OSI-SAF SST VALIDATION AT THE MET OFFICE

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ABSTRACT

The OSI-SAF merged Atlantic Sea Surface Temperature (SST) Product has been received and archived in the Met Office's Meteorological Database (MetDB) since June 2002 in GRIB format. Work is underway to routinely include these observations within our Observation Processing System (OPS) and then validate against 'pseudo' bulk SSTs derived at 1/6 degree spatial resolution from AATSR (Advanced Along Track Scanning Radiometer) onboard ENVISAT. Eventually we plan to include the OSI-SAF merged Atlantic Product within our operational North Atlantic European model SST analysis and any future global product within our global model SST analysis.

1. Introduction

Currently the high-resolution satellite data used within the Met Offices operational North Atlantic European model SST analysis are SSTs derived from locally received AVHRR data. These are received at 1km resolution and then averaged to a 5km grid. An example of these SSTs for the 6th March 2005 are shown in figure 1.

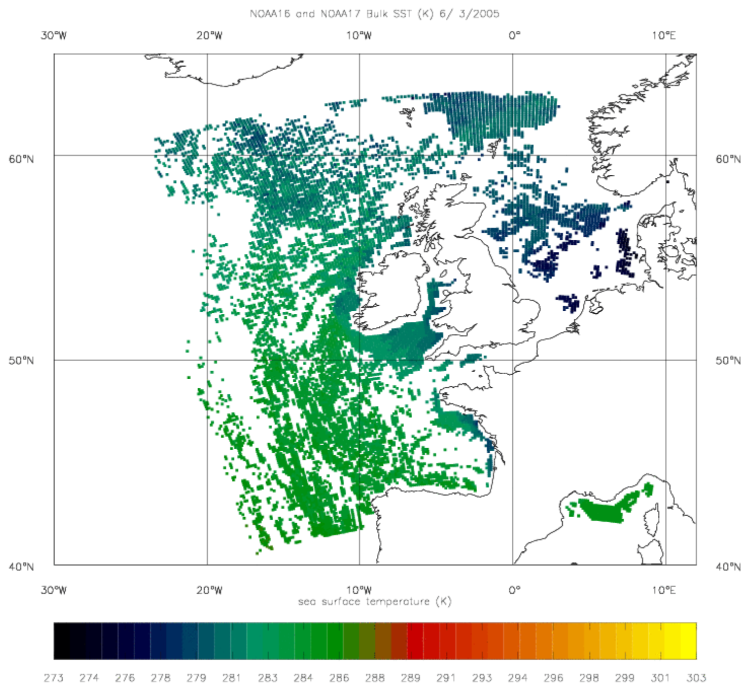

Figure 1. Sea-surface temperatures derived from AVHRR data for use in the Met Office's North Atlantic European SST analysis.

These SSTs derived from locally received AVHRR data will eventually be replaced by the OSI-SAF MAP SST product. Work is underway to routinely include these MAP

SSTs within the Met Office's OPS system and then validate against AATSR bulk SST observations, before implementation of the MAP SSTs within the SST analysis resumes.

2. Description of data

2.1 Ocean and Sea-Ice SAF Merged Atlantic Product (MAP) SST

The OSI-SAF SST MAP product has been received and archived in the MetDB at the Met Office since June 2002 in GRIB format. The satellites contributing to SSTs in the product are GOES-E, MSG, and NOAA-16/17. The frequency of the product is 12 hourly (at 00 and 12 UTC) and the spatial resolution is 0.1 degrees. The MAP region covers 60ºS to 60ºN and 45ºE to 100ºW. An example of the product, downloaded from the OSI-SAF website, is shown in figure 2.

