



**American Avalanche Association  
and  
USDA Forest Service National Avalanche Center**



# **Snow, Weather, and Avalanches: Observation Guidelines for Avalanche Programs in the United States**

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# Snow, Weather, and Avalanches: Observation Guidelines for Avalanche Programs in the United States

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## Preface

In 2004 the American Avalanche Association, in cooperation with the USDA Forest Service National Avalanche Center, published the inaugural edition of *Snow, Weather and Avalanches: Observational Guidelines for Avalanche Programs in the United States*. Getting to that point was a long and somewhat painful process taking several years, numerous individuals, and many organizations working to find common ground. In the end, the guidelines reflected our community's best effort at merging the Westwide data standards (which had been widely used in the United States since 1968) and the guidelines published by our friends north of the border at the Canadian Avalanche Association. The CAA generously offered their guidelines as a template for ours in the hopes that our two avalanche communities can eventually move toward a common document.

The trepidation we felt with the release of the first edition of these guidelines, which quickly became known as *SWAG*, was unnecessary. It gained immediate acceptance by the U.S. avalanche community, as well as by avalanche workers in many other countries. *SWAG* is now integrated into operations, handed out in avalanche classes, and can be found in most patrol rooms and on most forecaster's desks around the country.

*SWAG* aims to capture the techniques and tools currently being used by U.S. avalanche programs. Since these tools are constantly evolving and being updated, so too must this document. Originally we aimed to update *SWAG* every 5 to 10 years. The fact that we are now producing an updated document only five years after the first edition demonstrates the dynamic nature of our profession. In some sections of this edition you will find mostly minor changes in the form of small corrections, additions, or clarifications. In other sections you'll find more significant changes, such as the addition of increasingly popular block tests that aim to index the fracture propagation propensity of the snowpack. This edition also includes the new international snow classification scheme (Appendix F) and avalanche danger scale (Appendix G).

The goal of *SWAG* remains the same. It is meant to be a professional reference that establishes common methods. This benefits everyone by both increasing the ease of communication between operations, and by facilitating the development of long term datasets that will provide future insights into avalanche processes. Despite the changes to the current edition, we aimed to maintain the original tone of *SWAG*. As the late Ed LaChapelle pointed out nearly thirty years ago, there is no one correct path to an accurate avalanche forecast. Similarly, there is not one set of tools or one set methodology that must be used for avalanche operations. This document recognizes the unique nature of many avalanche programs and their special needs, and strives to provide the flexibility necessary for them to operate effectively while still providing a common language for all of us. Finally, this edition – like the first edition – is not meant to inhibit creativity or innovation. We encourage experimentation and the development of new tests and methods by practitioners and scientists alike, a fact emphasized in the major additions to Chapter 2. Here you will find that some of the new sections came out of M.S. and Ph.D. theses, while others started with discussions in a ski patrol shack.

Ron Perla provided extensive comments on the first edition of *SWAG*, and when he received his copy he wrote to us that "I believe it's much more than just 'Guidelines for Observations'. It's a valuable reference for a wide variety of avalanche studies. I'll keep it close to my desk together with my very limited collection of references which I expect to consult often." We hope this edition also merits such high praise and that you will find it to be a valuable and useful reference for your avalanche work.

Karl Birkeland  
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September, 2009

## Acknowledgements

This document is a collection of protocols and common practices developed during more than 60 years of avalanche work in the United States. Common practice in the United States, in turn, developed through fruitful collaborations with scientists and practitioners in Canada, Europe, Scandinavia, Asia, and other parts of the world. Although the people that contributed to what is now common practice are too numerous to mention here, their contribution to our field and the methods described within this document is significant.

The first version of this document started with a publication of the Canadian Avalanche Association (CAA) entitled *Observational Guidelines and Recording Standards for Weather, Snowpack, and Avalanches* (OGRS). The CAA has devoted a tremendous amount of time and money towards creating and maintaining that document, which has become a symbol of professional practice in North America. The CAA periodically revises OGRS and we have tried to include some of the changes they instituted during the 2007 revision. I sincerely appreciate the CAA's past and present efforts to promote common practice among avalanche programs, and for allowing the U.S. community to benefit from their effort. Within the CAA, Clair Israelson (former CAA Executive Director) and Ian Tomm (CAA, Executive Director) both provided us with support and encouragement. Cam Campbell (CAA, Technical Committee) helped us with CAA materials and their experience during the last revision of OGRS. Bruce Jamieson provided both material and insight from the work of the Applied Snow and Avalanche Research group at the University of Calgary.

