

pheric circulation or cloud patterns.

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## Atmospheric composition using infrared techniques

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University of Denver researchers carried out two experimental programs during the 1978-79 austral summer. Both programs, which involved using quantitative measurements of the infrared properties of the antarctic atmosphere (Murcray, 1978; Williams et al., 1976), were primarily concerned with assessing man's impact on the Earth's atmosphere.

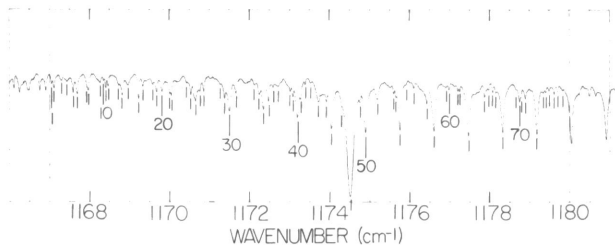
One experiment involved obtaining very high resolution atmospheric transmission spectra from Amundsen-Scott (South Pole) Station. The experiment's objectives were to obtain background data (that is, data representing, as nearly as is still possible, a natural atmosphere); to obtain data on the concentrations of both natural and pollutant-related atmospheric trace constituents; and to search for spectral features of previously undetected chemical species in wavelength regions normally masked by the HO absorptions in spectra taken from other ground sites.

The atmospheric transmission data were obtained at the South Pole on 30 November and on 1, 2, and 3 December 1978. Infrared solar spectra in the  $750^{-1}$  centimeter to  $1,350^{-1}$  centimeter (7.4 to 13.3 micrometers) region were recorded using a Fourier transform spectrometer of the moving-mirror Michelson type. The instrument was capable of a resolution of 0.01 centimeter (unapodized)—sufficient to distinguish lines of stratospheric species, such as ozone, from those arising in the troposphere by their smaller width. The spectra show several thousand absorption lines, which are currently being analyzed. A distinctive feature of these spectra is the remarkable transmission in spectral regions normally obscured by water vapor absorptions, because of the dry conditions and high altitude of the South Pole.

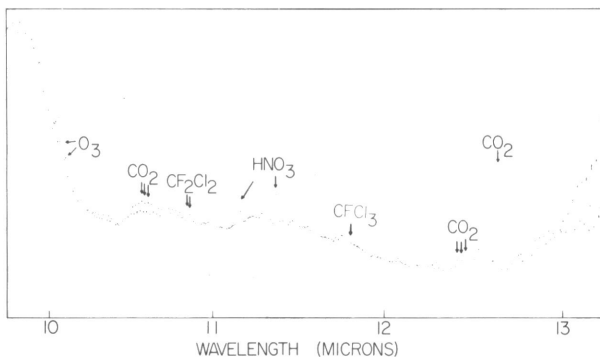
Figure 1 shows a small portion of one of the spectra. The majority of the strong spectral features in this section of the spectrum are due to NO, O<sub>3</sub>, CH<sub>4</sub>, and HO. A number of weaker absorption features are also related

### Reference

Shaw, G., 1979. Considerations on the origin and properties of the Antarctic aerosol. (Submitted to *Rev. Geophysics and Space Physics*.)



**Figure 1.** Selected portion of solar absorption spectrum taken 1 December 1978 from South Pole Station. Seventy-nine absorption lines have been marked in this frame (complete spectrum obtained with interferometer system consists of forty-five frames). Identifications of some of the lines are listed in the table.



**Figure 2.** Atmospheric emission spectrum observed from altitude of 5.5 kilometers from LC-130R-131 over South Pole Station on 24 November 1978. Some prominent features in spectrum are identified by atmospheric constituent.

to these molecules and to such other known atmospheric species as CO and CFCI. There remain a number of absorption lines that have not yet been identified with known atmospheric molecules. When they are identified, these absorptions will enable the authors to determine the concentration of the absorbing molecules at the time the spectrum was recorded. Identification of these features is part of the ongoing analysis of the data.

The second experiment involved aircraft measurements of the spectral emission from the atmosphere in order to obtain the column density for several species as a function of latitude from 34°N to the South Pole. The data also will be evaluated for other possible effects—geographic, meteorological, or temporal.

