Environment Canada
Environnement Canada

Environment Update

Vol. 5 No. 3 – Special Edition

All about Canada's Weather Service

Canada

Environment Update

Over the years Environment Canada has become increasingly aware of its responsibility towards its diverse publics. The aim of *Environment Update* is to inform interested people about the programs and activities of our department. We recognize the value of working cooperatively with Canadian citizens and our colleagues outside of government. We are in fact, creating links. These links will allow us to meet our objective along with those who share our concern for a better environment. Each publication features a specific issue and includes articles on other topics from across Canada reflecting the full spectrum of services of Environment Canada. Environment Update is a bi-monthly publication of the Information Directorate of Environment Canada.

Table of Contents

Regional Information Contacts

Atlantic: Peter Leblanc
Information Office
Environment Canada
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6
(902) 426-7990

Québec: Marcelle Girard
Information Office
Environment Canada
P.O. Box 10 000
Sainte-Foy (Québec)
G1V 4H5
(418) 694-7204

Ontario: Jeanne Jabanoski
Information Office
Environment Canada
25 St. Clair Avenue, East
Toronto, Ontario
(416) 966-6406

Western & Northern: Garth Norris
Information Office
Environment Canada
804, 9942-108th Street
Edmonton, Alberta
T5K 2J5
(403) 420-2546

Pacific & Yukon Paul Mitchell
Information Office
Environment Canada
P.O. Box 1540
800 Burrard Street
Vancouver, British Columbia
V6Z 2J7
(604) 666-5900

Foreword

Better forecasting of tomorrow's challenges

Five out of six Canadians use Environment Canada's weather service every day. The Atmospheric Environment Service (AES) advises on whether to wear a raincoat in case of a shower, and issues warnings when a severe thunderstorm threatens farms or power stations.

Most Canadians know that AES can also handle both long- and short-term meteorological challenges vital to our nation's economic well-being.

While Environment Canada's new supercomputer in Dorval, Quebec, will eventually be able to forecast the weather across Canada 10 days in advance, our first concern is still with the immediate "Day One" forecast, particularly for severe weather warnings. Our network of nine regional weather stations is expanding to 14 centres, all of them well equipped to answer a wide range of public questions.

In the area of research, AES is seeking to balance the need to plan a state-of-the-art weather service of the 21st century, and the call to pursue research in cooperation with Canadian industry and universities over the next five to 10 years. These long- and short-term contrasts are not surprising in an organization that dates back more than 100 years as a government weather service, but which has made most of its major technical strides in the last 10 to 15 years.

Major technical strides

Most Canadians are aware that climatology is a way of viewing weather over the long term. New computer technology, involving vector processing and sophisticated numerical modelling techniques, will soon enable AES to carry out climate predictions for a month or a season ahead and eventually for several decades.

This versatile new climate forecasting capacity comes at the right time. Canadians and many others around the globe are facing a major, potentially dangerous form of climate change produced by atmospheric carbon dioxide, popularly known as the *"Greenhouse Effect".*

On a per capita basis Canada emits the world's second-highest quantity of CO_2 into the atmosphere. Many other countries are potential sufferers from the warming effects of CO_2. Canada, with its typical northern climate, faces extreme temperature increases of up to 10°C in polar regions in winter.

At first glance the CO_2 threat appears inevitable given our present day dependence on fossil fuels. But like most other climatic problems, CO_2 warming has both short- and long-range implications that can scarcely be accepted and forgotten.

From a distant perspective, it could be said that CO_2 emissions from natural sources such as volcanoes have affected the climate throughout history. The effects of man-made CO_2 began to appear with the industrial revolution, but only in the past 20 years has the "Greenhouse Effect" had a measurable impact on the atmosphere. Some scientists expect the real danger to occur in the late 21st century, but Canadian researchers recently warned that serious impacts might materialize in just 30 to 40 years.

