

Figure 12.--Schematic diagram of the frost point hygrometer.

3.5 Halocarbons and N₂O

3.5.1 Operations

Few changes were made in the halocarbon and nitrous oxide monitoring programs during 1978. Data quality for all constituents measured (CCl₃F, CCl₂F₂, and N₂O) remained high, as it has since 1977 after sampling and analysis techniques were changed to use of pressurized dual sample flasks and calibration of the chromatograph with reference gases.

To upgrade the program further, research is continuing into a number of potential problems. Ambient air rather than dry air samples are currently collected, and analysis results are presented in terms of dry air using theoretically derived corrections based on measurements of pressure, temperature, and

relative humidity. Work is continuing to verify experimentally that the theoretically deduced corrections are highly reliable. Uncertainties of up to $\pm 10\%$ may be associated with absolute calibrations of the CCl_3F , CCl_2F_2 , and N_2O reference gases currently in use. Refinements in calibration gas preparation are needed to reduce this error to $\pm 1\%$ or less. Tests are being made to assess the stability of the reference gases during prolonged storage. CCl_2F_2 contamination, caused by temporary use of pure CCl_2F_2 to calibrate a nephelometer at Barrow, is being investigated. Other potential problem areas under investigation relate to contamination of sample flasks, flask trace gas-wall effects, and chromatographic analysis apparatus nonlinearity characteristics.

3.5.2 Data Analysis

During the latter part of 1978 past and current data were processed to improve their reliability. Statistical and meteorological data selection criteria were applied to raw data to eliminate data degraded by sampling and analysis problems. The work included recalibration of reference gas standards, as well as interlaboratory calibration gas intercomparisons.

Raw and selected data obtained from 1973 through 1978 are being prepared for archiving at the National Climate Center, Computer Products Branch, Federal Building, Asheville, NC 28801. The data will also be available in a NOAA Technical Report that will describe the sampling and data selection procedures.

Linear regression lines fitted to the selected data are shown in figs. 13 and 14. Preliminary data analysis results, yielding CCl_3F , CCl_2F_2 , and N_2O mixing ratios and mixing ratio growth rates, are given in table 10. Data for 1977 and

Table 10.--Summary of CCl_3F , CCl_2F_2 , and N_2 measurement results

Trace gas	Date	Station	Mixing ratio growth rate	(95%) S.E. growth rate	Res. standard deviation	Corr. coeff. squared	Mixing ratio	(95%) S.E. mixing ratio
CCl_3F	Jan 1, 1978	BRW	13.1 pptv yr ⁻¹	± 1.8	3.8	0.756	165.3 pptv	± 0.9
		NWR	13.1 "	± 1.6	3.8	0.785	162.1 "	± 0.9
		MLO	13.4 "	± 1.6	3.9	0.774	155.0 "	± 0.9
		SNO	13.2 "	± 1.4	3.4	0.826	146.5 "	± 0.8
		SPO	15.4 "	± 7.4	12.8	0.408	146.5 ^a "	± 5.1
CCl_3F	Jan 1, 1975	BRW	20.3 "	± 5.4	25.7	0.399	116.2 "	± 6.5
		MLO	17.6 "	± 3.7	21.9	0.469	107.4 "	± 4.6
		SNO	17.7 "	± 4.7	23.2	0.432	98.6 "	± 6.7
CCl_2F_2	Jan 1, 1978	BRW	10.1 "	± 8.1	5.2	0.161	296.9 ^b "	± 5.5
		NWR	19.1 "	± 3.7	6.6	0.707	285.8 "	± 2.3
		MLO	18.8 "	± 3.7	5.8	0.656	279.9 "	± 2.2
		SNO	18.4 "	± 3.3	6.6	0.655	262.5 "	± 1.5
		SPO	20.8 "	± 6.1	10.2	0.652	258.6 "	± 4.0
N_2O	Jan 1, 1978	BRW	-1.9 ppbv yr ⁻¹	± 1.5	2.0	0.097	336.0 ppbv	± 0.8
		NWR	0.6 "	± 1.7	2.6	0.009	335.8 "	± 0.9
		MLO	-1.9 "	± 1.4	2.1	0.109	334.4 "	± 0.8
		SNO	1.3 "	± 1.7	2.3	0.049	334.1 "	± 0.9
		SPO	-4.3 "	± 1.9	3.3	0.414	335.0 "	± 1.2

^aValue used in analysis was 143.8 pptv derived from observations made in Jan 1979 and extrapolated to Jan 1, 1978.

^bValue used was Dec 31, 1978, result of 288.3 pptv derived from linear regression line, extrapolated to Jan 1, 1978.

