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Seasonal and Temporal Changes in the Vertical Profiles of Polar Stratospheric Ozone: 1978-1986

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The long-term changes in stratospheric ozone in both Antarctic and Arctic regions during the period November 1978 - October 1986 exhibit significant interhemispheric differences in terms of time of onset, altitude, latitude, longitude, and phase. The 8-year data set of stratospheric ozone derived from observations with the Nimbus 7 SBUV instrument were deseasonalized by subtracting monthly deviations from 6-year monthly means for 10° bands centered at latitudes 80°S-80°N and the 64x64 standard NMC grid at standard pressure levels in the atmosphere. Linear trends are derived from the linear regression of monthly deviations from long term monthly means in terms of annual and monthly trends for the latitude region 55°-81° in both hemispheres. An assessment has been made of the SBUV instrument drift from analyses of annual deviations from long term annual means of stratospheric ozone in north temperate regions from 25°N-55°N with corresponding Umkehr observations from 5 stations at latitudes from 36°N-52°N which have been corrected for stratospheric aerosols derived from 5 lidar stations (DeLuisi and Mateer, 1988).

Antarctic Region (55°S-81°S)

The vertical distribution of ozone depletion in the Antarctic region can be separated into two altitude regions, above 10 mb and below 15 mb. At altitudes above 10 mb up to 0.3 mb, the maximum ozone depletion which is about 3% y^{-1} at 1.0 mb is observed during the months of May, June and July, (winter) which is the period of coldest temperatures at high latitudes in the Southern Hemisphere. In the lower stratosphere a maximum ozone depletion of about 5.5% y^{-1} is observed at 40-50 mb during October which is about two months after the coldest high latitude temperatures at the 40-50 mb level.

The geographical location of the zonally symmetric strongest poleward gradients of ozone depletion is the same in both the upper (altitudes 2 mb and below) and lower stratosphere, offset from the pole along the 30°E longitude meridian. In the upper stratosphere and lower stratosphere ozone ° depletion accelerates after early 1981.

Arctic Region (55°N-81°N)

The seasonal variation of the profile of ozone depletion in the region 55°N-81°N suggests the existence of two altitude regions of high values of ozone depletion in the upper stratosphere above 3 mb and the middle-lower stratosphere, 5 mb-40 mb with the maximum seasonal differences observed near the 1.0 mb and 10-15 mb levels.

Maximum rates of ozone depletion are observed during February and March in the upper stratospheric region and during February in middle stratospheric region. These maximum rates of ozone depletion are observed approximately two months after the coldest zonal mean high latitude stratospheric temperatures in the Northern Hemisphere. At altitudes of 2-5 mb and in the vicinity of the 30 mb level strong poleward gradients are observed in the geographical distribution which are centered slightly offset from the pole along the longitude meridian of about 30°E. An acceleration in the rates of ozone depletion in the Arctic region is observed beginning in early 1982. This onset of an acceleration of ozone depletion begins approximately one year later in the Northern Hemisphere than in the Southern Hemisphere.

The characteristics of high latitude rates of ozone depletion suggest that dynamical processes are important as well as photochemical and radiative processes in the formation of regions of enhanced ozone depletion in the Antarctic and Arctic regions.