

Book reviews

Atmospheric Ozone, edited by C. S. Zerefos and A. Ghazi. (D. Reidel Publishing Company, The Netherlands, 1985) Pp xxxi + 842. ISBN 90 227 1942 X \$US99.00.

For climatic time-scales, perturbations in the radiative forcing dominate the factors governing climatic change. Early in the 1970s atmospheric concentrations of ozone, methane and nitrous oxide were considered to have negligible effects on climate because of their trace concentrations. Recent studies have shown that these minute concentrations can have a significant impact on climate and climate sensitivity.

The 'greenhouse effect' of carbon dioxide is a well-presented example of radiative forcing of the climate. Now more than twenty trace gases, apart from carbon dioxide, have been found to have absorption bands in the atmospheric window region (7-13 microns), the spectral region where the atmosphere is transparent to emitted long wave radiation. While the present concentrations of these gases are, on average, four orders of magnitude less than carbon dioxide, these polyatomic trace gases may have the same effect on surface and atmospheric temperatures as carbon dioxide. The evidence suggests that a single molecule of the chlorofluorocarbons, for example, dichlorodifluoromethane (freon 11) and freon 12, whose concentrations are measured in parts per 10^{12} will have the same global warming effect as 10^4 molecules of carbon dioxide!

Knowledge and an understanding of chemical processes within the atmosphere, oceans and ecosphere that govern the formation, breakdown and transport of ozone, are innately tied to an equal understanding of the other trace gases and the biogeochemical cycles. This book for review, *Atmospheric Ozone*, is subtitled 'Proceedings of the Quadrennial Ozone Symposium held in Halkidiki, Greece, 3-7 September', and contains the collected summaries and abstracts of ozone related research presented at the symposium. The editors of this volume collated the work under nine headings or chapters corresponding to the nine sessions in the symposium, added a summary of the highlights for each session, and provided an author address list and report index.

Three invited papers preface the nine chapters in the volume. The President of the International Ozone Commission, C. L. Master, presents a summary of the (late 1983) state of ozone related research; R. D. Bojkov, representing the WMO, gives a review of the WMO Ozone Project for 1980 to 1984; and C. D.

Walshaw presents an *in memoriam* tribute to one of the pioneers of ozone work, Sir Charles Normad, who passed away in October 1985.

The first two chapters of the book focus attention on recent model investigations. Chapter 1 presents the results of 2D and 3D modelling and analysis of trace gas formulation and transport. Also included are papers on the analysis of the quasi-biennial oscillation (QBO) of ozone related to the tropical stratospheric QBO and estimations of the effect of the El Chichon eruptions in 1982 on ozone and nitrous oxide distributions. Chapter 2 concentrated on the interaction between ozone, other trace gases and climate.

The next three chapters contain over 65 per cent of the presentations at the symposium. The results of stratospheric trace gases measurements with a variety of different instrumentation and observation platforms are presented in a collection of 24 research summaries in Chapter 3. Chapter 4 is used to present a similar number of summaries of ozone analyses, from ground and satellite data bases, covering a variety of different time-scales.

The largest number of extended abstracts or summaries (34) resides in Chapter 5; this chapter amasses presentations on recent developments in new instrumentation for the detection of ozone and trace gases, together with presentations on the calibration and standardisation of the ground station network of spectrophotometers.

Chapter 6 returns our attention to the interaction of ozone and circulation; a heavy use of data from satellite measurements and vertical profiles of ozone and temperature is a feature of this collection of summaries. New results and recommendations concerning ultraviolet absorption cross-sections of ozone, a cornerstone of ozone measurements by remote sensing methods, are the subject of the eight summaries in Chapter 7.

Measurements of atmospheric attenuated solar irradiance and radiance are major source functions for determining ozone by remote sensing techniques, and Chapter 8 focuses on solar activity and radiation studies in ozone related areas. Measurements and analyses of tropospheric trace constituents at sites where little anthropogenic influence is expected are the subjects reported in the last chapter; a collection of 22 presentations are collated in this chapter.

The volume with its content of 161 'papers' has been produced by using camera-ready originals from presented and poster session reports. It has been subject to little if any editing and therefore suffers from a lack of standardisation and inconsistency in typesetting and diagram production, as well as numerous typographical errors common with this type of publication. The editors, by restricting themselves

to presenting the material in the order of presentation at the symposium, have made the chapter boundaries rather vague. However, the summary of the chapters provided as a preface to the book resolves a lot of these difficulties and provides an excellent launching place for any reader to find his way through the vast array of material. This latter point and high quality production make the volume an above average collation of symposium papers.

