Abstract

Knowledge about thermal radiation of the atmosphere is rich in hypotheses and theories but poor in empiric evidence. Thereby, the Stefan-Boltzmann relation is of central importance in atmosphere physics, and holds the status of a natural law. However, its empirical foundation is little, tracing back to experiments made by Dulong and Petit two hundred years ago. Originated by Stefan at the end of the 19th century, and theoretically founded afterwards by Boltzmann, it delivers the absolute temperature of a blackbody – or rather of a solid opaque body (SOB) – as a result of the incident solar radiation intensity, the emitted thermal radiation of this body, and the counter-radiation of the atmosphere. Thereby, a similar character of the blackbody radiation – describable by the expression $\sigma \cdot T^4$ - and the atmospheric counter-radiation was assumed. But this appears quite abstruse and must be questioned, not least since no pressure-dependency is provided. Thanks to the author's recently published work - proposing novel measuring methods -, the possibility was opened-up not only to find an alternative approach for the counter-radiation of the atmosphere, but also to verify it by measurements. This approach was ensued from the observation that the IR-radiative emission of gases is proportional to the pressure and to the square root of the absolute temperature, which could be bolstered by applying the kinetic gas theory. The here presented verification of the modified counter-radiation term $A \cdot p \cdot T^{0.5}$ in the Stefan-Boltzmann relation was feasible using a direct caloric method for determining the solar absorption coefficients of coloured aluminium-plates and the respective limiting temperatures under direct solar irradiation. For studying the pressure dependency, the experiments were carried out at locations with different altitudes. For the so-called atmospheric emission constant A an approximate value of 22 $Wm^{-2}bar^{-1}K^{-0.5}$ was found. In the non-steady-state, the total thermal emission power of the soil is given by the difference between its blackbody radiation and the counter-radiation of the atmosphere. This relation explains to a considerable part the fact that on mountains the atmospheric temperature is lower than on lowlands, in spite of the enhanced sunlight intensity. Thereto, the so-called greenhouse gases such as carbon-dioxide do not have any influence.