

vulnerability, that is, the risk and stress people face from environmental change and their response to such change; economic and political globalization; and adaptation to change as a political process at multiple levels of governance. Chapter 2 sets out the methodology that is adopted in the three case studies: a qualitative approach based on stakeholder interviews. The semi-structured interviews sought information on a stakeholder's socioeconomic circumstances, sensitivity to environmental changes, and the type of coping strategies a stakeholder might adopt in response to political and climate changes. This was supplemented by a review of local newspaper reports.

Chapters 3–5 detail the three case studies, which assess social vulnerabilities in key economic sectors of northern Norway, Sweden, and Finland, namely the forestry industry (chapter 3), commercial reindeer herding (chapter 4), and the fishing industry (chapter 5). These detailed descriptions provide a solid portrayal of the political, economic, and physical forces that individuals and organizations in each of the sectors contend with. In chapter 3 we become aware of the effects of increased internationalization of the forest industry on local sawmills in Sweden and the necessity for workers to become more mobile in order to seek employment. At the company and government level we are introduced to the ramifications of market-driven strengthening in forest certification — one stakeholder viewing this as the result of British consumer demand. The effects of increased mechanization, supplementary feeding, and global meat markets on reindeer herding are developed in chapter 4, with a particular focus on the impacts and adaptation of traditional Saami herders. A significant issue voiced is that while reindeer herders have the ability to respond to many of these changes, they have no ability to control market prices, something that impacts their profitability and in turn their livelihood. One stakeholder cites the impact on their profitability through lower demand for reindeer meat resulting from competition with New Zealand deer meat. Chapter 5 traces the numerous interacting factors that have affected the fishing industry along the Barents Sea coast of Norway, including the introduction of individual transferable quotas in 1990, changes in fish-processing, restructuring of the local fishery and fishing rights, and the evolving multiple-level structure of governance and regulation. One local fishing organization contrasts the

open rights people have had to fish for the last 10,300 years to the restricted rights of the last 15 years. The three case studies are notable for the detailed narratives (between 100 and 150 notes per chapter) that support each one.

Chapter 6 concludes the vulnerability assessment by summarizing the common economic, political, and environmental changes facing the various stakeholders across the three case studies, and the primary drivers of adaptive capacity. These drivers include human, social, political, financial, and institutional capital. Adaptations that stakeholders identify are described as being either individual economic adaptations (for example, diversification, technological changes, and marketing) or broader scale adaptations (for example, promoting legislative or regulatory changes to increase resource access, and greater inter-organizational coordination and networking to promote greater influence). The overriding adaptive strategies that emerge with respect to climate change are market diversification, reducing dependence on the local environment, and adjusting spatial and temporal harvesting patterns.

This volume provides a detailed and thorough examination of vulnerability and adaptation in the northern European Arctic, and serves as a useful reference for stakeholder views in the forestry, fishing, and reindeer herding sectors. It is impressive for the detailed narratives that support the case studies, and it is mainly these case studies that are the contribution to emerge from the text. The book is also valuable in providing a northern European perspective on globalization and climate changes effects in the Arctic. However, there is a minimal level of synthesis connecting both the three case studies and the conclusion that limits the relevance of the book beyond the northern European Arctic and the three industry sectors that are examined. The content of this volume would be strengthened by conceptual linkages in the concluding chapter to the key ideas on vulnerability and adaptation dynamics presented and reviewed in the introduction. Such a contribution will be highly valuable and broadly useful to diverse stakeholders striving to adapt to rapid change, such that vulnerabilities can be anticipated and, perhaps with enough knowledge and wisdom, minimized. (Lilian Alessa and Andrew Kliskey, University of Alaska Anchorage, 3211 Providence Drive, Anchorage, Alaska 99508, USA.)

THE LONG THAW. David Archer. 2009. Princeton: Princeton University Press. 180 p, illustrated, hard cover. ISBN 978-0-691-13654-7. U.S.\$22.95. doi:10.1017/S0032247409008559

We all have our own perspectives on climate change. Most of us probably see it as a problem to be faced by ourselves, our children and our grandchildren. If we are optimists, we may hope that within this time span humanity will have found ways of stabilising greenhouse gas concentrations and, consequently, the Earth's climate will start to return towards its pre-industrial state. Undoubtedly there will be problems to be faced in the meantime, while mitigation

measures are put into place, but, given enough time and the willingness to act, we may hope that we can put things right eventually.