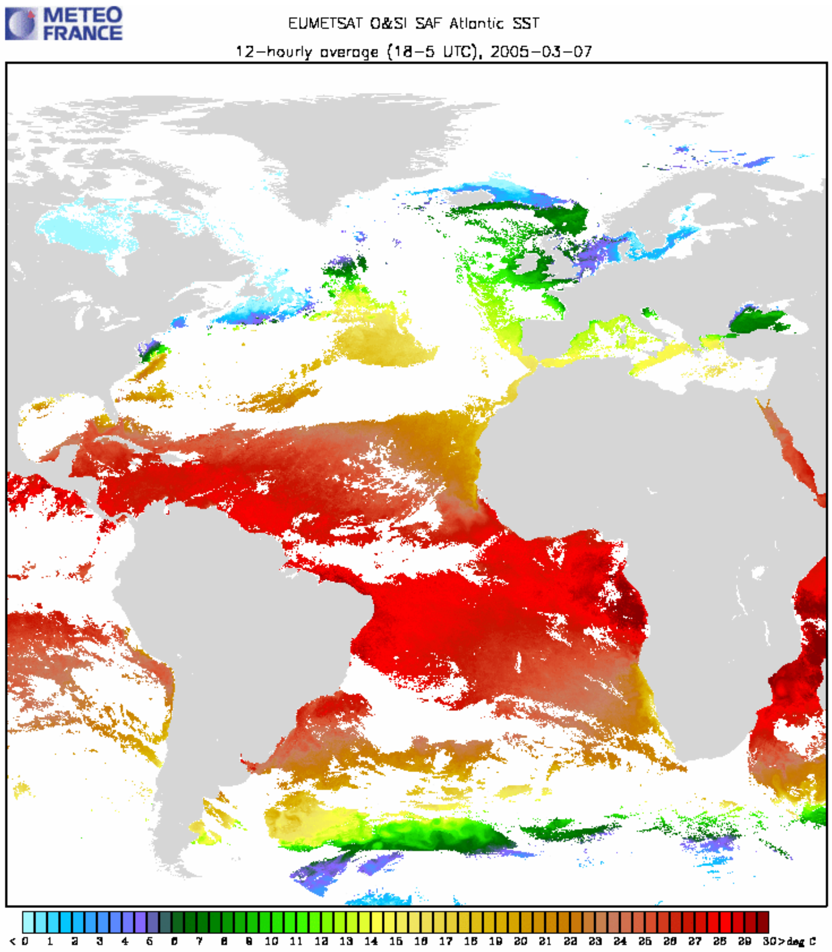

Figure 2. Example of OSI-SAF MAP SST product for 7th March 2005.

2.2 Advanced Along-Track Scanning Radiometer (AATSR)

The AATSR instrument upon the ENVISAT satellite aims to observe skin SST to within 0.3K accuracy in order to continue the collection of SST data begun by the ATSR-1 and ATSR-2 instruments upon the ERS 1 and 2 satellites since 1991. The instruments are designed to provide the high quality SST retrievals needed for climate monitoring.

AATSR provides SST retrievals which are dual-view, as shown in figure 3, enabling high quality SSTs to be derived. The instrument provides high-resolution retrievals, having a 1km spatial resolution at nadir. Since August 2002, the Met Office has received averaged AATSR brightness temperatures at 1/6 degree spatial resolution in near-real time. These have been processed to dual-view skin SSTs, using ESA supplied retrieval coefficients. Two types of dual-view retrieval are possible: those using the 11µm and 12µm brightness temperatures (hereafter known as D2 SST retrievals), and those using the additional 3.7µm channel during the night only (hereafter known as D3 SST retrievals).

