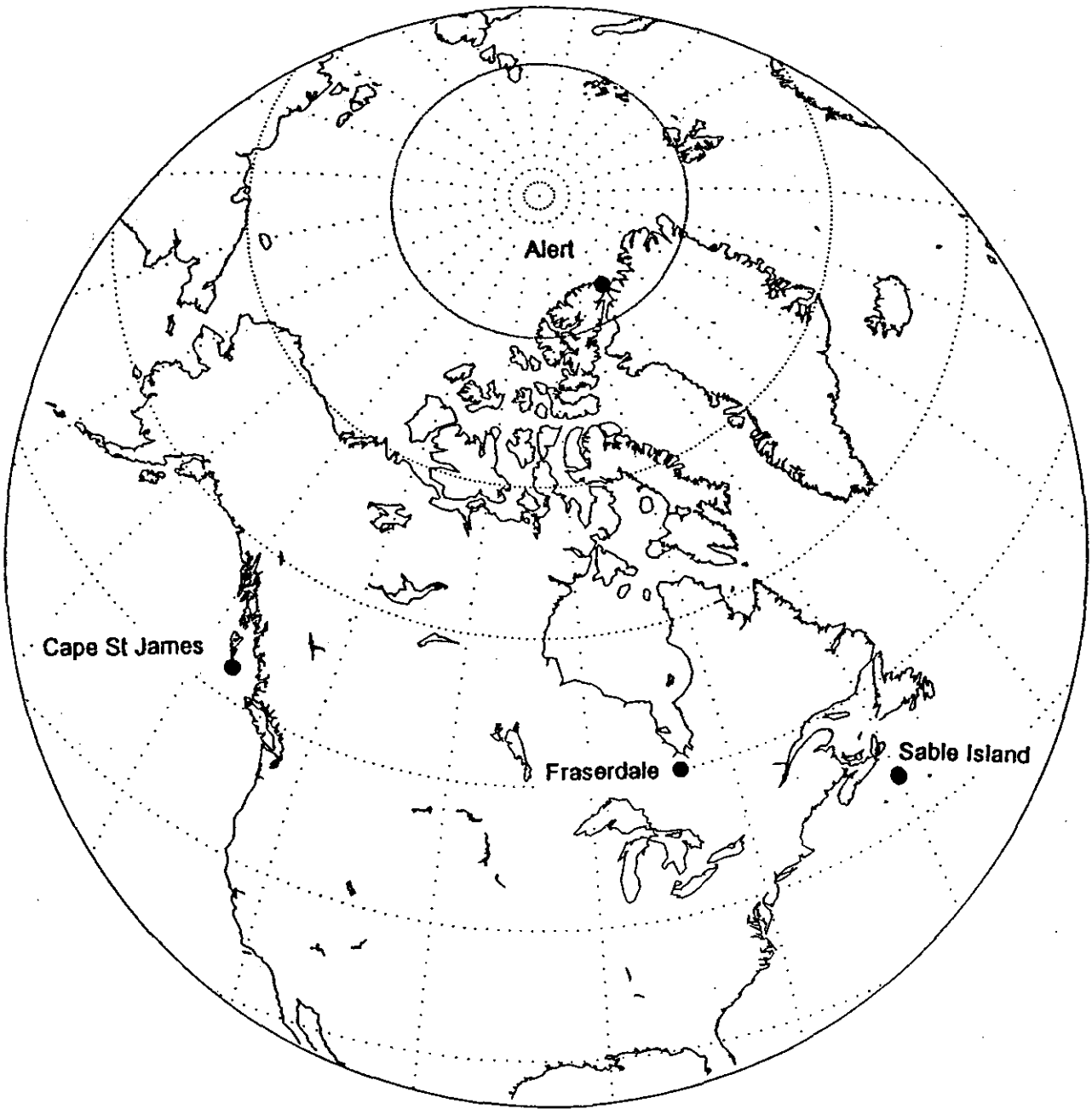
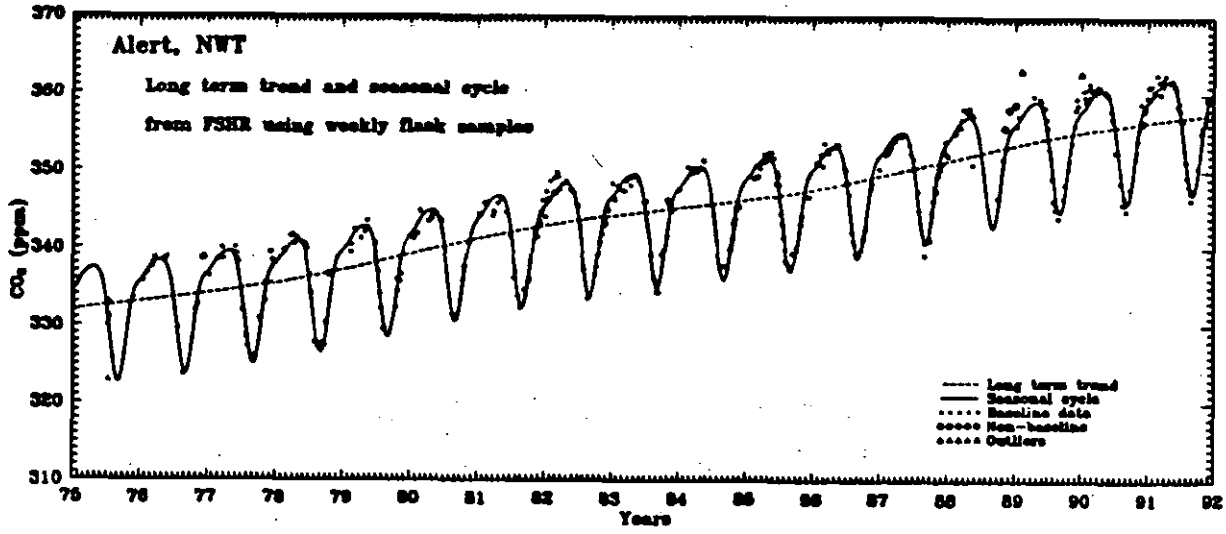
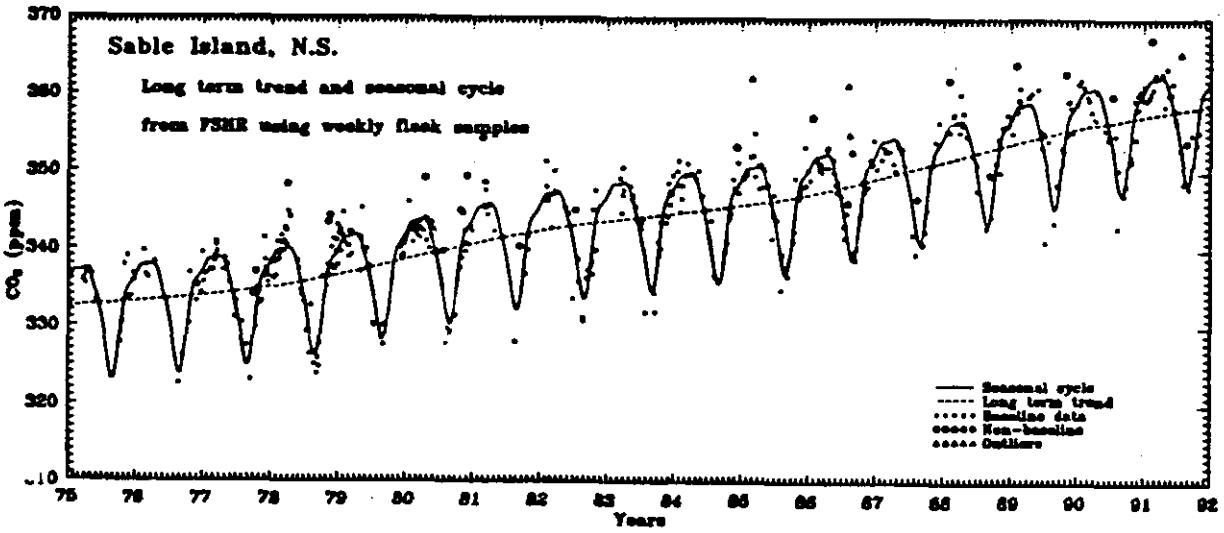
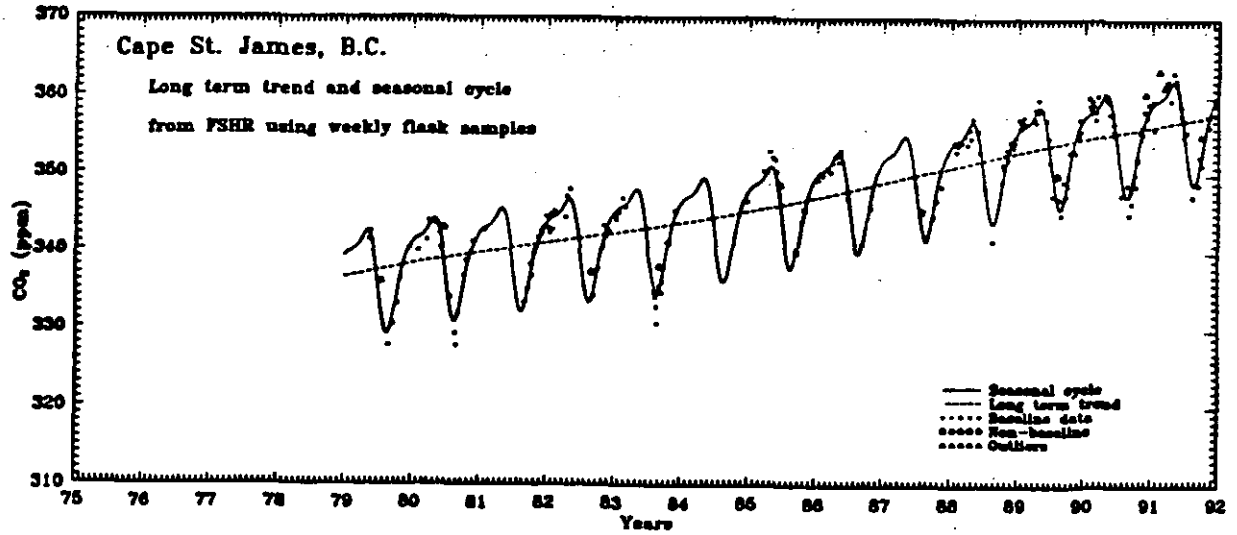
Canadian Baseline Program
Sampling Stations

