RECHERCHE ATMOSPHÉRIQUE

Air Quality and Inter-Environmental Research Branch

Annual Report

1990-91

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AIR QUALITY AND INTER-ENVIRONMENTAL RESEARCH BRANCH

ANNUAL REPORT

1990/91

Compiled by

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Air Quality and Inter-Environmental Research Branch
Atmospheric Environment Service
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AIR QUALITY & INTER-ENVIRONMENTAL RESEARCH BRANCH

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FOREWORD

Each year the Branch recognizes AES employees that have contributed significantly to the achievement of the goals of this Branch. This "All Seasons Research Award" was initiated in 1988. The first winners were Don Faulkner, Joe Kovalick, Bill Sukloff and Doug Whelpdale. The winners for the years 1989 and 1990 are listed below.

Year 1989

Billie Beattie for her significant contribution to the provision of air quality services to federal, provincial and university researchers in the Atlantic provinces.

John Bellefleur for his initiative and his expertise in conducting ozone sonde campaigns in support of the AES Stratoprobe balloon flights since 1974.

Bob Mickle for his skillful management of AES's Toxic Chemicals Program that has led to AES becoming the lead agency for Annex 15 of the Great Lakes Water Quality Agreement.

Alain Sirois for his significant contribution to the analysis and characterization of air and precipitation chemistry data at monitoring sites throughout Canada.

Year 1990

Dave Davies for his diligence and dedication in locating a major error in the 1985 emissions files that could have impacted on the credibility of our ADOM model and, consequently, the Canada/US model evaluation study.

Kathleen Ford for her adoption of new computer technology to manage efficiently the Branch's financial resource data system, BIBS, and for her commitment to her job during stressful times that are associated with external funding of our programs.

Frank Froude for his work in creating a first class research centre (Centre for Atmospheric Research Experiments) at Egbert that offers scientists a platform from which to conduct research.

Peter Summers for his devotion to first class research into many aspects of environmental pollution in Canada for which he has received international attention and respect.

Jadwiga Zarzycki for her exceptional secretarial support, including translation services to the whole Branch, and her conscientiousness and dedication to the objectives of the organization.

AIR QUALITY & INTER-ENVIRONMENTAL RESEARCH BRANCH

ANNUAL REPORT

1990/91

1.1 LONG RANGE TRANSPORT OF AIR POLLUTANTS (LRTAP)

1.1.1 LRTAP Assessment

- M.L. Phillips

The Atmospheric Sciences section of the Long Range Transport of Air Pollutants (LRTAP) assessment document was completed with input from Branch scientists, as well as from staff of provincial environment ministries.

1.1.2 Lagrangian Model

- M.P. Olson and K.K. Oikawa

The NAPAP 1985 baseline emissions inventories, prepared by Alliance Technologies in the U.S. and delivered to ORTECH, were used to produce sulphur dioxide (SO_2) and nitrogen oxides (NO_x) emissions inventories in a format suitable for the AES sulphur/nitrogen Lagrangian model.

The RADM Analysis Package (RAP), designed to perform interactive analysis of gridded ADOM data, was installed and tested on the MacIntosh (Mac) personal computer. The ADOM output data were converted into Mac binary format for the EMEFS period July 28 to August 8, 1988.

The sulphur Lagrangian model was run on the remaining six PERD episodes and the concentration/deposition data are available for analysis.

Nitrogen source-receptor matrices from the Lagrangian model were analysed. The same model was subsequently modified to incorporate the ADOM chemistry package and used to simulate non-linear photo-oxidant chemistry. A comparison was made, primarily for ozone, between the Eulerian/ADOM model and the modified Lagrangian/ADOM model for 10 days of the EMEFS period.

Computer programs were developed to read the hourly surface meteorological fields and the hourly vertical profiles of meteorological variables and to change the ADOM concentration unit from g/m^3 to ppb.

1.1.3 Acid Deposition and Oxidant Model (ADOM)

- D. Davies

Much of the effort associated with the inter-agency activities was focused on resolution of the current complications over the delivery of the 1985/88 emissions files. The data in the NAPAP inventory required extensive quality assurance and there are still many problems to be finally resolved. There will be another emissions contract for the delivery of emissions files for the second intensive period of EMEFS.

While there have been no official migrations of the ADOM code in the past six months, one is imminent. The changes will be the inclusion of ENSR's modifications to allow aqueous phase chemistry in non-precipitating stratiform cloud, the modification to read two point source emissions files and the modification to generate aqueous phase output.

1.1.4 Dry Deposition Modelling
- J. Padro

Progress has been made in four projects, all having the objective to compute deposition velocity (V_d) for evaluating the ADOM dry deposition module.

Project I consists of completing a journal paper that describes a comparison of V_d module estimates with local V_d observations taken over the Camp Borden forest. The paper uses data from the dry deposition to forests project carried out during the 1988 Summer Intensive of EMEFS.

Project II is similar to Project I but uses data from the 1990 Spring Intensive of EMEFS. The code has been prepared to accept Winter and Fall data including ground conditions of snow, dry and wet. Results of modelled V_d are available for ozone (O_3) and sulphur dioxide (SO_2).

Project III consists of evaluating the ADOM dry deposition module with data for nitrogen oxide (NO_2) and SO_2 over three different land use categories. The numerous previous graphs have been synthesized into a smaller number for further analysis. Surface temperatures are being recalculated from an improved micrometeorological formula.

Project IV consists of evaluating the ADOM dry deposition module with grid-average meteorological input data, as prepared for the summer intensive concentrations predictions. ADOM employs the grid-average input data to compute V_d for each landuse category, including the forests within the grid square in which Camp Borden is located. Some preliminary computations of V_d for O_3 have been done for Camp Borden. Numerical testing are being made of existing formulae for converting meteorological data from grid square averages to local values.

1.1.5 NOx/VOC Modelling
- D.M. Whelpdale and A. McMillan

Arrangements were made to hold an initial one-day workshop to explore integrated modelling of nitrogen oxides and volatile organic compounds (NO_x and VOCs). A requisition has been issued and an acceptable proposal received; however, funds have not been available to proceed. A presentation was given to ADMA on the status of models available to do NO_x/VOC modelling.

1.1.6 Eulerian Model Evaluation Field Study (EMEFS)
- K.J. Puckett

The 1990 Spring Intensive, second intensive measurement period of the Canada-US Eulerian Model Evaluation Field Study (EMEFS), was successfully carried out between March 15 - April 30, 1990. The period started under winter conditions, continued through spring and, at the end, almost summer conditions were experienced. As for the 1988 Summer Intensive, emissions of sulphur and nitrogen oxides from the major point sources in eastern Canada were collected on an hourly basis. Similarly, the synoptic meteorology conditions and the resulting objective analyses were archived in order to run the Acid Deposition and Oxidant Model (ADOM) for that period.

Field measurements for model verification were made at Egbert (Centre for Atmospheric Research Experiments), at Dorset (Ontario Ministry of the Environment research station), at Lake Traverse in Algonquin Park and at CFB Borden. The NAE Twin Otter based in North Bay flew a total of 150 flying hours, linking the measurements at the surface sites in both time and space.

Ozone sondes were flown every 12 hours at Egbert giving a continuous picture of ozone concentrations up to 10 km. Dry deposition measurements over the forest at CFB Borden were carried out before leaf break, and under snow-covered and snow-free ground conditions. The US intensive measurement period, whose field component consisted entirely of measurements aloft, ran from April 14 to May 15. After the field study, the US-Canada EMEFS Diagnostic Measurements Team met to discuss the initial results from the 1990 Spring Intensive.

