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Radiation Balance Variations on the Earth's Surface in Moscow

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The present surrey systemizes and generalizes ground-based measurements of the Earth's radiation balance, its components, and main factors defining their variations over more than 50 years (1958–2010). The data were collected on the basis of long-term observations at the Meteorological Observatory (MO) of the Moscow State University (MSU). The climatic norms of shortwave (Bk), longwave (Bd), and total (B=Bk+Bd) radiation balances were obtained and their variability (diurnal, annual and interannual) limits were estimated. The correlation dependences between the main balance components and factors influencing their variability have been determined. The results of the analysis demonstrated:
— a dramatic increase in the values of annual sums of radiation balance has been observed (by 23% over 15 years) since 1994;
— a growth in the values of radiation balance takes place both due to the increase in the annual sums of Bk (3%) and owing to the increase in the annual sums of Bd (7%) . First of all, the increase in Bk occurs due to the reflected radiation reduce. According to the data of MO MSU, a statistically significant tendency toward the reflected radiation decrease (by 16%) caused by the considerable decrease (by15%) of average annual values of albedo has been registered in recent 50 years
—the tendencies toward the increase in radiation balance, longwave balance, and atmospheric downward radiation (Ea) have a diurnal course: the maximum variations are observed at nighttime in winter months;
—the positive linear trend of B, Bd, and Ea has a diurnal course and the maximum increase is registered during winter and transient months between summer and winter;
—the increase of the radiation balance takes place due to the decrease in the amounts of the reflected radiation and the increase in Bd and Ea (the increase in Ea is the most important in this process);
—the increase in Bd is defined by the increase in the atmospheric downward radiation as the upwelling surface radiation can only increase due to the temperature growth. The increase in the atmospheric downward radiation takes place because of the increase in the cloudiness (the total cloud amount increased by 9.6% over 50 years) and total atmospheric moisture content (up by 9%) as well as, probably, due to the increase in the content of greenhouse gases in the atmosphere. As Ea defines the atmospheric greenhouse effect, one can speak about its intensification in recent years;
—the main factors influencing the increase in the radiation balance and its main components are: the decrease in the reflecting properties of underlying surface and the increase in the amount of total and lower cloudiness.