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A complete long-term series of integrated water vapour from ground-based microwave radiometers

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Integrated water vapour (IWV) is the vertical column density of atmospheric water vapour. IWV can be determined from microwave radiances measured by multi-channel radiometers at ground or in space. Quality and quantity of IWV measurements rapidly increased during the last 10 to 20 years. Global maps and time series of IWV give evidence for a strong spatio-temporal variability of atmospheric water vapour, playing a key role in weather prediction and climate change research. We analyse the relationships between microwave radiances and IWV using long-term observations of two radiometers at Bern, Switzerland. The first radiometer (TROWARA) measures 21, 31 GHz-radiances and permits the accurate retrieval of IWV. The long-term series of TROWARA have some data gaps which possibly influence the trend analysis. On the other hand, the series of 142 GHz-radiance of the second radiometer (GROMOS) are almost complete. The 142 GHz-radiance is more affected by integrated cloud liquid water (ILW) than the 21, 31 GHz-radiances. The coincident radiometer data of GROMOS and TROWARA are utilized for exploration of the relationship between 142 GHz-radiance, IWV, and ILW. IWV is calculated from the 142 GHz-radiance of GROMOS when TROWARA data are not available. Thus we can derive a complete series of IWV above Bern from 1994 to 2009. The combination of both series and the trend analysis are performed by means of multiple linear regression and bootstrapping. The observations indicate a positive trend up to 10 percent/decade of IWV in summer and a negative trend of -20 percent/decade of IWV in winter.