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First Annual Meeting of the European Meteorological Society

Budapest, 25-26 September 2001

Selected lectures from the symposium
The future of meteorology in Europe

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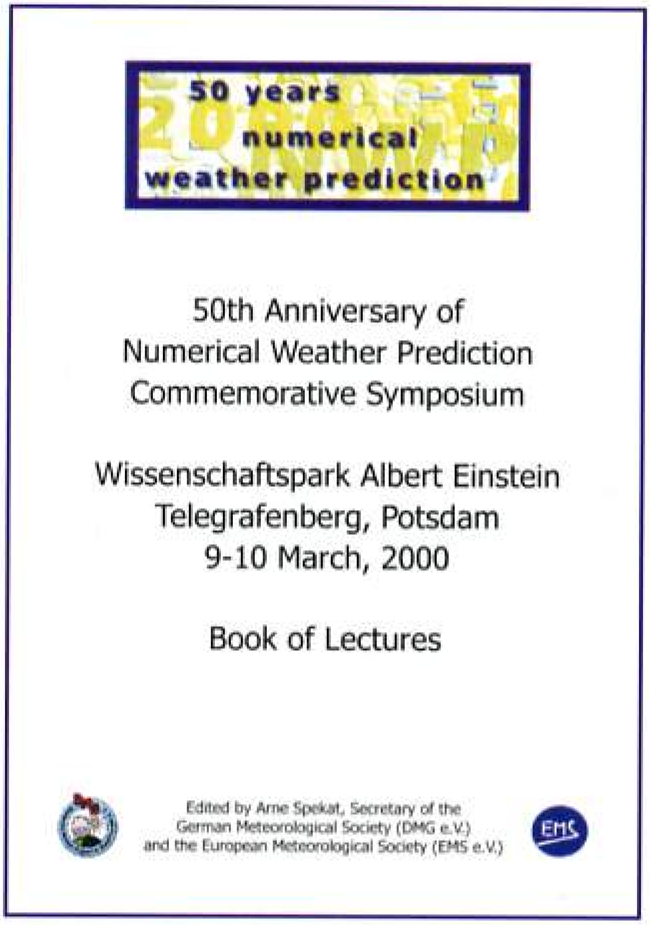

50th Anniversary of Numerical Weather Prediction Book of Lectures

Contents

This publication of the Deutsche Meteorologische Gesellschaft and the European Meteorological Society summarises the proceedings from a symposium held 9-10 March, 2000 in Potsdam, Germany to commemorate the 50th anniversary of numerical weather prediction. A suitable reference point for this celebration is the paper by Charney, Fjortoft and von Neumann on the numerical integration of the barotropic vorticity equation published in 1950 in the Swedish journal Tellus.

The figure to the right is an assemblage of graphical objects, mostly from the Charney, Fjortoft and von Neumann article. The background is a rendering of their Figure 1, a finite-difference grid. Clockwise from top left: Partial differential equation for the change of height with respect to time needed to solve the vorticity equation in a form "well adapted to a variety of high-speed computing machines"; portrait of John von Neumann; their Figure 2c, forecast of January 5, 1949, 0300 GMT observed and computed 24-hour height change; equation to estimate the level of non-divergence, which lead to the use of the 500 hPa level in their computations, portrait of Ragnar Fjortoft (left) and Jule Charney (right).

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First Annual Meeting of the European Meteorological Society 25–26 September 2001, Budapest, Hungary

Selected lectures from the symposium: The future of meteorology in Europe

By RENÉ MORIN[1] and ARNE SPEKAT[2,*]

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Born in September 1999, the European Meteorological Society (EMS) has become an association of about 30 Meteorological Societies and more than 15 major organizations, weather services, manufacturers and service providers from all over Europe. They have set out to establish a permanent organization for their cooperation, particularly to deal with those aspects of meteorology which can be solved only on a Europe-wide basis or are best approached on that scale.

In order to meet its responsibilities and challenges, the EMS held its First Annual Meeting on 25 and 26 September, 2001 in conjunction with the 5th European Conference on Applications of Meteorology (ECAM) 2001 in Budapest, Hungary. The First Annual Meeting of EMS focused on a lively exchange of ideas on the future of meteorology in Europe. An array of high-calibre lecturers from WMO, European Organizations, National Meteorological and Hydrological Services and private companies presented views on and overviews of the problem.

