C-07

Multi-objective Storage Reservoir Operation under Uncertainty

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1. Introduction

Operation of storage reservoirs within the scope of water resources management is seen as a great challenge for operators, particularly as a result of environmental concerns that have been paid much attention during the last three decades. Decisions must be made in uncertain situations, and in many cases reservoirs and associated watersheds are undergoing constant transformation, such as socio-economic and climatic change. Decision-making becomes even more relevant and complex when environmental quality characteristics, such as water quality, must be handled prior to when the decision is made.

Reservoir operation under uncertainty is proposed. Water quantity and quality are considered to be the main driving purposes for the operation. Barra Bonita reservoir is chosen as the case study for the application of the proposed methodology. The Reservoir is located in the southeast region of Brazil, in Sao Paulo state. The reservoir is suffering from intense degradation, and is experiencing many environmental problems, such as eutrophication.

2. Methodology

A Fuzzy Stochastic Dynamic Programming model (FSDP) is developed for calculating the optimal operation procedures. Optimization is applied to achieve multiple objectives, which are defined as fuzzy membership functions. This provides a more flexible method for dealing with objectives. Some of the objectives, such as improvement of water quality conditions can be extremely difficult to define precisely using economic units.

Moreover, the use of fuzzy sets theory makes it easier to compare different objectives. Stochastic techniques, such as Markov chain, are applied to assess the uncertainty characteristics of the system, such as those related to river discharge, climatic parameters, and water quality behavior.

Water quality analysis is carried out using a reservoir water quality model. The process of choosing the water quality model is discussed briefly. Water quality modeling has an extremely high degree of uncertainty related to it. Some of the factors responsible for the uncertainties, related to the modeling process of reservoir operation, are: data adequacy, parameter definition, and conceptual assumptions of biological processes. Many other sources of uncertainty are also found in the water quality modeling process and as well quality behavior.

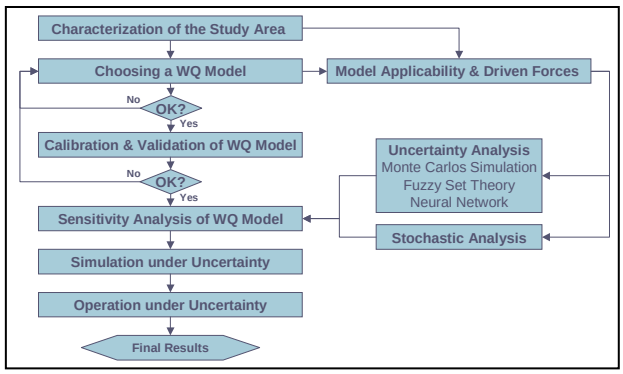

Figure 1: Flowchart of proposed methodology

3. Conclusion

Assessment of the uncertainties related to the water quality modeling and behavior, and the uncertainties inherent in the decision-making process, is extremely important.

Consideration of uncertainty in decision making may increase the reliability of the system. Moreover, it may help to avoid major problems concerning future situations, especially in regards to environmental conditions. However, it is still a very complex task and a great challenge for water researchers.