Accurate Determination of the TOA Solar Spectral NIR Irradiance Using a Primary Standard Source and Bouguer-Langley Technique

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We describe an instrument dedicated to the measurement of the top-of-the-atmosphere (TOA) solar spectral irradiance (SSI) in the near infrared (NIR) between 600 nm and 2300 nm at a 10 nm resolution. Ground-based measurements are performed through atmospheric NIR windows and the TOA SSI values extrapolated using the Bouguer-Langley technique. The interest in this spectral range comes from its main role in the Earth's radiative budget as well as for the validation of models used in solar physics. Moreover, some differences were observed between recent ground-based and space instruments measuring in the NIR, and the reference SOLSPEC (ATLAS3). In the 1.6 μm region, the deviations vary from 6% to 10%.

Our measuring system named IRSPERAD has been designed by Bentham (UK) and radiometrically characterized and absolute calibrated against a blackbody at the Belgian Institute for Space Aeronomy and at the Physikalisch-Technische Bundesanstalt (Germany), respectively. A four-month measurement campaign was carried out at the Izaña Atmospheric Observatory (Canary Islands, 2367 m a.s.l.). A set of top quality solar measurements was processed to obtain the TOA SSI in the referred NIR windows. We obtained an average standard uncertainty of 1% for 0.8 μm < λ < 2.3 μm. Between 1.6 μm and 2.3 μm, our measurements show a disagreement varying from 6% to 8% relative to ATLAS3, not explained by the declared standard uncertainties of both experiments.