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OSI SAF Sea Surface Temperature reprocessing of MSG/SEVIRI archive.

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Introduction

Context: Reprocessing of Sea Surface Temperature from MSG SEVIRI archive was planned under the second phase of OSI SAF scientific development.

Objective: Provide users with a homogeneous SST time series.

Deliverable:

- Period of the reprocessing: 2004-2012 (for now).
- Hourly level 3 dataset.
- 60S-60N and 60W-60E on a 0.05° regular grid.
- Sub-skin temperature (calibrated using drifting buoys measurements at 20 cm depth).

Outline:

1. Algorithm and methods
2. Assessment of the dataset
3. Conclusion and futur work

Algorithm and methods: SST

Algorithm: $\mathrm{SST} = a\,T_{10.8} + (b\,S_\Theta + c\,T_{clim})(T_{10.8} - T_{12.0}) + d + e\,S_\Theta$

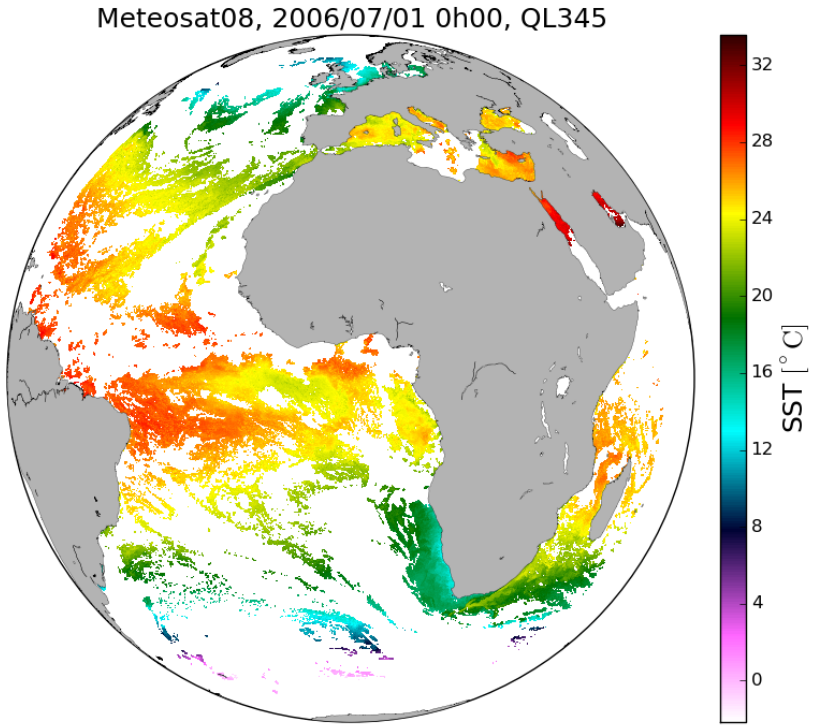
Data:

- SST climatology derived from OSTIA daily SST re-analyses
- MSG-1 and MSG-2 SEVIRI BTs reprocessed and near real-time from EUMETSAT central facility
- Cloud mask provided by CM SAF

Parameters are determine by regression using simulations of BTs.

Processing:

- Full spatial and temporal resolution
- All clear sky pixels are processed



Algorithm and methods: Sensitivity of the SST algorithm

Sensitivity of the estimated SST ($\widehat{x}$) to a change in true SST (x):

$$\frac{d\widehat{x}}{dx} = \sum_{c=1}^{n} \frac{\partial R}{\partial y_c} \frac{\partial y_c}{\partial x}$$

where R is the retrieval algorithm and y_c are the BTs.

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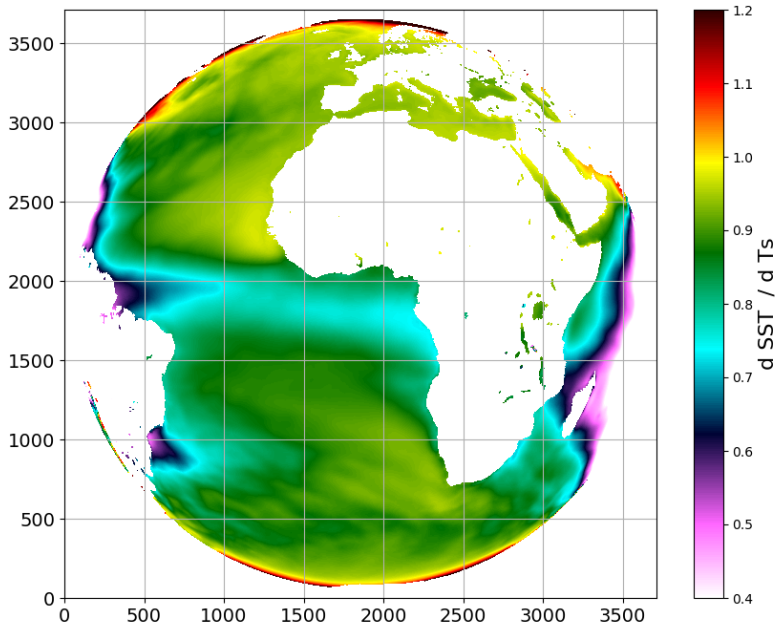

