

## Preface to the Second Edition

In the Preface to the First Edition of this book, we wrote about the goal to provide a one-stop reference text on intraseasonal variability (10–90 days) to bridge the gap between weather forecasts (a few days to a week), and climate predictions (seasonal, yearly, and longer timescales). We seek to further this goal in the Second Edition. The years since the publication of the First Edition have seen significant advances in our understanding of the physical processes, multiscale interactions, and predictability associated with intraseasonal variability in the tropical ocean–atmosphere system. These advances have been achieved by the scientific community at large through (a) increased capabilities in high-resolution global modeling and data assimilation, (b) in-depth theoretical studies, and (c) improved diagnostics mostly from new global satellite observations and improved reanalysis products.

At present, a realistic simulation of the Madden and Julian Oscillation (MJO) is considered a prerequisite for climate models to produce reliable predictions of inter-annual variability and longer term projections of regional impacts and extreme events from climate change. Common metrics for MJO prediction and diagnostics have been developed and adopted by the scientific community so that model validations and empirical forecasts of the MJO can be compared and evaluated. Operational forecast centers such as the U.S. National Oceanic and Atmospheric Administration Climate Prediction Center, the U.K. Meteorological Office, and the European Center for Medium-range Weather Forecasts, among many others, are producing routine forecasts of the MJO. Predictions of onsets and breaks in major monsoon regions around the world are now focused on the propagation and evolution of regional intraseasonal oscillations (ISOs). International and national organizations such as the World Climate Research Programme and the World Weather Research Programme have joined to sponsor working groups and task forces to organize international projects and workshops to facilitate and coordinate research on the MJO and ISOs. The science community has now coined the term “seamless prediction” to address the continuum of temporal and spatial scales linking weather and climate. Indeed, the MJO and associated regional ISOs represent critical linkages between global weather forecasts and regional climate

predictions. Another critical factor spurring the recent rapid advance in our understanding of the MJO and ISO phenomena was the advent of a series of NASA Earth-observing satellites launched between the early 2000s and the present. As a result, the scientific community has access to unprecedented information regarding propagation, horizontal and vertical structures of rainfall, clouds, moisture, and temperature. Such information is essential to define the characteristics of the MJO and associated regional ISOs and their far-field impacts. Other derived quantities such as latent heating profiles and cloud microphysics derived from satellite data and field campaigns are setting the stage for the next level of understanding and improved model fidelity associated with the MJO and ISOs. Studies documenting the influence of the MJO on ozone, aerosols, and carbon dioxide fluctuations in the atmosphere and in ocean productivity are emerging, further demonstrating the far-reaching importance of the MJO and ISOs not only in the physical domain but also in the biogeochemical component of the climate system. Given these momentous recent developments, the Second Edition of the book seems opportune.

The organization of the Second Edition is as follows. The first 12 chapters are either original chapters (Chapters 1, 8, 9), or original chapters with updates (Chapters 2, 3, 4, 5, 6, 7, 10, 11, 12). Chapters 13-18 are new shorter chapters that cover new topics or significant recent advances. In some cases, the latter can also serve as updates or complements to the original chapters. Specifically, the new chapters are: Chapter 13 on “Africa and West Asia” by M. Barlow; Chapter 14 on “Tropical and extratropical interactions” by P. Roundy; Chapter 15 on “Oceans and air–sea interaction” by J.-P. Duvel; Chapter 16 on “Vertical structure from recent observations” by C. Zhang; Chapter 17 on “Multiscale theories” by A. Majda and S. Stechmann; and Chapter 18 on “Chemical and biological impacts” by B. Tian and D. Waliser.

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