PREFACE

It gives me great pleasure to present the Annual Report for 2000-2001, my first as Scientist-in-Charge and C-MMACS' first for the new millennium. It is also the seventh report since C-MMACS began to bring out its annual report independently, as C-MMACS completes its twelfth year since its founding. Over these twelve years, the core competences of C-MMACS have been consolidating and this year's report is indicative of these major areas.

Study of data assimilation programs have been initiated for the Ocean modelling program; the adjoint method is being implemented. Altimeter data from Topex/Poseidon satellite has been procured and comparisons are being carried out with the model outputs. Model forcings with 6-hourly winds show finer spatial and temporal structures than climatologically forced runs as expected. Ocean color data from recent satellites like IRS-P4 and SeaWiFs are being analyzed for correlation with biology and related oceanographic phenomena. The extensive data sets from these satellites will help tune the C-MMACS biogeochemistry models better and allow them to be incorporated into data assimilation exercises; better biogeochemistry models with separation of phytoplanktons into smaller and larger sizes have also been implemented.

Forecasts from C-MMACS Cognitive Network model continue to be good and is attracting increased attention; many multinational banks, financial institutions and stock majors have come forward to receive monsoon forecasts from C-MMACS. On the research front, variable resolution GCMs are being studied as an alternative to uniform increase in horizontal resolution for better simulations. An important initiative being followed up is the setting up of a joint Indo-French Centre for Environmental Research (IFCER), where the many activities under ocean and atmospheric modelling are given a more coherent focus with applications to climate modelling, extreme events, global change, etc.

The GPS program continues to make rigorous progress. Measurements at the old stations have helped refine the computed strain rates for the Indian plate. The wider coverage achieved through the newer stations have helped the computation of an angular velocity vector for the Indian plate which can now be compared with the one obtained from sea floor data of last 3 Myrs. Highest intra plate velocity noted for Shillong has prompted further studies there; after

effects of the Bhuj earthquake are being followed up through the sophisticated measurements of GPS.

Work in Darjiling-Sikkim-Tibet (DaSiT) Himalayas to study the kinematics of mountain formation from the viewpoint of the critical wedge theory had earlier revealed that the middle part of DaSiT wedge is the location for neotectonic deformation; microtectonic work is now being carried out in this area.

A new program on computational structural mechanics using finite element modelling (FEM) has been started at the Centre. FEM of vibration of plates and beams with different simplifications of the nonlinear terms have been studied; active vibration control of smart structures is also being studied. A major direction being followed up is to lay down the canonical principles which guide error analysis of the method and which could be used to automate FEM computation. To characterize the strength and stiffness of jointed rock masses, an equivalent continuum model has been developed which simplifies the problem while giving reasonably accurate results.

Study of the viscoelastic fluids, a significant problem for the industry, has been carried forward where the oscillatory Rayleigh-Bénard convection, unique for these fluids, has been modeled and simulated. The study of the bioremediation problem for Borhola oil fields, Assam, has thrown up the challenging field of moving grid methods which is being taken up for study and implementation in this context.

In some efforts with a futuristic ambition, C-MMACS is exploring the feasibility of co-ordinating a program, on a mission basis, to apply the latest developments from nonlinear dynamical systems and quantum theories to cryptography and network security. In another instance of nonlinear dynamical systems theory, contacts between fractal and random surfaces are being simulated.

All these endeavors are being carried out in spite of C-MMACS having fallen behind with computing power resources, particularly over the last few years. Action has been taken to remedy this and it is hoped that, by August 2001, C-MMACS would, once again, offer high performance computing resources.

The 2000 Foundation Day lecture was delivered by one of

India's most eminent scientists, Prof. C. N. R. Rao, Honorary President of the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore on *Nanotubes and Nanoparticles*. At the beginning of this reporting year, I left my old assignment in the National Aerospace Laboratories, Bangalore, to take over as Scientist-in-Charge of C-MMACS from Dr. Anand Kumar, who was Acting Scientist-in-Charge since Dr. R. N. Singh's departure to NEERI, Nagpur.

During this year, we also saw the Advisory Committee (AC) of C-MMACS being re-constituted. C-MMACS has always been privileged to have its AC chaired by the Director General of CSIR; Dr. R. A. Mashelkar, FRS, continues to chair the new AC. C-MMACS expresses its most grateful thanks to the members who are retiring from the old AC and welcomes the new members of the re-constituted AC.

C-MMACS must particularly single out the unstinted support of Dr. T. S. Prahlad, Director, NAL. Department of Ocean Development (DOD) has continued to support wholeheartedly the scientific work of C-MMACS and, in fact, the new high performance computing setup being acquired by C-MMACS is funded by them. I thank Dr. A. E. Muthunayagam, former Secretary (who retired last year), and Dr. H. K. Gupta, present Secretary, DOD for their faith in C-MMACS. I also express my sincere thanks to Dr. V. S. Ramamurthy, Secretary, Department of Science and Technology for the generous help in C-MMACS activities.

I thank all the members of Team-C-MMACS for continuing to put up an excellent performance. Dr. T. R. Krishna Mohan, Convenor, Knowledge Management, has performed the difficult task of compiling and editing the Annual Report and he has been ably assisted by Ms. S. Sita and Mr. Arjun. He has also benefitted from the generous help extended to him by Dr. Srinivas Bhogle, Head, Information Management Division, NAL, and his team. In particular, Dr. Krishna Mohan likes to thank Mr. A. S. Rajasekar and Ms. Vaishali Vinay of Dr. Bhogle's team. The support of C-MMACS systems group headed by Mr. R. P. Thangavelu was vital to this exercise and, in particular, that of Mr. Prabhu.

Gangan Prathap
Scientist-in-Charge