Atmospheric Science & Global Change Division

Instrumentation and Measurement Capabilities

Many instruments on the G-1 are provided, maintained, and operated by PNNL. However, collaborative investigations with scientists from other research organizations greatly expand the measurement capabilities of the RAF. Access to collaborative instruments must be individually arranged for each mission. Italics font is used to indicate collaborative instruments in the tables that follow.

Real-time Particles				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
Size distribution	PMS PCASP-100X/DMT-SPP-200	Optical light scattering	0.1-3 μm	PNNL
Condensation particle concentration	TSI 3010	Supersaturation + optical detection	>7 nm 0-10^5 /cm^3	PNNL
Ultrafine particle concentration	TSI 3025A	supersaturation + optical detection	>3 nm 0-10^5 /cm^3	PNNL
Aerosol light scattering (bscat, total scat)	TSI 3563	3-wavelength integrating nephelometer	0-10-3/m	PNNL
Optical absorption coefficient	Radiance PSAP	Differential filter transmissivity	0-10-5/m	PNNL
Aerosol size distributions	*Tandem Scanning Electrical Mobility System (TSEMS)*	*Electrical mobility & optical counting*	*5 - 800 nm* *@ 60s* *noise ~$N^{1/2}$*	*BNL*
Particle organic composition	Aerodyne Aerosol Mass Spectrometer	TOF sizing, thermal vaporization, electron impact ionization, quadrupole MS	20 nm - 2 μm 0.1 μg/m^3 10<m/z<300 amu @ 1 s integration	PNNL
Isokinetic aerosol inlet	Brechtel inlet	Double-diffuser, active inlet	90 - 110 m/s TAS, 0-2500 m altitude	PNNL

Real-time Gases				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
O_3	TEI 49	UV absorption	5-500 ppb	BNL PNNL
O_3	Dasibi 1008	UV absorption	5-1 ppm	PNNL
SO_2	TEI 43S	Pulsed fluorescence	0.3-200 ppb	BNL PNNL
CO	*Vacuum UV*	*UV fluorescence*	*<5 ppb @1 s*	*BNL*
CO	TEI 48	IR absorption/gas filter correlation	20 ppb @10s	BNL PNNL
$NO/NO_2/NO_y$	*3-channel $NO/NO_2/NO_y$*	*O3 chemiluminescence (NO)* *Photolytic conversion (NO_2)* *Hot Mo conversion (NO_y)*	*NO ~10 ppt @ 10 s* *NO_2 ~50 ppt @10 s* *NO_y ~100 ppt @10 s*	*BNL*
NO/NOy	*TEI 42C*	*O3 chemiluminescence*	*0.2-200 ppb*	*BCO*
Trace gases	*TAGA*	*Mass spectrometry*	*ppt to ppb (compound specific)*	*BCO*
Trace gases	*API-365*	*Mass spectrometry*	*ppt to ppb (compound specific)*	*BCO*
Hydrocarbon trace gases	Ionicon Analytik PTR-MS	Proton transfer reaction mass spectrometry	~100 ppt detection limit	PNNL
Formaldehyde	Battelle built	Derivatization/fluorescence	0.1-100 ppb	BCO
H_2O_2	*3-channel Peroxide System*	*Glass scrubber, selective derivitization, fluorimetry*	*~60 ppt @1 min*	*BNL*

Time-Integrated Gases and Particles				
Measurement	**Instrument**	**Technique**	**Range**	**Source**

PAN	*GC/ECD*	*Gas chromatography electron capture detection*	*50 ppt-100 ppb*	*BCO*
NO_2 & PAN	*PAN/NO2*	*GC/Luminol chemiluminescence*	*15-30 ppt det. limit*	*ANL*
VOC	*Canister sampling system*	*Pump + SUMMA canisters*		*ANLM*
VOC	*VOC-GC*	*Gas chromatography*		*ANL*
HCHO+Carbonyls	*HPLC Sampling System*	*High pressure liquid chromatography*	*10-20 ppt @ 90 s*	*BNL*
Particle ionic composition	*Particle-in-Liquid System (PILS)*	*Liquid ion chromatography*	*~0.1 μg/m^3 @ ~3 min.*	*BNL*
Single particle chemical composition	Time-Resolved Aerosol Collector	Impaction + CCSEM/EDX	0.2 - 7 μm >2 atomic % 30-60 s sample	PNNL

