BUREAU OF METEOROLOGY

Department of the Environment, Sport and Territories

FIRE WEATHER WORKSHOP
3 - 7 MAY 1993
BOWRAL
NEW SOUTH WALES

PROCEEDINGS OF THE FOURTH FIRE WEATHER CONFERENCE

BOWRAL - NEW SOUTH WALES 3 - 7 MAY 1993

CONTENTS

1 INTRODUCTION

The Bureau of Meteorology's fire weather service relies for its effectiveness upon a combination of sound meteorological infrastructure (observations, communications, data processing), application of up-to-date scientific knowledge, an understanding of the basic principles of bushfire behaviour and close working relationship with fire authorities. The Bureau has established links with fire authorities at State, Territory and National levels and, for the Bowral fire weather conference, one of a series held about once every two years, brought together a representative gathering of Bureau forecasters, fire weather specialists and program managers, as well as bushfire specialists and fire managers. Copies of the agenda and list of participants are given in appendices 1 and 2.

The conference was structured to make use of interactive discussions in syndicates, whose outcomes are summarised in this report. A series of presentations from weather and fire specialists provided input and focus for the syndicate discussions.

2 SUMMARY OF PRESENTATIONS

2.1 Opening Remarks

Peter Noar, Assistant Director (Services) provided opening remarks to summarise the objectives of the conference and raised a number of significant issues. From the infrastructure point of view, a number of initiatives are being taken, for example data coverage in remote areas is expected to be enhanced by new forms of data such as the application of multi spectral satellite data; improved models are increasing the skill of basic predictions and powerful micro processors are providing opportunities for modelling studies on sub-regional scales; and new processes to assessing fire danger may emerge from university-based research, sponsored in part by the Bureau of Meteorology and the Victorian Country Fire Authority.

The Bureau considers the linkage to fire authority practitioners and managers to be very important and this is demonstrated by the mix of people at the Bowral conference. Peter Noar indicated that the Bureau's fire weather services to support the objective of contributing to minimising the loss of life and property from bushfires are of very high priority. However, some specialised services in support of, for example, timber management activities are subject to charging on an incremental or commercial basis.

He summarised a number of current Bureau issues and referred to the continuing restraint on resources. All programs are subject to a steady decrease in financial resources due, for example, to the general efficiency dividend. However, the upgrade of severe weather warning services approved by the government in 1987/88 has been well received by fire authorities and it is essential that we keep the momentum going.

2.2 Cold Front Reconnaissance/Wind Changes

Andrew Watson (Bureau of Meteorology, South Australia) summarised the history and objectives of cold front reconnaissance. The initial arrangements made with the RAAF were constrained by guidelines applying to Commonwealth assistance to States in times of

disaster, and required that significant fires be burning before reconnaissance arrangements could be invoked. To provide for more flexibility, the current reconnaissance program provides for contract operations from either South Australia or Tasmania on high risk days when an approaching cold front is expected to have major impact. He indicated, in summary, that an assessment of operations has shown there to be no impact on the quality of fire weather forecasts. It is therefore difficult to justify aircraft reconnaissance as cost effective. However, he acknowledged that it produced considerable improvement in the understanding of summer time cool changes and did not feel that it should be discontinued entirely.

John Bally (Bureau of Meteorology, Tasmania) presented the brief Tasmanian experience which, to date, indicates that reconnaissance is most useful for locating fronts without clear signature and for measuring post front conditions. Cool change mechanisms are complex and whilst aircraft reconnaissance has shown no operational benefits, from a research point of view it can assist in understanding this complexity as evidenced in one example presented, by information obtained on a mesoscale development in Storm Bay. There have been a number of instrument and communications problems and some difficulties with availability of staff to undertake the flights. It is difficult to time the expected duration of each flight, but the average cost of a flight is around $2,000. Other solutions to the problem of obtaining quantitative mesoscale data operationally could be, for example, a wind profiler or high level automatic weather station (AWS) on the west coast of Tasmania, or application of the proposed aerosonde.

2.3 Communication with Clients in the Computer Age

A presentation by John Nairn (Bureau of Meteorology, Victoria) stressed the need for the use of common language between forecasters and fire fighters. Victoria uses written and graphical information (gusts, lightning, instability depth, etc.) to convey explicit information to fire specialists but uses chatty plain language when briefing fire operations people. Both means of communication are important but the importance of regular face-to-face contact between forecasters and fire fighters needs to be stressed.

Ken Batt (Bureau of Meteorology, New South Wales) posed a series of questions:

- why communicate?
- can we agree on the need for common language?
- how and when do we communicate, and what medium do we use?

Ken also stressed the need for meteorologists to know something of fire behaviour.