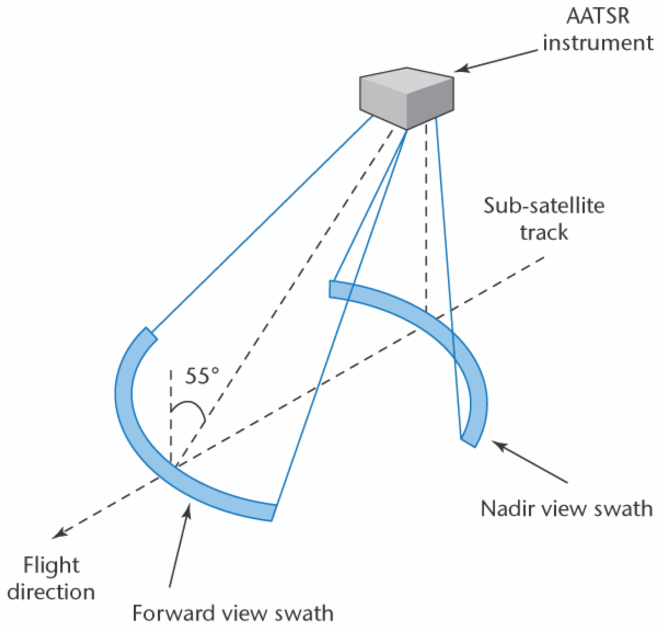

Figure 3. Diagram of the dual and nadir view retrievals possible from AATSR.

The AATSR dual-view skin SSTs are then passed through a processing scheme at the Met Office in order to produce a bulk SST, which is defined to be the temperature of the ocean at around 1 metre in depth. This is done using the Fairall model (Fairall et. al., 1996) to model the skin effect and is necessary because the satellite observes a radiative skin temperature which is most frequently cooler than the sub-skin by more than 0.1K. For obtaining SST for climate purposes we require an estimate of the bulk temperature which provides a more comparable measurement when looking at other climate datasets, and is more representative of the overall heat capacity of the ocean. Additionally a diurnal thermocline model is run (Kantha & Clayson, 1994) to try to predict occurrences of surface warmings during the day within each 1/6 degree observation cell. A diagram describing the processing scheme at the Met Office is shown in figure 4. Further details of the processing scheme at the Met Office and AATSR validation results are given in O’Carroll et. al, 2004.

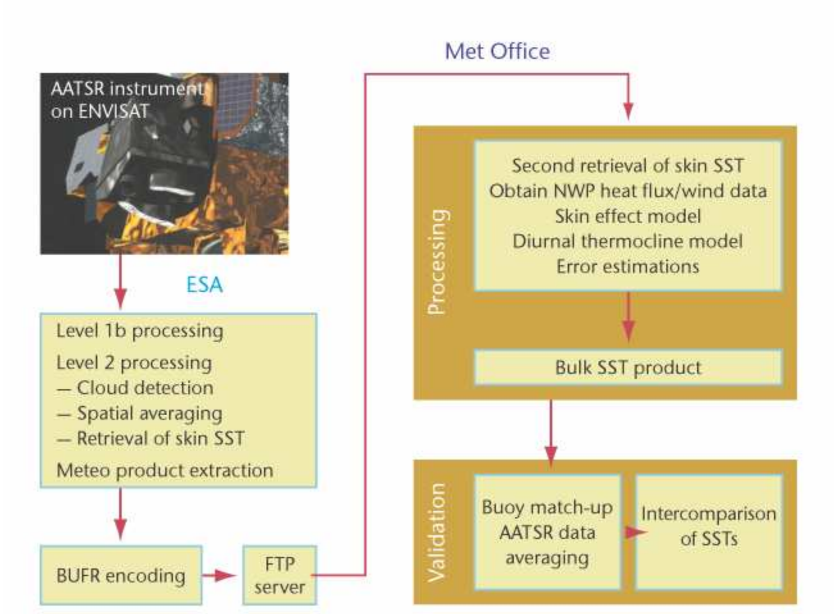

Figure 4. Processing of AATSR brightness temperatures to a bulk SST.

An example of the AATSR skin SST, averaged over a month at 1 degree resolution is shown in figure 5.