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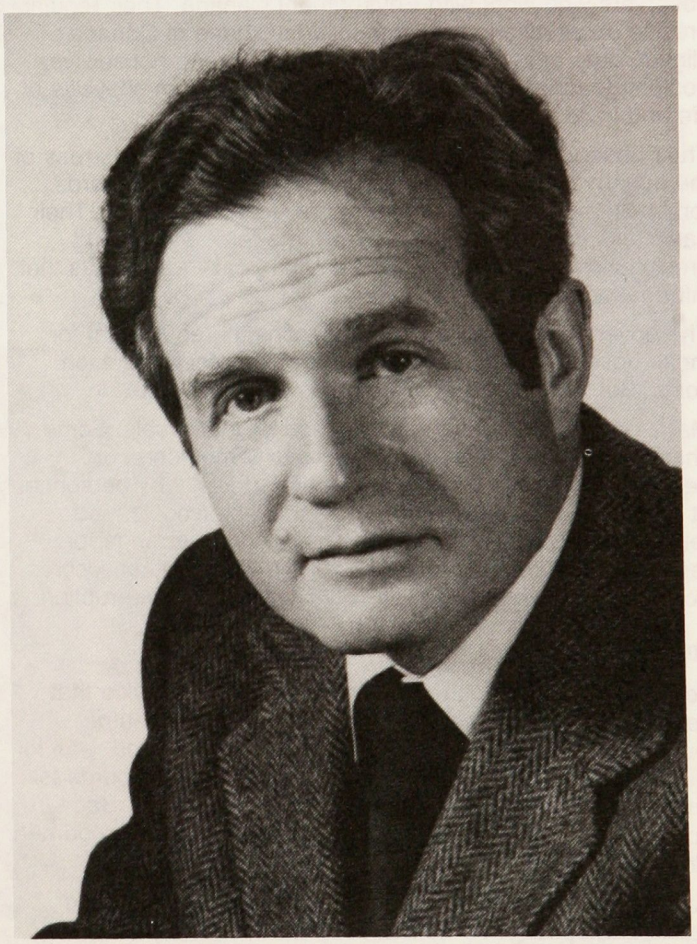

Update is published under the authority of the Honorable Charles Caccia, Minister, Environment Canada.

Volunteers form the backbone of Canada's weather service

Everyone is interested in the weather — in a general, uncommitted way — especially when it is extreme or unseasonable. But some people are committed to keeping track of it meticulously, recording the weather each day, year in, year out. AES is proud of the fact that it is one of the few federal organizations that uses more volunteers than paid employees to carry out its programs.

A large number of these selfless individuals assist the weather service by becoming part of a volunteer network of severe weather watchers, scanning the sky and spotting approaching tornadoes or severe thunderstorms.

The "typical" AES volunteer, however, is a climate observer who records weather facts and figures on a volunteer basis. The job is a perpetual hobby for more than 2,000 volunteer observers who work with Environment Canada. Their regular, precise observations form the solid backbone of Canada's climate data base. Their ranks include farmers, housewives, doctors, teachers and pensioners — people from all walks of life and in all age groups.

Their observation posts are spread across all settled areas of the country. Their instruments can be found in back yards, forest clearings, on farms and at university campuses. Their basic task is to observe and record the temperature and precipitation — twice daily, 365 days a year — and pass that information on monthly to AES.

The government supplies and maintains the equipment for these observers, and covers postage and other operation costs. But volunteers receive no pay for their work.

Many observation stations are staffed by individuals. Some share the task with spouses, other family members, or neighbours. Others stations are operated jointly by personnel at government and military establishments, schools, and religious institutions. The volunteer observers arrange for replacements when ill or on holiday, so that weather records from each observation site will continue without interruption.

Vernon Tuck, is 93-years-old and a volunteer weather observer, takes a temperature reading outside his Grimsby, Ontario home.

200-year history

Today's dedicated volunteers are continuing a service that began well over two centuries ago. The earliest weather journal in Canada, extending over a 12-month period, was for Quebec City for 1765-1766. Some of the earliest records for an extensive period were taken by the Reverend C. Dade in Toronto during the 1830s, and by Dr. Charles Smallwood near Montreal in the 1850s.

Canada's climate network has grown steadily and spread across the country. From a total of 126 weather stations in 1871, the system had expanded to include more than 2,700 sites in 1983.

Some stations have been maintained by the same volunteer family over many years, with the work passing from one

generation to the next. The Baird family of Brucefield, Ontario and the Waites of Ranfurly, Alberta have observed weather at their homes since the early 1900s, and have each involved three generations in the task.

Standard routine

The daily routine of a typical observer rarely varies. Usually at 7 a.m. and again at 6 p.m., the volunteer reads and then resets two thermometers — a maximum and a minimum — recording temperature extremes since the last observation. The thermometers are sheltered in a white box with louvered sides that allow air to circulate but prevent direct sunshine from striking or rain from falling on the instruments. The box, known as a Stevenson Screen, resembles a beehive and is perhaps the most distinctive symbol of the weather observer. A rain gauge generally sits on the ground nearby. The observer measures and records any rain collected since the last observation, then empties the gauge.

At the end of each month the observer mails a monthly report to a regional office of Environment Canada. There the figures are thoroughly checked, then sent on to Environment Canada's Climate Centre in Downsview, Ontario for final inspection and processing by computers. The final national records are available on demand in a variety of forms, including microfiche and computer tape.

Volunteer weather observers play an essential and unique role in Canada's complex and technological weather service. The volunteer is a valuable human link in a field increasingly dominated by impersonal machines.

Observations built up by these volunteers over the years provide basic facts about the climate of Canada, as well as climate statistics that can be calculated from the raw data. The information provided by volunteer observers is used to respond to nearly 200,000 annual requests for climatic data. Those requests come from planners and decision-makers in water resources, agriculture, transportation, energy, construction, and many other social and economic sectors of Canadian life.

