MAXIMIZING THE DEVELOPMENT OF AKUA ISLAND

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1 Executive Summary

To maximize the development of Akua Island, each zone must specialize in the good or service that will minimize the zone's opportunity cost. After selecting zone allocations that minimize opportunity cost and make a few minor adjustments to meet the interests of the Akua Island Commission, the recommended land allocations are:

Table 1.1

Coastal Zone	Recommended Use of Zone
1	Recreation
2	Recreation
3	Private Housing
4	Fishing
5	Agriculture
6	Agriculture
7	Private Housing
8	Other/Tourism
9	Agriculture
10	Fishing
11	Agriculture
12	Agriculture
13	Other/Tourism
14	Recreation
15	Recreation
16	Conservation
17	Fishing
18	Conservation
19	Private Housing
20	Agriculture

2 Introduction

2.1 Purpose

As the responsible team of actuaries hired by the Akua Coastal Commission to provide expert guidance on the development of the 20 undeveloped zones, Team Awesome (TA) has recommended designations for each area and this paper explains the recommendations.

2.2 Background

Akua Island is a small island roughly twice the size of Saint Lucia Island or about six times the size of Washington, DC (World Factbook, (2017)). Because Akua Island is small and has low-lying coastal zones, it falls into the Small Island Developing States (Boto, I., Biasca, R. (2012)) classification. Although SIDS vary in their geography, climate, culture and stage of economic development, they have many common characteristics, which highlight their vulnerability, particularly as it relates to sustainable development and climatic change (Maul, G., (1996) Leatherman, S., (1997)). SIDS face greater risk of marginalization from the global economy than many other developing countries as a result of their small size, remoteness from large markets, and high economic vulnerability to economic and natural shocks beyond domestic control (Boto, I., Biasca, R. (2012)). Because Akua Island has these vulnerabilities and risk factors, it is imperative that the most effective course of action be taken to mitigate negative, incoercible events.

3 Data

3.1 Strategic Approach

The idea of minimizing opportunity cost is a cornerstone in TA's method of using the theory of competitive advantages to maximize land use. The underlining principle is that if each zone specializes in the product or good that minimizes its opportunity cost, a higher output can be reached through synergy. Thus, some measurement is needed to compare opportunity cost. TA developed zone indexes for each of the different economic criteria, and by doing so, a minimum opportunity cost for that zone could be easily identified.

3.2 Methodology

To compare industries indexes, normalizing the data was necessary. TA accomplished this by taking the percent of each data point relative to the maximum value of that data set. Next, output indexes were calculated by taking an average of salient factors' scores to obtain a value on a scale from 0 to 100[1]. These factors came directly from the information provided by the Commission. Table 3.1 shows an example:

Table 3.1: Zone 1's Agriculture Index [2]

	Grassland Surface Area (%)	Average Soil Organic Matter (%)
Zone 1	48	2.5
Max	92	10.2
Score	52.17	24.51
Zone Index	35.76	

[1] A scale of 100 would indicate a "golden land" where production would be bountiful if resources where used effectively. Likewise, a score of 0 would indicate an inability to produce an output for a particular industry.

[2] Zone 1's Agriculture Index calculation: grassland received a score of (48/92)*100%=52.17% and likewise with soil organic matter (2.5/10.2)*100%=24.51%. Then, by multiplying the two factors together and taking the square root, the index was calculated. Note that a geometric average was used to zero indexes with no grassland or no organic soil matter; however, an arithmetic average can be used to account for different weights on each factor.

In this example, the two salient factors are amount of grassland (TA used percent grassland to find a competitive advantage, rather than an absolute advantage) and amount of organic soil matter. Appendix A shows the scores for each factor. Most of the factors did not require further computation. However, sea level projections and the probability of flooding had to be derived.

3.3 Sea Level Data Modeling

3.3.1 Approximating Missing Sea Level Data

An assumption was made that the water density and temperature will be approximately equal around the island. Meaning an equal base sea level can be assumed on December 2016. To obtain a more accurate projection for future sea levels, TA first approximated the missing sea level data for 19 uncompleted zones. Figure 3.1 is an example of using weighted moving average for data imputation [3] for zones that only had a small portion of data. Figure 3.2 is an example that uses zone 15 to predict zone 14 by linear regression method[4]. On average, our models account for 93% of the variance in the sea levels. To see the amount of variance explained by our models for each zone and further illustration, please refer to Appendix B.

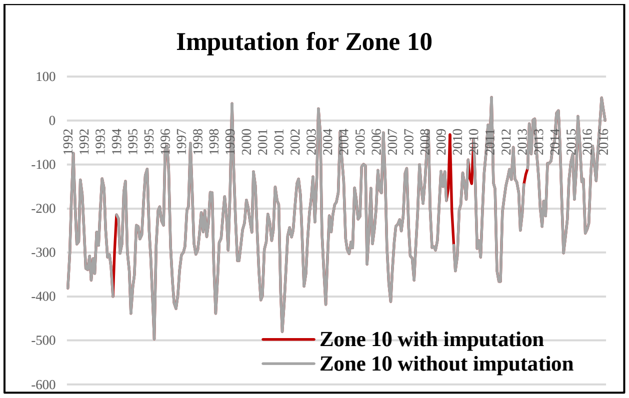

Figure 3.1: Missing Data Imputation for Zone 10

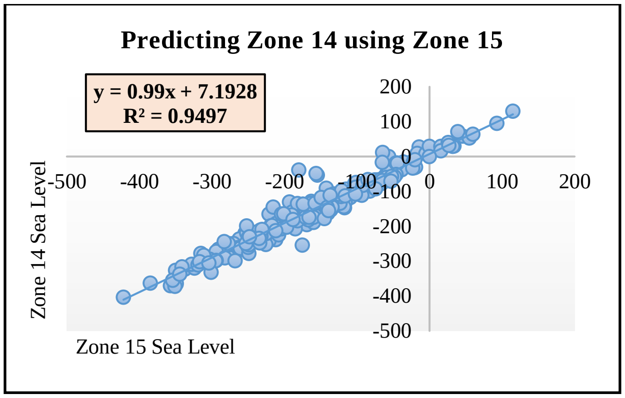

Figure 3. 2: Linear Regression between Zone 14 and Zone 15

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[3] Data of zones imputed by weighted moving average: zone 3, 6, 10, 15, 19, and part of zone 20.
[4] Data of zones imputed by linear regression: zone 2, 4, 5, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18 and 20.

3.3.2 Projecting Five Years Forward

Next, a time series model was applied to each zone. Using R's autoregressive integrated moving average (ARIMA) algorithm[5], we selected models[6] and plotted forecast with both 80% and 95% confidence intervals to check the general trend of the future data compared with existing sea level measurements. Figure 3.3 is a visual representation of projected sea levels for Zone 1:

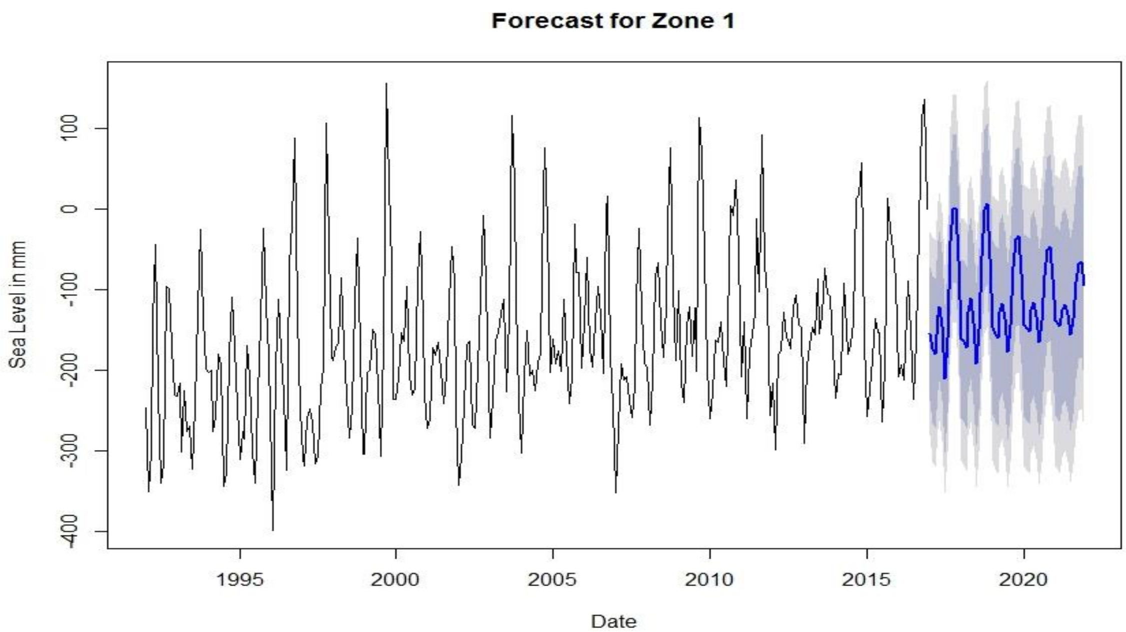

Figure 3.3

For more visual representations of the projected sea levels, please refer to Appendix C.

3.3.3. Simulating Flooding Likelihood

Probabilities of flooding were calculated by using the five year forecasted data. Every data point had a unique standard deviation based on the zone's seasonal ARIMA model. Once the standard

[5] Zones with seasonal ARIMA model: 1, 2, 3, 4, 5, 6, 7, 10, 12, 15, 16, 17, 18, 19, 20. Zones 8, 9, 11, 13, and 14, were calculated by changing the default settings to have more accurate results and became integrated moving average (IMA) models.

[6] Based on lowest Akaike information criterion (AIC) and Bayesian information criterion (BIC)

deviations were found, the average altitude of each zone was checked on a monthly basis to simulate the probability of a sea level forecasts exceeding an altitude more than 100m inland. Based on these simulations, the probability of a zone flooding at least once in the future data was calculated. The following table shows the probability of flood within the next five years:

Table 3.2

Zone	Probability
1	Near 0
2	Near 0
3	Near 0
4	0.00000015
5	0.00002959
6	Near 0
7	0.0000181
8	Near 0
9	Near 0
10	Near 0

Zone	Probability
11	Near 0
12	Near 0
13	Near 0
14	Near 0
15	0.00006859
16	0.795908
17	Near 0
18	0.00000267
19	Near 0
20	Near 0

3.4 Data Limitations

Using missing value imputations by weighted moving average is a great approach for zones that only have a small portion of data missing; however, several zones were missing too many data points. For example, Zone 13 had 261 data points missing out of 300. For these zones, linear regression was used. Although this is one of the best approaches, it may still cause some error.

Even though all of the missing data was approximated, the unknown values causes high variance when projecting future sea levels. Therefore, some of the zone's projected sea levels are less accurate than others, depending on the amount of approximated data.

4 Results

Table 4.1 shows the output indexes for each zone and industry:

Table 4.1

Coastal Zone	Agriculture	Fishing	Housing	Conservation	Recreation	Other/ Tourism	MAX	Max Allocation
1	35.76	48.99	72.66	0	**73.39**	58.64	73.39	**Recreation**
2	42.24	54.52	**76.63**	0	74.86	56.91	76.63	**Housing**
3	37.51	58.69	**89.52**	0	71.06	0.00	89.52	**Housing**
4	48.90	54.26	49.47	0	**67.94**	31.22	67.94	**Recreation**
5	**68.97**	30.41	47.08	0	40.10	21.14	68.97	**Agriculture**
6	**82.42**	54.64	71.17	0	57.71	37.04	82.42	**Agriculture**
7	36.00	77.66	**80.78**	28.19	70.54	33.27	80.78	**Housing**
8	20.35	51.71	**57.26**	27.01	53.27	44.65	57.26	**Housing**
9	**65.68**	24.53	40.46	15.94	33.07	27.72	65.68	**Agriculture**
10	76.82	86.77	**88.58**	37.62	71.56	43.11	88.58	**Housing**
11	**64.93**	53.72	52.45	32.57	52.04	50.64	64.93	**Agriculture**
12	**68.99**	56.49	66.01	34.16	54.85	42.27	68.99	**Agriculture**
13	53.52	49.00	**53.99**	32.05	51.48	48.23	53.99	**Housing**
14	49.16	48.37	48.81	47.87	**52.93**	34.34	52.93	**Recreation**
15	49.52	66.21	**67.39**	58.05	63.78	33.08	67.39	**Housing**
16	62.97	68.74	0.00	**71.93**	0	0.00	71.93	**Conservation**
17	91.29	**99.49**	95.05	78.07	79.70	54.52	99.49	**Fishing**
18	76.90	76.46	**79.13**	76.67	63.99	24.67	79.13	**Housing**
19	83.78	97.62	**98.68**	51.66	79.15	40.83	98.68	**Housing**
20	**92.52**	83.94	88.36	36.90	70.51	37.88	92.52	**Agriculture**
Max Island Index							**1501.17**	

The island index ranges from 0 to 2,000. An example of how these indexes were calculated can be seen in Section 3.2. Appendix D shows the index equations for each economic development.

