Name of research institute or organization:

Federal Office of Meteorology and Climatology MeteoSwiss, Payerne

Title of project:

Global Atmosphere Watch Radiation Measurements

Project leader and team:

Dr. Laurent Vuilleumier, project leader
Dr. Rolf Philipona, Dr. Stephan Nyeki, Armand Vernez

Project description:

In 2006 began the integration of the data acquisition infrastructure of the GAW Swiss Atmospheric Radiation Monitoring program (CHARM) in the main MeteoSwiss ground measurement network SwissMetNet (SMN). This required the interruption of the radiation monitoring while the infrastructure is renewed, which resulted in a lower than usual data availability. The CHARM radiation data was available 98.9% of the time until the 15/08/2006, when the data acquisition was stopped for the installation of a data acquisition system incorporated within SMN. Because SMN will include all standard surface meteorological stations as well as other stations such as the CHARM stations with common data acquisition software, hardware, and a dedicated data transmission network, resources can be focused on insuring the reliability of this network, and CHARM will profit from it. In addition, this common network will improve the compatibility of CHARM data with other meteorological data, and the maintenance of CHARM will be simplified. Finally, this will insure that CHARM data acquisition hardware and software are updated with state-of-the-art technology. While the data acquisition infrastructure is renewed, the measurement program is maintained with the same parameters using the same instrument models (brand and version) so that only one component of the general infrastructure is changed at a time. Thus, the configuration is the same than described in the 2002 HFSJG Activity Report.

Surface radiation flux measurements at Jungfraujoch are included in the dataset of the Alpine Surface Radiation Budget network (ASRB). During the data acquisition interruption related to the SwissMetNet infrastructure renewal, a self-sufficient traveling standard used by ASRB has been installed independently at Jungfraujoch. This device measures the main surface radiation budget downward components (short-wave and long-wave downward irradiance), and will allows closing the data gap in the CHARM data for these two parameters.

A project focused on analyzing the time evolution of aerosol optical depth (AOD) in Switzerland and Germany has been initiated in 2006. Aerosols are expected to play an important role with regard to climate change. Both their direct and indirect effects are responsible for large uncertainties in the prediction of climate evolution. While satellites are used for monitoring the global evolution of aerosol, ground-based measurements allow long-term series to be determined with a high level of accuracy and especially stability. Aerosol optical depth is one of the key aerosol optical properties that are continuously monitored from the ground for one to two decades at a series of stations. An accurate knowledge of the evolution of AOD is therefore important with regard to atmospheric transmittance and absorptance, cloud formation and cloud properties.

Aerosol Optical Depth (AOD) measurements are made by MeteoSwiss in Switzerland with automated sunphotometers (SPMs) and precision filter radiometers (PFRs) at several stations since about 1991. In Germany similar measurements started already in 1986 by the German weather service DWD. Part of this AOD data has already been analyzed and published (Schmid et al., 1997; Weller et al., 1998; Ingold et al., 2001, Weller and Gericke, 2005). However, a comprehensive analysis combining the results from all these stations has not yet been conducted.

The aim of this project is analyzing continuous AOD measurements at six to eight stations in Europe over the last two decades in collaboration between several institutions in Europe (MeteoSwiss, DWD, PMOD/WRC, and Bern University). This would allow establishing the climatology and trend of this parameter for the studied region. The stations are located in Germany (Zingst, Lindenberg, Hohenpeissenberg) and in Switzerland (Payerne, Bern, Locarno-Monti, Davos, Jungfraujoch) and cover a large part of main Europe and range from sea level all the way up to the Jungfraujoch. The AOD investigations will cover the time period 1986 to 2005.

Some analysis of the AOD has already been accomplished particularly for the German stations. However, a large part of the analysis remains to be done on the measurements of the Swiss stations. Such analysis was started in the framework of the NCCR Climate program P2.4, within an analysis of water vapor measurements with PFRs (Nyeki et al., 2005), but the project was focusing on water vapor.

