Preface

It is my great pleasure to present the Annual Report for 2014-15 highlighting the scientific achievements for the year along with other information. CSIR-4PI continued to march towards improving their niche areas of research in different subjects. The scientists of CSIR-4PI has taken up major projects in diverse areas of research and their contributions in multi-disciplinary areas are much acknowledged in the form of 47 publications in SCI and non SCI journals, 22 Conference publications and 25 Conference presentations during 2014-15. The institute continued its interactions with various national and international agencies through their collaborative research work. The major highlights of the year are briefed here for different groups.

The Intergovernmental Panel for Climate Change (IPCC) has clearly established anthropogenic greenhouse gases (GHG) as the main drivers of global warming and climate change. However, the budget of GHGs are still far from being established robustly due to lack of accurate measurements of GHG concentrations and gaps in modelling the carbon, nitrogen and oxygen cycles, especially the oceanic component. At CSIR 4PI, we have been contributing to both these efforts – (a) by establishing WMO-standard GHG stations and using this data to obtain robust fluxes by inversion and (b) making fundamental contributions to the processes in the carbon cycle, incorporating these into 3-D ocean circulation and biogeochemistry models to study the inter-annual variations of the carbon, nitrogen and oxygen cycles.

The primary strength of CEMP is its multi-disciplinary research and outreach. The year 2014-15 has seen this potential and efforts of CEMP realized through several high-impact multi-disciplinary SCI publications. These publications (total of 21, SCI: 10 + 11 others) in 2014-15 covered diverse topics from assessment of virtual trade in water (Nature Scientific Reports), modeling of malaria (PLOS ONE), extreme rainfall events (Climate Dynamics) and demonstrate the power of generic mathematical modeling, computer simulation and data analysis. The process models are developed completely in-house from computer coding to validation. The year also marks the fifth consecutive year of successful operation of CSIR (COMoN), with two new installations over Siachen (in collaboration with SASE, DRDO) and Leh (in collaboration with Kashmir University). The experimental advance dynamical high-resolution forecasting of Date of Onset of Monsoon saw the 13th successful year in 2014. Along with these applicable products, three students and scientists also submitted Ph D from CEMP. A number of international (UKIERI, CSRIO,..) and national (NDMA, ICRI, ICAR,..) agencies have approached CEMP for collaborative R&D. To enhance and integrate the efforts for applicability, an inter-group synergy on Integrated Disaster Assessment and Modelling (IDAM) Programme was initiated in 2014.

The homotopy analysis method was applied to a number of problems and satisfactory results were obtained. These problems consisted of systems of coupled nonlinear ordinary differential equations. Work was initiated on including particle inertia in our earlier work on periodically forced suspensions. Work on kernel determination for one dimensional carbon nanostructures was initiated.

During the year, the 360 TFLOPS CSIR Supercomputing facility continues to serve the CSIR scientific community for all their supercomputing needs. The facility is operational on a round-the-clock basis and it is being accessed by CSIR Scientists over the high speed National Knowledge Network.

The research in Cyber Security continues to produce innovative results in security aspects of next generation transport layer protocols, trust assessment of public cloud infrastructure and characterization of malicious cyber incidents. The team has prosed a new acknowledgement generation scheme called Data Enriched SACK for SCTP protocol.

The broadband seismic arrays was established in Kashmir Himalayas and quantified the first ever information about a consistent Moho geometry of the region even overlying décollement. We have also established seismic hazard and risk assessment based on multi-scale analysis embedded in Unified Scaling Law for Earthquakes (USLE) approach. We gave region specific dislocation models for Indian Himalaya and Indo-Burmese Arc, present day deformation rates in Assam Valley and adjoining region and initiated Landslide deformation modeling.

Multiscale Modeling and Simulation Group is involved in working with a multiscale, earth system model to address climate and climate change issues specific to India. Studies of tropical climate, Indian monsoon and variability, climate projections under different global warming scenarios, aerosol impact on climate, dynamical downscaling and statistical model-bias removing methods are being carried out employing an unprecedentaly high resolution global climate model, regional climate model, aerosol process model and earth system model. Since 2012, climate change projections for the state of Kerala are provided to Directorate of Environment and Climate Change, Government of Kerala.

