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Suitability of Meteosat satellite data for climatological LST retrieval

Anke Tetzlaff , Virgílio Bento, Frank Göttsche, Reto Stöckli, João Martins, Isabel Trigo, Folke Olesen, Jedrzej Bojanowski, Carlos da Camara and Heike Kunz

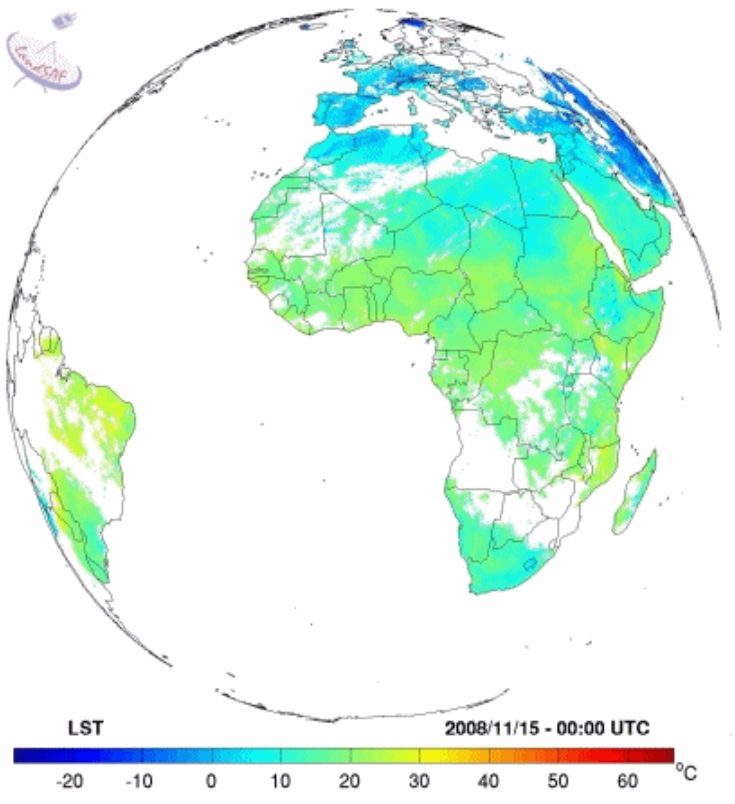
The EUMETSAT Network of Satellite Application Facilities