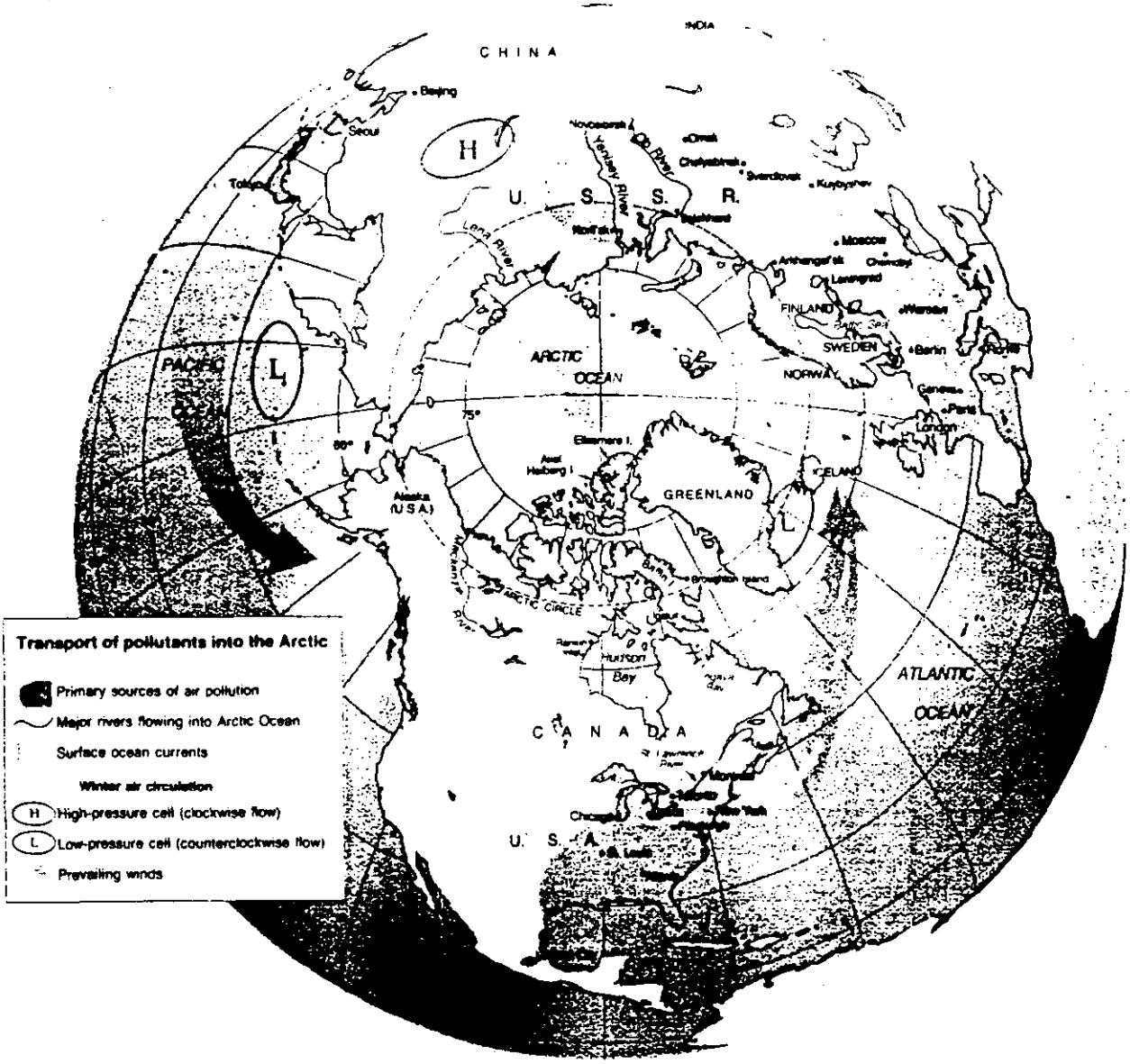


Dr. N. Trivett
Gas Standards Laboratory
RAGs Research Section
Canadian Baseline Programme


Alert, NWT
Long term trend and seasonal cycle
from FSHR using weekly flask samples
Long term trend
Seasonal cycle
Baseline data
Non-baseline
Outliers
Years


Sable Island, N.S.
Long term trend and seasonal cycle
from FSHR using weekly flask samples
Seasonal cycle
Long term trend
Baseline data
Non-baseline
Outliers
Years


Cape St. James, B.C.
Long term trend and seasonal cycle
from FSHR using weekly flask samples
Seasonal cycle
Long term trend
Baseline data
Non-baseline
Outliers
Years


Transport of pollutants into the Arctic
Primary sources of air pollution
Major rivers flowing into Arctic Ocean
Surface ocean currents
Winter air circulation
H High-pressure cell (clockwise flow)
L Low-pressure cell (counterclockwise flow)
Prevailing winds
CHINA
INDIA
Beijing
Seoul
Tokyo
U. S. S. R.
Yenisey River
Ob River
Lena River
Moscow
Leningrad
FINLAND
SWEDEN
NORWAY
Warsaw
Berlin
Geneva
Paris
London
ARCTIC OCEAN
PACIFIC OCEAN
Ellesmere I.
Axel Heiberg I.
GREENLAND
ICELAND
Alaska (USA)
ARCTIC CIRCLE
Hudson Bay
CANADA
U. S. A.
ATLANTIC OCEAN

MONITORING ACTIVITIES AT ALERT AS OF MARCH 1990
IN CHRONOLOGICAL ORDER

MEASUREMENT	RESPONSIBLE AGENCY	RESPONSIBLE INVESTIGATOR	BEGAN SAMPLING
CARBON DIOXIDE (weekly flask sample)	AES	Trivett/Wong	July 1975
AEROSOL CHEMISTRY (weekly integrated filter)	AES	Barrie	August 1979
CARBON DIOXIDE (weekly flask sample)	SIO	Keeling	June 1984
HALO-& HYDRO-CARBONS (weekly flask sample)	OGC	Rasmuseen	Jan. 1985
AITKEN NUCLEI AEROSOL SCATTERING SURFACE and BOUNDARY LAYER METEOROLOGY	AES	Trivett/Hopper	April 1985
CARBON DIOXIDE CARBON MONOXIDE METHANE (weekly flask sample)	NOAA	Dlugokencky/Steele	Jan. 1986