2.4 Smoke Dispersion Problems in Southwest Western Australia

Rick Sneeuwgat (Department of Conservation and Land Management, Western Australia) stated that hazard reduction burning is essential for fire management eg to minimise the impact of a Cyclone Alby type situation. Smoke from prescribed burning is a significant problem and there are emerging pressures to change burning practices. The Bureau in Western Australia has studied synoptic situations conducive to smoke problems and these results are used to assist in planning prescribed burning and smoke management.

Wind and atmospheric stability information are obtained by CALM before burning is commenced. Experience has shown that, although there is very little direct smoke pollution, there may be extensive haze initially blown out to sea, drifting back over the Perth metropolitan area with the sea breeze. Barry Hanstrum (Bureau of Meteorology, Western Australia) suggested that future developments in smoke management could include:

- a joint study to predict trajectories of smoke particles;
- application of the local mesoscale model (TRAM) to sea breeze and trajectory modelling;
- classification of synoptic situations; and
- use of a dispersion index.

Garry Boterhoven (Bureau of Meteorology, Western Australia) provided a review of the significant smoke pollution situation of 22-23 Oct 1992. In summary, the situation comprised the typical west coast trough with a cold front approaching the southwest coast.

- the trough did not move inland and the front weakened N of 40° S;
- there was warm continental air aloft and cooler sea breeze air at low levels (~1500ft);
- easterlies freshened due the effect of a high pressure system to the south.

The key points were the warm offshore flow above 2500 - 3000 ft blowing smoke out to sea and the low level return flow on the sea breeze and a temperature inversion forming a cap, preventing dispersal.

2.5 Aerosonde Plans

Jeff Kepert (Bureau of Meteorology Research Centre) presented background information on the aerosonde project which has the potential to provide low cost, quantitative data in remote areas for reconnaissance of systems such as tropical cyclones and significant cold fronts.

Navigation of the aerosonde will be computer controlled, utilising a satellite global positioning system (GPS). Communications with aerosonde will also be satellite based. The system is planned to measure horizontal and vertical wind velocities, temperature and pressure from the surface to 100hPa, and the possibility of obtaining rainfall measurements is also being investigated. There has been heightened interest in aerosonde from the international research community since the publication of an article in the Bulletin of the American Meteorological Society (BAMS). A prototype version of aerosonde (with wheels) is being flight tested in California. A three year development program is under way; late this year (year 2) longer range trial flights are planned, and the west coast of Tasmania has been mentioned as a possible proving ground. At a later stage, flights extending beyond 24 hours into tropical cyclones are planned. Part of the project is a publicity campaign to raise awareness and, thus, funding.

2.6 Mesoscale Models

Jeff Kepert provided background to the BMRC Mesoscale Group whose objective is to conduct research and scientific development to improve understanding of mesoscale processes and to improve the Bureau's forecast capacity. Projects include:

- Darwin climate monitoring;
- mesoscale analysis and modelling;
- tropical cyclone research;
- air sea interaction; and
- aerosonde.

The mesoscale analysis and modelling is focussed upon Darwin, looking at ocean and surface affects. Non-hydrostatic models will become an important component of the research.

Graeme Mills (Bureau of Meteorology Research Centre) provided information on the Short Range Group including the modified 75 kilometre resolution regional model and the multivariate statistical analysis scheme used in the Regional Assimilation Prediction Model (RASP).

2.7 The National Fire Danger Rating System and Fire Weather Forecasting in the United States

Rick Ochoa (National Inter-agency Fire Control Centre, Boise, Idaho) provided a comprehensive summary of US developments in fire weather forecasting and the national fire danger rating system. He provided a number of examples of application of the Haines Index, illustrating the relationship between high lapse rate, low relative humidity, and fire behaviour danger. The Haines Index relates lapse rates and dew point depression between 700 and 500 hPa in the following manner:

$$LASI = a(T_{p1}-T_{p2}) + b(T_p - T_{dp})$$

where LASI is the Lower Atmosphere Stability Index. T is the temperature at two pressure surfaces (p1, p2), T_p and T_{dp} are the temperature and dew-point temperature at one of the levels (ref. *Haines, D.A. (1988) "A Lower Atmosphere Services Index for Wildlife Fires", National Weather Digest 13 (2): 23*).

Differing weighting factors may be assigned for terms a and b. The Haines Index varies from 2 (low) to 6 (very high). It is considered important to distinguish between wind driven as distinct from plume driven fires. The relationship between fire behaviour and value of the index is non linear; thus a potential 6 situation is very significant. Rick referred to the Lowman (Idaho) Fire which indicated good correlation between Haines Index and rate of spread with index 6 being associated with much greater rates of spread. Haines indices 5 and 6 account for 90% of acreage burnt. Haines Index values of 5 occurred on 27% and 6 on 5% of fire outbreak occasions. The Haines Index is not a better prediction of fire spread than Richardson's number or wind speed but is still a valuable alerting tool.

