AVALANCHE NEWS

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In This Issue:

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Bulletins are updated Monday and Thursday mornings.
Additional updates may be made when conditions are changing rapidly.

- **Alberta and BC Toll Free:** 800-667-1105
- **Calgary:** 403-243-7253 +[7669]
- **Vancouver:** 604-290-9333
- **Personal Computer BBS:** 604-837-4893
- **Fax Network:** Call for details 604-837-2435
- **Internet:** gopher at University of Utah.

The deadline for the next issue is June 15, 1995. Material may be sent to the Canadian Avalanche Centre in Revelstoke in a variety of formats. Hardcopy, Fax, ASCII, or WP5.1 are preferred for text. Diagrams, charts, & figures may be submitted as hardcopy, WMF (preferred), CGM (preferred), WPG, or TIF files. Files can be sent on disk or to the PC BBS.

Notice of Meetings

Annual General Meeting

The AGM of The Canadian Avalanche Association will be held in Revelstoke, B.C. at the Revelstoke Community Centre May 3 - 4, 1995. The Technical Meeting will take place in the morning of May 3rd while the Business Meeting will take place in the afternoon. Please note that these meetings are open to CAA members and invited guests only and notices of pending special resolutions will be sent to members in advance of the business meeting. Anyone who wishes to make presentation at the Technical Meeting should contact Jim Bay or Alan Dennis (in writing) at the Canadian Avalanche Centre in Revelstoke. The deadline is April 15th. Fax 604-837-4624.

Public Meetings

After a great response at the 1994 Spring meetings we are looking forward to the third Annual Public Session of the Canadian Avalanche Association Spring meeting where topics of interest to the general public will be presented. the meeting will be held as follows:

Date: May 4, 1994
Time: 0830-1600
Location: Revelstoke Community Centre, Revelstoke, B.C

Anyone interested in making an avalanche related presentation of commercial research or recreational is welcome to submit their proposal to the Canadian Avalanche Centre (CAC) in Revelstoke. There will be facilities available for commercial/trade show exhibits. If you wish to display your services or products please contact the CAC. Send your inquiries/proposals to Jim Bay or Alan Dennis at the following address. Please note that this deadline is also April 15, 1995.

Canadian Avalanche Centre
Box 2759
Revelstoke, B.C
VOE 2SO
Phone (604) 837-2435
Fax (604) 837-4624

Micheal Zylicz

Micheal Zylicz died on 21 December 1994 aged 42 of a particularly rare and fast paced cancer. Immeasurably tragic for all family and friends his oldest son Russel also died, in an accident on 18 November 1994. Michael was born in Glasgow, went to high school in Hope BC, and completed a Geography degree at UBC.

In 1974, after the avalanche accident at the North Route Cafe near Terrace, the BC Ministry of Transportation & Highways established the Snow Avalanche Section. Mike was the first Snow Avalanche Technician on the Terrace - Prince Rupert highway. In 1983 Mike was among the first group of people to become members of the Canadian Avalanche Association.

In 1975 he travelled to Poland to look for the family name roots. When he returned to Canada with BJ they started a family, renovated one home, and built another. "Look at that hole for a foundation, now let's fill it with money."

Mike set up the avalanche program for the Remarkables Ski area in New Zealand. In the first year they travelled with two small children, found a home, and learnt about Russels new illness. Michael set new standards at Eikardts Pub in Queenstown making for stimulating stories for years after.

In the second season at the Remarkables with three children, mother-in-law, and nanny they lived in another tiny house in Queenstown. It was so small that the large Valiant station wagon they had borrowed was the only place Michael and BJ could get any privacy. Michael was proud their youngest child was conceived in the Valiant.

In the summers around Terrace Mike had the greatest happiness; organizing family river trips and complex hunting and fishing expeditions which friends will never forget.

A quote from his workmates in New Zealand is appropriate. "Michael always believed in living life to its fullest and his enthusiasm illuminated a light in all of us. Our ski areas are a safer and a better place from the time Mike spent here and his legacy will certainly live on in Queenstown."

