



Supplement of

Validation of aerosol backscatter profiles from Raman lidar and ceilometer using balloon-borne measurements

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Date of COBALD sounding	Host radiosonde	Remote sensing data
2014, 22 January	SRS-C34	CHM15K
2014, 20 March	SRS-C34	CHM15K
2014, 17 July	SRS-C34	CHM15K
2014, 28 October	SRS-C34	CHM15K
2014, 19 November	SRS-C34	CHM15K
2015, 15 April	SRS-C34	CHM15K
2015, 12 May	SRS-C34	CHM15K
2015, 11 June	SRS-C34	CHM15K
2015, 4 August	SRS-C34	CHM15K
2015, 2 October	SRS-C34	CHM15K
2015, 10 November	SRS-C34	CHM15K
2016, 6 April	SRS-C34	RALMO, CHM15K
2016, 3 May	SRS-C34	CHM15K
2016, 17 May	SRS-C34	RALMO, CHM15K
2016, 28 June	SRS-C34	RALMO, CHM15K
2016, 23 August	SRS-C34	RALMO, CHM15K
2016, 29 November	SRS-C34	RALMO, CHM15K
2017, 11 July	SRS-C34	RALMO, CHM15K
2017, 22 August	SRS-C34	RALMO, CHM15K
2018, 12 July	RS41	RALMO, CHM15K
2018, 28 August	RS41	RALMO, CHM15K
2018, 4 September	RS41	RALMO, CHM15K
2018, 30 October	RS41	CHM15K
2019, 5 March	RS41	RALMO, CHM15K
2019, 19 March	RS41	RALMO, CHM15K
2019, 30 April	RS41	RALMO, CHM15K
2019, 25 June	RS41	CHM15K
2019, 12 September	RS41	RALMO, CHM15K
2019, 17 September	RS41	RALMO, CHM15K
2019, 19 September	RS41	RALMO, CHM15K
2019, 10 October	RS41	RALMO, CHM15K

Table S1. List of dates of all COBALD soundings used for the statistical comparison, including information on host radiosonde model (MeteoLabor SRS-C34 or Vaisala RS41) and simultaneously available remote sensing data (RALMO and/or CHM15K).

