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Bulletin climatologique

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Information for Contributors and Subscribers

As a publication of the Canadian Meteorological and Oceanographic Society, the CLIMATOLOGICAL BULLETIN provides a medium of information on climatology. The Editorial Board gives special encouragement to the submission of manuscripts on applied climatology (e.g., agriculture, commerce, energy, environment, fisheries, forestry, health, recreation, transportation, and water resources), climatic change and variability, climate impact studies, climate model applications (including physical climatology), and regional studies (including ocean areas). It is published with the aid of a grant from the Government of Canada through the Natural Sciences and Engineering Research Council.

Authors may submit their manuscripts to "Articles", "Research Notes" or "News and Comments". This should be indicated in the cover letter accompanying the manuscript. Articles and Notes are independently reviewed by at least two anonymous referees. News or comments are reviewed by the Editor in consultation with the Editorial Board. Manuscripts are accepted in either English or French. An abstract (in both English and French) is required for Articles and Notes.

Contributors should submit manuscripts to Stewart J. Cohen, Editor, CLIMATOLOGICAL BULLETIN, Canadian Climate Centre, 4905 Dufferin St., Downsview, Ontario, M3H 5T4. All manuscripts should be typed double spaced on one side of good quality white paper, 28 cm x 21.5 cm, or its nearest equivalent. The abstract, list of references, tables, and a list of figure captions should be typed doubled spaced on separate sheets. Comments (including book reviews and opinions) and news items should not exceed 1 500 words. Furnish an original and three copies if possible, in the order listed below.

TITLE PAGE should include the full names of author(s), and professional affiliation(s).
The ABSTRACT should be less than 250 words, and typed on a separate page.
The TEXT of longer contributions should be typed double spaced on numbered pages, and divided into sections, each with a separate heading and numbered consecutively. The section heading should be typed on a separate line.
ACKNOWLEDGEMENTS are typed on a separate sheet immediately following the text.
If FOOTNOTES are required, they should be typed, double spaced, on a separate sheet under the heading "Notes" at the end of the text.
REFERENCES should be arranged alphabetically by senior author's last name. The text citation should consist of name(s) of the author(s) and the year of publication, for example Jones (1975) or (Jones, 1975). When there are two or more cited publications by the same author in the same year, distinguishing letters a, b, etc., should be added to the year. A reference to "in press" implies that the paper has been accepted for publication. Titles of periodicals should be given in full.
FIGURE LEGENDS must be provided for each figure, and should be typed together, double spaced, on a separate sheet.
ILLUSTRATIONS should be numbered sequentially. Original drawings, lettering, and symbols should be large enough so that after reduction, the smallest characters will be at least 1.5 mm high.
Each TABLE should be numbered sequentially. Type all tables double spaced on separate sheets.

Authors should use the International System of units, but may show other units in parentheses. Authors should provide instructions in the margin for any special type required (Greek letters, capitals, bold face, etc.).

Page charges are not levied against the author. Authors of research articles will receive 10 reprints. Notes authors will receive 2 reprints.

Correspondence regarding Society affairs, membership, Institutional subscriptions and back issues of the journal should be directed to the Corresponding Secretary, Canadian Meteorological and Oceanographic Society, Suite 805, 151 Slater Street, Ottawa, Ontario, K1P 5H3. Telephone (613) 237-3392.

Renseignements pour les collaborateurs et les abonnés

Publication de la Société canadienne de météorologie et d'océanographie, le Bulletin climatologique offre un moyen d'information sur la climatologie. Le comité de rédaction encourage en particulier la soumission de manuscrits sur la climatologie appliquée (comme l'agriculture, le commerce, l'énergie, l'environnement, la pêcherie, la sylviculture, la santé, les loisirs, les transports, et les ressources en eau), les changements et la variabilité du climat, la prospective climatologique, les applications des modèles du climat (inclus la climatologie physique), et les études régional (inclus les océans). Il est publié grâce à une subvention accordée par le gouvernement canadien par l'intermédiare du Conseil de recherches en sciences naturelles et en génie.

Les auteurs peuvent choisir de soumettre leurs manuscrits aux "Articles", "Notes de Recherches", ou "Nouvelles et Commentaires". Ils doivent l'indiquer sur la lettre d'accompagnement du manuscrit. Les articles de recherche et les "Notes" sont indépendamment soumis à l'examen d'au moins deux appréciateurs anonymes. Le rédacteur en chef examine les "Nouvelles et Commentaires" conjointement avec le comité de rédaction. On accepte les articles soit en français, soit en anglais. Il faut envoyer un résumé, de préférence en français et en anglais.

Les collaborateurs sont priés de soumettre leurs manuscrits à Stewart J. Cohen, rédacteur en chef, Centre climatologique canadien, 4905 rue Dufferin, Downsview, Ontario, Canada M3H 5T4. Il faut dactylographier tous les manuscrits à double interligne, sur un côté d'un papier blanc de bonne qualité, de 28 sur 21,5 cm ou des dimensions les plus rapprochées. Il faut dactylographier à double interligne, sur des feuilles à part, le résumé, la liste des références, les tableaux et la liste des légendes. Les commentaires, les critiques, les opinions et les informations ne doivent pas dépasser 1 500 mots. Fournir l'original et, si possible, trois copies, selon la disposition suivante:

LA PAGE DE TITRE doit comprendre: nom, prénoms des auteurs, ainsi que les affiliations professionnelles.

LE RÉSUMÉ, dactylographié sur une page à part, ne doit pas compter plus de 250 mots.

LE TEXTE. Il faut taper à double interligne, sur des pages numérotées, le texte des articles plus longs et le diviser en sections, chacune dotée d'une en-tête à part et numérotée dans l'ordre. Il faut dactylographier l'en-tête de section sur une ligne à part.

LE REMERCIEMENTS doivent être dactylographiés sur une page à part, après le texte.

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On ne fait pas payer de pages à l'auteur. L'auteur d'un article de recherche reçoit dix tirés à part et les auteurs des notes deux.

La correspondance concernant les activités de la Société, les souscriptions des membres et des institutions et les numéros déjà parus, devrait être adressée au Secrétaire-correspondant, Société canadienne de météorologie et d'océanographie, Suite n° 805, 151 rue Slater, Ottawa (ONT.) K1P 5H3. Téléphone: (613) 237-3392.

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Foreword / Avant-Propos

On March 15, 1986, the Natural Sciences and Engineering Research Council of Canada approved a grant application prepared by the CMOS Executive on behalf of the *Climatological Bulletin*. The Scientific Publications Selection Committee awarded a three-year grant to help offset our operating costs. This is a most encouraging development, for it is a sign that the *Bulletin* is earning the respect of the research community in Canada, and that it has the potential to become a world class publication. Presently, almost one-third of the *Bulletin*'s subscribers are located outside Canada.

This issue includes a thought-provoking comment on the marketing of climatology and climate information. Private consultants recognize the potential value of climatology, and are trying to build markets for climatic information services. Their clients include the private sector as well as government. On the other hand, academics and government scientists are in the "public information business," and their "clients" are usually government agencies, students, and the general public. Direct contact with the private sector does occur, but on a limited basis.

In this era of budgetary restraint and rationalization of programs, climatologists in government and universities must be able to demonstrate, in a quantitative manner, that climatic information can provide financial and social benefits, whether it be for the natural resource industries, construction, and transportation, or for the general public, who use outdoor recreation facilities, are interested in the environment, or are concerned about flooding or health problems. Such benefits can accrue through better planning and more informed risk-taking or risk avoidance. If there really is a market for climatic information, climatologists will have to pay more attention to marketing.

Stewart J. Cohen

News and Comments
Nouvelles et commentaires

MARKETING CLIMATOLOGY FOR TODAY'S USER*

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1. INTRODUCTION

I am pleased and honoured to have been asked to speak to you at the opening session of the Alberta Climatological Association's tenth annual meeting. I have always been impressed with the activities and longevity of the ACA. The early work of Dick Longley, Ed Stashko, Ben Janz and John Powell in promoting climatology in Alberta and the continued growth and work of the Association during the 1980s are the prime reasons for the more enlightened viewpoint of what climatology is all about in this Province. Several years ago I tried to convince the Ontario-based Friends of Climatology to adopt a more formal existence similar to the ACA, using your constitution as a model. Their reluctance to do so is the principal reason why the Friends is more often a non-group and why the Ontario Regional Climate Advisory Committee is barely alive and well.

