UNIVERSITY OF WASHINGTON
FLIGHT SCENARIOS FOR
THE CONVAIR C-131A IN
ALASKA (June 3-15, 1995)*

by

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SCENARIO I: ABSORPTION OF SOLAR RADIATION BY STRATUS CLOUDS

Objective

To measure the absorption of the sun's radiation by clouds. We will be looking for large continuous sheets of fairly uniform stratus clouds, that are sufficiently thick that when we fly near the middle of the cloud we cannot see the sun's disks (the so-called "diffusion domain").

Flight Plans (Fig. 1)

1. Fly horizontal leg for about 5 mins. (13 nautical miles) just above the top of the stratus cloud (to measure in-coming solar radiation).

2. Descend through cloud deck (to obtain vertical profile of cloud properties and to check if diffusion domain is satisfied).

3. Fly horizontal leg, parallel to leg (1), for about 5 mins. just below cloud base (to measure transmitted solar radiation and reflectivity of underlying surface).

4. Climb to near center of cloud layer. Fly horizontal leg (parallel to leg 1) for about 5 mins. staying in diffusion domain (to obtain CAR and cloud microphysical measurements).

5. Climb up half the distance between leg #4 and cloud top and fly horizontal leg (parallel to leg 1) for about 5 mins. (to obtain cloud microphysical measurements).

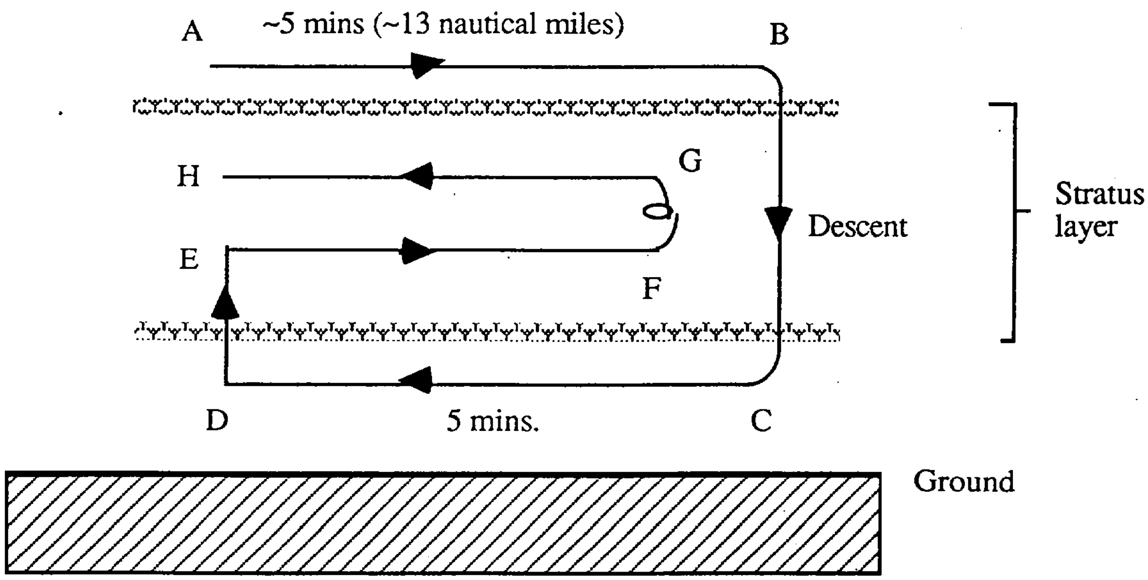

Fig. 1. Vertical Cross-Section of Aircraft Tracks for Scenario 1.

*Primary Instruments**

1. CAR.
2. All of the cloud microphysical measurements.
3. Eppley radiometers.

SCENARIO 2: REFLECTANCES OF VARIOUS SURFACES.

Objective

We want to use the CAR to measure the reflectance of the sun's radiation from various surfaces (tundra, open ocean, sea ice, snow, melting ice, refrozen ice, etc.) under *clear* sky conditions and various sun angles.

