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Title: Machine Learning Based Groundwater Level Predictions as a Proxy for Compound Flooding Events in Miami, Florida

Abstract:

Miami, Florida is prone to compound flooding (when multiple flood drivers occur concurrently or within a similar time period) which impacts property and lives. This is in large part due to anthropogenic changes to the region, relative sea level rise, and an increase in precipitation intensity. Better predictive modeling of these events is important to prepare for and mitigate their impact and improve the long-term resiliency of the region and its community. Miami, Florida is home to a karst aquifer that is vulnerable to saltwater intrusion. To combat this, water is pumped into canals throughout the city which helps to recharge the groundwater supply. Water can also be pumped into these canals during extreme precipitation events to decrease the chances or severity of flooding by diverting some of the excess water entering the water conservation areas (WCAs). The important role that groundwater plays in the flooding dynamic of Miami's urban areas suggests that groundwater may be used as a potential indicator for compound flooding. Using a data-driven approach, multiple machine learning Multi-Layer Perceptron (MLP) models will be trained that are capable of predicting short-term groundwater levels (1, 3, 6, 12, 24 hour lead times) at a target location in Miami-Dade County, Florida using groundwater levels, ocean water levels, and rainfall as inputs. These groundwater level predictions will then be used as a proxy for compound flooding events at the target location. The traditional machine learning pipeline will be followed with proper exploration and preprocessing of the data being implemented. Different hyperparameter tuning and regularization methods will also be applied to boost model performance and avoid overfitting. Several experiments will be run that test the performance of models using different combinations of the inputs. The model performance will be evaluated based on several popular metrics used by other ML groundwater level prediction studies. An emphasis will be placed on the performance of the models during confirmed flooding events. This study hopes to model the different drivers of compound flooding in Miami, Florida, such as groundwater levels, surge conditions, and rainfall, using data-driven machine learning methods.