Study on the Estimation of Net Surface Shortwave Radiation by MODIS data

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The Net Surface Shortwave Radiation (NSSR) is of primary interest in climate research because it controls the total energy exchange between the atmosphere and the land/ocean surface. In this paper, four methods, including three statistical methods (conventional algorithm from Tang etal. and two hybrid algorithms from Kim etal.) and a simplified atmospheric radiative transfer model using MODIS data were adopted to retrieve the Net Surface NSSR; Also, a detailed evaluation of the performance and characteristic behavior of these methods was described. Comparisons were made with radiation measurement data of six meteorological stations in china. The validation indicates that the simplified atmospheric radiative transfer model performs better than others, and the result is also steady; Conventional algorithm from Tang etal. is apt to get higher NSSR than measurements ,though the R square is large, RMSE also is large, and the result is worst in most sites; Two hybrid algorithms almost have the same accuracy, and in clear skies ,the direct estimation can produce a little better results but in cloudy skies ,the albedo-based estimation seems to behave better. All of the three above statistical methods, cloudy impact was considered too simple. when they run MODTRAN to simulate the spectral downward flux and MODIS TOA radiances then find relationship between the shortwave flux and MODIS apparent reflectance, they even did not change the default Cloud Extinction Coefficients in MODTRAN. Due to this, results retrieving from these methods in cloudy skies are larger than measurements in most situations. Currently, the statistical methods to deduce the NSSR mainly stay in linear and simple regression; they did not adequately utilize spectral bands which characterize the modern sensors. In the simplified atmospheric radiative transfer model, we must obtain the atmospheric datasets in advance, which are provided by MODIS atmosphere team. Because of a lot of missing data in these products, especially the aerosol properties, we had to fill these gaps with the datasets with coarser spatial and temporal resolutions (MOD08), and this are suspected to reduce the accuracy of the retrieval. Finally, it should be noted the methods that need albedo may result in smaller R square in some stations due to the discontinuity of the MODIS albedo product.

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