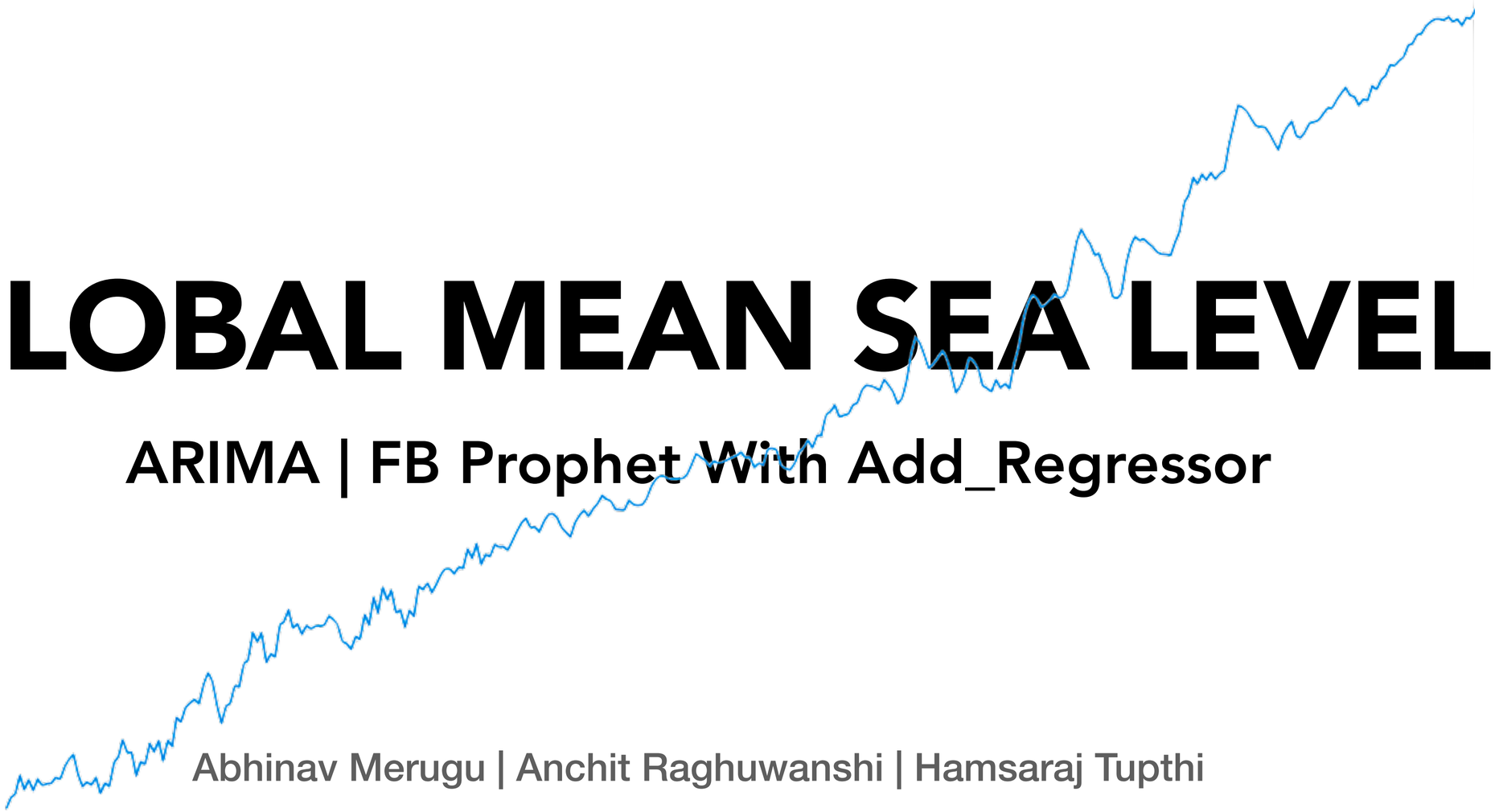
CSCI 611 ACV

GLOBAL MEAN SEA LEVEL

ARIMA | FB Prophet With Add_Regressor



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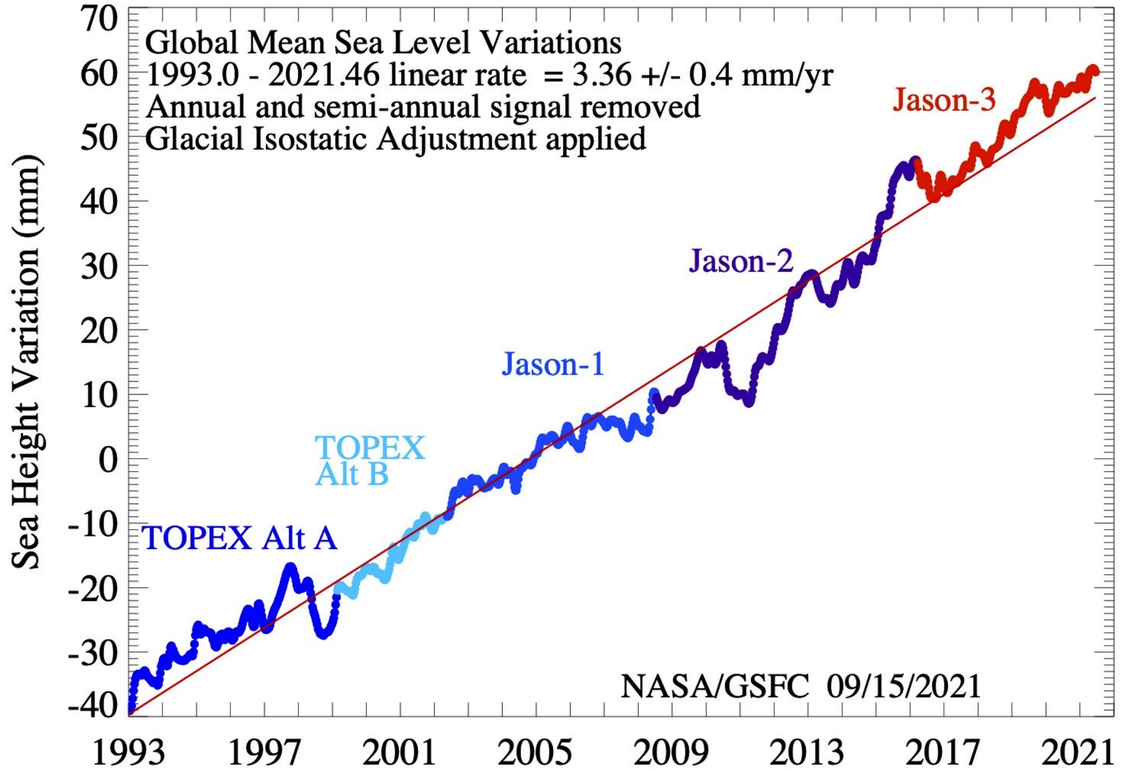
Global Mean Sea Level Variation

What is the variation of height?

- Find future values of co2ppm and global temperature anomalies.
- Find right hyperparameters.



Datasets

Sources of datasets used

