

## Book review

**Tropical Meteorology, Volumes 1 and 2** by G.C. Asnani (Published by the author, 1993) 1202 pp., US\$80.00 (US\$95 Air Mail).

The author of this two-volume text, G.C. Asnani, has had extensive experience in research meteorology, operational forecasting and graduate-level teaching. After commencing his career as a weather forecaster and completing his Ph.D., he became Officer-in-Charge of Advanced Training and Theoretical Studies Divisions at the Indian Institute of Tropical Meteorology, Pune, India. He has worked as WMO expert at the University of Nairobi, more recently at the University of Poona and has had extensive international experience. This unique background has enabled him to assemble scientific knowledge from many and varied sources, and present it in a structured and logical way. The book is intended for readers with some prior knowledge of synoptic and dynamical meteorology — concepts such as non-linear balance and pressure-wind adjustment are discussed in chapter one. The content has been well researched and the presentation is honest and convincing. Careful attention has been paid to historical accuracy. One of the most astonishing aspects of the volumes is the total content — everything from dust devils to stratospheric waves. A considerable effort has also been made by the author to investigate all research work relevant to a particular topic, although unfortunately (but understandably) some omissions have been made. One aspect I particularly like is the attempt to integrate observations with theoretical and modelling studies. The reference list is quite comprehensive and generally up-to-date, although in rare instances, a time lag is evident between the writing of some chapters and the current state of knowledge. Still, the reference list in itself provides a useful starting point for anyone wishing to better understand particular aspects of tropical meteorology. The author has tried to convey the joy and excitement he has experienced in observing the tropical atmosphere and contemplating its dynamics.

Chapter 1 deals with 'what makes the tropics special' and considers the implications of a small Coriolis force and the importance of diabatic heating. Interesting use is made of scale analysis and the linearised form of the shallow water equations to illustrate that generally in the tropics the pressure field adjusts to the wind field. The author highlights the importance of accurate wind

observations and analysis over low latitudes. Chapter 2 describes the climatology of the tropics with particular emphasis on (a) the zonally averaged distribution of variables, (b) meridional circulations, (c) structure of the ITCZ, (d) budget diagnostics, (e) deserts and (f) jet streams. Of particular interest is the contribution to the meridional circulation from the tropical diabatic heating (Hadley circulation) and mid-latitude tilting troughs. Chapter 3 deals with climate change. The author draws attention to the many uncertainties in numerical simulations, describes the classical GCM studies of Phillips (1956) and emphasises the need for observations from baseline stations. A long chapter 4 describes the monsoons of the world, with particular emphasis on the Indian monsoon. The components of the monsoon, its structure and embedded weather systems are described. The author documents the history of numerical simulations of the monsoon (using shallow water, quasi-geostrophic and primitive equations models) and their response to diabatic heating. The monsoons during FGGE (and its sub-components, Summer and Winter Monex) are described in some detail. Fifteen years after FGGE, although progress has been made, the physical processes associated with onset, withdrawal, revival and fluctuations of the monsoons are still not clearly understood! Chapter 5 is possibly my favourite chapter and deals with near-equatorial flows, both observationally and theoretically, through the classical work of Matsuno (1966) and Gill (1980). This then leads into discussion of subsidence near the equator, some interesting equatorial climates, the 30 to 50-day oscillation (Madden and Julian 1972), the quasi-biennial oscillation and the El Niño-Southern Oscillation. Chapter 6 covers instability of tropical flows and deals in a fairly standard way with conditional instability of the first kind, Kelvin-Helmholtz instability, inertial instability, barotropic and baroclinic instability and conditional instability of the second kind. The work of Charney (e.g. Charney and Eliassen 1964) is of course fundamental to much of this theory.

Volume 2, chapter 7 discusses the current state of knowledge on vertical propagation of waves in the stratosphere, the QBO, sudden stratospheric warmings and coupling between the troposphere and stratosphere. The works of Eliassen and Palm (1961) and Holton and Lindzen (1972) are considered in some detail. Chapter 8 deals with tropospheric easterly waves, which the author believes are quite fundamental to the development of

weather systems including tropical cyclones. Their occurrence and structure over India, Africa, the tropical Atlantic and the northwest and central Pacific are described, together with theories and simulations of their development. The claim that they are also important over the southern hemisphere tropics requires further confirmation. Chapter 9 deals with tropical cyclones from an observational, theoretical, modelling and forecasting perspective. The treatment is quite comprehensive, however, here I felt that some important work had not been considered and referenced. Chapter 10 discusses mesoscale systems. Attention is mostly focused on thunderstorms and squall lines (via, for example, Moncrieff and Miller (1976)), but consideration is also given to hail, tornadoes and orographic winds. The final chapter, entitled Recent Trends in Tropical Meteorology, concentrates mostly on numerical weather prediction. Quite detailed treatments are given of objective analysis techniques, initialisation, numerical methods and parametrisations of convection, the boundary layer and radiative processes. Finally, recent advances in observational technology, particularly from satellites, are described.

These volumes provide a quite comprehensive and detailed summary of the current state of knowledge in tropical meteorology. The book is well written (although some changes to phrasing may have slightly improved readability) and

contains surprisingly few typographical errors. I would recommend it as an important acquisition to any meteorologist's library, particularly at the very reasonable 1993 price of \$US80.00 by surface mail.

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- Holton, J.R. and Lindzen, R.S. 1972. An updated theory for the quasi-biennial cycle of the tropical stratosphere. *J. Atmos. Sci.*, 29, 1076-80.
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