Aust. Met. Mag. 39 (1991) 141–145

Book reviews

Weather Radar Networking (Seminar on COST Project 73) edited by C.G. Collier and M. Chapuis (Kluwer Academic Publishers, 1990). ISBN 0 792 30672 4. Pp. xvi + 580, Dfl.240.00.

The rapid development of operational meteorological radar networks in many western European countries during the last few years has led to an obvious need to exchange radar data between neighbouring countries. This need is now being met by COST Project 73; the COST (CO-operation in Science and Technology) programme being a program organised under the aegis of the Commission of European Communities (CEC) for European States which see advantage in pursuing joint research and development projects. COST 73, spanning the years 1986–1991, associates sixteen western European countries with the aim of setting up a weather radar network providing real-time measurements of precipitation. This book presents the proceedings of a seminar, cosponsored by CEC and WMO, which was held in Brussels on 5 to 8 September 1989, at the half-way point of the project.

The book is a collection of almost 60 papers presented at six sessions. It is hard covered, textbook-sized (C5) and the papers are the usual conference-type, author produced, camera-ready manuscripts which display the usual variety of typefaces, layout styles and typographical errors. Also, because of the international nature of the contributions, the quality of English expression is sometimes poor (two papers are in French!). Despite these drawbacks the book is an impressive production considering the sheer volume of material and the time constraints of the project.

Session 1, Radar Networking Programmes, is the largest with eighteen papers which consist mainly of descriptions of various national radar networks. Not only are the European networks described but also those in the USA, Japan and Brazil. While a lot of this material is technical and somewhat repetitive it is fascinating to compare the different approaches to radar networking adopted by the various countries. In the keynote paper by COST 73 chairman C.G. Collier the aims of the project are presented and he describes the state of current work on the important issues of communication formats, processing, display and hardware requirements, and meteorological applications of radar data. Examples of composited images from part of the European radar network are presented in colour.

Session 2, The Role of Reflectivity-Based Techniques in Operational Radar Networks, begins with two keynote papers, one dealing with radar rainfall measurement problems including the perennial one of the estimation of rainfall near the ground using radar data from higher levels, and the other with a suggested format for the communication of the large amounts of radar image data which will be generated by a large network. The second paper contains some of the most significant results to emerge from the COST project so far so it is a little unsettling to find it placed in a session dealing mainly with technical aspects of radar measurement such as reflectivity-rainfall relationships and ground clutter reduction. Unfortunately this is not the only example of inappropriate placement, probably due to haste in production of the volume.

Session 3, The Role of New Techniques in Operational Radar Networks, covers emerging techniques including Doppler and polarisation diversity measurements which are somewhat peripheral to the COST project at present but which may be operationally viable in a few years.

Session 4, Combining Radar, Satellite and Conventional Meteorological Data, contains a series of interesting papers from the USA, China and the UK. Of particular interest is one of the UK papers by Goddard and Conway which describes the present production of near real-time precipitation analyses at hourly intervals with a 5 km resolution for Europe using the COST 73 radar networks, satellite, conventional data and NWP models.

Session 5, Meteorological and Other Applications of Weather Radar Data, contains papers from a number of countries describing the uses to which radar data can be put. Topics covered include short-term forecasting of severe weather, daily rainfall measurements and input to NWP models. Considering the myriad meteorological applications of radar data this session seems very short with only six papers. By contrast, the final session, Hydrological and Other Applications of Weather Radar Data, contains thirteen papers. Perhaps this is an indication that the hydrologists can see the enormous potential of radar networks for the estimation of rainfall over large areas.

A final section contains some concluding remarks from the project chairman, and while these are very brief and are presented in point form, they provide a good indication of the key questions to be answered and the way ahead for radar networking, COST 73 and beyond. Some of them sound very familiar, e.g. 'A large variety of products will be available, but how do forecasters use them?' and 'Users must be listened to'.