Most prefer anonymity

Volunteer weather observers are the often hidden resource of Canada's weather service. Unlike the "weatherman", whose face or voice may be familiar to thousands of television viewers or radio listeners, volunteers perform their round-the-clock duties with little fanfare. A few weather observers get some publicity when the local media carry weather stories based on the information they provide. But most volunteers prefer anonymity, known as observers only to their AES contacts.

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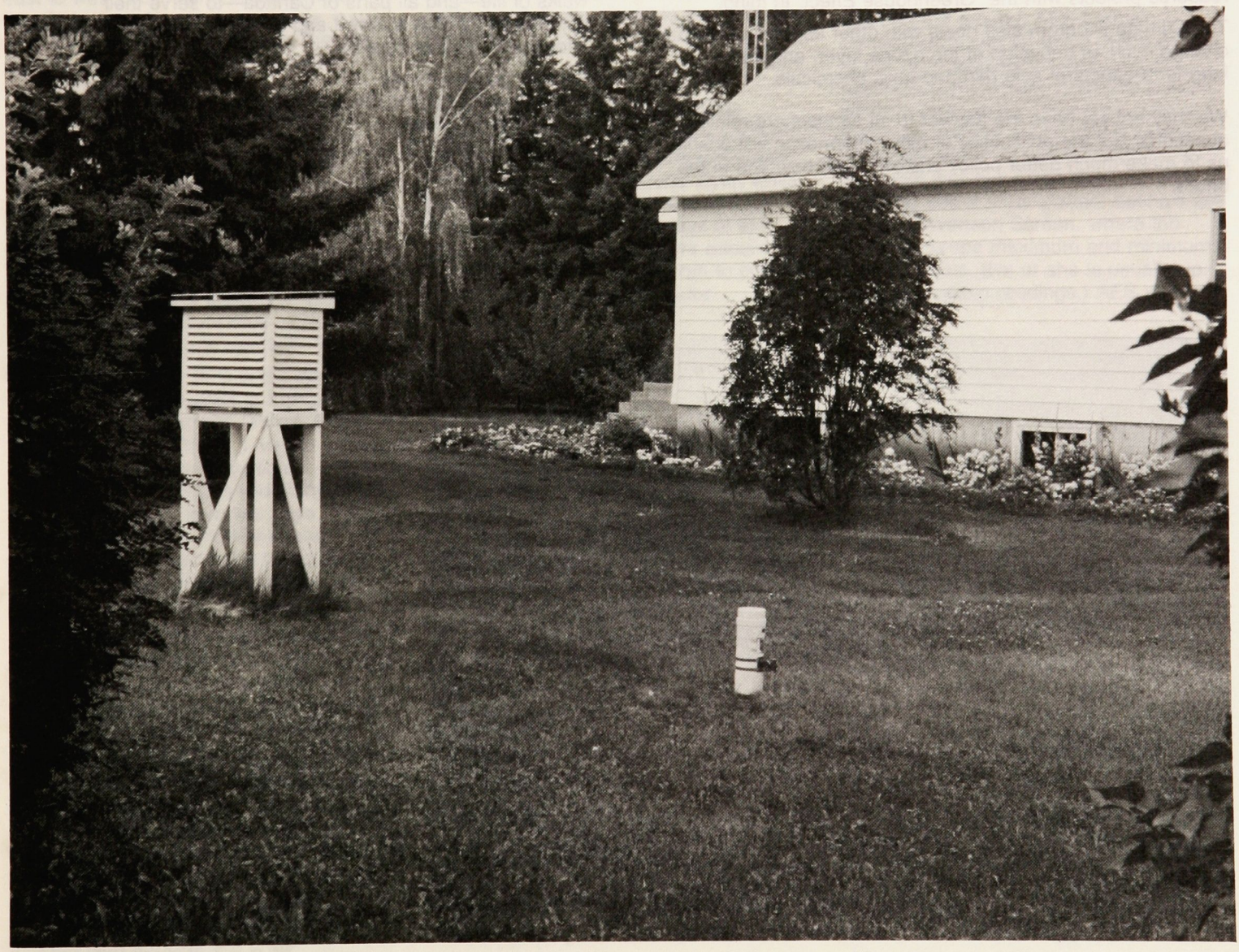

Weather recording devices installed at the home of voluntary climate observer in southern Alberta. At left a Stevenson screen which shades a maximum/minimum thermometer, and right, a collecting gauge to measure rainfall.

