SPACE-TIME MODELLING OF GROUNDWATER WITH ASSISTANCE FROM REMOTE SENSING

by

VIJAY KUMAR

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CERTIFICATE

This is to certify that the thesis entitled "**SPACE-TIME MODELLING OF GROUNDWATER WITH ASSISTANCE FROM REMOTE SENSING**", being submitted by **VIJAY KUMAR** for the award of degree of **DOCTOR OF PHILOSOPHY**, is a record of the original bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of his thesis. The results presented in this thesis have not been submitted in a part or full to any other University or Institute for award of any degree/diploma.

Rema devi

(Dr. (Mrs.) Remadevi)
Associate Professor
Department of Civil Engineering
Indian Institute of Technology
New Delhi- 110 016

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ABSTRACT

Water resources projects, which are often necessary to meet the demands of energy and agriculture, have often brought in some adverse environmental impacts while delivering the targetted benefits. One of the major environmental impacts associated with water resources projects, particularly with irrigation projects, is the rise in groundwater levels, which may lead eventually to waterlogging and perhaps to increased salinization as well. On the other hand, in some areas, where, there is over exploitation of groundwater for various purposes, the continuous depletion of groundwater may lead to lowering of groundwater levels well beyond recharge capabilities. Groundwater resource thus gets depleted and may result in eventual water scarcity. Thus, there exists a strong need to study the spatial and temporal behaviour of groundwater.

The measurement of groundwater level data is the simplest and most economical among the various other groundwater parameters. It is also widely used in the models available related to groundwater studies. In the near future also, groundwater levels are likely to be the major choice of input for estimation of groundwater.

The objectives of the thesis is to study the space-time behaviour of the groundwater levels and to explore its use with remote sensing techniques to provide mutually complementary and supplementary information so as to arrive at a more complete and reliable information base on groundwater behaviour.

To achieve the objectives of the study, spatial modelling techniques, namely inverse distance (which are widely used in hydrology) and geostatistical techniques are employed.

Temporal modelling is combined with spatial modelling to achieve space-time modelling. To delineate the water related features on the ground surface, remote sensing interpretation is carried out.

To apply and validate the adopted methodology, it is applied to model the behaviour of groundwater on a real life situation in the command area of a major irrigation project in the north-western part of India. Canal irrigation in this area has led to a general rise in water level of the aquifer in that area. The study area is a part of the desert area in the state of Rajasthan in India and has an areal extent of about 4500 sq km.

The results from the study show that groundwater levels are spatially related in the study area. The geostatistical techniques performed far better than the generally used techniques of inverse linear distance and inverse square distance in spatial modelling of groundwater levels. Also, this technique provides the information regarding the direction of flow of groundwater. Groundwater levels are found to be increasing continuously in most part of the study area. A genre of simple models are found to describe the behaviour of groundwater in the time domain. Spatial interpolation of forecast data using geostatistical techniques is found to be a promising approach towards space-time modelling of groundwater data. Results of the study also indicate the usefulness of remote sensing techniques for delineation of waterlogged areas.

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