Pacific 2001

PACIFIC 2001 Cessna 182 AIRCRAFT DATA REPORT

In August of 2001 two aircraft were based in Abbotsford British Columbia in support of the Pacific 2001 field program. The Canadian NRC (National Research Council) Convair 580 is a four-engine research airplane that was tasked with mapping of the vertical distribution of aerosol particles in the Lower Fraser Valley using lidar. The CFS (Canadian Forestry Service) Cessna 182 is a single person, single engine small aircraft instrumented to support or complement ground based measurements. This report details the data collected by both of these aircraft. The aircraft data collected during the field program has since undergone reduction to ease access. Value-added parameters have been created and quality control initiatives were implemented to produce a data-set that should be ready to use. Of course, this does not mean that an investigator cannot easily mis-use or mis-interpret the data. The key to avoiding this pitfall is to recognize the capabilities and failings of the instruments. In order to help investigators in this regard, this report has been assembled with the help of several scientists and technicians who are familiar with the instruments, configuration, and other details. Investigators are urged to read this report in its entirety, or at least the portions relating to the instruments of interest.

In this report aircraft are introduced and kept separate. Although instrument catgories may have similar names, the contents are different for each aircraft.

CFS CESSNA 182

Pacific 2001 was the first project in which the CFS Cessna was fully instrumented by the MSC aircraft facility. Consequently there are few redundant measurements. There were two instrument packages aboard the Cessna, which did some internal numerical processing. They are the PicoDAS and the AIMMS-10. Both of these have a GPS system, and measure some basic state parameters like temperature, relative humidity and pressure. The AIMMS-10 also comes with an airborne wind measurement system. See aimms10_technical_specifications.pdf for specific details.

The Cessna flew 20 flights during Pacific 2001. The aircraft flew on days with little or no cloud cover, and it is doubtful that the aircraft ever ventured into cloud. The AIMMS-10 delivered no data on Cessna flights 1, 17 and 18. This is especially noteworthy since the AIMMS-10 provides the only version of temperature, true air speed, relative humidity, heading and winds.

The aircraft also landed momentarily and took off again in Cessna flight 4. The data acquisition system (DAS) crashed near the end of Cessna flight 5, culminating in the loss of all data after that point in the flight. Due to an offset magnetic heading measurement, all AIMMS wind and position data had to be recalculated after the project by the manufacturer of the AIMMS package. Upon archiving the manufacturer re-calculated parameters, it was found that the parameters are missing near the end of Cessna flight 3.

1D Archive Parameter Identification

This has information about every item of interest on the 1D archive. Sometimes you have a choice of several similar measurements and this document may help you decide which one to use. Some important things are only mentioned in this document so you may want to look here first.

AIMMS-10

Features

- Defines atmospheric profiles of wind, temperature and humidity in three-dimensions along the flight path
- Provides continuous high-speed atmospheric measurement
- Negligible installation costs due to light-weight wing-strut mount design (other options available)
- Autonomously powered by internal batteries providing up to 7 hours of continuous operation
- FAA Supplemental Type Certificate (STC) for installation
- Accurate position and wind vector data derived using an advanced GPS-inertial measurement system and air-motion probe
- Operated as a logger, with real-time data transmission by digital radio modem or RS-232 hardwire communication
- Data logged if outside of radio range and transmitted when link is re-established to ensure data integrity

Technical Specifications

PHYSICAL

Sensor Assembly:		pylon supported, quasi-elliptical pod, 6" dia. x 13"
Telemetry Module:		7" x 4" x 1.375"
Weight:	Sensor Pod	7.63 lb (3.46 kg)
	Batteries	1.38 lb (0.62 kg)
	Strut Clamps	2.30 lb (1.04 kg)
	Telemetry	3.50 lb (1.60 kg)

ENVIRONMENTAL

Operating Temperature	-30 C to +50 C
Storage Temperature	-40 C to +90 C
Humidity	non-condensing

ELECTRICAL

Battery Capacity	4000 mAh, NiMH
Operating Voltage	9 - 14 V
Operating Current	480 mA (mean)
Maximum Operating Time	9 hours

PERFORMANCE

Sampling Frequency	16 Hz
Log Rate in Ascent	1 Hz
Log Rate in Cruise	0.1 - 1 Hz (user-selectable)
Maximum Airspeed	250 knots
Altitude	-500, 27500 ft. msl
Position Accuracy	330 ft (2-sigma)

- Includes PC software for configuring sonde, managing telemetry and data presentation

TEMPERATURE

Resolution / Accuracy	0.01 C / 0.2 C
Time Constant	10 seconds at 50 m/s TAS

HUMIDITY

Resolution	0.1% RH / 2% RH
Accuracy	7.5 seconds

WIND MEASUREMENT

N Vector Component	2 knots RMS, unaccelerated flight
E Vector Component	2 knots RMS, unaccelerated flight

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PACIFIC 2001 CESSNA PARAMETERS: ↺BACK

Altitude

Two measures of mean sea level (MSL) altitude are available. Both of these altitudes are calculated from pressure and are available only in metres. The accuracy of these pressure based altitudes depends to some degree on the appropriateness of the altimeter reading at the nearest airport, and how much it changes during the flight. Generally, the uncertainty of an altitude derived from pressure is ~±15m. The altitude generated from the PicoDAS comes with no details regarding how it was furnished. The altitude derived from the AIMMS barometric pressure was calculted by using an equation for pressure-altitude variation which assumes a standard atmospheric temperature gradient. The curve is forced to go through a point on the surface where the observed pressure corresponds to the published Abbotsford elevation (58m above sea level). The AIMMS altitude is not available on Cessna Flights 1,17 and 18.

The tag numbers associated with altitude are:

04015 AIMMS MSL ALTITUDE (m)
04117 PICO MSL ALTITUDE (m)

Avionics

Both the PICO ground speed and AIMMS true air speed are essentially untested and although the archived values look reasonable, there are no comparable measurements with which to scrutinize the data in further detail. In particular, the true air speed is prone to biases arising from the chosen location at which airflow is measured along the fuselage. The PICO aircraft heading has a range from 0 to ~512, rather than 360 degrees. The AIMMS aircraft heading was one of the parameters relayed back from the AIMMS manufacturers after the project. It appears to be correct but is essentially untested.

Aircraft heading is measured in degrees from true (as opposed to magnetic) North. The direction convention used is:

0-90° == true North→East
90-180° == East→South
180-270° == South→West
270-360° == West→North

The tag numbers associated with avionics are:

04107 PICO GROUND SPEED (m/sec)
04105 PICO AIRCRAFT HEADING (Deg T)
04007 AIMMS TRUE AIR SPEED (m/sec)
04012 AIMMS AIRCRAFT HEADING (Deg T)

Condensation Nuclei Counters

Please see the file 'Aerosol Instruments.pdf' for details on the operation of this instrument. In Pacific 2001, the only condensation nuclei counter onboard the Cessna was a TSI 7610. The CN counts data was stored in the the FSSP-300 Events tag. These counts must be divided by ten before dividing by the flow, in cubic centimetres per second, to get the condensation nuclei concentration. The numerous spikes found in the CN flowmeter voltage data had to be removed. The CN flow was slowly varying, allowing for a subsequent "filling in" of the CN flow rate by linear interpolation. The resulting CN flow rate is smooth and continuous. The occasional spikes in the CN counts time history plots look 'real' since the spikes vary in duration, and appear to be unrelated to radio frequency communications. From all indications the CN concentration data are of good quality.

