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

Zied SASSI

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Outline

1. Introduction
2. Comparison to in-situ LST
3. Intercomparison of IASI and SEVIRI LST
4. IASI simulation with RTTOV
5. Conclusions and perspectives

Introduction

AROME model

- Operational meso-scale non-hydrostatic model of Météo-France (1.3 km)
- 3h analysis for surface
- 1h 3D-Var assimilation cycle (Radars, satellites, in-situ) for atmosphere

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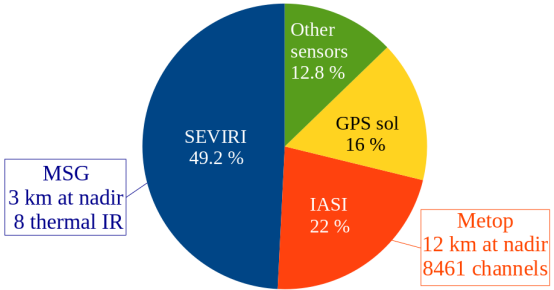
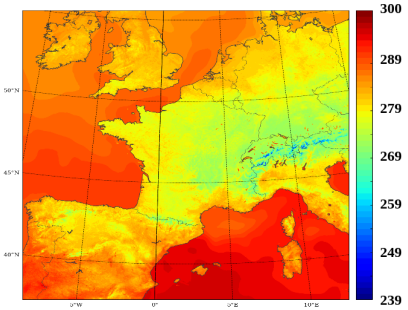


Satellite observations assimilated in AROME



Surface Temperature - 10/31/2017 - 19UTC

Introduction

Land Surface Temperature (LST)

- Important parameter for surface analysis in AROME
- High dependence to surface occupation
- Use of 2 m temperature increments to analyze LST

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Satellite derived LST

- Used to assimilate satellite radiances
- Use of window channels to retrieve LST
- Clear sky retrievals (Mono channel with known emissivity method [Karbou et al., 2006])

Retrieval of SEVIRI (10.8 μm) and IASI LST (10.6 μm)

Introduction

Objective : Evaluate the agreement between different sensors LSTs

- How much do retrieved LST from SEVIRI agree with local observations ?
- How much do retrieved LSTs from SEVIRI and IASI agree between each other ?
- What impact of using SEVIRI LST on simulating IASI brightness temperatures ?

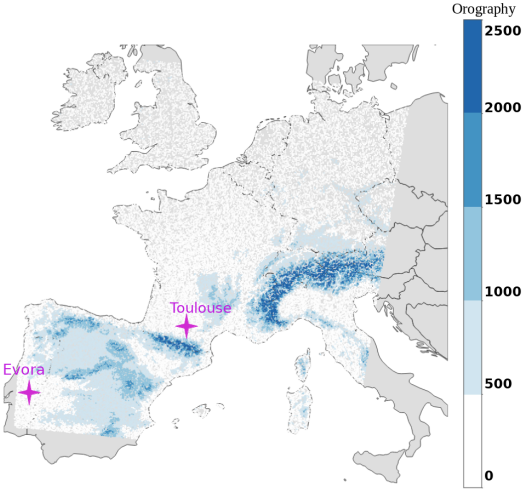
Comparison to in-situ LST

Land Surface Temperature (LST)

- KIT LST validation dedicated station in Evora, Portugal
- Météopole instrumented site station in Toulouse, France
- KT-15 infrared radiometer

Evora station

Toulouse station

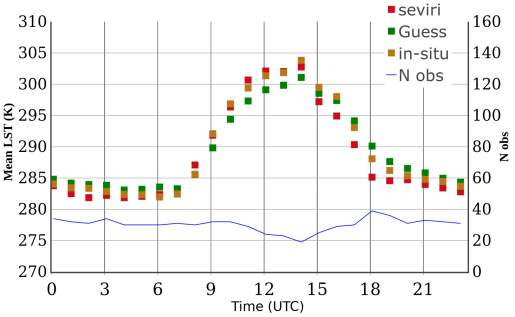


Model orography

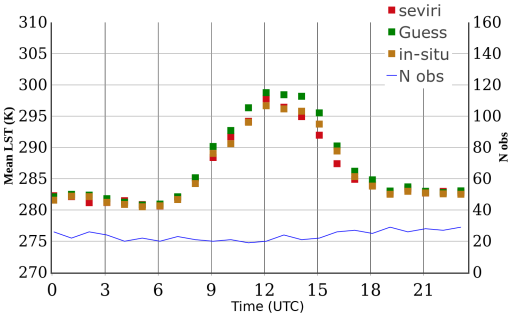
***Many thanks to KIT and Météopole-Flux colleagues**