The American Avalanche Association (AAA) and the USDA Forest Service National Avalanche Center (NAC) provided the majority of the funds and infrastructure to develop this document and complete the first revision. Janet Kellam (AAA, President), Mark Mueller (AAA, Executive Director), and Doug Abromeit (NAC, Director) all contributed to this effort.

A public and technical review process dramatically improved the content of the first version. Although we did not seek assistance from as large a group during the revision, their contribution remains a part of this document. They include: Pat Ahern, Jon Andrews, Don Bachman, Hal Boyne, Doug Chabot, Steve Conger, Nolan Doesken, Dave Hamre, Bill Glude, Liam Fitzgerald, Ron Johnson, Chris Joosen, Art Judson, Janet Kellam, Tom Kimbrough, Mark Kozak, Bill Lerch, Chris Lundy, Tom McKee, Art Mears, Peter Martinelli Jr., Rod Newcomb, Ron Perla, and Nancy Pfeiffer. I apologize to anyone that I forgot.

There are some individual contributions that are worthy of mention. Ian McCammon provided the field book figures snow profile reporting forms, and density nomogram. Dale Atkins was very helpful in creating the incident forms in Appendix H and the metadata fields in Appendix C. Dan Judd provided the sample programs in Appendix E. Joyce VanDeWater drew the illustrations in Chapter 2. Charles Fierz allowed us to include the new snow classification (Appendix F) and snow symbol fonts. Ron Simenhois contributed most of the material in the Extended Column Test and Propagation Saw Test sections. Many photographers provided images for this publication and they are listed with their contribution.

Lastly I would like to thank the members of the Working Group on Observation Guidelines for their dedication and patience during the development and revision of this document.

Ethan Greene  
Working Group on Observation Guidelines, Chairman  
August, 2010

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## **Introduction**

This document contains a set of guidelines for observing and recording snow, weather, and avalanche phenomena. These guidelines were prepared for avalanche forecasting operations, but can be applied to other programs as well. The guidelines are presented as a resource of common methods and are intended to promote efficient and fruitful communication among professional operations and between research and operational communities.

The observations presented in this manual were selected to support active avalanche forecasting programs. Observing these parameters will help avalanche forecasters make informed and consistent decisions, provide current and accurate information, and document methods and rationale for operational decisions. Recording these parameters will assist program managers to document and analyze unusual events, apply pattern recognition and statistical forecasting methods, and assist research into snow and avalanche phenomena. In addition, there is often little snow and weather data collected in mountainous areas and data collected by avalanche forecasting programs can be used in climatological and mountain systems research. Our hope is that this manual will help forecasters carefully choose the observations that support their programs, and that those observations will generate high quality and consistent data sets.

It is unlikely that any one operation will make all of the observations outlined within this document. Individual program managers should select a set of parameters that their staff can observe routinely. Programs with specialized needs may have to look elsewhere for information on additional observations. A set of references is listed in Appendix A as a starting point.

## **Structure of this Manual**

This manual is divided into three chapters and nine appendices. Within each chapter, methods for composing an observational scheme are presented first. A standard observation is presented next, and the remainder of each chapter is devoted to describing detailed methods for observing and recording a particular phenomenon. The appendices provide additional information without distracting from the main topics within the manual.

## **Units**

The avalanche community within the United States typically uses a combination of English and International (SI) unit systems. In this document we have attempted to adhere to the SI system whenever possible. In the United States, personnel of avalanche operations and users of their products may not be familiar with all SI units. Individual programs should choose a unit system that suits their particular application. A recommended system of units, an alternative system of English units, and methods for converting values between the two systems are presented in Appendix B. The most noticeable deviation from the SI system is the unit for elevation. In North America most topographic maps use feet as the unit for elevation. Therefore the recommended unit for elevation remains the foot. Throughout the document the recommended unit appears in the text with the common alternative unit adjacent in parentheses. Long-term data records should be stored in the recommended system of units in Appendix B. Data records submitted to a central database are assumed to be in the recommended system unless otherwise stated in the accompanying metadata file (see Appendix C).

## **Data Codes and Symbols**

Symbols and data codes for many of the observations in this document appear in tables within each section. The use of these codes will save space in field books and on log sheets. Many of the codes in Chapter 1 follow conventions from the meteorological community. The codes in Chapters 2 and 3 were chosen to conform to common methods in the avalanche community and to promote efficient communication.