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The tag numbers associated with the TSI 7610 Condensation Particle Counter:

01924 PMS 7610 CLOUD NUCLEI (particles/cm^3)

Flowmeters and Event Switchs

There were 4 flowmeters and 3 event switchs aboard the Cessna. The pilot controlled the filter and VOC flows with the corresponding switchs. Not all were used in all of the flights. Flows archived were in litres per minute (lpm). The identification and calibration of flow meters is detailed below:

Teflon Filter Flow Meter; Serial Number AW608009 ; Max Flow ~ 40 lpm at 5 Volts
May 23 2001 Calibration: Flow in lpm = Volts x 7.6628 – 4.721

Quartz Filter Flow Meter; Serial Number AW710279 ; Max Flow ~ 30 lpm at 5 Volts
May 23 2001 Calibration: Flow in lpm = Volts x 5.5463 – 0.486

CN 7610 Flow Meter; Serial Number AW710276 ; Max Flow ~ 2.5 lpm at 5 Volts
May 23 2001 Calibration: Flow in lpm = Volts x 0.39837 + 0.01374

Impactor Flow Meter; Serial Number AW710278 ; Max Flow ~ 30 lpm at 5 Volts
May 23 2001 Calibration: Flow in lpm = Volts x 5.6433 - 0.082

Filter Event Switch #1;	On is ~5V, Off is ~ 0V
Filter Event Switch #2;	On is ~5V, Off is ~ 0V
VOC Event Marker(Switch);	On is ~5V, Off is ~ 0V

The CN flow voltage had a lot of spikes. Consequently they were removed and the missing data was then filled by linear interpolation resulting in a continuous flow rate. The other flows had no similar bad data. The intercepts given in the calibrations above are the voltages seen when the flows were zero(off), and therefore only appropriate to this installation. The pilot often landed without shutting off the flows, resulting in less estimates of zero flow than is usual. It's quite likely that the recording of event switches did not work the way it was intended however, they appear to be sufficient to mark all the intended events.

Filter Chronology (these flight numbers match no other Cessna flight number convention)

Aug 17 2001	Flt#1	Quartz(4)	Exposed at both altitudes
		Quartz(3)	Not Exposed
		Teflon(1) VM76	Not Exposed
		Teflon(2) VM81	Exposed at both altitudes
Aug 18 2001	Flt#2	Quartz(4)	Exposed over Sumas at ~1.0 kft
		Quartz(3)	Exposed over Sumas at ~0.5 kft
		Teflon(2) VM75	Exposed over Sumas at ~1.0 kft
		Teflon(1) VM74	Exposed over Sumas at ~0.5 kft
Aug 18 2001	Flt#3	Quartz(1)	Not Exposed, Valve closed
		Quartz(2)	Not Exposed, Valve closed
		Teflon(1)	Exposed, Flow ~ 1.45 lpm
		Teflon(2)	Exposed, Flow ~ 2.9 lpm
Aug 20 2001	Flt#2	Teflon(1) 3	Exposed, Flow ~ 10 lpm
		Teflon(2) 4	Exposed, Flow ~ 20 lpm
		Quartz(3) 3	Exposed, Flow ~ 13 lpm
		Quartz(4) 4	Exposed, Flow ~ 15 lpm
Aug 24 2001	Flt#2	Teflon(1) 5	Exposed over Sumas at 1.6 kft

		Teflon(2) 6	Exposed over Sumas at 1.2 kft
		Quartz(3) 5	Exposed over Sumas at 1.6 kft
		Quartz(4) 6	Exposed over Sumas at 1.2 kft
Aug 24 2001	Flt#3	Teflon(1) 7	Not Exposed (Forgot)
		Teflon(2) 8	Exposed over Langley at 0.5 kft
		Quartz(3) 7	Not Exposed (Forgot)
		Quartz(4) 8	Exposed over Langley at 0.5 kft
Aug 25 2001	Flt#2	Teflon(1) 9	Exposed ~ 1 hour
		Teflon(2) 10	Exposed ~ 1 hour
		Quartz(3) 9	Exposed ~ 1 hour
		Quartz(4) 10	Exposed ~ 1 hour
Aug 31 2001	Flt#3	Teflon(1) 11	Exposed over Langley at 0.5 kft
		Teflon(2) 12	Exposed over Langley at 1.0 kft
		Quartz(3) 11	Exposed over Langley at 0.5 kft
		Quartz(4) 12	Exposed over Langley at 1.0 kft
Aug 31 2001	Flt#4	Teflon(1) 13	Exposed over Sumas
		Teflon(2) 14	Exposed over Sumas
		Quartz(3) 13	Exposed over Sumas
		Quartz(4) 14	Exposed over Sumas

The tag numbers associated with these flowmeters are:

08565 TEFLON FILTER FLOW RATE (lpm)
08566 QUARTZ FILTER FLOW RATE (lpm)
08073 CN 7610 FLOW RATE (lpm)
08524 IMPACTOR 1 FLOW RATE (lpm)

FSSP-300

The Cessna flew with an FSSP-300 aerosol probe mounted in a cannistor under the wing. The Cessna did not have sufficient power to accommodate the 115 VAC heater on photodetector module. The Positive-Intrinsic-Negative (PIN) diode in the FSSP-300 photo-detector module is the avalanche-type, that is prone to temperature dependence. The probe showed signs of temperature related noise in the lower size channels when the outside air temperature was lower than 10-15 degrees C. The channel#1 concentrations have been nulled on those occasions when temperature related noise was recognized. No data exists for Cessna flights 1, 17 & 18 when no true air speed measure was available.

Although bead calibrations were performed during the field study, no detailed calibration involving a differential mobility analyzer or a droplet generator has been attempted with this probe in the lab. The FSSP300 Standard channel definitions given by the manufacturers in file ‘FSSP300chn.pdf’ are all we have for the time being.

