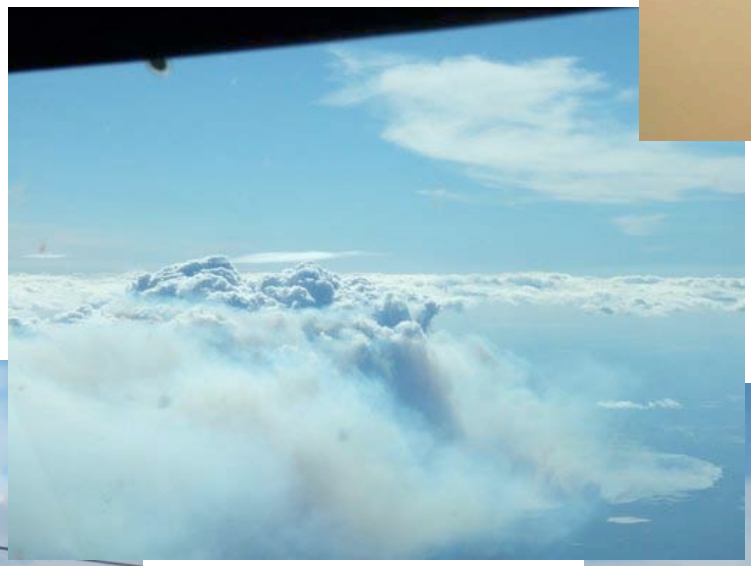
**Flight Report**
**ARCTAS P-3B Data Flight 17, flown 30 Jun 2008 (ARCTAS Summer)**
Submitted by Antony Clarke

**Objectives**

1) **Radiative forcing and closure measurements in cloud free air over plumes in stages of development**
2) **CALIPSO intercomparison with B200 in plume**
3) **Fire plume underflight with B200 w/ P3b below**
4) **Explore aerosol and optical differences in flaming (dark) and smoldering (light) fire plumes near source.**
5) **Fly fire outflow plume for aerosol ageing**
6) **Characterize aerosol/cloud interactions near inversion**
7) **Model validation**