Avalanche Safety Workshop 1994

After the success of the Workshop held in Calgary in 1993 it was decided to run a similar weekend session in Vancouver. The objective of the Workshops is to increase awareness about avalanche safety. Most participants are experienced backcountry travellers who are interested in improving their level of knowledge about snow stability evaluation and travelling in the mountains. Topics presented included a review of observing and evaluating mountain snowpack, terrain, weather and weather forecasts. The presentations also covered trip planning, decision making and self rescue. New techniques for field stability tests and developments in avalanche transceivers were presented.

Over three hundred people took part in the Workshop. There were skiers, snowboarders, snowmobilers, search and rescue personnel and mountain club groups who took part. All the speakers for the Workshop donated their time. Except for the promotional and site rental costs, all the money raised went towards paying for the Avalanche Bulletin service of the Canadian Avalanche Centre. The Provincial Emergency Program, BC Parks, Carleton Recreational Equipment and Pacific Weather Centre had displays that attracted a lot of interest.

The biggest debt of gratitude is owed to the FEDERATION OF MOUNTAIN CLUBS OF BC, Brian Jones, Suzanne and Lisa Mighton who served way above the call of duty to put the Workshop on and finally, Scott Flavelle who organized the agenda and was the MC extraordinaire. Nearly $ 15 000 was raised for the Canadian Avalanche Centre.

Many thanks to everyone involved - the backcountry enthusiasts who attended, FMCBC staff, the speakers and trade show presenters.

A number of participants asked if a similar workshop will be held next fall to prepare for winter 1995 -96....

The Rules of Twos and Threes

Usual advice is there are no Rules of Thumb in the avalanche business, however the following appeared on the editors desk:

The Rule of Twos: This rule recognizes many avalanche workers are not experienced snowmobilers. Scott Aitkens[1] advice to Anonymous[2] on using snowmobiles for avalanche work.

Remember to take: (in addition to the usual avalanche equipment)

- 2 people
- 2 radios
- 2 snowmobiles
- 2 skis **each**
- 2 shovels

([1] a very experienced snowmobiler)
([2] a very inexperienced snowmobiler)

The Rule of Threes: The following rule is taken from a manual about earthquakes and is presented for consideration from an avalanche perspective.

- 3 minutes after: You realize you have survived, if you're lucky.
- 3 hours after: Formal rescue mobilized in back country.
- 3 days after: Identify what is required for prevention.
- 3 weeks after: Emergency over.
- 3 months after: Memory is fading.
- 3 years after: **Make same mistakes.**

Canadian Avalanche Association Training Schools and other training

The first course of the season started on 28 November at Rogers Pass and the final course finished on 4 February. There was a total of twelve courses: one Level 2 course, two Transportation and Industry courses and nine Level One courses. The total number of students was 247. Two snowmobilers and a number of snowboarders took the course. Next year it is planned to hold a Level 1 course exclusively for snowmobilers. If you have any interest in this please contact the Canadian Avalanche Centre.

As usual the courses experienced a wide variety of conditions. Very weak snowpack, a surface soaked snowpack, cold air temperatures (only -30), avalanche cycles and one helicopter medevac with a wrecked knee. The injured person and students were all back at the Lodge for late dinner. The student with the injured knee successfully completed the course in a brace. Effective radio communications from a remote field location prevented an overnight adventure for the group.

The Canadian Avalanche Association is beginning a project to revise the training materials used for courses. This project will be discussed in detail at the Instructors Meeting in the Spring, but if anyone has any special interest in development of the Canadian Avalanche Association Training Schools please contact the CAC. Next winter will be the 25th year of technical avalanche courses in Canada.

The continued success of the courses still relies in major way on the support of people at the locations especially staff of highways, ski areas, lodges and parks from Stewart to Banff, Whistler & Blackcomb, Glacier National Park and Fernie.

The FEDERATION OF MOUNTAIN CLUBS OF BC have run avalanche awareness courses for many years. They report a conitnued growth in interest in theses coureses and this year had 160 students do the introductory level course. One course was for a snowboarder group. Most courses ran in the Lower Mainland/Fraser Valley but alos in the Prince george aarea and VAncouver Island.