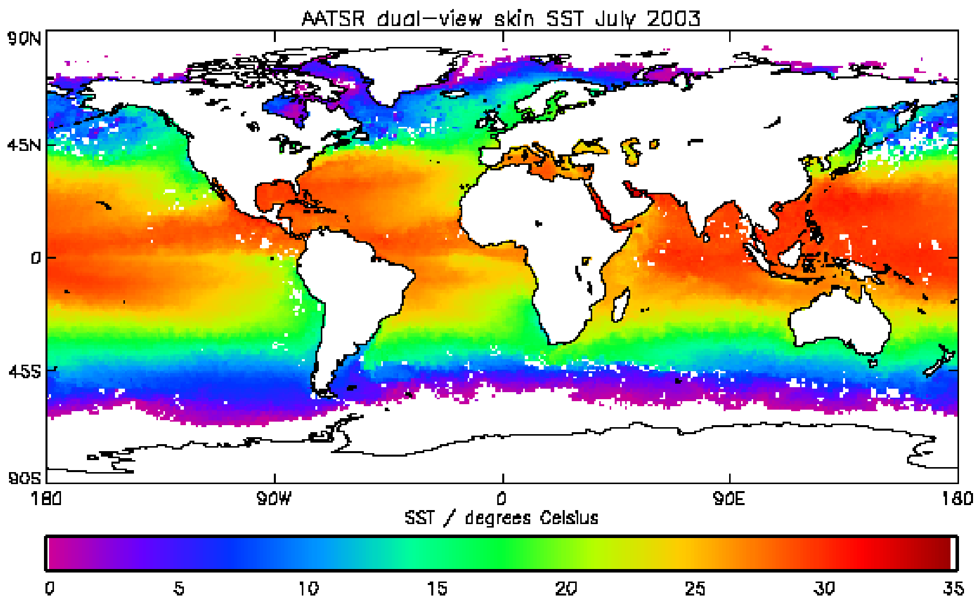

Figure 5. AATSR dual-view skin SST July 2003

3. AATSR validation results

From August 2002, AATSR skin and bulk SST observations have been routinely compared to drifting and moored buoy SST observations, downloaded from the Global Telecommunications System (GTS), on a weekly basis. An AATSR/buoy matchup database has been collated which is a collection of 79 different fields detailing the buoy observations, AATSR observations, and atmospheric conditions from Met Office Numerical Weather Prediction (NWP) model analyses. The matchup criteria are that the buoy observation needs to be within a 10 arc minute AATSR grid cell, and the observations need to have been taken within 3 hours of each other. In the event that 2 buoys SSTs are matched up to the same AATSR observation, the buoy observation closest in time to the AATSR observation is chosen. Figure 6 shows the distribution of AATSR/buoy matchups over one year period from April 2003 to March 2004. Approximately 16000 matchups were collected over this period.

