***Beneficial Collaboration for Distance Learning Training in Hydrological Sciences***

As of early 2021, there is 12 years of experience with multi-agency, global collaboration that resulted in online, self-paced hydrological sciences courses. Collaborating agencies for these courses include the World Meteorological Agency (WMO) in Geneva, The COMET Program at the University Corporation for Atmospheric Research in the U.S. state of Colorado, the National Water Academy in Pune, India, the Kenya Meteorological Agency, and the National institute for Water and Atmospheric Sciences (NIWA) in New Zealand. This team effort began well before the COVID-19 pandemic, and is well-suited for the pandemic era.

There are many benefits from multi-agency, global collaborations, including:

* Acquiring an optimal combination of global expertise and local knowledge. The training courses to date have experts from a diverse group of international organizations and local experts who can assist with integrating relevant local issues and experiences.
* Multi-agency collaborations lead to the establishment of meaningful and productive partnerships that can greatly benefit subsequent projects.
* Course instructors and student participants can build a more thorough and diverse knowledge base within the hydrological sciences.

Global collaborations are the means to organize and develop useful content for hydrological training. Distance learning is the tool to deliver that training to a broad and diverse set of global learners. Benefits of distance learning when compared to the in-person live classroom instruction include:

* Cost effectiveness since there are no travel or lodging expenses. This became more important after COVID restrictions on travel.
* Accessibility and flexibility with computer-based, mainly self-paced training. Students can schedule their course time when it is most convenient for them. Work supervisors are formally requested to allow students enough time to dedicate to following the course.
* Interactions are encouraged, and in some cases required, through questions, chats, and course forums. Assignments, in particular, focus on local issues and require student input in the form of short written reports, field observations, and online exercises.

Through global collaborations and distance learning tools, effective self-paced distance learning courses include three that have been successfully delivered multiple times and one that will debut in 2021.

Fourteen 7-week courses called *Basic Hydrological Sciences* occurred between 2009 and 2020 with hundreds of participants from 79 countries. Of those, 585 participants (about 80%) successfully completed all course requirements and received a certificate of completion. WMO Region II has delivered the most courses thanks to the tireless efforts of experts at the NWA in Pune, India. The 2020 offering had more attendees than previous courses offered in the pre-COVID era.

A somewhat more advanced collection of lessons called *Topics in Hydrological Sciences, Hydraulics, and Hydrometeorology* is a 7-week course that has been delivered four times to hundreds of participants in 34 countries with about 200 successful completions.

Both of these courses consisted of between 8 and 11 lessons that can be tailored somewhat based on the local needs and expertise. For example, the NWA in India developed a few lessons for use in the Region II deliveries. A key element of these courses is the mandatory short written assignment that allows the student to describe a local event, phenomena, or agency while addressing course topics.

The third of the distanced learning courses in hydrological sciences had a different approach for requiring local participation. This course, *Hydrology Technicians*, focused on hydrometric measurements, is an 8-week course first offered to Region V in 2017, and then to Region I in 2018. There have been 27 successful completions in 13 countries. NIWA, in New Zealand, was crucial for providing material and an instructor. The Kenya Meteorological Department provided useful input for the revision of some aspects of the course before delivering it to Region I.

This course required more hands-on assignments, including visits to field locations to make measurements and observations. These assignments proved to be too difficult for some participants which accounts for the lower completion rates when compared to the other courses; only 25% of those enrolled completed the Region V delivery. Adjustments were made for the Region I course that allowed some sharing of photos and videos of field sites between participants. The completion rate for the Region I course improved to more than 50%. This course offers a look at how hands-on training may take place during COVID.

A multi-week distance learning course to be delivered for the first time in 2021 is the *WMO Hydrological Observing Systems (WHOS)* course. An objective of this training is to demonstrate how National Hydrological Services (NHSs) can benefit from improved publication, use, and interoperability of hydrological data. This is an important goal, especially for transboundary river basins (basins that are shared by more than one country) within the global hydrological community.

Future efforts will concentrate in translating, adapting and delivering courses in other languages, such as French, Spanish and Russian, as this is expected to greatly increase their international audience.

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