The CANADIAN SKI PATROL SYSTEM also have an avalanche training program for their volunteers and the public. This winter 71 people took the Introductory Course and 8 took the Advanced course.

Avalanche awareness courses are offered by a number of CAA members listed in the Resource Agency list. It is estimated that a total of about 500 people per yearare taking avalanche awareness courses.

Course Development for Snowmobiler Avalanche Awareness Course

Prepared by Jim Bay and Lyle Birnie

This is a proposed outline for a weekend avalanche awareness course designed for snowmobilers. This course is meant to be conducted over a one and a half day period, for example: Friday evening and all day Saturday.

Evening Session

The evening session should be 3 hours in duration and consist of:

- **Avalanche Phenomena (20min)**
Describing the types of avalanches, their motion, and destructive potential.

- **Avalanche Terrain (30min)**
How to identify avalanche terrain by looking at factors such as; slope angle, vegetation, elevation, aspect, and slope shape.

- **Formation of Avalanches (30min)**
What makes avalanches happen? The layers and variation of strength in the snowpack. The influence of temperature, precipitation, wind, and time on the strength of snow.

- **Hazard Evaluation (20min)**
A description of the process on information gathering and interpretation through the use of Public Information, field tests, and observations.

- **Trip Planning (10min)**
Planning a safe trip considering such factors as trip length, terrain, group ability, options, etc.

- **Safety Measures and Safe Travel**
Techniques to minimize risk while travelling in avalanche terrain.

- **Survival in Avalanches**
What to do if caught in an avalanche and how to increase chance of survival.

- **Search and Rescue (30min)**
A summary of search and rescue equipment and techniques. This lesson would emphasize the importance of self-rescue by the group.

The evening session will be presented using slides, overhead transparencies and videos.

Field Day

The field day will put into practice the concepts introduced during the evening session. The field day should take place on or near avalanche terrain, with enough snow to conduct a realistic avalanche rescue practice.

The participants will have a chance to:

- Practice safe travel through avalanche terrain.
- Identify terrain features that influence on snow stability.
- Take part in a search and rescue practice.

At the end of this course, the participants should have a basic understanding of avalanche awareness and safe travel through avalanche terrain.

A course of such short duration can only impart a relatively small amount of information on a complex subject. We have to encourage people to use this information conservatively and travel as much as possible with experienced backcountry travellers until they gain sufficient experience themselves.

EDITORIAL NOTE

The intention of *AVALANCHE NEWS* is to assist communication among persons and organizations engaged in snow avalanche work in Canada. Short articles cover accidents, upcoming and past events, new techniques and equipment, publications, personal news, activities of organizations concerned with avalanche safety, education and research.

The editor welcomes and expects contributions; all reasonable comments and discussions will be printed. The articles in *AVALANCHE NEWS* reflect the views of the authors; only when it is specifically stated do they represent the opinion of the Canadian Avalanche Association.

No paid advertisements are carried. Suppliers who wish to draw attention to their products should send information to the editor who will publish a note when equipment has value in avalanche work and safety.

***AVALANCHE NEWS* is published three times per year. There is no subscription fee. Requests for copies and changes of address should be sent to the publisher.**

Avalanche Resource Agencies

Category/Name	Changes
Parks Canada/	
Jasper Natonal Park	Taped messages: 403-852-6177
Wilderness Operators/	
Jim Stanton	*Amiskwi Lodge (Golden B.C)* *Box 1747, Canmore* *Alberta, T0L 0M0* *Tel: 403-678-4039, Fax: 403-678-5437*
Cdn Av Rescue Dog Ass'n/	
Robin Siggers (p 19)	Dog's name is K2.
Blackcomb Teams	*Blackcomb dispatch: 938-7600*
Bruce Brink	Pager: 1-604-979-4050 Home: 932-6771 Work: 879-4515 Cell: 657-3975 Port Cell: 657-8437
Bruce Watt	*Pager: 1-604-979-8352* *Home: 932-6269* *Work: 932-2300* *Cell: 932-7674*
Craig Ross	Pager: 1-604-979-7990 Home: 938-9188 Work: 938-7600
Rene Long	*Pager: 1-604-979-7991* *Home: 932-4406* *Work: WVFD pager 932-2020*
Richard Wyne	Home: 938-1795 Work: 938-7600
Whistler Teams	*Whistler dispatch: 938-3210 local 300*
Anton Horvath	Pager: 1-604-979-7994 Home: 932-1110 Work: 932-3210 local 300
Yvonne Thornton	*Pager: 1-604-979-7995* *Home: 894-5565* *Work: 932-3210 local 300*
Jan Tindle	Pager: 1-604-979-7993 Home: 932-5196 Work: 932-3210 local 300

