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Earthquakes Risk Modelling with Quantile Approach

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Github repository:
https://github.com/claudio1975/Earthquakes_Risk_Modelling

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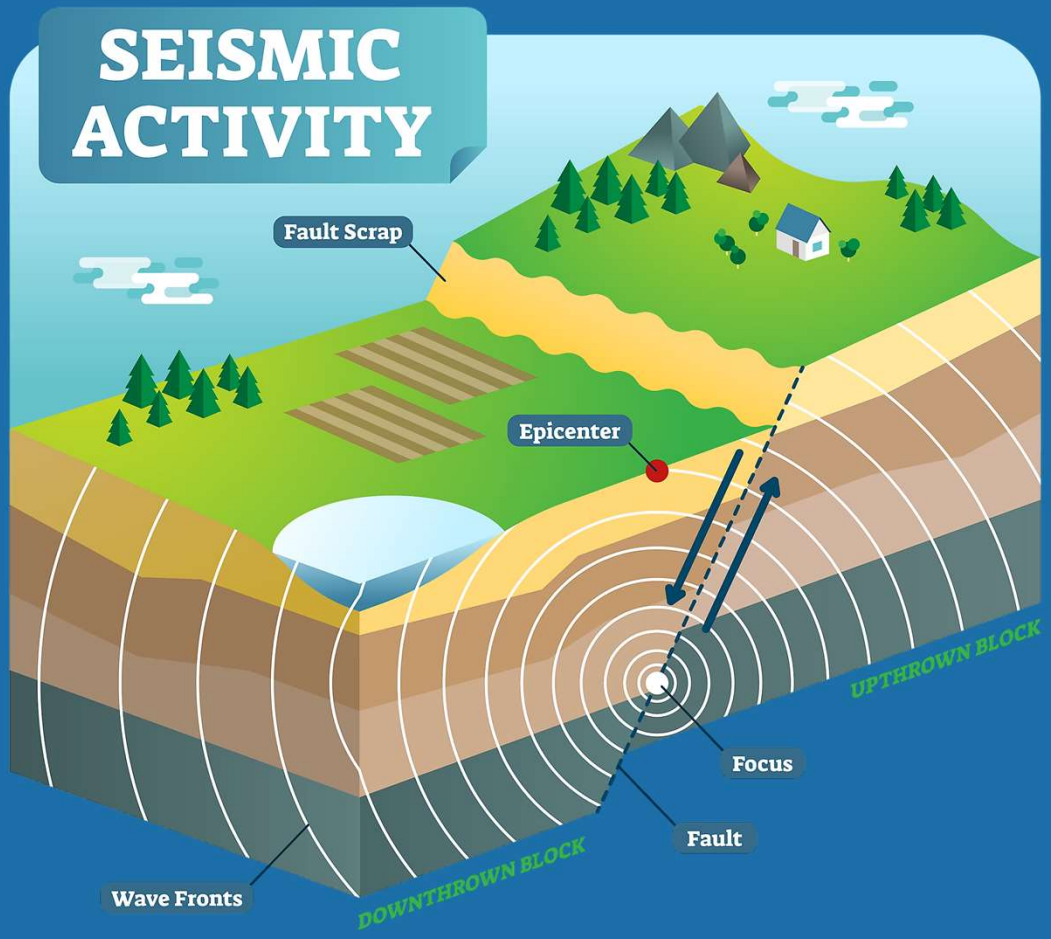

Some questions to understand the earthquake event:

-What is an earthquake and how does it work?

-Why does it happen?

-Why Insurance Companies are interested in study the event?

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A really short introduction of Quantile Regression

Quantile regression is a statistical method that estimates the relationship between a response variable and one or more predictor variables at different quantiles of the response distribution. Unlike mean regression, which estimates the conditional mean of the response variable given the predictor variables, quantile regression estimates the conditional quantiles of the response variable.

Mean regression

$$Q(\beta) = \sum_{i=1}^{n} (y_i - x_i\beta)^2 = \sum_{i=1}^{n} e_i^2$$

Median regression

$$Q(\beta) = \sum_{i=1}^{n} |y_i - x_i\beta| = \sum_{i=1}^{n} |e_i|$$

Quantile regression

$$Q(\beta_q) = \sum_{i=1}^{n} q|y_i - x_i\beta| + \sum_{i=1}^{n} (1-q)|y_i - x_i\beta|$$

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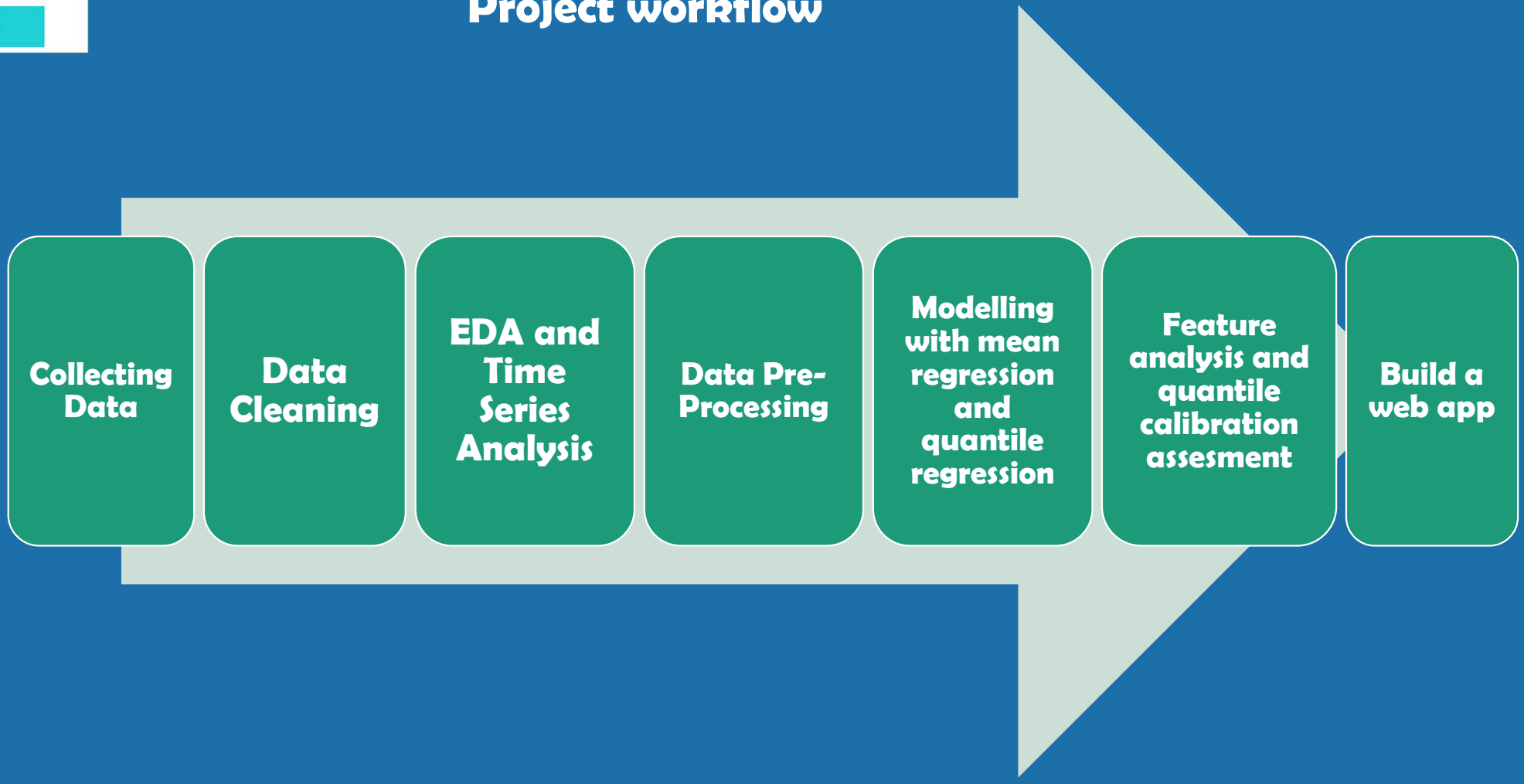
Project workflow



