

Atmospheric Greenhouse Gas  
Measurements with Aircraft in CGER

Katsuyuki Izumi

NIES

OHP1

New Title: Atmospheric Greenhouse Gas Measurements  
with Aircraft in CGER.

- 1) Targeted gases: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs  
and related gases.
  - 2) A proposal on regular grab sampling of air:
    - over the Hateruma station
    - once a month
    - for at least several years

↓

to understand the source-sink relation of greenhouse gases  
(provide a constraint in the model calculations)
  - 3) No research aircraft in the Japanese government organization.  
charter of an airplane from a civil aviation company
- ↓
- restriction of our activity in this field

Two preliminary flights

----as training for extensive aircraft observation.

1)over the Kanto districts, in which Tokyo is located.

main purposes are:

- (a) to examine the spatial (vertical) distributions of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O,
- (b) to estimate the emission of CO<sub>2</sub> from the Tokyo metropolitan area.

2)over Hateruma island

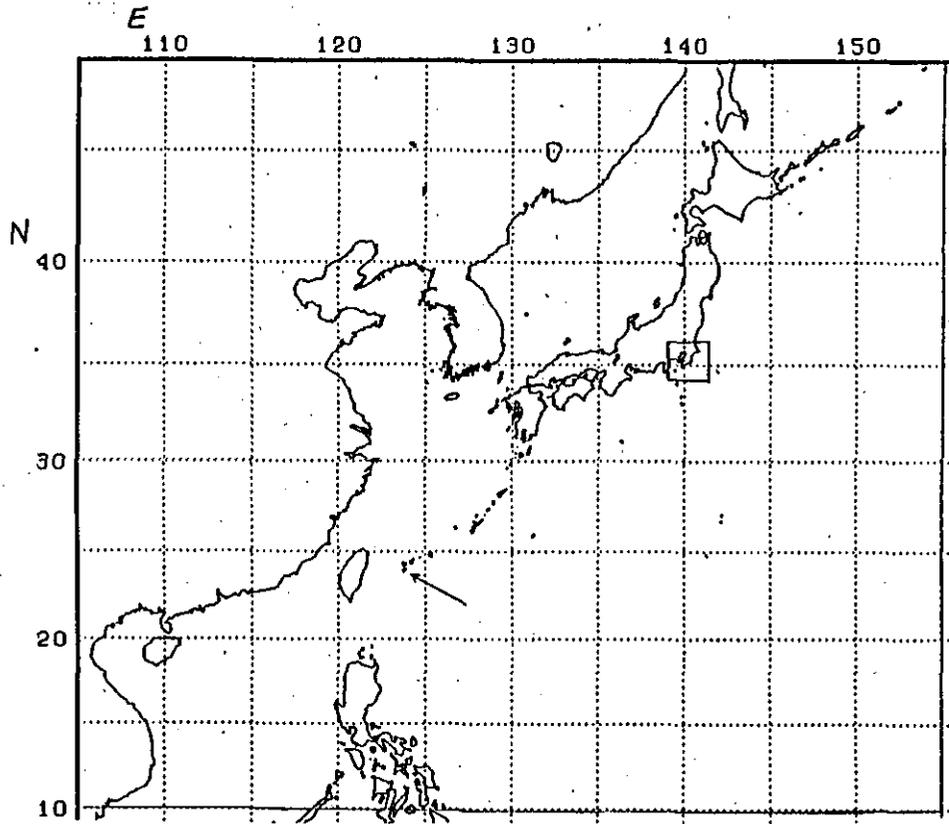
main purpose is:

- (a) to test performance of an NDIR-CO<sub>2</sub> analyzer.  
(matching of data from the CO<sub>2</sub> analyzer and canister sampling)

Date: January 27 & 28, 1992

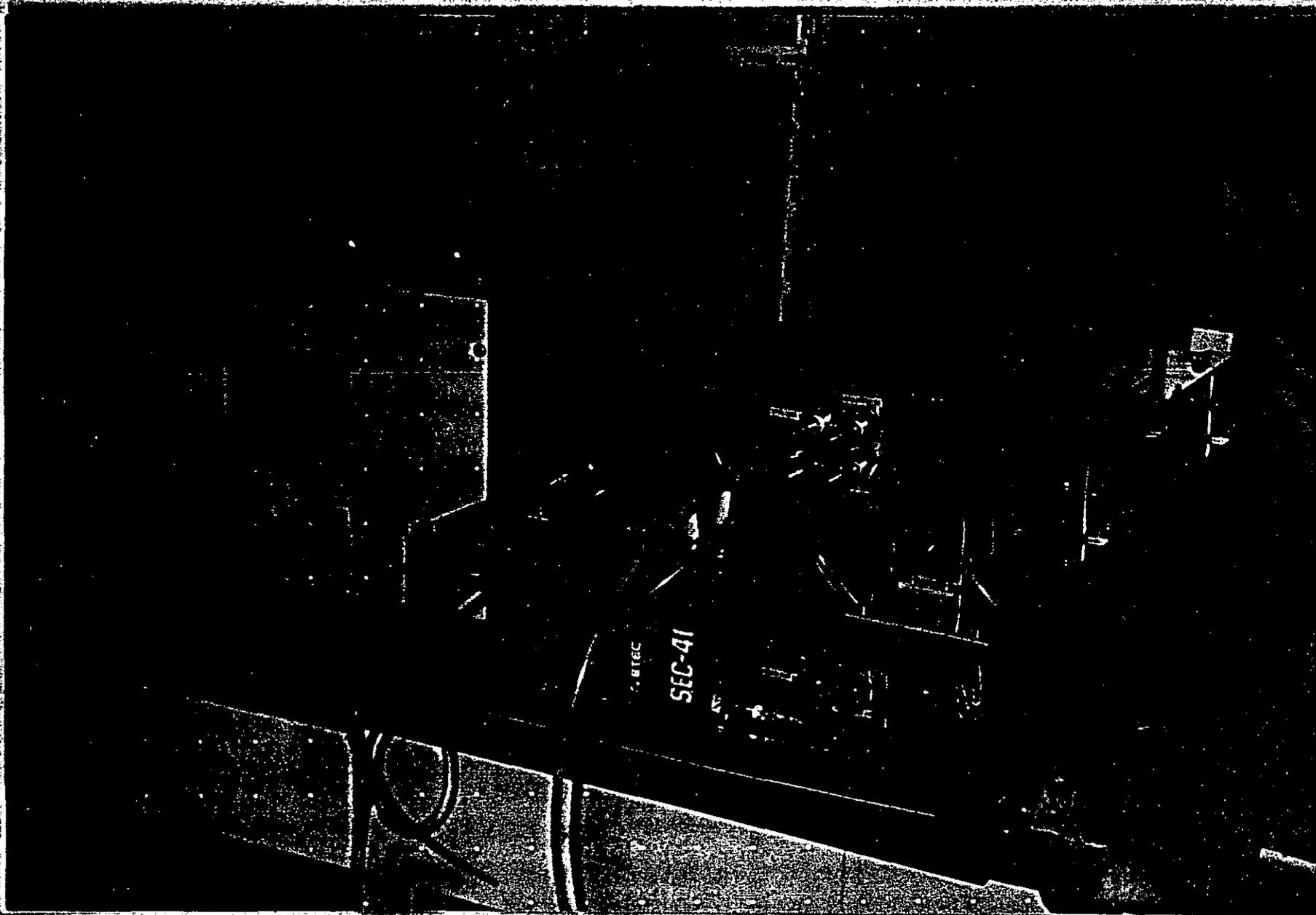
Aircraft: Briten Norman (9 seats including crew)

Flight Levels: 150 - 1800m



*Geographical positions of Hateruma & the districts of  
Kanto*

— 168 —



NDIR-CO<sub>2</sub> analyzer and vibration proof rack.

