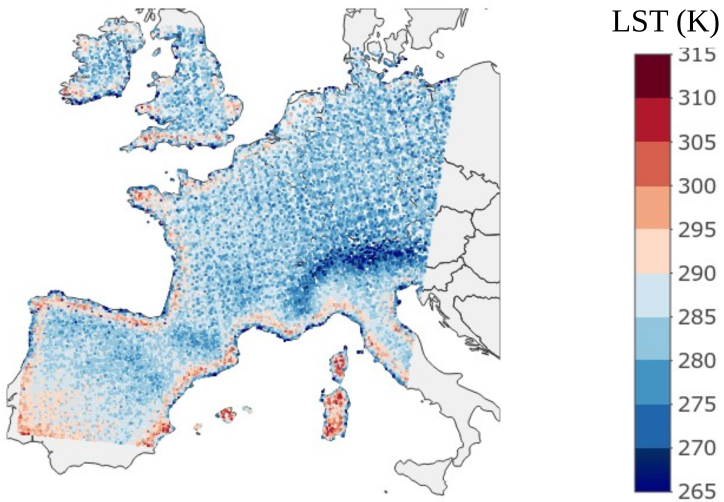
→ Global agreement between IASI and SEVIRI LST with some temporal variability:

- A better agreement during winter
- A better agreement during night-time

Satellite LST comparison - AMSU-A vs SEVIRI

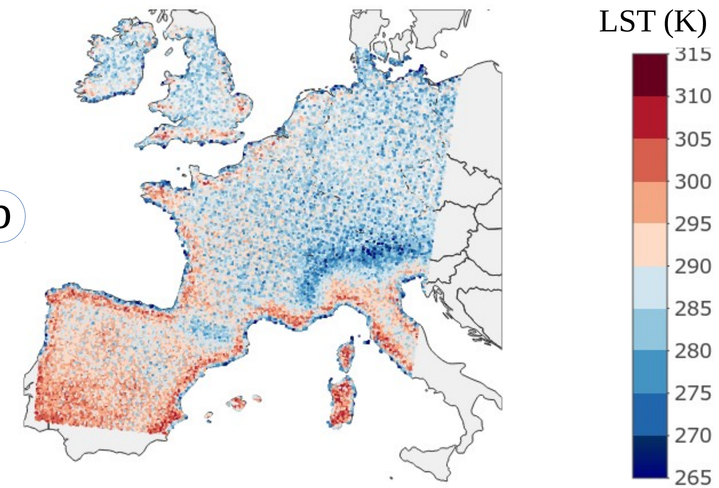
AMSU-A LST – Night-time (October 2017)

a



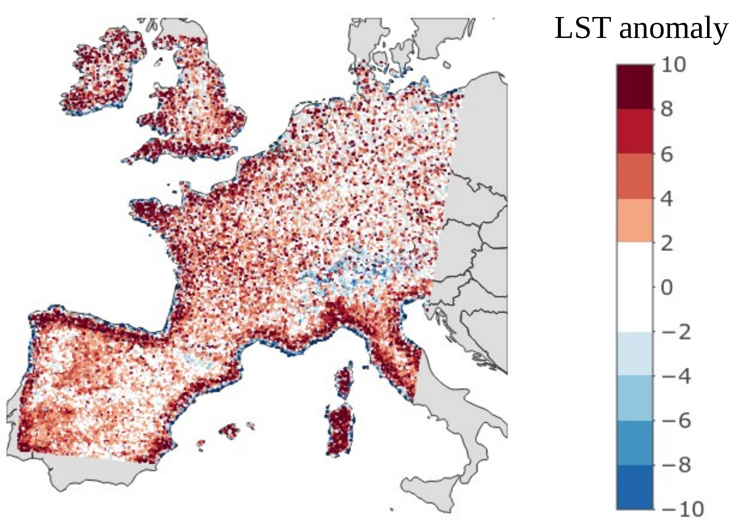
AMSU-A LST – Daytime (October 2017)

b



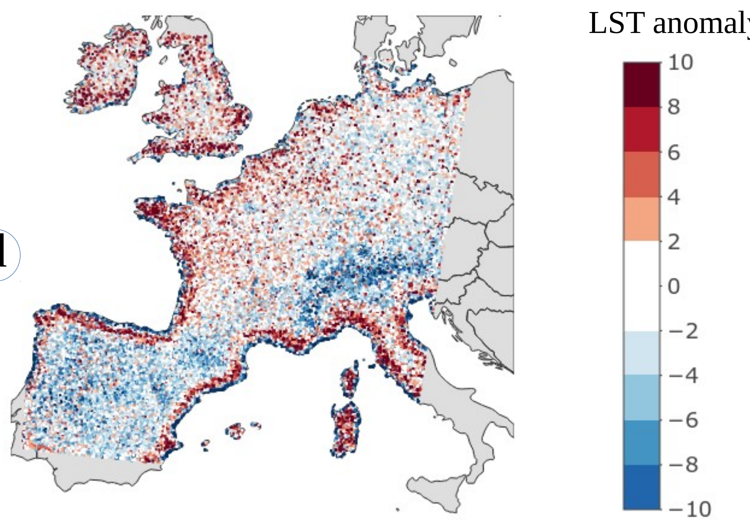
AMSU-A - SEVIRI LST anomaly – Night-time (October 2017)

