ICSIH Annual Report to IAHS Bureau

April 5, 2018; Dr. Tobias Jonas, ICSIH President

1. Introduction

ICSIH, the International Commission on Snow and Ice Hydrology, continues to promote the scientific study of the processes of snow, permafrost and ice dynamics, the interactions between snow, permafrost, ice and ecosystems, and impact of snow, permafrost and ice on runoff generation, rivers and lakes, with an emphasis on the seasons and regions where the solid phase of water and its subsequent runoff are prevalent.

Cold regions are particular responsive to changing environmental conditions, and small shifts can result in hydrological regimes that have not been observed in the past. Key to improve our understanding of the involved complex and interacting processes is collaboration, both geographically and across disciplines.

ICSIH maintains a network with many organizations acting in the field of cryospheric sciences. ICSIH strives to integrate the communities' effort within IAHS, enabling us to foster exciting research at the interface between cryospheric and hydrological sciences.

2. Organization

ICSIH Bureau 2017-2018:

- Immediate Past President: Dr. Danny Marks, Agricultural Research Service, Dept. of Agriculture, USA
- President: Dr. Tobias Jonas, WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland
- Vice-President: Dr. Timothy Link, University of Idaho, USA
- Vice-President: Dr. Sebastian Mernild*, Sogn og Fjordane University College, Norway
- Vice-President: Dr. Melody Sandells, CORES Science & Engineering, Edinburgh, UK
- Secretary: Dr. Alexander Gelfan, Water Problems Institute of the Russian Academy of Sciences, Moscow, Russia

*Note that we have lost contact to Dr. Sebastian Mernild who is no longer responsive to emails concerning ICSIH

3. ICSIH Activities 2017-2018

Following the IAHS Assembly in Port Elizabeth, ICSIH has been active to promote SIH related science on the occasion of a number of international science meetings.

3.1 International Conference on Snow Hydrology, February 12-15, 2018, Heidelberg, Germany

ICSIH was present with two officers (Tim Link, Tobias Jonas) and involved in the following activities:

- ICSIH hosted the following session:

  Advances in snow hydrological modeling (Tim Link, Tobias Jonas)
  The storage and release of water from seasonal snow constitutes an important component of the annual hydrological cycle in many parts of the world. Snow hydrological models are commonly used to monitor available snow water resources and to forecast expected snowmelt contributions to streamflow. Ongoing climate change necessitates the development of modeling approaches that perform adequately outside of meteorological conditions that prevailed in the past. Increased and improved process representation in models, multi-model frameworks, and data assimilation are among the various ways that simulation improvements are currently being realized.

  This session focuses on recent advances in model development and application towards improved estimation of snow water resources and snowmelt predictions. We welcome contributions related to topics such as, but not limited to:

  - Improved process representation in models
  - Advanced methods to provide meteorological input data to models
  - Impact of climate and landcover changes on snowcover dynamics
  - Representation of small-scale variability at coarser model grid scales
  - Coupling of modeling systems (e.g. meteorological, snowcover, and runoff models)
  - Case studies and model validation

  This session is sponsored by the IAHS International Commission on Snow and Ice Hydrology ICSIH.

- Involvement in a second session on ***Assimilation of snow data for hydrological modelling in cold regions*** (Tobias Jonas)
- Keynote on ***Challenges and advances in operational snow hydrological modelling*** (Tobias Jonas)
- We were invited to moderate a panel discussion on ***Recent advances and challenges in snow hydrology*** (Tim Link, Tobias Jonas), ICSIH and UPH were mentioned on several occasions. One of the topics that were discussed was the needs of early career scientist in snow and ice hydrology (see Section 3.5).

3.2 3rd Annual INARCH Workshop (Intl Network for Alpine Research Catchment Hydrology), February 8-9, 2018, Garmisch-Partenkirchen, Germany

Also at this meeting ICSIH was present with two officers (Tim Link, Tobias Jonas). As in recent years, ICSIH actively sponsors INARCH to support collaboration and exchange of knowledge and data between international researchers who work on mountain catchment hydrology. This year's workshop was organized around keynote lectures on each of the four themes of the meeting:

- ***Snow hydrology*** (Tobias Jonas)
- ***Glacier hydrology*** (Georg Kaser)
- ***Alpine measurements including remote sensing*** (Tom Painter)
- ***Climate models and downscaling for mountains*** (Roy Rasmussen)

Also at this meeting INARCH ties to ICSIH were acknowledged.

