Nicholas Constantinos Matalas (1930–2019)

A modest giant in the field of stochastic hydrology.

By R. M. Vogel, J. R. Stedinger, and J. M. Landwehr 2 hours ago

Nicholas Constantinos Matalas.
Credit: Stella Matalas

Nicholas C. Matalas was a pioneer in the fields of stochastic hydrology, flood frequency methods, and the use of multivariate statistical methods in the natural sciences. He died on 16 August 2019, at age 88, from complications of Parkinson's disease.

Nick, as he was known to all of his colleagues, was an original thinker with a genius for distilling a question to its essence. With his warm, open demeanor and twinkly sense of humor, he was an insightful resource to professional colleagues and an approachable mentor to students and anyone else who arrived at his office door to discuss a serious scientific inquiry.

Nick was a consummate researcher his entire life, during his professional career at the U.S. Geological Survey (USGS) and after he retired. His extensive list of sole-authored and coauthored publications contains many seminal papers that made him an intellectual leader and a role model within and beyond the hydrologic community.

Nick played a part in the USGS effort to launch the hydrology program at the University of Arizona, serving as a founding faculty member in that program. He served as president of the Hydrology section of AGU and was an AGU Fellow. He delivered "Reflections on Hydrology," the inaugural Chester Kisiel Memorial Lecture (https://has.arizona.edu/kisiel-lecturers-1982-2016), at the University of Arizona in 1982. He also gave the third AGU Walter Langbein Lecture (https://www.agu.org/Honor-and-Recognize/Honors/Section-Awards/Langbein-Lecture) in 1995. The U.S. Department of the Interior (DOI) awarded Nick both the Meritorious Service Award and the Distinguished Service Award.

A Retrospective of Enduring Scholarship

Matalas received his B.S. degree in civil engineering from North Carolina State University in 1952. In 1953, he began his career with the USGS in the North Carolina District while concurrently pursuing his M.S. in sanitary engineering from North Carolina State University, graduating in 1955. He then attended Harvard University as a student of the legendary hydrologist Harold A. Thomas, receiving his Ph.D. in 1958.

While at Harvard, Nick witnessed the development of the Harvard Water Program, which launched the field of water resources systems analysis using concepts for the design of water resources systems that drew on both civil engineering and economics. Those ideas influenced Nick throughout his career. Nick and Myron B. Fiering were contemporaries at Harvard who, along with their academic adviser Harold Thomas (and publications by V. M. Yevjevich of Colorado State University), created the field of stochastic hydrology.

Nick developed the framework for multivariate stochastic hydrologic models that is still used today. After leaving Harvard, Nick moved to the USGS Surface Water Office in Virginia, where he developed a long, collegial relationship with Walter Langbein. Their 1962 paper "Information Content of the Mean (https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/JZ067i009p03441)" demonstrated that cross-correlation diminishes the information in a regional mean, just as serial correlation does in a single series.

In 1961–1962, while he served as a founding faculty member in the hydrology program at the University of Arizona, Nick became intrigued with the structure of long-term memory in dendrochronologic (tree ring) records in comparison to streamflow. This interest led to his publishing highly cited studies on those topics with his colleagues D. Dawdy, J. R. Wallis, and J. M. Landwehr.

Returning to the USGS research offices in Virginia in 1962, Nick developed the framework for multivariate stochastic hydrologic models that is still used today. His 1967 paper "Mathematical Assessment of Synthetic Hydrology (https://agupubs.onlinelibrary.wiley.com/doi/10.1029/WR003i004p00937)" was honored with a retrospective AGU Robert E. Horton Award (now known as the Hydrologic Sciences

Award (https://www.agu.org/Honor-and-Recognize/Honors/Section-Awards/Hydrologic-Sciences-Award)) in 1968. Nick also introduced, with B. Jacobs, the mathematical foundation for extending short hydrologic records using nearby longer records. That work led to the class of maintenance of variance extension (MOVE) methods included in manuals and handbooks, with a special adaption in the 2018 *U.S. Geological Survey Bulletin* 17C (https://pubs.usgs.gov/tm/04/b05/tm4b5.pdf).

Forming the Systems Analysis Group

In 1970, Nick formed and led the Systems Analysis Group within the USGS Water Resources Division. In this group, Nick promoted rigorous statistical analyses and risk management efforts, including the development of procedures by which DOI auctioned mineral leases for the Outer Continental Shelf (https://www.boem.gov/Outer-Continental-Shelf/) and assessed the effectiveness of how the U.S. Bureau of Mines implemented the Federal Coal Mine Health and Safety Act of 1969.

Nick was also asked to undertake several foreign assignments. One such assignment with the Hydrologic Services of Israel in 1973 involved designing a groundwater observation network. This project led to Nick and his colleagues publishing many subsequent papers on monitoring network design.

A 1982 special study for the National Academy of Sciences provided the first explicit statement in the literature that human activity is inherently part of the hydrologic cycle and must be considered in making geophysical predictions.

In the early 1970s, Nick began addressing the question of how to create a theoretical decision framework for evaluating flood frequency methods. In 1974, he published "Just a Moment (https://agupubs.onlinelibrary.wiley.com/doi/10.1029/WR010i002p00211)!" with J. R. Slack and J. R. Wallis. This paper—still considered essential reading for hydrology students today—demonstrated how the short time periods covered by samples that were common in geophysical records could bias the distributions of estimates of the coefficients of variation and of skewness.

In 1976, as senior research scientist in the Office of the Chief Hydrologist, Nick was allowed to pursue new research directions. In addressing the problem of deciding on appropriate distributions for regional flood characterization, Nick developed, along with J. M. Landwehr and J. R. Wallis, the parameter estimation method of probability weighted moments, a method now widely used in hydrology and many other fields.

Nick, along with colleagues J. M. Landwehr and M. G. Wolman, conducted a 1982 special study for the National Academy of Sciences that probed the scientific basis of water resources management. This study provided the first explicit statement in the literature that human activity is inherently part of the

hydrologic cycle and must be considered in making geophysical predictions. This concept is fundamental to the current perception of environmental and climatic variation.

An Active Retirement—"Hydrology as a Hobby"

After retiring from the USGS in 1995, Nick continued his work as a hydrologic consultant, as a private scholar, and as a visiting scientist at several institutions. His broad range of interests included explorations of the concept of stationarity (https://towardsdatascience.com/stationarity-in-time-series-analysis-90c94f27322) in a changing world, the assessment and management of extreme risks, the vulnerability of water systems to terrorist attacks, statistics of record-breaking events, probabilistic interpretation of envelope curves (which describe the boundaries of our current experience of extreme floods in a given region), and hydrologic assessments and models for climate change impacts. During his last few years, Nick organized his extensive set of technical notes into a digital format to make them available for other scholars.

Nick's family, friends, and colleagues already miss Nick's smile and wit, his inquisitiveness, and his ability to distill complicated concepts into a uniquely clear, fundamental, and appropriate stochastic representation. He was a wonderful role model and a generous colleague.

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