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 current 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. Intermediate results
3. Ongoing development and plan

Algorithm and methods: SST

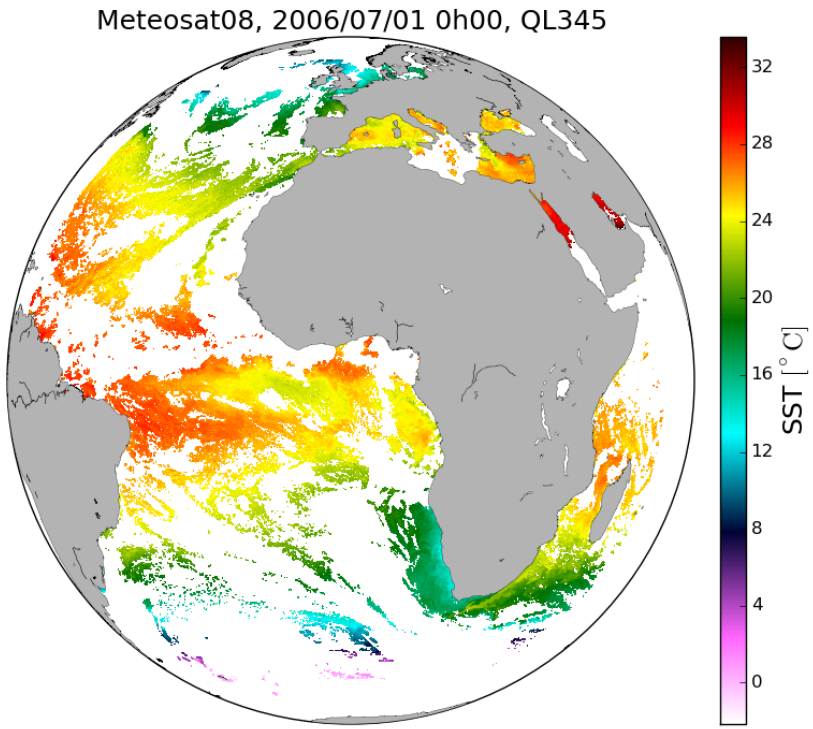
Algorithm: $\mathrm{SST} = a\,T_{10.8} + (b\,S_\Theta + c\,T_{clim})(T_{10.8} - T_{12.0}) + d + e\,S_\Theta$

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

Processing:

- Full spatial and temporal resolution (on L2)
- All clear sky pixels are processed



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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:

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

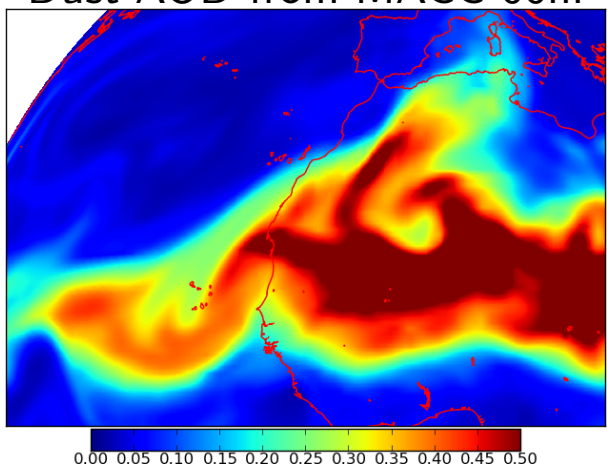
DS_i coefficient determined by local regression of night time SDI with channels available during daytime.

SDI correction:

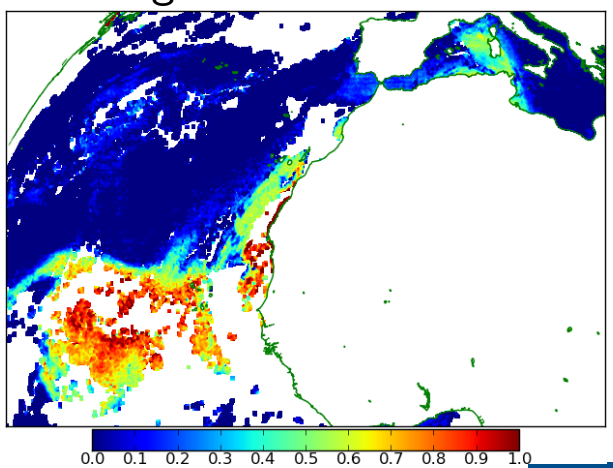
$$\varphi(\mathrm{SDI}) = a_0 + a_1\mathrm{SDI} + a_2\mathrm{SDI}^2$$

