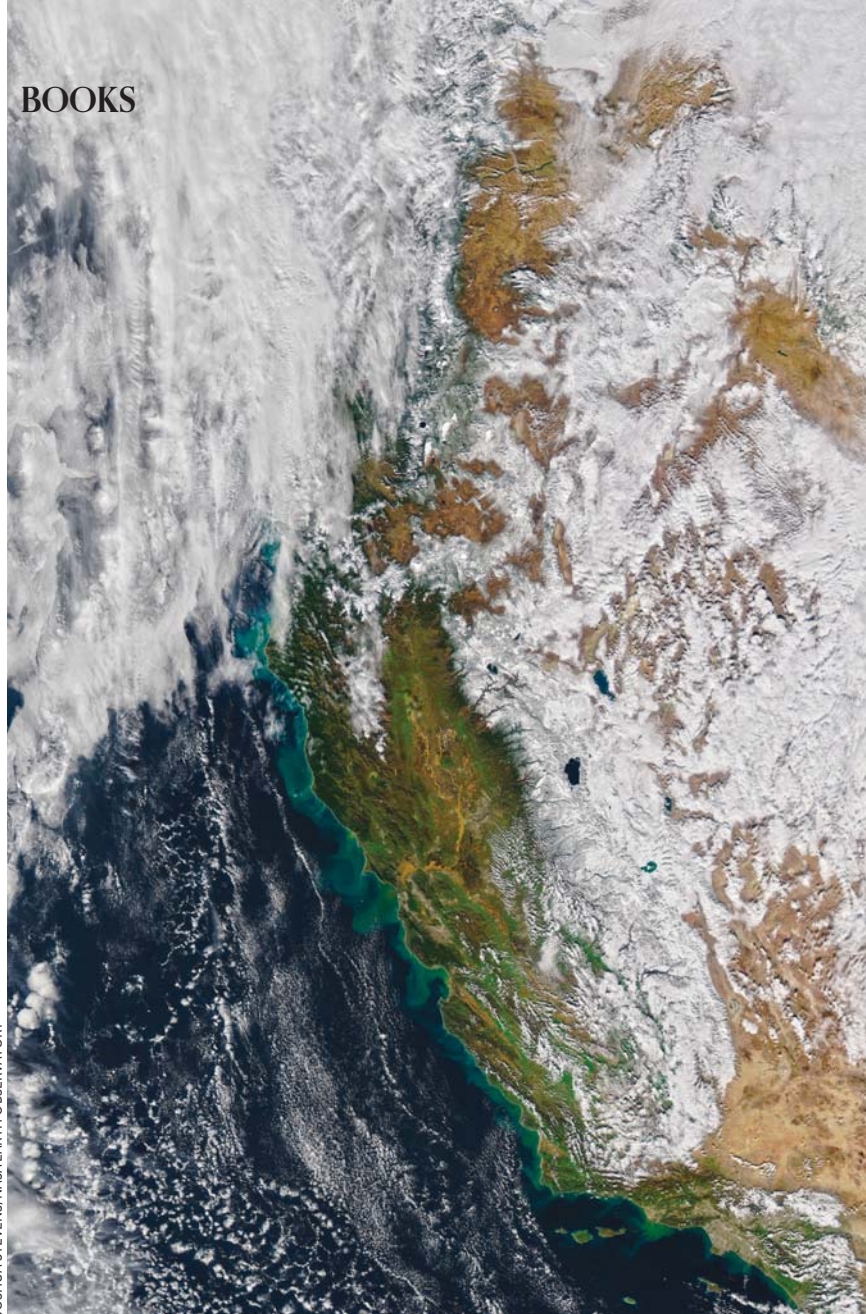
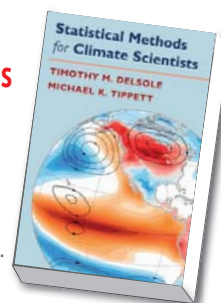




A satellite image of the western US taken 17 January 2023, after a month of atmospheric rivers battered the area. The swirls of sediment off the coast and extensive snowpack in the Sierra Nevada are evidence of the tremendous amount of precipitation.

Statistical Methods for Climate Scientists

Timothy M. DelSole
and Michael K. Tippett
Cambridge U. Press, 2022.
\$69.99



of interest to climate scientists include not only mean temperatures, variances, and extreme events but also spatiotemporal patterns, which are sometimes called teleconnections. The influence of the El Niño–Southern Oscillation on weather around the globe is the best known and most important teleconnection, but there are many others.

Students entering the field of climate science need to get up to speed quickly with the statistical tools commonly used in the discipline. They are typically familiar with some of the methods, but others, like extreme-value theory and data assimilation, are likely new, and budding climate scientists have typically needed to consult many different texts to learn about them. In *Statistical Methods for Climate Scientists*, Timothy DelSole and Michael Tippett aim to streamline students' mathematical training by collecting the most important methods into a single textbook. Taking all their examples from the climate system, the authors include intuitive explanations, helpful figures, and formal proofs, and they cover some advanced topics.