LSA SAF
Land Surface Analysis

The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

LST Climate Data Record

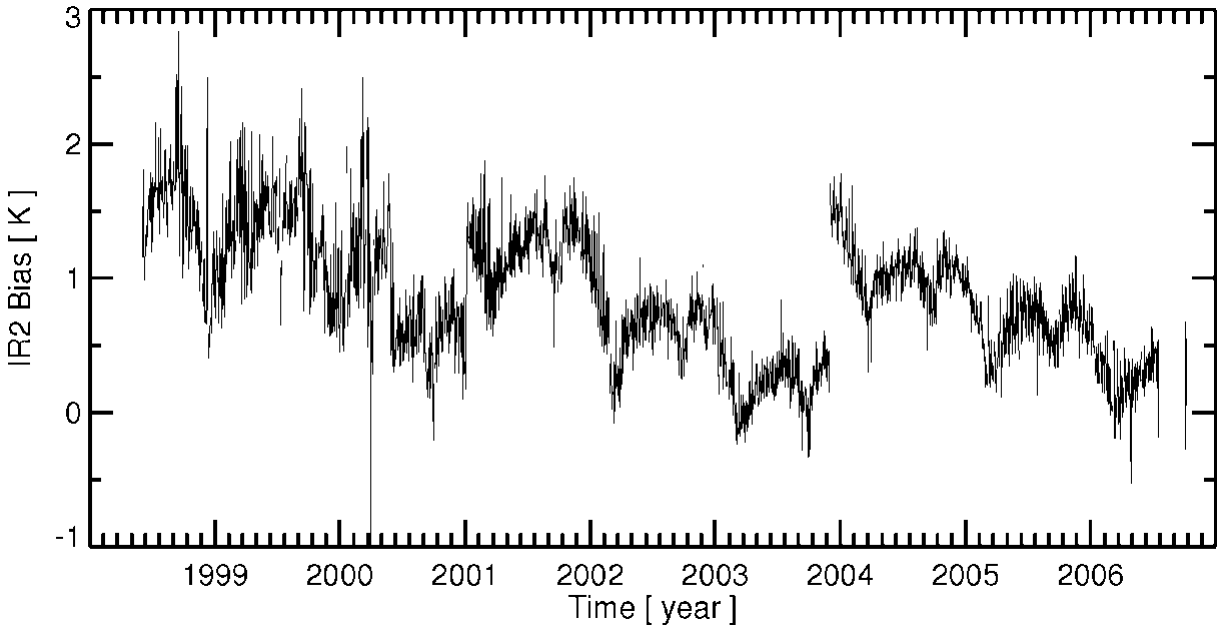


Meteosat SEVIRI Land Surface Temperature
(source: LSA SAF)

- Release planned for 2017
- MFG and MSG
- Hourly resolution
- 20 years+ Meteosat LST Climate Data Record (CDR)

Need for a consistent single-channel LST retrieval scheme.

Meteosat Data Calibration



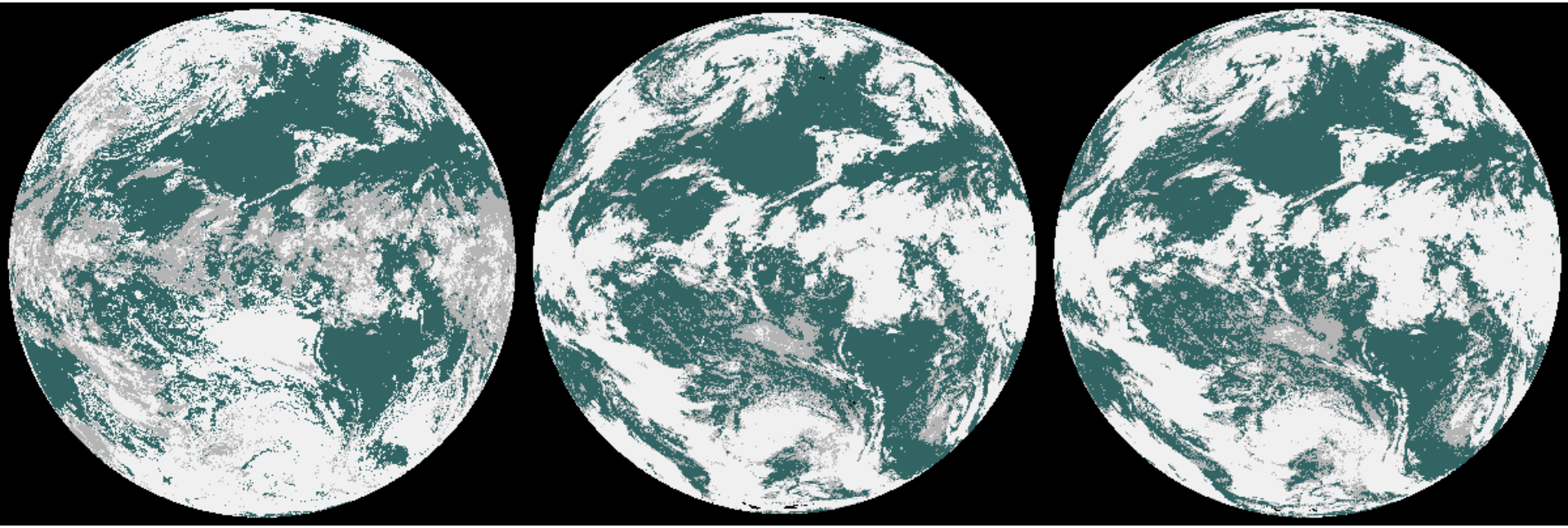
Recalibration of the Meteosat thermal channel against HIRS / IASI.

EUMETSAT

Meteosat 7. Image courtesy of EUMETSAT.

New Fundamental Climate Data Record for MFG associated with uncertainties.

