

Airborne Scientist Flight Logs

NCAR King Air N312D

HAPEX-MOBILHY
Toulouse, France
9 May - 15 July 1986

Edited by

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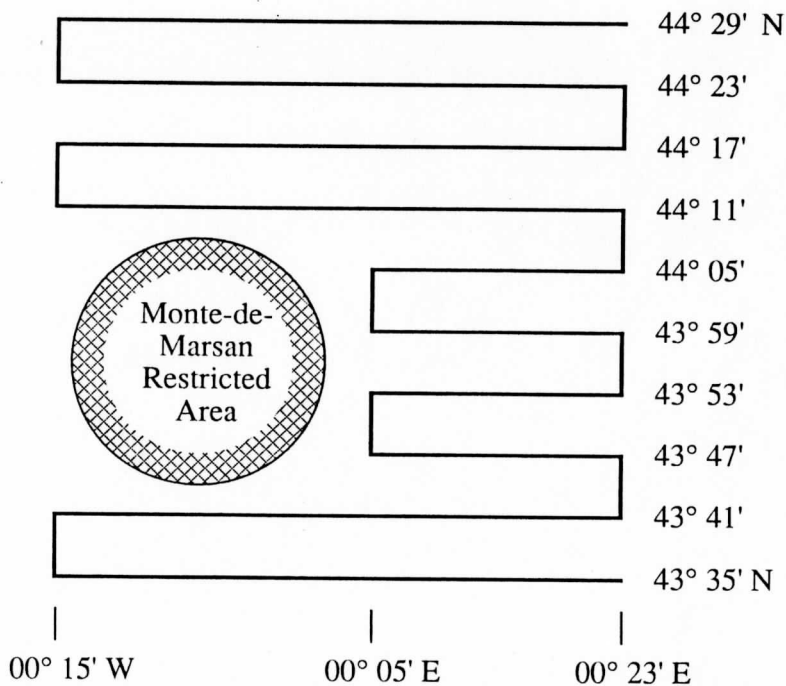
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October 1986

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HAPEX Grid (G) Pattern

(also known as the mapping mission)



<u>Mission</u>	<u>Flight</u>	<u>Date</u>	<u>Direction Flown</u>
1	4	17 May 86	South to North
2	25	14 July 86	North to South

Revised 10 Nov 86 based on data supplied by Peter Hildebrand.

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Table 1. *Flight Summary*

NCAR King Air
 HAPEX-MOBILHY Field Experiment, Toulouse, France
 9 May - 15 July 1986

Flight Number	Date 1986	Takeoff Time*	Duration (hours)	Pattern	Subjective Quality	Weather & Remarks
1	9 May	113430	4.8	S	Very Good	0.1-0.7 Cu
2	12	110000	4.7	S	Excellent	Clear to rain
3	14	110730	4.9	S	Good	Broken Cu & Sc
4	17	110340	4.5	G	Very Good	Mostly Clear
5	19	120300	4.0	M	Very Good	Ac & Ci
6	21	105745	4.9	S	Excellent	Deep Cu
7	24	130000	4.6	S	Good	Overcast to clear
8	25	110300	3.9	M	Good	Ac & Ci
9	27	105800	4.8	S	Good	Sct Cu, Ovc Ac
10	30	105800	4.9	S	Good	Deep Cu
11	3 June	121300	5.1	S	Good	Overcast, rain
12	6	125150	4.6	S	Fair	Overcast Cu,Sc
13	9	105800	4.8	S	Very Good	Scattered Ci
14	13	105945	5.1	S	Excellent	Few Cu
15	16	111045	4.8	S	Excellent	Clear
16	19	125342	4.0	S	Very Good	Clear & calm
17	22	110310	4.9	S	Excellent	K-H & band
18	25	110230	4.7	S	Good	Disorganized
19	28	120642	5.0	S	Good	Flew only HG leg
20	1 July	110831	4.7	S	Good	Hazy. Ci. Scat.Cu
21	2	110417	5.1	S	Very Good	Hazy. Ci
22	5	120500	4.0	S	Interesting	Hazy. Ci
23	8	114500	3.9	S	Very Good	Scattered Cu
24	11	120450	4.0	S	Good	Ci
25	14	115740	4.2	G	Excellent	Uniform Sc

		<u>Totals</u>
Flight hours:		118
Patterns:	S:	21
	M:	2
	G:	2

* All times are local "summer" time = GMT + 2hr.

Introduction

Twenty five flights were flown during the Hydrologic-Atmospheric Pilot Experiment (HAPEX-MOBILHY) during May-July 1986 (see Table 1 for a summary of flights).

A. Patterns

Three flight patterns were flown (see Table 2).

Table 2. Summary of patterns.

<u>Pattern</u>	<u>Goal</u>
S (<u>S</u> -shaped)	Measure moisture fluxes over a variety of surface types
M (<u>M</u> esoscale)	Determine mesoscale variability of moisture fluxes
G (<u>G</u> rid)	Mapping mission to inventory surface types

1. S-pattern

a. Location. The S-pattern was flown between four key points, labeled E,F,G & H (see Fig. 1).

- **Leg EF:** The leg between E and F was over rolling farmland, with numerous small valleys approximately perpendicular to the flight track.
- **Leg FG:** Leg FG had a wide variety of surface features: (1) the southern quarter followed the axis of an agricultural valley; (2) the middle third was over gently rolling farmland; (3) the northern quarter was over a flat forest region. In addition, leg FG was not flown along a straight track, but was flown as two segments in order to avoid the heavy glider traffic over Nogaro airport (roughly in the middle of the FG leg).
- **Leg GH:** The southern 2/3 of leg GH was over a very flat forest (mostly evergreen trees), but the northern third varied from partial forest to agricultural to a broad river valley (Garonne). No major cities were under the flight legs, although the aircraft flew over numerous small villages and towns.

b. Altitudes. Most S flights were flown for 4.5 to 5.0 hours, allowing many repetitions of the whole pattern (EFGH). Most of the legs were flown at an average altitude of 100m above ground level. Two legs were usually flown just below cloud base, or at 70% of the boundary layer depth if there were no clouds. The same two legs were then flown at roughly 40% of the boundary layer depth.

In addition, soundings between the surface to above the top of the boundary layer were occasionally made at some of the key points. The precise sequence of altitudes and legs varied from flight to flight, depending on the weather, fuel, air traffic, and other factors.

c. Scheduling and Weather. The S-pattern was flown roughly once every three days. This insured a contiguous sampling of the moisture fluxes during the whole duration of the special observing period (May-July). It also meant that date and not weather was the most important factor entering the decision process for each flight.

As a result, there is roughly an even partition between flights on fair weather days (with fair weather clouds) and on days with more disturbed weather and overcast clouds. There were only a few flights flown with cloud-free skies. On days with strong or continuous precipitation, or with fog or other difficulties for flight, the flight was postponed until the next good weather day.

2. M-pattern

a. Location. The M-pattern was flown back and forth along an east-west flight leg roughly 120 km long (see Fig. 2). Virtually the whole track was over the forest.

Introduction

Twelve flights were flown during the Hydrolog-Aerosols-Pilot Experiment (HAPX-MOBILITY) during May-July 1995 (see Table 1 for a summary of flights).

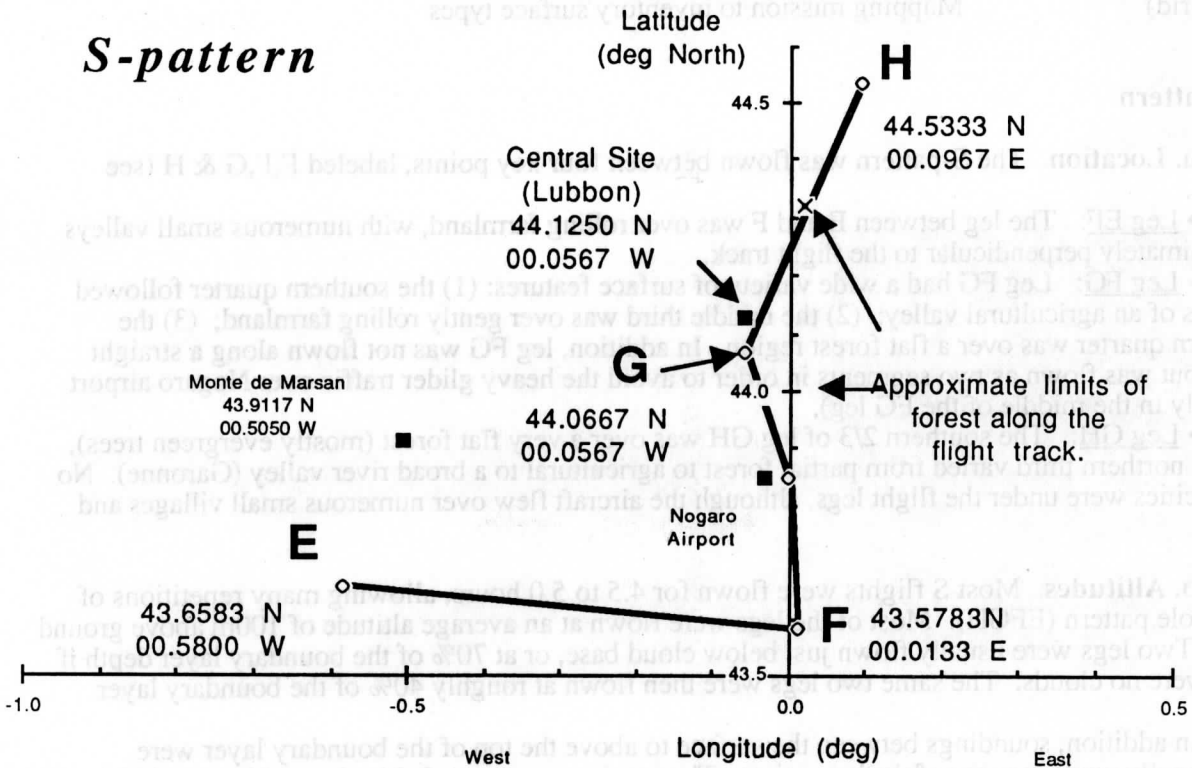
A. Patterns

Three flight patterns were flown (see Table 2).

Table 2. Summary of patterns.

Pattern	Shape	Scale	Altitude
1	(S-shaped)	M (Mesoscale)	0 (0-50)
2	(S-shaped)	M (Mesoscale)	0 (0-50)
3	(S-shaped)	M (Mesoscale)	0 (0-50)

S-pattern

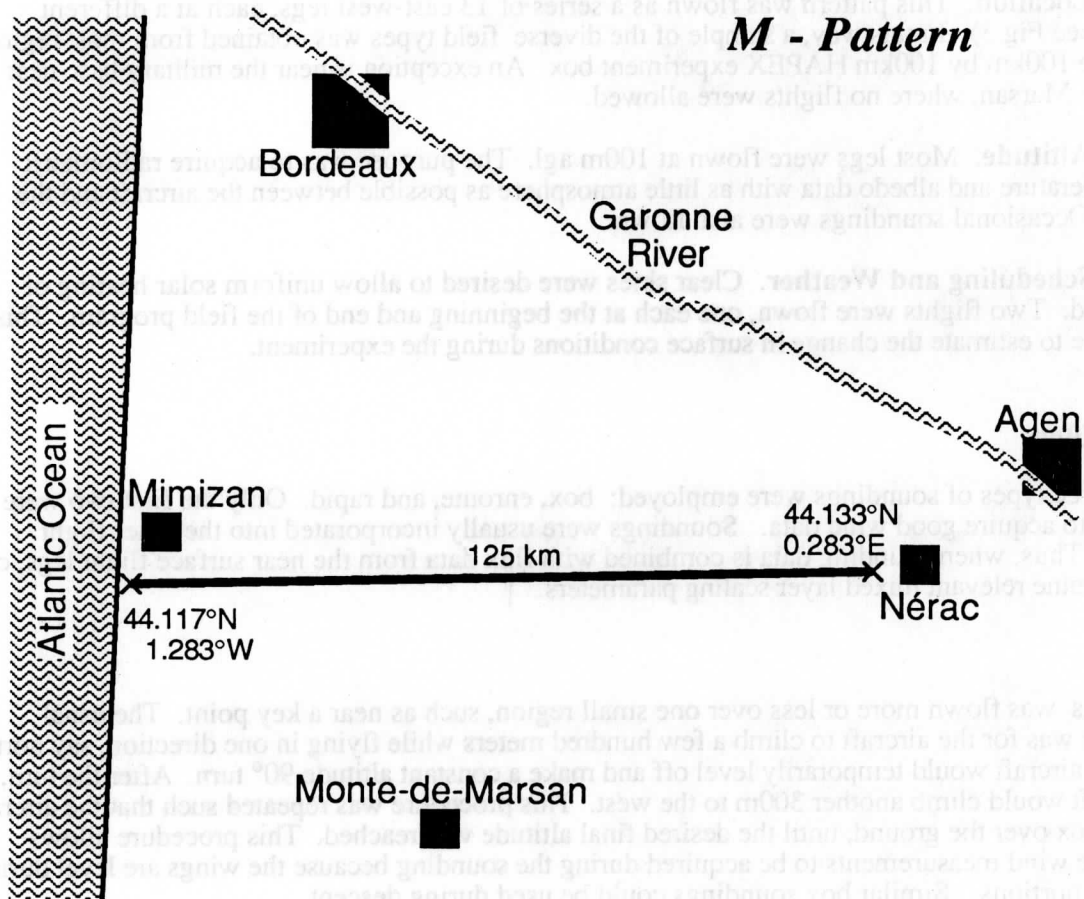


c. Scheduling and Weather. The S-pattern was flown roughly once every three days. This involved a continuous sampling of the moisture fluxes during the whole duration of the operating period (May-July). It also meant that date and not weather was the most important factor entering the decision process for each flight.

As a result, there is roughly an even partition between flights on fair weather days (with low weather clouds) and on days with more disturbed weather and overcast clouds. There were only a few flights flown with cloud-free skies. On days with strong or continuous precipitation, or with fog or other difficulties for flight, the flight was postponed until the next good weather day.

2. M-pattern

a. Location. The M-pattern was flown back and forth along an east-west flight leg roughly 120 km long (see Fig. 3). Usually the whole track was over the forest.



b. Altitude. An altitude of 100 to 200m above ground level was flown, except for soundings to higher altitudes at each end of the leg.

c. Scheduling and Weather. This flight could only be flown in fair weather, and only on weekends or holidays (in order to fly through military airspace). As a result, only two flights were flown, both during the first third of the experiment. The French aircraft (Piper Aztec) flew in formation for a portion of each of these flights to gather intercomparison data.

3. G-pattern

a. Location. This pattern was flown as a series of 13 east-west legs, each at a different latitude (see Fig 3). In this way, a sample of the diverse field types was obtained from most regions within the 100km by 100km HAPEX experiment box. An exception is near the military base near Monte-de-Marsan, where no flights were allowed.

b. Altitude. Most legs were flown at 100m agl. The purpose was to acquire radiometric skin temperature and albedo data with as little atmosphere as possible between the aircraft and the ground. Occasional soundings were also flown.

c. Scheduling and Weather. Clear skies were desired to allow uniform solar heating of the ground. Two flights were flown, one each at the beginning and end of the field program. This allows one to estimate the change in surface conditions during the experiment.

B. Soundings

Three types of soundings were employed: box, enroute, and rapid. Only the first two were designed to acquire good wind data. Soundings were usually incorporated into the other flight patterns. Thus, when sounding data is combined with flux data from the near surface flight legs, one can determine relevant mixed layer scaling parameters.

1. Box

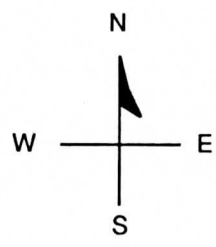
This was flown more or less over one small region, such as near a key point. The usual procedure was for the aircraft to climb a few hundred meters while flying in one direction, say north. Then, the aircraft would temporarily level off and make a constant altitude 90° turn. After the turn, the aircraft would climb another 300m to the west. This procedure was repeated such that the aircraft traced a box over the ground, until the desired final altitude was reached. This procedure allows acceptable wind measurements to be acquired during the sounding because the wings are level during the climb portions. Similar box soundings could be used during descent.

2. Enroute

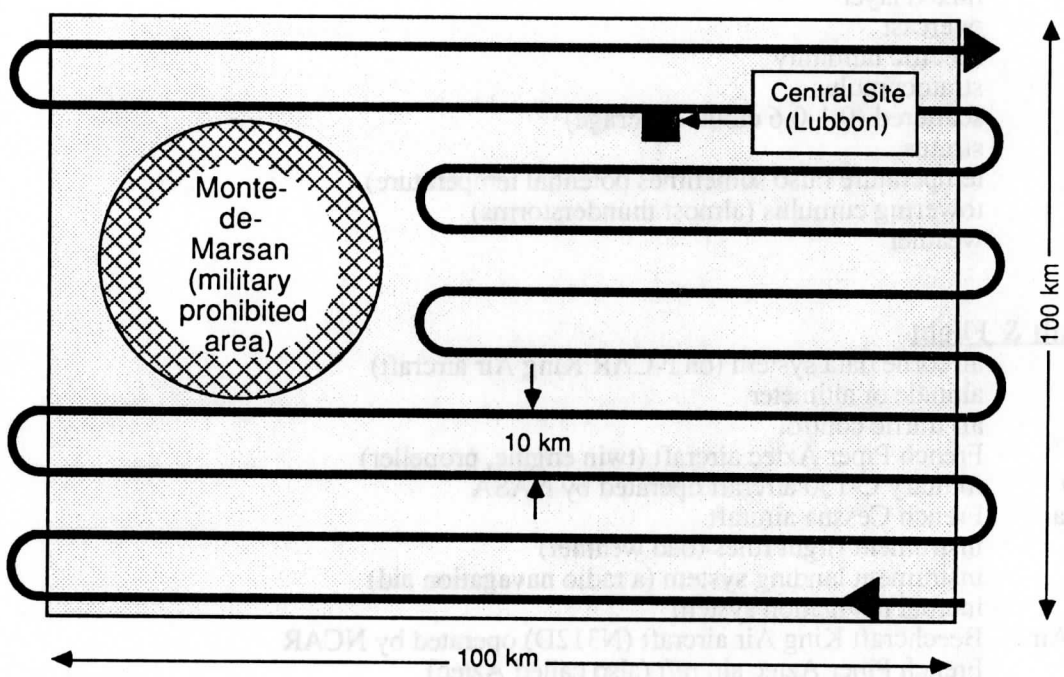
This sounding was flown while ferrying the aircraft from Toulouse, where the aircraft was based, to the field site west of Toulouse. This sounding consisted of an altitude change between the surface near one of the key points, to an altitude of roughly 3000m at a point roughly 30km to the east of the field site. These soundings were always flown in nearly straight tracks, insuring accurate wind data.

