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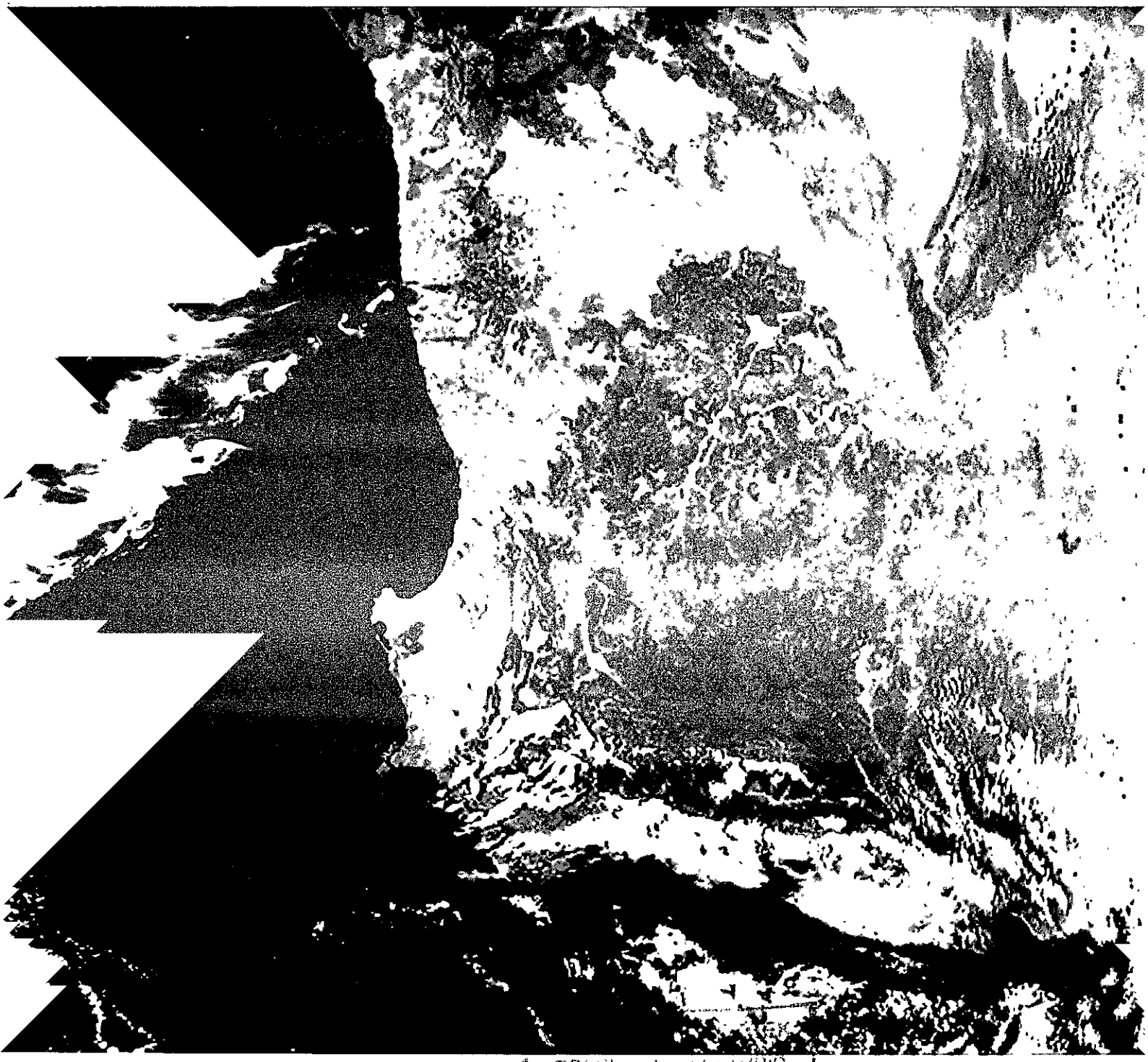
NATIONAL PROGRAMME FOR WEATHER, CLIMATE AND ATMOSPHERE RESEARCH

ANNUAL REPORT 1984/85



SOUTH AFRICAN NATIONAL SCIENTIFIC PROGRAMMES REPORT NO 95

DECEMBER 1984

NATIONAL PROGRAMME FOR WEATHER, CLIMATE AND ATMOSPHERE RESEARCH

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Issued by
Foundation for Research Development
Council for Scientific and Industrial Research
P O Box 395
0001 PRETORIA

from whom copies of reports in this series are available on request

Printed in 1985 in the Republic of South Africa
by the Graphic Arts Division of the CSIR

ISBN 0 7988 3256 8

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Coordinator: Atmosphere Programme
Foundation for Research Development

Cover: Polar-orbiting satellite (NOAA-7) image showing extent of cloudcover over the South Western part of the Southern African subcontinent and its adjacent oceans. NOAA imagery is currently employed in studies on climate variability over Southern Africa (University of the Witwatersrand) and the behaviour of the Agulhas Current (National Research Institute for Oceanology, CSIR in collaboration with Woods Hole Oceanographic Institution, USA).

This NOAA image was received and processed by the Satellite Remote Sensing Centre, Hartebeesthoek.

ABSTRACT

This report reviews the activities of the National Programme for Weather, Climate and Atmosphere Research (NPWCAR) for 1984/85, highlights the findings and also discusses future developments and general needs regarding research within the framework of the NPWCAR.

The NPWCAR currently supports some 50 research projects. These projects cover a number of key areas which accommodate important local ongoing research activities in the field of weather, climate and atmosphere research and are also in harmony with guidelines of the international World Climate Programme. Present participants include SA universities, CSIR laboratories, the SA Weather Bureau, the Nuclear Development Corporation of South Africa, museums, industries and air pollution consultants.

