INSTRUMENTATION ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN CLAMS

(a) Navigational and Flight Characteristics

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Latitude and longitude	Global Positioning System (GPS)	Trimble TANS/Vector	Global (~2-5 m)	tans-lat (deg) tans-lon (deg)
True airspeed	Variable capacitance	Rosemount Model F2VL 781A	0 to 250 m s^{-1} (<0.2%)	tasknt (kts)
True airspeed	Air computer	Shadin	0 to 250 m s^{-1} (<0.2%)	shadin_tas
Heading	From TANS/Vector	Trimble TANS/Vector	0 to 360˚ (± 1˚)	tans-azimth (0 deg is true north)
Altitude	Global Positioning System (GPS)	Trimble TANS/Vector	0-9 km (±15-25 ft)	tans-altft (msl, ft)
Altitude above terrain	Radar altimeter	Bendix Model ALA 51A	Up to 0.75 km	ralt (agl, ft)
Pitch	Differential GPS	Trimble TANS/Vector	0 to 360˚ (±0.15˚)	Tans-pitch (nose up positive)
Roll	Differential GPS	Trimble TANS/Vector	0 to 360˚ (±0.15˚)	Tans-roll (right wing down negative)
Radar reflectivity	3 cm wavelength (pilot's radar)	Bendix/King (now Allied Signal)	250 km	(Not recorded)

(b) General Meteorological

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Pressure	Variable capacitance	Rosemount Model 830 BA	1100 to 150 mb (<0.2%)	pstat
Pressure altitude	Computed from pstat assuming standard atmosphere	—	0-9 km (Error depends on atmospheric conditions.)	palt (ft)
Total air temperature	Reverse-flow	In-house	-60 to 40˚C	ttotr (˚C)
Static air temperature	Calculated from Rosemount total temperature	Rosemount Model 102CY2CG and 414 L Bridge	-60 to 40˚C	tstat (˚C)
Static air temperature	Reverse-flow thermometer	In-house	-60 to 40˚C (<0.5˚C)	tstatr (˚C)
Dew point temperature	Cooled-mirror dew point	Cambridge System Model TH73-244	-40 to 40˚C (<1˚C)	dp (˚C)
Absolute humidity	IR optical hygrometer	Ophir Corp. Model IR-2000	0 to 10 g m^{-3} (~5%)	rhovo = Ophir2k absolute humidity (g/m3). (Also, dp_o = Ophir dew point (degC). oairt = Ophir2k air temperature (degC). rh_o = Ophir2k relative humidity (%).)
Wind direction	Calculated from TANS/Vector and Shadin	Trimble	0-360˚ (0 deg is magnetic north).	wind_dir
Wind speed	Calculated from TANS/Vector and Shadin	Trimble	—	wind_spd (kts)
Video image	Forward-looking camera and time code	Ocean Systems Splash Cam	—	—

(Cont.)

TABLE (continued)

(c) Aerosol

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Number concentration of particles (continuous flow)	Condensation particle counter	TSI Model 3022A	0-10^7 cm^{-3} (d>0.003 μm)	cnc1 (/cc)
Number concentration of particles (continuous flow)	Condensation particle counter	TSI Model 3025A	0-10^5 cm^{-3} (d>0.003 μm)	cnc2 (/cc)
Size spectrum of particles	Differential Mobility Particle Sizing Spectrometer (DMPS)	TSI (modified in-house)	0.01 to 0.6 μm (21 channels)	dmpsdn = DMPS d(log D) spectrum (/cc).
Size spectrum of particles	35 to 120° light-scattering	Particle Measuring Systems Model PCASP-100X	0.12 to 3.0 μm (15 channels)	pcasprt = PCASP 100 total concentration (/cc). pcaspdn = PCASP 100 concentration spectrum (/cc).
Total particle concentration	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3dn = fsp300 d(log D) spectrum (/cc).
Aerodynamic size spectrum of particles and relative light scattering intensity	"Time-of-flight"	TSI Model 3320 APS	0.5-20 μm (52 channels)	tsirt = TSI 3320 (total concentration (/cc)).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-100	2 to 47 μm (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).
Light-scattering coefficient	Integrating 3-wavelength nephelometer with backscatter shutter	MS Electron 3W-02	1.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 550 (green) and 700 (red) nm channels. 2.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 450 nm channel (blue)	nepblu = total scatter blue (/m). nepgrn = total scatter green (/m). nepred = total scatter red (/m). bkspbl = backscatter blue (/m). bkspgr = backscatter green (/m). bksprd = backscatter red (/m).
Light-scattering coefficient (ambient and extinction cell)	Integrating nephelometer	CE	10^{-7} to 10^{-2} m^{-1} at 537 nm	cetspb (/m) cetspgr (/m) cetsprd (/m)
Light-scattering coefficient (for bag-house samples)	Integrating nephelometer	Radiance Research M903	1.0×10^{-6} to 2.0×10^{-4} m^{-1} or 1.0×10^{-6} m^{-1} to 1.0×10^{-3} m^{-1}	Neph bag (m^{-1})
Light absorption and graphitic carbon	Particle soot absorption photometer (PSAP)	Radiance Research	Absorption coefficient: 10^{-7} to 10^{-2} m^{-1}; Carbon: 0.1 μm m^{-3} to 10 mg m^{-3} (±5%)	rams (m^{-1})
Aerosol mass, elemental composition (Na to Pb), electron microscopy†	Nucleopore filters	University of Sao Paulo (V. Martins)	Mass >1 μg m^{-3} Elemental composition >1 ng m^{-3}	
Spectral reflectance of aerosol*	Aerosol spectroreflectometer	Univ. Sao Paulo/ NASA Goddard/ Analytical Spectral Devices (V. Martins)	Reflectance from 100-50%	

