Sea Levels, Honolulu, Guam, and Key West
09/25/2025

The most server effect of the climate change is the rise in sea level. Coast areas will suffer from frequent floods and small islands may become completely submerged under the water. The impact to the livelihood in these communities can be devastating.

University of Hawaii's "Sea Level Center" keeps a repository of decades of sea level measurements across the globe. This article uses some of the measurement data and attempts to make forecasts of the sea levels at these locations for the next ten years. The locations selected are Honolulu, HI, Guam, and the Key West, FL. Figure 1 shows the raw measurements at Honolulu (data file 057).

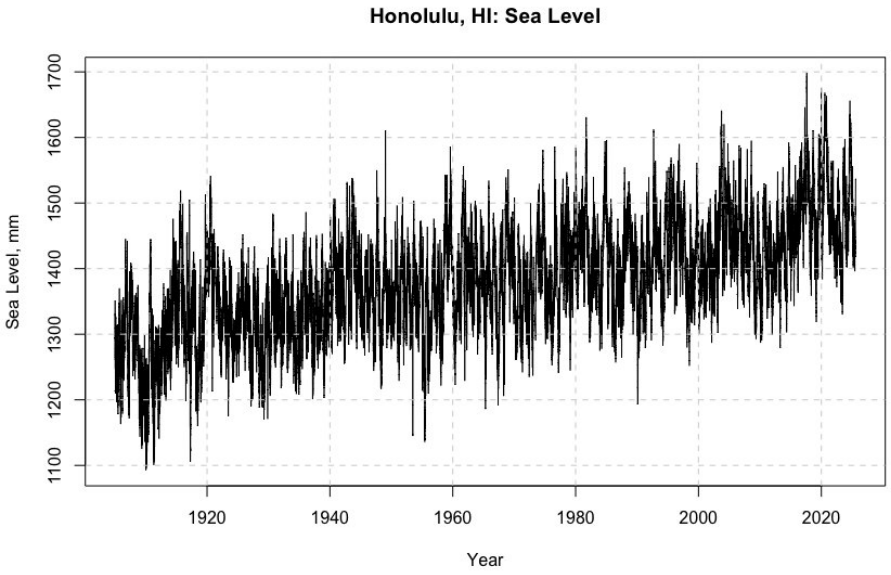

Figure 1, Sea Level Measurements at Honolulu, HI.

These measurements are reported daily. To make the data suitable for the forecast models, the data are averaged within a year after removing invalid (negative) readings.

ARIMA Models

Figure 2 shows an ARIMA(2,1,1) model using the Honolulu data (data file 057) from 1905 to 2015 and the forecast sea levels of 2015 through 2025 (blue line with the prediction intervals) against the actuals (red line).

Figure 3 shows an ARIMA(0,1,1) model using the Guam data (data file 053) from 1948 to 2015 and the sea level forecast results of 2015 through 2025 with the prediction intervals.

Figure 4 shows an ARIMA(0,1,2) model using the Key West data (data file 242) from 1948 to 2015 and the sea level forecast results of 2015 through 2025 along with the prediction intervals.

