PROCEEDINGS

OF THE FIRST CENTRAL REGION FIRE WEATHER COMMITTEE

SCIENTIFIC AND TECHNICAL SEMINAR

April 17, 1984
Winnipeg, Manitoba

Compiled and Edited

by

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Study NOR-5-191 File Report No. 10

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Government of Canada
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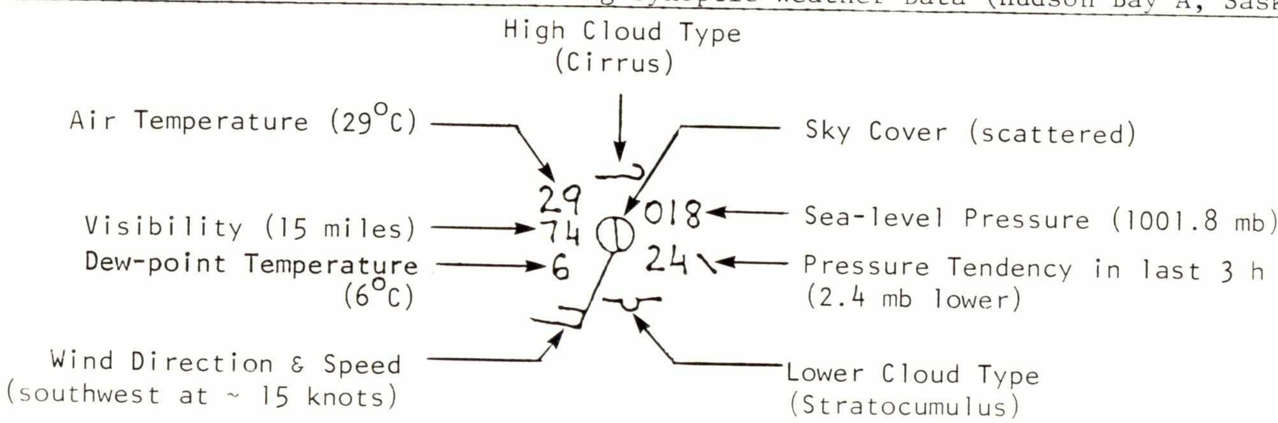
CONTENTS

COVER: Surface weather map for 1300 CDT, May 19, 1980 (courtesy of Alberta Forest Service Weather Section). The Woody Lake Fire in south-eastern Saskatchewan ran 19.3 km between 1200 and 1600 CDT for an average spread rate of 4.8 km/h. By late evening, it had advanced a further 12.9 km and crossed into Manitoba.

Sample Station Model Used For Plotting Synoptic Weather Data (Hudson Bay A, Sask.):



FOREWORD

The 1975 Federal Department of the Environment (DOE) Policy on Meteorological Services for Forest Fire Control sets out the responsibilities of the Atmospheric Environment Service (AES) and Canadian Forestry Service (CFS) in provision of fire weather forecasts, fire danger forecasts, and other weather-related services to the various fire control agencies. Briefly, this policy gives AES the responsibility of providing current and forecast fire weather and Fire Weather Indices in accordance with the needs of fire control agencies. The CFS role is that of research and development of improved Indices, research on fire behavior relationships with weather factors, and cooperation with AES in preparation of training aids and manuals. Both AES and CFS share the responsibility of improving meteorological services for fire control in Canada.

In 1976, six regional committees[1] were formed to facilitate the implementation of the DOE Policy on Meteorological Services for Forest Fire Control. The "charter" for these regional fire weather committees is as follows:

Membership: 1 or more AES representatives designated by AES Regional Director; 1 or more CFS representatives designated by CFS Regional Director; and 1 or more fire management agency representatives designated by the Provincial or territorial chief(s) of forest fire management.

Terms of Reference: Each Regional Committee will make recommendations to the Regional Directors of DOE Services (i.e., AES and CFS) for the development and implementation of a program of Meteorological Services for Forest Fire Control which is suited to the needs of the Region and is within the DOE Policy and Guidelines thereto.

Guidelines: Regional Committees will be responsible for (a) identifying the needs of regional fire management agencies for meteorological services; (b) making recommendations to the Regional Directors of DOE Services for the development and implementation of the services identified in sub-section (a); (c) monitoring the program and implementing changes, as required; (d) coordinating with the Development Committee; and (e) referring to the Development Committee those recommendations which the Regional Directors of DOE Services have been unable to implement.

The function of the Development Committee, referred to above, is to coordinate, in consultation with the Regional Committees, the development of meteorological services for forest fire management through contacts, at the technical level, between research and development officers of AES and CFS, operations supervisors in the AES field establishments and technical representatives of fire management agencies.

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[1] These were aligned on the basis of the existing AES administrative boundaries: Pacific (British Columbia); Western (Yukon, Northwest Territories, and Alberta); Central (Saskatchewan, Manitoba, and northwestern Ontario); Ontario; Quebec; and Atlantic (Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island).

INTRODUCTION

The inaugural meeting of the Central Region Fire Weather Committee (CRFWC) took place at the Atmospheric Environment Service's (AES) Central Region office in Winnipeg on January 26, 1976. In 1983, a "technical sub-committee" was formed. The terms of reference for the CRFWC Technical Sub-Committee state that it "... may (and is encouraged to) provide the opportunity for the presentation and discussion of scientific and technical papers on subjects relating to forest fire meteorology in the Region [i.e., Saskatchewan, Manitoba, and northwestern Ontario]." The Western Region Fire Weather Committee had previously organized two such gatherings in 1983[1] and 1984[2].

The first in a series of what is hoped to be continuing program of CRFWC Technical Sub-Committee seminars was held at the AES Central Region office in Winnipeg on April 17, 1984 in conjunction with the group's annual spring business meeting. Five presentations were made and this report constitutes the seminar "proceedings". A list of individuals attending the seminar is given at the end of this report. It is felt that such sessions provide an excellent forum for the exchange of information, ideas, etc. on fire-weather related topics of interest to all CRFWC member agencies.

Martin E. Alexander

CRFWC Seminar Coordinator

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[1] Alexander,M.E. (ed.). 1983. Western Region Fire Weather Committee (WRFWC) seminar proceedings (Mar. 22, Edmonton, Alta.). Environment Canada, Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alta. Study NOR-5-191 File Report No. 5. 11 p.

[2] Alexander, M.E. (ed.). 1985. Proceedings of the second Western Region Fire Weather Committee scientific and technical seminar (Mar. 6, 1984, Edmonton, Alta.). Government of Canada, Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alta. Study NOR-5-191 File Report No. 9. 29 p.

REVIEW OF OPERATIONAL WEATHER FORECAST PROCEDURES FOR THE 1984 FOREST FIRE SEASON[1]

by

Daniel A. Vandevyvere[2]

The first forecast product that was reviewed was the Forestry Area Forecast for Saskatchewan and Manitoba which have identical formats. An example of a Forestry Area Forecast for Saskatchewan was shown (Fig. 1) and the various parameters were explained. The procedure for updating and delivering these forecasts to the users (i.e., the provincial forestry services) was also discussed. The "Forestry Special Site Fire Forecast" for Saskatchewan and the "Special Area Forestry Forecast" for Manitoba were also reviewed.

The next subject was the Forestry Point Forecasts for Saskatchewan and Manitoba. Once again, both provinces employ the same format. Figure 2 was displayed in order to demonstrate to the forecasters what options are available to them when they use program "FIREP". An example of the Forestry Point Forecasts for Manitoba was presented (Fig. 3) and the various forecast parameters were explained.

```
FORECAST RELEASED FOR TRANSMISSION AT 1206Z
MS
142
ATTENTION WO YPA
FORESTRY AREA FORECASTS - SASKATCHEWAN

VALID 191300Z TO 201300Z  ISSUED 19 SEPTEMBER 1983
FCST WINDS ARE FOR 10 METERS IN AN OPEN CLEARING

REGIONS    TX TM RH RHX  R%  RA LTG INV TIL DDFF  TI DDFF TI DDFF

MEADOW LK  03 00 55 95   00  00 00  WK  16  3235  15 3250 02 3230

BFLO NRWS  02 00 60 95   20  05 00  WK  16  3335  15 3350 01 3335

PRNC ALBT  04 00 65 95   40  05 00  WK  17  3340  16 3350 01 3335

LA RONGE   00 00 70 95   60  05 00  WK  16  3335  16 3350 01 3335

HUDSON BY  04 00 65 95   40  05 00  WK  16  3235  16 3350 01 3335

$$$$
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Figure 1. An example of the Forestry Area Forecast (for Saskatchewan).

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[1] *Summary of a presentation made at the First Central Region Fire Weather Committee Scientific and Technical Seminar, Apirl 17, 1984, Winnipeg, Man.*

[2] *Meteorologist, Prairie Weather Centre, Atmospheric Environment Service, Central Region, 266 Graham Avenue, Winnipeg, Man. R3C 3V4.*

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: FIREP
SASKATCHEWAN(SA) OR MANITOBA(MA)?
     REPLY SA OR MA
SPECTRAL GRID-POINT DATA RECEIVED 1200Z APRIL 17  1984
DO YOU WISH TO:-
       USE SPECTRAL'S PRAIRIE WINDOW? (PW)
       OBTAIN A BLANK FORM? (BF)
       OR RECALL THE DATA ALREADY IN THE FILE? (RC)
```

Figure 2. An example of the options available with program FIREP.