* It is expected that most of the instruments will operate continuously on all flights. The lists of "*Primary Instruments*" is given to focus attention on the indispensable instruments for each flight scenario.

Flight Plans (Fig. 2)

The aircraft will fly about 600 m (200 ft) above the surface in a circular orbit about 3 km (~1.6 nautical miles) in diameter. The aircraft should be banked (~20° roll) TO THE RIGHT. With a speed of 80 meter per second (~155 knots), this will take about 2 mins. per orbit.

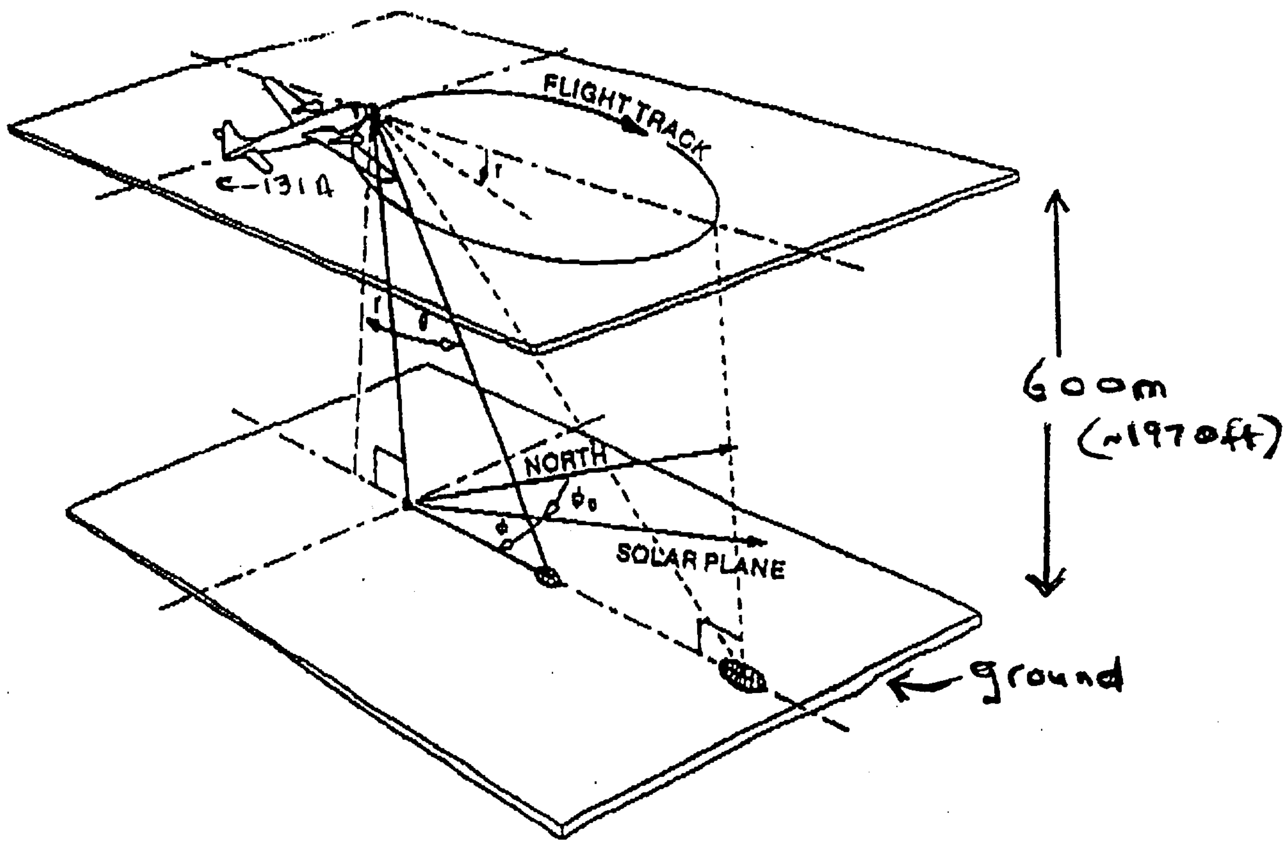

Fig. 2. Aircraft Track for Scenario 2

Primary Instruments

1. CAR
2. Eppley radiometer

SCENARIO 3: AEROSOL OPTICAL PROPERTIES

Objective

The objective of this scenario is to acquire sufficient *in-situ* airborne data to permit calculation of an aerosol optical depth for comparison with remote retrievals. (This constitutes a *column closure experiment*). The remote sensing measurements can be either via MODIS (ER-2) or from a ground photometer (located in Prudoe Bay area). If by MODIS, the measurements will have to be over the ocean surface. If by ground-based photometer, the measurements should be over the photometer site.

Flight Plans (Fig. 3)

The flight plan consists of two parts.

1. The aircraft will ascend from the lowest possible altitude in about seven increments each of ~300 m (~984 ft.) to a final altitude well above the boundary layer (say ~2100 m or 6890 ft.). At each of the seven heights, the aircraft will fly a horizontal leg for about 10 mins. (25 nautical miles). (During each horizontal leg, a bag sample will be obtained for humidigraph, DMPS, CCN and (occasionally) filter measurements).

2. After reaching maximum altitude (and processing the final bag sample), the aircraft will commence a spiral descent in an area adjacent to and just upwind (to avoid aircraft exhaust sampling problems) of the area of ascent. The descent should be at 150 meters per min. (~500 ft. per min.) and terminate at the altitude at which the previous ascent commenced. If the *in-situ* measurements are to be compared with the ER-2, the spiral descent should be coordinated with the ER-2 overpass, with the staged ascent done as time permits.

Primary Instruments

1. 3λ backscatter nephelometer
2. humidigraphs
3. aethelometer
4. DMPS
5. PCASP
6. ambient RH