3. Rapid

Occasionally, the aircraft made rapid ascent or descent maneuvers with no intention of acquiring useful wind data. These were often made just before or after good soundings, in order to return to a desired flight leg altitude with a minimum of fuel usage.



G - Pattern (approximate)



Abbreviations

Clouds & Weather

Ac	altocumulus clouds
bkn	broken cloud cover (0.7-0.9 coverage)
BL	boundary layer
cong	congestus (deep cumulus clouds)
h	depth of the boundary layer
hum	humilis (shallow cumulus clouds)
Cc	cirrocumulus
Ci	cirrus
Cs	cirrostratus
Cu	cumulus
K-H	Kelvin-Helmholtz waves
mb	millibar
med	mediocris (medium size cumulus clouds)
ML	mixed layer
ovc	overcast
q	specific humidity
Sc	stratocumulus
sct	scattered (0.1-0.6 cloud coverage)
St	stratus
T	temperature (also sometimes potential temperature)
Tcu	towering cumulus (almost thunderstorms)
WX	weather

Aircraft & Flight

ADS	airborne data system (on NCAR King Air aircraft)
alt	altitude or altimeter
ATC	air traffic control
Aztec	French Piper Aztec aircraft (twin engine, propeller)
C-130	military C-130 aircraft operated by NASA
Cessna	French Cessna aircraft
IFR	instrument flight rules (bad weather)
ILS	instrument landing system (a radio navigation aid)
INS	inertial navigation system
King Air	Beechcraft King Air aircraft (N312D) operated by NCAR
Piper	French Piper Aztec aircraft (also called Aztec)
VFR	visual flight rules (good weather)
VLA	voltage from the Lyman-alpha sensor on the King Air

Location

agl	above ground level (based on radio altimeter)
box	the 100 X 100km area of the HAPEX field program
E	east
E	key point labeled E
F	key point labeled F
G	key point labeled G
H	key point labeled H
km	kilometers
MdM	Monte-de-Marsan (a military restricted area and airport)
msl	above mean sea level (based on pressure altimeter)
m	meters
N	north
RR	railroad tracks
S	south
sfc	surface
TLS	Toulouse (airport)
W	west

Organizations

CEV	a French aviation organization, where the aircraft were hangered
NASA	National Aeronautics and Space Administration (USA)
NCAR	National Center for Atmospheric Research (USA), sponsored by the US National Science Foundation
RAF	research aviation facility (an organization within NCAR)

Miscellaneous

est	estimated
HAPEX	hydrological-atmospheric pilot experiment
->	to (or changing toward)

Time

GMT	Greenwich mean time (= UT = universal time) (= Z = zulu time)
hhmmss	hh=hour (24 hour clock), mm=minutes, ss=seconds
hr	All times are King Air data system times = local "summer" time = GMT + 2 hr. hours

4/22/86

Aircraft Research Instrumentation

King Air N312D - Project #6-210

HAPEX

Dr. R. Stull

RAF-Supplied Instrumentation:

- I. Airborne Data System.
 1. Acquisition: King Air ADS (Motorola 68000 based), and two Kennedy Model 9800 Tape Drives.
 2. Display: Hewlett-Packard Model 2113E Computer (1000 Series), HP Model 9885M Floppy Disk Drive, HP Model 9876A Printer, HP 85 (terminal emulator), and four Panasonic Model WV-5362 Twin Video Monitors.
- II. Aircraft Position, Velocity, and Attitude.
 1. Litton LTN-51 INS (Inertial Navigation System) located in the nose boom, SN-527.
- III. Static Pressures.
 1. Rosemount Model 1201F (starboard wing tip). SN-1510.
 2. Rosemount Model 1201F (boom). SN-1509.
 3. Rosemount Model 1501 Digital Transducer (fuselage). SN-36.
- IV. Dynamic Pressures.
 1. Rosemount Model 1221F1VL (starboard wing tip). SN-1380.
 2. Rosemount Model 1221F1VL (boom gust probe package). SN-1381.
 3. Rosemount Model 1332 (boom gust probe package). SN-9233.
- V. Air Temperatures.
 1. NCAR Reverse Flow Minco Sensor--Rosemount Model 510BF Amplifier, (starboard wing tip). SN-62.
 2. Rosemount Type 102 Non-deiced sensor - Rosemount Model 510BH. Amplifier (sensor on cabin top). SN-2933.
 3. Fast response temperature probe - NCAR built, (sensor on boom gust probe mounting location). SN-570.
- VI. Dew Point Temperatures and Humidity.
 1. EG&G Model 137-C3 Dew Point Hygrometer (2 units, starboard fuselage near station 345).
 2. NCAR Model LA-3 Lyman-alpha Hygrometer (2 units, boom gust probe mounting location).
- VII. Geometric Altitude. Collins Model ALT 55 B Radio Altimeter.
- VIII. Air Flow Angles (gust probe - vanes).
 1. Attack Measurement - Fixed Vanes: Left SN-106; Right SN-113.
 2. Sideslip Measurement - Fixed Vanes: Top SN-108; Bottom SN-106.

- IX. Liquid Water.
 - 1. Particle Measuring Systems CSIRO-King Probe (port wing tip).
 - 2. Cloud Technology - Hot wire probe (port wing tip).
- X. Radiation Fluxes.
 - 1. Visible radiation. RAF-modified Eppley Model PSP Pyranometers.
2 units: Upward looking and downward looking.
 - 2. Infrared radiation. RAF-modified Eppley Model PIR Pyrgeometer.
2 units: Upward looking and downward looking.
- XI. Surface Temperature.
 - 1. Barnes PRT-5, Precision Radiometer (downward looking).
- XII. Particle Imagery and Size Spectra.
 - 1. Particle Measuring Systems Model FSSP-100. SN-277-0676-06.
 - 2. Particle Measuring Systems Model 260X. SN-1854-1280-06.
- XIII. Voice recording. Sony Dictator Model BM-15 (4 units, cabin).
- XIV. Photography.
 - 1. GE Model No. 1CVK5040 Video Camera and Recorder (color camera - downward looking).
 - 2. PULNIX Model CCD Video Camera Module Cockpit - forward facing with ~~JVC~~ Video Tape Recorder (VHF-audio capability).

GE

Airborne Scientists' Flight Log

Flight: 1

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 9 May 1986
Pattern: S -cloud base option
Airborne Scientist: Stull
Data Manager: Miller
Pilot: Summers
Observer: André
Subjective Quality: Very Good

Weather: High pressure in the region, with light (5-7 m/s) westerly winds in the boundary layer, and 15 m/s winds aloft. Fair weather cumulus clouds, varying from 1/10 in the southern part of the box, to 7/10 in the north. Cloud bases were at about 915m msl at the start of the flight, but increased to 1370m msl at the end. In early afternoon, the clouds in the northern part of the region had significant vertical growth (ie, active clouds) up to 2135m msl, but at other times and the other locations, the clouds were generally flatter suppressed forced clouds. High thin scattered Cs clouds during the first half of the experiment gave way to clear skies aloft in the last half.

<u>Time</u>	<u>Description</u>
The following times are data system times = local daylight time = GMT+2hr.	
111830	Right engine start. Mostly clear, with scattered .1 - .2 Cu low, with scattered Ac higher.
112630	Data calibration problem delayed taxi, but problem was resolved.
113430	Takeoff on runway 33R. Well defined, polluted mixed layer near Toulouse, with .1 - .2 Cu, thin Ci aloft. Jet contrails aloft. North of location, a deck of scattered Ac, with Cu below. This seems like a mesoscale patch, which will exist in the central and northern portion of the box. To the south, fewer Cu, with clear skies closer to the Pyrennes.
114130	Level 2745m msl. Air is smooth. The Pyrennes are clearly visible.
115230	Time hack Data system time = 115400 wrist watch time of airborne scientist.
115330	At point Q.
120330	South of us is virtually clear. North of us is a mesoscale patch that looks broken Sc.
120830	Starting descent sounding. (Leg 1) Descending thru 2435m msl, clear where we are, scattered Cu ahead of us, with Sc to the north of our position. We can see the ocean off in the distance.
121134	At cloud top, 1433m msl, light turb. .4-.7 Cu north of us, but clear at our present location. We will not be flying through any clouds during this descent.
121216	1219m msl at mid cloud level. Presently heading westbound toward the ocean.
121300	Descending thru cloud base at 1006m msl. Light turbulence. On the plotted altitude in meters, top of of the inversion is at 1.4-1.5 km , corresponding to cloud base.
121530	At 800m we are in the entrainment zone below cloud base.
121644	274m msl almost finished descent sounding.
121744	Starting leg 2 (EF), at 229m msl, 72m/s airspeed, heading eastbound. Scattered .1-.2 Cu, not flat bases, very thin. .4 Ci higher. Mostly sunny and warm with light turbulence.
121924	Relatively flat gently rolling terrain, but will begin to cross our first valley running NW to SE in 30 s.
122126	At 287m msl in smoothed terrain following mode.
122459	329m msl, crossing diagonally narrow ridges with broad valleys inbetween.
122546	Sc & Cu .2-.3 , light turbulence. With very thin .4 Ci aloft, with numerous jet contrails visible.
122703	At point F, 335m msl, finished leg 2. Turning right. We are disoriented, therefore we

Airborne Scientists' Flight LogFlight: 1

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- are circling to find the proper starting point. It appears that we stopped too soon (ie, did not reach point F). Therefore the data between this time and the time of the start of the next leg is not useable. At 320m msl. Well above the ground. We are about 244m agl. Turning right. At 290m msl. At or just below the top of the ridge to our left (west), but are about 90m above the valley floor. .3-.4 Cu with flat bases. .2 Ci aloft.
- 123300 Starting leg 3 (FG) at about 122m agl, according to the radio altimeter.
90-122m agl, 229-244m msl. Going thru gently rolling valley.
- 123721 .4-.6 active Cu mediocris clouds. Estimate ground elevation to be about 122m msl, based on difference between pressure altitude and radio altitude.
- 124041 About 2/3 way from F to G, pilot is doing a great job flying smoothed 90m agl. About .6 Cu getting deeper.
- 124110 Passing over a body of water. Use for calibration of radiometer. End at 124122.
- 124212 Just entering the forest area. Definitely different size trees in patches, with cleared and farmed patches inbetween.
- 12-- 350 heading, radio altimeter 90m agl, forest is very flat.
- 124431 At point G. Finished leg 3. Starting climb. .7-.8 active Cu. Deep convection, but no precipitation.
- 124732 Still turning. At 85m agl, climbing to 90m agl. Turning to 018.
- 124801 Start leg 4 (GH) at G. 244m msl, 90m agl.
- 124852 About .5 W of the central site (Lubbon) trailers. The ground is definitely not uniform.
- 125624 About .8 finished with this leg. Leaving forest area. Less cloud coverage .4-.5 active clouds. With .1 or less thin Ci. Nearly calm winds near the surface.
- 12-- Ground level must be at 33-65m.
- 125902 End of leg 4 at H. Starting climb sounding leg 5.
- 130143 823m msl, maneuvering to say VFR, but occasionally going thru a few clouds. Nevertheless, the data as plotted on the display screen looks good.
- 130433 Average tops 1737m msl, with higher tops of clouds at 1981m. Making turns in a sounding at Point H. Highest cloud tops at 2134m msl. We will climb up to 2286m before descending. Strong inversion across cloud top, with not much change in theta at cloud base.
- 130625 End of climb, leg 5. Beginning descent back down to 762m msl for cloud base legs.
- 130930 During descent, cloud base at 914m msl, with a few lower bases.
- 131101 701m msl, turning back to point H.
- 13-- We are 90m -914m below cloud base.
- 131252 Starting 732m msl leg soon (will climb back to 762m soon).
- 131332 At point H, starting leg 6 (HG), level at 762m, about 33-90m below cloud base. Local clouds are .5-.7 Cu med.
- 131832 About .6 the way from H to G on leg 6. Cloud base 90-122m above us. Scattered .4-.6 Cu coverage, with not so deep convection. Still over the forest.
- 132122 Going under many Cu clouds. We should get lots of good updraft info. Yet, we are far enough below to be well out of any liquid water.
- 132321 Just passed over the central site, about a minute & 30 sec ago. Soon to pass over point G.
- 132440 Finished leg 6. at G. 762m msl, 90m below cloud base. Starting turn. .4-.5 Cu, not deep. Still lots of sunshine reaching the surface, with light turbulence in the PBL.
- 132542 Starting leg 7 (GF), 762m msl, about 183m below cloud base.
- 132940 About half way between G & F, about 152m below cloud base, .3-.4 Cu, shallow clouds. No Ci aloft, except for an occasional contrail.
- 133621 At F, finished leg 7, starting descent turn. 0.1- or less Cu. We were about 152-244m below cloud base at the end of leg 7.
- Note that the sounding at F (ie, leg 8) was completely omitted because of lack of time.

Airborne Scientists' Flight Log**Flight: 1**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- We had to plan to leave the military area at the end of the next two legs by 1400 local time.
- 133940 At F, 457m msl for mid level flight leg, starting leg 9 (FG).
- 134651 About .6 the way from F to G, about .4-.5 Cu with flat bases, medium vertical development. 0.1 Ci above contrails.
- 135121 At G at 457m msl, end of leg 9, starting turn for next leg. Will start leg 10 (GH) in a few seconds (ie, very small turn needed to start this leg).
- 135318 Flying over the central site (just off to the left) now. At 457m msl.
- 135403 Flying leg 10 (GH). Just north of point G with .4-.6 Cu based on cloud shadows. Only jet contrails aloft.
- 140100 90% of the way from G to H. Scattered Cu .2-.3 coverage, with no higher clouds. We are not quite out of the military area. Therefore, we need to take off earlier on the next S pattern flight.
- 140341 At H, ending leg 10. Beginning descent turn with no special sounding pattern.
- 140552 At 122m msl, 122m agl, at H, starting low level leg 11 (HG). Smooth terrain following mission. Clouds here are .2-.3 Cu off to the east, with greater .4-.5 cu to west.
- 140901 244m msl, 90m agl. about 1/3 way between H & G. .2-.3 Cu.
- 141002 90m agl, 213m msl. flying over forest.
- 141501 90m agl, 229m msl, over central site now. .4-.6 Cu, a bit more vertical development than there was to the north. Light turbulence. No high clouds.
- 141752 Over G, ending leg 11, starting turn to begin leg 12 (GF). .4 Cu with flat bases, with medium to little vertical development. No clouds higher. The forest area is very wet, with puddles and swampy areas between the trees.
- 142651 80% towards F on leg 12. Will enter valley in 30 seconds, flying very close to the ridge on the right of the aircraft. .1 or less Cu, not flat bases, will fewer clouds to the south.
- 142952 Finished leg 12, starting turn. 335m msl, 90m agl.
- 143043 Starting leg 13 (FE), heading 290 roughly.
- Note We plan to modify the pattern to do a sounding at E, up to above cloud top and back down to the surface. This makes up for the lack of sounding a F earlier. After one more S pattern, we will head home because we are running low on fuel. Therefore we will eliminate the whole last S pattern.
- Starting leg 13. At F there are Scattered Cu clouds, some aligned in rolls or streets, with less than .1 Cu to south, with .2-.3 Cu to the north. We are flying along the border between these two regions. 335m msl, 152m agl over a valley. Wind vectors from the WNW (280 deg).
- 143922 Near the end of leg 13 at 244m msl, 122m agl, with .2-.3 Cu with very shallow. Many brown dirt farms, intermingled with green fields and forest legs.
- 144102 End of leg 13, 213m msl, 90-122m agl, at F. Starting sounding (leg 13.5) with box turns.
- 144559 Still climbing. Cloud base at 1372m msl.
- 144712 Staying out of the cloud. Now at 1463m msl, above most of the cloud tops.
- 144731 Roughly at cloud top at 1524m msl. There is a mixed layer all the way up the top top of the clouds, with little or no stability at cloud base. .2 Cu here based on cloud shadows. No higher clouds. At point E.
- 144844 Beginning descent sounding, not a box pattern, but a quick descent to save time. Cloud base at 1372m, most tops at 1524m, and max tops at 1676m msl.
- 145200 198m msl, 90m agl, starting leg 14 (EF). 0.2 Cu (very flat), with Pyrenees visible to south.
- 150100 Almost at F, finishing leg 14, .1 or less Cu to south, with .2 Cu to north, no higher clouds. Light turbulence.
- 150202 At F, starting turn. Note that we climbed a bit just before reaching point F.