9:26 PM WED., 11 APR., 1984

CNO	STN	TS	RH	WND	PCP
1	LYNN L	1	74	8	0.0
2	HDSN B	5	80	8	0.0
3	W HAWK	5	54	17	0.0
4	HDSVLE	4	57	16	0.0
5	WHTMTH	4	58	16	0.0
6	NTMK L	4	55	17	0.0
7	BLCK L	4	56	16	0.0
8	BISSET	3	57	15	0.0
9	BISSET	3	57	15	0.0
10	LTL GR	3	57	13	0.0
11	ISLD L	3	57	11	0.0
12	ISLD L	3	57	11	0.0
13	GODS N	3	58	10	0.0
14	GILLAM	2	66	7	0.0
16	WNNPEG	3	65	14	0.0
17	PINEY	5	60	16	0.0
18	MRCHND	4	59	16	0.0
19	GIMLI	3	64	14	0.0
20	LAC DB	3	59	15	0.0
22	RIVRTN	3	64	14	0.0
23	BSJOUR	4	58	16	0.0
24	GRBCH	3	59	15	0.0
25	BRNS R	3	66	12	0.0
26	NRWY H	3	73	10	0.0
27	THMPSN	2	75	8	0.0
28	THMPSN	2	75	8	0.0
32	ASHERN	3	71	12	0.0
33	GYPSVL	3	73	11	0.0
34	WPGOSS	4	77	10	0.0
36	GR RPD	3	77	10	0.0
37	WBOWDN	3	76	9	0.0
38	DAUPHN	4	78	10	0.0
40	DUCK M	3	84	9	0.0
41	SWAN R	4	81	9	0.0
42	MAFKNG	4	81	9	0.0
43	HART M	3	85	9	0.0
44	TH PAS	4	79	9	0.0
45	TH PAS	4	79	9	0.0
47	SNOW L	2	78	8	0.0
48	CRBY P	4	79	9	0.0
49	PINFFL	3	61	15	0.0
50	PKTWGN	3	77	9	0.0

Figure 3. An example of the Forestry Point Forecast (for Manitoba).

