ATMOSPHERIC WIND FIELDS DERIVED FROM NIMBUS OZONE MEASUREMENTS

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Atmospheric ozone is known to be a good tracer of circulation in the upper troposphere and lower stratosphere. A knowledge of circulation in these upper layers can aid the meteorologists in understanding and predicting the behavior of the lower atmospheric circulation.

Because the ozone layer is well above the tropospheric clouds, it is ideally suited for remote sensing from satellites orbiting around the globe. Two independent experiments on board the Nimbus 4 satellite, namely the infrared interferometer spectrometer (IRIS) and the backscatter ultraviolet spectrometer (BUV), can measure ozone content in the atmosphere. The two sets of measurements are in good agreement and thereby conclusively prove our ability to measure the global distribution of this gas.

In this study the global ozone measurements made by the Nimbus 3 IRIS were used to trace the circulation in the upper troposphere. This was possible because the atmospheric ozone content is closely related to the geopotential heights in the upper troposphere. In Figure 1, we show that there is a linear relationship between 20-kN-m^{-2} (200 mbar) geopotential heights and the total ozone measured by Nimbus 3. With the help of the geostrophic law, atmospheric winds can be derived from the horizontal gradient of the geopotential heights. So, utilizing the linear relationship shown in Figure 1, we can deduce winds from our satellite measurements of total ozone.

A map of the global winds at the 20-kN-m^{-2} (200-mbar) level, for the month of July 1969, derived from the Nimbus 3 IRIS ozone measurements is shown in Figure 2. The solid lines are the stream lines and the isotachs are shown by dashed lines.

These ozone-derived winds bear a good agreement with the conventional maps of 20-kN-m^{-2} (200-mbar) flow over the Northern Hemisphere. However, over the Southern Hemisphere there are no such conventional maps readily available. Thus, the winds derived from our ozone data in the Southern Hemisphere can furnish the missing information.

From these 20-kN-m^{-2} (200-mbar) winds, we can also determine the strength and position of the jetstreams in both the hemispheres. The regions delineated by black shading are locations of the strongest winds or,

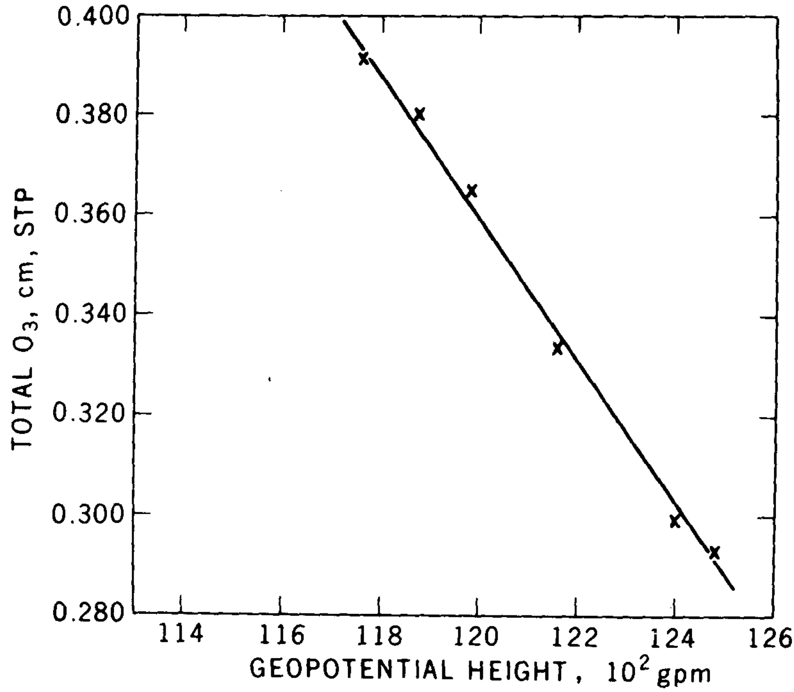

Figure 1–Total ozone versus 20-kN-m^{-2} (200-mbar) geopotential heights.

in other words, jetstreams. This information about the jetstreams can aid the meteorologists in their efforts to understand and predict the weather.

In addition to the subtropical and polar jetstreams that are shown in Figure 2, we have been able to observe the tropical easterly jetstream over Southeast Asia and Africa during the month of July 1969 from Nimbus 3 ozone measurements. The tropical easterly jetstream has a profound influence on the onset and progress of the southwest monsoon rains over southeastern Asia. However, the sparse upper-air conventional data over the tropics does not help the meteorologist to observe this jet well. In this regard the satellite measurements of ozone can be useful.

The total ozone distribution derived from Nimbus 3 over Asia and Africa during the period of July 1969 is shown in Figure 3. The heavy dashed lines define the axis of ozone maximum. This axis corresponds well with the course of the tropical easterly jet. The meteorologists can take advantage of such observations to predict the monsoon rainfalls.