Airborne Scientists' Flight Log

Flight: 1

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 150252 Doing an inside turn to save time and fuel.
150332 Starting leg 15 (FG). 290m msl, 168m agl.
151221 Flying over reservoir now, approaching point G. At 250m msl, 140m agl. With .3-.4 flat Cu.
151301 Rocking back and forth at bit. 90m agl.
151552 At G, about .5 mile to right of track. 244m msl, 98m agl. with .3-.4 flat suppressed Cu. No clouds higher.
151644 Starting leg 16 (GH) 244m msl, 90m agl.
151740 Over the central site. Right over.
152321 .75 the way from G to H on leg 16. Some new interesting clouds some flat, non convective stratiform almost lenticular clouds at the top of the Cu clouds. Cu have .3 coverage, while these lenticular clouds are 0.1 coverage.
152632 At end of leg 16. 229m msl. .5-.6 very flat Sc clouds, with some lenticular.
152725 Starting ascent straight line sounding enroute to Toulouse from H. Starting at 274m msl, about 152m agl. Present heading is 020.
152748 Starting a right turn during the sounding climb.
152933 Approaching cloud base 1097m msl over Auch?
153000 Cloud base now at 1280m to 1311m msl. Above most of the clouds at 1524m msl. 1585-1676m msl is layer of flat lenticular. We are well above the top of the fair weather Cu. Note that the Cu clouds are below the temperature inversion (tops hitting the inversion), while the lenticular clouds are imbedded within the lenticular.
153145 1829m msl, above all the clouds, well within the stable layer. Plan to climb to 2743m msl.
153545 Leveling off at 2743m msl enroute to Toulouse. Note that there is a dry layer of air above the cloud top inversion, with a moister layer here at 2743m. This will be a good layer to calibrate the lyman alpha against the dew pointer, because no turbulence.
154500 Begin a gentle descent sounding enroute to Toulouse. We see that dry layer again. Scattered .1-.2 Cu of very flat clouds.
Cloud tops at 1524m msl.
155018 Still flying level at 1524m msl. Still at cloud top. Being vectored by ATC. .1 flat Cu.
155140 Just flew thru a small cloud. still level at 1524m. Occasional light turbulence, perhaps withing thermals without clouds at this height.
155432 Cloud base at 1372m msl. light chop. Surface wind 240 degrees at 6 knots, as reported by Toulouse tower.
1605-- Landed.

Airborne Scientists Flight Log

Flight: 2

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 12 May 1986
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Miller
Pilot: Summers
Observer:
Subjective Quality: Excellent

Weather: Generally fair weather conditions on the back side of a high pressure area. The skies began clear. The initial surface inversion was at about 500m, msl (400m agl.) The inversion had a theta increase of about 10 deg C in 500m. Between about 1 and cloud base was a slightly stable layer. Cloud base was at about 3 km. During the day the surface inversion rose to about 700 m,msl at 1230, then about 800 m msl at 1500. Cloudiness increased, beginning along the southern border of the research area, with some rain showers beginning to the south at about 1300. These light showers moved slowly to the NNE across the area. At the end of the flight we passed through the same disturbance (?) between point H and Toulouse. After the flight ended the research area was again cloud-free. See comments below for additional weather observations.

<u>Time</u>	<u>Description</u>
110000	Takeoff altimeter setting 1015 mb. WX: clear skys. Haze layer to about 400 m,agl (~500m,msl). Not much shear at inversion. Shallow widely scattered Cu with bases at >3000m,msl.
111343	Some Cu at eastern edge of research area, principally to south.
111630	Beginning to pass under the Cu. Slightly increased turbulence.
112115	At point Q. Now tcu to south of research area, between here and mountains. Good potential for development of these storms.
113305-114520	descent sounding. Clear over research area. Scattered Cu to west with bases >3km. Tcu with anvil blowoff to sw.
113500	Cessna BLEB at point B. The most northward small Cu over track EF.
114330	First turbulence at 600m,msl. Inversion base at 400m,msl.
114520-115515	flight leg EF at 100m,agl.
115548-120748	flight leg FG at 100m,agl.
120755-121838	flight leg GH at 100m,agl.
120900	at central site
121838-122850	sounding at point H. Clear skys, all quads. The following flight levels selected: 670m,msl top of haze layer 490m,msl highest flight level 400m,msl middle flight level 100m,agl = 200-300m,msl lowest flight level
123345-124445	leg HG at 490m,msl
124355	At central site
124500-125705	leg GF at 490m,msl
124800	Small Cu to the west and south.
125030	Under first clouds near Nogaro.
125600	Precipitation visible from Tcu to the southwest of point F.
125720-130648	sounding at point F to 2300m,msl.
125800	Inversion at 610-670m,msl. Cloud cover is 0.7-0.9 to the south.
130550	Precip to the right and left of current position. Light rain from Tcu to sse. No

Airborne Scientists Flight Log

Flight: 2

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

lightening visible.
130836 Light rain on windscreen.
131120-132220 leg FG at 400m,msl.
131230 Tcu about 2-3 km east of Nogaro.
132230-133325 leg GH at 400m,msl.
132340 Over central site.
132500 Cloudy to south of G, clear north.
134600 "
133600-134640 leg HG at 100m,agl.
134800 Virga noted over Mont de Marsan.
134650-140010 leg GF at 100m,agl.
135200 In light precip north of Nogaro.
135600 Lots of haze in valley to the east of F.
140120-141220 leg FE at 100m,agl.
140500 Widely scattered small Cu over EF.
141405-142620 leg EF at 100m,agl.
142735-144010 leg FG at 100m,agl.
143000 Skys clear in south of research area, some Cu in north of area.
144025-145130 leg GH at 100m,agl.
143500 Under northern clouds.
145130-145700 sounding at point H to 2300m,msl.
145330 inversion at about 730 m,msl.
150700 Rain to NE of research area.
150755 In rain.
150855 Out of rain.
153030 Landing.

Airborne Scientists' Flight Log

Flight: 3

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 14 May 1986
Pattern: S
Airborne Scientist: Mahrt
Data Manager: Dawson
Pilot: Summers
Observer: Stull
Subjective Quality: Good

Weather: Generally cloudy conditions with weak winds. A cumulus cloud deck occupied a layer from 600 m to 1200 m with lifting of a few hundred meters at the end of the period. The cumulus layer ranged from more than 0.5 in the E-F region to less than 0.3 over the forest. An overlying stratus and stratocumulus deck ranged from the top of the cumulus deck at point F to above 2 km at point H. Winds in the boundary layer were generally between 0.5 and 2 m/s with a weak tendency for northwesterly direction.

<u>Time</u>	<u>Description</u>
110730	takeoff
1109	climb through base of cumulus deck at 400m. Only weak turbulence. Little turbulence above 500 m.
1110	stratus deck 800 m. strong inversion between cumulus deck and stratus
113545	have descended below inversion layer near point E. stratocumulus layer below inversion is about 0.6.
113742	descending through 700 m level, cloud base about 600 m
113925	300 m, light turbulence,
114550	200 m, light turbulence, winds weak, 1-2 m/s
114848	begin sounding at cloud base which are locally down to 300 m, pass through a few clouds, however most of sounding between clouds
114950	begin first EF leg, approximately 100 m above ground, light turbulence, a few patches of diffuse radiation reaching ground.
120030	begin leg FG
120250	on leg FG, cumulus layer about 0.3, overlying stratus 1.0 and looking thicker than before.
120356	pass castle at L of valley, as usually only light turbulence
121345	begin GH
121440	Cu layer about 0.3, fields show patchy soil color probably indicating variable soil drying, some areas of modest standing water.
121541	pass central site
122630	begin sounding at point H
122738	passing through 300 m level, base of cumulus 600 m,
123020	fly through cumulus, turbulence continues light
123100	1100 m, above most of cumulus except for a few towers which extend a little higher
123145	1250 m, smooth, sounding indicates strong stability, stratus deck above 1500 m, cloud base about 550 m although considerably higher in places
123745	begin leg HG to be flown at 350 m, all previous legs at 100 m
123950	on leg HG cu cover 0.3, overlying stratus
124900	begin GF
125900	continue on GF, stratus lowering to top of cumulus and thickening
130125	end GF
130150	start sounding, cloud base 600 m, not possible to ascend higher because of stratus

Airborne Scientists' Flight Log**Flight: 3**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 130614 begin FG at 100 m, rest of legs all at 100 m.
131800 end FG, begin GH
132033 pass over central site, radiosonde balloon off to left, turbulence still light but a little stronger
132900 continuing on GH, cumulus less than 0.3 here in northern part, smoke plumes indicate that wind direction at the surface is light and variable
133100 end GH
133255 begin HG, continue at 100 m. Some patches of weak diffuse sun, slightly more turbulence.
134455 begin leg GF
135720 end GF
135830 begin FE
140930 end FE
140945 start unscheduled sounding
141245 cloud base of scattered Cu at 600, flew through a little cumulus activity but sounding mostly in clear, at 1 km above most of the Cu except for a few towers, little turbulence between towers. Into strong inversion layer at 1200 m. Overlying stratus deck at 1300 m.
141650 turbulence between cumulus is mainly below 800 m
141900 end sounding
141918 start EF
143100 end EF
143200 begin FG
144500 end FG, begin GH, cumulus clouds appear flattened apparently as bases are lifting
145700 end GH
145720 begin departure sounding, cloud bases lifted to near 1 km in local region
150140 end sounding
150400 1300 m, smooth
154300 land at Toulouse, light rain, calibration cancelled

Airborne Scientists' Flight Log

Flight: 4

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 17 May 1986
Pattern: G
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Ringleman
Subjective Quality: very good

Weather: Clear skys with partial cirrus cover. Some wave-cirrus developed during the flight in the western portion of the research area. The northwestern portion of the research area was in air coming from the SSW associated with the colf front off shore. That region had about 0.5 Cu cover with bases at approximately 2600 m,msl, and was quite turbulent. At the beginning of the flight, clodiness was noted to the west of the research area and over the mountains.

<u>Time</u>	<u>Description</u>
110340	Takeoff
110826	At Auch at 2 km,msl. Surface inversion was at 0.7 km,msl and was strong.
111504	NS-oriented higher concentrations of haze noted in BL below to the SE. It is not clear whether these are the result of BL roll structure or due to greater BL depth in the valleys. I think rolls?
112025-112705	descent sounding. Inversion top at 1800'=600m,msl. The whole mapping pattern was flown at 100m,agl except for legs 2 and 3 which were flown at 30-50m,agl and 170m,agl, respectively.
112705-113805	leg 1. End of leg is 5 min flight time west of point F.
114040-114611	leg 2 at 30-50 m,agl (900-950ft,msl) flown back to point F.
114810-115210	leg 3 at 170 m,agl (1300 ft,msl) 5 min flight time to west of F.
115405-120035	leg 4 (completes southern flight track).
120330-122410	leg 5
122713-123715	leg 6
124015-125140	leg 7
125443-130450	leg 8
130110	over highway to SSE of Lapeyrade
130235	over highway to SSW of Lapeyrade
130750-131930	leg 9
132200-134130	leg10
133800	0.3-0.4 scattered Cu in NW corner of area. Now under clouds. Wind, T and Q change noted in this area. Considerably more turbulent here. The forest appears to be steaming!
134430-140325	leg11
140620-142435	leg12
142000	Cloudiness in NW corner has increased to about 0.6. There is a band of clouds running NNE-SSW.
142737-144640	leg13
144640-145200	sounding toward east to 2km,msl.
151300	landing.

Airborne Scientists' Flight Log

Flight: 5

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 19 May 1986
Pattern: M
Airborne Scientist: Mahrt
Data Manager: Miller
Pilot: Summers
Observer: Serafin
Subjective Quality: Very Good

Weather: A weak front was located just east of Toulouse. Over the HAPEX area, southerly flow of about 5 m/s advects drier air. Skies were generally clear with some altocumulus and cirrus, less than 30% cover. Toward the end of the period, a sea breeze circulation invaded the extreme western part of the observational area. The mixed layer depth ranged from about 600 m at the beginning of the period to about 1200m at the end of the period. As a result of the southerly flow, the flight track was perpendicular to the wind and sampling problems associated with longitudinal modes are not anticipated.

<u>Time</u>	<u>Description</u>
1203	takeoff, ground pressure altitude=500 ft.
1205	boundary layer top about 550 m, boundary layer turbulence is light, considerable haze in the boundary layer. 10% scattered cumulus at the boundary layer top.
121720	begin descent sounding into area, HAPEX area 10% -20% cirrus, Ac.
122020	boundary layer top very well defined, strong inversion, located at 600-650 m, winds above the boundary layer from the southwest, winds in the boundary layer from the south or southeast.
122045	now in boundary layer proper
1223	time check with Michele (pilot of Piper Aztec)
122708	begin leg 1, appr. 90 m above local terrain
122832	cross ridge at 65 m agl
123135	south of central site 1.5 km (est)
123245	soil mostly dry with a few wet spots
123555	pass village
123852	terrain slightly rolling, a few marshy areas
124220	Michele estimates 150-180m (500-600 feet) above (?), significant turbulence
124513	large clearings
124618	nuclear power plant to the south
124638	railroad
124702	continue over large clearings
124758	freeway, cirrus 10%, altocumulus to southwest out of area
124950	radioaltimeter about 170 m.
125122	end leg 1
125254	begin leg 2
125450	entering region of large clearings
125550	freeway, large clearing, extends two kilometers to the south (upwind) and extends to a much greater distance along flight path
125716	railroad
125742	north of nuclear power plant
125858	leaving large clearing
1303	Michele now briefly ahead of the King Air and 500m to the south (est)
130527	just behind Michele at 100 m (est.). For normal position, Michele flies behind King Air

Airborne Scientists' Flight Log

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

Flight: 5

- at roughly 500m or more.
- 130640 over clearing, small village 1km to the south.
- 131322 south of central site 1 km (est), radio altimeter about 90 m
- 131530 entering low hills, ridge up ahead
- 131737 over ridge
- 131900 end of leg 2
- 132010 begin leg 3
- 132058 over ridge, downstream from ridge pressure altitude about 105 m
- 132503 north of central site only about 100 m
- 132545 leaving second clearing, 20% cirrus, Michele off to north 500m to 1km
- 132817 a few Cu to north probably at boundary layer top, less than 10% coverage
- 132912 over highway
- 132958 radio alt. 115 m
- 133600 enter large clearings, Michele to the north and behind
- 133650 enter cloud shadow, radio alt 150 m
- 133734 leave cloud shadow
- 133805 region of large clearings begin about 1km to the south
- 133942 railroad and into cloud shadow (cloud shadow not well defined)
- 134052 freeway
- 134100 leave shadow, enter partial shadow
- 134200 Michele off to north and to the back 300 m(est)
- 134355 airport off to north
- 134423 end of leg 3
- 134548 begin leg 4, radio alt. 160 m
- 134648 second beginning of leg 4 after track adjustment, 20%-30% altocu and cirrus
- 134742 region of clearings begin to the south
- 134817 clearing to the south
- 135014 railroad
- 135158 end clearing to the south
- 135358 highway
- 135507 highway to the south, someway parallel with a slight angle to the south
- 135652 significant wing tilt
- 140045 radio alt. 115 m
- 140549 central site 1 km to the north, radio alt. 110 m, 20% cirrus
- 140734 hilly region begins, ridge ahead, cloud shadow
- 141020 over diffuse section of ridge
- 141140 end of leg 4
- 141300 begin leg 5
- 141354 over ridge, partially shaded, will be moving into sun
- 141645 major highway
- 141752 400 m north of central site (est),
- 142150 radio alt. 150 m
- 142705 entering partial cloud shadow, turbulence has been significantly stronger than on first legs
- 142838 two highways come to oblique junction, 500 m to the north
- 143225 railroad, Michele about 500 m to the north and slightly behind, cumulus now forming near boundary layer top well above Michele, mostly to the north and ahead perhaps in response to sea breeze, less than 10%, radio alt. 140 m
- 143425 large clearings to the south
- 143510 cumulus overhead
- 143737 end of leg 5

Airborne Scientists' Flight Log

Flight: 5

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

- 143850 begin leg 6
- 143908 see breeze invasion at surface, smoke plumes indicate significant westerly flow
- 144115 clearings begin 500m-1km to the south
- 144246 freeway, plume to the north indicates no sea breeze
- 144357 railroad
- 144540 end of clearings to the south
- 144742 over highway
- 145547 cloud shadow
- 145714 leave main cloud shadow, radio alt. 135 m
- 145838 end leg 6 early to carry out low fly by of central site
- 145942 back at normal level (pressure alt 800ft), Michele at 1500 ft.
- 150445 cross ridge
- 150505 end of leg 6 supplant
- 151505 sounding begins near central site
- 151725 boundary layer top at about 1200m
- 152122 end sounding at about 2300 m, still 20% cirrus, Ac
- 155200 landing, boundary layer depth over Toulouse only 600 m

Airborne Scientists' Flight Log

Flight: 6

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 21 May 1986
Pattern: S - Cumulus Option
Airborne Scientist: Stull
Data Manager: Dawson
Pilot: Summers
Observer: -
Subjective Quality: Excellent

Weather: A slow moving cold front passed through the area during the previous night, leaving widespread precipitation over the whole HAPEX box. At take off time, the front had just exited the box to the East, but had not yet left the Toulouse area. The aircraft took off in light rain, but quickly flew into the box having active cumulus clouds, with clear blue sky above. The field of active cumulus medeocris was fairly uniform in time and space during the flight. Some deeper convection at local noon gradually gave way to only mediocris. Winds were westerly in the boundary layer. Good visibilities. By evening, the skies were clear.