Preliminary result for the Flight over Hateruma.

- 1) matching between the CO2 analyzer and canister sampling:
  - discrepancy of several ppm
  - (the reason is unknown at present)
- 2) vibration proof rack:
  - a) successfully removed vibration due to the engine
  - b) vibrations due to turbulence of air caused noise signals as much as  $\pm 0.7$  ppm.
    - (further improvements; suspension of the analyzer part with springs)

Basic Concept of the Observation.

- 1) In Japan, northwesterly winds prevail From December to March.
- 2) If vertical transport is insignificant and if a main wind rules the spread of a gas, the emission rate of the gas is given by

$$E = (C2-C1)*U*S$$

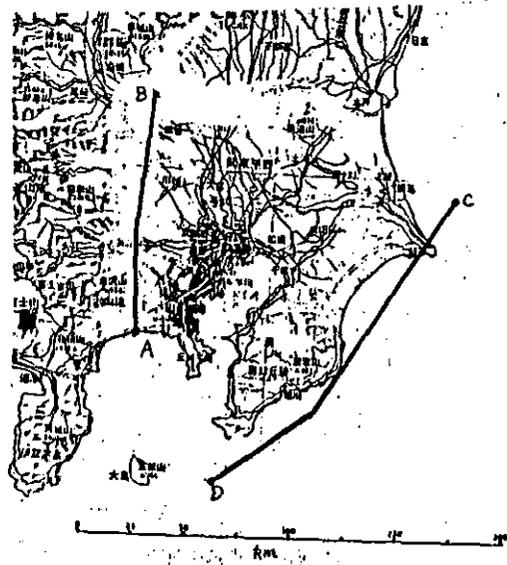
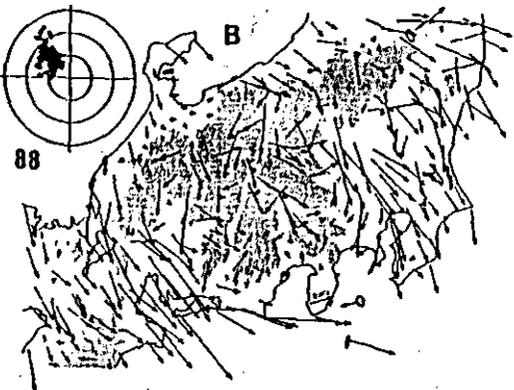
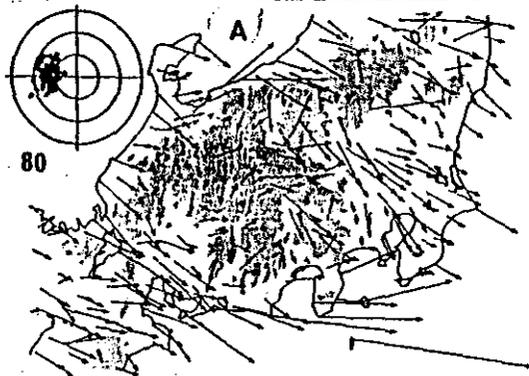
where, E; the emission rate of the gas from sources  
C1; the gas concentration in an upstream cross section traversing the prevailing wind  
----> Flight in the morning -----  
C2; the gas concentration in a downstream cross section traversing the prevailing wind  
----> Flight in the afternoon ----  
U; the speed of the prevailing wind  
----> Aerological data -----  
S; area of the cross section.

The two flights were made in different days.  
----> Only the first purpose was attained.-----

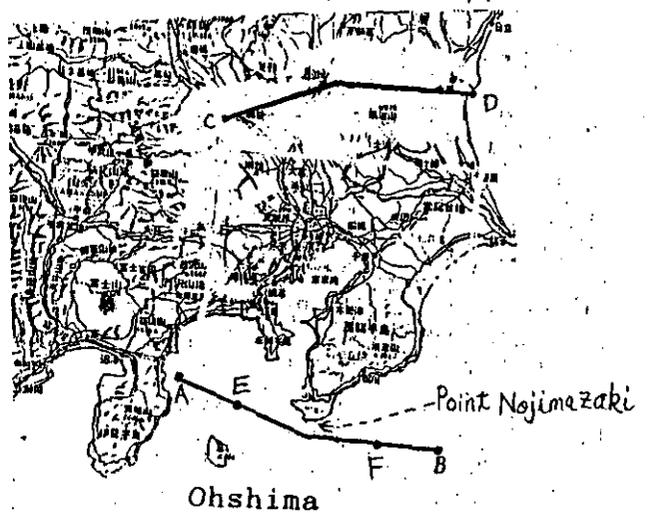
March 9 and 10, 1991

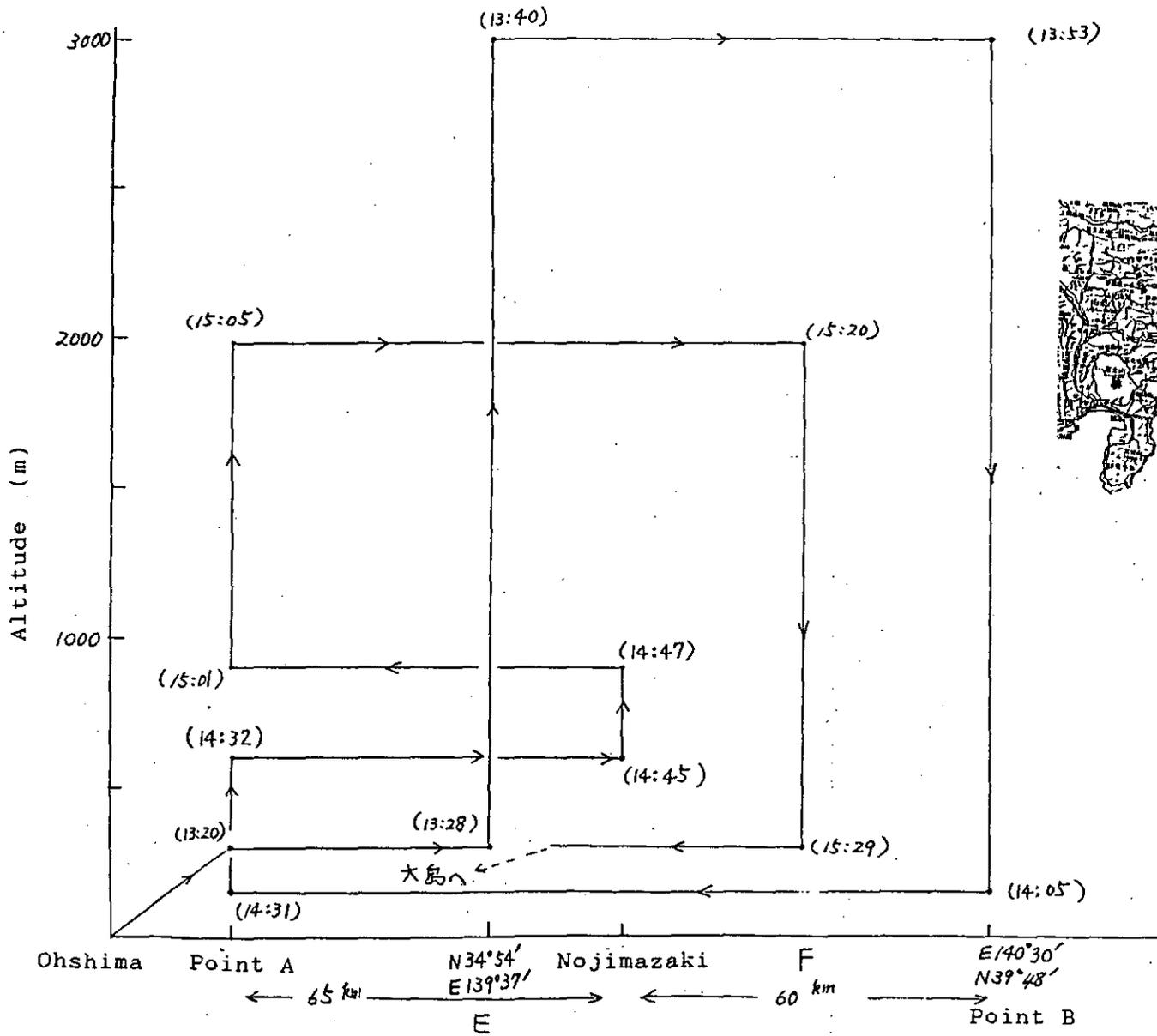
Typical surface wind patterns in the beginning of March and corresponding flight course.