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Solutions in sight

There are many ways to mitigate a possible doubling of CO_2 by the late 1990s. We could encourage the development and use of "soft", renewable energy sources such as biomass fuels, wind and solar power, or small-scale hydro projects. We should at the very least practice vigorous energy conservation in keeping with our overall environmental needs. As our efforts to contain the "Greenouse Effect" gradually unfold, AES' role in identifying and quantifying the problem will continue to be appreciated.

Apart from the weather service itself, which receives about 75 per cent of AES' budget, high priority has been given to the Canadian Climate Program. This program will receive another $3.8 million over the next three years, in addition to its current annual budget of $10 million. By 1986, the Service hopes to achieve accurate monitoring and a clear understanding of the "Greenhouse Effect".

Unfortunately, planning cannot entirely halt the burning of fossil fuels and emission of CO_2 into the atmosphere. But it can slow down the threat, giving us more time to think and prepare. For example, we could start designing new bridges, dams and waterways in the light of expected climate changes, and planning long-term agricultural, forestry, and offshore resource projects with the "Greenhouse Effect" in mind.

The Climate Program also deals with other aspects of climate change such as depletion of the ozone layer, and the long-term effects of acid rain and toxic chemicals.

We may not yet have the answer to all atmosphere-related questions. But the availability of more information will enable us to make much better policy choices, both now and in the future.

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In recent years, volunteer observers have been asked to provide specific information to regional offices to assist in flood forecasting, to pinpoint the location of severe weather, and to verify weather forecasts. From these reports, regional offices have generated valuable information used in the provision of warnings, and in supplying climatic data. Observers also answer occasional enquiries from other government agencies, particularly federal or provincial agriculture agencies. Since many observers are farmers themselves, they often make use of their own data when planning field work, managing their farms, or planting new crops.

Environment Canada honors its volunteers through a series of awards. Certificates of Achievements are presented to those who maintain high standards for five or more years. Awards of Merit are given for 20 years or more of continuous service. These awards are usually accompanied by books or weather instruments. The Morley K. Thomas Award goes to those who have maintained records for 30 years or more. From time to time, coveted long service awards are given to individuals, families, or institutions that have maintained records for 50 to 100 years at the same site.

For all Canadians

The volunteer program is an opportunity for Canadians in all walks of life—and all parts of Canada—to serve their community through a useful and rewarding pastime. For more information, please contact:

Information Directorate
Atmospheric Environment Service
4905 Dufferin Street
Downsview, Ontario
M3H 5T4
(416) 667-4551

Long reach Weather service extends from beet farm to outer space

As the weather service of the second-largest country in the world, the Atmospheric Environment Service covers a vast domain. Its presence reaches from east to west, from north to south, and from the ground up to outer space. It may come as no surprise, then, that the Service can be found in some pretty unusual places.

You could find AES on a Weatheradio Canada receiver aboard a tractor on a Manitoba beet farm. Changes in fall weather can be a crucial harvesting factor. Farm forecasts are a major economic advantage to the farmer. The 24-hour-a-day Weatheradio bulletins give constant weather reports to special users such as construction workers or pleasure boaters, and some receivers have a tone alert to warn of severe weather.

You could discover AES in the depths of a supercomputer located at the Canadian Meteorological Centre in Dorval, Que. The new ultrafast CRAY 1 Vector computer — Canada's speediest — will eventually handle nation-wide long-range weather forecasts, from two days to a week or more. New modelling and programming will allow the computer to perform detailed climate forecasts and track the path of acid rain clouds.

You might come across AES at a High Arctic weather station, or simply spot an isolated black box serving as an automatic weather station powered by a battery buried deep in the permafrost.

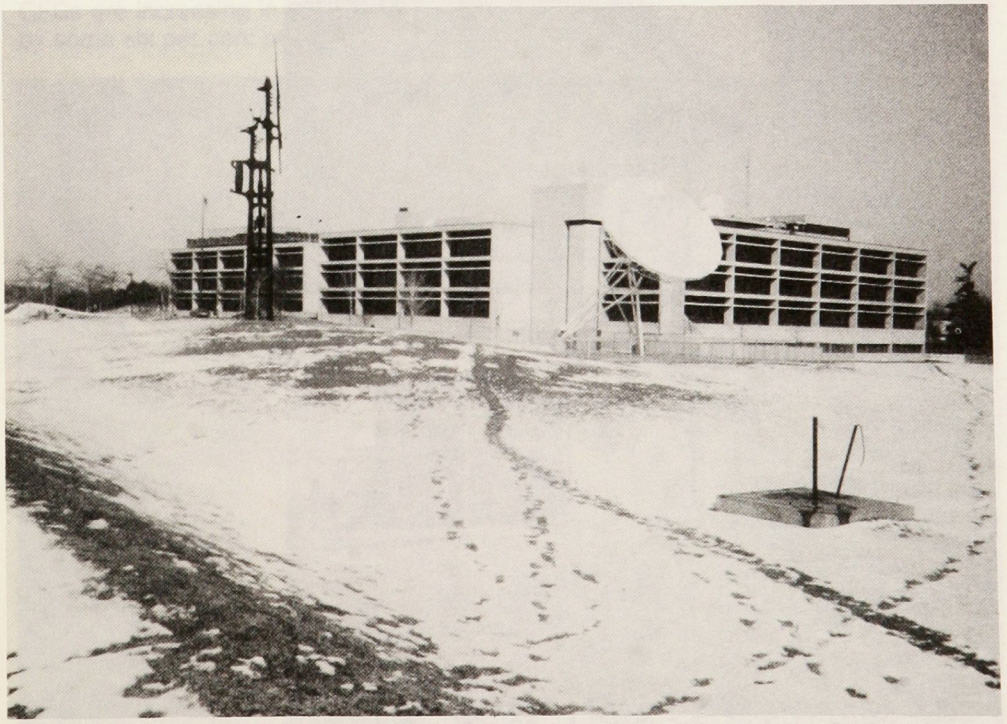
If you happen to be crossing the Pacific, you might find AES on a drifting ocean buoy with fine-tuned weather sensors communicating by radio to overhead weather satellites. Aboard a nearby Japanese car-carrier ship, you'd notice weather monitoring devices called *radiosondes* being launched by balloon into the high atmosphere under the Automated Shipboard Aerological Program (ASAP).

