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Variations of longwave downwelling irradiance due to different atmospheric factors in Moscow

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We present the results of continuous longwave downwelling radiation (LDR) monitoring in Moscow from April 2008 to December 2011 at the Meteorological Observatory of Moscow State University (MSU MO). The measurements are carried out within wavelength range 3.5-50 μm using a precision infrared radiometer (PIR) which is regularly calibrated against international standards and tested in Physical Meteorological Observatory in Davos (Switzerland) with the accuracy comparable with the BSRN measurements (2-3 W/m2) with one minute resolution using SUN hardware-software complex. According to these measurements the impact of various atmospheric factors on the longwave downwelling radiation has been assessed. For clear sky conditions we estimated the effects of temperature T and water vapor content W. Water vapor content W (cm) was evaluated from Cimel sunphotometer data (AERONET) in the 940 nm channel. A simple equation is proposed to retrieve the LDR in the absence of cloudiness and aerosol optical thickness at 500 nm (AOT500) less than 0.7. In conditions with a smoky aerosol with extremely high aerosol optical thickness the LDR dependence on AOT500 should be taken into account. For example, the LDR increases by about 40 W/m2 at AOT500 about 4 at fixed temperature and water vapor content. The analysis of cloud effects reveals a significant growth of LDR in cloudy conditions up to 30% during daytime and up to 25% at night. The upper layer thin cloudiness does not affect LDR.
On average, annual LDR in Moscow was 302 W/m2 with seasonal changes of about 100 W/m2 due to variations mainly in temperature and cloud cover. For the entire observation period the LDR changed from 424 W/m2 in July 2009, up to 150 W/m2 in February 2011. Maximum LDR values were observed under optically thick low layer cloudiness. Minimum LDR values were observed in clear sky conditions and low temperatures. The average LDR daily range is 18-33 W/m2 in summer and 6-17 W/m2 in winter conditions.