Florida County Sea Level Rise Risk Analysis

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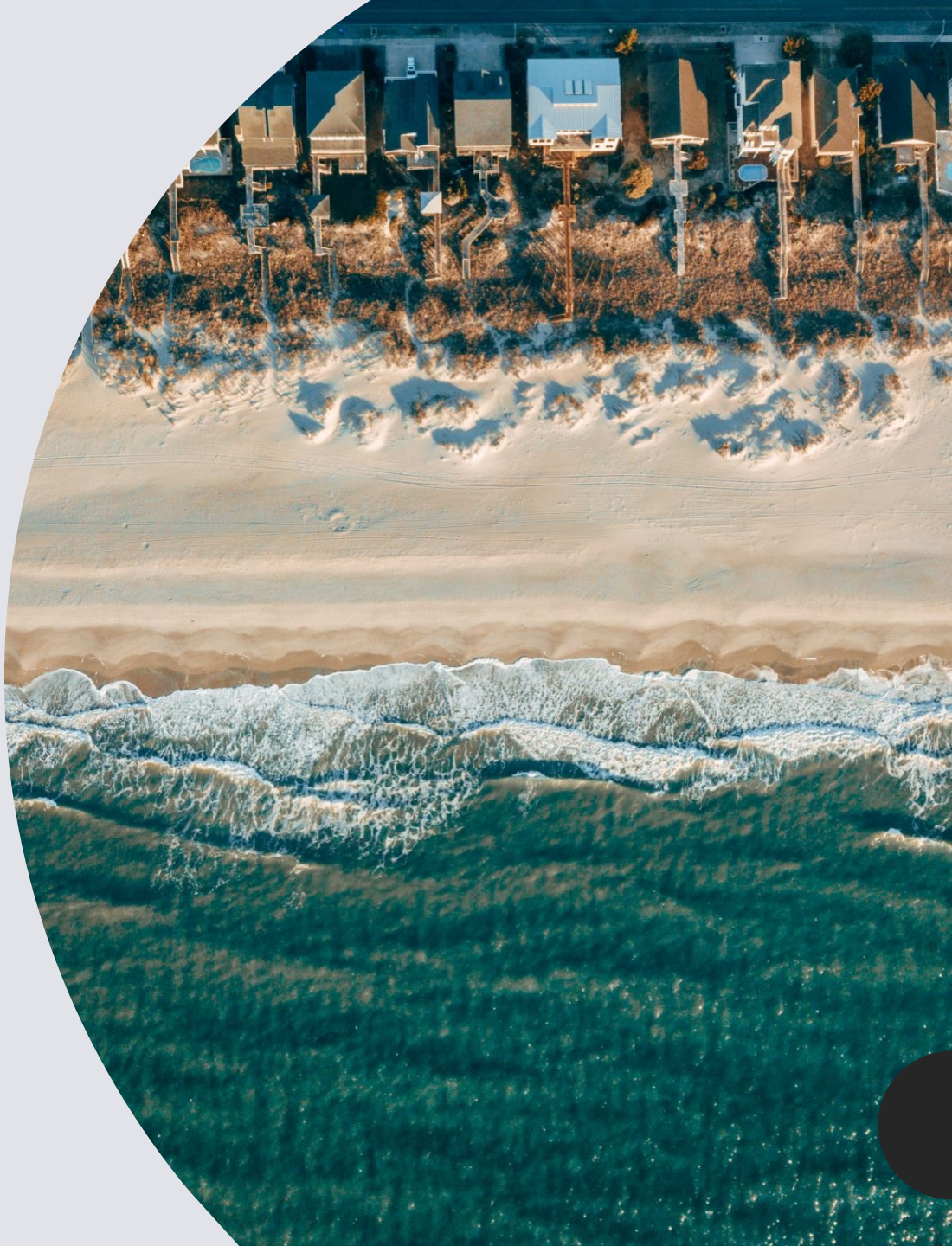
Overview

- Sea level rise is a new and challenging risk facing many parts of the world in this day and age. Florida is one of the unique places in its vulnerability to sea level rise, as it is one of few coastal places that is high enough population and low enough elevation above sea level leading it to vulnerability to sea level rise in the next century.
- Our goal has been to develop a system for users to accurately understand their counties risk to sea level rise and provided recommendations for their next steps.



Methodology: Data Preparation & Analysis

- Our data was collected from multiple sources, with many of the datasets coming from the Florida Government. Links to the data are available here.
- The data used in our project can be grouped into 3 categories: demographics, environment, and future change.
  - Demographics: Population and Income
  - Environment: Landcover, Land use, and elevation
  - Future change: Sea level, income, and population projections.

