Validation of JAXA/MODIS Sea Surface Temperature in Water around Taiwan Using the Terra and Aqua Satellites

Ming-An Lee[1,2], Mu-Tun Tzeng[1], Kohtaro Hosoda[3], Futoki Sakaida[3], Hiroshi Kawamura[3], Wei-Juan Shieh[2], Yih Yang[2], and Yi Chang[1,*]

[1] Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, Keelung, Taiwan, ROC
[2] Taiwan Ocean Research Institute, National Applied Research Laboratories, Taipei, Taiwan, ROC
[3] Ocean Environment Group, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University, Miyagi, Japan 980-8578

ABSTRACT

The research vessel-based Conductivity Temperature Depth profiler (CTD) provides underwater measurements of the bulk sea surface temperature (SST) at the depths of shallower than 5 m. The CTD observations of the seas around Taiwan provide useful data for comparison with SST of MODIS (Moderate Resolution Imaging Spectroradiometers) aboard Aqua and Terra satellites archived by JAXA (Japan Aerospace Exploration Agency). We produce a high-resolution (1 km) MODIS SST by using Multi-Channel SST (MCSST) algorithm. There were 1516 cloud-free match-up data pairs of MODIS SST and in situ measurements during the period from 2003 - 2005. The difference of the root mean square error (RMSE) of satellite observations from each platform during the day and at night was: 0.88°C in Aqua daytime, 0.71°C in Aqua nighttime, 0.71°C in Terra daytime, and 0.60°C in Terra nighttime. The total analysis of MODIS-derived SST shows good agreement with a bias of 0.03°C and RMSE of 0.75°C. The analyses indicate that the bias of Aqua daytime was always positive throughout the year and the large RMSE should be attributed to the large positive bias (0.45°C) under diurnal warming. It was also found that the bias of Terra daytime was usually negative with a mean bias of -0.41°C; its large RMSE should be treated with care because of low solar radiation in the morning.

Key word: SST, Taiwan, MODIS, Satellite observation

Citation: Lee, M. A., M. T. Tzeng, K. Hosoda, F. Sakaida, H. Kawamura, W. J. Shieh, Y. Yang, and Y. Chang, 2010: Validation of JAXA/MODIS sea surface temperature in water around Taiwan using the Terra and Aqua satellites. Terr. Atmos. Ocean. Sci., 21, 727-736, doi: 10.3319/TAO.2009.09.07.01(Oc)

1. INTRODUCTION

With the launch of technologically advanced and innovative satellite instruments like AVHRR (Advanced Vary High Resolution Radiometer) and MODIS (Moderate Resolution Imaging Spectroradiometer) high resolution sea surface temperature (SST) data are provided for atmospheric and oceanic observations. Satellite retrieved SST data using infrared sensor from AVHRR have been used for many years and well validated for open ocean and coastal water observation. Sakaida and Kawamura (1992) and Shenoi (1999) showed that the use of regional SST retrieval algorithms from AHVRR observations has a lower root mean square error (RMSE) than respective global algorithms in the western North Pacific and northern Indian oceans. Lee et al. (2005) indicated that MCSST (Multi-Channel Sea Surface Temperature; McClain et al. 1985) algorithm retrieved SSTs was in good agreement with in situ measurements of the coastal water around Taiwan with RMSE of 0.64°C.

After MODIS sensors were launched on 18 December 1999 (Terra) and 4 May 2002 (Aqua), geophysical observations have been continued to the present. Compared with the AVHRR SST, Goodrum et al. (2000) suggested that the noise equivalent temperature difference (NEdT) of MODIS 11 μm band is 0.05 K, which was a considerable improvement over that of AVHRR (NEdT = 0.12 K). Wan (2002) also indicated that the standard deviation of early on-orbit observations of MODIS 11 μm band is no greater than 0.05 K. In addition, many bands observed by MODIS yield

* Corresponding author
  E-mail: jeche7058@msn.com