Land surface temperature retrieval from Himawari-8

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1 .Introduction

Land surface temperature (LST) is one of the key parameters in land-atmosphere interaction of various scale. Therefore, understanding the variation characteristics of LST has a crucial role to solve environmental issues of desertification or urban heat island. Oku et al. [1],[2],[3] proposed a retrieval method of LST over the Tibetan Plateau using GMS-5 and calculated land surface energy fluxes by their proposed method. The newly launched Japanese Geostationary Satellite, Himawari-8 supplies data of improved horizontal, temporal and spectral resolution. Using these data, it is expected that Himawari-8 can observe the smaller scales such as urban area in Japan, and can resolve various phenomena in urban area concretely. In this study, a new retrieval method of LST using Himawari-8 data was developed for applicable to smaller scales such as urban area in Japan.

2. Calculation algorithm of LST

Estimation of LST from a geostationary weather satellite requires information of thermal infrared radiation from the land surface. Because thermal infrared radiation cannot transmit clouds, we need to exclude clouds from satellite data as preprocessing. Therefore, we firstly constructed the clouds detection algorithm using 7 Himawari-8 spectral bands and made cloud mask products. Next, we simulated various land surface and atmospheric conditions using the radiative transfer model Rstar6b for determining best calculating LST equation and best combination of thermal infrared Himawari-8 bands. Furthermore, we developed LST equation fitted with satellite zenith angle by simulating some viewing zenith angle situations. And also, thermal infrared radiation observed by the sensor is influenced not only by land surface temperature but also by land surface emissivity and water vapor. Therefore, Estimation of LST requires information of land surface emissivity and water vapor. So, we constructed estimation method of land surface emissivity and water vapor. Accordingly, a new retrieval method of LST using only Himawari-8 data was developed.

3. Results

To evaluate accuracy of LST calculated by our method, comparisons were made around Japan between retrieved LST by our method and MODerate resolution Imaging Spectrometer (MODIS) LST product (Collection-5) provided by NASA. Consequently, retrieved LST reasonably overestimated with MODIS LST product (Collection-5) which has a feature of underestimating with observed LST in hot and humid environment. Furthermore, cloud detection method constructed in this study was also evaluated by comparison with MODIS cloud mask product and AMeDAS actual sunshine duration data. Consequently, our cloud detection method was confirmed in urban regions that is difficult to detect clouds. Construction of retrieval method of LST using Himawari-8 geostationary satellite data enables high temporal resolution and global scale observations of LST compared to the polar orbit satellite data.

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References

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