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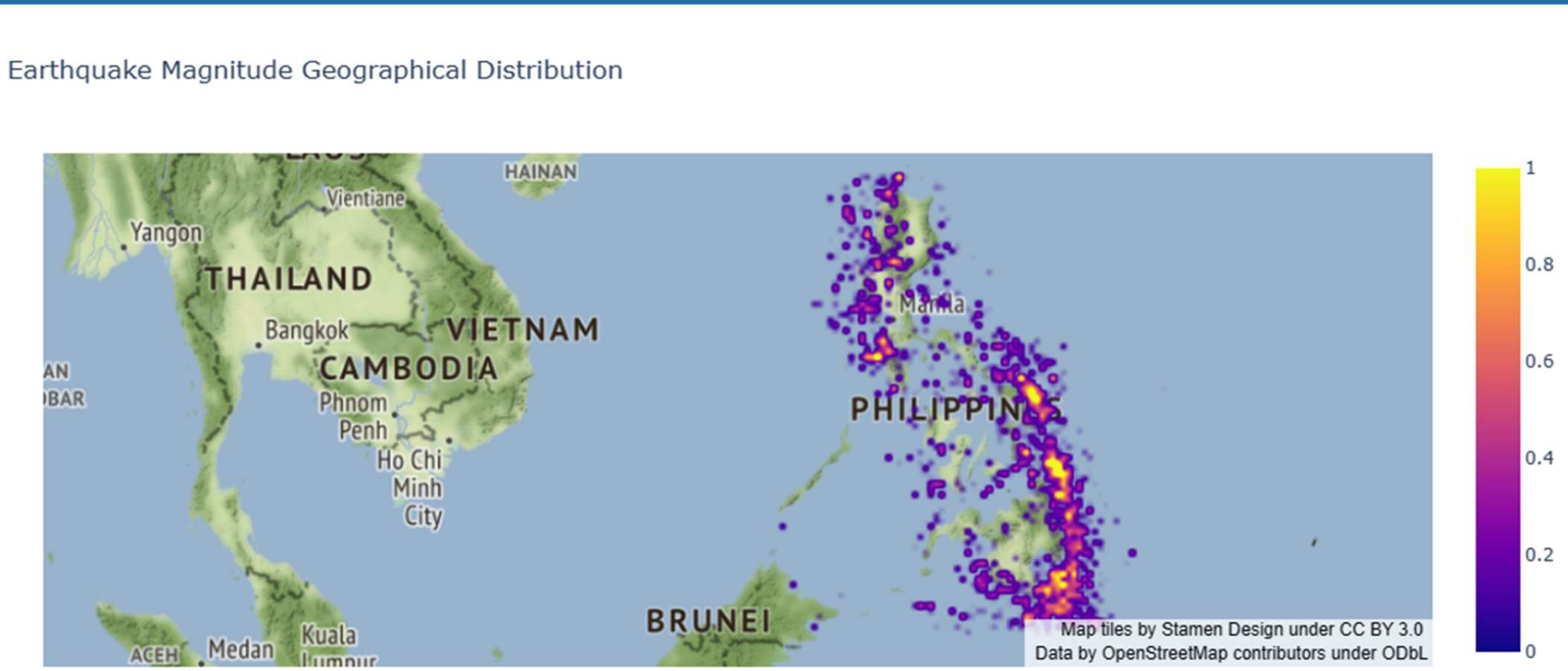
Use case: Predict Magnitude Philippine Earthquakes



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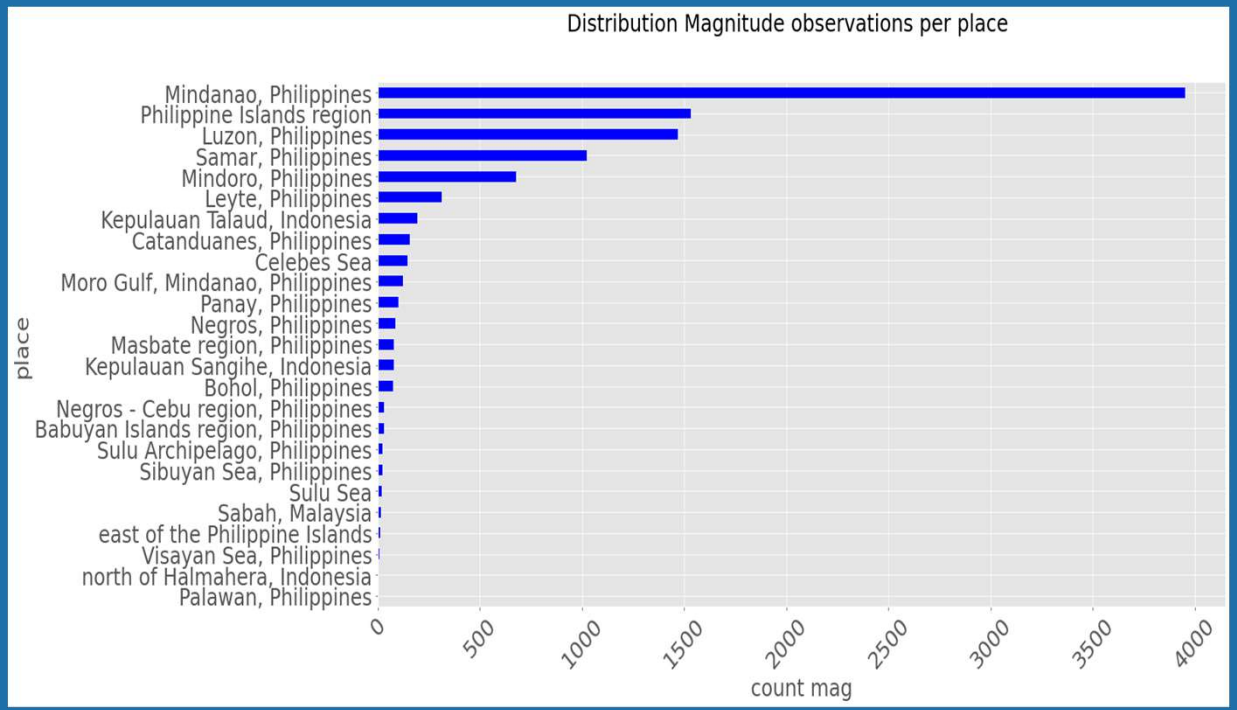
Data Set Structure

Columns	Dtype	Count
Latitude	num	10188
Longitude	num	10188
Depth	num	10188
Mag	num	10188
MagType	cat	10188
Place	cat	10188
Type	cat	10188
LocationSource	cat	10188
MagSource	cat	10188