CM SAF – Cloud masking



Standard MSG

CM SAF MFG

CM SAF MSG

Reto Stöckli, MeteoSchweiz

Objectives

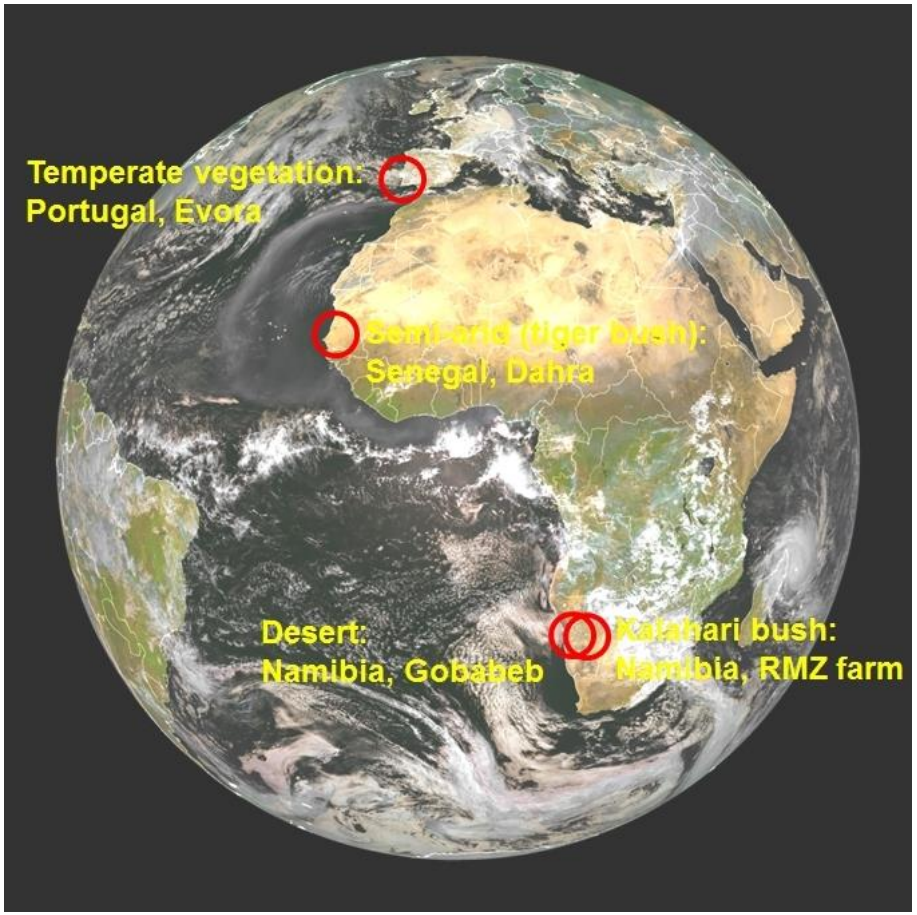
- Can Meteosat single-channel LST retrievals reach the accuracy of the operational LSA SAF LST product ?

- Can we characterize uncertainties for single-channel Meteosat LST retrievals ?

Can Meteosat single-channel LST retrievals reach the accuracy of the operational LSA SAF LST product ?

	LSA SAF Product	Physical-Mono-Window	Statistical-Mono-Window
Model	LSA SAFs operational Generalized Split Window model	Radiative transfer-based single-channel model	Empirical model (simple linear regression)
Radiance input	Meteosat SEVIRI 10.8 μm and 12 μm channel	Meteosat SEVIRI 10.8 μm channel	Meteosat SEVIRI 10.8 μm channel
Atmospheric input	ECMWF total column water vapour	ECMWF temperature and water vapour profiles	ECMWF total column water vapour

Can Meteosat single-channel LST retrievals reach the accuracy of the operational LSA SAF LST product ?



KIT validation sites.