The tag numbers associated with the FSSP-300 are:

01532 FSSP 300 CHAN 1 CONC (/cm^3)
01533 FSSP 300 CHAN 2 CONC (/cm^3)
01534 FSSP 300 CHAN 3 CONC (/cm^3)
01535 FSSP 300 CHAN 4 CONC (/cm^3)
01536 FSSP 300 CHAN 5 CONC (/cm^3)

01537 FSSP 300 CHAN 6 CONC ($/cm^3$)
01538 FSSP 300 CHAN 7 CONC ($/cm^3$)
01539 FSSP 300 CHAN 8 CONC ($/cm^3$)
01540 FSSP 300 CHAN 9 CONC ($/cm^3$)
01541 FSSP 300 CHAN 10 CONC ($/cm^3$)
01542 FSSP 300 CHAN 11 CONC ($/cm^3$)
01543 FSSP 300 CHAN 12 CONC ($/cm^3$)
01544 FSSP 300 CHAN 13 CONC ($/cm^3$)
01545 FSSP 300 CHAN 14 CONC ($/cm^3$)
01546 FSSP 300 CHAN 15 CONC ($/cm^3$)
01547 FSSP 300 CHAN 16 CONC ($/cm^3$)
01548 FSSP 300 CHAN 17 CONC ($/cm^3$)
01549 FSSP 300 CHAN 18 CONC ($/cm^3$)
01550 FSSP 300 CHAN 19 CONC ($/cm^3$)
01551 FSSP 300 CHAN 20 CONC ($/cm^3$)
01552 FSSP 300 CHAN 21 CONC ($/cm^3$)
01553 FSSP 300 CHAN 22 CONC ($/cm^3$)
01554 FSSP 300 CHAN 23 CONC ($/cm^3$)
01555 FSSP 300 CHAN 24 CONC ($/cm^3$)
01556 FSSP 300 CHAN 25 CONC ($/cm^3$)
01557 FSSP 300 CHAN 26 CONC ($/cm^3$)
01558 FSSP 300 CHAN 27 CONC ($/cm^3$)
01559 FSSP 300 CHAN 28 CONC ($/cm^3$)
01560 FSSP 300 CHAN 29 CONC ($/cm^3$)
01561 FSSP 300 CHAN 30 CONC ($/cm^3$)
01562 FSSP 300 CHAN 31 CONC ($/cm^3$)
01563 FSSP 300 TOTAL CONC ($/cm^3$)
01565 FS300 MASS (micro-g/cm^3)
01568 FSSP 300 MVD (micro-m)
01577 FSSP 300 MedVD (micro-m)
01578 FSSP 300 CONC > 2 micro-m ($/cm^3$)

Hg Analyser

The Tekran Hg vapour analyzer was used to measure the concentration of mercury in the air. The instrument analyses for mercury vapour with a continuous 2.5 minute integrated sample onto a gold adsorbent followed by thermal desorption and cold vapour atomic fluorescence spectroscopy.

Due to a lack of a pressure measure during Cessna flights 1, 17 & 18, a proxy pressure was determined from the relation of PICO-Altitude to AIMMS pressure in all other Cessna flights. This proxy pressure was then used in Cessna flights 1,17, & 18 to calculate mercury concentrations. These flights were also missing an air temperature measure. The temperature on ground before takeoff was used as a proxy temperature to perform 'standard temperature corrections' on mercury concentrations for these flights. The substitution of a constant temperature value in these cases increases the uncertainty in mercury concentrations insignificantly.

The Tekran analyzer appears to need a little time to warm up. In some of the flights, the mercury concentrations take upto 1000 seconds to settle down. See the file 'Tekran.pdf' for more information about this instrument.

The tag numbers associated with the Hg analyser are:

08820 Hg TYPE -> 0=ZERO 1=CLEAN 2=SPAN 3=Continuous MEASURE
08821 Hg CARTRIDGE INDICATION -> 0=A 1=B
08822 Hg ZERO SUBTRACTION FLAG -> 1=ENABLED
08823 Hg DESORPTION FLAGS
→ 1=NO PEAKS; 2=OVERLOAD; 3=MULTIPLE PEAKS; 4=OK
08824 Hg EXTERNAL EVENT STATUS -> 0=NONE 1=A 2=B 3=C
08825 Hg SAMPLE DURATION (Seconds) -> 0=CLEAN CYCLE
08826 Hg SAMPLE VOLUME (Litres) -> 0=CLEAN CYCLE
08827 Hg MEAN BASELINE VOLTAGE (Volts)
08828 Hg STD DEVIATION (MilliVolts)
08829 Hg PEAK MAXIMUM (Volts)
08830 Hg PEAK AREA (Counts x Seconds)
08819 Hg Static Pressure in millibars (Inlet #1)
08831 CELL "A" Hg CONCENTRATION (ng/sm^3)
08833 CELL "B" Hg CONCENTRATION (ng/sm^3)
08832 CELL "A" Hg CONCENTRATION (ng/m_3)
08834 CELL "B" Hg CONCENTRATION (ng/m^3)

Latitude and Longitude

Both the AIMMS and PICO have global positioning systems. They should be similar in all respects. They can be used interchangably and indeed are almost identical.

Ground site locations for Pacific 2001 can be found in file "P2001Sites.pdf".

The tag numbers associated with position are:

04010 AIMMS LATITUDE (decimal Degrees)
04011 AIMMS LONGITUDE (decimal Degrees)
04103 PICO LATITUDE (decimal Degrees)
04104 PICO LONGITUDE (decimal Degrees)

O_3 Analyzer

No details on the manufacturer and operation of this instrument are available. The Ozone analyser installed onto the Cessna is referred to the "2B" . This instrument requires the temperature and pressure to be monitored, hence the inlet temperature and pressure were measured. The inlet temperatrure was found to be riddled with spikes. To alleviate this problem, each flight was assigned a threshold value of temperature above which all temperatures were replaced with linear interpolated values. This approach was successful, but the 2B ozone signal itself was problemic. Often the signal was overtaken by high frequency (ie short duration) noise/drops, and at other times low frequency, high amplitude gyrations. Most of the time these anomalies are readily identifiable for removal. In the case of the low frequency gyrations, these periods were removed completely from the archived data set. With respect to the high frequency drops, the problem was restricted to Cessna flights 1 through 5, 7 and 8, and was alleviated by removing all seconds where the signal fell below a threshold value, which was different for each case. This approach saved a significant amount of data and resulted in periods where the data is somewhat fragmented.

The inlet temperature and pressure calibrations which correspond to INLET BOX#4 of previous aircraft projects is as follows.

Inlet Temperature in degrees C = Volts x 24.38 – 143.3
Inlet Pressure in millibar = Volts x 133.3 – 133.3

The July 5 2001 calibration yielded this best milli-volt polynomial fit:
O3 ppb [before standard T&P correction] = -2.e-05 x (mv)**2 + 0.2612* mv + 4.4883

The tag number associated with the 2B O_3 Analyzer is:

08623 2B OZONE CONCENTRATION (ppb)

PCASP Measurements

See the file 'ProbeID.pdf' for how the PCASPs are identified, and relative differences between them. Probe#3 was mounted on the Convair to the Primary card on all flights except for Convair flight 06. Probe#1 was mounted on the Cessna for all Cessna flights and mounted on the Convair to the Primary card for Convair flight 6 (only), and mounted on the Convair to the Secondary card for Convair flights 07 and 08. So both probes #3 & #1 flew on the Convair side-by-side on flights 07 & 08.

