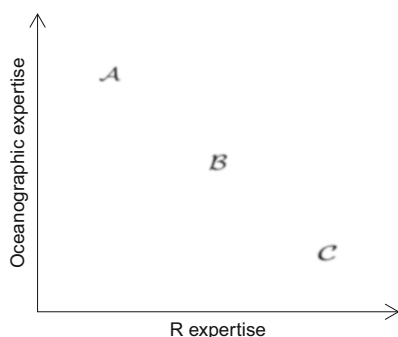# Preface

I wrote this book with three types of reader in mind. Type $\mathcal{A}$ consists mainly of experienced oceanographers[1] who want to add R to their list of tools for data analysis. They should expect to learn how R can simplify and energize their research programmes. In type $\mathcal{B}$ are technicians, consultants and others who may be called upon to solve new problems without sufficient time to study the literature or to implement clean algorithms. Since R provides a wide range of well-vetted solutions that are tied closely to the literature, readers of type $\mathcal{B}$ (and their employers) can look forward to an increase in productivity and a reduction in stress. Finally, type $\mathcal{C}$ comprises students who are entering oceanography, equipped with R skills gained during previous studies. I hope they will see how to use their skills to competitive advantage during the transition to oceanography.

Taken together, these three types make up the core of any department of oceanography, spanning ages, skills and interests. Given their varied backgrounds and ambitions, they may have different reasons to read this book, and so it is organized with this in mind.

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[1]Limnologists should also find the book useful, since many instruments and methods are shared between the fields. However, it is tiresome to read "oceanography and limnology" repeatedly, and OAR is a pleasingly nautical abbreviation for the book title.

Chapter 1 puts R in the context of other tools used in oceanography, as part of an argument that now is a good time for oceanographers to try R. Although this chapter is intended mainly for readers of types $\mathcal{A}$ and $\mathcal{B}$, who tend to be accustomed to old tools and wary of new ones, readers of type $\mathcal{C}$ may find it useful for setting the scene.

Chapter 2 provides an R tutorial that is framed in oceanographic examples. This should be examined closely by readers of types $\mathcal{A}$ and $\mathcal{B}$, who will need to learn R syntax. Readers of type $\mathcal{C}$ might choose to skim this chapter, with an eye to the peculiarities of oceanographic data.

Chapter 3 presents a sketch of the oce package. Since it was developed during the evolution of a research programme, oce is a very practical thing. It provides functions for a wide range of oceanographic computations, for reading dozens of instrument-specific oceanographic data formats, and for producing graphics that obey oceanographic conventions (Kelley and Richards 2018). Its object orientation scheme lets analysts work at a high level of abstraction, without losing the ability to probe lower levels when appropriate. Although there are excellent tools for individual tasks in other computing languages, few match oce as a coherent framework. Also, and very importantly, the decision to use R means that users have access to thousands of packages for statistical and other operations, yielding cutting-edge methodologies without the burden of extensive coding.

Chapter 4 contains explanations of how R might be used in real-world applications. Here, the steps of the analysis are explained in detail, from start to finish. Drawn from the classic oceanographic literature, the applications sample the four sub-disciplines of oceanography: chemical, biological, geological and physical. While practical-minded readers might focus on the R code, I hope that any reader with an interest in oceanography will welcome the chance to explore data put forward by the likes of Alfred Redfield, Gordon Riley, Tuzo Wilson and Walter Munk.

Chapter 5 continues the applied theme, but with less depth and more breadth. A miscellany of methods, this chapter is likely to be consulted a section at a time, as needs arise. Readers of type $\mathcal{C}$ should note that oceanography has yet to develop standard operating procedures, and so this chapter is more a suggestive guidebook than a detailed map.

Chapter 6 provides solutions to the many exercises that pepper the text. This is a key element of the book, because working on exercises is a sure way to build skill. Little is gained by passive reading ... nobody ever learned to play a violin by watching someone else play one.

Appendix A contains advice to readers who are switching to R from Matlab. Appendix B has an outline of popular GUI systems that simplify the use of R, without limiting its power. Appendix C holds a discussion of map projections in the oce package, while Appendix D explains how oce lets analysts switch between the UNESCO and GSW formulations of seawater properties. A few aspects of high-performance calculations in R are sketched in Appendix E. Finally, in Appendix F, readers will find some remarks on the future of R, in general terms and in the context of oceanographic analysis.

Colophon. This book was typeset in LaTeX, with R being used for all the diagrams. The code for the diagrams, along with all the sample code, is embedded in the text using Sweave (Leisch 2002), with R acting as a preprocessor that creates output and diagrams prior to typesetting. This setup means that readers can be confident that R code provided in this book will work as indicated.