NAME	Year	Income	Population	elevation	risk_score	risk_level	Recommendation	Score	Median Elevation
Alachua	2030	50475.47728	316236.6658	32.8984	60	Medium Risk	Avoid low elevation areas to live.	65	17.8984
Baker	2030	57178.77857	32091.77334	39.8984	25	Low Risk	No action recommended at this time.	9	17.8984
Bay	2030	59267.17471	198980.5781	12.8984	45	Medium Risk	Avoid low elevation areas to live.	55	17.8984
Bradford	2030	52133.39858	32141.74107	44.8984	30	Low Risk	No action recommended at this time.	32	17.8984
Brevard	2030	57586.81195	688886.8965	8.8984	70	High Risk	Avoid at all costs. Move if necessary. Sea level rise will significantly impact all areas of life.	42	17.8984
Broward	2030	61850.68487	2208090.937	4.8984	75	High Risk	Avoid at all costs. Move if necessary. Sea level rise will significantly impact all areas of life.	44	17.8984
Calhoun	2030	39598.49942	15499.08074	30.8984	35	Low Risk	No action recommended at this time.	33	17.8984
Charlotte	2030	54846.05205	212189.0928	9.8984	55	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	19	17.8984
Citrus	2030	46330.86227	174708.7542	13.8984	55	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	26	17.8984
Clay	2030	71428.55861	247845.6093	28.8984	45	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	18	17.8984
Collier	2030	77184.57827	426715.3125	4.8984	60	High Risk	Move to higher ground, avoid low areas and swamp areas.	27	17.8984
Columbia	2030	46218.58542	79151.15249	35.8984	35	Low Risk	Dialogue with county officials, risk is low at this time.	61	17.8984
DeSoto	2030	41755.09834	38584.17109	17.8984	50	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	4	17.8984
Dixie	2030	38660.5666	19032.02624	6.8984	50	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	28	17.8984
Duval	2030	59297.7058	1130595.934	10.8984	70	High Risk	Avoid at all costs. Move if necessary. Sea level rise will significantly impact all areas of life.	53	17.8984
Escambia	2030	51980.67652	365565.034	29.8984	55	Medium Risk	Avoid low elevation areas to live.	64	17.8984
Flagler	2030	60074.19278	131026.7392	5.8984	55	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	8	17.8984
Franklin	2030	47030.26421	14139.73141	3.8984	45	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	7	17.8984
Gadsden	2030	46363.38532	49770.1284	49.8984	35	Low Risk	Dialogue with county officials, risk is low at this time.	51	17.8984
Gilchrist	2030	45106.08881	20286.89759	18.8984	40	Low Risk	Dialogue with county officials, risk is low at this time.	40	17.8984
Glades	2030	47315.08984	13770.6516	11.8984	40	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	1	17.8984
Gulf	2030	49809.70723	16116.86356	4.8984	45	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	12	17.8984
Hamilton	2030	45715.36241	15903.36508	36.8984	25	Low Risk	Dialogue with county officials, risk is low at this time.	38	17.8984
Hardee	2030	43267.10549	28762.10564	7.8984	55	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	5	17.8984
Hendry	2030	40351.52909	44992.53222	7.8984	55	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	2	17.8984
Hernando	2030	51110.84906	220897.105	17.8984	60	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	20	17.8984
Highlands	2030	40676.28995	114965.5216	21.8984	60	Medium Risk	Be careful around rivers and swamp areas due to potential flooding.	30	17.8984
Hillsborough	2030	64031.62779	1657749.787	19.8984	60	Medium Risk	Avoid low elevation areas to live.	59	17.8984