In a few minutes, I will speak about marketing climatology. If that conjures up hucksterism in your mind, consider the broader, more popular meaning that says marketing has something to do with needs assessment, user research, product development and distribution, besides the familiar activities of selling, promoting and public relations. But first, I will discuss the evolution of the climate user, the types of climate products and services, and the value and importance of climate data and information.

For most of this century, climatology was largely an academic

* Paper presented at the Tenth Annual Meeting, Alberta Climatological Association, February 20, 1986, Edmonton, Alberta

subject. In most national meteorological services, climatologists were busy looking after networks of stations, collecting, correcting and publishing data, and producing "average" temperature and precipitation values, to be used in response to requests from the public. A few decades ago, however, climatologists began to develop the applied side of meteorology. Computers took the drudgery out of data handling and provided the climatologist with the opportunity and the means of supplying better and more useful services and applications.

The increasing interest in climatology all over the world, especially as it relates to the need for protection and planning of the human environment, is an encouraging sign that we may be entering an era of better understanding of the service climatology can provide.

2. PROFILE OF THE CLIMATE USER

Everyone uses climate data and information in one kind or another. Users range from individuals to agencies. Individuals purchase bathing suits and flood insurance based in part on their expectations of climate. Farmers invest in irrigation equipment and hail insurance. Homeowners budget funds for heating and air conditioning using past climate. Many persons plan for vacations or retirement in the climate they prefer. All are users of climate information. Many top-level decision makers are also likely users of climate information products such as designers, architects, engineers, policy analysts and retailers. Their needs may be greater and more sophisticated than the user who unconsciously applies climate knowledge.

The use of climate data and information has changed over time as the science of climatology has changed.

Many of early man's operational decisions were climate related: the march of the seasons dictated tribal migrations, controlled the available food resources, and governed the beginnings of agriculture. Medicine men, and high priests were often elevated to positions of prominence because the communities in which they functioned believed that these individuals could foretell the hardships and blessings of coming seasons. They were the original climate users.

With the invention of basic meteorological instruments in the 17th and 18th centuries came the scientific application of the knowledge of climate. The first real system of climate data producer-user originated in the 19th century as knowledge was transferred from scientist to scientist. Initially, most, if not all, climate data were used to compile averages. These data became part of each nation's climatological archive. Scientists used climate to explain the distribution of global life zones and soil types. Geographers, biologists and educators wrote eloquent descriptions of regional climatologies relying heavily on the availability of expanding climatological archives.

The next era in the development and dissemination of scientific technical information occurred in the 1940s. In changing direction following World War II, national meteorological services realized that the climatological archive could be used for planning in the medium and long terms, such as in designing transmission towers, siting hydro dams and planning residential areas and recreational facilities. In these examples, the information flow was from climate specialist to engineer, architect or designer. Consultation was more complex and information more sophisticated than in earlier applications.

Today's climate user wears many hats. In many ways, he is the early man and the scientist/researcher. In addition, he may be community spokesman, policy analyst, social scientist, lawyer, economist, legislator, environmentalist or resource-minded person. Today's user needs information in many different forms and combinations. He is demanding, technologically acute and information thirsty.

Most users require concise summaries, many are after risk and design statistics, and a few desire near real-time data. All expect information to be intelligible, convenient, high quality, meaningful and easy to interpret. An increasing number want to access climate data directly, from their office or home, and are anxious to have the data available for analysis on their micro- or mini-computers.

For a nation so greatly affected by the extremes of its weather, Canadians are surprisingly unaware of the enormous economic and social advantages to be gained by the proper application of climate information. Why do "could be/should be" users ignore climate information? What are the major impediments to the use of climate information?

Of those who do not use climate information, some feel they know all there is to know. They see climate as static, unchanging and only one of

TABLE 1 Percentage of respondents who do not use climate information because of reasons listed. Some respondents gave more than one reason for not using the information (Lamb et al., 1984)

	Percent
Historical Data:	
– not available	65
– not valuable even if believed to be available	42
– too costly to convert to a usable form	19
Year-to-date accumulations:	
– not required	54
– not available	43
– too costly	8
– not available when needed	27
Climate Predictions:	
– not required	28
– not accurate	73
– not available soon enough	13

many other, more important variables to consider. At the other extreme, others feel that climate is too complex, uncontrollable and abstract. There is nothing you can do about it, you are already locked in. Still other skeptics have reservations about the availability, utility, cost, value and (in the case of climate prediction) accuracy of the information or may have difficulty interpreting probabilistic data. Table 1 shows the results of a questionnaire given to several Illinois agribusiness people who indicated why they/their company did not currently utilize climate information (Lamb et al., 1984). The results point to a lack of appreciation of climate information and its use in decision-making which in turn has led to a lack of progress in acquiring climate data, and its analysis over the past several decades.

3. CLIMATE PRODUCTS AND SERVICES

One way of promoting the use of climate information is to make it easier for users and potential users to get the information. Useful, transferable and relevant climate information will also increase its use and range of possible applications. A full spectrum of material from historical time series analysis to the monitoring and prediction of climate anomalies now and into next season could be made available and attractive to users.

3.1 *Risk and Design Data*

Assessing the risk of occurrence of many climate events is reasonably straightforward where a substantial past data record exists. In this respect, the climatologist is in an enviable position compared to data specialists in other fields. Climate risks and indices can be derived from historical and statistical data, and such information is highly relevant to capital investment decisions for such activities as the site selection, design and construction of buildings and of facilities.

The Canadian Climate Centre publishes climate risk data in several forms, which include the following:

i) Data Periodicals:	Principal Station Data summaries
	Data abstracts on microfiche
	Storm Rainfall Canada
ii) Atlases:	Climatic Atlas Climatique - Canada
	Rainfall Frequency Atlas for Canada
	Solar Radiation Data Analyses for Canada
iii) Interpretive Studies:	Analysis of Solar Radiation Data for Selected Stations in Canada
	Wind and Ice Loading in Canada
	New Look at Ground Snow Loads in Canada

A new genre of climate analysis has emerged from technological advances in convertible software and personal computers. Easy to use, interactive, menu-driven climate analysis software has been developed to produce tabular, graphical and chart-form design summaries of meteorological and sea-state data. Two examples are MAST (MArine STatistics) and LAST (LAst STatistics), which produce univariate and bivariate tabulations and graphs compiled from observations over water and land. The systems are accessible via telephone modem.

There will always be new challenges for climatologists to make better use of archive data than they have done in the past. For many operational purposes, novel approaches are needed to utilize short-term weather forecasts to meet the requirements of specific applications.

3.2 *"Now" Information*

A new category of climate information is the monitoring of in-season or current conditions. Such information involves not only the year-to-date accumulations (heating degree-day totals, seasonal snowfall), but also the "now-only" conditions (e.g., mid-July soil moisture, late April soil temperature).

"Now" information leads to new decisions on the procedures that should be used during the rest of the season and revised estimations of their likely outcomes (including yields). Particularly prominent in this regard are agribusiness decisions.

The Canadian Climate Centre (CCC) carries out several monitoring activities. The Centre publishes weekly and monthly editions of *Climatic Perspectives*. More than 1300 subscribers receive up-to-date information on temperature and precipitation anomalies, forecasts and climate data in map, tabular and text form. The CCC is also processing the near real-time water budgets for approximately 300 synoptic stations across Canada. Because the water budget information (evapotranspiration, soil moisture, snowpack, etc.) is available within 36 hours after the end of each seven-day period, it is particularly useful for monitoring climate and for supplying timely climate information to those economic sectors who need it, such as the identification of potential drought and spring flood areas, and support for water supply forecasting and forest fire prediction and management. To a large extent, the value of these products lies in their timeliness, through direct mail, or in *Climatic Perspectives*, or through direct access via a remote computer terminal with a telephone modem. The CCC has also completed development of the Palmer Drought Index data base for Canada. Beginning in Spring 1986, drought index maps will be issued weekly for the Prairie Provinces.