The two-year field project, including the two intensive measurement periods, ended as of May 30, 1990. During the period 1988-1990, the major networks in North America monitored air quality and precipitation chemistry on a daily basis throughout eastern North America. These monitoring data will provide the evaluation data for both ADOM and its US equivalent, RADM.

1.1.7 Atmospheric Chemistry

- K.G. Anlauf, A.M. Macdonald, B. Misanchuk, A. Tham, M. Watt and H.A. Wiebe

During the 1990 EMEFS Spring Intensive, continuous field measurements were made (H_2O_2, O_3, NO_x, NO, NO_2, NO_y, PAN, CH_2O, HNO_3, NH_3, particulate NO_3 and SO_4 and $J(NO_2)$) at Egbert, Ontario, and similar (but fewer) measurements were also made at Lake Traverse in Algonquin Park. Grab samples of ambient air were taken throughout the period for analysis of ambient hydrocarbons.

As part of the 1990 EMEFS Spring Intensive, cloud water samples from 26 flights were analysed for hydrogen peroxide (H_2O_2). Analysis of aqueous-phase measurements in relation to gaseous measurements of H_2O_2 from both the 1988 Summer and 1990 Spring Intensives is underway. Surface and aircraft data during the 1988 EMEFS Summer Intensive have been compared and the chemical profiles associated with different airmasses have been examined. Vertical profile data was then used in a preliminary evaluation of the Acid Deposition and Oxidant Model. Model evaluation using the 1988 EMEFS aircraft data set is continuing.

A CIRAC-sponsored "National Oxidant Research Workshop" was held June 25-27, 1990. Workshop proceedings have been provided by CIRAC to all participants (extra copies are available). A final report of recommendations of research on oxidants has been submitted to AES management.

An intercomparison study on measurement of nitrogen oxides and PAN (peroxyacetylnitrate) was carried out during the month of October 1990. The comparison site was Egbert, Ontario. The results are presently being analysed.

1.1.8 EMEFS Quality Assurance

- R.J. Vet

The EMEFS Operational Measurement Team (OMT), chaired by R.J. Vet, focused on the preparation of a table of contents for the 'OMT Quality Assurance Synthesis Report' that documents the quality of the OMT's five-network data set.

1.1.9 VOC Network

- J.W. Bottenheim and M. Shepherd

The in-house capability for volatile organic compound (VOC) analysis of "routine" samples started development in September. Prototype "network" sampling started at 3 sites (Egbert, Montmorency and Kejimkujik) with samples being obtained every 3rd day with the purpose of obtaining preliminary insight into data variability and of obtaining empirical data on how to run a VOC network in conjunction with CAPMoN. Full operation of a network should commence late 1991.

1.1.10 Vertical Profiles of Ozone

- R.E. Mickle, J. Arnold, J. Markes, F. Froude, J.B. Martin and R.M. Hoff

During the 1990 EMEFS Spring Intensive, upper air sondes were launched from Egbert to measure ozone profiles to 10 km, the top level of the Acid Deposition and Oxidants Model (ADOM). Flights were made twice daily at 06Z and 18Z to intercompare ozone mixing ratios during periods of minimum and maximum mixing. Initial analyses indicated that the average ozone profile during this period of predominantly northerly winds shows the greatest variability in the lowest 1.5 km, above which the mixing ratio is constant at 50 - 60 ppbV to the base of elevated ozone levels associated with the tropopause. During the 45 days period, the tropopause height varied substantially with ozone-enriched air being found at levels as low as 5 km. During northerly flow conditions, the average ozone profile to 10 km was similar in shape and magnitude to profiles measured in the high Arctic at Alert. Comparisons with data from the 1988 EMEFS Summer Intensive showed substantial differences for profiles taken during the first hyperintensive period (July 29 - August 6: southerly flow) and marked similarities for the third hyperintensive period (August 26 - 31: northerly flow).

Output from the ADOM model for the 1988 Summer hyperintensive periods 1 and 3 have been intercompared with the upper air ozone flights from Egbert. From the first hyperintensive period (polluted air mass), mean profiles from the ADOM output tended to underestimate the measured data. This was particularly apparent at elevated levels (>4 km) where ADOM produces a constant mixing ratio to 10 km while measurements show a continuous increase to the base of the tropopause. From time/height isopleth diagrams, the onset of an elevated ozone episode was indicated in the ADOM output although the timing of the maximum ozone and maximum ozone levels were incorrectly modelled. During the third hyperintensive period (northerly flow), again the model underestimated the average profile and missed the upper level increase in mixing ratio. A short event, with increased ozone associated with trajectories from the south, was modelled by ADOM with close agreement in timing. Analyses on the data from the 1990 Spring Intensive were completed and results presented at the US-Canada EMEFS Diagnostic Measurements Team Meeting in Toronto in August.

1.1.11 Dry Deposition to Forests

- G. den Hartog, H.H. Neumann, N. Koshyk, L.F. Guise-Bagley and J. Deary

The field study was initiated in March 1990. The main objective was to measure the deposition rates of ozone and sulphur dioxide to the deciduous forest at CFB Borden in the early spring when the canopy was bare of leaves and to critically compare the measured values with those predicted by the Dry Deposition Module of the ADOM model. A secondary objective was to continuously measure the concentrations of ozone, sulphur dioxide, small particles and nitrogen dioxide in order to characterize the behaviour of these species in and over the leafless forest during the 1990 EMEFS Spring Intensive.

Approximately 500 half-hour runs of flux data were collected in a variety of weather and canopy conditions. In-field evaluations indicated that in general good quality measurements were obtained for ozone flux below and above the canopy, and for sulphur dioxide flux above the canopy. On selected days flux measurements were also made for nitrogen dioxide and for small particles. Continuous measurements of meteorological variables, ozone, sulphur dioxide and small particles were taken during the 1990 EMEFS Spring Intensive. In addition, a CAPMoN air filter system was operated with filter changes at six hour intervals. An Andersen impactor was also utilized to provide weekly size-differentiated samples of air-borne particulates above the canopy.

Post experiment data analysis and quality control was initiated in September. Calibrations to be used in data reduction were verified against logbook entries and cross-checked between different instruments measuring the same environmental variable. The calibrations were then utilized to produce corrected data tabulations from the raw data files collected in the field. Since the flux data was collected at a height of 34 m, it was necessary to account for changes in concentration in the air column from the surface to the measurement during each run in order to produce a dry deposition estimate.

1.1.12 EMEFS-II Diagnostics

- J.W. Bottenheim, A.J. Gallant and M. Shepherd

Monitoring continued at Egbert and Lake Traverse until the end of EMEFS. Data from the monitoring of volatile organic compounds (VOCs) twice daily, carbon monoxide (CO) continuously, peroxyacetylnitrate (PAN) with 1/2 hour grab samples and aldelyde for 6-hour averages have been analysed but awaiting finalization when the data have been verified with the calibrations.

1.1.13 CAPMoN Operations

- C.S. McNair, W. Kobelka, A. Gaudenzi and S. Iqbal

Field measurements for the Eulerian Model Evaluation Field Study (EMEFS) concluded in May 1990. However, it was decided to continue the ozone monitoring in support of the NO_x-VOC Management Plan. The duplicate Canadian Air and Precipitation Monitoring Network (CAPMoN) air sampling systems were removed from Penn State, U.S.A. One of these was installed at the CAPMoN site on Saturna Island, B.C., for long term measurements. The other was used for a one year study of filter pack performance in dusty conditions at Esther, Alberta.