Comparison to in-situ LST

Diurnal cycle of SEVIRI LST, in-situ LST and model LST (K)



Evora station



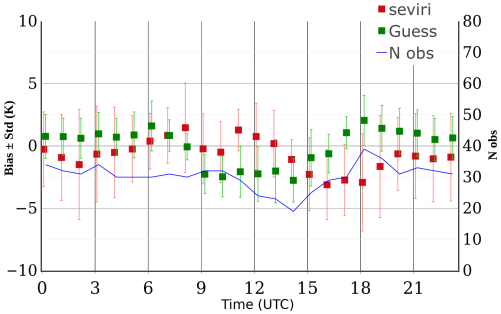
Toulouse station

October/November 2018

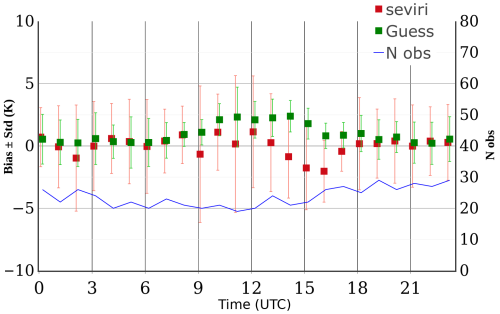
More realistic description with SEVIRI LST especially for maxima

Comparison to in-situ LST

Statistics of difference of SEVIRI LST and model LST minus in-situ LST (K)



Evora station



Toulouse station

October/November 2018

Smaller bias with SEVIRI LST

Comparison to in-situ LST

Conclusions

- Good agreement between SEVIRI LST and in-situ LST for Evora and Toulouse stations
- Better agreement during night-time
- **How much does SEVIRI LST agree with IASI LST ?**

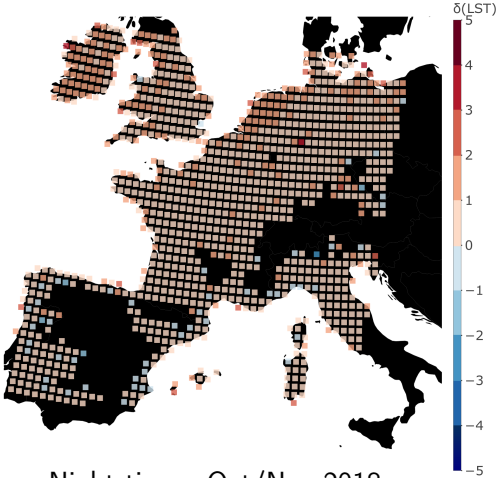
Intercomparison of IASI and SEVIRI LST

Comparison between SEVIRI LST and IASI LST

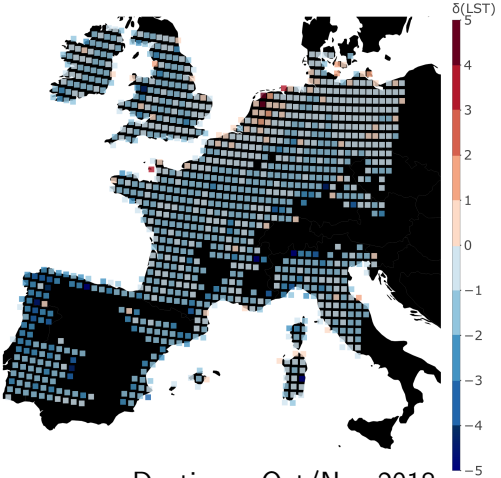
- Clear sky observations (SEVIRI and IASI)
- Exclusion of mountainous areas
- Four periods of comparison from different seasons