OPSOMMING

Hierdie verslag gee 'n oorsig van die aktiwiteite van die Nasionale Program vir Weerkunde-, Klimaat- en Atmosfeernavorsing (NPWKAN) vir 1984/85, met spesiale verwysing na die bevindings, en bespreek ook toekomstige ontwikkelings en algemene behoeftes ten opsigte van navorsing binne die raamwerk van die NPWKAN.

Die NPWKAN ondersteun huidiglik ongeveer 50 navorsingsprojekte. Hierdie projekte dek 'n aantal sleutelgebiede wat die plaaslike behoeftes ondervang en ook in ooreenstemming is met riglyne van die internasionale Wêreld Klimaat Program. Huidige deelnemers aan hierdie program is onder andere SA-universiteite, WNNR-laboratoriums, die SA Weerburo, die Kernontwikkelingskorporasie van Suid-Afrika, museums, nywerhede en lugbesoedelingskonsultante.

CONTENTS

1. INTRODUCTION

As a result of a need for a national programme on weather, climate and atmosphere research expressed by institutes within the CSIR as well as by government departments, universities and other organizations, the CSIR decided in 1981 to initiate and develop such a programme. Further contributing factors were developments on the international scene, where major research programmes on climate had been initiated by ICSU/WMO, the USA and countries in Europe.

The National Programme for Weather, Climate and Atmosphere Research (NPWCAR) focuses on cooperative research of national interest and its main goal is to promote basic and applied goal-oriented research on the weather, climate and atmosphere of the Southern African subcontinent and its adjacent oceans. It is coordinated by the National Committee for Weather, Climate and Atmosphere Research (NCWCAR) which operates under the auspices of the CSIR and is assisted by Working Groups and Steering Committees. The members of this Committee, its Working Groups and Steering Committees* are drawn from South African organizations with an interest in and knowledge of research in the atmospheric sciences. The secretariat of the NCWCAR is accommodated within the Foundation for Research Development of the CSIR.

The NCWCAR pursues a policy of broad consultation to continually identify important areas requiring supplementary research in the atmospheric sciences. These are made known in the form of invitations to various organizations within the public and private sectors to submit research proposals. The response to this approach has so far been enthusiastic and the research being supported significantly enhances the South African effort in the atmospheric sciences. During 1984/85 the total funds granted to projects** within the NPWCAR was approximately R958 000, supporting research mainly at universities and CSIR laboratories. The expenditure of participating organizations towards weather and climate related research of their own or the supplementation of NPWCAR projects, represents many times this amount. The sponsors of the NPWCAR are presently the Department of Environment Affairs, the Department of Health and Welfare and the CSIR.

The NPWCAR supports research in a number of key areas. These are Weather and Climate; Atmospheric Interaction; Mesoclimate Air Pollution Related Studies; Data and Information Requirements; and Education and Training. These key areas are appropriate because they accommodate important local ongoing research activities and needs in the field of weather, climate and atmosphere research. Moreover, they are in harmony with guidelines worked out by the international World Climate Programme.

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* Membership lists of the NCWCAR, its Working Groups and Steering Committees (as at December 1984) are given in Appendix A.

** Details of research projects supported by the NPWCAR are provided in Appendix B.

2. WEATHER AND CLIMATE*

Research in this area is focused on obtaining a basic understanding of weather and climatic systems including atmospheric processes underlying dispersion, leading to the development of models and to improved short and long range predictions of weather, atmosphere states and climate.

2.1 Climate variability and change

The specific goal is to gain understanding of the descriptive and causal aspects of weather/climate systems, including those relating to cloudiness and radiation, ocean processes, hydrology and land surface processes, with the ultimate purpose of modelling climate in the RSA.

Attention has been focused on climatic variability over Southern Africa during the period of meteorological record. Random and non-random components of rainfall have been described and their temporal and spatial distribution studied by the Climatology Research Group, University of the Witwatersrand (1). At the same time the circulation systems, forcing and modulating the variations, have been determined. Some of these are zonal hemispheric wave changes, tropical-temperate cloud bands, the southern oscillation and local circulation features. The causes and possible duration of the present drought are topics currently being examined.

A new research project (2) which aims to gain local scientific understanding and expertise in the field of climate modelling will be undertaken in 1985. A suitable general circulation model (the GLAS 4th Order General Circulation Model), which can be implemented on one of the CSIR's main frame computers, has already been acquired. The work will be focusing on understanding this model with the view to possible modifications and experimental applications.

2.2 Synoptic and dynamic meteorology

The specific goal is to obtain a better understanding of synoptic weather systems and related atmospheric processes, thereby contributing to improved weather forecasting on all time scales.

The role of clouds in the dynamics of the atmosphere and the resultant effect on climate are aspects currently receiving international attention. The S A Weather Bureau (SAWB) is successfully participating in the ICSU/WMO International Satellite Cloud Climatology Project aimed at developing a global cloud climatology which is regarded as an essential input for refining general circulation models. This project (3) will result in a comprehensive data base being acquired of Meteosat-data over the Southern African subcontinent. This can in addition serve as a basis for cooperative research which will promote knowledge and understanding of local weather systems and climate. Examples are the distribution patterns

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* Numbers given in brackets in the text refer to research projects which are supported by the NPWCAR (See Appendix B).

of extensive cloud over the RSA during wet and dry years; the influence of the Agulhas Current on the formation of cumulus clouds; and preferential areas for convective development over the highveld areas of the RSA.

A new research project (4) which aims to investigate the possibility of developing a statistical prognostic model whereby seasonal rainfall can be predicted, will be undertaken in 1985. The relationships between regional rainfall and the position, development and movement of large-scale circulation systems will be studied. The work will be carried out in close collaboration with the SAWB, using their facilities.