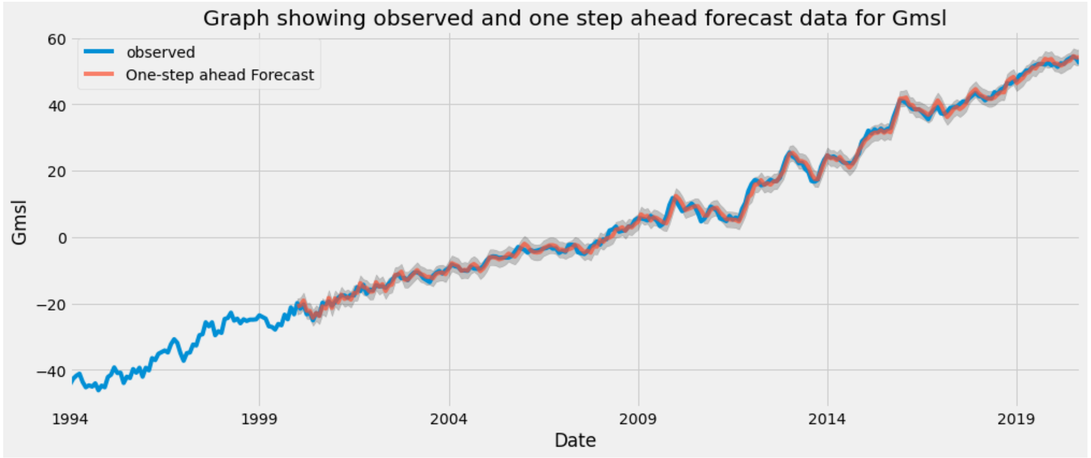
- Global Mean Sea Level Variations: S Environmental Protection Agency using data from CSIRO, NOAA.
- Global Temperature Anomalies: NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series, published May 2022, retrieved on May 16, 2022 from https://www.ncdc.noaa.gov/cag/
- CO2: Dr. Pieter Tans, NOAA/GML (gml.noaa.gov/ccgg/trends/) and Dr. Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu/).