(a) In the case of westerly prevailing winds (high pressure in the west of Japan and low pressure in the east)



(b) In the case of southern prevailing winds (high pressure in the south of Japan and low pressure in the north)





910309 (Sat.)  
 [関東地方南上空調査  
 のフライトコース]



Flight course on March 9 , 1991

Flight over the Kanto districts.

Planned days: one day of 7,8,9th of March in 1991

Aircraft: Cessna 404

Flight Levels: 150 - 3000m

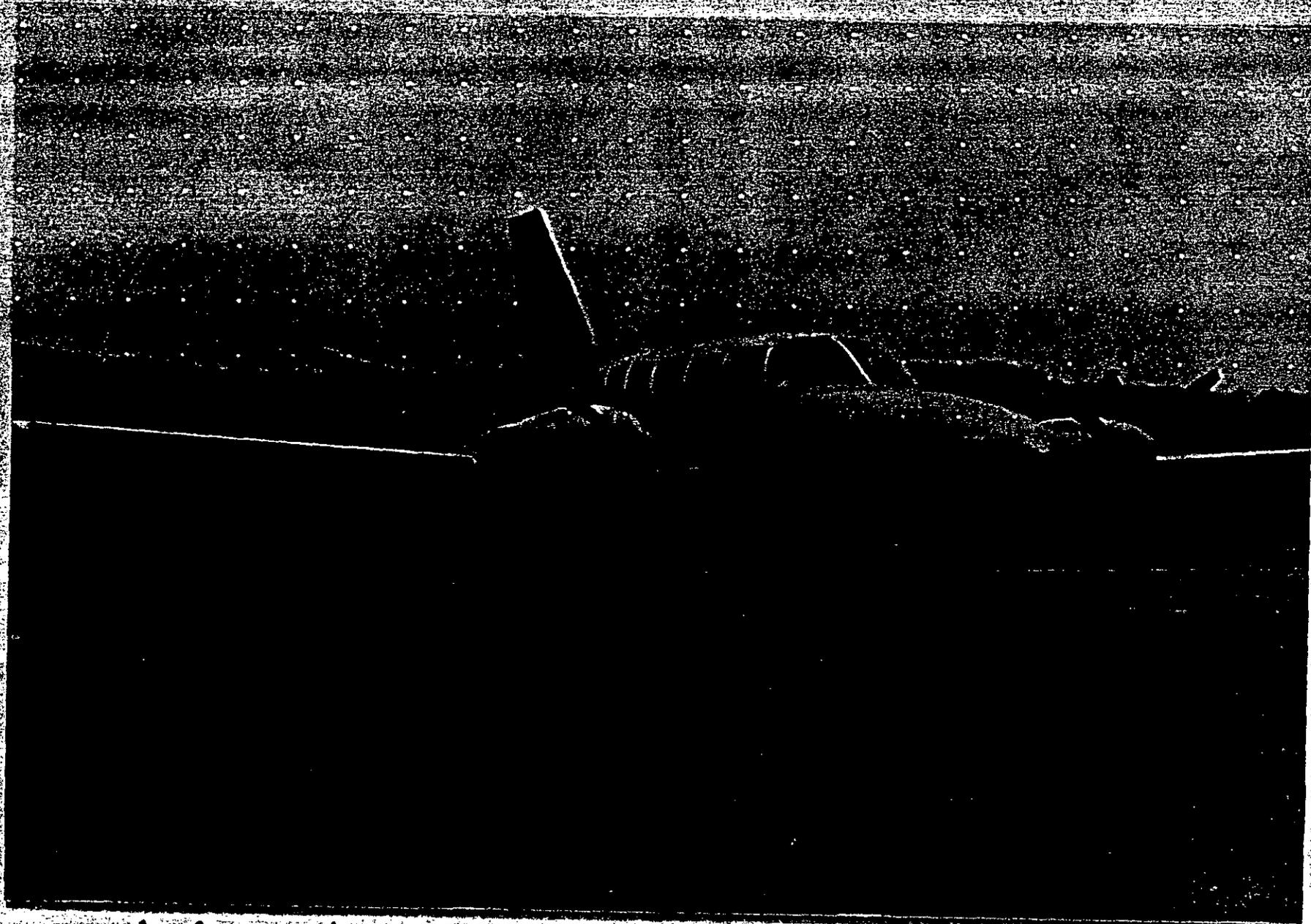
Executed days: March 9 & 10, 1991

Table 1. The apparatus loaded on Cessna 404

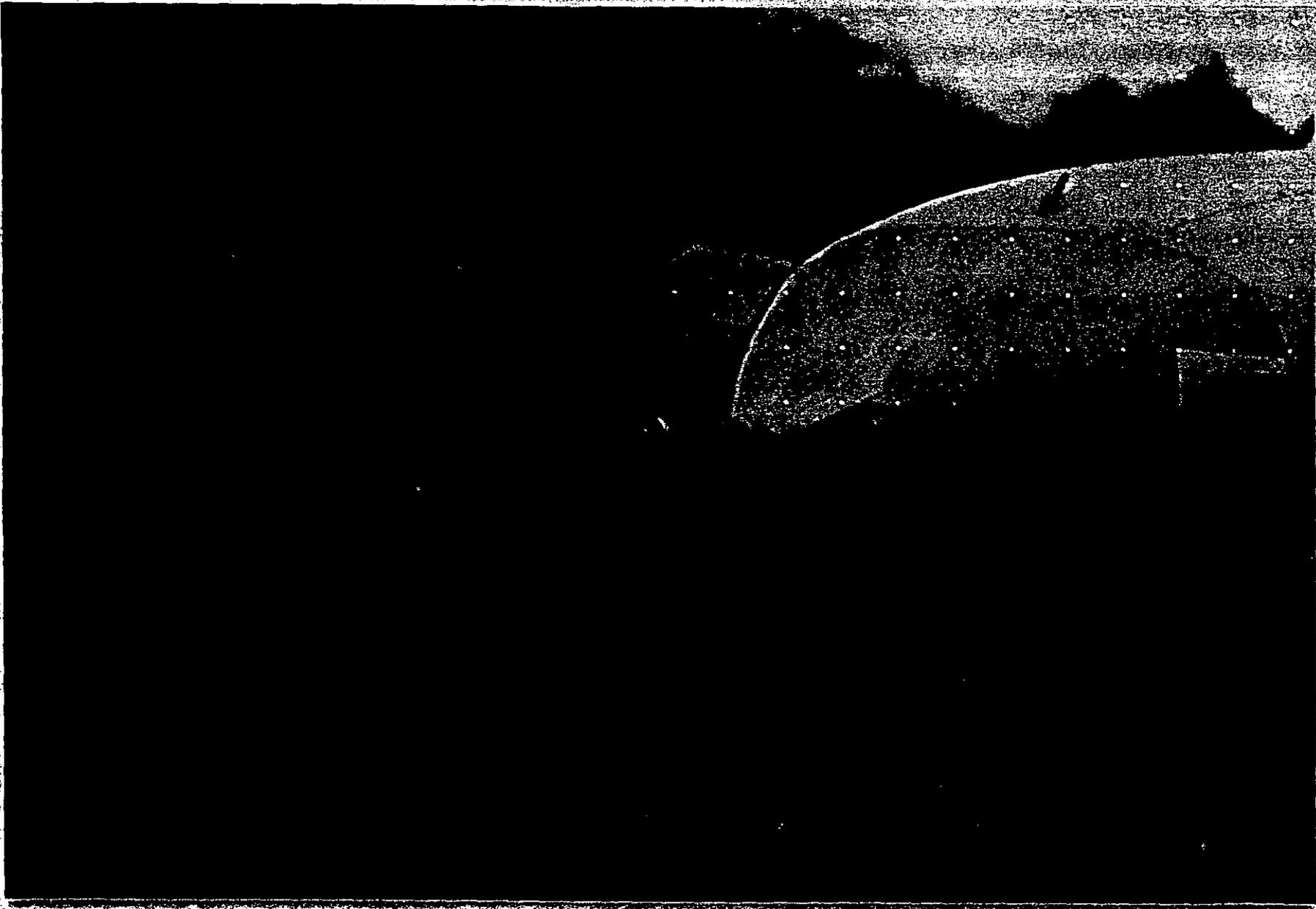
apparatus	number	manufacturer & type
X <u>NDIR-CO2 analyzer</u>	1	Shimadzu URA-207
high-precision barometer	1	Yokogawa Weathac F-452
metal bellows pump	1	Iwaki BA-330SN
<u>sampling canisters</u>	6x(8 sets)	Global Environmental Forum
personal computer	1	Epson 286 VG(backup battery)
cold trap	4	GEF (dry ice-ethanol)
Loran	1	
<u>thermometer/humidity</u>	1	Ogasawara Keiki

All tubing materials were sus 316 and glass.