The flow rate from Probe#3's internal flowmeter was obtained as follows: Mass Flow in cc/sec = flowmeter_Volts * 0.1666. This calibration is at least 5 years old. Probe#1 did not have a working internal flowmeter, and so all flow rates through this probe were estimated as a function of pressure. This estimate was based on data collected from Convair flights 7&8, when both probes flew side by side. The flow rate used for probe #1 was: Mass Flow Rate in cc/sec = Pressure in mb * 0.0006 + 0.128. This formulation was obtained by calculating a flow that would provide a probe#1 concentration (total = the sum of channels 2 to 15) equal to the simultaneous probe#3 concentration (total = the sum of channels 2-15), when both probes flew side by side. These flow rates were then plotted against the outside air pressure and the best linear fit produced the probe#1 mass flow rate stipulated above. The reason channel-01 concentrations of either probe are not used is because the lower size limit of these channels are different and unknown. The lower limit of channel #1 given in file 'PCASPchn.pdf', is 0.13 microns in diameter. This limit could be much lower or higher if a technician lowers or raises this threshold to compensate for noise introduced by radio frequency interference. In this case, the probes are set up such that channel#1 concentrations of probes #1&#3 gave no agreement when they were mounted side by side on the Convair. So both PCASPs, PCASP#3 on the Convair and PCASP#1 on the Cessna, have an unknown and different lower size limit in channel#1. Thus when we compare channel#1 concentrations, and the total (all channels summed) concentrations between the 2 probes, they are for the most part quite dissimilar.

On Cessna flights 1,17, & 18 have no AIMMS temperature and pressure available to convert from PCASP mass flow rate to volumetric flow rate. During these flights a proxy-pressure measure was determined from the relation of PICO-Altitude to AIMMS pressure in all other Cessna flights. This proxy pressure was then used in Cessna flights 1,17, & 18 to calculate the PCASP flow rate. During these flights no standard temperature correction was performed due to a lack of temperature measure, however this correction is small at best and of little inconsequence relative to the pressure correction..

Normally our wing mounted PCASPs experience problems due to lack of sufficient heating at temperatures below –35 °C. Insufficient heating of optical detectors causes anomalously high particle counts, primarily in size bins corresponding to the smallest particles. This problem occurred to some degree on the Cessna during Pacific 2001, even though temperatures experienced by the Cessna were always much higher than -35°C. The Cessna did not have sufficient power to accommodate the 115 VAC heater on photodetector module, or the 28 VDC heater on the nose-cone. Generally probe#1 aboard the Cessna did not encounter heating problems except for a few times at the top of the boundary layer during vertical profiles. These occasions have not been removed from the data since it was difficult to identify the anomolous spikes when they occurred near the top of the boundary layer. PCASP channel#1 concentrations remain highly suspect at high altitudes, specifically at the tops of the vertical profiles.

The tag numbers associated with the Primary card PCASP are:

01123 PCASP TOTAL CONC (/cm^3)

01124 PCASP CHAN 1 CONC (/cm^3)
01125 PCASP CHAN 2 CONC (/cm^3)
01126 PCASP CHAN 3 CONC (/cm^3)
01127 PCASP CHAN 4 CONC (/cm^3)
01128 PCASP CHAN 5 CONC (/cm^3)
01129 PCASP CHAN 6 CONC (/cm^3)
01130 PCASP CHAN 7 CONC (/cm^3)
01131 PCASP CHAN 8 CONC (/cm^3)
01132 PCASP CHAN 9 CONC (/cm^3)
01133 PCASP CHAN 10 CONC (/cm^3)
01134 PCASP CHAN 11 CONC (/cm^3)
01135 PCASP CHAN 12 CONC (/cm^3)
01136 PCASP CHAN 13 CONC (/cm^3)
01137 PCASP CHAN 14 CONC (/cm^3)
01138 PCASP CHAN 15 CONC (/cm^3)
01139 PCASP MEAN VOL DIAMETER (micro-m)
01140 PCASP MASS (micro-g/cm^3)

Pressures

The AIMMS static pressure is a measure of outside air pressure. The only pressures of interest to investigators are ‘static’ pressures. The ‘INLET’ and “Mercury” are static, meaning all dynamic pressure perturbations are negligible, but not out side the aircraft.

Cessna flights 1, 17 & 18 include an extra pressure parameter that has been calculated from the PICO altitude. It was obtained by plotting all good AIMMS pressure data against all good PICO altitude data to yield the following relation:

Rough pressure in millibar = 1013.25 / e**((PICO altitude in metres – 75.37)/8248)

It is not a real pressure measurement, and should only be used when no AIMMS pressure is available. The ‘inlet’ pressure calibration details are in the Cessna O_3 Analyzer section above.

The tag numbers associated with pressure are:

04006 AIMMS STATIC PRESSURE (mb)
08835 INLET-01 STATIC PRESSURE (mb)
08819 SHIFTED MERCURY STATIC PRESSURE (mb)
04117 ROUGH PRESSURE(mb) from PICO Altitude

Relative Humidity and Temperatures

The only humidity measure aboard the Cessna is the AIMMS relative humidity which has a resolution of 0.1% relative humidity, an accuracy of 2% relative humidity over the 0-100% range, and a time constant/response-time of 7.5 seconds at 50 m/sec TAS. This response time is a little slow for the rapid relative humidity changes that are seen in steep descents, however deconvolution of the signal did not change the relative humidity significantly, so it remains as originally recorded.

The AIMMS temperature has a resolution of 0.01 Deg C, an accuracy of 0.2 Deg C, and a time constant/response-time of 10 seconds at 50 m/sec TAS. This signal was archived after deconvoluting the signal with a 10 second response time. The AIMMS temperature is the only outside static temperature. The 'inlet' temperature calibration details are in the Cessna 'O_3 Analyzer' section above.

The tag numbers associated with relative humidity and temperature are:

04004 AIMMS STATIC TEMPERATURE (Deg C)
08840 INLET-01 STATIC TEMPERATURE (Deg C)
04005 AIMMS RELATIVE HUMIDITY (%)

Time

Time is measured by several data acquisition systems (DAS) aboard the aircraft. The first is the MSC/AES DAS. The PICO-DAS and AIMMS-DAS are instrumentation packages that pass back times with other signals to the MSC/AES DAS. Each DAS has a clock and its own time, but the date is not relayed from the AIMMS- and PICO- DAS. The MSC/AES clock is set to UTC, and is archived in the form of GMT (or Universal Time Coordinated - UTC) time, since there is no real alternative. In this project there is no assurance that the Cessna MSC/AES times&dates are truly GMT/UTC. GMT is the one we use in most situations, and time intervals listed refer to GMT time unless otherwise stated.

See the file "P2001CessnaTimes.pdf" for archive and in-air interval times from all of the Cessna clocks and flights.

The tag numbers associated with time are:

00001 GMT YEAR
00002 GMT MONTH
00003 GMT DAY
00004 GMT HOUR
00005 GMT MINUTE
00006 GMT SECOND
04000 AIMMS HOUR
04001 AIMMS MINUTE
04002 AIMMS SECOND
04100 PICO HOUR
04101 PICO MINUTE
04102 PICO SECOND

Winds

The AIMMS-10 package contains a horizontal wind measurement facility that is accurate to 2 knots RMS during unaccelerated flight. The manufacturer suggests that the winds are ~+/-1.0 m/sec during level flight. Turns and other accellerations tend to affect the wind measurement in an unpredictable manner. Initially the winds were erroneous due to an offset in the aircraft magnetic heading. The manufacturer returned to us recalculated values that now appear in the archive.