PAN & OZONE (continuous)	AES	Bottenheim	Dec. 1986
CARBON DIOXIDE (continuous)	AES	Trivett	Jan. 1987
METHANE (continuous)	AES	Trivett	Sept. 1987
^{14}C in CO_2 (weekly integrated sample)	UoH	Levin	Nov. 1987
CHLOROFLUOROCARBONS (weekly flask sample)	NOAA	Elkins	Jan. 1988
CARBON-13, CO_2, CO OXYGEN-18, CH_4 (monthly flask samples)	CSIRO	Francey	April 1988
LIGHT HYDROCARBONS (weekly flask samples)	IFC	Rudolph	April 1988
STRATOSPHERIC O_3 (Brewer, sondes)	AES	Wardle	August 1988
AEROSOL SOOT (continuous)	AES	Hopper/Trivett	March 1989
RADON (continuous)	UoH	Dorr	March 1989
OXYGEN MIXING RATIO/ ISOTOPES	NCAR	Keeling	Sept. 1989
$^{14}C/^{13}C$ in CH_4	UoH	Levin	Sept. 1990

MEASUREMENT PROGRAM

The basic measurement program (Table 1) for which the laboratory is responsible includes the aerosol measurements of condensation nucleus, aerosol back scatter and black carbon and gases such as carbon dioxide, methane, ozone, PAN, and radon.

Additional programs are under development for freons and nitrous oxide.

As well as the continuous measurement program the laboratory operates its own flask programs for carbon dioxide and methane.

Cooperative programs have been established for trace gases such as methane, freons, nitrous oxide, ^{14}C and ^{13}C, and hydrocarbons.

QA/QC DATA REDUCTION

A) MEASUREMENTS

(a) Alert - 5 megabytes/week - 2 day

(b) Fraserdale - 8 megabytes/week - 1 day

B) DATA COLLECTION

C) DAILY QUALITY CONTROL

D) DATA REDUCTION

(a) Weekly Files

(b) Weekly Parameter Files

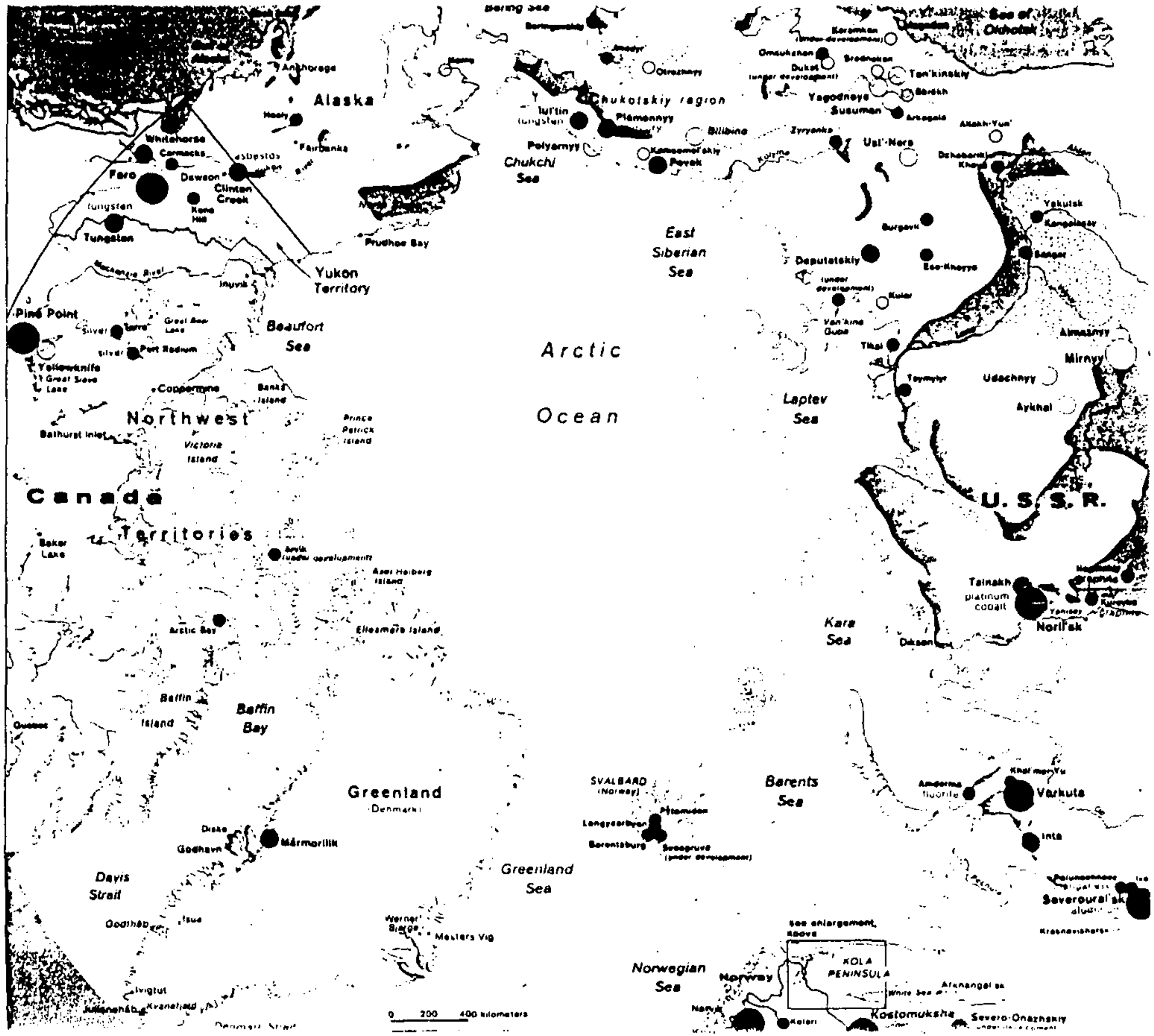
- manual flagging

(c) Daily Files - outlier analysis

(d) Hourly and Daily Data Sets

(e) Monthly Files of Hourly Data

E) TRAJECTORY ANALYSIS (CMC)