c



AMSU-A - SEVIRI LST anomaly – Daytime (October 2017)

d

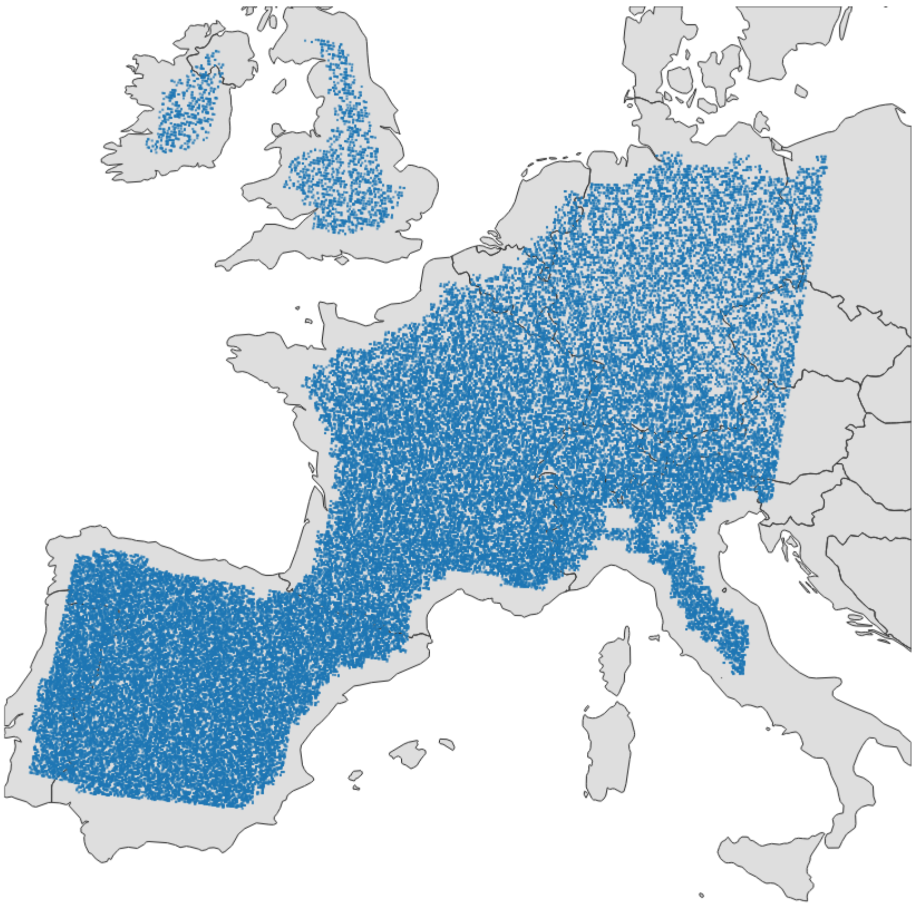


Satellite LST comparison - AMSU-A vs SEVIRI

Filtering coastal pixels in order to avoid contamination by oceans

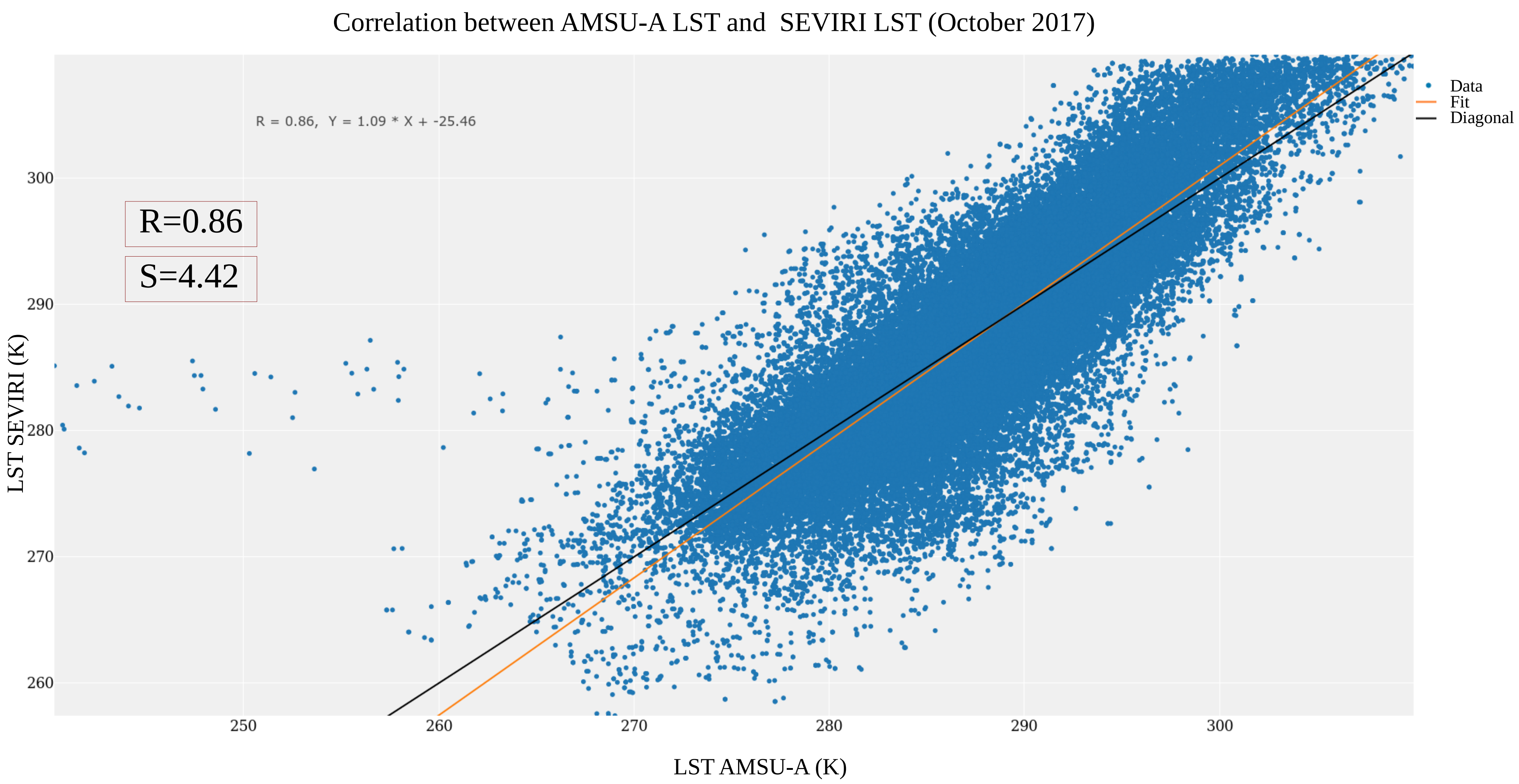
→ Applying an emissivity threshold of 0.93 (October 2017)

