Foreword

The onward march of science is driven by an eternally interactive triad: concept, observation (and analysis) and theory. Fortunately, in atmospheric science, this triad has been sufficiently active, and now with a healthy balance among its three components. Thanks to the advent of modern observing platforms, the red colour of the data void regions is slowly receding, and as the technology arms the modeller with ever-increasing computing power, the deepest secrets of the complex non-linear dynamics of the atmosphere are beginning to unravel. The papers included in this special issue fully reflect this wholesome trend.

Perhaps the weakest link in the triad, until recently, has been the sparcity of data. Fortunately, the entry of modern observing platforms, with space-borne platforms leading the way, has brought about a major change. The advent of satellite meteorology heralds a new era in meteorology in general, and monsoon meteorology in particular. The moist, cloud-covered tropical atmosphere offers special challenges to meaningful abstraction and use of satellite data. This trend is reflected in the three manuscripts in this volume which address three very important questions in this area. Thus the paper by **Prasad, Prasad, Prasad and Kelkar** shows that it is possible to obtain estimates of humidity profiles from cloud imagery data. These humidity profiles, as they show, are potential candidates for monitoring the genesis and the dynamics of tropical systems like depressions and cyclones. Since these synoptic scale systems form an important component of the monsoon circulation, work in this direction can also contribute to the understanding and prediction of the overall monsoon cloud climatology. The use of satellite data relating to another important parameter, radiative forcing, is discussed in the paper by **Mahajan, Chinthalu and Rajamani**, claiming that satellite derived energy budgets compare well with the observed characteristics of the radiative energy budget over the monsoon region, atleast for the year 1979. On the use of dynamical variables like surface winds from satellite observations, the paper by **Rao, Desai, Joshi, Pandey, Gohil and Simon** shows a clear and consistent signal in the pre-onset response of the winds over the Arabian Sea. While these are extremely promising trends, we need extensive analysis and validation of these results from larger samples. Hopefully, these studies will lead to more comprehensive ones in the future.

The monsoon now increasingly appears to be at the heart of a game involving complexity and predictability. For, despite the maze of interacting processes, there is a hierarchy of spatial and temporal organizations. There is now a growing appreciation that phenomena at widely different time scales, from a few days to a few years, are perhaps not isolated from one another but a part of an organized hierarchy. This is where the other two components of the triad, conceptualization and hypothesis testing, can be most useful. This, in turn, calls for objective, rigorous and quantitative analyses of observed data as well as of model outputs. Three papers – the first by **Goswami, Suresh Kumar and Sengupta**, the second by **Krishnan and Keshavamurthy** and the third by **Munot and Pant** present exciting developments in this area.

The paper by Goswami *et al* demonstrates the tantalizing connection among the components of the hierarchy of tropical oscillations. This is one area where analysis can be said to be ahead of conceptualization and modelling. However, that would be a hasty conclusion; for the objectively analyzed data sets have significant contribution coming from modelling studies. Still, a concerted effort is needed to understand the dynamical factors responsible for these observed temporal connections. Incorporation of these factors can significantly improve the quality and the scope of large scale models of climate leading to enhanced predictability.

An important aspect of the study of the complexity of a system is to identify its cause and effect connections. The atmosphere, and the monsoon system in particular, is characterized by a network of interactive causes and effects; identification of the sensitive nodes in this network is an important task. The paper by **Munot and Pant** supplies yet another piece to this jigsaw puzzle.

The paper by **Krishnan *et al***, on the other hand demonstrates the effectiveness of modelling in elucidating, and eventually predicting complex atmospheric flows, and the monsoon in particular. This

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paper also completes the triad by linking observations in a tight loop with theory. Thus it is shown that it is possible to identify certain upper-level stationary wave patterns during weak monsoons from observations. Using General Circulation Models, the authors then demonstrate that such stationary waves may result as a global response to SST anomalies in the eastern Pacific. The use of a barotropic vorticity equation to understand these stationary patterns during drought conditions then takes us one step closer to understanding the vagaries of a complex system like the monsoon.

A discipline such as monsoon meteorology is an ever-widening arena driven by *environmental pressures* of all kinds – from changing technologies to user demands. Indeed the challenge today is to model the entire geo-bio hydro-ecosphere as interacting components of a single complex system. The paper by **Sethu Raman *et al*** reflects this rising trend, and reports a pioneering investigation on the interaction of atmosphere and biosphere in the tropics. This, we hope, will be the beginning of a more comprehensive study involving all the three components: observations, hypothesis formulation and modelling.

The growing synergy of observation, analysis and theory in atmospheric science is good news! Yet science cannot be completely freed from its obligations to the society that supports it – an obligation that also provides an anchor and a direction in an otherwise vast neutral ocean. A more intense effort to link the knowledge gained to user needs must also be made. For, only knowledge thus potentiated can be claimed as (wholesome) power. The overwhelming dependence of the Indian economy on agriculture necessitates a clear understanding of the monsoon variabilities and underlines such an obligation. The overall trend, however, is good, as the papers in this special issue show.

I should like to thank all the authors who submitted manuscripts for this special issue. The response has been indeed, overwhelming. However, of about eighty manuscripts received, only a few could be included owing to the constraints of the review process and editorial standards. A special word of thanks is due to the reviewers of various manuscripts for a most thorough and painstaking scrutiny.

The TROPMET series of conferences has now become a major event in atmospheric science, both nationally and internationally, as the brief outline by Yajnik and Goswami presents (see facing page). However, this is the first systematic attempt to disseminate the large number of research works presented through an international research journal. This would not have been possible but for the encouragement and support received from Prof. V K Gaur, Editor, *Proceedings Earth and Planetary Sciences*. To him and to the editorial staff of the Indian Academy of Sciences we are deeply indebted for a most efficient organization of this issue.

P Goswami
Guest Editor