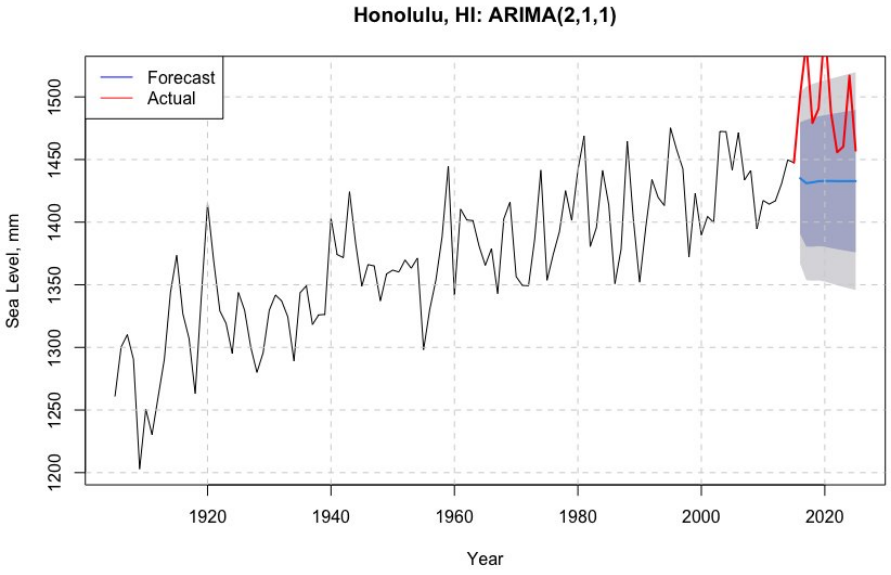

Figure 2, ARIMA Model of Honolulu, HI Sea Level.

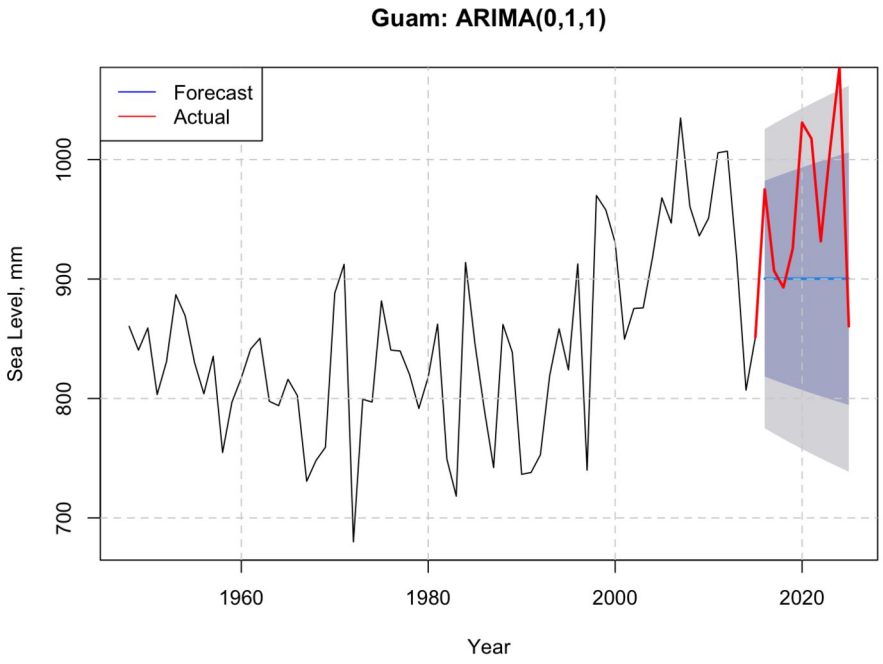

Figure 3, ARIMA Model of Guam Sea Level.

The forecast models show that that the Honolulu sea level will be between 1382 and 1569 mm in 2035, the Guam sea level between 804 and 1120 mm in 2035, and the Key West sea level between 1748 and 1889 mm in 2035. The average sea level increases are 13 mm (Honolulu), 0 mm (Guam), and 44 mm (Key West), respectively.

