

Estimation of Water Quality Parameters With Data-Driven Model

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Electrical conductivity and total dissolved solids are considered important parameters in determining quality of drinking and agricultural water because they directly represent total salt concentration in the water. Increases in these parameter values indicate a reduction in water quality. In this study, estimation of the two parameters in the Lighvan Chay River located in Eastern Azerbaijan, Iran, is studied using the *k*-nearest neighbors algorithm and support vector regression. Different sets of chemical parameters (i.e., phosphorus, chlorine, calcium,

magnesium, sodium, sodium adsorption ratio, sulfate, bicarbonate) were considered as inputs while the total dissolved solids and electrical conductivity were the outputs. Three statistics—coefficient of determination (R^2), root mean square error, and mean absolute error—were used to verify accuracy of these models. Comparison of the results showed that both algorithms accurately estimated the total dissolved solids and electrical conductivity, but the support vector regression model is recommended because of better performance.

Keywords: electric conductivity, *k*-nearest neighbors algorithm, support vector regression, total dissolved solids, water quality

Assessment of surface water quality is important in the management of water resources (Dogan et al. 2009). Water quality in rivers is paramount to the well-being of nature and humans, and surface water quality is usually related to the type of surrounding industries, agriculture, and human activities. Water is withdrawn from the hydrologic cycle to meet various needs and then is returned (Banejad & Olyaei 2011). Given the essential role of rivers to agricultural, industrial, and urban needs, it is necessary to regularly monitor and evaluate water quality in rivers. As rivers pass through different regions, changes in water quality and the level of hydrochemical parameters are observed in these regions. Because of the gradual decline in water quality over time, regulatory bodies in various countries have made decisions to mitigate the damage. Ecologically acceptable water management calls for accurate modeling, forecasting, and analyzing water quality in rivers (Darda 2010). Numerous models have been developed for management of water quality, such as QUAL2E, Water Quality Analysis Simulation, and the US Army Corps of Engineers' Hydrologic Engineering Center-SQ (Chen et al. 2003). Using these models is time-consuming and expensive; therefore, development of cost-effective models is encouraged.

Because of the propensity of varied standards for water quality, different parameters are used as quality indicators. The quantity of ammonia, cadmium, chemical oxygen demand, chlorine, copper,

dissolved phosphorus, lead, nitrogen dioxide, suspended solids, total nitrogen, total phosphorus, zinc, sodium, sodium adsorption ratio, sulfate ions, bicarbonate ions, electrical conductivity (EC), total dissolved solids (TDS), and pH is frequently measured at water quality monitoring stations. EC and TDS levels in water are two of the main parameters used to determine quality of drinking and agricultural water because they directly represent the total concentration of salt in water. High EC and TDS values are not desirable in water used for irrigation because salt affects plant growth through osmosis (Phocades 2000).

Advances in data science and data mining methods such as neural networks (NNs), fuzzy inference methods, support vector machines (SVMs), and *k*-nearest neighbors (*k*-NN), have made it possible to solve complex problems in high dimensions. The general principle behind these methods lies in exploring hidden relationships in large volumes of data and building models that reflect physical processes governing the system under study. A data-derived model represents a relationship between input variables and output variables. Such a model can be highly accurate because it captures relationships of any kind that are expressed in data, including the underlying physics and chemistry.

DATA SCIENCE METHODS

The growing use of data science methods in water resources engineering is seen in recent literature. Diamantopoulou et al.

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Rainfall-Runoff Modelling Keith J. Beven, 2012-01-30 *Rainfall Runoff Modelling The Primer Second Edition* is the follow up of this popular and authoritative text first published in 2001 The book provides both a primer for the novice and detailed descriptions of techniques for more advanced practitioners covering rainfall runoff models and their practical applications This new edition extends these aims to include additional chapters dealing with prediction in ungauged basins predicting residence time distributions predicting the impacts of change and the next generation of hydrological models Giving a comprehensive summary of available techniques based on established practices and recent research the book offers a thorough and accessible overview of the area *Rainfall Runoff Modelling The Primer Second Edition* focuses on predicting hydrographs using models based on data and on representations of hydrological process Dealing with the history of the development of rainfall runoff models uncertainty in model predictions good and bad practice and ending with a look at how to predict future catchment hydrological responses this book provides an essential underpinning of rainfall runoff modelling topics Fully revised and updated version of this highly popular text Suitable for both novices in the area and for more advanced users and developers Written by a leading expert in the field *Guide to internet sources for rainfall runoff modelling software*

