Eos

The art and science of weather forecasting has changed considerably over the past few decades. The most obvious change is the advent of accurate numerical weather prediction. Given a comprehensive three-dimensional analysis, an operational forecast model will consistently outperform a human at lead times ranging from ten hours to seven days. The role of the human forecaster is to add value to the forecast, to ensure (for the sake of his or her own professional longevity) that the combined forecast information from the computer and the human is clearly more useful than the information from the computer alone.

Another recent change is the use of potential vorticity concepts in weather forecasting. We must wait for a bored sociologist to tell us whether the underlying reasons are similar, but the comparative speed of implementation of potential vorticity concepts on the east side of the Atlantic Ocean compared to the west side parallels the uneven acceptance and implementation of Bergen School analysis and forecasting concepts in the 1920s and 1930s.

The first textbook to effectively incorporate these changes is Gary Lackmann's *Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting.* (The cover and title page disagree about the second comma in the title and whether the word following it should be replaced by an ampersand; here I choose my own preferred style from among the alternatives.) The book itself is soft-bound, roughly 8""x10"", with a binding that remained as good as new after my thorough reading. It is printed on glossy paper, with color illustrations throughout. With these characteristics, it is quite a bargain, even without a discount.

The book is excellent as a foundational text for a senior-level course. Chapters 2 through 4 cover different and complementary ways of diagnosing atmospheric vertical motion and development: quasigeostrophic theory, isentropic analysis, and select aspects of the potential vorticity framework. Chapters 5 and 6 apply these concepts to extratropical cyclones and fronts. Chapter 7, on baroclinic instability, is the most mathematical of the book, and it includes a complete derivation of the Eady model. Chapter 7 is independent of the rest of the book, as are Chapters 8 and 9.

Prof. Lackmann writes about what he is most familiar. For example, Chapter 8 is devoted to cold-air damming. Most readers not on the East Coast of the United States will not regard cold-air damming as a topic as important as cyclones or fronts, but Chapter 8 shows cold-air damming to be a complex subject in its own right. Likewise, Chapter 9, on winter storms, provides relatively little of direct value for future winter storm forecasters in the western United States, but provides illustrative examples of the complex interactions between thermodynamics and microphysics characteristic of winter weather forecasting. Throughout the book, examples generally involve the eastern United States, with places such as Europe or the Southern Hemisphere unrepresented.

The final three chapters return to broader subject matter. Chapter 10, the longest chapter in the book, is devoted to numerical weather prediction, and focuses on the key topics necessary for making good use of modern-day forecast model output: parameterizations, data assimilation, and ensemble forecasting. The chapter recognizes that its details may soon be out of date, and refers its readers to the extremely

valuable COMET modules for the latest information. Chapter 11 describes the process of weather forecasting, and Chapter 12 is on manual analysis. Since manual analysis is not incorporated into the forecast process recommended in Chapter 11, the manual analysis chapter seems to be here mainly as a set of technical reminders for students doing laboratory exercises that require manual analysis.

Each chapter concludes with review and study questions, problems, and additional references. The problems are mainly there to save the author from filling the text with derivations, and are not extensive enough to serve as a question pool for weekly problem sets.

This is a modern book, in its incorporation of potential vorticity, numerical weather prediction, and ensemble forecasting. As a textbook, it tends to be terse and needs to be combined with laboratory exercises and additional details from an instructor. According to the author, an instructor's packet with PowerPoint slides and a laboratory manual are both under development. I only found one major error, an incorrect description of phase-locking. At present, I know of no better choice for a senior-level textbook in synoptic meteorology and weather forecasting.

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