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Data Analysis

Min Magnitude per place

	place	mag	depth	year	month	day	hour
0	Samar, Philippines	3.0	33.0	1998	4	22	19
1	Philippine Islands region	3.1	10.0	1992	4	3	19
2	Luzon, Philippines	3.2	10.0	1994	6	9	7
3	Mindanao, Philippines	3.3	33.0	1997	11	27	20
4	Mindanao, Philippines	3.3	85.8	1988	5	4	4
5	Celebes Sea	3.3	390.3	2007	3	4	14
6	Panay, Philippines	3.4	119.0	1986	2	9	16
7	Luzon, Philippines	3.4	73.4	2008	8	25	20
8	Philippine Islands region	3.5	33.0	1998	3	25	22
9	Luzon, Philippines	3.5	5.0	1993	6	26	6

Max Magnitude per place

	place	mag	depth	year	month	day	hour
0	Mindanao, Philippines	6.1	104.0	1980	2	29	11
1	Mindanao, Philippines	6.0	63.0	1980	1	2	20
2	Mindanao, Philippines	6.0	33.0	1989	12	15	18
3	Philippine Islands region	6.0	145.0	1981	5	13	1
4	Bohol, Philippines	6.0	644.5	1981	9	4	11
5	Moro Gulf, Mindanao, Philippines	5.9	583.5	2003	5	26	23
6	Catanduanes, Philippines	5.9	33.0	1982	1	11	6
7	Mindanao, Philippines	5.9	49.0	1980	4	13	5
8	Mindanao, Philippines	5.9	178.0	1980	7	8	4
9	Mindanao, Philippines	5.8	114.0	1980	1	3	20

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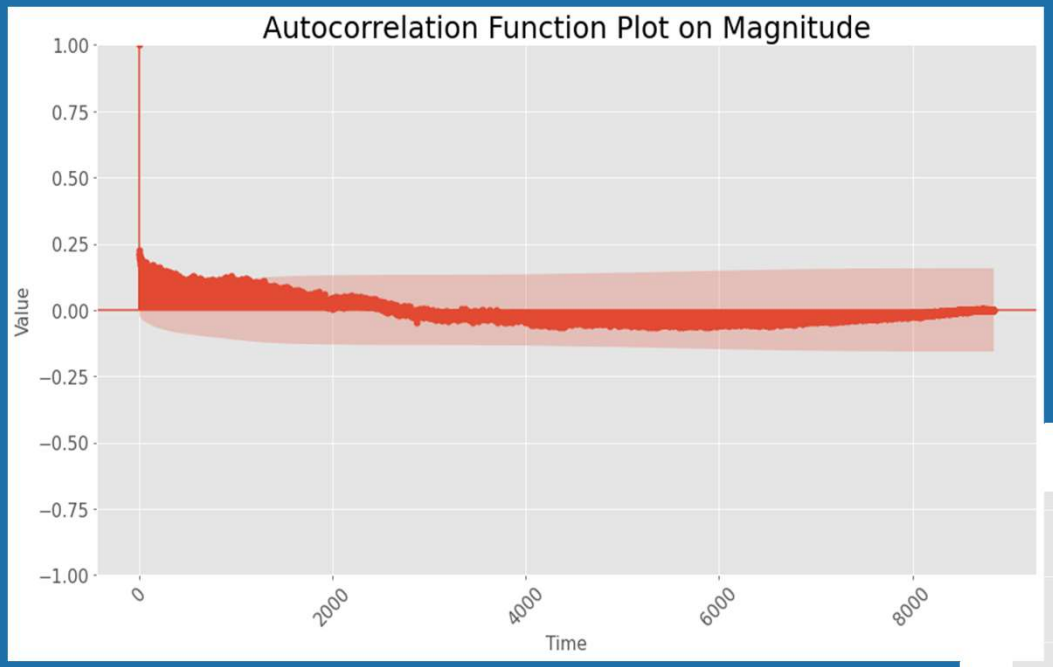
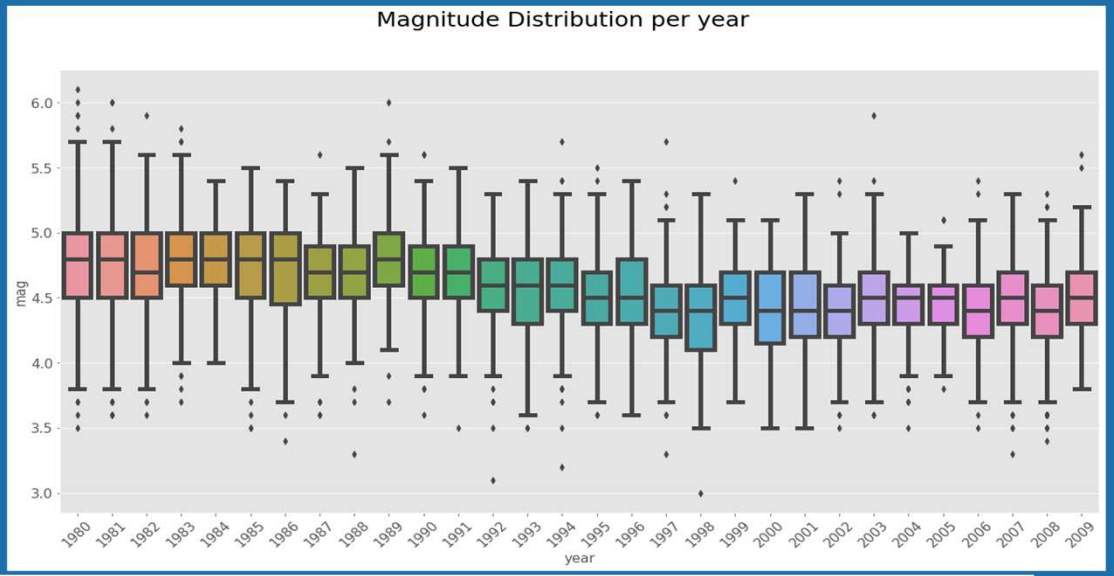
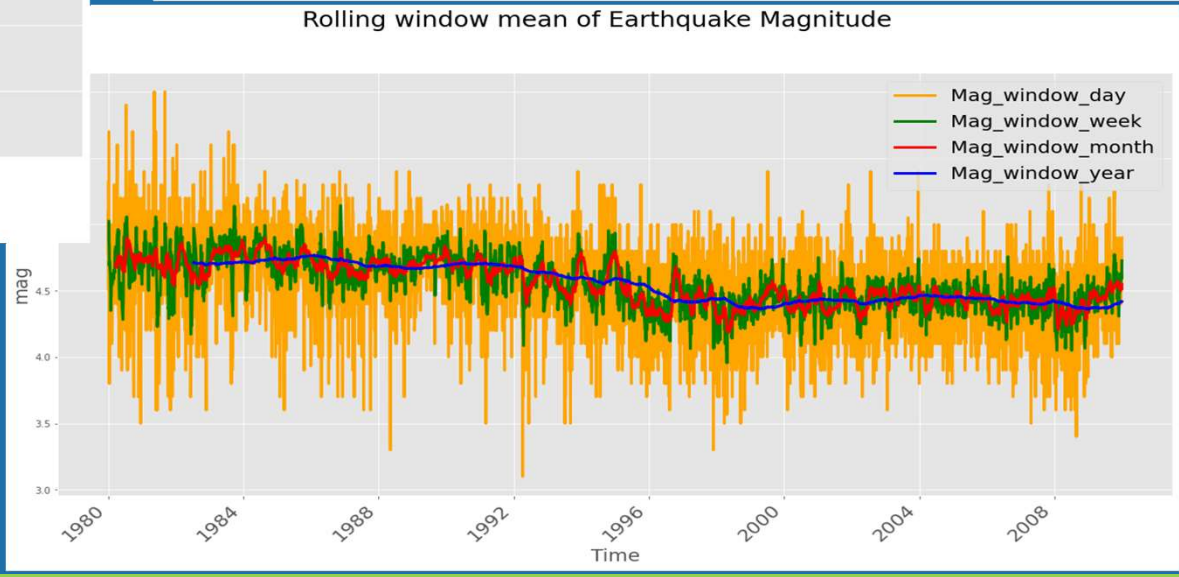
Time Series Analysis







