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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 (algorithm calibrated using drifting buoys measurements at 20 cm depth).

Outline:

1. Algorithm and methods
2. Validation results
3. Ongoing work

Algorithm and methods: SST

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

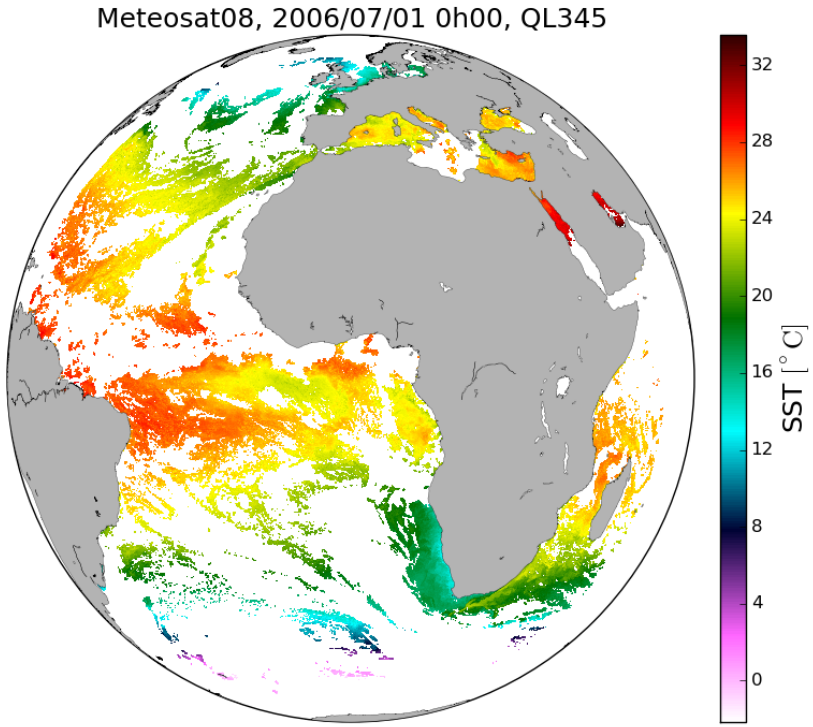
Data:

- 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: 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:

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

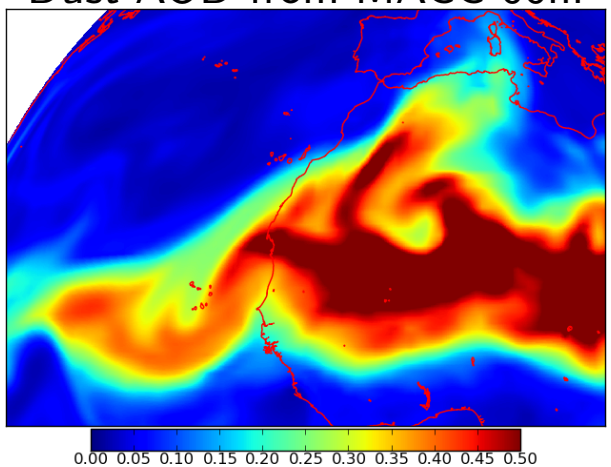
DS_i coefficient determined by local regression of night time SDI with channels available during daytime.

SDI correction:

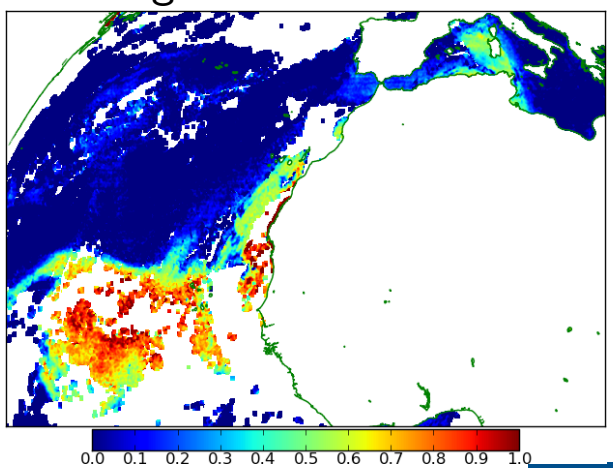
$$\varphi(\mathrm{SDI}) = a_0 + a_1\mathrm{SDI} + a_2\mathrm{SDI}^2$$