3.3 *Climate Forecasts*

Climate forecasts for a month or a season ahead are generally the product most eagerly desired by the public.

Techniques for predicting climate anomalies for the month and season ahead, have yet to demonstrate convincingly any degree of skill or reliability. The longest-running climate forecast is NOAA's monthly and seasonal forecasts, however, they yield only marginal accuracy in estimates of the probability of the deviation of temperature from normal, and hardly any in precipitation. There is no skill in forecasts for periods beyond a season. However, White (1980) believes there is a good scientific reason for expecting a systematic but gradual improvement in the accuracy and credibility of climate predictions. From all indications, credibility is essential because long-range forecasts could lead to unnecessary actions and expenses. In the survey of Illinois agribusiness users (Lamb et al., 1984), three-quarters of the respondents indicated that climate prediction would have to be "approximately correct 70-80% of the time before it could be incorporated into their decision-making process."

There are, however, some situations where improved predictability may even now be possible. The duration, intensity and extent of drought is highly dependent on known antecedent conditions. Cumulative climate events such as snowmelt floods, extreme (high or low) water levels and ice concentration are reasonably predictable far in advance. Certain persistent meteorological events such as atmospheric blocking or El Niño lend considerable predictability to climate conditions (White, 1980).

At the Canadian Climate Centre, an experimental monthly and seasonal climate prediction project began in February, 1985. National maps of predicted temperature and precipitation for the month or season ahead are prepared. The prediction takes the form of probability forecasts for above normal and below normal temperature and precipitation. These experimental products are being provided to a selected list of 140 interested clients in other government agencies, universities and the private sector across Canada. The predictions are developed using a combination of statistical and analogue techniques (Shabbar, 1985). The process is still rather subjective, but the final products represent the consensus of several professionals. A comprehensive verification scheme is being developed and a thorough evaluation of client feedback will be carried out in 1986. If results are good, the forecasts will be issued routinely to the Canadian public.

4. ASSESSING BENEFITS DERIVED FROM CLIMATOLOGY

4.1 *Assessing Benefits Derived from Climatology*

Climate information is a basic need for a multitude of wide-ranging social, economic and planning decisions. With the impressive array of climate services and products, and with the large number of ways in which the information can be used, it is surprising that so few are aware of the enormous potential and economic worth of using climate data and information. Until users become aware of the benefits, they will remain unconvinced as to its utility.

Seldom do national weather services attempt to quantify, or even identify the economic and social impacts or cost of climate services, although several studies on the economic value of weather services have been published. It is difficult to assess the full value of climate information and services for several reasons. For one thing, it is not enough to assess the purely monetary costs and benefits of a specific climate service, many of which cannot be quantified with precision. Other reasons relate to the pervasiveness and diffuseness of both users and uses (Changnon, 1982). Many users are the general public and it is not possible to define the economic value of knowledge in such a setting. Finally, climate information often produces secondary and intangible benefits that cannot be directly measured e.g., convenience, health, safety, comfort, and effectiveness.

Assessing the costs/benefits of a program that itself seeks to disseminate information is impractical, if not impossible. Even if you could identify who uses the information, it would be exceedingly difficult to assess precisely how much the information is worth. Instead, we should seek to answer the broader question: Does the data we provide enable the users to analyze issues that are important to them?

In partial fulfillment of my responsibilities as Rapporteur on Climate Applications for WMO Regional Association IV – North and Central America, I compiled several examples of studies that illustrate how different operational, investment and design decisions depend on climate information and services. Eight climate-sensitive sectors or activities were sampled including the major resource fields, recreation, building and construction, and transportation. The following selections are taken from verifiable case studies in Western and Northern Canada:

i) Three river diversion and dam projects near Winnipeg constructed between 1968 and 1972 cost $95 million. The damage to the city of Winnipeg prevented by the construction of these works was estimated to be $160 million in 1974 and $280 million in 1979 (Bowering, 1981).
ii) Manitoba Hydro estimated losses of $80 million in power it was unable to produce and export due to the lack of snow cover in the spring of 1981. Credible climate forecasts would have allowed abnormally high water storage in the preceding season and relevant operating strategies to avoid the loss (Lawford, 1981).
iii) A 1% improvement in the spring flow forecast at the Portage Mountain Reservoir in British Columbia could result in about a $1 million reduction in annual operational costs (McKay, 1976).
iv) A more accurate wind-load design for a communications tower in Alberta saved $55,000 in repair costs; and more accurate snowload data for an arena roof in Saskatchewan saved $25,000 (personal communication).
v) Parks Canada planners abandoned plans to build a

mechanical stairway from the Kluane Lake Basin to the summit of Kluane Mountain Range at a cost of $1.5 million. Historical data indicated that the frequency of summer cloudiness would preclude viewing the spectacular ice fields nearly 80% of the time (B. Findlay, personal communication).

vi) Alberta monitors winter climate in order to advise skiers about best snow conditions. Some years favour cross-country skiing, and in other years, snow and temperature conditions benefit downhill skiers (Leggat, et al., 1981).

vii) A valley bottom site was first selected for the Yukon mining town of Faro until climatologists pointed out their preference for a location 60 to 90 m above the valley floor to take advantage of milder temperatures within the Arctic inversion. Higher winter temperatures have resulted in lower fuel costs, fewer vehicle stoppages and higher personnel morale (Wahl and Hume, personal communication).

viii) Delineation of areas where climate is suitable for special crops is an important application of climatology. For example, canola seed is a $224 million business (1976) in Western Canada where the Prairie climate of hot sunny days and cool nights is ideally suited for canola production. To the south, the percentage of oil in the seed decreases so that growing it becomes uneconomic in southern Minnesota (McKay, 1984).

ix) Had the global drought of 1972 been predicted, Canada would not have constrained wheat production through the LIFT (Lower Inventories for Tomorrow) program and would have been able to sell the additional production at 1973 prices for a gain of about $1 billion (Williams, personal communication).

4.2 *Documenting Uses of Climate Information*

Brad Schneller of the Ontario Ministry of Agriculture and Food and the University of Guelph was reflecting on the neglect of weather and climate services when he posed these two questions:

> *"If the potential value and cost-benefit ratios are so impressive, why hasn't the adoption and use of this information by farmers been quicker and more widespread? Why haven't those who make or influence decisions directed more resources to climate and weather programs for agriculture?"* (Schneller, 1985).

These questions refer to farmers and agriculture but they could as well have been asked about any group or sector. Answers to these problems are not easily found.

There is an important need to demonstrate through examples the economic usefulness of the services that climatologists provide to various human activities. Our charge is three-fold:

(1) to describe practical examples of successful uses of climate information
(2) to identify opportunities for productive use of climate information in long-range planning
(3) to produce practical information that can be readily understood and integrated into the decision-making process.

If testimonials cannot be presented, if opportunities cannot be generated, and if exciting new products cannot be produced, then there will be little motivation for investing in climate services or supporting network expansion and data exchange. To secure funding, it makes sense to ensure that the funding agency is receiving value for its investment. Morley Thomas put it best when he said:

> *"Most governments are looking for ways to reduce expenditures and if climatologists hope to obtain the resources necessary to contribute significantly they must draw attention to, and prove the worth or value of, their products and the necessity to use them in national planning"* (Thomas, 1982).

5. ELEMENTS OF A MARKETING STRATEGY

I now return to the theme I began with when I implied that marketing was not merely a synonym for selling. In fact as Peter Drucker, one of the leading management theorists, has said, "The aim of marketing is to make selling superfluous." There are several characteristics of an effective marketing orientation. They involve knowing the market, developing a product or service as a need not a want, packaging, distribution, and promotion.

5.1 *Knowing Your Market*

Public non-profit organizations must communicate with a diverse market. Often their messages are weak, fail to describe the service adequately and do not cite the benefits and value of the services in sufficient detail. While we must continue to provide services to all citizens on an equal basis, climatology must also begin to serve special groups with specific needs. Time and resource constraints necessitate a focused campaign to identify and work with markets that are most sensitive to climate and ones where the biggest payoff can be realized from improving the delivery and usefulness of information.

The National Climate Data Advisory Committee of the Canadian Climate Program has begun a pilot project to try and improve the sophistication of climate information/data usage by the Canadian insurance industry. Discussions with insurance directors, agents, brokers, and actuaries, especially those in marine insurance and reinsurance have revealed some positive ways in which that industry can benefit from the right climate information.