The simulation of weather observations was the next topic. The reason for these 'observations' was explained and an illustration of the computer output requesting the bogusing of weather data was displayed (Fig. 4). The input parameters as well as the technique for entering them was reviewed.

```
TIME OF REQUEST - 1983  263   18   45
BOGUSING OF WEATHER DATA IS REQUIRED FOR

SASKATCHEWAN FORESTRY

PLEASE CHECK THE FOLLOWING AND REENTER ALL VALUES
EVEN IF THE DATA APPEARS TO BE CORRECT
                                             24HR PCPN   6HR PCPN
 STN              TEMP         RH   WND SPEED  18Z-18Z    12Z-18Z
  ID   CNO          C           %         KMH     TENTHS OF MM

YBE      2          3          47           2

YVC     18      32767       32767       32767

YPA     24      32767       32767       32767

YBU     26          5          65          31

TO BOGUS USE A CRT AT A FORECAST DESK
IN RESPONSE TO THE PROMPT ENTER 'BOGUS'
ENTER THE CNO AND THE 5 REQUIRED PARAMETERS WITH
A COMMA BETWEEN EACH ONE
ENTER 99 OR BLANKS FOR CNO TO FINISH
FILE FORM ON THE FORESTRY FILE
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Figure 4. An example of simulating weather observations (for Saskstchewan).

Finally the Ontario Forestry Area Forecasts were discussed. Since the format of this forecast had changed from that of the previous years, this forecast was explained in more detail. Examples of the afternoon (Fig. 5) and morning (Fig. 6) versions were presented. The valid times of the different portions of the forecast (the synopsis, the worded forecast, and the coded forecasts were detailed.

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FPCN32 CWWG 301830
FORESTRY FIRE WEATHER SYNOPSIS AND FORECASTS FOR ONTARIO REGIONS
WEST OF NIPIGON ISSUED BY ENVIRONMENT CANADA AT 1.30 PM MONDAY
APRIL 30 1984 FOR TONIGHT AND TUESDAY WITH AN OUTLOOK FOR TUESDAY NIGHT.

SYNOPSIS.
AT 10 AM CDT (15Z)...QUASI-STATIONARY ARCTIC FRONT PORTAGE LA PRAIRIE
TO ISLAND LAKE TO WINISK. LOW CENTERED OVER NORTHEASTERN IOWA.
BY 7 AM CDT TUESDAY (12Z)...ARCTIC FRONT PORTAGE LA PRAIRIE TO ISLAND
TO WINISK. LOW CENTERED OVER EASTERN ILLINOIS.
MODERATE EASTERLY FLOW OF DRY AIR OVER REGIONS.

CODED FORECASTS...
TONIGHT...AVERAGE WIND (AT TREE TOP LEVEL) - MIN TEMP - MAX RH -
          RAINFALL: 12 HR FROM 8 PM (01Z) TO 8 AM (13Z) -
          REMARKS (USUALLY WINDSHIFTS).
TOMORROW...WIND (AT TREE TOP LEVEL) - TEMP - RH: FOR 1 PM (18Z)
           RAINFALL: 24 HR AMOUNT FROM 1 PM (18Z) TODAY TO 1 PM (18Z)
           TOMORROW - STABILITY: FROM 2 PM TO 6 PM - REMARKS

NW-1-2-3 NC-2
TONIGHT AND TUESDAY...MAINLY CLEAR.
TUESDAY NIGHT...CLEAR.

NW-1-3 NC-2
TONIGHT NE30/0/90/0
TUESDAY NE40/12/40/0/U

NW-2
TONIGHT NE25/0/90/0
TUESDAY N30/13/40/0/U
------------------------------------------------------------------------
NC-1
TONIGHT...CLEARING.
TUESDAY...SUNNY.
TUESDAY NIGHT... INCREASING CLOUD.

NC-1
TONIGHT E35/0/90/0
TUESDAY NE40/12/40/0/S

END
$$$$..
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Figure 5. An example of the 'afternoon issue' of the Ontario Forestry Area Forecast.

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FPCN31 CWWG 301200
FORESTRY FIRE WEATHER SYNOPSIS AND FORECASTS FOR ONTARIO REGIONS
WEST OF NIPIGON ISSUED BY ENVIRONMENT CANADA AT 7 AM MONDAY
APRIL 30 1984 FOR TODAY AND TONIGHT.

SYNOPSIS.
AT 4 AM CDT (09Z)...DIFFUSE ARCTIC WARM FRONT ISLAND LAKE TO LANSDOWNE
HOUSE. MARITIME COLD FRONT NORTH TO SOUTH THROUGH WINNIPEG.
BY 7 PM CDT (00Z)...WARM FRONT 50 KM NORTH OF TROUT LAKE TO GILLAM.
COLD FRONT NORTH SOUTH THROUGH ATIKOKAN.
UNSTABLE AIRMASS AHEAD OF COLD FRONT AND SOUTH OF WARM FRONT. AIRMASS
MORE STABLE WEST OF COLD FRONT. AIRMASS EAST OF THE COLD FRONT MOIST
BECOMING MODERATELY DRY WEST OF COLD FRONT.

CODED FORECASTS...
WIND (AT TREE TOP LEVEL) - TEMP - RH: FOR 1 PM (18Z) TODAY.
RAINFALL: FROM 8 AM (13Z) TO 1PM (18Z) TODAY.
STABILITY: FROM 2 PM TO 6 PM - REMARKS (USUALLY WINDSHIFTS)

NW-1-2-3
TODAY...VARIABLE CLOUDINESS WITH SHOWERS AND THUNDERSHOWERS.
TONIGHT...CLOUDY WITH OCCASIONAL SHOWERS.

NW-1
TODAY S15/20/65/1-3/VU WIND BECOMING SW20 THIS AFTERNOON.

NW-2-3
TODAY S20/22/65/1-4/VU WIND BECOMING SW20 THIS EVENING.
----------------------------------------------------------------------
NC-1-2
TODAY...VARIABLE CLOUDINESS WITH OCCASIONAL SHOWERS OR THUNDERSHOWERS.
TONIGHT...VARIABLE CLOUDINESS.

NC-1-2
TODAY SE35/23/60/1-2/U

END
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Figure 6. An example of the 'morning issue' of the Ontario Forestry Area Forecast.

Editor's Note: The following reference and accompanying abstract are directly related to the author's presentation.

Raddatz, R.L.; Atkinson, G.B. 1982. Automated weather element input to forest fire severity forecasting. Environment Canada, Atmospheric Environment Service, Downsview, Ont. Technical Memoranda TEC 877. 15 p.

Abstract: Across Manitoba and Saskatchewan appropriate weather element forecasts for each forestry station are automatically derived from grid-point output from the Canadian Meteorological Centre Spectral Model assuming a well-mixed planetary boundary layer. After modification, as required, by the Forestry Meteorolgist, these forecasts are used to calculate Fire Weather Index values, which are entirely a function of weather, to predict the short-term potential forest fire severity. Verification statistics for 1980 and 1981 indicate that the forecasts of temperature, humidity and wind speed were correct about two thirds of the time, and the forecasts of precipitation about 80 per cent of the time.

SYNOPTIC FIRE WEATHER CLIMATOLOGY[1]

by

Roger B. Street[2]