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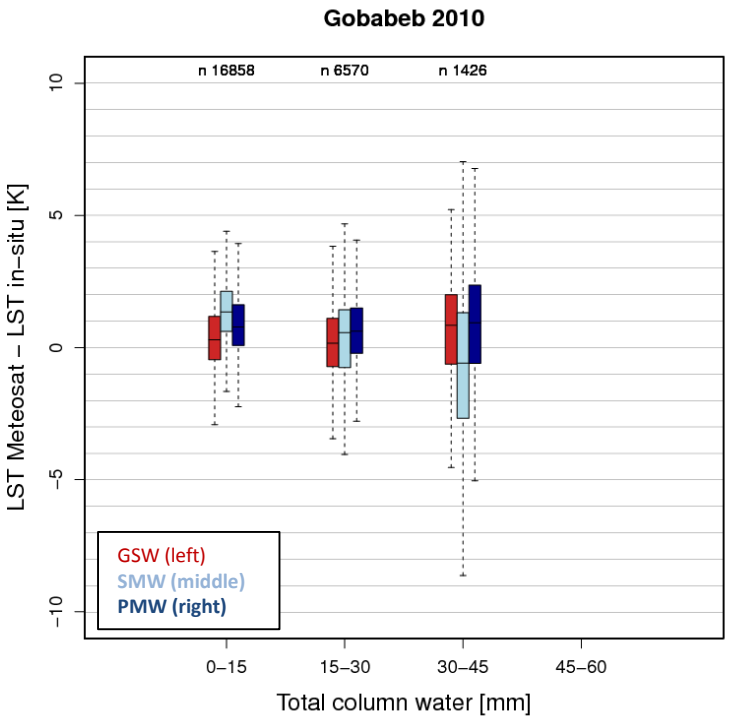
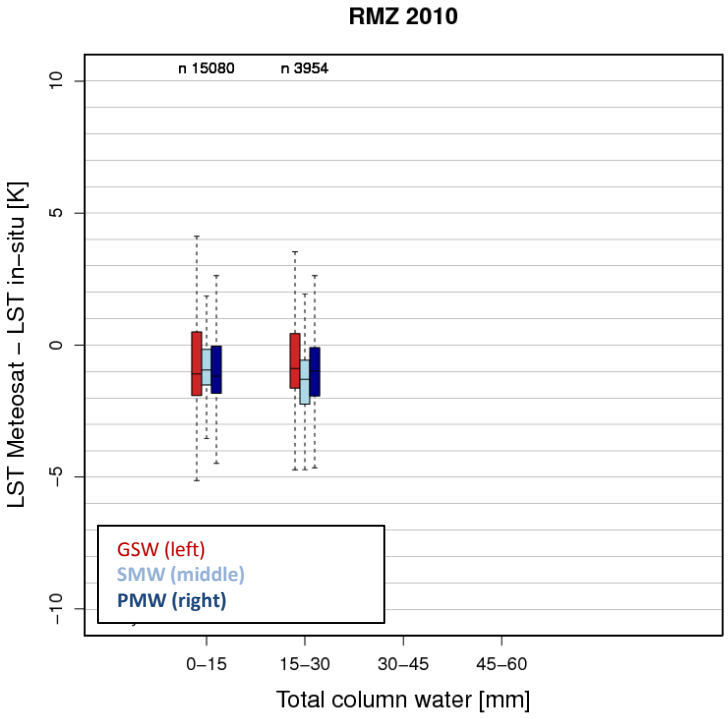
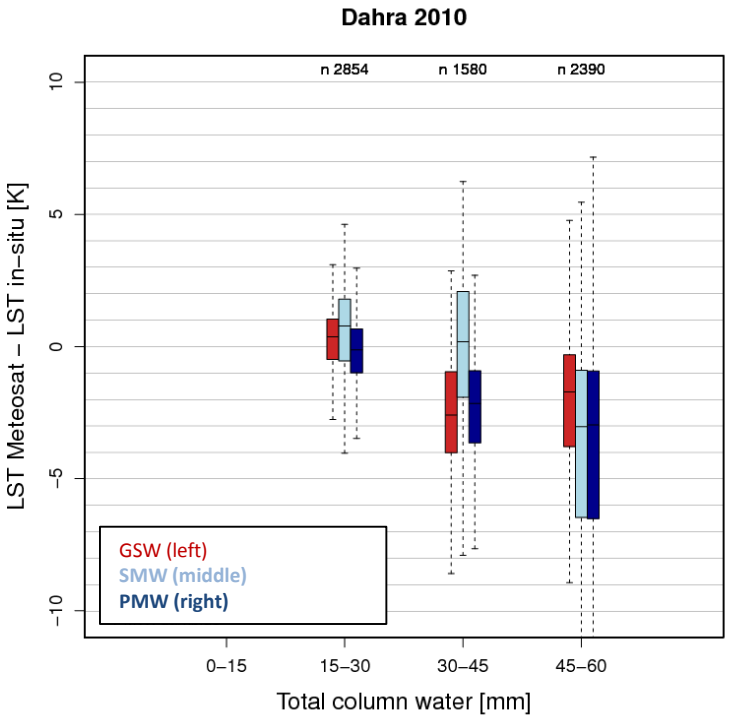


