

THE 2008 INTERNATIONAL CLASSIFICATION OF SEASONAL SNOW ON THE GROUND

C. Fierz^{1*}, R. L. Armstrong², Y. Durand³, P. Etchevers³, E. Greene⁴, D. M. McClung⁵,
K. Nishimura⁶, P. K. Satyawali⁷ and S. A. Sokratov⁸

¹ WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland

² National Snow and Ice Data Center NSIDC, University of Colorado, Boulder, CO, USA

³ Centre d'Etudes de la Neige CEN, Météo-France, St Martin d'Hères, France

⁴ Colorado Avalanche Information Center CAIC, Boulder, CO, USA

⁵ Department of Geography, University of British Columbia, Vancouver, BC, Canada

⁶ Department of Environmental Science, Faculty of Science, Niigata University, Niigata, Japan

⁷ Snow and Avalanche Study Establishment SASE, Manali HP, India

⁸ Research Laboratory of Snow Avalanches and Debris Flows, Faculty of Geography,
Moscow State University, Moscow, Russia

ABSTRACT: The "International Classification for Seasonal Snow on the Ground" published in 1990 is now well accepted by most snow scientists and practitioners around the world. Nevertheless, the snow community felt some points needed to be revised. Most problems were spotted within the classification of wet snow and crusts, but also in conjunction with polar snow, blowing snow, snow in forests or on how well a non-specialist end-user may be able to use the classification. In 2003, a working group on Snow Classification was established by the former International Commission on Snow and Ice (ICSI) that now has become the International Association of Cryospheric Sciences (IACS) within the International Union of Geodesy and Geophysics (IUGG). Based on feedbacks provided by both practitioners and scientists, the Working Group discussed and implemented necessary changes to the 1990 snow classification. The revised classification has then been reviewed by a representative committee of worldwide snow practitioners, snow researchers and agencies. The 2008 classification will be published by UNESCO in the series a "Technical Documents in Hydrology" and will be downloadable from the web. Here we will present the main revisions focusing on those of importance for snow and avalanche practitioners and scientists.

KEYWORDS: snow, snow classification, snow cover, snow metamorphism, snow properties, snow stratigraphy

1 INTRODUCTION

The wide range of interests and knowledge in both snow observation and snow science makes common descriptions of snow as well as common measurement practices very desirable.

Knowledge increased and the way observations are made evolved since the release of the current "International Classification for Seasonal Snow on the Ground" by Colbeck and co-workers in 1990. In 2003, the general feeling was that the 1990 classification needed an update, applying corrections and making additions only where the whole snow community felt it most necessary. Following the spirit of the previous editions, the

Working Group on Snow Classification took care to still provide a concise document usable by users of quite different horizons, that is, snow scientists, practitioners, scientists from other fields as well as interested lay persons. It is however indubitable that the classification becomes more technical as new knowledge, state-of-the-art field measurement techniques and new observation methods emerges.

2 MAJOR CHANGES TO THE 1990 CLASSIFICATION

In general the revised classification sticks to the scheme of the 1990 one. However, the main entries of Part 1 and 2 have been extended or augmented as needed. Contrary to 1990, a substantial but not exhaustive bibliography was added to refer the reader to basic or seminal work on the topics addressed.

The grain shape classification is augmented by one new main class, namely machine

* *Corresponding author address:* Charles Fierz, WSL Institute for Snow and Avalanche Research SLF, Flüelastrasse 11, CH-7260 Davos Dorf, Switzerland;
tel: +41 81 417 01 65; fax: +41 81 417 01 10;
email: fierz@slf.ch

made snow, a few additional sub-classes and a redistribution of the old surface deposit sub-classes among other main classes. The abbreviation code is no longer alphanumeric, getting rid of the idea of a tree-like classification that cannot fit the subtleties of snow metamorphism. The new code will help to avoid misunderstandings and adds flexibility to the classification scheme. Furthermore, the 1990 process-oriented classification has been merged with the description of the process itself.

One important premise is that a single snow layer cannot be characterized by a single parameter, such as grain size or shape. Therefore, basic guidelines for snow and snowpack observations are provided in a separate appendix.

Very promising research tools and methods such as the Snow Micro Penetrometer, Near Infrared Photography or 3D-tomography were neither included nor mentioned, as they cannot be considered to have advanced to standard and simple field tools yet. On the other hand, a text describing the most promising snow microstructure parameters could be agreed upon and is included as an appendix. The latter is deeply needed to give snow scientists a common language with respect to snow microstructure, even though full consensus among experts in the field could not be reached yet.

Finally, the glossary part of the classification has been thoroughly revised. Important terms relating to snow and the snow-cover but having no entry in the main text are defined here. A multilingual list provides translations of these terms into French, Spanish, Russian and German.

3 SUMMARY AND OUTLOOK

As it was in the past, it is probably still not possible to provide a classification that would truly satisfy all levels of users in all countries. The community of snow scientists and snow practitioners has participated from the beginning in this updating process. The present document is a good compromise between not changing anything, improving where needed, and not including all recent developments that are not fully agreed upon by the whole community.

Attempts were made to include special sections or appendices on forest snow covers and surface formation – mainly in Polar Regions – but could not be worked out satisfactorily. In future, it is expected that the International Association of Cryospheric Sciences IACS will install a Standing Group on Ice and Snow Classifications and Glos-

saries ISCLAG. The latter would be able to tackle such topics again as well as to react more promptly and flexibly to future developments in the field. In addition, companion documents, a snow symbol font as well as an XML-based international exchange format for snow profiles will be made available on IACS website.

The publishing of a hard copy version of the 2008 IACS Snow Classification in the UNESCO-IHP series '*IHP Technical Documents in Hydrology*' will undoubtedly help meet the goal of making the classification available to as many as possible groups of interested users. By providing authoritative translations of the classification as well as additional versions of the multilingual list of terms on its website, IACS will further contribute to the dissemination of the classification.

(www.cryosphericciences.org)

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REFERENCES

Colbeck, S. C., and 7 others (1990) *The International Classification for Seasonal Snow on the Ground*. International Commission on Snow and Ice (IAHS), World Data Center A for Glaciology, University of Colorado, Boulder, CO, USA.