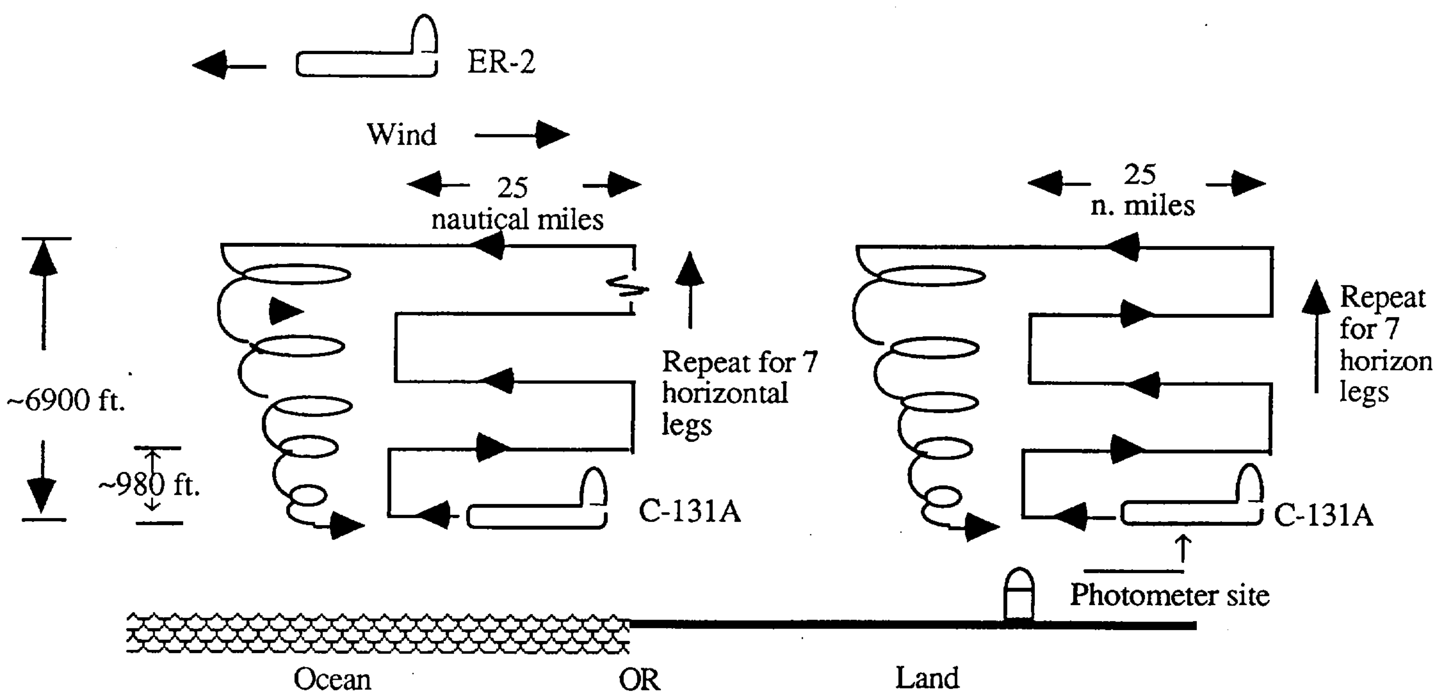

Fig. 3. Vertical Cross-Section of Aircraft Tracks for Scenario 3.

SCENARIO 4: STATISTICAL PROPERTIES OF CLOUD MICROSTRUCTURES

We want to collect data that can be used to investigate the spatial and temporal variability in the microstructures (liquid water content, drop size distribution, ice content) of Arctic stratus clouds.

Flight Plans (Fig. 4)

1. Vertical profile up through depth of cloud layer.

2. Drop down *below* cloud top to about *1/3* of cloud depth. Fly a horizontal path *in cloud* at this level for ~30 mins. (~145 km or ~80 nautical miles).

3. Drop down to middle of cloud layer. Fly another horizontal path in cloud at this level for ~30 mins. (~180 nautical miles).

4. Drop down to a height of about 1/3 above cloud base. Fly third horizontal leg in cloud at this level for about 30 mins. (~180 nautical miles).

5. Drop down just below cloud base. Fly fourth horizontal leg in clear air for about 30 mins. (~180 nautical miles) (to obtain CCN, CN, aerosol measurements).

