Name of research institute or organization:

MeteoSwiss, Payerne

Title of project:

Global Atmosphere Watch Radiation Measurements

Project leader and team

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Project description:

During 2003, measurements of the Swiss Atmospheric Radiation Monitoring program (CHARM) at Jungfraujoch were continued in the configuration described in the 2002 HFSJG Activity Report. The rugged design of the automatic CHARM station at Jungfraujoch allowed reaching over 98% of data availability in 2003 for all but one parameter (UV erythemal global irradiance), for which the data availability was 92.5%.

The analysis of the stability of the Precision Filter Radiometers (PFR) that is described in the 2002 HFSJG Activity Report was pursued in 2003. As in 2002, the Langley plot method was used for checking the stability over time of the extrapolated V_0 values that would be determined in case the instrument were measuring the extraterrestrial solar irradiance. Analysis carried on in 2003 was performed with an optimized event selection allowing reduced uncertainty. In addition, the 2003 analysis was performed on datasets from the Jungfraujoch and Davos CHARM station allowing comparison, and a longer time span was considered. The preliminary results of this analysis are summarized in Table 1.

Table 1: Results of stability analysis for CHARM PFR at Jungfraujoch and Davos.

	Jungfraujoch					Davos				
	Fit		Residuals			Fit		Residuals		
wl nm	V_0 on 07/01 mV	Yearly drift mV	Nb event per year	10 %tile mV	90 %tile mV	V_0 on 03/02 mV	Yearly drift mV	Nb event per year	10 %tile mV	90 %tile mV
332	9760	204.93	46	-203	167	10428	111.44	63	-517	445
368	1749	4.03	78	-26	26	1823	14.92	37	-59	52
412	1595	1.50	79	-27	24	1655	7.35	31	-49	38
450	2288	0.25	78	-26	25	2382	4.23	61	-57	55
500	1629	0.74	80	-17	16	1642	6.75	57	-35	37
610	2088	-4.87	80	-27	27	2106	-5.26	68	-47	46
675	1917	-0.04	72	-19	20	1893	5.94	34	-26	27
778	2242	-9.76	48	-19	20	2296	-24.72	24	-22	39
862	1425	1.29	46	-10	11	1511	7.95	18	-28	30
1024	2169	-2.24	36	-20	18	1476	-5.09	18	-20	17

Table 1 gives the extrapolated V_0 values for each analyzed wavelength at the middle of the considered period, the averaged yearly drift determined by a linear regression fit over the considered period, the averaged number of selected days for Langley plot analysis per year, as well as the 10^{th} and 90^{th} percentile of the distribution of the residuals around the linear regression fit. The statistical precision of the analysis depends on the width of the residual distribution and the number of selected events. The averaged yearly drift are well below 1% per year at Jungfraujoch, except for the wavelength λ = 332 nm. This confirms results from the 2002 analysis. At Davos, the averaged yearly drift are slightly larger than at Jungfraujoch, for most wavelengths, although they are still on the order of 1% or below, except for λ = 332 nm. However, this difference in drift between Davos and Jungfraujoch should be interpreted with caution, because values of Davos yearly drifts still depend on criteria used for selecting Langley events, and a larger statistics may be necessary for definite conclusion. Conclusions that are warranted for Davos are that the yearly drift is important at λ = 332 nm, and significant at λ = 778 nm, which is similar to what is observed at Jungfraujoch. Wavelengths between 368 and 1024 nm are used for inferring aerosol optical depths. Consequently, the calibration values (V_0) must be known with good precision. An uncertainty of 1% on the calibration values produces an uncertainty of 0.005 on the AOD (Schmid and Wehrli, 1995). At Jungfraujoch, AOD as low as 0.01 are measured. Thus, the uncertainty on calibration must be well below 1% for PFR measuring at the Jungfraujoch CHARM station. At other CHARM station a limit of 1% or lower on the calibration uncertainty is desirable. Comparison between Jungfraujoch and Davos results shows that the uncertainty on calibration at Jungfraujoch is half that of calibration at Davos (see number of events selected per year and width of residual distribution). Consequently, it was decided to start a program in 2004 for calibrating PFR of all other CHARM stations at the Jungfraujoch station.

A joint campaign of the Swiss Federal Office of Public Health, the Swiss Krebsliga and MeteoSwiss for raising the awareness of Swiss public to the danger of UV radiation was conducted in 2003. As a contribution to this campaign, the measurements of the UV radiation level at the CHARM station (including Jungfraujoch) were made available in quasi real time for the campaign, and are displayed at the web address www.uv-index.ch. The UV radiation level was given as UV index following the recommendations of the World Health Organization and the World Meteorological Organization. These organizations have also defined classes (weak, moderate, strong, very strong and extreme) used to classify the level of protection required according to the maximum daily value reached by the UV index. Following the unusual conditions of 2003, a comparison of the number of occurrences of the different classes in the period June-July-August between 2002 and 2003 was performed. This comparison is summarized in Figure 1.