2.3 Ocean climatology

The specific goal is to obtain a better understanding of the long-term trends in the kinematics and dynamics of the oceans adjacent to the Southern African subcontinent and how these are related to changes in climate of the subcontinent.

The National Research Institute for Oceanology, CSIR has undertaken a study on the spatial and temporal coherence of sea surface temperature anomalies in the South East Atlantic Ocean and their possible relationship to weather patterns over the Southern African subcontinent (5). It has been shown that the year 1982/83 was an unusual one as far as sea surface temperature distributions along South Africa's West Coast are concerned and that the seasonal movements of the subtropical convergence were anomalous.

2.4 Mesometeorology and -climatology

The specific goal is to gain understanding of the physics and dynamics of the atmosphere on meso as well as micro scales. The ultimate purpose is to develop a predictive ability to aid, **inter alia** , the planning of important regions.

The first quantitative observations have been obtained towards characterizing the escarpment breeze phenomenon over the Eastern Transvaal Highveld (6). Knowledge of such a wind circulation will have a considerable impact on understanding the dispersion of plumes from the most eastward power stations in the area.

First results from a study on the impact of a power station (Grootvlei, Eastern Transvaal) on local climate (7) seem to indicate that the effect is relatively small. Although some disturbance of the boundary layer was observed in the immediate vicinity of the power station, no evidence for converging air flow towards it could be detected.

2.5 Agrometeorology and -climatology

The specific goal is to determine and describe the relationships between weather/climatic elements and agriculture/forestry/vegetation. The ultimate purpose is to use these relationships for the management of agricultural land and water resources in given areas, as well as for prediction.

In assessing the rainfall regime of the Orange Free State (OFS) to develop an index (model) that can express the effectiveness of rainfall in terms of agricultural requirements (8), it could be confirmed that spatial constraints existed on moisture models when employing daily rainfall data. However, some relaxation of these constraints occurred when cumulative daily totals of rainfall were used. The spatially restricted constraints in modelling soil moisture, as well as the influence of low rainfall/irrigation applications on the storage of soil moisture, are being examined in order to arrive at a realistic water/soil moisture budget for regional scales.

Steady progress is being made with the identification of significant factors that will aid in the local forecasting of convection over the OFS (9). The effort has, up to now, centred on devising an objective classification scheme for identifying the various convective situations. Identification of these will be based primarily on cloud observations supplemented by hail damage reports. In addition, the organization of convective situations is being analyzed using probability analysis of rainfall. Cloud observations have revealed the dominance of the diurnal heating cycle in the development of convective activity over the OFS.

2.6 Hail and thunderstorm climatology

The specific goal is to obtain sufficient understanding of precipitation and electrification mechanisms and their effects.

A study aimed at better understanding of hail storms and hail formation (10) had unfortunately to be terminated, for the interim, because of manpower problems.

2.7 Weather modification

Weather modification is considered as a possible mechanism for increasing the water resources in the RSA. Research is focused on understanding the processes occurring in convective clouds and to examine techniques for suppression of hail and augmentation of rainfall in the RSA.

A substantial cloud modelling project (11) is being conducted by the National Research Institute for Mathematical Sciences, CSIR in collaboration with the SAWB in support of the Bethlehem Weather Modification Experiment. This will hopefully lead to the development of a good cloud seeding procedure for rain enhancement. At this stage, good agreement has been obtained between numerical simulations and aircraft observations on updraft, downdraft, cloud size and liquid water content. This reflects growing understanding of mixing processes occurring within cumulus clouds which is of importance to cloud seeding.

2.8 Palaeoclimatology

The specific goal is to reconstruct past climates as an aid in predicting future climates. Studies covering arid and wet zones in Southern Africa are particularly concerned with the Late Quarternary geological period (i.e. the Late Pleistocene and Holocene epochs).

Very rewarding results have been obtained with dating of geomorphic material collected from the Namib desert (12), which reflect distinct past regional climatic events that are being correlated with the sequence of past changes in the climate of the Southern African subcontinent as a whole.

Useful evidence has been found towards establishing environmental conditions and patterns prevailing in Southern Africa over the last 130 000 years (13). This was accomplished by analyzing various types of terrestrial carbonate deposits occurring in caves, springs, rivers, lakes, pans and soils, using stable isotope techniques.

A synthesis of the evidence for climatic change in Southern Africa over the last 125 000 years is in the final stages of completion (14). It will serve as a valuable guide for future research in the field of palaeoclimatology and will be published.

A new research project (17) will be undertaken in 1985. Its objectives are to review and synthesize the existing evidence of palaeoclimatic fluctuations in the eastern part of the Southern African subcontinent, to carry out field and laboratory studies in order to obtain supplementary or new evidence in key areas, to integrate the various lines of evidence into a framework of climatic oscillations for the region, and finally to relate the palaeoclimatic reconstruction thus obtained to the present distribution of vegetation, soils and geomorphic features. This study will contribute towards improving current knowledge on South African pedology in important agricultural areas. This will, in turn, aid in a better classification of resources and hence future planning of agricultural activities in these areas.

2.9 Solar-terrestrial weather/climate relationships

The specific goals are to establish

- the processes by which the sun and/or other extra-terrestrial phenomena may be able to affect terrestrial weather;

- the rôle that the upper atmosphere, in particular the middle atmosphere (i.e. stratosphere, mesosphere and lower ionosphere) plays in determining terrestrial climate and climatic changes.

Following delays due to problems with finding suitable staff and with purchasing equipment, the first research project (18) can now be initiated in this field. Successful execution thereof will make a useful contribution towards understanding circulation patterns in the middle atmosphere.

