Validation of the NASA GEWEX-SRB Radiation Data over the Tropical Oceans: Comparisons with PIRATA, RAMA, TAO and WHOI Buoy Observations

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Paper No.: A43B-0251

AGU 2013 Fall Meeting

Introduction

The NASA GEWEX SRB (Global Energy and Water Exchanges, Surface Radiation Budget) project produces and archives shortwave and longwave radiation budget flux estimates at the top of the atmosphere and at the Earth's surface. The latest version in the archive, Release 3.0, is available as 3-hourly, 3-hourly-monthly, daily and monthly means continuously over the period from July 1983 to December 2007 on a quasi-equal-area grid system of 44016 grid boxes. SRB Release 4 with further improvements in data quality and higher spatial resolution is being developed.

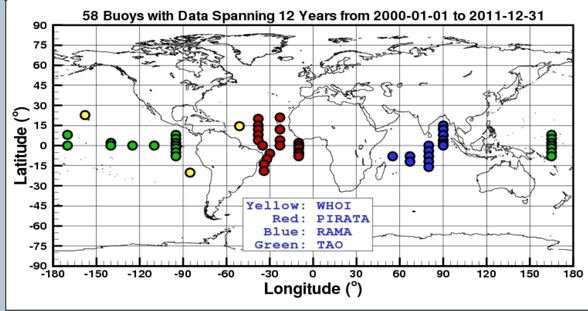
The SRB shortwave/longwave fluxes at the Earth's surface from the algorithm GSW(V3.0)/GLW(V3.1) have been extensively validated against high-quality ground-based observations, in particular observed data from the Baseline Surface Radiation Network (BSRN). Comparisons with nearly 6000 site-months of both shortwave and longwave data from 52 BSRN sites show generally good agreement. In addition, the GEWEX SRB data have also been found to compare favorably with the World Radiation Data Centre (WRDC) data and the Global Energy Balance Archive (GEBA) data.

In spite of the fact that the BSRN sites are scattered on all seven continents, the validation of the SRB data over the vast oceans had not been done until recently. In this paper, we present comparisons of the GEWEX-SRB data shortwave/longwave data with observations made on arrays moored in tropical oceans. Specifically, we have data from 21 buoys, or moorings, from Prediction and Research Moored Array in the Atlantic (PIRATA), 14 buoys from the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) in the Indian Ocean, 20 buoys from the Tropical Atmosphere Ocean (TAO) array in the Pacific, and 3 buoys from the Woods Hole Oceanographic Institute (WHOI) (2 in the Pacific and 1 in the Atlantic). The data from these buoys span 12 years from 2000 to 2011, though not necessarily continuously.

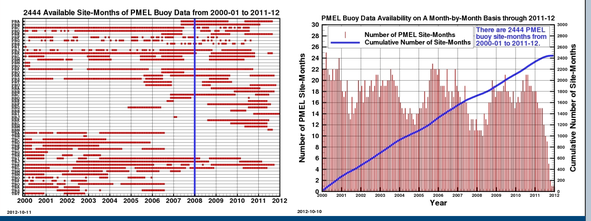
It is found that except for occasional outliers, the majority of the comparable pairs of data points agree well. For instance, the bias/RMS from 1644 monthly mean data points is 11.1/19.0 W m^{-2}. Further examination of the outliers is necessary to determine whether they can be attributed to wind-driven tilt and/or aerosol accumulation on the instruments.

In order to see how the ocean-based validation compares with land-based validation, we made SRB-BSRN monthly mean shortwave/longwave radiation comparisons in the tropical region only, where all the buoys are moored. The results show that in the case of shortwave radiation, the bias error from the ocean-based validation is somewhat larger than its land-based counterpart, but their RMS errors are not significantly different. In the case of longwave radiation, the ocean-based and land-based validations show nearly identical comparison statistics