Several operational changes were implemented. CAPMoN adopted 8 a.m. Local Standard Time as its official time of observation; a pump-off zero procedure was added for better zero readings of the air monitoring system; and partitioning of large samples within the sample bag was begun in order to reduce the loss of large samples due to bag leaks. Performance of the air monitoring system was tracked using an objective routine and results indicate that system improvements have improved system reliability.

This year's CAPMoN Inspectors Workshop was attended by staff from 8 provinces in addition to all AES inspection offices. The workshop is beginning to take on an expanded role as a forum for exchange of technical information on deposition measurements. Several provinces have decided to follow the CAPMoN lead for wet and dry deposition measurement methods.

1.1.14 CAPMoN Analytical Chemistry Laboratory

- C.S. McNair, D. MacTavish, T. Knott, S. Ahmed, R. Braga and M. Rauh

The CAPMoN Analytical Chemistry Laboratory has completed the chemical analysis required for the 1990 EMEFS data set.

As part of the intensive EMEFS program, the laboratory completed the last of twenty E-series laboratory inter-comparisons, two Hunter-ESE filter inter-comparisons and an extensive methods detection limit study. Inter-comparison L24 of the LRTAP Laboratory Series was also completed.

Methodology development continued on an integrated filter method using TEA to measure nitrogen dioxide (NO_2) as part of the NO_x-VOC program. A five-week CAPMoN NO_2 Methods Intercomparison Study was conducted at Egbert in October.

1.1.15 CAPMoN Quality Assurance and Data Management
- R.J. Vet

The CAPMoN quality assurance program continued. Activities included the participation in precipitation laboratory intercomparison studies, the assessment of laboratory precision and detection limits, the quality control of new sample bags, and the operation of a blind audit for the pH Reporting Program (the program in which daily pH measurements are reported to the media).

Quality control of CAPMoN precipitation chemistry, ozone and filter pack data was completed (both internally and under contract) for the period between June 1988 to May 1990 (the Eulerian Model Evaluation Field Study period). The ozone and precipitation data were submitted to the EMEFS central data base.

1.1.16 National Atmospheric Chemistry Data Base (NAtChem)
- R.J. Vet

NAtChem activity focused on the production of 5-year mean deposition maps for the UN ECE Critical Loads/Critical Levels Mapping Program. Researchers at the National Water Research Institute used these maps to evaluate critical levels of wet deposition in eastern Canada. Gridded maps of atmospheric deposition for eastern Canada were submitted to the ECE Task Force on Mapping through the letting of a contract for the "Production of Acid Precipitation Maps Using the Geographical Information System, 'SPANS'".

A prototype NAtChem Data Base was implemented using data from CAPMoN and Ontario provincial networks. A summary program, which combines the Chemistry, the Network and the Site Information Data Bases, and produces monthly, seasonal and annual statistical summaries, has been developed according to the Canada-US Unified Deposition Data Base Committee guidelines. A contract was awarded for the preparation of NAtChem Data Base System Documentation and an Operators' Manual. Documentation will be done on the Site Information System, the Network Information System and the Chemistry Information System.

NAtChem staff attended the US National Atmospheric Deposition Program (NADP) Technical Committee Meeting and Symposium, and the NADP Data Management Subcommittee Meeting. Information exchange centred on the future directions of the U.S. for atmospheric deposition monitoring activities and on technical problems related to the NAtChem Data Base System.

1.1.17 Measurements at Kejimkujik/Alert
- J.W. Bottenheim and A.J. Gallant

At Kejimkujik, the measurement of nitrogen dioxide (NO_2) was terminated on September 30, 1990. Calibrations of the equipment measuring peroxyacetylnitrate (PAN) and NO_2 were undertaken in May and September 1990.

At Alert, the equipment measuring peroxyacetylnitrate (PAN) and ozone (O_3) is operating correctly. Calibrations were undertaken in May and October 1990.

1.1.18 CAPMoN Data Analysis
- A. Sirois

A paper on the air chemistry data at CAPMoN sites entitled "Regionally representative daily air concentrations of acid-related substances in Canada: 1983-1987" has been completed. An analysis of the precision of the CAPMoN precipitation network has been initiated and the results will be published.

1.1.19 LRTAP Data Analysis
- P.W. Summers

The objective is to determine by means of empirical analysis (as distinct from, but complementary to, numerical modelling) a better understanding of transport processes and loss terms for sulphur and nitrogen species and long-term trends in deposition. Three data analysis projects were completed -- a sulphur budget, sulphate (SO_4) and nitrate (NO_3) deposition trends, and SO_4 and NO_3 dry deposition estimates. Two papers were presented at a Canadian Oxidants Workshop on the source of airborne NO_3 in eastern Canada and on the spatial variability of ozone (O_3), nitrogen dioxide (NO_2) and p-NO_3 in southern Ontario. Work continued on the application of airmass trajectory analysis to pollen episodes with C. Rogers (Department of Life Sciences, University of Toronto).

1.1.20 North Atlantic Regional Study
- D.M. Whelpdale

The objective is to understand the fate of continental emissions transported over the Atlantic Ocean and their impact on the marine environment. The data sets from the shipboard sampling during CGE/CASE/WATOX were finalized and used in the preparation of three journal articles and a NOAA Technical Report.

1.1.21 Health Effects
- P.W. Summers

The objective of these studies is to support Health and Welfare Canada (HWC) by providing advice and assistance in the design, operation and interpretation of studies relating human health response to air pollution exposure. Detailed terms of reference were prepared for a contract with M. Daoust, climatologist, for statistical analysis of HWC air quality data.

Acid aerosol monitoring for the joint HWC/Harvard School of Public Health (HSPH) 24 city study continues at Egbert, although a recent site audit by HSPH revealed some improvements needed - these are being implemented.

Work continues on developing a simple technique to indirectly estimate hydrogen ion (H+) concentrations from CAPMoN filter-pack measurements. A special study was conducted from June to September using a modified filter-pack system run at Egbert in parallel with the HSPH and CAPMoN systems.

A "aerosol aging study" was conducted using 2 Hi-Vol samplers with Anderson size-selective heads at Egbert and at Ann Arbor, Michigan. The goal was to collect samples for animal toxicology studies separated by 1 day to look for possible effects of aging. Trajectory analyses were completed and selection of days for inter-tachial injection of filter extract into test animals will soon be made.

1.2 TOXIC CHEMICALS

1.2.1 Organics Analysis (Air Toxics) Laboratory
- K. Brice, G. Franks, K. Su and N.P. Alexandrou

The laboratory provides an in-house service for the trace analysis of air samples collected as part of AES activities under Annex 15 of the Great Lakes Water Quality Agreement (GLWQA), with emphasis on a set of target species identified for "semi-routine" determination: polychlorinated biphenyls (PCBs) congeners, organochlorine pesticides (OCs) and polycyclic aromatic hydrocarbons (PAHs).

This year's purchase of instrumentation and equipment provide improved speed and automation, particularly in sample preparation, increased sample handling and analytical capacity, and an instrumental capability to investigate improved and new techniques and procedures for existing target analytes and those that may arise on subsequent Annex 15 target lists. Some equipment has been installed, tested and fully incorporated into the analytical procedures.

