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Column water vapour: An intertechnique comparison of estimation methods in Estonia

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Despite of different estimation techniques for integrated column water vapour (precipitable water, PW, W), no method is identified as the most accurate or reference method. In this work we report intercomparisons, by assessing the reliability, linear fits, correlations and biases, between four W estimation methods — radiosonde, AERONET, GPS and HIRLAM. Two intensive observational periods at Tõravere, Estonia, were used: (1) 9–12 August 2010, and (2) 22 June – 7 November 2008.

For the first, short campaign, data obtained with all four methods were available. During the campaign, 17 GRAW DFM-06 (Germany) sondes were launched. Average differences between W, from radiosonde, as a traditional instrument, and other three methods were smaller than 5%. HIRLAM produced the lowest W estimates of the four methods. Considering the second, longer campaign, only observations by GPS, AERONET and HIRLAM were conducted (GPS-registered W ranged from 4.3 to 42.8 mm). By analyzing more than 1000 concurrent observations, a good agreement among all three methods was established: W(GPS) was 1% higher than W(HIRLAM) and 3% higher than W(AERONET), W(HIRLAM) was 2% higher than W(AERONET). The comparison indicates that correlations between different techniques were high, with coefficient of determination (R^2) above 0.86 in all cases. However, compared to HIRLAM and GPS, AERONET overestimated W by 5–9% at $W < 12$ mm and underestimated by 6–10% at $W > 25$ mm. Relatively low temporal and spatial resolution of the HIRLAM grid caused higher scatter from other methods.

The study suggests that besides radiosonde, as a traditional meteorological tool, the most reliable W estimation is by GPS.