A second research project (19) will be undertaken in 1985. Its objectives are to study the composition, as well as the physical and chemical processes, of the middle atmosphere because these could have a bearing on terrestrial climate. Substances such as stratospheric ozone, aerosols and nitrogen oxides will receive high priority. In addition to gaining important local expertise in observing, processing and using such information, this work will benefit from being linked to other similar investigations, such as those coordinated under the SCOSTEP/ICSU Middle Atmosphere Programme.

3. ATMOSPHERIC INTERACTION

Research in this area is focused on understanding and describing the interactive relationship between man's activities and climate and the resulting impact on the environment. The ultimate purpose is to aid in planning and management of resources and urban/industrial developments.

3.1 Methodology of climate impact assessment and its application

The specific goal is the accurate quantification of potential risks and consequences of climate phenomena.

A preliminary analysis of mortality amongst the population of the RSA for 1980 has indicated differences in mortality for certain diseases which seem to relate to climatic zones (20). However, these differences cannot as yet be ascribed to climatic variations since several additional variables, e.g. dietary, genetic and demographic effects, may be responsible and need to be considered in the final analysis. The major contribution of this study will lie in the development of the technique of linking epidemiological information to climatological data.

3.2 Influence of climate on man and his environment

The specific goal is to derive and apply techniques and/or models to describe climate/environmental relationships.

A study is underway in the Umfolozi/Hluhluwe Game Reserve complex (21) to test the hypothesis that an increase in rainfall run-off and soil loss will occur in a non-cull portion of this complex because the vegetation cover will decrease due to the growing grazer stocking rate. The converse is expected to occur in a culled portion of this complex. Base-line data are presently being collected. The results of this study will aid in establishing the optimum herbivore carrying capacity of this and similar game reserves.

Confirmatory evidence has been found of how fynbos vegetation extracts notable quantities of moisture from mountain-top cloud through the physical interception of cloud/mist droplets (in the absence of rain) which eventually reach the soil via plant-drip and stem-flow (22). These results will be used to establish whether this source is significant in supplementing rainfall to contribute to the water balance of the Southern Cape mountains.

Tentative findings from an investigation on the economic implications of weather and climate pertaining to planning of building operations in the RSA (23) indicate that the majority of large construction companies do indeed take climatic conditions into account in planning their activities. In some cases particular operational techniques are applied for given climatic seasons.

A new research project (24) which aims to identify areas in South Africa which are climatologically best suited to the production of avocado pears and mangos, will be undertaken in 1985. These two crops are both of economic importance form the point of view of local demand as well as export potential. However, their cultivation is subject to quite stringent climatic requirements. This research will complement similar research on other crops being undertaken by the Department of Agriculture.

3.3 Influence of man's activity on climate and the environment

The specific goal is to determine the extent to which man's activity, i.e. urbanization, energy generation, industrial development and land use practises have an influence on the atmosphere (and hence on climate) and the environment on local and regional scales in South Africa. This requires research on aspects such as atmospheric, physical and chemical processes, atmospheric quality, atmospheric pollution effects and land surface modification.

Atmospheric physical and chemical processes

A project has recently been initiated to study the three-dimensional wind patterns of the Greater Cape Town area and their influence on the dispersion of atmospheric pollution over the area (25). The wind climatological data obtained will also serve to supplement several air pollution impact related studies presently carried out in the same area by local authorities and other organizations.

Two complementary projects are being undertaken that will promote understanding of atmospheric chemistry. The one (27) involves reactions of nitrogen compounds which are the precursors of photochemical smog and acid precipitation. The other (28) entails a synthesis on the current state-of-the-art regarding the chemistry of photochemical smog in order to enable the planning and initiation of relevant research in South Africa.

An investigation has been started on the transport and transformation of air pollutants originating from industrial areas within the Eastern Transvaal Highveld (29). The ultimate objective is to determine the impact of these pollutants and their transformed species on adjacent regions, giving particular attention to assessing the potential for the occurrence of an acid precipitation problem in the region.

Atmospheric quality

A study (30) is being conducted to establish whether the occurence of relatively high lead-in-blood levels could be attributed to pollution of the atmosphere, soil, dust or water, using a sample of children in

suburban Cape Town. Attention is currently focused on acquiring relevant pollution and biomedical data. The outcome of this study will be of importance to the control authorities.

The first quantitative results have been obtained on the atmospheric pollution situation in Soweto (31). Relatively high levels have been recorded for suspended particulates and sulphates at a site on the edge of the city. A second mobile monitoring laboratory has now been commissioned at a more central site.

An on-line continuous micro-processor based air pollution monitor has been developed (32). It is capable of realistically predicting ground level concentration distributions of a pollutant emitted by a point source over a region up to 10 km in radius from the source. A prototype of this system has already been commissioned and installed at a local industrial site where it has proved useful by checking/confirming occasional complaints of high sulphur dioxide concentrations in the neighbourhood. The possibility of marketing this monitor is being investigated.

Encouraging results have been yielded by using vegetation as a reconnaissance tool in determining the spatial distribution of potentially harmful trace elements in urban environments (33).

Atmospheric pollution effects

A comprehensive study of health effects associated with air pollution in the Greater Cape Town area (36) has indicated, so far, that incidences of mortality do not seem to reveal any pattern that can be related to air pollution. With regard to morbidity, a greater percentage of upper respiratory tract infections appear to occur in an area where air pollution problems are claimed to exist.

A new research project (37) which aims to evaluate the extent to which major gaseous pollutants affect agricultural crops and indigenous plants growing in the greater Cape Town area and vicinity will be undertaken in 1985.

