Progress on the OSI-SAF MSG/SEVIRI SST reprocessing

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Introduction

The Eumetsat Ocean and Sea-Ice Satellite Application Facility (OSI-SAF) is in charge of SEVIRI/MSG SST reprocessing from 2004 to 2012 . A new processor based on the current OSI-SAF operational processing chain of SST is being developed. Final produtcs will be hourly SST from -60 to 60 $^\circ$ N and E on a regular 0.05° latitude / longitude grid, derived from Level 1.5 MSG/SEVIRI data reprocessed by EUMETSAT (the main difference is the calibration of infrared channels).
Here, we present the methodologies being developped or improved as part of the implementation of the SST processor for the MSG/SEVIRI archive.

Methods for SST retrieval

OSI-SAF SEVIRI SST is traditionally retrieved from the IR channels at 11 and 12 μm using a non-linear split-window algorithm.
Such algorithms have a limited ability to cope with the variability of atmospheric absorption and emission.In the reprocessing, we envisage two methods to correct for this effect:
1) **The Bias correction** suggested by Le Borgne et al. (2011) using simulation of brightness temperature from radiative transfer model (RTTOV) for each pixel
2) **The Optimal estimation (OE)** suggested by Merchant et al. (2013).

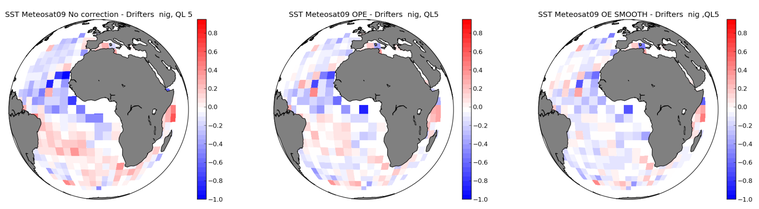
These methods are applied on Meteosat09 dataset in 2012.

Statistics of comparison against drifting buoys quality level 3,4,5 (2012):

method	bias	Std
DAY **Bias corr.**	-0.01	0.53
NIGHT **Bias corr.**	-0.04	0.54
DAY **OE**	-0.00	0.49
NIGHT **OE**	-0.06	0.51

Maps of binned average difference (2012):

No correction Algorithm correction Optimal Estimation

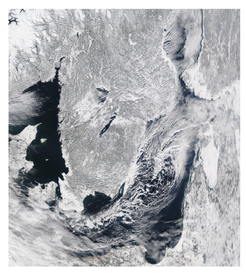


Le Borgne, P., Roquet, H. and Merchant, C. Estimation of Sea Surface Temperature from the Spinning Enhanced Visible and Infrared Imager, improved using numerical weather prediction. *Remote Sensing of Environment*, 2011, 115, 55-65.
Merchant C. J., Le Borgne P., Roquet, H. and Legendre, G. Extended optimal estimation techniques for sea surface temperature from the Spinning Enhanced Visible and Infra-Red Imager (SEVIRI). *Remote Sensing of Environment*, 2013, 131, 287-297.

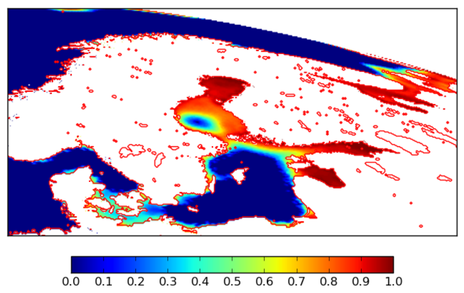
Ice and Cloud mask

The cloud mask is provided by the Climate SAF, based on the NWC SAF v2011 software package.Sea ice information is not available for night time so we use only the OSI-SAF sea ice product available in the OSTIA Sea Surface Temperature and Sea Ice Analysis data as ice fraction with a threshold value of 0.15 to flag the ice indicator.