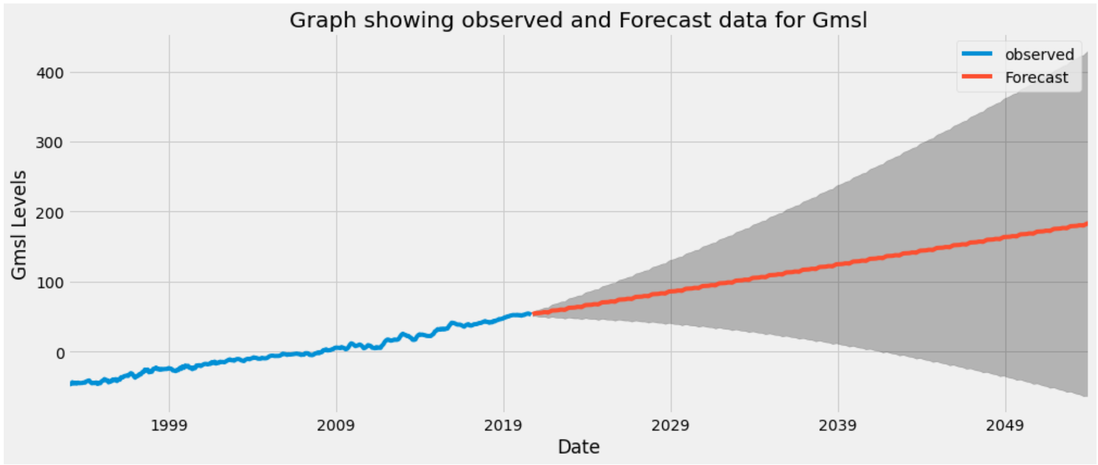
	Date	Gmsl	Co2ppm	Gt_anomalies
0	1993-01-01	-48	356.37	0.36
1	1993-02-01	-46.6	356.4	0.38
2	1993-03-01	-46.3	356.51	0.41
3	1993-04-01	-43.8	356.66	0.31
4	1993-05-01	-45.7	356.72	0.35
5	1993-06-01	-44.4	356.69	0.33
6	1993-07-01	-45.8	356.75	0.27
7	1993-08-01	-44.3	356.91	0.22
8	1993-09-01	-45.2	357.06	0.18
9	1993-10-01	-44.9	357.18	0.22
10	1993-11-01	-44.9	357.3	0.07
11	1993-12-01	-44.1	357.48	0.27
12	1994-01-01	-44.4	357.62	0.27
13	1994-02-01	-42.7	357.86	0.08
14	1994-03-01	-41.8	357.91	0.38
15	1994-04-01	-41.2	357.92	0.36
16	1994-05-01	-43.7	358.06	0.4
17	1994-06-01	-45.3	358.11	0.4
18	1994-07-01	-44.7	358.27	0.31
19	1994-08-01	-45.1	358.56	0.3
20	1994-09-01	-44.1	358.67	0.33
21	1994-10-01	-46.2	358.8	0.42

ARIMA

Requirements and Implementations

- Only requires the prior data of a time series to generalize the forecast.
- Performs well on short term forecasts.
- Models non-stationary time series.



