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New observation techniques lead to new insights.

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Most scientific discoveries are the result of new observations. A researcher who observes something that at first sight seems odd is triggered to think beyond the obvious. The obvious often corresponds with an established theory. The interesting moment arises when an observation challenges established theory. Some researchers may then be inclined to get rid of the unexpected observation, so as not to harm the well-established theory, while others see it as an opportunity to improve the theory. New observations, from a different or unexpected angle, may offer a new perspective on a physical phenomenon, and hence are important triggers for innovation.

Established theory has not been able to provide adequate answers to the high predictive uncertainty of most hydrological models. Several hydrologists have indicated that our fixture on catchment runoff as the main state variable for calibration is partly to blame for that. What we indeed need is 'orthogonal' information that provides a perspective into the inner functioning of a catchment, preferably as an integrated signal at the scale of our model.

Some observation techniques offer themselves to hydrology as an opportunity (since they were developed for other purposes). Good examples of such opportunities are: the GRACE mission, which offers insights into stock variations at the river basin scale; new satellites providing insight into the state of vegetation and the processes determining evaporation; LIDAR, providing detailed DEMs, and the cellular telephone network, which allows high resolution estimates of rainfall reaching the surface. Also there are new instruments that can be readily used for hydrological research, such as the DTS (distributed temperature sensing) fiber optic cable, or the Liquid-Water Isotope Analyser. But there are also instruments that can be developed specifically to get a better grip on a particular process or its spatial distribution. Recently instruments have been developed to continuously measure forest floor interception, tree water accumulation, or high resolution climatic variables.

The paper provides an overview of these measurement techniques and the way how the information can be applied to develop, test or refine hydrological theory.