<u>Time</u>	<u>Description</u>
105745	Take off from runway 33R. Scattered scud at 335m msl. Stratus base at 457m msl, in continuous light rain.
110210	At 1768m msl at St top, with a few tops up to 1981. Above are scattered Ac castellatus.
110307	Flying thru a few light showers from the upper clouds, even though we are above the St deck.
110336	We are at the border of the trailing edge of the front: overcast aloft with showers to the east, clear blue skies aloft to the west (towards the box). Flying level at 1829m msl, just at St top, and just in the first strong temperature inversion.
110539	Starting climb from 1829m msl to 2743m msl.
110840	Cloud deck below is breaking up. Becoming broken St, with scattered to broken Cu below. Pyrenees are clearly visible to the south. Out position is east of point F about a distance equal to the distance between E and F.
111230	At 2743m with clear skies above, with broken Cu below and sunshine hitting the ground in places. Near the tops of the Cu clouds is a broken layer of St. There is also a haze layer with a top near our present altitude. Visible to the north are a few cu towers reaching up to the top of this haze layer. No tops this high at our location.
112023	We are ESE of point F. We are at the W edge of the stratus deck. Further W are only Cu. We are canceling IFR at this point, and heading to point E.
112211	Over big patches of clear areas with sun reaching the ground. Since the ground is wet from the rain, we expect strong moisture flux. The previous showers were from stratiform type clouds, therefore broad rain coverage.
112513	Same cloud .3 fair WX cu, with about .1 building cu med. No stratus. near point F. Lots of sun hitting the ground.
112742	Half way between E and F, entering a mesoscale area where all the Cu are active cu med, with coverage 0.6 - 0.7.
113318	Starting descent from 2743m. clear above. Still haze layer near 2743m. Near point E, about 0.5 coverage. Many of the clouds are smaller diameter than their depth, almost resembling cu cast. A few have an aspect ratio of about 1. Tops of the highest cu at 2286m msl. Good field of active, venting cu.
113750	At 2134m, near the top of an inversion. Staying out of the clouds during descent.
113851	At 1372m msl, where most of the Cu tops are. Few remnants of St, perhaps from the

Airborne Scientists' Flight LogFlight: 6

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- Cu below.
- 11---- Strong inversion at 1372m msl.
- 114007 At base of inversion at 1280m msl.
- 114126 Near 1069m, accidentally flying thru some cloud.
- 114156 Cloud base at 762m msl, with a few bases to 671m msl. Moisture profile increases almost linearly from moist near the surface to dry at 2743m.
- 114500 At end of descent sounding at 229m msl, 90m agl.
- 114620 Starting leg EF, at 90m agl. Some of the ridges are only 76m below aircraft, valleys about 107m. At 287m msl. Clouds .7-.8 active cu med. No other clouds above. Hazy air down here.
- 115430 End EF, at 320m msl, 213m agl. Outside turn next. Clouds at F are .5-.6 Cu med, not as deep as earlier in the leg. No standing water on the fields, but they all look damp.
- 115612 Starting FG. 107m agl, almost at center of valley, over river. We are about 5 time as far away from the ridge on the left as our altitude above the valley. Further from the right ridge. Blue skies above the Cu.
- 115851 Officially at F, according to pilot. A number of large birds flying above us.
- 120332 Half from F to G. .3-.4 coverage, a bit more suppressed Cu, but still mostly active cu med. Ground is very lush and green, with pasture land and crops covering about 45%, 45% forests, and 10% brown fields. West winds in boundary layer.
- 120621 Leaving rolling farm area entering the forest plateau area, about .8 the way from F to G. Alt 244m msl, 107m agl. Cover is .5 - .6 at G, Cu med. With larger diameters than before, and with large gaps inbetween clouds.
- 120821 End FG.
- 120911 Starting GH at 90m agl, 244m msl. Light to moderate turb over forest.
- 121231 About 1/3 way to H. Very deep cu cong in the vicinity, particularly to the N. Estimate tops above 3048m msl. .3-.5 active cu. Large diameter clouds with large gaps.
- 121941 Over river at end of GH. 137m msl, 122m agl. .4-.5 Cu at H. Few higher cu cong to NE.
- 122154 At 457m & climbing (we started our sounding a bit earlier).
- 12---- Cloud base at 823m msl. Cloud cover .5 active Cu. Some of the tops of deeper cu are spreading out to form As or St (but not quite anvils). 5% coverage is these bigger clouds.
- 122905 Still climbing thre 1890m, not quite to cloud top. The potential temperature changed from dry to moist adiabatic near cloud base, with no apparent cloud base inversion. The boundary layer obviously extends to cloud top. Strong moisture decrease at cloud base.
- 122935 Most cloud tops at 2042m msl.
- 123150 Strong temp inversion at 2286m msl, with just a few Cu tops reaching and overshooting this level.
- 123410 At 2896m msl, just a few Cu tops above us, towering Cu.
- 123445 Finished box climb. Starting steep descent between clouds.
- 123634 Descending very rapidly, over 1.27 m/s.
- 123910 At cloud base at 853m. Leveling at 762m msl for next leg.
- 124030 Over river at 732m msl. Near point H.
- 124130 Starting HG leg. at 762m msl. .3-.5 active cu med. We are about 61-90m below cloud base.
- 124640 Half way between H & G, 61-152m below cloud base. No liquid water at this altitude. We are much closer to cloud base than the diameters of the clouds. .4-.6 active cu
- 124950 Flying thru a very light rain shower lasting about 30 sec. Cloud base is still 61-90m above us.
- 125142 At G, ending HG.
- 125222 Starting GF at 762m msl. .4-.6 active cu med. Some towers. We are still 61-90m

Airborne Scientists' Flight Log

Flight: 6

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- below the bases.
- 125601 Half between G & F. The nature of the active cu have changed from large diameter to smaller diameter, looking almost like cu cast (but based on ML thermals). .3-.4 coverage. At 762m msl.
- 130120 Near end GF. .5-.7 active cu. More remenants of clouds aloft, some resembling St. Light turb. Still 61m below cloud base.
- 130331 There is a lower cloud base here, but it is still above us.
- 130423 End GF. Starting descent sounding. at F.
- 130612 At 366m msl, 152m agl.
- 130755 183m msl, 33m above field. Flat valley floor, with many brown plowed fields.
130817. Starting climbing sounding at 15m agl.
- 131101 At cloud base at 823m msl at F, climbing, not doing box pattern, but staying out of clouds (.6-.7 coverage).
- 131246 Very thin Cs aloft with .3 coverage in one patch, almost not visible. But jet contrails are lingering and expanding. Mostly clear aloft.
- 131403 Most cloud tops at 1524m msl. A few higher
- 131630 At 2134m, above all cloud tops.
- 131726 Stopping sounding at 2438m msl.
- 131736 Starting rapid descent.
- 132141 Finished descent at F. Now at 457m msl.
- 132220 Starting FG at 457m msl. .4-.6 active cu, with .3 St near tops of Cu.
- 133020 Half between F & G. Cu are a bit flatter. .4 cu
- 133440 At G, end FG. Moderate turb. .7 active, deeper cu.
- 133512 Starting GH leg at 457m msl.
- 133622 Over central site 457m msl.
- 134600 Over river near H. No more towering cu. Coverage .3-.5.
- 134912 At H ending GH. Starting descent to 90m agl. 122m msl.
- 134953 Starting HG leg at 90m agl. .4-.5 active cu. Flat bases.
- 135130 Climbed a bit to not hit a bird.
- 135440 Starting at about 13:49, we starting getting positive voltage spikes on the Lyman alpha VLA, 10-12 spikes in 5-6 min. Strong updrafts here.
- 135915 Over central site at 90m agl.
- 140010 Finished HG, starting inside left turn.
- 140111 Starting GF, 238m msl, 104m agl. .2-.3 cu med, becoming flatter. Lots of sunny spots and stronger turbulence.
- 141251 Finished GF. Starting inside turn.
- 141351 305m msl, 137m agl, starting EF leg. .3-.4 cu med. Larger diameters compared to their heights.
- 141752 Deviating slightly to the left around smoke from a fire in a garbage dump.
- 142412 Finished FE. Starting ascent sounding at 122m agl. .3-.4 cu med, with diameters twice as large as their depths.
- 142517 Dawson notes that the left side gust vane has apparently failed. (Post flight analysis indicates that the vane did not fail, but that the electrical connection opened. This might explain the other 2 "failures" of the left vane so far in this experiment.)
- 142605 Winds still from West in BL.
- 142745 At cloud base at 1069m msl.
- 142910 At 1676m at most tops. Strong inversion base here. Highest tops at 1981m msl.
- 143044 Finished ascent at 2134m msl at point E, starting rapid descent. Bases at 1219m.
- 143410 Finished descent at E. Starting EF.
- 143536 Clouds near E are .3-.4 cu med, with diameters 2-3 times their depths. Clear skies above that except for a few contrails.

Airborne Scientists' Flight Log

Flight: 6

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

- 144441 Finished EF. Starting inside turn.
- 144522 Starting FG 229m msl, 107m agl. Clouds at F are .3 cu med, getting flatter again.
- 145726 Finished FG. Starting inside turn for FH leg.
- 14---- 90m above forest. .4-.5 cu med, deeper than the ones on the previous leg, with heights roughly equal to their diameter.
- 145855 Over central site at 98m agl. Light to moderate turb over forest.
- 150820 Over river near H.
- 150901 Finished GH. Starting climb back to Toulouse. Bases 1219m msl.
- 151314 Flew thru a cloud fragment just above cloud base. .6-.8 cu
- 151644 At 2134m msl, above most the cloud tops.
- 151804 At 2438m msl, above highest tops. .5-.7 cu.
- 151958 At 2743m msl. Clear skies above. Well to the south is a very thin Cs deck near mountains.
- 152711 Starting descent to Toulouse.
- 152846 Descending between cloud streets, parallel to the mean flow, at 2042m msl, at highest cloud tops.
- 152948 Most cloud tops at 1829m msl. We are descending in a cloud free area.
- 153045 Cloud base at 1069m
- 1536-- Landed in Toulouse. .4 Cu med over Toulouse, no clouds higher.

Lyman alpha notes: Preflight calibration used the old aviation oxygen, the post flight will use the new N48 high purity oxygen.

Airborne Scientists' Flight Log

Flight: 7

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 24 May 1986
Pattern: S
Airborne Scientist: Serafin
Data Manager: Miller
Pilot: Summers
Observer:
Subjective Quality: good

Weather: Marine air had invaded the area the evening of 23 May leaving considerable stratus and local drizzle. At flight time, the stratus was lifting and breaking up.

<u>Time</u>	<u>Description</u>
1300	takeoff, cloud base at 550 m, cumulus tops below 1400 m, overlying stratus deck
1318	generally overcast over the experiment region
1319	picture taken off right wingtip
1327	descent begins, top of stratus layer at 1500 m, breakout of stratus at 1400 m, cumulus broken below, less than 50% coverage, tops 900 m, bases 750 m, considerable haze
1331	abort ILS approach at Pau, head to point E, 3 miles visibility, weak turbulence
134036	begin EF leg, some sun reaching surface, moderate turbulence, alt. setting 1029
1351	at point F, cloud cover similar to point E, winds from north at 1-2 m/s
1358	stratus breaking up
1400	cumulus cloud cover 70%, winds variable or easterly,
1403	At point G
1404	cloud cover decreasing, stratus aloft is gone, 50% Cu
140555	Over central site
1413	30% cu, northwest winds
141630	At point H, begin sounding, 20% Cu, over 15 km visibility, cloud base 900m, begin inversion, well-mixed below, cloud tops 1300 m, begin HG just below cloud base at 650 m
1427	4 miles south of H, Cu less than 20%, pickup cloud cover toward the south
1436	winds out of NW
143743	At G, 70% cloud cover, visibility degenerating, some clouds almost at flight altitude
1441	mostly cloudy,
1443	breaking out of Sc deck
1446	descend to 500 m due to lowering cloud base to be about 100 m below cloud base, inhomogeneous conditions
145003	At F, begin sounding, cloud base at 750 m although quite variable,
1453	descending through 400 m
145802	completed sounding
1500	start FG at about 100m, take picture off right wind tip
1502	glider on the left, alter flight path
151206	central site,
1516	clearing to 25% or less, increasing turbulence, take picture
152240	At H, cloud cover at less than 10%,
1524	descending back to flight level
1526	begin HG
1532	winds northerly 3-4 m/s, picture,
153436	central site, 40% Cu

Airborne Scientists' Flight Log

Flight: 7

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

- 1536 At point G, green tint to some of the fields, some of the plowing is raising dust while standing water in a few areas,
- 153905 70% cu within a band, darker to the west
- 1545 Cu cover decreasing, some higher level clouds, Cu is 60%, temp 18 C
- 154835 At F
- 1549 winds from north, 4 m/s, switch to easterly later in leg
- 160032 At E, will start sounding, cloud base 900 m, some stratus overhead but dissipating, well-mixed layer
- 160838 begin EF
- 1615 mostly overcast, some blue sky to the north
- 1619 At F, sun to the north
- 1624 back into cloud cover
- 1628 less cloud cover, 50% Cu
- 163220 At G
- 1634 Over central site, almost clear, less than 10%, 19.3C temp, northerly or northeast winds, 2m/s, no clouds to north
- 164430 At H, begin sounding, sharp inversion at 900 m, top of inversion at 1100 m
- 1653 reach 2500 km
- 172020 landing

Airborne Scientists' Flight Log

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Flight: 8

Date: 25 May 1986
Pattern: M pattern
Airborne Scientist: Mahrt
Data Manager: Dawson
Pilot: Summers
Observer:
Subjective Quality: good

Weather: Good weather prevailed with no low-level cloudiness and scattered patches of altocumulus and cirrus. Winds were generally weak and from the east. Conditions were "relatively" homogeneous over the flight track as no marine air penetration occurred.

<u>Time</u>	<u>Description</u>
1103	takeoff, light turbulence, boundary layer depth about 300m
1117	begin descent sounding, boundary layer top about 550 m.
1123	end sounding, 10% Ci.
112725	begin leg 1, Aztec will fly approximately 200 m above and a few hundred meters in front.
1133	over central site, 100 AGL, balloon
113929	enter cloud shadow, winds easterly 3 m/s
114308	over RR, 170 m AGL, winds NE 5 m/s
1152	end leg 1, 70%, Ac and Ci
1154	begin leg 2,
115640	Ac has decreased from 60% to 40%, begin region of clear cuts to the south
115804	RR
115945	end clear cut area
121332	central site, sunny, 10% Ci
121930	end leg 2
122210	begin leg 3, King Air flight level increased 100 m, same for Aztec
122741	central site, 200 AGL, 20% Ci
1235	over highway, 50% Ci, east winds 5 m/s
124207	RR, 50% Ci, 230 AGL
124656	end leg 3, smoke plume indicates surface flow out to sea
124820	begin leg 4, 280 AGL, 50% Ci
1256	Ci 20%
130855	central site, 30% Ac and Ci
1315	end leg 4, 10% Ci
131728	begin leg 5, turbulence becoming strong
132156	central site, 30% Ac and Ci
1341	end leg 5, smoke plume still out to sea, 40% Ac and Ci
134330	begin leg 6, Ac increasing to 70%
134748	RR, 40% Ac
135134	highway, 20% Ci
140253	central site, 30% Ac and Ci
140930	end leg 6
1411	begin second intercomparison with Aztec, 450m AGL headed east toward central site
141745	have finished intercomparison and descended to central site to begin sounding
142152	passing through boundary layer top at 1100 m.
142320	end sounding
1445	landing

Airborne Scientists' Flight Log**Flight: 9**

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 27 May 1986
Pattern: S
Airborne Scientist: Serafin
Data Manager: Miller
Pilot: Summers
Observer:
Subjective Quality: good

Weather: A front had passed through the area the previous evening leaving considerable cloudiness in the HAPEX region. Low-level cumulus cover ranged from less than 10% in the north to more than 50% in the south. A patchy layer of altocumulus increased the total cloud cover to near 100% in some areas. Nonetheless, surface heating was sufficient to generate a mixed layer which exceeded 1 km at the end of the flight especially in the north. Winds were generally weak and westerly.

Time	Description
1058	takeoff, 50% Sc at 300 m, 100% St 900m, 70% St overhead.
1122	over F enroute, 70% Sc at 2800 m, 20% Cu over area
1125	begin sounding near point E, 60% Sc, tops 750 m, bases 600m, well mixed layer below
1136	end sounding
1137	begin EF, now 80% Sc, radio altimeter indicates 130 m, several minor heading adjustments during the leg
1145	At F, 20% Cu, 60% Ac
115735	At G, 10% Cu, 80% Ac
115920	Over central site
120942	At H, 20% Ac, begin sounding
121342	boundary layer depth 1000m
1218	end sounding, begin HG at level 550 m
122731	Over central site, 70% Ac
122850	20% Cu, 70% Ac
123045	Cu bases lowering to just above flight level
123250	skimming cloud bottoms
123645	skimming cloud bottoms again, cloud bases higher in mostly sunny areas
124155	At F
124242	begin sounding, 20% Cu with bases typically 700 m and tops 900m, some variability
124735	end sounding, begin FG at 275m
125926	At G 10% Cu, 40% Ac
130114	Over central site
131150	At H, Cu less than 10%, Ac 70%
131415	begin HG
132426	central site, balloon launch
132605	At G 20% Cu, 60% Ac
133833	At F 30% Cu, 40% Ac
133938	begin FE
135104	At E, begin sounding
135325	boundary layer top 800 m, thin Ac 60% at 1500m
140028	end sounding, begin EF
141230	At F, 70% Sc
141405	begin FG
142650	At G, 30% Cu, 80% Ac
142834	Over central site, strong turbulence over pine forest
143852	At H, 10% Cu, 50% Ac, begin slant sounding, boundary layer top 1500m, Ac 1650 m.
1536	landing

Airborne Scientists' Flight Log

Flight: 10

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 30 May 1986
Pattern: S - L option
Airborne Scientist: Stull
Data Manager: Miller
Pilot: Summers
Observer:
Subjective Quality: Good

Weather: Cold north winds brought in an unstable air mass behind the previous day's cold front. A few cumulus clouds in the early morning quickly grew to 50% cover of cumulus mediocris. This air mass was capped by a strong inversion at about 2438m. As the day progressed, cloud base rose, but cloud top was still limited by the inversion, resulting in broken stratocumulus clouds by the end of the day.

Because of the north winds, the S pattern was modified to allow the upper flight legs to include an east-west crosswind leg in addition to a north-south leg (ie, L shape). One of the upper flight legs was split into two parts at two different altitudes, because of lower cloud bases than expected. Hence, the subjective rating is only "good".