Through the presented articles this volume has shown that ozone related research has continued to develop over the last decade. Highlights include the reporting of a new set of relative ozone absorption coefficients in the ultraviolet region, the justification of satellites as the most appropriate platforms for global ozone monitoring, reports of the effect of El Chichon emissions on ozone concentrations together with the induced errors in remotely sensed data caused by the increased aerosol loading, and the series of papers on the previously neglected topic of non-urban tropospheric ozone. It was also interesting to read the reports of complex global climate models (GCM) which model changes in the biogeochemical cycles, and which were not constrained within the boundaries of the typical dynamic GCM which have dominated climate research in the past.

Any collation of symposium papers has its disappointing aspects, and this volume has its share. A limitation on the number of pages per report is a fact of life for most symposia and workshop reprints. This volume does not escape the tendency of most authors to preen the discussion in the article to keep page numbers down, leaving the material presented as a collection of disjointed facts. There is also the frustration of turning to an interesting report title to find that the list of authors takes up more space than the text, that the report is in essence an abstract of an article 'in press', or the authors mention a valuable reference in the text but fail to mention it in the reference list!

An example of the latter is found in the Presidential Address. In the opening paragraph Mateer notes two recent reports, which he states give 'one a reasonably balanced view of our knowledge of atmospheric ozone as of sometime in late 1983'. Unfortunately, Mateer does not list any references and only an extensive search of the reference list in the 161 papers in the volume reveals their title and source.

Despite these criticisms which could apply to any collection of symposium papers, the volume provides an excellent vehicle to study the directions of ozone related research in this decade. It also provides an extensive source of recent references for students and research workers. Most importantly, it shows that atmospheric ozone science requires close cooperation between several disciplines and that climate research can only make headway by using an interdisciplinary approach. At \$US99 this hard cover volume is beyond the reach of most individuals,

however, I recommend it as a useful reference source on current ozone research, and it would be a valuable acquisition in any atmospheric science library.

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Dynamic Meteorology by S. Panchev (D. Reidel Publishing Company, The Netherlands, 1985) Pp xxi + 360. ISBN 90 277 1744 3. \$US74.00.

Stoicho Panchev has taught dynamic meteorology for many years at Sofia University, Bulgaria, and has published a companion textbook for the course in 1981. This present work in English is based on that edition and has been translated by Panchev and two former students.

The book is quite comprehensive, in that it considers the necessary background material on kinematics, the basic dynamic and thermodynamic equations, atmospheric energetics and instabilities and has chapters on turbulence, the surface layer and the boundary layer. The last three are often given only scant attention in texts of this type so the expanded treatment here is a useful reference. There are also chapters on geostrophic adjustment, meteorological forecasts and the general circulation.

Most people probably have a view on the 'correct' layout and emphasis of a book on dynamic meteorology. This reviewer felt that some of the important material was treated in a very cursory fashion or in an order which did not help clarify the overall direction. As examples, the modifications to the equations of motion to account for the rotation of the earth are introduced in an almost intuitive manner. Further, the section on dynamic instability considers inertial, barotropic and convective instabilities at some length but very little discussion is devoted to baroclinic instability which is arguably the most interesting of them all and its proper understanding leads to an appreciation of the way the general circulation works. The chapter on the general circulation of the atmosphere I found to be rather obscure and not particularly helpful to those who would like to learn something about the topic. Some aspects of the general circulation are described (without diagrams) with little or no relation to the discussions which had taken place earlier in the book. In many instances the author indulges in detailed analyses of systems which are of only historical or peripheral interest. The chapter on the basis of meteorological forecasts is an example of this. The discussion on primitive equation models is very terse and the consideration of initialisation of these is limited to the variational technique of Sasaki, which could hardly be considered a scheme in common use today.

The book is pleasingly presented (even though there are a number of minor misprints) and the translation, with the exception of some stilted passages, is good. The book appears to be directed to third and fourth year students and as a reference text for the specialist. As I have indicated the subject is not treated as clearly and logically as in other works, such as those of Holton and of Haltiner and Williams, and as such could not be recommended as a primary text for students. However, the book does contain material not usually found in texts and the approach to some of the topics is refreshingly novel. As such it would be useful backup reading for students and a worthwhile addition to the reference library of the specialist.

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The Proceedings of the First Conference on Tornadoes, Waterspouts, Wind-Devils and Severe Storm Phenomena. Journal of Meteorology vol. 10, no. 100.
(Aretech Publishing Co., Bradford-On-Avon, England) 72 pp, £4.00.

The above conference (the first in Europe?) was sponsored by The Tornado and Storm Research Organisation (TORRO) UK, and the Proceedings were published by the Journal of Meteorology in association with TORRO—described as ‘a privately-supported research body serving the national public interest’, with future goals of ‘providing the basic tornado data, advice, research expertise and consultative services required in these matters. . .’

Most of the papers presented were by heads of the various TORRO divisions, which comprise the Tornado Division, the Thunderstorm Division, the Hailstorm Division, the Ball Lightning Division and the Weather Disasters Division. The accent however is on tornadoes, the incidence of which seems to be getting increased publicity. More than half of the papers deal with tornadoes in Britain, the first of which is recorded as occurring as far back as 1091.