DelSole is a professor of atmospheric, oceanic, and Earth sciences at George Mason University; is well known for his work in geophysical fluid dynamics on such topics as wave instabilities and stochastic modeling; and is the former co-chief editor of the *Journal of Climate*. Tippett is an associate professor of applied physics and applied mathematics at Columbia University and focuses his research on the El Niño–Southern Oscillation and extreme weather phenomena. The book is based on climate-statistics courses they taught for many years, and it includes insights they gained from “flipping” the format of the class: Instead of lecturing, they had students read chapters and submit questions beforehand and devoted instructional time to answering the submissions.

DelSole and Tippett begin the book with an overview of basic concepts in statistics. Next comes hypothesis testing,

A climatologist's introduction to data analysis tools

Asksed to define climate, most people—including many physical scientists!—give confused answers. A typical reply would likely conflate climate with weather. A slightly more sophisticated response might mention how Earth's mean temperature is increasing. A better answer would be that climate is the statistics of weather, which echoes Robert Heinlein's quip, “Climate

is what we expect, weather is what we get.” In reality, there is no sharp distinction between climate and weather: The seasonal cycle is just one example of an oscillation that occurs at time scales between the two.

In addition to the behavior of the lower atmosphere, climate also deals with the oceans, the upper atmosphere, Earth's icy regions, and the biosphere. Statistics

NEW BOOKS & MEDIA

which is also a topic most students will be familiar with. But by focusing on the climate system, the authors present the ideas from a fresh perspective. They then turn to time-series analysis, power spectra, and model selection.

The second half of the book is largely concerned with methods to effectively reduce the dimensionality of a system. It's an appropriate topic because the climate is a system with nearly an infinite number of degrees of freedom. One chapter is devoted to principle-component analysis, which is perhaps the mostly widely used approach to reducing dimensionality. Subsequent chapters explore related methods, such as canonical-correlation analysis. Chapters on extreme-value theory and data assimilation round out the book.

Statistical Methods for Climate Scientists does have some weaknesses. Power-spectra estimation is given a rather cursory treatment despite its importance to climate science and to many other fields. That means readers will need to look elsewhere for information about different choices for tapering windows. And it is rather surprising that machine learning receives no attention given its rapidly growing importance to climate science. The index also could be more comprehensive.

Perhaps more curiously, DelSole and Tippet chose not to supply code or pseudo-code in the book even though a computer is required to reproduce nearly every example they discuss. The authors argue in the preface that no code was included because it is essential for students to write their own code instead of using existing software packages so that they can more deeply understand what they are doing. I wholeheartedly agree with DelSole and Tippet, but readers could benefit from some guidance.

Those weaknesses are more than compensated for by the pedagogical value of bringing together disparate methods of statistics into one volume. As more climate scientists venture into such subtle problems as whether to attribute extreme events like prolonged heat waves to climate change, the critical statistical-thinking skills fostered in *Statistical Methods for Climate Scientists* will be of increasing importance.

Brad Marston

*Brown University
Providence, Rhode Island*



Severance

Dan Erickson, creator

Apple TV+, 2022

Can't stop thinking about work on the weekend? What if you could permanently bifurcate yourself so that your work life never impinged on your leisure self? The Apple TV+ series *Severance* envisions such a world. A mysterious corporation, Lumon Industries, requires certain employees to undergo the titular, irreversible procedure. Situated on Lumon's "severed floor," they have no idea what they work on—or what their outside selves are like. Mark Scout, known at work only as Mark S., originally took a job on the severed floor of Lumon to hide from grief after losing his wife in a tragic accident. But when a new employee, Helly R., starts asking questions and tries to quit her job, Mark begins to question his decision. *Severance's* strict devotion to the rules of its universe add gravitas to this taut thriller.

—RD

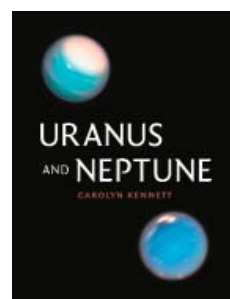
Uranus and Neptune

Carolyn Kennett

Reaktion Books, 2022. \$40.00

Until some three decades ago, not much was known about the two outermost planets in our solar system. That changed with the *Voyager 2* mission, which conducted flybys of Uranus in 1986 and Neptune in 1989. In her recent book, the astronomer Carolyn Kennett provides a comprehensive introduction to both of those distant worlds. She discusses their discovery and origins, *Voyager 2's* flybys, and observations made from space- and ground-based telescopes. Written for a general audience, the text is nontechnical and illustrated with more than 100 images.

—CC



matchless.

Unrivalled Precision, Unmatched Measurement Speed!



WS8-2

High End Wavelength Meter



TOPTICA

www.toptica.com/HighFinesse