Intercomparison of IASI and SEVIRI LST

IASI LST - SEVIRI LST (K)



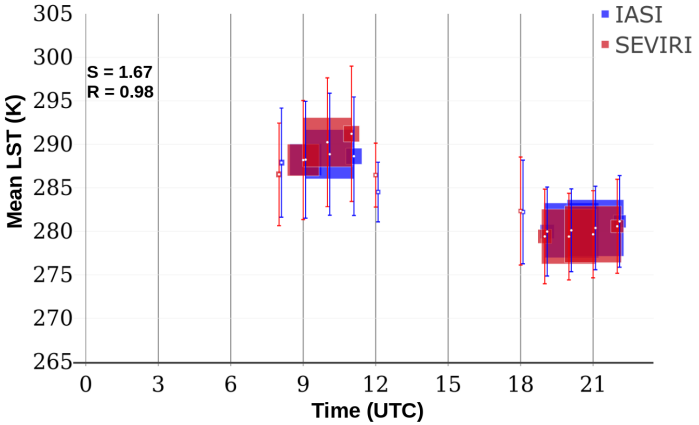
Night-time - Oct/Nov 2018



Daytime - Oct/Nov 2018

Intercomparison of IASI and SEVIRI LST

Diurnal cycle of IASI LST and SEVIRI LST (Oct/Nov 2018)



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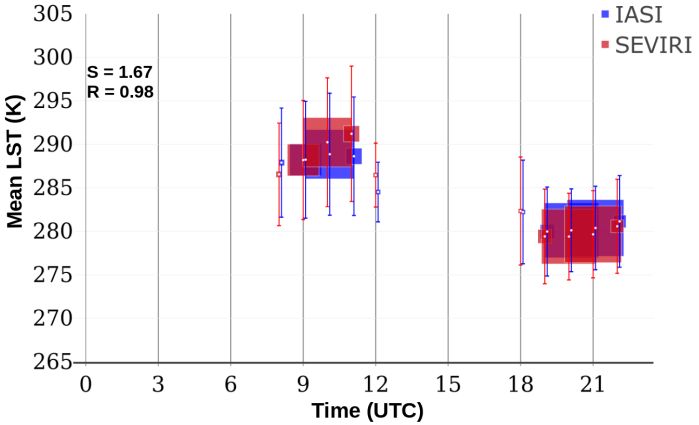
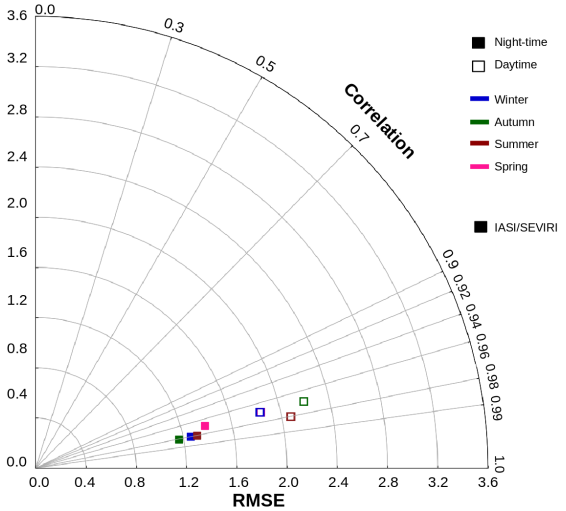


