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Analysis of Sea Surface Temperature due to Climate Change using Satellite Products and Spatial Gap-filling Approaches

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Extended Abstract

Sea Surface Temperature(SST) is crucial for atmosphere-ocean interaction and one of the essential factor for the Earth system. The distribution and characteristics of SST have been used in various fields such as climate modeling, global heat balance, weather forecasting, atmospheric and ocean circulation, and ocean data assimilation. Global SST is on the rise due to climate change, and this change can be observed with satellites. Currently, Geostationary Korea Multi-Purpose Satellite-2A(GK2A) daily SST product is provided for East Asia. However, the SST value based on infrared sensors is missing in the case of sea areas where clouds or aerosols appear continuously. Since these missing data increase the uncertainty of the satellite product, it is necessary to improve it in order to expand the use of SST product.

Therefore, this study aims to produce high-quality gap-free SST data for climate change monitoring in East Asian Seas. For this purpose, three steps of outlier removal, spatial gap-filling techniques, and validation with in-situ observations were applied. Outlier detection was performed using Deviation from Spatial Autocorrelation Trend(DSAT) [1]. DSAT detects extreme outliers with exceptional characteristics when compared to neighboring pixels. Our spatial gap-filling approaches were based on statistics such as Multiple Linear Regression(MLR) and Regression Kriging(RK). These regression techniques used the relation between SST with meteorological factors like temperature, humidity, and wind speeds, etc. Specifically, RK was performed through the following procedure [2]. Initially, MLR modeling was carried out to estimate the regression parameters. Then, the residuals from MLR were incorporated into ordinary kriging to account for prediction uncertainty. Finally, the values of the target variable were calculated by adding the predictions of MLR and the kriged values of the residuals.

After that the accuracy of each technique was compared using in-situ data and the accuracy characteristics were analyzed. The RK model reflecting the trend with surrounding observed values yielded a more spatially reasonable result for the gap-filling and showed a pretty high accuracy: a root mean square error between 0.550 and 0.858℃ and a correlation coefficient between 0.987 and 0.994. In addition, the rapid decrease of SST caused by typhoons was well explained in RK. The gap-free SST produced by this study can be useful for long-term climate change monitoring and future works will be necessary to enhance the gap-filling process including inpainting and ensemble methods.

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