Geophysical Research Abstracts
Vol. 21, EGU2019-4186, 2019
EGU General Assembly 2019

Developing a Dynamic Bayesian Network to Assess and Manage Saltwater Intrusion in a Data Sparse Urban Coastal Aquifer

Grace Rachid, Ibrahim Alameddine, and Mutasem El Fadel
Department of Civil and Environmental Engineering, American University of Beirut, Lebanon (gkr00@aub.edu.lb)

Landward intrusion of seawater into coastal aquifers, known as saltwater intrusion (SWI), is a global coastal problem caused by aquifer over-pumping, land-use change, and potential climate change impacts. Given the complex pathways that lead to SWI, many coastal urban areas with poorly monitored aquifers are in need of simple, robust, and probabilistic decision support models that can assist in better understanding and predicting SWI, while also exploring the impacts of various mitigation and adaptation plans on reversing aquifers salinization. In this study, we develop a generic Bayesian Belief Network (BBN) to account for the complex physical and geo-chemical processes leading to SWI along an urban coastal setting. The generated BBN is also used to link the severity of the SWI to the associated socioeconomic impacts. The BBN is further expanded into a dynamic Bayesian network (DBN) to assess the temporal progression of SWI and to accurately compound uncertainties over time. The DBN is then tested and validated in a pilot aquifer underlying a highly urbanized water-stressed coastal metropolitan area along the Eastern Mediterranean coastline (Beirut). The model results showed that the future impacts of climate change were largely secondary as compared to the persistent water deficits in the study region, hinting towards the importance of demand management towards stopping and reversing SWI. The model results also highlighted the socioeconomic burden that the coastal community will suffer under the "do nothing scenario" as compared to the costs associated with proposed new water supply projects and suggested changes to the existing water use taxation system. Moreover, a value of information analysis is conducted to guide future data collection efforts. Through building a robust representation of drivers and impacts of SWI and the socioeconomic implications and policy options, the DBN acts as an effective decision support tool to aid coastal managers towards sustainable aquifer management.

Keywords: Bayesian network, saltwater intrusion, aquifer management, adaptation.

Acknowledgements
This study is part of a program on climate change and seawater intrusion along the Eastern Mediterranean funded by the International Development Research Center (IDRC) of Canada at the American University of Beirut Grant No. 106706-001. Special thanks are extended to Dr. Charlotte Macalister at IDRC for her support and feedback in implementing this program.