Blacklisted observations

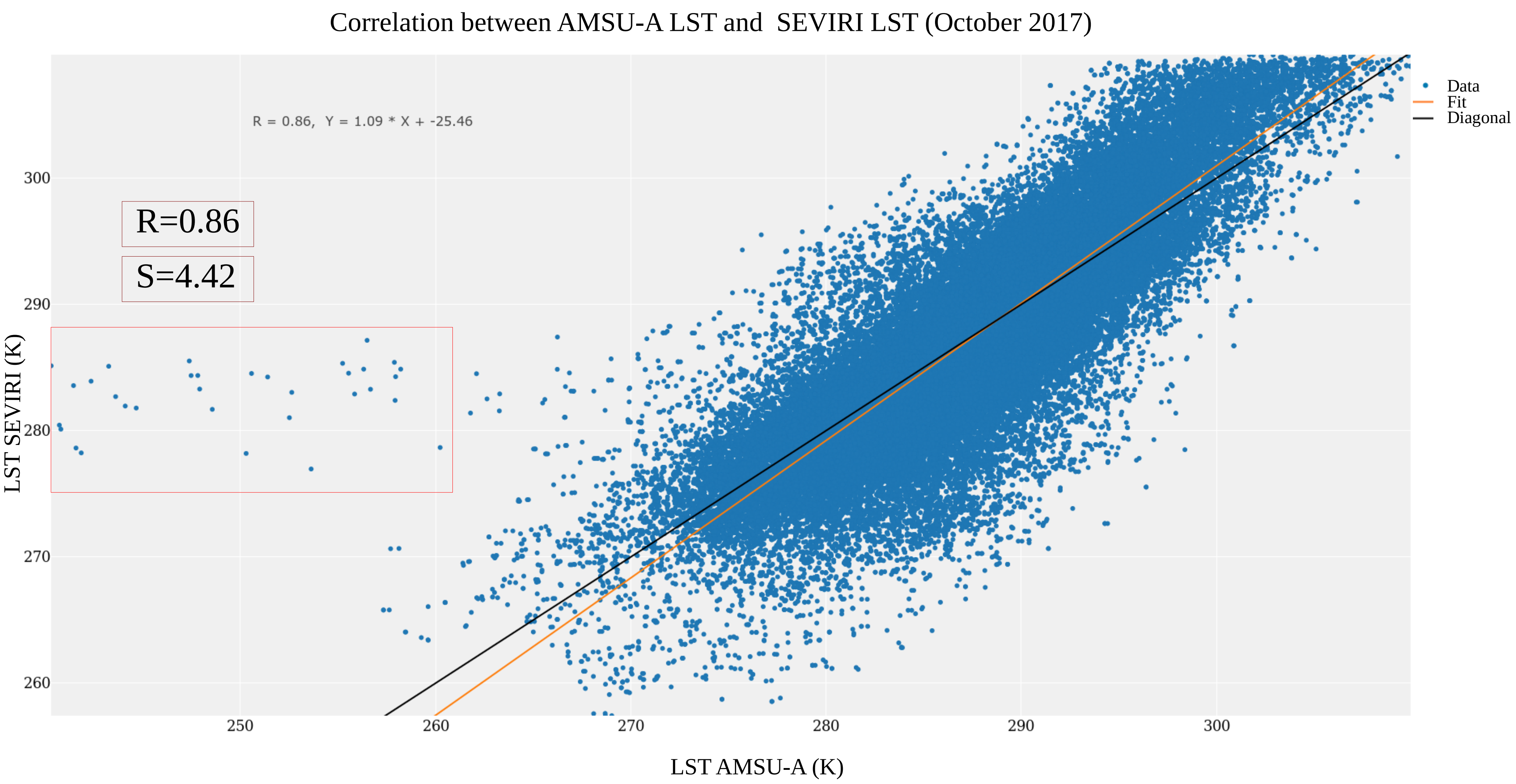


Considered observations

Satellite LST comparison - AMSU-A vs SEVIRI



Satellite LST comparison - AMSU-A vs SEVIRI



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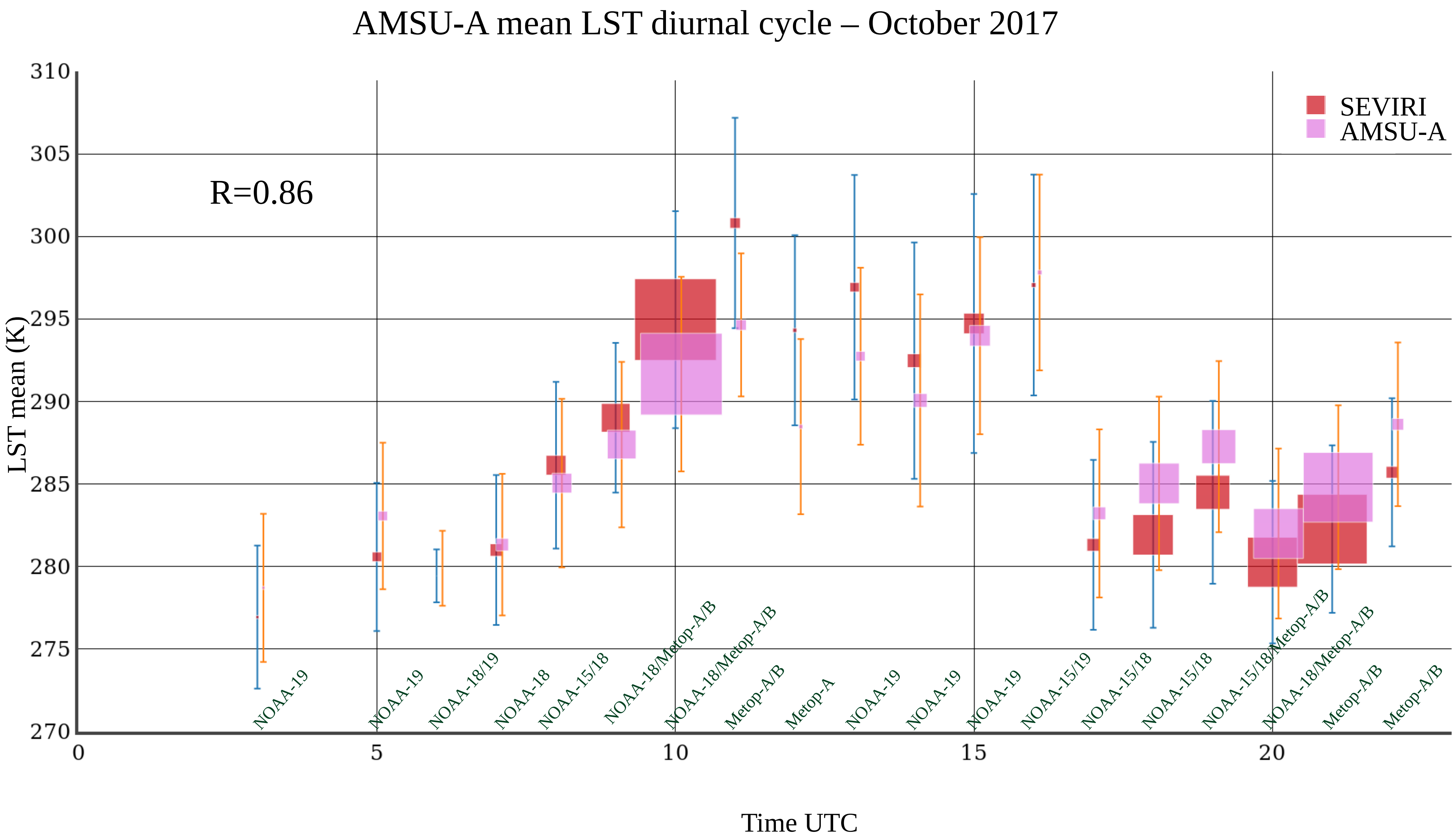