Severe fire weather can generally be directly related to prolonged periods of dry weather. Climatological analyses of the temporal and spatial charactersitics of extratropical cyclones and anticyclones and the general circulation reveal some plausible explanations for this relationship. The casual factors involved is explored during this investigation with particular reference to forest fires in central Canada.

A study of the synoptic-scale weather associated with severe forest fires is by no means a new approach. Investigators in Australia, Canada and the United States have documented the fire weather and associated fuel and fire behavior characteristics for selected fires. Investigations have shown that the vast majority of fires studied were associated with: (a) the eastern portion of small amplitude but intense shortwave troughs at 500mb; (b) flow patterns which blocked low level (85kPa) moisture advection; and (c) a surface frontal system and in particular a surface cold front. Examination of the meteorological conditions associated with major wildland fires in the United States, Canada and Australia and concluded that comparable casual synoptic-scale weather factors were associated with major fires in all three countries.

The 1980 Rolling River Fire in Riding Mountain National Park and the 1983 forest fire season in central Canada demonstrate the relationship between fire behavior and synoptic-scale weather features suggested by other investigators.

The primary cause of the prolonged periods of dry weather which are directly related to periods of major wildfire activity is upper-air long wave ridging in the atmospheric circulation pattern over central North America. The development and persistence of this type of circulation pattern over the center of the continent effectively blocks the influx of atmospheric moisture into central Canada. In addition, this upper-air circulation pattern favors the establishment of a subsidence inversion over Manitoba and northwestern Ontario and the advection at the surface of warm, dry air from the south-central United States. This combination of meteorological conditions is responsible for severe fire weather periods in central Canada.

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[1] *Summary of a presentation made at the First Central Region Fire Weather Committee Scientific and Technical Seminar, April 17, 1984, Winnipeg, Man.*

[2] *Forestry Applications Meteorologist, Atmospheric Environment Service, Climatological Applications Branch, Application and Impact Division, 4905 Dufferin Street, Downsview, Ont. M3H 5T4.*

Editor's Note: the following is a selected list of publications related to the author's presentation.

Anonymous. 1982. Forest fire management - meteorology: a training manual. First edition. Environment Canada, Atmospheric Environment Service, Central Services Directorate, Toronto, Ont. 261 p.

Stocks, B.J.; Street, R.B. 1983. Forest fire weather and wildfire occurrence in the boreal forest of northwestern Ontario. Pages 249-265 *In* Resources and Dynamics of the Boreal Forest Zone - Proceedings of a Conference (Aug. 23-26, 1982, Thunder Bay, Ont.). Association of Canadian Universities for Northern Studies, Ottawa, Ont.

Street, R.B. 1979. Forest fires-- as effected by low-level jets and wet-bulb potential temperatures. M.Sc. Thesis, Univ. Toronto, Toronto, Ont. 157 p.

Street, R.B. 1983. Fire weather forecasting: a synoptic overview. Atmospheric-Ocean 21: 55.

Street, R.B.; Alexander, M.E. 1980. Synoptic weather associated with five major forest fires in Pukaskwa National Park. Environment Canada, Atmospheric Environment Service, Ontario Region, Scientific Services Division, Toronto, Ont. Internal Report SSD-80-2. 62 p.

Street, R.B.; Stocks, B.J. 1983. Synoptic-scale fire weather in north-western Ontario. Pages 9-12 *In* Preprint Volume Seventh Conference on Fire and Forest Meteorology (Apr. 25-28, Fort Collins, Colo.). American Meteorological Society, Boston, Mass.

Alexander, M.E.; Janz, B.; Quintilio, D. 1983. Analysis of extreme wildfire behavior in east-central Alberta: a case study. Pages 38-47 *In* Preprint Volume Seventh Conference on Fire and Forest Meteorology (Apr. 25-28, Fort Collins, Colo.). American Meteorological Society, Boston, Mass.

Brotak, E.A. 1980. A comparison of the meteorological conditions associated with major wildland fires in the United States, Canada, and Australia. Pages 38-41 *In* Proceedings Sixth Conference on Fire and Forest Meteorology (Apr. 22-24, Seattle, Wash.). Society of American Foresters, Washington, D.C.

Brotak, E.A.; Reifsnyder, W.E. 1977. Predicting major wildland fire occurrence. Fire Management Notes 38(2): 5-8.

Newark, M.J. 1974. The relationship between forest fire occurrence and 500 mb longwave ridging. Atmosphere 13: 26-33.

Nimchuk, N. 1983. Wildfire behavior associated with upper ridge breakdown. Alberta Energy and Natural Resources, Forest Service, Edmonton, Alta. ENR Report No. T/50. 45 p.

DAY-1 FORECASTING IN FOREST FIRE DANGER RATING[1]

by

Peter M. Paul[2]

An effective forest fire weather/danger forecasting system requires the rapid dissemination of pertinent information necessary for fire control operations. Such a system must deal with the acquisition of current weather as well as with the prediction of future weather. In Canada, the routine daily fire weather/danger forecasting procedure is handled in a number of different ways. The system described is a much improved version of one originally introduced into the Maritime Provinces by the author in 1970. It is, however, applicable to all of Canada east of the Rocky Mountains. The presentation dealt exclusively with the daily forecasting procedure rather than the special forecasting routine that is activated when fires start. A particular area and time period was selected to illustrate the steps and procedures involved (Fig. 1). The locale is northeastern New Brunswick and the time interval is the 48-h period from 1300 ADT on Sunday, June 23 (Figs. 2 and 3) to 1300 ADT on Tuesday, June 25 (Figs. 4 and 5). This example was chosen because the protection unit experienced dry and then wet weather during which the fire danger dropped from EXTREME to LOW.