— 169 —



*Airplane used in the observation : Cessna 404.*

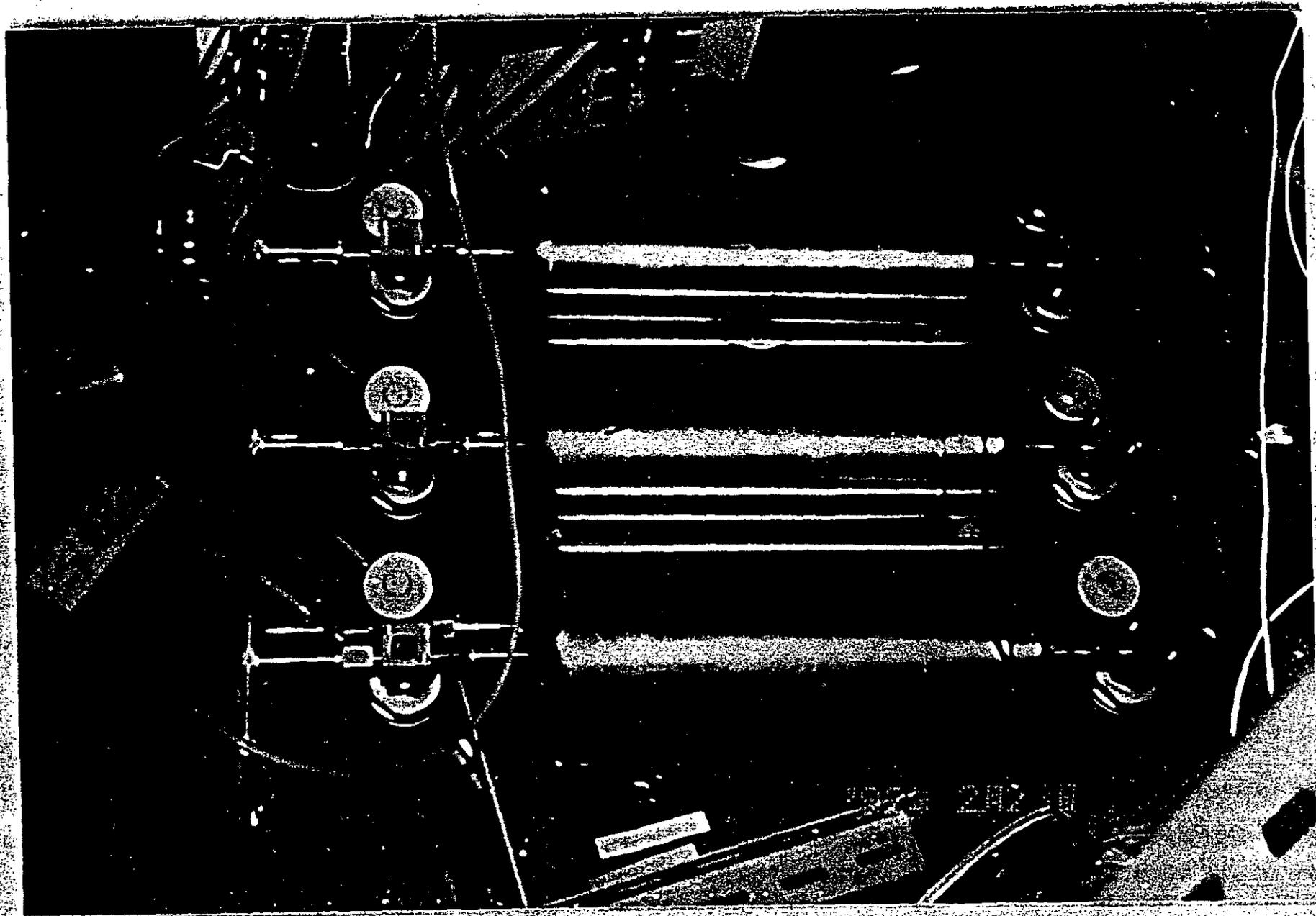


- 170 -

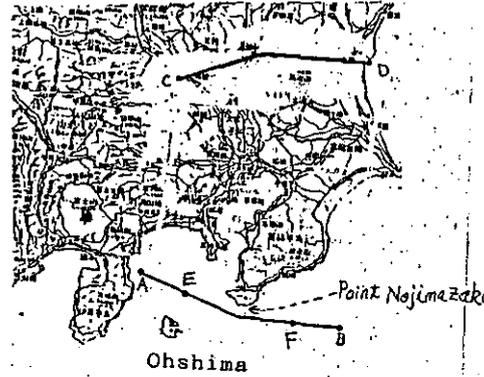