There is an urgent need for better communication between climatologists and users of climatological data and information to ensure that the services supplied are those that are needed, and that users can make effective use of the information supplied. Our challenge is to break down the one-way, colonial style information flow. Climatologists do not necessarily know what is best for the user. Effective climate information requires input from users in order to ensure its relevancy and transferability. On the other hand, users also need guidance in applying climate information effectively. In other words, we need to know each other better. We can do this by meeting on each other's turf, participating in each other's courses and co-publishing in the popular literature.

In 1985, the Atmospheric Environment Service commissioned The DPA Group to study the total market for weather services and products in Canada, to recommend ways in which the content, presentation and delivery of products and services could be improved, and to communicate better the value of weather information to users and potential users. The focus was weather but most of the findings and conclusions apply to climatology as well (DPA, 1985). The DPA survey made it quite clear that AES lacks knowledge about the types of users and their needs for information in decision-making. Further, AES was uncertain about which products each user utilizes and which person in the user organization was responsible for co-ordinating the acquisition of weather and climate information. Even more damning, few user groups knew what services AES does or could provide beyond public weather forecasts.

5.2 *Product or Service*

Much has been said already about climate products and services. Climate data and information are most unglamorous to the non-climatologist and unlikely to be embraced in their own right. As Gordon McKay used to say, "You can't eat, drink or bank climate." Yet, climate information is often vital in assessing the viability of food, water and economic projects.

Climatological information is saleable. The marketing prospect depends in large measure on how well the selling process is addressed. Climatologists must not forget to sell the value of their information.

DPA had this to say about our products, "There are too many products. Where possible these should be reduced in number, simplified and standardized." They went on to say that special products and special services should be differentiated by their localized focus, better content, tailored presentation (packaging), timely delivery and expert interpretation. There are other product/service improvement possibilities. These include:

- re-doing traditional data summaries to make them more usable and understandable
- development of more indices e.g., degree-days, climate severity index; and more secondary information e.g. crop yields, forest

fire potential

- update information on creeping disasters, e.g., drought, ice conditions
- more information on impacts of climate and less on non-significant extremes.

These special products should be designed according to the client's needs – not produced first and sold second. Further, we must enlist climatologists who can work closely with new groups of users such as commodity dealers, marketing board officials, insurance brokers, financiers, chief executive officers, retailers, and others whose decision-making can be made more rational through climate planning.

Above all, we must develop simpler and more digestible information. As information suppliers we have to compete with other information specialists for the valuable time of the decision-maker. Clear, simple information will have a better chance of being read and used.

5.3 *Presentation or Packaging*

It is generally believed that the large amounts of published data and documents on such subjects as soil temperature normals, last week's provincial high and low temperatures, or regional climatographies end up on the shelf collecting dust. The conclusion is that the treatment and format of any subject is too complex or too detailed. Most users cannot understand what it is that is being provided. Further, they cannot afford the time to wade through countless copy, tables and figures. And most people are not thrilled about using mathematical equations and probabilities in management decision-making.

We must begin to package information that is convenient, timely and useful. Data presented in the language of the user, e.g. return periods, simple frequency, joint probabilities, have a greater chance of being used further by the user.

Another new challenge is to develop ways of integrating climate data with non-climate data and models e.g. economic statistics, crop yields, lake levels. Our data must fit the spatial and temporal constraints of today's user.

5.4 *Distribution*

> *"It is often assumed that once information is available it naturally flows to useful outlets: in fact the reverse is much more frequently true – much of the world's knowledge lies unused behind dams of ignorance, indifference, and inefficiency"*

This comment, appearing in a brochure of the United Nations University, describes succinctly the problem of information transfer. Indeed, producing information is easy; getting it to where it is effective can be a lot harder. In the past the emphasis in climate services has been on producing data. We have underestimated the crucial link of distributing processed information to places of decision-making. Increasingly, emphasis must be directed at getting information to groups, such as wheat growers in Saskatchewan, forest management officials in central British Columbia, soybean buyers in Toronto, hydroelectric authorities in Québec, apple growers in Nova Scotia, television crews in Montreal, and oil drillers in the Beaufort Sea.

Permitting easy access to data is a way of making better use of it. New personal computer-based information delivery systems will be common place in the future. New technology for presenting information must constantly be assessed and tried. However, we cannot abandon some of the traditional information seeking habits e.g., publications, microfilm and face-to-face contact. As Schneller (1985) states, users must be the prime consideration in the development of any climate-based delivery system.

5.5 *Promotion*

The future prospects for applied climatology depends in large measure on how well AES and others promote the product. Again, as Gordon McKay used to say, "If a product or service is rated as a need, not a want, then it is likely to be successful". We must work closely with users from the private and public sectors to increase their awareness of their need for climate information and the opportunities provided by the existence of climate data.

A program of education to improve the sophistication of the use of currently available products makes good sense. Once climatology is seen to be practical and profitable, users can be expected to make use of it quickly and widely. The sell should be soft, emphasizing the professional expertise and competence of the climatologist, and the potential benefits that can be derived from specific applications of climate knowledge.

Conventional promotional means through glossy brochures, films, slide-sets and exhibits should be tried. In addition, on-site demonstrations to get potential users to adopt new or improved practices are worth trying. Also promising are extension-type, printed literature written so that farmers, entrepreneurs and bureaucrats can believe in it and want the information.

6. CONCLUSION

Climatologists today have challenges far greater than those of yesterday. There is always the challenge to continue to generate good climate data sets. But, there is the new challenge to make maximum use of the opportunities that exist from climate information through imaginative information, effective marketing and good public relations.

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RAINFALL AND EARTHWORK

G.A. McKay
Thornhill, Ontario

INTRODUCTION

The construction of roads, canals, and earthen dams requires extensive haulage, manipulation and compaction of earth. This work grinds to a halt when rains turn the earth into a sticky morass. Delays due to soggy earth can be costly and may bankrupt small contractors. Consideration of weather risks in bidding on and evaluating bids for such contracts is highly desirable for practical and economic reasons.

This brief evaluation presents some approximate relationships between the time-loss or "down time" and rainfall as experienced during work on an earth-fill dam with a view to assessing such risks. It was made in response to questions being raised over missed schedules. Were they the result of unusually bad weather or inadequate performance on the part of the contractor? The relationships between time-loss and weather are complex and vary with the equipment used, soil type, topography, rainfall characteristics, etc. Unfortunately the information and time available for the evaluation were skimpy and for those reasons the results do not merit general application. Nevertheless the method may interest those confronted with a similar problem.

PROCEDURE

The project, construction of an earthen dam, was located in southeastern Saskatchewan. The resident engineer had the foresight to take daily rainfall observations and log the weather conditions, and these were made available by the Regional Office of the Prairie Farm Rehabilitation Administration. The project observations were taken starting in late May and ending in August. Their number was insufficient to evaluate seasonal differences that must occur. The rainfall record was corroborated by and interpreted in the light of records obtained regionally at Atmospheric Environment Service climate stations – particularly those for Yorkton and Foam Lake – and measurements taken by the Saskatchewan Wheat Pool at nearby Insinger, Saskatchewan. In that way, estimates of 6-hour rainfall were obtained. The relationships between rainfall amounts, duration and down-time were developed using the reconstructed values and information from the resident engineer's log. The deduced relationships were applied to climatological records for Yorkton, Sask., to obtain estimates of risk and to thereby judge the nature of the anomaly that was experienced.

