Book reviews

The Stratosphere: Phenomena, History and Relevance by K. Labitzke and H. Van Loon (Springer, 1999). ISBN 3-540-65784-3. US$62.

Labitzke and van Loon have been a familiar duo in the analysis and interpretation of stratospheric observations during the last three decades. Together, they have authoured dozens of papers on variations in stratospheric fields (e.g. temperature, geopotential height, zonal wind) and their possible connection to the solar cycle. Although some of their analysis has generated controversy and criticism, in part because of the lack of physical basis for the connections they propose, their work has also been an intriguing examination of the relationship between the atmosphere and solar variations. In their book, the authors stress how early observations were often initially met with scepticism and doubt when their conclusions did not agree with the already developed theory. In presenting their own research into connections between the solar cycle and stratospheric fields, the authors seem to parallel their own experiences and difficulties with those of the early observers. Regardless of whether their analysis will ever be validated by physical understanding, it is interesting to consider the connections between observational discovery and theory.

In addition to the book's historical perspective, the authors present a general overview of the stratosphere, including many of the current issues important in stratospheric research and their relationship to climate change. Although the book is not intended to be a comprehensive treatment of the stratosphere, each chapter is fairly well referenced, and should provide the interested reader with a direction to search for more detailed information. While there is considerable emphasis on the history of stratospheric observations and theory, the more descriptive sections focusing on stratospheric processes would likely be difficult to follow for the non-technical reader. For meteorologists or researchers working in the field, this book broadly describes the stratosphere using numerous figures, without the equations of more rigorous academic texts. Although on the one hand this makes for easier reading, there are those who may feel that some rigor is lacking in various descriptions of the stratosphere. Regardless, readers with an interest in the atmosphere, including its history of observations, should find this book readable and enjoyable.

The book begins with a historical account of early observations of the stratosphere, and the large role the Berlin community has had on stratospheric analysis. The authors recount the early discovery of the stratosphere through some remarkable manned balloon flights, and they present some of the first daily weather maps of the stratosphere. In addition, they also discuss other early discoveries including the time varying winds in the equatorial stratosphere known as the quasi-biennial oscillation (QBO). The historical flavour of this book is refreshing and allows the reader to reflect on how far meteorology has come in the last century.

Chapters 2 and 3 focus on both the general climatology of the stratosphere and the high latitude variations that occur during winter and spring. Colour plates of hemispheric temperature and geopotential height help to illustrate the seasonal variations of the stratosphere, while plots of temperature, ozone and geopotential height are used to describe the rapid changes that occur in the winter Arctic region (e.g. sudden stratospheric warming). An accurate and thorough distinction is made between the Arctic and Antarctic, and why the polar vortex in the two hemispheres is so different. These differences explain why an ozone hole forms over Antarctica and not (in general) over the Arctic.

Chapter 4 is a brief description of the QBO, one of the most intriguing atmospheric variations ever discovered. The authors describe the early observations of this wind oscillation, followed by our present understanding of the processes responsible for its origin. The following chapter presents the discovery of the ozone layer and a fairly good account of the ozone depletion story. Also included is an interesting description of ozone observations over Tromsö, Norway in the 1940s.

The final chapter of the book is devoted to the relationship between the stratosphere and the 11-year solar cycle. As mentioned above, this is the author's bread and butter, and they have written extensively on this subject. In presenting their research, they are quick to point out that while physical mechanisms to explain their statistics are not yet available, the observations suggest connections that cannot be ignored. Although the descriptions of the connections between the solar cycle and the stratosphere are not always clear, and would require further reading to more adequately understand the details, they are none the less quite interesting. In the end, the authors again remind

the reader of the scepticism that greeted some of the early observers. Whether an improved understanding of stratospheric processes will ever validate their analysis is difficult to say. However, as the authors point out, the road that science travels often includes the process of observing, then developing adequate theory to match. In the case of this book, and the road the authors travel, it is an enjoyable ride.

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Global Warming: The Hard Science by L. Danny Harvey (Pearson Education Ltd., 2000). ISBN 0582-38167-3. $50.

