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The realization of autonomous, aircraft-based, real-time aerosol mass spectrometry in the upper troposphere and lower stratosphere

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S1 Instrument design and performance

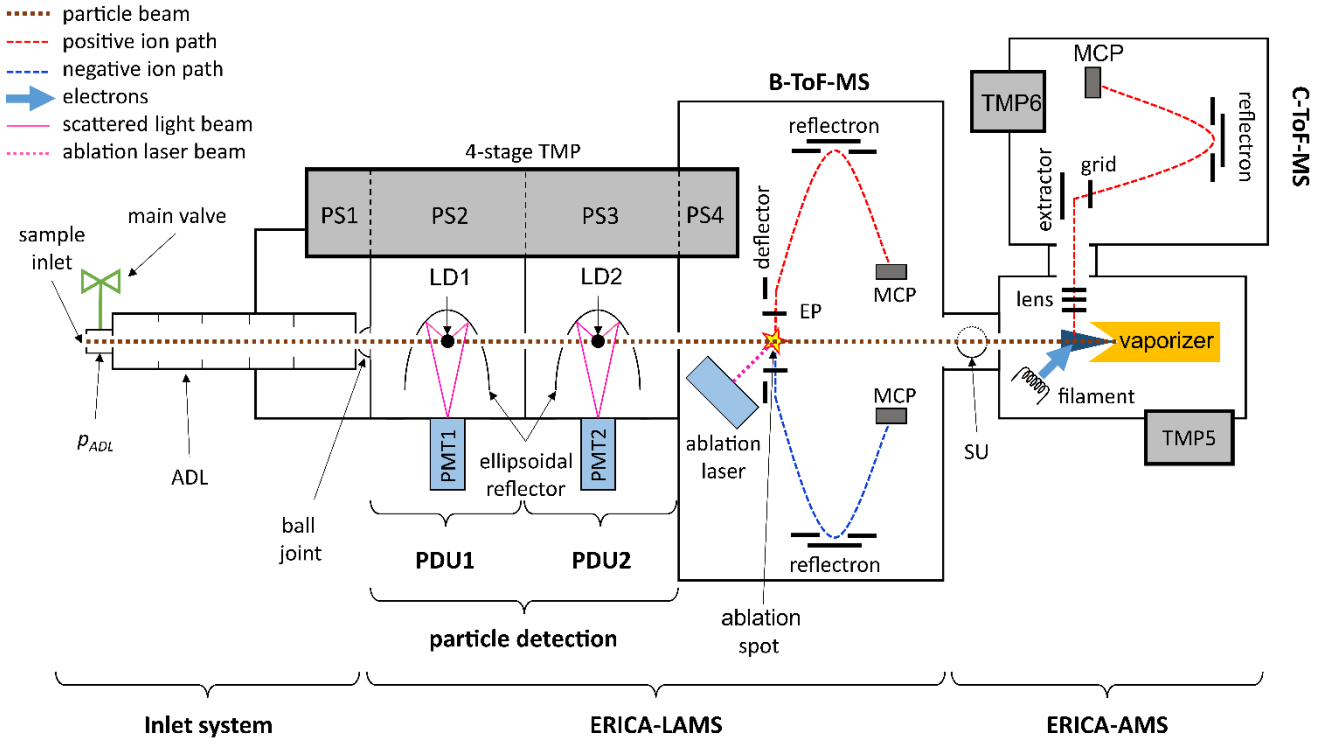

Figure S1 - A simplified drawing of the ERICA mass spectrometer. This figure is also presented in Hünig et al. (2022).

