The Need for Mission Overlap in Creating Climate Data Records: Lessons Learned from Analyses of the ATSR Series

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1. ABSTRACT

Sea Surface Temperature (SST) is an Essential Climate Variable (ECV) of the Global Climate Observing System (GCOS) [1,2] and the Along-Track Scanning Radiometer (ATSR) SST record is defined as a Fundamental Climate Data Record (FCDR) within the GCOS implementation plan [3]. One of the GCOS Climate Monitoring Principles (GCMP) [3] for satellite data records is the requirement to have a suitable period of overlap in order to determine inter-satellite biases and maintain the homogeneity and consistency of the entire series of observations.

The Advanced Along-Track Scanning Radiometer (AATSR) was launched on ENVISAT in March 2002. The AATSR instrument is designed to retrieve precise and accurate global SST that, combined with the large data set collected from its predecessors, ATSR-1 and ATSR-2, will provide a long term record of SST data that is greater than 17 years. Indeed, the ATSR series of instruments provide an excellent example of adherence to the GCMP, and a homogenous consistent time series of SST data is obtained by having a minimum 6 month overlap between successive instruments.

The AATSR instrument [4] has a Mean Local Solar Time (MLST) in the descending node of 10:00 am, with the ATSR-2 instrument on ERS-2 following 30 minutes later at 10:30 am. For the purposes of the comparison, it is assumed that geophysical conditions are consistent and have not changed during the 30 minutes. However, unlike the situation for the overlap between AATSR and ATSR-2, analysis of the overlap between ATSR-2 and ATSR-1 is not as trivial owing to the fact that although ATSR-2 and ATSR-1 have the same MLST, their ground-tracks are 1 day apart.

Furthermore, AATSR is expected to operate until 2013 at the latest. Unfortunately, the ATSR follow-on instrument on the ESA Sentinel 3 satellite is not expected to fly before 2014 and so there will be an enforced break in the ATSR climate record. Moreover, the break will mean that an overlap between AATSR and Sentinel 3 will not be possible, thereby violating the GCMP. This raises two fundamental SST data continuity questions:

1. How can the calibration of the ATSR dataset record be transferred to Sentinel 3 if there is a gap?

2. How might the data gap between the two missions be filled using alternative SST data with the minimum loss of quality?

The former is by far the most critical issue, as climate scientists need to be assured that there are no biases between aatsr and sentinel 3 and that any observed change in temperature is real.

This presentation summarises key results from the analysis of two six-month long overlap periods in the ATSR data record, namely the overlap of ATSR-1 and ATSR-2 from July 1995 to December 1995, and the overlap of ATSR-2 and AATSR from January 2003 to June 2003. The presentation will demonstrate how quality controlled consistent time series of SST observations require rigorous analysis of overlap periods within a time series, using African waters as an example. The presentation will also show how consistent performance between AATSR and Sentinel 3 can be demonstrated in the event of no data overlap between sensors.

2. REFERENCES

[1] Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC, GCOS-82, WMO/TD No. 1143 and its Technical Annexes, April 2003.

[2] Implementation plan for the Global Observing System for Climate in Support of the UNFCCC, GCOS-92WMO/TD No. 1219, October 2004.

[3] Systematic Observation Requirements for Satellite-based Products for climate: Supplement details to the satellite-based component of the "Implementation plan for the Global Observing System for Climate in Support of the UNFCCC, GCOS-92", GCOS-107, WMO/TD No. 1338, September 2006.

[4] Llewellyn-Jones, D.T., M.C. Edwards, C.T. Mutlow, A.R. Birks, I.J. Barton and H. Tait, AATSR: Global-Change and surface-Temperature Measurements from Envisat, ESA Bulletin, 105, 10-21, 2001.