Geophysical Research Abstracts
Vol. 19, EGU2017-3394, 2017
EGU General Assembly 2017

Hypothesis testing in hydrology: Theory and practice

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Well-posed hypothesis tests have spurred major advances in hydrological theory. However, a random sample of recent research papers suggests that in hydrology, as in other fields, hypothesis formulation and testing rarely correspond to the idealized model of the scientific method. Practices such as "p-hacking" or "HARKing" (Hypothesizing After the Results are Known) are major obstacles to more rigorous hypothesis testing in hydrology, along with the well-known problem of confirmation bias – the tendency to value and trust confirmations more than refutations – among both researchers and reviewers. Hypothesis testing is not the only recipe for scientific progress, however: exploratory research, driven by innovations in measurement and observation, has also underlain many key advances. Further improvements in observation and measurement will be vital to both exploratory research and hypothesis testing, and thus to advancing the science of hydrology.