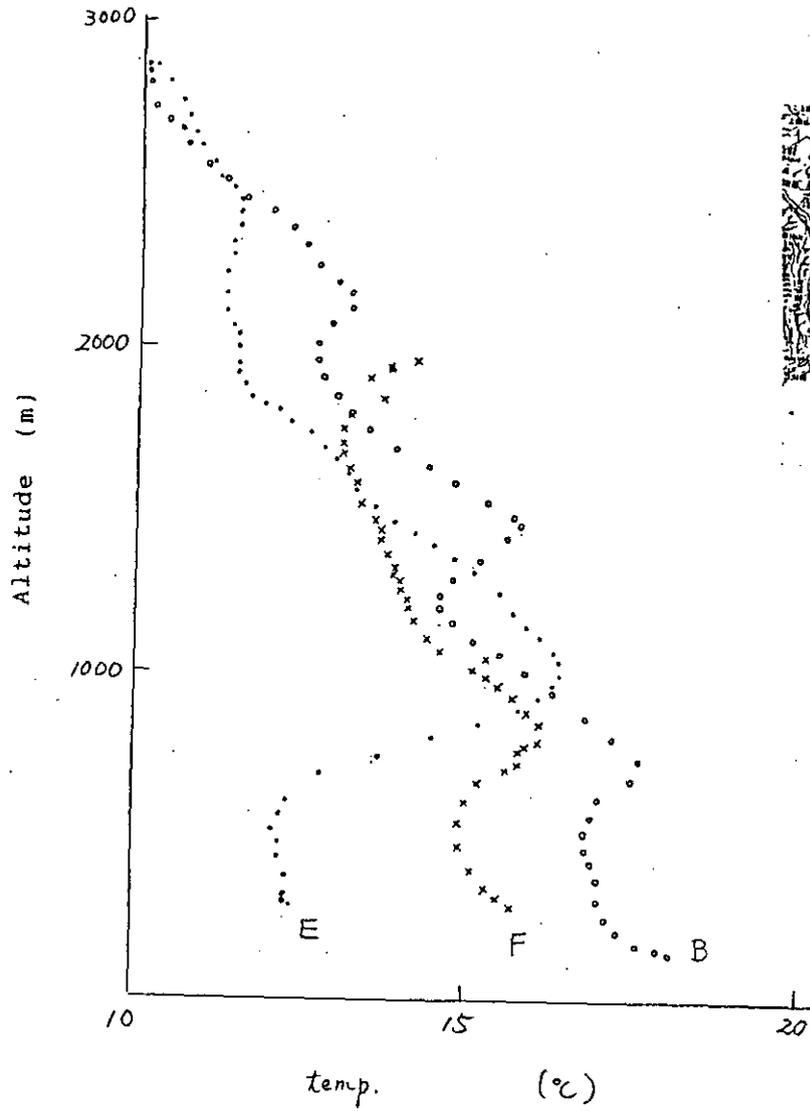
*Air intake*

12

-171-



Sampling canisters for the aircraft observation.



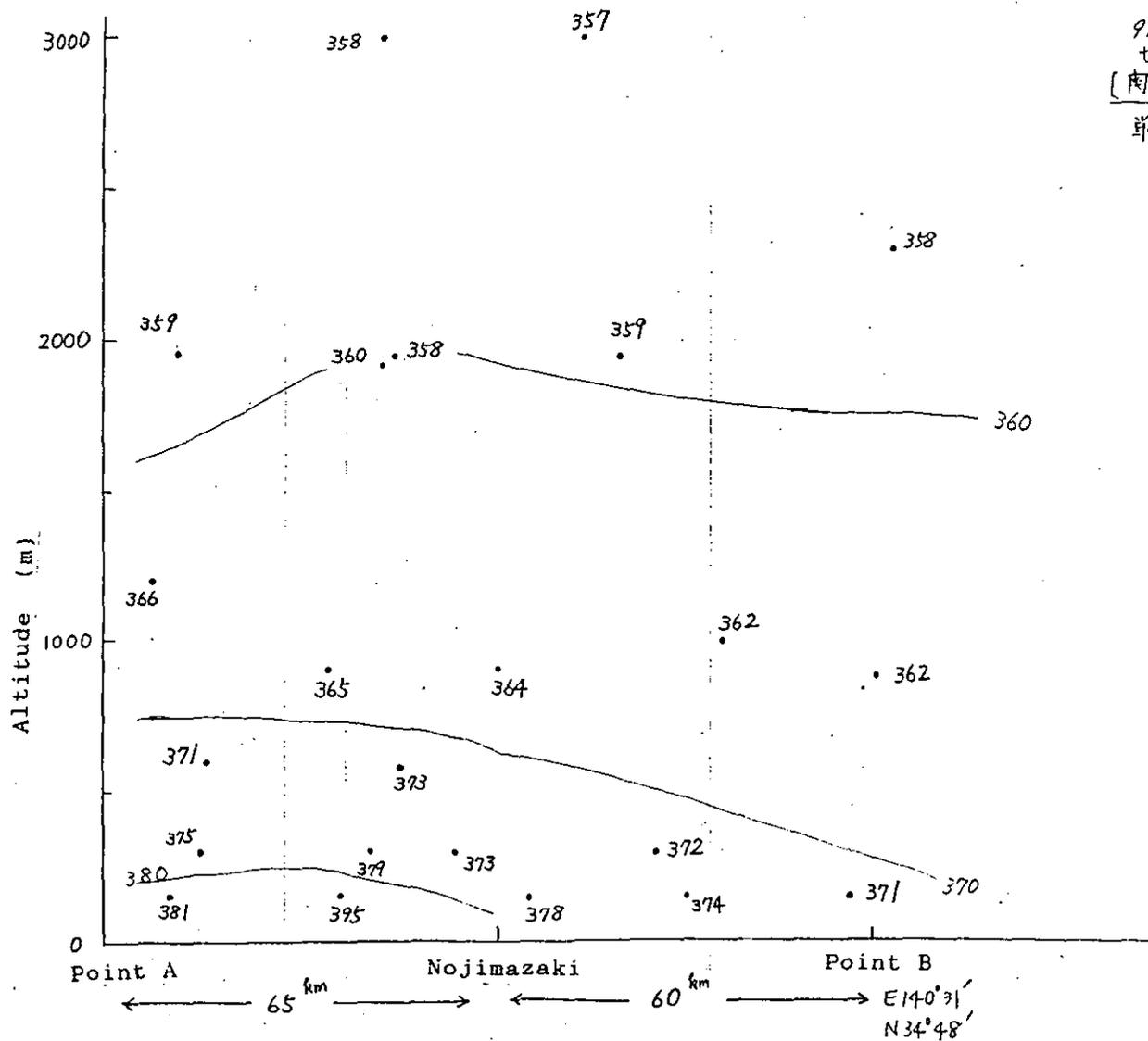
[ 910309 ]

