

A challenge for reconstruction of solar spectral irradiance based on solar Ca-K images

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The goal of this study is to reconstruct the past solar spectral irradiance using full solar image data derived from ground-based observations. Since atmospheric transparency of the earth depends on wavelength of solar radiation, variation of solar spectral irradiance is very important and valuable information in order to clarify the relationship between solar radiation and global climate change. However, there is a not so long history of observations of solar spectral irradiance in the space. Fortunately, there are both data of ground-based observations and space observations now. If it is able to connect between solar surface conditions seen in full solar image data and solar spectral irradiance variations, it will be also possible to deduce the past solar spectral irradiance only from full solar image data which were observed before the space age. Now, this study is standing at the first step for the goal. Ca-K full solar image data of the Big Bear Solar Observatory and solar spectral irradiance data of the SORCE satellite were used in this study. July 2004 includes the period that the total solar irradiance became the minimum through the year 2004. Since it is also expected that large variations of the solar spectral irradiance might appear due to changes of solar surface conditions in this period, we selected this month for the initial analyses. A simple solar surface model which consists of three components (dark region, quiet region and bright region) was prepared for reconstruction of solar spectral irradiance. After the solar spectral irradiance of three components were estimated by coordinating between solar spectral irradiance variations and changes of solar surface conditions, the solar spectral irradiance of an arbitrary day in August 2004 was reconstructed from Ca-K full solar image data. The difference between the real solar spectral irradiance of the SORCE satellite and the reconstructed solar spectral irradiance was less than 10% in the ultraviolet wavelength and less than 1% in the visible and infrared wavelengths.