The academic programme of CSIR-4PI is progressing very well with increasing number of students enrolling for the SPARK programme. A number of students from premier institutions in India joining for their project work under the guidance of scientists in different areas. Three students received their Ph.D. degree.

My sincere thanks to all the concerned Departments and Organizations, both national and international, for supporting the research efforts of CSIR-4PI . It is my privilege to express my gratitude to DG, CSIR and members of our Advisory Committee for their support & guidance. Our special thanks to all the divisions of CSIR NAL for their unstinted support. Thanks are also due to Prof V K Gaur, Dr K S Yajnik, Dr U N Sinha, Dr Ehrlich Desa and Dr T S Balganesh for continuing to be involved with the activities of CSIR-4PI and providing advice and guidance to the scientists. I take this opportunity to thank all scientists and other staff members of CSIR-4PI for their commitment to this unique organization.

Head, CSIR-4PI

Highlights 2014-15

- ***Climatalogical and interannual simulations of the carbon, nitrogen and oxygen cycles in the ocean***
- ***Simulations reproduced observed features such as subsurface chlorophyll maxima, primary productivity and profiles of nutrient concentrations well***
- ***Accurate measurements of greenhouse gases concentrations***
- ***Correlated measurements of different species to identify common sources***
- ***Impact of monsoon on GHG concentrations seen clearly***
- ***Eighth Successful year of advance forecasting of Date of Onset of Monsoon; zero error in the advance forecasting of the onset for 2014***
- ***Fifth successful year of Hobli (Village Cluster) Level forecasting over Karnataka enhanced to Gram Panchayat level in 2014***
- ***Multi-disciplinary SCI Publications: Climate Projections, Malaria model, Air pollution model, Crop disease, sustainability***
- ***IPCC Assessment Report 5 Lead Authorship (Working Group I, Chapter 14)***
- ***International Workshop on Assessment, Modelling and Applications of Renewable Energy (AMARE) 20-22 May 2014, Hyderabad, India***
- ***Workshop on Weather and Climate Informatics for Pro-Active Healthcare (WACIPH), 26-27 November, 2014***
- ***National Discussion Meeting on Modelling and Projections for Spices, Aromatic and Medicinal Plants, Coffee and Tea (MP-TRACS), August 26, 2014, C- MMACS***
- ***MOU with Indian Cardamom Research Institute for joint collaboration on forecasting of capsule rot of cardamom***
- ***Integrated Disaster Assessment and Modelling (IDAM) Programme with inter-group synergy***
- ***Proposed a Best fit Gaussian kernel which clearly gives most accurate fit, improving even upon the fourth-order strain gradient kernel.***
- ***Molecular Simulations carried out for the carbon nanotube***
- ***Application of the homotopy analysis method to a number of technically important problems***
- ***Equations derived for including particle inertia for perioidically forced particles in simple shear flow***
- ***Kernel determination for one dimensional carbon nanostructures***
- ***Centralised 360 TF Supercomputing facility for CSIR computational scientists***
- ***Earth System Model: New version of the coupled ocean-atmosphere climate model***

- ***Impact of increased GHG emissions for the state of Kerala***
- ***RCP 8.5 scenario climate change projection for India using high resolution Global Climate Model***
- ***Role of mean and variability of Indian summer monsoon rainfall in reliability of future projections in CMIP5 coupled models***
- ***Comparing statistically downscaled simulations of Indian monsoon at different spatial resolutions***
- ***Implementation of regional climate model for climate change applications***
- ***Bivariate PDF analysis of latent heating over the tropics***
- ***Cyclonic events in Megha-Tropiques tata***
- ***Rainfall and aerosol optical depth from an aerosol coupled GCM during the abnormal Indian Summer Monsoon of 2000***
- ***Characteristics of MODIS aerosol optical depth during 2002 drought monsoon***
- ***Trust rating for public cloud infrastructure***
- ***Active landslide monitoring in Chamoli district of Uttarakand***
- ***Present day rotation of Assam valley and adjoining regions***