Retrieval of Surface Solar Radiation from Himawari-8 measurements

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Abstract: Surface solar radiation (SSR) is essential for calculating surface radiation budget and is a key parameter for climate change research. Accurate cloud optical properties are the important input parameters for calculating SSR for cloudy sky. In this study, a look-up table (LUT) method is developed to retrieve cloud optical properties (cloud phase, cloud optical thickness, cloud effective radius) from the Advanced Himawari Imager (AHI) instrument onboard the Himawari-8, a new generation geostationary meteorological satellite. Then, SSR is estimated from cloud optical properties and other auxiliary data (aerosol optical thickness, surface albedo, precipitable water vapor) by LUT method. Furthermore, to accelerate the calculation speed without loss accuracy, deep neural network (DNN) method is used to estimate SSR by learning input parameters (aerosol, cloud optical properties and other auxiliary data) and SSR simulated by RSTAR radiative transfer model. The estimated SSR for 2016 is validated at 122 radiation stations from several radiation networks located in the full disk regions of Himawari-8 data, with an RMSE of 112.14 Wm^{-2} for instantaneous SSR, 96.91 Wm^{-2} for hourly SSR, 29.30 Wm^{-2} for daily SSR, as well as an MBE of about 10 Wm^{-2}. Compared with the SSR estimated from conventional geostationary satellites, the accuracy of the SSR proposed by this study is significantly improved.

Keywords: Cloud optical properties, Surface solar radiation, Himawari-8, LUT, Deep learning