

Name of research institute or organization:

Division for Biomedical Physics, Innsbruck Medical University

Title of project:

Solar UV irradiance

Project leader and team:

Prof. Dr. Mario Blumthaler, project leader
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Project description:

Since 1980 variability and long-term trend of solar UV irradiance have been observed at the High Alpine Research Station Jungfraujoch in annual campaigns of about 8 weeks duration. Especially the erythemally weighted UV-irradiance is of high interest, as it can be taken as a general indicator of harmful reactions of UV radiation on humans. The erythema dose is measured with broadband detectors, and long-term variations are investigated within our long-term project.

Additionally, spectral measurements of solar global irradiance between 280 nm and 500 nm with a resolution of 0.25 nm are carried out with a double-monochromator spectroradiometer. Total ozone column and spectral extinction by aerosols is derived from spectral measurements of direct sun irradiance. Close international cooperation guarantees high quality of the UV measurements. The spectral measurements allow the quantitative determination of the effects of individual parameters like ozone, albedo and aerosols, because each parameter has a different spectral effect on UV radiation.

In 2005, the measurements at Jungfraujoch took place between 06.04.2005 and 10.05.2003. During the whole period at least one scientific co-worker from the Division for Biomedical Physics, Innsbruck, was taking care of the measurements at Jungfraujoch for continuous quality control and for manual ancillary measurements on clear sky days. With the spectroradiometer, spectral global irradiance and actinic flux density were measured continuously under all weather conditions. Measurements of direct sun irradiance with the spectroradiometer and with hand-held detectors during cloudless days allowed verifying the absolute calibration of these instruments by applying the Langley-method. Furthermore, on clear sky days, measurements of sky radiance in the vertical plane of the sun and in the almucantar were carried out for 320 nm, 350 nm and 450 nm with a field of view of about 1.6°. At each selected point on the sky, a UV-polarising filter in front of the input optics was rotated in 4 steps over 135°. This allows to determine the degree and the direction of polarisation of the diffuse sky radiance in the UV wavelength range. These data will be analysed in combination with radiative transfer models. The measurements at Jungfraujoch can serve as a base line for such measurements, as the amount of aerosols is there extremely small and therefore their effect on polarisation can almost be neglected. However, the inhomogeneous distribution of snow coverage in the surrounding up to a distance of about 20 km has a significant influence on the diffuse sky radiance and also on its degree of polarisation. This makes the interpretation of the measurements quite complicate.



Figure 1: Installation of the radiation detectors on the roof of the Sphinx observatory, looking towards Mönchsjoch. On the right, detectors for global, UVA and UVB irradiance and in the middle the respective detectors covered by a shadow band to measure the diffuse component only. On the left on the pole the sun tracker with the input optics of the spectroradiometer for direct sun and diffuse sky measurements.



Figure 2: Further radiation detectors: on the left input optics of the spectroradiometer for global irradiance (dark blue) and actinic flux density (black) All input optics of the spectroradiometer are connected with quartz fibres (6 m) to the spectroradiometer itself, which is installed in the laboratory just below the terrace. The 3 white detectors are broadband instruments for global, UVA and UVB irradiance.

Key words

UV, erythemal irradiance, ozone, aerosols, albedo effects, polarisation

Internet data bases:

<http://www.uv-index.at>

Collaborating partners/networks:

Close contact to Meteo Schweiz concerning radiation measurements and to BUWAL concerning ground level ozone measurements. International cooperation in several EC-funded projects concerning spectral solar UV measurements.

Scientific publications and public outreach 2005:

Refereed journal article:

Huber M., M. Blumthaler, J. Schreder, B. Schallhart and J. Lenoble, Effect of inhomogeneous surface albedo on diffuse UV sky radiance at a high altitude site, *J Geophys Res*, **109**, D08107, 10.1029/2003JD004013, 1-7, 2004.

Schallhart B., M. Huber and M. Blumthaler, Semi-empirical method for the conversion of spectral UV global irradiance data into actinic flux, *Atm Env* **38**, 4341-4346, 2004.

Thesis:

Schallhart B., Spectral global and actinic UV radiation – measurements and correlations. PhD Thesis, University Innsbruck, 2004.

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