Among the various aspects covered in the First Annual Meeting of EMS were the scientific, technical, industrial, economical and social sides of meteorology and their implications. The ECAM in Budapest was a very suitable environment in two respects: (i) ECAM conferences have been instrumental in bringing EMS to life and (ii) the host country exemplifies the fascinating way in which Europe is developing, in meteorology as in many other ways.

The Meeting programme included invited speakers on the following topics:

- The demands to meteorology: safety of life and property, quality of life, optimization of economic activities, climate change.
- The tools of meteorology: general views of the evolution of systems of observing, communicating, computing, forecasting, dissemination of information and products.
- The structures of meteorology: the European Meteorological Organizations, cooperation/coordination of National Meteorological Services, role of all actors public and private, relation between public and private entities, pricing of basic information.

In this volume which marks the launch of the EMS Publication Series, a number of lectures from the three topics of the First Annual Meeting of EMS are presented in extended form.

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Article

Demands on meteorology

JOHN ZILLMAN

Director of the Australian Bureau of Meteorology and President of the World Meteorological Organization

(Manuscript received February 15, 2002)

Abstract

The demands on meteorology for more, and more accurate and useful, data, scientific understanding and service provision are increasing at global, regional, national and local levels. The demands come from many sources, are determined by many influences and cover a wide range of products and services. The global interdependence of most meteorological activities and the public good properties (of non rivalry and non excludability) of much meteorological infrastructure and information means that the conventional market concepts of competitive demand and supply provide an inadequate framework for meteorology. Given the current near world-wide commitment to the use of competitive market models for an increasing range of traditionally non-market processes, there is an urgent need for a more comprehensive and more coherent economic framework for assessing and meeting the demands for meteorological services than has been found necessary in the past. Such a framework must be expected to encompass, at least, the source of the demand (the community at large, government, media, industry, educational institutions, environmental organisations, and the international community), the object of the demand (infrastructure, research, past present and future information, advice and investigation) the extent of the demand (including quantity, quality and timeliness) the multifaceted influences on the demand and assessment of the capability for meeting the demand. It must also, ultimately, address the social and economic basis for meeting the demand and the extent to which it should and can be met; as well as the scientific and public policy basis for management of unrealistic expectations.

No such coherent overall framework yet exists, but the present and foreseeable future demands on meteorology are such that pragmatic approaches involving both public sector National Meteorological Services (NMSs) and private sector service providers, and academic institutions, individually and in partnership, are evolving rapidly in individual country Members of the World Meteorological Organization. They include demands both for greatly enhanced public meteorological services in support of general community safety, convenience and economic and social wellbeing and for special services tailored to the needs of such major weather and climate sensitive industry sectors as aviation, shipping, agriculture, tourism, water supply, and financial services (including insurance and weather derivatives). The challenge for the coming decade will be to properly understand and quantify that demand and to provide the staff education and training, technical infrastructure, partnerships and overall framework of cooperation to ensure that it can be met in ways which result in the best use of the limited national and international resources and the largest ultimate benefits to the users and customers of meteorological and related science and services in all parts of the world.

1 Introduction

The human preoccupation with weather and climate and their impact on almost every aspect of our lives has placed the science of meteorology in a central and very demanding position in human affairs.

Our attitude to it, as citizens, seems to fall somewhere between:

- our attitude to religion where, if it fails to deliver what we seek of it, we have been taught to accept that the fault is probably our own and the failure is fair and just punishment for our lack of faith or for past wrong doing; and
- our attitude to modern technology where, if it fails, we assume someone is to blame for shoddy workmanship or criminal negligence, and the guilty party should be identified and punished; or, at the very least, we should get an apology and our money back.

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It is, I believe, too little understood that the products of meteorology are fundamentally different from most other types of goods and services demanded and consumed by society in that:

- much, or even most, of what is demanded of meteorology is of the nature of public goods for which market models of demand and supply demonstrably fail; and
- a comprehensive international framework has been built up over time, which is based primarily on cooperative modes of interaction, rather than on competitive markets models, for meeting the demands.

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In fact, as a field of science and as a profession, meteorology has a long and proud history of enthusiastic and effective response to community needs and user demands.