Satellite LST comparison – AMSU-A/B vs SEVIRI

Bias and standard deviation of AMSU-A to SEVIRI LST comparison

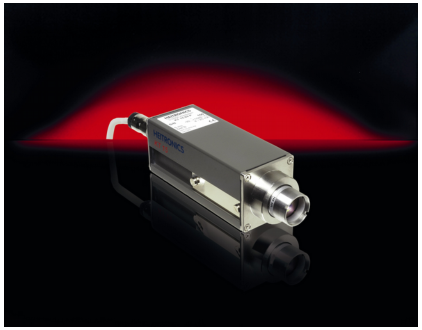
	ALL (K)			Night-time (K)			Daytime (K)		
	Bias	S	N° obs	Bias	S	N° obs	Bias	S	N° obs
90 days	0.424	4.306	273758	2.159	3.672	101984	-0.606	4.324	171774

Bias and standard deviation of AMSU-B to SEVIRI LST comparison

	ALL (K)			Night-time (K)			Daytime (K)		
	Bias	S	N° obs	Bias	S	N° obs	Bias	S	N° obs
90 days	-0.686	5.186	216644	0.762	4.790	92998	-1.775	5.206	123646

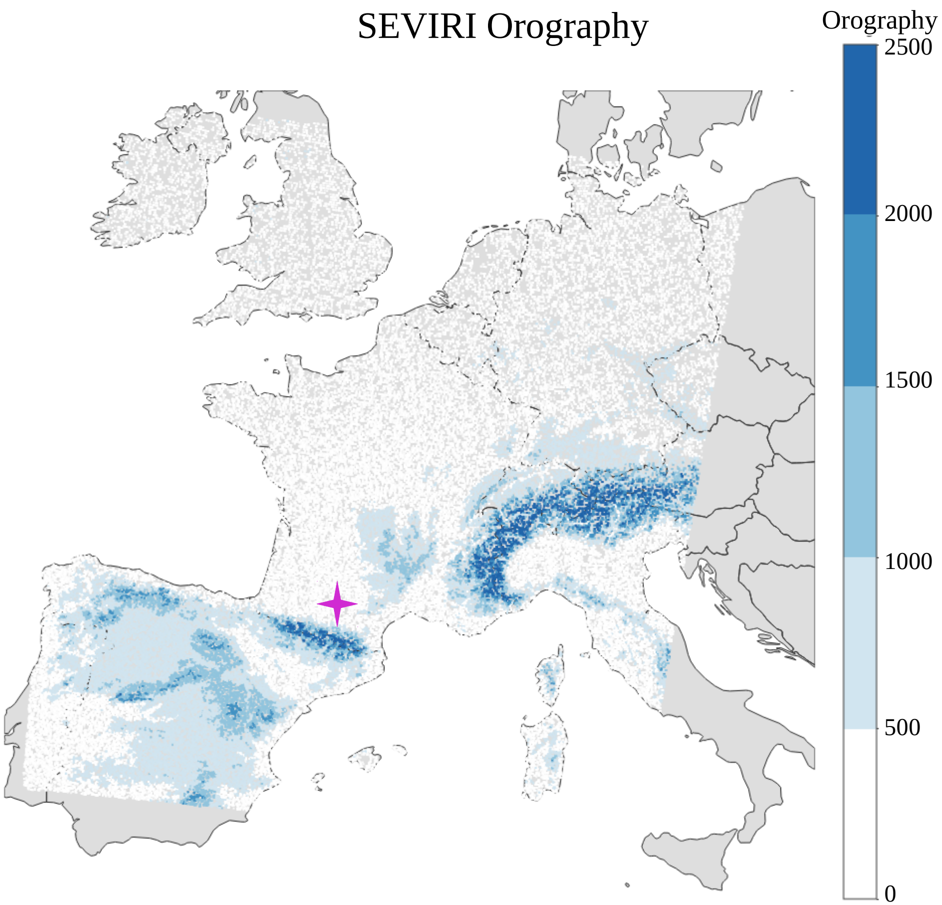
Validation to in-situ data – Toulouse Meteopole

