

Global Atmosphere Watch radiation measurements

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1. 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 2018, a satisfactory degree of data availability was achieved, especially considering the challenging conditions at Jungfraujoch. On average, the data availability for radiation parameters reached 95%. Achieving this level of data availability for continuous automatic monitoring at Jungfraujoch 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.

In association with the WMO GAW Precision Filter Radiometer (PFR) network, MeteoSwiss also operates sun photometers at the four SACRaM stations 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, characterized by an alpine environment and partial free tropospheric conditions. At nine wavelengths, aerosol optical depth (AOD) is computed at times when no clouds are in the path of the direct solar beam.

In collaboration and under the lead of the PMOD/WRC (Physikalisch-Meteorologisches Observatorium Davos / World

Radiation Centre), the time series of meteorological parameters and surface downward shortwave and longwave radiation were analysed for trends at the four stations of the SACRaM network for the 1996–2015 period. Ground temperature, specific humidity and integrated water vapour were found to increase during all conditions as well as cloud-free conditions. All-sky and cloud-free trends of downward shortwave radiation and downward longwave radiation were all positive, and most were significant at the 90% confidence level.

References

Nyeki, S., S. Wacker, C. Aebi, J. Gröbner, G. Martucci, and L. Vuilleumier, submitted, Trends in surface radiation and cloud radiative effect at four Swiss sites for the 1996–2015 period, submitted to Atmos. Chem. Phys.

Internet data bases

<http://www.meteoswiss.admin.ch/home/measurement-and-forecasting-systems/atmosphere/strahlungsmessnetz.html>
<http://wrdc.mgo.rssi.ru/>

Collaborating partners / networks

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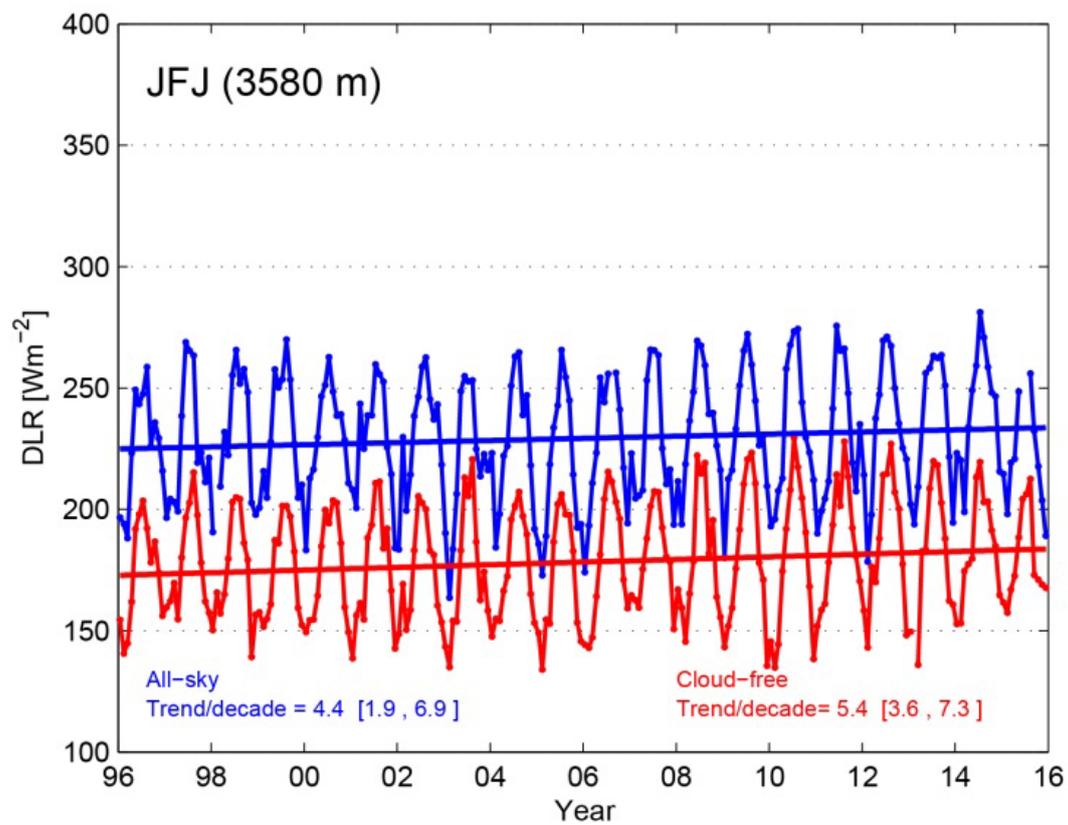


Figure 1 (updated from Nyeki et al., submitted). Monthly average downward longwave radiation values during all-sky (blue) and cloud-free (red) conditions at Jungfraujoch. The trend results from linear least squares analysis method are also given. Values in brackets represent the upper and lower bounds of the 90% confidence interval.