The analytical methodology for the analysis of PUF/GFF for PCBs and OCs has continued to work well, although sample throughput has been limited. The slow operation and poor performance of the GC Chemstation has been a major obstacle to increased analytical run capacity, but the installation of an enhanced controller in January 1991 appears to have removed many of these restrictions. The successful testing and introduction of the Turbovap Evaporation Workstations (nitrogen blowdown) has allowed the semi-automation of an important step in the sample preparation procedure.

Progress with the analysis of samples for PAHs has been hampered by a continuing series of breakdowns of the HPLC system. The overall methodology for sample preparation and analysis has undergone a number of revisions as a result of various anomalies observed in the application of the protocol to the atmospheric particulate matter (Andersen Impactor) samples from the "Organics Scavenging" project. A detailed re-investigation of possible analyte losses during the sample preparation procedure indicated that operator technique is probably the most important factor.

The selection and acquisition of an automated system for performing solid-phase extraction (SPE) cleanup was accomplished by demonstration tests and evaluations being performed on several systems and the corresponding SPE cartridges. This resulted in the delivery and installation of the Waters Millilab unit in February, followed by initial operator training. The unit is currently being subjected to a detailed evaluation to confirm the absence of problems before incorporation into the existing methodology, which employs manual SPE.

1.2.2 Toxics Dry Deposition

- G. den Hartog, H.H. Neumann, L.F. Guise-Bagley and J. Deary

Development of the tuneable diode laser for use in eddy flux measurements was continued. Although the current instrument utilizes a laser meant for measurement of methane, the instrument can be adopted for other gases by using different combinations of laser current and temperature, or by changing lasers. This instrument was field tested at Egbert in May and deployed for use in the Northern Wetlands Methane Flux Study in June. For application to the Toxics Program, further study is required to select an atmospheric gas that should be measured. A possibility being considered is to study the process of atmosphere-water exchange over the Great Lakes using a dissolved gas such as carbon dioxide as a surrogate for dissolved toxic chemicals.

Evaluation of particle flux data collected during the 1990 Spring Intensive of EMEFS was initiated in June. Particle fluxes are more difficult to measure by eddy correlation then gases and so stringent criteria for selecting data appropriate for analysis was developed. The initial analysis suggests that, for conditions meeting the selection criteria, the PMS ASASP probe, which optically counts and sizes particles, can be used for eddy correlation measurements of particle fluxes over forests. Our analysis of particle concentration power spectra and covariance spectra (with vertical velocity) indicates that submicron particles behave the same as gases in the atmosphere in terms of their turbulent motions.

1.2.3 GAP Sampler Measurements at Point Petre
- D. Lane

The original goal was to obtain the gas/particle phase (GAP) distribution of alpha- and gamma-Hexachlorocyclohexane (HCH), Hexachlorobenzene (HCB) and selected Polychlorinated biphenyl (PCB) congeners at Point Petre over a 12-month period. As funding was not available to perform the analyses over the full year, a reduced program was devised. Since sampling at Point Petre over the past two years took place during the months of November to March, analyses were performed only during the warmer, summer months (August to October). In addition to obtaining the gas/particle partition of the targets, the mass loading of each was obtained. Three one-week field sampling programs were completed: August 13 - 17; August 27 - 31; and September 17 - 21. ORTECH International undertook the preparative and analytical services (preparation of filters, adsorbers and denuders for the field work and, following the sample collection, the extraction, workup, analysis and regeneration of the denuders and adsorbers for subsequent field sampling). Analyses for alpha- and gamma-HCH, HCB and for approximately 80 PCB congeners have been completed but are still under review by ORTECH.

Design modifications to facilitate the changing of the filters were made to the "conventional" sampler portion of the GAP sampler by ORTECH. In addition, a duplicate set of filter holders was produced so that filters can be mounted in the holders and taken to the site for installation.

1.2.4 PAH Transformations
- D. Lane

This project is a portion of a larger proposal to NSERC with York University as the lead university. The object of the proposal is to develop a versatile photochemical reaction system capable of elucidating the atmospheric transformations of the polycyclic aromatic compounds (and other species as well).

A workshop steering committee has been established, comprising of Paul Shepson (York University), Ed Lee-Ruff (York University), Doug Lane (AES), Diane Somers (Department of Health and Welfare), Neville Reid (Ontario Ministry of the Environment), Harry McAdie (CIRAC), Bob Jervis (University of Toronto), and Phil Fellin (Concord Scientific). The committee organized a Workshop in November 1990 entitled "Atmospheric Processes of Organic Toxic Pollutants and Their Role in Current Environmental Issues". Invited speakers included T. Bidleman (University of South Carolina), R. Atkinson (University of California at Riverside), E.L. Wehry (University of Tennessee), C. Franklin (Health and Welfare Canada) and C.D. Metcalfe (Trent University). A formal report on the workshop is scheduled for spring 1991.

1.2.5 Atmospheric Mercury
- W.H. Schroeder and J. Markes

Daily measurements for total vapour-phase mercury (involving collection of 24-hour integrated samples) were performed at Egbert during the 1990 EMEFS Spring Intensive. Weekly integrated filter samples were also collected for subsequent determination of particulate-phase mercury present in ambient air at this rural site. Chemical analyses of samples for total vapour-phase mercury have been completed and arrangements have been made for chemical analyses of the particulate-phase mercury samples. Intermittent sampling (four days per month) for atmospheric mercury was initiated at the Pt. Petre master research station during the month of September. Based on our experience to date, improvements to the sampling and analytical procedures are indicated and will be investigated.

1.2.6 Air-Water Exchange
- W.H. Schroeder

Annex 15 in the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement of 1978 calls for research to investigate air-water exchange processes involving volatile inorganic and organic substances. This multi-year project (started in 1990) incorporates two unsolicited proposals received by AES in its capacity as the lead agency for atmospheric research to be undertaken in support of Annex 15. The main objective is the development, evaluation and deployment in the field of viable methods for in-situ investigations of air-water exchange phenomena, particularly volatilization of chemicals from lakes and rivers.

Project activities revolve around two complementary technologies/methodologies: a) sparger experiments (DMER Ltd./Eisenreich); b) flux chamber experiments (Concord Scientific/DMER Ltd.). In consultation with the principal investigators, the nature, scope and timing of the various phases of the project were established. The chemicals to be investigated have been identified and laboratory/design work has started on the first phase of this project.

1.2.7 Air-Water Flux Measurements
- B. Kerman

There are plans for a major gas exchange study on Lake Ontario, beginning with a run-up study this autumn. This study is expected to utilize a Coast Guard helicopter to take bottle samples to thermocline depth, approximately weekly, and to analyse them for argon, oxygen and nitrogen, with a gas chromatograph using a helium-ionization detector. At the same time, the wind-mixing state of the lake will be closely monitored and modelled. These activities may become part of a joint Canada-US research initiative in response to Annex 15 of the IJC agreement.

Another major study proposal has been initiated - that of a Smart, High Resolution (optical line) Scanner (SHIRES) which will provide about a 400 m wide swath of 10 cm resolution optical imagery of whitecaps from a 50-100 m/sec aircraft from a height of about 350 m. The equipment involved will allow for in-flight, statistically adaptive calibration and processing of the 4 Mb/sec data rates, storage on multi gigabyte tapes, and real time fractal extraction and sea state identification.

AES trailers have been renovated and now form a portion of the Air Quality Processes Research Division at the CCIW complex in Burlington, Ontario.

