



Total solar radiation in the Arctic from 1950s to present time: observations at Russian drifting and stationary stations

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In this paper, we present the results of the joint analysis of monthly and annual sums of the total solar radiation (TSR) measured in the Arctic at the stationary stations (SS) and at the drifting “North Pole” stations (NPS). The observations cover the period from the mid-1950s to the present time at the SS and from 1954 to 1991 as well as 2007 and 2009 at the NPS. The variability of the coordinates and time results in the statistical heterogeneity of the time series of data collected at each of the moving platforms, such as NPS. This heterogeneity complicates the joint analysis of measurements made at the SS and the NPS, and should be filtered out by the statistical technique in use.

To obtain homogeneous series of data for the moving platforms, we used an approach based on the calculation and analysis of the relative anomalies of monthly sums of TSR. This allowed us to exclude the natural annual variations and the systematic component of the spatial variability of the analyzed variables and to compare the data of observations obtained on the moving platforms at different times and geographical locations.

To assess the trends of the long-term variation of the TSR in the Arctic Basin, we calculated the interannual variations of monthly and annual TSR sums at the NPS. They were recovered with the use of the above-mentioned relative anomalies. Comparison of the recovered annual TSR sums averaged for all NPS and of the TSR values observed at the ten coastal and insular SS in 1954 – 1991 showed that these data were fully comparable. Thus, the recovered values of the TSR can be used as the characteristic of the radiation regime of the Arctic Basin as a whole.

We could not find any statistically significant long-term trend of the TSR for the period of the continuous work of the drifting and stationary stations (1954 – 1991). Statistical analysis for the SS, in particular, showed that, for the linear trend, the coefficients of determination R^2 did not exceed 0.08 for the Vize, Uedineniya, Golomyanny Islands, Chelyuskin Cape, Tiksi, Wrangel Island as well as for the recovered averaged curve of the TSR for drifting stations. For Dixon Island, Chetyrekhstolbovoi Island and Uelen, the values of R^2 were 0.16, 0.11 and 0.25, respectively. The only stationary station under consideration with slightly larger R^2 was the Schmidt Cape ($R^2 = 0.45$) situated in the Eastern Sector of the Arctic.

In the 1990s, the observational data at the stationary stations were incomplete, and no observations on the drifting stations were conducted. However, the comparison of the TSR data from 1954 – 1991 with the TSR data obtained in the first decade of the XXI-th century at the existing SS (Vize, Dixon and Golomyanny Islands, Chelyuskin Cape, Wrangel Island and Uelen), mostly confirmed the lack of a systematic trend of TSR in the Russian Arctic.