DOI: 10.24425/academiaPAS.2020.134860

Let's Talk About Water

Prof. Monika Kalinowska and **Dr. Agata Goździk** of the PAS Institute of Geophysics talk about ways to bolster public awareness of water issues.

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What role could the IAHR Congress in Poland play in terms of better educating the public and boosting public awareness?

MONIKA KALINOWSKA: Above all, it is the only water conference in Poland ever to have been organized on such a large scale. When organizing the event, we tried to engage all research centers and universities involved in the study of water, both underground and surface waters as well as seas and oceans. We've reached out to many companies in Poland that are involved in conducting water research and measurements as well as selling equipment used in hydrology, hydrodynamics, and water engineering. We've also attempted to engage the local and central authorities in the congress. How effective those efforts have been is demonstrated by the fact that the abstracts submitted by Polish participants account for over 20% of all the submissions we've received.

Currently, the biggest problem facing Poland and the world is the fight against the COVID-19 pandemic. In the long term, however, an enormous challenge is posed by the climate-change-related shrinking of water resources. This is why it's so important that we present the current situation in this field and discuss possible solutions. Participants in the IAHR Congress include the most prominent scholars involved in water research. In addition, the educational role of the congress will be boosted by workshops and courses for young scholars, including those conducted as "master classes." The purpose is to enable young scholars to present their research and discuss it with experienced scientists.

The congress will also include a special session devoted to education and professional development in the field of water engineering. The session will be used to present various case studies in the area of hydro-

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-environment engineering and water management, such as innovative teaching methods and training courses, as well as modern teaching labs and equipment. We also want to use the session to present one of the educational projects being conducted at the Institute. As part of this project, we have announced a competition for students and teachers. The prizes will be awarded during the congress, and the winning submissions will be presented to its participants.

Could you tell me more about this project?

AGATA GOŹDZIK: The project is called BRITEC (Bringing Research into the Classroom). It is an initiative addressed to primary and secondary schools in four partner countries: Poland, Belgium, Greece, and Spain. It involves several pilot programs in the spirit of the Citizen Science approach, which is a way of conducting scientific research that enlists the support of ordinary citizens in collecting and interpreting large amounts of data. The BRITEC project promotes such programs in schools so as to bring pupils closer to the world of science and research and, by the same token, to encourage young Europeans to take a greater interest in STEM subjects. Currently, the project is in a pilot phase – the pupils are conducting observations as well as collecting and analyzing various types of data under the supervision of teachers. By doing so, they're both learning and getting to know the practical aspects of research work. In addition, scientists obtain additional data which would take longer to collect without the help of pupils. The experience gained in this way will provide a basis for teachers and researchers to draft guidelines on how such joint initiatives should be created in the future. In addition, we are preparing a MOOC that will make it possible to bring the good practices resulting from the project also into other schools, universities, and research institutions interested in such collaboration.

What research projects will be conducted as part of BRITEC?

A.G.: We've planned two pilot projects: one pertains to ultraviolet radiation and the other involves observations of seasonal changes in river and riparian vegetation. In the first pilot project, the pupils will measure the intensity of UV radiation, calculate the production of vitamin D_3 by the body, and observe areas of skin exposed to sunlight. After that, they will use formulas provided by the scientists to assess the risk of sunburn and determine how much time they can safely spend in the sun, taking into account their skin phototype – one of six types of skin classified according to its reaction to UV radiation. Such measurements can be taken for example during school trips.

M.K.: In the latter project, pupils conduct observations of river and riparian vegetation and changes that occur during the year. Some of the schools also take simple hydrological and meteorological measurements. The pupils take photographs of the channels of selected rivers at specific intervals and send them to me together with the measurements using special electronic forms.

We'd like to use the information gathered by pupils in our studies of how vegetation affects the processes of transport and mixing of substances in rivers, such as pollutants. In addition, year-round observations of many different rivers and watercourses in different places in Poland will help us choose the best location for planned tracer experiments. Such experiments involve releasing an environmentally safe dye into water and observing how it gets transported. This, in turn, allows us to determine the parameters necessary to describe the mixing of substances and their transport in water.

You have access to the presentations submitted to the congress. Based on their content, could you tell me what kind of topics are currently dominating hydrology and water engineering?

M.K.: I have the pleasure to chair the Congress's program committee. We received nearly 550 submissions from scholars from Poland, Europe, and all over the world who want to present their research. This number far exceeded our expectations. We decided to approve 500 of these submissions, but the coronavirus pandemic may cause the final number of the presentations to change.

The proposed presentations and abstracts vary broadly in terms of topics, which pertain to hydrodynamics, hydrology, water engineering, climate change, such extreme phenomena as floods and droughts, the spread of pollution, underground waters, and polar regions. The abstracts we've received present both findings of experimental and field research as well as results obtained with the use of different mathematical models or computer methods.