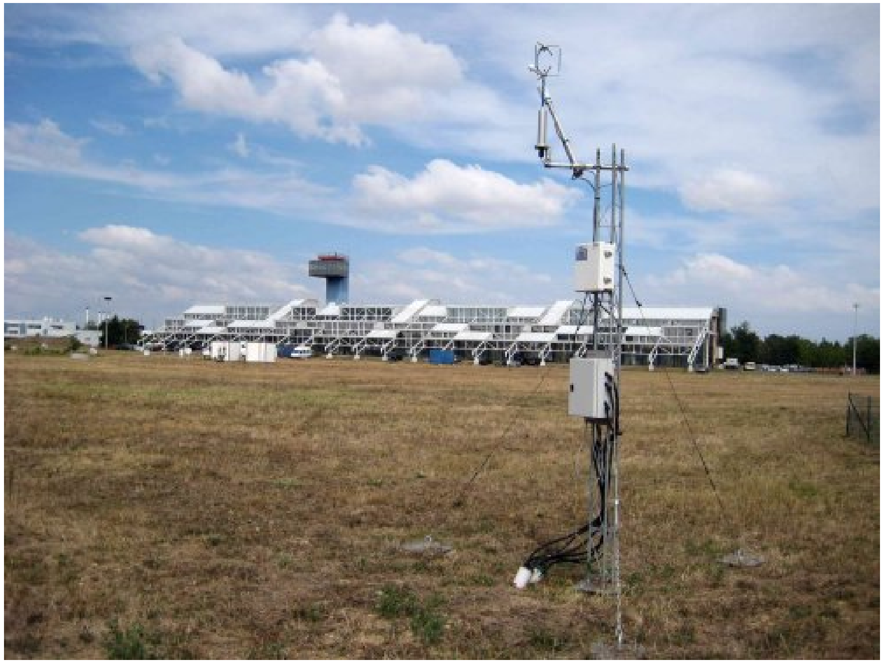
- Observation station at Toulouse Meteopole site
- Available data every 30minutes
- Surface brightness temperature issued from KT15 Infrared radiation pyrometer