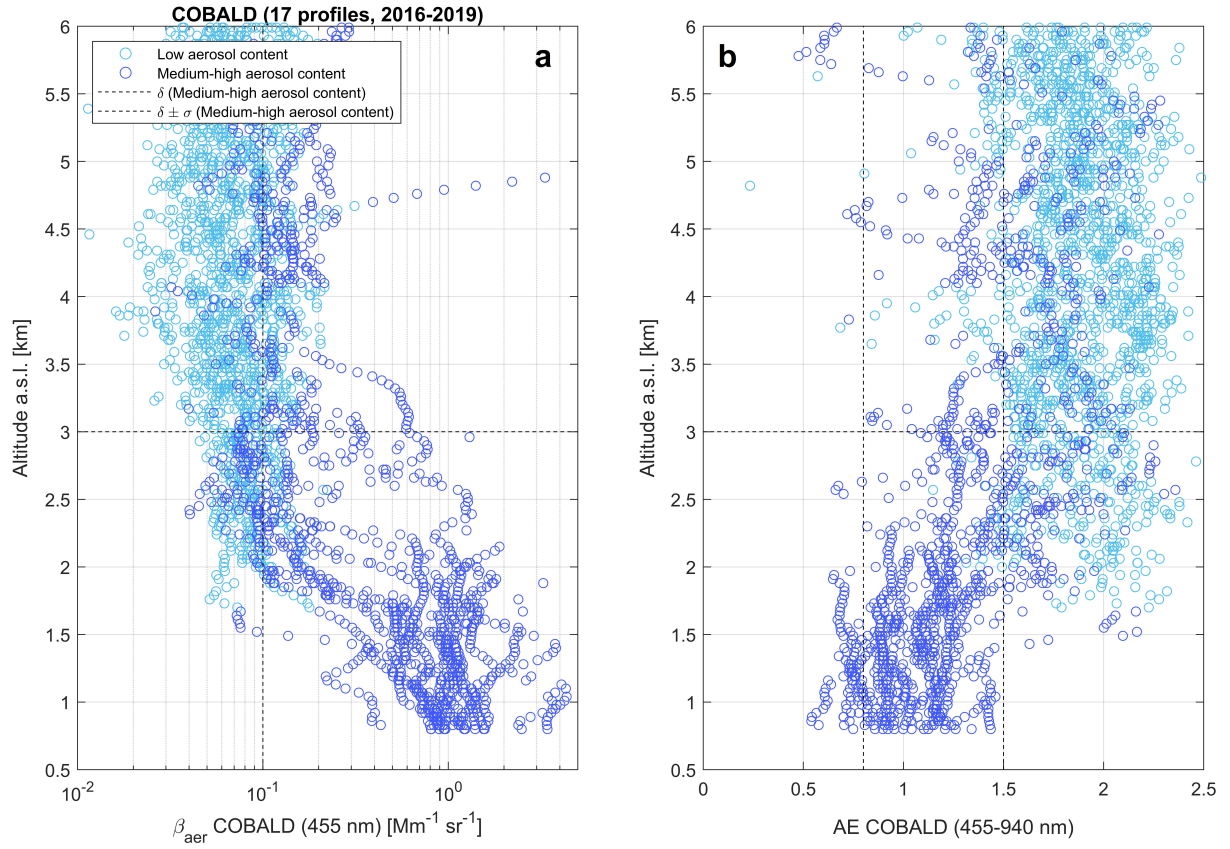


Figure S1. Panel (a): all medium-migh aerosol content (dark blue circles) and low aerosol content (light blue circles) data points of the COBALD aerosol backscatter coefficient (β_{aer}) at 455 nm, as function of altitude. The 0.1 $\text{Mm}^{-1} \text{sr}^{-1}$ threshold in COBALD β_{aer} , separating low from medium-high aerosol content data at 455 nm (as described in Section 3.3), is shown by a vertical black dashed line. Panel (b): same as Panel (a), for COBALD-derived Angstrom exponent (AE) between 455-940 nm. Vertical black dashed lines indicate the thresholds of AE = 0.8 and AE = 1.5 used for the parameterization of the correction factors (see Section 3.2).

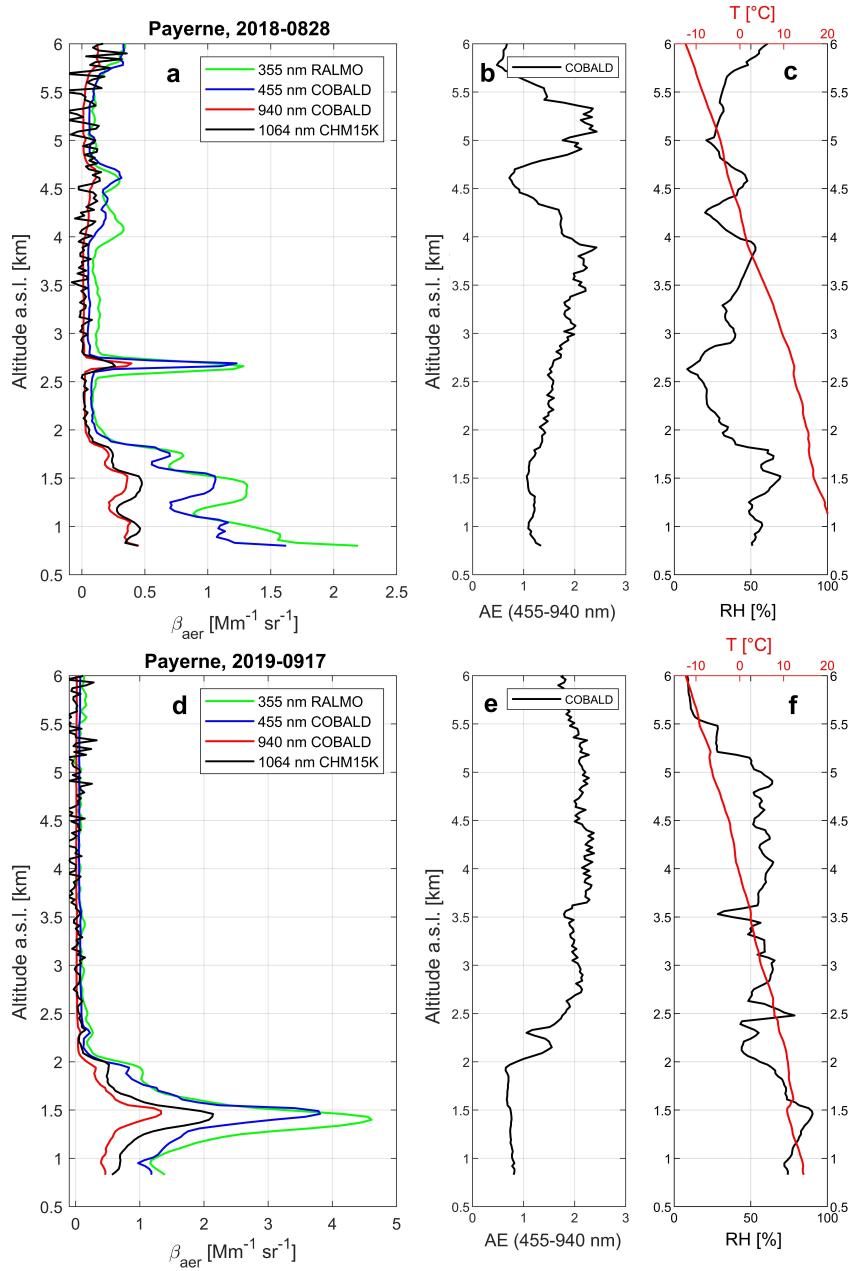


Figure S2. Overview of selected profiles measured on 28 August 2018 (Panels a-c) and 19 September 2019 (Panels d-f). Panels (a, c): vertical profiles of aerosol backscatter coefficient (β_{aer}) as function of altitude, measured by RALMO (355 nm, green), COBALD (455 nm, blue and 940 nm, red) and CHM15K (1064 nm, black). Panels (b, d): vertical profiles of Angstrom exponent (AE) for wavelengths 455-940 nm, calculated from the COBALD data. Panels (c, f): vertical profiles of relative humidity (RH, black) and temperature (red, top scale) measured by the Vaisala RS41-SGP radiosonde (flying in tandem with the COBALD sonde).