Taken purely as a text this book has a number of failings including the variety of type styles and layouts, hand-drawn corrections on figures, the standard of presentation, the relevance of some of the papers and the overall organisation of the material. However, these factors, while annoying (and indeed, such problems are typical of most published seminar proceedings), are more than offset, at least in this reader's estimation, by the importance of the book's content. As a former radar meteorologist I can appreciate the enormous steps made in the last few years in the application of radar technology to meteorology and this book indicates to me that the riches promised by weather radar over four decades ago are now almost within our grasp.

I would recommend this book to any weather forecaster or hydrologist, not perhaps to read from cover to cover, but at least to dip into and get a feel for the topic. For meteorologists, engineers and others involved in the specification and design of weather radar systems it is an essential reference although at US$139.00 it is a bit expensive for an individual to buy.

Phillip Meighen

Phillip Meighen is a meteorologist in the Scientific and Technical Services Branch of the Bureau of Meteorology. He has had a long association with radar meteorology.

Global Air Pollution by Howard Bridgman (Belhaven Press, London, 1990) ISBN 9 781852 930943. 261 pp. £30.00 (hardback).

With this book Howard Bridgman makes a useful addition to the growing number of books on atmospheric sciences written in Australia. The motivation clearly stems from his background in a university geography department, where students often have varying backgrounds. His stated aim was to produce a text for undergraduates involved in a range of courses from geography, environmental studies or engineering through to social sciences, for whom he saw a need for a text on atmospheric pollution that was not too specialised and 'too narrow in focus'.

Accordingly this book presents an overview of 'Global Air Pollution' via chapters on Primary Gaseous Pollutants and Transport, Tropospheric and Stratospheric Ozone, Atmospheric Aerosols, Trace Gases and Global Warming, Rainwater Quality and Acidity, The Environmental Consequences of Nuclear War, Long Range Transport of Air Pollution and Air Quality in Urban Atmospheres. The author's focus for the book is on 'major air pollution problems which will affect the world in the next ten years'. Some time ago I might have quibbled about whether nuclear winter was likely to affect the world within the next ten years, however this section in the book is not without interest now against the background of widespread oil-well fires in Kuwait. Otherwise, the selection of topics certainly corresponds with the author's focus, and while there are other topics which might also have been included, in a book of only 261 pages it is impossible to avoid being selective.

Indeed the topics are covered in considerably less than the 261 pages, since the book is well served by two pages on Units/Conversion Factors, a three-page Glossary of Meteorological Terms, an extensive bibliography of 26 pages, and a useful subject index of twelve pages. Thus the organisation is good, giving a student reader ready access to the minimum of necessary specialist information as well as ample scope for following up areas of interest via the bibliography. The latter is up to date to the end of 1989.

Since this book is not aimed at specialists there are no mathematical definitions or equations, though chemical equations are used in a number of places to indicate reaction pathways and qualitative relationships between species. This is a descriptive book, in which the author aims to present undergraduates with an informed summary of the current scientific understanding of each of the topics dealt with. The book is written from a perspective which acknowledges three factors which I would agree need emphasis: (a) the global extent of the problems discussed; (b) the limitations to current measured (and modelled) information; and (c) limitations to our current understanding of the links between various atmospheric processes. In this regard I think the author serves his readers well.

One other major emphasis is evident in the book's subtitle 'Problems for the 1990s'. Throughout the text there are short allusions to possible future scenarios, and the final chapter in the book is devoted specifically to the author's views on what the furture may hold early in the 21st century. To end the book with this forward-looking emphasis is commendable, though I would have valued a longer and more in-depth discussion than that allowed in the short seven pages of this chapter.

I found the book easy to read, combining as it does clarity of argument with a sensible acknowledgment of the uncertainties attending many of the current sceintific conclusions that are discussed. Figures and tables are used well throughout to illustrate key points (in total 54 figures and 74 tables).

It is here that I have a significant criticism of the book. There were printing errors (unwanted additional rows of text) in several of the tables, and in both tables and figures a mixture of layouts and font sizes has been used which is visually messy, and leads to parts of some figures and tables hav-

ing text which can only be described as microscopic. I found these things quite annoying.