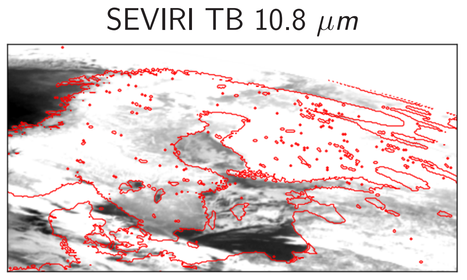
Modis 2006/03/06-10 UTC



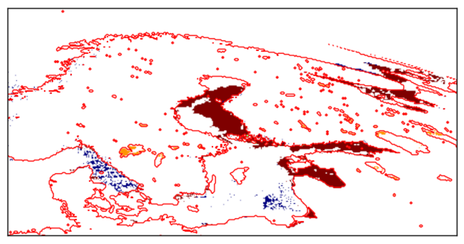
Ice Fraction from OSTIA SST



SEVIRI TB 10.8 μm



MSG Ice indicator

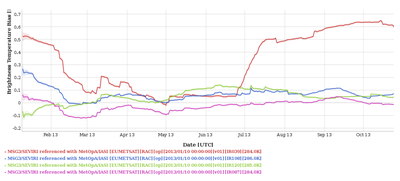


We have no ice information for lakes so we use a threshold on TB10.8μm in night and day to flag ice.

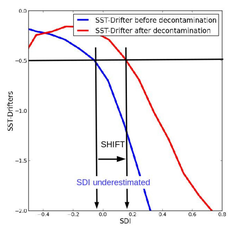
Saharan Dust Index : SDI

Saharan dust has a significant impact on SST calculation. Its detection is implemented to correct SST. The hourly Saharan Dust Index (SDI) is defined on the MSG satellite projection and resolution from 40°S to 50° N only on cloud/ice free sea pixels.
Night time SDI is based on Brightness Temperatures (BT) at 3.9, 8.7, 10.8 and 12.0 μm (C. Merchant et al, 2006).
The BT displacements, when dust is injected, take place along the first Principal Components (PCs) of the distribution of the aerosol free BTs, in theT3.9-T8.7 and T10.8-T12.0 plan.
Night SDI represents the distance to the line defined by the first PCs of the distribution of the aerosol free BTs :
SDI night= S1(T3.9 - T8.7 + Γ1) + $S2(T10.8 - T12 + \Gamma 2) + S3$.
Γ1 and Γ2 are daily correction to avoid decontamination and drift of BTs causing underestimated SDI and correspond to the median of Simu - OBS on global area in night time. Coefficients *Si* are determinated with RTTOV simulations.
For day time, a linear relation permits to calculate an interpolated SDI :
SDI interpolated= DS1.T8.7+ DS2.T10.8+ DS3.T12+ DS4.T13+ DS5
Local weighted regression at 8.7,10.8,12,13 μm on cloud/ice free pixels determine the coefficients (DSi), using the nearest night time SDI values in time and in space for each regression box. SDI is performed with the weighted mean of interpolation boxes.

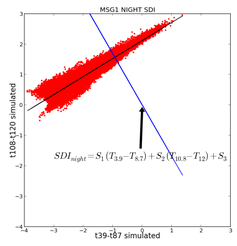
MSG3Seviri−IASI (http://gsics.tools.eumetsat.int)



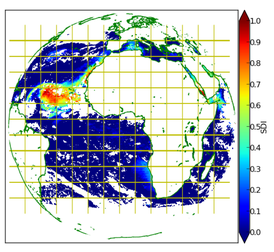
SST Sat-SST drifters vs SDI in 2013 before and after decontamination



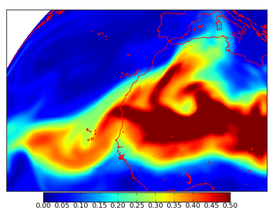
Night SDI determination method



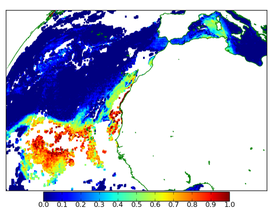
Day SDI 16h UTC + grid of regression box