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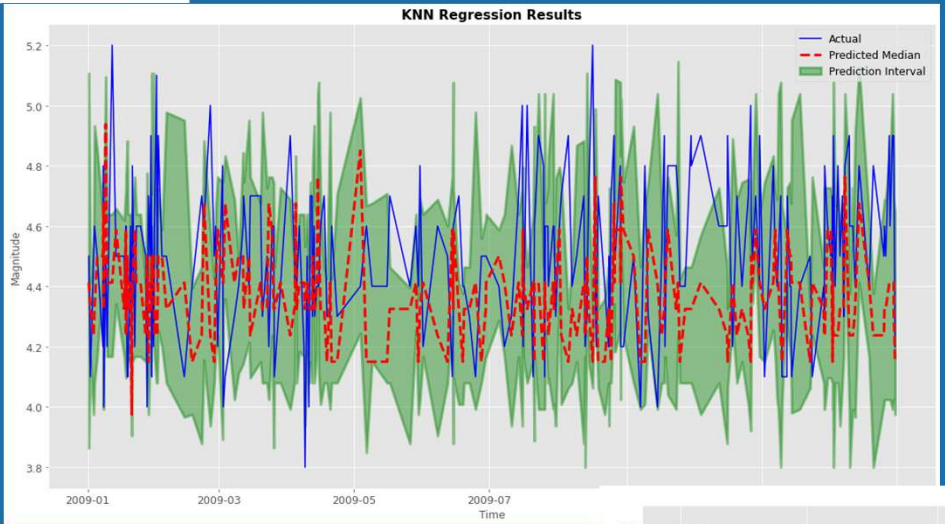
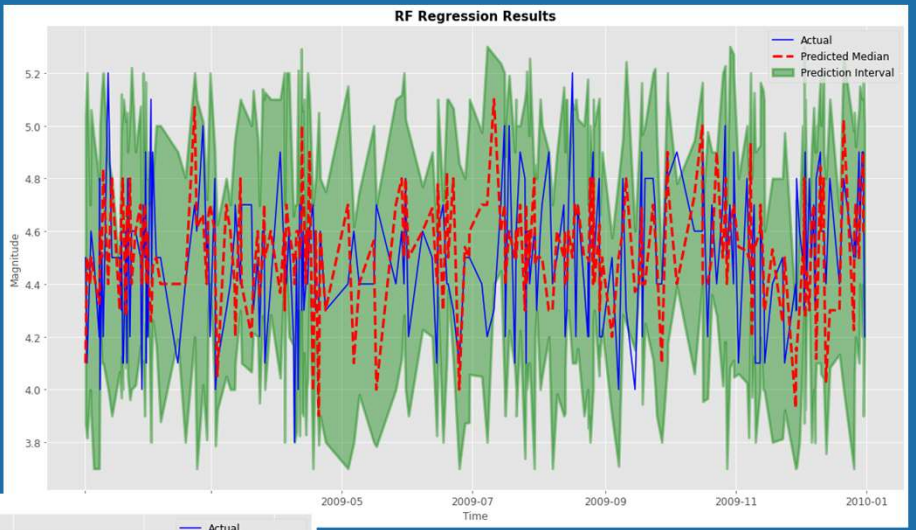
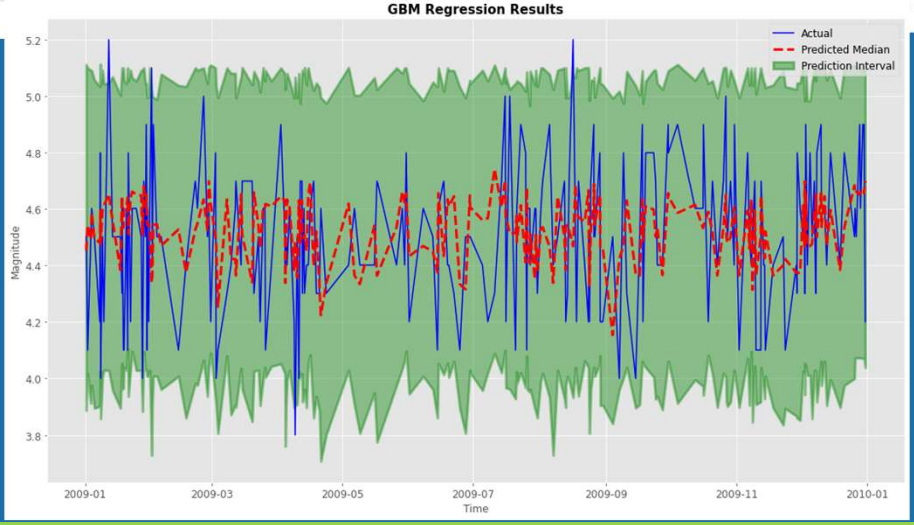
Projection Results







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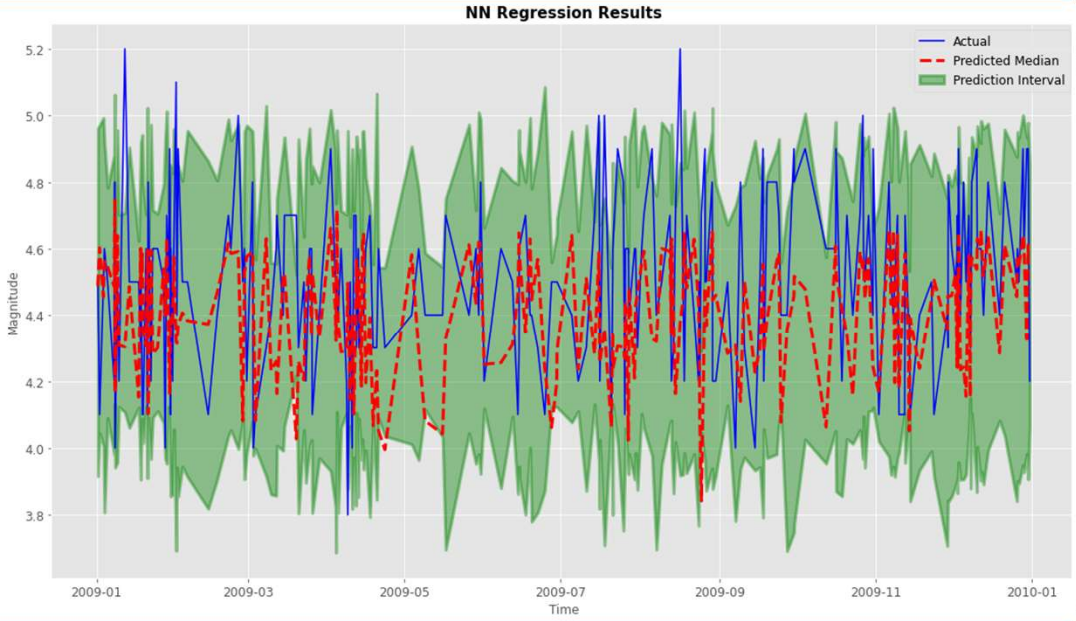