Data looks like this

- Separated by decade

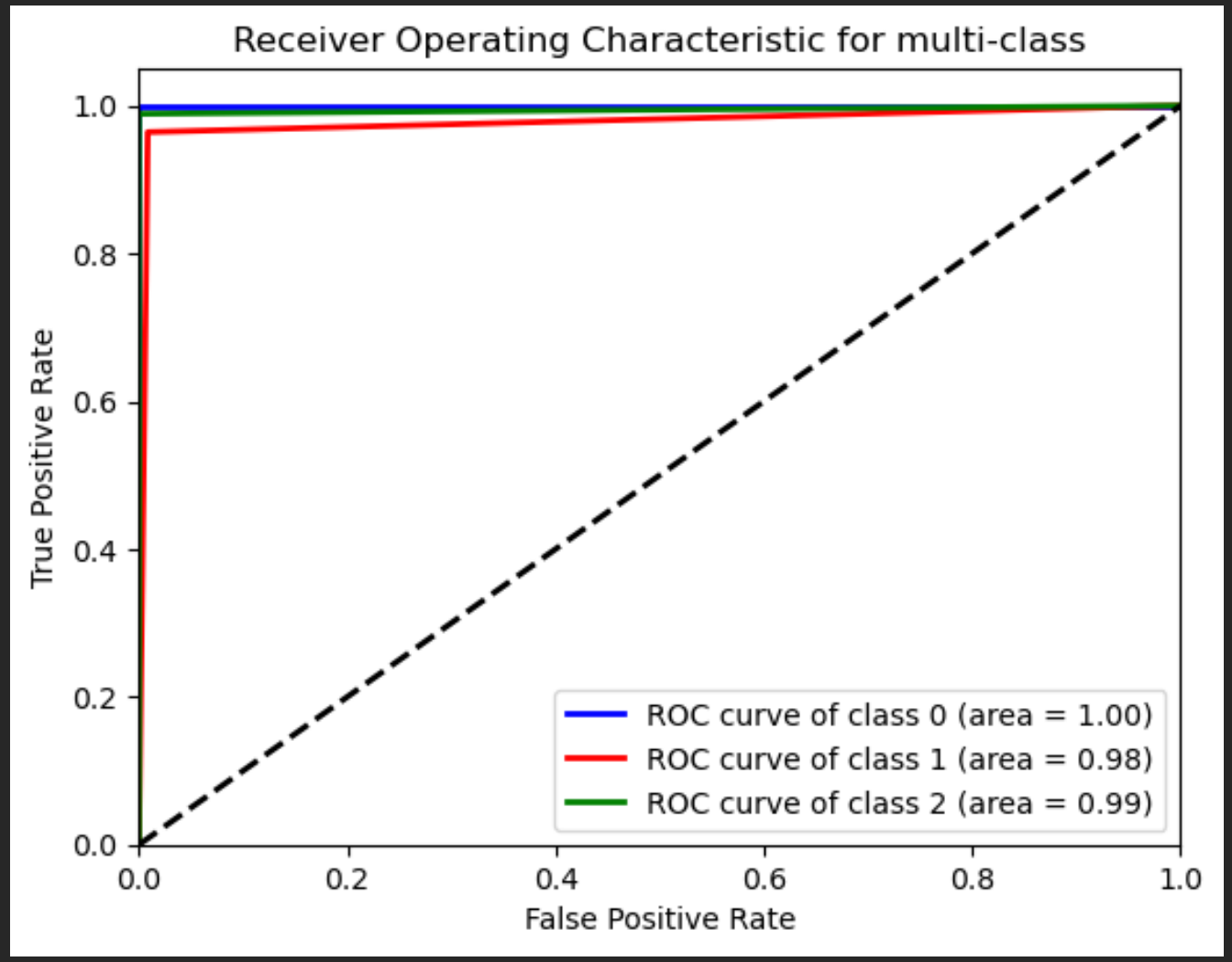
Modelling: Decision Tree Classifier

	precision	recall	f1-score	support
0	1.00	1.00	1.00	28
1	0.98	1.00	0.99	56
2	1.00	0.99	0.99	91
accuracy			0.99	175
macro avg	0.99	1.00	1.00	175
weighted avg	0.99	0.99	0.99	175

- We used the model to predict our risk level, using key features.
- We removed irrelevant columns like name, and year.
- The model is very successful on our data at current, but in the future we want to expand the model to more states, in order to build a better model and a larger visualization.

Cross Validation, 5 fold

- Cross-validation scores for each fold: [0.94285714 0.99425287 1. 0.99425287 0.97701149]
- Average cross-validation score: 0.9816748768472905
- Due to the nature of our data, we implemented cross-validation in order to make our model more robust. This simulated more data for us, allowing our model to become better at understanding “new” data.