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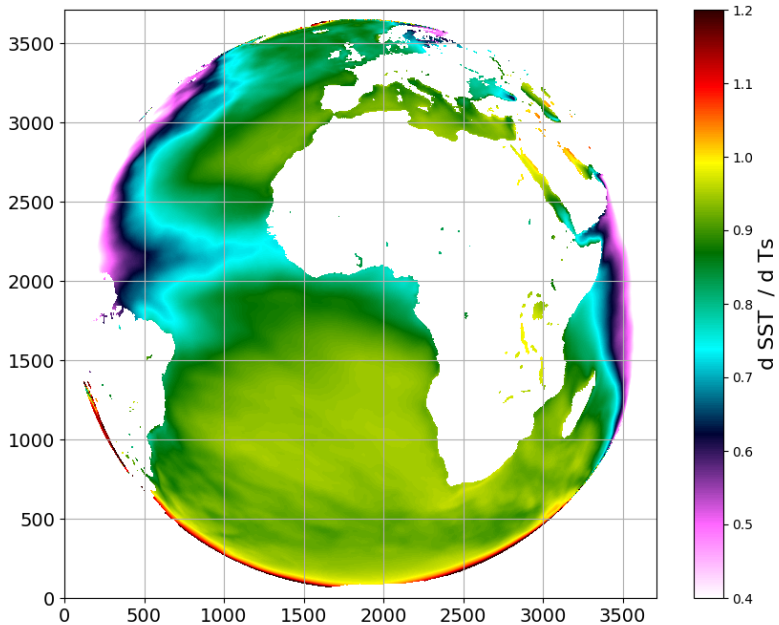

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Algorithm and methods: Atmospheric Saharan dust correction

Saharan Dust Index (Merchant et al., 2006)

Night time retrieval:

$$\mathrm{SDI}_{\mathrm{night}} = S_1(T_{3.9} - T_{8.7} + \Gamma_1) + S_2(T_{10.8s} - T_{12.0s} + \Gamma_2) + S_3$$

S_i coefficients determined by regression using BT simulations.

Day time retrieval:

$$\mathrm{SDI}_{\mathrm{day}} = DS_1\,T_{8.7} + DS_2\,T_{10.8} + DS_3\,T_{12.0} + DS_4\,T_{13.4} + DS_5$$

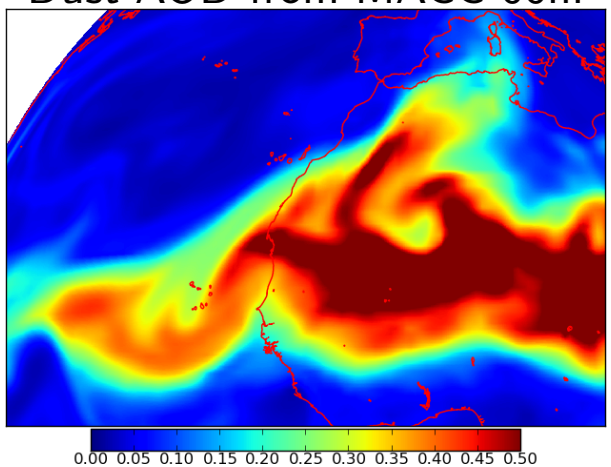
DS_i coefficient determined by local regression of night time SDI with channels available during daytime.

SDI correction:

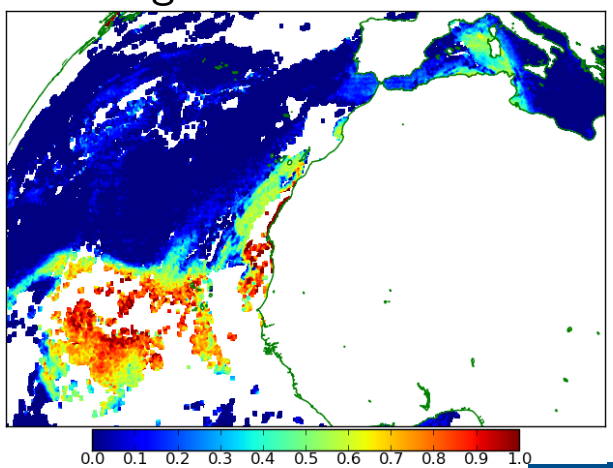
$$\varphi(\mathrm{SDI}) = a_0 + a_1\mathrm{SDI} + a_2\mathrm{SDI}^2$$

a_i coefficients determined by regression using a dataset of match-ups.