Category/Name	Changes
RCMP/	
Cpl Cec Brandt	Pager 1-604-978-1053
Cpl Bud Mercer	*Pager 645-0165 /792-5227*
RCMP Nelson	Postal code is V1L 6P6 24hr emergency phone: 604-352-2156
Weather Services/	
Banff	*Direct: 762-4707* *24hr Rec: 762-2088* *Fax: 762-8430*
Calgary	Direct: 299-7814 24hr Rec: 299-7878 Fax: 299-3594
Edmonton	*Direct: 468-7077* *24hr Rec: 468-4940* *Fax: 951-8762*
Jasper	Direct: 852-3260 24hr Rec: 852-3185 Fax: 852-5355
Whitehorse	*Direct: 667-8463* *24hr Rec: 668-6061* *Fax: 668-3591*

• When paging for avalanche calls enter the number you want us to reply to and 9999 when asked to enter a numeric or voice message. (This means you are paging about an avalanche emergency). Please avoid leaving "Voice Messages".

•• Brink, Thornton and Horvath should be called for all missing persons (certified in the general search profile as well as avalanche).

Call Procedure

Brink, Horvath, Tindle, Thornton are available on pager call 24 hrs a day. Once paged, any one of the four will initiate a fan-out call to additional dog handlers, avalanche control personnel and avalanche forecasters as required.

SARSCENE 95

Search and Rescue Conference
19-21 October 1995, Kelowna, BC

The fourth workshop sponsored by the **National Search and Rescue Secretariat** will be held 19-21 October at the:

Coast Capri Hotel
1171 Harvey Avenue
Kelowna, BC.

The conference, part of **SAR Expo 95** and held in conjunction with the **North American Technical Rescue Symposium** and the **Wildlands Rescue Workshop,** will present a wide range of sessions.

Hotel accommodation is available at a special conference rate at the Coast Capri Hotel: 604-860-6060, 1-800-663-1144 (Canada) or fax 604-762-3420

There is no charge for attendance, however a registration is required. Please mail or fax the form to the Secretariat to register. Mail to:

The National Search and Rescue Secretariat
275 Slater Street
Ottawa, Ontario, K1A 0K2
Fax: 613-996-3746
Tel: 1-800-SAR-9414

Avalanche Safety Equipment

Rental Locations: Transceivers/Probes/Shovels

Valemount BC
Shell Mighty Mart 604-566-9837
Tags 604-566-9977

McBride BC
Husky Valley Service 604-569-2441

Edmonton AB
Alberta Cycle, 9131-118 Ave, Edmonton
403-477-3525

Revelstoke BC
Boulder Mountain Services, across from the Peaks Lodge
604-837-3799

Ft Saskatchewan, AB
Elk Island Sales
403-998-9159

Calgary, AB
Renfrew Power Sports, 7120 Blackfoot Trail S.E.
403-253-6933

Red Deer, AB
Yamaha Sports World, 6782 Gaetz Ave
403-346-7838

Radium Hot Springs, BC
Radium Esso, Downtown Radium
604-347-9726

Prince George, BC
604-562-4151
Prince George Yamaha,

Crowsnest, BC/AB
The Inn On The Border, 1001-20th Ave
403-563-3101/604-425-0153

Tumbler Ridge, BC
Tags Food and Gas, 3115 Southgate Ave
604-242-3394

Fernie, BC
B & N Ent Ltd, 1501-9th Ave
604-423-4161

Sherwood Park, AB
Flatlanders, HWY 16 Cloverbar Rd
604-423-4161

Vernon, BC
Four Seasons Motor Sports, #3-4216-25 Ave
604-549-3730

St Albert, AB
Head Office, Box 1 Site 218 RR#2, T8N 1M9
403-973-5412, Fax: 403-973-3318