1.2.8 Aerial Application of Pesticides
- R.E. Mickle and J. Arnold

Analysis has continued on the two field experiments conducted during 1989 - the effects of operational parameters on the aerial application of ULV insecticide and the optimization of herbicide deposits for varying emission spectra. In the first experiment, colour enhanced spray cloud cross-sections have been produced for all flights mapped by the ARAL (AES Rapid Acquisition LIDAR) during the experiment. This encompasses both cross and highly oblique wind situations for fixed and rotary wing aircraft flying in various meteorological conditions. An animated display which can be run on a PC with EGA shows the effects of wind direction on deposit and drift. Direct comparison of LIDAR mapped dosage profiles with in situ measurements made by NRC will be used to assess the potential for quantifying the LIDAR data. Analyses of the 1989 Red Rock field trial are ongoing. A comparison of sampler techniques has indicated a potential bias in collection efficiency due to wind speed and droplet size.

A joint experiment (AES, NRC, FPMI) was conducted at Thessalon, Ontario, in September to directly intercompare collection efficiencies of different flat plate collectors for source emissions for varying droplet sizes and wind speeds. Flat plate collectors, rotorods, screen cages and anemometry were placed at 2 heights for 10 cross-wind locations along two lines which were 100 and 200 m downwind of the sprayline. Artificial foliage simulators and string harps completed the array of samplers. During each spray, ground deposit to 400 m and drift cloud measurements at 200 m and 400 m were made to determine deposit and drift profiles. The FPMI Agtruck was instrumented with a dual tank assembly to produce 100 and 200 micron (Vmd) spectra from separate wings of the aircraft. Each spectrum was spiked with a different tracer in order to intercompare differences. It is expected that the results of this experiment will enable the researchers to make recommendations on appropriate samplers for the measurement of in-target and off-target deposit where droplet sizes may be substantially different.

1.2.9 Regional Toxics Modelling
- E.C. Voldner

The scientific objective of this work is to estimate concentration and deposition of toxic chemicals to various receptors in North America with emphasis on the Great Lakes Basin. Avenues for cooperative research have been discussed with Dr. J. Shannon of the Argonne National Laboratory.

1.2.10 Pathways of Mercury
- E.C. Voldner

The objective is to investigate the atmospheric pathway and air/soil exchange of mercury. A speciated mercury emissions inventory is near completion and is scheduled for incorporation into the mercury version of ADOM/TADAP (MAD). An algorithm for estimation of "natural" emissions has been incorporated into MAD.

A cooperative project with University of Toronto to investigate causes and extent of mercury contamination of fish in Ontario has been initiated. Model runs with both MAD (extension of ENV3) and LRTOX are envisaged. Use of the latter model is required for simulating annual deposition. Mercury chemistry and removal processes have been simplified for incorporation into LRTOX.

1.2.11 Air-Soil Exchange
- E.C. Voldner

The objective is to investigate the importance of air/soil exchange (secondary emissions/cycling) of persistent toxic chemicals. Heat advection and temperature dependence of physical/chemical properties have been incorporated into the model. Episodic simulations show the importance of these improvements for relatively heavy precipitation events and relatively strong temperature gradients. Sensitivity tests on a seasonal basis are in progress. In addition, proposals for generating gridded emissions factors for pesticide in North America and emissions from landfills by use of the model have been submitted for discussion.

1.2.12 Verification of Source Data
- E.C. Voldner

The scientific objective is to compile a computerized data base of historical, present and predicted usage of organochlorine pesticides on a global basis and grid information for input to regional toxics models. The suitability of the Battelle International data base is being investigated.

1.3 CLIMATE CHANGE

1.3.1 Northern Wetlands Methane Flux Study

- G. den Hartog, H.H. Neumann, L.F. Guise-Bagley and J. Deary

The objective was to make micrometeorological measurements of methane evolution from a bog site in the wetlands west of Moosonee at Lake Kinosheo. This study formed part of a larger study aimed at investigating the release of methane from the northern wetlands and evaluating the role of the wetlands in global warming. Our study was intended to provide a link between methane emission estimates derived from numerous small chambers and from aircraft measurements, as well as to provide detailed information on diurnal variations in methane fluxes.

A 17 m tower was erected at Lake Kinosheo and instrumented with two levels of sonic anemometers and Lyman alpha hygrometers. At the top level, instrumentation for measurement of ozone and carbon dioxide fluxes was installed. A tuneable diode laser was used to measure methane fluctuations for flux determinations. Measurements of wind, solar radiation, ozone concentration and small particle concentration, and of ambient air through periodic flasks samples were taken from June 28 to the end of July. Over one thousand half hour runs of flux data were collected, including about 700 half hour runs of methane fluxes. Data analysis and quality control was initiated in October. Instruments were cross calibrated were possible, for example, the ethylene reaction ozone analyser versus the ultra-violet ozone analyser. Data validity was checked based on log book entries and non-valid data was removed from the data base. By December, an initial set of data tables for the experiment had been produced.

1.3.2 Global Biogeochemical Cycles and Climate Research

- K. Higuchi

The major activity has been the final phase of the construction of a 2-D (latitude and height) climate model and its validation. The model is based on a paper published by Peng et al. in 1987. The radiation model was obtained from Dr. Jean-Pierre Blanchet (CCRN). The model has been shown to be very sensitive to the cloud amount and type. Another alteration of the Peng et al. model is the replacement of their ocean model with a more sophisticated 2-D advective-diffusive ocean model developed by Dr. Charles Lin.

In the coming year, the 2-D climate model will be coupled to a 2-D global carbon cycle model. The oceanic carbon cycle model is in the final phase of the construction, while the development of a global land biota model compatible with the climate model has been contracted out to Dr. Y.H. Chan of the Western Ecological Services Limited.

Two other projects, one of which has been completed, were initiated in 1990. One project involved an investigation of interannual variability of the tropospheric meridional eddy sensible heat transport in the northern latitudes. A clear signal of an inter-decadal oscillation was identified in this atmospheric property over the northern Pacific region. This project has been completed and the results submitted for a publication.

The other project focused on the identification of causal mechanism(s) for an atmospheric carbon dioxide bimodal distribution sometimes observed during winter seasons at the northern monitoring stations of Alert, Mould Bay and Pt. Barrow. We wanted to test the speculation that this feature is caused mainly by interannual variability in the winter atmospheric circulation pattern over the Arctic. The results of the preliminary study were inconclusive.

1.3.3 Black Carbon
- J.F. Hopper

Improvements to the Black Carbon instruments at the Fraserdale observatory were carried out and have reduced the system noise by a factor of 3-5. Further improvements in sensitivity are expected.

A complete data set of all available Black Carbon concentrations at Fraserdale for 1990 has been prepared and checked for reliability of the data. This data set is being used a study of carbonaceous species at Fraserdale. A similar data set of all available Condensation Nuclei concentrations at Fraserdale for 1990 has been checked for reliability of the data and will be included in the overall 1990 Fraserdale data set.

1.3.4 Greenhouse Gas Monitoring
- N.B.A. Trivett

Greenhouse gas monitoring programs at Alert, Sable Island, Cape St. James and Fraserdale are continuing. An intercomparison of Canadian and Russian CO_2 monitoring methods was carried out in the Kyzylkum Dessert in the USSR. Data management for all stations was upgraded and emphasis put on analysis of Fraserdale data in preparation for the Wetlands Workshop in February.

