INTRODUCTION

The main objectives of the Centre are to take up major mathematical modelling and simulation tasks of interest to CSIR by the Centre itself or jointly with other CSIR laboratories and to provide value additions to the CSIR products and services by innovative applications of mathematical modelling. This report briefly presents the developments made during 1995-96 in various areas of modelling: resources, climate variability, earthquake hazard estimation using GPS geodesy, as well as new design approaches based on modelling and innovative numerical algorithms.

The issue of climate variability in tropical regions has been addressed by developing more realistic models of sea-air coupling involving atmospheric convective activity. Sea level data around the Pacific have been analysed by using nonlinear fractal techniques and the results compared with those for the Indian ocean. Quite interestingly, the fractal dimension for both the oceans lie between 1.2 to 1.3.

Modular Ocean Model Version 2 (MOM2) has been used to model the climatology in the Indian ocean, using a finer mesh in the region of interest. The nature of the velocity field at various depths has been computed using the mixing scheme based on the Philander-Pacanonski's Richardson number, and Hellerman wind stresses and initial conditions of salinity and temperature given by the Levitus Database. The simulation also gives quantitative information on the regions of upwelling which is required to estimate marine biological resources.

Global Positioning System (GPS) measurements and their processing have been extended over several crucial regions of the country such as the central and north India and Bidar. The analysis of data acquired during the South Indian Strain Measuring Experiment (SISME) has shown evidence of folding of the southern Indian shield. In another approach to modelling earthquakes caused by sudden release of accumulated strains along weak zones (faults) in the earth, the process has been quantified by using compound slider block models. An innovation introduced in this model involves coupling of the slider block stretching with the chaotic mantle convection.

Resource generation processes that control mineralization on land as well as in the deep ocean, and primary productivity in the oceans have been modelled. Mineralization in the wake of fluid generation from thermal heating of the crust was quantified by modelling the effects of perturbations such as uplift erosion and fluid advection on thermal regimes. In another work, the ash content of coal was statistically analysed to maximize yields. A contemporary dynamical model of marine ecosystem for simulating marine productivity is being intensively investigated for parametric sensitivity and calibration, using the recently acquired data during Indian Joint Global Ocean Flux Studies (JGOFS) cruises. A conceptual model aimed at delienating bioremediation strategies for restoring biosphere integrity threatened by

increasing use of hydrocarbons, is also being investigated.

Several engineering problems such as stability of tunnels, design of coke ovens, pavements of roads, strength distribution of leather surfaces, lift due to leading edge vortex flow, film cooling of plates and thermal effluent dispersion near coast were also analysed during the year, using modelling techniques; the scope of improvements in the designs are presented in the following pages.

Two versatile new numerical algorithms were developed, one involving a generalised neural network (cognitive networks) and the other based on series expansion of functions.

Recognising that high performance computing environment is an essential prerequisite for undertaking large scale computer simulation, significant improvements were made during the year in the operations of CONVEX C3820. As a result, utilisation during the year exceeded 13,500 CPU hrs which marks 50 percent increase over the previous year. Progress has also taken place in networking, and visible improvements are expected during the next year.

One of the most important programmes of C-MMACS constitutes design and implementation of collaborative researches with other CSIR laboratories. This is increasing both in scope and content. Several results of these joint works are presented in this report.

Organisation of scientific meetings is another important component of the activities of the Centre. Out of several meetings organised during the year, one that deserves special mention is the workshop on ocean colour, held during April 1995. This workshop was devoted to applications of quantitative tools to understand the coupling of biological and physical processes in the oceans using satellite data. It was sponsored by seven international agencies and attended by participants from several institutions in the country and abroad.

It is a matter of deep gratification to report that the external cash flow during the year was Rs.50.14 lakhs with CSIR support of Rs.101 lakhs.

This is the last time I am presenting the annual report of the Centre as I lay down my office on 31st March 1996. I should therefore like to take this opportunity to thank the Directors General of CSIR: Dr. A.P. Mitra, Dr. S.K. Joshi, Dr. R.A. Mashelkar, and the Directors of NAL: Prof. R. Narasimha and Dr. K. N. Raju, and the members of the C-MMACS Management Committee for supporting the Centre in its development. I thank all the staff of C-MMACS for their magnificent contributions in the making of a new kind of institution. Financial support from the Department of Ocean Development and the Department of Science and Technology are gratefully acknowledged. I should like to thank Ms.M.K. Sharada and Ms. Sridevi Jade for compiling this report. They along with Dr. Anand Kumar, Dr.P. Goswami, Prof.V.K. Gaur and Dr.R.N. Singh have contributed in various ways to the preparation of this report. Special thanks are due to Ms. Stella Margaret and Ms T.Rani for preparing this report using LaTeX and Mr.M.B. Ananda and Mr.S.T. Anandhan for getting the report published in a short time.

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