

# READINGS

## BOOK REVIEWS

### LIGHTNING: PHYSICS AND EFFECTS

Vladimir A. Rakov and Martin A. Uman, 2003, 698 pp., \$200.00, hardbound, Cambridge University Press, ISBN 0-521-58327-6

Lightning is clearly among the nation's worst weather hazards, and in recent years, scientists and engineers have made considerable progress in measuring the physical characteristics of lightning, and in understanding its effects on ground-based and airborne systems. The authors of this book, Vladimir A. Rakov and Martin A. Uman, have more than 70 years of experience in lightning research, and are responsible for much of this progress. Together, they have authored or coauthored more than 300 scientific and technical papers, many of them jointly, and here they have attempted to present all that is known about lightning and its effects in a single volume.

Chapter 1 begins with a brief review of the history of the subject and the terminology that is used to describe cloud-to-ground (CG) discharges, and it concludes with a summary of the characteristics of negative CG flashes and the global electric circuit. Chapter 2 reviews the frequencies and types of discharges and the area densities of flashes that have been inferred from thunder statistics, lightning locating systems, and satellite measurements. It also shows how to use the measured area densities to estimate the frequency of strikes to buildings and tall towers. Chapter 3 describes the electrical structure of air mass thunderstorms and larger storm systems, and the mechanisms of cloud electrification on small and large spatial scales. Chapter 4, the largest and probably the most important chapter in the book, gives a detailed description of the luminous and electrical characteristics of the most common type of CG lightning—negative flashes initiated by a downward-propagating leader that contain one or more return strokes. Chapters 5–8 discuss positive and bipolar flashes to ground, upward lightning initiated by ground-based objects, the artificial initiation (or triggering) of lightning by ground-based activity (especially rockets trailing grounded and ungrounded wires), and winter lightning in Japan, respectively. Chapter 9 describes the electric field and

radio-frequency (RF) signatures produced by cloud discharges, and chapter 10 discusses the frequency and characteristics of lightning strikes to aircraft. Chapter 11 reviews the causes and characteristics of thunder, and chapter 12 summarizes models of return strokes, stepped- and dart-leaders, and M-components, and the ways of describing the electromagnetic fields produced by these processes. Chapter 13 discusses “atmospherics” (i.e., the radio signals produced by distant lightning), the propagation of these signals in the Earth–ionosphere cavity, Schumann resonances, and whistlers. Chapter 14 reviews the effects of lightning on the middle and upper atmosphere and the properties of transient luminous events, such as red sprites, elves, and blue jets. Chapter 15 describes the production of nonequilibrium trace gases (e.g., NO and NO<sub>x</sub>) by lightning and the relative importance of lightning as a source of these gases on a global scale. Chapter 16 reviews what is known about the characteristics of extraterrestrial lightning, and chapter 17 describes the principles of operation of most ground-based and satellite lightning-detection systems. Chapter 18 reviews the mechanisms of lightning damage, the basic elements of lightning protection, and lightning test standards, and chapter 19 describes lightning safety and the hazards that lightning presents to humans. The book concludes with a discussion of ball lightning and other unusual discharges in chapter 20. There is an excellent subject index, and a list of previous books about lightning and related subjects is given in an appendix. Nine color plates of selected figures have been inserted in chapter 12 between pages 406 and 407.

In the preface, Rakov and Uman state that their goal in writing this book was to “present a balanced review of the present knowledge of lightning phys-