Dust AOD from MACC 00h:



Night time SDI 00h:



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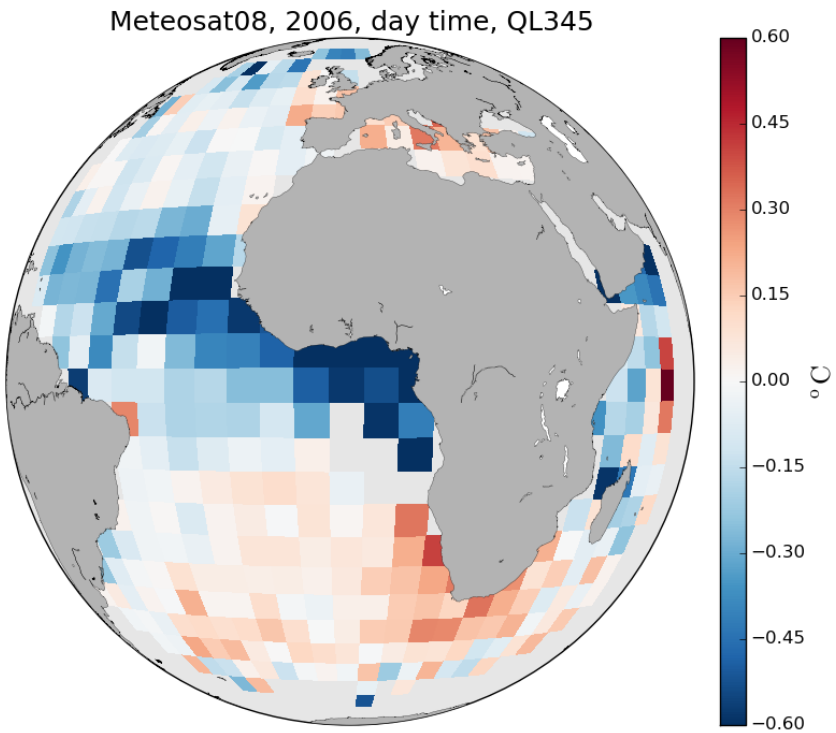
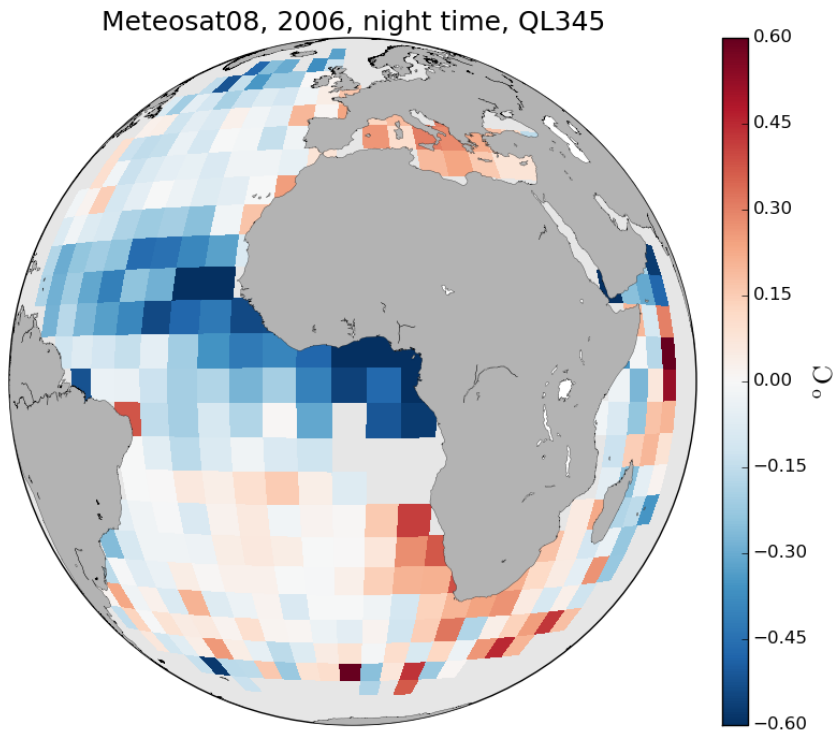
Algorithm and methods: Regional/seasonal biases

Binned map of (Satellite SST - in situ SST)





Regional and seasonal biases:

- Cool bias in the inter-tropical zone.
- Warm bias around South African coast and Mediterranean sea.