You will soon find AES up in space. In October, Canadian astronaut Marc Garneau will point the AES-designed Sunphotometer at the sun from aboard the U.S. Space shuttle in order to monitor pollutants related to acid rain and acid snow.

Up in the Air

That device is not the only original instrument AES' scientists are pointing at the sky. The Brewer Spectrophotometer monitors freons in the ozone layer, while the Suntracker traces the sun through cloud and haze. On most days of the year, AES ice observers work aboard special reconnaissance aircraft to provide visual, photographic, and radar monitoring of ice conditions in Canadian waters. And terms of cloud physicists fly specially-equipped research aircraft into cloud banks to determine how acid rain is formed, and even why it rains.

Back on the ground, AES forensic climatologists can be found in the courts of the land, helping law enforcement agencies solve crimes which have strong weather links. And across your garden fence, the person next door may be acting as one of Canada's 2,500 volunteer weather observers. You will probably see a white-slatted, beehive-like box or Stevenson Screen, where the observer keeps maximum and minimum thermometers. (He or she is usually up by 7 a.m. taking readings.) AES is proud



Headquarters of the Atmospheric Environment Service, Downsview, Ontario.

of its unpaid "army", and of the fact that it is setting a federal government record by outnumbering paid staff members with volunteers.

Since 85 per cent of Canadians use the weather service on a daily basis, it is appropriate to list some usual places to find AES. Radio and television are an important means of presenting weather information to Canadians at large. Forecasts in your daily newspaper cover wide areas, with maps to keep readers up to date. The weather service also receives more than 12 million telephone enquiries annually, over seven million of which are handled by automatic telephone-answering devices.

Way of the Future

Behind the weather forecasts, there is a major effort to achieve a state-of-the-art weather service. This involves establishment of a weather radar network to span the country, transfer of meteorologists to regional weather centres to produce short-range weather forecasts, recruiting of more volunteer weather watchers for spotting tornadoes or severe thunderstorms, and improving of internal communications and data processing systems.

It is becoming easier to find well-displayed weather reports on cable TV. These features, as well as the Weatheradio Canada broadcasts, are the way of the future for providing weather information to most Canadians. AES

Calgary Radar Station, Vulcan, Alberta.

Canadian Astronauts, (left to right) Steve MacLean; Marc Garneau holding Sun photometer designed by AES, and Bob Thirsk.

backs these systems with a network of weather offices staffed by meteorologists and technicians, ranging all the way from local weather observing stations to large, comprehensive regional centres. The regional centres receive data from surface observing stations, weather radar sites, satellites, and of course the Dorval supercomputer. Forescasts for short-term and severe weather are produced at the large regional centres.

Domes, dishes and screens

AES office also play a role as climate advisors. Canadians can consult the Canadian Climate Centre at Downsview, Ontario or AES regional offices about how the climate will affect their businesses, farms, or livelihoods. Over 100 years of climate data for locations across the country are available on computers archives. The Service maintains a wide range of buildings, many with easily recognizable features such as domes, "dishes" or Stevenson Screens. The headquarters building in Downsview, which houses about 800 employees, is the weather service's main administrative centre as well as its chief scientific and research base.

All in all AES employs 2,300 people with a wide range of scientific technical skills. The weather service has a network of 380 first-order surface observing stations, about 3,500 climate observing stations, 33 upper air stations, 13 weather radar stations, and 14 Weatheradio Canada transmitters with a number of repeaters. The weather service operates 24 hours a day, 365 days a year. It is estimated that the economic value of weather predictions in Canada, over and about the lives saved through severe weather warnings, is over $1.5 billion per year.