4.1 Decision Rationale

As mentioned before, by minimizing opportunity cost, Akua Island will be able to maximize the utilization of its land. Therefore, land allocations were chosen based on the highest index for that zone. For example, Zone 1 will have an opportunity cost of 61.93 if Zone 1 specialized in recreation. However, its opportunity cost would be 73.39 if it specialized in agriculture. By choosing the maximum zone indexes, the maximum island index would be 1501.17.

4.2 Trade-offs

Despite maximizing the island's output, the land allocations do not meet the needs of the Akua Commission. The following map shows TA's recommendation to the Commission:

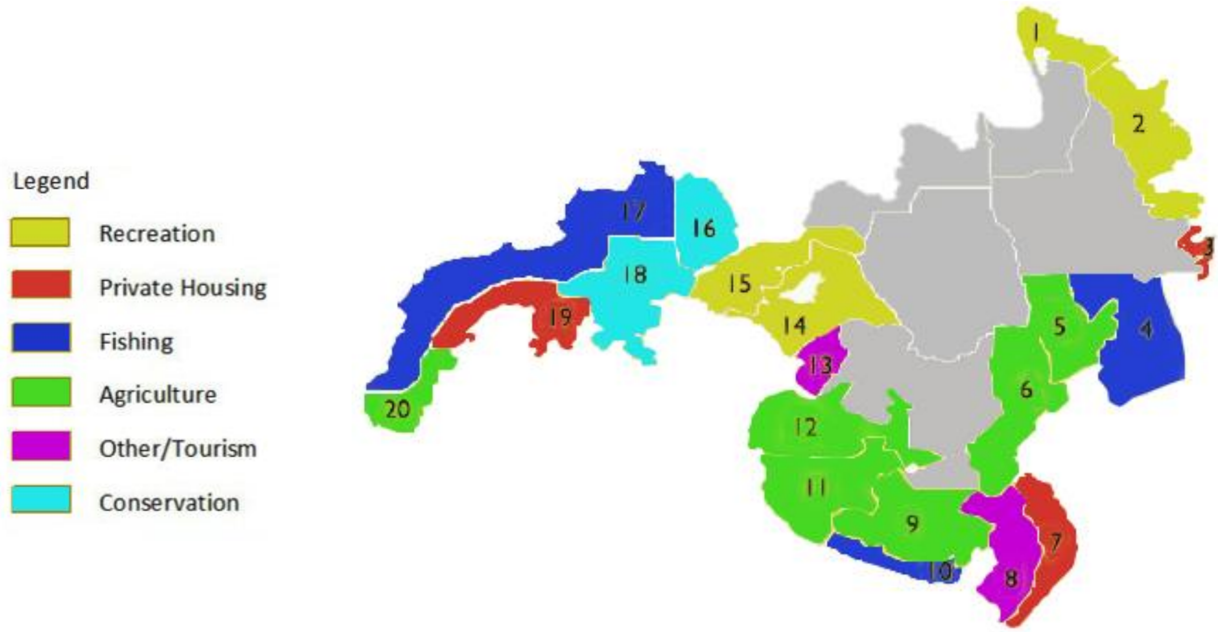

Figure 4.1[7]

These allocations first meet the needs of the commission and then maximize output. The island index for this recommendation is 1501.17. Thus, Akua Island would be at 97.2% operational efficiency and balance the interests of all stakeholders.

4.3 Opportunities

Middle-class employment will increase along with tourism. Additionally, private housing zones are located on both sides of the island, allowing for population growth. Finally, the mission of the Commission will be upheld by "protecting, restoring, conserving, and enhancing the environment" with the many public developments. If these priorities should change, this model provides the opportunity for the Commission to adjust the weights for each factor.

[7] Changes from the maximum allocations are as follows: Zone 2 and 15 are now Recreation, Zone 4 and 10 are now Fishing, Zone 8 and 13 are now Other/Tourism, and Zone 18 is now Conservation.

5 Discussion

Akua Island is the combination of its zones. Likewise, a particular industry in Akua Island is the combination of zones that specialize in that industry:

$$TotalFish = Quantity_{Zone_n} + Quantity_{Zone_{n+1}} + \cdots$$

Where *n* is an arbitrary zone. A similar notion can be applied to our index model:

$$FishIndex = Index_{FishingZone_n} + Index_{FishingZone_{n+1}} + \cdots$$

In this model, industrial indexes can be used to gauge the efficiency of each industry. In this sense, our indexing model provides a measurement for both zone efficiency levels and industry efficiency levels. The commission can use these indexes to identify particular zones or industries that might not be developing as fast as the others or developing too fast. Then an action plan can be made to correct such a scenario.

6 Conclusion

To maximize the development of Akua Island, opportunity cost must be minimized. Output indexes for each industry were calculated along with their opportunity costs, and the highest index for each zone were selected. After a few minor adjustments to meet the interests of the Akua Island Commission, the total index is 1501.17. The recommended land allocations are located in Table 1.1 and Figure 4.1. TA's model allows for many future adjustments to be made. Once more data is collected, regressions can be computed to find significant factors that should be added or subtracted to each key factor. Additionally, different weights can be assigned to each key factors. Lastly, Appendix E provides a table of opportunity costs for each zone and industry under the current model. With financial information, Gross Output (GO) and Gross Domestic Product (GDP) could have been calculated. Both GO and GDP would be great indicators of economic development and provide a quantitative measurement.

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Appendices

Appendix A – Factor Scores

Some slight adjustments were needed before calculating each factor's score. The following adjustments were made:

- The compliment of snapper exploitation rate was used to show a high number of fish remaining.
- The coastline proportion was taken by dividing a zone's coastline with its total zone area.
- The flood factor is a dummy variable with score of 100 was assigned if the probability of flooding was equal to or greater than 1% and 0 if the probability was less than 1%.
- The sea level slope is a dummy variable with a score of 100 was assigned if the zone's projected sea levels had a positive trend, measured by a linear slope function and 0 if the slope was negative.

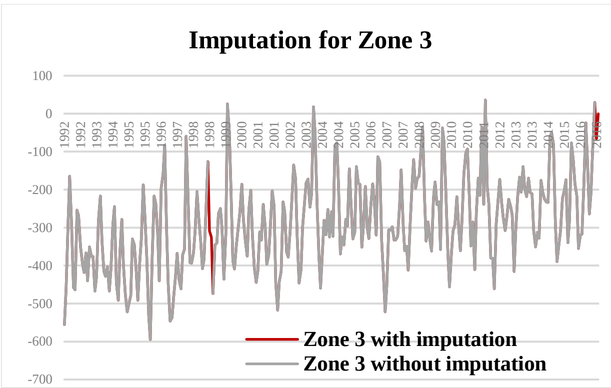
Once these adjustments were made, the factors were calculated by taking the original data set, dividing by the data set's maximum value, and multiplying by 100. The following table shows the factor scores that contribute to each economic development equation, which are found in Appendix D.

Coastal Zone	Zone Surface Area	Wetland Surface Area	Grassland Surface Area	Forest Surface Area	Other Surface Area	Akua Duck Population	Low Snapper Exploitation Rate	Amount of Soil Organic Matter	Coastline Proportion	Altitude	Flood	Sea level Slope
1	45.60	58.82	52.17	55.38	20.95	0.00	32.65	24.51	73.51	100.00	0	100
2	77.69	58.82	58.70	50.77	17.85	0.00	38.78	30.39	76.66	67.37	0	100
3	22.90	70.59	95.65	0.00	0.00	0.00	45.92	14.71	75.01	37.89	0	100
4	96.87	64.71	23.91	100.00	14.84	0.00	58.16	100.00	50.62	4.21	0	0
5	70.65	41.18	78.26	18.46	48.70	0.00	69.39	60.78	13.33	3.16	0	100
6	74.56	41.18	92.39	6.15	22.84	0.00	76.53	73.53	39.01	41.05	0	0
7	63.60	70.59	69.57	23.08	43.84	0.93	79.59	18.63	75.78	4.21	0	100
8	67.91	58.82	63.04	38.46	36.41	1.25	89.80	6.57	29.78	27.37	0	100
9	79.45	5.88	100.00	9.23	6.09	1.56	90.82	43.14	6.62	29.47	0	100
10	35.81	100.00	84.78	4.62	5.49	4.05	91.84	69.61	81.99	50.53	0	100
11	81.60	41.18	50.00	47.69	100.00	5.30	100.00	84.31	28.85	48.42	0	100
12	74.95	35.29	83.70	12.31	51.66	6.54	92.86	56.86	34.37	41.05	0	100
13	40.70	17.65	60.87	44.62	37.41	9.97	92.86	47.06	25.86	40.00	0	100
14	76.13	35.29	45.65	70.77	34.98	15.89	91.84	52.94	25.47	6.32	0	100
15	67.91	58.82	64.13	44.62	10.40	19.94	91.84	38.24	47.73	3.16	0	100
16	64.77	70.59	66.30	21.54	64.49	38.32	92.86	59.80	50.89	1.05	100	100
17	100.00	58.82	85.87	15.38	7.66	100.00	98.98	97.06	100.00	36.84	0	100
18	75.54	70.59	80.43	4.62	63.64	51.09	94.90	73.53	61.61	4.21	0	100
19	53.82	47.06	96.74	3.08	4.12	25.23	95.92	72.55	99.34	40.00	0	100
20	43.44	64.71	94.91	1.54	3.33	11.84	96.94	90.20	72.69	75.79	0	100
Max	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Min	22.90	5.88	23.91	0.00	0.00	0.00	32.65	6.57	6.62	1.05	0.00	0.00

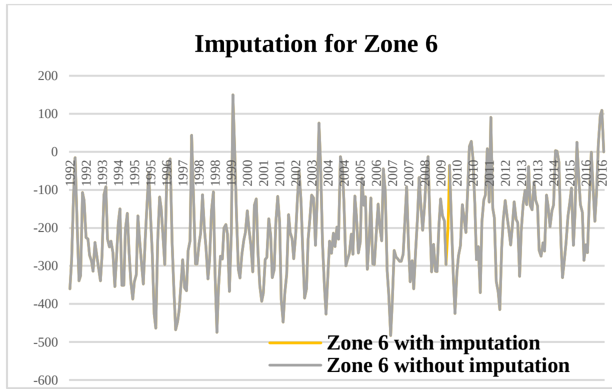
Appendix B – Sea Level Approximations

For missing data imputation, two steps are listed as follow.

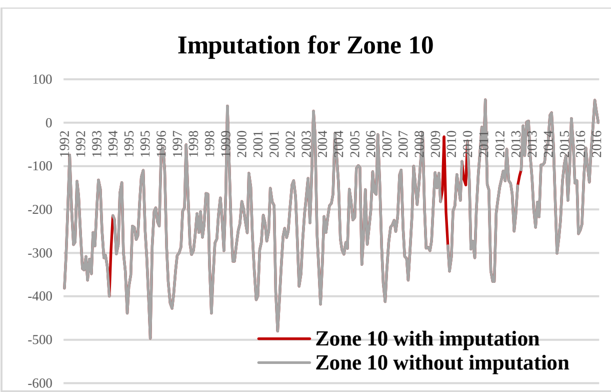
Step 1: Using missing value imputation by weighted moving average, zone 3, 6, 10, 15, 19, and also part of zone 20 are estimated by R-software. The R-plots below show the result:



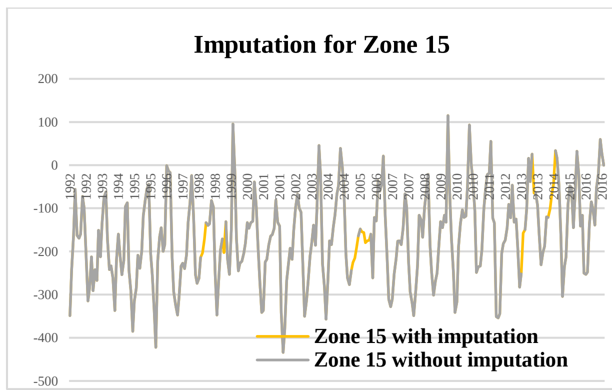
Missing Data Imputation for Zone 3



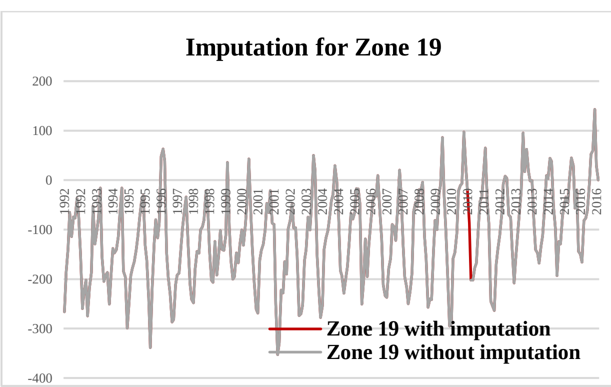
Missing Data Imputation for Zone 6



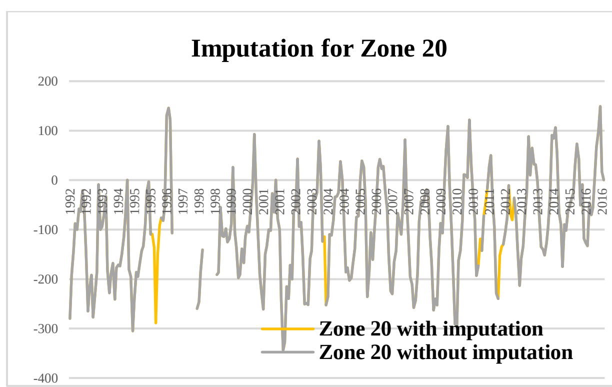
Missing Data Imputation for Zone 10



Missing Data Imputation for Zone 15

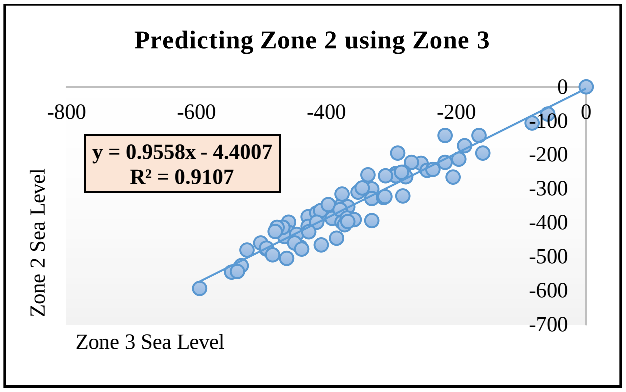


Missing Data Imputation for Zone 19

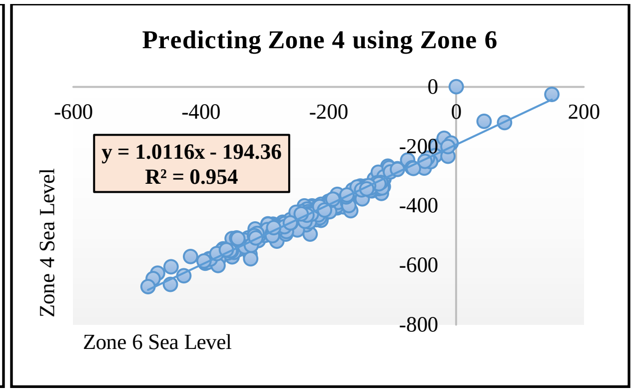


Missing Data Imputation for Zone 20

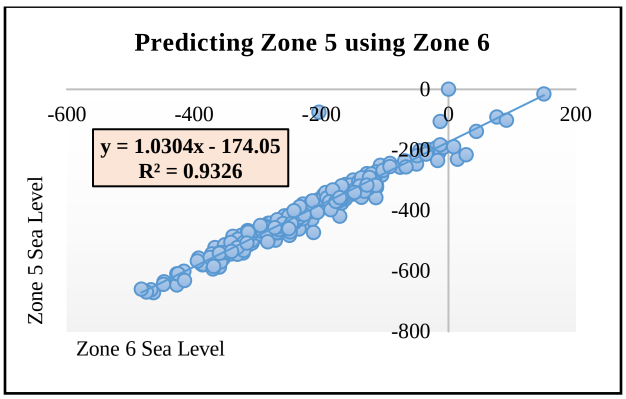
Step 2: Based on the linear relationship among the close zones, linear regression method is used to estimate the rest of zones by Microsoft Excel. The charts are listed as follow:



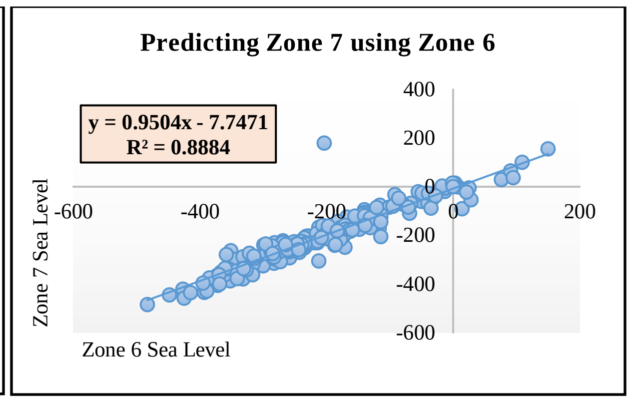
Linear Regression between Zone 2 and Zone 3



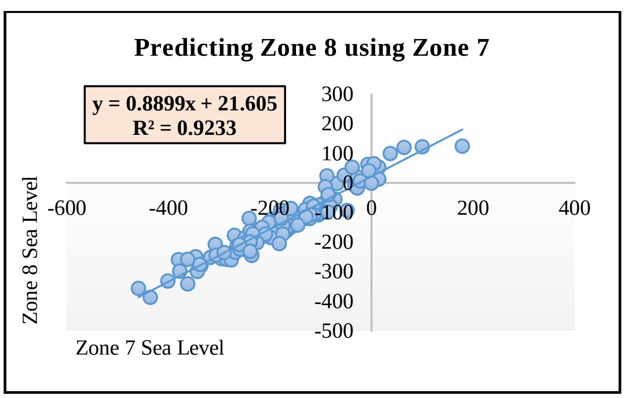
Linear Regression between Zone 4 and Zone 6



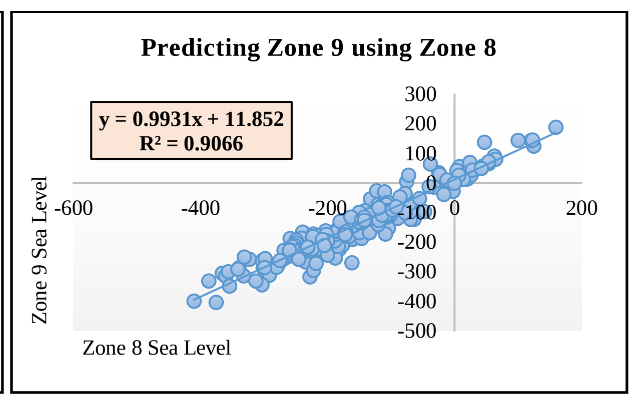
Linear Regression between Zone 5 and Zone 6



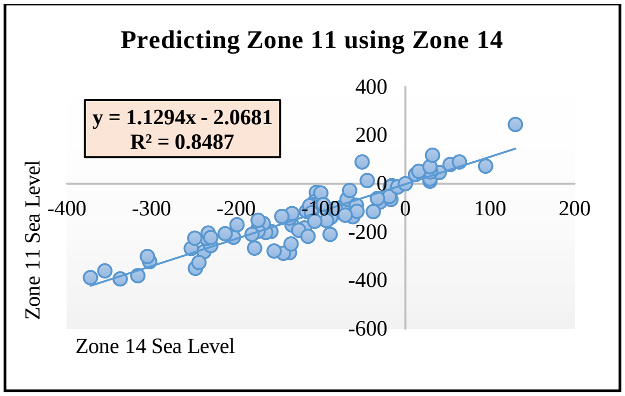
Linear Regression between Zone 7 and Zone 6



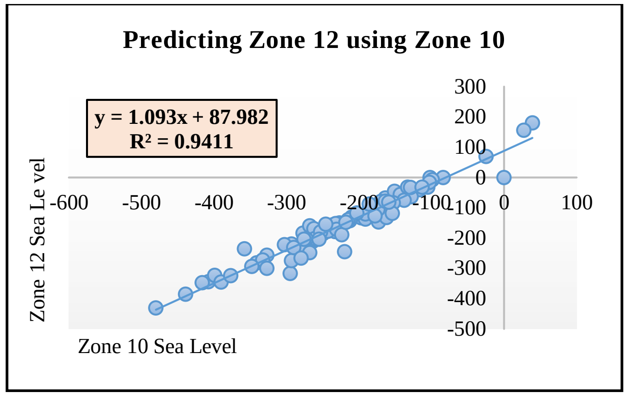
Linear Regression between Zone 7 and Zone 8



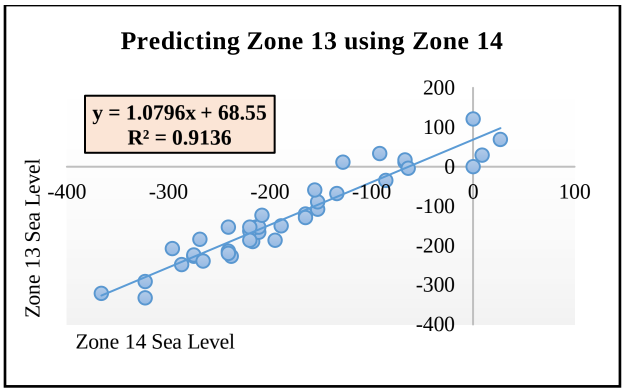
Linear Regression between Zone 8 and Zone 9



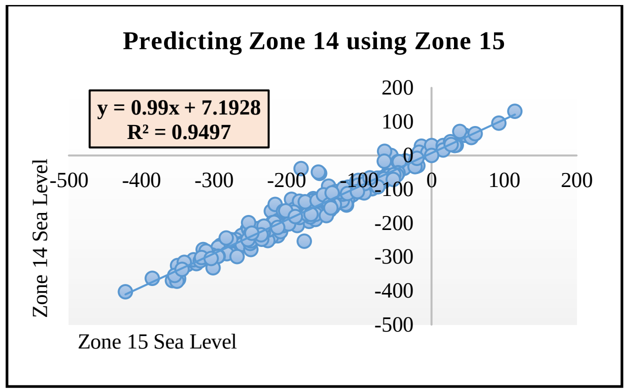
Linear Regression between Zone 11 and Zone 14



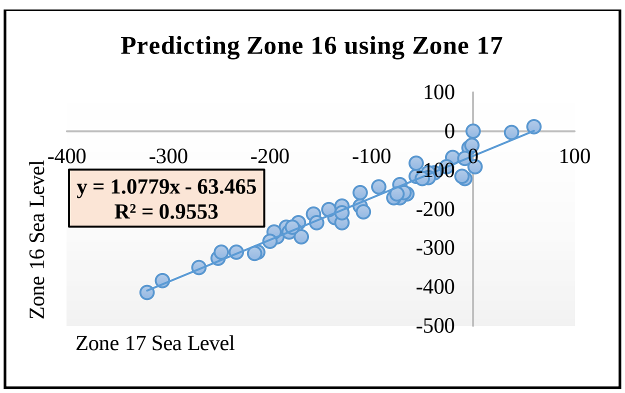
Linear Regression between Zone 10 and Zone 12



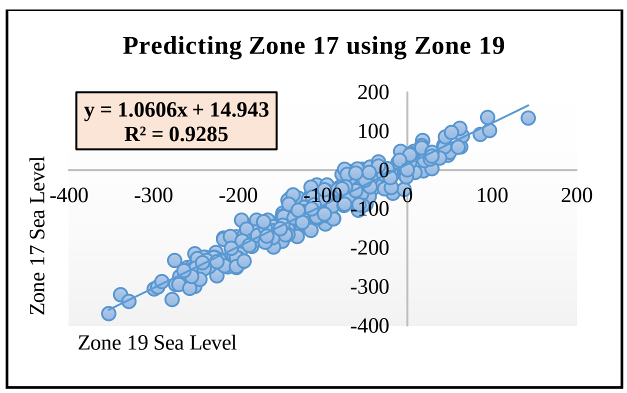
Linear Regression between Zone 13 and Zone 14



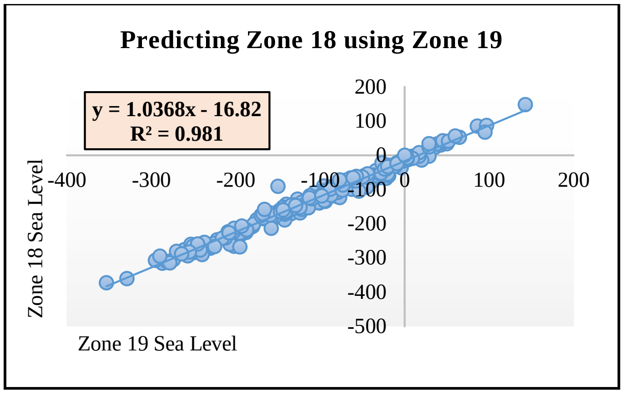
Linear Regression between Zone 14 and Zone 15



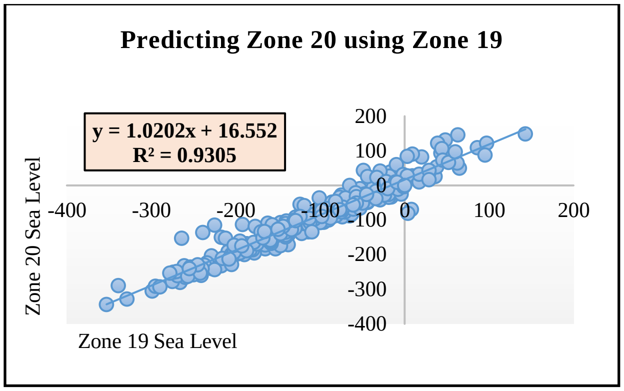
Linear Regression between Zone 16 and Zone 17