Overall the book strikes me as being a quite useful addition to the available literature on atmospheric pollution. It is not a text for specialists or others requiring technical information, but that is not the audience for whom it was written. It should serve well in its intended task of giving a wide range of undergraduates (or other interested non-specialists) an up-to-date perspective on the global aspects of air pollution.

Greg Ayers

Greg Ayers, of CSIRO's Division of Atmospheric Research, pursues interests in atmospheric chemistry stretching from regional air pollution to global climate change.

Principles of Air Pollution Meteorology by Tom Lyons and Bill Scott (Belhaven Press, London, 1990) ISBN 1 85293 079 9. 224 pp., £39.00.

The authors are from the Department of Atmospheric Science, Murdoch University, Western Australia. The aim of the book is said to be to provide a structured and comprehensive introduction to the techniques and models developed for the regulatory analysis and monitoring of air pollution in the atmospheric boundary layer. The book is 'both a handbook for practising environmental scientists as well as an essential textbook for advanced students.' The authors state in Chapter 1 that they 'seek to lay the foundations of air-quality modelling as an essential component of environmental science through a discussion of the pathway processes in the atmosphere and the estimations of ambient levels.'

The book is in five chapters and an appendix as follows:

1. Introduction. This is cursory, and a little confusing. For example the authors state 'Of necessity we will concentrate on the development of air-quality models for lighter-than-air gases . . .' (in contrast to denser-than-air gases), but buoyancy effects are only discussed in the context of plume rise in Chapter 3.

2. Atmospheric Boundary Layer. Covers solar radiation; terrestrial radiation; soil temperature; air stability; local wind structure; the logarithmic profile (includes a brief discussion of dimensional analysis, Richardson numbers); the Ekman spiral; turbulence; statistical measures (spectra); and boundary-layer scaling.

There are several moderately detailed derivations in this chapter, such as derivation of the Stefan-Boltzmann law, showing σ in terms of Planck's constant, the speed of light and Boltzmann's constant. There is also a derivation of Reynolds' equations for turbulent flow.

3. Atmospheric Diffusion. The chapter covers turbulent gradient transport; statistical theories of turbulent diffusion (Taylor's theorem, of course); Gaussian plume model (including the Pasquill-Gifford curves, Briggs' dispersion formulae, Draxler's relations); plume rise; applications of the Gaussian model (to mixing layers, line sources, fumigation); models based on K-theory; other models (a few are mentioned); removal mechanisms (radioactive decay, dry and wet-deposition); and box models.

There are few derivations in this chapter, yet this is where they are particularly needed if the reader is approaching the subject from a related discipline. The chapter gives a particularly brief overview only.

4. Pollutants and their Properties. The topics are residence time and reaction rates; sulphur compounds; nitrogen compounds (includes a simplified chemistry of smog formation); carbon compounds; organic compounds (methane, terpenes, mercaptans, formaldehyde); aerosols (size ranges, formation, saltation); and kinetic modelling.

The chapter is no more than a conceptual introduction, but it is useful for that. 'Pathway processes in the atmosphere' are so briefly discussed that the reader seeking a good foundation will of necessity have to look further. The references given will serve the reader well in this endeavour.

5. Environmental Monitoring and Impact. Qualitative discussions cover network design (a difficult subject for objective methods; the authors give good advice); meteorological monitoring (more good advice); pollutant monitoring (ten-page outline of techniques); pollutant effects on plants; pollutant effects on humans (only a half page and three tables); pollutant indices; and environmental assessment.

Remember that the authors stated that they would discuss '. . . the estimations of ambient levels.' Well there are NO estimates given anywhere. They do show how readers could in principle obtain their own estimates.

Appendix: Standard Air-Quality Models. A short paragraph is devoted to discussing each of 23, mostly USEPA-approved, models. There is no discussion of the important Australian models such as EPAWA's DISPMOD, EPAV's AUSPLUME, or CSIRO's LPMS.