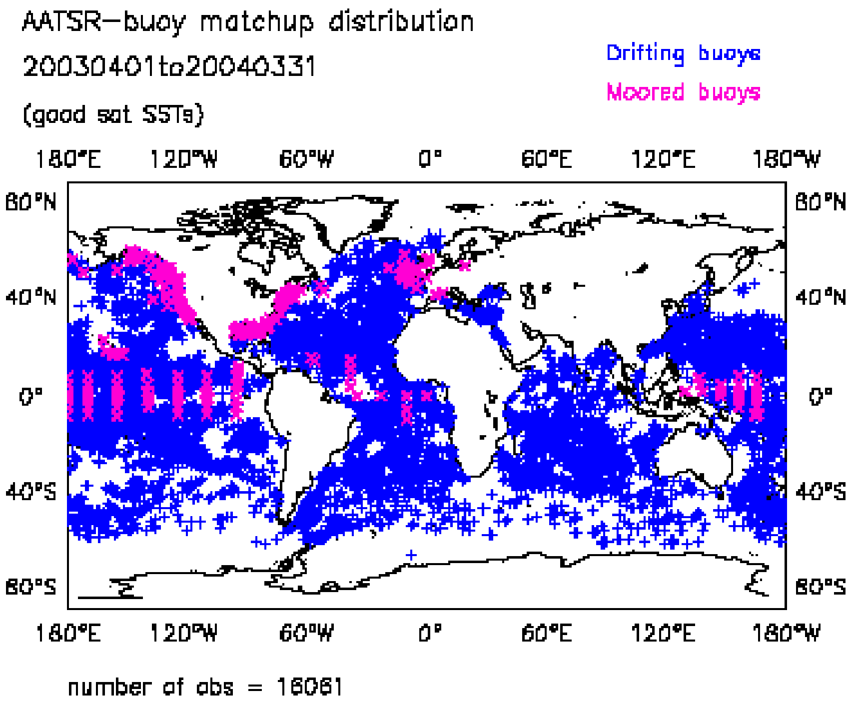

Figure 6. Distribution of AATSR/buoy matchups, from April 2003 to March 2004.

Figure 7 shows a time-series of AATSR skin (pink) and bulk (blue) SSTs minus buoy SSTs from August 2002 to December 2004. The results show that the buoy SSTs are closer to AATSR skin SSTs than they are to bulk SSTs, indicating a bias between the AATSR bulk SSTs and the buoy (bulk) SSTs. The daily mean differences of AATSR SSTs with buoy SSTs throughout the year are less than 0.5K, where the majority are less than 0.3K. Table 1 show the statistics (using an initial 3 sigma standard deviation test to screen out outliers) of AATSR skin and bulk SSTs minus buoy SSTs for the period. For these comparisons D3 SSTs during the night-time and D2 SSTs during the day-time are used. The results display how a cool skin with respect to buoy SSTs are not observed at night, which leads to the conclusion that the night-time (3-channel) SST retrievals are too warm.

	Mean difference (satellite – buoy) K	**Standard deviation**
Skin		
Day and night	0.03	0.30
Night	0.06	0.27
Day	-0.01	0.33
Bulk:		
Day and night	0.19	0.30
Night	0.22	0.26
Day	0.15	0.43

Table 6. Statistics of differences between AATSR SSTs and buoy SSTs from 1st April 2003 to 31st March 2004.