The Haines Index is used as a forecasting tool and can be of assistance in forecasting dry lightning or unusually low relative humidity. Under high Haines index conditions, there may be an increase in fire spotting and extent of smoke plumes.

Rick also described the significant value placed on the application of water vapour imagery from NOAA satellites for fire weather forecasting. There is usually, but not always, good correlation between brightness and mid level moisture. The significance of the correlation depends on the intensity, stratification and temperature of the moist layer. Consequently, there is a need to check sonde data against the satellite water vapour imagery. There is also some value in averaging the moisture over deeper layers.

US fire weather meteorologists, as well as those elsewhere, have looked closely at the relationship between upper level jet stream structure and fire weather. The Boise group has taken particular account of the influence of sub tropical jets, which may be summarised briefly in the following manner:

- *dynamic* - left exit quadrant (NH) upper divergence/lower convergence
- *thermal* - baroclinic zone below jet core - cold air poleward of jet
- *solar* - lack of clouds poleward of jet for low level heating

2.8 New Equations for Estimating the Rate of Spread in Grassland

Phil Cheney (CSIRO Division of Applied Chemistry, Canberra) presented new equations for predicting fire spreading Grassland and described their possible application. He defined fire danger as the resultant of constant and variable factors affecting ignition, spread, suppression and difficulty of control of fires. He then discussed the variable and constant factors. Referring to McArthur's development of fire danger metres, Phil indicated that a significant factor was Mc Arthur's opinion on the difficulty of suppression. A recent survey indicated that most fire authorities were satisfied with the McArthur meter, particular in undertaking preparedness measures and improving restriction procedures and warnings. Prime factors affecting rate of spread were windspeed, natural grass height, content and volume, and moisture content. There was discussion during Phil's session about whether the relationship between wind speed and rate of spread is linear or exponential. He believes that the relationship between Fire Danger Index and rate of spread was linear for all rates of spread.

If a gross rate of spread of 6.4 km/h is considered by fire authorities to be critical, a total ban would be imposed for Fire Danger Index of ~35 for a reasonable combination of weather parameters. Phil stated that there is not a lot of justification of imposing bans at such a level in most circumstances.

The McArthur Meter Mark I is adequate for public warnings and there is no reason to adjust for rate of spread; however, there is possibly some justification for fire managers to make adjustments in interpretations based on fuel loadings. Most of the experimental burns referred to by Phil Cheney were carried out in the Northern Territory in July/August under conditions of low level instability. The extent of burning may be affectively estimated from 1 km^2 satellite derived vegetation indices.

2.9 Fire Weather Forecasting Requirements for Prescription Burning

Rick Sneewujagt summarised the Western Australian Department of Conservation and Land Management's requirement for prescribed burning. CALM undertakes prescribed burning of 150-200,000 hectares each year and there is a narrow window of opportunity.

Objectives are to achieve an average flame height of 1.5m, to avoid scorching, and to achieve 60-80% coverage. The rate of spread should also enable comfortable control of the fire. The achievement of the objectives is affected by fuel type, temperature, relative humidity (10-15%), wind (10-20 km/hr), rain, and days since rain. The conditions required occur mainly in November/December. Reference was made to the Western Australian Red Book, eg the fact that the ratio between wind strength in the free atmosphere and that in the canopy affects the rate of spread.

Very accurate, specialised forecasts are required for the WA prescriptive burning program, and the service is currently provided under private contract from Ocean Routes. The types of accuracy standard required are maximum temperatures to within 2° and RH within 7% low range, 15% high range. Wind requirements are fairly complex. Verification procedures use Fire Service and Bureau stations and overall accuracy requirements vary from 75% to 80%, dependent upon parameters and time of the day. Both bonus and penalty clauses form part of the contract.

3 SUMMARY OF SYNDICATE DISCUSSIONS

3.1 Cold Front Reconnaissance and Wind Changes

A major requirement for effective fire weather services in southern Australia is the best possible prediction of the timing and intensity of cold fronts and the key meteorological elements ahead of and behind them. The cold fronts reconnaissance program for south eastern Australia was set up to assist this, encouraged by the results of an earlier Cold Fronts Research Program. In evaluating the impact of the reconnaissance program the syndicate reviewed the question *What do we need to accurately forecast cold fronts?*

It was agreed that a good three dimensional picture at the atmosphere is required, combined with a model which incorporates appropriate physical parameters, including land/sea contrast and topography.