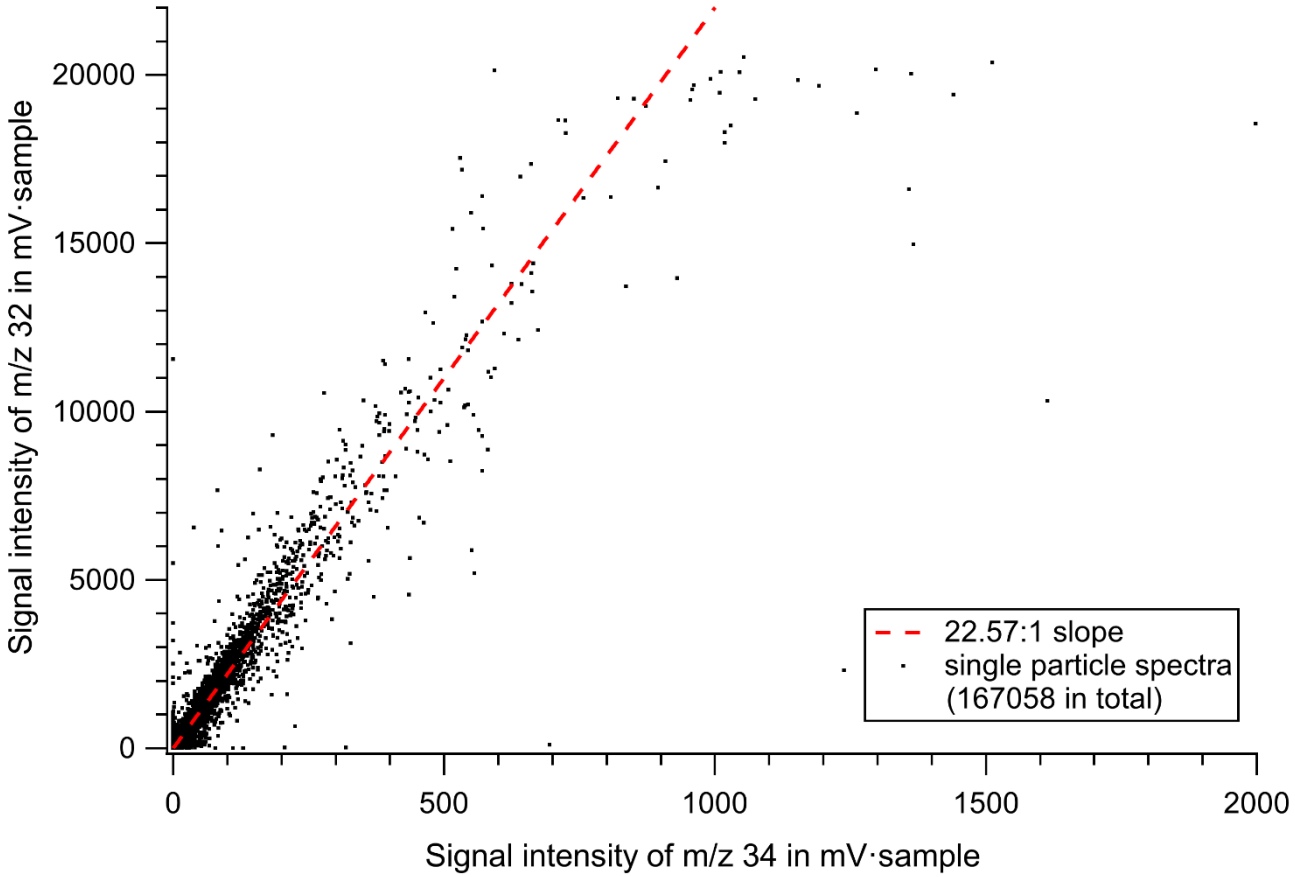

Figure S2 – Signal intensity of m/z 32 versus signal intensity of m/z 34 for a total number of 167058 analysed single particles using ERICA-LAMS. The dashed red line indicates the ratio of the naturally occurring abundance of the two respective isotopes of sulfur (^{32}S and ^{34}S).

