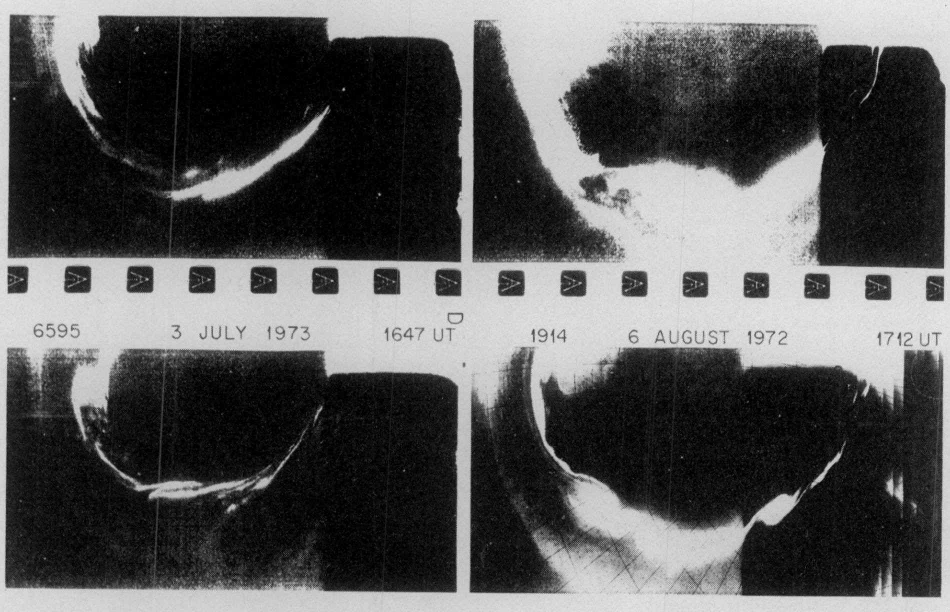

Four DMSP-1 satellite photographs that show different sizes of the auroral oval (in the afternoon-evening sector). These were taken from above the South Pole region.

the north-south component B_z of the interplanetary magnetic field in magnetospheric processes. We have already shown, based on all-sky photographs taken from the Alaska meridian chain of stations, that the size of the auroral oval is partially controlled by the B_z component (Akasofu *et al.*, 1973).

A better way of studying this relationship is to continuously monitor the auroral oval with a television camera aboard a satellite orbiting high above the polar region. We are far from having such an ideal situation, although we do have DMSP-1 satellite photographs taken at about 100-minute intervals. This is less than ideal because DMSP photographs cannot cover the entire oval.

A fortunate combination of the inclinations of the geomagnetic axis and of the DMSP-1 satellite with respect to earth's rotation axis makes it possible to observe the afternoon-evening half of the oval around 1600 to 1700 universal time (UT). This period coincides with the period when the South Pole is located in the midday sector. We also hope to be able to work with Soviet scientists who operate an all-sky camera at Mirnyy, which is located in the midnight sector around 1600 to 1700 UT. By combining all-sky photographs from the South Pole and Mirnyy stations, as well as from the DMSP-1 satellite, it therefore will be possible to continuously monitor changes in oval size for a few hours each day.

The figure illustrates how much the size of the oval (the afternoon-evening half) varies on different days. In each photograph the top of the oval is the midday part and the bottom is the midnight part. The South Pole is located in the midday vicinity of the oval and Mirnyy is located in the midnight sector.

Since the auroral oval approximates the boundary of the polar cap from which the open magnetic flux originates, it is possible to derive the total magnetic flux in the magnetotail and to observe its changes (Akasofu, 1975; Akasofu, in press).

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Atmospheric processes and energy transfers at the South Pole

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This project's principal objective is to determine all of the components that are important in the energy balance of the snow surface-atmosphere system in the antarctic interior. Amundsen-Scott South Pole Station was selected for the program because its location represents a large region of the continent's interior. The most important energy components that are being measured routinely are the various components of the solar and terrestrial radiation fields, the sensible and latent heat transfers between atmosphere and snow pack, and the storage or release of heat energy by the snow pack itself. Transport of momentum between atmosphere and surface also is being determined from measurements of the vertical and horizontal wind fields, obtained by a special turbulence meter that has a very rapid response to changes of the turbulent eddies.

Our second objective is to detect and characterize antarctic atmospheric particulates by measurement of their effects on the polarization and intensity of light from a sunlit sky. A specially developed polarizing radiometer has already yielded a large number of measurements of skylight characteristics, and it will continue to operate during appropriate periods of sunlit skies. These data will help to detect and evaluate future changes in antarctic, and by inference global, atmospheric particulates.

An important auxiliary development at South Pole Station was the December 1974 installation of two Hewlett-Packard 2100S minicomputers; one is used for instrument operation control and for data logging, and the other is used for offline data reduction and backup. A third and similar computer is maintained at the University of California, Davis, for development of programs and equipment to be used in Antarctica, and for training personnel in use and maintenance of the South Pole computers.

As of June 1975, the energy balance measurements have been in operation for about 6 months. While a few malfunctions have occurred, the instrumentation has generally operated satisfactorily. The computers have also given good service despite the limited maintenance available at the remote location. Details of measurement results will be available only after data are returned to the United States during the 1975-1976 austral summer, and an appropriate analysis has been completed.

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Changes in the antarctic thermal radiation budget

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Vertical profiles of the thermal infrared radiation budget over Antarctica have been made during 16 austral winters. These profiles include upward- and downward-directed radiant fluxes, which yield data on net irradiance and layer cooling. An economical net radiometer (Suomi-Kuhn, 1958) is carried aloft piggyback on a standard radiosonde until the balloon bursts. The homogeneous terrain surrounding antarctic stations and the continued use of the same design and material fabrication since the program's inception have enabled exceptionally meaningful profile comparisons.

Radiative cooling, which is a function of the one-dimensional divergence of the net radiant flux with height, has changed through the years. At Amundsen-Scott South Pole Station the columnar cooling from 575 through 125 millibars during the deepest cold period (June through August) increased from 1963 through 1967 by 0.31°C per day. After 1967 the cooling change is small. This is based on a total of 430 ascents in 10 years, with a minimum of 19 and a maximum of 88 flights per year.

Similarly, Byrd Station showed a steady increase in cooling from 1963 through 1968, with no leveling off in 1967. The Byrd observations were discontinued after 1968. The increase noted here was 0.41°C per day. This average was based on a total of 298 flights in 6 years. The standard error for this number of flights and values was computed to be 0.095°C per day for South Pole Station and 0.11°C per day for Byrd Station. Such statistics indicate that the increases shown were all significant.

Further, calculations were made with a radiative transfer equation to determine the influence of altostratus and cirrus clouds on the observed radiant flux. A value of 1.0×10^{-5} per centimeter was used for the bulk absorption coefficient. The tentative conclusion is that cloud (most likely moisture) contamination decreased over this period. The possibility of radiative feedback due to a carbon dioxide increase is nonetheless being investigated.

Other studies are being made to determine the thermal energy balance at the ice-air interface,