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The STARTWAVE atmospheric water database

J. Morland[1], B. Deuber[1,*], D. G. Feist[1], L. Martin[1], S. Nyeki[1,2], N. Kämpfer[1], C. Mätzler[1], P. Jeannet[2], and L. Vuilleumier[2]

[1]Institute of Applied Physics, University of Bern, Sidlerstrasse 5,Bern 3012, Switzerland

[2]MeteoSwiss, Atmospheric Data Department, Les Invuardes, Payerne 1530,Switzerland

[*]now at: BKW FMB Energie AG, Switzerland

Abstract. The STARTWAVE (STudies in Atmospheric Radiative Transfer and Water Vapour Effects) project aims to investigate the role which water vapour plays in the climate system, and in particular its interaction with radiation. Within this framework, an ongoing water vapour database project was set up which comprises integrated water vapour (IWV) measurements made over the last ten years by ground-based microwave radiometers, Global Positioning System (GPS) receivers and sun photometers located throughout Switzerland at altitudes between 330 and 3584 m. At Bern (46.95° N, 7.44° E) tropospheric and stratospheric water vapour profiles are obtained on a regular basis and integrated liquid water, which is important for cloud characterisation, is also measured. Additional stratospheric water vapour profiles are obtained by an airborne microwave radiometer which observes large parts of the northern hemisphere during yearly flight campaigns. The database allows us to validate the various water vapour measurement techniques. Comparisons between IWV measured by the Payerne radiosonde with that measured at Bern by two microwave radiometers, GPS and sun photometer showed instrument biases within ±0.5 mm. The bias in GPS relative to sun photometer over the 2001 to 2004 period was –0.8 mm at Payerne (46.81° N, 6.94° E, 490 m), which lies in the Swiss plains north of the Alps, and +0.6 mm at Davos (46.81° N, 9.84° E, 1598 m), which is located within the Alps in the eastern part of Switzerland. At Locarno (46.18° N, 8.78° E, 366 m), which is located on the south side of the Alps, the bias is +1.9 mm. The sun photometer at Locarno was found to have a bias of –2.2 mm (13% of the mean annual IWV) relative to the data from the closest radiosonde station at Milano. This result led to a yearly rotation of the sun photometer instruments between low and high altitude stations to improve the calibrations. In order to demonstrate the capabilites of the database for studying water vapour variations, we investigated a front which crossed Switzerland between 18 November 2004 and 19 November 2004. During the frontal passage, the GPS and microwave radiometers at Bern and Payerne showed an increase in IWV of between 7 and 9 mm. The GPS IWV measurements were corrected to a standard height of 500 m, using an empirically derived exponential relationship between IWV and altitude. A qualitative comparison was made between plots of the IWV distribution measured by the GPS and the 6.2 µm water vapour channel on the

Meteosat Second Generation (MSG) satellite. Both showed that the moist air moved in from a northerly direction, although the MSG showed an increase in water vapour several hours before increases in IWV were detected by GPS or microwave radiometer. This is probably due to the fact that the satellite instrument is sensitive to an atmospheric layer at around 320 hPa, which makes a contribution of one percent or less to the IWV.

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