Is the book a success? Yes, and No. It reads like a book based on a lecture series. It *does* provide a comprehensive introduction to the principles of air pollution meteorology, focused on models and their bases and imputs, and could be used as a textbook for an advanced course on air pollution. It is *not* a handbook suitable for practicing environmental scientists. To such people the book is useful only because of the breadth of topics mentioned — there is inadequate detail to be of more than ephemeral interest.

The writing style is dry and usually clear. There are exceptions, as for example in the discussion of measuring mixing-layer height (p.170) 'Since the mechanically generated mixed layer normally lies below 200 m, it is best measured from an instrumented tower supported by the acoustic sounder.' — the mind boggles.

There are seventeen pages of references with a good sprinkling of Australian writers. However some choices of references reflect more on the backgrounds of the authors than accessibility and relevance to the subject: for example, a paper by colleague Pavel Zib (1977, University of Witwatersrand, Johannesburg, *Occasional Paper No. 16*), or the KAMS paper (1982, Department of Conservation and the Environment, Perth, WA). Some choices are idiosyncratic: to illustrate the literature on studies of the effects of particular pollutants on humans the authors quote Mainwaring (1989: *Clean Air, 23*, p.24): I am sure Sylvia would be flattered.

There are no noticeable errors in the book, which is attractively produced. I will be pleased to keep the review copy on my shelves but at the usual Australian price of three times the UK price for the hardcover, I would want to wait for a paperback version before buying it.

Peter Manins

Peter Manins is a specialist in air pollution meteorology. He is Senior Principal Research Scientist, CSIRO Division of Atmospheric Research and associate editor of the Australian Meteorological Magazine.

Polar Oceanography, Part A: Physical Science edited by Walker O. Smith, Jr (Academic Press, San Diego, 1990)* ISBN 0 12 653031 9. Pp. xviii + 406, $152.50.

This volume, the first of two in a series, deals with the atmosphere, ice and ocean in the polar regions, and their interactions. (The second volume will consider the chemical, biological and sedimentation processes in the polar oceans.) Both Arctic and Antarctic polar oceans are treated and the two hemispheres are compared and contrasted throughout the volume, although data available for the Antarctic are often restricted.

The book contains seven review chapters, each written by a prominent and active researcher, all of whom are based in North America. Each individual chapter provides a good and reasonably up-to-date review but the scope of the chapters varies from a broad overview of a topic to a fairly narrow perspective of the author's own research speciality. It is this lack of a unified approach, plus the failure to stress the interdisciplinary connections between the chapters rather than let them stand as a collection of independent papers, that are the main weakness of the total volume.

Chapter 1, by R.A. Brown, is entitled Meteorology but, within the scope of the total volume, deals only with those aspects of meteorology directly bearing on ocean dynamics and thermodynamics. After an introduction to boundary-layer theory the chapter strongly focuses on evaluation and modelling of the surface stress over ice-covered ocean. Drag and heat flux parametrisations for various conditions in polar regions are reviewed, largely from results of the arctic experiments AIDJEX and MIZEX. Because of the relative uniformity of polar surfaces these measurement programs have led to significant advances in knowledge of the PBL. There are few equivalent boundary-layer experiments in the Antarctic and those mentioned here are over the continental ice, not the ocean.

Energy exchange over an ice-covered ocean, and ice growth and decay estimated from simple 1-D thermodynamic models are discussed in Chapter 2, Sea Ice in the Polar Regions (A.J. Gow and W.B. Tucker III). Chapter 2 also deals with the momentum balance and drift of sea-ice, plus other large-scale characteristics such as the thickness distribution and morphology. The contrasts between Arctic and Antarctic sea-ice conditions are emphasised, but it is apparent how few substantial data we have on Antarctic ice conditions. The second part of this chapter reviews the small-scale physical properties of sea-ice including salinity, crystallography and structure. Processes determining these have been reasonably well understood for some time but *in situ* observations are now providing insight into forcing terms in the heat and momentum balance within the pack. In particular the different crystal structure of the bulk of Antarctic pack ice from that in the central Arctic reflects the more divergent drift and greater production of new thin ice in the Antarctic.