The tag numbers associated with time are:

04013 AIMMS WIND SPEED (m/s)
04014 AIMMS WIND DIRECTION (degrees from true North)

FSSP 300

Use: The FSSP 300 is an optical probe used for measuring cloud droplet size distribution and concentration in the particle size range of 0.3-20 μm at velocities of 10-125 m/s. The FSSP 300 classifies particles into 31 size channels where scattering calculations suppose that aerosol particles are spherical in shape, with an index of refraction close to that of common aerosols.

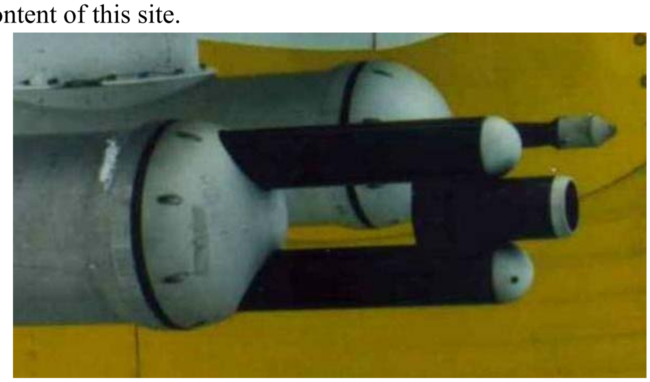
Operation: The FSSP 300 measures the magnitude of laser light scattered from a particle passing through the object plane. A He-Ne laser strikes a particle causing it to scatter light, mainly in the forward direction. A dump spot stops the beam from being collected, while the scattered light is directed by a prism through a set of condensing lenses into a beam splitter, and onto masked and unmasked photodetectors. The photodetectors are arranged so that only particles that pass within a few millimetres of the centre of focus of the laser beam are registered. This distance, combined with the velocity of the aircraft and the dimensions of the sampling cavity, give the volume needed to calculate particle concentration. Particle size is derived from the magnitude of the voltage pulse produced by the photodetectors in response to the scattered light (Baumgartner, 1999).

Factors that influence the performance of the FSSP include: the velocity of the aircraft, the probe response time, the size spectrum and phase of the droplets, the definition of the depth-of-field, the geometry of the optics etc. The sample volume and sizing are important in calibration of the FSSP both as functions of each other and of the airspeed (Vali, 1998).

Errors and Uncertainty: Sources of error include deadtime errors in which droplets are not registered if they pass through the sampling volume during the time when the probe is occupied with processing data. Another source of error, optical coincidence error, occurs when droplets pass through the laser beam simultaneously, appearing to be a single unit. Coincidence errors have the effect of introducing a bias toward the loss of small droplets, sizing droplets greater than actual size, causing a narrow size distribution to appear broader than it is and reducing the total measured concentration of droplets. The above effect is particularly significant when droplet concentration increases beyond 500 cm^3 and is insignificant at less than 100 cm^3 (Cooper, 1988).

Historical Notes: This probe had a series of problems that included: a wire from the PIN diode breaking, mask slit fell off, insufficient heating of photodetector/PIN diode. The duration of these problems, ~10 years, was such that almost no good data was obtained from this probe until Pacific 2001. The heating of the avalanche-type 'PIN' diode appears to be the controlling factor in getting good data from this instrument. However, given the lack to date of a good historical record with respect to use and calibration of this instrument, researchers are advised to be careful when using the data collected by this instrument.

Other information on the FSSP 300 can be found on Darrel Baumgartner's page on the NCAR web site: http://raf.atd.ucar.edu/~darrel/htmlFiles/fssp300.html Please note that Environment Canada is not responsible for the content of this site.



FSSP 300

Passive Cavity Aerosol Spectrometer Probe (PCASP)

Use: The PCASP is an optical particle counter used for measuring the concentration and size distribution of particles assumed to have a spherical shape, and an index of refraction between 1.52 and 1.59. These particles are in the size range of 0.14 µm to 3 µm.

Operation: The PCASP works by collecting light scattered from particles passing through the object plane. Air enters the probe through a heated diffuser cone about 13 cm in length. A diffuser decelerates the air, most of which is exhausted near its rear, and the remainder is sampled with a small needle at a rate of 1 cm^3/s. Particles in the air sample enter the probe's optics where they scatter light as they pass through the object plane and are struck by a focused He-Ne laser beam. The scattered light is sent to a photodetector and its magnitude is compared with light on a reference photodetector. The result is output as a voltage signal which is related to particle size through Mie scattering theory and signal magnitude. The signal is classified into one of fifteen size channels (or bins) ranging from 140 nm to 3000 nm. Incorrect sizing of particles is minimised by evaporation of clinging water and the particles themselves are not volatile and remain intact through the heating process. This is done through heat transmitted by the diffuser, dry sheath air in the detection area and the internal heat of the probe.

Errors and Uncertainty: The PCASP is calibrated in the field using monodisperse particles of NaCl and $(NH_4)_2SO_4$ in the manner described by Liu et al. (1992). Uncertainties in the concentration measurements are related to flow measurement. An internal flow meter provides a continuous measurement of the flow that is used with the particle count to derive a concentration, the uncertainty of which is ± 5%. Uncertainties in the sizing are related to the ability to calibrate each bin and the spread of the near monodisperse particles. The uncertainty in sizing is estimated as the width of each size bin. Please see the file 'PCASPchn.pdf' for bin size definitions.

Other information on the PCASP can be found on Darrel Baumgartner's page on the NCAR web site: http://raf.atd.ucar.edu/~darrel/htmlFiles/pcasp100.html Please note that Environment Canada is not responsible for the content of this site.

PCASP mounted on the NRC Convair 580 in FIRE ACE

Condensation Particle Counter (CPC 7610)

Use: The TSI 7610 Condensation Particle Counter is a single particle counter used for counting particles capable of acting as cloud nucleation sites. Its lower detection limit is approximately 18 nm.

Operation: The particles are grown to micrometer sizes by condensation of butanol from a supersaturated vapour. The large droplets of butanol are detected and counted by light scattering.

Errors and Uncertainty: Comparisons are done in the ARMP lab against other single particle counters. Based on those comparisons, the standard uncertainty in particle concentration is ±10%.