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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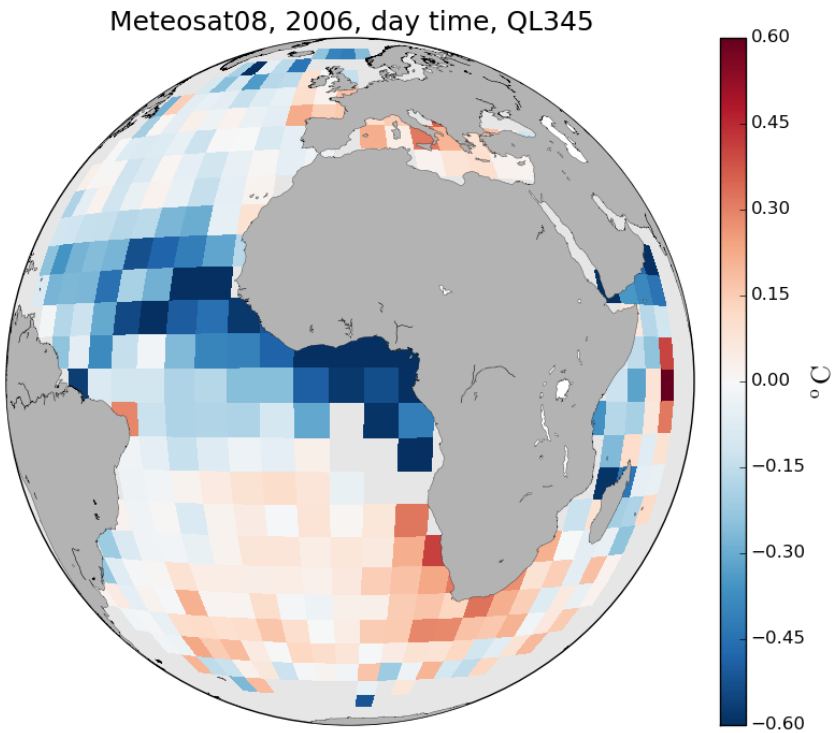
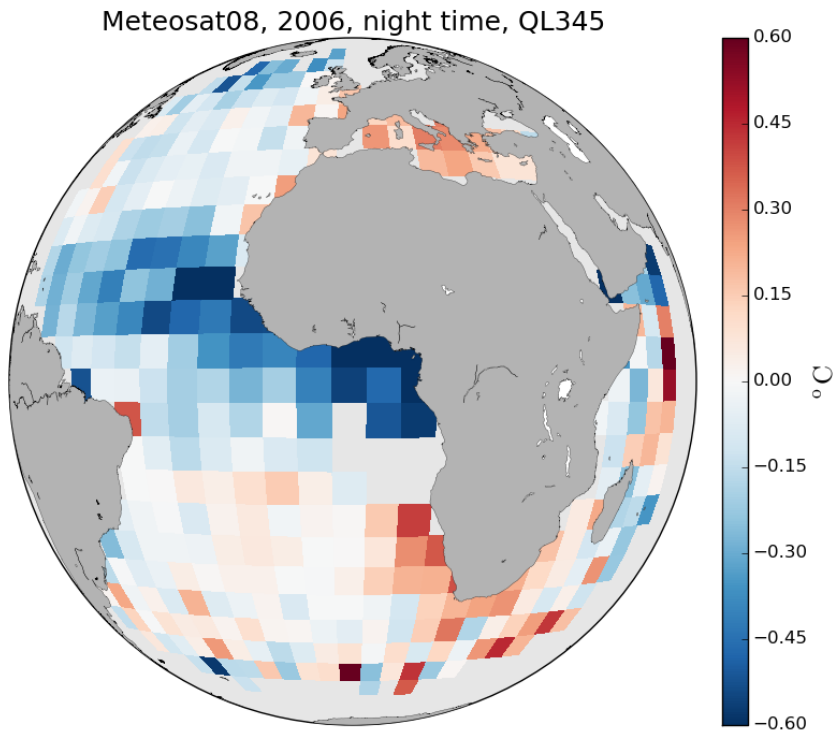
Algorithm and methods: Regional/seasonal biases

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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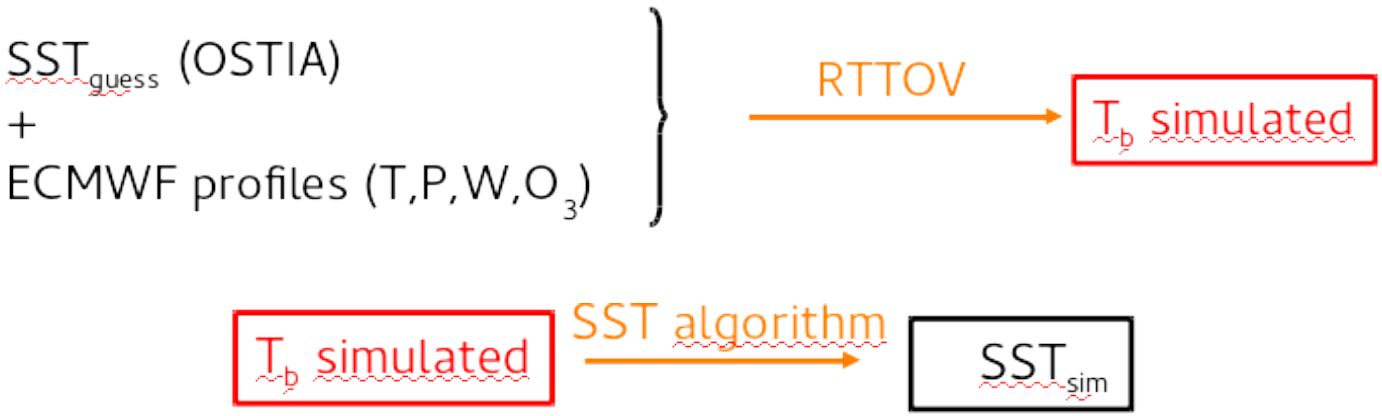
Algorithm and methods: bias correction

Algorithm correction from Le Borgne et al. (2011):
Method relying on simulations of brightness temperature using atmospheric profiles from NWP model.