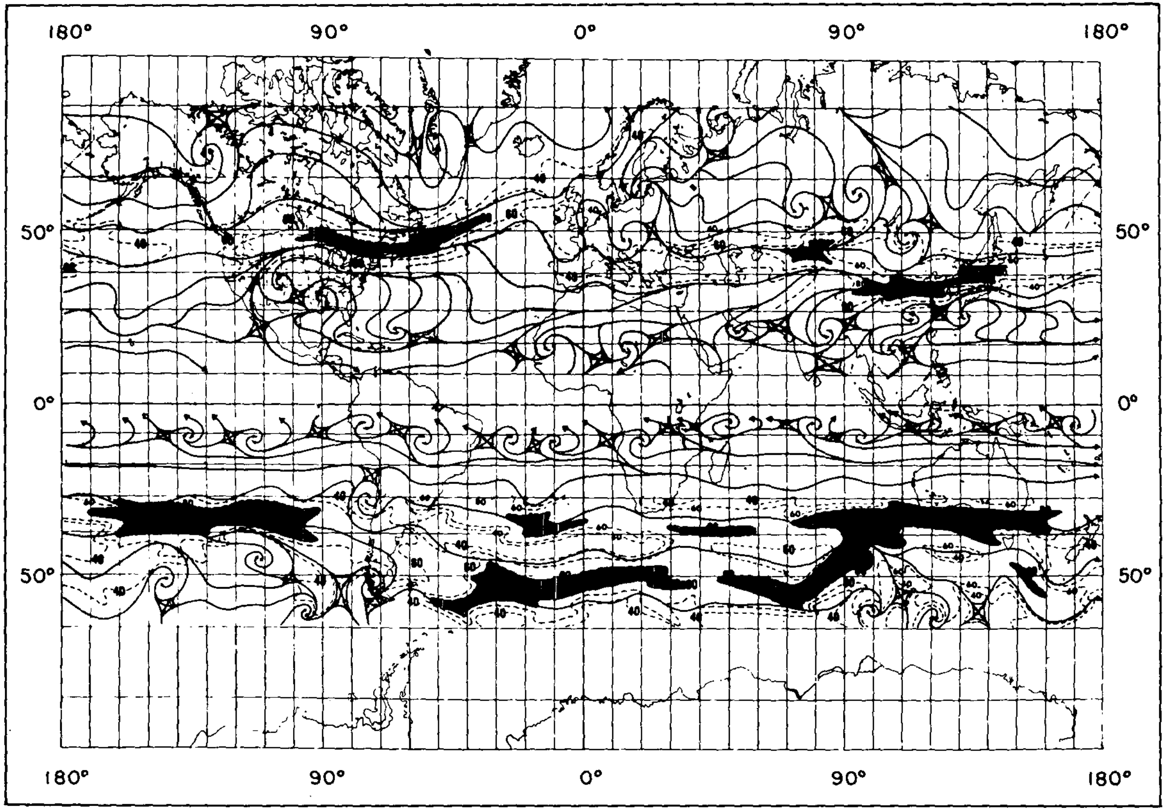

Figure 2–Geostrophic winds for 20-kN-m^{-2} (200-mbar), derived from total ozone data, IRIS, July 1969.

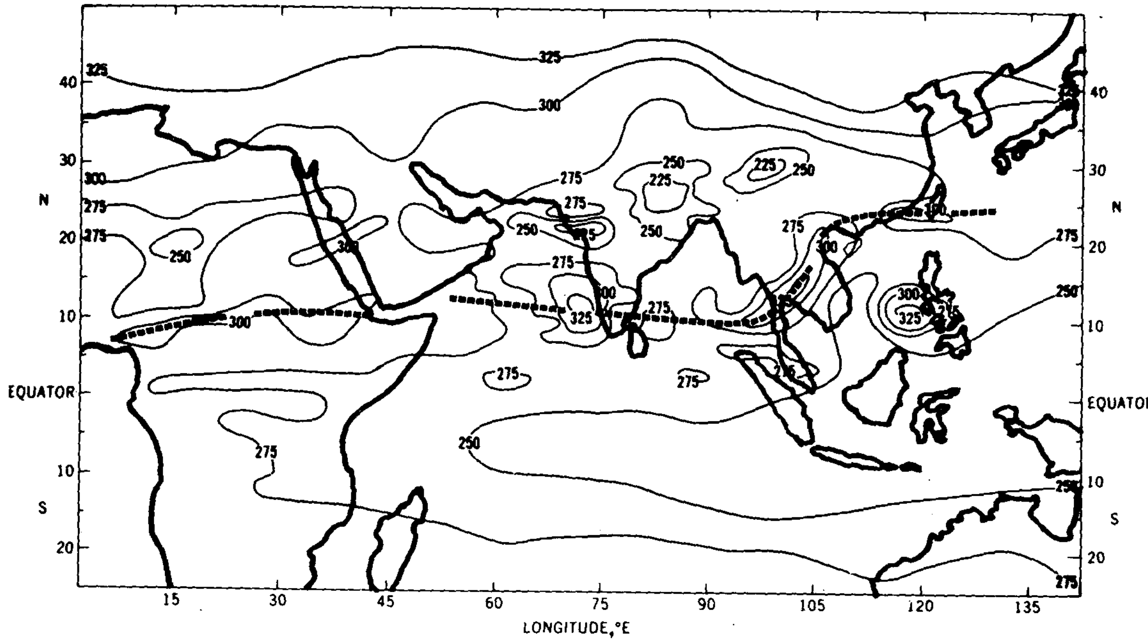

Figure 3–Total ozone data (10^{-3} cm, STP), July 5 to 22, 1969.