Jasper, AB
Jasper Park Lodge
403-852-5552

Edmonton, AB
Cycle Works, 9918-71 Ave
403-448-5818

Chetwynd, BC
Peace Country Rentals
604-788-9505

Other suppliers of avalanche safety equipment who would like to be included in next winters listing should send information by 15 November 1995 to the CAC.

For avalanche personnel making their summer plans:

RIVER RAFT GUIDE CERTIFICATION
May 1-14 1995
$1,395.00

REO RAFTING ADVENTURES:
612-1200 W Pender St
Vancouver, B.C.
604-684-4438

Preliminary tests in Canada of a numerical model of snow cover stratigraphy

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Department of Civil Engineering, University of British Columbia
2324 Main Mall, Vancouver V6T 1Z4.

Introduction

Since the winter of 1993/94, the Avalanche Research Group at UBC, has been running a series of experiments to assess the snow cover stratigraphy model CROCUS in collaboration with the Avalanche Control section of Parks Canada at Glacier National Park. This numerical model, developed by the "Centre d'Etude de la Neige" in Grenoble - France, was designed to simulate energy and mass evolution of the snow-pack at a given location from meteorological and snow measurements. Our research project consists in testing the model by comparing simulated and measured profiles and in estimating its suitability for avalanche control and avalanche forecasting. This is the first time CROCUS is tested out of France and it will be quite exciting to explore its capabilities for the mountain climates existing in western Canada.

In this paper we briefly present the model and the initial part of the project as well as some preliminary results obtained with CROCUS during this initial period of test.

CROCUS

This physically-based model takes into account the whole energy and mass exchanges between the atmosphere, the snow-pack and the ground (Brun and al., 1989,1992). As shown on Figure 1 (below) the following meteorological data are supplied to the model, usually once an hour:

- air temperature
- wind speed
- relative humidity
- incoming short-wave and long-wave radiation
- amount and density of solid precipitation
- amount of liquid precipitation
- soil thermal flux.

If there is already snow on the ground, a snow profile is used to provide the initial conditions for the model. This provides the initial snow-pack variables for the next runs. In return, CROCUS

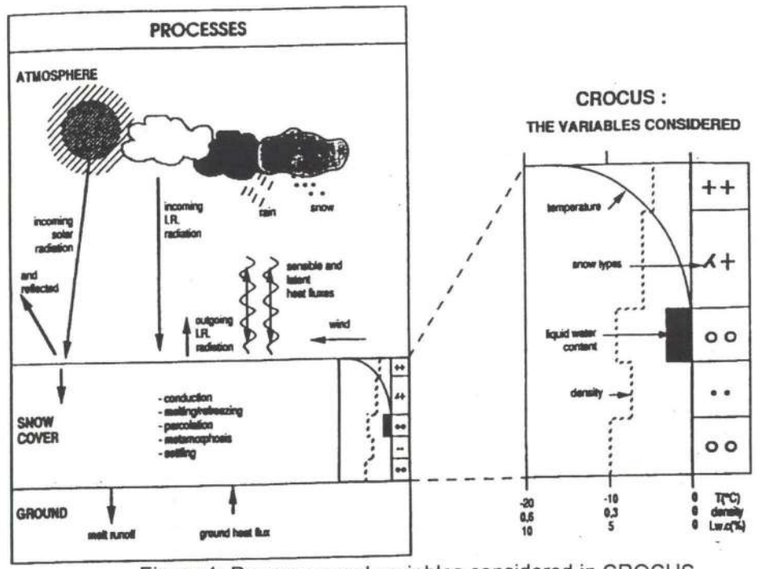

Figure 1: Processes and variables considered in CROCUS.

sessions. Moreover, weather input data for the model could be derived from the weather forecast and would lead to the upcoming snow stratigraphy. As a result, a stability appraisal could be obtained.