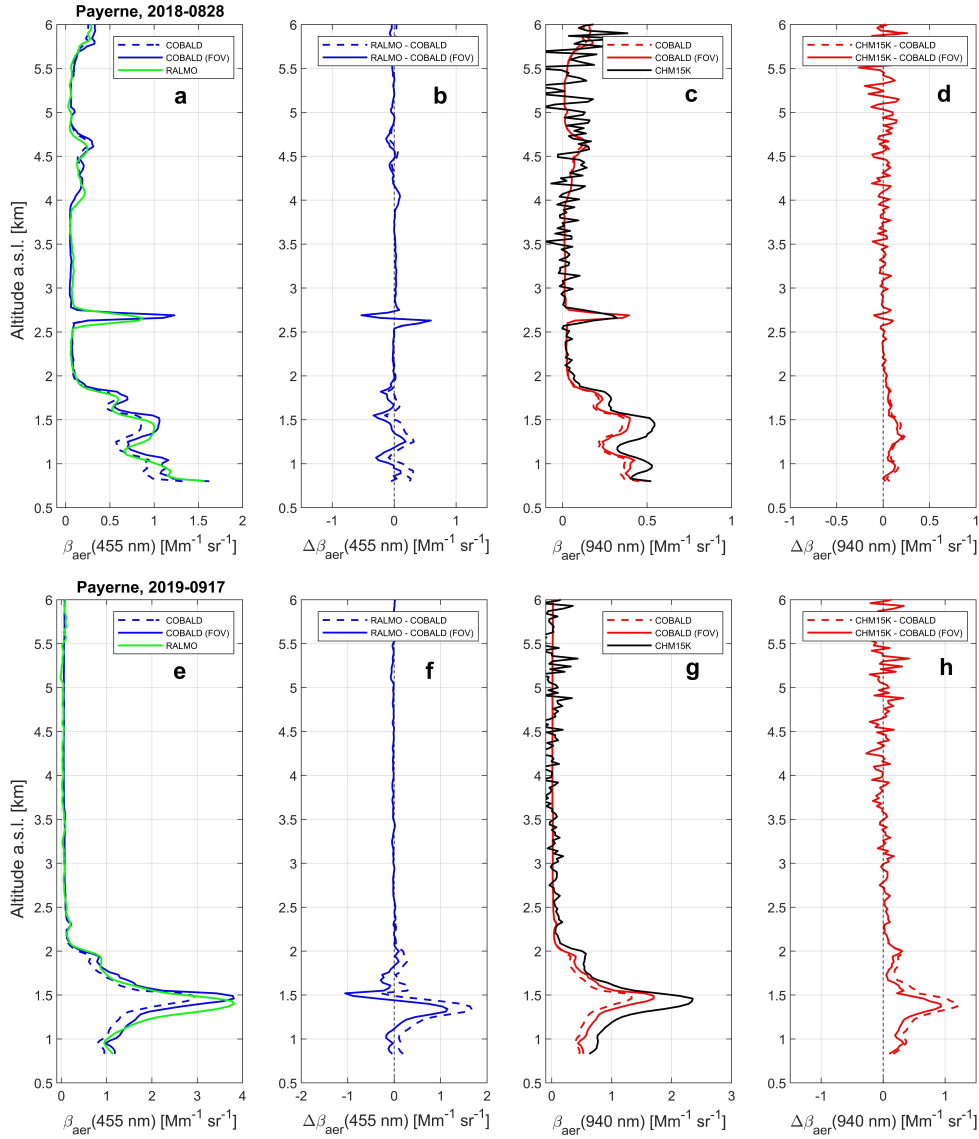


Figure S3. Quantitative comparison of RALMO vs. COBALD (Panels a-b, e-f) and CHM15K vs. COBALD (Panels c-d, g-h) for the selected profiles measured on 28 August 2018 (Panels a-d) and 19 September 2019 (Panels e-h). Panels (a, e): vertical profiles of aerosol backscatter coefficient (β_{aer}) at 455 nm measured by RALMO (green) and COBALD (blue), both without (dashed) and with (solid) application of the FOV correction. Panels (b, f): vertical profiles of the RALMO – COBALD difference in β_{aer} ($\Delta\beta_{aer}$) at 455 nm, both without (dashed) and with (solid) application of the FOV correction. Panels (c, g): vertical profiles of β_{aer} at 940 nm measured by CHM15K (black) and COBALD (red), both without (dashed) and with (solid) FOV correction. Panels (d, h): vertical profiles of $\Delta\beta_{aer}$ for CHM15k – COBALD at 940 nm, both without (dashed) and with (solid) FOV correction.