Figure 1 shows hours of down-time plotted as a field using storm precipitation amounts as ordinate and storm duration as abscissa. Down-time

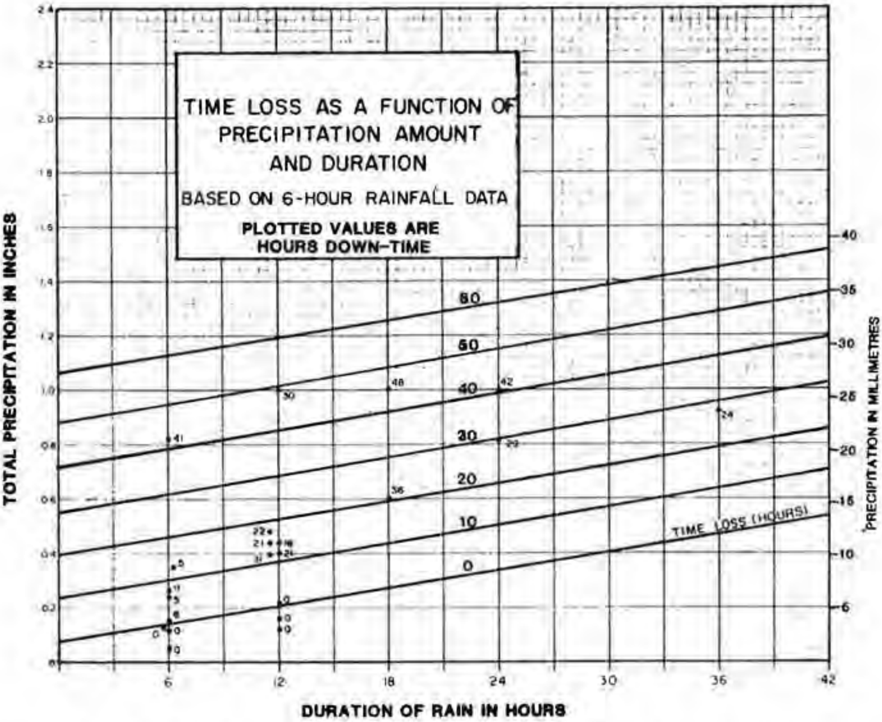

FIGURE 1 Time loss, based on log notes, plotted as a function of precipitation duration and amount.

lines were fitted visually to the plotted values with due consideration of log notes. The fitting process was very approximate and assumed the existence of a general relationship. As a result, the time loss in hours shown at each point does not always conform to the drawn lines. Close examination of the information available indicated that 6-hour rainfalls of at least 4 mm and 24-hour rainfalls of 5 mm were required to stop work when there was no significant antecedent rainfall. With wet antecedent conditions, lighter rains led to delays.

With stoppage of rain, recovery rates were generally rapid – and the longest stoppage was three days. A probable relationship between storm rainfall character and the time required for the soil to recover acceptable tractionability was assumed. Figure 2 shows the visual-average fitting of lines to the recovery-time data field. Like Figure 1, it must be accepted as suggestive rather than definitive. A much longer series of measurements is needed for definitive results.

Accepting these approximate relationships, climate data records were used to obtain time series of estimates of down time, and these were used

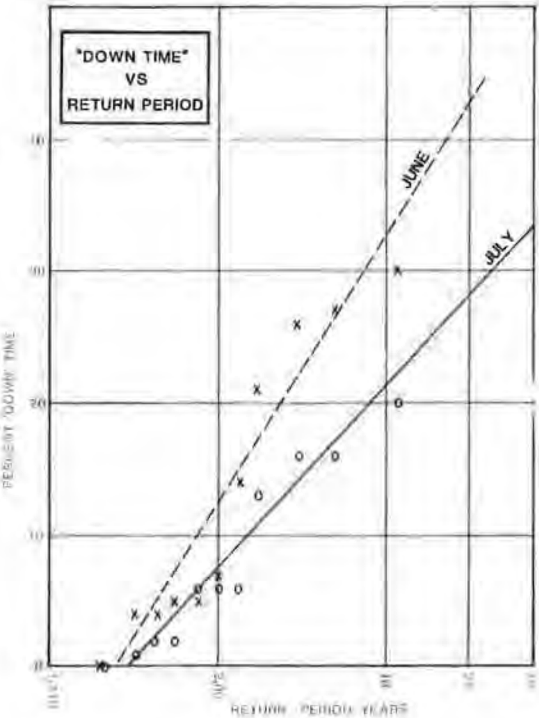

FIGURE 2. Percent "down-time" vs. return period.

to evaluate the normalcy of the year in question. This required some definitions as to what was a rainy day and where did it lie within a sequence of days with rain. That was done in the following manner:

- Rainfalls in excess of 4 mm were accepted as the first day of rainfall if the two preceding days had less than 1.3 mm of rain.
- Predicted down times were made to conform to the actual time available (cf. Figure 1). That is the 3-day computed down time was not allowed to exceed hours. That process effectively eliminated rainfall amounts in excess of 58 mm on the first day of the storm and of amounts over 25 mm on the ensuing 2 days. Those amounts were assumed to be lost to runoff. (There was no need to consider time losses for periods in excess of three days.)
- When the first day of rainfall was >1.3 but <3.8 mm and the rains continued, measurements for the first two days were combined for computational purposes and credited to the second day.

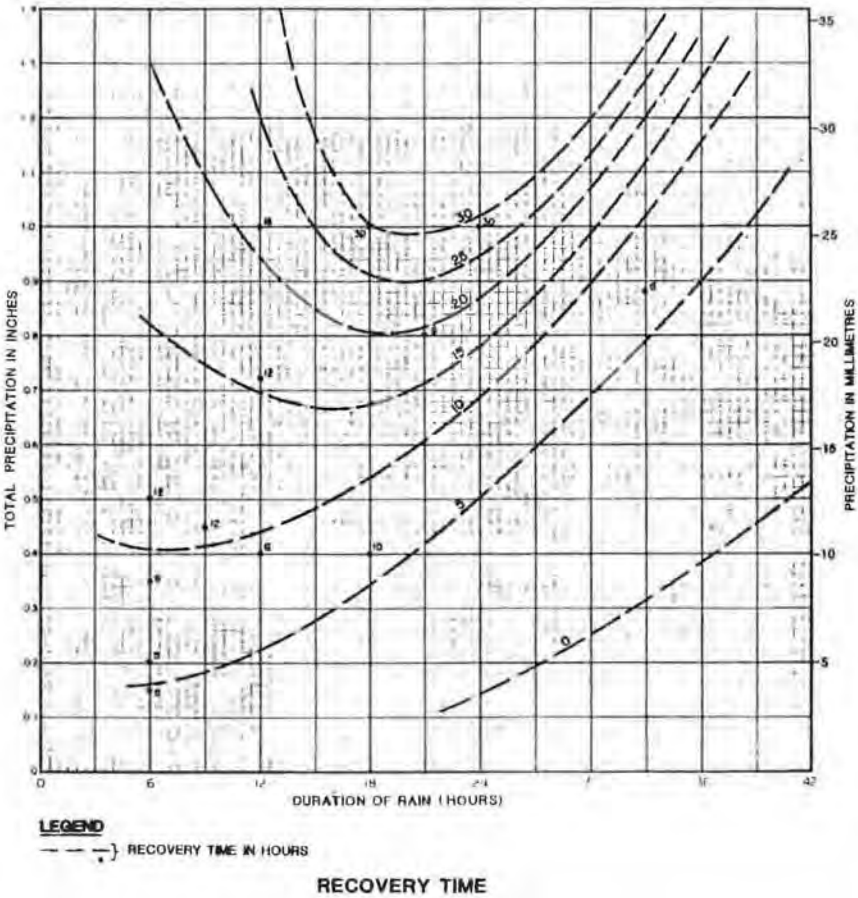

FIGURE 3. Computed recovery time, based on figures 1 and 2, plotted as a function of precipitation duration and amount, Yorkton, Saskatchewan.

- Rainfall amounts less than 1.3 mm on other second and following days were ignored.

The relationships depicted in Figures 1 and 2 were used to estimate the probable time loss for earthwork for the period 1953-1963 using records for Yorkton, Sask. The predicted values were then used to estimate probable recovery time on a monthly basis as shown in Figure 3. The array of monthly estimates were found to approximate a straight line when plotted on Gumbel extreme-value probability paper. Only 11 years of data were used because of the exploratory nature of the study and the data available at the time. Using the lines fitted to the graphs the following probabilities were obtained:

TABLE 1. Down-time (% of total) due to weather

Probability Return Period	0.5 2 years	0.2 5 years	0.1 10 years
Month			
May	9	16	21
June	12	24	32
July	7	16	21
Aug.	7	11	15
Sept.	7	14	22
Oct.	2	5	17

DISCUSSION

The foregoing computations are based on very approximate data and assumptions. Since the treatment is not rigorous, few firm conclusions can be drawn. The scatter diagram indicates a relationship between daily rainfall and down-time, but the validity of the fitted lines, and in particular their extrapolation must be questioned. Both are based on very little data. Clearly the energy balance changes over the season causes a steadily changing response of the soil to rainfall, so that the straight-line fit shown in Figure 1 is of doubtful validity, except for short periods. Furthermore, the spatial differences in soil types means that the response observed here is site specific. The adjustment made to predictions to correct for heavier rains can be justified in part since heavier rains would tend to runoff, but the procedure is highly subjective.

