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Title: Analysis and Interpretation of Variabilities in Ozone and Temperature Fields

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Abstract of Research Objectives:

The purpose of this research is to study the temporal and spatial variabilities of ozone and temperature in the stratosphere on time scales varying from a solar rotation to a solar cycle.

Summary of Progress and Results:

We have studied the temporal and spatial characteristics of short and long term fluctuations in stratospheric ozone and temperature at various pressure levels using several years of ozone , temperature and solar flux data from Nimbus-4, Nimbus-7 and SME satellites. Some of the important results of this study, which have been published in scientific journals and presented at both national and international meetings, are summarized as follows:

a. The solar UV flux and various indices of solar activity indicate a strong period at about 5 months. In the 10.7 cm solar radio flux (F10.7), a conventional index for the solar EUV and UV variabilities, the spectral power of the 5 month period is comparable to the well known 27 day solar period. However, in the solar UV flux at 205 nm, directly measured from the Nimbus-7 SBUV spectrometer, the (spectral) power of the 5 month period is about half that of the 27 day period. In a paper published in the July 1989 issue of the Geophysical Research letters, we have studied the possible impact of the 5 month solar period on ozone and temperature at various pressure levels in the stratosphere and the implications of differences in solar forcing at the 27 day and 5 month periods. It is shown that ozone, both in the lower and the upper stratosphere, has a measurable response to solar UV forcing at 27 days. Such a solar response is not observed at 5 month period because of a relatively weaker 5 month solar UV component in the solar signal and a strong interference from dynamical signals associated with planetary wave activity.

b. Satellite total ozone observations were analyzed using 17 years of data (1970- 1986) from the Nimbus-4 BUV and the Nimbus-7 SBUV experiments. These two data sets show very similar seasonal variations and quasibiennial oscillation(QBO) with some indication of a 4 year component. The QBO maximum and minimum are best correlated with the west and the east components of the QBO wind at 30 mb respectively. For the period 79-86, the ozone standing wave eddies decreased by about 5 percent at 50°N and by about 20 percent at 50°S. These changes are independent of instrument degradation and represent real climatological change

suggesting a decrease in the poleward transport of ozone in the south polar region.

c. The zonal characteristics of both the ozone and temperature trends were derived from ten years (1979-1988) of total ozone and 50 mb temperature based on the Nimbus-7 TOMS measurements and the NMC analyses respectively. The zonal anomalies in ozone and temperature trends are generally in phase and are positively correlated in both the northern and the southern hemispheres. The ozone sensitivity to temperature, derived from their spatial variability, varies from 1-4 percent for 1 K change in temperature and are attributed to dynamical perturbations. After correcting for temperature related changes and instrument drift, the trends in total ozone are still very large (20- 30 percent decrease) in the southern polar region during spring months. It is estimated that about 30 percent of the inferred decrease in total ozone is related to dynamically induced temperature changes and the remaining 70 percent is most probably due to chemistry involving heterogeneous reactions.

Publications:

1. "Satellite Total Ozone Climatology Covering 18 Years", E. Hilsenrath and S.Chandra, Proceedings of International Ozone Symposium 1988, ed. R. D. Bojkov & P. Fabian, A. Deepak Publishing, Hampton, VA.

2. "A Search for a Five Month Solar Induced Periodicity in the Middle Atmosphere", Geophys. Res. Lett., S. Chandra, 16, 711-714, 1989

3. "Response of the Middle Atmosphere to Solar and Dynamical Perturbations, S. Chandra, Middle Atmosphere Program Handbook, In Press, 1989.

4. " Assessments of El Chichon and Solar Cycle Perturbations on Stratospheric Ozone", S. Chandra, Submitted for publication.

5. "The Role of Planetary Waves on Ozone Depletion in the Antarctic," S. Chandra, Submitted for publication.