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Cloud Effect on Surface Radiation at Payerne, Switzerland

D. Nowak (1,2), L. Vuilleumier (2) and C. N. Long (3)

(1) Swiss Federal Institute of Technology Zurich, Switzerland, (2) Federal Office of Meteorology and Climatology (MeteoSwiss), Payerne, Switzerland, (3) Pacific Northwest National Laboratory, Washington, USA (daniela.nowak@env.ethz.ch / Phone: +41 26-6626211)

The effect of clouds on radiation is responsible for large uncertainties in climatology (IPCC, 2001). This project aims at improving information on the effects of clouds on radiation with separate analyses of different cloud classes. The effects of stratiform clouds on solar radiation are analysed. The net radiation effect, the absorption, transmission and reflectance of clouds are considered.

Data used for the analyses are a) radiation observation on the ground, measured at the Baseline Surface Radiation Network (BSRN) station at Meteoswiss Payerne, b) Ceilometer data, c) Total Sky Imager, d) cloud radar measurements and e) radiosonde profiles. The Short Wave Flux Analysis (SWFA) algorithm of C. N. Long (2004) is used for estimations of the clear sky radiation, while the radiative transfer model MODTRAN is used in the determination of the absorption, transmission and reflectance.

The Long and Ackerman SWFA algorithm was applied on six years of shortwave and longwave radiation data from the Payerne BSRN station. This allowed determining the cloud effect on incoming radiation by calculating the difference between the observed radiation (all sky measurements BSRN) and the estimated clear sky radiation. Clouds were responsible for a 72 Wm^{-2} reduction of shortwave incoming radiation, and a 36 Wm^{-2} increase on longwave incoming radiation. The net effect on the incoming radiation was a reduction by 36 Wm^{-2}. For two specific cloud types, more detailed analyses were performed to determine their impact on radiation. Stratus nebulosus and nimbostratus with 100% coverage were chosen, and the analysis was performed

on the period 1998 – 2003. Information about cloud type and cloud amount was retrieved from the synoptic observations. For complete coverage with stratus nebulosus the net effect on incoming radiation was a 4.8 Wm^{-2} reduction, averaged over 1998 – 2003 with respect to clear sky situations. The net effect for complete coverage with nimbostratus was an increase of 19.5 Wm^{-2} for the same time period.

To further analyse the effect of these cloud types, clear sky cases and cases with well described cloud situations are analysed with the radiative transfer model MODTRAN to provide detailed information on the processes determining how much of the solar radiation is absorbed, transmitted and reflected back to space. First results of the model calculations will be presented.

Long, C. N., 2004: The Next Generation Flux Analysis: Adding clear-sky LW and LW Cloud Effects, Cloud Optical Depths, and Improved Sky Cover Estimates., 14th ARM Science Team Meeting Proceedings, Albuquerque, New Mexico, March 22-26, 2004.