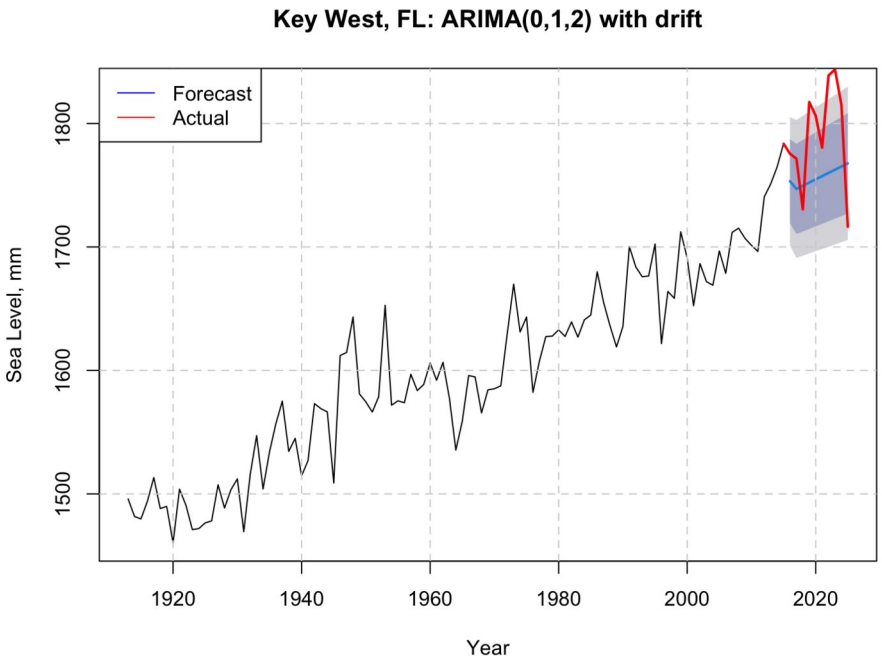

Figure 4, ARIMA Model of Key West, FL Sea Level.

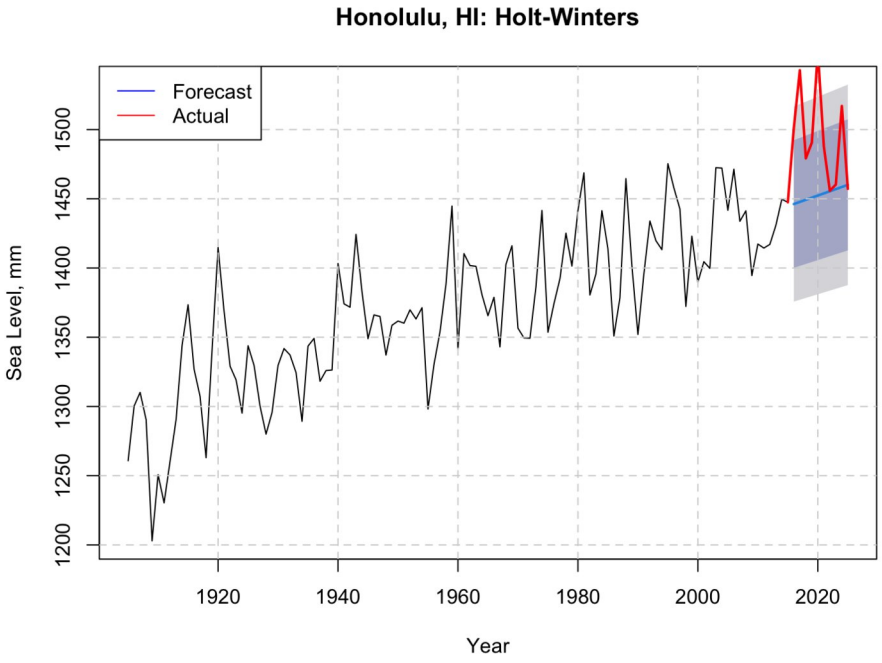

Figure 5, Holt-Winders Model of Honolulu, HI Sea Level.

Holt-Winters Models

Figures 5 through 7 show the Holt-Winters models using the Honolulu data, Guam data, and Key West data, respectively.

