



Analysis of integrated water vapour observed in a sub-arctic Finland area from GPS, ground-based microwave radiometers and RAOB data

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This study compares concurrent tropospheric integrated water vapour (IWV) values derived from GPS, two ground-based microwave radiometers (MWRs) and radiosonde (RAOB) data collected in Hyttiälä (Finland, 61°51' N, 24°17' E) where two MWRs operated during the 2014 Biogenic Aerosols–Effects on Clouds and Climate (BAECC) research campaign. The MWRs were deployed as part of the US Dep. of Energy Atmospheric Radiation Measurement (ARM) program mobile facility, with channels at 23.8, 31.4, 30.0 and 89.0 GHz. During the research campaign, atmospheric profiles were collected by radiosondes Vaisala RS92 launched four times a day near the MWRs stations. Moreover, about 20 km away from the MWR stations, in Orivesi (61°36' N, 25°40' E) a GPS ground-based receiver was operating providing data to derive IWV values. The Finnish Geodetic Institute manages this GPS station.

The GPS data were processed in PPP mode using GIPSY-OASIS II and the state-of-the-art processing options to derive zenith total delay with a 5-minute sampling. The wet delay was derived from the total delay and from this the IWV was estimated using a specific “a priori” computed conversion coefficient. To calculate IWV from MWR observations, six different retrieval algorithms were developed and tested, and the algorithm yielding the best fit was selected for further analysis. All retrieval coefficients used here were determined from simulations by applying the Radiative Transfer Equation (RTE) together with an appropriate cloud model to a representative database of RAOB profiles. These RAOB data were collected from 2000 to 2013 in Jyväskylä (62°24' N, 25°40' E), located about 120 km away from the MWR stations. The derived coefficients were then applied to the data in Hyttiälä.

In this work we present an inter-comparison analysis of the IWV from the three methodologies to highlight performances, strengths and weaknesses of each instrument in this particular climatic region. To perform the above mentioned analysis scatterplots of concurrent IWV values from MWRs, RAOB and GPS have been used.