The influence of increasing man-made pollution on the natural physical and chemical processes of the atmosphere and hence on global climate, is a topic of international interest. Presently a number of important trace gases (CO, CH_4, O_3, N_2O, $CFC\ell_3$ and $CC\ell_4$) that might be causing climatic changes are continuously monitored in maritime air at a specially equipped background monitoring station situated at Cape Point (32/38). Significant findings on the long-term trends and behaviour of halocarbons and carbon monoxide have already attracted attention.

Land surface modification

In a study which investigated the nature of reflectivity variations in various veld types (notably fynbos) within the South Western Cape (40) it could be established conclusively that human activities produced greater differences in surface reflectivity than changes that occurred due to variations in natural vegetation. A direct measurable

indication of man's impact on processes governing weather and climate has thus been obtained. This study also provides the basic data for mathematical models which will elucidate the mechanisms of how changes in reflectivity affect weather and climate.

4. MESOCLIMATE AIR POLLUTION RELATED STUDIES

A Steering Committee for Mesoclimate Studies was appointed early in 1984, following consultations between the CSIR and the Department of Health and Welfare.

The first task of the Steering Committee was to formulate and adopt a strategy for a cooperative mesoclimate air pollution related research programme in important regions of South Africa and to identify key participants in this programme. An 'Announcement of Opportunity' to submit proposals addressing this strategy was issued and distributed widely amongst the research community.

Secondly, the Steering Committee evaluated and recommended on the proposals that were received in response to the 'Announcement of Opportunity'. During the evaluation of proposals all known current activities in the South Eastern Transvaal Highveld and its vicinity were considered and taken into account. In the latter regard, a special survey was conducted by FRD, CSIR on behalf of the Steering Committee and the information made available to all members of this Committee.

4.1 Goal and components of the strategy

The main goal of the strategy is to develop a predictive capability, with emphasis on the South Eastern Transvaal Highveld with regard to

- required efficiency of methods for controlling pollution emissions;
- impact of such emissions on the local climate, inhabitants and environment;
- atmospheric pollution levels and their impact with further development; and
- supporting the efficient planning of development of such regions.

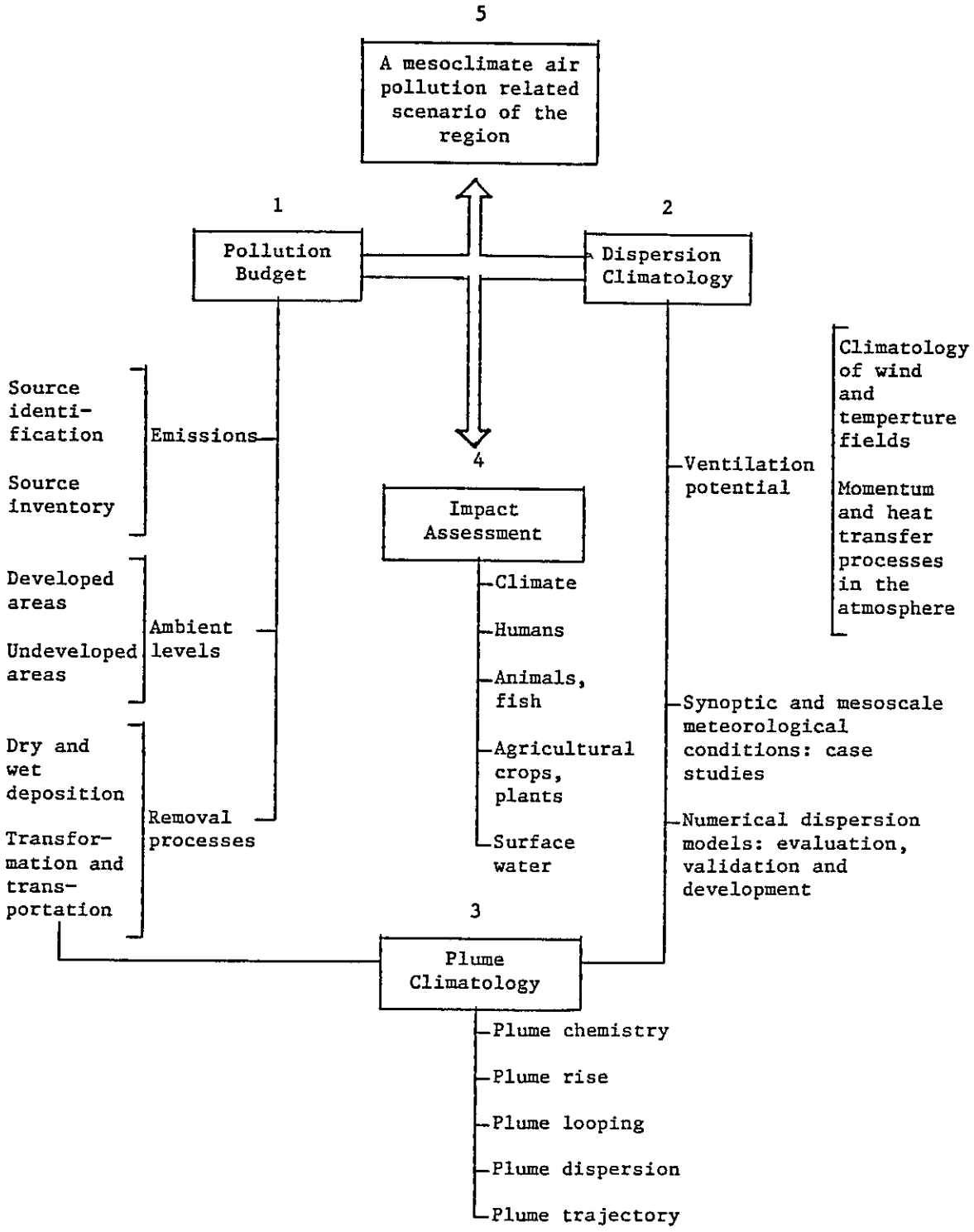
The main components of the strategy and their interrelationships are shown schematically in Figure 1. Essentially, these cover the pollution budget, dispersion climatology, plume climatology and impact assessment.

