PRODUCTION AND PRELIMINARY EVALUATION OF OPERATIONAL SST AND AEROSOL PRODUCTS FROM NOAA-18 AVHRR/3

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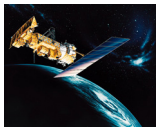
Introduction

N18 was launched in May 2005 into an *afternoon* orbit (~2PM), to replace N16 which was in operation since September 2000. N18 joined the *mid-morning* N17 (~10AM), to form the new operational NOAA constellation. Upon testing the AVHRR/3 instrument onboard N18, NESDIS started generating two N18 operational products over ocean, Sea Surface Temperature (SST) and Aerosol Optical Depth (AOD).

Objectives

Document operational SST and AOD products from N18, validate against buoy SST, and evaluate N18 products for self-consistency and cross-consistency with the respective N16 and N17 products.



Data

- N18 SST and Aerosol Observations (SST/AEROBS) 8-km data
- For analyses, 8-km data averaged into 1day×(1°)^2 grids
- SSTOBS: Day ("Type=151") and Night ("Type=152") retrievals
- Full scan within view zenith angle -54° (solar) < θ < 54° (anti-solar)
- Subtract climate SST (Bauer-Robinson 1985) to calculate anomaly
- AEROBS: Day/Anti-solar side of orbit/Outside 40° cone glint angle
- 8 days of global data (1-9 January 2006)

SST Algorithm

Physical-Statistical: (Form of equations derived using RTM/physical considerations; parameters tuned empirically against buoy SSTs.)

Daytime: $T_s = \alpha_1 T_{11} + \gamma(T_{11} - T_{12}) + \alpha_o$ *where* $\gamma = \gamma_o(T_c) + \gamma_1(\sec\theta - 1)$

Nighttime: $T_s = \alpha_1 T_{3.7} + \alpha_2 T_{11} + \alpha_3 T_{12} + \alpha_4\left(T_{3.7} - T_{12}\right)\times(\sec\theta - 1) + \alpha_5(\sec\theta - 1) + \alpha_o$

Aerosol Algorithm

Physical: Measured reflectances compared with RTM look-up-tables.

NESDIS Main Unit Task System

SST and AOD retrievals are done within the common Main Unit Task (MUT) processor which handles navigation, calibration, cloud screening, and preliminary quality control of radiances. The MUT system was set up at NESDIS in the early 1980s and remained largely unchanged in its overall structure and functionality. Output of the MUT system are two retrieval files: the SST Observations (SSTOBS) and Aerosol Observations (AEROBS) files, which share much in common. The two products reside on the NESDIS Central Environmental Monitoring Satellite Computer System (CEMSCS) as rotated files, one per product and platform. Each file contains all global SST and AOD retrievals, respectively, during the last 8 days. The files are renewed automatically 4 times a day around 0100, 0700, 1300, and 1800 EST. In this study, we use 3 AEROBS and 3 SSTOBS files from N16, 17 and 18.

Derivation of N18 SST coefficients

AVHRR brightness temperatures are continuously merged with drifting and TOGA/TAO moored buoys closes in space and time but not to exceed 25 km and 4 hours, respectively. The match-up dataset collected in June 2005 was used to train the coefficients of the daytime ("Type=151") and nighttime ("Type=152") SST algorithms. The respective training statistics are shown below

$T_s = a_o + a_1 T_{11} + a_2 T_{sat}(T_{11} - T_{12}) + a_3(T_{11} - T_{12})(\sec\theta - 1)$

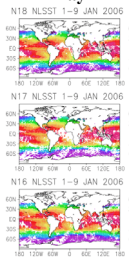
$a_o =$	-251.308	$a_2 =$	0.934804
$a_1 =$	0.0724457	$a_3 =$	0.748044
$R^2 =$	0.989418	N of Obs:	3120
Recalculated SST Bias:		$1.71264\cdot10^{-5}$ K	
Recalculated SST STD:		0.467033 K	
N of bad match-ups (outside 4K):		0	

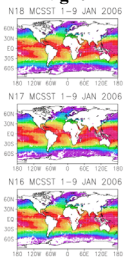
$T_s = a_o + a_1 T_{3.7} + a_2 T_{11} + a_3 T_{12} + a_4(T_{3.7} - T_{12})(\sec\theta - 1) + a_5(\sec\theta - 1)$

$a_o =$	-274.686	$a_3 =$	1.08356
$a_1 =$	0.46757	$a_4 =$	-0.543265
$a_2 =$	0.137627	$a_5 =$	1.12622
$R^2 =$	0.98993	N of Obs:	4710
Recalculated SST Bias:		0.0180887 K	
Recalculated SST STD:		0.474232 K	
N of bad match-ups (outside 4K):		14	