3.3 The IUGG General Assembly, July 8-19, 2019, Montreal, Canada

ICSIH has actively contributed to draft a program for the upcoming GA. We have particularly reached out to IACS to discuss collaborations. Currently we are involved in 4 session proposals:

- ***Advances in snow hydrology*** (IAHS; cross-listed with IACS)

  The storage and release of water from seasonal snowcovers constitutes a critical component of the annual hydrological cycle in many parts of the world. Quantifying, understanding, and predicting the processes that control snow distribution and ablation dynamics provide ample research challenges, especially in complex mountainous terrain. The spatial distribution of snowcover and its physical properties is typically highly variable at the meter to the regional scale. Its dynamics are influenced by surrounding topography and vegetation that control accumulation and redistribution processes, as well as local micrometerological conditions that control snowcover energetics and ablation. Accurate modelling of snowcover dynamics requires methods to simulate a large range of physical processes that act and interact at a range of spatial and temporal scales. Advances in these areas are needed and relevant to develop improved tools for water managers concerned with floods, droughts, water supply, and/or hydropower generation.

  This session will bring together experimental and modeling experts to address recent research in snow hydrology. We especially encourage contributions related to topics such as:

  - Novel measurement approaches for snowpack states and fluxes
  - Feedbacks between climatic and snow hydrological processes and patterns
  - Snow-vegetation interactions in complex terrain
  - Effects of climate variability and change, especially in the rain-snow transition zone
  - Impact of landcover changes on snow hydrology
  - Advances in modeling, including operational applications
  - Representing small scale variability in large scale modeling applications

Conveners: Timothy Link (ICSIH), Melody Sandells (ICSIH), Danny Marks (ICSIH), Tobias Jonas (ICSIH), Alexander Gelfan (ICSIH)

- ***Advances in remote observation of seasonal snow*** (IAHS; cross-listed with IACS)

  Seasonal snow represents an important freshwater resource and critically sets conditions for ecosystem functioning in cold regions around the world. Today's remote sensing technologies not only allow to measure snow distribution across the landscape, but also to characterize terrain and vegetation canopy structure at the same time. These combined dataset have reached a level of detail that ultimately allows to study snowcover dynamics and ecosystem feedbacks at the level of small-scale processes. This session aims to bring together those working on data from remote sensing technologies such as laser scanners, radar, as well as RGB, thermal, and hyperspectral imagery with the aim of quantifying snow water resources, studying snowcover dynamics, and investigating interactions with atmospheric and ecohydrological processes.

  Conveners: Tobias Jonas (ICSIH), Jeff Deems, Jessica Lundquist, Danny Marks (ICSIH), María José Polo (ICRS)

- ***Declining glaciers and snow cover and their impacts on downstream hydrology*** (joint IACS-IAHS)

  Snow and ice melt controls streamflow in many watersheds around the world. A warming climate has started to induce hydro-climatic systems to transition from snow to rain dominated conditions. As glacier mass loss proceeds and snow cover declines, significant changes in the hydrological regime are expected to affect millions of people downstream of today's mountain regions. Being able to predict the amount and timing of meltwater is therefore of paramount importance. This session will focus on new insights into relevant processes, new observational evidence of ongoing changes, as well as advances in our ability to project future water availability based on models with a physical foundation.

  Conveners: TBD (IACS), Danny Marks (ICSIH), Alexander Gelfan (ICSIH)

- ***Coupling processes between the atmospheric boundary-layer and snow/ice surfaces: observations and modelling*** (IACS; cross-listed with IAHS)

  The symposium addresses fundamental exchange mechanisms of mass and energy between the cryosphere, vegetation and the atmospheric boundary layer in snow-covered regions. The interaction between the near-surface atmosphere and the cryosphere can lead to significant spatial and temporal variations of momentum, mass- and energy exchange as well as complex atmospheric flow patterns that are modulated by complexities in topography and vegetation cover. Horizontal advection of blowing snow, heat and water vapor in particular are poorly represented in models. These processes strongly affect the temporal and spatial evolution of seasonal snow cover, permafrost, sea ice, vegetation and glaciers and drive snow and ice hydrology. Furthermore, the feedbacks between changing snow/ice surfaces and the atmosphere have a very strong influence on the boundary layer, which is insufficiently understood and suggests a grand challenge is to accurately describe the co-development of the atmosphere and cryosphere. We invite contributions that consider boundary-layer meteorology, turbulent energy and

mass fluxes and exchanges in cryospheric environments. Examples include the treatment of turbulent fluxes in models and measurements, advection of energy to patchy snow-covers, orographically-induced precipitation, preferential deposition of snowfall or wind-induced snow transport and sublimation. Both, model studies and experimental work in level and complex terrain are welcome, as are studies that address mountain environments – a priority identified by GEWEX-INARCH. We particularly encourage abstracts that propose advances in a) modelling techniques to represent the physics of coupling the atmospheric boundary layer to snow and ice surfaces and b) observational techniques to explore complex processes that govern the mass and energy exchange between the lower boundary layer and the snow/ice surface.