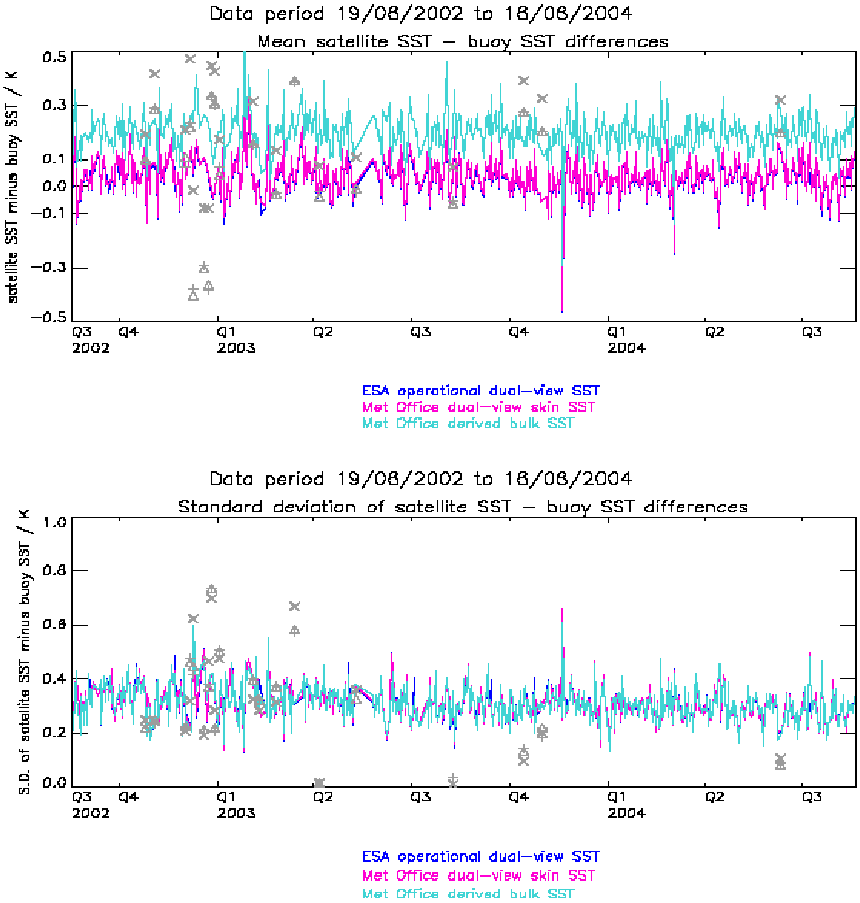

Figure 7. Timeseries of weekly mean AATSR minus buoy SSTs from August 2002 to December 2004.

AATSR SSTs have also been compared to the Hadley Centre Sea-Ice and Sea Surface temperature analysis (HadISST), which is a monthly mean SST analysis gridded at 1° spatial resolution. HadISST includes a combination of in situ data from ships and buoys, as well as satellite SSTs currently from the Advance Very High Resolution Radiometer (AVHRR) upon the NOAA satellites. Further information on HadISST can be found in Rayner et. al, 2003. Figure 8 shows a global difference map between night-time AATSR SSTs and HadISST1 for April 2003. Generally the differences are less than 0.5K, although in the South Atlantic and North Pacific AATSR is cooler than HadISST. Impact studies on the use of AATSR in HadISST, rather than AVHRR, has shown that significant improvements are made with the use of the dual-view sensor, especially over regions affects by aerosol and marine stratiform cloud. Overall, for the period 1st April 2003 to 31st March 2004, the night-time mean difference between AATSR bulk SST minus HadISST1 is 0.12K, with a standard deviation of 0.62K, again perhaps reinforcing the conclusion that the night-time AATSR D3 SST are slightly too warm.

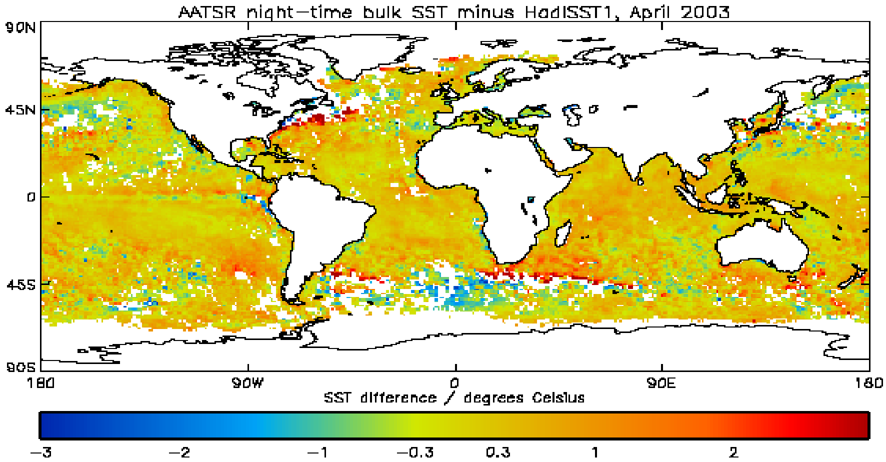

Figure 8. Global map of night-time AATSR bulk SST minus HadISST April 2003.

4. Conclusions and future work

These results show that the AATSR SST retrievals are of a very high quality. In addition the biases with respect to in situ, and other SST analyses are well understood. Therefore, AATSR SSTs provide an ideal validation source for the comparison of the OSI-SAF SSTs.

The OSI-SAF merged Atlantic SST product is already stored at the Met Office in the Meteorological database (MetDB) in GRIB format. Work is currently underway to routinely include these observations within out Observation Processing System (OPS), and to validate against AATSR bulk SSTs on a daily basis.

Eventually it is planned that the OSI-SAF MAP SST product will be used in the Met Offices operational North Atlantic European model SST analysis. Plans are in place to include any future global OSI-SAF SST produce within our global SST analysis.

5. Acknowledgments

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6. References

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