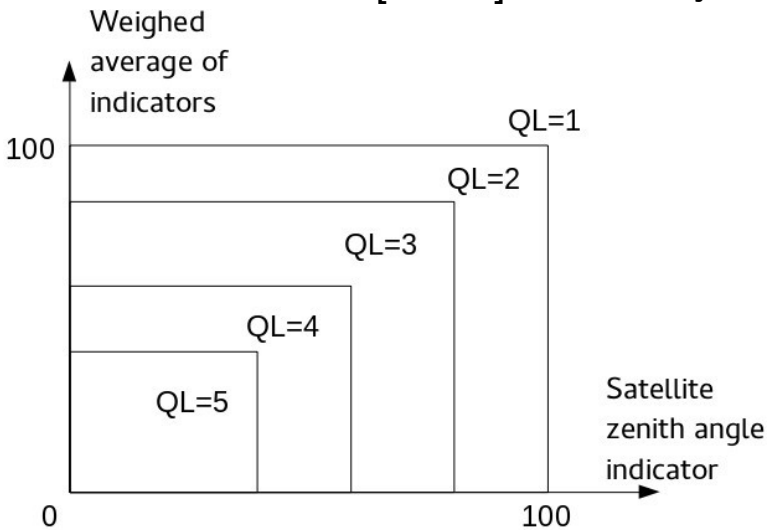


$$SST_{corrected} = SST_{obs} - (SST_{sim} - SST_{guess})$$

Algorithm and methods: Quality Level

Test	Description/purpose
SST value	Compares SST to SST climatology.
SST spatial variability	Compares the local value of the SST gradient to a climatology of maximum gradient.
SST temporal variability	Detects quickly changing SST.
Aerosol dust	Penalises pixels with high SDI.
Distance to cloud	Penalises pixels in the vicinity of clouds.
Sea ice	Detects pixels containing sea ice.
Satellite zenith angle	Penalises pixels with high satellite zenith angle.

Tests > indicators [0,100] > Quality level

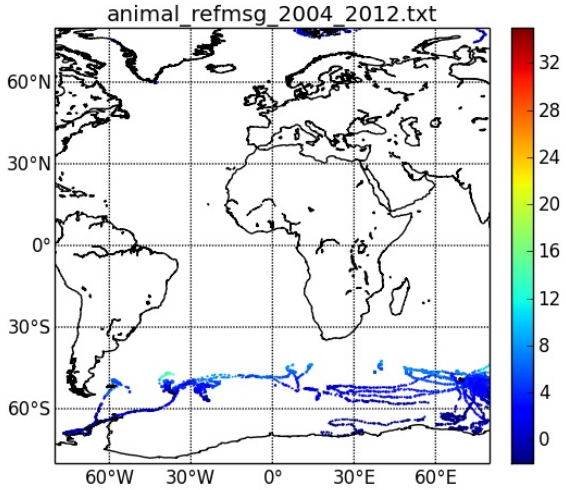


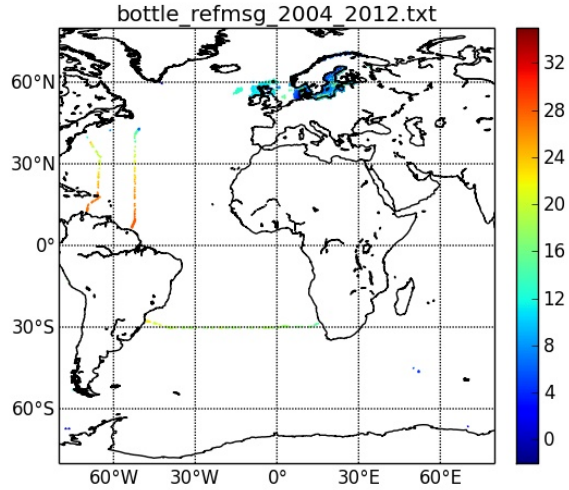
Quality level ranges from 0 to 5:

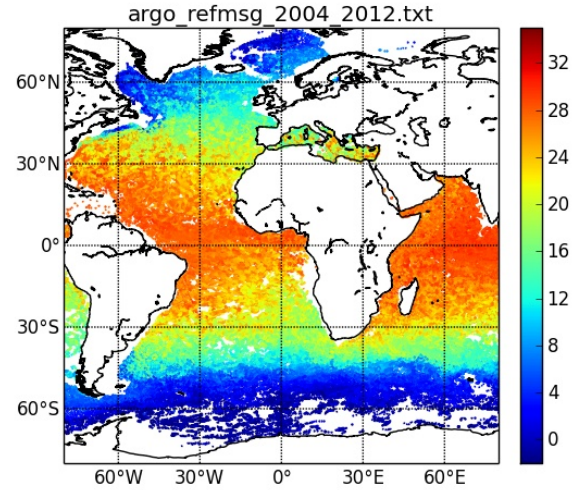
- 0: unprocessed
- 1: cloudy
- 2: bad
- 3: suspect
- 4: acceptable
- 5: excellent