Day 23

1300 Sunday Fire Danger for Chatham: EXTREME

1600 24 Hr. Fcst 55A for Monday

Afternoon Routine:

- A1 Noon Wx Obs
- A2 Stn / Area Print-Out
- A3 Area 'ANX' Map
- A4 Fcst Wx Map
- A5 Fcst Print-Out
- A6 Fcst Message
- A7 Fcst Media Map

Day 24

0600 Update Fcst 55B for Monday. (Procedure not illustrated; see Fcst 56B.)

1000 Fires reported from Chatham area Monday morning. (Special forecasts issued; procedure not illustrated.)

Day 24

1300 Monday Fire Danger for Chatham: HIGH

1600 24 Hr. Fcst 56A for Tuesday. (Procedure not illustrated; see Fcst 55A).

Day 25

0600 Update Fcst 56B for Tuesday.

Morning Routine:

- B1 Fcst Wx Map
- B2 Fcst Print-Out
- B3 Fcst Message
- B4 Morn Wx Obs
- B5 Synoptic Rain Obs
- B6 Rain Check
- B7 Stn Rain Map
- B8 Fcst Wx Check
- B9 Area FWI Map

1300 Tuesday Fire Danger for Chatham: LOW

Figure 1. Sequence of events associated with the New Brunswick case study.

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[1] *Summary of a presentation made at the First Central Region Fire Weather Committee Scientific and Technical Seminar, April 17, 1984, Winnipeg, Man.*

[2] *Forestry Officer, Canadian Forestry Service, Place Vincent Massey - 19th Floor, 351 St. Joseph Blvd., Hull, Que. K1A 1G5.*

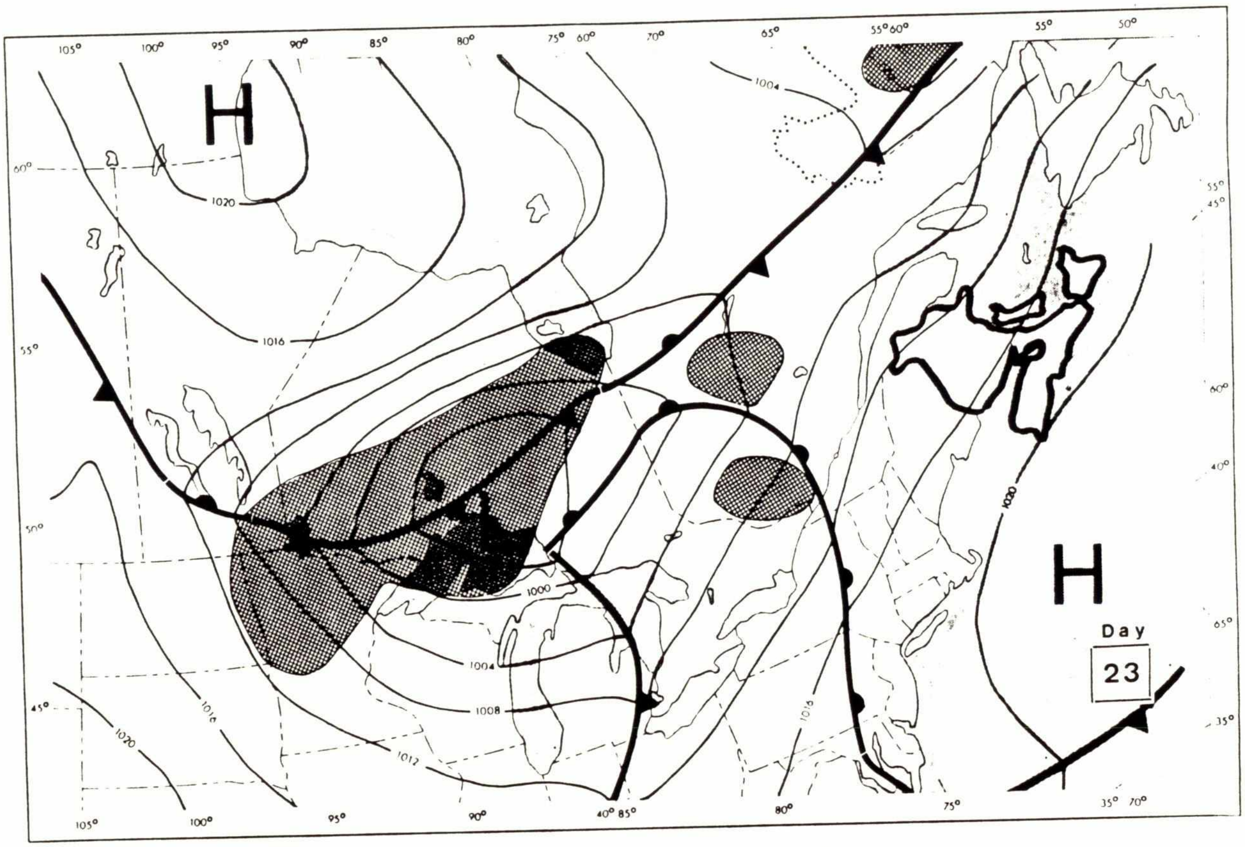

Figure 2. Surface Weather Map for 1800 GMT (1500 ADT), Sunday, June 23.

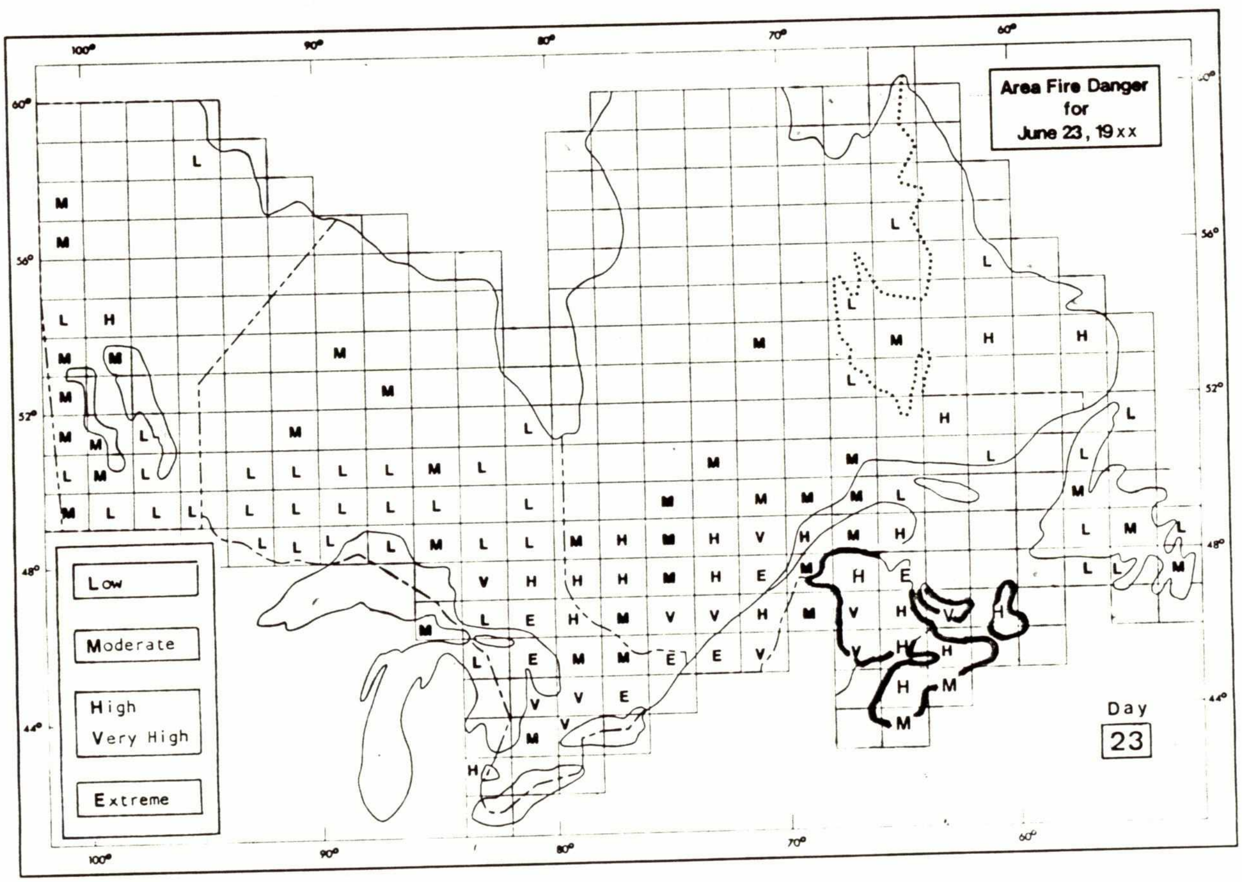

Figure 3. Area Fire Danger (FWI adjective class) Map for Sunday, June 23.

Figure 4. Surface Weather Map for 1800 GMT (1500 ADT), Tuesday, June 25.

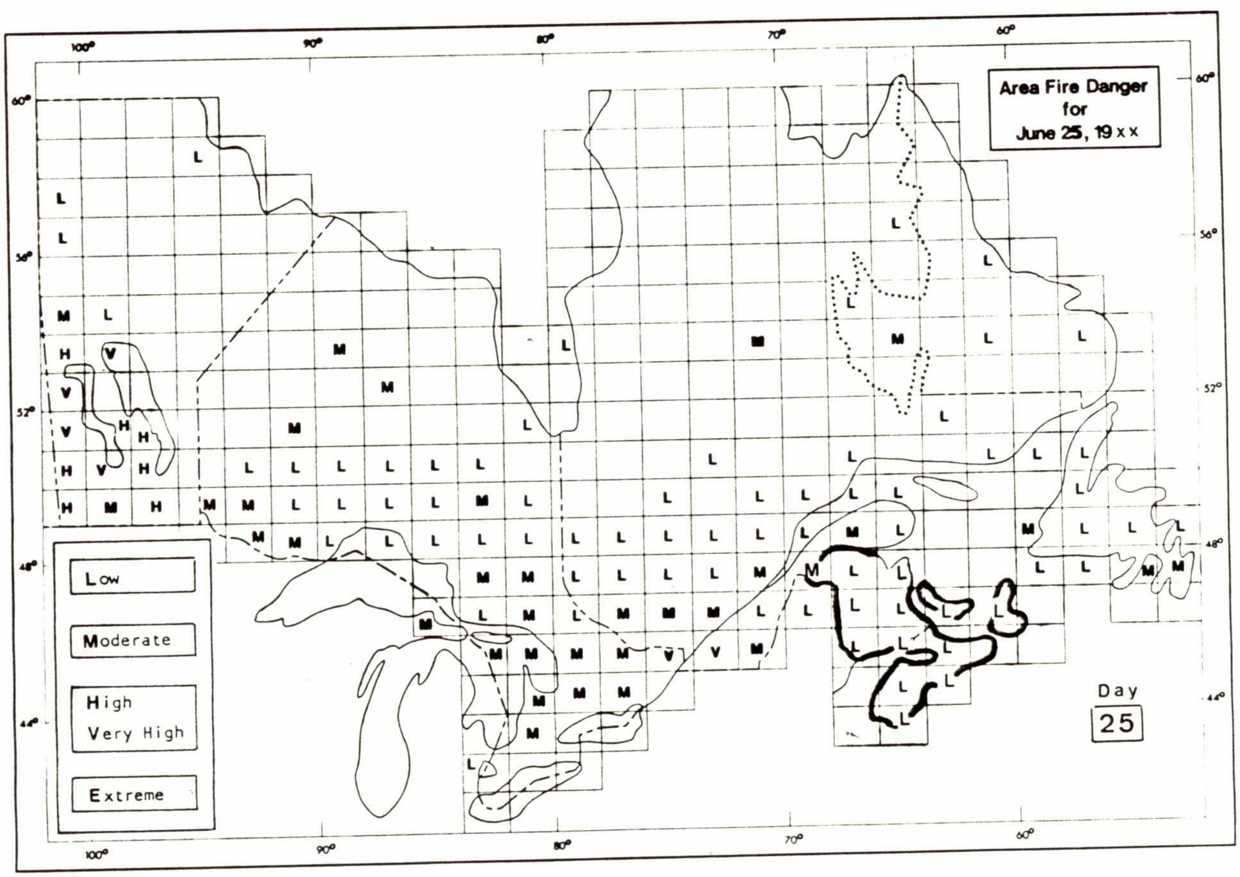

Figure 5. Area Fire Danger (FWI adjective class) Map for Tuesday, June 25.

Editor's Note: the following is a list of publications related to the author's presentation.

Goldrup, B.T. 1968. The use of a synoptic weather station in forecasting forest fire danger for the Maritime Provinces. Canada Department of Forestry and Rural Development, Forestry Branch, Forest Research Laboratory, Fredericton, N.B. Internal Report M-28. 6 p.

Goldrup, B.T. 1970. The accuracy in forecasting forest fire danger for the Maritime Provinces, 1964 to 1969. Canada Department of Fisheries and Forestry, Canadian Forestry Service, Forest Research Laboratory, Fredericton, N.B. Internal Report M-54. 36 p.

Goldrup, B.T.; Jordan, G.A. 1974. Computerized fire weather forecasting in Atlantic Canada. Forestry Chronicle 50(4): 146-148.

Jordan, G.A. 1973. The analysis, design, and implementation of a computerized system of Fire Weather Index in Atlantic Canada. M.Sc. Thesis, University of New Brunswick, Fredericton, N.B. 90 p.

Paul, P.M. 1963. Forecasting forest fire danger in the Maritime Provinces. Paper presented at the Canadian Institute of Forestry Annual Meeting (Oct. 10, Halifax, N.S.). Canada Department of Forestry, Forest Research Branch, Fredericton, N.B. Mimeo. Report 63-M-20. 8 p.

Paul, P.M. 1964. Forecasting forest fire danger in the Maritime Provinces. Canada Department of Forestry, Forest Research Branch, Ottawa, Ont. Publication No. 1047. 14 p.

Paul, P.M. 1966. Steps in forecasting forest fire danger in the Maritime Provinces. Background paper for the Canadian Institute of Forestry Session on 'Forest Fire Control' (Oct. 3-6, Banff, Alta.). Canada Department of Forestry, Forest Research Laboratory, Fredericton, N.B. 39 p.

Paul, P.M. 1970. Fire weather forecasting for the Maritime Provinces (1964-70). Canada Department of Fisheries and Forestry, Canadian Forestry Service, Forest Research Laboratory, Fredericton, N.B. Information Report M-X-22. 75 p. + Appendix.

Paul, P.M. 1974. A national fire weather forecasting system for the forests of Canada. Ph.D. Thesis, Cornell University, Ithaca, N.Y. 442 p. (Dissertation Abstract International 35: 4581-B).

Paul, P.M. 1983. Day-1 forecasting in forest fire danger rating. Atmosphere-Ocean 21: 55.

Editor's Note: the following is a list of publications detailing with the fire danger forecasting aspects of the Canadian Forest Fire Weather Index System.

Berry, M.O. 1974. Occurrence and prediction of Fire Weather Indices in the Northwest Territories. Environment Canada, Atmospheric Environment Service, Downsview, Ont. Technical Memoranda TEC 803. 14 p.

Doan, G.E.; Martell, D.L. 1974. The computer based fire weather information system in Ontario. Forestry Chronicle 50(4): 149-150.

Gilbert, D.E.; Nias, J.M. 1980. The British Columbia fire weather management information system. Pages 13-17 *In* Proceedings Sixth Conference on Fire and Forest Meteorology (Apr. 22-24, Seattle, Wash.). Society of American Foresters, Washington, D.C.

Kayll, A.J. 1974. Computer based fire weather forecasting systems in eastern Canada. Forestry Chronicle 50(4): 145.

Kiil, A.D. 1972. Computerized Canadian Forest Fire Weather Index. Environment Canada, Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alta. Forestry Report 2(1): 7.

Kourtz, P. 1972. Probability makes fire danger index more reliable. Fire Control Notes 33(4): 11-12.

Raddatz, R.L.; Atkinson, G.B. 1982. Automated weather element input to forest fire severity forecasting. Environment Canada, Atmospheric Environment Service, Downsview, Ont. Technical Memoranda TEC 877. 15 p.