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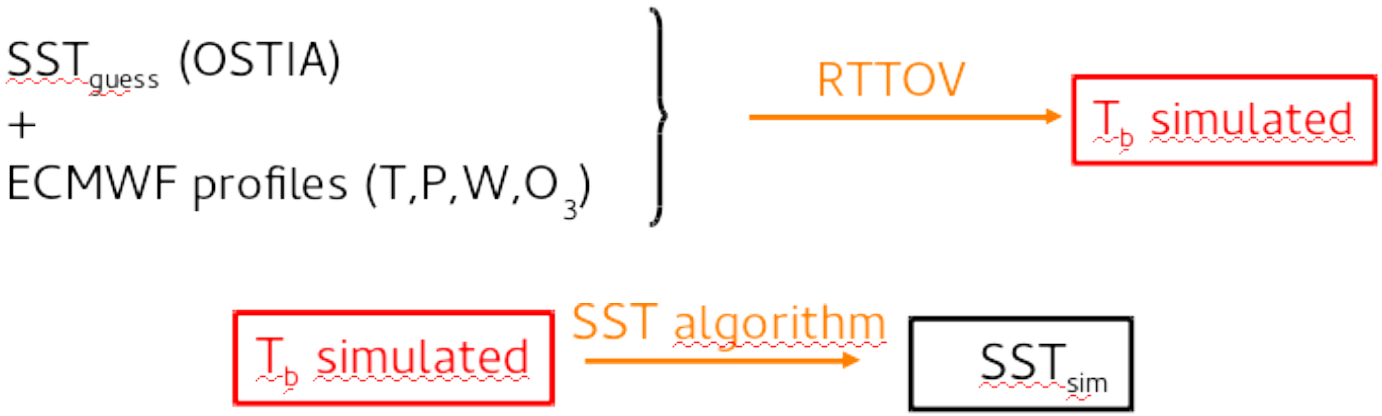
Algorithm and methods: bias correction

Algorithm correction from Le Borgne et al. (2011):

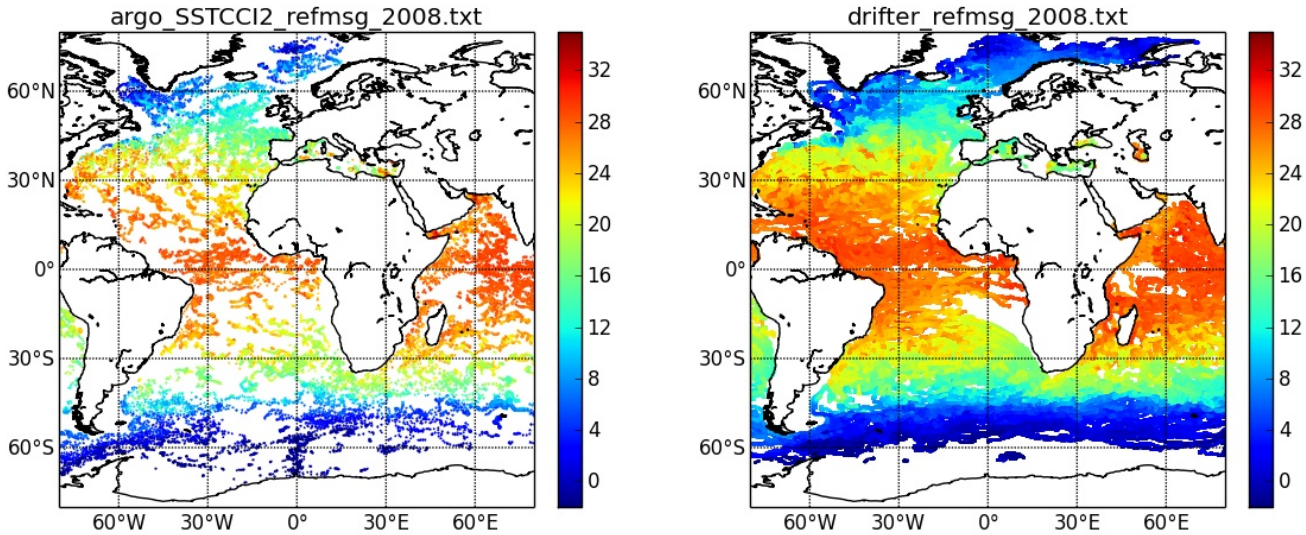
Method relying on simulations of brightness temperature using atmospheric profiles from NWP model.