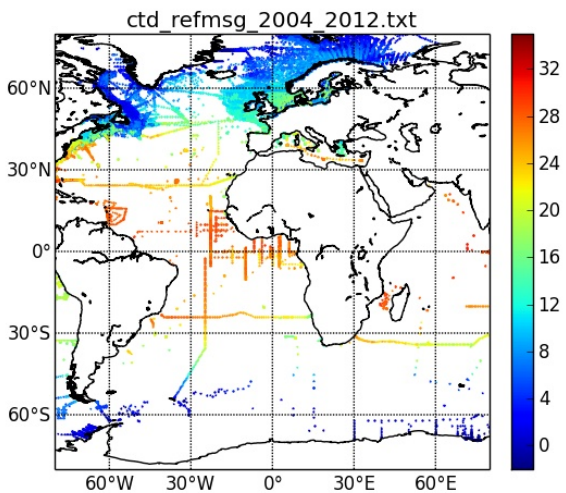
Assessment: data

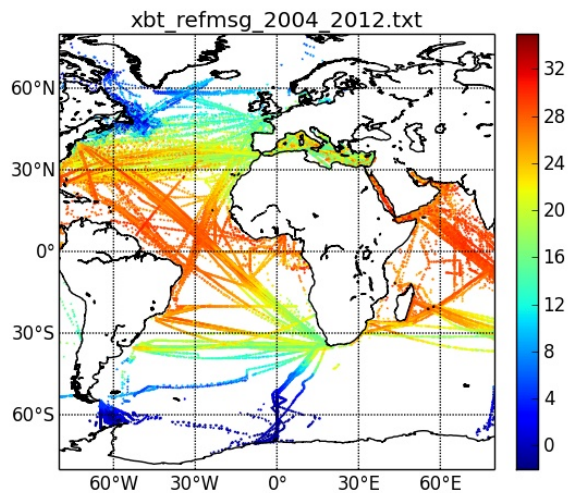
ERA-clim dataset (Atkinson et al., 2014)

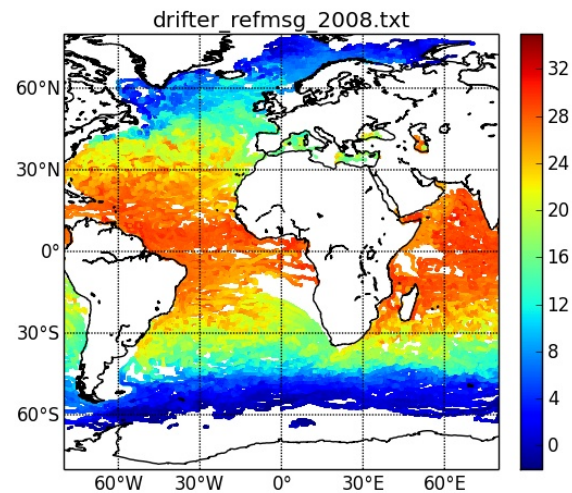












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Assessment: Global statistics

Comparison to drifting buoys: MSG1 (2004-2007)

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

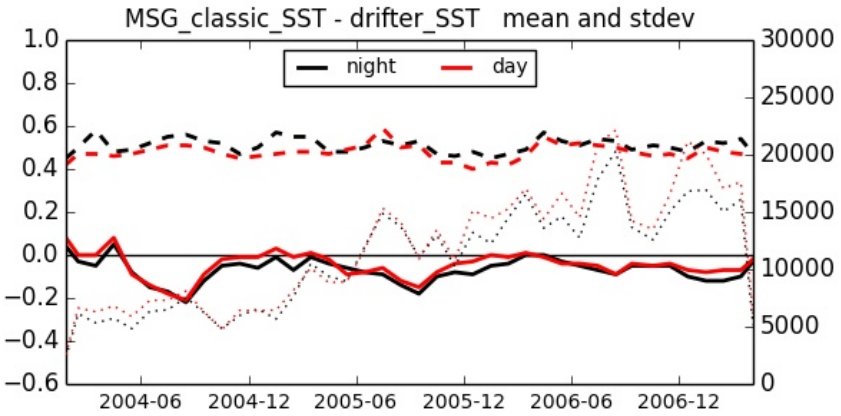
		Uncorrected				Corrected			
	Num	**bias**	**STD**	**median**	**RSD**	**bias**	**STD**	**median**	**RSD**
Night	432100	-0.07	0.51	-0.03	0.43	-0.06	0.44	-0.03	0.35
Day	470168	-0.05	0.48	-0.01	0.41	0.01	0.42	0.04	0.34

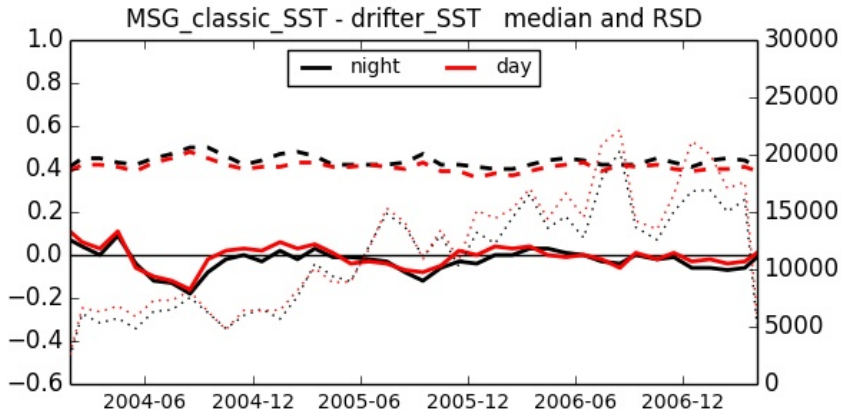
Robust standard deviation (RSD):