Turner, J.A.; Lawson, B.D. 1978. Fire weather forecasts and fire danger forecasting. Chapter 6 (p. 28-29) *In* Weather in the Canadian Forest Fire Danger Rating System: a user guide to national standards and practices. Environment Canada, Canadian Forestry Service, Pacific Forest Research Centre, Victoria, B.C. Information Report BC-X-177. 40 p.

CANADIAN FOREST FIRE DANGER RATING SYSTEM: AN UPDATE[1]

by

Martin E. Alexander[2]

'Fire danger' is a general term used to express an assessment of both fixed and variable factors which influence the chances of a fire(s) starting, spreading and doing damage, and its difficulty of control. Fixed or constant fire danger factors vary from place to place at a given time (e.g., topography, solar radiation, values at stake, fire climate, fuel complexes). It is the object of presuppression planning to take these constant elements into account in permanent fire plans as part of an assessment of 'total fire danger'. Variable fire danger factors are those that vary from time to time (throughout the day and from day to day) at any given place (e.g., temperature, relative humidity, wind, precipitation, condition of lesser vegetation, fire risk or ignition sources, fuel moisture, upper air conditions). The purpose of a fire danger rating system is to properly integrate the combined effects of these constant and variable elements on fire potential (i.e., occurrence, behavior, and impact) into one or more qualitative and/or numerical indices of current protection needs. Practical and scientific considerations limit the number of variables that can be accounted for in a fire danger rating system.

The Canadian Forest Fire Danger Rating System (CFFDRS) has been under development in its present form since 1968, when the Canadian Forestry Service (CFS) adopted a "modular" approach to a new national system of fire danger rating (Fig. 1). The first major module or sub-system of the CFFDRS, the Canadian Forest Fire Weather Index (FWI) System, was released provisionally in 1969. The first edition of the FWI System tables appeared in 1970. The first metric version of the system appeared in 1976 and this was followed by a second one in 1978. The fourth edition of the tables for the FWI System has now been published (Canadian Forestry Service 1984). A companion publication, dealing with the mathematical formulae and computer program for the FWI System, has also been prepared (Van Wagner and Pickett 1984). The six standard components of the FWI System provide numerical ratings of relative wildland fire potential in a standard fuel type (i.e., mature pine stand) on level terrain. The system components are based on consecutive daily fire weather observations at a properly established and maintained station. The first three components are fuel moisture codes that follow daily changes in the moisture content of three classes of forest fuel -- fine surface litter (FFMC), loosely compact duff of moderate depth (DMC), and deep compact organic matter (DC). The final three components are relative fire behavior indexes that represent rate of spread (ISI), amount of available fuel for combustion (BUI), and line- or frontal fire intensity (FWI). The system provides a basic, uniform method of rating fire danger across Canada. Turner and Lawson's (1978) weather guide for the CFFDRS is currently under revision for publication in the CFS Forestry Technical Report (FTR) series.

The second major module of the CFFDRS was conceived, in the original modular approach, as a series of regionally developed guides to absolute or

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[1] *Summary of a presentation made at the First Central Region Fire Weather Committee Scientific and Technical Seminar, April 17, 1984, Winnipeg, Man.*

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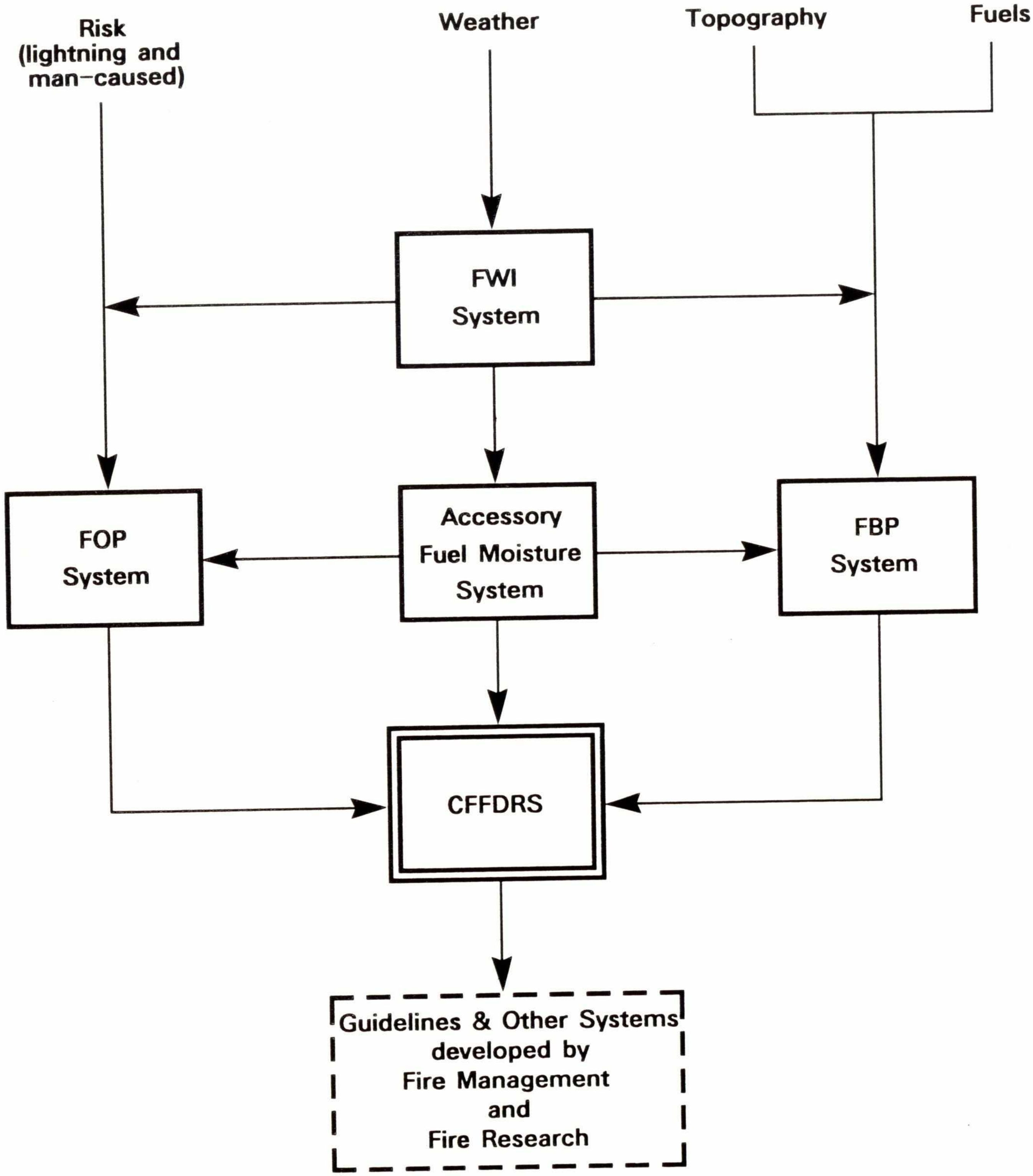

FWI System – Canadian Forest Fire Weather Index System

FBP System – Canadian Forest Fire Behavior Prediction System

FOP System – Canadian Forest Fire Occurrence Prediction System

Figure 1. Conceptual structure of the Canadian Forest Fire Danger Rating System (CFFDRS) currently envisioned by the CFS Fire Danger Group.

actual (rather than relative) fire behavior characteristics for specific fuel fuel complexes. A discussion paper outiling a slightly revised approach to such a scheme, but on a national basis, was prepared and widely distributed for comment in December 1982.[3] This concept has now become known as the Canadian Forest Fire Behavior Prediction (FBP) System. The FBP System consists of three components as primary outputs: rate of spread (m/min & km/h); fuel consumption (kg/m^2 & t/ha); and line- or frontal fire intensity (kW/m). An interim edition of the rate of spread (ROS) component has recently been produced (Alexander, Lawson, Stocks, and Van Wagner 1984). The FBP System has been released in interim form to: (1) avoid any further delay in transmittal of the existing information on quantitative prediction of fire spread and (2) for field testing and evaluation by fire management agencies. The principal input variable is the Initial Spread Index (ISI), a component of the FWI System that combines the effects of wind and the Fine Fuel Moisture Code (FFMC) on fire spread rate. Head fire ROS/ISI relationships were developed fro 14 major Canadian fuel types from a data base consisting of 245 experimental/operational prescribed fire and 45 wildfire observations. Fuel types in the FBP System, consisting of five major groups (coniferous, deciduous, mixedwood, slash, and open), are described mainly in qualitative terms. Graphs and tables have been produced for field use from the ROS component equations which have been provided for computer users. Threshold conditions for crown fire development are defined in terms of ISI and the slope adjusted ROS. Procedures for adjusting the FFMC for time of day and topography, determining upslope/downslope spread rate relative to wind direction and ground slope, and projecting fire growth from a point ignition or active perimeter source have been included in the user guide to the 1984 interim edition of the FBP System. The other two major components of the FBP System are currently under development for inclusion in the first published version of the complete system which is scheduled for 1986.

