

Name of research institute or organization:

Federal Office of Meteorology and Climatology MeteoSwiss, Payerne

Title of project:

Global Atmosphere Watch Radiation Measurements

Part of this programme:

GAW

Project leader and team:

Dr. Laurent Vuilleumier, project leader

Dr. Giovanni Martucci

Mr. Gilles Durieux

Project description:

The goal of the Global Atmosphere Watch Radiation Measurement program at Jungfraujoch is providing long-term monitoring of surface downward radiation fluxes. It is conducted in the framework of the GAW Swiss Alpine Climate Radiation Monitoring program (SACRaM), which applies operational guidelines similar to those of the international Baseline Surface Radiation Network, except for the daily maintenance requirements due to the remote nature of the site. In 2016, the degree of availability of the data was less satisfactory than for previous years. In average, the data availability for radiation parameters reached 92.5%, while it is usually about 97% or higher. The reason for this lower than usual data availability was that the sun tracker pointing to the sun for automatic direct irradiance measurements was 1 to 2 degrees off the sun for a couple of months at the end of the year, which resulted in low quality direct irradiance data. Because the data was not obviously wrong, the problem was only identified after a couple of months. The corresponding data were discarded. The problem was solved, but this emphasizes the constant effort necessary 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.

In association with the WMO GAW Precision Filter Radiometer (PFR) network, MeteoSwiss operates sun photometers at the four SACRaM stations (Philipona et al. 1996; Heimo, 1998) measuring the direct solar irradiance in 16 narrow spectral bands within the range 305-1024 nm since 1998. One of the four sites is Jungfraujoch (timeseries 1999-2016), characterized by alpine environment and partial free tropospheric conditions (mainly in winter, Hermann et al, 2015).

A long-term time series of Aerosol Optical Depth (AOD) in the spectral range 368-1024 nm has been calculated using the SPMT00L (IAP Research Report, T. Ingold, 2001) for the site at Jungfraujoch.

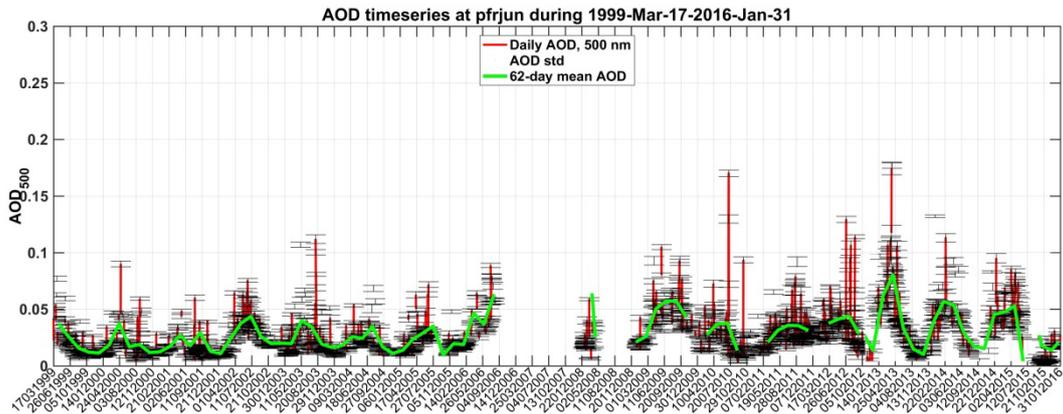


Figure 1. Time series of AOD at 500 nm at the alpine site JFJ.

The AOD values are calculated using the raw irradiances measured by three PFRs and calibrated using Langley plots to retrieve the calibration factors, V_0 . The V_0 values are obtained for each PFR instrument (standard “N”, extended-1 “E1”, extended-2 “E2”) during their permanence at the Jungfrauoch station and at the Davos station on the roof of the Physikalisch-Meteorologisches Observatorium Davos (PMOD) building.

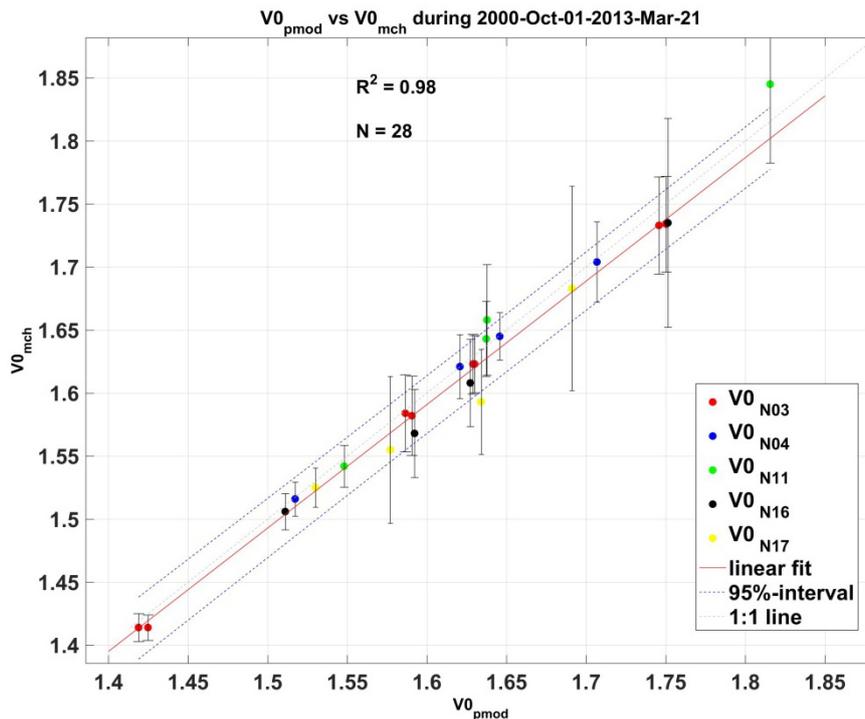


Figure 2. Comparison of the V_0 values obtained by Langley plot by MeteoSwiss (mch) and by direct comparison with a reference instrument by the PMOD.

The calculated V_0 values for the N-series PFR installed at Davos can be directly compared with the ones calculated by the PMOD when they calibrate the instruments against their world reference instruments. Figure 2 shows the agreement between the V_0 values calculated by the Langley plot and those by the PMOD reference. The comparison shows that, within the uncertainty, the calibration factors are in a very good agreement.

References:

Philipona, R., A. Heimo, C. Marty, A. Ohmura, and C. Wehrli, The Swiss Atmospheric Radiation Monitoring Program: CHARM, International Radiation Symposium IRS96, Fairbanks, Alaska, 1996.

Heimo, A., R. Philipona, C. Fröhlich, C. Marty, and A. Ohmura, The Swiss Atmospheric Radiation Monitoring network CHARM, Proceedings of the World Meteorological Organization Technical Conference on Meteorological and Environmental Instruments and Methods of Observations (TECO-98), Casablanca, Morocco, WMO/TD-877, 291–294, 1998.

Key words:

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

Internet data bases:

<http://wrdc-mgo.nrel.gov/> (World Radiation Data Centre – WRDC)

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)

Address:

Office fédéral de météorologie et de climatologie MétéoSuisse
Station Aérologique
Ch. de l'Aérologie 1
CH-1530 Payerne

Contacts:

Dr. Laurent Vuilleumier
Tel.: +41 58 460 95 41
Fax: +41 58 460 90 04
e-mail: laurent.vuilleumier@meteoswiss.ch
URL: <http://www.meteoswiss.admin.ch/home/measurement-and-forecasting-systems/atmosphere/strahlungsmessnetz.html>