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

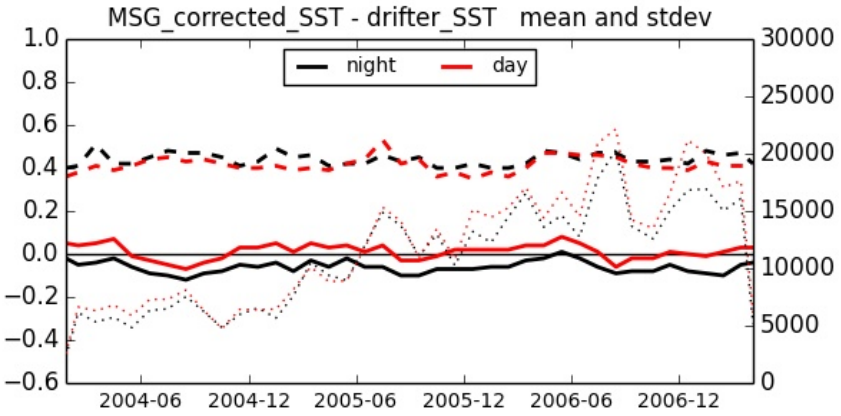
Assessment: Monthly statistics

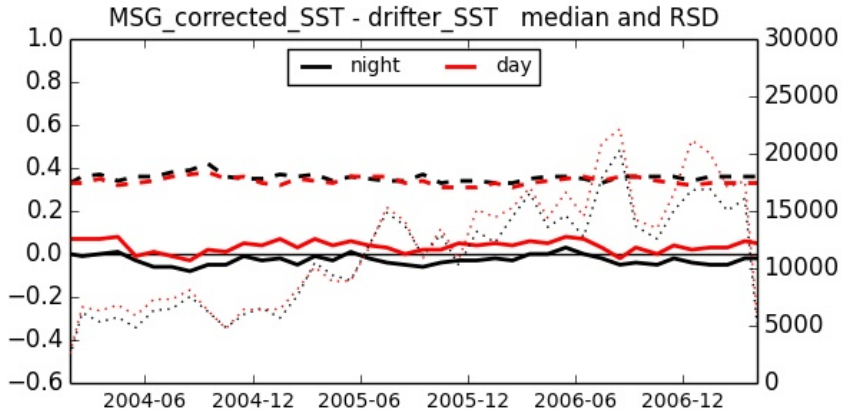
Without correction





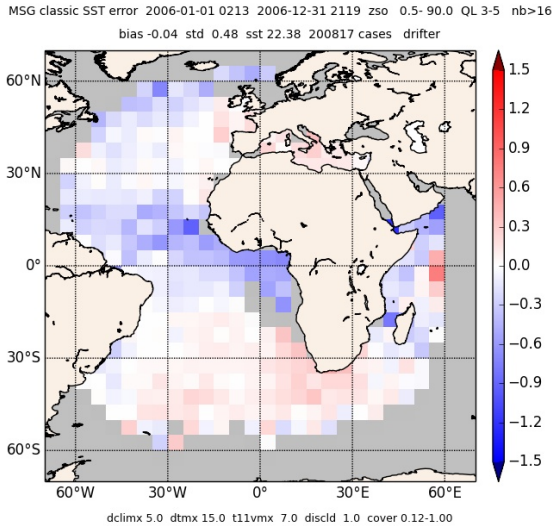
With correction

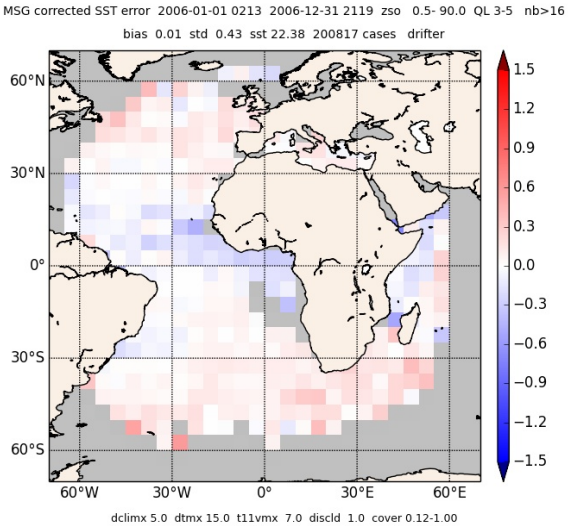


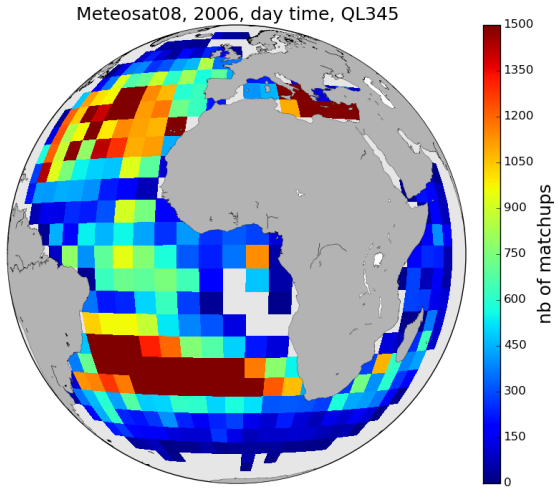


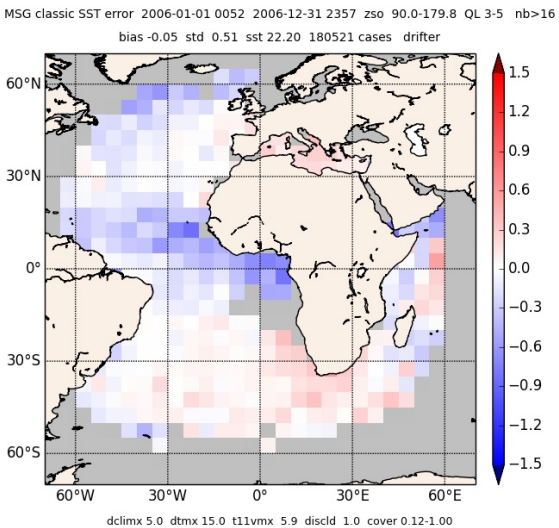
Assessment: Spatial distribution of the bias

