

Reviews

H. EICKEN, R. GRADINGER, M. SALGANEK, K. SHIRASAWA, D. PEROVICH and M. LEPPÄRANTA, eds. 2009. *Field techniques for sea ice research*. Fairbanks, AK, University of Alaska Press. 588pp. ISBN-10: 1-602230-59-5, ISBN-13: 978-1-602-23059-0, hardback, US\$65.

This book adds to a growing number of recent sea-ice texts, also evidenced by reviews of books by Thomas and Dieckmann (2009) and Weeks (2010) in this issue of the *Journal*. To these might be added Krupnik and others (2010) which documents sea-ice knowledge and use by indigenous Inuit peoples. These publications come at a time when increasing attention is being paid to the diminishing extent of Arctic summer sea ice, the nature of sea-ice studies is increasingly multidisciplinary and there is an ongoing requirement to update published material as sea-ice science advances. Each of these recent texts approaches the subject from a different perspective, and together they provide a complementary resource.

Field techniques for sea ice research developed from practical sea-ice field courses taught by several of the editors in different countries, culminating in an internationally collaborative field course held at Barrow, Alaska, USA, in May 2008, during the International Polar Year (IPY) 2007–08. It is a multi-authored volume, with the individual chapters contributed by nearly 30 experts in the different topics, and includes sections not covered in the original field courses but solicited to provide more comprehensive coverage of sea-ice research techniques. The focus is very much on Arctic sea ice and techniques, although many of the authors also have research interests in the Antarctic, so the differences in sea-ice characteristics and processes between the two poles are discussed in several chapters.

A central framework for the book is provided in section 2 within the concept of 'sea ice system services (SISS)'. This aims to recognize the societal relevance and priority of sea-ice research and to maximize its relevance to stakeholders and the general public. SISS are classified into categories of 'regulating' (e.g. climate regulation), 'provisioning' (e.g. access to food sources), 'cultural' (traditional culture and spiritualism) and 'supporting' (e.g. sea-ice based ecosystems). This is not a concept that comes easily to some natural scientists, and the subsequent chapters are fitted to this framework with varying degrees of success. In some (e.g. chapter 3.2 on ice thickness) the SISS concept is integrated into the discussion of field techniques, in others it is paid only lip service and in some it is ignored altogether. The Illulissat Declaration made by the five Arctic circumpolar nations in May 2008 is also discussed in this section, in the context of Arctic political futures and its potential to promote Arctic governance that is more fortress-like than equitable.

Section 3, 'Research techniques', is the core of the book, with 18 chapters covering field techniques and methodologies in different disciplines, and including the broader background of topics such as remote sensing, modelling and field logistics that are necessary to support in situ sea-ice research.

The first seven chapters of section 3 focus mostly on physical measurements (snow cover, ice thickness, sampling and core processing, thermal, electrical and hydraulic

properties, ice strength, optical properties, and air–sea interaction). Noticeably missing is a specific chapter on sea-ice motion and deformation which are extremely important in determining ice properties and the ice-thickness distribution. Motion and deformation are discussed in the chapters on automatic systems, remote sensing and modelling (and in the DVD supplement to the indigenous observation section; see below), but not in their own right. Also largely missing is coverage of ice–atmosphere interaction including wind stress and the full surface energy balance (solar radiation is covered in chapter 3.6) and aspects of ice mechanics beyond ice strength (e.g. fracture mechanics, wave–ice interaction, etc.).

Chapters 3.8–3.10 cover field techniques in biogeochemistry, the biodiversity of organisms within and beneath the ice, and sea-ice seals. The latter chapter focuses largely on one species, the ringed seal, and there is no discussion of other top predators. This chapter includes a detailed and interesting but somewhat quirky section on how to train and use a dog to locate seal breathing holes beneath a snow cover, and then how to capture the seals and fit trackers to them. There is less detail on how and why the observations are used to study the physiology, life cycle and population distribution of seals. The next chapter, on community-based observations, deals with planning and implementing collaborative programs, including fieldwork, to benefit from the wealth of sea-ice knowledge held by indigenous residents of the Arctic. This is a research area that has been expanding over the last decade or so, and came to prominence during IPY 2007–08 (e.g. Krupnik and others, 2010).

Chapters 3.12–3.16 are on topics and observations that are broader, but which support the in situ measurements. They cover ship-based observations, automatic stations, data management, sea-ice remote sensing, and sea-ice modelling. The last two of these are large fields for which several dedicated texts exist, so the approach in both chapters is to focus on how they are used in support of in situ investigations. The remote-sensing chapter is still the second longest in the book, exceeded only by the chapter on ice thickness. Chapter 3.17 is on multidisciplinary integrated sea-ice observations, with examples from a fixed coastal observatory program at Barrow and a ship-based in situ program in the Antarctic. The final chapter of section 3 discusses personal field logistics, including planning, clothing, equipment and the interpersonal etiquette necessary to ensure a safe and harmonious field program at a remote polar location.

As is often the case with multi-authored compilations, the core chapters tend to be uneven in length and structure. All contain useful information, but the balance between why the measurements are required, the background theory to their relevance and observation, and the techniques by which they are made varies from chapter to chapter. Stricter editorial control could have resulted in a more homogeneous product, although the editors acknowledge in the preface that they wanted to balance this 'with a commitment towards diversity and, occasionally, idiosyncrasy'. The majority of the chapters in this section conclude with a thoughtful discussion of the future directions in observational requirements and technological developments of the various field measurements.

Brief concluding remarks are presented in section 4 (although labelled as 'chapter 4' in the body of the text). These emphasize the need to develop a standard methodology for measuring and reporting those sea-ice parameters for which this does not already exist (e.g. inorganic nutrient concentrations) and re-emphasize the importance of interdisciplinary sea-ice research and of the need for a system science approach to understand the relevance of sea ice for human societies. Throughout, the book is well illustrated with many full-colour photographs and cartoons demonstrating field techniques, and with numerous example figures of the results that come from these.

Included with the book is a multimedia DVD. This contains video footage introducing the participants and activities in the field course that provided the background for the book (section 1) and video discussion of policy issues related to the SISS framework (section 2). The first ten chapters of section 3 each have a video clip demonstrating field techniques, typically of 5–10 min length. Generally these show the use of a particular instrument or technique and provide a visual adjunct to the text, rather than a systematic field guide. The exception is the much longer (~30 min) video film of the ice-sampling and core-analysis chapter (3.3). This does provide a practical step-by-step guide to ice coring and sampling. The video footage accompanying chapter 3.11 consists of discussions with Iñupiaq elders on their sea-ice use and knowledge. The motion and deformation of ice under the influence of winds and current, and how they monitor it, is a major factor in their safe use of sea ice. The video section 3.18 is a collection of largely unexplained 'then and now' images of sea ice and sea-ice activities near Barrow, and appears unrelated to chapter 3.18 on personal logistics. The DVD

also includes other useful reference material such as the World Meteorological Organization (WMO) Sea-ice Nomenclature, the International Snow Classification, and manuals and tutorials on ship-based sea-ice observations.

Undoubtedly the best way to learn field techniques is from a mentor or by participation in a practical field course rather than from a book. This book, however, is a useful resource to supplement and reinforce such learning and will also provide a valuable guide to those who may have to learn by themselves, primarily through trial and error, as many of us have done in the past. Ultimately, though, the book will most usefully provide a broad overview of all aspects of sea-ice field research. This will inform specialists in one discipline of the possibilities and limitations of the work of their colleagues in an increasingly multidisciplinary field.

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