David Archer's book, *The Long Thaw*, could be read as a polemic against such complacent thinking and makes a strong case for taking urgent action on greenhouse gas emissions. His central thesis is that human-generated CO₂ has a very long lifetime in the atmosphere. While much of this additional atmospheric carbon gets absorbed by the oceans relatively quickly (on a timescale of a few hundred years), further reduction through neutralisation by ocean carbonates and by silicate weathering takes much longer. Archer has estimated that 17–33% of the total fossil fuel

carbon burned will still reside in the atmosphere after 1000 years. Even after 100000 years, 7% remains. While these figures are derived from carbon cycle models that will, inevitably, be improved as we learn more about the workings of the Earth system, we can be fairly certain about the long timescales involved. We need to recognise that burning fossil fuels now is committing us not just to a short-term ‘blip’ in climate, but to *The Long Thaw* of the title.

Archer argues his case well. As a palaeoclimatologist, specialising in the operation of the global carbon cycle on geological time scales, he is well placed to present the evidence for the need to take the long view and to argue that we need to restrict our total carbon emissions if we are to avoid long lasting, potentially dangerous climate change. This long term perspective sets the book apart from other recent offerings on global warming. Having said that, Archer starts fairly conventionally, with an exposition of the physics behind the greenhouse effect, an examination of recent observed climate change and a very brief summary of Inter Governmental Panel on Climate Change (IPCC) projections for the next century. He then leads the reader on a journey into the Earth’s past, looking at evidence for climate variability on timescales from millennia (the Holocene), through hundreds of millennia (glacial cycles) to millions of years (geological time), and shows how examining evidence for past climate change can help us to understand the workings of the global carbon cycle on long time scales. In the final part of the book, Archer demonstrates how this understanding can be applied to the problem of forecasting the long term fate of human generated CO₂ and the consequence of such forecasts for the prediction of climates into the deep future. An epilogue explores economic and ethical issues arising out of the science described within the book. Here the author is entering contentious territory, in which scientists, economists and politicians argue endlessly about the relative costs and benefits of various strategies for tackling climate change. Archer makes some interesting observations that are of relevance to this debate. In particular, he shows that carbon capture and storage, either in the oceans or in stable geological formations, is no panacea for avoiding the long lasting effects of climate change that he discusses in the book. However, it is doubtful that this observation will have much impact on policy. Carbon capture and storage could reduce the peak CO₂ concentrations over the coming couple of centuries and the focus of almost all policy decisions is on timescales even shorter than this. Decisions will probably be made on short term economic grounds,

but the ethical question remains – what right do we have to commit future generations to living with long term climate change in order that we may enjoy the short term benefits of burning fossil fuels?

The book does not have a particular polar focus, but Archer emphasises the importance of the polar regions in the global climate system and in the global carbon cycle. He discusses the role of methane hydrates in polar marine sediments and in permafrost as potential amplifiers of climate change through the carbon cycle. A notable omission from the book is any detailed discussion of the contribution of biological processes in the high latitude oceans to the carbon cycle. Indeed, the author’s emphasis throughout is on the physical pathways in the oceanic carbon cycle. The polar regions also feature in a short chapter on sea level rise, which summarises our current understanding of how two major ice sheets – Greenland and West Antarctica – will respond to a warming climate. Archer emphasises that current predictions of future sea level rise contain considerable uncertainties as a result of our imperfect understanding of how these ice sheets behave. There is a clear need for further research.

I found the book quite readable and felt that it usefully filled some gaps in my understanding of the global carbon cycle. However, I did find the text annoyingly repetitive in places. This seems to be a deliberate choice by the author to ensure that he gets his message across to all readers, even those who just skim through the book. Indeed, he almost encourages such behaviour by inviting the impatient reader to skip the detail contained in chapters 4–6 and rejoin the text at chapter 7. This is a strange invitation in a book that is already quite short, and begs the question of who the intended audience is. Presumably Archer wants to get his message across to politicians and their advisers, and recognises the importance of brevity when addressing this group. However, I fear that he may have overestimated the appetite of this group of readers for scientific detail. While the book only requires a very basic understanding of physics and chemistry, the author’s liberal use of equations and chemical formulae may put off some general readers. I hope that this is not the case, because the ideas expounded in the book are of great importance to the debate on climate change and deserve to be more widely appreciated. Let us hope that Archer’s message becomes widely understood and acted upon before we find that we have already committed ourselves to damaging (and potentially irreversible) climate change. (John King, Antarctic Climate and the Earth System Programme, British Antarctic Survey, High Cross, Madingley Rd., Cambridge CB3 0ET).

OF DOGS AND MEN, FIFTY YEARS IN THE ANTARCTIC: THE ILLUSTRATED STORY OF THE DOGS OF THE BRITISH ANTARCTIC SURVEY 1944–1994. Kevin Walton and Rick Atkinson. Foreword by HRH The Prince of Wales. 2nd edition. 2008. First published 1996. Malvern Wells: Images Publishing

(Malvern) Ltd. 190 p, illustrated, paper cover. ISBN 978-1-897-81755-1. US\$ 30.

doi:10.1017/S0032247409008547

This great and very informative book about the era of dog sledging in Antarctica was not written by journalists or