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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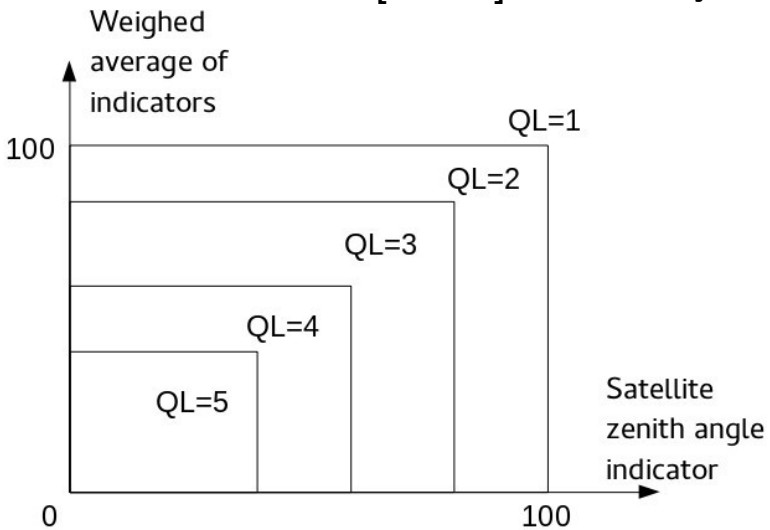
Algorithm and methods: Quality Level

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

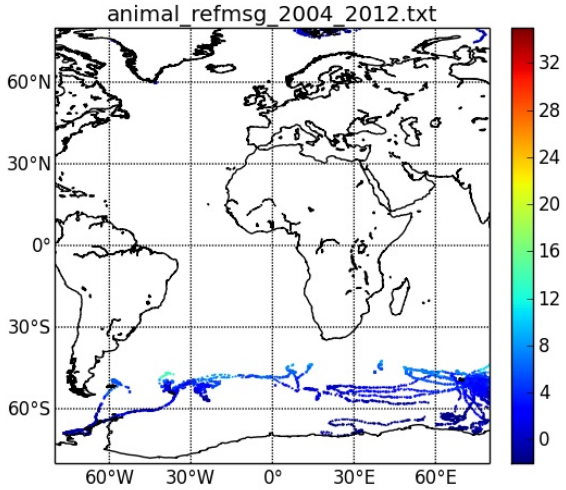


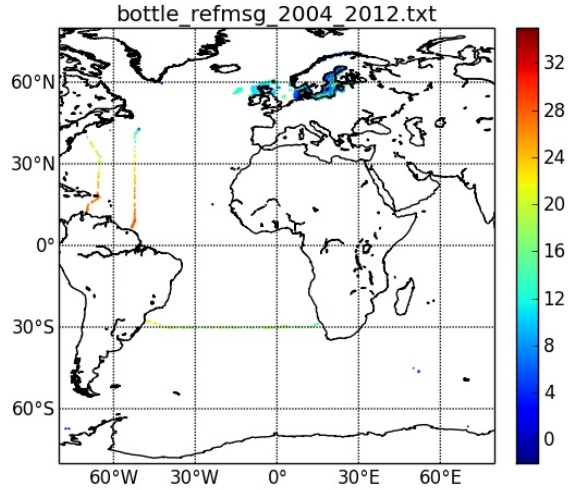
Quality level ranges from 0 to 5:

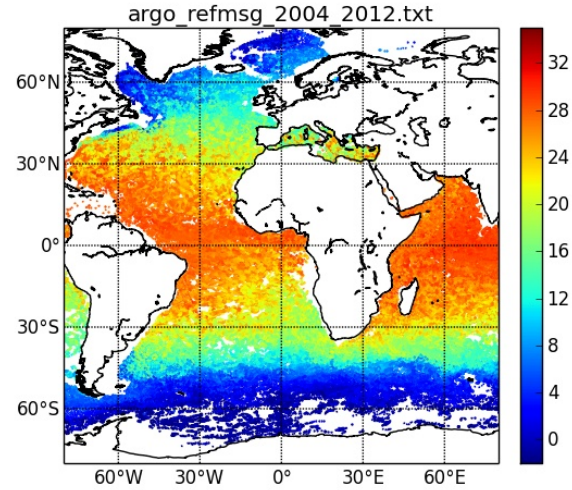
- 0: unprocessed
- 1: cloudy
- 2: bad
- 3: suspect
- 4: acceptable
- 5: excellent

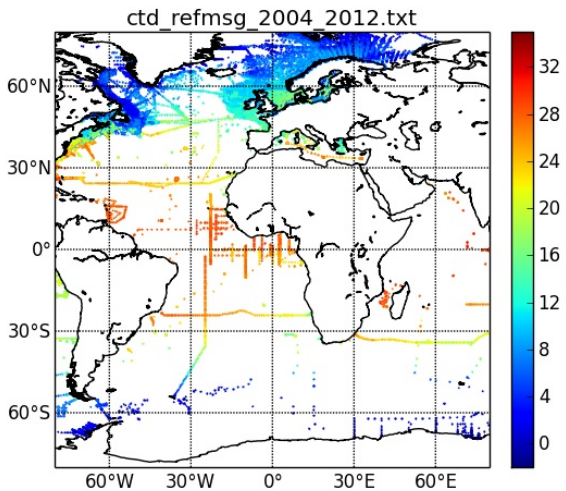
Results: Validation data

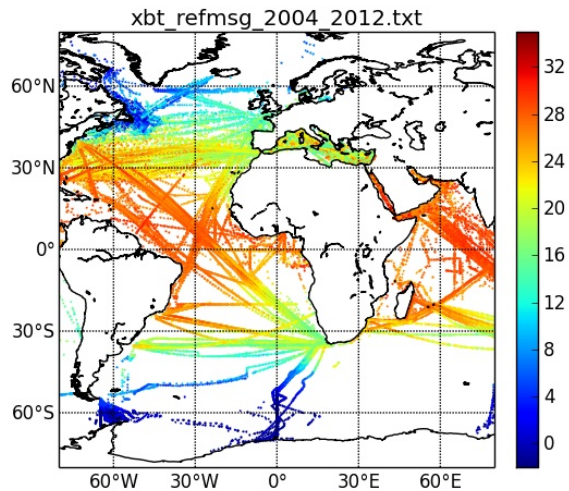
ERA-clim dataset (Atkinson et al., 2014)

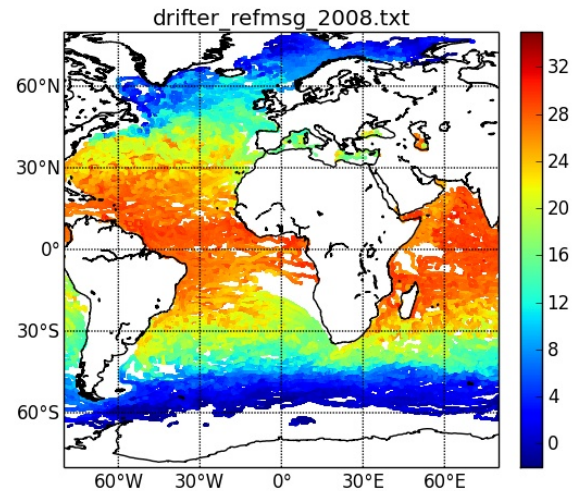












Results: Drifting buoys and moorings

Statistics against drifting buoys:

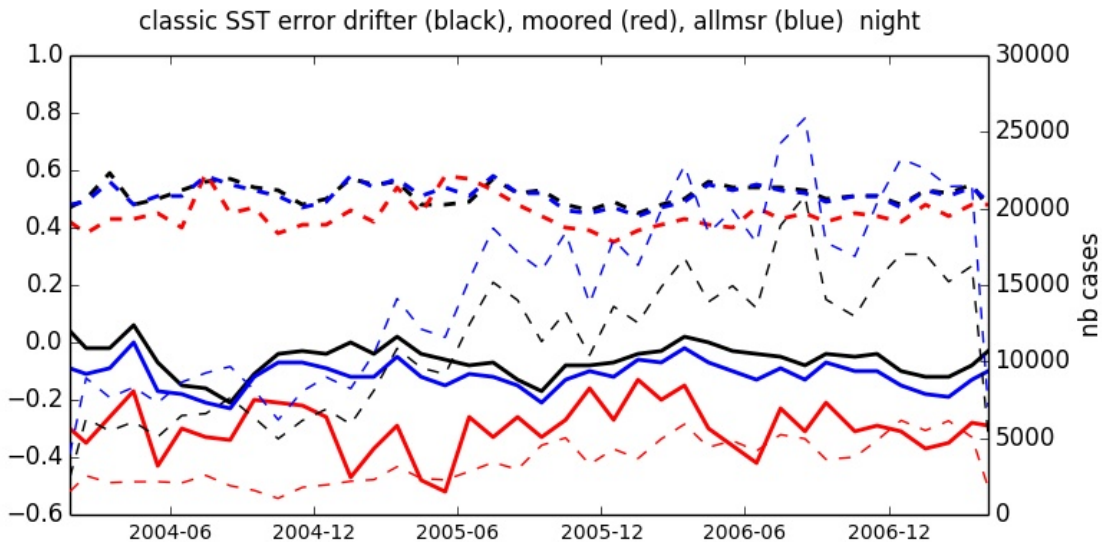
2006	Day			Night		
Quality level	N	bias (K)	Std (K)	N	bias (K)	Std (K)
3-4-5	201988	-0.036	0.457	131079	-0.030	0.484
5	92404	0.045	0.392	56968	0.060	0.401
4	66591	-0.062	0.456	43623	-0.046	0.489
3	42993	-0.172	0.542	30488	-0.175	0.573
2	126032	-0.371	1.128	93077	-0.355	1.130

Data selection:

Quality level 3 to 5

$|\mathrm{SST}_{\mathrm{in\,situ}} - \mathrm{SST}_{\mathrm{clim}}| <= 5^{\circ}\mathrm{C}$

$|\mathrm{t}_{\mathrm{in\,situ}} - \mathrm{t}_{\mathrm{satellite}}| <= 15\ \mathrm{min}$



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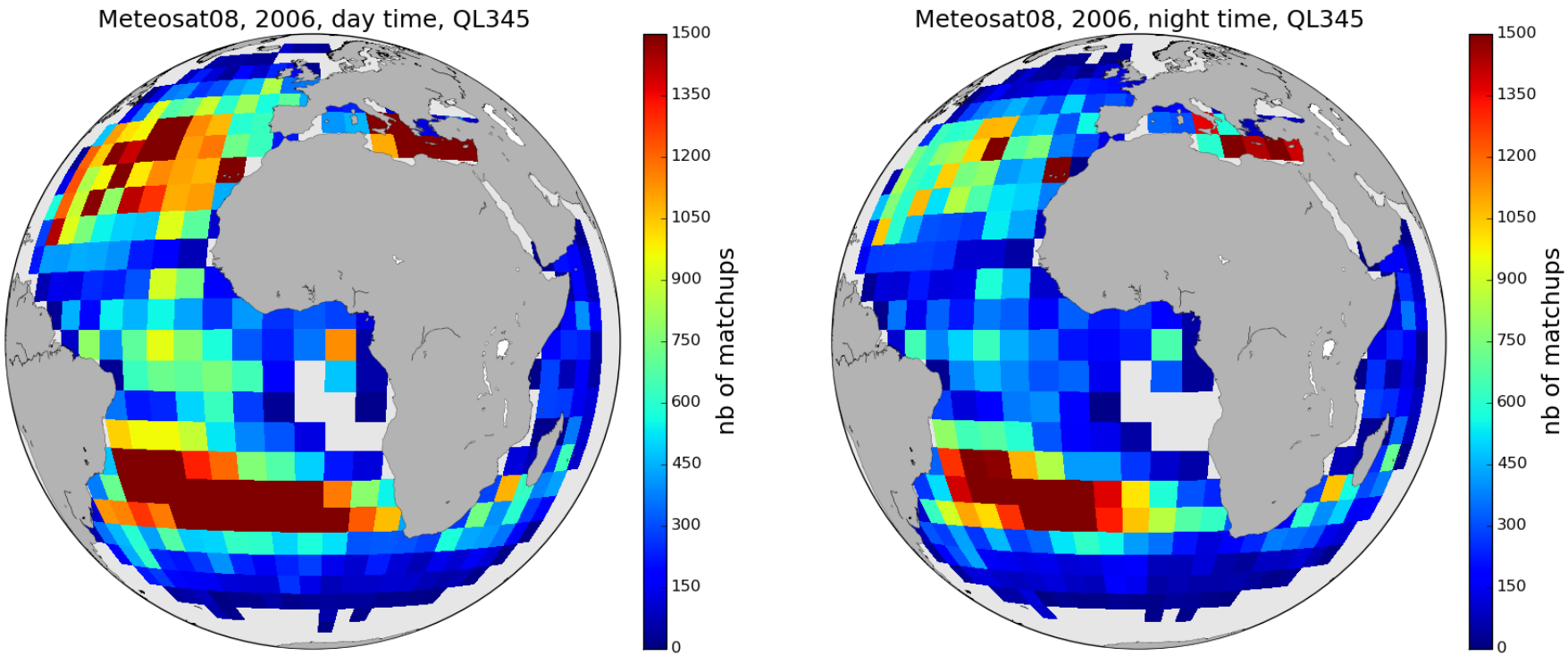
Results: Drifting buoys