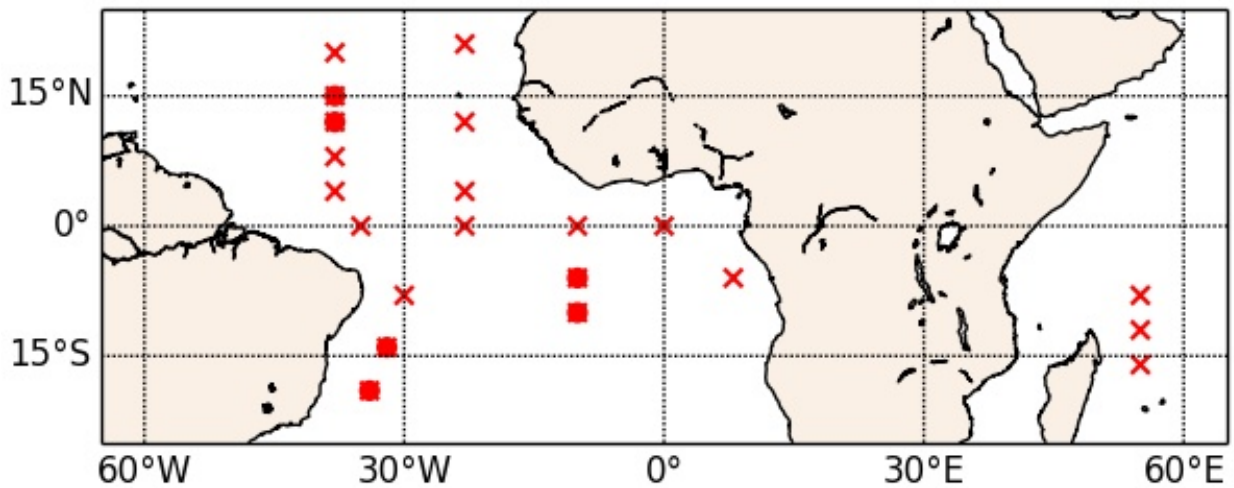


$$SST_{corrected} = SST_{obs} - (SST_{sim} - SST_{guess})$$

Assessment: data

ERA-clim dataset (Atkinson et al., 2014)





Assessment: Global statistics

Comparison to drifting buoys:

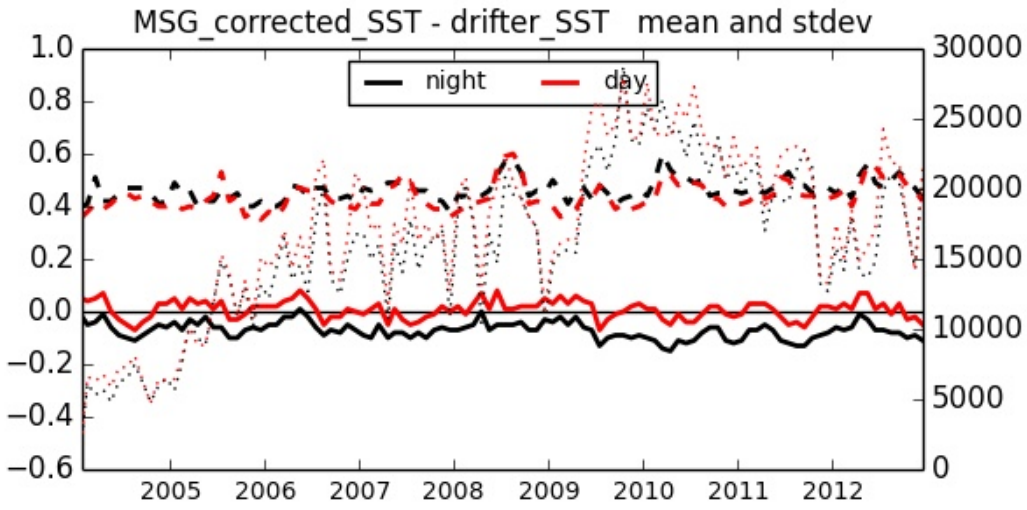
QL 3-4-5, $\Delta t \leq 15\,\mathrm{min}$, $|\mathrm{SST_{insitu}} - \mathrm{SST_{clim}}| \leq 5\mathrm{K}$

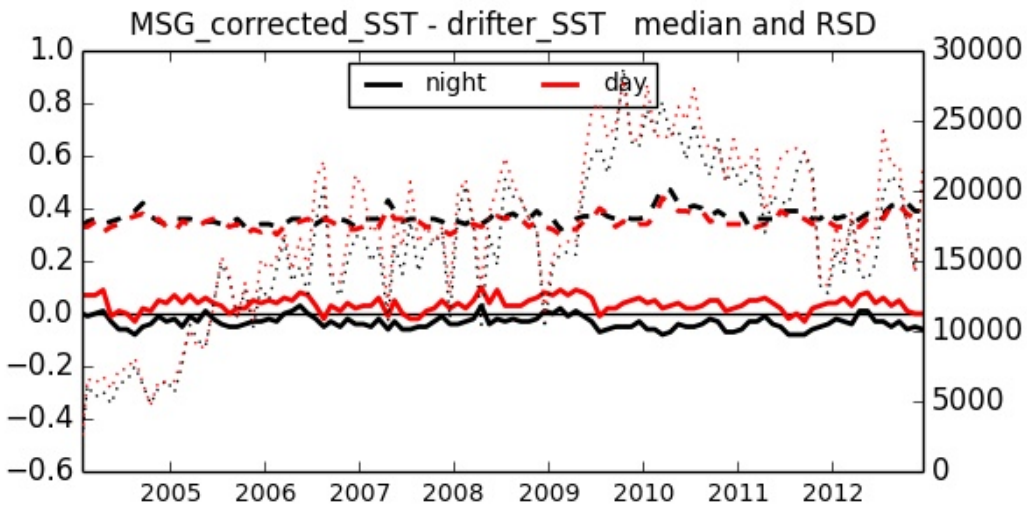
		mean SST	nb	mean	SD	median	RSD
Night	Meteosat-8	22.23	425132	-0.06	0.44	-0.03	0.35
	Meteosat-9	22.67	1299635	-0.08	0.48	-0.04	0.38
	ALL	22.56	1724767	-0.08	0.47	-0.04	0.37
Day	Meteosat-8	22.38	463219	0.01	0.42	0.04	0.34
	Meteosat-9	22.80	1383170	0.00	0.46	0.04	0.36
	ALL	22.69	1846389	0.00	0.45	0.04	0.35

