Tropical Circulation Systems and Monsoons

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Dedicated with gratitude to my beloved wife,
Usha

Preface

The present book is a sequel to the author's first book entitled 'The Earth's Atmosphere – Its Physics and Dynamics', published in 2008, and addresses the practical side of the subject with stress on proper analysis and interpretation of tropical data. It deals specifically with circulation systems that are excited by heat sources and sinks in the Earth-atmosphere system over the tropics and extratropics. Together, the two volumes are intended to form a fairly comprehensive course of study of tropical meteorology, in theory and practice. A few new ideas, especially on monsoons, though empirically derived from data and analysis, would appear to be intuitionally born out of nowhere and are put forward by the author in the hope that they will be verified by practicing meteorologists in the years to come.

The book is divided into three parts: the first deals with some general aspects of tropical general circulations and their disturbances; the second with monsoons over seven regions of the tropics, and the third with monsoons over Central America and the extratropical belt of North America.

Part I, in dealing with the General circulation of the atmosphere in the tropics and its large-scale perturbations, introduces the Hadley, Walker and Monsoon circulations in a unified system. It also introduces the synoptic-scale tropical disturbances, such as Easterly waves, monsoon troughs, depressions and cyclones and gives a detailed account of their formation, structure, development and movement over different parts of the globe. Part II is devoted wholly to Monsoons in different parts of the tropics. The regions covered are Southern Asia, Eastern Asia, Maritime Continent, Australia, North and South Africa, and South America. Part III deals with monsoon over Central America and adjoining Southwestern North America as well as monsoons over North America.

Monsoon is one area where the book advances several new ideas and concepts. It offers an entirely new definition of monsoon which allows monsoon to be detected and identified over several hitherto-unsuspected regions of the globe. It unveils the wave structure of the monsoon and identifies the areas to be associated with organized clouding and rainfall. Among the other important issues discussed in the book are the origin of African wave disturbances which later in their life cycle develop into Atlantic hurricanes, Low-Level Jets over several parts of the globe, and monsoon lows and depressions over South America, and formation of tropical cyclones over the South Atlantic Ocean.

Written in an easy-to-understand style, with minimal mathematics, the book is intended for use by students pursuing courses in atmospheric science at undergraduate and graduate levels in colleges and universities and by scientists of other disciplines interested in tropical meteorology. It is likely to appeal to a large circle of readers interested in studies of tropical monsoons. Practicing meteorologists may find it particularly useful and challenging while comparing the results of their analysis and diagnosis of tropical circulation systems with the empirical and conceptual models suggested in the book.

Inspite of the utmost care taken in the preparation of the book, it is likely that there have been errors and omissions. The author will be thankful if such lapses are brought to his notice.

University Park, Maryland Kshudiram Saha
June 15, 2009

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Guide to Numbering Figures and Equations

Figures are numbered serially chapterwise. For example, Fig. 5.12 is diagram No. 12 of Chapter 5.

Equations are numbered serially, sectionwise and chapterwise. For example, Eq. (5.12.4) is Equation No. 4 in Section 12 of Chapter 5.