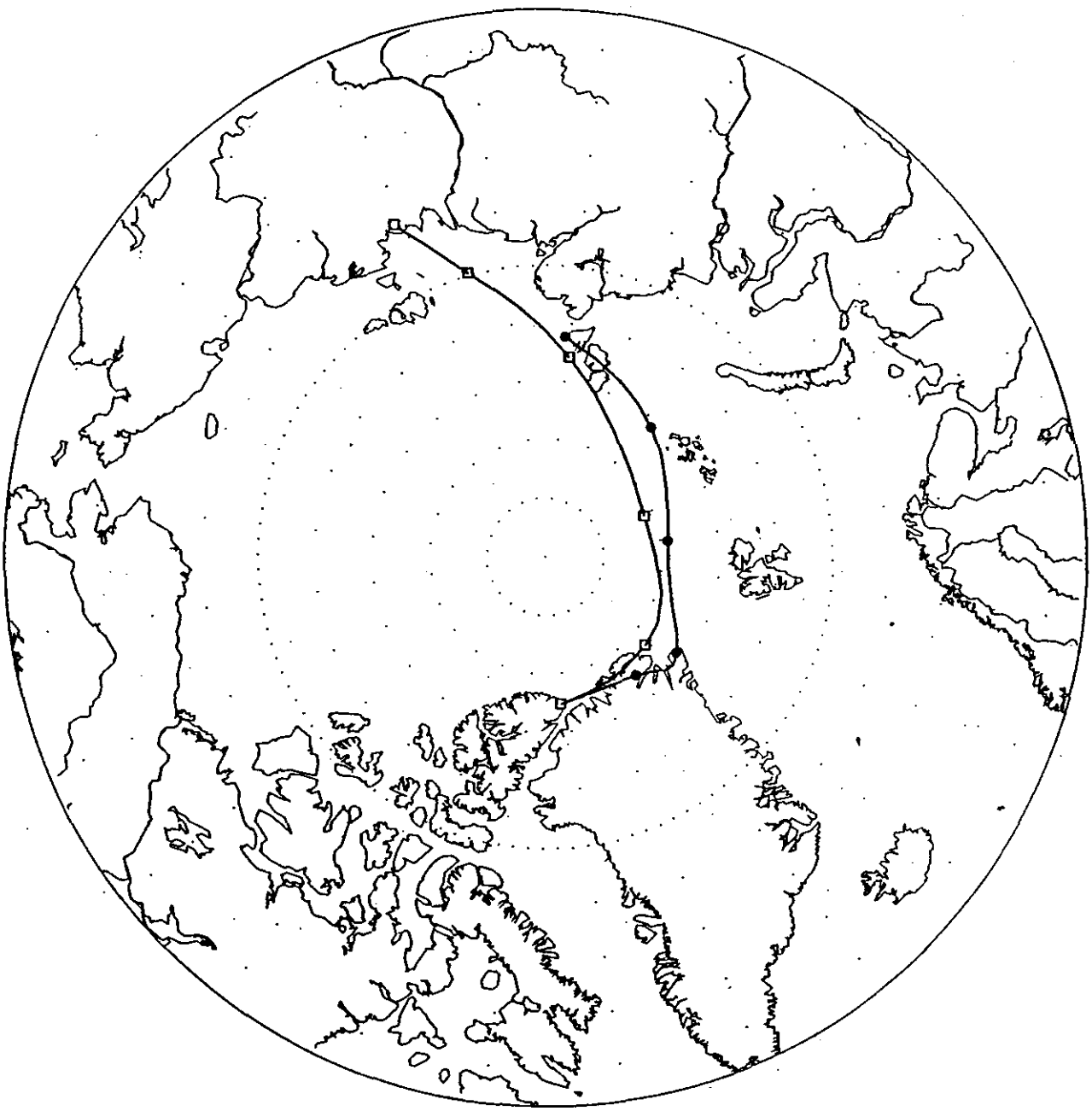

Alaska
Anchorage
Fairbanks
Prudhoe Bay
Whitehorse
Carmacks
Faro
Dawson
Clinton Creek
Tungsten
Yukon Territory
Inuvik
Pine Point
Yellowknife
Great Slave Lake
Port Radium
Great Bear Lake
Coppermine
Banks Island
Beaufort Sea
Northwest
Bathurst Inlet
Victoria Island
Prince Patrick Island
Canada
Territories
Baker Lake
Arctic Bay
Ellesmere Island
Baffin Island
Baffin Bay
Greenland
(Denmark)
Disko
Godhavn
Mármorilik
Davis Strait
Godthåb
Ivigtut
Greenland Sea
Werner Bjerge
Mesters Vig
Bering Sea
Chukotskiy region
Chukchi Sea
Bilibino
Polyarnyy
Pevek
East Siberian Sea
Sea of Okhotsk
Omsukchan
Yagodnoye
Susuman
Ust'-Nera
Deputatskiy
Tiksi
Laptev Sea
Yakutsk
Aikhal
Udachnyy
Mirnyy
U.S.S.R.
Talnakh
platinum
cobalt
Noril'sk
Kara Sea
Dikson
Arctic
Ocean
SVALBARD
(Norway)
Barentsburg
Barents Sea
Amderma
fluorite
Vorkuta
Inta
Norwegian Sea
Norway
KOLA PENINSULA
see enlargement, above
Kostomuksha
Arkhangel'sk
0 200 400 kilometers

5 Day Back-Trajectories

Nov. 23, 1990 00(Z)

