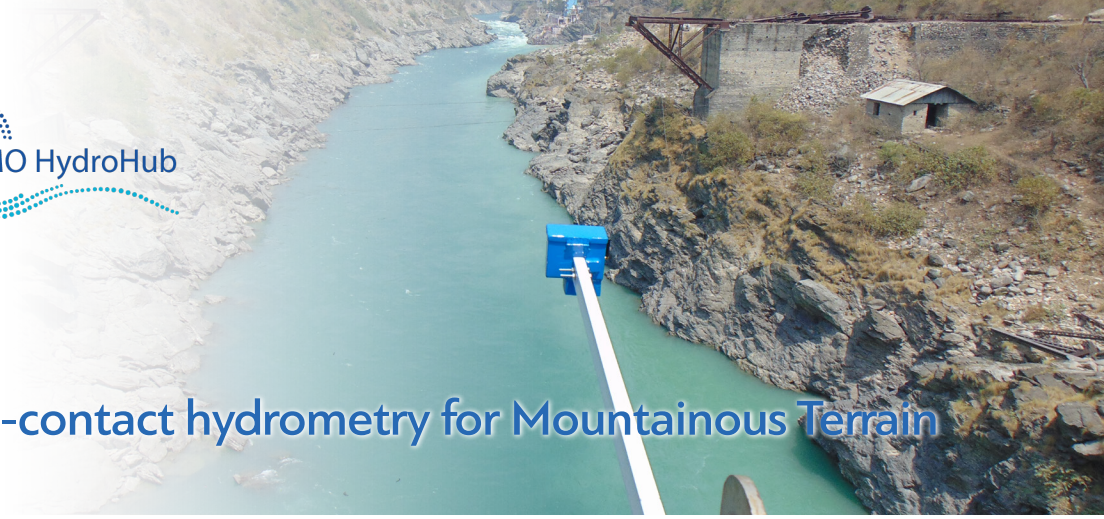
WORLD METEOROLOGICAL ORGANIZATION

WMO HydroHub



CASE STUDY:

Lidar-based non-contact hydrometry for Mountainous Terrain

WMO HydroHub Second Innovation Call

Implementation dates: November 2020 to May 2021
Innovation supplier: Indian Institute of Technology Roorkee
Project implementation country: Indian Himalayan Region

Challenge

In the Indian Himalayan Region (IHR) – with its rugged landscape and rivers characterized by extreme variability in discharge, sediment load and turbidity – traditional observational hydrology is difficult, time-consuming and life-threatening, and traditional non-contact technologies are unreliable. Among the available non-contact water level observation technologies, lidar-based systems are promising because they can reliably measure water levels in highly turbid river systems under various angles, while remaining cost-effective and energy efficient.

The Technology

The lidar-based technology proposed in the project was extensively tested by Imperial College London to gauge and optimize its performance in diverse environmental conditions: distance, turbidity, inclination, temperature and water surface roughness. The technology offers comparable data quality (accuracy and sensitivity) at a much lower cost than other non-contact technologies available in the market. In addition, the proposed sensor has some very specific advantages, especially its unique ability to make accurate measurements at inclination angles up to 30°. This makes it particularly suited for application in remote regions with rivers with unstable riverbeds, where little or no infrastructure can be in the river, and in which the installation of non-contact sensors above the water level – as required for methods such as radar and ultrasound – is very difficult.

Approach

The project was implemented in three phases:

1 A total of 13 lidar-based water level sensors with telemetry capabilities were assembled and cross-calibrated by Riverlabs Ltd. and the University of Birmingham, United Kingdom. However, because of a component shortage and Brexit import delays, only five could be shipped on time for installation in the field. The remaining eight were shipped later in the project and used to train the Central Water Commission (CWC) staff. They will be deployed at a later stage. To support the deployment of the sensors, an open-source telemetry solution was implemented. This setup consists of a data server, based on the open source Thingsboard system, and a tailor-made web-based Graphical User Interface (GUI) for data visualization (Anaconda). The Anaconda platform is available on GitHub in combination with user and developer documentation, to facilitate future development and adoption by CWC and other interested parties.

2 A set of primary sites – among the existing CWC and India hydrological observation sites – were jointly identified by IIT Roorkee and CWC for the installation of the water level sensor with a focus on river reaches in the Himalayan Region. Gauge measurements in the existing CWC sites were used as secondary data for comparison.

3 CWC staff training was carried out in two modules. The first was an introductory workshop on innovations in non-contact hydrometry with a focus on the lidar-based water level sensor. The second was a more detailed training on the installation of the water level sensor, basic data-retrieval steps, troubleshooting, sensor calibration and maintenance. To ensure sustainability, detailed user manuals were prepared describing, amongst others, site development, installation and operational procedures.

Results

- The project increased the monitoring capacity and capabilities of the CWC through lidar-based sensors for near-real-time measurement of water level.
- All hardware and software designs are available in the public domain and the bespoke assembly of the lidar-based water level sensor for use in India can be replicated by local vendors in India.
- Water level sensor installations were completed at the proposed CWC sites, allowing continuous water level measurements at five-minute intervals.
- More than 50 CWC staff attended the introductory workshop. The interest shown by the CWC engineers is promising for the future of technology within CWC.
- At least 10 CWC field engineers are expected to be trained on the installation of the water level sensor and basic data-retrieval steps using the web-based application.
- The project consortium is working closely with the local vendor community and CWC to develop local manufacturing capabilities for the lidar-based water level sensor.
- Detailed user manuals describing site development and installation, operational and standard operating procedures for the maintenance of the field installations and use of the web-based GUI for data-retrieval and processing is available to scale-up the use of the lidar-based sensor in additional sites.

Way Forward

Over the course of the project, CWC was appraised of the scope of the technology and of the possible improvements to its design. Some immediate developments that CWC would like to implement include:

1. The use of more powerful Lidar sensors
2. The setting up of a data server within India for the water level data
3. Installation of the water level sensor in a few additional sites higher up within the Himalayas to test the technology in more difficult settings.

These will involve a longer collaboration of the project consortium with CWC to ensure the technology is embedded within the operational hydrometry of the Himalayan Ganges. The project consortium is committed to a longer partnership for a smooth handing over of technology to CWC.

Partners

Indian Institute of Technology (IIT) Roorkee, India

Riverlabs Ltd. UK

Central Water Commission, India

University of Birmingham, UK

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