Linear Regression between Zone 17 and Zone 19



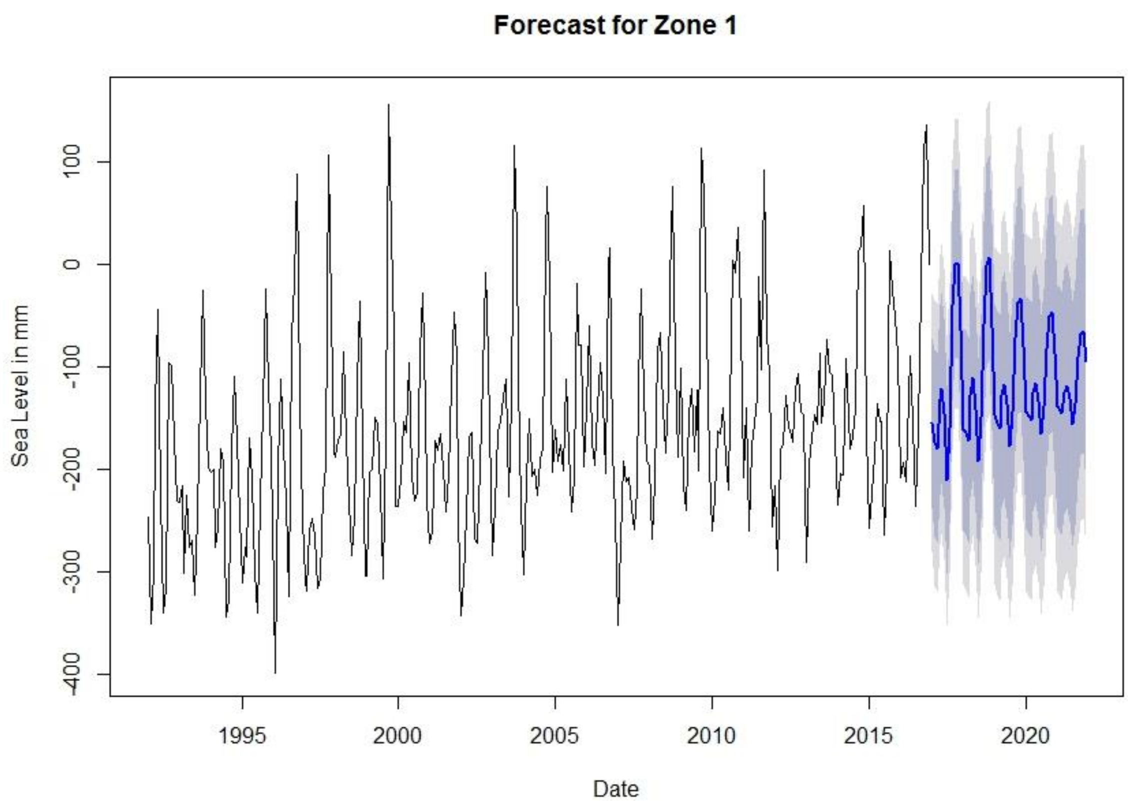
Linear Regression between Zone 18 and Zone 19

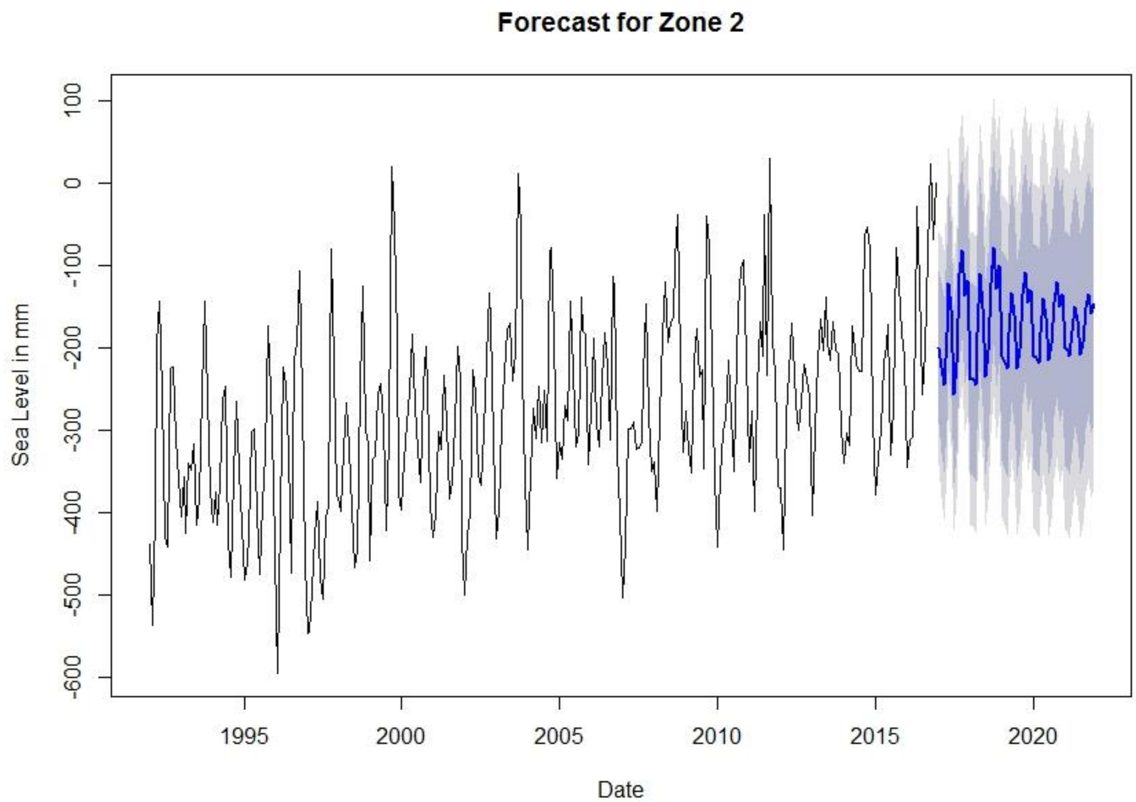


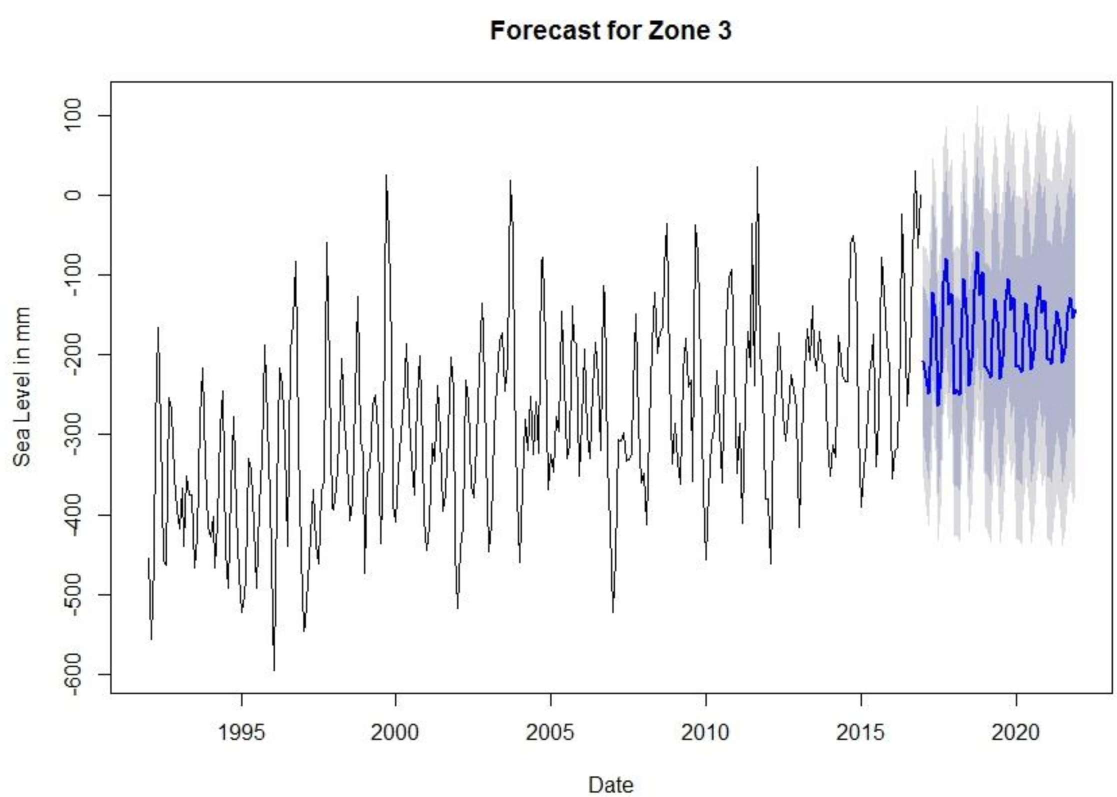
Linear Regression between Zone 19 and Zone 20

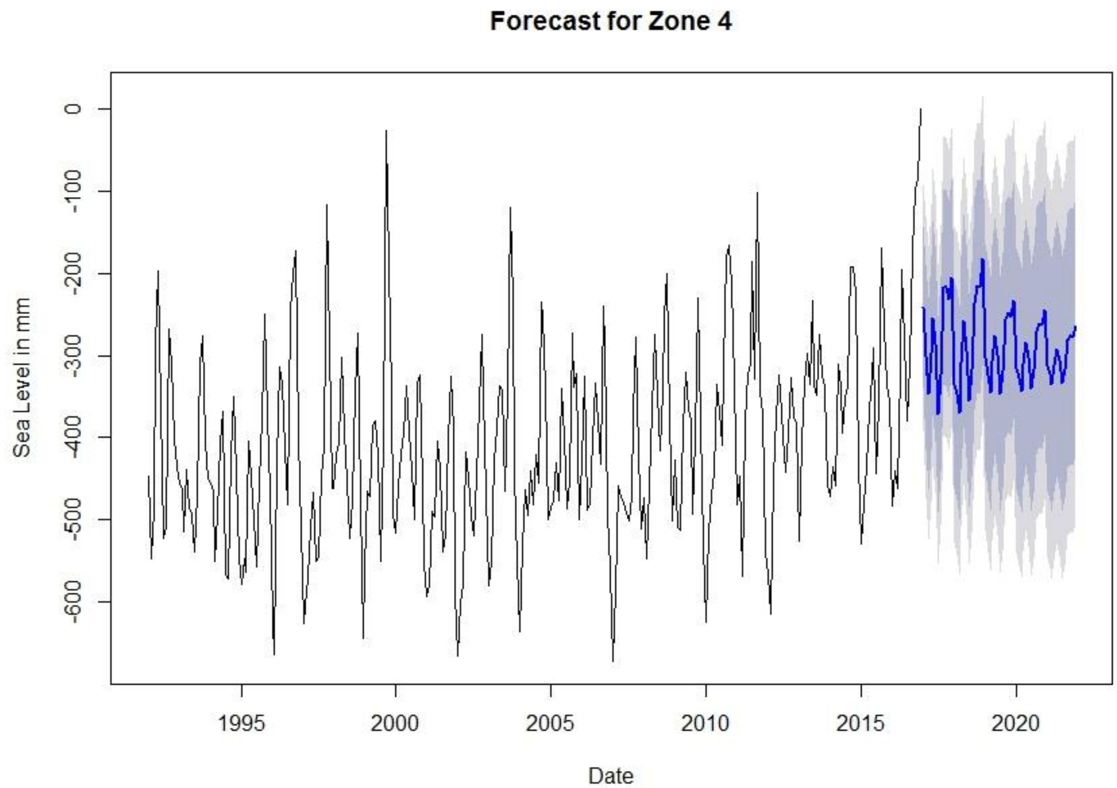
Appendix C – Projected Sea Levels

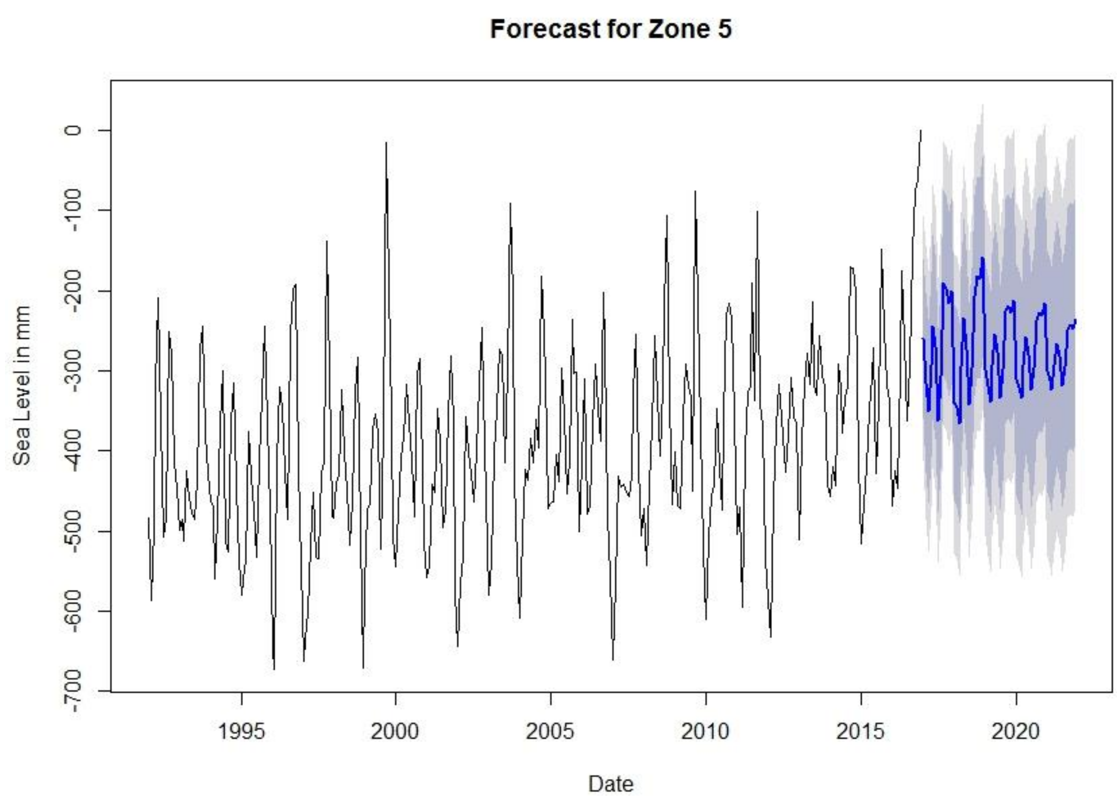
Each plot is forecasted with an 80% Confidence Interval (colored dark grey) and a 90% Confidence Interval (colored light grey). The forecasted estimates (colored dark blue) are for each month starting with January 2017 to December 2021.

