ICSIH Annual Report to IAHS Bureau

4 July 2010 John Pomeroy, ICSIH President

1. **Introduction.**

ICSIH, the International Commission on Snow and Ice Hydrology, continues its work in promoting and developing an exciting and growing area of hydrology – that which occurs at the triple phase change from snow and ice to water and water vapour and is dominant at the high altitude and high latitude cold regions and in cold seasons over much of the Earth's surface. Snow and ice hydrology has an inordinately effective role in generating runoff that is important outside of the cold regions and seasons and can form an important water source for temperate and tropical regions downstream. Snow and ice hydrological systems are relatively ungauged, difficult to predict and highly sensitive to the impacts of climate change. ICSIH has a special role within IAHS by fostering a connection with the International Association of Cryospheric Sciences.

2. **Organisation**

ICSIH Bureau 2009-2010.
President: Professor John Pomeroy, University of Saskatchewan, Canada & Aberystwyth University, Aberystwyth, Wales, UK
Vice-President: Dr. Alexander Gelfan, Russian Academy of Sciences, Moscow, Russia
Vice-President: Dr. Daniel Marks, Agricultural Research Service, Dept. of Agriculture, USA
Vice-President: Dr. Philip Marsh, National Water Research Institute, Environment Canada, Canada
Secretary: Dr. Regine Hock, Uppsala University, Sweden & University of Alaska, Fairbanks, USA

3. **ICSIH Activities 2009-2010**

i) *Meetings:* ICSIH has been active since Hyderabad by cosponsoring two scientific meetings dealing with cold regions hydrology and polar hydrology. The *Workshop on Cold Regions Hydrology* was held in Innsbruck, Austria 28-30 April 2010 and was organised by the University of Innsbruck and the European Space Agency. The Workshop was attended by almost 100 participants from Europe, North America and South America and dealt with a wide range of snow hydrology issues with a particular emphasis on enhanced observations. To wrap up the International Polar Year, the *IPY Oslo Science Conference* was held 8-12 June 2010 and ICSIH co-sponsored the session "From land to ocean: hydrological, coastal, nearshore and upper shelf processes in polar regions" at which 53 papers were presented. ICSIH is joining in a working group on mountain glaciers being organised by Georg Kaser, to help clarify recent misunderstandings of the rate of disappearance of glaciers and the associated hydrological impacts.

ii) *ICSIH Publications*: a Red Book is being edited and a special issue of a journal has been completed this year.

Essery, R., D. Marks, P. Marsh, 2009. Thematic Set on Subsurface, Surface and Atmospheric Processes in Cold Regions Hydrology, Hydrological Processes 23(17).

Collins, D. 2010. High Mountain Snow and Ice Hydrology. IAHS Publ. No. 332.

5. **ICSIH Plans 2010-2011**

At Melbourne, ICSIH has five sessions by convening an IAHS symposium and workshop and a joint symposium and two joint workshops (with IACS). It is maintaining especially strong links with PUB and IACS.

IAHS Symposium: Cold Regions Hydrology in a Changing Climate

Lead Convenor: Daqing Yang (United States of America)
Co-Convenors: Alexander Gelfan (Russia), Phil Marsh (Canada), Doerthe Tetzlaff (United Kingdom)

Scope: The high latitude and lowland cold regions of the globe are experiencing some of the most rapid changes in climate. These also represent one of the most severely ungauged regions on Earth and suffer from sparse meteorological observations. Although the hydrology of these regions is dominated by snow and ice, our understanding of the hydrological response to a changing climate over cold regions is incomplete. Changes in hydrology related to changing frozen soils, snowfall/rainfall ratio, snowcover, river and lake ice, glacier cover and vegetation are not well known. Our ability to model the effect of these changes on both the fluxes of energy and water between the land surface and the

atmosphere, soil and water bodies needs improvement. A particular issue for modelling is the impracticability of model calibration due to the sparse gauge network and rapid climate change. There is also lack of knowledge on process emergence with scale change across these regions. This session will address major issues and challenges in cold regions hydrological research and applications with an emphasis on snow and ice hydrology. It will examine changes in the characteristics and functioning of rivers, lakes, and wetlands in cold regions, and their interactions with changing human activities and ecosystems. It will explore and examine the biological**,** physical, and social impacts of hydrological and climatic change in cold regions.

IAHS Workshop: <u>Snow and Ice Hydrology: Principles, Processes and Prediction</u>
Lead Convenor: Tim Link (United States of America)
Co-Convenor: Michele Reba (United States of America)

Scope: This poster only session encourages papers on all aspects of snow and ice hydrology including physical principles underlying hydrological behaviour with snow and ice involvement, measurement using remote sensing and surface observations, snow and ice processes and hydrological prediction in regions where snow and ice affect flow regimes. The storage and modulated release of water from snowpacks and glaciers are major components of hydrological systems in many parts of the world, particularly in mountainous and circumpolar areas. In these regions, the seasonal snowcover, permanent snow and glacial ice are critical components of the annual water cycle, controlling soil moisture, soil temperature, streamflow, and the development and stability of terrestrial and aquatic ecosystems. This session will bring together operational, experimental and modelling experts to address a broad range of topics that are important to understanding this important resource. The session is scheduled for an entire day to facilitate interactions between snow and ice hydrology and related researchers.