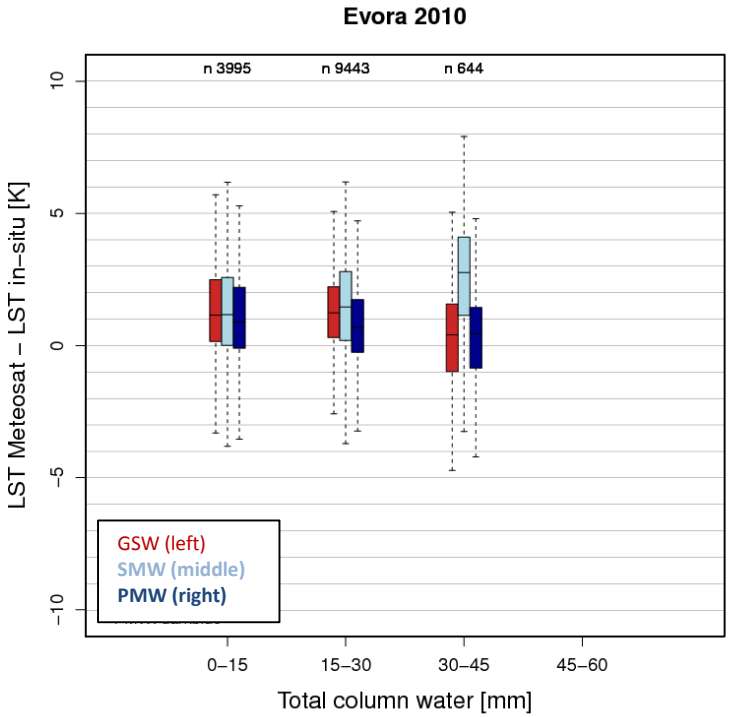
LSA SAF Split-Window
Statistical Mono-Window
Radiative transfer-based Mono-Window



LSA SAF Split-Window
Statistical Mono-Window
Radiative transfer-based Mono-Window



LSA SAF Split-Window
Statistical Mono-Window
Radiative transfer-based Mono-Window



LSA SAF Split-Window
Statistical Mono-Window
Radiative transfer-based Mono-Window

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LSA SAF Land Surface Analysis

Can we characterize uncertainties for single-channel Meteosat LST retrievals ?

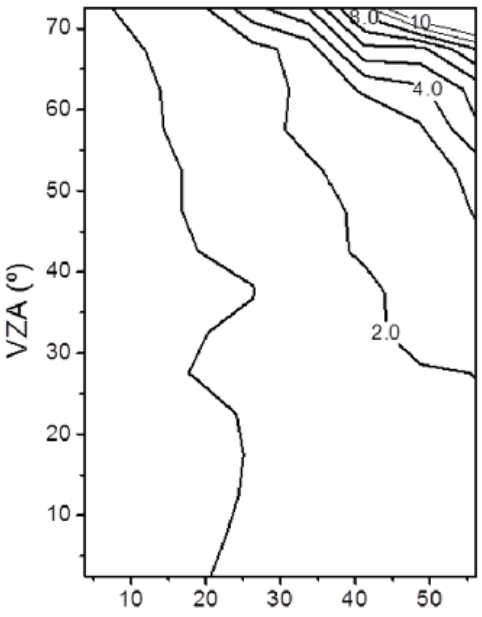
Radiative transfer simulations for a wide range of atmospheric and surface conditions.