This strategy will complement ongoing monitoring and research activities in the South Eastern Transvaal Highveld and its vicinity.

4.2 The Mesoclimate Air Pollution Related Research Programme

The following is a brief description of the programme currently carried out to implement the abovementioned strategy. It is initially focused primarily on the South Eastern Transvaal Highveld and, to a lesser extent, the Northern Orange Free State.

FIGURE 1 : MAIN COMPONENTS OF THE STRATEGY FOR MESOLCIMATE AIR POLLUTION RELATED RESEARCH AND THEIR INTERRELATIONSHIPS



4.2.1 Pollution budget

Objective

Establish the nett pollution burden of the region by determining the parameters comprising the pollution budget, i.e. emissions, ambient levels and removal processes in order to use this information towards developing a predictive capability.

Current and new projects

- Identification of sources, quantification of emissions and emission factors (41).
- Identification of sources, quantification of emissions and emission factors: In the Northern Free State and Southern Transvaal (42).
- Contribution of smouldering coal dumps to atmospheric sulphurous gasconcentration (43).
- National Physical Research Laboratory (NPRL), CSIR. (See 4.2.5 Comprehensive research: NPRL, CSIR, below).
- Isotopic tracing of nitrogen oxides (44).
- Characterization of particulate emissions from a 300m chimney stack at Secunda (45).
- Tracer dispersion experiments (46).

4.2.2 Dispersion climatology

Objective

Understanding of the dispersion climatology of the region by studying the ventilation potential as well as synoptic and mesoscale meteorological conditions and to use this information towards the development of numerical dispersion models for predicting ambient atmospheric pollution levels within the region.

Current and new projects

- Robust real-time dispersion model based on measured vertical and horizontal wind structure (47)
- NPRL, CSIR (See 4.2.5 Comprehensive research: NPRL, CSIR below).

4.2.3 Plume climatology

Objective

Understanding of the physical/chemical behaviour of pollutant plumes from major industries and power stations situated within the region and its vicinity in order to be able to predict the behaviour and trajectories of such plumes.

Current and new projects

- NPRL, CSIR (See 4.2.5 Comprehensive research: NPRL, CSIR below).

4.2.4 Impact assessment

Objective

Assess the impact of present emissions from industry and other local pollution sources on the climate, inhabitants and environment of the region and to develop a predictive capability with regard to impacts with further development in the region.

Current and new projects

- Impact on human health of atmospheric pollution in the Eastern Transvaal Highveld (48)

- Monitoring of the chemical composition and the acidity of precipitation at a forestry site in the Eastern Transvaal Highveld (49)

- Impact of atmospheric pollution on the quality of surface waters and their biota in the Eastern Transvaal Highveld (50)

4.2.5 Comprehensive research

National Physical Research Laboratory (NPRL), CSIR

The NPRL undertakes a comprehensive programme entitled 'Air pollution and meteorological studies in the South Eastern Transvaal Highveld' (51). It addresses the following aspects, which are all related to the components identified under 4.2.1 to 4.2.3:

- Data base: Development and analysis.

- Sulphur dioxide and nitrogen oxide measurements of smouldering coal dumps.

- Ambient levels of air pollutants including gases, free acids, organic substances and anions.

- Dispersion climatology: Ventilation potential.

- Dispersion climatology: Synoptic and meteorological conditions; case studies.

- Dispersion climatology: Modelling.

- Plume climatology: Plume behaviour.

Other supporting research

The most significant relevant ongoing work is that of ESCOM and SASOL, weather stations maintained by the SAWB and the Department of Agriculture, and acid precipitation measurements by the Department of Environment Affairs. ESCOM and SASOL have promised their full

cooperation in the programme, while the Departments of Agriculture and Environment Affairs are in a position to report developments to the Steering Committee for Mesoclimate Studies through their representatives.

Acid precipitation

Acid precipitation - or 'acid rain' - is not addressed by any of the projects receiving special financial support under this programme. ESCOM operates a network of acid precipitation measuring stations as part of its own programme.

It should be noted, however, that the precursors of 'acid rain' (i.e. sulphur dioxide, nitrogen oxides, sulphates and nitrates) are, in fact, being studied as part of the comprehensive programme undertaken by NPRL.

5. DATA AND INFORMATION

Activities in this area are focused on the promotion of data collection and archiving, data exchange between data banks and data information dissemination that will meet research and application requirements.

The NCWCAR Working Group on Data and Information requested three main users, i.e. the SAWB, the Soil and Irrigation Research Institute and the Directorate of Forestry to compile basic requirements for the collection of climatological data to serve as a guideline for observations and research purposes. Also, practical guidelines were drawn up for formatting and exchange of data. This information was made available to the Coordinating Committee for Climatological and Weather Observation Projects and Practices recently established by the SAWB.

A national register for weather, climate and atmosphere numeric data sources is currently being compiled (52) by the National Institute for Informatics of the CSIR and will fulfill an important need by serving as a national information source of available data for users.

6. EDUCATION AND TRAINING

Activities in this area are concerned with the promotion of education and training of meteorologists, climatologists, data processing specialists and related users.

6.1 Short courses in the atmospheric sciences

A country-wide survey of career opportunities, educational requirements and manpower needs in the atmospheric sciences was made during 1982 on behalf of the NCWCAR. This survey indicated the need for in-service training via short courses in the areas of air pollution control, meteorology and hydrology.