Thus, the first part of the project is to figure out whether the model is satisfactory for simulating the snow-pack stratigraphy and secondly to determine its suitability for avalanche control and avalanche forecasting.

The Site: Mount Fidelity's Study Plot

Situated in Glacier National Park at an elevation of 1910m on the west side of the Selkirk Mountains, part of the Columbia Mountains, the Mt Fidelity's study plot, maintained year round by Parks Canada, is the weather and snow study station where the greatest amounts of snowfall in Canada are regularly recorded (Schleiss). It belongs to the network of stations that are located by many avalanche paths stretching along the 60 km of the Trans-Canada-Highway between Revelstoke and Golden. This zone is one of the most active avalanche areas in North America where public and transportation systems are present.

Because of its location, this mid-alpine station is representative of the snow conditions prevailing on the surrounding avalanche starting zones which are found above the nearby section of the highway. Like many others in the area, the station is equipped with weather and snow telemetric measurement systems and is used by Parks Canada to perform active avalanche control on the Trans-Canada Highway and on the railway to keep them open with the highest degree of safety for the traffic.

The Rogers Pass area represents a formidable site to undertake avalanche research because of the huge amounts of snowfall received every year, the climate: lying between maritime and continental snow climate where great temperature variations are common. This conducts to a snow-pack with varied and changing characteristics and to a considerable variability in avalanche phenomena like in few easily accessible places in the world.

Experimental Set-up

The following parameters necessary for the simulation are automatically collected every hour: air temperature and relative humidity, liquid and solid precipitation, wind velocity, incoming short-wave and long-wave radiation. Twice daily, avalanche control people visit the study plot of Mt. Fidelity to carefully collect standard snow and weather observations. Some of these observations are used to check the automatically recorded data like:

- height of new snow fallen since the last visit
- 24-hour new snow
- density and weight of new snow
- water equivalent of new snow
- liquid precipitation
- surface condition, indeed collected on a less strict basis than the above mentioned data.

Preliminary Results

Snow depth evolution throughout the season

Solid precipitation measurements were obtained with the automatic snow gauge. Accumulated values were computed twice daily at 7 am and 4 pm in order to be checked with the snow board data gathered on the study plot, and if necessary corrected. Figure 2 (below) shows the result of the simulation for the snow depth evolution. CROCUS was not re-initialized after the first profile of December 20th was entered. This means no correction was brought to the model and simulations were only based on this initial profile with the meteorological data transferred to it every hour. During the test period a very good agreement characterizes both curves although 20/25 cm are lacking on a 316cm snow-pack of the simulated curve of January 18th, which was the last day of an intense snowfalls period where more than 310 cm of new snow had been accumulated since the beginning of January. From this point the simulated curve displays an offset that remains steady all along the test period. However it does not affect the match of both curves,

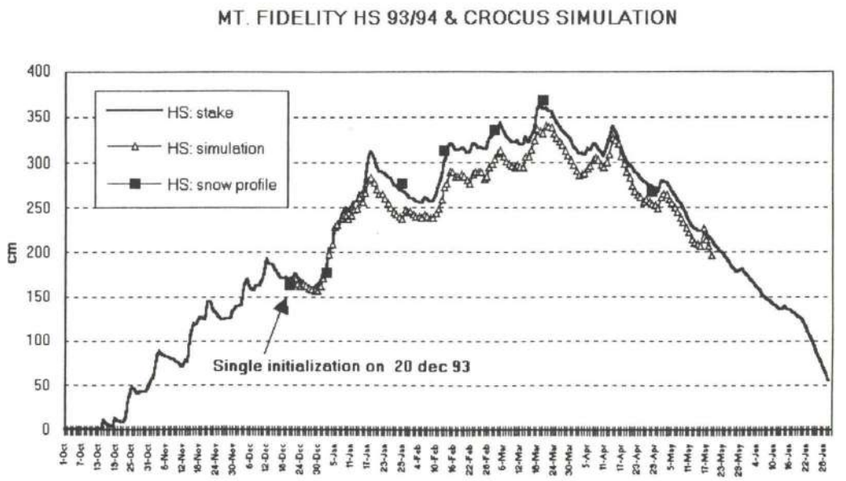

Figure 2: Simulated and measured snow depths.

demonstrating a promising performance of the model.