	Input Errors		
	Radiometric noise	Emissivity (ε) uncertainty	Errors in NWP profiles
Range	[-0.3 K, 0.3 K]	[-0.04,0.04] for ε <0.95 [-0.02,0.02] for 0.95≤ ε <0.98 [-0.01,0.01] for ε ≥0.98	Replacement of the profiles at hour h by the corresponding ones at hour h+6.

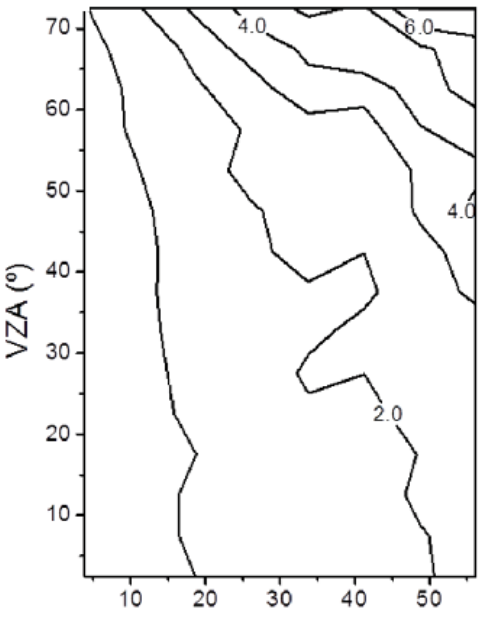
Freitas et al. (2010)

Estimated uncertainty
RMSE [K]

Radiative transfer-based
MW



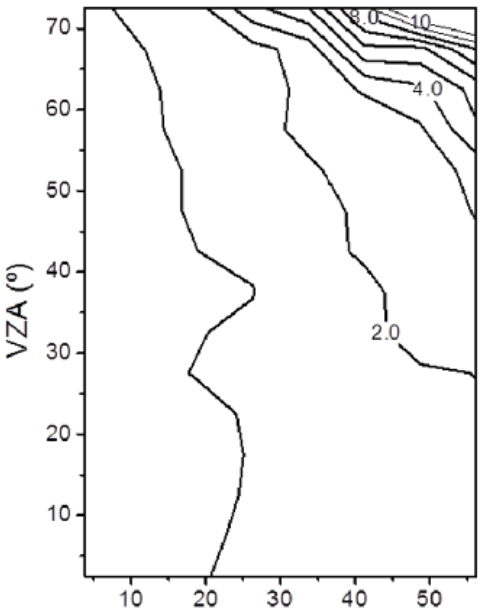
Statistical
MW



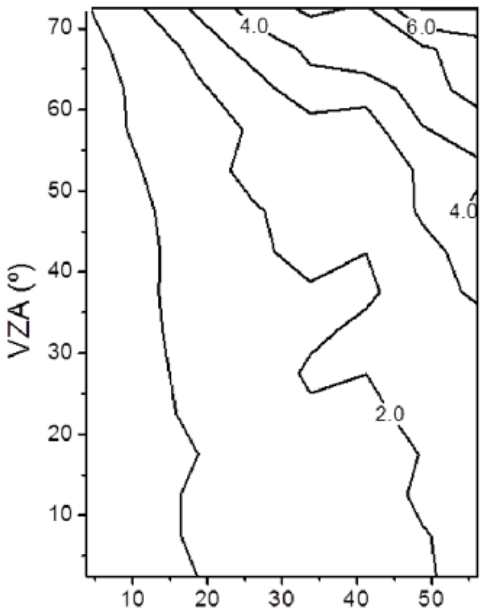
Virgilio Bento et al.