KT15 Infrared pyrometer

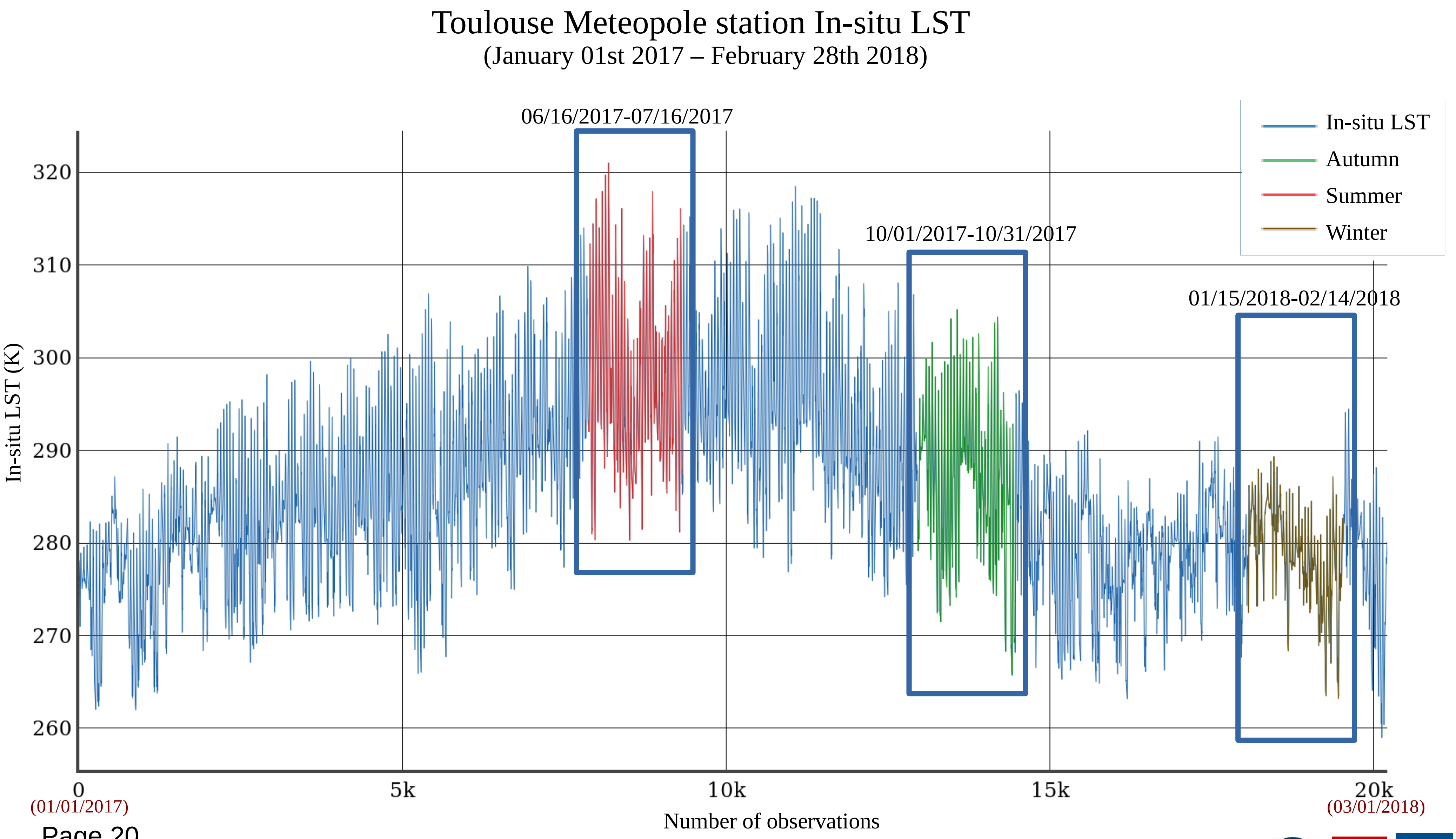
SEVIRI Orography





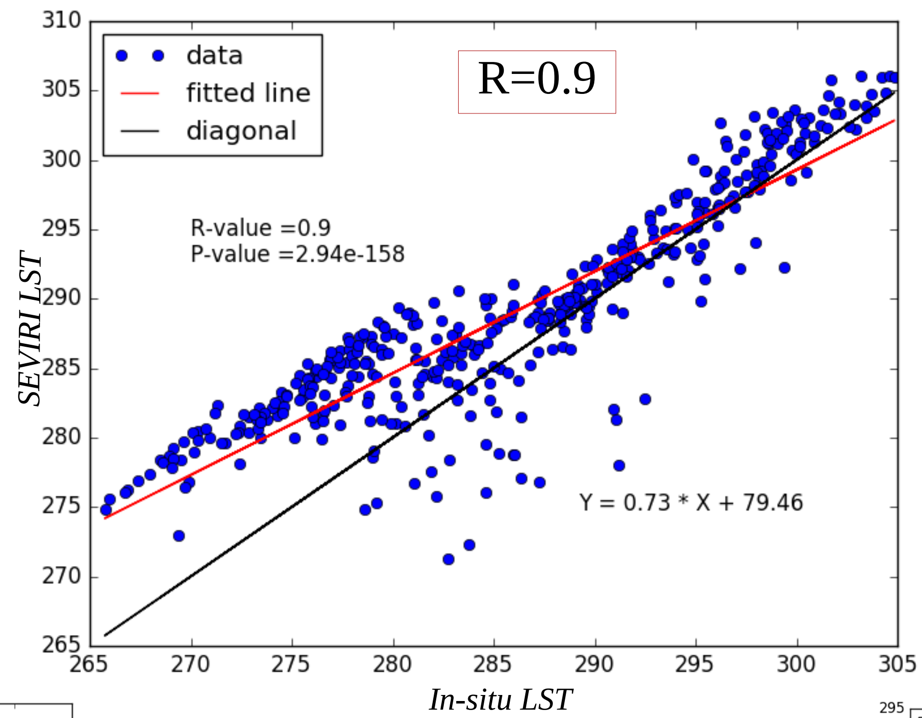
Meteopole-Flux observation station

Validation to in-situ data – Toulouse Meteopole