(Cont.)

* Guest instrument

TABLE (continued)

(d) Cloud Physics

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Liquid water content	Hot wire resistance	DMT	0 to 5 g m^{-3}	lwdmt = cloud liquid water content from DMT (g/m^3)
Liquid water content; effective droplet radius; particle surface area	Optical sensor	Gerber Scientific Ins. PVM-100A	LWC = 0.001-10 g m^{-3}	lwpvm = cloud liquid water from PVM (g/m^3). erpvm = PVM100A effective radius (μm). psapvm = PVM100A raw surface area (cm^2/m^3). sapvm = PVM100A surface area [corrected using fssp100 drop rate] (cm^2/m^3).
Total particle concentration	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc). fsp3dn = fsp300 d(log D) spectrum (/cc).
Size spectrum cloud particles	Forward light-scattering	Particle Measuring Systems FSSP-100	2 to 47 μm (3 μm) (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).

(e) Chemistry

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
SO_2	Pulsed fluorescence	Teco 43S (modified in-house)	0.1 to 200 ppb	so2 (ppb) = Teco 43S
O_3	UV absorption	TEI Model 49C	1-1000 ppbv (<0.5 ppbv)	o3 = Pressure corrected TEI49C ozone concentration (ppb). (o3tei = Raw TEI49C ozone concentration (ppb).)
CO	IR correlation spectrometer	Teco Model 48	0-50 ppb (~0.1 ppmv)	co (ppb) = Teco 48 (ppb)
CO_2	Infrared correlation spectrometer	Li-Cor Li-6262	0 to 300 ppmv (0.2 ppmv at 350 ppmv)	co2 (ppm) = Licor 6262
Total particulate mass and species $SO_4^=$, NO_3^-, Cl^-, Na^+, K^+, NH_4^+, Ca^{++}, Mg^{++}	37 Teflon filters, gravimetric analysis and ion exchange chromatography	Gelman Dionix (UW)	0.1 to 50 μg m^{-3} (for 500 liter air sample)	—
Carbonaceous particles (black and organic carbon)*	Quartz filters (Thermal Evolution Techniques)	T. Novakov and T. Kirchstetter (LBNL)	4-160 μg m^{-3} (±1.6 μg m^{-3}) for 1 m^3 sample	—

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* Guest instrument

TABLE (continued)

(f) Radiation

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
UV hemispheric radiation, one upward, one downward	Diffuser, filter photo-cell (0.295 to 0.390 μm)	Eppley Lab. Inc. Model TUVR	0 to 70 W m-2 (±3 W m-2)	uvup = uv upward looking (W m-2) uvdn = uv downward looking (W m-2)
VIS-NIR hemispheric radiation (one downward and one upward viewing)	Eppley thermopile (0.3 to 3 μm)	Eppley Lab. Inc. Model PSP	0 to 1400 W m-2 (±10 W m-2)	pyrup = vis-nir upward looking (W m-2) pyrdn = vis-nir downward looking (W m-2)
Surface radiative temperature	IR radiometer 1.5˚ FOV (8 to 14 μm)	Omega Engineering OS3701	-50˚ to 1000˚C ±0.8% or reading	irtemp (degC) = surface temp. (˚C)
Absorption and scattering of solar radiation by clouds and aerosols; BRDF and albedo of surfaces	Fourteen wavelength all-directions scanning radiometer	NASA-Goddard/ University of Washington	14 discrete wavelengths between 340 and 2300 nm	—
Aerosol optical depth, water vapor, and ozone*	14-channel Sun-tracking photometer (AATS-14)	NASA Ames (J. Redemann)	14 discrete wavelengths, 350-1558 nm	—

* Guest instrument