The underestimation of January 18th is not completely explained yet. It might be due to an overestimation of the settlement, but good agreements for other periods do not really suggest it. Nevertheless, this is the single period with such a great accumulation of new snow and this might have negative effect on the simulation. Another explanation might be to re-consider the density of new snow passed to the model. Density can be derived either from the values of the air temperature and the wind (Pahaut, 1975) on a hourly basis, or directly picked from the study plot values. Another method is to use snow gauge and water equivalent gauge readings to derive the density but measurement precision is somewhat limited on both and this can lead to considerable errors for the final density value. However, the preliminary behavior of the model for snow depth simulation remains satisfactory.

Temperature and density profiles

Temperature and density profiles are compared on Figure 3. Each set of curves depict an acceptable similarity. Densities simulated by CROCUS match well the values recorded in the snow pit especially for the upper snow-pack above 1m deep. The density drops occurring in the simulation curves, for instance at 150 cm on the profile of January 2nd, at 225cm for March 3rd and March 20th are likely due to buried thin layers of surface hoar. This was not deduced after

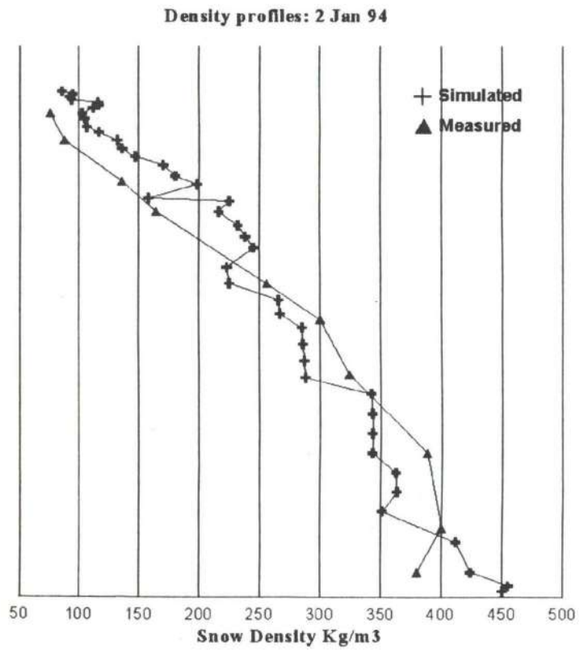

Figure 3: Temperature and density profiles.

reading of the density only, but mainly after checking the grain type and size returned by the model, which was found to confirm the presence of surface hoar in these particular layers. For such thin layers, density is usually not measured, that explains why no corresponding sharp declines are found in the experimental density curves.

Liquid water content

During this first winter of testing, liquid water content was only estimated according to the International Classification for Snow and Ice. Furthermore, the snow-pack remained dry during most of the period of the test and only few comparison were undertaken. That is why tests on the liquid water content are not considered meaningful to assess the capabilities of the model on this particular point. Nevertheless estimated and simulated values are shown on Figure 4.

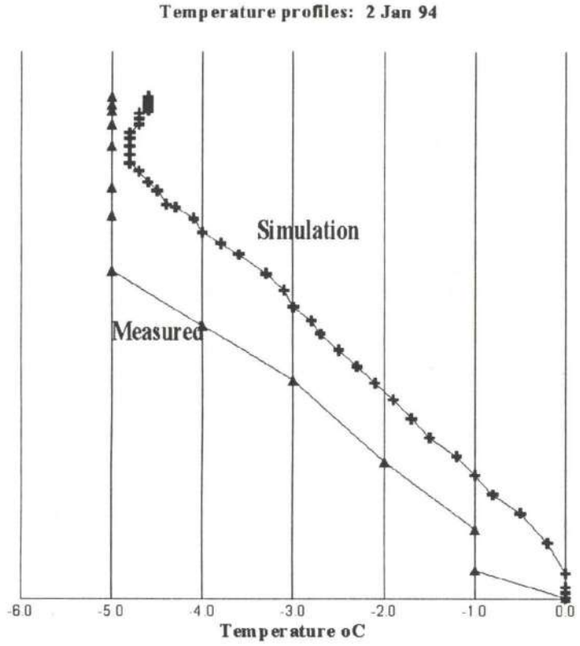

Figure 4: Liquid water content profiles.