Figure 1: Number of days with maximum UV index in WMO defined classes during the June-July-August period in 2002 and 2003 at CHARM stations.

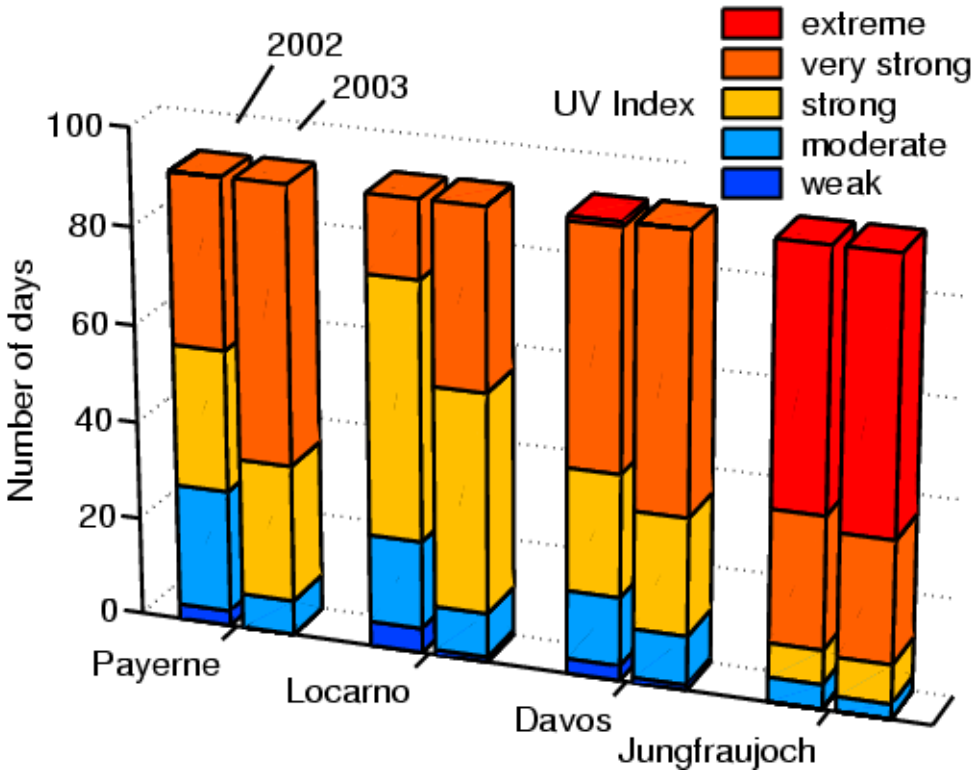

Figure 1 shows that 2003 had a significantly higher number of occurrences of strong and very strong maximum measured UV indices at Payerne and Locarno-Monti. On the other hand, the number of occurrences of different classes did not differ so significantly at the mountain station of Davos and Jungfraujoch. It appears that due to the high altitude of the Jungfraujoch station, the frequency of occurrence of very strong or extreme UV radiation level is much less dependent on general yearly meteorological conditions than at lower altitude station.

References

Schmid, B. and C. Wehrli, 1995. “Comparison of sun photometer calibration by use of the Langley technique and the standard lamp”. *Applied Optics* **34**, pp. 4500-4512.

Key words:

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

Collaborating partners/networks:

Short- and long-wave global irradiance data shared with the Alpine Surface Radiation Budget network under the responsibility of the Word Radiation Center/Physikalisch-Meteorologisches Observatorium Davos
Columnar water vapor data submitted to the NCCR Climate P2.4 STARTWAVE database at the Institute for Applied Physics, University of Bern.

Scientific publications and public outreach 2003:

Conference papers

Vuilleumier, L., A. Heimo, A. Lehmann, A. Vernez and P. Viatte, UV erythemal measurements by the Swiss Atmospheric Radiation Monitoring program. 2003 EGS-AGU-EUG Joint Assembly. *Geophysical Research Abstracts,* **5**, 10950.

Nyeki, S., L. Vuilleumier, A. Heimo, N. Kämpfer, C. Mätzler, A. Vernez and P. Viatte, Column water vapour using a PFR radiometer at a high-alpine site. 2003 EGS-AGU-EUG Joint Assembly. *Geophysical Research Abstracts,* **5**, 08726.

Data books and reports

Les mesures GAW du rayonnement UV et des aérosols in Annalen 2002 MeteoSchweiz, Zürich (2003).

Ozone, rayonnement UV et aérosols (GAW) in Annalen 2002 MeteoSchweiz, Zürich (2003)

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