Notably, as many as 40 topics of the sessions have been proposed by participants as part of special sessions. These topics are consistent with the main topics addressed by the congress, but we also have 10 additional sessions that go beyond the topics we've proposed.

What are the fields of your day-to-day research at the PAS Institute of Geophysics?

M.K.: I deal with modeling the spread of pollutants in open channels, in other words in rivers, channels, streams, and so on. I'm working on a computer model called RivMix (River Mixing Model) that I have designed and implemented, which can be used to predict how pollutants spread in water and at what rate. Pollutants may be introduced into water as a result of breakdowns, catastrophes, or controlled discharge of household or industrial waste or heated water from industrial facilities that use water for the cooling

purpose (heated water may also act as a pollutant and have an adverse effect on the aquatic environment, for example fish populations). In my research work, I also focus on improving the methods of describing the transport of pollutants, trying to assess the value of the parameters that determine transport in water, and improving formulas for their estimation. The findings may be used in practice to improve computer models that help assess the situation, for example in the event of breakdowns or during the drafting of environmental impact assessments for newly-built power plants or factories. The most important parameters are called dispersion coefficients – they determine the speed at which pollutants spread. These coefficients are hard to estimate in practice, especially in vegetated channels. In such situations, the tracer experiments I've discussed earlier often prove essential.

Moreover, I get a great deal of satisfaction from working with kids, so I'm also involved in popular-science and education initiatives such as BRITEC and the project "Geophysics at School," which our institute has been running for many years.

Also, I'm chair of the biennial International School of Hydraulics, which deals with current problems in environmental hydraulics. It provides a forum for scholars and engineers who work in the field of broadly-understood hydraulics. By gathering the most prominent specialists (researchers and practitioners from the world's top research centers) as well as students and young scholars from all over the world, we are trying to create a good atmosphere for scientific debate. I encourage everyone interested in hydraulics related topics to get involved in the future editions.

A.G.: I specialized in the investigation of the impact of vegetation on the dynamics of flows in channels with complex cross-sections with trees on floodplains. Currently, however, I'm implementing educational programs related to natural sciences. The Institute of Geophysics has an impressive portfolio in this respect, but each project contributes something qualitatively new. Several years ago, we implemented a gigantic project called EDUSCIENCE. In the test phase, it was used by 250 schools in Poland. At the end of the project, there were over 15,000 teachers from 3,500 schools registered on the project's educational platform. The purpose of EDUSCIENCE was to boost the interest of children and young people in mathematics and natural sciences thanks to innovating teaching methods and contact with scientists, including those employed at the Polish Polar Station Hornsund on Spitsbergen. The Institute's employees supported those activities and were authors of over 6,000 educational materials. The project featured an e-learning platform, a popular science portal (www.eduscience.pl), teaching materials, programs for nine educational trips, and environmental monitoring, and comprised around 56,000 class hours, 254 trips, 89 EDUSCIENCE picnics, and 20 science festivals.

We later managed to offer the innovative ideas that had been tested in Poland to locations elsewhere in Europe or essentially the world. More than 1,200 teachers from 60 countries have registered with the EDU-ARCTIC project, funded by the HORIZON 2020 program. The project was addressed to secondary schools in the whole of Europe and aimed at helping them to get to know the fascinating world of the Arctic and polar research. Scientists explained these topics in a clear and easily understandable way, thus encouraging pupils to take an interest in the exact sciences and pursue careers in science. The pupils got to know the work of scientists and the characteristics of polar regions by participating in online classes from the Arctic and even by going on polar trips. The project offered webinars involving polar researchers, an environmental monitoring program, Polarpedia, Arctic competitions, and workshops for teachers.

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We're currently running a project that promotes awareness of polar research among the whole of society. We're organizing classes for all age groups: from children's universities to the universities of the third age. The students get to know the secrets of glaciers, and the scientists who run the courses take them on virtual tours into ice caves. Other classes show the students how researchers live and work at a polar station, discuss the most unusual animals that live in the Arctic, or explain why the Arctic reacts to climate change faster than the rest of the globe. In addition, we're coordinating several smaller projects. One of them is ERIS, in which we have offered schools access to databases, measurements, and findings of scientific research that can be used in geography, physics, or biology classes. Other projects include ODYSSEY, in which we encourage young people to take part in Oxford-style debates on scientific issues, and the aforementioned BRITEC, which makes use of the Citizen Science approach. All these projects have one important thing in common: they all demonstrate that natural sciences are quite simply fascinating.

Interview by **Dr. Justyna Orłowska**