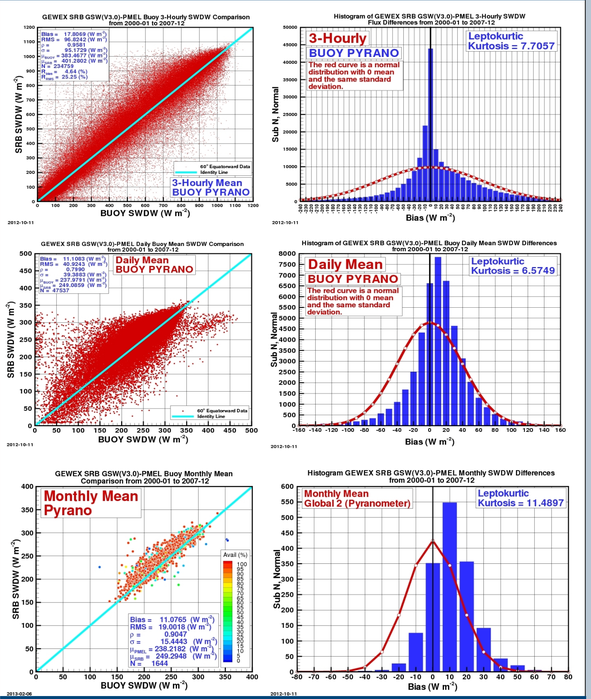
The Buoys in the Tropical Oceans



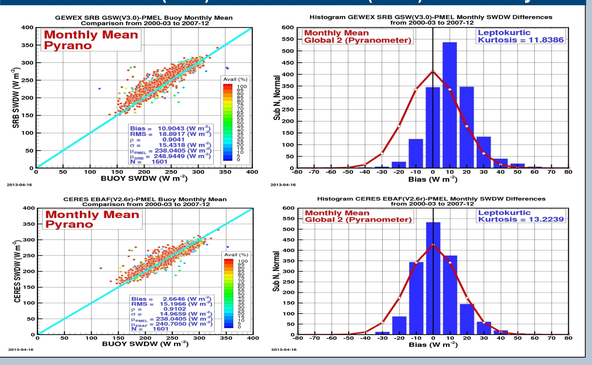
Site-Month Availability from the Buoys in the Tropical Oceans



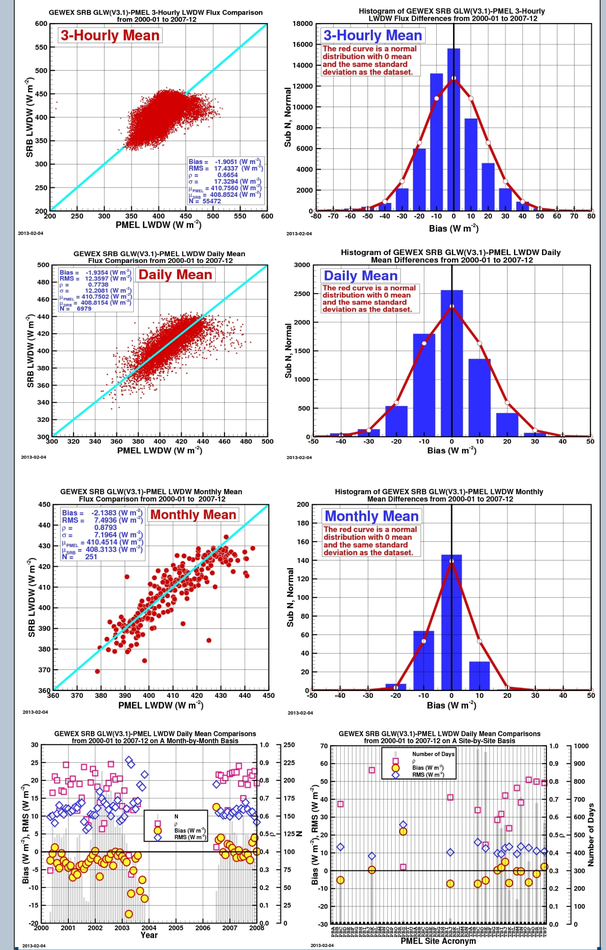
GEWEX-SRB SW (V3.0) Data Validation against the Buoy Data



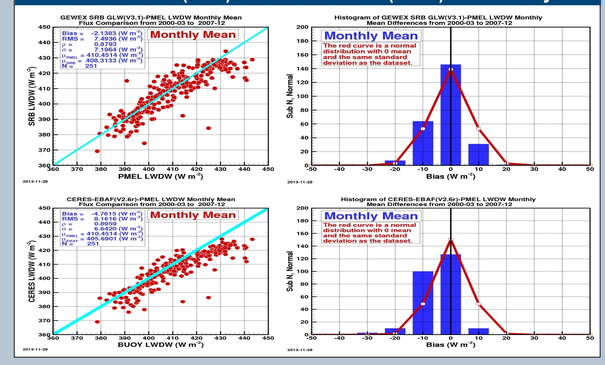
GEWEX-SRB(V3.0) vs. CERES-EBAF(V2.6r) SW Monthly