The cold fronts reconnaissance program, whilst providing some new insights into local frontal structures, is not providing this for the following reasons:

- the area traversed is too small;
- the data are comprised of lines and difficult to assimilate into models;
- the coverage is too infrequent, and to increase the frequency would be too expensive;
- the instruments are not our own and therefore difficult or expensive to calibrate; and
- there are logistics problems, including flexibility of deployment and inadequacy of effective real time communication.

Alternative approaches to obtaining the required data are:

- aerosonde, once development has been funded, undertaken and proven;
- additional drifting or moored buoys which could possibly utilise funds diverted from a reduced aircraft reconnaissance program;
- high resolution modelling to provide improved forecasting and understanding;
- deployment of a marwinsonde on a short term, trial basis from a location such as King Island or Cape Grim, or on a suitable (fishing) boat;
- trial of a profiler (a lower altitude, fairly mobile profiler is now available for under $100,00); and
- Automatic Weather Stations - There is a requirement for at least one high altitude AWS in western Tasmania and up to six general AWS in South Australia.

A number of alternative approaches, for example, additional automatic weather stations and drifting buoys, are achievable; several others would require new initiatives. It may be possible to temporarily deploy a marwinsonde for a short period at a selected location but new initiatives would be required to acquire a profiler. For these reasons and the fact that, because of the mild fire weather season, several reconnaissance flights were undertaken under conditions that would not normally by justified, the conference believed that it would be premature to terminate the trial program. Fire authority representatives, whilst not being prepared to assist in funding the program, believe that the Bureau should take all necessary measures to ensure accurate forecasts of frontal movement and intensity.

The conference recognised operational difficulties which need to be overcome in operating routine reconnaissance, but agreed that an aircraft reconnaissance program be maintained at a lower level, using simpler instrumentation, perhaps maintaining 2 to 3 flights per year from South Australia. The Severe Weather Program Office and the South Australian and Tasmanian Regions will prepare a report to review operations to date and to assist decisions on the future program.

3.2 **Communication with Clients in the Computer Age**

The syndicate addressed the question of what should be communicated to whom and in what manner. It suggested that possible communications methods be investigated, taking into account existing fire and weather information systems. Possible systems would include a newsletter, bulletin board or small task force.

It was also suggested that a user survey be undertaken, involving Fire Authorities, the public and others. Other suggestions included:

- investigation of a weather radio AM or FM band on a routine or special fire day basis;
- e-Mail between Bureau and fire agencies;
- fire weather forecasts/updates on METFAX on a trial basis; and
- investigation of an existing Municipal Council network (an e-Mail System),

The Syndicate examined the **Status Quo**, considering both positives and negatives.

Positives include the following:

- lessons learned from outposting ie, service responsiveness, service development, enhanced inter-agency understanding of critical information, available data/information exchange, the recognition that forecasters and fire people have much in common; and

- routine services are enhanced by the increase in the amount of direct contact with fire managers which has occurred, both face-to-face and over the phone. Confidence is an essential element of an effective service. There is a need to have Bureau and Fire Agencies responsive to service relevance (to scale up or scale down services needs to be driven by "delivery and response").

Negatives include the following:

- although some differences between Regions in products provided are inevitable because of the necessity to respond to States'/Territories' needs, lack of a common approach in the Bureau to communicating information to fire authorities is seen as a disadvantage. As an example, participants cited developments available in Victoria, such as the Bureau multi component McIDAS display and the CFA automatic weather station display;

- fire authorities are frustrated to some extent when they see different services being supplied in other states and not being able to obtain such services themselves; and

- there is a lack of a common approach within States (Fire Agencies) in communicating information and some doubts that fire agencies obtain the greatest advantage from weather data today.

The plenary session discussed measures which could be undertaken to further improve communication between the Bureau and Fire Authorities, taking advantage of computer technology. The following points were made:

- there is a role for outposted devices as well as (rather than?) forecasters to provide processed information and data to fire authorities. To fulfil this role there is the possibility of developing an emergency management module in the Australian Integrated Forecast System (AIFS);

- the contribution of forecasters goes well beyond that of models alone. People involved with immediate service delivery add value to automated products. In New South Wales, fire authorities support relocation of a Bureau expert to their Headquarter during fire events, rather than outposting to going fires; Outposting is most developed in Victoria;

- in response to requests from fire authority representatives the Bureau will compile examples of each Region's fire weather forecast products to demonstrate the range of products which could be provided;

- there is an immediate requirement for the Bureau to routinely prepare and issue a wind change forecast chart for improved input into fire spread model;

- there is also an immediate requirement for routine daily rainfall bulletins/charts;

- the effectiveness of the fire weather service could be enhanced if the Bureau received routine fire combat/situation charts; and

- there is potential for the Bureau to play a significant leading role in the common application of technology.