A much longer time series is desired for the probability analysis, but the 11 years dictated by time and access was considered adequate for this specific evaluation – particularly since several months were taken into consideration. The significance of the early and late season probability curves must be seriously questioned since they are based primarily on crude extrapolation of the relationships obtained for mid-summer. Were the drying power adequately considered and the analysis suitably refined, it may be possible to show climatic "windows" that are most favorable for earthwork – if they exist.

CONCLUSIONS

The time lost by earthwork contractors can be estimated from climatic records and field observations. The practice of maintaining a precipitation gauge on construction sites is necessary for such analysis. Ideally the soil water balance relationships for specific soil types should be known for such computation. However, these are manifest in the field operating experience, and simple assumptions concerning the water balance may suffice for estimation purposes. Estimates of potential time loss and its annual, monthly variations should be considered by those involved in preparing and evaluating earthwork proposals and bids.

WORKSHOP ON IMPACTS OF CLIMATIC CHANGE IN THE ARCTIC

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The workshop was held March 3-5, 1986, at Geneva Park, near Orillia, Ontario. The following report is based on my own observations of the keynote lectures, and the deliberations of the socio-economic working group, one of three organized at the workshop. All three groups presented their recommendations at the final plenary session. Proceedings will be published by the Canadian Climate Centre, Atmospheric Environment Service. The program was organized by B. Maxwell and D. Etkin of the Arctic Meteorology Section of CCC/AES.

The workshop began on the evening of March 3 with B. Maxwell (AES) and S. Lapczak (AES) presenting opening remarks. D. Etkin (AES) described a number of CCC activities, including paleoclimate research, scenario development, impacts studies, and monitoring. J.P, Blanchet (AES) outlined the work of the Numerical Modelling Division of CCC, including the development of a general circulation model (GCM), which is being used in several studies, including one on Arctic Haze.

A total of nine keynote lectures were presented, two on March 3, six on March 4, and one on March 5. The opening two lectures were on climate change scenarios. J. Palutikof (Univ. of East Anglia) discussed regional scenarios using the analogue approach. Since past climate changes (the last 100 years) were not dominated by CO2 alone, one must assume that the forcing mechanism is not important, i.e. for the purpose of scenario development, it doesn't matter whether a warm climate occurred because of volcanoes, El Niño, or CO2. There is evidence both to support and contradict this assumption. A number of other problems were raised, including the need for data correction due to the urban heat island, station movement, and changes in instrument location within stations or on ships. The resulting scenario for North America, published in 1984 by the U.S. Dept. of Energy, showed some areas of cooling, and a warming of 0-2 C in other areas.

M. Schlesinger (Oregon State Univ.) compared GCMs developed by Goddard Institute for Space Studies (GISS), Geophysical Fluid Dynamics Lab (GFDL), and National Center for Atmospheric Research (NCAR), all located in the U.S. Recent versions of all three models project similar global temperature increases (near 4 C) due to a doubling of CO2. Warming in the Arctic is projected to be higher than this, but GFDL shows greater warming in the Arctic than the other models. GFDL also projects a decrease in soil moisture in most areas of the mid-latitudes, while GISS shows wetter conditions in eastern

Europe, and NCAR projects wetter soils in many high latitude zones. All three GCMs exhibit precipitation increases in the Arctic. Major feedbacks due to sea ice extent, water vapour, cloud optical depth, and lapse rates have mixed effects on model results. For example, water vapour increases the warming by up to 70%, while cloud optical depth decreases it by up to 60%. Schlesinger concluded that GCMs were better than analogues for scenario development, though they still have large errors.

The next session was on primary impacts. R. Barry (Univ. of Colorado) discussed snow and ice, while M. Smith (Carleton) concentrated on permafrost. Barry noted that lake ice would be the most likely candidate for early detection of CO2 impacts, in which a delay in freeze-up and an earlier date of break-up would be expected. Other possible indicators include Arctic snow cover, mass balance of thin polar ice caps, and sea ice. Smith stated that permafrost is presently in retreat due to recent warming, but there are many unanswered questions regarding future projections. These include the effects of changes in vegetation and snow cover. Also, the rate of change is important because of the impacts on engineering structures, such as buildings, pipes, and roads.

Environmental impacts were addressed by S. Edlund (Geological Survey of Canada) and C.R. Harington (National Museums of Canada). Edlund spoke on Arctic vegetation, describing the spatial distribution of woodland, tundra, grasses, and other plants. There is a strong relationship with temperature, and future warming would probably lead to a poleward advance of vegetation. Reference was made, however, to a study by Emanuel et al. (*Climatic Change*, 7, 29-43) which projected the replacement of much of the boreal forest by either temperate forest or steppe. Harington reviewed how past climatic changes affected wildlife, including the northward shift of fish and marine mammals (seals, whales) during the early 20th century warming, and the recent southward retreat due to cooling from 1940-1970.

Socio-economic impacts were reviewed by G. McKay (consultant, Thornhill, Ontario) and W. Baker (consultant, Scarborough, Ontario), while past impacts on native people were discussed by J. Jacobs (Univ. of Windsor). Major economic activities that are climate sensitive are transportation, oil exploration, and mining. Hunting and fishing are important to native people, and are also climate sensitive. Past impacts often involved migration to new hunting areas, but future impacts will be dependent on technological change, and external economic and political forces. The challenge is to produce economic impact models that include the effects of changes in climate, the bio-physical environment, and technology, as well as external market forces.

During the evening of March 4, the three workshop groups (physical, environmental, socio-economic) were each divided into two small discussion sections. I was in one of the socio-economic sections, chaired by F. Roots (Environment Canada). The purposes of the workshop discussions were to identify information requirements, areas of likely impacts, and future research directions. A number of possible case studies were identified in the following areas: marine transportation, settlement, tourism, land transportation, use of renewable resources, energy resources, and water resources. Examples include an iron mine on Baffin Island, a railroad at Pine Point, and oil production in the Beaufort Sea. Would climate change affect the planning, operation, and economic viability of these activities?

The first plenary session, held on the morning of March 5, was chaired by H. French (Univ. of Ottawa). The six discussion sections presented their reports. Both physical sections pointed out the need to improve the climate data base in the Arctic, especially for inland regions, and that more variables should be monitored, including soil temperature. Continued research on GCMs was encouraged, particularly the development of regional scenarios. The two environmental sections also wanted more data on microclimate conditions, and easier exchange of existing data bases. The socio-economic sections stated that many indirect impacts would occur through impacts on the bio-physical environment. In addition, external economic and political forces would be affected by global climate change (e.g. would a drier climate in the Prairies lead to increased demands for water exports from a warmer wetter Arctic?). The formulation of functional relationships between climate and society in the Arctic might require analogues from outside the Arctic. It would certainly require more socio-economic data.

This session was followed by a keynote address on policy implications by F. Roots (Environment Canada). He surprised the audience by quoting from the final communique of the 1985 Bonn Summit which brought together the leaders of seven major industrialized nations, including Canada. The communique included a statement on the impacts of CO2-induced climatic change, saying that it is of major concern, and that action may be needed before full scientific knowledge becomes available. Roots noted that policy makers consider climate to be a resource or cost, not a tool of policy making. Policy change does not occur due to climate *variability*, which is usually handled by relief efforts. However, climate *change* may require new goals/policies, and a step-by-step adjustment to new conditions. Climate change, depending on its temporal definition, would be more rapid than changes in human institutions (e.g. settlement patterns, marine shipping system). These institutions would thus find themselves operating in a climate different from their original design climate. Since climate change would not affect all people equally, future policies would have to be site specific. Climate modellers should describe the new mean as the new stable case for economic models. These models cannot describe *the change to a new state*, but could describe *the new state*.