S2 Aircraft inlet

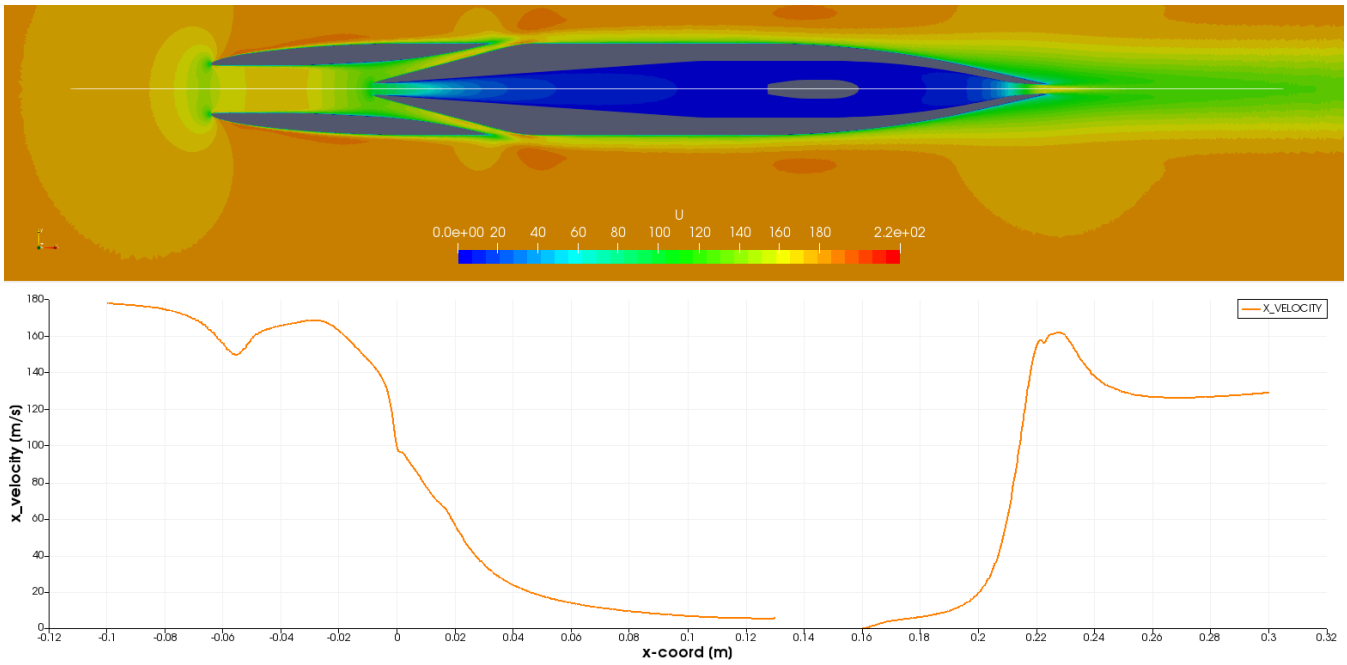

Figure S3 - Top panel: velocity distribution inside the inlet head (x-component) at 180 m s^{-1} true air speed and 55 hPa ambient pressure, modelled using Computational Fluid Dynamics (CFD) software (Ansys Fluent). Bottom panel: velocity profile along the inlet head long axis, only the x-component for the same parameters is shown. The plot illustrates that in the outer diffuser the velocity is reduced from 180 m s^{-1} to 6-7 m s^{-1}. Further reduction is accomplished by the inner diffuser, which is not included in this model.