Other information on the CPC can be found on the TSI web page:
http://www.tsi.com/particle/homepage/particlehome.htm. Please note that Environment Canada does not endorse this company or its products and is not responsible for the content of this site.

```
; FSSP300 Standard channel definitions (FSSP300.CHN)
; sizes are diameters in micro-meters
;CHN#    MIN      MAX      MID       dD    dLOGD     AREA      VOL   S-AREA
;**************************************************************************
01      0.300    0.350    0.325    0.050    0.067    0.083    0.018     .200
02      0.350    0.400    0.375    0.050    0.058    0.110    0.028     .200
03      0.400    0.450    0.425    0.050    0.051    0.142    0.040     .200
04      0.450    0.500    0.475    0.050    0.046    0.177    0.056     .200
05      0.500    0.550    0.525    0.050    0.041    0.216    0.076     .200
06      0.550    0.600    0.575    0.050    0.038    0.260    0.100     .200
07      0.600    0.650    0.625    0.050    0.035    0.307    0.128     .200
08      0.650    0.700    0.675    0.050    0.032    0.358    0.161     .200
09      0.700    0.800    0.750    0.100    0.058    0.442    0.221     .200
10      0.800    0.900    0.850    0.100    0.051    0.567    0.322     .200
11      0.900    1.000    0.950    0.100    0.046    0.709    0.449     .200
12      1.000    1.200    1.100    0.200    0.079    0.950    0.697     .200
13      1.200    1.400    1.300    0.200    0.067    1.327    1.150     .200
14      1.400    1.700    1.550    0.300    0.084    1.887    1.950     .200
15      1.700    2.000    1.850    0.300    0.071    2.688    3.315     .200
16      2.000    2.500    2.250    0.500    0.097    3.976    5.964     .200
17      2.500    3.000    2.750    0.500    0.079    5.940   10.889     .200
18      3.000    3.500    3.250    0.500    0.067    8.296   17.974     .200
19      3.500    4.000    3.750    0.500    0.058   11.045   27.612     .200
20      4.000    4.500    4.250    0.500    0.051   14.186   40.194     .200
21      4.500    5.000    4.750    0.500    0.046   17.721   56.115     .200
22      5.000    6.000    5.500    1.000    0.079   23.758   87.114     .200
23      6.000    7.000    6.500    1.000    0.067   33.183  143.793     .200
24      7.000    8.000    7.500    1.000    0.058   44.179  220.893     .200
25      8.000    9.000    8.500    1.000    0.051   56.745  321.555     .200
26      9.000   10.000    9.500    1.000    0.046   70.882  448.921     .200
27     10.000   12.000   11.000    2.000    0.079   95.033  696.910     .200
28     12.000   14.000   13.000    2.000    0.067  132.732 1150.347     .200
29     14.000   16.000   15.000    2.000    0.058  176.715 1767.146     .200
30     16.000   18.000   17.000    2.000    0.051  226.980 2572.441     .200
31     18.000   20.000   19.000    0.046    0.046  283.529 3591.364     .200
32     18.000   20.000   19.000    0.046    0.046  283.529 3591.364     .200
;
```

↺BACK

THE TEKRAN HG ANALYZER:

↺BACK

Operation:

Sampling at low pressure

The response of the Tekran varies with the pressure in the detection cell. The pressure in the cell is a function of the amount of argon entering the cell and the pressure at the exhaust of the cell. The exhaust pressure was monitored at all times. The response of the instrument was investigated as a function of the exhaust pressure in laboratory tests during which 2 analyzers were run in parallel sampling the same source gas. The analyzer used in FIRE.ACE had inlet and outlet pressures varied while the reference instrument remained at atmospheric pressure. The response was characterized for the instrument cell during the 10 or so seconds of each cycle when the fluorescence signal is detected. This response was slightly different for cells A and B. All data were corrected for this effect.

Leak testing

All connections within the Tekran were tightened with the pump running and the inlet line blocked. The instrument itself was verified to have no flow with the inlet closed. When plumbed into the aircraft, the instrument was set to sample from the inlet line with the inlet blocked. All fittings were tightened until zero flow was obtained.

Zero corrections

In-flights zeros were performed on the Tekran mercury instrument by passing ambient air through a charcoal canister followed by a fine particle filter on nine of the fifteen flights during which valid mercury data were collected. The zeros were done at varying altitudes and for a duration of several cycles of A and B cells.

The peak areas for zeros were plotted as a function of the Convair noseboom pressure and a zero correction equation was determined for each cell using peak areas which were detectable (i.e. "no peak" results ignored). This process leads to a slight over-correction of the data, which is included in the error estimates given below. The fitted peak areas for zero TGM for cell A and cell B were subtracted from the cell A and cell B peak areas before calculation of concentrations. The zero offsets for TGM from the fits corresponded to 0.0, 0.2 and 0.4 ng/sm3 at 1000, 700 and 400 mb, respectively.

Errors and Uncertainty:

Calibration

All field calibrations were done at the surface (i.e. pressure near 1000 mb). The Tekran was calibrated once in the field with its internal permeation source. This calibration was performed in mid-April. All peak areas obtained during the project were converted to mass of TGM based on this calibration. Manual injection of mercury vapour was done at least 6 times on each of ten different days throughout the field project. The difference between the calculated mass injected and the mass determined with the calibration varied by up to 5% from day to day. The mean of the calculated values for all the injections agreed with the mean value determined by the calibration to better than 1%.

Periods of data loss

Data for Flights 1 and 2 were discarded because of a leak in the inlet line during that time. The source of the leak was discovered after Flight 2 and corrected before Flight 3.

There are no data for Flight 16. The instrument had not recovered a good zero after the manual injections before the flight and was left in zero mode for the entire flight to allow confirmation that the residual contamination was flushed out before Flight 17. All times with the instrument sampling through the zero-air line were also nulled out of the final archive.

The error limits of the mercury data are a function of altitude and are outlined in the following table:

Altitude	Error Standard cubic meters
less than 3 km	± 0.1 ng/m^3
3 km to 5 km	± 0.2 ng/m^3

greater than 5 km	± 0.3 ng/m^3

These errors increase with altitude due to (1) the decreased volume sampled leading to decreased sensitivity of the instrument and (2) increased uncertainty in the zero offset.

Ground Sites

↺BACK

	Slocan Park	Burnaby South HS	Lochiel School	Sumas Mountain	Cassiar Tunnel	Abbotsford Airport Site
Latitude (N)	49d 14m 38.2s	49d 12.923m	49d 01m 42.2s	49d 03m 07.2s	49d 17m 01.9s	49d 01m 24.5s
Longitude (W)	123d 02m 55.1s	122d 58.918m	123d 36m 13.0s	122d 14m 46.9s	123d 01m 54.2s	122d 20m 37.5s
Elevation (meters)	92	116	94	300	41	72

Identification of probes serviced by PMI

↺**BACK**

(Particle Metrics Inc.; Steve Mathews at 303-247-0411)

PCASP

NOTE! Each PCASP has a single signal pulse gain applied to bins 1->2, a second/different signal pulse gain applied to bins 3->6, and a third/different signal pulse gain applied to bins 7->15.