Much of our present knowledge of polar oceans and their ice cover has been gained from satellites. In Chapter 3, Remote Sensing of the Polar Oceans (R.A. Schuchman and R.G. Onstott), the emphasis is on remote sensing of sea-ice, predominantly using microwave sensors. The basic theory and examples of passive and active (synthetic aperture radar) microwave sensing of sea-ice are treated in some depth but there is little on visible and infrared sensing. Although passive microwave is the prime mapping tool for sea-ice, and active radar systems offer exciting possibilities for the future, lower frequency sensors remain important for many applications.

Chapter 3, Large Scale Physical Oceanography of Polar Oceans (E.C. Carmack), and Chapter 4, Mesoscale Phenomena in Polar Oceans (R.C. Muench), are both comprehensive and well structured reviews that provide a good introduction to

*Available in Australia through Harcourt Brace Jovanovich Group (Aust.) Pty Ltd.

the topics for the non-specialist. Carmack descriptively reviews present knowledge of the physical setting currents, water masses, and vertical (thermohaline) circulation processes in the polar oceans, emphasising comparisons between hemispheres. He presents an interesting comparison of the volumetric comparison of Arctic and Antarctic water mass properties as T-S diagrams which are a synthesis of many data sources. This chapter also has an exhaustive bibliography of around 250 entries. Muench's chapter, which deals with mesoscale phenomena, including frontal systems and eddies, is similarly aimed at the non-specialist and provides a good phenomenologically based description of mesoscale processes and their consequences, with adequate references for those who wish to delve deeper. Polynyas, areas within the ice edge which remain partially or totally ice free, are treated as a special case of mesoscale processes, although with the exception of the Weddell Polynya (really a regional-scale feature) all examples cited are for the Arctic.

Chapter 6 on the oceanic boundary layer (Small Scale Processes, M.G. McPhee) is more physically rigourous than the two previous oceanographic chapters, but is equally systematic. The fundamental physics of fluid dynamics and turbulent processes are reviewed as a background for discussion of under ice drag, heat and mass flux at the ice/ocean interface, and internal waves. As for the atmospheric boundary layer, advances in the understanding of the oceanic boundary layer under sea-ice come almost exclusively from several major Arctic experiments.

The final chapter, Models and Their Applications to Polar Oceanography (S. Hakkinen), includes ice, ocean, and coupled ice-ocean models. The historical development of both regional and large-scale models is reviewed, although some recent work is not included. Coupled ice-ocean models offer the best hope of understanding feedback processes, but all present models use prescribed atmospheric forcing and none are yet adequate to predict the role and response of polar oceans to climate change.

The technical presentation of the book is generally of high standard and there are few typographical errors in the text. There are a number of errors however in the figures, including erroneous and switched captions, as well as inadequate labelling, particularly of diagrams extracted from other sources.

It is difficult to envisage a large market for this book and, at a price in Australia of more than $150.00, it will be restricted mostly to institution libraries. The lack of strong editorial direction makes it unsuitable for the novice or postgraduate student and many of the individual fields are better served by recent, more detailed specialist reviews. Its most probable audience is the specialist in one discipline who requires a current overview of the total field. Since, however, many of the chapters define problems and outline current research directions, rather than presenting definite conclusions, it is likely to become fairly quickly dated. In the preface the editor notes a criticism made by many colleagues during compilation of the book that, since our knowledge of polar oceanography is expanding at such a rapid pace '. . . a synthesis might be premature'. This criticism is not adequately answered.

Ian Allison

Ian Allison is a Principal Research Scientist with the Australian Antarctic Division whose research interests include Antarctic sea-ice and its interaction with atmosphere and ocean.