The three workshop groups met for a second time. In the socio-economic group, a major topic of discussion was the role of AES in socio-economic impacts research. During the final plenary session, the group recommended that AES should remain active in promoting impacts research, and that the Canadian Climate Program and the Canadian Climate Planning Board should also encourage research in this field. Other recommendations include the previously mentioned case studies of climate sensitive activities, and research on health effects due to thawing permafrost, climate awareness in the Arctic, and future problems in waste disposal. The physical group recommended expanded microclimate monitoring of inland areas, and increased interaction between climate modellers and impacts workers. Historical climatologies were encouraged. The environmental group echoed the above statement on monitoring, and also recommended standardization of data formats and production of bibliographies from various disciplines that might be relevant to impacts work.

H. French (Univ. of Ottawa) will write the final report, in consultation with the workshop leaders. This will be published by CCC as an executive summary. The keynote lectures will appear in the Proceedings.

CURING OUR COMMON COLD – WORKSHOP ON URBAN DESIGN CHALLENGES FOR THE LIVABLE WINTER CITY

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Atmospheric Environment Service
Downsview, Ontario

The Livable Winter City Association (LWCA) workshop on urban design challenges was held February 21-22, 1986, in Toronto. The workshop provided an opportunity to hear presentations from architects, planners, and others from Norway, Sweden, Finland, the U.S., and Canada. Many of the speakers had participated in the Winter Cities 86 conference, which had been held in Edmonton, February 15-19.

Various types of projects were discussed, including residential developments with glass-enclosed public spaces, towns with wind shields on their northern boundaries, enclosed commercial developments, pedestrian linkages between buildings (e.g. "skyways" in Minneapolis), and large underground commercial developments, some of them linked to multi-unit residential buildings. A person could live and work without ever going outside.

Questions were raised regarding the effects of these developments on society. Do individuals act differently when they spend more (or all) of their time indoors? J. Nash (sociologist, Macalester College, Minnesota) concluded that such developments impede adaptations to winter, commercialize public life, reduce group activity, and may lead to greater incidence of psychological problems and crime. B. Culjat (architect, Sweden) noted that putting a roof over a space doesn't necessarily make it good, or public. Outdoor spaces should be designed differently from indoor spaces, and the design should be wholistic, not just oriented to climate alone. M. Hough (landscape architect, Ontario) pointed to the loss of regionality in building styles, and the implementation of "universal solutions" as part of the overall problem. The outdoor environment becomes less livable because of wind channeling, automobile exhaust and summer heat, so that the indoor climate (described as "the make believe world of air conditioned fantasy") can be built to suit a desired lifestyle which originated outside the region (e.g. a tropical climate, without a hot sun).

There are technological and architectural solutions that could make cities more livable in winter. Design can be responsive to the uniqueness of the region, i.e. the geography (climate, vegetation, etc.). The "galleria" concept used in shopping malls (i.e. a retractable glass roof) could be used for small and large residential developments, as it has in Sweden. This application of passive solar energy has been demonstrated in Canada (C. Simon, architect, Ontario). Good design of outdoor public space would provide all season capability (e.g. Toronto City Hall). Ottawa has been cited as a good example of a city that has truly "planned" for winter.

However, there have been a number of obstacles to winter planning in many regions, due to economic and political forces. Design has been "pro-economy" or "pro-automobile" at the expense of other interests (i.e. "anti-community"). Planners have no power against such forces. This has led to bylaws for street networks, building heights, etc., that are almost identical across Canada, despite the differences in climate. Finally, there are the realities of the real estate market, in which the selling price of a building (especially single family dwellings) is influenced by the increased mobility of modern society. Consequently, they have to be similar in design to buildings in other cities.

Where does climate and climatology fit into the livable winter city? Obviously, climate is competing with other factors that influence urban design, but there is also the issue of information transfer from climatologist to "user", i.e. the architect/planner. V. Matus (planner, Ontario) noted that architects are not formally trained in climatology or geography, so they need information in a form other than statistical tables. He proposed the use of maps and charts displaying slope and aspect classes ("Slope Descriptive Synthesis"), seasonal variations of climate elements ("Ecocharts"), and microclimate charts ("Orographic Cells"). This would be a way for architects to look at geography and climate from their perspective (i.e. user oriented).

Proceedings of this workshop will be published by LWCA during the fall of 1986.

"PACLIM" WORKSHOP

S. Tabata
Institute of Ocean Sciences
Sidney, B.C.

During 25-28 March 1986 the 3rd Annual PACLIM (Pacific Climate) Workshop was held at the ASILOMAR Conference Center, Pacific Grove, California. This is one of the series of workshops that have been organized and directed towards the production of an interdisciplinary AGU monograph characterizing climate variability of the Eastern North Pacific and Western North America.

At the first workshop in 1984 planning for a production of the monograph was essentially completed. About 50 potential contributors to the monograph gave papers or presented talks associated with their current climatology research projects. A lecture on some aspects of time-series analysis was given by Dr. R. Preisendorfer.

The second workshop was held in 1985. More papers and talks were presented, some by previous participants but also by newcomers.

INTERNATIONAL SYMPOSIUM ON DROUGHT

William E. Easterling
Illinois State Water Survey
Champaign, Illinois, U.S.A.

Improving our international capacity to respond to drought is the theme of a conference entitled an "International Symposium on Drought: Prediction, Detection, Impacts Assessment, and Response" to be held September 29 – October 1, 1986 at the University of Nebraska, Lincoln. Commissioned papers from an international roster of distinguished experts (e.g., F. Kenneth Hare, Gordon McKay, Canada; Martin Parry, U.K.; Eugene Rasmusson, Mickey Glantz, U.S.; Neville Nicholls, Australia, and others) will address physical and societal implications of drought in the context of a variety of spatial scales, from local (i.e., farm level) to supernational regions. Moreover, these issues will be addressed in the contexts of developed as well as developing nations. Symposium objectives are to (1) facilitate the interchange of ideas between scientists and decision makers; (2) identify research needs; and (3) review the need for and development of effective drought response plans in an international arena.

Conference organizers are Dr. D.A. Wilhite and Dr. N.J.

Rosenberg of the Center for Agricultural Meteorology and Climatology, University of Nebraska, Lincoln and Dr. W.E. Easterling and Dr. P.J. Lamb of the Climate and Meteorology Section of the Illinois State Water Survey. For more information contact either Don Wilhite (241 L.W. Chase Hall, University of Nebraska, Lincoln, Nebraska 68583-0728 Phone: 402/472-6707) or Bill Easterling (2204 Griffith Drive, Champaign, Illinois 61820 Phone: 217/333-5380).

NEWS FROM SASKATCHEWAN

Elaine Wheaton
Saskatchewan Research Council
Saskatoon, Sask.

Past Meetings and News
(1) The Water Studies Institute twenty-first annual meeting was held in Regina, Saskatchewan on November 14, 1985. The guest speaker was Dr. Frank Quinn, Research Director of the Inquiry on Federal Water Policy, and his topic was "Currents of Change, Final Report on the Inquiry of Federal Water Policy". The Water Studies Institute is sponsored by the Saskatchewan Research Council and the Universities of Saskatchewan and Regina. Its main objectives are to promote information exchange and dialogue needed to advance water-related studies.

(2) The Saskatchewan Intercouncil Committee on Agrometeorology met on December 11, 1985. Dr. Stan Shewchuk of the Saskatchewan Research Council is the new chairman of this committee.

(3) The IIASA/UNEP Study entitled *Assessment of Climate Impacts on Agriculture in High Latitudes*, Volume I is in the final editing stages (as of March, 1986). The draft title of the Canadian portion of this volume is: "Estimating Impacts of Climatic Change on Agriculture in the Canadian Prairies: The Saskatchewan Case Study". The Canadian authors are: G.D.V. Williams, K.H. Jones, E.E. Wheaton, R.B. Stewart, and R.A. Fautley.

Future Events
(1) An Agrometeorological Session is to be held at the Agricultural Institute of Canada Annual Meeting in Saskatoon, Saskatchewan on July 8, 1986. The theme is "Age of Information" and the first business meeting will also be held. For more information contact: D.M. Brown, Land Resource Science, University of Guelph, Guelph, Ontario N1G 2W1.