Atmospheric research: A matter of global security

The atmosphere poses more questions than it answers, but major new scientific research is speeding the growth of knowledge about all parts of the environment.

In the past, atmospheric research could often be carried out in an almost academic manner. Nowadays, environmental safety is a major challenge for the entire population, and there is much greater awareness of the choices involved. This gives research into the atmospheric environment an awesome relevance.

Thinking about the atmosphere as a major security concern helps emphasize important issues like acid rain, or the long-term results of the carbon dioxide/"Greenhouse Effect". AES has been doing the lion's share of Canada's atmospheric research at all levels, from the earth's surface to the upper stratosphere. The Service is the lead agency for studies on the long-range transport of airborne pollutants, an important part of the federal acid rain program.

High-tech helper

In an organization like AES, environmental security and interest in high technology go hand in hand. Research on the ozone layer illustrates this point very well. For years, scientists have known that depletion of the ozone layer by synthetic chlorofluorocarbons (CFCs), released into the upper atmosphere from aerosol spray cans and from certain plastics and refrigerants, facilitates penetration to the earth's surface of harmful ultraviolet rays, a major cause of skin cancer.

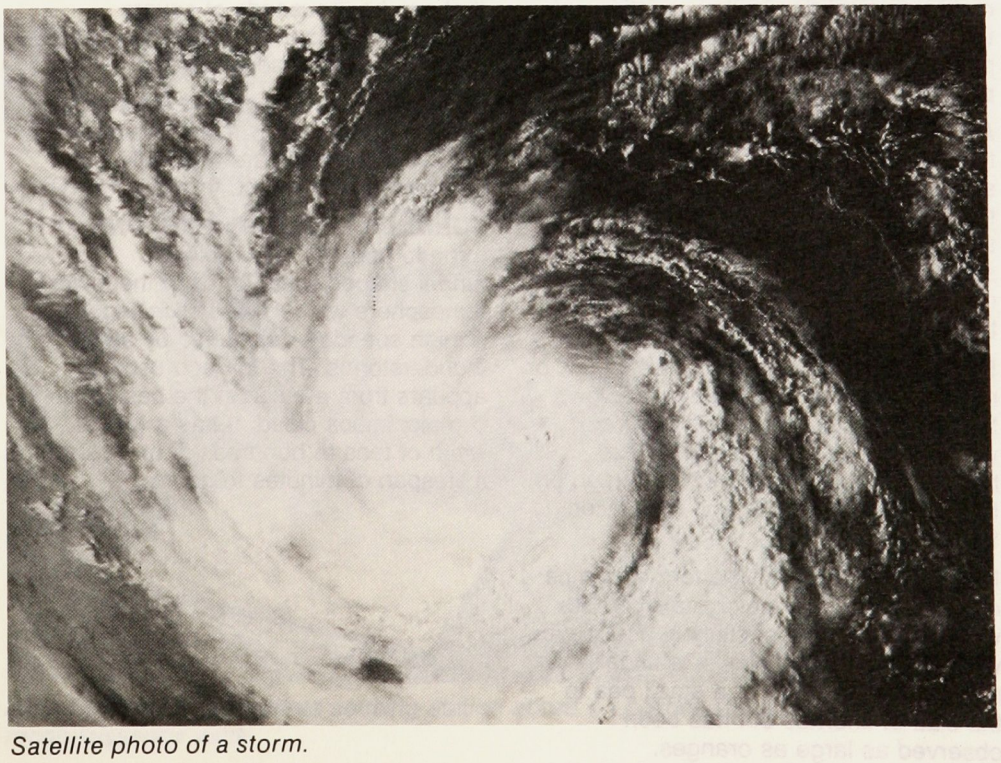
Since its appointment as international ozone monitor by the United Nations World Meteorological Organization in 1964, AES has collected ozone layer data that could be vital to the health and security of all Canadians. The research effort has received a boost from the development of technology capable of physically monitoring the ozone layer up to 35 km from the ground. Instruments include the "in-house" Brewer Spectrophotometer, which takes accurate ozone measurements using the sun as a radiation source, and a device called a Suntracker, which allows the path of the sun to be traced through cloud during ozone monitoring. Scientists are able to measure ozone from the ground, from aircraft, from satellites or space platforms, and they can verify their results by making computer models of their observations.

Breaking the barrier

As a result of this Canadian expertise, scientists recently broke the "semi-certainty barrier" regarding ozone layer depletion, and can confirm that CFCs are increasing in the stratosphere by some six per cent per year.

Canadian scientists have been equally successful in developing an exciting new weather radar technology with proven ability to track fast-moving tornadoes. And cloud physicists flying specially-equipped research aircraft have developed excellent cloud particle measuring techniques, enabling them to study cloud chemistry processes which make major contributions to acid precipitation.