Probe #1

- Origianlly was a 115 VAC 400 Hz ASASP, with Serial Number 1861-0381-02
- Converted from an ASASP to a PCASP in Nov 2000.
- Now is a 115VAC 60Hz PCASP, with Serial Number 1861-1100-28

Heaters: 28 VDC on photo-detector/PIN(Positive-Intrinsic-Negative)diode mount
28 VDC circuit with 3 heaters.
Note: each of these heaters can be bypassed
(1) nose(de-icing) heater
(2) inlet heater
(3) inlet shroud heater
115 VAC circuit for single heater over photo-detector module

Probe #2

- Origianlly was a 115 VAC 60 Hz ASASP, with Serial Number 2834-0582-04
- Converted from an ASASP to a PCASP in Feb 1990.
- Now is a 115VAC 60Hz PCASP, with Serial Number 19370--390-05

Heaters: 28 VDC on photo-detector/PIN(Positive-Intrinsic-Negative)diode mount
28 VDC circuit with 3 heaters.
Note: each of these heaters can be bypassed
(1) nose(de-icing) heater
(2) inlet heater
(3) inlet shroud heater
115 VAC circuit for single heater over photo-detector module

Probe #3

- was/is a 115VAC 400Hz PCASP, with Serial Number 15281-0389-02

Heaters: 28 VDC on photo/PIN(Positive-Intrinsic-Negative)diode mount
28 VDC circuit with 3 heaters.
Note: each of these heaters can be bypassed
(1) nose(de-icing) heater
(2) inlet heater
(3) inlet shroud heater

For Pacific 2001:
Probe#3 - was mounted on the Convair to the Primary card for all flights except
for Convair flight 6
Probe#1 - was mounted on the Cessna for all Cessna flights AND
mounted on the Convair to the Primary card for flight 6 only AND
mounted on the Convair to the Secondary card for flights 7 and 8
So both probes 3 & 1 flew on the convair side-by-side on flights 7 & 8

Cessna PCASP -> 28 VDC heater on photodiode mount was ON
-> 28 VDC heater on nose was OFF
-> 28 VDC heater on inlet was ON
-> 28 VDC heater on shroud was OFF
`-> 115 VAC heater on photodetector module was OFF

Convair PCASP-> 28 VDC heater on photodiode mount was ON
-> 28 VDC heater on nose was ON
-> 28 VDC heater on inlet was ON
-> 28 VDC heater on shroud was ON
`-> 115 VAC heater on photodetector module was ON
Also Note!
The Twin Otter flies Probe#3 almost without exception
Currently Probe#2 is touring with WRL and Nicole

FSSP-300

NOTE! The FSSP-300 has a single signal pulse gain applied to bins 1->8, and a second/different signal pulse gain applied to bins 9->31.

- Serial Number 16010-1189-02, 115ACV 60->400 Hz

Heaters: 28 VDC on photo/PIN(Positive-Intrinsic-Negative)diode mount
115 VAC over Photo-detector module (added after FIREIII, ie 1998)

Series of historical problems with this probe include:
- wire from PIN diode broken
- mask slit fell off
- insufficient heating

For Pacific 2001:
FSSP-300 on Cessna -> 28 VDC heater on photodiode mount was ON
` -> 115 VAC heater on photodetector module was OFF

FSSP-100

NOTE! FSSP-100s don't use avalanche photo-diodes, so the temperature range where additional heating is required for the photo-detector module occurs below –30 Deg C.

Probe #1
- Serial Number 223-176-002, 115ACV 60->400 Hz
- nominally detects particles in the 0.5 to 45 microns diameter range

Heaters: 28 VDC for sample tube & mirror(s) & prism

Probe #2
- Serial Number 4670-1283-096, 115ACV 60->400 Hz,
- nominally detects particles in the 0.5 to 45 microns diameter range

Heaters: 115 VAC for sample tube & mirror(s) & prism

Probe #3
- Serial Number 15421-0389-124, 115ACV 60->400 Hz
- nominally detects particles in the 1.0 to 95 microns diameter range

Heaters: 115 VAC for sample tube & mirror(s) & prism

;   PCASP CHANNEL DEFINITION TABLE   ↺BACK
;   LITE Calibration
;   using E.C. and NaCl solution, 18 Sept. 1994, Palm Springs
;   and latex beads
;
;   VERSION 3
;

;CHN#	MIN	MAX	MID	dD	dlogD	Area	Vol	SArea
1	.130	.150	.140	.020	.062	.154E-01	.274E-02	.583
2	.150	.165	.157	.015	.041	.195E-01	.391E-02	.583
3	.165	.190	.178	.025	.061	.247E-01	.559E-02	.583
4	.190	.220	.205	.030	.064	.330E-01	.862E-02	.583
5	.220	.263	.242	.043	.078	.458E-01	.141E-01	.583
6	.263	.340	.302	.077	.112	.714E-01	.274E-01	.583
7	.340	.470	.405	.130	.141	.129E+00	.664E-01	.583
8	.470	.590	.530	.120	.099	.221E+00	.149E+00	.583
9	.590	.730	.660	.140	.092	.342E+00	.287E+00	.583
10	.730	.930	.830	.200	.105	.541E+00	.572E+00	.583
11	.930	1.200	1.065	.270	.111	.891E+00	.121E+01	.583
12	1.200	1.500	1.350	.300	.097	.143E+01	.246E+01	.583
13	1.500	2.000	1.750	.500	.125	.241E+01	.536E+01	.583
14	2.000	2.500	2.250	.500	.097	.398E+01	.114E+02	.583
15	2.500	3.000	2.750	.500	.079	.594E+01	.208E+02	.583

START OF ARCHIVED TIME INTERVAL ↺**BACK**

FLT	GMTDATE			GMTSTART			AESDATE			AESTIME			AIMSTIME			PICOTIME		
	YEAR	MM	DD	HH	MM	SS	YEAR	MM	DD	HH	MM	SS	HH	MM	SS	HH	MM	SS
001	2001	08	14	20	04	55	0625	03	04	06	01	17	21	08	53	21	08	10
002	2001	08	15	19	17	08	0625	03	05	06	05	03	21	08	53	23	00	46
003	2001	08	16	23	00	32	0625	03	05	07	00	10	23	00	32	23	00	45
004	2001	08	17	21	12	41	0625	03	05	07	04	13	21	12	47	21	13	00
005	2001	08	18	00	02	26	0625	03	06	00	01	08	00	02	32	00	02	47
006	2001	08	18	18	07	42	0625	03	06	06	02	13	18	07	55	18	08	07
007	2001	08	18	21	53	34	0625	03	06	07	17	11	21	53	47	23	47	25
008	2001	08	19	01	40	10	0625	03	06	00	13	03	01	40	24	01	40	37
009	2001	08	20	17	54	54	0625	03	06	05	17	17	17	55	19	04	08	17
010	2001	08	20	21	08	42	0625	03	06	07	03	13	21	09	09	21	09	23
011	2001	08	24	18	21	23	0625	03	08	06	07	07	18	22	21	00	37	09
012	2001	08	24	21	36	49	0625	03	08	07	11	15	20	54	07	20	54	20
013	2001	08	25	01	09	41	0625	03	08	00	03	13	01	10	41	01	10	54
014	2001	08	25	18	13	52	0625	03	08	06	04	16	18	14	59	03	39	47
015	2001	08	25	21	24	06	0625	03	08	07	08	02	21	25	14	20	45	06
016	2001	08	31	00	22	03	0625	03	10	00	07	01	00	23	41	00	23	53
017	2001	08	31	17	26	22	0625	03	10	05	08	07	17	28	06	17	28	19
018	2001	08	31	18	05	41	0625	03	10	06	02	13	01	51	31	01	51	44
019	2001	08	31	20	10	05	0625	03	10	06	03	02	20	11	50	20	12	03
020	2001	08	31	23	38	02	0625	03	10	07	12	01	23	39	48	23	40	00