1.4 STRATOSPHERIC STUDIES

1.4.1 Ozone Monitoring
- J.B. Kerr, C.T. McElroy, W.J. Clark, R.A. Olafson and J.J. Bellefleur

The first Consultation Meeting on the Brewer Ozone Spectrophotometer Operation, Calibration and Data Reporting was held in Arosa, Switzerland, August 2-4, 1990. The meeting, organized by WMO and chaired by Dr. J.B. Kerr, was held in conjunction with the WMO Intercomparison of Dobson Spectrophotometers in order to encourage communication and promote the exchange of ideas between users of Brewer and Dobson instruments. Thirty-two scientists from eighteen countries attended the meeting. Topics of discussion included instrument standards, calibration procedures, data reporting, Umkehr measurements and special observations (e.g. NO_2, UV-B). A report of the meeting is to be published in the WMO Ozone Report series.

In July 1990, AES donated to WMO a Brewer spectrophotometer to be used as a travelling standard for calibrating field Dobson and Brewer instruments in the world ozone network. Calibration of the instrument is to be maintained by WMO and AES through regular comparisons with the Brewer standard in Toronto. The WMO reference instrument was present at the Dobson intercomparison in Arosa. It has been used for the calibration of field instruments in Kislovodsk, USSR, in August 1990, as part of the Canada/USSR cooperation program, and in Singapore, Malaysia, in September 1990.

Ground-based monitoring of total ozone on a daily basis using the Brewer spectrophotometer continued at 7 sites in Canada. A Brewer instrument was installed at the CAPMoN site on Saturna Island, B.C. Weekly ozonesonde measurements of the ozone profile continued at 5 sites.

The NASA Network for the Detection of Stratospheric Change (NDSC) steering committee has tentatively decided to locate the northern high latitude station at Resolute and Thule, Greenland.

1.4.2 Stratospheric Research

- H. Fast, D.I. Wardle, R.H. Hoogerbrug, J.J. Bellefleur, C. Midwinter, W.J. Clark and A. Ullberg

A stratospheric balloon campaign was conducted at Vanscoy, Saskatchewan, in August. Eight mini-radiometers were constructed and calibrated on contract by Scientific Instrumentation Ltd. (SIL) of Saskatoon for stratospheric balloon flights. Four payloads were launched by SIL, the balloon operations contractor, carrying a total of seven mini-radiometers, two Unisearch NO_2 sondes, two University of Wyoming backscatter sondes and four ozone sondes. Four ozone sondes were also launched separately. These flights obtained altitude profiles of atmospheric emission in the 5 to 14 micrometer wavelength region, tested the operation of the NO_2 and backscatter sondes, and helped SIL to achieve expertise in preparing and launching mini-radiometers and ozone sondes.

The 6th Canadian Ozone Experiment (CANOZE 6) campaign at Alert started in December 1990. By the end of January 1991, 5 hand-launched balloon payloads had carried radiometers and ozone sondes into the polar vortex to measure ozone and nitric acid altitude profiles. A number of backscatter sondes, in cooperation with the University of Wyoming, were also launched in order to detect polar stratospheric clouds. Total ozone measurements were made with Brewer spectrophotometers on the ground at Alert and Resolute in addition to the regular ozone sonde flights.

A project to measure atmospheric trace gases with BOMEM interferometers at the Centre for Atmospheric Research Experiments (CARE) was initiated. The roof-hatch cover was modified to support a solar tracker for directing sunlight to the interferometers.

1.4.3 Space Shuttle Experiments

- C.T. McElroy, D.I. Wardle, L.J.B. McArthur, R.A. Olafson, C. Midwinter, A. Ullberg, D.V. Barton and W.J. Clark

Work on the Sunphotometer Earth Atmosphere Measurement experiment (SPEAM-2) has met required deadlines for a space shuttle flight with Steve MacLean scheduled for September 1992. Prototype hardware was tested and a contract has been awarded for the construction of mechanical components for the instrument control computer. Measurements of nitrogen dioxide, nitrogen trioxide, ozone and aerosols are planned using a sunphotospectrometer (SPS). An airglow imaging radiometer (AIR) is also being developed for altitude profile measurements of ozone on the same shuttle flight.

In preparation for the Brewer Earth Atmosphere Measurement (BEAM) experiment, work continued on the modified Brewer ozone spectrophotometer so as to measure ozone from the Shuttle platform. Bristol Aerospace proceeded with the manufacture of the payload while the Division continued with preparation of the flight instrument. The BEAM safety data package, phase 0, has been received by NASA. Bristol Aerospace is working on the next phase of the safety process.

1.4.4 National Atmospheric Radiation Centre

- L.J.B. McArthur, T. Grajnar and G.M. Shah

The National Atmospheric Radiation Centre (NARC) continued operating its radiation facilities at Egbert and at the RAGS station at Vanscoy, Saskatchewan. During August an internal check of the contractor charged with the day-to-day operations of the RAGS station found a number of serious problems that have since been rectified.

NARC was involved in two inter-comparisons. The first was the International Energy Agency Task 9 pyranometer intercomparison held during August in Sweden. The second was the World Radiation Centre comparison of regional standard pyrheliometers. This latter intercomparison, held once every 5 years, systematically establishes that the world radiation standard is being consistently applied throughout the WMO. New computer software and instrumentation hardware was developed to obtain the quality of measurements that have come to be expected from NARC. Analyses of the data from these intercomparisons is being undertaken.

The experiment to determine the long-term calibration characteristics, begun in the summer of 1988, continues. Latest results indicate that long-term outdoor exposure effects are insignificant. The frequent recalibration of instruments is also leading to a more complete understanding of inter-calibration variability within the calibration sphere system.

Co-operative measurements and research into spectral optical depths is continuing with the University of Sherbrooke.

1.4.5 Canada/USSR Exchange of Scientists
- C.T. McElroy

The purpose of these exchange visits is to improve the calibration of the Soviet ozone monitoring network, and to compare radiation monitoring instrumentation. In addition, there is a cooperative project to investigate the arctic stratosphere. Under this agreement K. Lamb from Sci-Tec Instrumentation Limited, the manufacturer of the Brewer ozone spectrophotometer, helped to install a Brewer instrument, which is on loan to the USSR, at their arctic base on Heiss Island (81^{o}N). The Soviet Union now operates 3 Brewer instruments.

1.4.6 Cooperative Research
- C.T. McElroy

C.T. McElroy spent one week at the Jungfraujoch in Switzerland in July to provide consulting support for the Tuneable Diode Laser Heterodyne Spectrometer which the National Physical Laboratory (NPL) is developing. This cooperative research between AES, NPL and the University of Denver could eventually lead to improved trace gas measurement capabilities at AES.

1.5 CORE RESEARCH

1.5.1 Flow Over Complex Terrain
- J.L. Walmsley and J. Padro

A contract has been let for incorporation of thermal stability effects into the MSFD complex terrain model. Improvements to the method of calculating effects of variations in surface roughness are being incorporated at the same time. Work is progressing on the implementation of MSFD on a microcomputer.

Version 3 of the MS-Micro model for wind flow in complex terrain was written, documented and made available for distribution. A demonstration of the software was presented at seminar/workshop sessions in Czechoslovakia.

Software for an existing two-site wind correlation technique has been revived and implemented on a microcomputer. Work has begun on inclusion of humidity effects in the computer program for Wind Profiles over Water.

1.5.2 Gaussian and Heavy Gas Research
- C.S. Matthias

The objective of this project is to compare results from the instantaneous release dense gas model with data from several experiments. The comparison of modelled and measured instantaneous concentrations is favourable. A statistical analysis of the scatter examines the relative contributions of model uncertainty and inherent uncertainty. When plotted non-dimensionally, the concentration results are stratified solely by a characteristic Richardson number.