Binned map of number of match-ups



Non-homogeneous distribution of the match-ups

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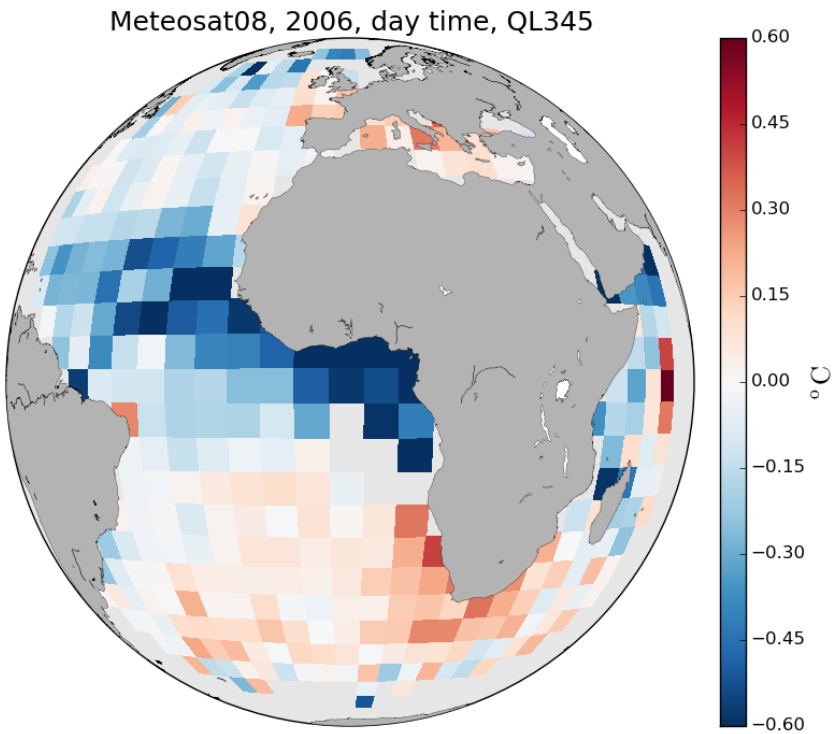
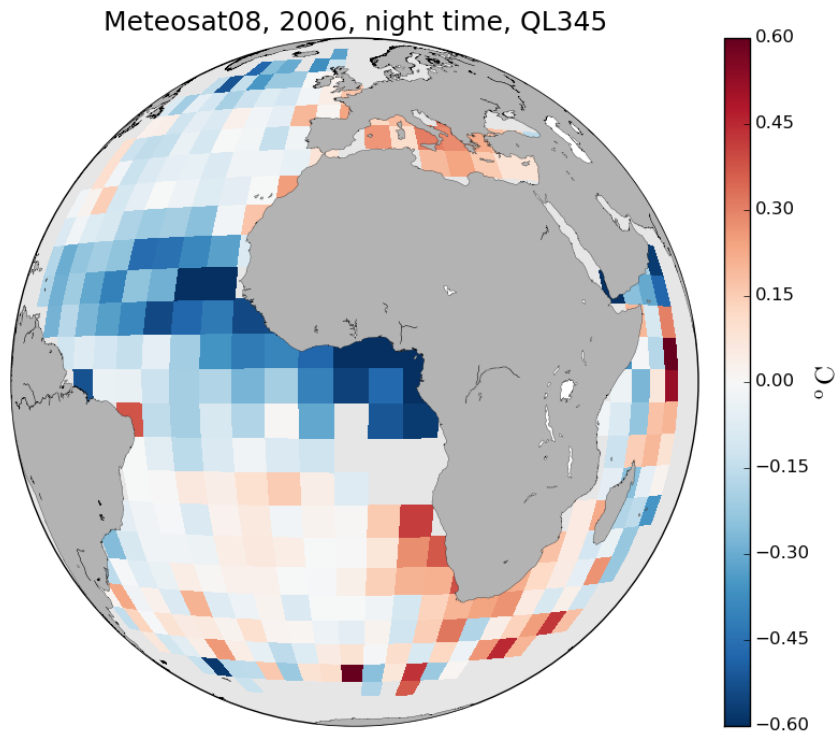
Results: Drifting buoys