Conclusion

The numerical model CROCUS was tested during the winter 93/94 at Mt. Fidelity in Glacier National Park. In this paper we have presented the preliminary results we obtained with the model. Simulated snow depth, temperature and density profiles of the snow-pack were compared with measured profiles and quite encouraging results were obtained. Liquid water content was compared to estimated field values with satisfactory agreement although not enough tests could be performed. Briefly mentioned in the present article, simulation of grain metamorphism was not described and will be more widely exposed in an upcoming article.

Field experiments are being pursued during the winter 94/95 at Glacier National Park. We also have extended the experiment on the site of Blackcomb Mountain Resort. This will allows us to test the model under other climatic and meteorological conditions than the ones prevailing at Mt Fidelity. Therefore, with this new set of upcoming tests and data we expect to assess CROCUS reliability for the simulation of the snow-pack and its suitability for avalanche control and avalanche forecasting.

Acknowledgement

The author thanks the avalanche control staff of Glacier National Park at Rogers Pass, who supplied part of the observations necessary for the test and helped us during our field trips, and the "Centre d'Etude de la Neige" in Grenoble - France for providing us with the model. The Snow and Avalanche Group of UBC also wishes to thank the International Council for Canadian Studies and the Natural Sciences and Engineering Research Council of Canada for funding this project.

References

[1] Brun, E., Martin, E., Simon, V., Gendre, C., Coleou, C., An energy and mass model of snow cover suitable for operational avalanche forecasting. *Journal of glaciology*, Vol **35**(121). 1989.

[2] Brun, E., David, P., Sudul, M. and Brunot, G., A numerical model to simulate snow cover stratigraphy for operational avalanche forecasting. *Journal of glaciology*, Vol **38**(128). 1992.

[3] Schleiss, V.G., *Rogers Pass Snow Avalanche Atlas*, Glacier National Park. Environment Canada, Canadian Parks Services.

[4] Pahaut, E., Les cristaux de neige et leurs métamorphoses.... *Monographie n° 96 de la Météorologie Nationale*, E.E.R.M./ Centre d'Etude de la Neige, St-Martin d'Hères - France. 1975.

Avalanche Publications

Available from: Alaska Mountain Safety Center
9140 Brewsters Drive, Anchorage, Alaska 99516

SNOW SENSE
Publication #, ISBN 0-916003-0-6
Author: Jill Fredston and Doug Fesler

Available from: Chockstone Press Inc
Box 3505, Evergreen, Colorado, 80439

AVALANCHE AWARENESS
Publication #, ISBN 0 934641-72-2, 1993
Author: John Moynier

Available from: ICS Books
One Tower Plaza, 107 E 89th Avenue, Merrillville, Indiana, 46410

THE BASIC ESSENTIALS OF AVALANCHE SAFETY
Publication #, ISBN 0-934802-84-X
Author: Buck Tilton

Available from: NZ Mountain Safety Council
Box 6027, Te Aro, Wellington, New Zealand

NZ MILFORD ROAD AVALANCHE ATLAS
& (separate book) NZ MILFORD TRACK ATLAS

Available from the CAC:
BACKCOUNTRY AVALANCHE AWARENESS
Publication #, ISBN 0-969-6611-1-8
Revised 1990/1992/1993/1994
Author: Bruce Jamieson

AVALANCHE SAFETY FOR SNOWMOBILERS
Publication #, ISBN 0-9696611-2-6/1984
Author: Bruce Jamieson

AVALANCHE SAFETY FOR SKIERS AND CLIMBERS
Publication #, ISBN 0-921102-15-1, 2nd Edition
Author: Tony Daffern

LA NEVE E LE VALANGHE
Author: Renato Cresta

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