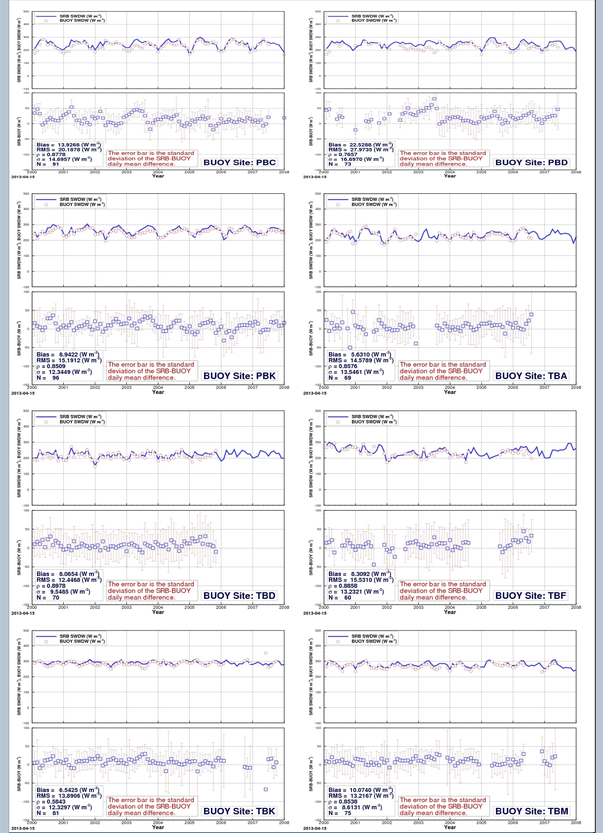
GEWEX-SRB LW (V3.1) Data Validation against the Buoy Data



GEWEX-SRB(V3.1) vs. CERES-EBAF(V2.6r) LW Monthly



GEWEX-SRB SW (V3.0)-BUOY Monthly Mean Time Series



Summary and Conclusions

- The PMEL (Pacific Marine Environmental Laboratory) data used in this study consist of 2444 buoy-months from 21 buoys of PIRATA , 14 of RAMA and 20 of TAO, spanning 12 years from 2000 to 2011;
- The GEWEX-SRB(V3.0)-PMEL 3-hourly, daily and monthly mean shortwave flux comparisons from January 2000 to December 2007 show bias/RMS of , respectively, 17.8/96.8, 11.1/40.9 and 11.1/19.0 W m^{-2}. And the longwave counterparts of these statistics are, respectively, -1.9/17.4, -1.9/12.4 and -2.1/7.4 W m^{-2};
- Over the period from March 2000 to December 2007, the GEWEX-SRB(V3.0)-PMEL monthly mean shortwave and longwave flux comparisons show bias/RMS of 10.9/18.9 and -2.1/7.4 W m^{-2}, while its CERES-EBAF(V2.6r)-PMEL counterparts show bias/RMS of 2.6/15.2 and -4.7/8.1 W m^{-2};
- The GEWEX-SRB(V3.0)-BSRN monthly mean shortwave flux comparison of 786 site-months of data from all BSRN sites 24° equatorward (the latitudinal range of PMEL buoys) shows bias/RMS of 3.3/18.4 W m^{-2}. This appears to indicate that ocean- and land-based observations of shortwave fluxes show roughly the same level of uncertainties. Further investigation is needed to determine whether or not they differ systematically.

References

[1] Bourles, B., et al., 2008. THE PIRATA PROGRAM: History, Accomplishments, and Future Directions. BAMS, August 2008, 1111-1125.

[2] McPhaden, M.J., et al., 2009. RAMA: The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction. BAMS, April, 2009, 459-480.

[3] McPhaden, M.J., et al., 1998. The Tropical Ocean-Global Atmosphere observing system: A decade of progress. JGR, 103(C7), 14,169-14,240.

[4] Medovaya, M. and Waliser, D.E., 2002. Assessing ocean buoy shortwave observations using clear-sky model calculations. JGR, 107(C2), 3014, 10.1029/2000JC000558.

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