3.3 Smoke Management

Smoke management is an increasingly sensitive environmental challenge. Failure to meet it could result in curtailing beneficial prescribed burning programs. In discussing requirements for weather services to improve smoke management, it is necessary to:

- understand the variety of users;
- predict the trajectories of smoke;
- assess the probability of smoke reaching specific sensitive zones; and
- identify synoptic situations in which poor smoke dispersal may cause problems.

In considering the how/what of addressing the smoke management problem, the following conclusions were made:

- little research has been undertaken to date on smoke management. Meteorological aspects lend themselves to early, beneficial results since the problem is well posed. However, there are difficulties in assessing smoke generation and intensity;

- there is considerable scope to apply dispersion packages to the output of numerical models and to relatively simply review and classify synoptic situations;

- there is a need to undertake developmental work at a Regional level, even if applying centrally developed methodologies, and to identify who does the work. There is scope for a project approach to be developed by inter-agency working groups at the Regional level. Such groups could also review regional applied research priorities, dispersion index (map form); and

- smoke management forecasts should be part of the basic service. Specific information, including an outlook to 2-4 days would be required by 8 a.m. Routine feedback from fire authorities would be required.

3.4 Aerosonde

The aerosonde system has considerable potential to contribute to fire weather services and services in general, assuming that cost and reliability targets are met. Its potential applications are as follows:

- the aerosonde is likely to be more effective and economical than conventional aircraft frontal reconnaissance;
- the system will be valuable in the 500 to 3000km offshore range for earlier warning;
- it will be useful for providing routine observations in remote areas and for other severe weather phenomena; and
- the aerosonde clearly has significant potential as a research tool.

Whilst recognising that additional instrumentation could not be too heavy or too large, the conference discussed possibilities such as a smoke detection instrument or a still video camera. The design philosophy for aerosonde is to keep it as simple and cheap as possible and not to build redundancy for maximum reliability into individual units. Any redundancy would be provided by a spare unit.

3.5 Training of Fire Weather Meteorologists

The Syndicate considered several questions and these, with a generally agreed response, are summarised below:

(a) *Who should be trained?* There is a different set of people in each region, some severe weather specialists, some general RFC forecasters. Regions would therefore set their own priorities.

(b) *What type of training?* The type of training would vary according to the group at which it would be directed eg Specialists/key people RFC meteorologists/practitioners.

(c) *What should the content be?* Specialists should undertake formal fire behaviour courses run by fire authorities, have knowledge of fire authority operations, attend going fires and have a thorough meteorological knowledge. Practitioners would have more informal training in fire behaviour, including orientation training (service ethic/media). Junior staff would undertake basic on-the-job familiarisation and be expected to have had a specified minimum period of experience before going to the practitioner level. Competencies should be set down and assessed for each level.

(d) *Who should do the training?* Key people in the syndicates (severe weather meteorologists and RFC SPOCs) believe that the Boise Fire Weather Forecasting Course is important, but not sufficient. Most of the training should be undertaken in Australia eg. the incident Command System (ICS) Courses, fire site attendance. In-house workshops held in Regions could borrow interstate staff if necessary. Inter-Region exchange and Fire Weather Workshops of the present type are also considered to be important. Basic training should be undertaken within each Region, partly by key people and practitioners and it would also be desirable for junior staff involved in fire weather services to attend Fire Weather Workshops. Fire weather matter should also be included as part of the Bureau's Diploma of Meteorology Course.

3.6 Long Term Outlook for Fire Danger Ratings in Australia

The Syndicate made the following recommendations:

(a) The Bureau and fire authorities, on a state level, should agree on ratings system to be used and fire weather districts for which ratings are issued. Whatever rating system is used, the Bureau and fire authorities should co-ordinate the level at which fire weather warnings and total fire bans are issued, again at a state level.

(b) There should be a system for disseminating information on the probability of lightning (eg on prognosis of instability). The Bureau should proceed with the acquisition (in coordinating with other authorities) of a real time lightning data system. This could be jointly financed.

(c) The Bureau and state fire authorities should evaluate the utility of the Haines Index, described by Rich Ochoa. If it proves useful, the Bureau should disseminate such information to fire authorities on a regular basis.

(d) The Bureau should investigate the production of a Normalised Difference Vegetation Index (NDVI) based on McIDAS processed satellite data.

3.7 Mesoscale Models for Fire Weather Forecasting

Syndicate discussion focussed on the Training Regional Atmospheric Model (TRAM) which is not seen to be an operational tool in the foreseeable future, rather a valuable diagnostic, training and developmental tool. There was discussion of the possibility of adapting a mesoscale limited area version of RASP to run on Regional SPARC work stations, supported by BMRC. It would be expected that TRAM or its successor would be ultimately integrated into AIFS.