The 'Accessory Fuel Moisture' System (name still tentative) shown in Figure 1 is currently in various stages of completion. It will eventually include fuel-specific moisture codes not accounted for by the standard moisture codes of the FWI System (e.g., grass, surface lichen, fine slash, cutover organic layer, slash roundwood) and corrections/adjustments to moisture codes for topography, latitude, time of day, etc.

A single, national vs. various regional versions of a fire occurrence prediction module to the CFFDRS, consisting of both man-caused fire and lightning fire components, is currently under consideration. Several approaches to predicting the number of lightning and man-caused fires, which rely in one way or another on the FWI System fuel moisture codes, are being used on an operational and/or experimental basis in east-central Canada.[4]

Conceptually the CFFDRS will consist of a series of FTR's published by CFS-HQ Ottawa (e.g., Canadian Forestry Service 1984; Van Wagner and Pickett 1984). All such "national" publications will collectively form the CFFDRS. Each report will be identified by the CFFDRS "logo" (Fig. 2) and a standard cover photo. A CFFDRS binder (3-ring) to house all of the FTR's is being

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[3]Van Wagner, C.E.(Chairman); Alexander, M.E.; Lawson, B.D.; Stocks, B.J. 1982. Proposed extension of the Canadian Forest Fire Danger Rating System (CFFDRS). CFS Fire Danger Group. Mimeo. Report. 12 p.

[4]Proceedings of Fire Occurrence Prediction Workshop (October 20-21, 1983, Sault Ste. Marie, Ont.). Ontario Ministry of Natural Resources, Sault Ste. Marie, Ont. 16 p.

readied for distribution. Several CFFDRS reports, in addition to the existing or scheduled ones (i.e., CFFDRS weather guide and FBP System ser guide), are planned over the next couple of years (e.g., CFFDRS overview and annotated bibliography, CFFDRS interpretive guide, FWI System structure and technical development).

Figure 2. The Canadian Forest Fire Danger Rating System (CFFDRS) "logo" (final design by J. Wiens, Pacific Forest Research Centre, Canadian Forestry Service, Victoria, B.C.).

The CFFDRS will ultimately form the basic buildling block for many fire management agency systems (e.g., Anon. 1985) and other systems developed by fire research (e.g., Kourtz 1984). Since its inception, responsibility for continually assessing, calibrating, upgrading, and expanding the CFFDRS has rested with what has traditionally been referred to as the "CFS Fire Danger Group", an ad hoc group of fire researchers from the various CFS establishments. This informal group's membership has fluctuated over the years but presently consists of one representative from each of the three regional forest research centres maintaining a fire research program (i.e., Northern, Great Lakes, and Pacific) and the Petawawa National Forestry Institute. The need for a formalized group to continue the RD&A work activities associated with the CFFDRS has been recognized[5].

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[5]Stocks, B.J.(Chairman); Alexander, M.E.; Lawson, B.D.; Van Wagner, C.E. 1985. A proposal for a Canadian Forestry Service National Working Group on the Canadian Forest Fire Danger Rating System. CFS Fire Danger Group. 3 p.

THE ASH WEDNESDAY BUSHFIRES OF 16 FEBRUARY 1983 IN SOUTH-EASTERN AUSTRALIA: Video Tape[1]

overview by

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The 20-min video tape shown at the seminar was edited by Mr. N.P. (Phil) Cheney from Australian television coverage of the wildland fires that devastated south-eastern Australia on February 16, 1983. Mr. Cheney is a Senior Research Scientist with the Commonwealth Scientific and Industrial Research Organization's (CSIRO) Division of Forest Research located in Canberra, A.C.T. The following overview was prepared from the published material that has become available on the Ash Wednesday bushfires (see References listed on Page 24).

On February 16, 1983, weather conditions, fuels, and ignition sources combined to produce the most devastating bushfires seen in the states of South Australia and Victoria since 1939. The 'Ash Wednesday' Fires (the grass and forest fires ironically coincided with Ash Wednesday in the Christian calendar) erupted in an area reaching from a point north of Adelaide, South Australia to the Melbourne region of Victoria (Fig. 1).

Some 22 major fires occurred and these burnt a total area of approximately 350 000 ha and resulted in the loss of 75 lives (civilians and fire fighters), 2463 houses, and substantial losses of other property (e.g., livestock). Maximum head fire spread rates of 18-22 km/h were documented in "grasslands" (a single fire run of 65 km was recorded) and 12-14 km/h in native hardwood forests and exotic pine plantations (maximum spot fire distances of 10 km and 200 m flame heights were reported).