Dust AOD from Macc - 00h UTC



zoom Night SDI - 00h UTC

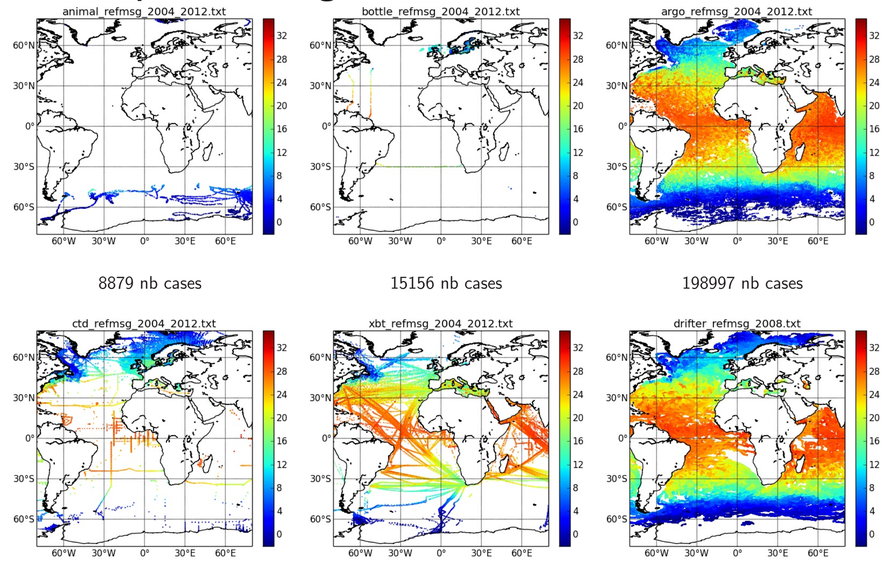


Merchant C. J., Embury O., Le Borgne P., Bellec B. (2006a). Saharan dust in night time thermal imagery: Detection and reduction of the related biases in retrieved sea surface temperature. Remote Sensing of Environment, 106, 15-30, DOI:10.1016/j.rse.2006.03.007.
Merchant C. J. (2006b). Saharan dust and SST bias:A dust index for day time imagery. OSI-SAF Associated/Visiting Scientist Report, February 2006

ERA CLIM in-situ dataset

For SST validation purposes, we will use the ERA CLIM (European Re-Analysis of global CLIMate observations) in-situ dataset provided by UK Met Office.In-situ measurements will collocated with full resolution MSG data to produce comparison statistics. This dataset contains instrumented-animals, Argo floats, CTD (Conductivity Temperature Depht cast), bottle and XBT (eXpendable BathyThermographs), drifter data with quality control. A subset limited to the region 80S-80N and 80W-80E in MSG retrieval period is presented here. Argo floats, CTD, XBT, bottle and instrumented -animals could only be used for night validation because of various depths. Drifters will contribute to night and day validation.

Spatial coverage of ERA CLIM in-situ dataset



8879 nb cases | 15156 nb cases | 198997 nb cases

115037 nb cases | 63199 nb cases | from 1.7 million in 2004 to 6.1 million in 2010

Argo floats ,CTD and XBT datasets with their important number of cases and their good spatial coverage, could complete poor drifters coverage in Mediterranean sea , Tropical Atlantic, Arabian sea and in the Persian Golf.

Atkinson, C.P., N.A. Rayner, J.J. Kennedy, S.A. Good, 2014: An Integrated Database of Ocean Temperature and Salinity Observations. JGR-Oceans, 119, 7139-7163, doi:10.1002/2014JC010053.

Conclusion

- Make more tests on OE and algorithm correction comparison
- Set up algorithm correction with cloud mask control
- Compare MSG SST retrieved with ERA CLIM *in-situ* data

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