S3 Software

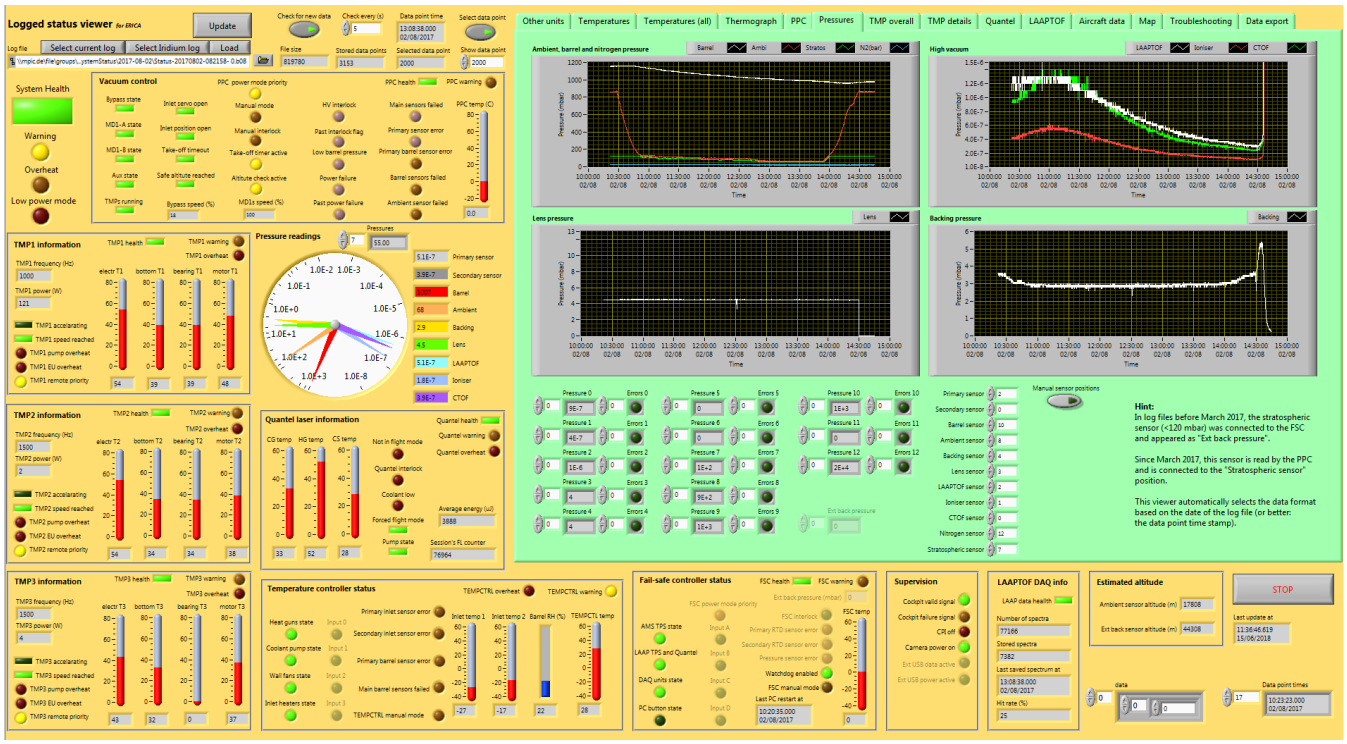

Figure S4 – The graphical user interface for remote system monitoring. The green system health indicator (top left) confirms that all critical parameters are within their respective acceptable ranges.

S4 Flight data

Table S1 - Flight information for the StratoClim project including all flights from Kalamata (KLX) and Kathmandu (KTM) airports

Flight name	Date (DD/MM/YYYY)	Flight duration (h:min)	Southern-most Latitude (° N)	Northern-most Latitude (° N)	Western-most Longitude (° E)	Eastern-most Longitude (° E)	Maximum flight altitude – barom. (m)	Maximum flight altitude – GPS (m)	Minimum ambient temperature (°C)	Minimum ambient pressure (hPa)	Number of recorded SAP bipolar spectra
KLX 1	30/08/2016	4:01	34.2060	38.4280	21.2940	30.8870	17761	18276	-71.6	77.8	3329
KLX 2	01/09/2016	4:27	34.4768	41.0369	21.3012	27.7897	19569	20030	-72.7	58.5	6314
KLX 3	06/09/2016	3:34	33.3993	37.2623	21.6674	31.8126	19845	20239	-71.7	56.0	2404
KTM 1	27/07/2017	2:46	23.8790	27.7864	84.9838	89.4201	18999	19463	-79.5	64.0	20518
KTM 2	29/07/2017	4:26	26.8689	29.4116	80.6550	87.3895	19994	20477	-78.9	54.7	18605
KTM 3	31/07/2017	4:39	21.2786	27.7943	78.8450	85.8700	19992	20372	-80.2	54.7	23927
KTM 4	02/08/2017	4:01	26.9618	29.4688	80.8401	87.2466	20017	20447	-81.6	54.5	14124
KTM 5	04/08/2017	4:21	26.9950	29.4143	80.9130	87.3183	19855	20274	-81.8	55.9	15868
KTM 6	06/08/2017	4:05	20.8300	27.7850	84.9920	90.6600	16249	17000	-81.4	98.7	18003
KTM 7	08/08/2017	3:34	20.9536	27.7890	85.0355	86.5105	18970	19429	-85.8	64.3	13625
KTM 8	10/08/2017	3:45	24.1188	29.0504	81.7349	86.2741	18653	19158	-86.1	67.6	13608
Total		49:26									150325