By mid-February 1983, south-eastern Australia was continuing to experience one of the worst droughts ever recorded. Severe rainfall deficiencies, which began in 1982, continued into 1983. Many stations in South Australia and the forested areas of Victoria reported their lowest rainfall on record for the 10-month period ending on January 31, 1983 (Fig. 2). The prolonged drought did however reduce the fire hazard in most grassland areas because growth was poor and the fuel quantities were correspondingly low.

The specific meteorological conditions that give rise to severe burning conditions in south-eastern Australia are well known. Both Victoria and South Australia are located to the southeast of the expansive desert areas of interior Australia. Anticyclonic subsidence in summer leads to the

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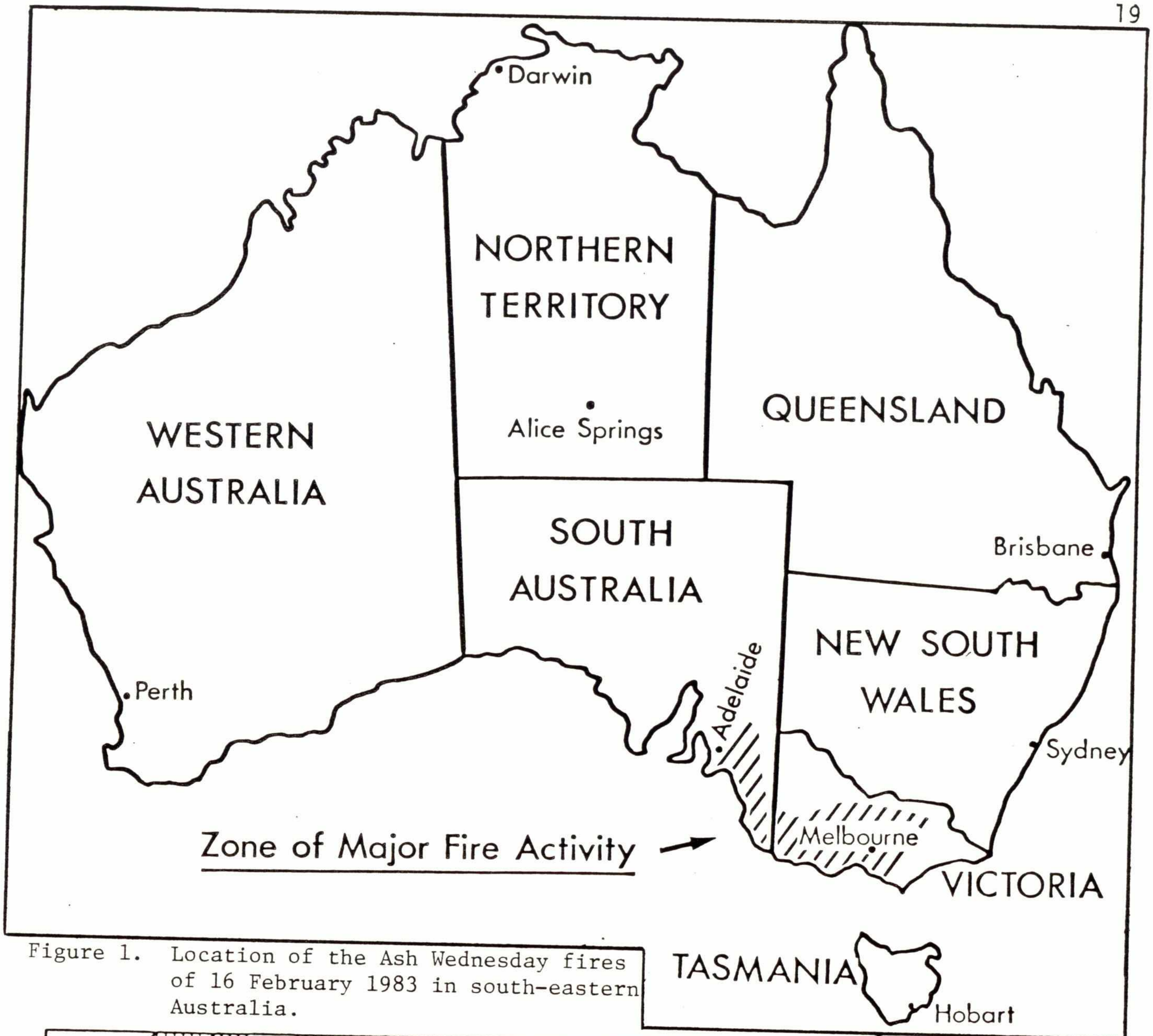

Figure 1. Location of the Ash Wednesday fires of 16 February 1983 in south-eastern Australia.

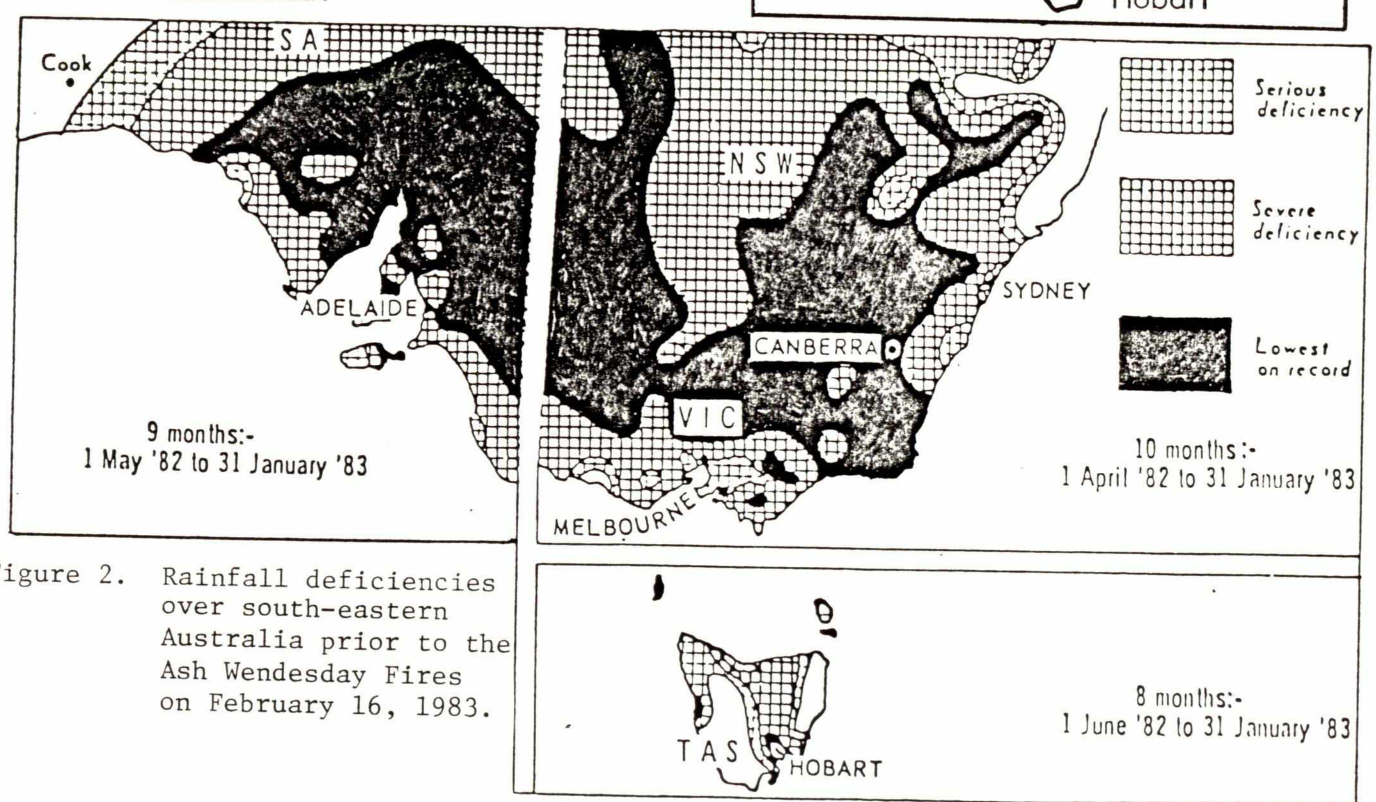

Figure 2. Rainfall deficiencies over south-eastern Australia prior to the Ash Wendesday Fires on February 16, 1983.

development of air masses with high surface temperatures and low relative humidities. The west to east movement of anticyclones, usually in the latitude of the Tasman Sea, brings hot dry northerly to north-westerly winds from the centre of the continent. Such a synoptic-scale situation was responsible for the fire weather associated with the bushfires on Ash Wednesday and in other years (e.g., McArthur et al. 1982). The specific details are described below.

On February 15 an anticyclone over New Zealand extended a ridge towards central Australia, and in the Southern Ocean a cold front was advancing northeastwards. The pressure gradient over eastern Australia, was fairly weak and surface winds were light. This is a familiar pattern in summer and usually recurs every 7-8 days. The pressure gradient usually becomes steeper as the front approaches, bringing strong dry northerly winds to southern Australia ahead of a cool change with south to south-westerly winds.

A deep reservoir of hot dry air existed over central Australia during the afternoon of February 15. This was drawn southwards over South Australia by large pressure falls in the Great Australia Bight, with the speed of the airflow gradually increasing. Combined with the overall eastward movement of the approaching systems, this in turn resulted in the advection of hot, dry air southwards over western Victoria.

The temperature discontinuity between the hot, dry air mass over south-eastern Australia, and the cold air moving up from the Southern Ocean resulted in the intensification of the newly formed front on the Great Australian Bight during the morning of February 16 -- Ash Wednesday.

The frontal system and associated cloud mass in the Great Australian Bight continued to move rapdily eastward and had now become the major influence on the weather (Fig. 3). By Ash Wednesday afternoon the front had intensified further as it approached south-eastern Australia due to the effects of the large thermal contrast between the very hot land mass and the much colder ocean surface ahead of the front, the hot dry air flow continued to strengthen and become more turbulent producing gale force north-north-westerly winds, very high air temperatures, very low relative humidities, and extensive areas of raised dust and smoke which dramatically reduced visibility. At 1500 h local time on February 16 the Mount Gambier Aerodrome in South Australia and the Melbourne Airport in Victoria (see Fig. 4 for locations) recorded maximum air temperatures of 43°C and minimum relative humidities of 7% and 5%, respectively.

The dry cold front moved across South Australia and Victoria during the afternoon and late evening of February 16 and by 0300 h on February 17 it had crossed into New South Wales (Fig. 4). Mean wind speeds of at least 40-50 km/h were recorded at many stations prior to the frontal passage. With the passage of the front, winds changed sharply to south-southwesterly and increased in strength to 70 km/h, with gusts in excess of 110 km/h, for up to 2 hours afterwards. Following passage of the front, there was a marked drop in temperature and an increase in relative humidity. Winds moderated considerably and tended to be more south-southwesterly.

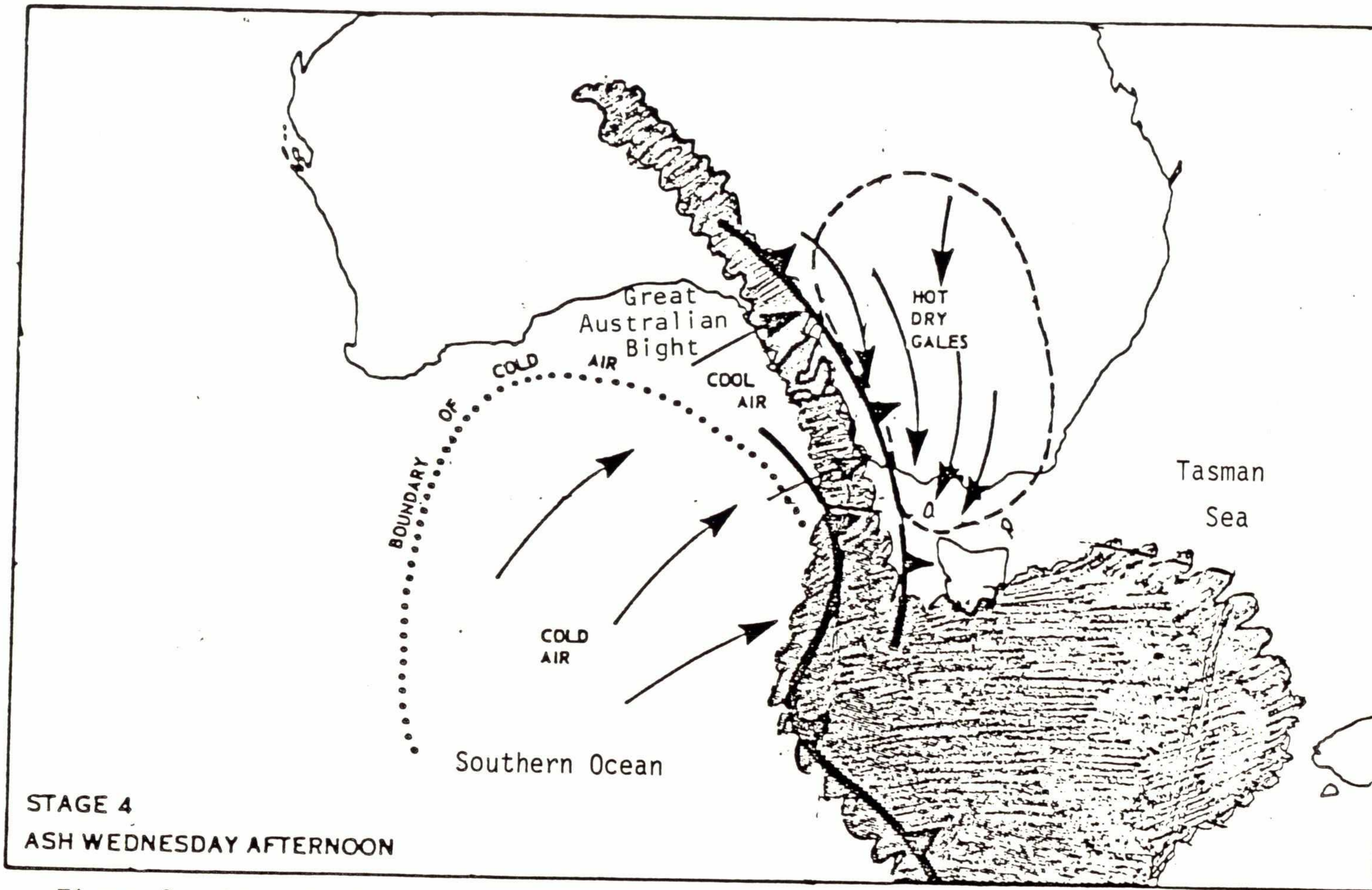

Figure 3. Atmospheric circulation over south-eastern Australia during the afternoon of February 16, 1983 (after Country Fire Authority 1983).

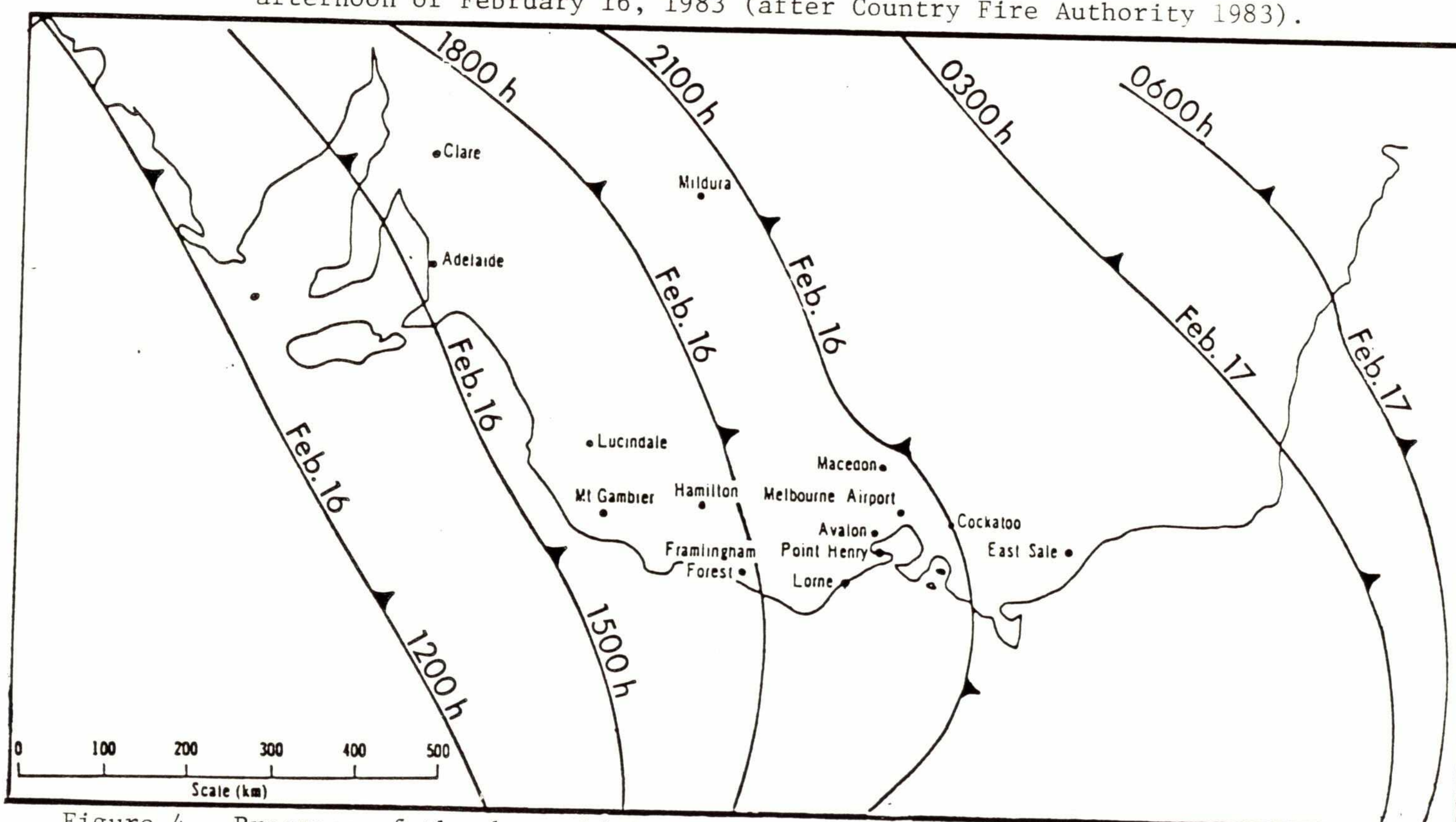

Figure 4. Progress of the dry cold front across south-eastern Australia on February 16-17, 1983 (after Country Fire Authority 1983).

Numerous man-caused fires started throughout Ash Wednesday and spread rapidly south-southeasterly under the influence of strong north-northwesterly winds. When the wind changed to the south-southwest after passage of the dry cold front, fires broke away along the whole of the eastern flanks. Such a spread pattern is exemplified by the Cudgee-Ballangeich Fire (Fig. 5) which resulted from two independent ignitions which eventually burned approximately 50 000 ha of pasture lands after joining together following the south-westerly wind change (the fire is located near Framlingham Forest in Fig. 4). The two separate fires advanced at 5.8 km/h and 8.5 km/h, respectively, prior to the frontal passage just before 1800 h. The series of "tongues" or "fingers" that resulted from the change in wind speed and direction were due to a combination of partial containment along the eastern flanks, fuel discontinuities, and the flames being "blown out" along sections of the fire front.

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PROCEEDINGS OF THE FIRST CENTRAL REGION FIRE WEATHER COMMITTEE

SCIENTIFIC AND TECHNICAL SEMINAR - April 17,1984, Winnipeg, Manitoba