

BOOK REVIEW

A First Course in Atmospheric Thermodynamics



Grant W. Petty

Sundog; 2008; xiv + 338 pp.; ISBN 978-0-9729033-2-5; \$48.

It is not uncommon to find textbooks that have been written with the intention of catering to a broad spectrum of readers. Often, though not always, the result is a book appropriate for neither advanced nor beginning students. However, Grant Petty had a very specific target audience in mind when he wrote *A First Course in Atmospheric Thermodynamics*. The book is clearly gauged for atmospheric science and meteorology students who have had introductory courses in physics and calculus but who have not necessarily established a firm foundation in analytic problem solving.

The book stands out among other textbooks devoted to this topic. Every aspect of *A First Course* seems to have been tailored in such a way as to best serve the interests of the student. That is, Petty does not simply adopt a “fire hose” approach geared toward packing in as much material as possible, nor does he resort to qualitative arguments when a quantitative explanation is needed. Instead, the author has made a conscious decision to concentrate primarily on the most relevant concepts required to build a solid foundation in atmospheric thermodynamics. I definitely support this approach, which gives students the opportunity to consolidate their understanding of the fundamentals and to become less fixated on recipe-style problem solving.

Similar to other textbooks on the topic, the first chapter presents an overview of the composition and structure of the Earth’s atmosphere. Unlike other textbooks, however, is the inclusion of an “in practice” section at the end of many chapters. This section is meant to ground the material in the chapter in “real-world” applications. In the context of chapter 1, this grounding is accomplished by the author discussing in situ and remote sensor observations of pressure, temperature, and humidity. The discussion focuses on balloon-borne measurements and introduces the basic layout of the skew $T - \log p$ thermodynamic diagram, which is widely used to plot radiosonde and rawinsonde data and examine the state of the atmosphere. In total, six of the book’s eight chapters conclude with an “in practice” section appropriate to the material that has just been covered.

Subsequent chapters focus on thermodynamic systems and variables, the physical properties of air, atmospheric pressure, the first law of thermodynamics, the second law of thermodynamics, moist processes, and atmospheric stability.

One may be surprised, or perhaps disappointed, by the author’s cursory treatment of the second law. Indeed, the chapter dedicated to this topic is the shortest in the book and spans only six pages. However, Petty maintains (on page xiii of the preface) that “relatively few undergraduate meteorology majors are ready to ponder the meaning of the Second Law of Thermodynamics, or the theoretical properties of heat engines and refrigeration cycles.” Therefore, he provides only an overview of the second law and some of its more relevant consequences, such as the introduction of entropy as a thermodynamic state variable and applications to the concept of potential temperature. Petty assumes that students needing to know more about the second law will independently pursue the topic or study it in more detail in a future course. I do not find myself at odds with this position, although when I teach atmospheric thermodynamics from this book I find it helpful to provide students with supplemental material.

Finally, it is worth mentioning that the book contains a well-organized appendix consisting of six parts. The two parts that I find particularly useful for students (assuming they take advantage of these sections) are those covering physical problem solving and a review of relevant mathematical concepts. Many students in the early stages of their meteorology or atmospheric studies have not yet developed the necessary analytic skills needed to solve complex problems. These sections are designed to help students systematically approach such problems and point them toward the mathematical tools needed to obtain a solution. Other materials included in the appendix are lists of recommended reading and online resources, a compilation of physical dimensions and units, and various tables and charts.

In summary, I am impressed with *A First Course in Atmospheric Thermodynamics*. Also, I have heard many positive comments about the book from students who have taken my course. If you are a student starting out in your studies of meteorology, someone needing an introduction to atmospheric thermodynamics, or a professor in search of a textbook for a physical meteorology course, you should consider reading and buying this book.

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