Good agreement between SEVIRI LST and IASI LST especially during night-time

Intercomparison of IASI and SEVIRI LST



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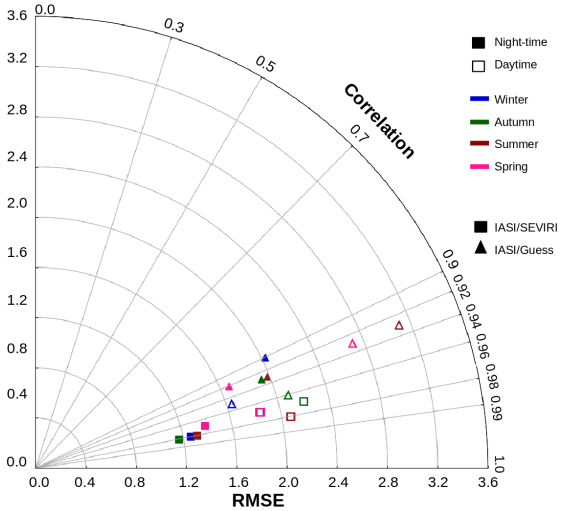

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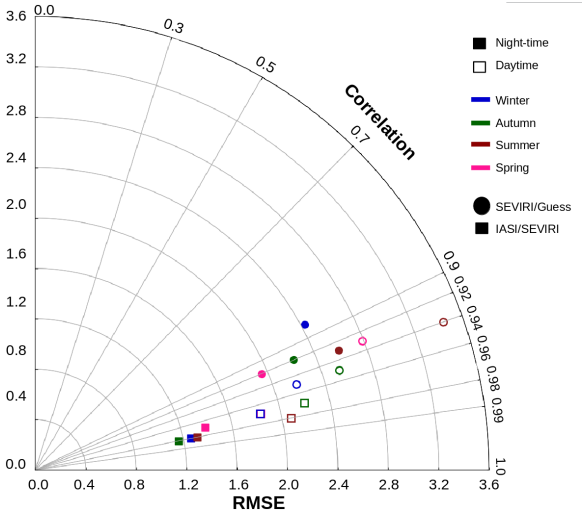

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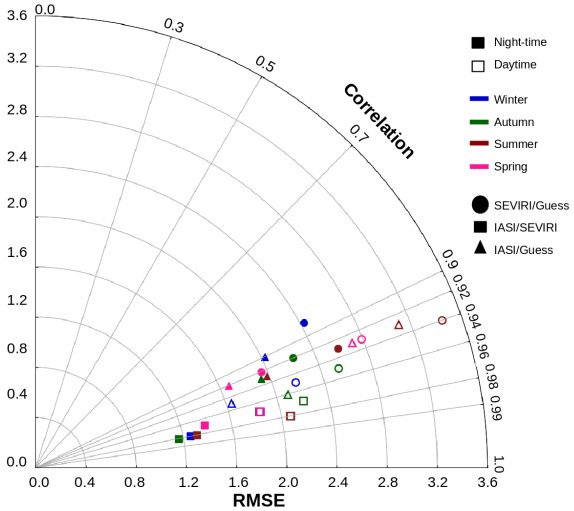


Better agreement between sensors LSTs than with model LST

Intercomparison of IASI and SEVIRI LST

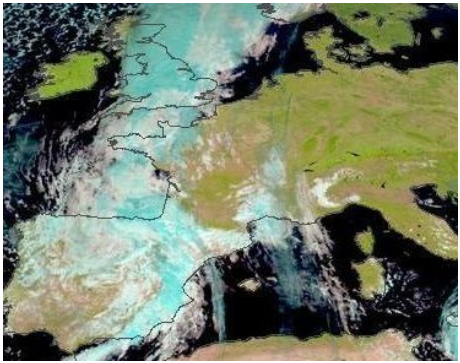
Conclusions

- Good agreement and strong positive correlation between SEVIRI LST and IASI LST over the four periods of study
- Better agreement during night-time
- Better agreement between the two sensors LST than between sensor LST and model LST
- **How much does one sensor LST impact the simulation of the other sensor radiances ?**

IASI simulation with RTTOV

Simulation of IASI brightness temperature with RTTOV

- Simulation of the 314 IASI channels monitored at Météo-France [Collard et al., 2007]
- Use of more than 21 000 vertical profiles from AROME-France model and LST
- 3 values of LST :
  - IASI LST
  - SEVIRI LST
  - Model forecasted LST
- Comparison against IASI observations