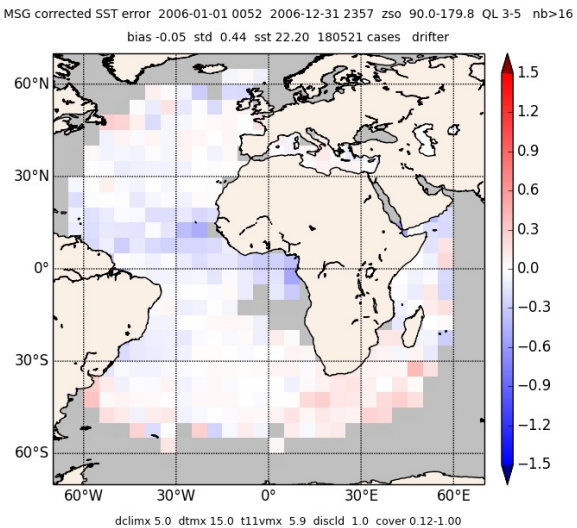
2006 - Median of the SST difference per box of $5 \times 5°$

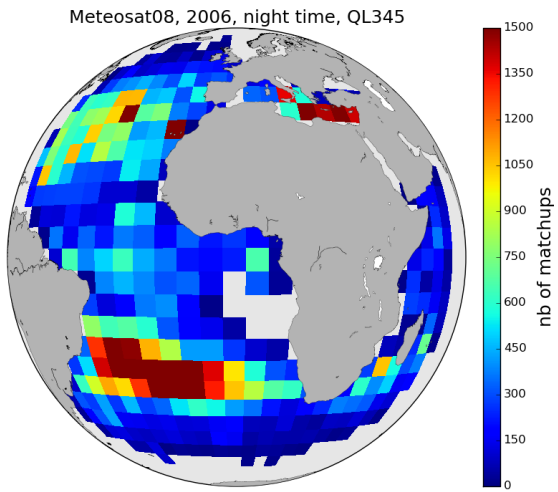












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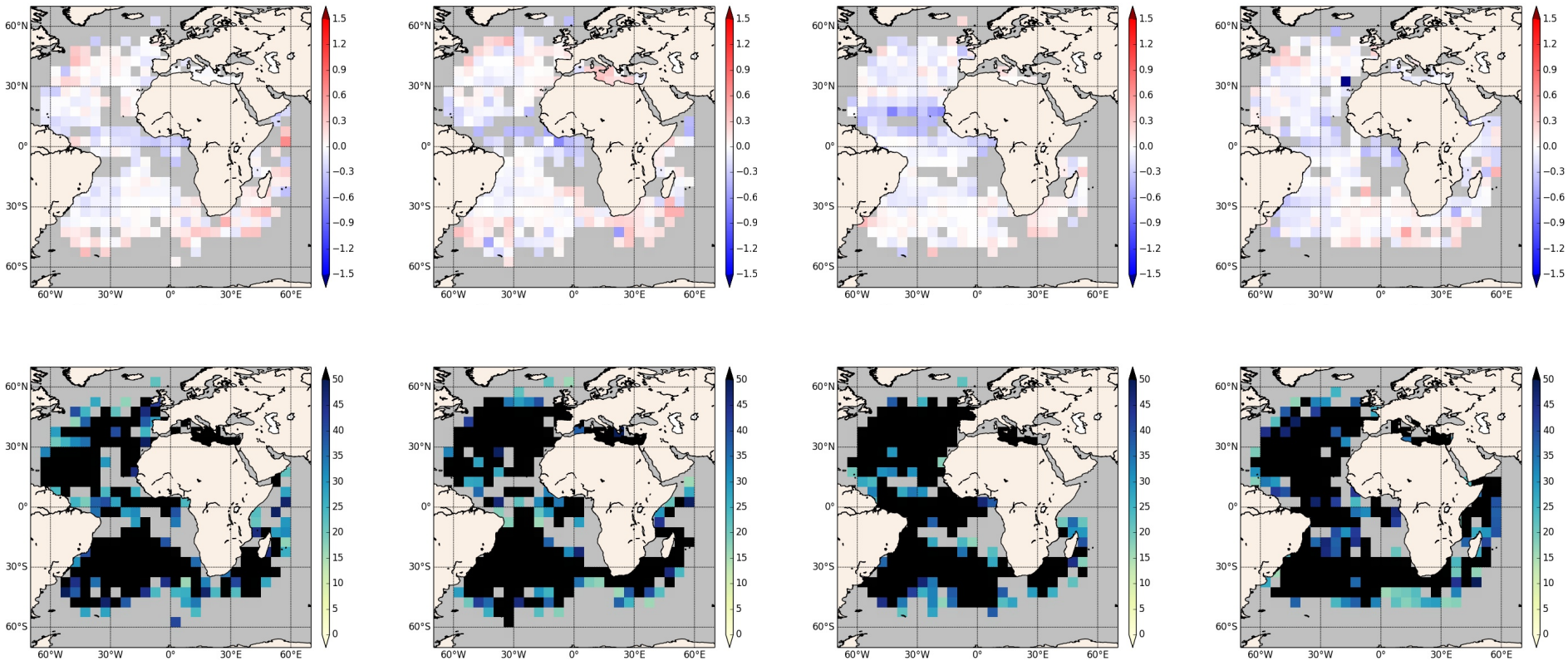
Assessment: Spatial distribution of the bias

