
BOOK REVIEW

SYNOPTIC–DYNAMIC METEOROLOGY AND WEATHER ANALYSIS AND FORECASTING: A TRIBUTE TO FRED SANDERS, edited by Lance F. Bosart and Howard B. Bluestein. Meteorological Monograph Vol. 33 No. 55, American Meteorological Society, 2008. Hardcover, \$120, 440 pp. ISBN 978-1-878220-84-4

Fred Sanders (1923–2006), Emeritus Professor of Meteorology at the Massachusetts Institute of Technology, was a leading light in synoptic meteorology for decades. His teaching inspired several generations of students. The great respect he commanded shines through the pages of this book, written by many of his former students and collaborators. The book illustrates the evolution of our understanding of the atmosphere over the past half century, and is a valuable record of the major contributions of Sanders, in whose honour this collection of articles has been assembled.

The scientific rigour of synoptic meteorology has been questioned from time to time. Fred Sanders provided a solid scientific foundation for his synoptic studies by merging the application of dynamics and quantitative diagnosis with his studies of observed weather systems. Sanders believed in using time series of conventional surface observations for all that they are worth, extracting from them maximum understanding of how the fundamental dynamical principles manifest themselves in synoptic developments.

The book is a collection of sixteen articles, generally by leading figures in synoptic or dynamic meteorology. It is heavily American in content, with almost all the twenty-eight authors coming from the USA, and the synoptic cases have an emphasis on the Southern Plains and East Coast of the United States. The book is in four parts, with Introductions to Parts 1 and 2 by Howard Bluestein, and to Parts 3 and 4 by Lance Bosart.

Part 1, on Fronts, has six chapters, the first (Bluestein) on surfaces of discontinuity and their role in the initiation of convective storms. This is followed by a chapter on fronts in sloping terrain (Bosart, Wasula, Drag, Meier). Then comes a discussion of the out-of-date concept of air masses (Emanuel), with a proposal for a new definition in terms of saturation potential temperature. Next is an empirical perspective on cold fronts (Kessler) illustrating some limitations of the Norwegian model. This reflects one of Sanders' concerns: 'What I do see wrong is the practice of identifying ALL wind shifts, whether accompanied or not by density contrast, as fronts'. The critical role of surface observations in synoptic analysis is stressed here once again. Chapter 5 (Schultz) provides an excellent review of the highs

and lows of fashion of frontal theory, and of Sanders' work in shaping the role of frontal theory in synoptic analysis. The author discusses the complexity of real fronts, revisiting Sanders' observation that when the wind shift is coincident with the temperature gradient, frontogenesis ensues; when the wind shift or pressure trough lies ahead, frontolysis results. In the final chapter of Part 1 (Schultz and Roebber), the front analysed in Sanders' seminal 1955 paper is simulated with a mesoscale NWP model, MM5. Methods hardly imagined fifty years ago shine new light on Sanders' study, showing some weaknesses, but also the remarkable strengths of his original analysis.

Part 2 comprises four chapters on Analysis and Diagnosis. The first (Hakim and Torn) describes techniques available for ensemble synoptic analysis and demonstrates them by illustrative examples. The next (Hoffman) discusses the use of surface potential temperature analysis and its capacity to distinguish between fronts, baroclinic troughs and non-frontal baroclinic zones. The third (Nielsen-Gammon and Gold) expounds the view that PV (potential vorticity) thinking, which is consistent with commonly used QG (quasi-geostrophic) diagnostic techniques, is overdue in the United States. The conclusion is that PV 'helps the forecaster see what the atmosphere is capable of doing, thereby helping not just the forecast itself but also the forecast of what can go wrong', i.e. forecast uncertainty. Part 2 ends with an article (Weiss, Bluestein, Pazmany and Geerts) on a fine-scale radar analysis of a dry-line, in which the authors present observational evidence of vertical velocities up to 10 m/s at 500 m.

Part 3 comprises four articles on forecasting. The first, by the late Robert Burpee, gives an account of the barotropic forecasting model that Sanders developed with him, and that was in operational use for some two decades for predicting the paths of tropical cyclones. The next (Gyakum) discusses cold-season precipitation events in the northeastern USA, and the insight that Sanders provided for predicting them. Then an article 'Must Surprise Snowstorms be a Surprise?' (Tracton) considers the source and nature of uncertainties in forecasts, in particular East Coast snowstorms. With recent developments in ensemble forecasting, the answer is essentially 'no'. The change in thinking amongst operational forecasters, from deterministic to probabilistic forecasting, is noted. Part 3 ends with a paper (Uccellini, Kocin, Sienkiewicz, Kistler and Baker) on Sanders' many contributions to synoptic meteorology. The authors revisit the New York snowstorm of 26 December 1947, missed by the public forecast but anticipated by Fred Sanders, who was then working at La Guardia Airport. They simulated the storm with a

modern NWP system. Lack of observations limited the predictability of this event. The authors concluded that Sanders was '56 years ahead of his time!'

Part 4, on Climate and Climatology, opens with a 52-page article (Dole) on the linkage between weather and climate. The emphasis is on the processes that bridge the time-scales between synoptic events and seasonal and longer climate developments, and a broad range of observed variations and theoretical models are reviewed. The concluding chapter (Galarneau, Bosart and Aiyyer) looks at closed anticyclones, often associated with heat-waves and droughts.

There is a pictorial section with fifty photographs featuring many of Sanders' students and collaborators. An Appendix, written by Sanders himself, outlines his

'Career with Fronts: Real Ones and Bogus Ones'. He looks at changing views on frontal theory over the course of his career, and concludes that, even in present-day operational analysis, a distinction between features that agree with the Norwegian conceptual model and those that do not, is essential.

The book is nicely produced, in large format on high-quality paper. It contains much of interest to anyone involved in synoptic meteorology. It will be of special interest to those of us who knew Sanders or who admire his work. There is some repetition, unavoidable in a book of this nature. The book contains much material that could be of value in teaching. However, with its high cost and inhomogeneous content and style, it is not suitable as a text book.

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