'Global Warming: The Hard Science' tackles the complex physical and biological science of global-scale climatic change due to human activities. Its comprehensive discussion of the climate system, the greenhouse effect, anthropogenic forcing of climate change, observed changes, and modelling of future change rivals that of the Assessment Reports by the Intergovernmental Panel on Climate Change (IPCC). It is a remarkable achievement from a single author, Danny Harvey, who is a Professor of physical geography at the University of Toronto, as well as a contributor of journal papers over a range of fields, in particular, simple models of climate change.

The book contains 14 chapters, grouped into three parts. The first part, an 'Introduction' of 118 pages, deals with the climate system and climatic change, including the carbon, sulphur and other chemical cycles, and their linkages to climate. The physics of the greenhouse effect and climate sensitivity is presented. Factors driving anthropogenic emissions are discussed in considerable detail, including a table listing Australia as the greatest carbon dioxide emitter per capita. Observed changes of climate and sea level are presented. Part two, a 'Climatic Change' section of 160 pages, presents a summary of models used in projecting change, much of which is based on the 1997 IPCC Technical Paper on simple models, by Harvey and others. Detailed discussions of the forcing by greenhouse gases and aerosols and the response of the biogeochemical cycles of the land and ocean are given. The broad-scale responses of the system, both equilibrium and transient, including sea level rise, are discussed. Part three, 'The science-policy interface' at only 24 pages, considers some simple model projections and inverse calculations, a discussion critical of the 'global warming potential' concept, and a section on the prospects for 'surprises' or abrupt climate changes.

The material is very well presented, and includes numerous tables and figures (13 in colour) mostly redrawn from original papers. The technical level approaches that of a journal publication, although some of the more detailed material is given in 21 boxes covering a range of topics. An introductory 'Chapter highlights' section, a five page glossary, a summary of websites of data sources, and a comprehensive reference list add further value to the reader. The high quality of the text, and the use of some 22 specialist reviewers (including me), adds to one's confidence that the book is a reliable reference.

As I see it, 'Global Warming' comes close to matching the IPCC Working Group I 1995 report in its quality and depth of coverage, except for its limited treatment of general circulation modelling and dynamics in general. There is no evaluation of the simulation of the present climate by full climate models, and only selected results of climate change experiments are given, including some from both the BMRC and CSIRO modelling groups. This doesn't detract from a book with a stated emphasis on physical principles and understanding of results. However, the author's bias towards simple models is perhaps evident in the rather pessimistic suggestion that 'it might never be possible to make reliable regional-scale forecasts'. This suits the author's argument that only a 'collective policy response based on generalized risks' should be adopted by the global community, but rather downplays the potential for impact assessments and adaptation strategies. Overall, though, the book appears compatible with the IPCC assessment. It concludes that there is 'no reason to suspect that water vapour feedback is other than positive', and it gives 1.5 K as a likely lower limit to the sensitivity to a doubling of carbon dioxide. New simple model calculations are included that indicate that values of this order are compatible with the observed warming, if some net cooling by aerosols is allowed.

The book should be a valuable reference to most climate researchers, particularly those with a meteorological background. It should be suitable as a textbook for some postgraduate studies. I suspect that the level is beyond that desired by most other potential readers. A shorter (256 pages) and cheaper version of the material has been published as 'Climate and Global Environmental Change', intended for undergraduate

study. Those seeking more detail on climate models, particularly the relevant equations and numerical techniques, should complement the book with (multi-authoured) volumes such as 'Climate System Modeling' (1993, edited by K. Trenberth). For an Australian perspective, CSIRO's 'Greenhouse: Coping with Climate Change' (1996) is to be recommended. The impending IPCC Third Assessment Report will, no doubt, be more comprehensive and authoritative, but it is unlikely to be as conveniently presented and as readable as Harvey's account.

I highly recommend 'Global Warming' as a fascinating presentation of climate change, and a valuable reference for all those with a keen interest in this 'Hard Science'.

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