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Book review

Light Scattering by Ice Crystals: Fundamentals and Applications, K.-N. Liou, P. Yang, with contributions by, Y. Takano. Cambridge University Press, Cambridge, UK 2016, xv + 443 pp., Hardbound, ISBN: 978-0-521–88916-2

The overall objective of this fundamental monograph is to summarize the state-of-the-art of the entire discipline of light scattering by cirrus cloud particles in the terrestrial atmosphere. The six chapters accomplish this ambitious objective by describing in detail

- the physics of ice clouds;
- the fundamentals of single and multiple scattering of electromagnetic radiation by ice crystals;
- the geometric optics approximation and several direct computer solvers of the macroscopic Maxwell equations widely used to model the single-scattering and absorption properties of atmospheric ice crystals;
- remote sensing of cirrus clouds; and
- modeling of atmospheric-radiation and climate effects of cirrus clouds.

This encyclopedic book is authored by indisputable leaders in the field of cirrus-cloud research and is remarkable for its uniform and comprehensive coverage.

Reading the book by Liou and Yang reminded me vividly of the 1984 monograph by Volkovitsky et al. [1] that was so helpful during my graduate studies. That monograph has never been translated into English and remains largely unknown to the atmospheric-radiation community at large. Fortunately, Liou and Yang's book far surpasses Ref. [1] by covering more topics and summarizing voluminous knowledge that did not exist three decades ago.

As with any other research monograph, the specific presentation of material in the book by Liou and Yang often reflects personal preferences of the authors that may not be universally accepted. For example, the second paragraph of Section 2.1 states that scattering is a physical process involving the abstraction of energy from the incident field and re-radiation of this abstracted energy in all directions. However, electromagnetic scattering by its very nature does not change the incident field and thus does not abstract energy from it [2]. Another example is the second paragraph of Section 2.5 which attributes the outset of the phenomenological radiative transfer theory to the work of Schuster, Schwarzschild, and Eddington rather than to the much earlier pioneering contributions by Lommel and Khvolson (see, e.g., the historical account of the radiative transfer theory in Ref. [3]). Also in Section 2.5, the radiative transfer theory is introduced using the old phenomenological approach rather than the modern physical-optics methodology directly based on the Maxwell equations [4]. Last but not least, it could be more appropriate to follow the modern trend of using SI rather than Gaussian units (see, e.g., the monographs [4–12]). However, such criticisms are not meant to diminish my overwhelmingly positive appraisal of this book.

As is typical of Cambridge University Press, the design and polygraphic quality of the book are quite impressive. Color figures are imbedded in the text rather than are grouped together in a separate color section, which makes reading the book a lot easier.

In summary, the book by Liou and Yang is a comprehensive account of light scattering by atmospheric ice crystals and is unique in its combination of breadth and depth of content. It is a must for all graduate students and experts specializing in atmospheric radiation, remote sensing, and climate research and can serve as an essential supplement to the corresponding graduate lecture courses. Owing to the wealth of up-to-date material, this book belongs on the researcher's desk rather than on a library bookshelf.

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