HELPING ETHIOPIA MAP ITS AGROCLIMATE

Dan Williams
Coldwater, Ontario

Just before taking early retirement from Environment Canada in July, 1985, I had the privilege of serving as a W.M.O. consultant to the National Meteorological Services Agency of Ethiopia in Addis Ababa for two periods totalling 6 weeks in April-June, 1985. Ethiopia has several climate-related problems, including a quite unstable food supply and an extreme spatial variability of agroclimate. My task was to help NMSA meteorologists begin mapping the agroclimatic resources of Ethiopia. It proved to be one of the most interesting and challenging assignments of my career.

ACLIQ ET CLIMAT

A. Hufty
Université Laval

Une association des climatologues de Québec (ACLIQ) a été créée. Elle regroupe des scientifiques issus de divers milieux et de différentes disciplines, et des professionnels et des usagers de la climatologie.

Outre l'assemblée générale annuelle (8 novembre 1985) de nombreuses réunions des membres du conseil ont été tenues. Parmi les activités, on peut retenir les points suivants:

a) Publication annuelle d'un "répertoire" qui contient une liste des membres et de leurs activités. Il est notamment distribué à un maximum d'organismes susceptibles de recourir aux services de climatologues.
b) Organisation de la session "climatologie et météorologie" au prochain congrès de l'ACFAS (à Montréal, mai 1986).
c) Mise sur pied d'une enquête sur la recherche en climatologie au Québec, en particulier sur les difficultés d'obtenir des subventions.
d) Publication bi-annuelle de la revue "CLIMAT" qui a pour objectif principal de favoriser le développement et la diffusion de la climatologie et de ses applications; un comité de rédaction vient d'être formé et une liste de lecteurs d'articles a été établie.

L'orientation de la revue devrait se préciser au fur et à mesure de sa parution.

Pour tout renseignement concernant les activités de l'ACLIQ, on peut s'adresser à P. Dubreuil, Environnement atmosphérique, 100 Alexis-Nihon, Ville Saint-Laurent, Qué., H4M 2N6.

ALBERTA CLIMATOLOGICAL ASSOCIATION

Serge Dupuis
Past Chairman, ACA

Through the sponsorship of Environment Canada, the ACA recently held its Tenth Annual Workshop at the University of Alberta. The workshop's opening address was presented by David Phillips of the Canadian Climate Centre, Atmospheric Environment Service. Mr. Phillips' topic was "Marketing Climatology for Today's User."

The remainder of the morning's session was devoted to ACA business that included elections, various member agency reports on climate activities, a proposal for ACA to undertake a climate project inventory catalogue, and the introduction of the ACA newsletter "The General Circulation."

The afternoon session was dedicated to technical papers on various topics including:

- The Use of Satellite Imagery to Monitor Snow Depletion
- The Effects of Climate on Yields of Barley
- A Description of Climate in the Olympic Corridor
- Microclimate of Clearcuts in West-Central Alberta
- The Application and Worth of Climate Data in Alberta

Proceedings of this workshop will be available at a later date. A limited number of proceedings from previous workshops are still available by contacting the Information Centre, Alberta Energy and Natural Resources, 9920 – 108 Street, Edmonton.

For more information on the workshop or ACA, please contact Bruce Thomson, Chairman, ACA, Atmospheric Environment Service, Twin Atria, 2nd Floor, 4999 – 98 Avenue, Edmonton, T6B 2X3 (403-420-3143).

Book Review / Critique de livre

THE JOURNAL OF METEOROLOGY, Volume 10, number 100, 1985. Published by The Artetech Publishing Company, England. Individual subscription rate (outside the U.K.) £18.00 per annum or £24.00 including airmail.

This particular issue of The Journal of Meteorology contains the Proceedings of the First Conference on Tornadoes, Waterspouts, Wind-Devils, and Severe Storm Phenomena which was sponsored by the Tornado and Storm Research Organization (TORRO), and held at Oxford Polytechnic in the U.K. Both TORRO and The Journal of Meteorology were begun in the mid-1970's by Dr. G.T. Meaden who has an intense interest in tornadoes and related phenomena, as well as in such unusual and somewhat controversial meteorological events as ball lighting and remarkable falls of matter from the sky.

Papers presented at the conference run the gamut from a description of TORRO and its work to the where, when, and how often of tornadoes and thunderstorms in Britain. A number of case studies are also included. All of this work is in a style that is more descriptive and much less academic than the papers usually presented at similar conferences in North America. This is understandable given the relatively recent interest in severe local storms in the U.K., and the fact that considerable effort has been given to collecting data, thus leaving less time available for analysis. Nonetheless, the papers serve to shatter the widely held perception that such storms (particularly tornadoes) are infrequent and inconsequential in the British Isles. It comes as somewhat of a surprise, for example, to read of an outbreak of 105 tornadoes in a six-hour period on November 23, 1981. Fortunately for the British, it is reported in one of the papers that "the scale of damage caused in the U.K. is far less severe than that experienced in countries such as the U.S.A.". Several illustrations of tornadoes and waterspouts are printed in the publication, as well as pictures of hail, including one of a hailstone the size of a tennis ball.

A meteorologist might justifiably complain about the lack of meteorological documentation in the various papers. Given the fact that the super-outbreak of tornadoes occurred in November, an unusual time from a

North American point of view, it would be of great interest to see what meteorological circumstances prevailed during the event. New insights could possibly be gained from a study of the meteorology of this case and others like it.

Some pertinent issues are addressed by the various authors. For example, P.S.J. Buller of the Building Research Establishment presented a paper concerning structural damage due to tornadoes. He reported that it is possible for large numbers of buildings to be exposed to tornado wind speeds estimated to exceed the once-in-50-year return period gust speeds used in building design. This concern is echoed by G.T. Meaden in a paper dealing with the risk of tornado damage to the Severn Bridge. It is interesting to note that similar questions arose concerning Canadian building standards following the severe tornado outbreak of May 31, 1985 in Ontario. Another issue that was addressed concerned the provision of tornado warnings to the general public. This is a regular practice in the U.S. and Canada, but apparently it is a controversial topic in Europe. In the interest of public safety, G.T. Meaden and D. Elsom, on behalf of TORRO, formally urged that such warnings should be included in the services provided by European national meteorological agencies.

In his message of welcome, Professor H.H. Lamb of the University of East Anglia made the following statement about the investigation of tornadoes, hailstorms and severe thunderstorms; "Sad to say, such efforts seem rarely to be appreciated by the well-funded establishment groups until at least one generation later! Happily, however, collaboration in such exploits brings its own kinds of rewards." Perhaps it *will* take years before the work of TORRO comes to fruition, but in the meantime anyone who is interested in severe local storms will enjoy The Journal of Meteorology which is full of information about them.

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Necrology / Nécrologie

The death of Donald Alvie Murray occurred November 25, 1985 at the Doctor Everett Chalmers Hospital in Fredericton, N.B. after a lengthy illness.

He is survived by his wife Audrey, one son Ted and two daughters Diane and Jean.

Born in Pugwash, N.S. on August 24, 1938, he joined the Royal Canadian Air Force in 1956 and trained as a meteorological technician. After serving approximately 20 years in various military bases across Canada and in Europe and achieving the rank of Sergeant, he left the Canadian Armed Forces and took up residence in Fredericton.

He was employed by the New Brunswick Department of the Environment as a meteorological technologist from April 7, 1976 until his demise. While in this position, he was a driving force in the formation of the New Brunswick Meteorological Committee. As the coordinator of the Meteorological Committee, he was the author of a study of the "New Brunswick Climatological Network" which outlined the highlights and shortcomings of the N.B. Climatological Network and the N.B. Climate Data Base. He was also instrumental in the promotion and use of meteorological and climatological data within the provincial government and its agencies.

He was a member in good standing of the Association of American Weather Observers, the Canadian Meteorological and Oceanographic Society, the American Meteorological Society and the Air Pollution Control – Atlantic Canada Chapter.

Donald is sorely missed by his family and friends. All who worked with him over the years remember him with affection and respect. We appreciate the contribution he made to Canadian operations both here and overseas.