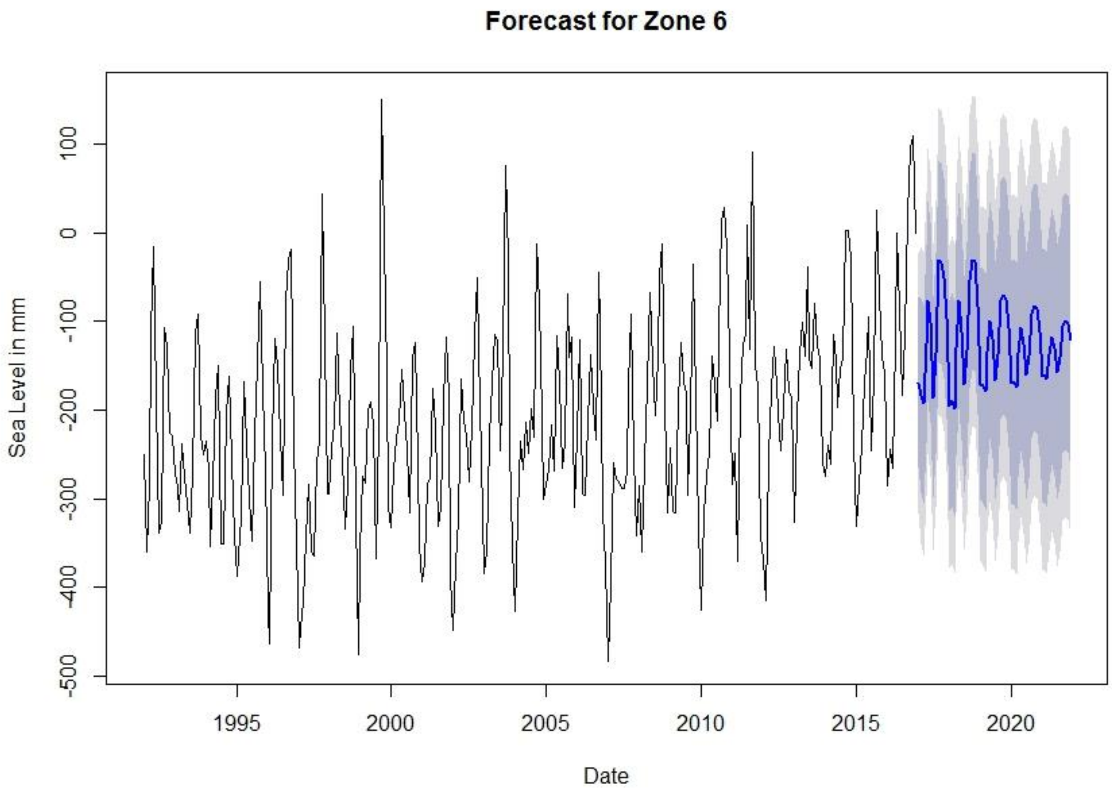



Forecast for Zone 2
Sea Level in mm
Date
100
0
-100
-200
-300
-400
-500
-600
1995
2000
2005
2010
2015
2020

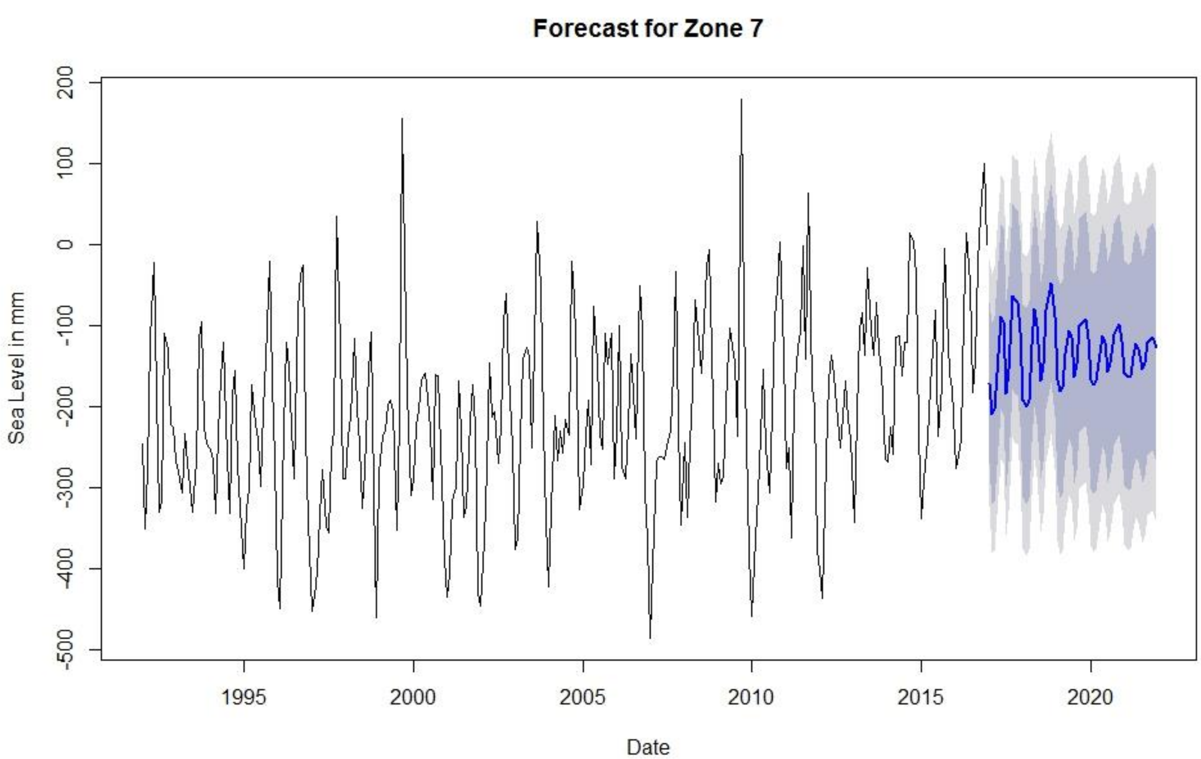

Forecast for Zone 3
Sea Level in mm
Date
100
0
-100
-200
-300
-400
-500
-600
1995
2000
2005
2010
2015
2020


Forecast for Zone 4
Sea Level in mm
0
-100
-200
-300
-400
-500
-600
1995
2000
2005
2010
2015
2020
Date

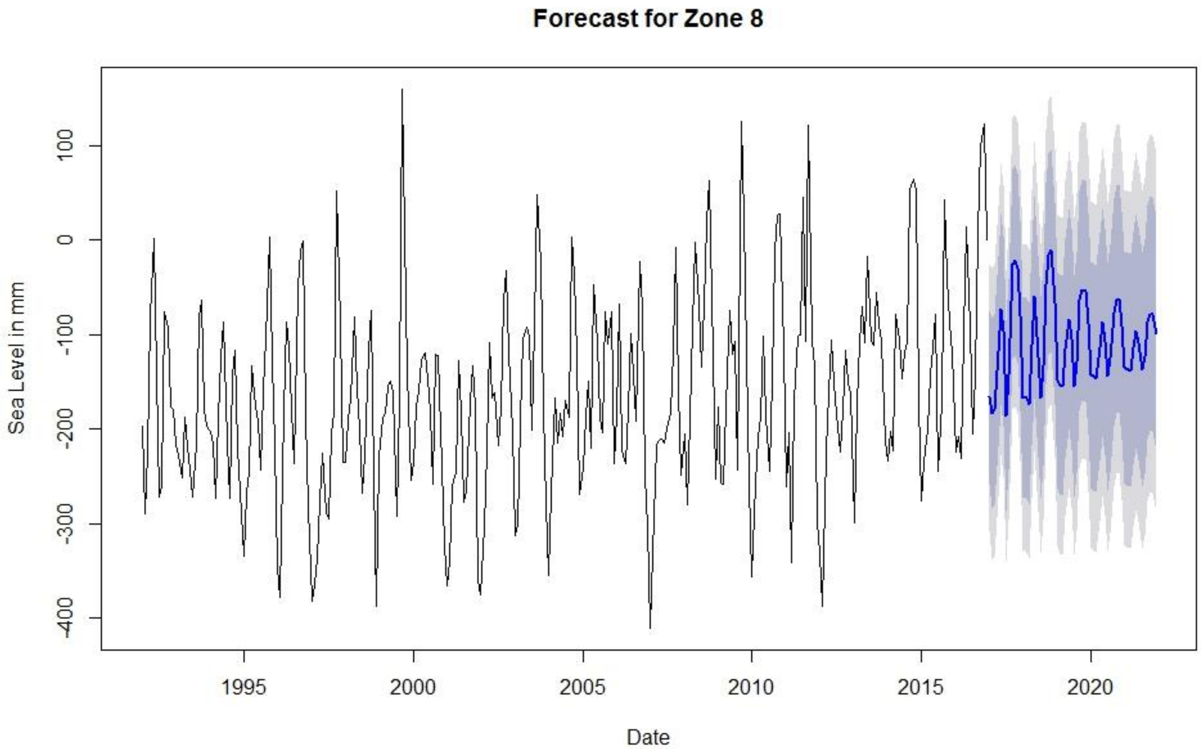

Forecast for Zone 5
Sea Level in mm
0
-100
-200
-300
-400
-500
-600
-700
1995
2000
2005
2010
2015
2020
Date