Conveners: Vincent Vionnet, Rebecca Mott, Ruzica Dadic, John Pomeroy, Ethan Gutmann, Tobias Jonas (ICSIH)

- ***Celebration of 125 years of the Commission Internationale des Glaciers (CIG)***
  CIG can be seen as the predecessor of both IACS, WGMS, and ICSIH. We are involved in discussing an event to celebrate this anniversary.

3.4 IAHS initiative to identify 23 Unsolved Problems in Hydrology (UPH)

ICSIH had interesting internal discussions towards developing contributions related to snow and ice hydrology. We have come up with 3 new blog entries and 1 response to an existing entry:

- ***How can we ensure that improved snowmelt models translate into improved capabilities to simulate streamflow from snowy watersheds?*** (Melody Sandells)

  A lot of effort has been put into improving snowmelt models, and existing models today can resolve numerous complex processes. Yet many operational snowmelt runoff model systems use rather conceptual methods to calculate the resulting streamflow. Also, literature demonstrating the benefit of improved snow routines on the performance of streamflow simulations is relatively limited. Are there other areas of hydrological science that must be advanced before the benefits of improved snow process knowledge and representation in models can be realized as a step towards improving streamflow estimates? Ultimately the initial question is fundamental as it has the potential to challenge the relevance of snow hydrology as a discipline.

- ***How can small-scale variability of snow distribution be better represented in larger scale models, and what level of detail is needed for snowmelt runoff modelling?*** (Tim Link)

  Snow distribution is highly variable across spatial scales from the meter to the continental scale. While small-scale processes cannot be ignored, they also cannot be resolved for larger-scale applications. We may therefore need a new level of subgrid parameterizations which better reflect our current understanding of small-scale processes. For example, rather than universal stochastic relationships, these parameterizations could potentially include results from prior and/or one-off high resolution simulations to allow a higher level of process representation.

- ***How to reconstruct paleohydrological phenomena during the Holocene and why did they happen?*** (Alexander Gelfan)

  Paleohydrological phenomena, such as paleo-floods, paleo-draughts, multi-century changes in the water cycle, happened, most likely, during the Holocene (last ~ 11650 years) both globally and regionally. There are quite a few circumstantial indicators of these phenomena, derived, for instance, from tree-ring-based reconstructions, lake-sediment, planktonic and benthic isotope analysis, glacial and geomorphological studies, etc. However, these circumstantial evidences are not only very uncertain but, more importantly, do not provide any understanding of physical causes of these phenomena. Were they caused by climate changes or happened due to post-glacial geomorphological restructuring of river network and watershed sizes or were associated with changes in permafrost, vegetation cover, etc., or with earthquakes and volcanic eruption or anything else? We do know almost nothing about the drivers of the paleohydrologal phenomena. Solving the above formulated problem can provide new insight in possible physical (natural) mechanisms of the future hydrological systems' dynamics at the geological time scales.

- ***Under what conditions is snow melt a more efficient generator of streamflow and groundwater recharge than rainfall?*** (posted by Anne Van Loon; replied to by Tim Link)

We have invited contributions to UPH via CRYOLIST and Twitter. A feedback we have received from the community multiple times, is that many were generally interested in the UPH initiative but not willing to sign in to LinkedIn to participate. In response, IAHS is now accepting contributions also via email.

3.5 Assessing needs of early career scientists

During the International Conference on Snow Hydrology (Section 3.1) we set up a panel discussion to assess together with about 25 early career scientists (ECS) whether they had specific needs. Seed questions such as ***"Is there an interest in a special journal issue with contributions from ECS?"*** were prepared to kick off the discussion. Interestingly, there was a general agreement amongst the present ECS that they just wanted to be perceived as "normal" scientist and not treated in any special way. Having advantages as ESC (e.g. easier access) should not come at the price that contributions of ECS were seen as less valuable.

ICSIH Bureau, April 2018.