Robust standard deviation (RSD):

$$\mathrm{RSD} = (75^{\mathrm{th}}\mathrm{percentile}(\Delta\mathrm{SST}) - 25^{\mathrm{th}}\mathrm{percentile}(\Delta\mathrm{SST}))/1.348$$

Assessment: Monthly statistics

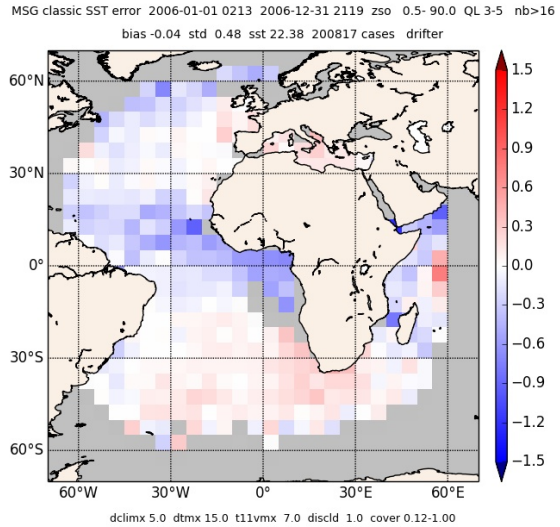


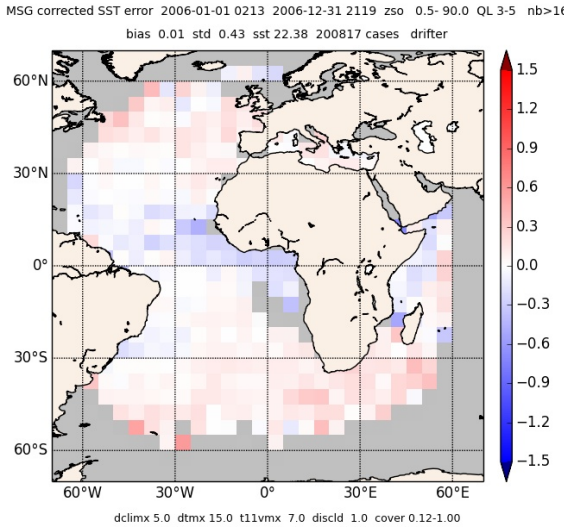


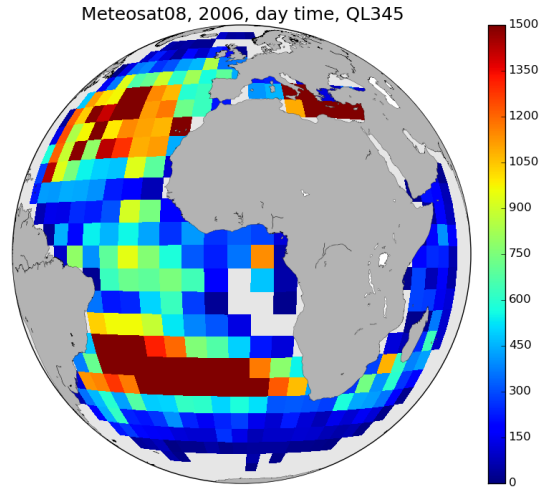
Assessment: Spatial distribution of the bias