ALERT

925 mb
850 mb

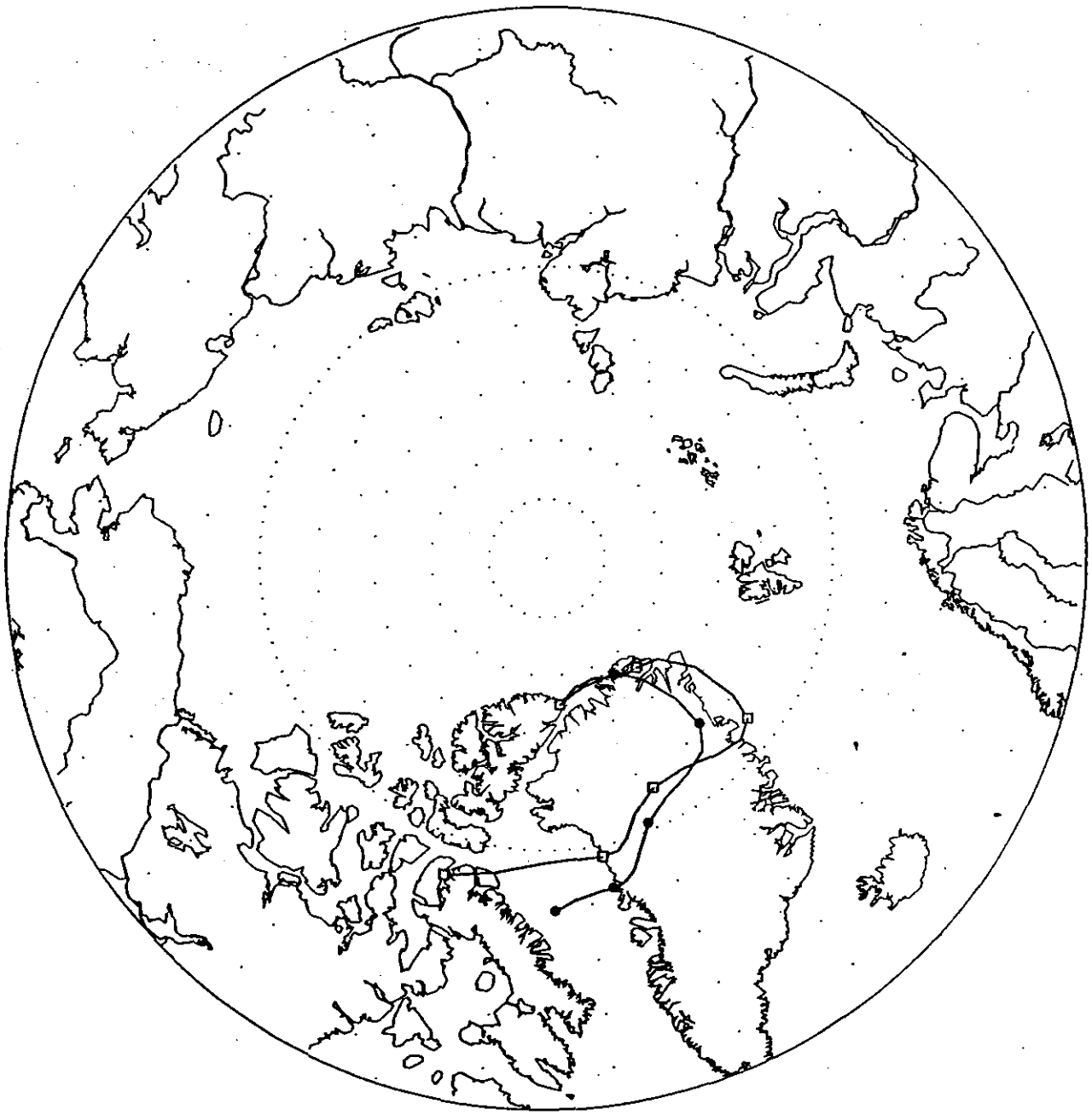


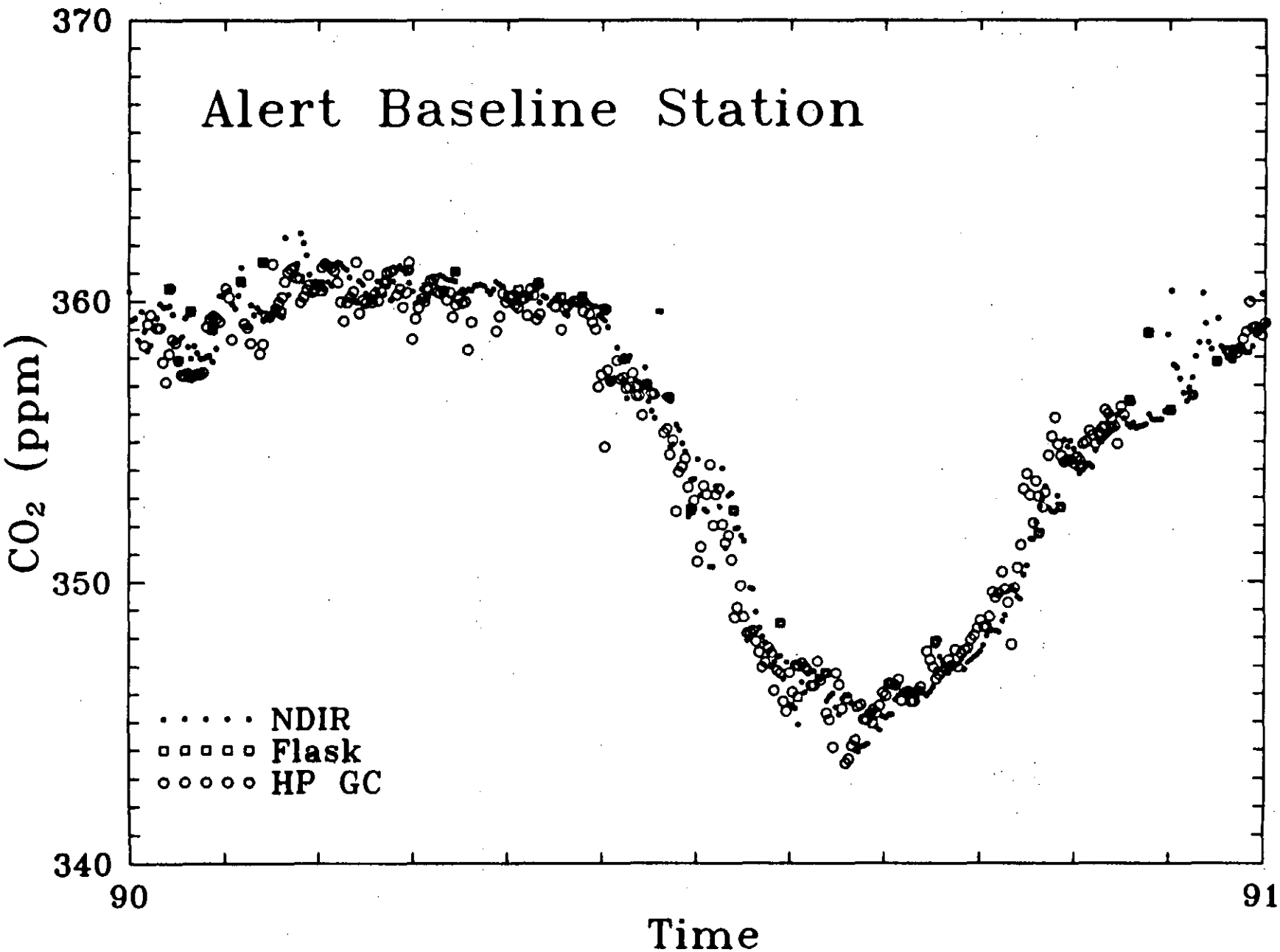
5 Day Back-Trajectories

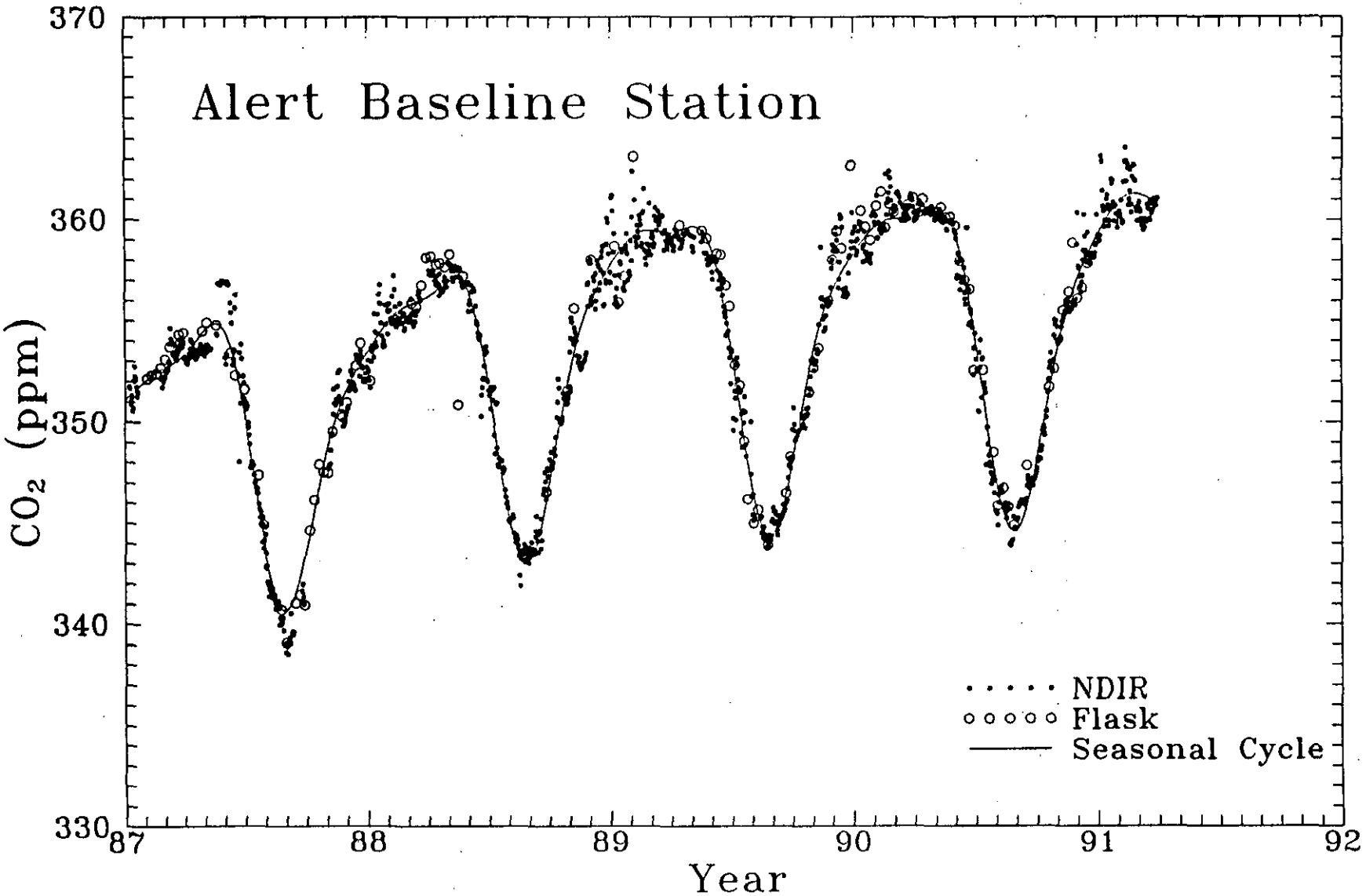
Dec. 1, 1990 06(Z)

