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THE IAHR ICE RESEARCH AND ENGINEERING COMMITTEE AND THE SDGs

BY MATTI LEPPÄRANTA

The mission of the IAHR Ice Research and Engineering Committee is to promote research towards a better understanding of ice properties and processes, and related environmental and ecological issues on rivers, lakes, and the ocean, and to develop knowledge for water resources problems in cold regions, including natural and anthropogenic ice-related challenges. The Ice Committee has established working groups and organizes biennial Ice Symposia. A recent effort was to provide a set of articles on ice topics to the UNESCO EOLLS (Encyclopedia of Life Support Systems)^[1]. The next symposium organized by the Committee will be held in Vladivostok, Russia, in June 4-8, 2018. Proceedings of earlier symposia (held 23 times in 1971-2016) are available in electronic form in the IAHR web site^[2].

The region where river and lake ice occurs covers in fact a large part of land areas is located north of 45°N (Fig. 1). In oceans sea ice forms above latitudes 60°N and 60°S except in the northeast Atlantic where the Gulf Stream keeps the sea open up to 75°N. In northern Eurasian and American continents, the annual



Figure 1. The zone of seasonally freezing lakes in the northern hemisphere and the 0°C January climatological isotherm. The contours 100 and 180 refer to the mean length of the ice season (days)^[4].

ice season is even longer than the open water season. However, ice research has been under-represented in many science, engineering and environmental programs concerning surface waters. The IAHR Ice Committee has tried to take care of this field within the IAHR

community. Ice management is connected to the Sustainable Development Goals (SDG) as it affects the ecology in natural waters and human life in cold climate conditions. Due to links between ice and liquid water resources, more collaboration between the Ice Committee and other committees is needed in order to increase IAHR's contribution to the efforts to achieve the SDGs.

The effects of ice on human activities can be either harmful or beneficial. Problems caused by ice are floods induced by ice jams^[3]. See Fig. 2. Also clogging of water intakes and trash racks by frazil ice, severe impediment to winter navigation, and damage to coastal and offshore structures by moving ice are important issues of concern. On the positive side, stable ice covers have extensively been used for traffic and transportation, recreational activities, landing of aircrafts and working platforms, and also ice is a source of clear drinking water. In earlier times, ice was stored to be used for cooling in summer. At times, however, mishaps during these activities have resulted in loss of life.



Figure 2. Ice jamming in the Yellow River, China. Photograph: Xinlei Guo.



Figure 3. Ice road maintenance in Lake Pielinen, Finland. Photograph: Maritta Räsänen

The presence of ice cover has a major impact on the circulation of water below ice. Diffusion and dispersion of pollutants is different in ice-covered waters from those in ice-free waters. Oil spills are a major issue in ice-infested waters due to difficulties to detect and predict oil movement and to remove oil. The effects of ice on stream ecology and the presence of an ice cover in lakes influences the level of dissolved oxygen. Ice control techniques may also affect the stream habitat. These are all emerging areas of research. To provide safe and economical vessels is an essential goal for investigators. Exploitation of petroleum and other natural resources in polar regions requires ice navigating vessels to transport massive amounts of products. Ship operators strongly request vessels that can safely and effectively navigate in ice-covered waters. The presence of an ice cover is not only a severe impediment to winter navigation in inland waters, but also affects ships and barges passing through locks and dams. Coastal regions and harbors have to be protected from ice forces.

About 77% of the fresh water of the world is stored in glaciers and ice sheets, mostly in Antarctica and Greenland. Possible global warming will affect these ice massifs, resulting in a global change of the sea level. Regionally, the formation of ice on water bodies strongly affects human activities in countries located at higher latitudes. In a moderately cold climate, the existence of ice is limited to short periods of a few weeks per year, but unexpected winter conditions can cause severe ice-related problems, such as interruption of navigation,



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ice-jam induced floods, ice damage to bridges, coastal structures, hydropower plants and other hydraulic structures, ice blockage of water intakes, etc.

Ice research and engineering efforts are mainly directed toward better understanding of ice and how best to manage it. Research topics include ice formation and evolution, physical properties of ice, movement and accumulation of ice in surface waters and around structures, interaction between flow and ice cover, effects of ice on the environment and ecology, and ice control and use. Ice engineering deals with ice formation, ice movement, the thermal regimes of rivers, lakes and seas, and the development of methods to alleviate the harmful effects of ice. Research should aid in the solution of ice related problems affecting strong economic and environmental interests, such as

hydropower production, navigation in ice-infested waters, water transfer in cold regions, mitigation of ice-jam floods, effects of ice on hydraulic structures, and exploitation for petroleum and other natural resources in polar regions. The effects of global climate change need to be assessed with respect to the ice regimes of rivers, lakes and seas. Active co-operation exists between the research community and industry in ice hydraulic engineering.

A major goal of ice research and engineering is to protect life and property against the harmful effects of ice by understanding ice phenomena and processes. Therefore, the activities of the Ice Committee strongly support the SDGs, in particular Life under ice and Climate change and they are also linked to several other SDGs in high latitudes, where the life and society are closely connected to the seasonal presence of ice. Also in lower latitudes better understanding of ice helps to prepare for extreme cold events. In the field of education, producing the article collection "Cold Regions science and marine technology" for EOLLS^[1] was a major effort. Developing countries have free access to this electronic encyclopedia, but elsewhere UNESCO requires a fee. ■

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