Joint Workshop: <u>Impacts of changing climate, snow and ice on mountain hydrology</u>

Lead Convenor: Danny Marks (United States of America)
Co-Convenors: Michael Lehning (Switzerland), David Collins (United Kingdom), Mark Seyfried (United States of America), Regine Hock (Sweden), John Pomeroy (Canada), Marc Parlange (Switzerland)

Scope: Changes in storage of water as seasonal snowpack, frozen ground, and perennial snow and glacier ice, and release of meltwater are major components of hydrological systems in the high mountain regions of the world. In such areas, the annual cycle of meltwater production from snow and ice is critical, influencing streamflow regime, soil moisture, and both terrestrial and aquatic ecosystems. Meltwater availability is crucial in cold mountain environments and in areas downstream, for agriculture and hydropower, particularly where the areas surrounding mountains are otherwise arid and susceptible to drought. Mountain snowpack, permafrost, glaciers and meltwater runoff will continue to

be influenced strongly by climate change into the future. Detailed understanding of and the ability accurately to model inter-relationships between climate, snowpack, ground ice and glacier dynamics coupled with intra-basin hydrological processes are necessary in order to test hypotheses concerning contemporary and future interactions between high mountain climate, snow, ice, runoff, biogeochemistry and water quality. This symposium addresses a broad range of topics important for better understanding of snow and ice hydrology in mountain regions and for reducing uncertainty and increasing physical realism in modelling and prediction under climate change. Contributions on the following topics are particularly welcome: measurement and monitoring techniques for snow and ice in cold mountainous regions; physical properties of snow, permafrost and ice – parameterisation of microscale properties for macroscale prediction; using remote sensing for improvement of prediction of runoff from snow and ice in data-sparse mountain areas; forecasting meltwater runoff from ungauged high mountain basins; assessment of risk and prediction of glacier lake outburst floods in mountain areas, and impacts of mountain snow and ice hydrology on water resources in drier downstream areas in a changing climate.

Joint Workshop: <u>Subglacial water: Properties, Processes and Role in Ice-mass Dynamics.</u>

Lead Convenor: Bryn Hubbard (United Kingdom)
Co-convenors: Steffan Vogel (United States of America), Robert Bingham (United Kingdom), Helen Fricker (United States of America)

Subglacial water represents one of the most important yet poorly-understood aspects of glaciology. It exerts a key control over the dynamic behaviour of glaciers and ice sheets, contributes to unique ecological habitats, and acts as a potent geomorphic agent. For example, a growing number of remote sensing and ground-based observations across Antarctica and Greenland are highlighting the existence of subglacial water in a variety of forms, ranging from vast subglacial lakes (providing distinctive habitats for potentially unique life forms) to mm-thick water flows at the ice-substrate interface. These hydrological phenomena have great potential to impact on ice dynamics – from the scale of valley glaciers to large ice sheets - feeding back into the response of ice masses to climate change and their consequent contributions to changes in sea level. The precise nature of this control is far from well-constrained, despite the sensitivity of numerical models to (what are currently at best approximated basal sliding terms).

Characterizing the role of basal meltwater quantitatively therefore remains an important outstanding glaciological problem, as does structuring and scaling that knowledge for use in models of ice mass motion. However, it is difficult to access the base of ice masses, and it is perhaps even more challenging to characterize spatio-temporal variations in the water that may be present there. These challenges continually drive the application of innovative methods and new technologies in the investigation of subglacial water.

We solicit scientific contributions that include, but are not limited to, measurements and/or modelling of: (i) water flows at the ice-mass bed and through subglacial sediments; (ii) feedbacks between ice-mass hydrology and ice dynamics, and the impact of that relationship on ice-mass response to climate change; (iii) theoretical-, field-, or laboratory-based parameterization of basal hydrological processes, including the application of innovative technologies; (iv) formation, geometry and potential linkages between subglacial lakes; (v) subglacial lake drainage and meltwater outbursts from ice-mass margins; and (vi) geomorphological evidence of subglacial water flows from contemporary ice-sheet margins and across formerly glaciated regions.

Joint Symposium: <u>Snow-Atmosphere interactions in mountains</u>.
Lead Convenors: Michael Lehning (Switzerland), Marc Parlange (Switzerland), Pierre Etchevers (France), Eric Brun (France)
Co-Convenors: Samuel Morin (France)

Scope: Mass balance of Alpine glaciers, snow water storage in the mountains providing water to arid areas and local microclimate are only a few examples why snow – atmosphere interactions in mountains need to be understood. Snow deposition in mountains is governed by precipitation gradients across mountain ranges, preferential deposition caused by local flow – precipitation interactions and redistribution of snow via saltation and suspension. Snow ablation depends heavily on the local energy balance with spatially varying radiation and turbulent fluxes. In complex terrain, shortwave radiation varies because of shadowing and reflections, longwave radiation varies because of varying emissions from snow, rock, soil or vegetation and turbulent fluxes vary because of differences in surface properties as well as varying wind speeds. Inversely, the presence or partial presence of a snow cover alters the forcing of the land surface on the atmosphere. In order to answer the question “how much snow is there on the mountain, where, when and why” and to make assessments of current and future snow cover, these interactions need to be understood quantitatively. This session invites contributions on the subject from atmospheric scientists, hydrologists and snow scientists.