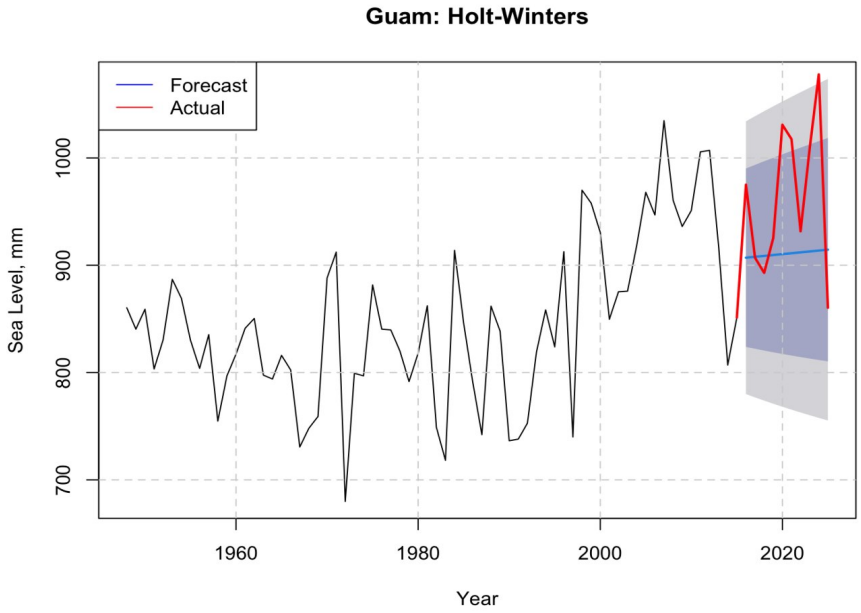

Figure 6, Holt-Winders Model of Guam Sea Level.

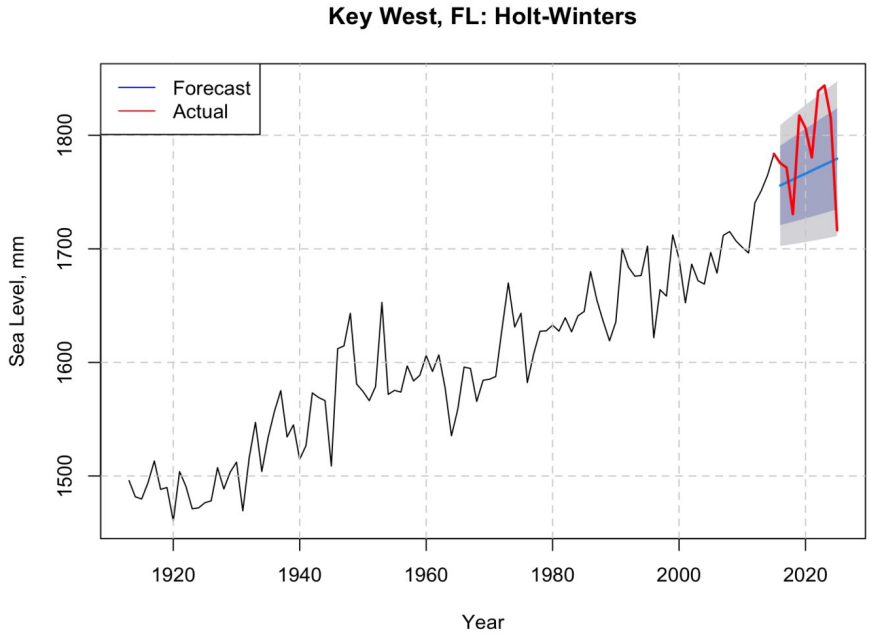

Figure 7, Holt-Winders Model of Key West, FL Sea Level.

The models show that the Honolulu sea level will be between 1426 and 1576 mm in 2035, the Guam sea level between 831 and 1135 mm in 2035, and the Key West sea level between 1746 and 1894 mm in 2035. The average sea level increases are 16 mm (Honolulu), 15 mm (Guam), and 25 mm (Key West), respectively.

Apparently, among these locations, Key West will experience the most rise in the sea level. This may have something to do with the locations of Honolulu and Guam, both are located close to a volcanic belt and the ground geology may change along with the volcanic activities. On the contrary, Key West is far away from volcanic activities and the ground is relative quiet. Therefore the sea level measured at Key West may be more representative of the global sea level changes.

Appendix R Script

```
library(dplyr)

input=function(fn)
{y=read.table(fn,header=F,sep=",");data.frame(date=y[,1]+(y[,2]-
1)/12+y[,3]/365,level=y[,4])}
# Load data
loc="Honolulu, HI:"
#loc="Guam:"
#loc="Key West, FL:"
df_data0=input("d053.csv")
df_data=df_data0[df_data0$level>0,]
df_data$yr=floor(df_data$date)
df_sea <- df_data %>%
  group_by(yr) %>%
  summarise(
    avg = mean(level),
  )
ts_data=ts(df_sea$avg,start=df_sea$yr[1],end=df_sea$yr[nrow(df_s
ea)])
```

Figure 6 R Script Used for Preparing the Time Series from the Measurements using the Powerful dplyr Library