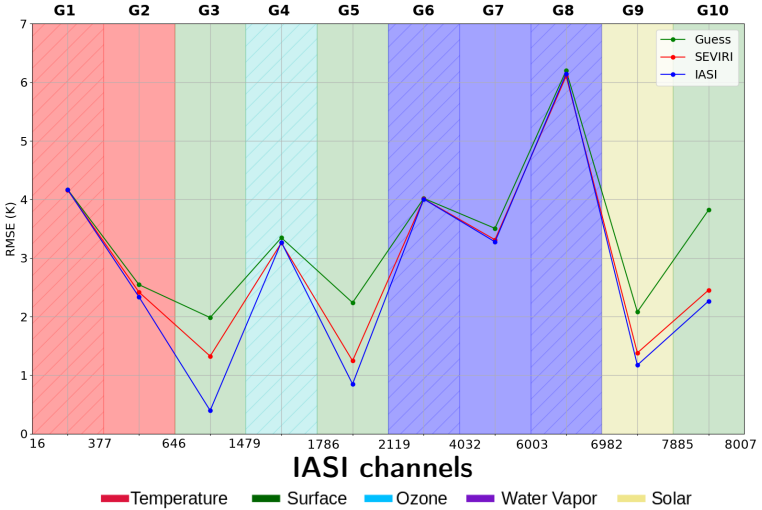
October 14^{th} 2018, 11 UTC SEVIRI image

IASI simulation with RTTOV

Night-time simulation

Group	Number of channels	Bandwidth (cm^{-1})
G1	105	648.75 - 738.5
G2	27	739 - 788
G3	14	806.25 - 962.5
G4	15	1014.5 - 1062.5
G5	6	1091.25 - 1168.25
G6	101	1174.5 - 16305
G7	25	1652.75 - 2143.25
G8	6	2145.5 - 2389.75
G9	13	2390.25 - 2501.75
G10	2	2616 - 2646.5

Better simulations with SEVIRI LST than with model LST in all cases



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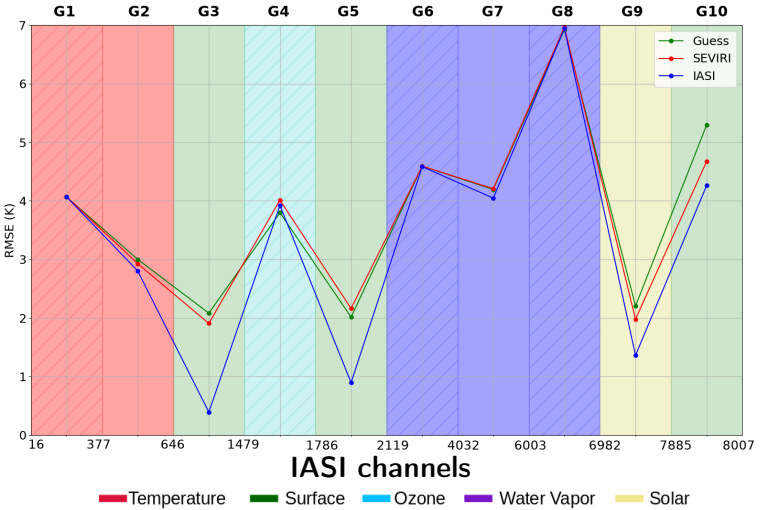
Less impact of SEVIRI LST than night-time simulation



IASI simulation with RTTOV

Conclusions

- Best simulations used IASI LST
- Better simulations with SEVIRI LST than with model LST
- Better simulations during night-time
- Seasonal variability with better simulations during summer and spring periods

Conclusions and perspectives

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- Good agreement between SEVIRI LST and in-situ LST in Evora and Toulouse stations especially during night-time
- Good agreement between SEVIRI LST and IASI LST especially during night-time
- Better simulation of IASI brightness temperature with SEVIRI LST than with model forecasted LST
- **Sassi et al., 2019 submitted to *Remote sensing* : "Use of infrared satellite observations for the surface temperature estimation over land in a NWP context"**

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Perspectives

- Towards a synergy between the sensors
- Use of SEVIRI LST to simulate other sensors
- Use of satellite LST in the surface analysis