

Supplementary Material

Table S1. List of items added to the UHSAS flow system

Part of the flow system	Item added	Specifications
Sample flow	Laminar flow element (LFE)	ID=0.069 cm Length=17.5 cm Laminar flow range: 0-0.1 L min ⁻¹
	Differential pressure transducer	Alicat, P-5in-dp, range: 0-2" H ₂ O
Sheath flow	Volumetric flow controller (VFC) replaces needle valve	Alicat, MC-15LPM, operated in volume flow control mode

Table S2. Thermodenuder components and dimensions

Part	Model	Manufacturer
Temperature controller	CN32PT-224-C24	Omega Engineering Inc., Stamford, CT, USA
Solid state relay	120D25	OPTO 22, Temecula, CA, USA
Platinum resistance temperature detector (RTD)	HEL-707-U-1-12-00	Honeywell Sensing and Control, Golden Valley, MN, USA
Cylindrical cartridge heater	HDC00066	Honeywell Sensing and Control, Golden Valley, MN, USA
Housing tube	stainless steel, ID=1.12 cm	
Perforated tube insert	PS4542A: Stainless Steel 17-4 PH	Xometry, Inc., Gaithersburg, MD, USA
Activated carbon fiber cloth	FlexZorb Thickness 0.3 mm	Calgon Carbon Corporation, Moon Township, Pennsylvania, USA

Table S3. Estimated relative uncertainties in aerosol number (σ_N), surface (σ_S) and volume (σ_V) at STP conditions. Uncertainties are calculated for representative size distributions in the marine boundary layer (MBL) and free troposphere (FT) using different averaging times.

Date and location	Integration time (s)	Counts	N	S	V	P	σ_N (%)	σ_S (%)	σ_V (%)
			(cm ⁻³)	($\mu\text{m}^2\text{cm}^{-3}$)	($\mu\text{m}^3\text{cm}^{-3}$)	(hPa)			
2017/02/05	1	31	34.1	2.376	0.074	1101	±18	+29.5/-43.0	+35.0/-55.8
MBL	10	297	27.4	2.888	0.177	1101	±5.9	+17.4/-29.7	+22.9/-40.5
32 °S	60	1654	27.4	2.81	0.14	1104	±2.6	+14.1/-26.6	+19.7/-38.0
2017/02/10	1	134	138.2	19.614	1.636	1061	±8.7	+20.2/-31.6	+25.7/-42.2
MBL	10	1582	150.3	26.065	2.779	1058	±2.7	+14.2/-25.2	+19.7/-36.0
59.77 °S	60	8705	145.9	25.585	2.628	1061	±1.4	+12.9/-23.9	+18.5/-34.7
2017/01/26	1	6	35.5	0.938	0.015	294	±40.8	+52.4/-70.8	+57.9/-86.3
FT	10	40	21.7	0.458	0.007	293	±15.8	+27.4/-47.1	+32.9/-62.9
4 °N	60	255	24.0	0.597	0.01	294	±6.3	+17.9/-36.4	+23.4/-50.9
2017/01/26	1	53	442.4	10.119	0.156	256	±13.8	+25.3/-44.4	+30.8/-59.5
FT	10	541	411.9	12.775	0.262	256	±4.4	+15.9/-33.1	+21.4/-46.3
18.7 °N	60	3208	438.9	13.994	0.361	256	±2.0	+13.5/-30.5	+19.0/-41.7

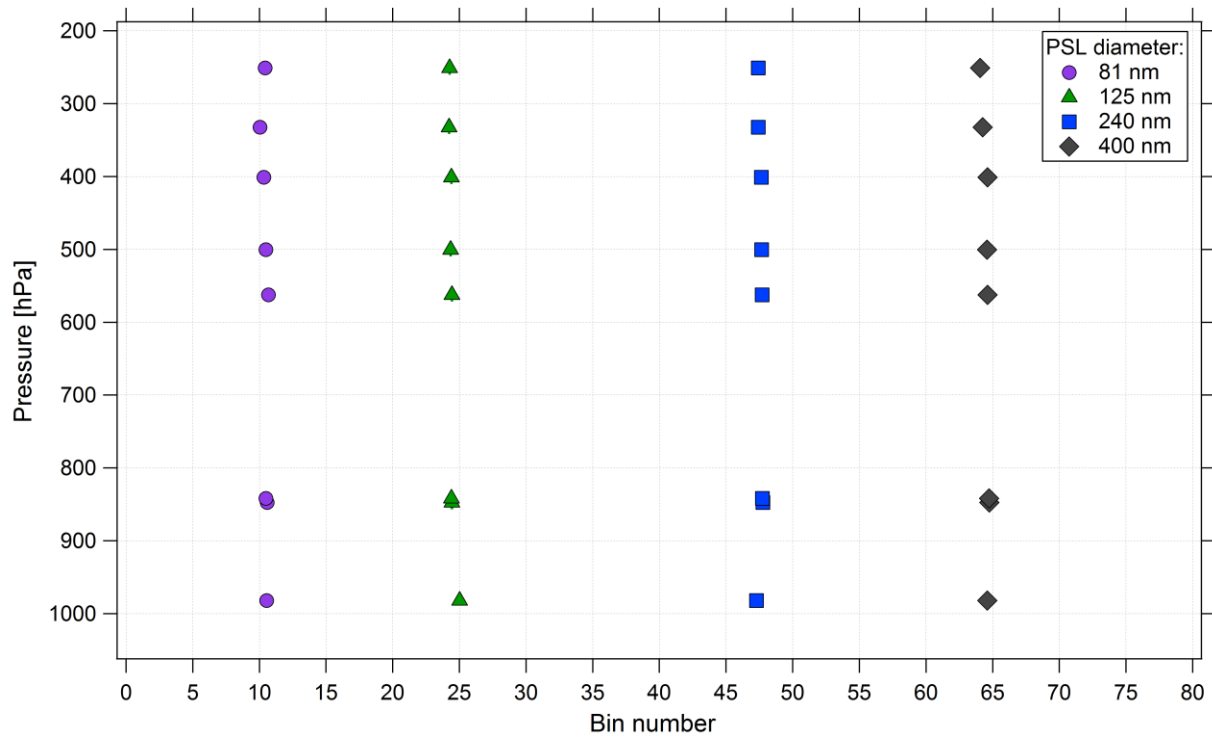


Fig.S1. UHSAS-2 sizing response to pressure change as a function of bin number for a mixture of four PSL particle sizes. Bin uncertainty, obscured by the symbols, is based on the uncertainty in a Gaussian fit to the size distribution histogram.