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Hydrological Hypothesis Testing

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Editorial

Hydrology is a difficult subject. Richard Feynman refers to turbulence as the greatest outstanding problem of classical physics that cannot be solved from basic principles in his famous lectures. Indeed, turbulence complicates matters for hydrologists both directly – in the study of overland and open channel flow – and indirectly – in the study of subsurface flow, which is frequently influenced by the legacy of turbulent flow from the erosion and sedimentation processes that formed the soils. In addition, chemical and biological processes, as well as human actions, play an influence. Hydrologists examine these dynamics at the landscape scale, where observations are difficult, particularly of the subsurface, and boundary conditions are uncontrollable. This indicates that we can rarely conduct our own experiments and must instead make do with whatever boundary circumstances Nature supplies.

The Michelson–Morley experiment on the speed of light, which eventually led to special relativity, is one of the most renowned experiments in scientific history. It did contain controlled boundary conditions and was repeated with increasing precision to evaluate alternate possibilities. This type of experimenting is uncommon in hydrology. As a result, hydrological research is difficult to match with the scientific process. So, how can we move forward in hydrology? This question encouraged me to invite four eminent hydrologists and co-authors with diverse viewpoints to participate in a discussion series titled "Debates - Hypothesis Testing in Hydrology."

The debaters were asked to comment on how hydrologic questions can be framed in such a way that hypotheses can be tested and, ideally, generalised; how experiments should be designed to facilitate hypothesis testing; and whether there are alternatives to the hypothesis-driven approach as a way to organise our research and make tangible scientific progress. The four debate pieces do, in fact, represent a diverse spectrum of viewpoints. I applaud the authors' insight and broad opinions. Anecdotal evidence from corridor discussions suggests the following typical hydrologist viewpoint: “Yeah, we need hypothesis testing, we don't do enough of it, we should do more.” Most research funding agencies insist on testable hypotheses, so if you want to get funded, you'll need to include one in your proposal. Discussions on hypothesis testing at the Vienna Catchment Science Symposium in April 2016, where the idea for this debate series arose, were a little more nuanced, and the articles in this debate series clearly take a more nuanced view on how and why we should test hypotheses.

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