

TABLE 1. INSTRUMENTATION ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 FOR TRMM/KWAJEX

(a) Navigational and Flight Characteristics			
Parameter	Instrument Type	Manufacturer	Range (and error)
Latitude and longitude, ground speed and horizontal winds	Global positioning system	Bendix/King KLN900	Global
True airspeed	Variable capacitance	Rosemount Model F2VL 781A	0 to 250 m s ⁻¹ (<0.2%)
Heading	Gyrocompass	King KCS-55A	0 to 360° (± 1°)
Pressure	Variable capacitance	Rosemount Model 830 BA	150 to 1100 mb (<0.2%)
Altitude above terrain	Radar altimeter	Bendix Model ALA 51A	
Heading	Gyrocompass	King KCS-55A	0 to 360° (± 1°)
Pitch and Roll	Differential GPS	Trimble TANS/Vector GPS Attitude System	0 to 360° (±0.15°)
(b) Communications			
Parameter	Instrument Type	Manufacturer	Range (and error)
Air-to-ground telephone	Via Iridium satellite	Motorola	Worldwide
Air-to-ground e-mail	Via satellite	Magellan	Worldwide
Two-way voice communications	Radios	Various	Variable
(c) General Meteorological			
Parameter	Instrument Type	Manufacturer	Range (and error)
Radar reflectivity (not recorded)	3 cm wavelength (pilot's radar)	Bendix/King (now Allied Signal)	160 nm
Total air temperature	Platinum wire resistance	Rosemount Model 102CY2CG and 414 L Bridge	-60 to 40°C (<0.1°C)
Static air temperature	Reverse-flow thermometer	In-house	-60 to 40°C (<0.5°C)
Dew point	Cooled-mirror dew point	Cambridge System Model TH73-244	-40 to 40°C (<1°C)
Absolute humidity	IR optical hygrometer	Ophir Corp. Model IR-2000	0 to 10 g m ⁻³ (~5%)
Air turbulence	RMS pressure variation	Meteorology Research Inc. Model 1120	0 to 10 cm ^{2/3} s ⁻¹ (<10%)

(Cont.)

(c) General Meteorological (continued)

Parameter	Instrument Type	Manufacturer	Range (and error)
UV hemispheric radiation, one upward, one downward	Diffuser, filter photocell (0.295 to 0.390 μm)	Eppley Lab. Inc. Model TUVR	0 to 70 W m ⁻² (± 3 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)
Surface radiative temperature	IR radiometer 1.5° FOV (8 to 14 μm)	Omega Engineering OS3701	-50° to 1000°C $\pm 0.8\%$ or reading
Video image	Forward-looking camera and time code	Ocean Systems Splash Cam	SVHS tape

(d) Aerosol

Parameter	Instrument Type	Manufacturer	Range (and error)
Number concentration of particles	Condensation particle counter	TSI Model 3760	10 ⁻² to 10 ⁴ cm ⁻³ ($>0.02 \mu\text{m}$)
Number concentration of particles	Condensation particle counter	TSI Model 3022A	0-107 cm ⁻³ ($d > 0.003 \mu\text{m}$)
Number concentration of particles	Condensation particle counter (continuous flow)	TSI Model 3025A	0-105 cm ⁻³ ($d > 0.003 \mu\text{m}$)
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)
Size spectrum of particles	35 to 120° light-scattering	Particle Measuring Systems Model PCASP-100X	0.12 to 3.0 μm (15 channels)
Size spectrum of particles	90° light-scattering	Particle Measuring Systems Model LAS-200	0.5 to 11 μm (15 channels)
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-100	2 to 47 μm (15 channels)
Size spectrum of particles	Differential Mobility Particle Sizing Spectrometer (DMPS)	TSI, modified in-house	0.01 to 0.6 μm (21 channels)
Light-scattering coefficient	Integrating 3-wavelength nephelometer with backscatter shutter	MS Electron 3W-02	1.0 $\times 10^{-7}$ m ⁻¹ to 1.0 $\times 10^{-3}$ m ⁻¹ for 550 and 700 nm channels, 2.0 $\times 10^{-7}$ m ⁻¹ to 1.0 $\times 10^{-3}$ m ⁻¹ for 450 nm channel
Light absorption and graphitic carbon	Particle soot/absorption photometer	Radiance Research MD01	Absorption coefficient: 10 ⁻⁷ to 10 ⁻² m ⁻¹ ; Carbon: 0.1 μm m ⁻³ to 10 mg m ⁻³ ($\pm 5\%$)
Humidification factor for aerosol light-scattering	Scanning humidigraph	In house	bsp (RH) for 30% \leq RH \leq 85% (Cont.)

(e) Cloud Physics

Parameter	Instrument Type	Manufacturer	Range (resolution)
Cloud and precipitation particle imagery	Digital holographic camera	SPEC Inc. Model CPI-230	5 μm to 2.5 mm (2.3 μm)
Size spectrum of precipitation particles	256 photodiode CCD array	SPEC (1 channel HVPS)	200 μm -5 cm. 5 cm _ 20 cm optical cross section. (200 μm resolution with 1 m ³ s ⁻¹ sampling rate.)
Size spectrum cloud particles	Forward light-scattering	Particle Measuring Systems FSSP-100	2 to 47 μm (3 μm)
Images of cloud particles	Diode imaging	Particle Measuring Systems OAP-2D-C	25-800 μm (25 μm)
Images of precipitation particles	Diode imaging	Particle Measuring Systems OAP-2D-P	200-3200 μm (100 μm)
Liquid water content	Hot wire resistance	Johnson-Williams	0 to 2 or 0 to 6 g m ⁻³
Liquid water content	Hot wire resistance	DMT	0 to 5 g m ⁻³
Liquid water content; particle surface area; effective droplet radius	Optical sensor	Gerber Scientific Inc. PVM-100A	0.001-10 g m ⁻³ ; 5-10,000
Thermal emission ($^{\circ}\text{K}$) from surface and atmosphere (hydrometeors)	Airborne multichannel microwave radiometer (AMMR)	NASA Goddard (J. Wang)	

(f) Chemistry

Parameter	Instrument Type	Manufacturer	Range (and error)
Particulate species SO_4^- , NO_3^- , Cl^- , Na^+ , K^+ , NH_4^+ , Ca^{++} , Mg^{++}	Teflon filters and ion exchange chromatography	Gelman Dionix	0.1 to 50 $\mu\text{g m}^{-3}$ (for 500 liter air sample)
Hydrocarbons, CO, CO ₂	Collected in stainless steel canisters; analysis by GC/FID	R. Gammon	Variable
O ₃	UV absorption	Thermo Environmental Inst. Model 49C	1-1000 ppbv (<1 ppbv)
CO ₂	Infrared correlation spectrometer	LI-COR Li-6262	0 to 300 ppmv (0.2 ppmv at 350 ppmv)
NO/NO _y	Chemiluminescence (with heated catalytic converter to NO _y)	Air Quality Design Model HSS-200 (NO _y)	10 pptv-100 ppbv ($\pm 5\%$ for NO, $\pm 10\%$ for NO _y)
CO, H ₂	Oxidation over hot HgO	Trace Analytical RGA3 Reduction Gas Analyzer	Detection limits: sub-ppb

(Cont.)

(g) Data Processing and Display

Parameter	Instrument Type	Manufacturer	Range (and error)
In-flight data processing and recording	Microcomputer	In-house, based on Motorola MVME-133A technology	
Recording (analog voice transcription)	Cassette recorder	---	
In-flight data processing and display	Laptop PC	NEC Versa 5060X	
Digital printout	Impact printer	Epson MX-80	

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