Some of the papers surprisingly advocate changes to the accepted methods of reporting and defining weather phenomena. For example in a paper on ‘The spatial and temporal distribution of British thunderstorms’ Prichard suggests that the definition of ‘thunder days’ be altered from ‘days of thunder heard’ to ‘days of overhead (or close) thunderstorm’ in order to get a better idea of the actual distribution of thunder.

Elsom, describing the work of the hailstorm division, has given us ‘The TORRO hailstone scale’, which classifies hail into four main categories: ordinary, large, giant and super.

A paper by Meaden presents an ‘International TORRO Tornado Intensity Scale’ designed for the weaker tornadoes of the non-American world. At present most countries use the Fujita—Pearson (FPP) scale for reporting and documenting tornado intensity and size. Meaden has increased Fujita’s 6 scales (code figs. 0 to 5) to 11 (code figs. 0-10), narrowing the ranges of intensity for each scale and with corresponding descriptions of damage.

In each instance the changes seem unwarranted and would have more disadvantages than advantages. The thunder definition would mean ‘under-recording’ in sparsely populated areas. The ranges in the four main categories for hail size are too wide. Hailstones of diameter 51 mm and 100 mm are grouped together! The existing finer scale of ‘pea’, ‘marble’, ‘golf ball’, etc. is better suited for an understanding of hail distribution. Meaden’s ‘International Tornado Intensity Scale’ has not had favourable comment elsewhere. One tends to agree with Fujita (who initially proposed sub-divisions of his scales) that ‘from the statistical point of view, it is desirable to categorize all tornadoes in a coarse scale rather than assessing a limited number of storms in a scale of extreme accuracy’. Fujita’s scales — evaluated in thousands of tornadoes — have been found most acceptable.

The other papers presented however were less controversial.

Elsom’s other paper ‘Tornadoes in Britain, where when and how often’ described TORRO’s work in identifying tornadoes and discussed the criteria used. A seasonal distribution of tornadoes since 1951 is presented. There is a hint of over-subscribing to the concept of ‘explosive effects’ caused by tornadoes.

Another paper by Meaden entitled ‘The classification of whirlwind types and a discussion of their physical origins’ provides a well thought out and most acceptable classification ‘tree’ for all types of whirlwinds. He also asks and provides plausible answers to very pertinent questions such as ‘Where does the rotation (in tornadoes) commence?’ ‘What conditions start it off?’ ‘Why do only a small fraction of storms produce tornadoes?’.

‘Britain’s greatest tornadoes and tornado outbreaks’ by Michael Rowe covers the more significant tornado occurrences from 1091 A.D. to the present day. Many long hours of searching must have been required to acquire some of the data which stem from interesting sources like *The Gentlemen’s Magazine*, *Illustrated London News*, *The Times*, *The Oxford Journal* and *Weather* to name some. Rowe gives details of an outbreak in Britain in 1981 which he claims produced the world’s second largest number of tornadoes — 105 — for a single day. While there are descriptions which certainly support tornadic activity, too many inferences seem to depend on spectacular photographs of wrecked and shifted caravans and roofs ripped off houses, which feats, according to Fujita (1978) can be wrought by downbursts and microbursts. When one reads in this case that ‘only

about 35 tornadoes came to light through the press-cutting agencies' but that an appeal 'on Anglia Television produced another 30', one wonders whether the investigators were sufficiently mindful of the caution of Forbes and Wakimoto (1983) that 'classification of eddy tornadoes and downburst and microburst related vortices as tornadoes may increase tornado frequency statistics' and 'that there are cases where multiple vortices within a tornado have been reported as several tornadoes'.

The paper on 'Ball Lightning' by Stenhoff surveys selected and mostly unpublished reports — some of which were in response to an appeal — on the subject. The author draws a few conclusions and discusses the various theories relating to the phenomenon.

Some of the shorter presentations on case histories of tornadic activity refer to the 'skipping action' of tornadoes — a concept no longer accepted — and do not consider suction vortex behaviour.

A paper by Buller on 'Building damage caused by tornadoes in the United Kingdom' shows how en-

gineering tests help in assessing wind speeds and points out that the collapse of older war-damaged buildings by tornadic winds can give exaggerated ideas of wind strength.

A third paper by Meaden points out that 'tornadic-risk' opinion should be sought when designing structures like the suspension Severn bridge, for which locality he presents tornado return periods.

We learn from the 'Proceedings' that TORRO has its own observers for reporting thunder and other weather phenomena. They do not generally observe on a 24-hour basis!

There is also a conspicuous lack of reference to the British Meteorological Service records. These would prove invaluable to TORRO.

The director of TORRO in a closing statement formally urge that the responsible authorities recognise the tornado threat, re-examine building safety standards for key structures and include tornado forecasting as a part of the national meteorological services. If they succeed, then the efforts of TORRO would not have been in vain.

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