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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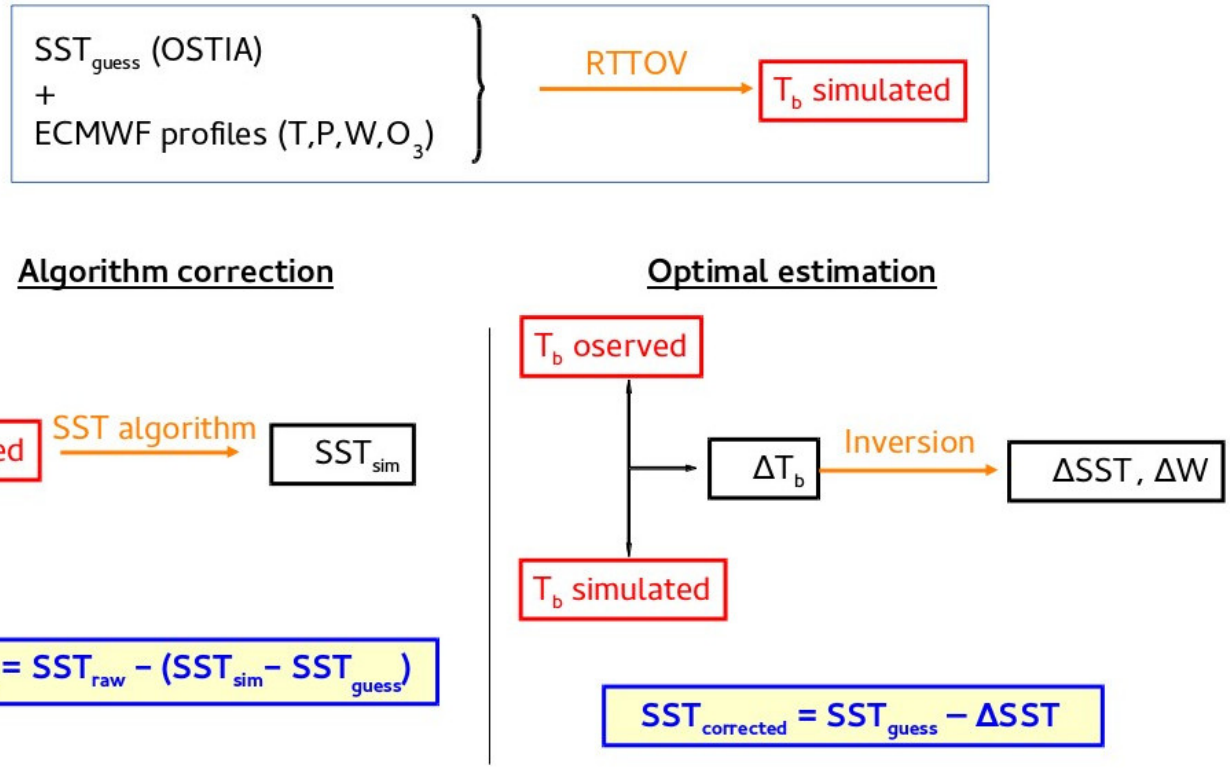
Ongoing activities and plan: bias correction