<u>Time</u>	<u>Description</u>
105121	Start taxi. .2-.3 Cu, with moderate winds. A few patches of Ac above. The Cu are active clouds, but not too deep yet.
105800	Takeoff, with winds out of the north at 6 knots as reported by the tower.
110045	At cloud base at 1069m msl.
110205	At average cloud top at 1676m msl.
110344	At 2286m msl. Above all the cloud tops. The top of a very well defined haze layer is evident at cloud top, at about 2438m msl.
110518	At 2591m, level. Just above the top of the haze and cloud layer. No higher cloud decks, except for a thin Cs patch over the Pyrenees.
110801	Winds at 350 deg at about 10-15 m/s, at 2591m msl.
112225	Starting enroute descent sounding just west of F. Just at cloud top at 2438m. .3-.4 Cu mediocris, very active, but hitting the strong inversion at 2438m. Descent is VFR.
112424	At 2134m, descending. Most cloud tops and top of the haze layer between here and 2438m msl. The is at the base of the strong inversion.
112752	At cloud base at 1006m msl, it is an irregular cloud base, with some bases lower.
112808	At 914m msl, with a few cloud bases this low.
113044	Finished descent sounding. Starting leg EF at 100m agl. 183m msl.
113515	.5-.6 active Cu, with ragged irregular bases, probably associated with the strong wind. Clear skies above. We are now half way between E & F.
114123	End leg EF. Inside left turn next. At 122m agl. 274m msl
114154	Starting leg FG, 107m agl, 244m msl. Clouds at F are .5-.7 active Cu with irregular bases. Lighter winds in the boundary layer (about 3 m/) than aloft.
114424	We are flying through a lot of cottonwood "fuzzies" at this altitude. (Note, this continued for all the flight legs at 100m agl.
114755	About 2 min to go till end of this leg. At 100m agl, 244m msl. .7-.8 Active Cu with flatter bases than before. We are deviating around Nogaro airport, because of glider traffic.
115053 - 115105	Flying over lake resort area at 100m agl.
115353	At point G, ending FG leg. Inside turn.

Airborne Scientists' Flight Log**Flight: 10**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 115412 Starting GH leg at 100 m agl. Active Cu .6-.7 with flat bases.
115545 Over central site. Winds at 040 at 4-5 m/s on this leg.
120554 Almost at H, flying over the river at 100m agl, 100m msl.
120644 End leg GH.
120813 Starting HG leg at 107m agl, 137m msl.
120830 Over river. Clouds at H are .4-.5 active Cu mediocris, with relatively flat bases.
121944 End HG. Start sounding at 244m msl. Clouds at G are .5-.6 Cu mediocris. Very large diameter and shallow. Height to width ratio is 1/4 or 1/5.
122801 Cloud cover based on shadows are .5. Cloud base at 1676m. We are flying an elongated box sounding to include the central site within the box.
123159 At 2438m msl at most cloud tops. Strong inversion, with very flat cloud tops that look much like stratocumulus.
123336 At 2743m at highest cloud top.
123503 End sounding at 3048m msl. Starting rapid descent.
123955 At G starting GF leg at 1372m msl. This is a cloud base leg. We are at cloud base minus 305m. We are so low because cloud base is irregular, and we want to stay below the lowest bases.
124414 Cloud base became much lower. Therefore, we are beginning descent from 1372m msl to 1069m. This breaks this GF leg into two parts. The last part of the last leg was above the average cloud base, although we managed to stay out of the clouds.
124554 Now at 1069m, starting second half of leg. Cover is .7-.8 flat Cu. with aspect ratio of 1/10.
124914 Note that the GF leg also has a kink in it, concave to the west, around Nogaro airport.
125050 End GF leg. Starting inside right turn at 1069m msl.
125115 Starting FE leg. Clouds are .6-.7 flat stratocumulus.
130141 End leg FE. Start ascent sounding.
130307 Cloud base at 1372m msl. at E
130346 Going through a few wisps of clouds during the climb.
130355 Exiting cloud at 1707m.
130641 Average cloud top at 2286m msl.
130708 Highest cloud top at 2438m msl.
130806 Stopping the sounding at 2591m, above all the cloud tops. No clouds high
130821 Starting descent from 2591m to 610m msl. .7-.8 St and Cu at E. The tops of the Cu enter the bases of the Sc. The Sc cloud bases are between 1981m and 2134m msl.
131133 At 1524m crossing cloud base.
131525 Ending descent at E. Starting EF leg at 610m msl.
132600 End EF leg at F. Making inside turn to next leg.
132635 Starting FG leg. .7-.8 Sc. A few look like Cu, but most look like Sc with an aspect ratio of 1/20. At 610m msl.
133913 End FG leg at G.
133945 Starting GH leg. at 610m msl. .6 fair weather Cu with flat bases. Clouds almost resemble Cu humilis, although most look like cu med. But just a few minutes later on the leg, the clouds start to resemble Sc again, with flat aspect ratios of 1/15 to 1/20.
135151 Finished GH leg at H at 610m msl. Clouds are .6 Sc, aspect ratio of 1/8 to 1/10, with clear skies above.
135454 At H, starting HG leg at 61m agl.
140034 About 3/4 way to H to G. Note that there is no standing water visible in the forest today.
140354 Over central site at 100 m agl.
140503 Over forest tower near G.
140530 Ending HG leg at G.

Airborne Scientists' Flight Log

Flight: 10

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 140604 At G starting GF leg. Clouds are .6 Sc.
141755 End GF leg at F. 100 m agl. Inside turn.
141854 At F, starting FE leg. Clouds at F are .6 Cu, mixed with Sc at the top.
142925 Finished leg FE at E. Starting ascent sounding.
143506 Cloud base at 1524m msl.
143614 At Sc base at 1981m msl.
143702 At 2286m at average cloud top, with strong inversion and dry air aloft.
143833 At 2743m, end of sounding. Starting descent. Clouds at E are .7-.8 total coverage, with .4 Cu and .6-.7 sc above.
144103 Cloud base at 1524m msl.
144345 Finished descent sounding at E.
144405 Starting EF leg at 100 m agl. 213m msl
145515 End EF leg. inside turn to G. At F, clouds are .5-.6 Cu hum and Sc clouds.
145624 Starting FG leg at F.
150802 End FG at G. 100m agl. Starting turn towards Toulouse for an enroute sounding back to Toulouse.
150900 Starting climb sounding now. clouds are .6-.7 Sc
151442 At cloud base at 1829m msl.
151629 At average cloud top at 2438m msl.
151700 Max cloud top at 2591m msl.
151801 Finished climb sounding at 2896m msl, enroute to Toulouse.
152200 Begin descent, but not a useful sounding because we are going through some clouds.
152522 Cloud base at 1829m, with a few bases as low as 1676m.
1534-- Landed on runway 33R.

Airborne Scientists' Flight Log

Flight: 11

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 3 June
Pattern: S
Airborne Scientist: Serafin
Data Manager: Dawson
Pilot: Summers
Observer:
Subjective Quality: good

Weather: General overcast, warm air advection. Delayed takeoff until 1200 local to take advantage of forecasted better afternoon conditions.

<u>Time</u>	<u>Description</u>
1213	takeoff, cloud base 600m MSL, cloud tops 1000m MSL, clear above. Boundary layer winds 6 m/s from 210 deg.
1224	60% cu, heavier stratus to the north
1236	begin inst. approach to Pau, cu tops 1.7 km MSL, cloud base 1 km, visibility 10 km
1243	completed sounding, sun on surface, moderately bumpy
1252	arrive at point E, temp 16.4, dew pt. 11.8, winds 2.6 m/s from 300 deg. Proceed to F at 100 m AGL
1255	winds generally westerly 3-6 m/s, some sun
1303	arrive at point E, 50% shallow cu, proceed to G
1315	At G
1317	Over central site, C-130 flying overhead E to W below cloud base, rawinsonde balloon ascending through 100m AGL, deeper cu, little sun, proceed to H at 100 m AGL, 160 MSL.
1322	sunny, bumpy
1327	H, begin sounding to cloud base which is at 790m
1331	desend to 500 m. Proceed to G and F at this level, 60% cu, bumpy.
1344	At G
1355	At F, begin sounding, cloud base 900 m
1400	cloud top 1900 m, descend through visual hole
1405	At F, proceed to E at 100 m
1411	winds 4 m/s from 280
1415	At E
1418	proceed to F 100 m AGL, still cloudy
1428	At F, winds 4 m/s from 330
1444	At G
1442 (?)	central site, very light rain
1445	some sun, bumpier, most turbulent part of entire flight over forest north of central site.
1453	At H, begin sounding, cloud base 700 m MSL
1500	complete sounding at base of upper cloud deck (2 km)
1505	begin HG at 100 m AGL, T= 18.2, Td=12.8
1508	quite turbulent over forest
151430	central site, winds 4 m/s, from 270
151548	At G, elevated tower over forest
1528	At F, diffuse sunlight, smooth flight with a few bumps
1539	At E
1541	proceed to F
1551	At F

Airborne Scientists' Flight Log

Flight: 11

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

1600 some sun, stratus and cu above
 1604 At G
 160555 Over central site
 161550 At H
 161640 begin sounding, boundary layer shallow, 600 MSL, upper level cloud base at 2000m, cloud tops 2300 m, clear above, boundary layer to 2400 m MSL but not well-mixed.
 1627 sounding completed
 1629 begin maneuvers, winds at 3 km, 6 m/s, westerly
 1639 end maneuvers
 1707 land at Toulouse

Time	Decription
1713	End of flight
1707	At G, 3000 shallow cu, proceed to G
1705	At G
1700	Over central site, C-150 flying overhead E to W below cloud base, rawinsonde balloon ascending through 1000m AGL, deeper cu, little sun, proceed to H at 100 m AGL, 1000 MSL
1655	At G
1650	At F, begin sounding, cloud base 900 m
1645	Cloud top 1900 at horizon through visual hole
1640	At F, proceed to E at 100 m
1635	Wind 4 m/s from 280
1630	At E
1625	proceed to F 100 m AGL, still cloudy
1620	At F, wind 4 m/s from 300
1615	At G
1610	central site very light rain
1605	some sun, bumpy, over northern part of entire flight over town north of central site
1600	At H, begin sounding, cloud base 700 m MSL
1555	complete sounding at base of upper cloud deck (2 km)
1550	begin HG at 100 m AGL, T = 18.5, Td = 12.8
1545	quite turbulent over forest
1540	central site, wind 4 m/s from 300
1535	At G, elevated lower over forest
1530	At F, diffuse sunlight, smooth flight with a few bumps
1525	At E
1520	proceed to F
1515	At F

Airborne Scientists' Flight LogFlight: 12

NCAR King Air N312D. Project # 210.
 HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 6 June 1986
Pattern: S - (cloud option)
Airborne Scientist: Stull
Data Manager: Miller
Pilot: Summers
Observer:
Subjective Quality: Fair

Weather: Moderate, continuous rains the previous two days were associated with a cold frontal passage. Early morning clear skies gave way to cumulus clouds that quickly grew, with tops hitting a strong inversion at about 2500m msl. Continued convection pumped much moisture up to this inversion, causing a stratocumulus deck to form there that became broken to overcast by late afternoon. Convection continued under the stratocumulus deck, with some light scattered drizzle over the HAPEX area. Mechanical problems on the King Air caused takeoff to be delayed two hours until just before 1300 local time. As a result, much of the flight was during the mid to late afternoon, under the stratocumulus clouds, with light drizzle on many of the later flight legs.

<u>Time</u>	<u>Description</u>
1034--	Scattered shallow cumulus now with .4 coverage, irregular bases and sheared appearance. Clear skies above. Takeoff is delayed till about 1300 local time due to ventilation blower replacement on King Air aircraft. Light winds now, expected to increase to about 5 m/s out of the northwest later in the afternoon. The air mass is very cold, causing vigorous convection.
125150	Takeoff, runway 33R. Winds 300 at 5 knots, as reported by tower. Now .4-.5 coverage of cumulus, with .5 stratocumulus clouds forming at the top fo the cumulus. Above that are clear skies.
125724	Starting climb now from 610 m msl, enroute out of Toulouse. Heading to point H first to fly the upper level legs, because the late takeoff means we will have only about 30 minutes to fly the upper level legs before we are required to leave the restricted military airspace.
125859	Cloud base at 1372 m msl. Stratocumulus bases at about 1829m msl, but very irregular.
130245	Flew through a cloud fragment during the climb at 2591m msl, which is roughly at the tops of the sc.
130440	Level at 3200 m msl, at the level of the highest overshooting convective tops above the average stratocumulus deck. .7-.8 Sc coverage, viewed from above. Ambient temperature here is -5.3C. The top of a polluted layer boundary layer is visible at about 3000 m msl.
130920	Halfway between Toulouse and point H. Some of the penetrative convective tops are estimated to reach to about 4000 m msl. .7-.8 sc coverage, with a few large diameter breaks in the overcast.
131009	Start descent sounding enroute, maneuvering to stay out of clouds.
131324	Strong inversion here at 2438 m msl, and top of the polluted layer, and top of average sc.
131408	Continuing gentle descent. Sc is organized into large diameter mesoscale patches. We are descending in a large mesoscale whole, but there are large cloudy areas to the north and south of us, as visible by cloud shadows.
131551	Cloud base at 1676 m msl.
132007-132010	Flying over the river near H. Will cross it a few more times, while descending. At

Airborne Scientists' Flight Log

Flight: 12

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- about 274 m msl now.
- 132101 End of sounding, 61 m msl, 30 m agl, near point H.
- 1321-- Starting ascent up to 1372 m msl.
- 132442 At H at 1372m msl, starting HG leg. Fair weather cu .6-.8 coverage. We are flying about 152 m below cloud base now, but cloud base is irregular. Note that for the first few minutes of this leg, the plane was at about 120m (ie, 30 m below the desired altitude) climbing slowly. Lots of sc at cloud top with about .8 coverage in mesoscale patches. Started this leg in a region with little sc, but middle portion of the leg will have more sc. Vigorous convection even under the stratocumulus, because of the cold air advection over the warmer land. Winds from the WNW at this altitude.
- 133213 Leaving 1372m and descending to get below a large diameter dark cloud with a lower cloud base than the others. This makes the leg a bit shorter than desired (ie, about 5/6 of the full length), because we are not yet at point G. Therefore, end of HG leg.
- 133311 Level at 1219 m msl, not quite at G.
- 133451 At G at 1219m msl.
- 133502 Starting GF leg at 1219m. Clouds are .5-.8 sc above us, with cu below the sc.
- 135751 On third the way from G to F, under a very thick sc cloud.
- 134212 2/3 from G to F. Leaving the area of the sc aloft. Flying into an area of suppressed cu, .3-.5 coverage, with no other clouds aloft. Some cs deck aloft much further to the south.
- 134600 At F, ending GF leg at 1219m msl. .4-.5 fair wx cu of limited vertical extent. Some cs to south and southwest.
- 134642 Start FE leg at 1219m msl. Much more sunshine here. Winds are more westerly, parallel to the FE leg.
- 135322 3/4 from F to E. we are about 200 m below cloud base, with the clouds being very large diameter (compared to the clouds at F). Not much sc aloft. No evidence of rolls or other organization of clouds with the wind shear or wind direction.
- 135631 End FE leg. Maneuvering for rapid climb between the clouds (not good for a sounding).
- 135801 At cloud base at 1372 m.
- 140029 Level, within the sc, at 2591 m, near the Sc top.
- 140215 End ascent at 3048m msl. Some of the penetrating convection reaches this altitude.
- 140247 Start descent sounding from 3048 m msl. Sc .9 coverage. Sounding will be box pattern, except near clouds where we will maneuver to stay out of clouds. Very dry air aloft. Highest tops at 2896 m msl.
- 140530 2591m msl is top of sc deck. Very thin sc layer.
- 141021- 141032 Flying through a few cloud fragments at 1372 m msl.
- 141039 Cloud base at 1219m msl. .6-.7 cu coverage.
- 141555 Finished descent sounding at 100m agl.
- 141600 Start EF 100m agl leg.
- 142541 335m msl, 213 m agl above forest floor. End EF leg. Scattered .4-.5 shallow cu at F, with mostly clear above that (no sc or cs). But thin cs deck to southwest. Start climb to next mid level leg back to E.
- 142732 Start FE leg at 762 m msl.
- 143832 About 5/6 to E, overcast here with cu or sc. Bases are sometimes difficult to define.
- 143851 Flying through a bit of light drizzle at 762 m msl.
- 1439-- End FE leg.
- 144051 Start EF leg at 213 m msl, 100 m agl. Light drizzle at E. There is a large diameter dark cloud, imbedded in the sc above.
- 145030 Finished EF, at 305 m msl, 61 m agl.
- 145101 Start FG leg, at 100m agl. Weather is .6 cu mediocris. No sc here, but some is visible further to the north and most other quadrants. Above that, clear skies.

Airborne Scientists' Flight LogFlight: 12

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 150000 Over the lake resort for a few seconds. 107m agl.
150301 End FG leg. 107 m agl. Large patches of sc at G. .7-.9 coverage. .4-.6 cu below
150341 Start GH leg.
150455 Over central site
150731 Flying through some light drizzle. about 2/3 way to H.
150830 Flew through some more drizzle. This drizzle appeared to come out of a sc deck.
151441-151510 Over the river at 107 m agl, almost at point H.
151520 End GH leg.
151712 Start HG leg. 105 m agl. Large mesoscale patches of thick sc at H. Very irregular features. This leg is approximately perpendicular to wind.
152451-152551 2/3 from H to G, flying through some light drizzle. over forest
152701 Over central site at 107 m agl.
152831 End HG leg.
152902 Start GF leg. 110 m agl.
154030 Finished GF leg. at 100m agl. Inside turns. No showers on last leg, but significant light turbulence suggested vigorous convection.
154242 Start FE leg. Thick sc here, or large flat cu, difficult to classify. These are under a higher sc deck.
154501 Enter light showers.
154600 Leave rain.
154601 Light to moderate turbulence.
155001 Enter light drizzle.
155252 End FE leg. Start climb sounding.
155540 At cloud base at 1069 m msl.
155720 At tops of some small cu at 1372m msl. still under an overcast sc (or ac or as) deck. A few monster cu, however, do reach this sc deck, and are probably responsible for pumping up most of the moisture.
155919 A thin layer of lenticular -looking clouds at 2134m msl.
160013 End ascent, start descent. At 2431 m msl, at base of thin sc overcast. We will not fly through this deck to get to the top of the boundary layer. Even so, the cloud deck is so thin that we estimate the top of the boundary layer to be at 2590 m msl. Occasional glimpses of blue sky are seen through the sc deck. Sc is overcast here. 0.1 coverage of small cu below. But the large mesoscale thick convective clouds are visible at all quadrants.
160500 End descent in light rain.
160522 Start EF leg at 100m agl. All the drizzle we have flown through so far has been very light, just a few drops on the windshield.
161331 Enter some light rain, at 183 m agl, almost at F. So most of this leg was rain-free. Overcast sc near F. with .2-.4 small cu, but still large mesoscale deeper cu in area.
161412 Enter heavier drizzle. Exit shower at F.
161521 End EF leg at F.
161551 Start FG leg 100 m agl
162021 Half way between F and G, with some breaks in the overcast sc, and more vigorous clouds aloft.
162340 Light rain.
162451 Exit rain, flying over lake resort not.
162731 A gentle left turn was made during the last 10% of this leg.
162741 End FG leg.
162812 Start GH leg at 100m. .4 deep cu, with thin sc deck above it .7-.8 coverage.
162821 Over forest tower. Patches of sun over central site. Light to moderate turbulence
162941 Over central site.