The syndicate made the following recommendations:

(a) "TRAM conductors" groups should be set up in each region.

(b) Communication between them should be undertaken by a common e-mail address.

(c) There is a need for an expanded manual and a common training strategy, involving BMTC commitment, for regional meteorologists in the use of TRAM and its successors.

A need was recognised for an effective running strategy for the tropics. For example, nesting in TAPS would make TRAM or its successor appropriate for use in tropical regions. The ability to run associated storm surge models would be most important, particularly in the tropics.

The syndicate put forward suggestions for case studies, for example:

- smoke pollution trajectories;
- dry fire weather cases;
- east coast lows;
- meso lows;
- downslope winds;
- sea breezes; and
- trough movement.

The conference considered that it is vital to foster improved relations between BMRC and two regions and suggested 6 month visits to BMRC for techniques development. It also supported a recommendation from the syndicate that Regions should have access to and participate in evaluation of the parallel runs of new BMRC models prior to their implementation by NMC. There is sufficient capacity available within DIFACS to enable a selection of additional parallel output to be distributed to Regions.

4 RICK OCHOA'S OVERVIEW OF FIRE WEATHER IN AUSTRALIA

4.1 Background

Rick Ochoa gave an overview of his observations of the Australian Fire Weather Services from an American perspective. Rick was surprised by the range of services offered and the general advanced level of the Australian fire weather service. He believes that we are on the right track but sees an obvious need to keep improving, particularly in the areas of education, outposting, information and off-season services.

The joint AWS programs are great and the graphical CFA display is very good (he will take that back home). Rick suggested that we be careful to maintain high standards as there is very little fire weather research and the forecast formats are static.

4.2 Education

Education is a two-way street. Further fire behaviour education for fire weather meteorologists should be provided but should be at a national level and the course could even travel around to different agencies and states.

The Bureau should provide fire weather teaching facilities for its user agencies. The curriculum should be developed in conjunction with users. There will be a strengthening of ties and creditability as a result of effort put into education. The NSW training approach looks good.

4.3 Outposting

The Bureau should be active in offering outposting services and not wait until asked. Outposting has great benefits to the Bureau. A useful approach is to offer to provide on-site services and then to negotiate the kind and extent of services.

4.4 Preparedness

Are we really ready for another Ash Wednesday in the fire weather service? What is our disaster contingency planning? Are there extra people on the region ready to assist and also people from "out of State?". The efforts here should not be just preliminary planning. In conjunction with users, plan for the worst situation.

4.5 Ways to improve fire weather services

Rick suggested the following ways in which fire weather services could be improved:

- *fire weather newsletter and e-Mail to communicate with users.* Both the Bureau and users would like a high quality product.

- *off-season services.* Winter season rainfall, el nino status, etc. Need to use the off- season time to improve the total service.

- *conferences.* Keep the fire weather conferences going, maintain a program of informal meetings and some visits to users to ask the question "How are we doing?

- *media liaison.* We are kidding ourselves if we only keep to the technical side of forecasting. Visit the media and show them the techniques that are used in fire weather forecasting and they can be invited to prepare clips. They can only show so many firefighters on the fireline. When we had a week with a lot of fire we put out a press statement on the fire weather situation.

- *research.* There is very little fire weather research. Last year only two papers were produced in the USA on fire weather. Two areas that show promise are cold front reconnaissance and meso-modelling in Tasmania as fire weather research.

5 COST RECOVERY

Peter Noar (Assistant Director Services) addressed the question of cost recovery. He stated that the Bureau sees services related to fire protection as being in the public interest and therefore would not levy charges for them. We may, however, seek overtime top-up for outposting services. He stated that there is the necessity for a nationally agreed level of services. Brian Parry from NSW Bushfire Services pointed out that it is difficult to

redirect money from firefighting activities towards everyday services.

6 WRAP UP

Andrew Watson from Severe Weather in South Australia made a number of points summarising the key points arising from the conference.

There are slight inconsistencies due to different uses of different fire danger meters. We must not be too regional in outlook and maintain a high level of border communication. Cross border fire meetings should include Bureau participation. The question of one fire-danger meter provoked David Packham to suggest that there was not enough science available at this stage and that we need to ask the questions about the purpose for such meters. Are we predicting rate of spread, fire intensity or fire danger and fire activity?

On the question of levels of fire danger ratings for the setting of fire bans it appears that details of the appropriate level should be determined at the regional level. Graded warnings are desirable and it was suggested that Tasmania is on the right track.