25

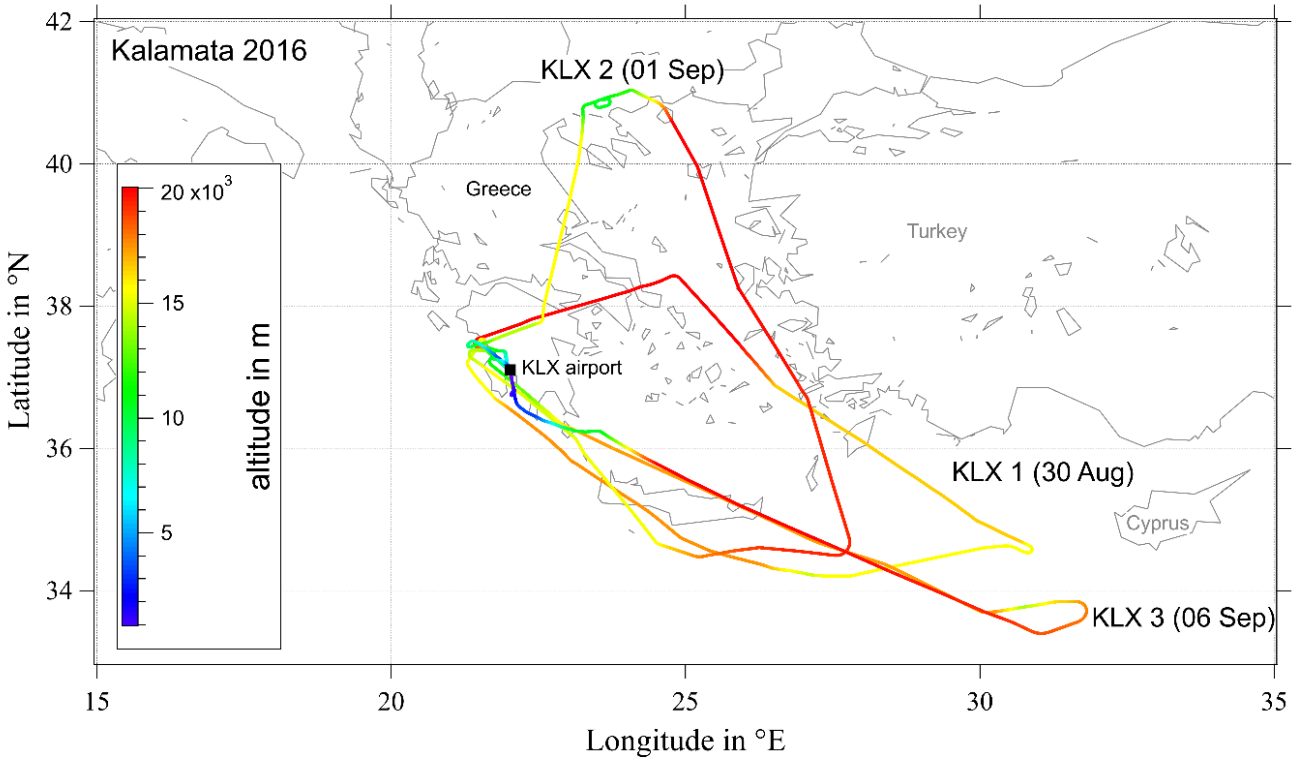

Figure S5 - Map of all three flights from Kalamata (KLX) airport. The colour scale depicts the flight altitude.