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

JFM AMJ JAS OND



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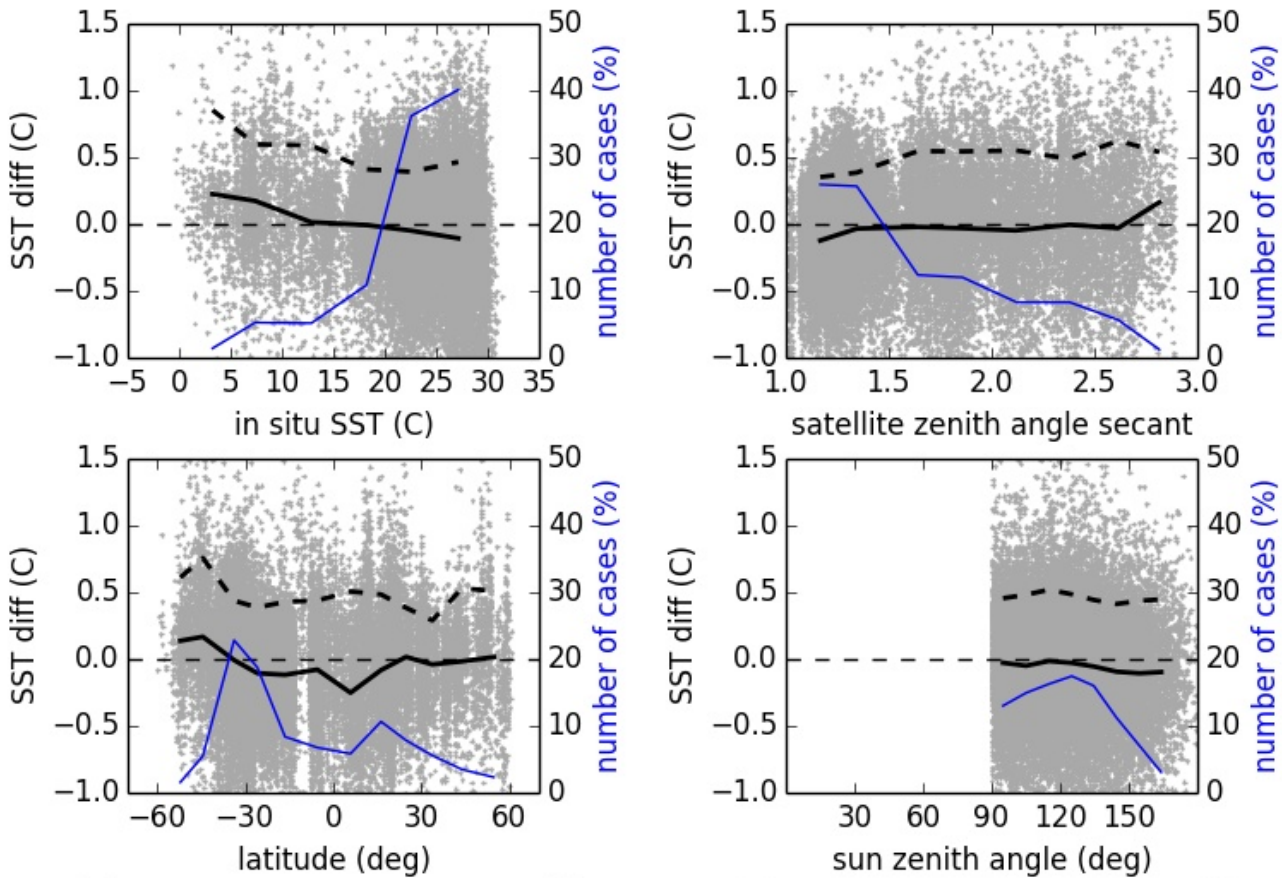
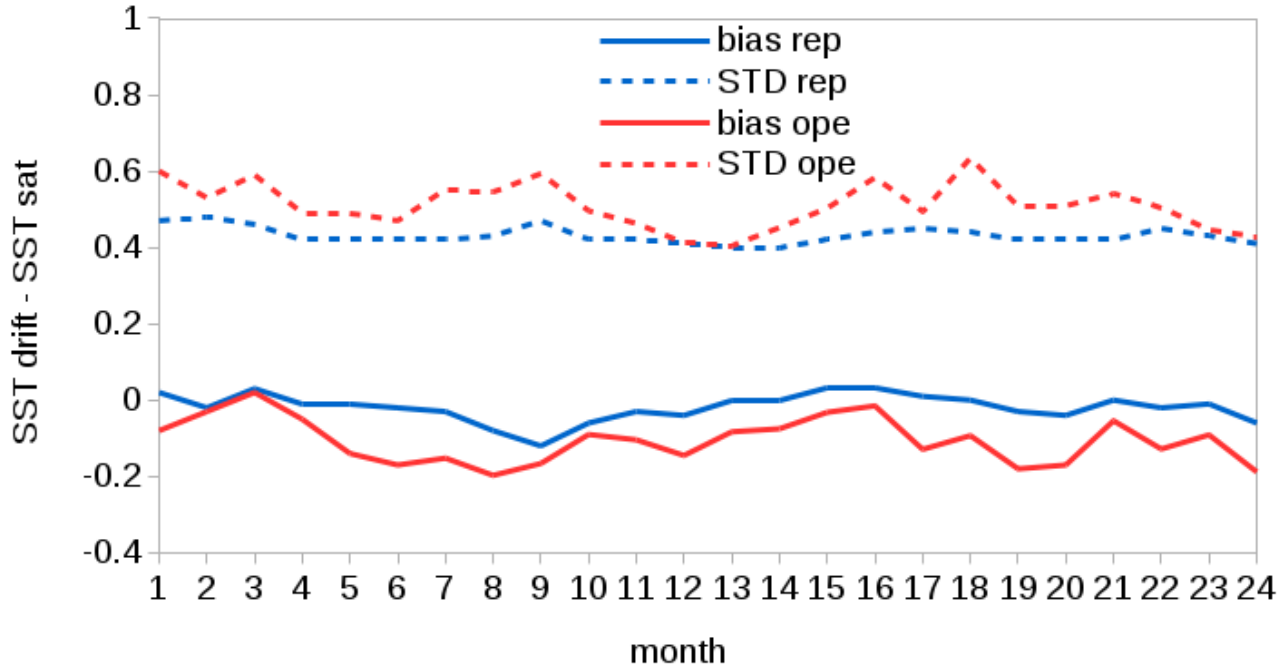
Assessment: Dependencies