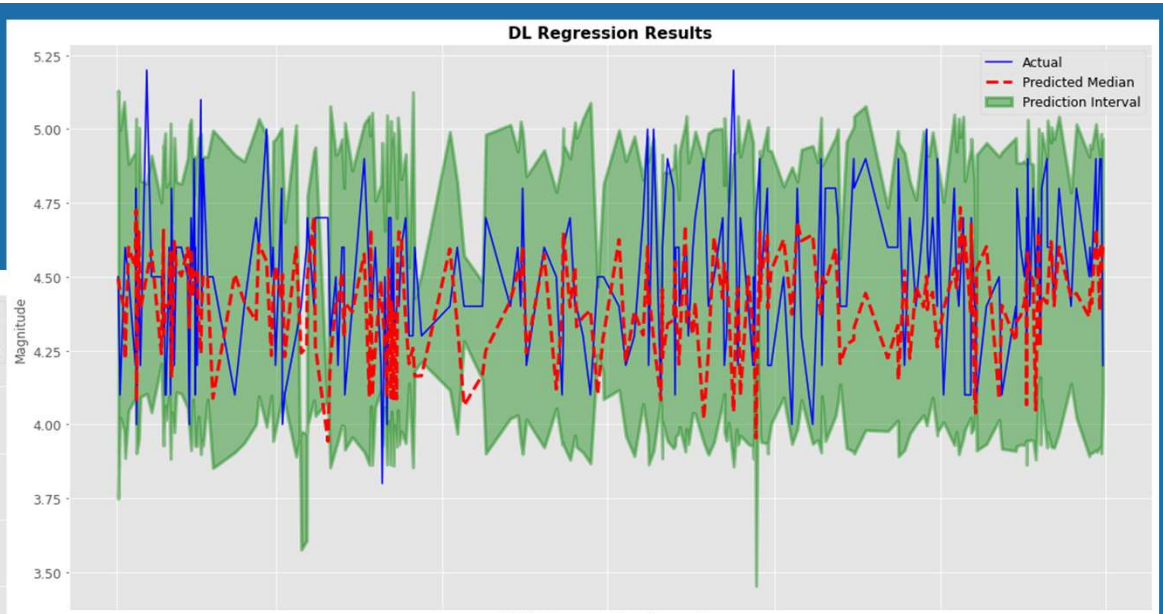

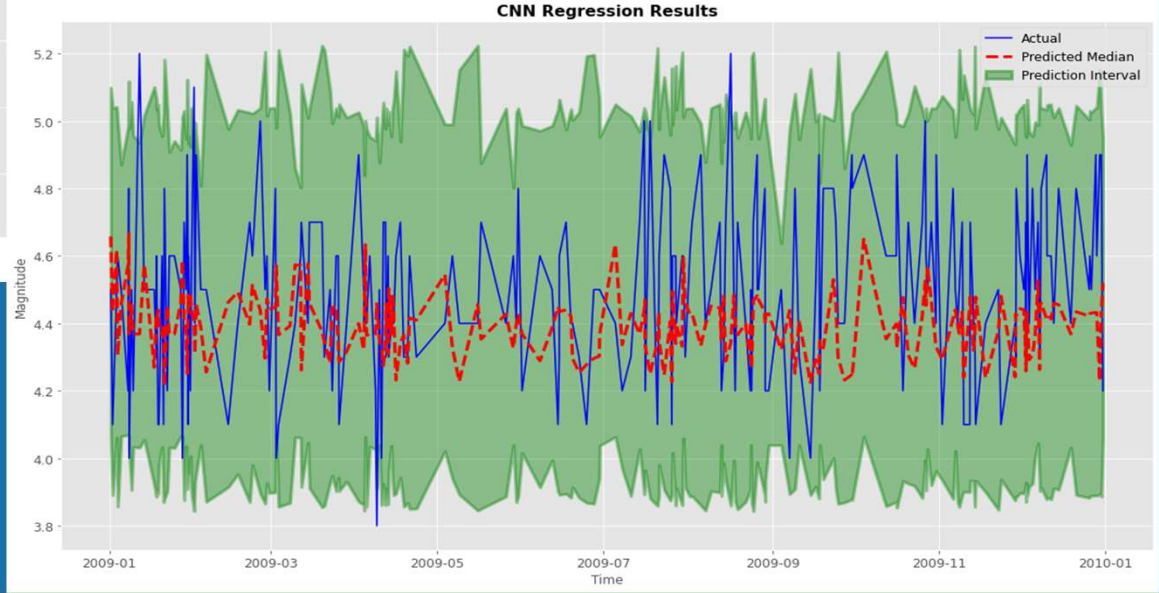

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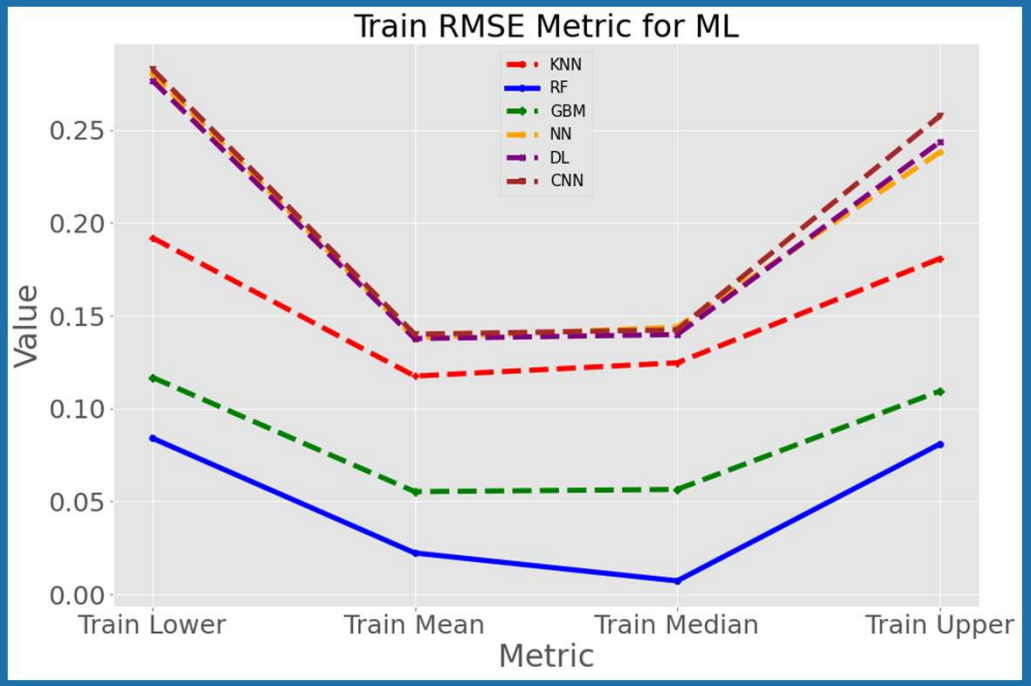
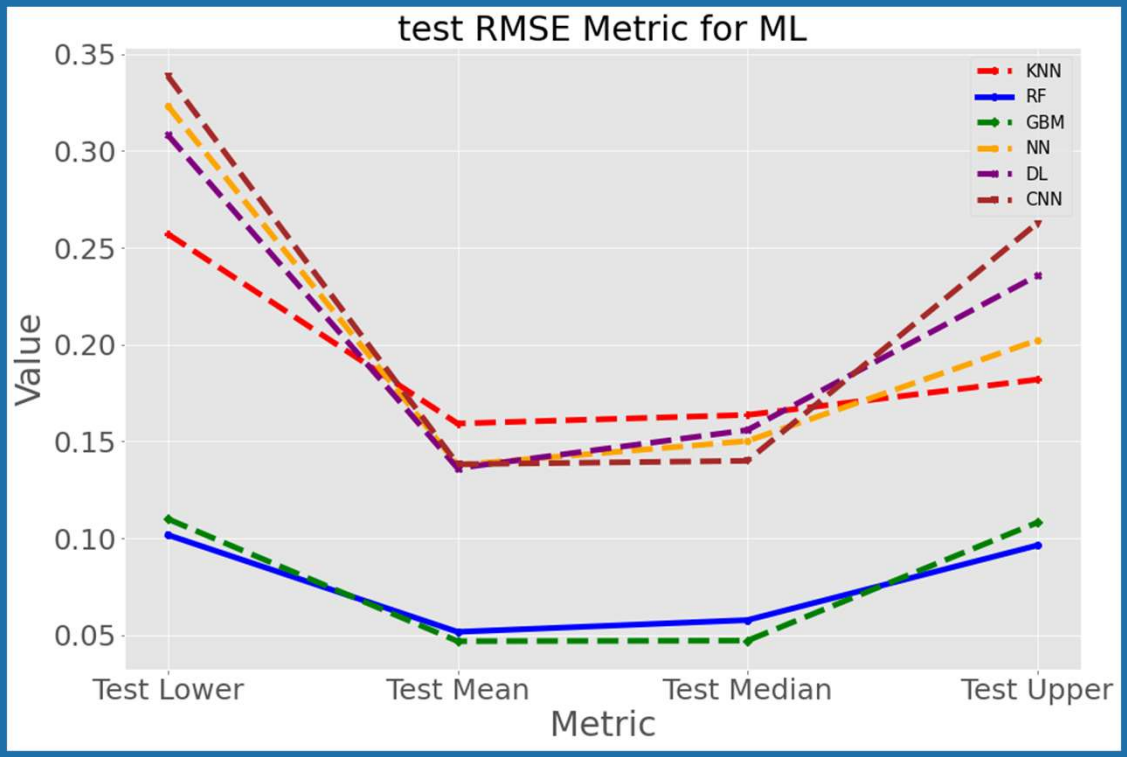
Evaluation Results