Maintaining its position as a leading research organization is a constant challenge for AES. The first concern is that there is sufficient funding to carry out all its major long-term projects, some of which are scheduled to last until the turn of the century. There is also a need to maintain the ability to draw top-ranking scientists who can devote significant time to long-term research projects. Close liaison with Canada universities is essential for carrying out joint research projects, and for training new research scientists. It is only through such measures that AES can expect to remain a major research establishment in the 21st century.



Satellite photo of a storm.

In the provision of security for the public and the use of advanced technology, AES has achieved international recognition. Major successes have come about in the area of carbon dioxide monitoring, use of weather satellites to monitor local rain and snow, development of short range weather forecasting or "mesoscale meteorology" and design of instruments for tracing atmospheric gases. Through the World Meteorological Organization, AES promotes global security,especially in developing countries plagued by drought, floods, air pollution, deforestation, or degradation of water supplies.

Formation of a tornado.

Coming to Terms with the Weather

WEATHER: State of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness, also weather is the meteorological day-to-day variations of the atmosphere. It includes temperature, pressure, humidity, clouds, wind, precipitation and fog.

ATMOSPHERE: The mass of air held to the earth by gravity. The atmosphere is subdivided into four sections: the troposphere — from the earth's surface to an altitude of about 10 km; the stratosphere — from 10 km to 50 km; the mesophere — from 50 km to 80 km; and the thermosphere — beyond 80 km.

BLIZZARD: A severe storm lasting six or more hours. It is characterized by low temperatures, strong winds and poor visibility due to blowing snow. True blizzard conditions are most common on the prairies of Canada and the United States.

HAIL: Precipitation in the form of lumps of ice — individual ice crystals coated with layers of ice — mainly in association with thunderstorms. Hail size usually ranges from the size of a small pea to the size of cherries but has been observed as large as oranges.

HURRICANE (TYPHOON, TROPICAL CYCLONES, WILLY-WILLIES): Tropical storms with wind speeds of 65 knots (120 km/h) up to 240 knots (460 km/h) that can be thousands of square kilometers in size. Such systems usually have a lifetime of several days.

SQUALL: A strong wind which starts suddenly, lasts a few minutes and drops off quickly. Squalls are generally associated with severe thunderstorms.

TORNADO (TWISTER, CYCLONE): A tornado appears as a violent funnel-shaped wind vortex in the lower atmosphere with upward spiralling winds of high speeds — spawned by severe thunderstorms. The tornado usually appears from a bulge in the base of a cumulonimbus cloud. It has a typical width of tens to hundreds of metres and a lifespan of minutes to hours.

WEATHER WARNINGS: Announcements separate from and supplementary to routine forecasts issued to warn of weather conditions that may endanger lives, property and the welfare of the general public. Warnings are broadcast by the media, on the Weatheradio Canada system and by the Coast Guard. They are issued for snowstorms, blizzards, heavy blowing snow, heavy rains, frost, cold waves, freezing rain, severe thunderstorms and strong winds — according to thresholds established for local and regional public needs. In Vancouver a warning might be issued for an expected snowfall of five centimetres or more but in Montreal a warning would only be issued for 15 centimetres or more of snow.

WIND CHILL FACTOR: This is a single number combining the chilling effect of wind and low temperature. At a wind chill factor of 1625 exposed flesh freezes. At 2300 many outdoor activities are dangerous.

Technological Transfer: Spin-Offs Benefits AES, Canadian Industry

Not unlike the environment it measures, the equipment designed or commissioned for Canada's world-class weather service has a habit of crossing international boundaries. Many of the companies that have produced modern observation of communications equipment for AES have gained enough credibility to break through global markets for their product.

This greatly expanded transfer of technology is helping AES achieve its goal of a highly automated weather service by 1990. It is also an important factor in making Canada a world leader in several industrial areas.

Canadian connection

One Canadian firm which has achieved international success after a decade of association with AES is MacDonald Dettwiler and Associates (MDA) of Vancouver. First involved in designing satellite data receiving stations in Toronto, Edmonton and Vancouver, MDA worked with AES to develop mapping systems for ice reconnaissance. The company has also taken a lead in helping to produce sophisticated weather information display terminals with zoom magnification and "pseudo" colouring.

Close links with AES have helped MDA to become a world leader in satellite data processing systems with millions of dollars of exports. Most recently, the company signed a multi-million dollar contract with the U.S. Air Force to design prototypes for the world-wide Automated Weather Distribution System (AWDS). MDA feels this latest bonanza would never have materialized without its strong connection to AES.