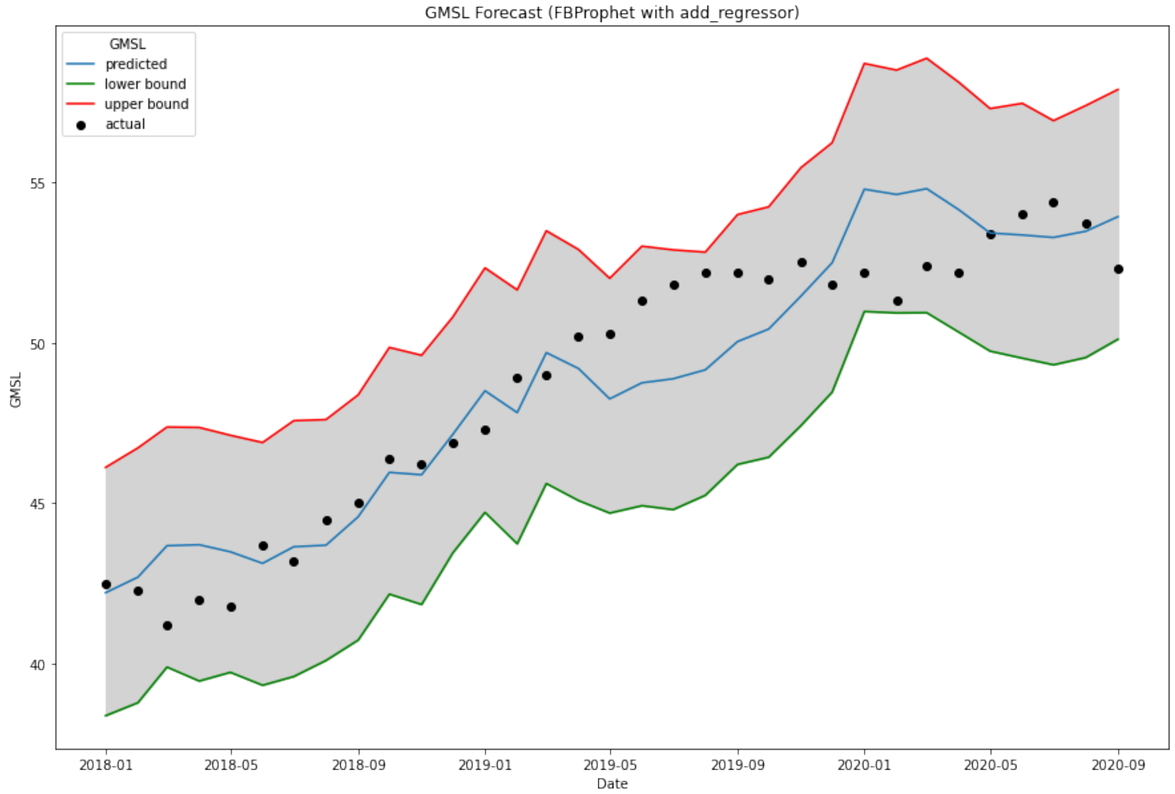


ARIMA(p,d,q)
p is the auto-regressive part of the model
d is the integrated part of the model
q is the moving average part of the model
Generate all different combinations of p, q and q triplets

FB Prophet

With add_regressor

- No data pre-processing necessary.
- Flexibility: We can easily accommodate seasonality with multiple periods and let the analyst make different assumptions about trends.Verify model accuracy visually with lower and upper bound plotting.
- Tune change point priority scale for better fitting, trying to avoid overfitting and underfitting.
- Doesn’t need prior experience with forecasting.



$$y(t) = g(t) + s(t) + h(t) + \epsilon_t.$$

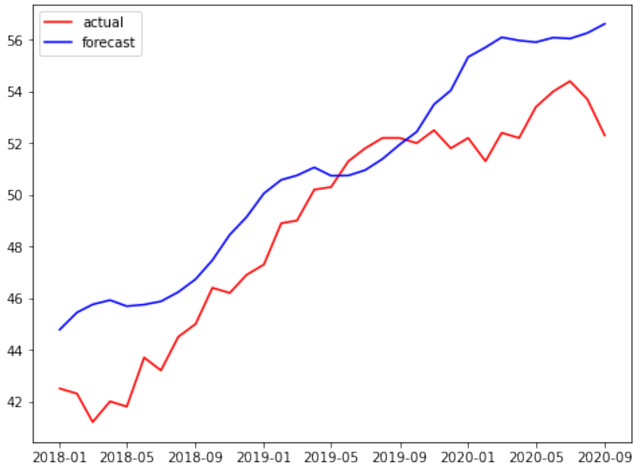
- g(t) is the trend function which models non-periodic changes in the value of the
- time series.
- s(t) represents periodic changes (e.g., weekly and yearly seasonality), and
- h(t) represents the effects of holidays which occur on potentially irregular schedules over one or more days.
- e(t) represents any idiosyncratic changes which are not
- accommodated by the mode.