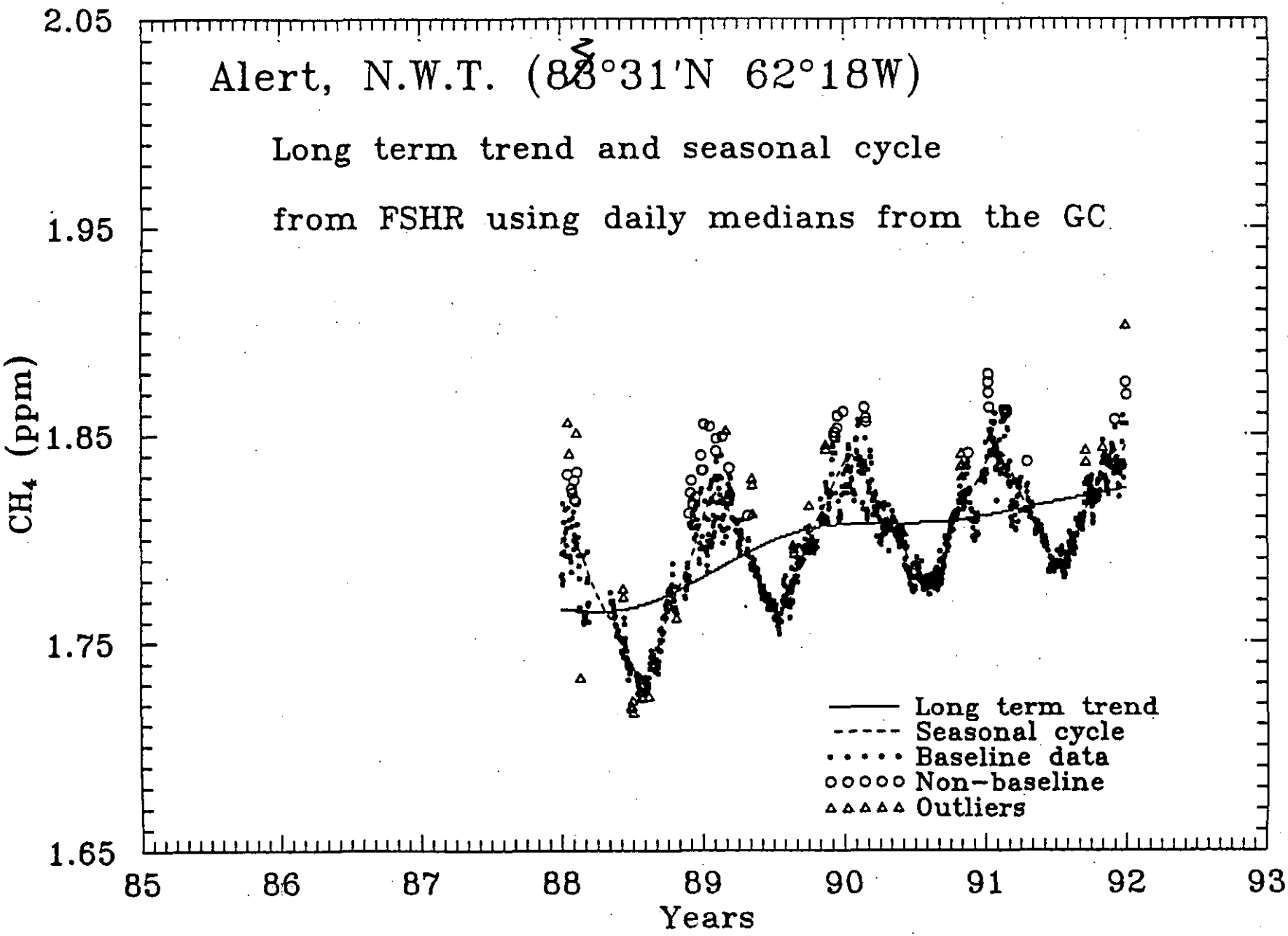
ALERT

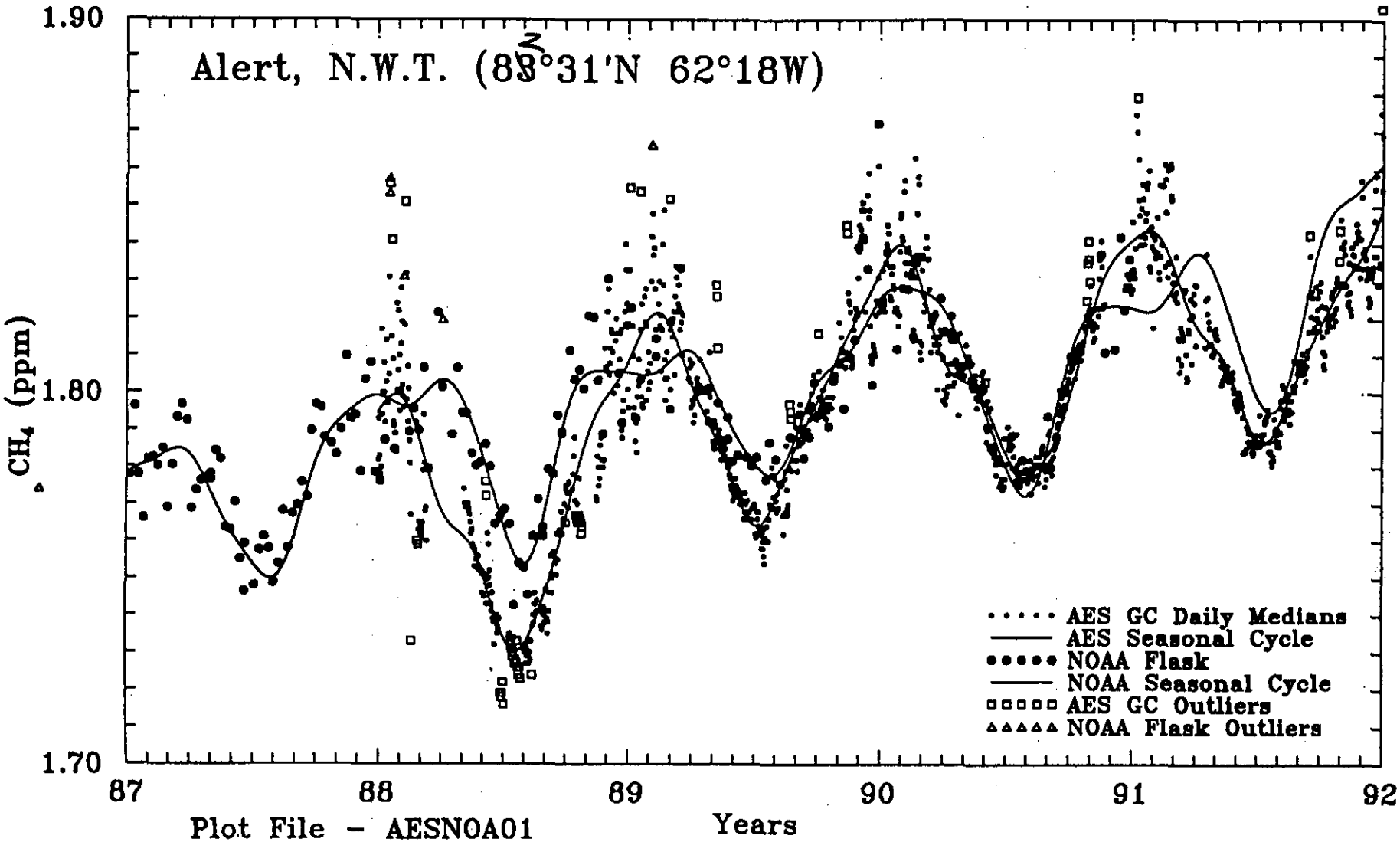
925 mb
850 mb

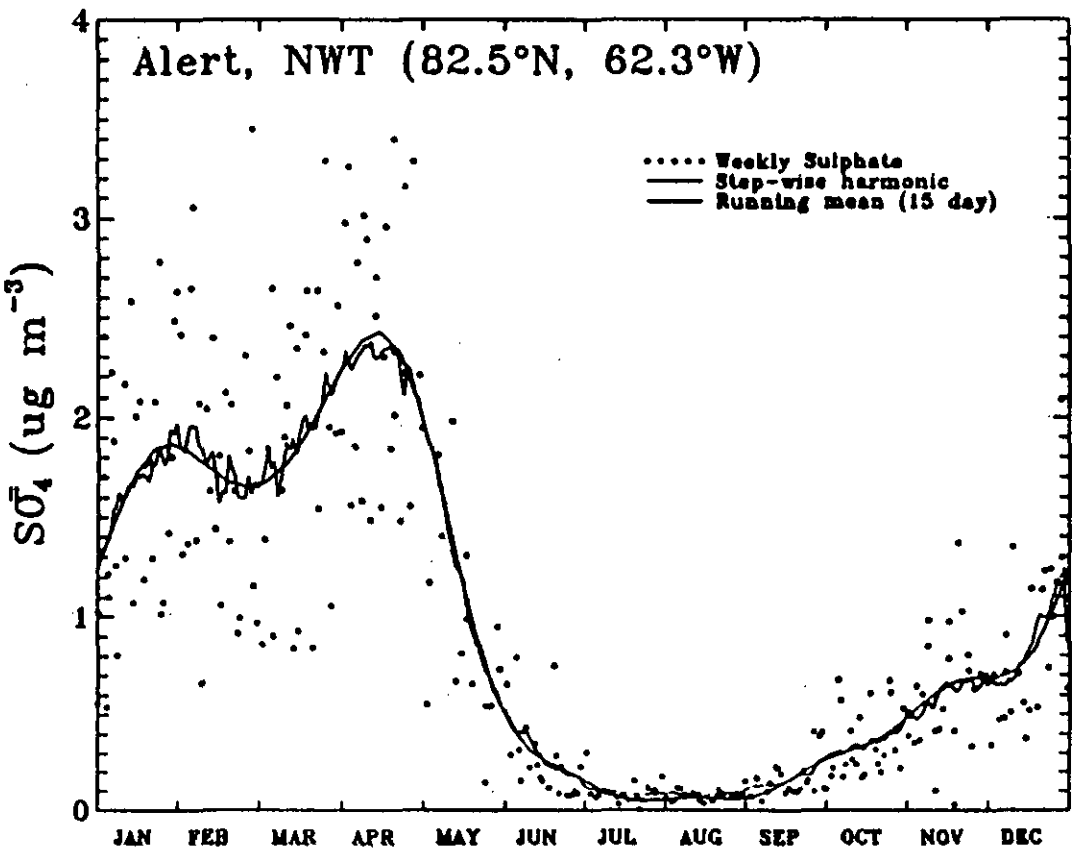


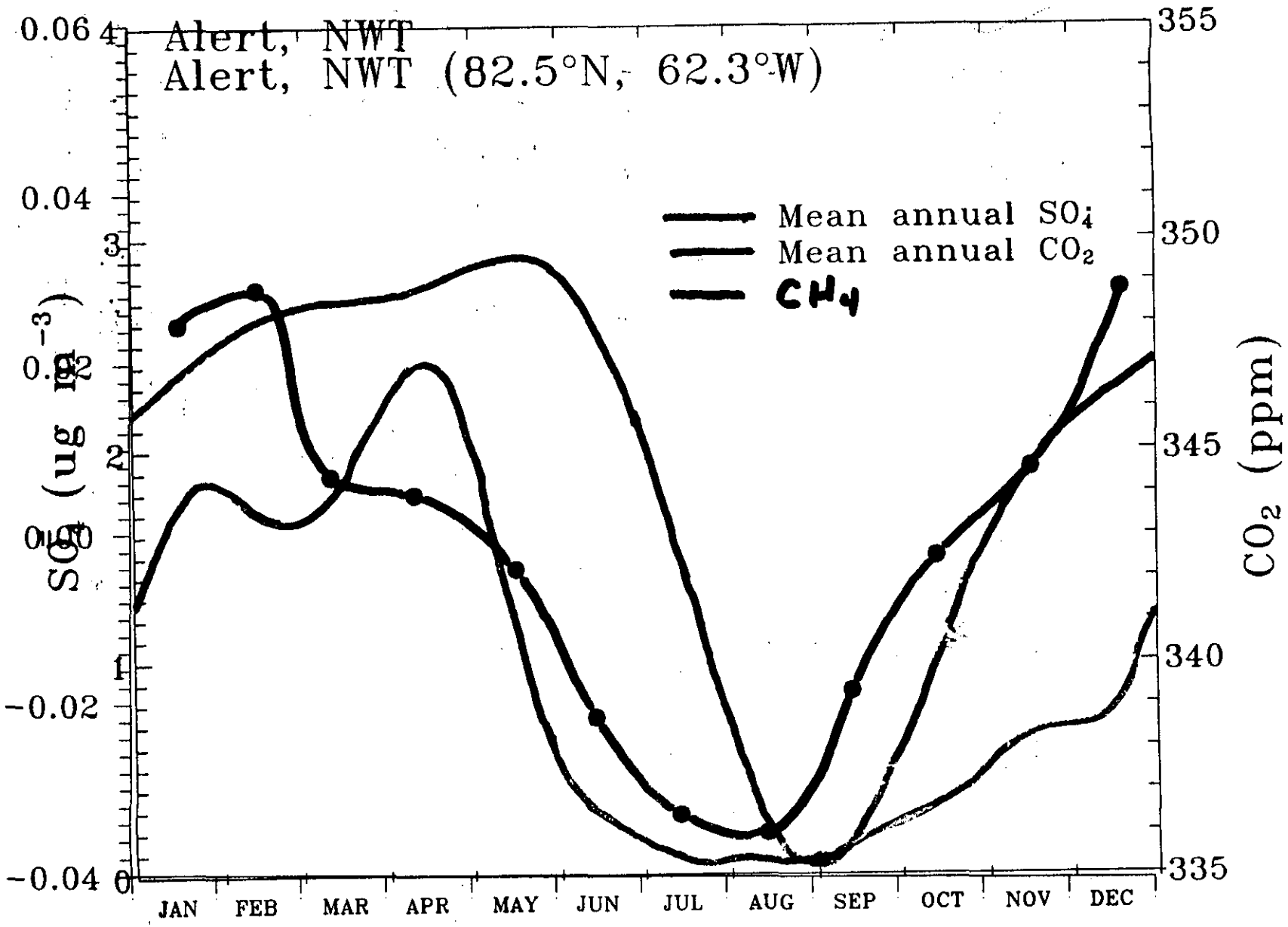

Alert Baseline Station
370
360
350
340
90
91
Time
CO_2 (ppm)
NDIR
Flask
HP GC

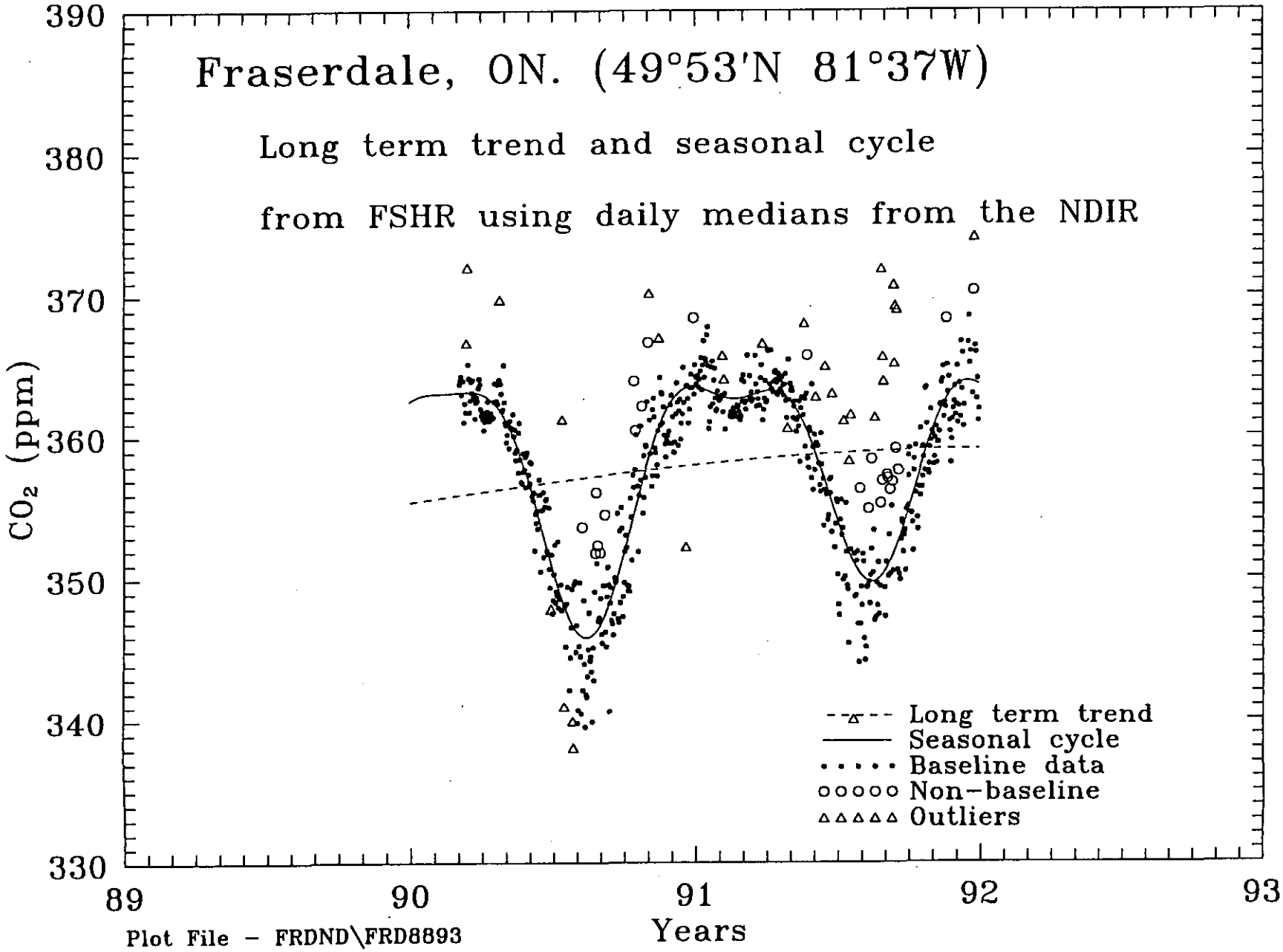

Alert Baseline Station
370
360
350
340
330
87
88
89
90
91
92
Year
CO_2 (ppm)
NDIR
Flask
Seasonal Cycle

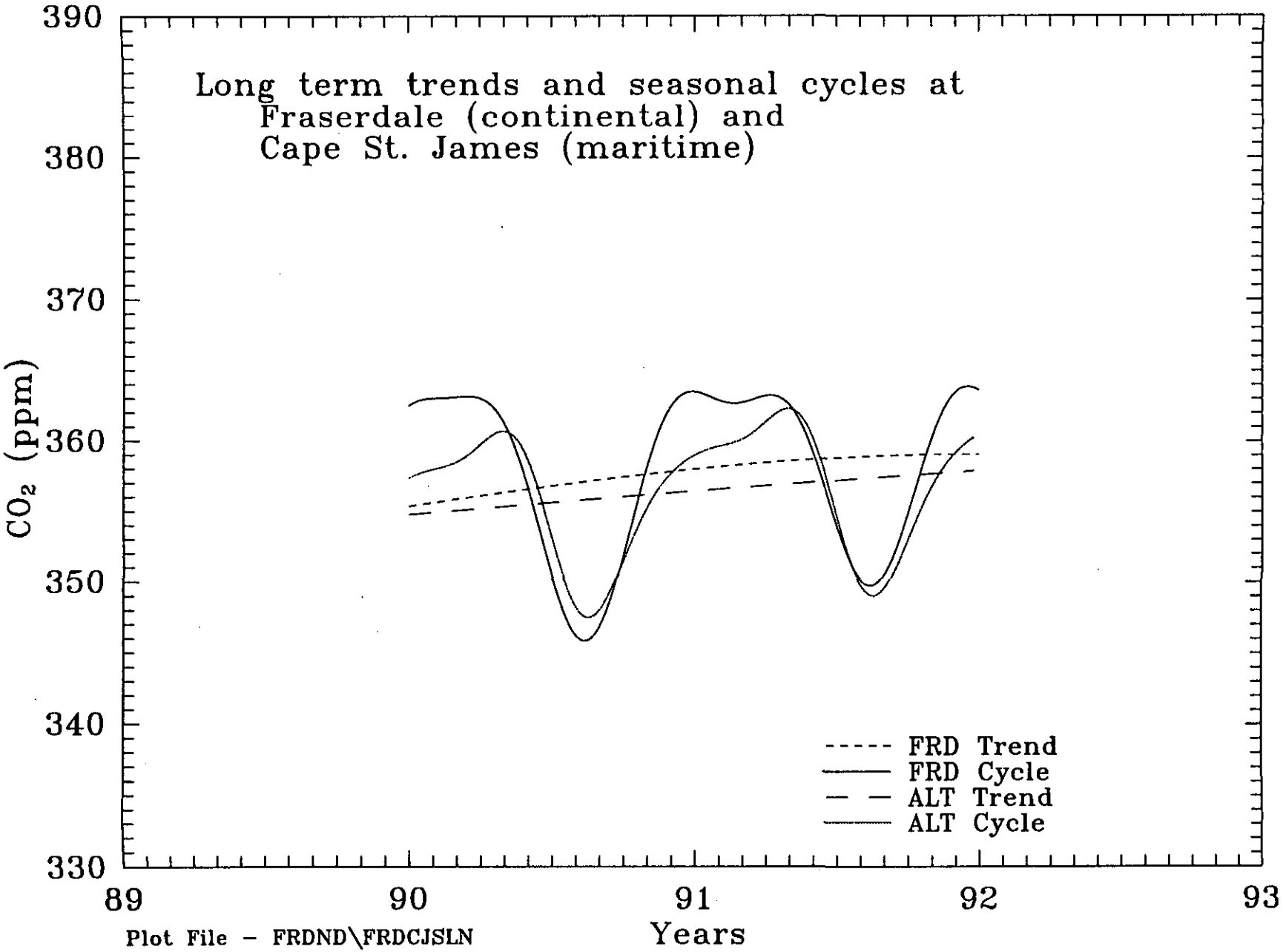

Alert, N.W.T. (82°31'N 62°18W)
Long term trend and seasonal cycle
from FSHR using daily medians from the GC
CH4 (ppm)
2.05
1.95
1.85
1.75
1.65
85
86
87
88
89
90
91
92
93
Years
Long term trend
Seasonal cycle
Baseline data
Non-baseline
Outliers


Alert, N.W.T. (82°31'N 62°18W)
1.90
1.80
1.70
CH4 (ppm)
87
88
89
90
91
92
Years
Plot File - AESNOA01
AES GC Daily Medians
