A STUDY OF POLLUTANT DISPERSAL IN URBAN TERRAINS

by

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CERTIFICATE

This is to certify that the thesis entitled " A STUDY OF POLLUTANT DISPERSAL IN URBAN TERRAINS", being submitted by MANJU KUMARI for the award of the degree of DOCTOR OF PHILOSOPHY, is a record of the original bonafide research work carried out by her. She has worked under our joint guidance and supervision and has fulfilled the requirements for the submission of this thesis. The results presented in this thesis have not been submitted in part or full to any other University or Institute for award of any degree/ diploma.

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ABSTRACT

Rapid industrialisation and urbanisation are taking place in India. Dispersion models provide expertise to relate the influence of growth and urbanisation to future air pollution events. Therefore, air pollution dispersion models play vital role in impact assessment studies and land-use planning. The prime motivation of the present thesis has been to acquire an expertise with a wide range of air pollution dispersion models in relation to the source type, data availability, computer facilities and type of forecast. These models, when fully developed, could provide a powerful tool in air pollution forecasts for this region.

Many important input parameters are needed in air pollution modelling studies. These input parameters are either lacking or sparsely available. This is because of the non-availability of facilities for instruments, to measure these directly. Even when the facilities for measurements are available, they do not cover all the observation stations in the country. Hence, these parameters have been derived from the routine meteorological surface observations. A considerable part of this thesis has been devoted for the evaluation of necessary input parameters for the models. These are described in Chapters II to IV. These parameters have been used in a multiple box (grid) model developed and described in this thesis. The model is capable

of providing concentration patterns from a ground based area source. In addition to this, a one-dimensional planetary boundary layer (PBL) model has been developed to study the velocity and thermal fields in conjunction with a radiation model. Besides, an urban diffusion model has also been developed where boundary layer structure could be studied with heat island intensities. Consequently, from this 2-D PBL model, the velocity fields are used in a pollution dispersion model to predict the concentration patterns.

Chapter I describes the necessity and the salient features of the work undertaken in this thesis. A review of the related work pertaining to this study has also been presented.

Chapter II of this thesis presents the evaluation of mean monthly diurnal variation of mixing depths over Delhi based on five year's data.

Chapter III deals with the development of a radiation model from the heat balance equation. The principal components of the energy budget have been parameterised and their diurnal variation is presented for some selected cities of India.

Chapter IV of this thesis deals with the estimation of turbulence parameters at the surface based on Monin-Obukhov similarity theory during day time over Delhi. Vertical dispersion height, σ_z has been derived by making use of these parameters during four different months in Delhi. Stability of the

atmosphere has also been assessed and presented for the same period.

Chapter V presents the development of a multiple box model which predicts the concentration pattern over an area of interest, from a ground based area source. Input parameters needed in this model have been obtained from the studies made in Chapter II to IV.

Chapter VI presents a one-dimensional PBL model with the energy-budget analysis at the surface. Flow fields are obtained from model simulations which compare well with the observations. A study of different factors responsible for the thermal changes has also been performed with the help of this model.

Chapter VII presents an urban diffusion model which essentially couples a two-dimensional PBL model with a three dimensional pollution dispersion model. Concentration patterns from an elevated point source and flow fields are presented with varying heat island intensities.

The summary of the thesis has been given in Chapter VIII. This chapter deals with many important scientific problems which can be undertaken as extension of the present thesis.

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