TAKE-OFF TIMES

FLT	GMTDATE			GMTSTART			AESDATE			AESTIME			AIMSTIME			PICOTIME		
	YEAR	MM	DD	HH	MM	SS	YEAR	MM	DD	HH	MM	SS	HH	MM	SS	HH	MM	SS
001	2001	08	14	20	18	40	0625	03	04	06	06	13	21	08	53	20	30	18
002	2001	08	15	19	36	23	0625	03	05	06	11	07	19	47	59	19	48	12
003	2001	08	16	23	15	36	0625	03	05	07	05	11	23	15	36	23	15	50
004	2001	08	17	21	26	13	0625	03	05	07	08	04	21	19	01	21	26	32
005	2001	08	18	00	13	44	0625	03	06	00	04	14	00	13	50	00	14	05
006	2001	08	18	18	30	16	0625	03	06	06	09	05	18	30	29	18	30	41
007	2001	08	18	22	09	25	0625	03	06	07	03	08	22	09	38	22	09	51
008	2001	08	19	01	52	02	0625	03	06	00	16	01	01	52	16	01	52	29
009	2001	08	20	18	09	03	0625	03	06	06	03	01	18	09	28	18	09	42
010	2001	08	20	21	18	52	0625	03	06	07	06	16	21	19	19	21	19	33
011	2001	08	24	18	36	00	0625	03	08	06	11	00	18	36	58	18	37	12
012	2001	08	24	21	50	12	0625	03	08	07	16	04	21	51	12	21	51	25
013	2001	08	25	01	22	56	0625	03	08	00	07	18	01	23	56	01	24	09
014	2001	08	25	18	30	44	0625	03	08	06	09	14	18	31	51	18	32	04
015	2001	08	25	21	41	56	0625	03	08	07	13	18	21	43	04	21	43	16
016	2001	08	31	00	30	29	0625	03	10	00	09	09	00	32	07	00	32	19
017	2001	08	31	17	39	39	0625	03	10	05	12	12	17	28	26	17	41	36
018	2001	08	31	18	12	10	0625	03	10	06	04	03	01	51	31	18	14	07
019	2001	08	31	20	25	03	0625	03	10	06	08	01	20	26	48	20	27	01
020	2001	08	31	23	47	36	0625	03	10	07	15	11	23	49	22	23	49	34

TOUCH-DOWN TIMES (OR END OF DATA IF THAT COMES FIRST)

FLT	GMTDATE			GMTSTART			AESDATE			AESTIME			AIMSTIME			PICOTIME		
	YEAR	MM	DD	HH	MM	SS	YEAR	MM	DD	HH	MM	SS	HH	MM	SS	HH	MM	SS
001	2001	08	14	22	43	53	0625	03	04	07	13	17	21	08	53	22	55	31
002	2001	08	15	21	15	09	0625	03	05	07	05	03	21	26	45	21	26	58
003	2001	08	17	00	00	49	0625	03	05	00	00	15	00	00	49	00	01	02
004	2001	08	17	22	42	46	0625	03	05	07	13	14	22	42	52	22	43	05
005	2001	08	18	01	10	48	0625	03	06	00	03	15	01	10	54	01	47	12

006	2001	08	18	20	43	59	0625	03	06	06	13	18	20	44	11	20	44	24
007	2001	08	19	00	52	50	0625	03	06	00	16	16	00	53	03	00	53	16
008	2001	08	19	04	03	38	0625	03	06	01	01	12	04	03	52	04	04	06
009	2001	08	20	23	00	00	0625	03	06	07	00	00	23	00	27	23	00	40
010	2001	08	21	00	31	34	0625	03	07	00	10	11	00	32	01	00	32	14
011	2001	08	24	20	49	00	0625	03	08	06	15	00	20	49	57	20	50	11
012	2001	08	25	00	16	17	0625	03	08	00	05	05	00	17	17	00	17	30
013	2001	08	25	03	33	37	0625	03	08	01	10	12	03	34	37	03	34	50
014	2001	08	25	20	38	57	0625	03	08	06	12	18	20	40	04	20	40	16
015	2001	08	25	23	45	31	0625	03	08	07	14	10	23	46	39	23	46	51
016	2001	08	31	01	06	34	0625	03	10	00	02	11	01	08	12	01	08	24
017	2001	08	31	17	54	39	0625	03	10	05	17	12	17	28	26	17	56	36
018	2001	08	31	18	39	12	0625	03	10	06	12	04	01	51	31	18	41	09
019	2001	08	31	22	31	15	0625	03	10	07	10	05	22	33	00	22	33	12
020	2001	09	01	01	45	10	0625	03	99	00	14	03	01	46	56	01	47	09

END OF ARCHIVED TIME INTERVAL

FLT	GMTDATE			GMTSTART			AESDATE			AESTIME			AIMSTIME			PICOTIME		
	YEAR	MM	DD	HH	MM	SS	YEAR	MM	DD	HH	MM	SS	HH	MM	SS	HH	MM	SS
001	2001	08	14	22	49	07	0625	03	04	07	15	02	21	08	53	23	00	45
002	2001	08	15	21	19	55	0625	03	05	07	06	17	21	31	31	21	31	44
003	2001	08	17	00	05	56	0625	03	05	00	02	18	00	05	56	00	04	11
004	2001	08	17	23	01	36	0625	03	05	07	00	11	22	47	24	23	01	55
005	2001	08	18	01	10	48	0625	03	06	00	03	15	01	10	54	01	51	59
006	2001	08	18	20	48	27	0625	03	06	06	15	08	20	48	39	20	48	52
007	2001	08	19	00	57	21	0625	03	06	00	18	07	00	57	34	00	57	47
008	2001	08	19	04	07	49	0625	03	06	01	02	15	04	08	03	04	08	17
009	2001	08	20	20	00	59	0625	03	06	06	00	18	20	01	24	20	01	37
010	2001	08	21	00	36	28	0625	03	07	00	11	09	00	36	55	00	37	08
011	2001	08	24	20	53	09	0625	03	08	06	17	03	20	54	06	20	54	20
012	2001	08	25	00	21	52	0625	03	08	00	07	16	00	22	52	00	23	05
013	2001	08	25	03	38	48	0625	03	08	01	12	15	03	39	48	03	39	47
014	2001	08	25	20	43	46	0625	03	08	06	13	14	20	44	53	20	45	05
015	2001	08	25	23	46	04	0625	03	08	07	14	01	23	47	12	23	47	24
016	2001	08	31	01	10	59	0625	03	10	00	03	18	01	12	37	01	12	38
017	2001	08	31	18	01	03	0625	03	10	06	00	01	17	28	26	18	03	00
018	2001	08	31	18	44	24	0625	03	10	06	14	08	01	51	31	18	46	21
019	2001	08	31	22	36	57	0625	03	10	07	11	18	22	38	42	22	38	15
020	2001	09	01	01	49	45	0625	03	99	00	15	14	01	51	31	01	51	44