Estimated uncertainty RMSE [K]

Radiative transfer-based MW



Statistical MW



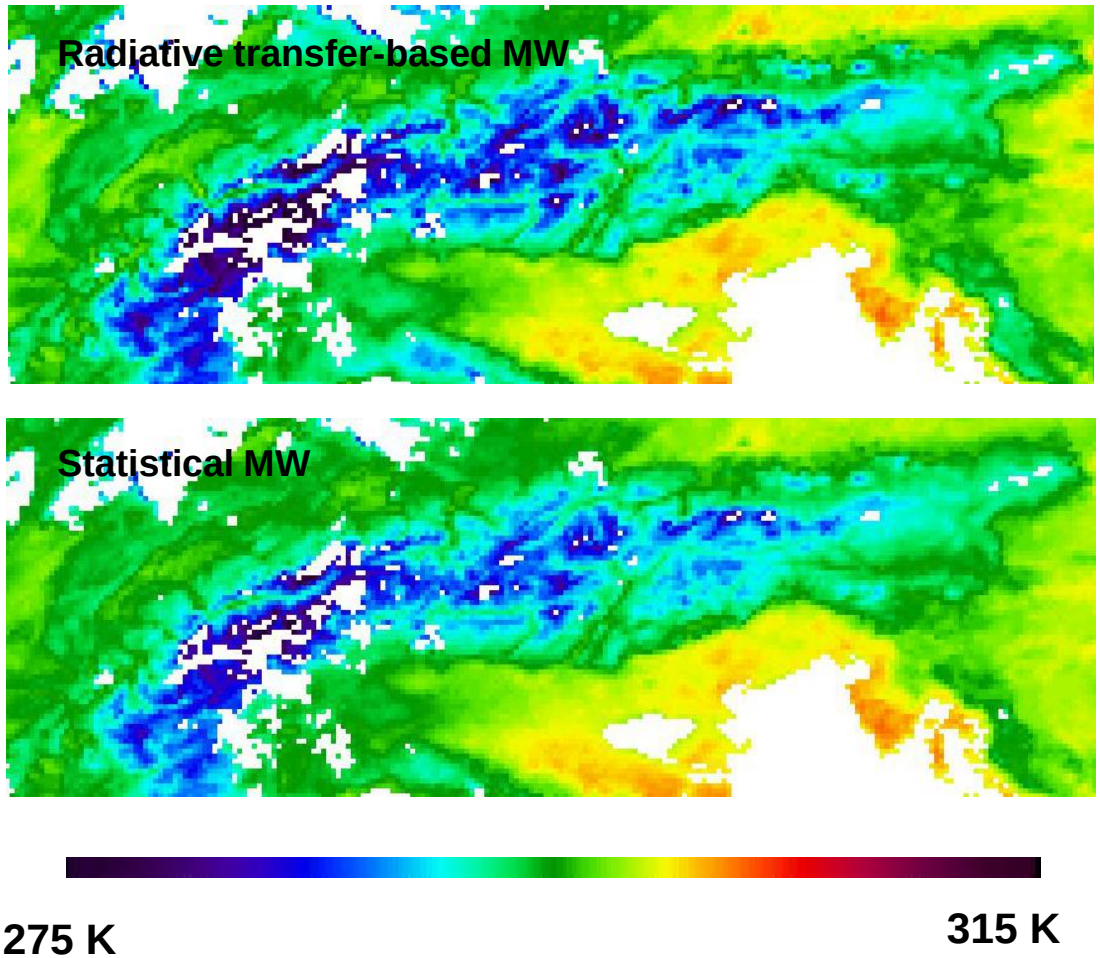
Virgilio Bento et al.

Validation results

TCWV <= 45 mm	GSW	PMW	SMW
	RMSE [K]	RMSE [K]	RMSE [K]
Gobabeb	1.5	1.8	2.0
Evora	2.0	1.9	2.5
Dahra	2.3	2.6	2.4
RMZ	1.9	1.9	1.7

TCWV > 45 mm	GSW	PMW	SMW
	RMSE [K]	RMSE [K]	RMSE [K]
Dahra	3.4	6.3	5.3

CM SAF – LSA SAF LST algorithm



MSG Alps 2005/07/28, 6:45 am

Conclusions

- LSA SAF / CM SAF have developed a consistent single-channel LST retrieval algorithm for all Meteosat sensors
- Meteosat single-channel retrievals match those of the operational LSA SAF LST within 0.1-0.5 K at selected sites except for very moist atmospheres
- Meteosat single-channel LST retrievals can be associated with realistic uncertainties which will simplify the assimilation of those data into land surface models

Tetzlaff et al. (in review): Meteosat land surface temperature climate data record: Achievable accuracy and potential uncertainties. Remote Sensing.

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