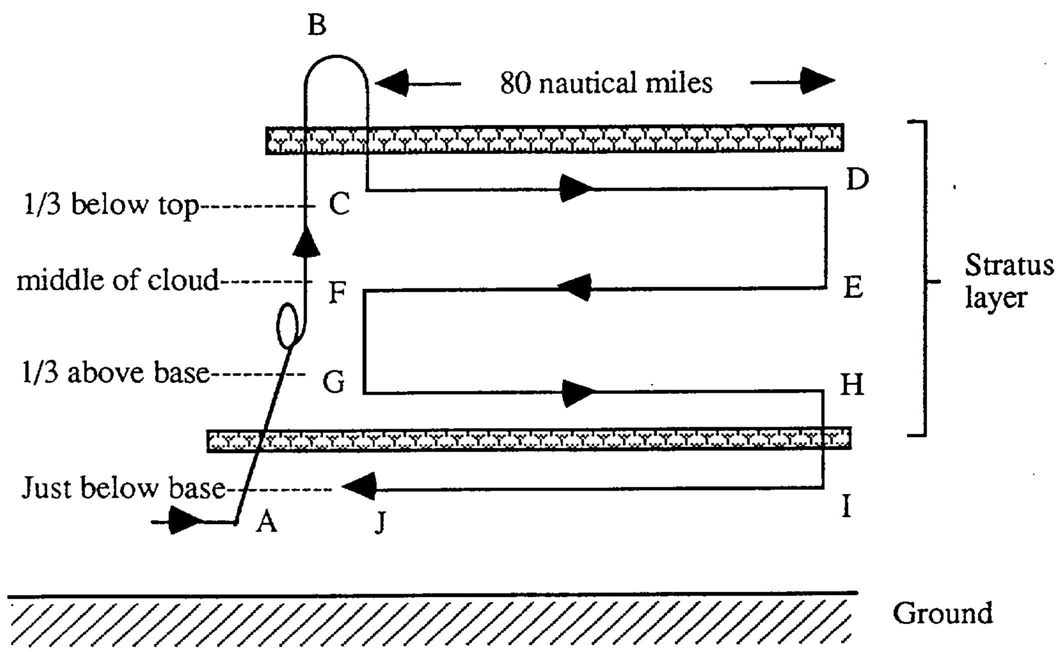

Fig. 4. Vertical Cross-Section of Aircraft tracks for Scenario 4.

Primary Instruments

1. All of the cloud microphysical measurements (at 10-100 Hz).
2. CCN and aerosol instruments.

SCENARIO 5: TO SUPPORT ER-2 "CLOUD MASK" STUDIES

In remote sensing studies a "cloud mask" indicates whether a given field of view has an unobstructed view of the earth's surface. We will support the ER-2 in such studies.

Flight Plan (Fig. 5)

1. The ER-2 will fly a race track pattern with flight legs 30 km (16 nautical miles) apart, starting with AB and concluding with DC.

2. The C-131 will fly a series of flight tracks in-cloud *perpendicular* to those of the ER-2 (i.e., U-V, W-X, Y-Z) within a smaller area inside the area covered by the ER-2.