Sample of Photos
- courtesy P3B team



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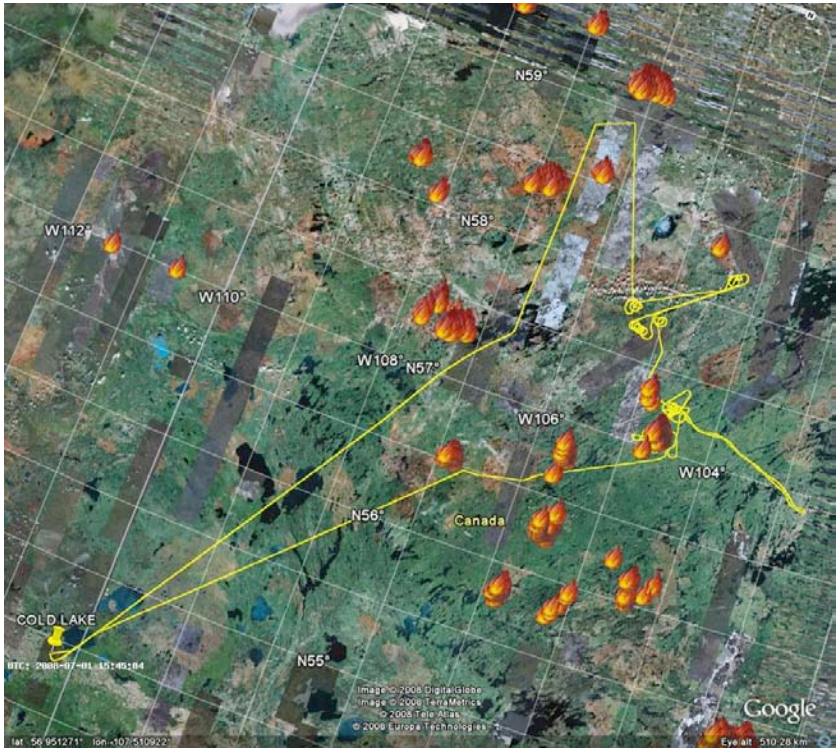
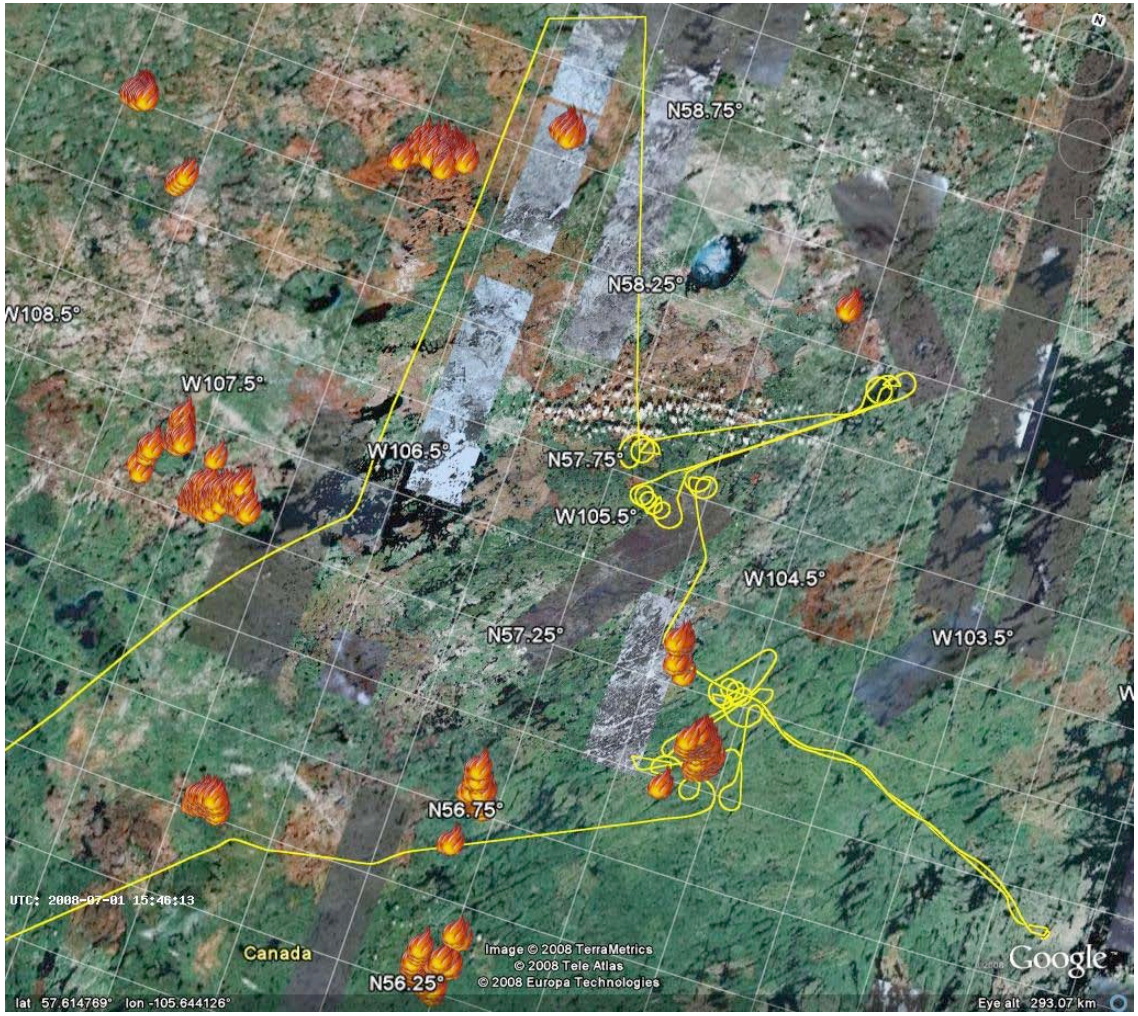
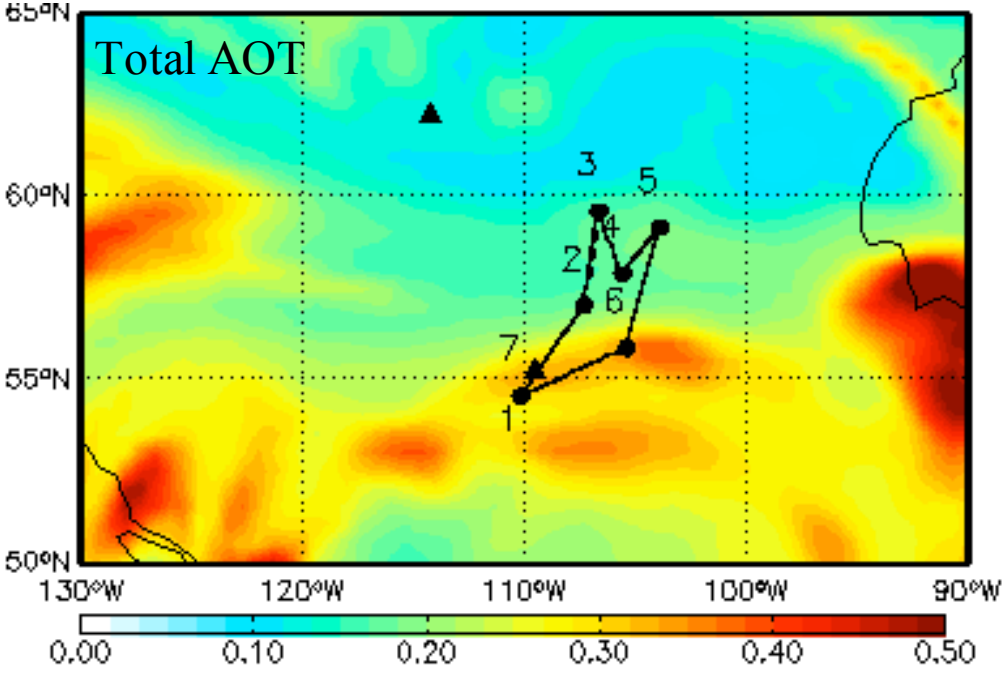
**Flight tracks of P3b as flown**