1.6 AIR QUALITY SERVICES

1.6.1 Modelling for Air Pollution Emergency Response
- S.M. Daggupaty

The AQPAC version 5.6 has been modified: (i) by including in the Source Strength model the estimated time for the complete evaporation of spilled hazardous liquid from a pool and (ii) by improving entrainment process in the Heavy gas puff model. This new version 5.6A was has been made operational at AES Headquarters. The user's guide to the Heavy gas puff model with the above-mentioned modification was completed.

A paper was written describing the AQPAC's comprehensive model on estimating the source strength (emission rate or total emission) of accidentally released chemical from transportation tankers, pipelines or storage vessels.

Phase I development of a PC version of AQPAC has been completed in conjunction with a private company. It has user friendly input features with windows, responds rapidly, and has graphical outputs with a choice of four scales. There is also an user-specified independent scale that is useful for overlaying the hazardous zone on commonly available maps and that facilitates transmission of the information.

1.6.2 Mesoscale Boundary Layer Forecast Model (BLFM)
- S.M. Daggupaty

A three dimensional mesoscale boundary layer forecast model was successfully implemented on our IBM-PC 386 machine. The model is applied over a 150 km by 150 km area surrounding the Pickering Nuclear Generating Station on Lake Ontario. The model was run for a few case studies of synoptic situations in 1988. The model has simulated the mesoscale circulations due to effects of the topography, and due to differential frictional and thermal forces.

The simulated lake breeze circulation, with particular reference to winds and temperature, are compared with the data collected from a field study of meso-meteorological network of towers around the Pickering Nuclear Generating Station. The results are quite encouraging. The computational time of only 20 minutes on a microcomputer for a 12-hour forecast is an added attraction.

1.6.3 Environmental Assessment and Review Process
- S.M. Daggupaty

The environmental audit of "Toronto's East Bayfront/Port Industrial Area - Phase II: Atmospheric Environment" for the Royal Commission on the Future of the Toronto Waterfront was completed and three reports were published.

1.6.4 Arctic Coordination
- W. Hart

In September 1990, the Branch established an Arctic Logistics and Research Liaison Office. The work undertaken to date consists of coordinating Arctic logistics activities amongst various groups of AES and outside agencies, of providing project management for Arctic construction projects, and of providing liaison between AES research programs or data outputs and those of other research or interest groups.

2.0 REGIONAL AIR QUALITY REPORT

The following section recognizes the role of the AES Regions in delivering the Air Quality Research and Services Program by highlighting some of their activities obtained from AES Regional Scientific Services Quarterly Reports.

This year the Regions hired Regional Atmospheric Processes Specialists: Wayne Belzer (Pacific Region); Yan Lau (Western Region); Norm Treloar (Central Region); Ram Shayka (Ontario Region); Jean Tremblay (Quebec Region); and Steve Beauchamp (Atlantic Region). They were invited to AES Headquarters to visit with the management and staff of the Branch in the Fall 1990.

2.1 LONG RANGE TRANSPORT OF AIR POLLUTANTS

2.1.1 Pacific Region

- AES asked by C&P to lead negotiations for NOx/VOC management plan in BC
- participated in organising conference on a Clean Air Strategy for BC
- assumed role of Secretary to the Western and Northern Canada LRTAP Technical Committee until its termination in 1991
- reviewed proposed changes to BC MOE air quality monitoring networks
- gave advice to BC MOE on potential acidic deposition to forests from fog and low cloud

2.1.2 Western Region

- provided guidance to a Clean Air Strategy for Alberta (CASA) subcommittee tasked to define what clean air is
- reported that disbanded Western and Northern Canada LRTAP Technical Committee will be replaced by new Western Canada Provincial/Territorial Committee but with no federal government involvement
- planned air monitoring at CAPMoN station at Esther

2.1.3 Central Region

- reported on air and precipitation monitoring at Cree Lake for the Western and Northern Canada LRTAP Technical Committee

2.1.4 Ontario Region

- completed analysis and narratives for high wet deposition episodes of SO_4 and NO_3 at selected CAPMoN and Ontario MOE stations
- discussed with Ontario MOE the delivery of the Ontario Air Quality Index with the AES weather forecasts

2.1.5 Quebec Region

- continued publishing weekly "pH in the Media" bulletin
- prepared report which compares the "pH in the Media" data with CAPMoN over the last 4 years

2.1.6 Atlantic Region

- reviewed draft C&P report "Saint John, New Brunswick, Inventory of Nitrogen Oxides and VOCs Emissions Study"
- invited to be member of newly formed Nova Scotia Task Force on Clean Air
- inspected 3 Nova Scotia Environment acid rain monitoring stations and prepared a report on findings and recommendations

2.2 TOXIC CHEMICALS

2.2.1 Quebec Region

- received reports on how better to identify airborne contribution of organic and inorganic components into the St. Lawrence River (contracts with the Universities of Laval and Montreal)

2.2.2 Atlantic Region

- prepared summary of CEPA-related activities in the Atlantic Region for Regional Toxic Chemicals Coordinating (RTCC) Committee
- assisted in organization of regional toxic chemicals workshop

2.3 ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS (EARP)

2.3.1 Pacific Region

- reviewed proposals (pulp mill, gas plant and Vancouver International Airport Expansion) and participated in technical hearings for Celgar Pulp Mill and Port Hardy ferrochromium plant
- reviewed Terms of Reference for air quality modelling contract for Vancouver International Airport Expansion
- prepared environmental screening report for 2 new automatic weather stations on the Queen Charlotte Islands

2.3.2 Western Region

- designated as AES focal point regarding cleanup of DEWLINE sites prior to transfer from the U.S. to DND
- reviewed draft Environmental Protection Plan for disposal of hazardous waste at the Defence Research Establishment Suffield Experiment Proving Ground
- reviewed proposals for pulp mill, mine extensions, sodium chlorate plant and Beaufort sea drilling

2.3.3 Central Region

- reviewed proposals for Mould Bay POPS, pulp mill, wetland development and various mines (zinc/copper sulphide, gold and copper/nickel)

2.3.4 Ontario Region

- prepared with C&P the DOE paper on the Pearson International Expansion for Panel presentation
- participated in DOE Advisory Group evaluating DOE intervention options for the Ontario Hydro 25-year Energy Demand/Supply Plan
- participated in preparation of reports for "Environmental Audit of Toronto's East Bayfront/Port Industrial Area - Phase II: Atmospheric Environment"

2.3.5 Quebec Region

- participated in activities concerned with SOLIGAZ and Grande-Baleine (James Bay Phase II)

2.3.6 Atlantic Region

- reviewed proposals for oil fields, Fixed Link between PEI and NB and Gulf of Maine Action Plan

2.4 STATE-OF-THE-ENVIRONMENT (SOE) REPORTING

2.4.1 Western Region

- reviewed Prairie chapter of National SOE report

2.4.2 Ontario Region

- reviewed Great Lakes chapter of National SOE Report

2.4.3 Atlantic Region

- provided input to regional SOE report
- reviewed MAED's discussion paper on integrated monitoring for SOE
- hosted regional SOE Coordinating Committee meeting

2.5 PUBLICATIONS

2.5.1 Reports

Desautels, G., 1990: "Analyse des pH des précipitations tels que mesurés pour le bulletin hebdomadaire des précipitations acides et par le Réseau canadien d'échantillonnage des précipitations et de l'air", rapport interne, Division des services scientifiques, Région du Québec

Lau, Y., 1990: "A Comparison of Daily and Monthly Precipitation Chemistry Data at Esther and High Prairie", Scientific Services Division, Western Region

2.5.2 Papers

Chen, P., and S.R. Knott: "Operational Air Quality Services: Scoping of Services and Issue", 3rd Annual CMOS Operational Meteorology Workshop, Montreal, May 2-4, 1990.