Two methods to account for regional and seasonal biases:
- Algorithm correction from Le Borgne et al. (2011)
- Optimal Estimation from Merchant et al. (2013)

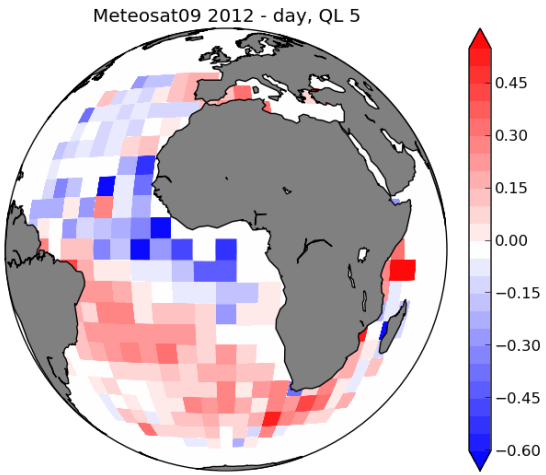
Both methods rely on simulation of brightness temperature simulation using atmospheric profiles from NWP model.



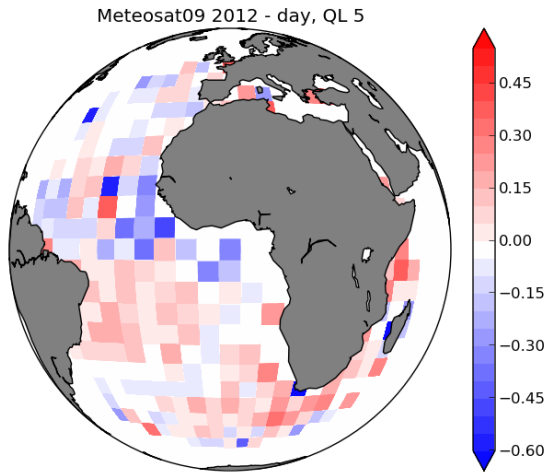
Ongoing activities and plan: bias correction

Preliminary study on the match-up dataset from the operational MSG processing chain.

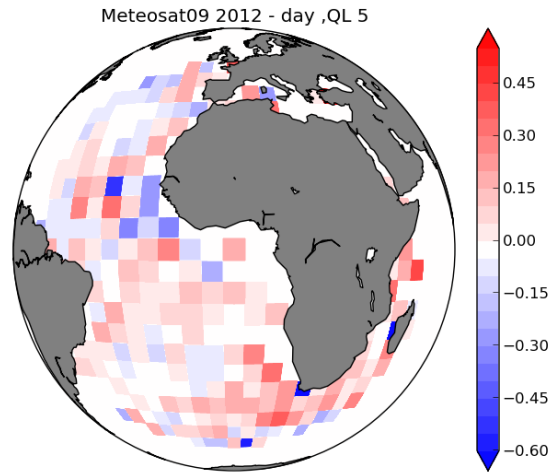
No bias correction



Algorithm correction



Optimal Estimation



- Visible reduction of the regional biases
- Results are similar between OE and algorithm correction
- We are hoping to do better: BT adjustment

Conclusion

- Encouraging results (good quality of the cloud mask).
- Methods for bias correction are effective:
  - It is likely the two methods will be applied.
  - Simulation have been prepared.
- Intermediate work file available on demand (huge).
- Delivery planned for early 2017 after a ORR.