ADVANCES IN WATER SCIENCE METHODOLOGIES by Dr U Aswathanarayana, A A Balkema Publishers, Leiden, The Netherlands, 2005, 230p , Price US$108, Rs 4860

Our present era is characterized by the stark reality of ever increasing water demand and shrinking water availability coupled with degrading water quality The study of hydrology has assumed crucial importance in the wake of this looming water crisis, and the consequent outcry for a proper water management, which is the key to the sustainability of our water resources This needs a sound understanding of the various components of the hydrological cycle and their interrelation, as also realistic and efficient hydrological modeling The hydrological sciences have evolved manifold in this direction during the last few decades Use of remote sensing is the latest in the technological advances in the field This book is an outcome of the laudable efforts of the editor, Dr U Aswathanarayana, to bring out the latest thinking and advances in hydrological sciences for the benefit of students, researchers, planners and scientists

Management and predictive modeling in hydrology, be it for flood forecasting or drought management, for water availability in the upcoming year or competitive water uses, for locating subsurface water or for solute transport in the aquifer, — need a wide range of earth and atmosphere related data The study is conventionally dependent on hydrological measurements on the ground which suffer from limitations of reliability, time effectiveness, adequacy and prohibitive costs Remote sensing is capable of supplementing the ground measurements, providing repetitive and synoptic overview of large areas and inaccessible terrain It also enables identification and quantification of earth-atmosphere related variables used as model inputs Hence it is finding wide application in hydrological modeling, prediction analysis and management of water resource This, the editor, has magnificently brought out in the book through carefully organized chapters written by eminent experts on the subject with commendable lucidity and supported by case studies, neat illustrations, tables and attractive colour plates An important aspect of the book is its relevance in the Indian context

The book is divided into three parts The first part includes four chapters dealing with the vast utility of remote sensing data in hydrological modeling Readers are introduced to the concepts and methods of hydrological modeling and satellite data validation, brought out step wise Remotely sensed satellite data offers not only inputs of earth atmosphere related variables, but also validation of model outputs, and assimilation of satellite derived products in the land surface models This has made the hydrological model in the Upper Mississippi River Basin more realistic (Venkat Lakshmi, Ch 1) Hydrological data assimilation is an objective method aimed at merging satellite data with predictions of hydrologic model based on irregularly distributed observations, to yield best possible hydrologic system state estimation (Walker and Houser, Ch 2) The authors have lucidly elaborated the steps in the construction of the various models with case studies However these innovative concepts are still in infancy, and there is scope for further improvement

The second part of the book deals with application of remote sensing in specific areas of hydrological sciences Remote sensing based processing systems for actual estimate of evapotranspiration (ET) and soil moisture information need special mention Estimation of actual ET improved calibration of groundwater models in Snake River plain of South Eastern Idaho (Allen, Morse and others, Ch 5) Microwave sensors operating at very low microwave frequencies provide the best soil moisture information used in hydrologic, weather and climatic modeling (Johnson, Ch 6)

Hydrological cycle undergoes changes with climatic variations, induced by natural processes or anthropogenic factors, like emission of green house gases The latter is thought to be increasingly the cause of global warming and extreme weather volatility in recent years affecting the hydrologic system globally Thus, in the management and planning of flood protection, drought management, water conservation agricultural practices, civil and industrial water supply, accurate knowledge of rainfall and drought regimes is essential Use of large scale climatic data in the hydrological modeling makes stream flow forecasts pretty reliable This is amply demonstrated by application of ensemble stream flow forecasting method in the river basins of western United States (Rajagopalan and others, Ch 7) In another case study in Amo river basin, Italy, long term climatological analysis and prediction provided quantitative information on future variability and trends of rainfall and droughts This helped in design of flood protection works, and formulation of water quality and conservation practices (Gozzini and others, Ch 8) Flood risks, too, change dynamically, contingent on climatic states Remote sensing, mapping, and modeling tools enable monitoring rapidly changing conditions over a large area very effectively Dynamic flood risk management addresses the need for

estimating the potentially changing flood frequency distribution and offers a climate-driven risk management approach for flood hazards (Pizarro and Lall, Ch.9).

The proponents of interbasin transfer of water in our country may take a cue from these chapters for realistic hydrological modeling and stream flow forecasting, and a scientific assessment of water surplus of a basin, which is now hotly debated.

Remote sensing has provided a gamut of opportunities in diverse fields of water resource management such as snow and glacier studies, flood and drought management, watershed management, etc. Of particular importance is its use in groundwater management. Occurring in a complex framework of geology, topography, lithology or aquifer media, stream network, intensity and distribution of precipitation, groundwater is highly non-uniform in availability. Satellite imageries are now widely used in India for targeting groundwater, particularly in hard rock terrain, through understanding of these variables in space and mapping of these parameters in conjunction with existing geological and hydro-geological data and limited field checks (Rao, Ch.10). Remote sensing combined with geospatial information technology provides a proven technology in watershed management (Murali Krishna, Ch.11). GIS, a prime component of spatial nformation technology, helps to handle digital maps, analyze them and suggest management strategies. While one third of our country is drought- prone, and suffering from endemic water shortage, the role of remote sensing is crucial in groundwater exploration and water conservation for mitigating the crisis.

The last two chapters in Part 3 of the book dwell on two other important aspects of water management - water harvesting and water pollution. In arid and semi arid regions water harvesting is the only option to stabilize crop yield. Rain water Agro Forestry (Berliner, Ch.12) is one such technique which may find application in arid and semiarid regions of our country too. This also underlines the enormous value of our traditional knowledge of water harvesting, which with inputs of modem science may be effective tools of water management in India, suited to our needs or ground realities. These indigenously developed techniques are efficient, cost effective and easy to implement.

Management of water quality is likely to dominate sustainability of freshwater resource in the coming years. The coastal ecosystem is highly sensitive to environmental pollution, caused by natural processes or anthropogenic activities. Numerical water quality modeling is an effective tool to understand source, type, genesis of pollution, hydrodynamics and hydrochemistry in order to evolve proper control measures as illustrated in Godavari delta (Bobba and Singh, Ch.13). The model outputs regarding saltwater ingress *vis a vis* irrigation and sea tides are remarkable. A finite element model constructed in Port Granby uranium waste disposal site provides another interesting study of leachate infiltration and plume movement. In the coastal areas of India, degradation of groundwater quality is reported due to its overexploitation and sea water ingress or due to contamination from agricultural chemicals and untreated industrial effluents. Numerical modeling may help in protecting the freshwater aquifers from contamination through adoption of preemptive measures.

Overall this book offers a good reading and a valuable guide of the latest innovative methodologies in water science. This book is a must for avid readers and practitioners of this discipline. This is the latest in a series of publications of Dr. Aswathanarayana, each one of which is a masterpiece. Dr. Aswathanarayana has rendered yeoman service by his untiring zeal to transmit the advanced concepts and methodologies in environment and water science in a manner accessible to all students of these disciplines.

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