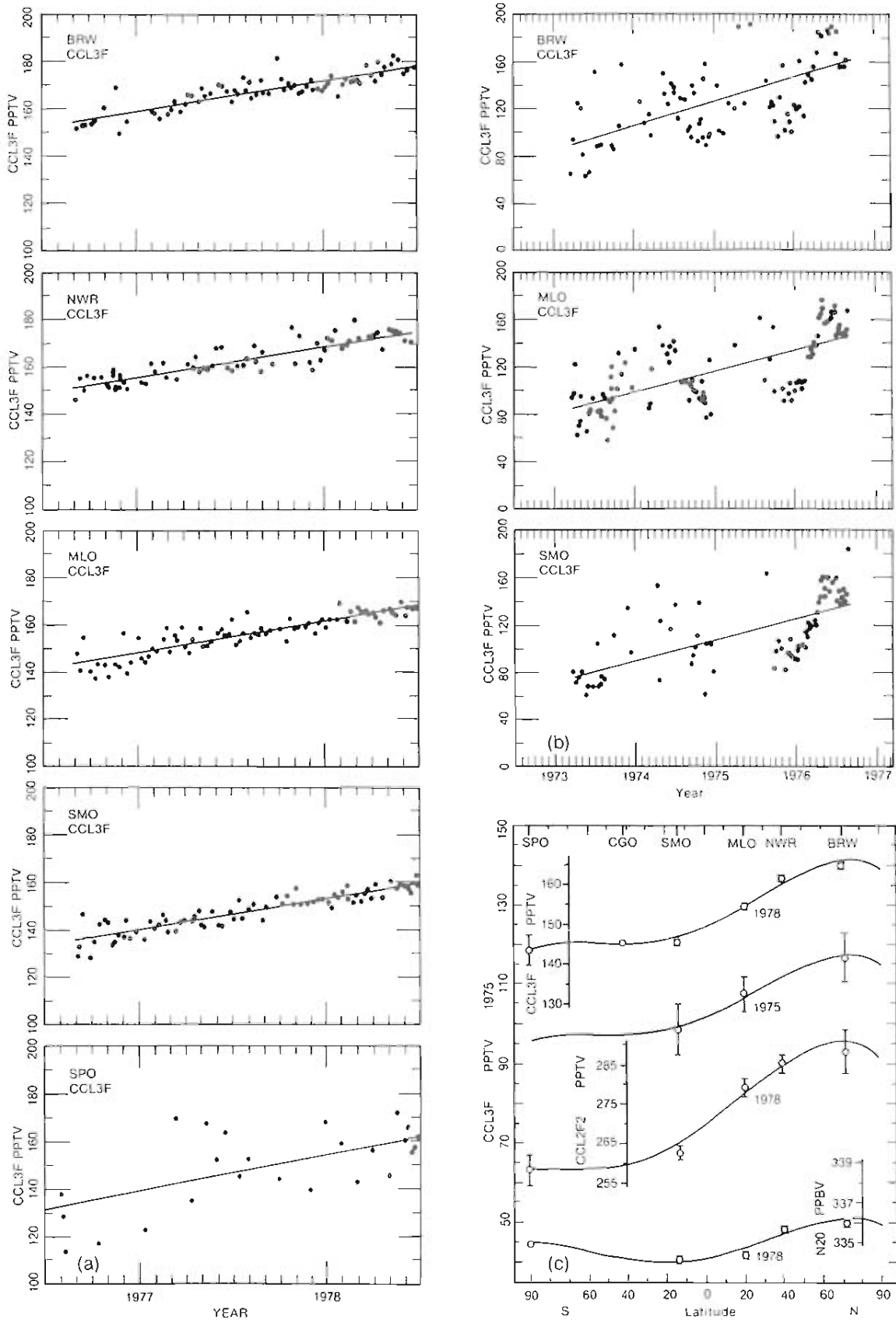


Figure 13.--Linear regression lines fitted to (a) selected 1977 and 1978 CCL₃F data and (b) selected 1973 to 1977 CCL₃F data; and (c) plots of latitudinal distributions of near ground-level CCL₃F, CCL₂F₂, and N₂O.

