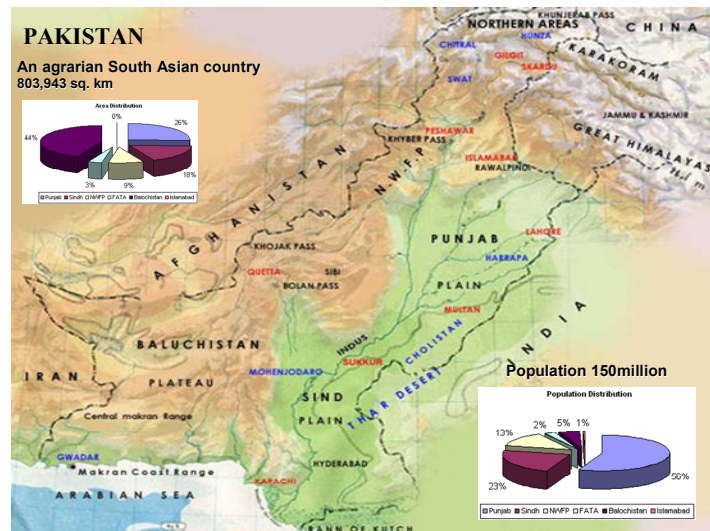


PAKISTAN

INTRODUCTION

Pakistan lies in the temperate zone. The climate is generally arid, characterized by hot summers and cool or cold winters, and wide variations between extremes of temperature at given locations. There is little rainfall. These generalizations should not, however, obscure the distinct differences existing among particular locations. For example, the coastal area along the Arabian Sea is usually warm, whereas the frozen snow-covered ridges of the Karakoram Range and of other mountains of the far north are so cold year round that they are only accessible by world-class climbers for a few weeks in May and June of each year.



Ozone Layer Depletion is a global problem that is affecting the whole world today. From the global data coverage and the research conducted by world famous scientists, it is well understood that ozone layer is being depleted everywhere, but in different magnitudes. From the information we receive, it is noted that Polar Regions account for major destruction especially the Antarctic Region. There is also a very large seasonal variation in depletion where the largest ozone hole is found in spring and summer. In the tropics there is very little seasonal change but the ozone layer is very thin thought out the year. Change in the mid- latitudes are erratic.

Pakistan ratified the Vienna Convention, the Montreal Protocol, the London Amendment in 1992, the Copenhagen Amendment in 1995 and the Montreal Amendment-1997 and Beijing Amendment-1999 in February, 2005. The Ozone Cell was established in the Ministry of Environment in 1996 for the implementation of the Montreal Protocol. Country Programme was approved in 1996 and subsequently updated in 2003. As party to the Montreal protocol, Pakistan in cooperation with other countries is phasing out the consumption of ozone-depleting substances in an effort to safeguard the ozone layer. Pakistan is not an ODS producing country but imports a few such hazardous substances to meet its domestic needs. Pakistan has provided financial and technical assistance to various enterprises for phasing out the uses of ODS and switching over to the ozone friendly technology in collaboration with the implementing agencies World Bank, UNIDO and UNDP through Multilateral Fund for the implementation of the Montreal Protocol. CAP, UNEP, provides compliance assistance to Pakistan.

OBSERVATIONAL ACTIVITIES

Column measurements of ozone and other gases /variables relevant to ozone loss

Pakistan has no adequate facilities for Column measurement of Ozone, as country is still endeavouring to improve its satellite technology for physical monitoring of stratospheric substances.

Profile measurements of ozone and other gases/variables relevant to ozone loss

The stratosphere is one of the constituents of thermal structure of the atmosphere. The maximum concentration of ozone is found at the stratospheric region where it is interacted by many species including chemical and physical processes. Atmosphere as a whole is an open system that is regarded as a non linear system and that seems to be complex. Therefore, a non-linear trend is

plausible to explain phenomenon of ozone layer depletion (OLD). Attention has been paid on analysis of the major portion of historic data on stratospheric O₃ based on ground-based measurements by the Dobson spectrophotometer. Where in estimated parameters for describing non-linearity in the process using polynomial trend functions and predicted values are calculated for the period from 1960 to 1999. Future values for ozone depths are computed till 2006 and compared with the minor portion of the data set.