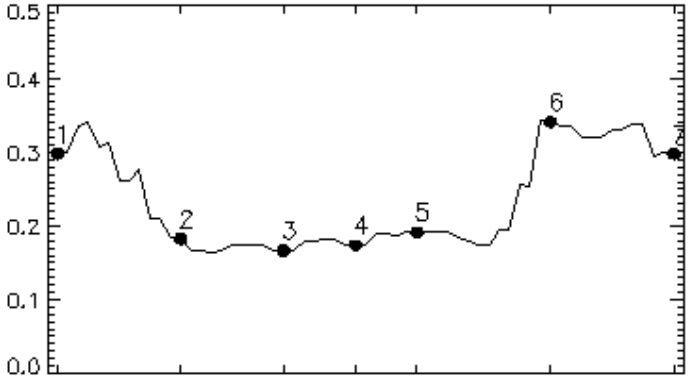



GEOS5 Predictions- P3B flight on 6/30/2008 at 19:30Z (13:30 LT)

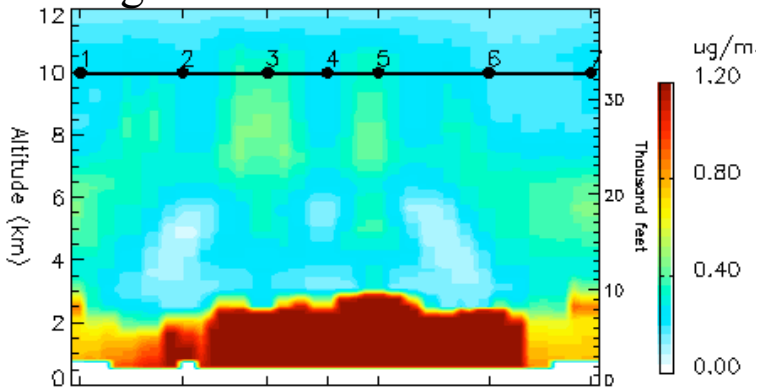
- transported dust & sulfate at 4-8 km near Cold Lake
- aerosol in BL all from fires