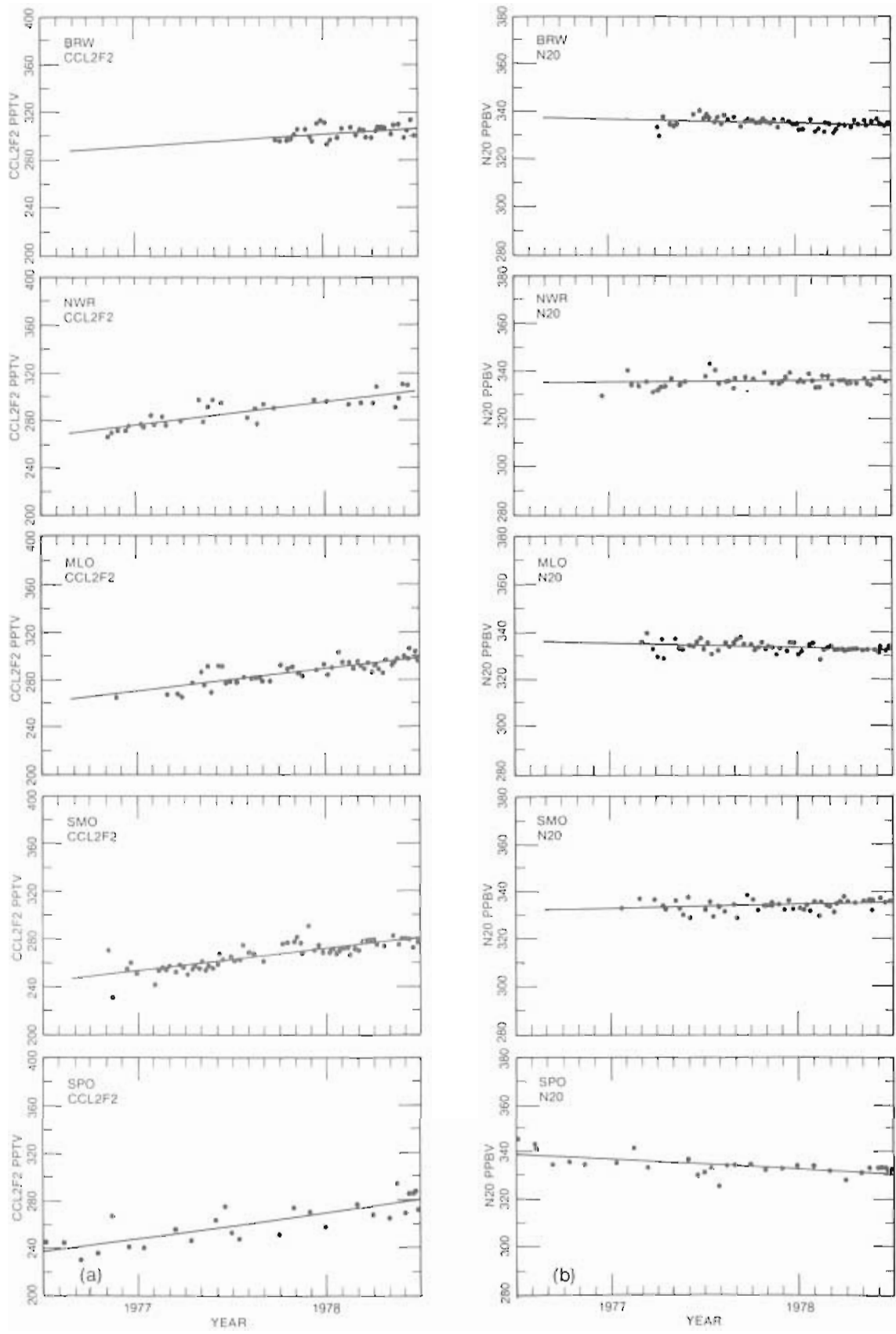


Figure 14.--Linear regression lines fitted to (a) selected 1977 and 1978 CCL₂F₂ data and (b) selected 1977 and 1978 N₂O data.

1978 are considered to be of high quality since air samples during this time interval were analyzed by using reference calibration gases traceable to R. A. Rasmussen standards maintained at the Oregon Graduate Center. Data obtained before 1977 are considerably less reliable since calibration gases were not used when analyzing samples; rather, reliance was placed on the coulometric performance of the chromatographic analysis apparatus.

Results of a preliminary analysis of the CCl_3F and CCl_2F_2 data are shown in table 11. The analysis has yielded best estimate tropospheric residence times of 86 yr for CCl_3F and 113 yr for CCl_2F_2 . Taking into account measurement random standard errors, as well as estimated systematic errors associated with the calibration gas mixing ratios, minimum tropospheric residence times for CCl_3F and CCl_2F_2 of 30 and 33 yr, respectively, have been determined. Included in table 11 is information on global abundances, global mixing ratios, gradients, and interhemispheric exchange parameters derived from the CCl_3F and CCl_2F_2 measurement data.

3.6 Stratospheric Aerosols

3.6.1 Mauna Loa Lidar

Although the lidar performed exceptionally well during the first half of 1978, problems developed afterward. During spring 1978, the output etalon on the laser was replaced with a 35% dielectric reflector, which boosted power output and made adjustment much more stable. We were able to achieve output energies 50% greater than the manufacturer's specifications. The laser head was thoroughly rejuvenated at this time, and we also began using neutral density filters to attenuate the signal so that more accurate tropospheric profiles could be obtained.

Although the laser was operated at very high power levels during summer 1978, the laser output decreased slowly during the fall, probably because of damage to the new output reflector. The field staff did not find damage to the mirror during a system inspection, but subtle damage was apparent on closer inspection during the following spring, at which time the reflector was repaired.

From November to January minor problems in the data acquisition system prevented computer analysis, and Polaroid photos were taken.

3.6.2 Barrow Lidar

The Barrow lidar system is nearly completed. Development of the signal processing system was a major task this year. In spring 1978, a new dynode chain was designed and fabricated. After testing, it was found that the signals were still being distorted by the strong return from the near atmosphere, so we tested the NCAR dynode design. The circuit was fabricated during winter 1978 and seemed satisfactory. It was also discovered that the Biomation transient digitizer on the Barrow lidar was more sensitive to overload than the Mauna Loa digitizer. This meant that we had to either develop a clipper unit and implement a switching amplifier as NCAR had done, or find another solution. During summer 1978 we tested the NCAR switching amplifier, and began fabricating our updated version of the NCAR unit. If the unit works well in Alaska, we will want to build one for the Mauna Loa lidar system.