2006 - Median of the SST difference per box of $5 \times 5°$

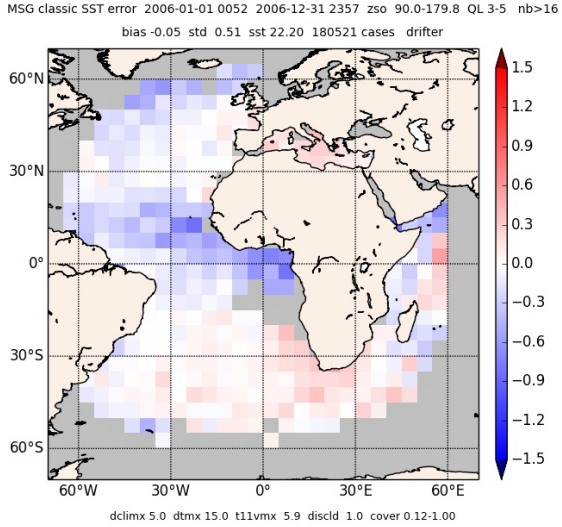
Day

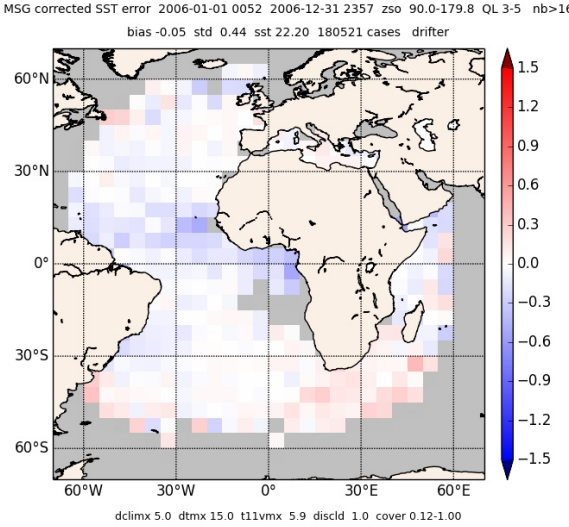


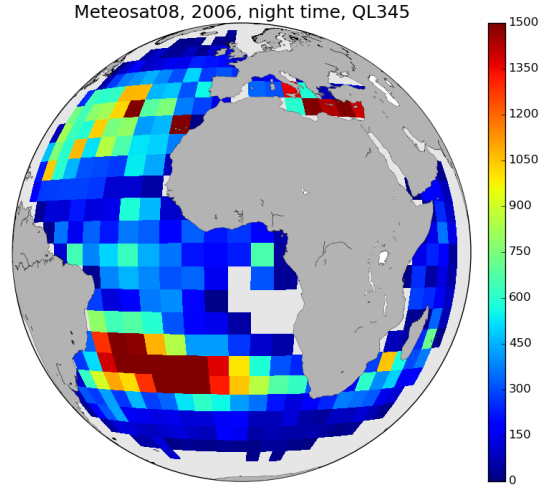




Night







Assessment:Climate data record type

Following the Climate Data Assessment Framework, CDR-TAG_CDAF v1.0.5

Systematic effects:

- Global median of $SST_{sat} - SST_{in\ situ}$: Overall systematic difference.
- Geographical variation: STD of median computed on space scales of about 1000km.

Non-systematic effects: Robust STD after removing systematic effects.

Relative to drifting buoys measurements:

	Meteosat-8	Meteosat-9	All
Global median (K)	0.01	0.00	0.00
Geographical variation (K)	0.10	0.12	0.11
Dispersion (K)	0.33	0.36	0.35

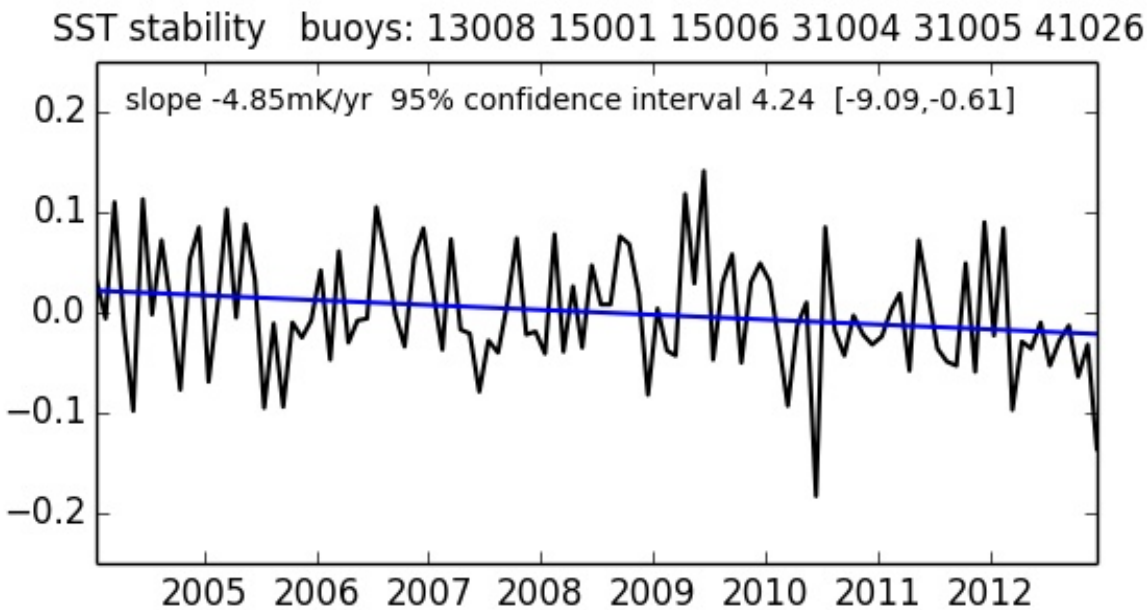
Relative to Argo floats measurements:

	Meteosat-8	Meteosat-9	All
Global median (K)	0.10	0.11	0.11
Geographical variation (K)	0.09	0.13	0.11
Dispersion (K)	0.39	0.38	0.38

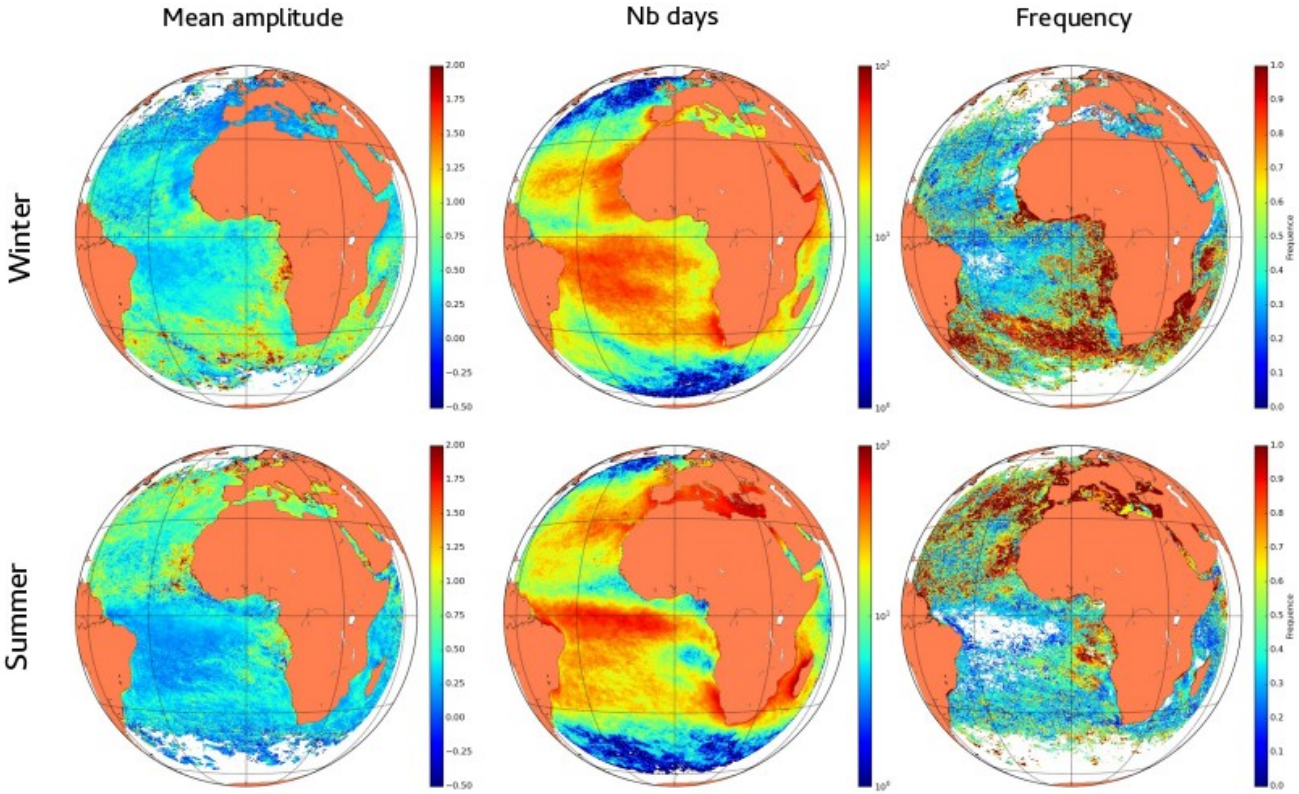
Assessment:Climate data record type

Stability: Degree of invariance over time of the mean error

- Using moored buoys from Global Tropical Moored Buoy Array
- Data available for 75% of the period
- Deseasonalized monthly mean difference to moored buoy measurements (each location)
- Average of all locations



Diurnal variability



Mean amplitude: $mean(max(\Delta SST = SST_{time} - SST_{ref}))$
Nb days: number of days when Mean amplitude could be computed
Frequency: Nb days $(\Delta SST > 0.5K)$/Nb days

Conclusions/perspectives

- Good quality and homogeneous dataset
- L3C are available on Ifremer ftp (information on `http://osi-saf.eumetsat.int`)
- L2 are available on demand
- Matchup dataset can also be shared

Future work:

- Reprocessing using OE: will help us decide for the future processing methodologies to be used for MTG and Metop-SG.
- We would like to make the dataset longer