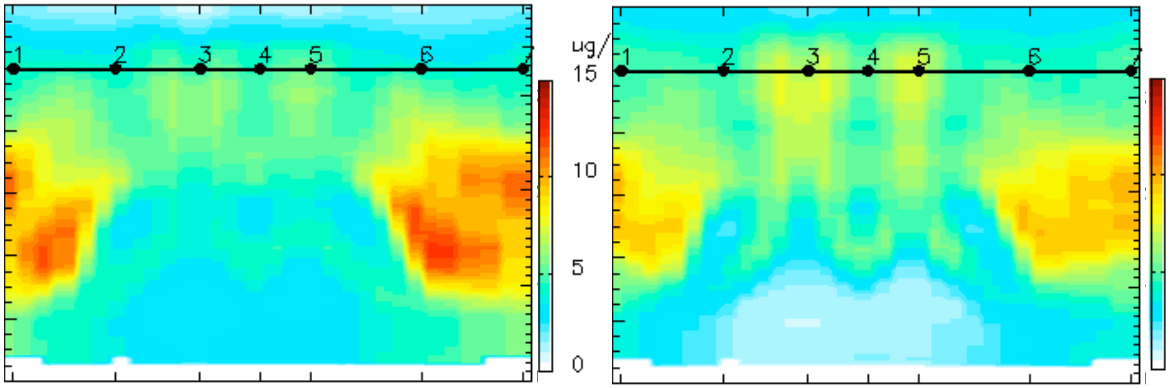

Total AOT



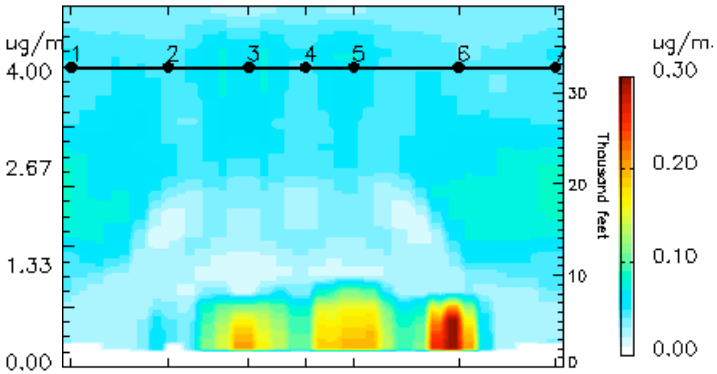

Organic carbon aerosol




Sulfate aerosol




Black carbon aerosol



| ~HHMM |
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Time History

1828 UT TAKEOFF (12:28:40 LST) –
~1834 9500'scatter 40Mm-1
~1836 12500' scatter 40Mm-1
~1837 12500' in high organic layer (AMS)
~1844 SO4 up, and f(RH) up
~1852 10200' in clean layer
~1854 11500' CN-130/cc all volatile O3 – 22; CO - 105
~1900 8200' Bumpy and concentrations increasing; heading for fires to fly plume
~1911 1000'; fire plume
~1914 in plume 1ppm CO; O3 – 45; AOD 2-3
~1916 Climb to reach CALIPSO
~1928 58 14'; 106 58' about to hit PyroCumulus outflow – DARK plume
~1942 Under CALIPSO with B200, Winds at 315 deg; @25knts
~2012 Descend to 500' leg
~2017 Do 2 CAR circles waiting for B200
~2025 start 500' run to SW; 58 08' 104 20'
~20381Spiral up – change PSAP filters 57 43'; 104 20'
~2049 level at 14,500'
~2050 on track under B200; start leg ot NE
~2051 End 14,500' run and start spiral descent to 6000' at 2000 ft/min; AOD – 0.02 over haze.
~2119 Pick a closer fire
~2123 Hit DARK PYROCU just at cloud back in new cloud top with black smoke.
~2125 Start long downwind run at 7,000'
~2126 57 12'; 104 08', heading 080
~2132 Ci and Cu about.
~2140 Spiral to 1000' before other plumes mix into ours. Reverse heading and retrace plume.
~2143 Start 1000' run under plume
~2152 Plume appear to have drifted S of track a bit, Wind 15 knts @ 338deg, AOD=2
~2200 End run 57 18'; 104 23'
~2202 Start cross wind leg at 500' (400msl)
~2206 Reverse plume and cross plume back to north
~2212 Into clean air – turn back into plume
~2216 Spiral up at 57 17', 104 42', scatter 1000Mm-1 at 6000'.
~2225 near top of plume, AMS – 345 ug/m3 nitrate – highest ever
~2228 14300 skim top of PyrocCU , tops about 15000
~2233 CU tops in smoke – make cloud penetration.
~2236 Penetrate Smoke (evaporated cloud) and then into cloud

~2242 3 CAR circles over smoke cloud – couple of CI streaks
~2212 Penetrate top of PyroCU cloud top (picture taken) – smoke pumping out of it 36 29'; 106 35'
~2230 Elevated plume aloft, high sulfate, dust, (30% of scatter due to dust)
~2252 TOUCHDOWN