13:40 の上昇  
( $N34^{\circ}54'$ ,  $E139^{\circ}37'$ )

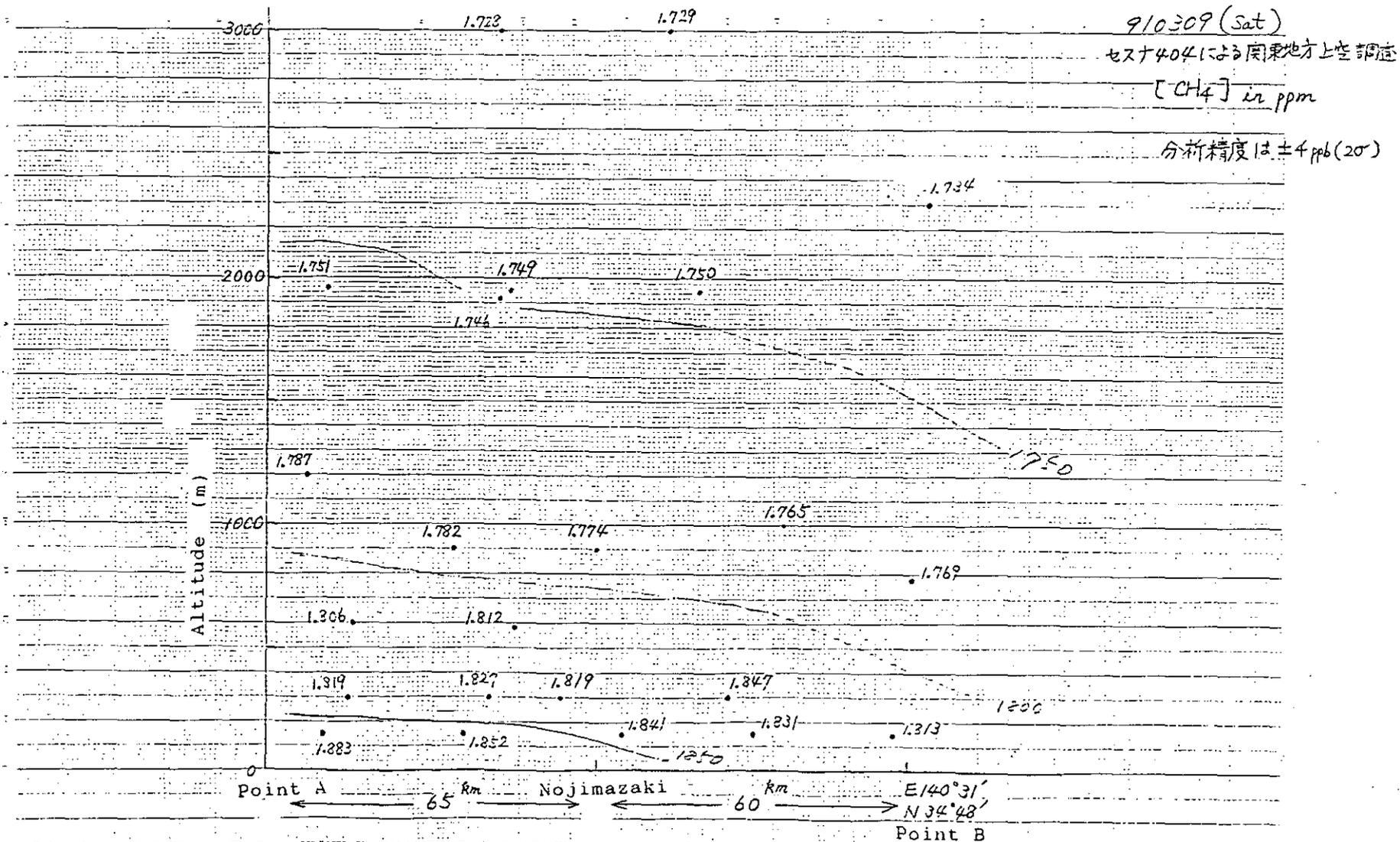
14:05 の下降  
( $E140^{\circ}30'$ ,  $N39^{\circ}48'$ )

15:29 の下降  
( $134^{\circ}51'$ ,  $140^{\circ}12'$ )

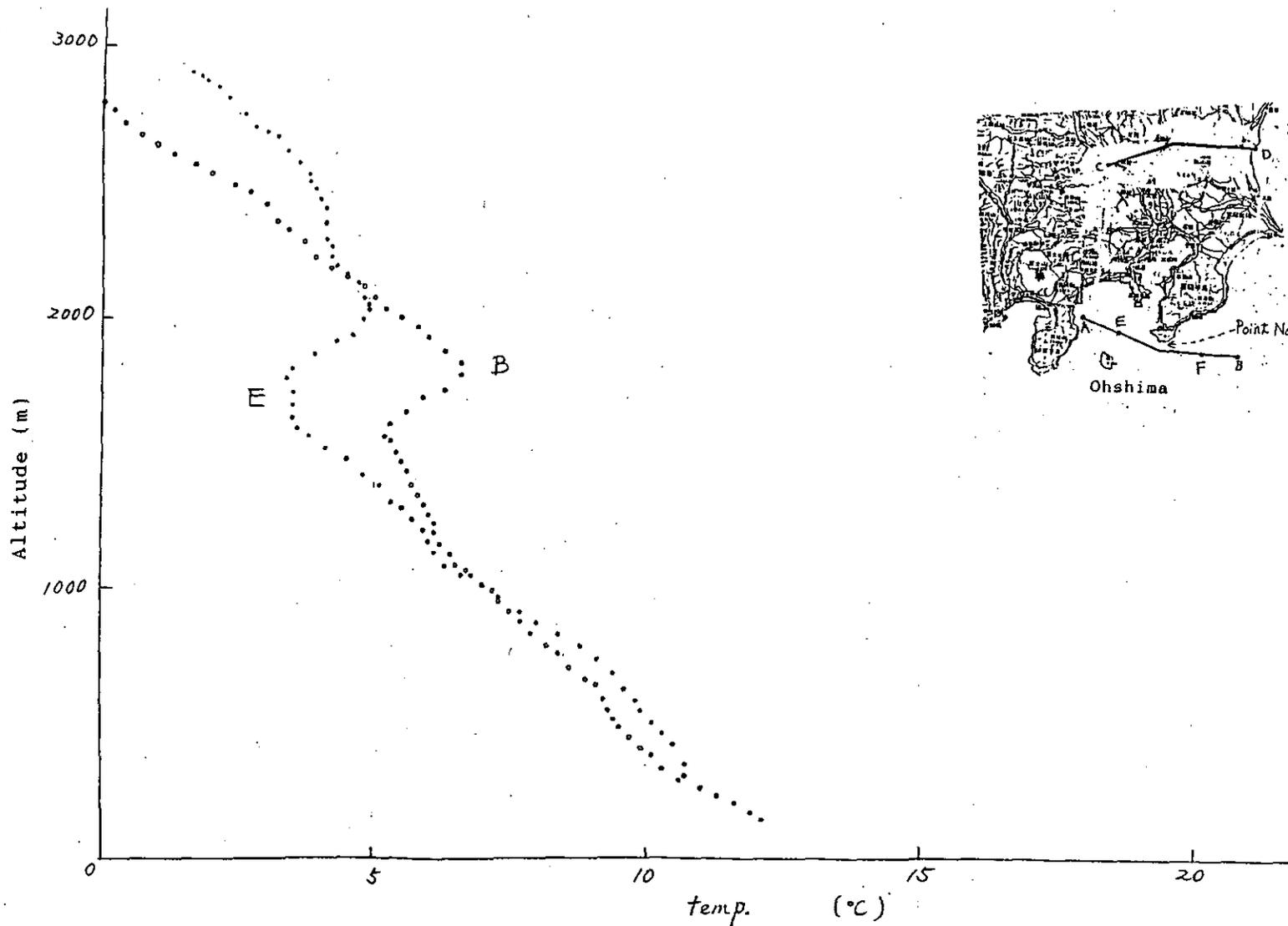
Vertical profiles of temperature (March 9)