Atmospheric emission data were obtained with a liquid helium-cooled grating spectrometer on board LC-130R-131. Successful measurements were made be-

Table 1. Preliminary line identifications for solar absorption spectrum shown in figure 1

Line Number	Identification	Line Number	Identification	Line Number	Identification
1	N <sub>2</sub> O	28	N <sub>2</sub> O	55	?
2	O <sub>3</sub> ? + N <sub>2</sub> O	29	N <sub>2</sub> O	56	O <sub>3</sub> ?
3	N <sub>2</sub> O + O <sub>3</sub>	30	N <sub>2</sub> O	57	O <sub>3</sub> + N <sub>2</sub> O
4	?	31	O <sub>3</sub>	58	N <sub>2</sub> O
5	O <sub>3</sub> ?	32	N <sub>2</sub> O + O <sub>3</sub>	59	?
6	O <sub>3</sub> ?	33	O <sub>3</sub> + N <sub>2</sub> O	60	O <sub>3</sub>
7	N <sub>2</sub> O	34	N <sub>2</sub> O	61	O <sub>3</sub>
8	O <sub>3</sub> ?	35	O <sub>3</sub>	62	?
9	?	36	O <sub>3</sub> + CH <sub>4</sub>	63	N <sub>2</sub> O
10	CH <sub>4</sub>	37	?	64	CH <sub>4</sub> + O <sub>3</sub>
11	O <sub>3</sub> ?	38	O <sub>3</sub> + N <sub>2</sub> O	65	O <sub>3</sub>
12	O <sub>3</sub>	39	O <sub>3</sub>	66	O <sub>3</sub> + N <sub>2</sub> O
13	N <sub>2</sub> O	40	N <sub>2</sub> O	67	?
14	O <sub>3</sub> + N <sub>2</sub> O	41	O <sub>3</sub>	68	N <sub>2</sub> O
15	N <sub>2</sub> O	42	H <sub>2</sub> O	69	?
16	O <sub>3</sub>	43	?	70	?
17	O <sub>3</sub> + CH <sub>4</sub>	44	H <sub>2</sub> O	71	O <sub>3</sub>
18	O <sub>3</sub> + N <sub>2</sub> O	45	O <sub>3</sub>	72	O <sub>3</sub> + N <sub>2</sub> O
19	O <sub>3</sub> + N <sub>2</sub> O	46	N <sub>2</sub> O + O <sub>3</sub>	73	N <sub>2</sub> O
20	N <sub>2</sub> O	47	?	74	N <sub>2</sub> O + CH <sub>4</sub>
21	?	48	H <sub>2</sub> O	75	?
22	O <sub>3</sub>	49	?	76	O <sub>3</sub>
23	CH <sub>4</sub> + N <sub>2</sub> O	50	N <sub>2</sub> O	77	O <sub>3</sub> ?
24	O <sub>3</sub> + N <sub>2</sub> O	51	O <sub>3</sub> + ?	78	O <sub>3</sub>
25	N <sub>2</sub> O + ?	52	O <sub>3</sub>	79	O <sub>3</sub> + CH <sub>4</sub>
26	O <sub>3</sub>	53	?		
27	O <sub>3</sub> + CH <sub>4</sub>	54	N <sub>2</sub> O		

tween 9 and 27 November 1978 on ten flights, including the transport to McMurdo Station and flight over the polar plateau. These provide a data base of the column density of a number of atmospheric constituents over a wide range of latitudes. Figure 2 shows a sample of part of one spectral scan observed near South Pole Station on 24 November. Several features have been identified in the figure. Over 2,000 spectral scans were recorded on this series of flights. Selected scans are being reduced to absolute spectral radiance and will then be converted to column densities for the respective chemical species. In addition to constituents shown in figure 2, column densities will be calculated for HO, CH<sub>4</sub>, and possibly NO.

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## Antarctic and Pacific atmospheric tritium

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Our study of antarctic tritium continued this year with both land-based and airborne sampling (Mason and Östlund, 1978).

The land-based sampler at South Pole Station, which has been taking biweekly samples since late December 1977, separates tritiated water vapor (HTO), tritium gas (HT), and tritiated hydrocarbons (figure 1). Samples are returned to the University of Miami Tritium Laboratory for analysis. At the time this report was prepared, we had completed analytical work on only the first 14 sets of samples, too few to interpret. The remainder of the 1978 samples arrived in Miami in April 1979 and are being processed.

For the second austral summer season, we carried out an airborne sampling program with a series of flights in November 1978. We took samples on the transpacific ferry flight between Point Mugu, California, and Christchurch, New Zealand, as well as on flights in the Ant-