Name of research institute or organization:

Federal Office of Meteorology and Climatology MeteoSwiss, Payerne

Title of project:

Global Atmosphere Watch Radiation Measurements

Project leader and team:

Dr. Laurent Vuilleumier, project leader
Mr. Gilles Durieux

Project description:

Long-term monitoring of surface radiation flux at the Jungfraujoch in the framework of the GAW Swiss Alpine Climate Radiation Monitoring program (SACRaM) was conducted in 2013 with a high degree of data availability considering the challenging conditions at Jungfraujoch. In average, the data availability for radiation parameters reached 99%. Such continuous monitoring implies a constant effort to sustain the highest achievable accuracy, stability and continuity in the measurements.

The measurement program includes short-wave (solar spectrum) and long-wave (infrared thermal) broadband measurements as well as UV broadband measurements. Short- and long-wave measurement series are important for climate research, while UV measurements are of interest for both public health and exploring the relationship between the evolution of the ozone layer and radiation. Broadband radiation is measured both as global downward hemispheric irradiance and as direct sun irradiance. In addition, direct spectral irradiance is also measured, which allows the total column of several atmospheric constituents to be determined.

A method for improving the performance of commonly used parameterizations to calculate the cloud-free down-welling long-wave radiation at the surface was developed. The method uses a monthly climatology of the effective radiating temperature of the atmosphere instead of the instantaneous screen-level temperature. The climatology of the effective radiating temperature can be derived from pyrgeometer measurements and was incorporated into two commonly used schemes. We compared the calculated cloud-free down-welling long-wave irradiances to high-quality pyrgeometer measurements from four Swiss sites, including Jungfraujoch. The discrepancies between observations and modified schemes can be reduced by up to 35%, resulting in a model uncertainty close to 5 Wm^{-2}, which corresponds to the measurement uncertainty of pyrgeometers. Furthermore, we introduced a new long-wave model which is based on radiative transfer calculations in the 8-14 μm wavelength range. In the remaining long-wave spectrum, the radiation is calculated using the Planck function with the effective radiating temperature of the atmosphere. The performance of this new model is consistent with the modified parameterizations.

Key words:

Solar irradiance, ultraviolet, visible, infrared, spectral irradiance, precision filter radiometer (PFR), pyranometer, pyrheliometer, UV biometer, total aerosol optical depth (AOD), integrated water vapor (IWV)

Internet data bases:

http://wrdc-mgo.nrel.gov/ (World Radiation Data Centre – WRDC)
http://www.iapmw.unibe.ch/research/projects/STARTWAVE/database/ (IWV STARWAVE data)

Collaborating partners/networks:

Radiation data submitted to the World Radiation Data Centre (WRDC, St. Petersburg, Russian Federation) within the framework of the Global Atmosphere Watch.
Study of solar photometry (aerosol optical depth) and long-wave infrared radiative forcing in collaboration with the "Physikalisch-Meteorologisches Observatorium Davos" (PMOD) World Radiation Center (WRC).

Scientific publications and public outreach 2013:

Refereed journal articles and their internet access

Wacker, S., J. Gröbner and L. Vuilleumier, A method to calculate cloud-free long-wave irradiance at the surface based on radiative transfer modeling and temperature lapse rate estimates, Theoretical and Applied Climatology, **1**, 11, doi: 10.1007/s00704-013-0901-5, 2013.
http://dx.doi.org/10.1007/s00704-013-0901-5

Conference papers

Wacker, S., J. Gröbner and L. Vuilleumier, Trends in surface radiation and cloud radiative effect over Switzerland in the past 15 years, AIP Conference Proceedings, Cahalan, R. F. & Fischer, J. (ed.), AIP, **1531**, 672-675, Dahlem Cube, Free University, Berlin, Germany, August 6-10, 2012, 2013.
http://dx.doi.org/10.1063/1.4804859

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