The objective of the research is to present the result of an analysis of the Total Ozone Mapping Spectrometer (TOMS), total ozone data over Pakistan. Ozone measurement from the American satellite, Nimbus 7 TOMS, which operated from November 1978 through early May 1993 and later on data from the TOMS on-board the Russian Meteor 3 satellite till Dec, 1994 have been used to determine trends in total ozone over Pakistan. Both TOMS data records with spectral range 311-380 nm, and spectral resolution 1 nm, provide global measurements of total column of ozone on daily basis. Ozone data from 1995 onwards was obtained from Earth Probe and Japanese Advance Earth Observation Satellite (ADEOS) measurements, However, data gap existed for the period between mid 1994 to mid 1995, The reprocessed daily total ozone observations made by these satellites over Pakistan (Karachi 24°N, 67°E, Lahore 31°N, 74°E, Quetta 31°N, 67°E, Chitral 35° N, 71° E) for the period from November 1978 till December 1998 have been used to investigate total ozone trends. Long term trend estimates obtained from the linear multiple regression analysis show no significant ozone trend in the south of the county (Karachi), However, the measurement for mid latitude (Lahore, Ouetta) northern region (Chitral 35°N, 71°E) have shown significant negative trend in ozone.

In another study, the tropospheric ozone formation, stratospheric ozone subsidence and its variation (Seasonal) near and above the ground, temperature and dynamic behaviour of the troposphere and stratosphere have been explored. Ozone profile are also measured using GPS based Radiosonde / Ozonesonde balloon sounding system. The flight was carried out at 25° N and 66° E up to 30-35 Km altitude.

Global environmental issues include ozone layer depletion, global warming, acid deposition, tropical deforestation, desertification, pollution problems in developing countries, its impacts and damages affect not only the countries that caused the problems but go beyond their national boundaries and reached a global scale. These problems are inter- related in a complicated manner. The loss of ozone high in the atmosphere as consequences of human activities is a serious global scale environmental problem. Total ozone measurements from Total Ozone Mapping Spectrometer onboard Nimbus 7 (NASA). Meteor 3 (Russian), and Earth Probe (NASA) from November 1978-2001 use to determine the quantitative spatial and a temporal resolution of ozone over the South Asia have been used to investigate total Ozone trends. Long- term trend estimates obtained from the linear multiple regression analysis show no significant Ozone trend in the Southern part of Asia However, the measurement for mid latitude and northern region have shown significant negative trend in ozone.

UV measurements

Ozone Increased surface UV leads to increased troposphere ozone. Ground-level ozone is generally recognized to be a health risk, as ozone is toxic due to its strong oxidant properties. At this time, ozone at ground level is produced mainly by the action of UV radiation on combustion gases from vehicle exhausts.

The depletion of the ozone shield over the Polar regions has raised many questions such as climate and risks for humans and ecosystems resulting from enhanced UV radiations. The human exposure to UV radiation may result in many skin and eye disorders. A quantitative relation between the amount of UV radiation received and its adverse effects needs to be investigated. It is well known that even if the emission of ozone-depleting substances is halted immediately. The continuing depletion of the ozone layer will result in several thousands of extra cases of skin carcinoma. One of the important parameters to determine the extent of the climate change and the increase in UV radiation in the Asia-Pacific region is to monitor solar radiation (UV radiation) on a regional basis Minimum UV irradiation has been observed at coastal city of Karachi (24.87°N,

67.03°E) during summer monsoon (July-Aug-Sep) with a cloud cover ranging from 90 to 100% UV-B perturbations have also shown ante-correlation with total ozone.

Calibration activities

Calibrations are done on experimental scale for specific research needs, large scale calibrations are not performed periodically.

THEORY, MODELLING AND OTHER RESEARCH

Pakistan lack in physical infrastructure as well as skilled human resource for the simulation and mathematical modeling based research in upper atmosphere. The lack of ozone research is due to various reasons including lack of funding, lack of awareness and interest among the society and scientists etc. However research at least to measure ozone concentration over Pakistan and the amount of UV reaching the earth surface is underway.