Environmental Foresight and Models M.B. Beck, 2002-03-20 Policy makers and the public it has famously been said are more interested in the possibility of non linear discontinuities and surprises in the behaviour of the environment than in smooth extrapolations of current trends The International Task Force in Forecasting Environmental Change 1993 1998 dedicated its work to developing procedures of model building capable of addressing our palpable concerns for substantial change in the future This volume discusses the immense challenges that such structural change presents that the behaviour of the environment may become radically different from that observed in the past and investigates the potentially profound implications for model development Drawing upon case histories from the Great Lakes acidic atmospheric deposition and among others the urban ozone problem this discourse responds to a new agenda of questions For example What system of radar might we design to detect threats to the environment lying just beyond the horizon and Are the seeds of structural change identifiable within the record of the recent past Meticulously researched by leading environmental modellers this milestone volume engages vigorously with its subject and offers an animated account of how models can begin to take into consideration the significant threats and uncertainties posed by structural change

Concise Encyclopedia of Environmental Systems P.C. Young, 1993-08-09 The *Concise Encyclopedia of Environmental Systems* provides a concise overview of the current state of the art in the study of environmental systems Contains specially commissioned articles and updated and revised articles from the acclaimed *Systems* atmospheric processes and air quality ecosystems environmental chemistry geology soil processes and geophysics hydrology fluid dynamics and water quality marine processes meteorology and climatology In addition many of the articles cover the methodological procedures used in environmental systems analysis

with contributions on automatic control and management computers in modelling and management environmental planning environmental methods including time series analysis mathematical modelling including data based physically based and simulation modelling remote sensing and image processing uncertainty in environmental systems and sensitivity analysis The encyclopedia is extensively cross referenced on two levels to articles of direct relevance as well as to other articles which will provide the reader with more general background information

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Identification and System Parameter Estimation, 1985 H. A. Barker, Peter C. Young, 1985

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Watermatex '91 Thomas O. Barnwell, M. B. Beck, Paul John Ossenbruggen, 1991 Recent years have seen rapid advances in computer technology and in the application of systems analysis to environmental problems These advances were discussed and critically assessed at the Watermatex 91 conference The proceedings which cover the principles of modelling policy and planning operations and control and new technologies and expert systems provide a bridge between theory and practice in the use of systems analysis applied to water quality management and other aspects of the water cycle

Treatise on

Water Science ,2010-09-01 Water quality and management are of great significance globally as the demand for clean potable water far exceeds the availability Water science research brings together the natural and applied sciences engineering chemistry law and policy and economics and the Treatise on Water Science seeks to unite these areas through contributions from a global team of author experts The 4 volume set examines topics in depth with an emphasis on innovative research and technologies for those working in applied areas Published in partnership with and endorsed by the International Water Association IWA demonstrating the authority of the content Editor in Chief Peter Wilderer a Stockholm Water Prize recipient has assembled a world class team of volume editors and contributing authors Topics related to water resource management water quality and supply and handling of wastewater are treated in depth **Proceedings of the Second I.F.A.C./I.S.H.S. Workshop on Mathematical and Control Applications in Agriculture and Horticulture, Silsoe, United Kingdom, 12-15 September 1994** W. Day,P. C. Young,1996 Proceedings International Association of Theoretical and Applied Limnology,1990 **Environmental Modelling of Hydrological Systems: Summary** Arabinda Ghosh Bobba,1996 **Mathematical Modeling of Water Quality** Gerald T. Orlob,1983 Methods for Projecting Future Changes in Surface Water Acid-base Chemistry Kent W. Thornton,David Marmorek,Patrick F. Ryan,Kim Heltcher,Donald Robinson,1990 *Statistics for the Environment* Vic Barnett,K. Feridun Turkman,1993-08-24 Environmental statistics are a high profile area of study throughout the world The SPRUCE initiative Statistics in Public Resources Utilities and in Care of the Environment was set up to promote interest in this area This volume contains the proceedings of the 1st SPRUCE Conference held in Lisbon Portugal The contributors discuss environmental monitoring and sampling measuring levels and the consequences of pollution and contamination climatological and meteorological issues and water resources They examine such techniques as data analysis probability modelling and statistical methodology International Books in Print, 1995 Barbara Hopkinson,[Anonymus AC01401231],1995 *Model Validation* Malcolm G. Anderson,2001-06-11 Validation is a central issue to future model design in environmental science This book is the first to provide a critical appraisal of today s validation needs capabilities and required changes in philosophy It takes examples from four different scales hillslope and river channel catchment regional and global This timely book offers unique multifaceted coverage of model validation in hydrological science today Topics covered include calibration procedures data assimilation scaling critical future need in validation and evidence of field data State of the art research book on an important new topic End of section discussion chapters written by leading international researchers A Technique for the Assessment of Uncertainty in Water Quality Models Used for Public Health Risk Analysis Mark A. Tumeo,Gerald T. Orlob,1990 Acta Hydrochimica Et Hydrobiologica,2003

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