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Through the Use of Modified DRASTIC Methodology

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Aquifer vulnerability modeling in New Jersey through the use of modified DRASTIC methodology

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Portland State University Student Research Symposium 2016

Introduction
As the average global temperature has increased over last 50 years, sea level rise (SLR) has become an issue to monitor due to the fact that it makes coastal aquifers more susceptible to saltwater intrusion. Mapping aquifer vulnerability is possible with GIS through the use of a universal model created by the United States Environmental Protection Agency (EPA) called the DRASTIC model. The DRASTIC model does not account for saltwater intrusion as a contaminant. It also does not take any other types of contaminants into account when mapping aquifer vulnerability. To ensure that saltwater intrusion as a contaminant is quantified, our project required the DRASTIC model to be modified to accommodate the inclusion of saltwater intrusion. This project sets out to investigate and compare the effectiveness of aquifer vulnerability mapping via the DRASTIC model and a modified DRASTIC model for the state of New Jersey.

Definition of the DRASTIC Model
To better understand how aquifer vulnerability is mapped through the DRASTIC model, each of the parameter of the model need to be defined. Included are the two extra parameters used in the modified DRASTIC model.

- Depth to water table, D
- Distance to Contaminants, D
- Impact vadose zone, D
- Hydraulic conductivity, C
- Topography, T
- Recharge, R
- Soil media, S

Methodology

Results
To the left are the aquifer vulnerability maps of New Jersey. These maps were used to investigate and compare which best mapped aquifer vulnerability, especially with regards to contamination by saltwater intrusion and known contaminant sources. Fig. 1 is the EPA’s DRASTIC model with no modifications added. Fig. 2 is the DRASTIC model with two extra parameters added, DTCoast and DTContaminants, at a magnitude weight of 1. Fig. 3 is the DRASTIC model with two extra parameters added, DTCoast and DTContaminants, at a magnitude weight of 3.

Discussion
From the model outputs we were able to compare, contrast and decide which model depicted aquifer vulnerability with respect to the potentiality of contamination by saltwater intrusion. Below are observations that can be made from viewing the map:

- The DRASTIC model in Fig. 1
  - No potential contaminants are accounted for or included
  - Fig. 1 shows that areas of the New Jersey coast would not experience effects to their aquifers due to saltwater intrusion while inland aquifers would, which instinctually seems counterintuitive.
  - EPA’s DRASTIC model does not properly answer the project question in regards to aquifer vulnerability to saltwater intrusion and other contaminants.
  - The first modified model built, the DRASTIC + DTCoast + DTContaminants model in Fig. 2
    - Magnitude weight of 1 was given to both DTCoast and DTContaminants because we needed to have an understanding of the baselines.
    - From literature review of the GALDIT model by Ferreira et al., the distance from coast measure (also known as D in GALDIT and DTCoast in our model) makes up for the lack of contamination potential seen in the DRASTIC model.
    - This model does a better job yet it still had a few gaps on portions of the coastal aquifers.
  - The second and final modified model that we built, the DRASTIC + 3DTCoast + 3DTContaminants model in Fig. 3
    - Demonstrated the best way to map aquifer vulnerability with respect to salt water intrusion and contaminants.
    - Utilizing Ferreira et al., we set the contaminant weights both to 3 because if DTCoast was a measure of 3, then by extension DTContaminants also should be weighted similarly.
    - This modified DRASTIC model demonstrated the importance of magnitude weighting within the model with respect to contamination potential.

Conclusion
The DRASTIC model has the ability to evaluate aquifers’ potential vulnerability to contamination, however as saltwater intrusion becomes a prevalent issue methods for assessing aquifer vulnerability that include vulnerability to saltwater intrusion are necessary. Including the distance to the coast, as well as known contaminants, is crucial to know the true vulnerability that aquifers face. In addition to adding these measures, the coefficient magnitude weight is necessary to properly scrutinize because it places the level of importance that the contaminants have on the vulnerability of the aquifer. From this study, we have found that utilizing a modified DRASTIC model that is aided by a weighted measure from the GALDIT model has better potential for mapping aquifer vulnerability than utilizing DRASTIC on its own.