DISSEMINATION OF RESULTS

The research activity for the upper atmospheric research is almost negligible and results are disseminated only through the collaborating parties as well as peer reviewed science publications.

Data reporting

Data is reported off and on to the collaborating space research organizations as well as it is occasionally posted on website, whenever available.

Information to the public

Country has no specific mechanism for public awareness regarding atmospheric forecast. Nevertheless, the Ozone Cell is conducting awareness programmes using information regarding amount of ozone over Pakistan and the global pictures provided by researchers from other countries and the agencies like UNEP and WMO.

Relevant scientific papers

Study of Nonlinear Dynamics of Ozone Layer Depletion for Stratospheric Region of Pakistan using Ground Based Instrumentation, Ayub Khan Yousuf Zai and Asif Khan.

Long-Term Trends in Total Ozone over Pakistan Using TOMS Data 1978-98 (SUPARCO–Pakistan).

Ozone Bio-monitoring in Punjab, Prof. Dr. S. Razi Abbas Shamsi.

A Quantitative Study of Effects of Ozone Layer Depletion on Marine Organisms with Reference to Coastal Region of Pakistan, Muhammad Ayub Khan Yousafzai, University of Karachi/ Institute of Space and Planet Astrophysic.

UV Insulation Monitoring in Asia--Pacific Region (SUPARCO-Pakistan).

PROJECTS AND COLLABORATION

Pakistan does not possess adequate facilities for upper atmospheric research. Space and Upper Atmosphere Research Council (SUPARCO) is the only public sector organization of satellite research and development. Thus a project titled “*Long-Term Trend in the Total Ozone over Asia using Satellites and Balloon Based Ozonesonde*” is underway but the outcome of research is not very presentable at any international forum.

Research is also underway for “UV Insulation monitoring in Asia-Pacific Region”. The sole organization has collaborations with:-

- Asian Association for remote sensing (AARS).
- Asia Pacific Space corporation Organization (APSCO).
- Committee on Space Research (COSPAR).

FUTURE PLAN

- Monitoring of ozone profile over the country.
- Study on atmospheric chemistry in relation to ozone layer depletion and climate change.
- Participate in the international inter-comparisons of Dobson Spectrophotometer, Brewer Spectrophotometer and Ozonesonde.
- Develop biological system to monitor UV-B.
- Research on impact of UV-B on human health and eco-systems.
- Develop climatic models to predict the climatic change over Pakistan.

NEEDS AND RECOMMENDATIONS

UV Monitoring Network

A satellite-based UV monitoring network can be useful to observe the distribution of the solar UV insolation over a large area and its seasonal dependence. The salient features of such programme can be the determination of seasonal trends and the variations in the distribution of solar UV radiation. Such a network would help arriving at representative models of UV radiation incidence and would enable the study of the temperature and dynamic behaviour of the troposphere and stratosphere providing ground truth information for the calibration and verification of remote measurements using satellite, radar.

Ozone Research Talent Pool

Pakistan and most developing countries desperately need some sort of human resource talent pool motivating the young talent for Ozone research. Therefore, a strategy may be evolved at South Asia Ozone Network level at least to encourage scientific talent in these countries for Ozone related research.

Training of Ozone Research Managers

Since Ozone research is not of much interest for corporate / business companies, therefore, there are least opportunities for training in frontier technologies in Ozone research. Therefore, a periodic research training fellowship is needed to be offered to developing countries, so that appropriate skilled researchers pool can be built in developing countries. The Ozone Research Managers meeting may recommend to the Meeting of Parties for taking decisions to request Parties to provide adequate support to continue the present activities and to carry out future plans.

Monitoring Stations

It will be useful and necessary to set up few monitory stations in the country. These stations can be also linked to the global network of monitoring station so that researchers can exchange global data and information. It is hoped that Pakistan scientists working in the field of environment will take part in this very important exercise.

Bilateral Assistance

Developed countries may consider having bilateral assistance programme with developing countries to strengthen ozone and UV-monitoring and research system. UNEP networking system may also include ozone and UV monitoring activities in their agenda.