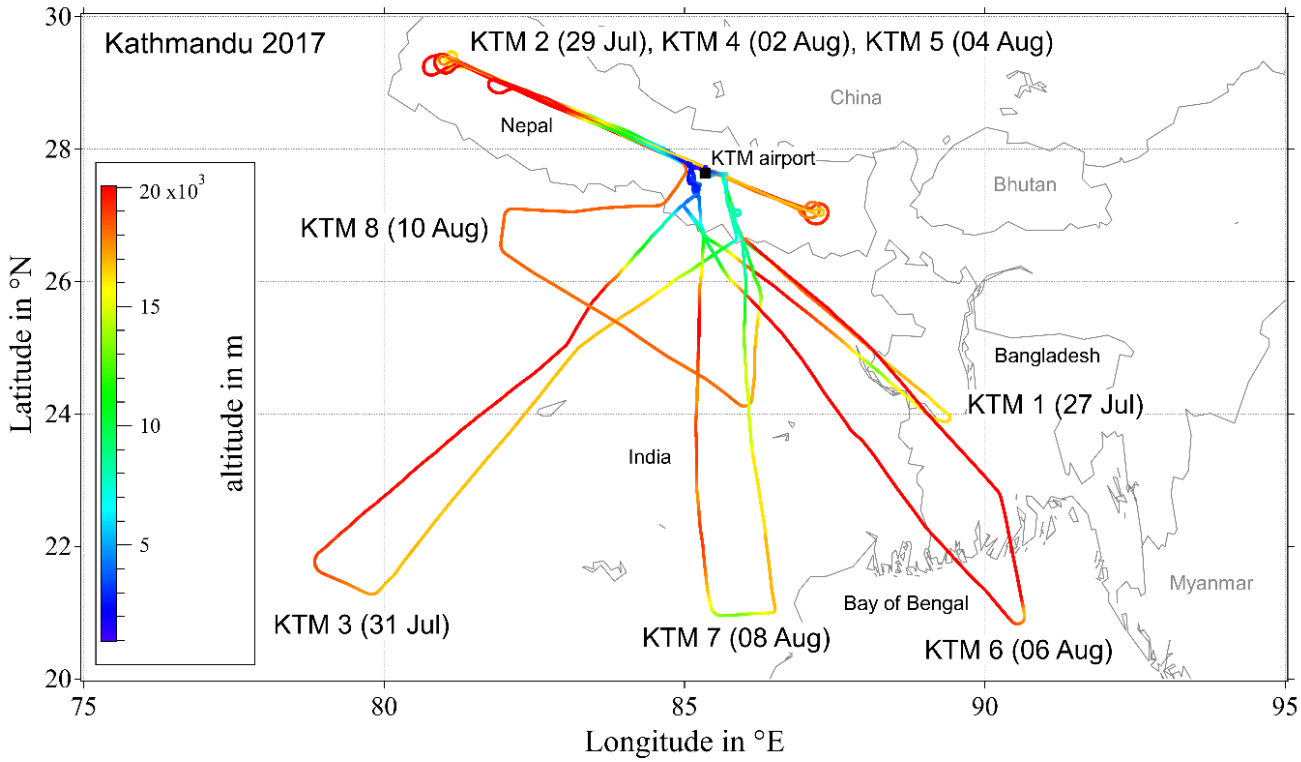

Figure S6 - Map of all eight flights from Kathmandu (KTM) airport. The colour scale depicts the flight altitude.

S5 Photographs

Figure S7 - Photographs from the ERICA deployment in the field: (a) the instrument and the Pressure Vessel (PV) in the hangar before installation, (b) the M-55 *Geophysica* at the apron with an air-conditioning unit attached to Bay II providing cooling to the ERICA, (c) close-up of the equipment installed at the bottom of the PV, (d) the ERICA installed on the aircraft as seen from the starboard side, the coiled-wire vibration isolators can be seen at the top and the removed cowling at the bottom of the photograph, and (e) the ERICA installed on the aircraft as seen from the port side, the electrical connections to the aircraft can be seen on the RHS of the photograph.

References

Hünig, A., Appel, O., Dragoneas, A., Molleker, S., Clemen, H. C., Helleis, F., Klimach, T., Köllner, F., Böttger, T., Drewnick, F., Schneider, J., and Borrmann, S.: Design, characterization, and first field deployment of a novel aircraft-based aerosol mass spectrometer combining the laser ablation and flash vaporization techniques, Atmos. Meas. Tech., 15, 2889-2921, 10.5194/amt-15-2889-2022, 2022.