By providing incentives for Canadian industry to produce fine-tuned instrumentation on a marketable scale, AES serves as a springboard for international orders. For 20 years the Electrolyser Corporation of Toronto has built hydrogen generators to produce the gas for filling weather balloons. After meeting domestic needs, Electrolyser produced several hundred more generators for international use. The company soon became the world's leading supplier of hydrogen generators for national weather services.

In 1980, AES asked Electrolyser to produce a new, improved generator. The company obliged and the design attracted still more international interest, especially from Australia and the United States. An initial, domestic order for the new generators effectively launched them onto the world market.

In the area of ice reconnaissance, ship and aircraft observations have been carried out for years. But soon AES' Ice Branch will be acquiring the latest in ice monitoring equipment — everything from laser profilometers with the ability to draw clear ice boundary lines, to an ultra-modern radar monitoring device called Synthetic Aperature Radar (SAR). Canadian Astronautics Ltd. of Ottawa was the company commissioned to supply the new equipment, some of which will go aboard a new series of ice monitoring satellites.

Better reconnaissance

Meanwhile, the Ice Branch has used funding from the Special Recovery Capital Projects Program to commission a new state-of-the-art ice reconnaissance plane — an extended range de Havilland Dash 7 — due to come into service in 1985.

The agreement with de Havilland had an innovative aspect. For the first time the company undertook to deliver one of its aircraft with all of the remote-sensing and communications equipment already installed. This arrangement added a new dimension to the company, which had previously supplied only the avionics equipment required by a purchaser. As a result of this sale, de Havilland is gaining experience as a prime contractor with a much wider scope.

John Comeau at his remote sensing station abord a Lockheed Electra, used in ice reconnaissance work.

With severe weather forecasts and warnings a top priority for AES, improved radar is shaping up as a key technical requirement. The Service plans to add four or five new weather radar stations to its current network of 13 posts. The radar hardware itself comes from the United States but the processing component is a totally Canadian product. As it turns out, the processing part of the operation is more complex and expensive than the radar equipment itself.

Broader scope

With the application of atmospheric sciences to the environment expanding in scope, stretching ever more widely over oceans and continents, AES has already reached the stratosphere and will soon reach into space. Technology transfer has begun to reflect this growth.

The equipment required for monitoring the depletion of the ozone layer, known as the Brewer Spectrophotometer, was developed partly at AES and partly at the University of Toronto by its creator, Alan Brewer. The company chosen to produce the instrument was SCI-TEC Instruments Incorporate of Saskatoon.

Once the Canadian instrument successfully demonstrated that it could meet the requirements of current ozone layer monitoring, orders were placed in countries as far apart as Sweden, India, China and New Zealand. The product has yet to saturate world markets, but promises to put Canadian technology in the very forefront of world recognition.

Nowadays, the ultimate frontier for many endeavours is space itself. AES will soon have the good fortune to climb aboard the U.S. Space Shuttle with Canadian astronaut Marc Garneau. This time the instrument is the Sunphotometer, which will be pointed directly at the sun to measure dust particles and other chemical pollutants that cause acid precipitation.

In future, weather monitoring will rely upon greatly improved internal communications using the ANIK communications satellite for large-scale broadcast of weather information between Canadian weather centres. Digital teletype terminals, regional computers, and new data management facilities — including a communications dictionary and request-reply access to national and regional data bases — will round out the picture.

Two-way street

Needless to say, many aspects of tomorrow's weather service will depend on powerful computers. The new CRAY supercomputer will soon have models of the atmosphere capable of generating nation-wide weather forecasts from two days to more than a week. The models, if not the hardware, are products of research scientists at the Canadian Meteorological Centre in Dorval, Que. Short-term forecasts will remain in the hands of skilled meteorologists.

It is important to realize that all technology transfer is a two-way street, than any public or private organization usually gets as much as it gives. Without the skill and drive of Canadian high technology companies, AES' wish to become a world-class weather service would be little more than a pipe dream. On the other hand, AES has provided the incentives for many of these firms, supplying the credibility to enable them to become international leaders in their field.

New map series the first in 17 years

The Atmospheric Environment Service has just released the first series of maps in its new Climatic Atlas Climatique — Canada. Series 1, Temperature and Degree Days, contains 59 maps based on the 1951-1980 climate normals.

Over the next two years AES will issue nine more series charting precipitation, wind, solar radiation and bright sunshine, cloud cover, atmospheric pressure, humidity, soil temperature and evaporation, snow and ice cover, and fog and hail. The completed series, containing 400 maps, will be the first new edition of Canadian climatic maps in 17 years.

Each series will be made available for sale through the Department of Supply and Services. In 1986, a selection of maps for the full year, as well as the mid-seasonal months of January, April, July and October, will be reproduced in a book-size mini-atlas.
For further information about Climatic Atlas Climatique - Canada, contact:
D. W. Phillips
Canadian Climate Centre
Downsview, Ontario
M3H 5T4
(416) 667-4612