But much more has always been demanded of it than it has been able to give. And, in seeking to meet the demand, its practitioners have always walked a tightrope between failing, for want of sufficient confidence in their science, to deliver benefits that are potentially deliverable to society, on the one hand; and, on the other, being pressured into providing products that lack integrity in a situation where the user cannot tell the difference and where it is easier, or more conducive to personal or institutional gain, to say yes than to say no.

This dilemma has been well recognised but not always well addressed over the past 150 years of rapid development of meteorology as a science and as a service. According to Sir Napier Shaw of the United Kingdom, writing in 1939 (Shaw, 1939) on 'the stress of public service':

From … the course of development of the study of weather it will be clear that throughout the ages mankind has been demanding for its guidance more information than science has been able to give, just as in the science of medicine human needs have always asked for more assistance that the profession had at its disposal. It is not so with all the sciences. Astronomy, for example, is so efficient that by its aid a ship can ascertain its own position anywhere on the sea; with a little magnetism to help, it can start from any port in the world and find its way to any other port as directly as if it were on a line of rails provided that the weather does not interfere by fog or hurricane. The measurement of time has been carried to such a degree of perfection that by the aid of wireless and its own chronometers, a ship may know beforehand, wherever it may happen to be, the exact time of sunrise, noon and sunset.

Writing after L. F. Richardson (RICHARDSON, 1922), but before the concepts of chaos and the limits of predicability (LORENZ, 1993) had entered the meteorological lexicon, he went on:

Towards perfection of that kind meteorologists may perhaps look forward; but at present the cautious confine themselves to a 'further outlook' which occasionally reaches a few days ahead; they have to decline the demands of the daily press to know what kind of winter will follow a wet summer? Will fog be unusually frequent? What are the prospects for the summer holidays? Or the Christmas week? and a hundred of other questions that have been asked every year in the past and will be asked every year in the future.

But then he goes on further to assert:

The stress of service has hampered the progress of the science. Apart from the opportunity which it gives to what may be called rash speculation or imposture, it places the science in an awkward position. It is the habit of scientific folk who work in the seclusion of a laboratory to draw inferences from their experience and arrange experiments to test them; but to publish their inferences before they have been tested by experiment is, to say the lease, unusual. It is not done in the best scientific circles as it provokes remarks about meteorology not being an exact science, meaning that its predictions (like those of any other science) are not always correct. Yet that sort of premature announcement is what the forecaster has to make; the stress of necessity overrides the laws of conduct.

And he concludes, with only thinly disguised regret, that … *In a properly regulated world (the meteorologist) might have continued the practice, adopted by the Meteorological Committee of the Royal Society from 1867 to 1879 and confined his attention to accounting for the recorded sequence of events ….*

The age old dilemma of the meteorologist, so eloquently captured by Sir Napier Shaw, took on a new dimension in the 1950's and 60's with the development of the numerical models for simulation of the atmosphere which, in the words of Professor Joe Smagorinsky (SMAGORINSKY, 1970), were soon forced into 'premature servitude' in the then rapidly advancing field of numerical weather prediction.

While having great sympathy with the concerns of Sir Napier Shaw and all those in our discipline who are committed to maintaining the integrity of the science, I believe it is true to say, in 2001, that the demands of service have greatly stimulated the progress of the science. There is little doubt, in my view, that, without the demands of the operational user communities of aviation, shipping and agriculture, in particular; without the pressing needs for advance warning of natural disasters; without the user pull of the World Weather Watch and the Intergovernmental Panel on Climate Change (IPCC) on GARP (Global Atmospheric Research Programme) and the World Climate Research Programme, we would not have made the enormous progress that has been achieved over the past half century, under the framework of international cooperation provided by the World Meteorological Organization (WMO).

At the beginning of the twenty-first century, the demands on meteorology are continuing to expand at a staggering pace; and it is incumbent on us to critically re-examine the framework for meeting these demands, which proved so successful through the twentieth century, to see if it is still adequate to respond to such difficult challenges as:

- our nearer approach to the inherent limits of predicability;
- the management of unrealistic expectations in a world of instant communication and insatiable demand;
- the substantial costs, in money terms, of continuing scientific progress; and
- the greater reliance on market mechanisms for the provision of public goods.