Radiation				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
UV radiation, up- & downwelling	Eppley	Radiometer	295-385 nm	PNNL
Short-wave irradiance, up- & downwelling	Eppley PSP	Pyranometer	285-2800 nm	PNNL
Long-wave irradiance, up- & downwelling	Eppley PIR	Pyrgeometer	4-50 μm	PNNL
Short-wave spectral irradiance, up- & downwelling	Yankee MFR	Radiometer	415, 500, 615, 665, 862, & 940 nm; 10 nm FWHM	PNNL
Surface/Sky IR temperature	PRT 5	IR radiometry	9.5-11.5 μm -20 to 50 C	PNNL

Meteorology				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
Temperature	Rosemount 102U2U/510BF	Platinum resistance	-50 to +50°C	PNNL

	Rosemount E102AL/510BF	Platinum resistance	-50 to +50°C	PNNL
Dew-point temperature	General Eastern 1011B	Cooled mirror hygrometer	-75 to +50°C	PNNL
Absolute humidity	AIR	Lyman-Alpha Hygrometer	-60 to +50°C	PNNL
Static pressure	Rosemount 1201F1	Capacitive capsule with electronic conditioning (temperature correction, etc.)	400 to 1060 mb; -55° C to +71°C	PNNL
Gust-probe differential pressure, attack & sideslip	Rosemont 1221F2	Capacitive capsule with electronic conditioning (temperature correction, etc.)	-40 to +40mb; -55°C to +71°C	PNNL
Gust-probe differential pressure, dynamic	Rosemont 1221F2	Capacitive capsule with electronic conditioning (temperature correction, etc.)	0 to +100mb; -55°C to +71°C	PNNL

Cloud Physics				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
Particle & Droplet size distribution	DMT CAPS	Optical light scattering	.5-50µm	BNL
Particle & droplet imaging	DMT CAPS	Optical imaging	25-1550µm	BNL
Airspeed	DMT CAPS	Pitot tube	20-200m/s	BNL
Ambient & internal temperatures	DMT CAPS	---	-50 to +50 C	BNL
Liquid water content	DMT CAPS	Hot wire	0.01-3.0 g/m^3	BNL
Liquid water content	PMS KLWC-5	Hot wire	0-5 g/m^3	PNNL
Liquid water content and droplet size	Gerber PVM-100A	Optical light scattering	0-10 g/m3 2-70 µm	PNNL
Droplet size distribution	PMS FSSP-300	Optical light scattering	2-47 µm	PNNL
	PMS OAP-2D	Optical light scattering	20-1240 µm	PNNL
Cloud water	SUNY/NCAR (modified)	Manually-operated collectors	--	PNNL

Cloud condensation nuclei	DH Associates CCN	Supersaturation/optical imaging	submicron	PNNL

Other				
Measurement	**Instrument**	**Technique**	**Range**	**Source**
Position & velocity	Garmin 500	GPS	--	PNNL
Position & velocity	Trimble 3000	GPS	--	PNNL
Position, velocity (1Hz), attitude (10Hz)	Trimble TANS Vector	4-antenna GPS	--	PNNL
Position & velocity (10Hz)	Trimble DSM	GPS		PNNL
Aircraft altitude	Rosemount 1201F1	Absolute pressure transducer	--	PNNL
Height above ground	Terra	Radar altimeter	200-2400 ft.	PNNL
Traffic & collision avoidance system	BF Goodrich SKY497	Transponder		PNNL
Terrain awareness and warning system	Landmark TAWS 8000	DEM/GPS		PNNL
Lightning	WX500 Stormscope	Static discharge detection		
Photographs	Olympus	C-720 digital camera	--	PNNL
Area precipitation	Honeywell-Sperry	Color weather radar	(not recorded)	PNNL

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