The possibility of setting up and introducing short courses in these areas was taken up on behalf of the NCWCAR with a number of educational institutions, i.e. universities and technikons, and as a result, a number of courses have either been implemented or are being contemplated.

The Department of Chemical Engineering, University of Pretoria presented a three-day course at graduate level on **air pollution control** during January this year. The course covered a wide range of aspects with the main emphasis being on air pollution control. It was attended by some 55 participants representing various organizations including the CSIR, ISCOR, NUCOR and the chemical industry. In general the participants agreed that this course was a success and indications are that it might well be the forerunner of similar courses.

The Department of the School for Health Services, Witwatersrand Technikon, has expressed interest in presenting short courses on **air pollution control** at the technical level to Air Pollution Control Officers to supplement the National Diploma in Public Health which is currently offered by technikons.

The Department of Applied Mathematics, University of Pretoria, in collaboration with the SAWB, envisages presenting a short course in **meteorology** at graduate level during 1985. The contents of such a course will take into account the specific needs and preferences of the local atmospheric scientists and these will be established by way of a suitable questionnaire. Provided it is found necessary, a recognized specialist from abroad might be invited under the auspices of the NPWCAR to present some of the topics in such a course.

6.2 Permanent courses in the atmospheric sciences

A course for a new three-year BSc degree (Meteorology), including Atmospheric Chemistry as a secondary subject, will possibly be instituted at the Department of Agrometeorology, University of the Orange Free State as from the beginning of 1985. It will also be possible to take up follow-up courses at Honours, Masters and PhD levels.

The **curriculum** for the National Diploma in Public Health, which is a three-year course at technical level and designed for training Health and Air Pollution Officers, is presently under revision in order to meet the latest needs and requirements in these fields.

6.3 Other developments

Other noteworthy developments in which the NCWCAR played a stimulating rôle are the following:

- The acceptance of revised requirements for appointment of meteorologists by the SAWB. These requirements open new possibilities in terms of appointment and promotion for agrometeorologists as well as persons with a four year education in mathematics, applied mathematics, physics, computer science, mathematical statistics and geography.

- The approval of a Chair of Meteorology within the Department of Applied Mathematics, University of Pretoria.

- The reinstatement of the National Diploma in Agrometeorology with a revised syllabus by the Pretoria Technikon.

- The increased awareness and specific availability of undergraduate bursaries for students in the atmospheric sciences by the CSIR.

7. GENERAL NEEDS

A number of general needs were identified regarding local research in the atmospheric sciences. These are briefly discussed below.

7.1 Super computing power in South Africa

At least one 'super-computer' will be required for national use to enable and stimulate local research in the areas of general circulation models, climate modelling, data assimilation techniques, cloud modelling and numerical weather prediction technology. Research in these areas require access to computers with the capabilities of a CRAY-1 or CDC Cyber 205. This matter is already receiving attention.

7.2 Regional cooperation

The greatest need as regards regional cooperation at this stage appears to be in the South Western Cape where a considerable degree of mesoclimate and atmospheric pollution related work is undertaken. Attention is being given by the FRD, CSIR to the exploring of suitable mechanisms of liaison to stimulate cooperative activities in this area.

7.3 Training of persons in meteorology

There is an acute shortage of academically trained persons in the dynamic and physical aspects of meteorology. Although no general solution is at hand, some improvements can be expected from the institution of appropriate short and/or permanent courses in the atmospheric sciences at SA technikons and universities.

8. PUBLICATIONS

8.1 Weather and Climate

Mesometeorology and -climatology

HELD, G. The impact of a power station on airflow and temperature fields. Accepted for publication. In: Proceedings of the Sixth International Conference on Air Pollution, CSIR, Pretoria, 23-25 October 1984, (1984).

Climate variability and change

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1. Climatic change project. Prof P D Tyson (Climatology Research Group, University of the Witwatersrand), 1981 - 1985.
2. Climatic studies using a general circulation model. Dr I M Navon (NRIMS, CSIR), 1985 - 1987
3. International Satellite Cloud Climatology Project. Dr J van Heerden (Dept of Research, South African Weather Bureau), 1983 - 1985.
4. Relationship between large-scale circulation systems and rainfall patterns over Southern Africa. Mr E E Katsiambirtas (Medumsa) 1985 - 1987
5. Ocean climatology. Dr J R E Lutjeharms (NRIO, CSIR), 1982/3 - 1986/7
6. Study of the escarpment breeze and its influence on the ventilation potencial over the Eastern Transvaal Highveld. Dr G Held (NPRL, CSIR), 1983/4 - 1984/5.
7. Study of air flow and convection in the immediate vicinity of a power station. Dr G Held (NPRL, CSIR), 1983/4 -1984/5.
8. Analysis of effective rainfall in the Orange Free State. Dr B E Kelbe (Dept of Agrometeorology, University of the Orange Free State), 1983 - 1985.
9. Analysis of the synoptic and mesoscale factors influencing convection in the Orange Free State. Dr B E Kelbe (Dept of Agrometeorology, University of the Orange Free State), 1983 - 1985.
10. Deuterium variations in hail stones. Mr A S Talma (NPRL, CSIR), 1983/4 - 1985/6.
11. Numerical modelling of the dynamics of cumulus clouds. Dr I M Navon (NRIMS, CSIR), 1983/4 - 1984/5
12. Chronological framework of palaeoclimatic events in the Namib. Dr M K Seely (Desert Ecological Research Unit), 1983/4 - 1985/6
13. Isotopic investigation of climatic change during the late Quaternary in Southern Africa. Mr A S Talma (NPRL, CSIR), 1983/4 -1985/6.
14. Geomorphic and sedimentary evidence for Quaternary palaeoclimates in Southern Africa. Dr N Lancaster (School for Environmental Studies, University of Cape Town), 1984 - 1986.
15. A history of climate and marine productivity from sediments off the West Coast of Southern Africa. Dr R F Johnson (Marine Geoscience Unit, University of Cape Town), 1984 - 1986.
16. Pollen analyses of late Pleistocene and Holocene deposits in Venda and the Orange Free State. Dr L Scott (Research Institute for Environmental Sciences, University of the Orange Free State), 1983 - 1985.
17. Palaeoclimatic changes in South East African during the late Pleistocene and Holocene. Prof J M de Villiers (Dept of soil, University of Natal), 1985 - 1987.
18. Observation of OI 557,7 nm airglow by means of a changed-coupled device and optical system. Prof J A Gledhill (Dept of Physics and Electronics, Rhodes University), 1984 - 1987
19. Lidar investigation of the middle atmosphere. Prof J A Gledhill (Dept of Physics and Electronics, Rhodes University) 1985 - Indefinite.