AUC-ROC: OvR approach

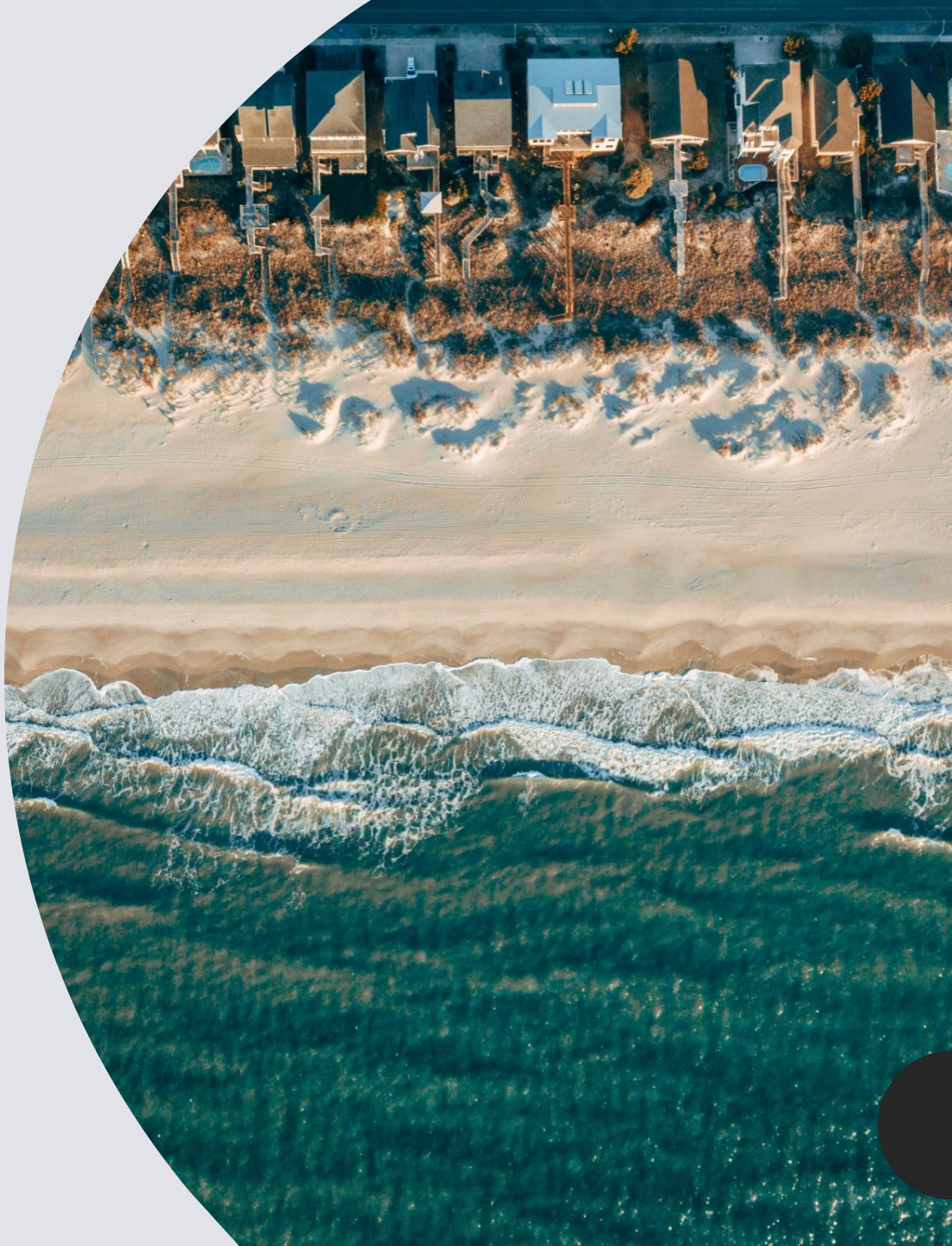
- AUC-ROC for each class: [1.0, 0.9868697478991597, 0.9945054945054945]
- Average AUC-ROC: 0.9937917474682182
- Because our classifier is multi-class, we used a One vs. Rest approach.
- Our model performs very well with the current data. We are looking forward to building it out further by the inclusion of more state's data.

Demonstration

- The program is available here.
- An interactive dashboard was created using ArcGIS Dashboards.
- You are able to:
  - Examine how risk score or risk level changes for all counties in Florida.
  - Select any decade between 2030 – 2150.
  - Get a recommendation by clicking on a county.

Findings & Evaluations

- We were able to accurately and effectively estimate the counties data over the next century. This allowed us to develop a risk class weight system to calculate a risk level for each county. This was done with a multiple linear regression model. This risk level allowed us to give personalized recommendations for each county.
- One interesting note is that our original analysis revealed to us that the Miami-Dade county was the highest risk county, but as the time continues, two other counties end up with higher risk, which we did not see until the work was done.
- This system will be very valuable to any in Florida who are worried about their home. This will allow them to have a good understanding of the risks they face.



Notes on estimations

- It should be noted that we were very conservative in our estimations of sea level rise. Respected estimates are anywhere between 1-3.5 meters by the year 2150, but we felt to only present the worst case would be an unfair analysis.
- We used robust data sources detailed earlier to predict estimates, especially with income and population levels. Income is an incredibly risky estimation due to the nature of inflation and deflation, so we felt a conservative estimate would be the most valuable.

Summary & Future Prospects

- In summary, we have developed the data into a robust system to analyze and visually represent the Florida counties and their risk to sea levels rising in the next century. We have used data from Florida government systems in order to accurately estimate what our features will look like in the coming decades. Using this we built an interactive map to allow Florida residents to deeply understand their risks to the rising seas.
- In the future, we would like to extend this work to the rest of the coastal states in the United States, allowing for anyone in the US to understand their risks in the coming century.