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A kite-based approach for water-vapor lidar calibration and application to multi-platform intercomparison in the Western Mediterranean during ChArMEx/ADRIMED

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In the framework of the ADRIMED campaign included in the ChArMEx (Chemistry Aerosol Mediterranean Experiment) research program, performed in June 2013 in the western Mediterranean, the mobile Water vapor Aerosol LIdar (WALI) developed by LSCE was deployed at Cap d'en Font on the island of Menorca (Spain). Alongside an elastic backscatter channel, it features depolarization, N_2- and H_2O-Raman channels, the two latter yielding profiles of atmospheric water vapor mixing ratio (WVMR). The water content thus provided by the lidar is essential to validate models or satellite water vapor products for meteorological purposes. It also proved to be very helpful in characterizing particle types and sources, especially for the multi-layer situations observed during the ChArMEx/ADRIMED special observation period. Beforehand, however, a precise calibration of the WVMR had to be done on-site. Balloon rawindsoundings performed by CNES were available about 10 km off-site on Saint-Lluis aerodrome or 100 km away on Majorca for this purpose, but strong inhomogeneities in the WVMR observed under 2 km altitude prevent an accurate calibration and the determination of the lidar overlap factor, which biases WVMR retrieval under 300 m. Instead, we propose the use of a lightweight Pressure-Temperature-Relative Humidity (PTU) sound carried under a simple kite to perform a co-localized sounding. Modern kites indeed combine the advantages of an easy deployment and the possibility of longer, more precise soundings in the low troposphere. After showing that this approach leads to calibration with less than 2% error from 80 m altitude, we validate it against rawindsounding WVMR profiles, with very good agreement at high altitude. We also present further comparisons between the lidar-derived WVMR and the one given by meteorological model reanalyses (AROME, ECMWF) or satellite inversion products (IASI).