Primary Instruments

1. Cloud microphysics.

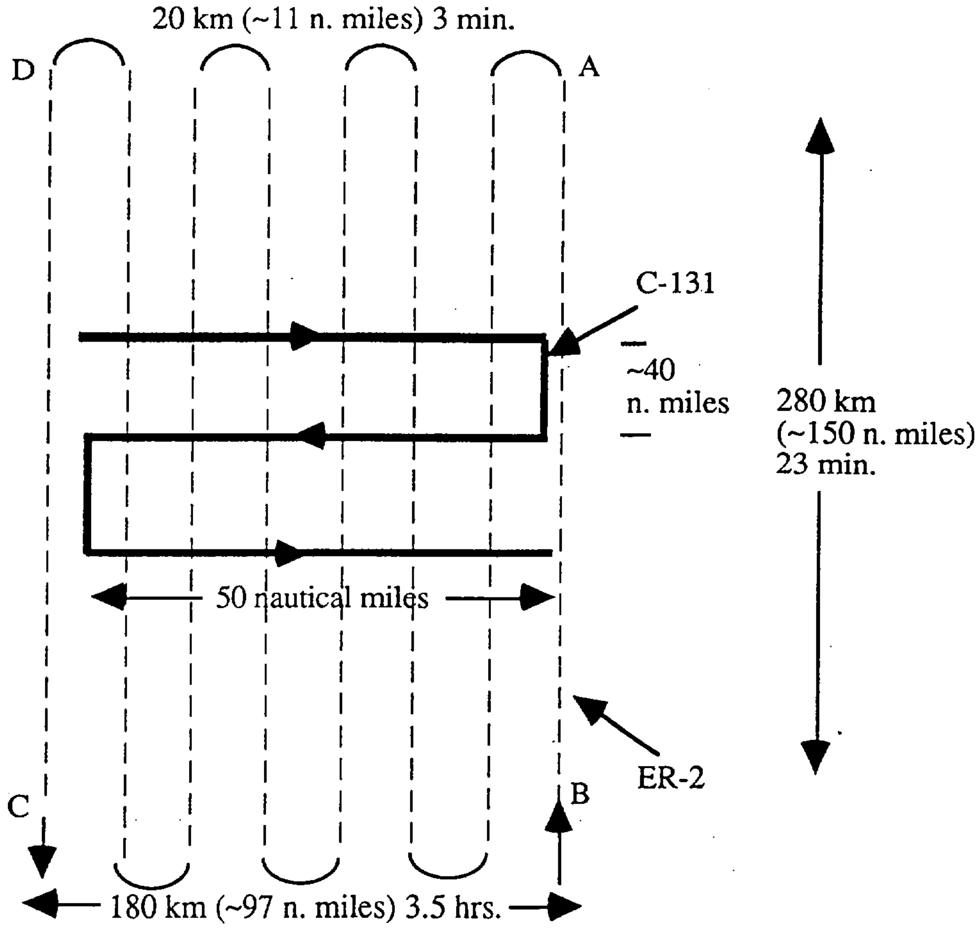

Fig. 5. Plan View of ER-2 and C-131 Flight Tracks for Scenario 5.

SCENARIO 6: TO SUPPORT ER-2 REMOTE SENSING MEASUREMENTS OF CLOUD PROPERTIES

Remote sensing measurements from the ER-2 can be used to derive cloud properties, but this has been done previously primarily with a (low reflecting) ocean surface beneath the cloud. We want to test the technique with (highly-reflecting) ice surfaces beneath the cloud.

Flight Plans (Fig. 6)

1. The ER-2 will fly four horizontal legs (A-B, B-A, A-B, B-A) each 280 km (155 miles) in length (Fig. 6). It will take the ER-2 about 30 mins. to complete one leg (A-B).

