

Name of research institute or organization:

**Physikalisch-Meteorologisches Observatorium Davos,
World Radiation Center**

Title of project:

Solar and terrestrial radiation measurements

Project leader and team:

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Project description:

General:

Within the Swiss Atmospheric Radiation Monitoring (CHARM) program, PMOD/WRC in collaboration with MeteoSwiss and IACETH conducts solar and terrestrial surface radiation measurements at Jungfraujoch and Gornergrat mainly for radiation budget, UV-radiation and aerosol optical depth (AOD) investigations. Within the CHARM program, Jungfraujoch and Gornergrat are key stations of the Alpine Surface Radiation Budget (ASRB) network, where shortwave solar and long-wave terrestrial radiation is accurately measured to determine the altitude dependence of the radiation budget and possible changes related to climate change. Jungfraujoch being the highest site within CHARM is also extensively used as reference and calibration station and for comparisons of radiation instruments.

Alpine surface radiation budget investigations

The ASRB network (1), comprising eleven stations from 370 m (Locarno-Monti) to 3580 m (Jungfraujoch), primarily measures downward and upward fluxes of short-wave and longwave radiation. Temperature and humidity at screen level height are also measured at each station. Measurements at the individual stations started in 1994 and an extensive radiation climatology (2) over the Alps is now available based on 10 minutes data from 1995-1998. Longwave radiation, combined with surface temperature and humidity measurements also allow to separate clear-sky from cloudy-sky situations (3), which is very important to investigate the effects of clouds, the so-called cloud forcing, on the radiation budget. In conjunction with radiative transfer models longwave measurements and the cloud forcing was finally used to determine the greenhouse effect at the individual ASRB stations and its altitude dependence (4). Sustained high quality measurements at ASRB stations may allow in the future to monitor possible changes of the greenhouse radiative forcing in a changing climate.

Spectral UV-radiation measurements

As part of the CHARM program solar direct and global broadband UVB (erythemally effective) as well as global broadband UVA radiation is continuously measured at Jungfraujoch since 1997. In 1999 PMOD/WRC installed a UV Precision Filter Radiometer (UV-PFR) measuring direct solar spectral UV radiation within a bandwidth of 1.5 nanometer at wavelength of 305, 311, 318 and 332 nanometers. These spectral UV-PFR measurements have been compared with spectral measurements of the University of Innsbruck spectroradiometer, which were taken during their intensive UV-measurement campaigns in 1999, 2000 and 2001. Direct solar spectral UV radiation

was found to agree within better than 5% for the four wavelength over the two years period of the comparisons. A paper on these results is in preparation. Within the CHARM program MeteoSwiss has now permanently installed UV-PFR instruments at Jungfraujoch, Davos, Locarno-Monti and Payerne with the aim to provide spectral direct solar UV-radiation measurements from divers locations in Switzerland.

Aerosol Optical Depth calibration and test measurements

Within WMO's Global Atmosphere Watch (GAW) program, PMOD/WRC also acts as the World Optical depth Research and Calibration Center (WORCC). Tasks within WORCC are: to develop accurate radiometric references for spectral solar radiometry used to determine optical depth; develop procedures to ensure world-wide homogeneity of optical depth measurements; test new instrumentation and methods for the determination of optical depth. Since 1998 three newly built Precision Filter Radiometers (PFRs) are permanently located at Jungfraujoch for Langley calibration and long-term tests of stability and performance of PFRs under harsh environmental conditions.

Key words

Surface radiation budget; Radiative cloud forcing; Greenhouse effect; Spectral UV radiation; Aerosol optical depth.

Collaborating partners/networks:

MeteoSwiss (MCH)
Institute for Atmospheric and Climate science at ETH (IACETH)

Scientific publications and public outreach 2001:

Claus Fröhlich, Rolf Philipona und Christoph Marty: Untersuchung des Oberflächenstrahlungshaushalt in den Alpen und im Vergleich zum schweizerischen Mittelland. *Schlussbericht NFP31, vdf Hochschulverlag AG an der ETH Zürich*, ISBN 3 7281 2504 0 (1998).

Christoph Marty: Surface Radiation, Cloud Forcing and Greenhouse Effect in the Alps. *Zürcher Klima-Schriften, Institut für Klimaforschung ETH, Diss. ETHZ 13'609*, pp.122, ISBN 3 906 148 27 0 (2001).

Christoph Marty and Rolf Philipona: The clear-sky Index to separate Clear-Sky from Cloudy-Sky situations in Climate Research. *Geophysical Research Letters*, **27**, 2649-2652 (2000).

Rolf Philipona and Christoph Marty: The Greenhouse Effect and its altitude Gradients – by Accurate Surface Longwave Radiation Measurements. *Accepted for publication in Geophysical Research Letters*.

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