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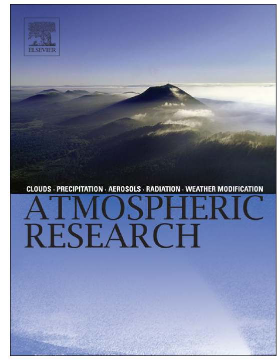

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Accuracy Assessment of Three Remote Sensing Shortwave Radiation Products in the Arctic

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Abstract: In this study, the shortwave radiation data in 2007 from GEWEX-SRB, ISCCP-FD and CERES-SYN radiation products were evaluated against ground observations from BSRN, CEOP and GC-Net in the Arctic. The evaluation result shows that the accuracy of the three shortwave radiation products in the Arctic is low. In the Arctic Region, CERES-SYN radiation product quality is superior to GEWEX-SRB and ISCCP-FD. The RMSEs and MAEs of the three shortwave radiation products are greater than 20W/m^2 at most sites. The mean RMSE and MAE of the downward shortwave radiation data of CERES-SYN are 54.4W/m^2 (42.9%) and 28.4W/m^2 (23.0%), respectively, the mean RMSE and MAE of the upward shortwave radiation data are 50.8W/m^2 (80.4%), 28.4W/m^2 (41.3%). The indexes values of the other two products are greater than CERES-SYN. Through accuracy analysis, it can be concluded that there are seasonal shortwave differences between satellite-estimates and ground measurements. The error sources are mainly systematic errors, rather than random errors. The main factors that affect the accuracy of the flux data include the spatial heterogeneity of the surface, the influence of the cloud, the accuracy of input inversion parameters and the low spatial resolution of the radiation products.

Keyword: Arctic Region; Shortwave Radiation Products; GEWEX-SRB; ISCCP-FD; CERES-SYN

1 Introduction

Surface shortwave radiation includes downward shortwave radiation (DSR) and upward shortwave radiation (USR); it is an important component of surface net radiation and one of the main sources of surface energy. Shortwave radiation not only provides the original power for ocean circulation movement and atmospheric thermodynamic movement to change the state of the ground gas system, but also it has the function of regulating and controlling the energy input and distribution of the earth's surface, providing basic and important energy source for all life activities of the earth (Niemelä et al., 2001; Sanchez‐Lorenzo et al., 2015).

Although the shortwave radiation data obtained by traditional ground observation has higher time resolution and precision (Yan et al., 2011; Zhang et al., 2013), the number of observation stations is limited. Therefore, in order to better monitor weather and climate changes, measurements of surface radiation (Hartmann et al., 1986; Ramanathan, 1987; Ramanathan et al., 1989) are needed globally. As satellite remote sensing technology continues to progress, high temporal and spatial resolution make it to a certain extent make up for the lack of ground monitoring, and become an significant means of surface parameter research, such as estimating surface evapotranspiration, surface net radiation flux, surface and atmospheric temperature (Li et al., 2009; Tang et al., 2006, 2010). Since 1980, using remote sensing data to invert surface radiation flux has made great progress and produced large scale shortwave radiation products (Königlanglo and Sieger, 2013; Gupta et al., 1999). Such as the Global Energy and Water Exchanges Project-Surface Radiation Budget (GEWEX-SRB), International Satellite Cloud Climatology Project-Flux Data (ISCCP-FD), and Clouds and the Earth's Radiant Energy System-Synoptic Radiative Fluxes and Clouds (CERES-SYN). The data accuracy of the three products in the non-polar low latitudes had been verified (Gui et al., 2010; Kratz et al., 2010; Yan et al., 2011), but the data quality studies in the polar regions are relatively small and even vacant. Moreover, although lots of assessments of the three products monthly mean fluxes against ground observations have been done by data developers (Zhang et al., 1995; Gupta et al., 2006) and other researchers (Liu et al., 2005; Raschke et al., 2006), very few evaluations have been conducted on the 3-hourly average data.

In the high latitudes, low temperature, low precipitation, high snow coverage, which making the shortwave radiation in the study of global climate changes and the stability of the ecological environment has a more important practical value. Moreover, the Polar Regions are the key areas of global energy cycling and global energy balance,