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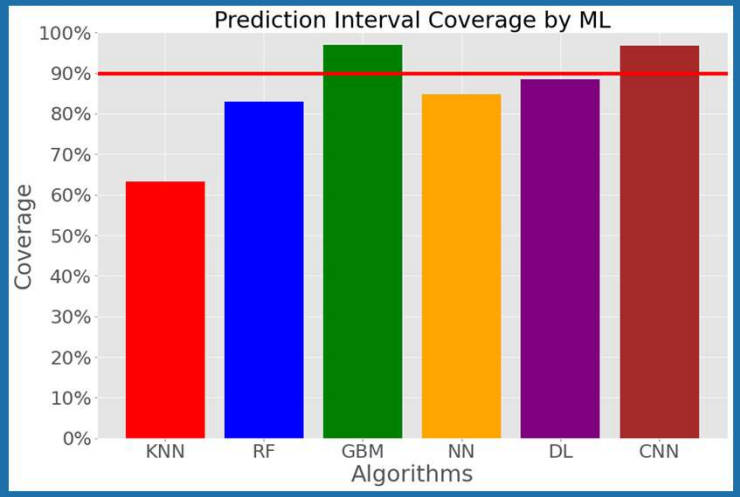
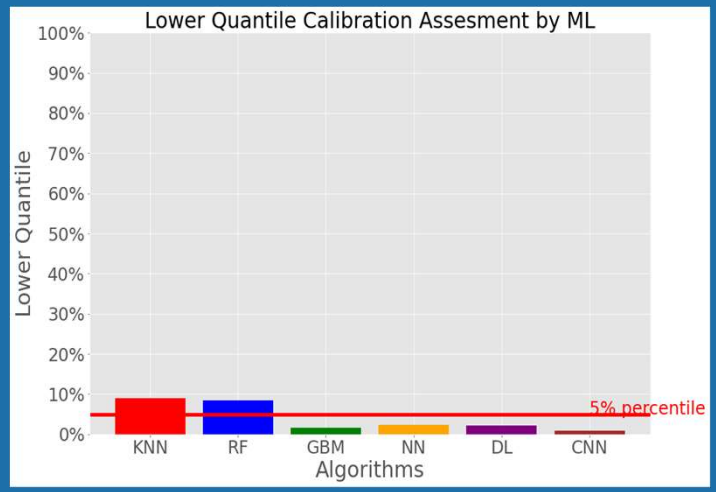
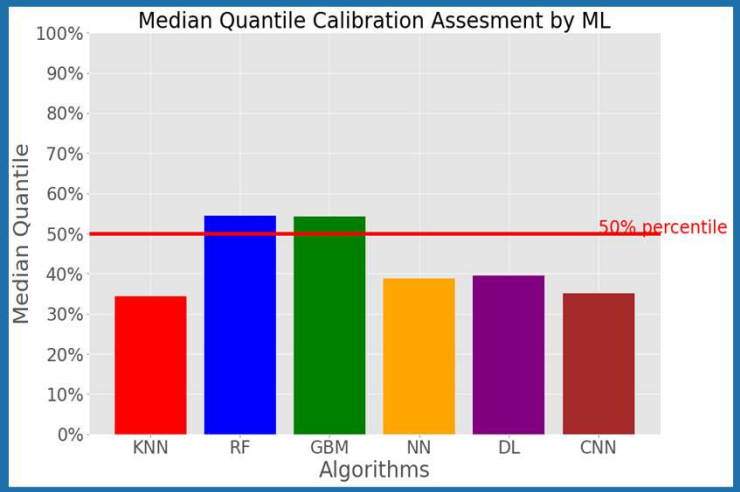
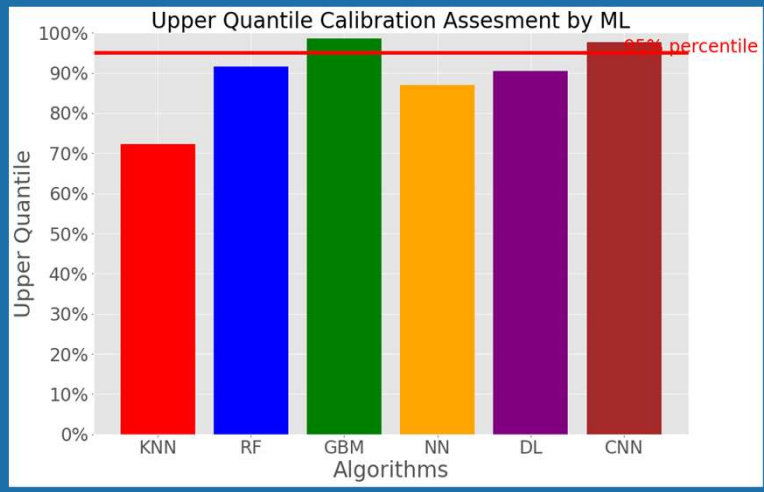
Quantile Calibration Assesment