Such a study will allow studying data from station representing a large diversity of environment. This will allow distinguishing between local specificities and characteristics representative of larger regions. In addition, the following issues will be specifically investigated:

1. The evolution of AOD over the first decade will be briefly discussed and referenced to other papers. A more extended analysis of possible trends will be made on the second decade (1996 to 2005) with a specific emphasis on the dependence on altitude.
2. In the radiation budget a change of AOD should primarily have an impact on the shortwave radiation under cloud-free skies. Therefore the analysis will be completed with an investigation of shortwave radiation under cloud-free conditions at the six stations.

References:

Ingold, T., C. Mätzler, A. Heimo and N. Kämpfer (2001) Aerosol optical depth measurements by means of a Sun photometer network in Switzerland. J. Geophys. Res., 106, 27537-27554.

Nyeki, S., L. Vuilleumier, J. Morland, A. Bokoye, P. Viatte, C. Mätzler, and N. Kämpfer (2005), A 10-year integrated atmospheric water vapor record using precision filter radiometers at two high-alpine sites. Geophys. Res. Lett., 32, L23803, http://dx.doi.org/10.1029/2005GL024079

Schmid, B., C. Mätzler, A. Heimo and N. Kämpfer (1997) Retrieval of optical depth and particle size distribution of tropospheric and stratospheric aerosols by means of sun photometry. IEEE Transactions on Geosciences and Remote Sensing, 35, 172-182.

Weller, M., E. Schulz, U. Leiterer, T. Naebert, A. Herber and L.W. Thomason (1998) Ten years of aerosol optical depth observation at the Lindenberg meteorological observatory. Contr. Atmos. Phys., 71, 387-400.

Weller, M., and K. Gericke (2005) Long-term observations of aerosol optical depths at the meteorological observatory Lindenberg. Meteorologische Zeitschrift, 14, http://dx.doi.org/10.1127/0941-2948/2005/0070.

Key words:

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

Internet data bases:

http://www.iapmw.unibe.ch/research/projects/STARTWAVE/startwave_dbs.html (IWV STARWAVE data)
http://wrdc.mgo.rssi.ru/ (World Radiation Data Centre – WRDC)

Collaborating partners/networks:

- Integrated water vapor data submitted to the NCCR Climate P2.4 STARTWAVE database at the Institute for Applied Physics, University of Bern.
- Radiation data submitted to the World Radiation Data Centre (WRDC, St. Petersburg, Russian Federation) within the framework of the Global Atmosphere Watch
- Study of AOD evolution in collaboration with the German Weather Service (DWD) and the Institute for Applied Physics, University of Bern.

Scientific publications and public outreach 2006:

Refereed journal articles

Morland, J., M. A. Liniger, H. Kunz, I. Balin, S. Nyeki, C. Mätzler, and N. Kämpfer (2006), Comparison of GPS and ERA40 IWV in the Alpine region, including correction of GPS observations at Jungfraujoch (3584 m), *J. Geophys. Res.*, **111**, D04102, http://dx.doi.org/doi:10.1029/2005JD006043.

Morland, J., B. Deuber, D. G. Feist, L. Martin, S. Nyeki, N. Kämpfer, C. Mätzler, P. Jeannet, and L. Vuilleumier (2006), The STARTWAVE atmospheric water database, *Atmos. Chem. Phys.*, **6**, 2039–2056, http://www.atmos-chem-phys.net/6/2039/2006/.

Conference papers

Vuilleumier, L. and S. Nyeki (2006), Aerosol Optical Depth and Integrated Water Vapor column from solar photometry at Swiss Alpine sites, *9th BSRN Scientific Review and Workshop*, 29 May–2 June 2006, Deutsche Wetterdienst, Lindenberg, Germany

Vuilleumier, L., A. Vernez and S. Nyeki (2006), GAW-CH Radiation Measurements at Jungfraujoch, *Research at the Jungfraujoch - Top of science*, 11-14 September 2005, Interlaken, CH.

Data books and reports

“Ozone, rayonnement et aérosols (GAW)” in Annalen 2005 MeteoSchweiz, Zürich SZ ISSN 0080-7338 pp. 113–130.

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