Installation of a national lightning detection system was found to be particularly important, although some research effort will be required to establish skills in applying the data operationally. Advice on the probability of likely occurrence of lightning would be welcomed, especially in Victoria.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 *Aircraft Reconnaissance*

The conference recognised operational difficulties which need to be overcome in operating routine reconnaissance, but agreed that an aircraft reconnaissance program be maintained at a lower level, using simpler instrumentation, perhaps maintaining 2 to 3 flights per year from South Australia. The conference **recommended** that:

R1 the Severe Weather Program Office and the South Australian and Tasmanian Regions prepare a report to review operations to date and to assist decisions on the future program.

7.2 *Communication with Clients in the Computer Age*

The plenary session discussed measures which could be undertaken to further improve communication between the Bureau and Fire Authorities, taking advantage of computer technology and **recommended** that:

R2 to fulfil the forecaster outposting role to either going fires or fire authority headquarters, development of an emergency management module in the Australian Integrated Forecast System (AIFS) should be investigated;

R3 in response to requests from fire authority representatives, the Bureau will compile examples of each Region's fire weather forecast products to demonstrate the range of products which could be provided;

R4 there is an immediate requirement for the Bureau to routinely prepare and issue a wind change forecast chart for improved input into fire spread models;

R5 there is also an immediate requirement for routine daily rainfall bulletins/charts to be provided to fire authorities; and

R6 the effectiveness of the fire weather service could be enhanced if the Bureau received routine fire combat/situation charts.

7.3 ***Smoke Management***

In considering the how/what of addressing the smoke management problem, the following conclusions were made:

- little research has been undertaken to date on smoke management. Meteorological aspects lend themselves to early, beneficial results since the problem is well posed. However, there are difficulties in assessing smoke generation and intensity;

- there is considerable scope to apply dispersion packages to the output of numerical models and to relatively simply review and classify synoptic situations;

- there is a need to undertake developmental work at a Regional level, even if applying centrally developed methodologies, and to identify who does the work.

The conference **recommended** that:

R7 a project approach be developed by inter-agency working groups at the Regional level. Such groups could also review regional applied research priorities, dispersion index (map form);

R8 smoke management forecasts should be part of the basic service. Specific information, including an outlook to 2-4 days, would be required by 8 a.m. Routine feedback from fire authorities would be required.

7.4 ***Aerosonde***

The aerosonde system has considerable potential to contribute to fire weather services and services in general, assuming that cost and reliability targets are met. The conference reached the following **conclusions**:

- the aerosonde is likely to be more effective and economical than conventional frontal reconnaissance;

- it will be useful for providing routine observations in remote areas or for other severe weather phenomena; and

- the aerosonde clearly has significant potential as a valuable research tool.

7.5 *Training of Fire Weather Meteorologists*

The conference supported the conclusions and recommendations of the syndicate as summarised below:

- with respect to the question *"Who should be trained?"*, there is a different set of people in each region, some severe weather specialists, some general RFC forecasters. Regions would therefore set their own priorities;

- although the Boise Fire Weather Forecasting Course is important, it is not sufficient. Most of the training should be undertaken in Australia eg. the incident Command System (ICS) Courses, fire site attendance. In-house workshops held in Regions could borrow interstate staff if necessary; and

The conference **recommended** that:

R9 training fire weather be undertaken, varying according to the group at which it would be directed eg specialists/key people, RFC meteorologists/practitioners, and competencies should be set down and assessed for each level;

- specialists should undertake formal fire behaviour courses run by fire authorities, have knowledge of fire authority operations, attend going fires and have a thorough meteorological knowledge.

- practitioners would have more informal training in fire behaviour, including orientation training (service ethic/media).

- junior staff would undertake basic on-the-job familiarisation and be expected to have had a specified minimum period of experience before going to the practitioner level.

R10 the basic training in fire weather be undertaken within each Region, partly by key people and practitioners and that junior staff involved in fire weather services to attend Fire Weather Workshops.

R11 fire weather matters be addressed as part of the Bureau's Diploma of Meteorology Course.

7.6 *Long Term Outlook for Fire Danger Ratings in Australia*

The Conference **recommended** that:

R12 the Bureau and fire authorities, on a state level, should agree on ratings system to be used and fire weather districts for which ratings are issued. Whatever rating system is used, the Bureau and fire authorities should co-ordinate the level at which fire weather warnings and total fire bans are issued, again at a state level;

R13 there should be a system for disseminating information on the probability of lightning (eg on prognosis of instability). The Bureau should proceed with the acquisition (in coordinating with other authorities) of a real time lightning data system. This could be jointly financed;

R14 the Bureau and state fire authorities should evaluate the utility of the Haines Index, described by Rich Ochoa. If it proves useful the Bureau should disseminate such information to fire authorities on a regular basis; and

R15 the Bureau should investigate the production of a Normalised Difference Vegetation Index (NDVI) based on McIDAS processed satellite data.