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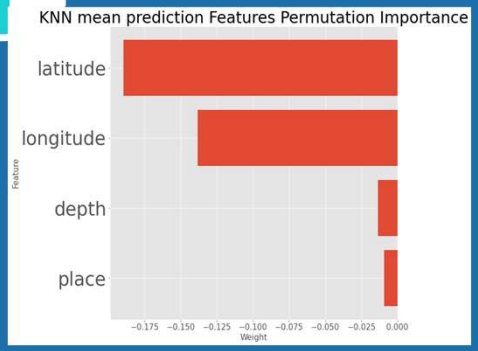
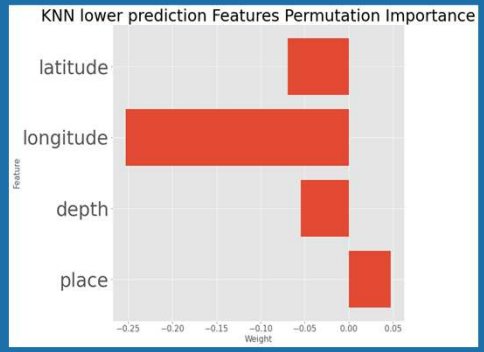
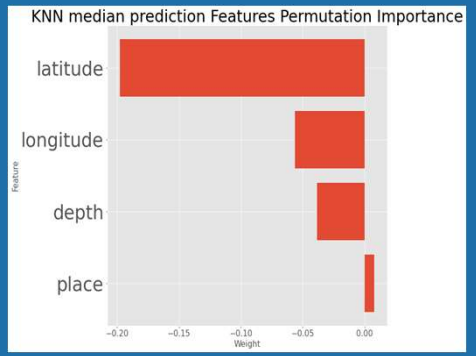
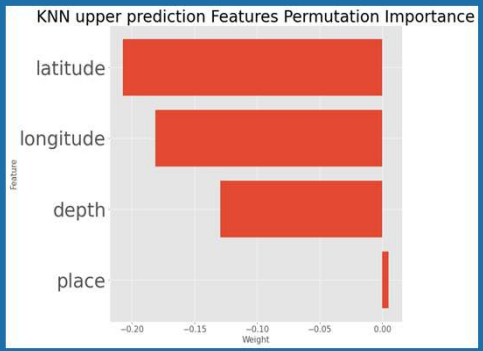
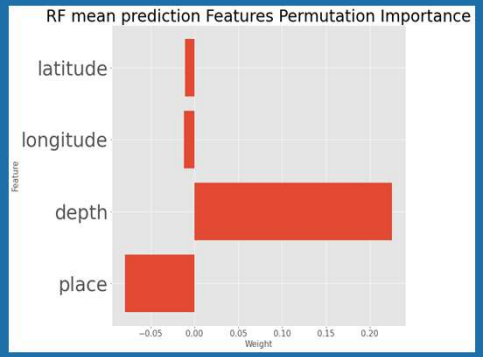
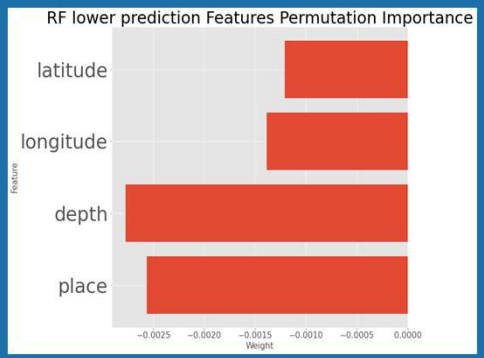
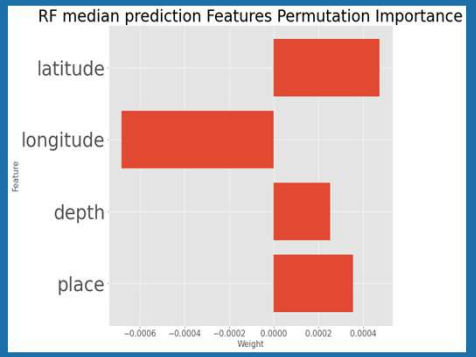
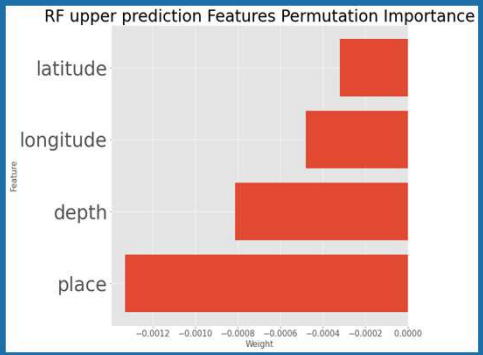
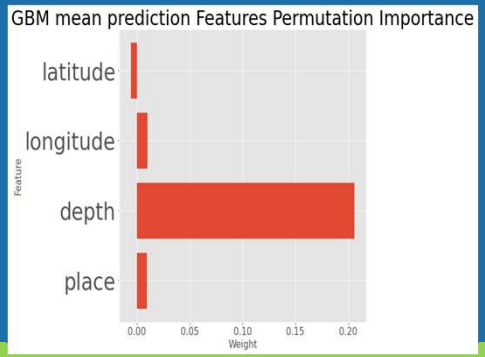
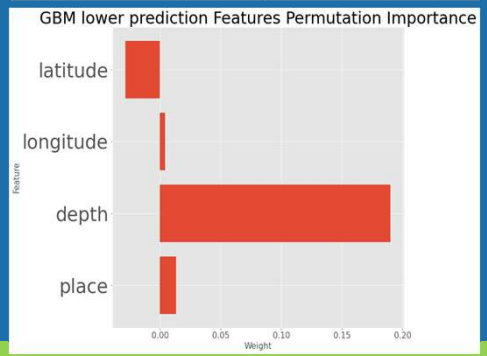
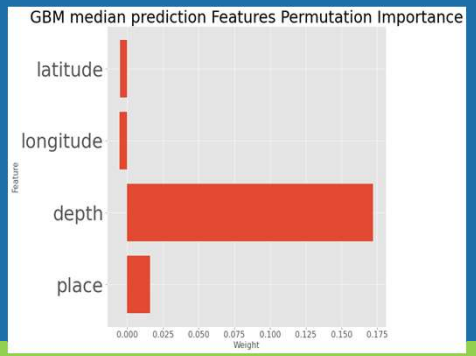
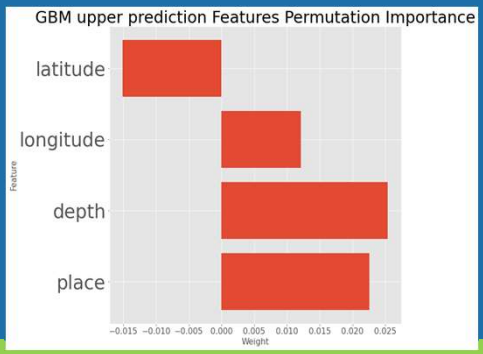
Feature Importance

	mean prediction	lower prediction	median prediction	upper prediction
KNN				
RF				
GBM				

