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Innovative method for gathering river stage data using only the sound of the water

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Splosh, gurgle, burble are all terms that can be used to describe how a river sounds as we stand on the bank. We have developed a new approach that uses the passive sound generated by a river, to gauge the current stage of the river, and generate (sono)hydrographs from the safety of the river bank. Our approach offers a cost-effective, power-efficient and flexible means to install flood monitors. We have developed a method of how to take the sound from around a river and translate it into a useful gauging tool without the need to listen to individual recordings. Using an internet of things approach we have developed a system of sound monitors that can be placed anywhere in the vicinity of a river. We aim to target the lesser studied parts of a river catchment, the headwaters, which are often data scarce environments. These environments are an opportunity to identify the real time responses of sub-catchments. The ultimate goal of our research is to enable community level flood monitoring, in areas that may be susceptible to river flooding, but are not yet actively gauged.

We hypothesise that the sound generated by a river is a direct response to the obstacles found within the channel and the turbulence they cause. Sound is generated by the increase of energy available in the channel, being transformed into sound energy through turbulence generating structures, i.e. boulders. Data gathered over a winter season from several rivers in the North East of England, during Storm Ciara and Dennis, has shown sound to be a reliable method for determining rapid changes in river stage and is comparable to what the official Environment Agency gauges measured. Through an innovative approach, we have begun to understand the limits on sound data and the calibration of sound to the channel properties. Utilising a 7.5 m wide flume at a white water course we have recreated controlled environments and simulated different discharges and their effect on sound.

Overall, we have found that sound is an opportunity to be taken to measure river stage in areas that are seldom studied. We have identified that sound works during extreme conditions, and

being placed on the banks of the channel our monitors have a lower risk of being damaged during storm events and are easy and safe to install. We present the first means of using sound from a river to actively gauge a river and the full workflow from collection, analysis and dissemination of results.