AES Seasonal Cycle
NOAA Flask
NOAA Seasonal Cycle
AES GC Outliers
NOAA Flask Outliers


Alert, NWT (82.5°N, 62.3°W)
Weekly Sulphate
Step-wise harmonic
Running mean (15 day)
$SO_4^=$ (ug m^{-3})
0
1
2
3
4
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


Alert, NWT
Alert, NWT (82.5°N, 62.3°W)
Mean annual SO_4
Mean annual CO_2
CH_4
CH_4
SO_4 (ug m^{-3})
CO_2 (ppm)
0.06
0.04
0.02
0.00
−0.02
−0.04
4
3
2
1
0
355
350
345
340
335
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


Fraserdale, ON. (49°53'N 81°37W)
Long term trend and seasonal cycle
from FSHR using daily medians from the NDIR
390
380
370
360
350
340
330
CO_2 (ppm)
89
90
91
92
93
Years
Long term trend
Seasonal cycle
Baseline data
Non-baseline
Outliers
Plot File - FRDND\FRD8893


Long term trends and seasonal cycles at
Fraserdale (continental) and
Cape St. James (maritime)
390
380
370
360
350
340
330
CO_2 (ppm)
89
90
91
92
93
Years
FRD Trend
FRD Cycle
ALT Trend
ALT Cycle
Plot File - FRDND\FRDCJSLN

Future Plans

1 - Alert	Autumn 92
add freons to in situ monitoring program	AES/NOAA
add nitrous oxide	NOAA/AES
upgrade nephelometer	AES
upgrade radon	AES/UofH
2 - Sable Island	Summer 92
add carbon dioxide (NDIR)	AES
add tropospheric ozone	AES
add black carbon	AES
add aerosols (size and number)	NOAA
3 - Cape St. James	
closing	October 92
establishing Cape Scott as replacement	April 92
replace evacuated flasks with pressure type for CO_2/CH_4	
4 - Fraserdale	1992
install radon	AES/U of H
start carbon isotopes CO_2/CH_4	U of H/AES
install upgraded nephelometer	AES
5 - Aircraft/Ships	
flask sampling from DND aircraft	
flask sampling from ships from Vancouver to Japan to Los Angeles	