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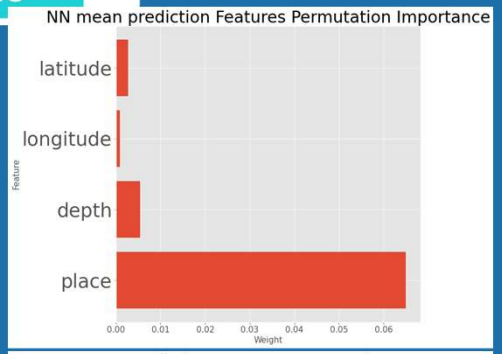
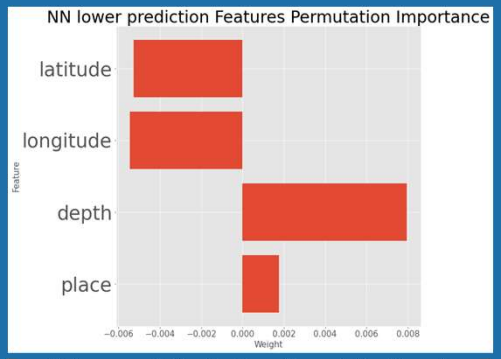
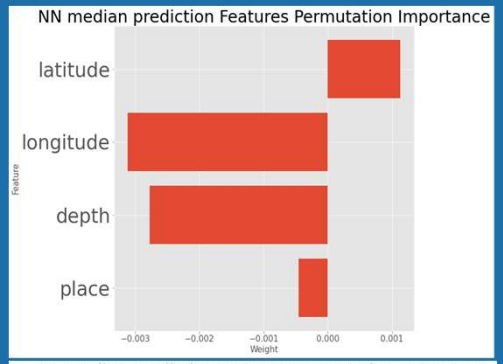
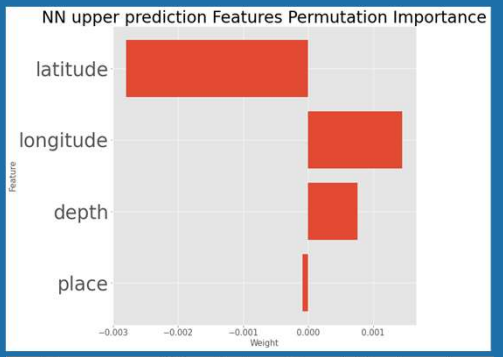
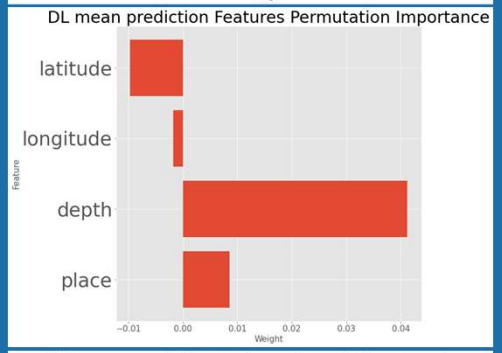
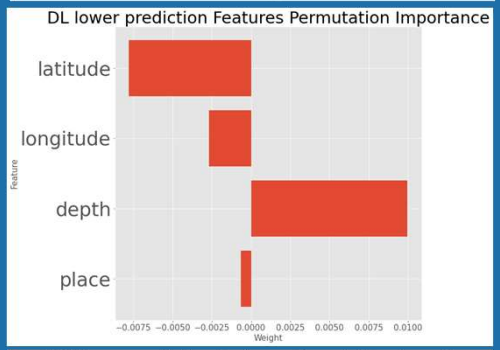
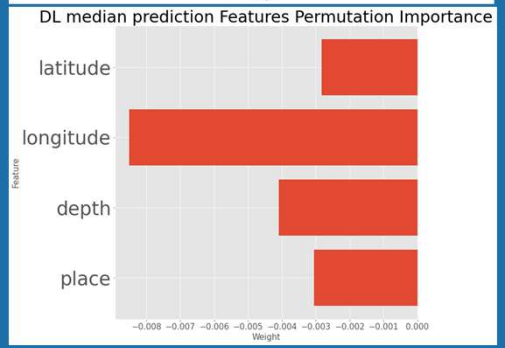
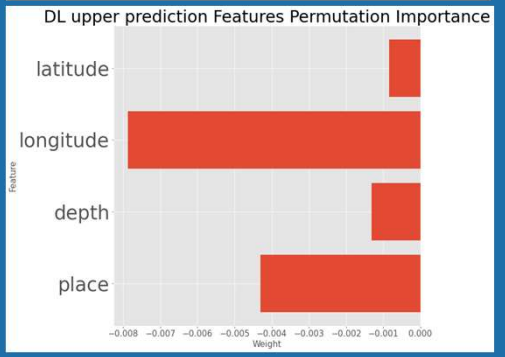
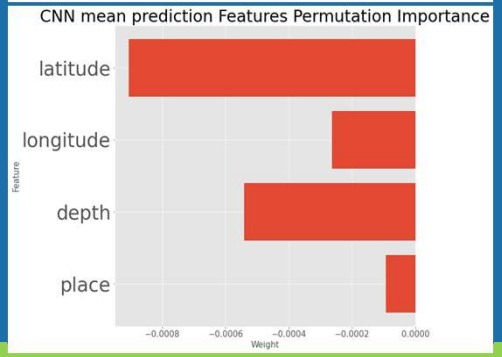
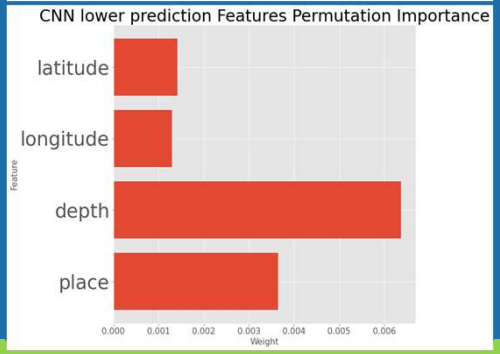
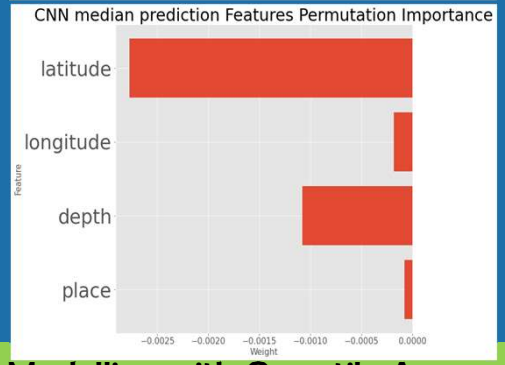
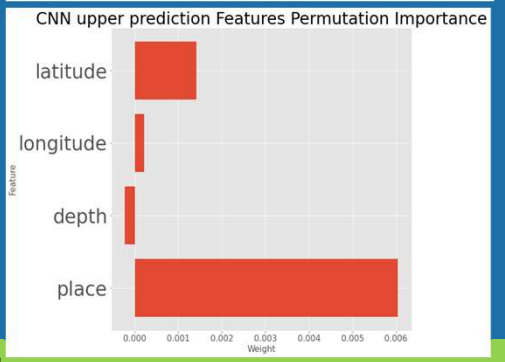
	mean prediction	lower prediction	median prediction	upper prediction
NN				
DL				
CNN				

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What I learned

-For extreme events, more data, better quality data and more features are required to perform better predictions and to better comprehend the phenomenon.

-Quantile regression is able to handle the uncertainty associated with the prediction of the event.

-There is no single model that performs well at every quantile point.

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