SST Products

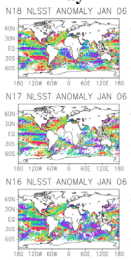
Day Night

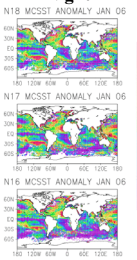




SST Anomalies

Day Night



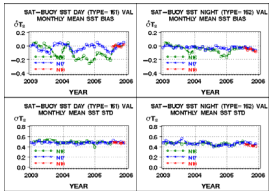


Daytime coverage is less complete than nighttime. Work is underway to improve.

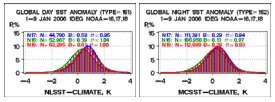
Validation

SST match-up datasets are continuously updated and used to estimate accuracy of AVHRR SST. Time series of monthly validation statistics show that typically, bias is within ±0.1K and RMSD within 0.5K. N16 SST anomalies are presumably related to its AVHRR sensor anomalies. (Note that a non-uniform performance of the N16 AVHHR was one of the major reasons for replacing N16 with N18.)

Day Night



Day Night

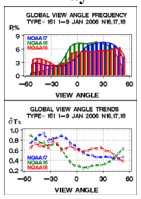


SST Consistency Checks

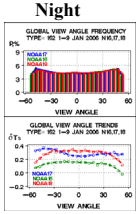
Global histograms of SST anomalies are close to Gaussian. N17 and N18 SST products are highly consistent: both show warm bias +0.6K during daytime, +0.3K during nighttime. N16 (currently in back-up mode) is biased cold.

SST Consistency Checks (Continued)

Day Night

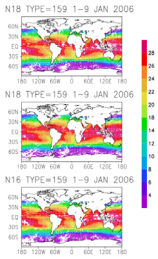


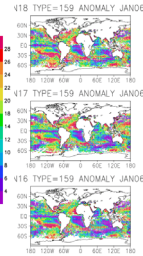
View angle depen-dence in MC/NLSST algorithms is treated empirically. At night, coverage is uniform, SST amplitude ~0.2K. Day: coverage non-uniform due to glint and SST amplitude is ~0.4K. Improvements are underway.



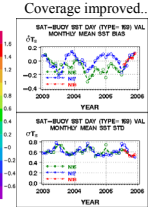
Work in progress: Daytime coverage

During daytime, coverage by "Type=151" is sparse. Relaxing visible threshold is being considered to improve coverage (experimental "Type=159"). Preliminary results are shown below.



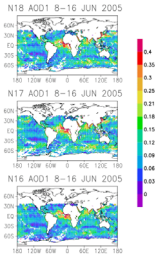


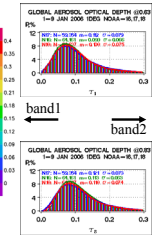
Coverage improved..

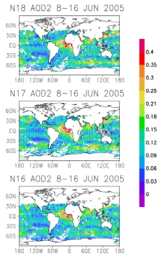


..but validates worse. Working to resolve.

Aerosol

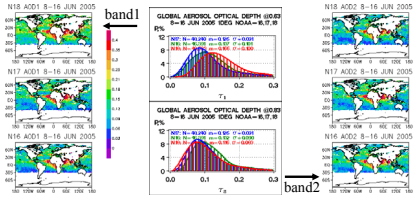






AOD shows excellent consistency across 3 platforms, in both bands. Single-channel AOD is a sensitive indicator of AVHRR radiometric performance. Cal in 2 VIS bands on 3 platforms are consistent within 1-2%.

Aerosol 6 months earlier..



In June 2005, AODs showed significant differences across 3 NOAA platforms, in both bands. Estimates show that AVHRR visible calibration was inconsistent up to 5-10% between 3 platforms. AVHRR VIS calibration has dramatically improved over the last half-year, for all three platforms.

Conclusion

SSTs and AOD products from 2 operational platforms, N17 and new N18, are highly inter-consistent. SST from N16 is biased low by 0.15-0.20K, probably due to continuing problems with its AVHRR sensor. N16 AOD compares well with N17 and N18 AODs.

Plans

The MUT processor and SST algorithm are currently undergoing a careful reevaluation and redesign, in preparation for METOP 1-km global AVHRR resolution data (planned launch date is June 2006). CLAVR-x is explored as a front end. Comprehensive consistency checks of the SST/AOD products will be performed in near-real time and results published on the web.

Literature

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Acknowledgments

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