2005 JFM



Assessment: Comparison with operational product

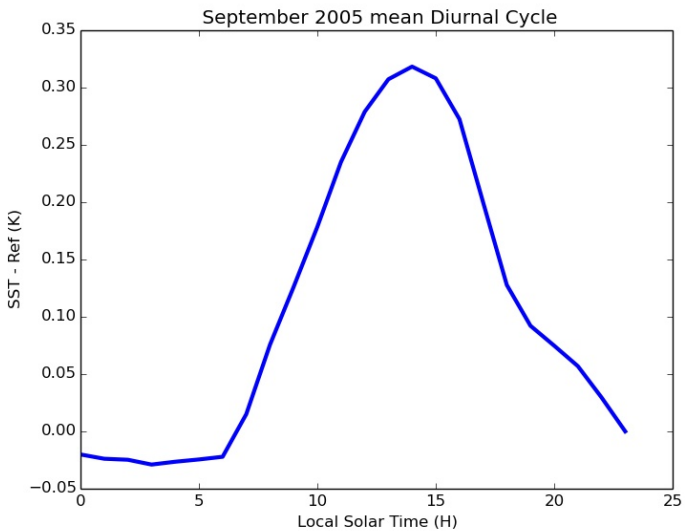
Monthly statistics for 2005-2006

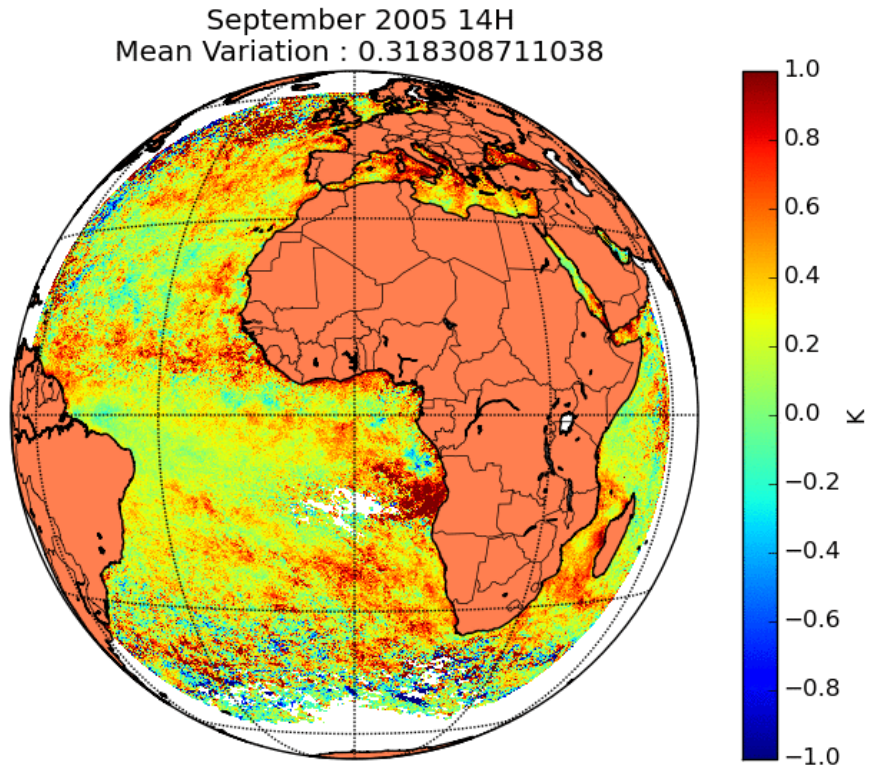


Assessment: Diurnal variability

Preliminary characterisation of diurnal cycle on the reprocessed data:

- One month of data is used: 09/2005
- Avererage maximum amplitude of diurnal cycle is 0.31K





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Conclusions/perspectives

- Good quality of the cloud mask (CM SAF) and L1 data (EUMETSAT).
- Comparison to drifting buoys is satisfying.
- Methods for bias correction are effective.

Future work:

- Finish the processing of MSG2.
- CDR-type validation and comparison to other datasets.
- Delivery planned for autumn 2017 after a DRR.
- Longer term:
  - Reprocessing using OE.
  - Reprocess more recent years.