Atmospheric interaction

20. Climatic effects upon the incidence of certain infectious diseases in South Africa. Prof G S Watermeyer (Dept of Community Health University of Cape Town) 1983 - 1984.
21. The relationship between rainfall run-off and soil loss in the Umfolozi/Hluhluwe Game Reserve complex. Mr J Venter (Natal Parks, Game and Fish Preservation Board), 1982 - 1986.
22. Extraction of water from mountain-top cloud by fynbos vegetation. Prof R F Fuggle (School for Environmental Studies, University of Cape Town), 1984 - 1987.
23. The influence of the weather and climate on the building and construction industry in South Africa. Dr G du T de Villiers (Dept of Geography, University of Durban-Westville), 1983 - 1984.
24. The climatic suitability of South Africa for production of avocado pears and mangos. Miss J S Whitmore (Climatoque) 1985.
25. The monitoring, analysis and evaluation of the dispersion meteorology ??er the greater Cape Town area using Doppler Acoustic Sounding. Dr C S Keen (Dept of Geography, University of Cape Town), 1984 - 1985.
26. A continuous wind profiling system for air pollution and other studies. Dr A E Carte (NPRL, CSIR), 1984.
27. Isotopic characteristics of atmospheric nitrogen compounds. Dr T H E Heaton (NPRL, CSIR), 1983/4 - 1984/5.
28. The effect of various precursors on the influence of photochemical smog. Prof R K Dutkiewicz (Energy Research Institute, University of Cape Town), 1984.
29. Long range transport of air pollution from the Eastern Transvaal Highveld. Dr R B Wells (NPRL, CSIR), 1983/4 - 1985/6.
30. Levels of lead in the atmosphere and in children's blood in Cape Town. Prof R F Fuggle (School for Environmental Studies, University of Cape Town), 1983 - 1985.
31. Atmospheric pollution in Soweto: particulate and organic. Dr H J Annegarn (Nuclear Physics Research Unit, University of the Witwatersrand), 1983 - 1985.
32. Continuous pollutant distribution monitor. Dr M Mulholland (Dept of Chemical Engineering, University of Natal), 1983 - 1984.
33. The use of vegetation in the study of spatial distribution of heavy metals in the urban environment. Mr N Walker (NPRL, CSIR), 1984/5 - 1985/6.
34. Evaluation and application of an improved sampling method for the analysis of atmospheric particulates resulting from transformation of pollutants released in the Eastern Transvaal. Dr R B Wells (NPRL, CSIR), 1984/5 -1985/6.
35. Investigation of airborne organic compounds in Sasolburg. Dr R B Wells (NPRL, CSIR), 1984/5 - 1985/6
36. An epidemiological study of health effects associated with air pollution in the greater Cape Town area. Prof G S Watermeyer (Dept of Community Health, University of Cape Town), 1983 - 1988.
37. Effects of air pollution on plants growing in an industrialised area near Cape Town. Prof H J Visser (Dept of Botany, University of Stellenbosch) 1985 - 1988.
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Mesoclimate air pollutions related studies

41. Identification of sources, quantification of emissions and emission factors in the East Tvl Highveld. Dr N Boegman (Consultant) 1984/5 - 1986/7.
42. Identification of sources, quantification of emissions and emission factors in the Northern Free State and Southern Transvaal. Dr N Boegman (Consultant) 1984/5 - 1986/7.
43. Contribution of smouldering coal dumps to atmospheric sulphurous gas concentration, Mr G Kornelius (Dept of Chemical Engineering, University of Pretoria) 1985.
44. Isotopic tracing of nitrogen oxides. Dr T H E Heaton (NPRL, CSIR) 1985/6 - 1987/8
45. Characterization of particulate emission from the 300 m chimney stack at Secunda. Dr D W Mingay (Nuclear Physics Dept, NUCOR), 1984/5.
46. Tracer dispersion experiments. Mr P S Botha (Earth Science Services (Pty) Ltd), 1984/5
47. Robust real-time dispersion model based on measured vertical and horizontal wind structure. Dr M Mulholland (Dept of Chemical Engineering, University of Natal), 1985/6 - 1986/7
48. Impact on human health of atmospheric pollution in the Eastern Transvaal Highveld. Prof S Zwi (Department of Medicine, University of the Witwatersrand), 1984 - 1986.
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50. Impact of atmospheric pollution on the quality of surface waters and their biota in the Eastern Transvaal Highveld (Dr F H Chutter, NIWR, CSIR), 1985/6 - 1986/7.
51. Air pollution and meteorological studies in the South Eastern Transvaal Highveld. Dr G Held (NPRL, CSIR), 1984/5 onwards.

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