Introduction

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On 27 January 2011, a special symposium honoring the late Professor Michio Yanai was held, taking place during the 91st American Meteorological Society Annual Meeting in Seattle. The symposium consisted of invited talks (conceived as ''lessons'') organized around the principal research areas that attracted Professor Yanai's attention and passion. As a tribute not only to his many important contributions but also to his dedicated mentorship of students and junior researchers, many of the lessons represented collaborations between more senior and junior scientists. This monograph was crafted from a subset of oral and poster presentations from the symposium, in the hope of creating a lasting tribute to Professor Yanai and his legacy, and a useful reference for scientists in all stages of their careers. Also included are personal reminisces from Professor Taroh Matsuno (Forward) and a biographical sketch of Professor Yanai's life (Epilogue).

Professor Yanai started his academic career as an assistant professor at the University of Tokyo in 1965, followed by a full professor appointment at the University of California, Los Angeles, in 1970. He began his career studying tropical cyclones (TCs) and his 1964 review paper on TC formation served as the most comprehensive reference on the topic for more than a decade. Much of his groundbreaking work continues to guide research even today, including his observations of the mixed Rossby–gravity wave, his systematic approach of estimating apparent heat sources (Q_1) and moisture sinks (Q_2) and associating them with the bulk properties of convective systems, and his diagnostic studies of the Asian monsoon, in particular his pioneering works on the impacts of the Tibetan Plateau on the Asian monsoon. In 1986, the American Meteorological Society honored him with the Charney Award. In 1993, he received the Fujiwara Award from the Meteorological Society of Japan. Before the advent of online archives and powerful search engines, his *UCLA Tropical Meteorology and Climate Newsletter* functioned as an invaluable resource to the community since its founding in 1996.

This monograph pays tribute to these distinguished aspects of Professor Yanai's work and life. The first part (chapters 1–8) deals with phenomena, starting with observations from ground-based or spaceborne platforms (chapters 1 and 2) as examples of multiscale convection coupled tropical systems and utilizing, at the start, nothing other than a few elementary conservation laws. As their significance cannot be understated, Q_1 and Q_2 are introduced right away (in chapter 1). Students learn in introductory dynamical meteorology that due to the smallness of the Coriolis parameter, the geostrophic approximation breaks down in the tropics. In lieu of geostrophy, tropical synoptic meteorologists make use of the thermodynamic equation, in which the vertical advection of potential temperature is approximately balanced by the apparent heating (i.e., Q_1) that includes radiative heating, latent heat release by net condensation, and the vertical convergence of the vertical eddy transport of sensible heat. To be a practical reference, the discretization of the thermodynamic equation from which Q_1 can be obtained over a fixed grid in the pressure coordinate on a sphere is shown in the appendix of chapter 8.

In the convectively active tropical troposphere, there is a strong coupling between the thermodynamic equation and the moisture conservation equation, and hence between Q_1 and Q_2. Other than reflecting the consistency between the net latent heat release present in both equations, the beauty of examining this coupling is to

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reveal the vertical eddy transport of moist static energy due to convection. Much of the complexity in tropical convection coupled motions results from the convective eddy transport interacting with the baroclinic atmospheric states associated, for example, with tropical waves and the Madden–Julian oscillation (chapters 3–5) and monsoon circulations over Asia and the Maritime Continent (chapters 6 and 7), owing to the inherent nonlinearity and the apparent randomness in moist convective processes. The outcomes of the system are manifested in multiple spatiotemporal scales.

In the second part, chapters 9 to 16, a hierarchy of models is presented, ranging from the theoretical ones purposefully constructed to elucidate essential mechanisms in the multiscale convection coupled tropical waves and the Madden–Julian oscillation (chapters 9 and 10) to full-physics cloud-system-resolving or multiscale (''superparameterization'') global climate models aimed to simulate the atmosphere with cloud processes in high fidelity (chapters 14 and 15), and those in between. There are multitudes of physical processes operating in the modeled system, most notably here the cloud microphysics–radiation feedback from weather to climate scales (chapters 11–13). Note that cloud microphysics and radiation are processes contributing to the true heat sources as opposed to the apparent ones, which include the heat transports due to unresolved eddies. Chapter 16 articulates the fundamental requirement and the ongoing efforts for the physics to converge from the apparent to the true heat sources as the models with cloud processes are refined.