2. The C-131A will fly co-located legs (U-V, V-U, U-V, V-U) beneath the ER-2. These legs will be about half the length of the ER-2's (i.e., about 140 km or 75 nautical miles) and will be in cloud at about 1/3 of the cloud thickness below cloud top.

3. The ER-2 flight tracks may have to be repeated along CD, and the C-131 tracks along a half-length parallel track beneath the ER-2.

Primary instruments

1. All of the cloud microphysical measurements.

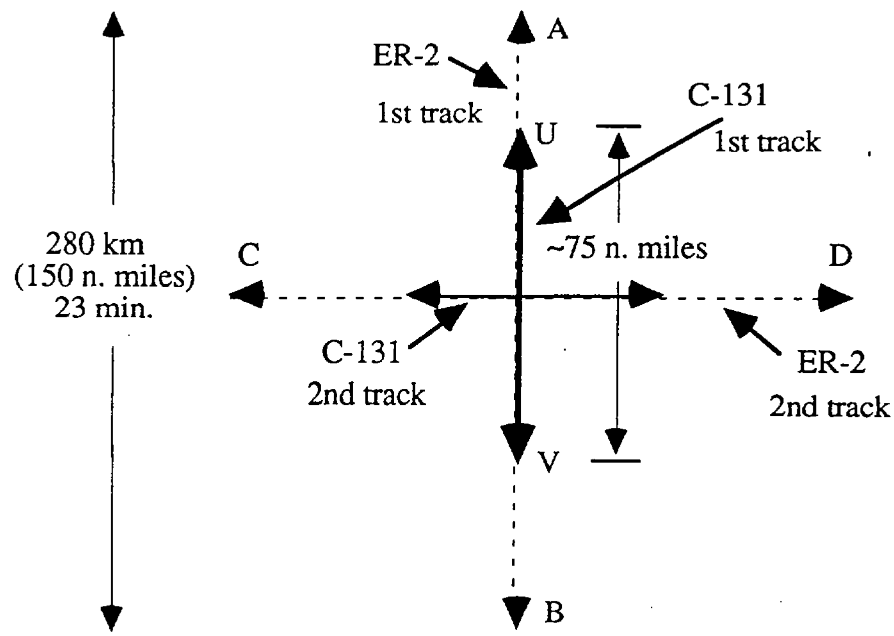

Fig. 6. Plan View of ER-2 and C-131A Flight Tracks for Scenario 6.