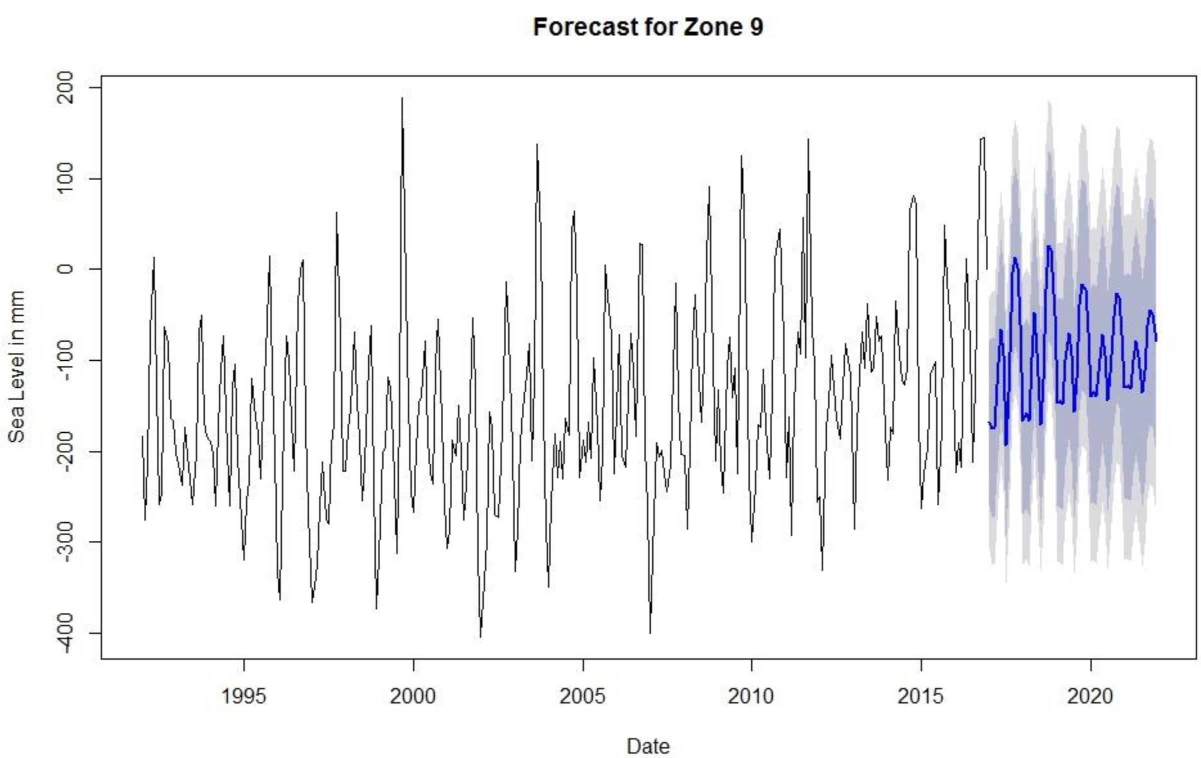


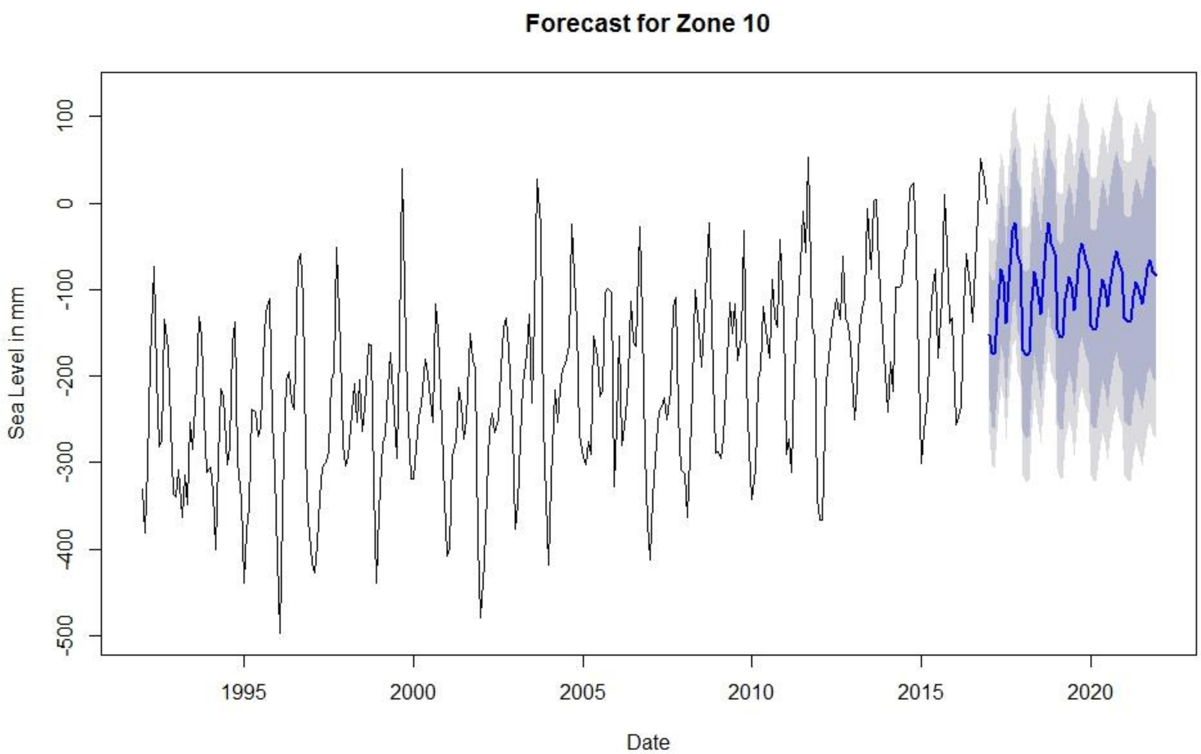
Forecast for Zone 6
Sea Level in mm
100
0
-100
-200
-300
-400
-500
1995
2000
2005
2010
2015
2020
Date

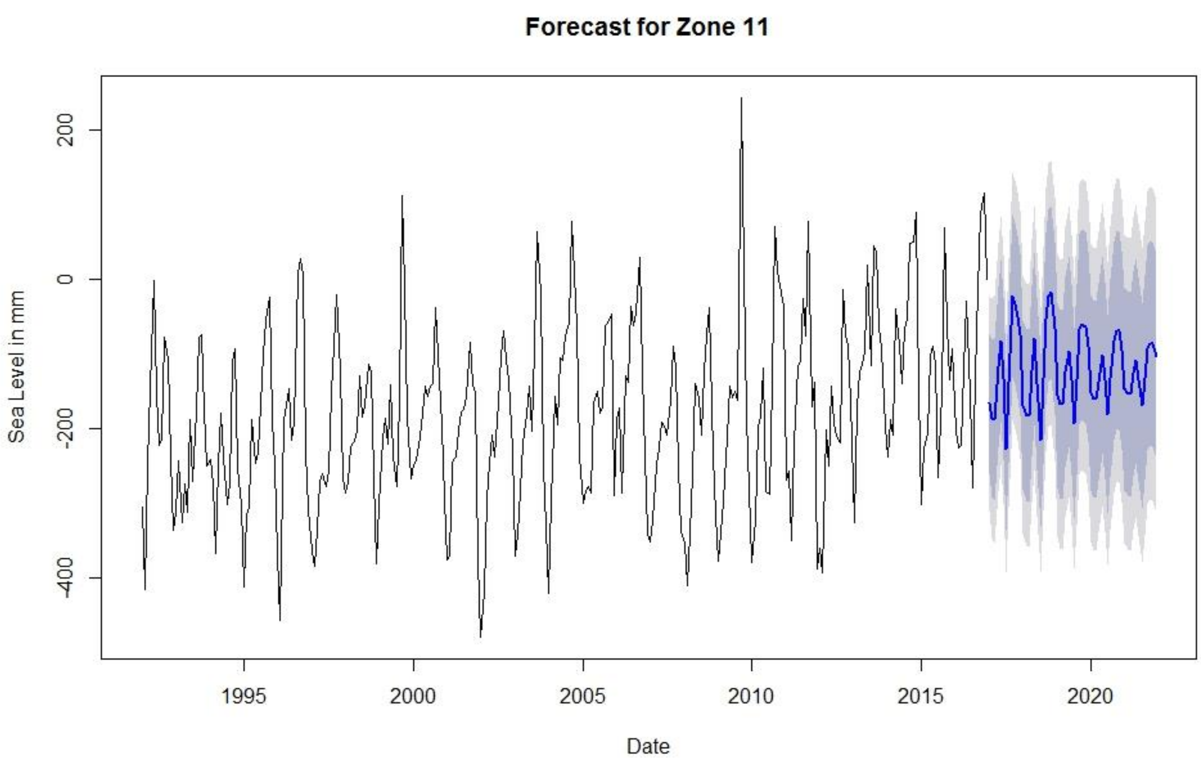


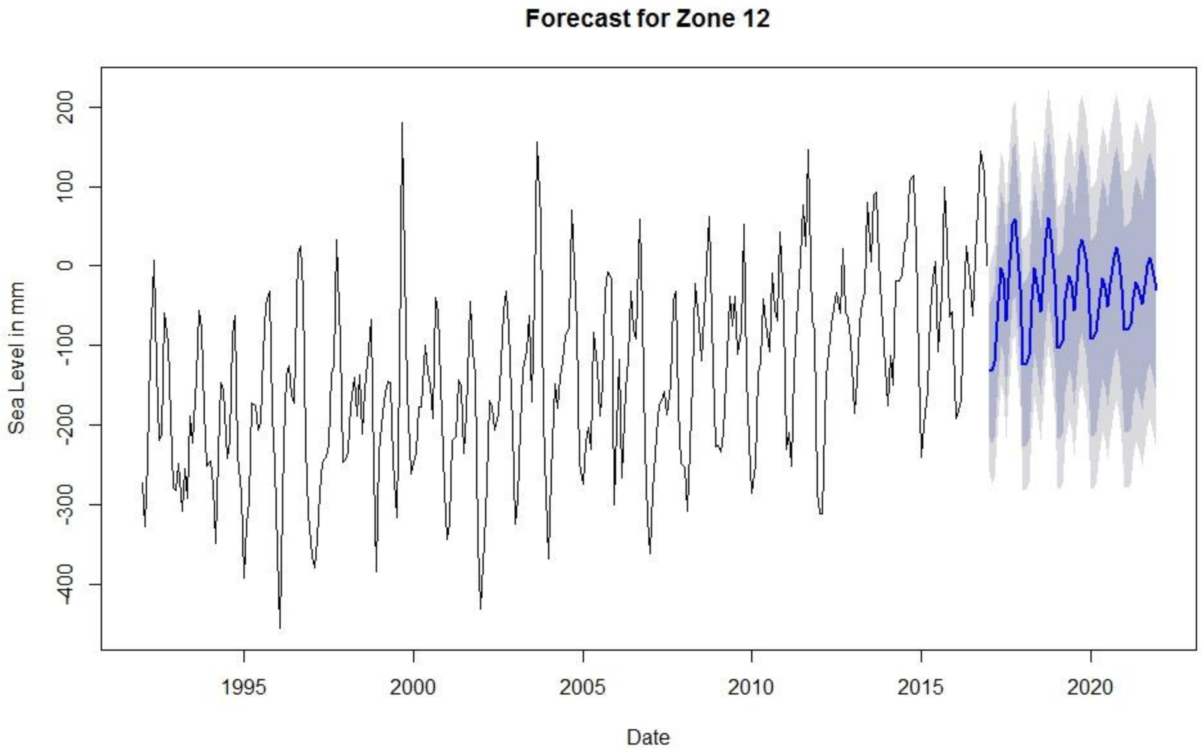
Forecast for Zone 7
Sea Level in mm
200
100
0
-100
-200
-300
-400
-500
1995
2000
2005
2010
2015
2020
Date

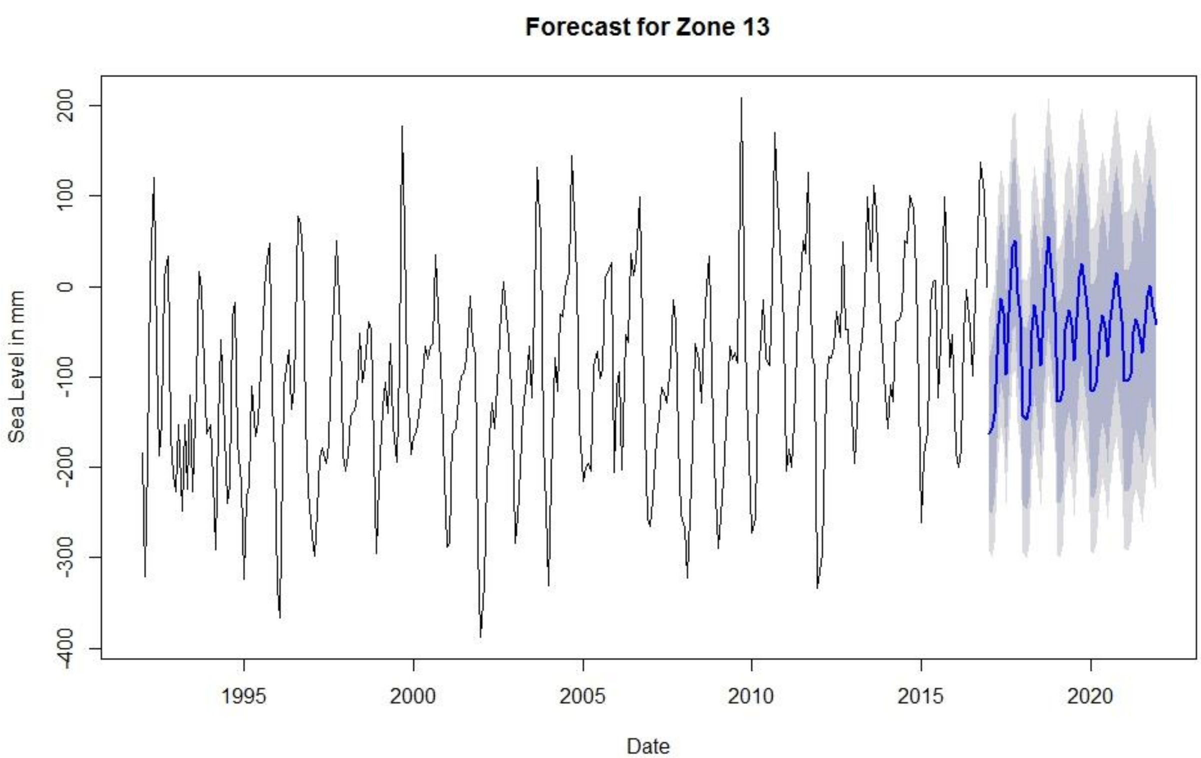

Forecast for Zone 8
Sea Level in mm
100
0
-100
-200
-300
-400
1995
2000
2005
2010
2015
2020
Date