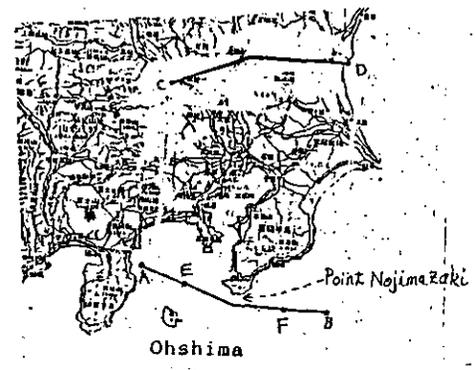
The concentration distribution of CO<sub>2</sub> over the south coast of the Kanto districts. (March 9, 1991)



The concentration distribution of CH<sub>4</sub> over the south coast of the Kanto districts. (March 9, 1991)

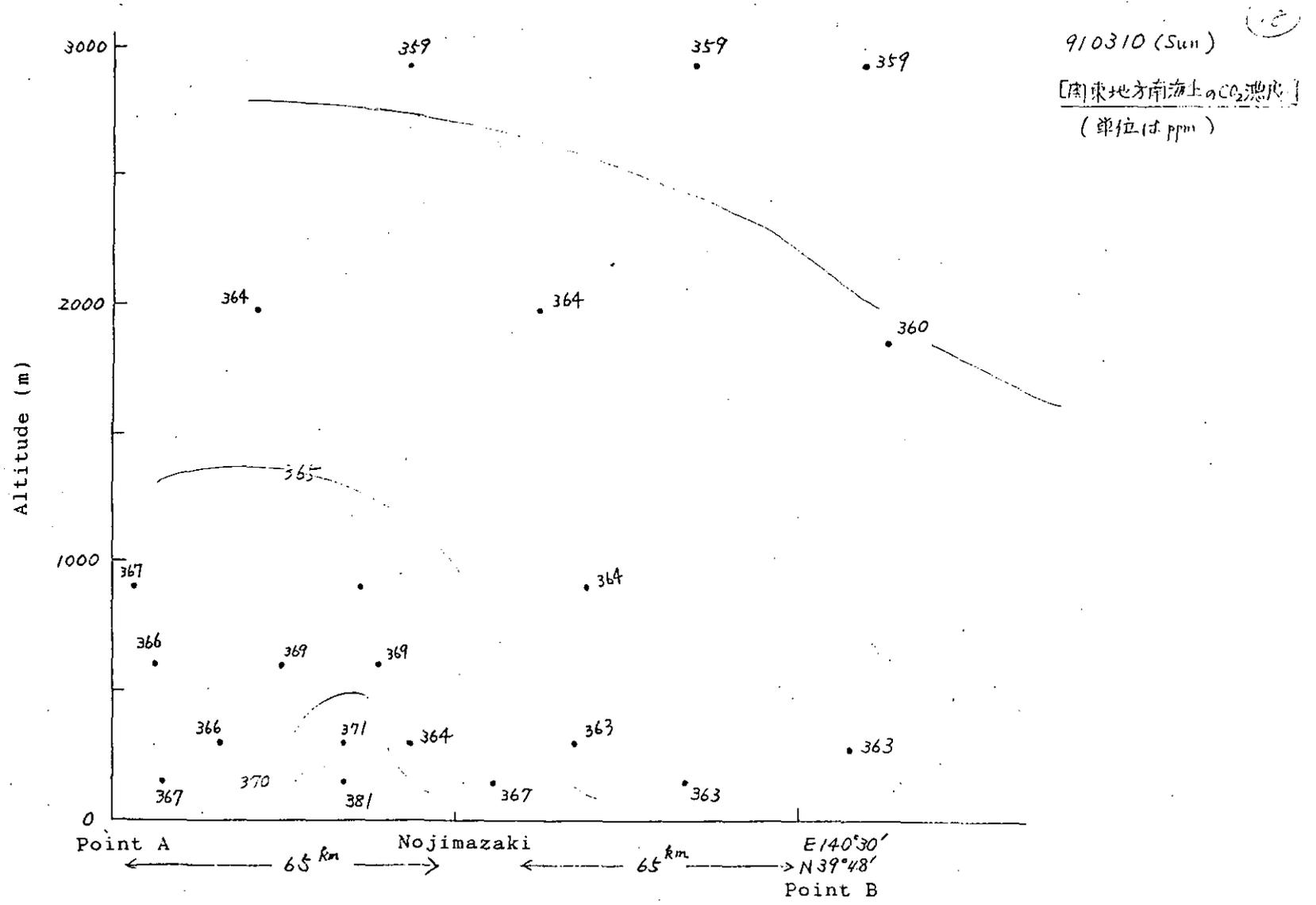


910310

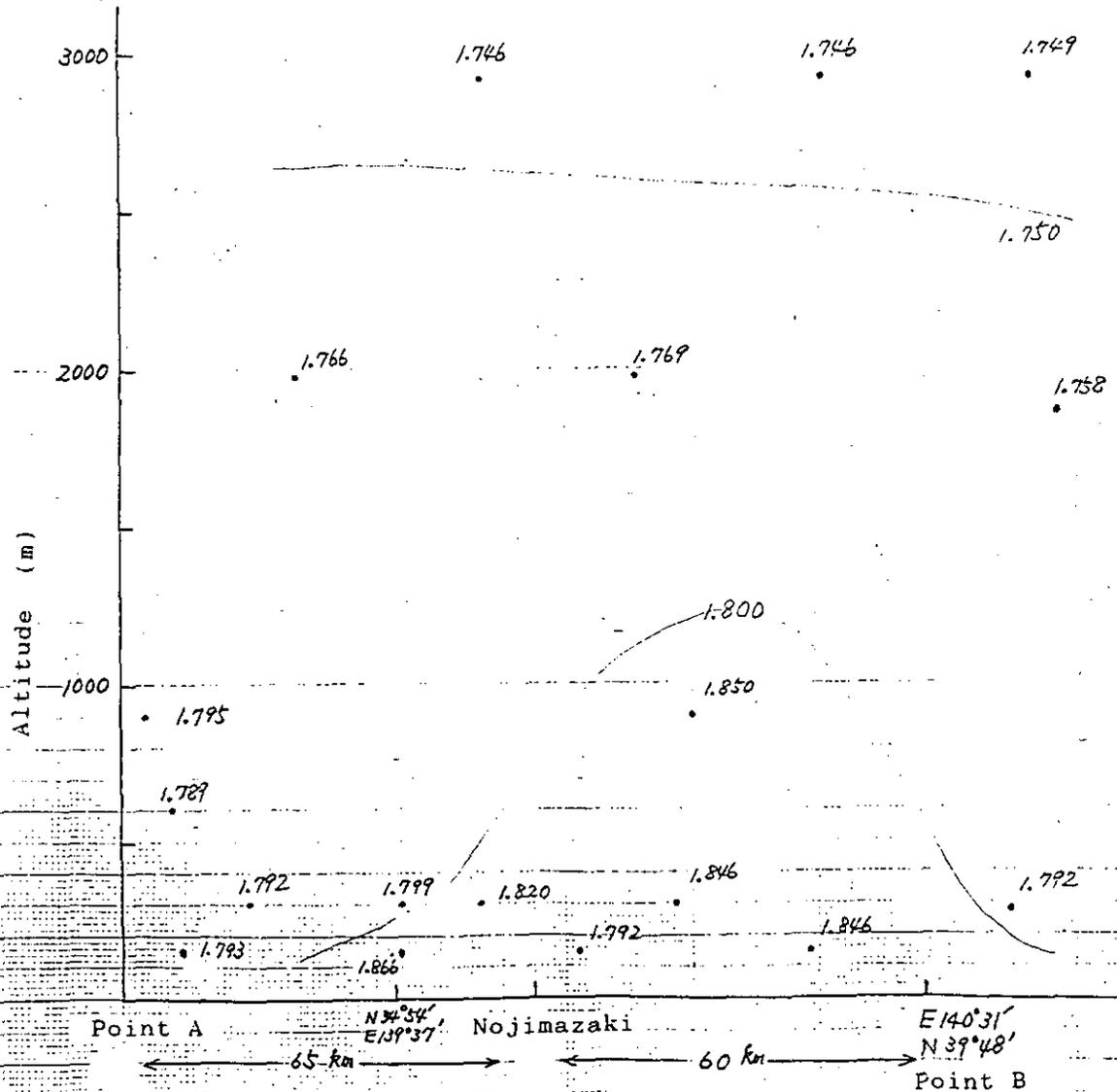


139° 37'  
140° 30'

Vertical profile of temperature (March 10)



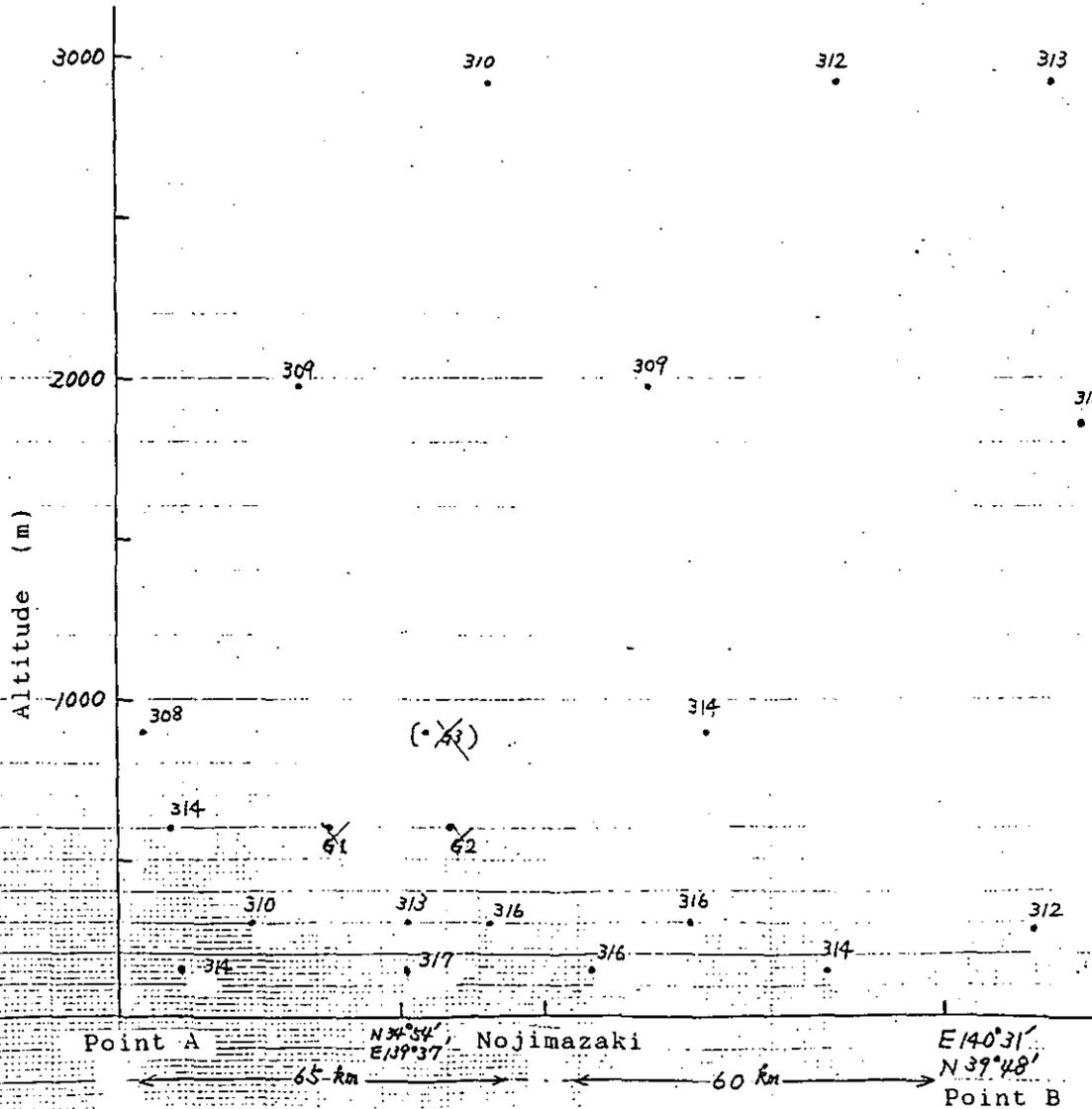
The concentration distribution of CO<sub>2</sub> over the south coast of the Kanto districts. (March 10, 1991)



910310(Sun)  
 セス+404による上空調査  
 [CH<sub>4</sub>] in ppm.  
 accuracy ± 4ppb (2σ)  
 (G3... サンプリングミス  
 G1, G2... サンプリング誤差  
 排除)

Point A  $\xleftarrow{65 \text{ km}}$   $\begin{matrix} N 34^{\circ} 54' \\ E 139^{\circ} 37' \end{matrix}$  Nojimazaki  $\xrightarrow{60 \text{ km}}$   $\begin{matrix} E 140^{\circ} 31' \\ N 39^{\circ} 48' \end{matrix}$  Point B

The concentration distribution of CH<sub>4</sub> over the south coast of the Kanto districts. (March 10, 1991)



910310(Sun)  
 セス+404による上空調査  
 [N<sub>2</sub>O] in ppb  
 accuracy ± 2 ppb (2σ)

( 93 ... サンプルミス  
 91, 92 ... サンプルエア  
 誤りて排気 )

Point A  $\xrightarrow{65 \text{ km}}$   $N 34^{\circ} 54'$  Nojimizaki  $E 140^{\circ} 31'$   
 $E 119^{\circ} 37'$   $N 39^{\circ} 48'$  Point B

The concentration distribution of N<sub>2</sub>O over the south coast of the Kanto districts. (March 10, 1991)