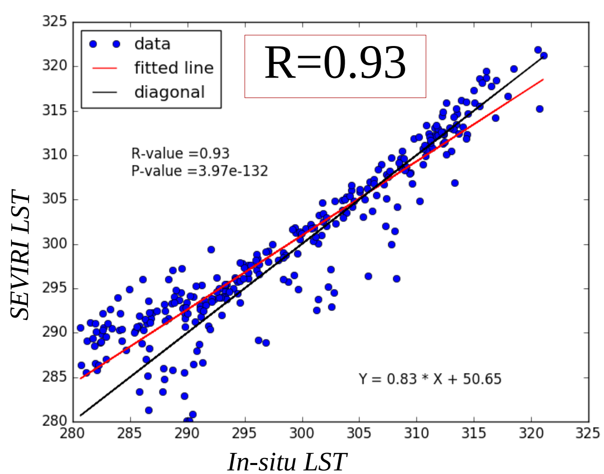
Validation to in-situ data – Toulouse Meteopole

a



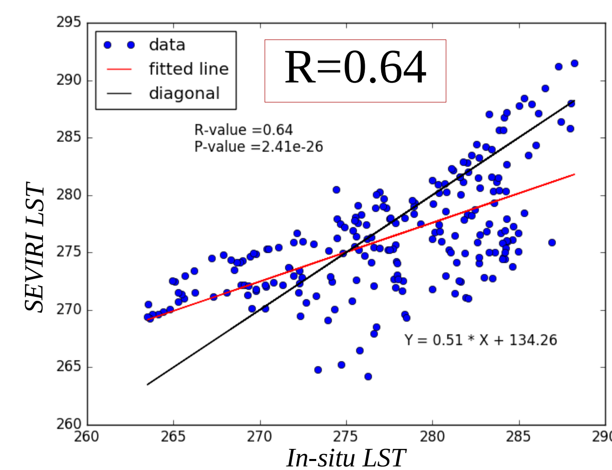
SEVIRI LST correlation to In-situ data (October 2017)