Thomson, B., and E. Taylor: "Operational Atmospheric Dispersion Forecasting", 3rd Annual CMOS Operational Meteorology Workshop, Montreal, May 2-4, 1990.

3.0 PUBLICATIONS

3.1 Journal Publications

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Daggupaty, S.M., and R.E. Sellers 1990: "Airborne Spread of Foot and Mouth Disease in Saskatchewan, Canada, 1951-52", Can. J. Veterinary Res., 54, p.465-468.

Galloway, J.N., W.C. Keene, A.A.P. Pszenny, D.M. Whelpdale, H. Sievering, J.T. Merrill and J.F. Boatman 1990: "Sulfur in the Western North Atlantic Ocean Atmosphere: Results from a Summer 1988 Ship/Aircraft Experiment", Global Biogeochemical Cycles, 4, p.349-365.

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Higuchi, K., and N. Sargent 1990: "Response of a Stochastically-perturbed 1-D Energy Balance Model to Increased Temperature", Theoretical and Applied Climatology, 41, p.117-120.

Hooper, J.F., H.B. Ross, W.T. Sturges and L.A. Barrie 1990: "Regional Source Discrimination of Atmospheric Aerosols in Europe Using the Isotopic Composition of Lead", Tellus, 43B, p.45-60.

Johnson, N.D., D.A. Lane, W.H. Schroeder and W.M. Strachan 1990: "Measurement of Selected Organchlorine Compounds in Air near Ontario Lakes: Gas-Particle Relationships", In: The Long Range Transport of Pesticides (ed.: D.A. Kurtz), Lewis Publishers, Chelsea, MI, p.105-114.

Katsoulis, B.D., and D.M. Whelpdale 1991: "Atmospheric Sulfur and Nitrogen Budgets for Southeast Europe", Atmos. Environ., 24A, p.2959-2970.

Kerman, B.R., and L. Bernier 1990: "Airborne Remote Sensing of Breaking Waves with Implications for Gas Exchange", In: Air-Water Mass Transfer, Amer. Soc. Civil Engineers, p.257-266.

Kerr, J.B., C.T. McElroy, D.I. Wardle and V. Dorokhov 1990: "Measurements of Arctic Total Ozone during the Polar Winter", Atmos.-Ocean, 28, p.383-392.

Leclerc, M.Y., K.C. Beisner, R.H. Shaw, G. den Hartog and H.H. Neumann 1990: "The Influence of Atmospheric Stability on the Budgets of the Reynolds Stress and Turbulent Kinetic Energy within and above a Deciduous Forest", J. Appl. Meteorol., 29, p.916-933.

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Olson, M.P., J.W. Bottenheim and K.K. Oikawa 1990: "Nitrogen Budget for Eastern Canada", Atmos. Environ., 24A, p.897-901.

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Shaw, R.H., K.T. Paw U, X.J. Zhang, W. Goo, G. den Hartog and H.H. Neumann 1990: "Retrieval of Turbulent Pressure Fluctuations at the Ground Surface beneath a Forest", Boundary-Layer Meteorol., 50, p.319-338.

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3.2 Other Publications

In addition to the journal publications, there were another 25 papers in official proceedings and 13 internal reports. A listing is available.

4.0 CONTRACTS

4.1 Major Contracts ($45,000 and over)

Contractor	Contract
ARM Consultants $ 50,710	Provide systems programming support for ADOM Project
Bristol Aerospace Ltd. $176,640	Produce Gascan for Brewer ozone spectrometer on space shuttle - III(A)
Concord Environmental Corp. $ 46,900	Develop and demonstrate GC-based method for determination of volatile gases
Concord Environmental Corp. $ 51,040	Load and unload 3-stage CAPMoN filterpacks
D. MacKay Environmental Research Ltd. $ 89,580	Research air-water exchange processes
Ortech International $ 78,180	Model volatilization of toxic materials from vegetative soils
Ph.D. Associates $116,430	Provide Brewer ozone data support
Scientific Instrumentation Ltd. $135,980	Provide research balloon launch services
Scientific Instrumentation Ltd. $ 66,650	Provide support and development for SPEAM II and stratoprobe projects
Scientific Instrumentation Ltd. $ 46,570	Operate the RAGS site in Asquith, Saskatchewan
Scientific Instrumentation Ltd. $ 75,050	Provide mini-radiometer identifier
Sea Scan $ 71,310	Evaluate and critically test a digital camera
Skelton Technical Services $ 75,760	Quality control air and precipitation data from CAPMoN
Unisearch Associates Inc. $ 45,310	Set up, calibrate and operate tuneable diode laser system
S.G. Werchohlad $ 62,810	Develop and test SPEAM II electronics

4.2 Other Contracts ($23,000 to $45,000)

Contractor	Contract
CIRAC $ 30,000	Evaluate atmospheric processes of organic toxic pollutants and their role in the environment
CIRAC $ 24,990	Produce data report on Wetlands summer 1990 intensive field study
Concord Environmental Corp. $ 41,730	Develop atmospheric toxic organic sampler for Canadian Arctic
Concord Environmental Corp. $ 23,500	Analyse whole air samples for hydrocarbons
MEP Company $ 28,590	Develop PC-based emergency response system for the AQPAC system
Ortech International $ 44,450	Provide emission field for ADOM for Spring Intensive of EMEFS
Ortech International $ 39,780	Provide preparation and analytical services related to GAP sampler
Scientific Instrumentation Ltd. $ 39,320	Manage and maintain AES Vanscoy, Saskatchewan, balloon launch facility
Sci-Tech Instruments Inc. $ 34,400	Provide service and calibration of brewer ozone spectrophotometers
Unisearch Associates Inc. $ 44,200	Analyse NAE - tuneable-diode laser methane for Wetlands study
Unisearch Associates Inc. $ 42,070	Provide field support for NO_2 sonde at Vanscoy, Saskatchewan
Unisearch Associates Inc. $ 28,700	Measure formaldehyde and nitrogen dioxide at Egbert, Ontario
Vericom Systems Ltd. $ 24,270	Prepare functional specification document for generic and toxics data system
Western Ecological Services $ 37,770	Develop global carbon cycle model of terrestrial biosphere
E. Wu $ 24,960	Evaluate effects of instrument scattered light on ozone and UV-B measurements
York University $ 35,550	Evaluate 1D model of polar ozone anomaly and effects of halocarbons

AIR QUALITY AND INTER-ENVIRONMENTAL RESEARCH BRANCH

ANNUAL REPORT

1990/91

STAFF LIST

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AIR QUALITY AND INTER-ENVIRONMENTAL RESEARCH BRANCH

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		CO_2 Lab	4462	1S201

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Division des études expérimentales

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	ULLBERG, Aaron	4636/4621	4S550
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	Ozone Lab	4946	
	Stratospheric Lab	4634	
	Data Room	4635	
	Rooftop (Ozone Observatory)	6060/4256	
	World Ozone Data Centre (L. Morrison)	4633	
	3rd Floor Computer Room	4638	

* Denotes term or assignment
** Development Leave