Airborne Scientists' Flight Log

Flight: 12

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 163001 Light rain
- 163939 Over the river near H
- 164006 End GH leg. Start climbing sounding back to Toulouse.
- 164410 Cloud base at 1372m msl.
- 164713 Sc base at 2438m msl.
- 164807 Flew through a few cloud fragments at 2743m msl.
- 16---- Most cloud tops at 3000m.
- 164940 End sounding at 3200m. A few cloud tops reach 3500m. Very uniform Sc is visible from above, with .9 coverage (virtually overcast). Clear skies above. But a patch of thin Cs well to the south.
- 165840 Starting descent to Toulouse. Cloud tops here are about 2896m msl.
- 170140 Cloud base at 1676m msl. Note that there is a much stronger difference between the cloud and subcloud layers evident in the moisture profile than in the potential temperature profile.
- 171202 Landed.

Airborne Scientists' Flight LogFlight: 13

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 9 June 1986
Pattern: S
Airborne Scientist: Serafin
Data Manager: Dawson
Pilot: Summers
Observer:
Subjective Quality: Very Good

Weather: Generally clear skies in a region of large scale subsidence. Winds from 110 degrees at 5m/s throughout the boundary layer. No cumulus or stratus, but some light cirrus.

Time	Description
1051	Leave CEV ramp.
1058	Takeoff. Some cirrus aloft. During climb, top of boundary layer at about 400m msl.
1128	Begin descent sounding. BL top at 610 m msl.
1140	Arrive at point E. Start EF leg at 100m agl.
114-	Winds 110 degrees at about 5 m/s, (relatively constant throughout the flight).
1151	End EF leg. Start FG leg at 100m agl.
1200	End FG. Start GH leg at 100m agl. No cirrus north of G (totally cloud free).
1205	Over the central site.
1215	End GH. Start sounding up to 2743m msl. BL top at 1100m msl. No clouds. Bumpy in the BL, but quiet air above.
1231	Begin HG leg at 732m msl (approximately 0.7 times the BL depth). Winds 100° at 5 m/s.
1241	Over central site. Winds 100° at 4 m/s. Contrails above are not dissipating very quickly.
12--	End HG, start GF leg at 732m msl.
1256	End GF. Start sounding to 1280m msl. BL top at 1069 m msl.
1258	End sounding. Begin descent back to point F.
1302	Start FG leg at 424 m msl (mid way between about 0.4 times BL depth). Many contrails south of the HAPEX box. Winds 120° at 5 m/s.
1313	End FG. Start GH at 424m msl. Some cirrus in north now.
1315	Over central site. Winds 120° at 5 m/s.
1325	End GH. Descent to 100m agl.
1327	Start HG leg at 100m agl.
1337	Over central site.
1340	End HG leg. Air temperature is 21.5 C, radiometric soil surface temperature varies between 26 to 39 C. Start GF leg.
1352	End GF leg at 100m agl. Start FE leg at 100m agl.
1403	End FE. Begin sounding. BL top at 732 m msl.
1406	End sounding at 1252 m msl.
1410	Start EF at 100m agl.
1422	End EF. Start FG at 100m agl.
1425	Cirrus coverage is greater, still much less to the north and northwest.
1434	End FG. Start GH at 100m agl.
143430	Over forest tower.
1436	Over central site at 100m agl.
1446	End GH leg. Start sounding. Top of BL at 1252 m msl.
1456	End sounding at 2650m msl.
1458	Begin maneuvers at 2650m msl. Winds while going west are 270 at 2.3 m/s. While

Airborne Scientists' Flight Log**Flight: 14**

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 13 June 1986
Pattern: S-modified (cloud option)
Airborne Scientist: Stull
Data Manager: Le Hardy
Pilot: Summers
Observer:
Subjective Quality: Excellent

Weather: High pressure centered to the northwest caused fair weather, strong subsidence, and northerly winds. Fair weather cumulus developed in the morning, and persisted at about 10% coverage or less during the remainder of the day.

Time	Description
1053--	Start taxi. Occasional fog existed earlier in the morning. Now, there are scattered 10% shallow cumulus clouds, with evidence of wind shear. No higher clouds.
105945	Takeoff on runway 33R.
110530	Beginning climb from 610m msl, leaving the Toulouse traffic area.
110720	Cloud base at 1135m msl.
110759	Cloud top at 1313m msl. 5-10% shallow cumulus clouds. There is evidence that the polluted layer goes well above the cloud top. This is probably the "residual layer" from the previous day's mixed layer.
111115	Top of polluted layer at 2286 m msl. Clear above.
111327	Level at 2700m msl. Lenticular clouds over the Pyrenees.
112221	Start descent sounding at point F, flying towards point E. Top of the haze layer at 2134m msl. Cloud base at 1069 m msl. Turbulence felt in the aircraft only below about 1100m msl.
11--	(Voice recorder malfunction. Start and end times missing until after 1200.)
	End sounding
11--	Begin EF leg at 100m agl.
11--	End EF.
11--	Begin FG leg at 100m agl.
11--	End FG leg.
11--	Start GH leg. When over the central site, the pilot rocked the wings of the aircraft to a group of dignitaries visiting the site. Therefore, the first 15% of this leg might not be useful.
120151	Established on GH leg. 1 % scattered cumulus clouds, clear above that.
120920	End GH leg at 100m.
121111	Start HG leg at 100m agl. 0.5% Very small cumulus, changing to 2-5% just south of point H.
122030	Over central site at 100m agl.
122131	Over forest tower. End HG leg.
122247	Start ascent sounding from 61 m agl, just west of the forest tower.
122830	At average cloud base at 1372m msl, but cloud base is variable.
123043	Some of the cloud bases were at 1676 m msl.
123136	Cloud top at 1890m msl.
123325	Lenticular clouds over mountains.
123400	At top of haze layer at 2286m msl. 2-5% small suppressed cumulus. No clouds above. Distant patch of Ac lenticular over the Pyrenees. Also a small patch of Ac well to the northwest of the HAPEX box.
123535	Finish ascent sounding at 2591m msl. Begin rapid descent.
123900	Finished descent to 1219m msl. Start GF leg at 1219m msl just west of point G. This is roughly cloud base minus 200-300m. Leg was started towards the southeast, followed by a gentle turn more towards the south. So this leg has a big kink in it.

Airborne Scientists' Flight Log

Flight: 14

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 124400 Established on a southbound heading.
124950 End GF at 1219 m msl. No outside turns during this flight. 5% small cumulus, fairly flat bases, sheared looking.
125052 Start FE leg at 1219m msl.
130111 Finished FE. Begin quick ascent.
130221 Cloud base at 1372m to 1524m msl.
130433 End quick ascent at 2591m msl.
130541 Begin slow descent sounding. 10% suppressed cu. No other clouds aloft over the box, other than the growing region of lenticular over the Pyrenees.
130711 Top of the highest cumulus, and top of the haze layer at 2286m msl.
130723 Average cloud top at 2134m msl. Turbulence felt in aircraft below 1981m msl.
131042 Cloud base between 1372 and 1524m msl.
131747 End descent sounding. Starting climb back to 762m msl.
132050 Start EF leg at 762 m msl, at roughly 0.4 times the boundary layer depth. Clouds are 10-15% suppressed (forced) cumulus clouds.
133101 End EF.
133151 Start FG at 762 m msl. Clouds at F are 8% flat forced cumulus, flatter than at E.
134450 Finish FG at 762m
134510 Start GH at 762
134630 Over central site.
135242 Finish GH leg. Start descent.
140002 Start HG at 100m agl. Clouds at H are 2% very flat cumulus. Cloud cover gradient appears to be: smallest clouds in the northern part of the box, greatest in the southwest.
141021 Finish HG at 100m agl. Moderate turbulence felt in the aircraft over the forest, weaker turbulence over the other parts of the legs.
141042 Start GF leg at 100m. 8-10% flat forced cumulus. Winds are still from the NNW.
142141 End GF leg at 100m agl. Clouds are 10-20% flat cumulus.
142220 Start FE leg
143330 End FE leg at 100m.
143425 Start ascent sounding from 61m agl.
144050 Cloud base at 1829m msl.
144215 Cloud top at 2286m msl.
144312 End sounding at 2591 m msl. Begin rapid descent with flaps end gear extended.
144731 Finished descent. Start EF leg at 100m agl. 10% flat cumulus, clear above, but lenticular over Pyrenees.
145522 Some irrigation has already started. About 30 fields are being irrigated on the EF leg.
145841 Finish EF leg.
145900 Start FG leg at 100m
151131 End FG leg. Start GH at 100m agl. Clouds are 8% flat cumulus. Clear above.
151331 Over central site. Still stronger turbulence over the forest than elsewhere.
152436 Finished GH leg at 100m agl. Start turn and ascent sounding enroute to Toulouse.
152917 Cloud base at 1739 m msl.
153000 Cloud top at 2134m msl.
153236 End ascent at 2896m msl. Level enroute to Toulouse. Haze layer appears much deeper here, even though it is not turbulent. Haze layer appears to extend above our present altitude. 10% cu.
154121 Begin descent from 3000m msl
154336 Average cloud top 2134m msl. Coverage is 40% stratocumulus arranged in large diameter flat mesoscale patches, with an aspect ratio of 1 to 20.
154428 Cloud base at 1829m msl.
154754 Level at 610 m msl.
155405 Landed.

Airborne Scientists' Flight Log**Flight: 15**

NCAR King Air N312D. Project # 210.
 HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 16 June 1985
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Hildebrand
Subjective Quality: Excellent

Weather: Severe clear! The full HAPEX area was clear during the full flight. There was a wind gradient across the area with stronger ESE winds to the north and almost calm conditions to the south. There was a weak temperature gradient on the first leg EF with E being higher. The altitudes below are in m,msl (from the ADS plots) and in ft,msl (from the pilot's corrected altitude).

<u>Time</u>	<u>Description</u>
111045	takeoff
111850	inversion 950 m,msl (2900 ft)
114345	start descent east of point E en route. [alt setting 1013]. Sharp increase in q and haze at 2100 m,msl. Marine intrusion says Gil. top of thermals about 1000m,msl. Inversion between 500-950m (1300-2500ft).
114510-115640	leg EF 100 m,agl (700-1100ft,msl) Note temperature gradient between E<-F (E higher).
115720-120825	leg FG 100 m,agl
120705	approximate forest boundary
121031	over central site
120850-122020	leg GH 100 m,agl.
122020-123020	sounding at point H. inversion at 950 m,msl (2900 ft).
123440-124650	leg HG 760m,msl (2200ft)
124715-125920	leg GF 760m,msl (2200ft)
130415-131458	sounding at F. Two haze layers noted above and below 4500 ft,msl. The inversion was at 770-1000m,msl (2500-3300ft). Cumulus clouds noted to S over mountains.
131648-132830	leg FG 460m,msl (1500 ft)
132840-134030	leg GH 460m,msl (1500 ft)
134245-135445	leg HG 100m,agl
135510-140655	leg GF 100m,agl
140730-141735	leg FE 100m,agl
141735-142300	sounding at point E to 5000 ft. Inversion at 1050-1500 m,msl (4000-4500ft).
142710-143810	leg EF 100m,agl
143844-145050	leg FG 100m,agl
145110-150200	leg GH 100m,agl
150200-151000	sounding at H. Inversion at 1141-1300 m,msl (3000-4200ft)
151242-152545	Maneuvers
154235	Landing in Toulouse

Airborne Scientists' Flight Log

Flight: 16

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 19 June 1986
Pattern: S
Airborne Scientist: Stull
Data Manager: Friesen
Pilot: Summers
Observer: J-C. André
Subjective Quality: Very Good

Weather: Takeoff was delayed 1.5 hours by instrumentation problems. There were clear skies and nearly calm winds in the boundary layer most of the day. A weak depression just west of the HAPEX box had little influence. The boundary layer remained very shallow (750m) during most of the flight, but rapidly grew to depths of about 2000m as the aircraft was flying back to Toulouse at the end of the flight. Near the end of the flight, some Cc or Ac just began to move into the area, and a few cumulus clouds formed at the top of the rapidly growing boundary layer. Thunderstorms were visible all afternoon over the Pyrenees.

<u>Time</u>	<u>Description</u>
124800	Start taxi. Clear skies.
125342	Takeoff
125842	At point K near the airport. Start climb from 600m up to 2590m
130000	A layer of very dry air at 762m, marking the top of the turbulent boundary layer. The polluted residual layer goes up above the top of this sounding.
130547	Finished ascent at 2590m msl. Not quite to the top of the residual layer.
130853	Start descent.
131520	First light turbulence at 1006m msl, during descent.
131622	Average top of the boundary layer at 671 m msl.
131645	End descent sounding at 610m. Will fly high altitude legs first because of military airspace restrictions associated with our late takeoff.
131851	Start FG at 610m. Roughly 0.7 times boundary layer depth.
132711	Over lake resort.
133012	End FG. Clear but hazy
133040	Start GH at 610m msl.
133139	Over central site.
134113	End GH. Start rapid ascent (not to be used as a sounding).
134202	Top of turbulence at 914 m msl.
134713	Top of haze layer at 3353m msl.
134740	Finished ascent at 3505, just above top of haze layer. Clear skies, except for thunderstorms over the Pyrenees. Start slow descent sounding.
134940	Top of the haze layer at 3200m msl.
135645	At 1372m experiencing light turbulence, but probably not the top of the boundary layer.
135835	A very dry layer of air between 914 and 1000m msl in the sounding, with that layer clearly visible out the window as a less polluted layer.
135922	Top of boundary layer at 914m msl, based on turbulence and sounding.
135933	Average top of BL at 853m msl.
140221	End descent sounding at 122m msl.
140500	Start HG leg at 457m msl. This is roughly 0.4 times the BL depth.
141441	Over the central site. Winds in the BL are very light out of the East.
141601	End HG leg.
141630	Start GF leg at 457m msl.

Airborne Scientists' Flight Log**Flight: 16**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 141920 Over lake resort.
142812 End GF. Clear
142920 Start FE leg at 457 m msl.
143642 Almost finished FE. Almost all fields show evidence of green on them now.
143946 End FE. Start quick ascent.
144140 Top of BL at 1069m msl. Top of the capping inversion at 1219 m msl.
144223 Finished climb at 1371m msl.
144315 Start gentle descent at E.
144832 Finished descent sounding at 20 m agl.
145222 Start EF leg at 100m agl.
150245 End EF.
150321 Start FG leg at 100m agl.
150730 Deviating to avoid air traffic. Steep rolls. This effectively breaks this leg into two parts.
150901 Start part 2 of this leg (FG).
152140 Over lake resort
151521 End FG.
151552 Start GH leg at 100m agl. Some roll maneuvers were made at the start of this leg .
151712 Rocked the wings over central site.
152710 End GH.
152841 Start HG leg at 100m. Clear
153251 Half way between H & G. First cumulus clouds forming over the area. 5-10% coverage.
154031 End HG leg. Start GF leg. Clear skies from G to F, but scattered Cu between H and G.
154345 Over lake resort.
155240 End GF
155322 Start FE leg at 100m agl.
160343 End FE leg.
160520 Start EF leg at 100m agl.
161231 2/3 from E to F, some Ac aloft, in a mesoscale patch covering 40% of the south half of the sky. To the north, no clouds aloft. Decreasing Ac to the east.
161628 End EF. Start descent to surface.
161705 Begin ascent sounding from 33m agl, enroute to Toulouse.
162300 1900m msl is cloud base. 5-10% cumulus mediocris, active. The cloud tops reach a whole spectrum of altitudes. A very weak inversion at cloud base, but a strong drying there.
162600 A weak inversion at 2896m msl. Few cloud tops higher than this. The haze layer is deeper, however.
162630 More drying aloft.
162750 Top of the haze layer at 3505m msl. Weak inversion here, but very low moisture.
162840 End ascent sounding at 3810m msl. Start rapid descent.
164205 Finished descent to about 914 m msl. Many maneuvers in response to air traffic control, so the descent is not useful for a sounding.
164421 Landed.

Airborne Scientists' Flight Log**Flight: 17**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 22 June 1986
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Goutorbe
Subjective Quality: Excellent

Weather: A very weak, nearly stationary cold front was located between Toulouse and the research area. There was a change in winds and humidity across this front. The frontal area was characterized by cloudiness; however, the HAPEX area had clear skies: no cirrus and only limited cloudiness. Throughout the early part of the data collection there were extremely small K-H wisps of clouds scattered in various areas over the HAPEX area. Later there was one band of clouds (cumulus nonexistus) noted in a N-S orientation (possibly a N-S roll). At about 1418 (near the end of data collection) there was a N-S cloud line coming off the mountains (same wispy things... see the video tape). At 1243, when flying the higher legs we passed under a patch of cloudiness (about 0.1 cloud cover) between F & G, with lowered bases. There was nothing to suggest roll-type orientation either in these clouds or at other times during the day, except as noted. Much of the time the clouds appeared randomly located within patches as noted below.