b



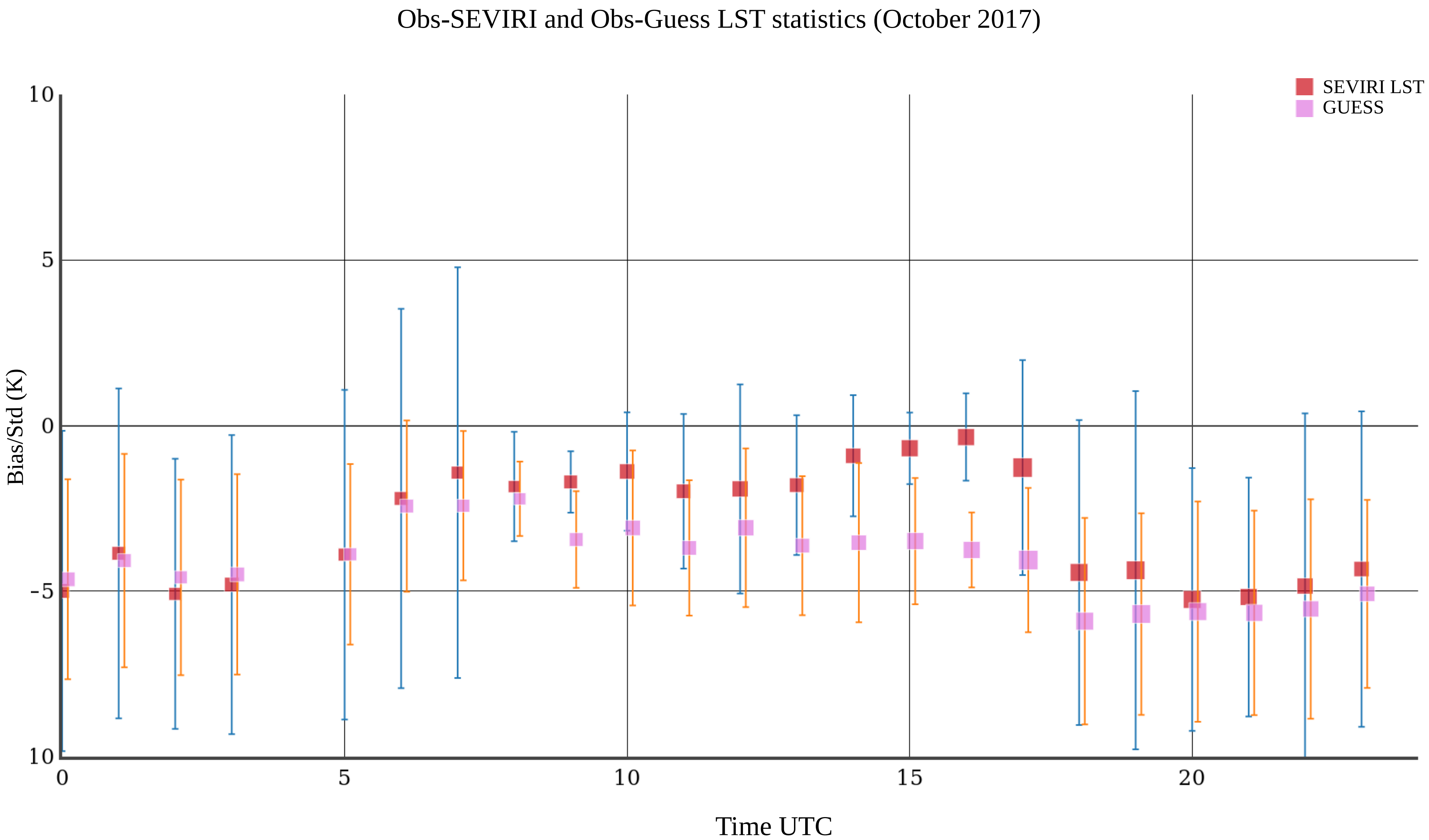
SEVIRI LST correlation to In-situ data (Jun/Jul 2017)

c



SEVIRI LST correlation to In-situ data (Jan/Feb 2018)

Validation to in-situ data – Toulouse Meteopole



Conclusions and perspectives

- Global agreement between IASI and SEVIRI LST over the three studied periods
- Better SEVIRI/IASI agreement on winter and night-time
- Good correlation of IASI/AMSU-A/B LST with SEVIRI LST
- Global agreement of different sensors LST diurnal cycles compared to SEVIRI

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- More realistic SEVIRI LST compared to guess especially in summer period and daytime

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- Towards a synergy between sensors → Further use of SEVIRI LST for other sensors simulation
- Use of Satellite LST in surface analysis

Thanks for your attention