Forecast for Zone 9
Sea Level in mm
200
100
0
-100
-200
-300
-400
1995
2000
2005
2010
2015
2020
Date

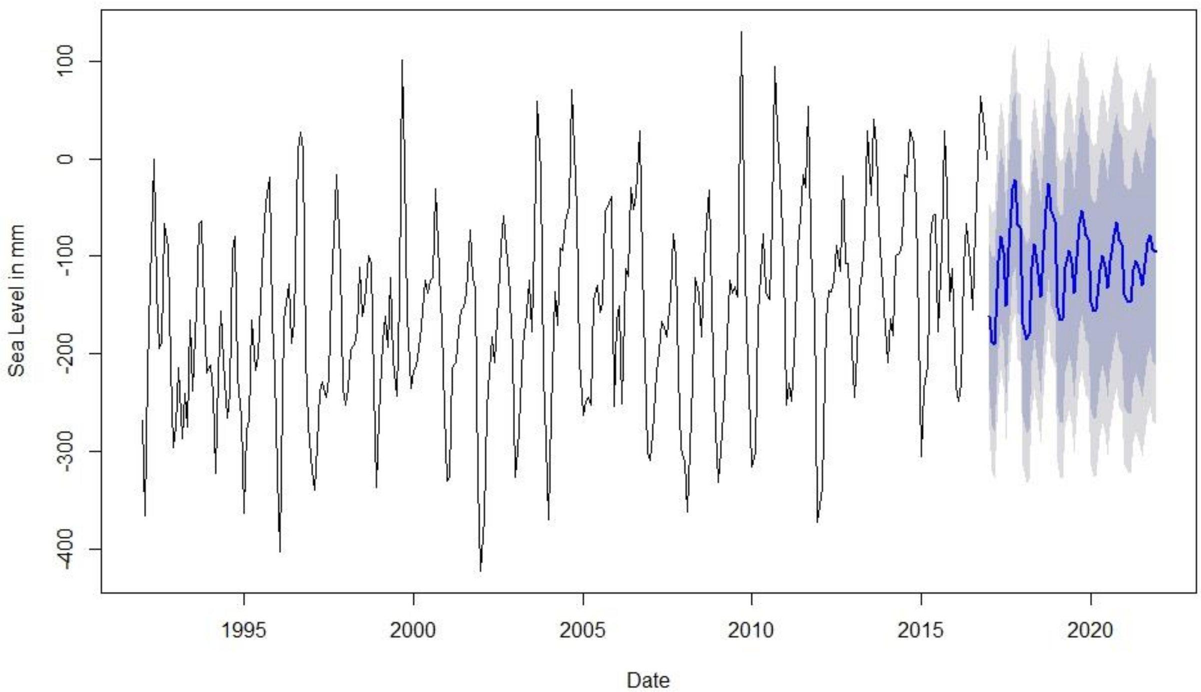

Forecast for Zone 10
Sea Level in mm
100
0
-100
-200
-300
-400
-500
1995
2000
2005
2010
2015
2020
Date


Forecast for Zone 11
Sea Level in mm
200
0
-200
-400
1995
2000
2005
2010
2015
2020
Date

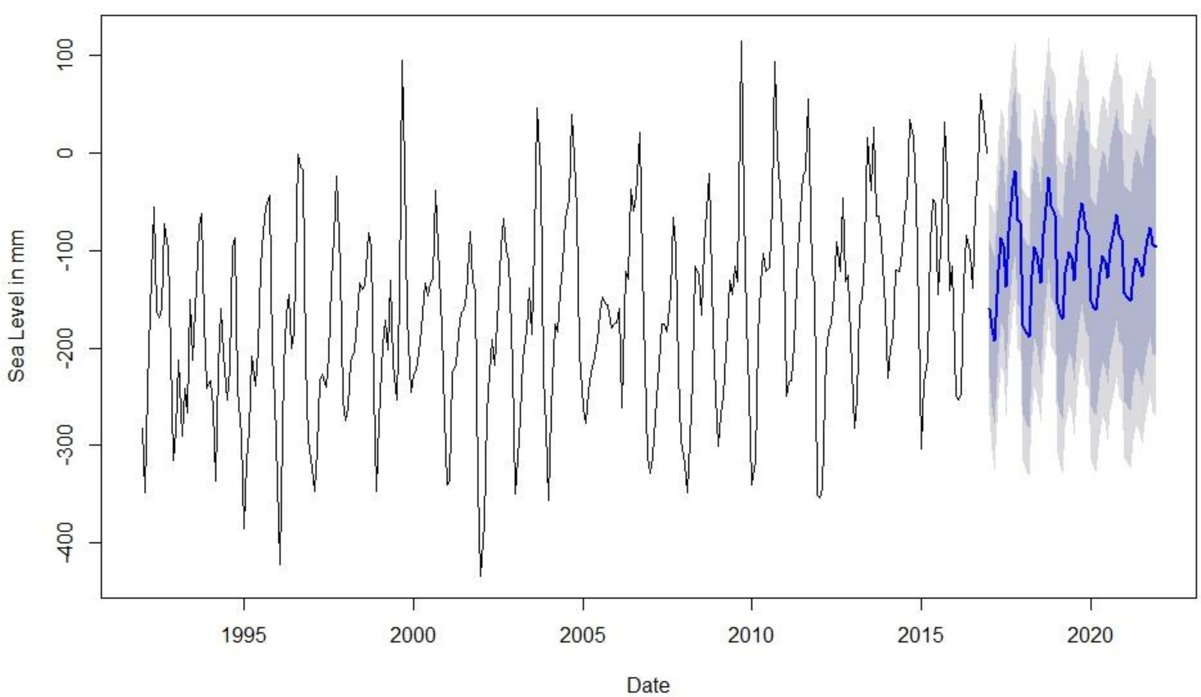

Forecast for Zone 12
Sea Level in mm
Date
200
100
0
-100
-200
-300
-400
1995
2000
2005
2010
2015
2020

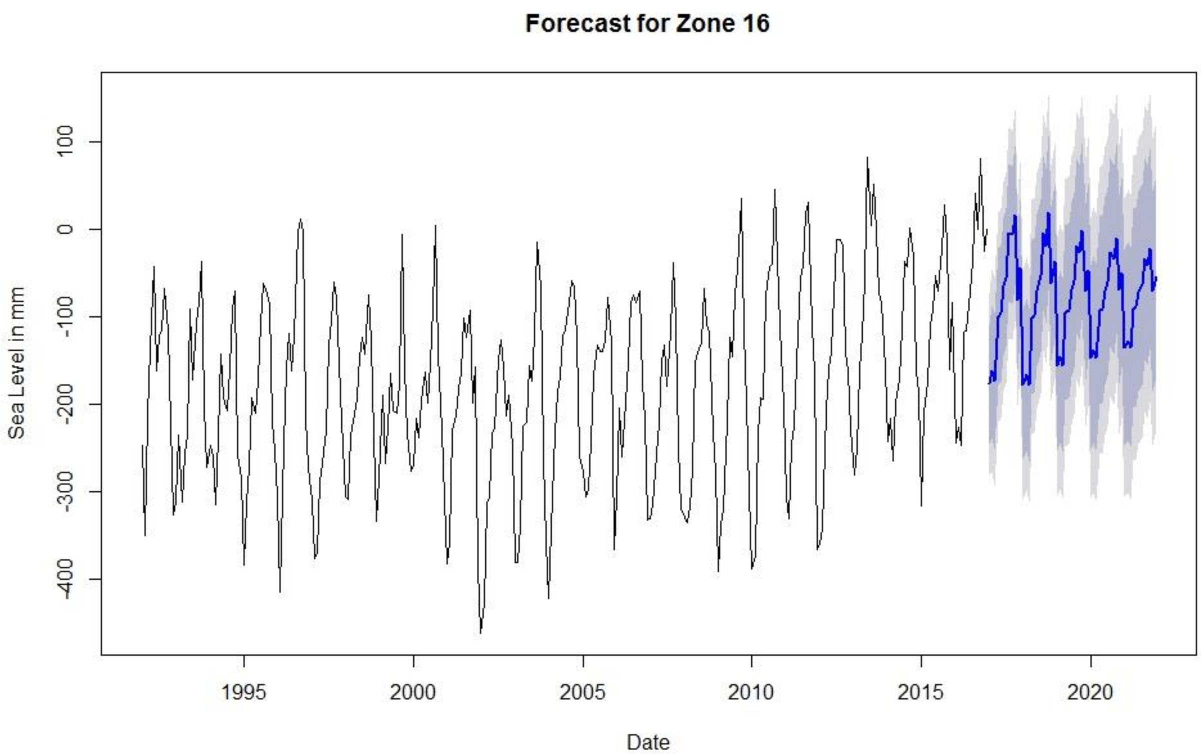

Forecast for Zone 13
Sea Level in mm
Date
200
100
0
-100
-200
-300
-400
1995
2000
2005
2010
2015
2020