Time	Description
110310	takeoff. Ac all quads with bases=2200 (670m), top inversion = 2600ft (750m) and tops = 3000 ft (900m).
111645	passed over cloudy area with Ac (0.8). Cloud bands noted on W side of cloudy area to E of research area.
112422	passing over W edge of cloudy area. clear to the W.
112800-113722	descent sounding F->E. h = 800m,msl. Skys clear above, with <0.01 wispy K-H cu at inversion. Elevated wet layer noted at 1.5-2.2 km,msl.
113900-114850	leg EF 100m,msl. gradient noted E->F: Temperature decreasing, q increasing, WS decreasing
114750	passing under small scud
114928-120200	leg FG 100 m,msl
1200	passing under small scud to NW
120205-121300	leg GH 100m,msl. start at forest tower. possible NS roll noted to N
121300-122605	sounding at H to 7500 ft. h = 1250m (4000ft). Cumulus clouds (frontal) to the NE: staying clear.
123016-124105	leg HG 820m,msl (2700ft) altimeter setting 1013.
124140-125325	leg GF 820m,msl (2700ft)
1243	under several small cu (<0.01) with lowered bases. No evidence of rolls.
125705-130726	sounding from 7500ft to sfc. h = 1300m (4300ft) [top] - 1100m (3300ft) base.
125700-125835	see fwd video tape for view of cloud patch.
131105-132300	leg FG 510m,msl (1700ft)
131640	cloud patch now dissipated a bit and is to the east of flight track. (<0.1 cover) rest of area clear.
132325-133500	leg GH 510m,msl (1700ft)
133715-133848	leg HG 100m,msl
134905-140045	leg GF 100m,msl
140115-141220	leg FE 100m,msl
141220-142000	sounding at E to 6000ft. h = 1285m (4200ft)

Airborne Scientists' Flight Log

Flight: 17

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

- 141850 NS cu scuddus line has formed off the mountains. It appears to be an elevated disturbance and not associated with the BL: cloud bases are above 1300m.
- 1424 see forward video
- 142420-143440 leg EF 100m,msl
- 142630-142700 (approximate) under cloud line
- 143517-144710 leg FG 100m,msl
- 144730-145910 leg GH 100m,msl
- 150030-150950 sounding at H to 9500ft. h = 2050m (6600ft) - 2400m (7800ft)
- 152716 Lateral vibration noted in boom. Seems to be closely associated with turbulence-induced airframe vibrations. Does not appear to be something to worry about!?
- 153212-154520 descent sounding into Toulouse. Toulouse air still not the same as within research area: wetter and different winds. h = 2200m.
- 154520 Landing in Toulouse.

Airborne Scientists' Flight LogFlight: 18

NCAR King Air N312D. Project # 210.
 HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 25 June 1986
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Champeaux
Subjective Quality: good flight: likely difficult analysis

Weather: Cold front off west coast. Stratus over network should dissipate by the time of the flight. Alto stratus/cumulus forecast at 20k ft, plus the possibility of some thunderstorms to the south, but not in the network. Southwesterly winds aloft.

At takeoff from TLS there were alto cumulus/stratus over much of the network, with virga visible from TLS and very light precip in the SW corner of the area. This precip dissipated by 1300. Thereafter, the weather was characterized by :

1. a gradient in radiation with overcast in the SW and weak sunlight in the NE.
2. stronger winds (ESE, 8 m/s) in the NE, and weak winds in the south.
3. a T and q gradient with cooler, wetter (maritime?) air in the first 25 kn of the EF leg.
4. generally disorganized winds in the PBL, with large scale wind variability across the full EFGH flight track.

These observations generally confirmed by the Aztec and Cessna flight crews. This was the most disorganized BL I've seen to date in HAPEX.

<u>Time</u>	<u>Description</u>
110230	takeoff h=650m. altimeter=1016.
112412	just E of F. alto stratus shield over area. One band of Sc visible below and to S of research area: has wave-like character to top.
112840	turbulent layer entered at 2000m
112940	N of cloud patch
113100	still photo of cloud patch to SSE
113500	h=500m
112611-113602	sounding 2600m -> sfc. Very light precip noted hitting windscreen, but only in the sw corner of area.
113910	photo SE of cloud patch and its wave-like top
114430	variable top height to BL: photo of dark (dirt?) area in top of BL forming a distinct wave-like structure with several km length and several 100m height.
114621	weak sun.
113700-114855	leg EF 100m,msl
114933-115401	leg FG1 100m,msl
115512-120130	leg FG2 100m,msl blue sky to NE
120155-121330	leg GH 100m,msl in weak sun
121339-122410	sounding at H 100m -> 2250m,msl h=650m (2000ft) Weak sun due to thin cirrus cover.
112930-124115	leg HG 525m (1700ft) weak sun -> weaker sun
124135-125343	leg GF 525m (1700ft) --> overcast This track was a little curved due to beginning the track headed a little too E. INS drift by 1.6 km at F, but this large a drift not noted prior of after during flight.
125759-130957	sounding 2270->sfc. h=540m The light precip and heavier cloud cover has now dissipated into light to medium overcast in the S of the research area.

Airborne Scientists' Flight Log

Flight: 18

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

- 131225-132412 leg FG 400m (1300ft) light overcast
- 131225-133600 leg GH 400m (1300ft) in weak sun at H
- 133908-134951 leg HG (end at Central Site) 100m,agl
join with NASA C130 (5000ft)
- 135435-140831 leg GF (Central Site to Castelnau Riviere-Basse+4km) 100m,agl During
intercomparison King Air flew at 100m,agl or about 500m,msl (avg) and
the C130 at 1500m. The King Air trailed the C130 by about 2 km. Time hack:
King Air (140950) , C130 (141000). Good position-time points of
reference beginning with direct overflight of Central Site.
- 140912-141815 leg FE 100m,agl overcast at E, no precip
- 1411 INS error 1? acknowledged OK
- 142031-143225 leg EF 100m,agl first 4 min (about) in maritime (?) air with different
winds, lower T and higher q. Note gradients of winds, T and q in this and other
EFGH legs.
- 143300-143720 leg FG1 100m,agl
- 143850-144522 leg FG2 100m,agl (break for traffic at Nogaro)
- 144540-145709 leg GH 100m,agl
- 145720-150640 sounding at H 100m,agl->2350m,msl. h=700m,msl Generally overcast
skys with light sun to the NN of research area.
- 142930 landing

Airborne Scientists' Flight Log

Flight: 19

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 28 June 1986
Pattern: S (only North third)
Airborne Scientist: Stull
Data Manager: LeHardy
Pilot: Summers
Observer: Puech
Subjective Quality: Good

Weather: A weak high just east of France and a weak low just west resulted in a fair weather condition with nearly calm winds. Local low-level weak westerly winds brought in maritime air from the Atlantic Ocean, stratocumulus clouds and very low visibilities over the southern 2/3 of the HAPEX box. Takeoff was postponed until noon to allow more time for the stratocumulus to burn off. These clouds never dissipated during the day. As a result, only the north third (leg GH) of the S pattern was flown during the first half of the flight. During the second half, we were also able to fly some northern portions of leg FG. No higher clouds aloft.

As a result we have frequent low level flights over the forest in clear conditions.

<u>Time</u>	<u>Description</u>
120000	Start taxi.
120642	Takeoff. Calm winds. Clear skies.
120845	Base of inversion at 610m. This is also roughly the altitude of the stratocumulus clouds visible to the west.
121551	Level at 2800m msl. Overcast Sc clouds now below us. Statically stable lapse rate from cloud top all the way to the present altitude.
1216-1258	IFR conditions prevented descent at point E. Therefore, the flight pattern was modified to fly to point H, which was clear. During the resulting maneuvers, descent was made from 2800m to 1372m msl outside of the HAPEX area.
125852	Start descent from 1372m msl in cloud-free air. Heading NW towards point H.
130021	Strong inversion and moisture gradient at 970m msl. Although statically stable over a very deep layer.
130152	Base of stable layer marked by strong temperature jump at 550 m msl.
130315	End descent near surface. 152 m msl
130453	Start HG leg at 100m agl. No clouds over point H. Very hazy. Much irrigation on farms.
130513	Over river for a few seconds.
131403	85% from H to G. First scattered Sc here.
131530	Over central site.
131632	End HG at 100m agl.
131643	Start GF. 100m agl. At G, sky is 50-70% Sc. Hazy.
131953	Over the lake resort. Overcast Sc and very hazy conditions prevent continued VFR flight. This leg is too short to be useful. Returning to point G.
132520	Start GH at 100m. Scattered Cu at G, quickly disappearing further north over most of the leg.
133523-133531	Over the river.
133629	End GH leg at 100m agl. Begin descent.
133633	Begin ascent sounding from just above the surface.
133830	Base of the inversion (ie, top of the boundary layer) at 610m msl.
134225	End ascent sounding at 1372m msl.

Airborne Scientists' Flight LogFlight: 19

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

134257 Begin descent.
134439 Very rapid descent and high bank angles.
134513 End descent . Start HG leg at 489m msl, roughly 0.7 times the boundary layer depth.
135652 End HG leg. Start rapid ascent.
135901 End climb at 1372m msl. Start slow descent sounding. Scattered Cu 10%-20% .
140000 Cloud top at 1006 m msl.
140038 Cloud base at 823 m msl.
140347 Finished descent sounding over central site, just above the surface.
140712 Start HG leg at 400m msl, at roughly 30% mixed layer depth.
140833 Over central site at 400m msl. No clouds, hazy. Gentle rolls of aircraft.
141923 End GH leg at 400m agl. Start descent to 100m.
142133 Finished descent. Start GH at 100m agl.
143115 Over central site
143222 End HG. at 100m agl. No clouds. Hazy.
143233 Start GF. 100m agl.
143503 First Cu over leg, roughly 1/4 the way from G to F.
143544 Over lake resort. 50% Cu. Hazy.
143733 Overcast. Ending leg early and turning back
143843 Start back to leg G.
144025 Over lake resort.
144433 End FG half-leg. 100m agl.
144453 Start GH leg at 100m agl.
144513 Over central site flying on the incorrect heading. The pilot is turning to get back on course.
144533 Start GH leg stabilized.
145444-145510 Over the river, but near some of the banks.
145533 End GH
145723 Start HG at 100m agl.
145732-145753. Over river.
150854 End HG leg at
150913 Start GF leg at 100m. No clouds at G.
151225 Over lake resort. First Cu, 10% coverage.
151453 Overcast half way between G and F. Ending leg early.
151550 Start return leg F to G, starting midway between F & G. 100m agl.
151805 Over lake resort.
152103 End FG at 100m.
152113 Start GH leg at 100m.
152255 Over central site.
153235-153300 Over river.
153323 End GH. No clouds. Hazy.
153452 Start HG leg at 100m.
153516-153533 Over river.
154505 Over central site
154602 End HG.
154623 Start GF. No clouds at G. Very hazy.
154945 Over lake resort. First few Cu visible just south of the lake. No clouds to north.
155413 Passing well east of the Nogaro airport.
155433 End GF leg early. 100m agl.
155533 Start FG leg near F, at 100m agl. Overcast and hazy. Becoming IFR. Calm winds.
155933 Over lake resort.
160232 This FG leg was flown relatively straight, but on a slightly incorrect heading (ie, more to

Airborne Scientists' Flight Log

Flight: 19

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- the NW than normal).
- 160244 End FG leg, southwest of G. Doing turns and maneuvers over the forest tower to get back on track.
- 160332 Start GH leg at 100m agl. No clouds at G.
- 160418 Over central site.
- 160933 Halfway from G to H, the winds are just now changing to light easterly in the boundary layer.
- 161343-161415 Over river.
- 161444 End GH leg 100m agl.
- 161530 Start ascent sounding from 61m msl enroute to Toulouse. No clouds at H.
- 161735 Top of boundary layer at 762 m msl.
- 162324 Level at 2340m msl.
- 163650 End maneuvers.
- 164223 Start descent from 2340m msl enroute to Toulouse.
- 164600 Light turbulence below 1372m msl.
- 164705 Still in inversion, must be shear causing turbulence.
- 164751 Base of inversion at 823 m msl.
- 165308 Landed.

Airborne Scientists' Flight LogFlight: 20

NCAR King Air N312D. Project # 210.
 HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 1 July 1986
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Hildebrand
Subjective Quality: good

Weather: Post cold-frontal with rain over research area. Previous flight, 3 days prior, had only sampled the GH leg well.

At takeoff the skys were clear all quadrants in TLS. In the research area the BL was quite hazy, with cirrus and <0.1 Sc (very small) scattered over much of the area. At the time of the first sounding at H, there was a distinct edge to a stratus deck aloft to the NE of point H. There was a 0.6-0.7 Sc deck in the GH portion of research area, which dissipated by the end of the research flight. These clouds were within the BL, with bases at about 900m and tops at about 1200m,msl. The BL top was near cloud top, with obvious stratus fragments at the BL top, between the Sc. The highest flight level was flown at 840m,msl, about 100m below cloud base on the 1234-1245 HG leg. On the following GF leg the cloud base rose, but BL top remained about the same at about 1200m,msl. At the end of the flight the clouds were again 0.0-0.1Sc.

<u>Time</u>	<u>Description</u>
110831	takeoff from TLS. Skys clear all quadrants after morning overcast moved off to the east. Altimeter setting 1023mb. The BL is fairly hazy with some cirrus high up. Sc (about 0.1) noted in BL, mostly to the south. Inversion height 400m; cloud base 1000m - top 1100m; higher inversions at 1300 and 1650m,msl.
113000	Very few Sc in BL over research area between EF.
113134-114132	sounding 2700m-surface cloud base at 1050m,msl. turbulence and BL top at about 850m,msl.
114200-115320	leg EF 100m,agl 0.1 Sc
115350-120610	leg FG 100m,agl 0.1 Sc
120625-121840	leg GH 100m,agl 0.2 Sc to NW of G; 0.6 Sc S of H.
121900-122850	sounding at H sfc-2200m,msl. Stratus deck noted to NE of H, having sharp NW-SE edge. Sounding flown over and to S of H clear of this deck and obviously in research area air, thru small Sc. Cloud base 900m; BL top 1200m, cloud top 1250m. Sc fragments noted at BL top between Sc.
123400-124520	leg HG 840 m,msl, about 100m (?) below cloud base. 0.6-0.7 Sc on this leg decreasing to about 0.4-0.5 at G. Clear to W of G.
124614-125741	leg GF 840m,msl
125100	At Nogaro about 0.1 Sc here and less to S. Cloud base rising to S.
130200-131200	sounding at F 2200m-sfc cloud tops (<0.1 strcu) at about 1300m, bases and BL top at about 1100m.
131513-131930	leg FN (Nogaro) 620m,msl deviate for sailplane
132020-132640	leg NG 620m,msl
132710-133900	leg GH 620m,msl 0.5 Sc between GH
134105-135220	leg HG 100m,agl
135300-140445	leg GF 100m,agl
140523-141550	leg FE 100m,agl clear skys [Possible position glitch between 1407-08.]
141700-142400	sounding sfc-2100m,msl h=1100m (cloud base), 1400m,msl cloud tops.

Airborne Scientists' Flight Log

Flight: 20

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- 142801-143915 leg EF 100m,agl <0.1 Sc During the FE and EF legs there seemed to be an increased probability of turbulence just downwind (a few 100 m W) of hill tops.
- 143950-144430 leg FN 100m,agl <0.1 Sc
- 144500-145204 leg NG 100m,agl <0.1 Sc
- 145217-150420 leg GH 100m,agl <0.1 Sc
- 150505-151330 sounding at H sfc-1700m,msl cloud base =1300, cloud top=1450, h=1500-1650.
- 152340-153600 sounding into Toulouse. Altimeter settings 1021 (MdM), 1020 (TLS).

Time	Description
142801-143915	leg EF 100m,agl <0.1 Sc During the FE and EF legs there seemed to be an increased probability of turbulence just downwind (a few 100 m W) of hill tops.
143950-144430	leg FN 100m,agl <0.1 Sc
144500-145204	leg NG 100m,agl <0.1 Sc
145217-150420	leg GH 100m,agl <0.1 Sc
150505-151330	sounding at H sfc-1700m,msl cloud base =1300, cloud top=1450, h=1500-1650.
152340-153600	sounding into Toulouse. Altimeter settings 1021 (MdM), 1020 (TLS).

Airborne Scientists' Flight LogFlight: 21

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 2 July 1986
Pattern: S (included intercomparison with NASA C-130)
Airborne Scientist: Stull
Data Manager: LeHardy
Pilot: Summers
Observer:
Subjective Quality: Very Good

Weather: A ridge of high pressure caused fair weather. Light winds were from the northeast in the boundary layer with no low level clouds. A patch of cirrus drifted from the southwest over the area from Spain. Very hazy in the boundary layer.

<u>Time</u>	<u>Description</u>
105545	Start taxi. No low or mid clouds. Ground is mostly sunny, even though thin overcast of cirrostratus.
110417	Takeoff on runway 15L
110600	Level at 457m msl near the airport traffic area.
110955	Start climb enroute from Toulouse.
111058	Top of boundary layer at 671m msl.
111757	Near the top of the haze layer at 2438m msl.
111841	End climb at 2600m msl, still not quite at the top of the haze layer. Ci aloft, patchy, covering 80-90% of sky between Toulouse and point F. Further west over the box, there is less Ci coverage.
112751	Just south of point F, turning point E. Behind us, to the East, is 80-90% Ci and Cs, but ahead of us to the west the Ci decreases to 20% and quickly to zero beyond that.
112821	Start enroute descent sounding from 2600m msl.
113533	Top of BL at 521m msl.
113715	End descent sounding 15 m agl, 366m msl. Start climb back up to 100m agl.
113855	Start EF leg at 100m agl. 183m msl. Clear skies and hazy. Ci to east.
115001	End EF leg. East is 60-90% thin Cs coverage. West is clear. North is the dividing line between Ci to east and clear to west.
115041	Start FG leg at 100m agl. 220m msl.
115935	Over lake resort.
120230	End FG leg. Thick patch of Cs above us, causing noticeable shading of the ground. 50% of sky covered by this thick patch, with an additional 20% covered by thinner Ci.
120301	Start GH leg at 100m agl.
120421	Over central site.
121331	Over the river for a few seconds, 100m agl
121441	Finish GH leg. Start descent to surface.
121450	Start climb sounding from 61 m agl, 366m msl
121900	Top of BL at 914 m msl. Weak inversion
122013	Stronger inversion at 1219m msl. Clouds at H are 80-90% Cs and Ci, thick in patches
121430	Finished ascent sounding at 2286m msl. Start rapid descent with flaps and gear down.
12275	Start HG leg at 0.7 * Zi leg at 762 m msl.
123940	End HG leg at 762 m msl.
124011	Start GF leg at 762 m msl
125231	End GF leg at 762 m msl. Start rapid climb
125536	Finished rapid ascent at 2134m msl. Not to be used for sounding purposes.
125641	Start slow descent sounding from 2134m msl.
130200	Top of BL at 914 m msl. First bumps, and top of hazier layer.
130603	Finished descent sounding at 15 m agl. Start quick ascent.
130725	Level at 457 m msl.
130831	Start FG leg at 0.3 Zi at 457 m msl. Clear at point F. Some Ci visible in the distance to

Airborne Scientists' Flight Log**Flight: 21**

NCAR King Air N312D. Project # 210.

