Lin. Y.-L.: Mesoscale Dynamics. Cambridge University

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The study of mesoscale phenomena forms a branch of meteorology with ever increasing relevance in contemporary research. The still quickly growing computer power, advanced numerical methods, and the evolving forecasting techniques based on ensemble prediction systems enable to quantitatively treat processes for which only qualitative understanding could be achieved in the past. Yet, surprisingly few textbooks on mesoscale meteorology are available. This may be in part due to the fact that the term "mesoscale" may mean to some researchers a horizontal scale of up to 1000 km and a timescale of days, while others perceive the "mesoscale" more like having a spatial scale of one to a few hundred kilometres and a timescale of hours. Clearly, no single accepted definition of the mesoscale exists, but only a variety of definitions; see e.g. FUJITA (1981) for an overview. The atmospheric phenomena occurring in this broad band of spatial and temporal scales are so diverse that writing a comprehensive textbook on this matter clearly is a challenge.

Yuh-Lang Lin has taken this challenge and presented a book of very high technical quality, with clear printing, instructive figures and an extensive index. It starts with an introductory chapter dealing with a review of definitions of the "mesoscale" (which, however, ignores the particular definition given by FUJITA, 1981). Chapters 2–7 then present the theoretical background needed in the book: Governing equations, wave dynamics and generation, orographically and thermally forced flows, and mesoscale instabilities. Chapters 8–11 focus on the description of meteorological phenomena on the mesoscale: Isolated convective storms, mesoscale convective systems (including tropical cyclones), fronts and jet streaks, and dynamics of orographic precipitation. The final chapters 12–14 cover the numerical treatment of mesoscale phenomena by introducing basic numerical methods, numerical model setup, and parameterisation of physical processes. Each chapter has its own references section and a number of problems. For the modelling problems, program codes are available on the book's website at www.cambridge.org/9780521808750/.

When looking at the book and its scope, one other book comes to mind, despite its different title: "Cloud Dynamics" by HOUZE (1993). Even though Houze's motivation was the treatment of clouds, he nevertheless treated the whole scope of mesoscale phenomena and dynamics as well, and in doing so, created a classic textbook. Much advancement has been achieved in the 15 years since the publication of Houze's book, and it will

cerning the style of presentation which was one of the earlier one's main strengths.

When looking ate the introductory chapters, it is notable that chapter 2 on the governing equations appears rather short in comparison to the extensive treatments later on, for instance the wave dynamics chapters 3and 4. The description of orographically forced flows in chapter 5 mainly focuses on wave generation by flow over idealised mountains or lee cyclogenesis. What I miss here a bit is an illustration of smaller-scale orographic effects like boundary layer convergence lines which play a role in the initiation of deep convection, or the notable effects that even hilly terrain can have on precipitation or storm severity, for example by low-level channelling of airflow. However, some of this is covered in chapters 6 and 11.

After presenting mesoscale instabilities in chapter 7, chapter 8 focuses on isolated thunderstorms and gives a thorough overview, not only on the various storm types but also on hail or tornado formation. However, the illustrations in this chapter have been used previously by so many other authors that they will hardly excite more advanced readers any more, and even students may find it a bit boring to see the same figures reproduced in any textbook. Chapter 9 extends the previous chapter to mesoscale convective systems, mesoscale convective clusters, and eventually tropical cyclones. I find it highly appropriate to include tropical cyclones here, as many processes in their rainbands clearly relate to the dynamics of mesoscale convective systems.

Another strong point of the book is to include introductory material on numerical schemes and models. Chapter 12 uses the advection equation to illustrate various discretisation schemes and their stability analysis. Given the importance of the advection terms for the accuracy of numerical modelling of atmospheric flows, it is a very good idea to highlight their numerical realisation. Chapter 13 reviews grid systems and boundary conditions, before presenting the model equations for stratified flow, a short section of predictability and ensemble forecasting, and an overview of basic parameterisation techniques for various terms in atmospheric model equations.

In comparison to HOUZE (1993), Lin's book appeared similar to me in many ways. This impression is based on the one hand on the roughly similar range of topics, and one the other hand on the balance between equations and text as well as on many figures which were reproduced in both textbooks. The latter became particularly notable in chapter 8 on thunderstorms. It may be due to the fact that not such a vast amount of didactically well-suited figures is available to serve as textbook examples. However, some older or not so well-suited figures from original literature contained in the book should probably be replaced by newer or optimised ones. Besides, throughout the book, only relatively few of the cited references date from after 1995 and thus might convey the impression to the reader that mesoscale dynamics is not a very dynamical discipline.

Nevertheless, despite these minor weaknesses, Lin's book is well-suited for graduate students in meteorology and related disciplines. The adequate, but relatively high price from an individual student's point of view will make the present edition more a valuable addition to meteorological libraries than a classic textbook on everyone's desk. But this may change with a future paperback edition which would be worthwhile, given Lin's tremendous effort to condense the whole scope of mesoscale dynamics in one self-contained volume.

References

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HOUZE, R.A., 1993: Cloud Dynamics. – Inter. Geophys. Ser. Vol. 53, Acad. Press, San Diego, 570 pp.

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