Forecast for Zone 14

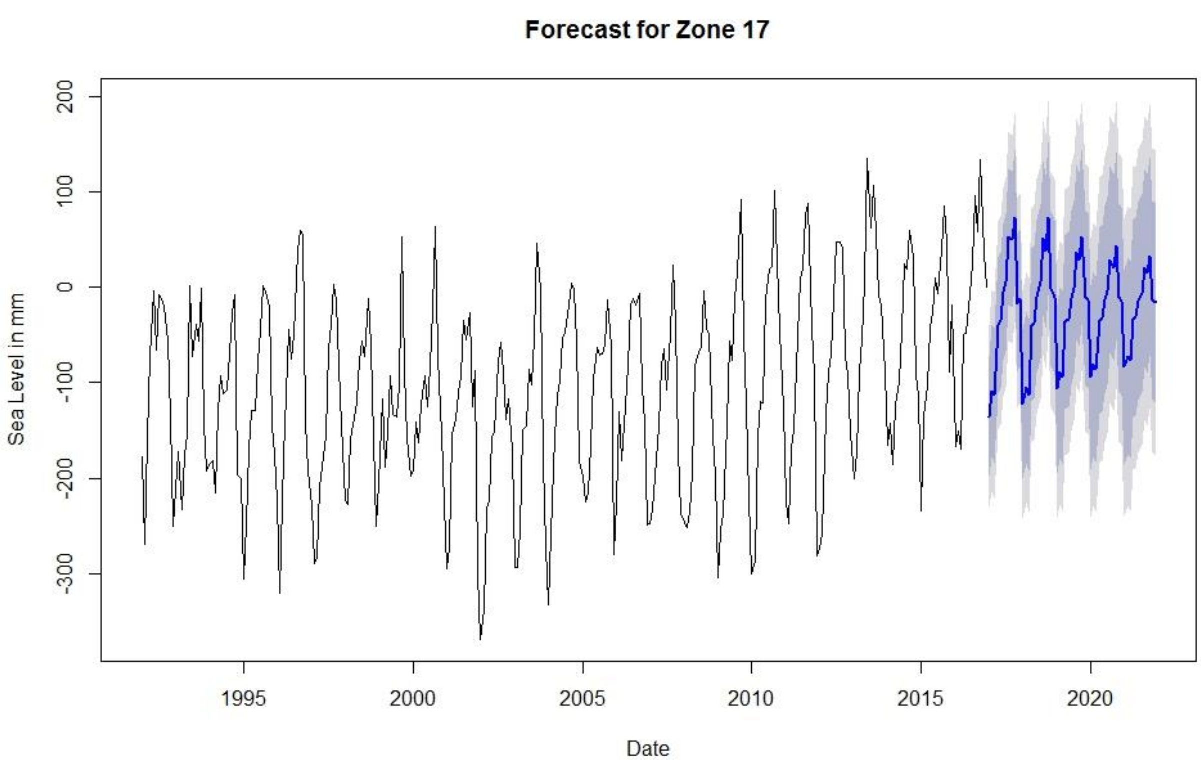


Forecast for Zone 15

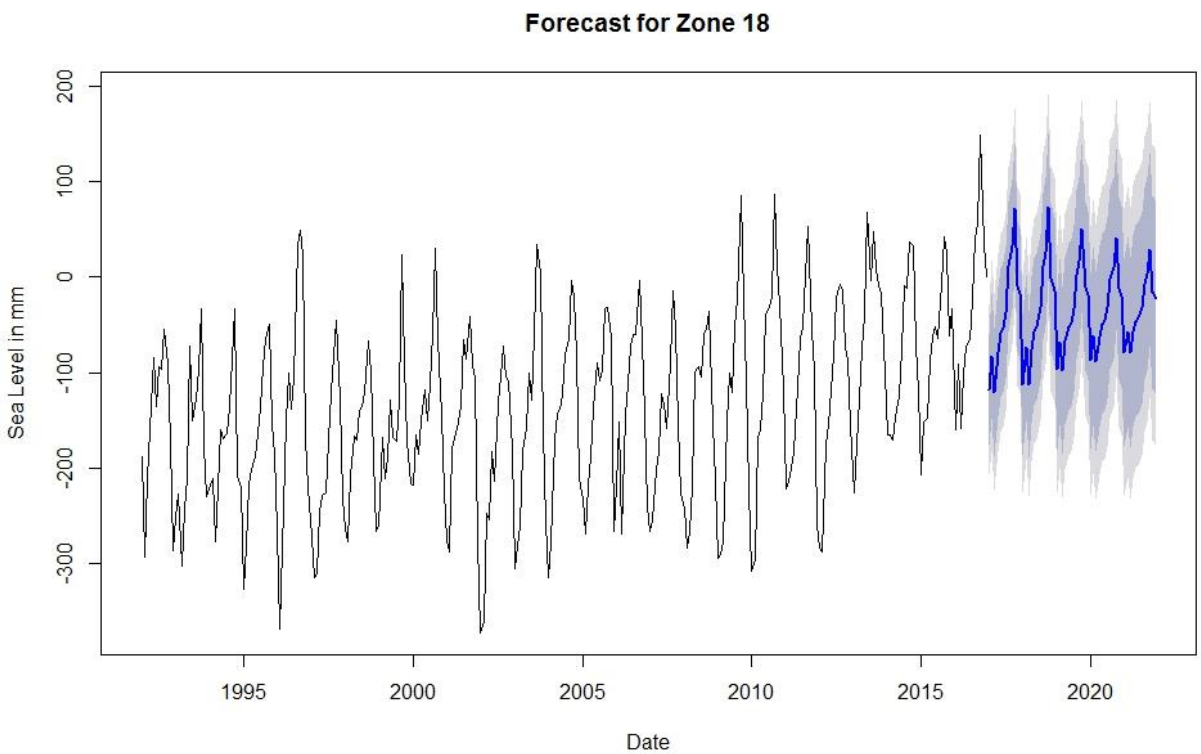


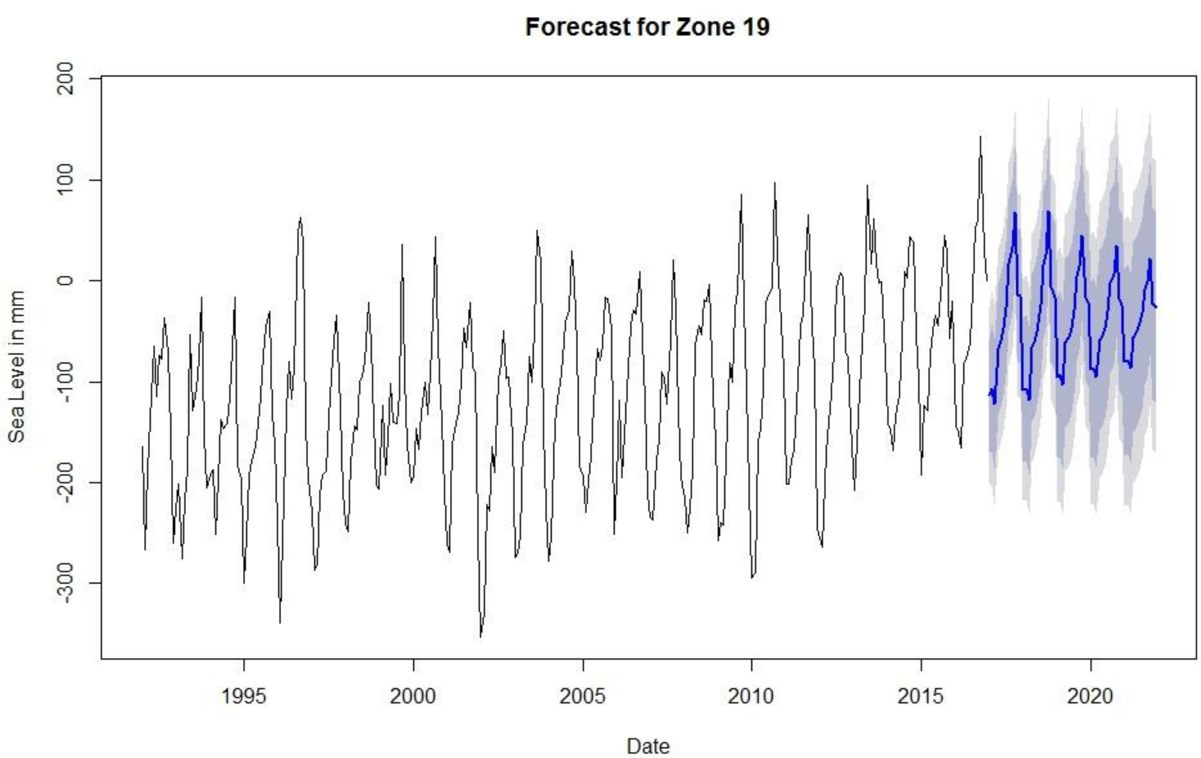


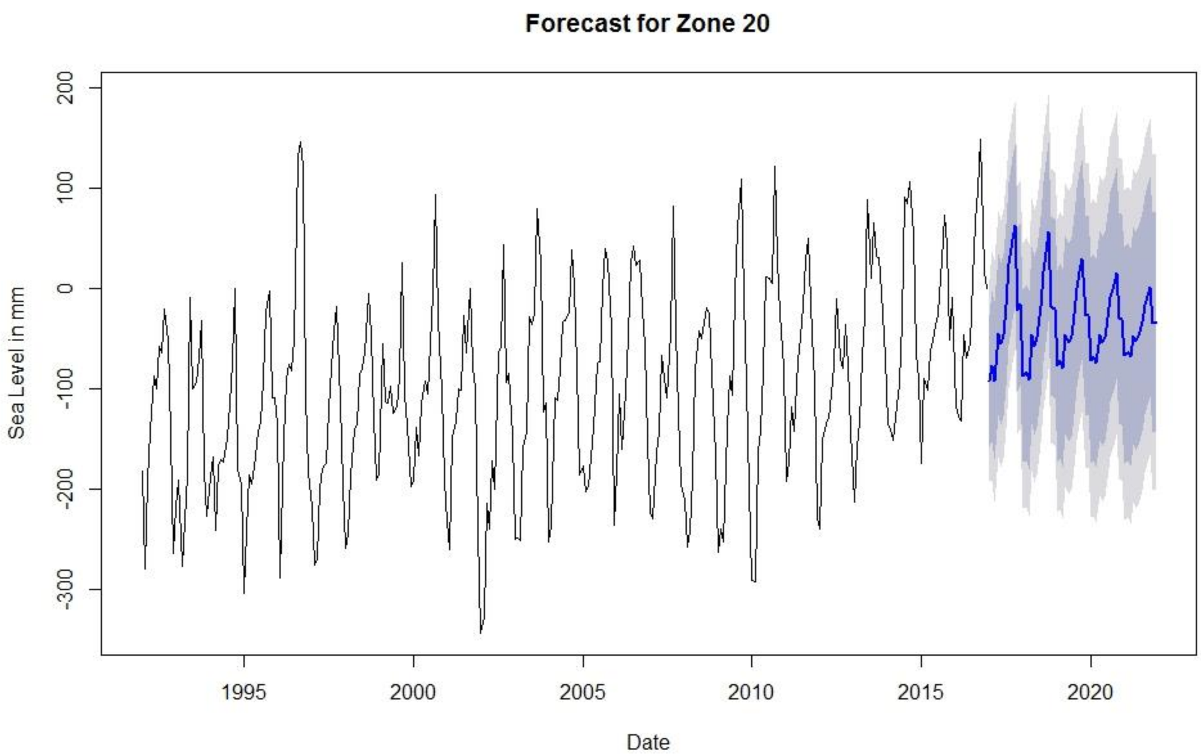
Forecast for Zone 16
Sea Level in mm
100
0
-100
-200
-300
-400
1995
2000
2005
2010
2015
2020
Date



Forecast for Zone 17
Sea Level in mm
200
100
0
-100
-200
-300
1995
2000
2005
2010
2015
2020
Date


Forecast for Zone 18
Sea Level in mm
200
100
0
-100
-200
-300
1995
2000
2005
2010
2015
2020
Date


Forecast for Zone 19
Sea Level in mm
200
100
0
-100
-200
-300
1995
2000
2005
2010
2015
2020
Date



Forecast for Zone 20
Sea Level in mm
200
100
0
-100
-200
-300
1995
2000
2005
2010
2015
2020
Date

Appendix D – Index Equations

Factor scores can be found in Appendix A. The following are the index equations for each economic development:

Agriculture Index:

$$\sqrt{\%Grassland\ \times AvgOrganicSoilMatter}$$

Where *%Grassland* is the factor score from percent of the zone's area that is grassland and *AvgOrganicSoilMatter* is the factor score from the zone's average amount of Soil Organic Matter measured in grassland soil as of December 2016 (% organic matter per hectare furrow slice[8]).

Fishing Index:

$$\sqrt{SnapperExploitationRate\ \times CoastlineProportion}$$

Where *SnapperExploitationRate* is the factor score from the percent of total fish remaining and *CoastlineProportion* is the factor score from the length of the zone's coastline proportional to its total area.

[8] Hectare furrow slice = unit of area

Private Housing Index:

$$\sqrt[3]{\%Grassland \times CoastlineProportion \times (100 - ProbabilityFlood)}$$

Where *%Grassland* is the factor score from the percent of the zone's area that is grassland, *CoastlineProportion* is the factor score from the length of the zone's coastline proportional to its total area, and ProbabilityFlood is a dummy variable[9] of the zone's probability of flooding at least once over the next five years.

Conservation Index:

$$\sqrt[4]{\%Wetland \times DuckPopulaton \times HighAltitude \times (100 - PositiveSeaLevelSope)}$$

Where *%Wetland* is the factor score from the percent of the zone's area that is wetland, *DuckPopulation* is the factor score from the zone's duck population, *HighAltitude* is the factor score from the zone's altitude, and *PositiveSeaLevelSlope* is a dummy variable[10] if the zone's projected sea levels' expected values had a positive trend.

[9] A score of 100 was assigned if the probability of flooding was equal to or greater than 1% and 0 if the probability was less than 1%.
[10] A score of 100 was assigned if the zone's projected sea levels had a positive trend, measured by a linear slope function and 0 if the slope was negative.

Recreation Index:

$$\sqrt[3]{\frac{\%Grassland + \%Wetland}{2} \times CoastlineProportion \ \times (100 - ProbabilityFlood)}$$

Where *%Grassland* is the factor score from the percent of the zone's area that is grassland, *%Wetland* is the factor score from the percent of the zone's area that is wetland, *CoastlineProportion* is the factor score from the length of the zone's coastline proportional to its total area, and *ProbabilityFlood* is a dummy variable[11] of the zone's probability of flooding at least once over the next five years.

Other/Tourism Index:

$$\sqrt[5]{\%Grassland \times \%Forest \times SnapperExploitationRate \times CoastlineProportion \times HighAltitude}$$

Where *%Grassland* is the factor score from the percent of the zone's area that is grassland, *%Forest* is the factor score from the percent of the zone's area that is forest, *SnapperExploitationRate* is the factor score from the percent of total fish remaining, *CoastlineProportion* is the factor score from the length of the zone's coastline proportional to its total area, and *HighAltitude* is the factor score from the zone's altitude.

[11] A score of 100 was assigned if the probability of flooding was equal to or greater than 1% and 0 if the probability was less than 1%.

Appendix E – Opportunity Cost Table

The values in this table reflect the change in the output index is the zone allocation were to change from the maximum output. Green values reflect small decreases, yellow values reflect medium decrease, and red values reflect large decreases. In other terms, green values show low opportunity costs and red values show high opportunity costs.

Costal Zone	Agriculture	Fishing	Private Housing	Conservation	Recreation	Other/ Tourism
1	-37.63	-24.40	-0.74	-73.39	0.00	-14.75
2	-34.39	-22.11	0.00	-76.63	-1.77	-19.72
3	-52.02	-30.84	0.00	-89.52	-18.47	-89.52
4	-19.04	-13.68	-18.47	-67.94	0.00	-36.72
5	0.00	-38.56	-21.89	-68.97	-28.87	-47.83
6	0.00	-27.78	-11.26	-82.42	-24.71	-45.39
7	-44.79	-3.12	0.00	-52.59	-10.24	-47.51
8	-36.91	-5.55	0.00	-30.25	-3.99	-12.61
9	0.00	-41.15	-25.22	-49.74	-32.61	-37.96
10	-11.76	-1.81	0.00	-50.96	-17.02	-45.48
11	0.00	-11.21	-12.48	-32.36	-12.89	-14.28
12	0.00	-12.49	-2.97	-34.83	-14.14	-26.72
13	-0.47	-4.99	0.00	-21.94	-2.52	-5.77
14	-3.77	-4.56	-4.12	-5.05	0.00	-18.59
15	-17.87	-1.19	0.00	-9.34	-3.61	-34.31
16	-8.96	-3.18	-71.93	0.00	-71.93	-71.93
17	-8.20	0.00	-4.44	-21.42	-19.79	-44.97
18	-2.23	-2.67	0.00	-2.47	-15.15	-54.46
19	-14.91	-1.07	0.00	-47.02	-19.54	-57.86
20	0.00	-8.58	-4.16	-55.62	-22.01	-54.65