HAPEX-MOBILHY Field Experiment, Toulouse, France

- the east, north, and southwest.
- 131710 Over lake resort .
- 131950 End FG at 457 m msl.
- 132020 Start GH leg at 457 m msl.
- 132145 Over central site.
- 133000 There was a brief period in this leg where we slowed down and speeded up again.
- 133201 End GH leg at 457 m msl
- 133420 Start HG leg at 100m agl.
- 134445 Over central site.
- 134700 End HG leg at 100m agl. Start of NOT good data because of maneuvering of the aircraft. Turning back towards the central site (not a good data leg) to start intercomparison with NASA C-130 aircraft.
- 135051 Circling the central site, waiting to rendezvous with the C-130.
- 135352 Flying westbound in trail with the C-130. This is still not a good data leg. The C-130 is climbing to 1500m msl to allow condensation to evaporate from their mirrors. Also, they are flying circles in a holding pattern for about 10 minutes.
- 135931 A few cumulus clouds are forming.
- 141421 At 100m agl. End BAD data portion. Start modified GF leg at 100m agl, that starts from the central site and proceeds southbound to just west of point F. Over the forest now. Not quite directly behind the C-130 aircraft.
- 141642 Now more or less directly behind and below the C-130, still over the forest.
- 141901 A few minutes south of point G.
- 142451 A time hack with the C-130 indicates that their time is about 1 second behind our ADS system clock.
- 143851 Fly over the data trailer at 100m near point F, still flying southbound in trail behind the C-130.
- 144902 End GF leg. Start outside turn at F.
- 143521 Start FE leg at 100m agl, still in trail behind the C-130.
- 143541 Flying over the river in the valley near point F.
- 143635 Over the trailer.
- 144542 End of FE leg at 100m agl. End trail of C-130.
- 144611 Start rapid climb from 305m msl. At E is 10% Ac castellatus, and 10% Ci.
- 145031 Finish rapid ascent at 2286m msl. Start slow descent sounding.
- 145639 First bumps at 701 m msl. Average top of the boundary layer was a bit higher as indicated by the inversion at 914 m msl.
- 145901 End descent sounding 33m agl. Start climb and circle back to 100m agl.
- 150131 Start EF leg at 100m agl.
- 151201 End EF leg.
- 151241 Start FG leg at 100m agl. 40% Ci, thin. 10% Ac cast.
- 152142 Over lake resort. 10% patchy thin Cs, clear elsewhere.
- 152501 End FG leg near the forest tower
- 152541 Start ascent sounding from 61m agl, enroute back to Toulouse.
- 153020 Top of BL at 1400m msl.
- 153307 Level at 2286 m msl. Start maneuvers.
- 154612 Finished maneuvers.
- 154630 Start descent from 2286m msl enroute to Toulouse.
- 154843 First turbulence felt during descent at 1372m msl.
- 154916 Average top of BL and base of strong inversion at 1135m msl.
- 155140 Leveling at 610 m msl.
- 155452 Descending again.
- 155713 Landed at Toulouse.

Airborne Scientists' Flight Log**Flight: 22**

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 5 July 1986
Pattern: S (abbreviated)
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Hildebrand
Subjective Quality: Interesting

Weather: Pre cold frontal, warm, moist, hazy air with low wind speeds. Some pre-frontal bands were over the research area as cirrus; however no clouds developed at lower levels in the research area during the day. The boundary layer was somewhat complex, having a lower ML which never grew very much. Our 650m,msl flight leg was at 0.7-0.8 h at the time it was flown, and is probably representing of that height during the full day. Above the ML was another layer which was very hazy, neutral, and also had light winds. The top of this layer was about 1750m,msl. The only sunny area during the flight was in the SE corner. Elsewhere, the haze was so thick it allowed only weak sun.

Time	Description
1205	takeoff from TLS
120500-121845	sounding from TLS. sfc->2600m,msl. altimeter setting 1017mb. top of ML = 600m; top of haze at 1200m,msl.
122739-123645	sounding at H 2600m->sfc. h=760m. top of haze=1200m.
123830-124950	leg HG 100m,agl very hazy with cirrus aloft
125030-130211	leg GF 100m,agl
130250-131340	leg FE 100m,agl still very hazy. Also some cirrus in SW portion of area.
131455-132130	sounding at E 50m->1500m,msl h=760m,msl. other inversions at 1070 and 1370m,msl with near neutral layers below them.
132458-133605	leg EF 610m,msl very hazy
133644-134830	leg FG 610m,msl "
134850-140000	leg GH 610m,msl very hazy. some Sc on top of the haze to the west of E
140000-140500	sounding at H. 620m->1500m,msl
140500-140830	quick descent sounding at H. 1500m-> sfc
140830-142020	leg HG 100m,agl very hazy
142040-143251	leg GF 100m,agl sunny at F only, hazy elsewhere
143335-144412	leg FE 100m,agl very hazy
144621-145720	leg EF 100m,agl "
145755-150951	leg FG 100m,agl "
151020-152115	leg GH 100m,agl "
152220-153028	sounding at H sfc->2300m,msl h=600m haze top=1400m,msl
153500-154920	descent sounding and landing into Toulouse.

Airborne Scientists' Flight Log**Flight: 23**

NCAR King Air N312D. Project # 210.
 HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 8 July 1986
Pattern: S (shortened)
Airborne Scientist: Stull
Data Manager: Friesen
Pilot: Summers
Observer: Bessemoulin
Subjective Quality: Very Good

Weather: Scattered flat fair weather cumulus clouds of about 20% coverage all day. Clear aloft. Westnorthwesterly winds in the boundary layer of about 8 m/s.

Time	Description
114500	Start taxi. At Toulouse, flat Sc clouds with 40% coverage, decreasing to about 10% to the north. Strong winds during the previous days cleared out the haze from the boundary layer, leaving exceptionally good visibilities.
115048	Takeoff
115226	Leveling at 457m msl leaving Toulouse traffic area.
115620	Start climb from 456m msl.
115955	Cloud base at 1345m msl.
120015	Cloud top at 1433m msl.
120450	Level at 2600m msl. Scattered, flat Sc coverage 30%.
121220	Begin descent from 2600m msl.
121656	At highest cloud tops at 1524m msl. Flat cumulus or Sc of 30-40%.
121723	At average top of Sc at 1372 m msl.
121813	Cloud base at 1219m
122215	Finished descent sounding at 20m agl at point H.
122401	Over the river. Start HG leg at 100m agl
123348	Over central site
123505	Over forest tower
123545	End HG leg at 100m . Weather at G is 20% flat Cu. Clear above.
123612	Start GF leg 100m
123825	Over lake resort.
124721	End GF leg at 100m. Weather at F is 10-20% flat Sc or Cu.
124812	Start FE leg at 100m
125856	End FE leg at 100m.
130008	Start ascent sounding at E from 33m agl. Weather at E is 20% flat Cu or Sc.
130442	Cloud base at 1102m msl.
130501	Average cloud top at 1219m msl.
130605	End ascent sounding at 1524m msl, roughly 300m above cloud top at E.
130845	Start EF leg at 914 m msl. This is about 150m below cloud base. The clouds here at E are about 150m lower at E than at H.
131810	End EF leg at 914m msl.
131931	Start FG leg at 914m msl. Weather at F is 5-10% very flat Cu. Note, the tops of thermals are visible to the eye because of their excess pollution, compared to the very clear skies aloft. This holds for even thermals without clouds.
133145	End FG leg at 914m. Weather at G is 10-20% Cu, a bit thicker at F.
133220	Start GH at 914 m. We are about 300m below cloud base now.
134350	End GH leg at 914m . Start ascent sounding from 914m.
134542	Cloud base at 1372m msl.

Airborne Scientists' Flight Log**Flight: 23**

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- 134617 Average cloud top at 1585m msl.
134645 Cloud top at 1676m msl.
134705 End ascent sounding at 1829 m msl. Start rapid descent.
135112 End rapid descent at 100m agl.
135125 Over the river. Start HG leg at 100m agl. Weather at H is 20-30% flat Sc in medium size patches.
140112 Over central site.
140245 End HG leg. Weather at G is 15-20% very flat Sc clouds.
140321 Start GF leg at 100m agl.
140542 Over the lake resort.
141435 End GF leg at 100m agl.
141530 Start FE leg at 100m agl. Weather at F 5-10% very small fair weather cu.
142640 End FE leg. Weather at E is 20% flat forced Cu clouds.
142842 Start EF leg at 100m.
143920 End EF leg. Weather at F is 1-2% very small fair weather cu.
144000 Start FG leg at 100m agl.
144915 Over lake resort. Note that there were a number of steep bank maneuvers of the aircraft while avoiding birds, gliders, space ships, giant mosquitoes & helicopters.
145215 End FG leg. Weather at G is 10-15% flat Cu. clear above.
145250 Start GH leg.
145255 Over forest tower.
145315 The start of the leg up to this point might be difficult to analyze because of continued maneuvering of the aircraft.
145415 Over central site.
150350 Over the river for a long period of time.
150430 End GH leg at 100m agl.
150535 Start ascent sounding from point H at 61m agl, enroute to Toulouse. During the first part of the climb the aircraft maneuvered. Weather at H is hazier boundary layer. 10-20% fair weather cu.
151000 Cloud base at 1372m msl
151045 Average cloud top at 1524m msl.
151110 Highest cloud tops at 1676m msl.
151342 End climb sounding at 2300m msl enroute to Toulouse. Cloud cover 2-5% fair weather Cu, reducing to zero as we approach Toulouse.
151410 Start calibration maneuvers.
152115 End maneuvers at 2300m msl.
152310 Start descent into Toulouse. Sky clear. But 1% cu visible in distance to north.
152630 Top of boundary layer at 1372m msl.
153353 Landed.

Airborne Scientists' Flight Log

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HAPEX-MOBILHY Field Experiment, Toulouse, France

Flight: 24

Date: 11 July 86
Pattern: S
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Hildebrand
Subjective Quality: Good

Weather: There was cirrus cover aloft during the entire flight. This cirrus cover thickened during the flight. The boundary layer was unusually clear. During the first high level flight leg (1321-1332) the top of the BL was visible due to haze and slight condensation at the tops of the highest thermals. Near the end of the flight a band of clouds formed across the research area, which was visible from satellite. Other than this, the research area was fairly homogeneous. There were a few data system problems during this flight; hence, the data have 3 or 4 short time gaps, of which only one occurs within a flight leg (leg 6: GH).

<u>Time</u>	<u>Description</u>
120450-121830	takeoff and sounding out of Toulouse. sfc->2600m. h=1100m,msl. Altimeter setting 1019.
122300-123335	descent sounding at H. 2600-sfc. h=700m,msl
123535-124545	leg HG 100m,agl Cirrus aloft: more to the west.
124640-125815	leg GF 100m,agl
125855-131000	leg FE 100m,agl
130800	A line of very small cu noted to the west of E: possibly the sea breeze front.
131115-131905	sounding at E sfc->1830m,msl. h=650-700m,msl. Cloud base is about 915m,msl (above ML).
132145-133120	leg EF 610m,msl Top of ML visible as white haze and incipient clouds on the tops of thermals.
133220-134420	leg FG 610m,msl
134420	tape drive problems.
134500-134731	leg GH part 1, 610m,msl tape drive problems
134948-135700	leg GH part 2, 610 m,msl.
135701-140300	sounding at H 610-1830m,msl. h=950m,msl.
140620-141755	leg HG 100m,agl
141815-143000	leg GF 100m,agl cirrus thicker now.
143100-144135	leg FE 100m,agl
144340-145440	leg EF 100m,agl about 0.2 cu to south of flight leg.
145525-150720	leg FG 100m,agl
150745-151945	leg GH 100m,agl
151000-151300	passed under a NNW-SSE line of strato cu just north of the central site. Complete overcast in this region.
152035-152800	sounding at H sfc->2290m,msl h=1150m,msl The cirrus over the research area is thicker than at the beginning of the flight.
153500-155245	sounding into TLS 2290m->sfc. h=1280m,msl.

Airborne Scientists' Flight Log**Flight: 25**

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 14 July 1986
Pattern: G (& intercomparison with Piper Aztec)
Airborne Scientist: Hildebrand
Data Manager: Hildebrand
Pilot: Summers
Observer: Hildebrand
Subjective Quality: Excellent

Weather: The whole of the HAPEX research area was covered by a uniform layer of about 0.5 stratocumulus. The boundary layer under these clouds was uniform and provided an excellent mapping mission. Cloud base was at about 1220m,msl at the beginning of the flight and 1520m,msl near the end of the flight. Cloud top and the inversion was at about 2150m,msl near the beginning of the flight and was not sampled later (estimated at about 2500m,msl).

The mapping pattern was flown north to south, in the reverse direction from the previous mapping pattern (flight 4, 17 May 86) because of the northerly winds and the expectation that cloudiness would lessen north to south during the day. All flight legs were flown at 100m,agl.

The beginning of the flight was flown with the Piper Aztec as a final intercomparison flight. The King Air took off behind the Aztec and generally flew about 30m to the right of the Aztec during the ascent to 2290m,msl; level legs at 2300 and 915m,msl; the descent to 100m,agl; and during the first two 100m,agl flight legs. These two flight legs might be suitable as M-pattern analyses. The fore and aft positions of the two aircraft varied; however, the lateral spacing remained fairly constant at about 30m. Several photos were taken which can be used to estimate the distance between the two aircraft. During the ascent and descent through the cloud layer (120558-120730 and 121730-121930), the two aircraft separated by about 1 km.

Time	Description
115740-120900	Takeoff and sounding sfc->2290m,msl. cloud base=1300m,msl. h=2150m,msl altimeter 1022mb.
120600-120730	broke contact with Piper during ascent through cloud layer.
120900-121600	joint flight at 2300m,msl
121930-122440	joint flight at 915m,msl
123050-125300	leg 1 with Piper Aztec
123450	Over Garrone skys 0.5-0.6 Sc
123753	over autoroute
123840	beginning of forest: about 25% forest, the rest mixed agricultural use
124230	60-70% forest
124350	90-100% forest
125610-131815	leg 2 with Piper Aztec
1259-1302	over area with about 50% large fields, of which soem are fields of new trees, others are other crops.
1305-10	10-20% fields clouds are 0.5-0.6 str cu
1310	now about 50% forest
1312	25% forest
1314	10% forest
131550	Garrone going E
131830	over Garrone going S

Airborne Scientists' Flight Log

Flight: 25

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HAPEX-MOBILHY Field Experiment, Toulouse, France

132120-134205	leg 3
1322	90-100% forest
133350?-134020	over large field
134020-1349	over forest
134455-140510	leg 4
1350-1353	over bombing range
1353-1355	over big fields similar to site central.
1356	90-100% forest
1401	80% forest
140230	30% forest
140810-141915	leg 5
1409	about 0.3 Sc to east
1410	over forest
142230-143315	leg 6
1423	30% forest increasing to north
1424	50% forest increasing to north
1429	20% forest increasing to north
1430	20% forest increasing to north; still about 0.5 str cu over research area, but clouds are larger.
143600-144710	leg 7
145012-150110	leg 8
150355-152445	leg 9
152730-154740	leg 10
154740-155255	sounding 100m->1680m,msl (cloud base)
1553	Estimated cloud tops are about 2500m,msl
1607	Landing Toulouse.

Airborne Scientists' Flight Log**Flight: 26**

NCAR King Air N312D. Project # 210.
HAPEX-MOBILHY Field Experiment, Toulouse, France

Date: 15 July 1986
Pattern: S (incomplete)
Airborne Scientist: Stull
Data Manager: LeHardy
Pilot: Summers
Observer: -
Subjective Quality: Poor

Weather: This flight was terminated early because of an engine failure. The weather was mostly clear, with patches of thin stratocumulus to the northwest of point H.

Time	Description
110400	Takeoff. Clear weather at Toulouse. Only 10% of sky covered by very thin Cs.
110235	Level at 640m msl enroute from Toulouse traffic area.
110---	Start climb from 640m msl.
111041	Base of shallow inversion at 800m msl. Inversion is very weak.
111249	Another weak inversion at 1536m msl.
111430	Strong inversion at 1984m msl. Top of a very definite haze layer.
111821	Level at 2720m msl enroute to point H.
112322	Start descent from 2720m msl.
112449	Base of very strong inversion at 2175m msl, which marks the top of the haze layer.
112810	First bumps at 1184m msl during descent.
112920	Passing under some small Sc patches, covering less than 10% of sky.
113045	Further to the north west of point H is are large, almost overcast patch of Sc.
113150	Finished descent sounding at 30m agl, just southeast of point H.
113339	Over the river. Clouds at H is a broken patch of Sc to north, but to the south over HG leg are no clouds. The ground over the whole leg is heated by the sun.
113608	Start HG leg at 100m agl. Winds aloft during the ferry portion are northeast at 15 m/s.
114100	Enter uniform part of the forest at location 44° 19.9' N / 00° 1.2' E. Definitely more bumpy over the forest.
114325	Doing some banking maneuvers while trying to find the central site.
114542	Fire seen in the exhaust port of the starboard engine. Torque has dropped. The engine is being shut down, and the propeller feathered. The research portion of this flight is terminated, and we are headed back to Toulouse. Power to the data system has been cut off before a normal shutdown could be completed.
-----	Landed at Toulouse. End of HAPEX field experiment special observing period.