7.7 *Mesoscale Models for Fire Weather Forecasting*

The conference strongly **recommended**

R16 that there be increased application of mesoscale models for the study and forecasting of systems important to fire weather and other applications, for example:

- smoke pollution trajectories;
- dry fire weather cases;
- east coast lows;
- meso lows;
- downslope winds;
- sea breezes; and
- trough movement.

With respect to the TRAM model, the conference recognised the essentiality for there to be commonality in mesoscale models utilised for training, operations and research, but was generally supportive of the conclusions reached by the Syndicate, as summarised in the earlier section of this report. TRAM is seen to be a valuable diagnostic, training and developmental tool for the intermediate future.

The conference recommended that:

R17 Regions should have access to and participate in evaluation of the parallel runs of new BMRC models prior to their implementation by NMC. There is considered to be sufficient capacity available with DIFACS to enable the transmission of test prognoses for real time evaluation.

R18 to foster improved relations between BMRC and the Regions, Regional meteorologists should continue to undertake visits to BMRC for techniques development. These visits should be up to six months, if possible.

A need was recognised for an effective running strategy for the tropics. For example, nesting in TAPS would make TRAM appropriate for use in tropical regions. The ability to run associated storm surge models would be most important, particularly in the tropics.

FIRE WEATHER WORKSHOP
PROGRAMME
2 - 7 MAY 1993
BOWRAL, NEW SOUTH WALES

SUNDAY 2 MAY

20.30 Happy Hour

MONDAY 3 MAY

8.30 **Opening - Patrick Sullivan**
Peter Noar
David Packham
9.30 Syndicates
. Cold front reconnaissance and wind changes.
(Andrew Watson/John Bally)
. Communication with clients in the computer age
(Tarini Casinader/John Nairn)
10.00 **Morning Tea**
10.30 . The smoke dispersion problem in southwest WA
(Rick Sneeuwjagt)
. Aerosonde
(Jeff Kepert)
11.00 Syndicate Meetings
12.00 **Lunch**
13.30 Resume Syndicates
14.15 Ageostrophic flow in vicinity of cold fronts
(Graham Mills)
15.00 **Afternoon Tea**
15.30 Plenary session - to discuss morning syndicates
17.00 Finish
18.30 **Dinner**
20.30 Meso modelling
(Jeff Kepert)

TUESDAY 4 MAY

8.30 Developments in fire weather forecasting
Haines Index and outposting of fire weather meteorologists
(Rick Ochoa)
10.00 **Morning Tea**
10.30 New equations for predicting fire spread in grasslands and their implication for fire danger rating
(Phil Cheney)
11.10 Fire weather forecasting requirements for prescription burning

12.00 **Lunch**
13.30 Syndicates
. Training for fire weather Meteorologists
(Tarini Casinader/Peter Gigliotti)
. Long term outlook for fire danger ratings in Australia
(David Packham)
. Mesoscale models for fire weather forecasting
(John Bally)
14.15 Syndicate Meetings
15.00 **Afternoon Tea**
15.30 Resume Syndicates
17.00 Finish
18.30 **Dinner**
20.30 *Information Sharing*
Use of stability in fire weather forecasting
(NSW Severe Weather)
Wind forecasting and observation networks
(WA Severe Weather)
Inter-regional communication between fire weather meteorologists
(VIC Severe Weather)

WEDNESDAY 5 MAY

8.30 Modelling the interaction between the weather and bushfires.
(John Bally/David Packham)
9.30 Plenary session
10.00 **Morning Tea**
10.30 Super plenary session
12.00 **Lunch**
13.30 Recreation
18.30 **Workshop Dinner**
(Rick Ochoa)

THURSDAY 6 MAY

8.30 Other severe weather matters
(Colin Pierrehumbert/Chris Ryan)
10.00 **Morning Tea**
10.30 Fire weather verification using RDIS and EMPRESS
(John Pethick)
11.10 Fuel assessment including remote sensing
10 mins Introduction, then discussion
(QLD Severe Weather)
12.00 **Lunch**
13.30 A climatology of extreme fire weather events over southern WA
(Barry Hanstrum)

14.15 TBA
15.00 **Afternoon Tea**
15.30 TBA
18.30 **Dinner**
20.30 *Soap Box Session**

FRIDAY 7 MAY
Chairperson: Peter Noar

8.30 Conclusions
10.00 **Morning Tea**
10.30 Conclusions cont'd
12.00 **Lunch**
13.30 Finish
14.30 Bus Departs for Sydney

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