**Summary**

**Excellent: A GOLDEN DAY --** Great flight with all objectives met in 4.5 hours. Co-ordinated CALIPSO underflight with AOD and in-situ microphysics. Plume differences characterized in "black - flaming" and "white - smoldering" plumes, both chemically and optically. Successful coordination of in-situ and radiation in B200 lidar curtain. Aerosol physiochemical and optical evolution in ageing plumes. CAR BRDF measurements over biomass smoke pall (first ever!). Radiative properties inside smoke plumes reveal strong wavelength dependence consistent with enhanced shortwave absorption from the elevated organics measured. Nitrates also a record at 345ug/m3 near top of plume. Radiative flux stacks successful in crosswind legs above and below plume. AOD data in clear air for most plume and smoke layers studies including profiles. Plumes and Asian pollution layer with dust sampled at 17,500' on return to Cold Lake very consistent with that predicted by GEOS-5. Smoke aerosol and cloud interactions explored.

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# Flight Report

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|---|---|
| **Aircraft :** | NASA P-3B |
| **Operating Site(s) From / To :** | CYOD/CYOD |
| **Flight Date :** | June 30 2008 |
| **Flight Number / Data Flight # :** | 593/ ARCTAS Science Flight # 17 |

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|---|---|
| **Time out:** | **1223 (L)** |
| **Time in:** | **1757 (L)** |
| **Flight Time :** | 5.6 |
| **Flt Request # / PI:** | **8P301/ Phil Russell** |
| **Purpose of Flight :** | **Data [ X ] Ferry [ ] Functional Check [ ] Other [ ]** |
| **Sensor Payload :** | ARCTAS ( flight) |
| **Comments :** | Aircraft is in an up status and ready for the next flight. All science instruments are functioning nominally. Flight #593, Data Flight #17 was 5.6 hours with a departure time of 1223 (L) and landing 1757(L).<br>Flight #17, June 30, 2008, was a great flight worthy of a Golden Day identifier. We completed numerous successful coupled aerosol and radiation objectives in cloud free air. A coordinated CALIPSO underflight was carried out under the B200 lidar curtain. This was followed by stacked radiation legs under the B200 with in-situ microphysics. Direct pyrocumulus penetration for near source characteristics was carried out with subsequent 75mi downwind runs in the plume, under the plume and across the plume looking at plume aerosol aging and associated radiative effects. Vertical profiles in plumes were followed by cloud top penetrations of mixed smoke and cloudy air where Ozone production was suggested. The first ever BRDF characterization of an extended smoke deck were completed by CAR before returning back to base in Asian pollution and dust at 17,500'.<br>REVEAL system worked well today, except the first 20 minutes of the flight. We lost the Ground connection at the time of takeoff. After takeoff, REVEAL called ground GTR support and they quickly identified the problem source. After REVEAL INDS server was restarted, everything went well. B200 had its own problem, which affected P3 for receiving the B200 fly track. Most of the time, data connection between B200 and P3 was fine. Xchat was used by more people on this mission. REVEAL had a few drop offs, but restarted immediately after each drop off. Iridium links become unstable which is a common problem among all the flights when the aircraft is spiraling. Unstable links is also a common problem for the DC8 when spiraling. REVEAL scientist feel this may be a research topic for future applications. |

**SUBMITTED BY: Colleen Kelly 30 June 2008**

Flight Hours for ARCTAS Campaign

| Flight | Date | Aircraft Flight # | Data Flight# | Duration (hr) | Remaining Hours* |
|---|---|---|---|---|---|
| *Total Allocated* | | | | | *90.3* |
| Reveal Test /Training Flight | 6/13/2008 | 583 | PCF 1 | 2.0 | 88.3 |
| Transit To NUQ | 6/19/2008 | 582 | Trans | 7.7** | No charge |
| PCF/Data | 6/22/08 | 584 | #11 | 3.5 | 84.8 |
| CARB/Data | 6/24/08 | 585 | #12 | 8.0 | 76.8 |
| ARCTAS Transit Flt | 6/26/08 | 587 | #13/14 | 6.6/.9 | 69.3 |
| ARCTAS Science Flt | 6/28/08 | 591 | #15 | 4.0 | 65.3 |
| ARCTAS Science Flt | 6/29/08 | 592 | #16 | 7.9 | 57.4 |
| ARCTAS Science Flt | 6/30/08 | 593 | #17 | 5.6 | 51.8 |
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*Allotted flight hours include the following:
ARCTAS – 75 hours
CARB – 8 hours
Hours carried over from Spring ARCTAS – 7.3
** transit flight billed as a maintenance flight
Transit flight allow approx 5.5 hours to include customs clearance at Dover