Challenges

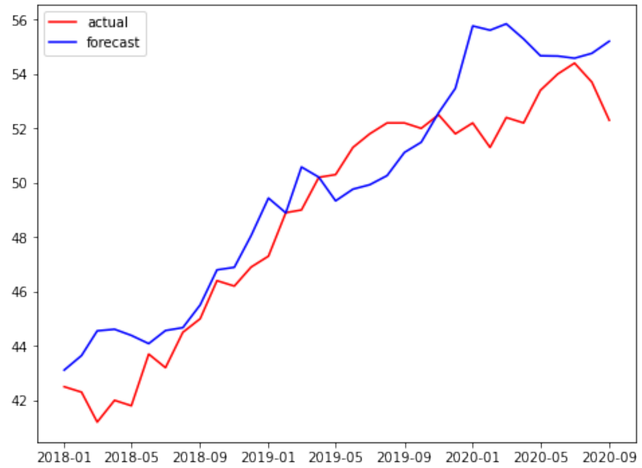
Dataset & Model

- Small dataset.
- Choosing right model.
- ARIMA Vs. FB Prophet
- Hyperparameters.
- Future values if chose add_regressor.
- Evaluation.

No add_regressor



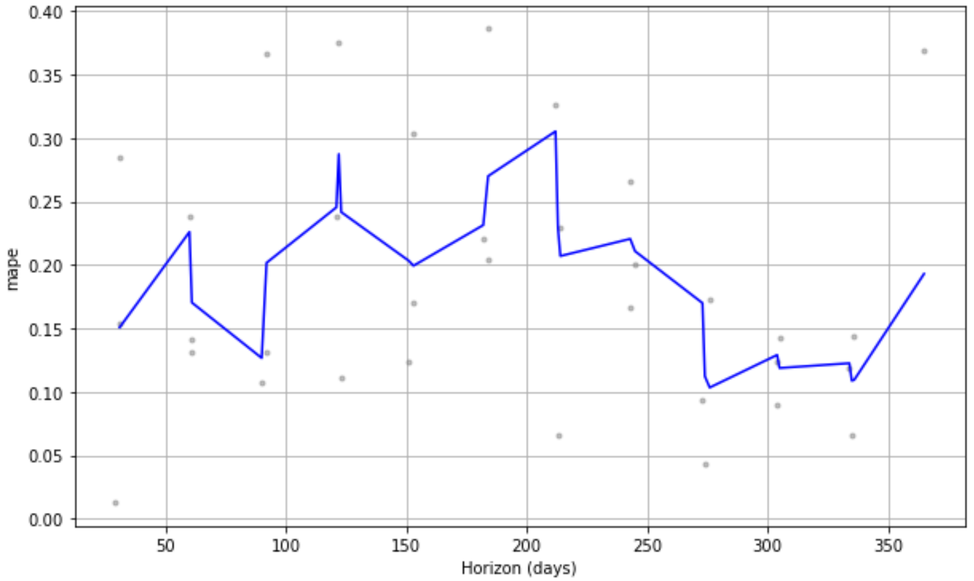
add_regressor



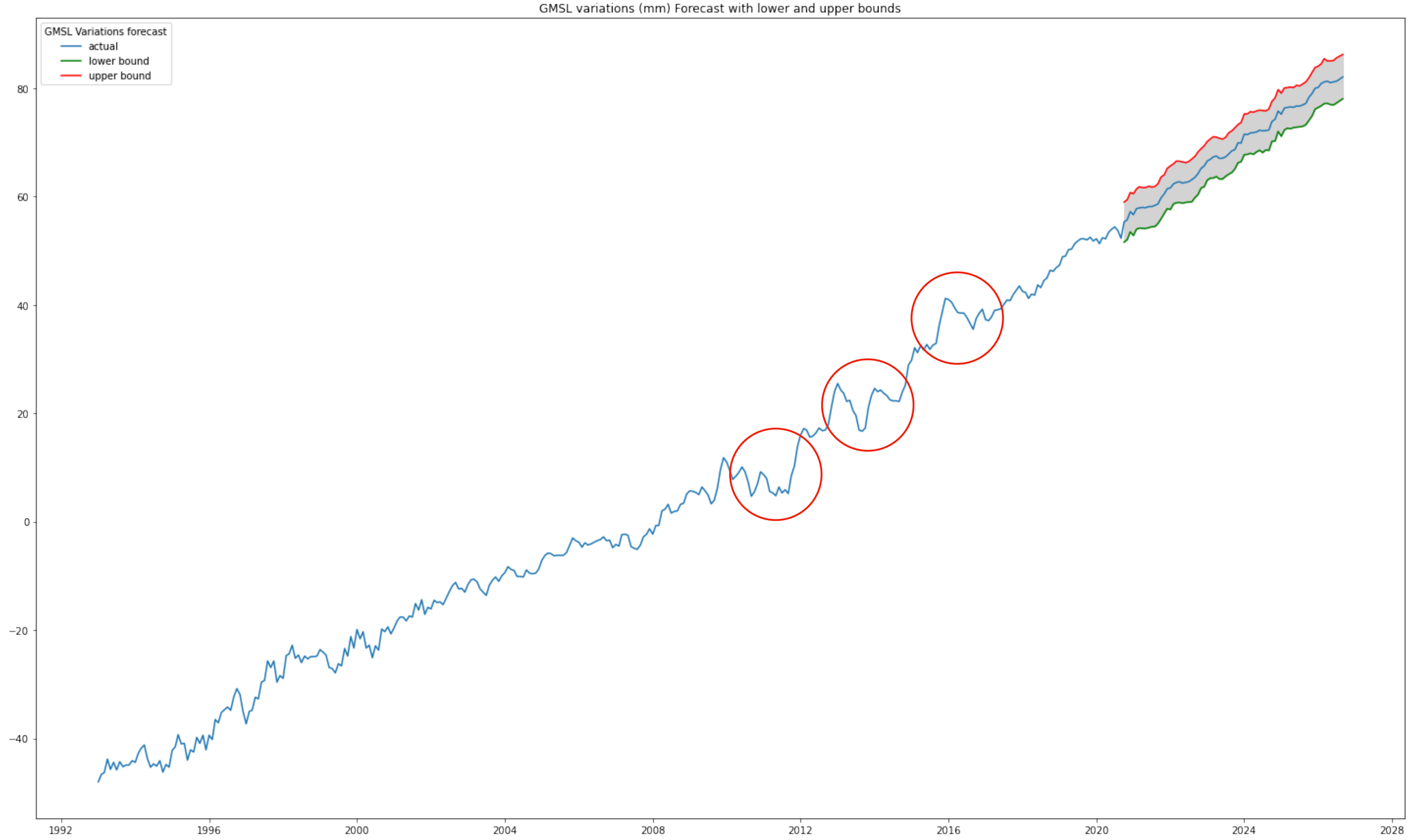
Evaluation

Cutoffs and Horizon

- **Mse:** Mean absolute error.
- **Rmse:** Mean squared error.
- **Mae:** Mean average error.
- **Mape:** Mean average percentage error.
- **Mdape:** Median average percentage error.



horizon	194 days 02:00:00
mse	6.209608
rmse	2.317222
mae	1.884162
mape	0.136569
mdape	0.126251
coverage	0.805556


GMSL variations (mm) Forecast with lower and upper bounds
GMSL Variations forecast
actual
lower bound
upper bound
80
60
40
20
0
−20
−40
1992
1996
2000
2004
2008
2012
2016
2020
2024
2028

Implications

What does our study imply

- Upward trend and usually increases around every January.
- GMSL variation is dependent on other factors such as CO2 and Global Temperature.
- GMSL variation is increasing every month with ~4mm each year.
- Nature is unpredictable but technology can help in avoiding natural calamities.