The Yanai Symposium was not only well received but also very well attended, with one very sorrowful absence: Professor Yanai himself. Humbled yet thrilled by the event, Professor Yanai enthusiastically participated in the planning. However, he was also beset with health problems, and passed away on 13 October 2010, a few short months prior to the symposium. He would also have been honored and humbled by this volume, which is the result of the dedicated efforts of the authors, editors, reviewers, and advisors listed below:

Prof. Akio Arakawa, Dr. Jian-Wen Bao, Dr. James Benedict, Dr. Amit Bhardwaj, Prof. Lance Bosart, Dr. Mark Branson, Dr. Scott Braun, Dr. Yizhe Peggy Bu, Dr. Yang Cao, Prof. Chih-Pei Chang, Dr. Baode Chen, Prof. Tsing-Chang Chen, Dr. Jiun-Dar Chern, Prof. Jan-hwa Chu, Dr. Paul Ciesielski, Prof. Kristen L. Corbosiero, Dr. Mark DeMaria, Prof. Yihui Ding, Prof. Leo Donner, Dr. Timothy Dunkerton, Prof. Russ Elsberry, Prof. Steve Esbensen, Dr. Wojciech Grabowski, Dr. Mircea Grecu, Dr. Yu Gu, Dr. Samson Hagos, Dr. Arthur Hou (deceased), Prof. Robert Houze Jr., Dr. Li-Huan Hsu, Dr. Xian-an Jiang, Prof. Richard Johnson, Dr. Joon-Hee Jung, Dr. Ramesh Kakar, Prof. Marat Khairoutdinov, Prof. Boualem Khouider, Dr. George Kiladis, Prof. Ruby Krishnamurti, Prof. T. N. Krishnamurti, Dr. Vinay Kumar, Prof. Hung-Chi Kuo, Mr. Stephen E. Lang, Dr. William K.-M. Lau, Dr. Seungwon Lee, Dr. Frank J.-L. Li, Prof. Hock Lim, Dr. Changhai Liu, Prof. Fei Liu, Prof. Xiaodong Liu, Prof. Yimin Liu, Dr. Mong-Ming Lu, Prof. Victor Magaña, Prof. Andrew J. Majda, Prof. Eric Maloney, Prof. Brian Mapes, Prof. Taroh Matsuno, Dr. Rachel McCrary, Dr. Mitchell W. Moncrieff, Prof. Kenji Nakamura, Dr. Riko Oki, Dr. William Olson, Dr. Kazuyoshi Oouchi, Prof. David Randall, Prof. Thomas Rickenbach, Dr. Andrew Robertson, Prof. Masaki Satoh, Prof. Courtney Schumacher, Prof. Shoichi Shige, Dr. Anu Simon, Dr. Xiaoliang Song, Dr. Cristiana Stan, Prof. Sam Stechmann, Dr. Graeme Stephens, Dr. Hui Su, Prof. Yukari N. Takayabu, Dr. Wei-Kuo Tao, Dr. Katherine Thayer-Calder, Dr. Aype Thomas, Dr. Duane Waliser, Prof. Chien-Ming Wu, Prof. Guoxiong Wu, Dr. Shaochen Xie, Dr. Kuan-Man Xu, Prof. Yongkang Xue, Prof. Ming-Jen Yang, Prof. Chidong Zhang, Dr. Guang Zhang, Prof. Minghua Zhang, and two anonymous reviewers.

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For information on supporting the Michio Yanai Memorial Fund, please contact UCLA Physical Sciences Development by phone at +1 (310) 794-9045 or e-mail to physicalsciences@support.ucla.edu. To learn more about the Yanai Lecture, please contact the Department of Atmospheric and Oceanic Sciences at +1 (310) 825-1217 or visit http://www.atmos.ucla.edu/yanai.