Environment Setup

In [ ]:
```
def install_packages():
    """
    Install or upgrade the following packages using pip:
    - pip: Package manager for Python.
    - numpy: Library for numerical computing.
    - pandas: Library for data manipulation and analysis.
    - tensorflow: Framework for machine learning and deep learning.
    - scikit-learn: Library for machine learning algorithms.
    - matplotlib: Library for data visualization.
    - seaborn: Library for statistical data visualization.
    - plotly: Library for interactive plotting and visualization.

    Example:
    >>> install_packages()
    """

    %pip install --upgrade pip
    %pip install numpy
    %pip install pandas
    %pip install tensorflow
    %pip install -U scikit-learn
    %pip install -U matplotlib
    %pip install seaborn
    %pip install plotly

    pass

#install_packages()
```

In [ ]:
```
# Libraries for data manipulation and analysis
import numpy as np
import pandas as pd

# Libraries for machine learning
from sklearn.model_selection import train_test_split  # Splitting data into tra
from sklearn.decomposition import PCA
from sklearn.metrics import mean_squared_error, mean_absolute_error  # Evaluat

# Libraries for data visualization
import seaborn as sns
```

```
---------------------------------------------------------------------------
ModuleNotFoundError                       Traceback (most recent call last)
Cell In[2], line 2
      1 # Libraries for data manipulation and analysis
----> 2 import numpy as np
      3 import pandas as pd
      5 # Libraries for machine learning

ModuleNotFoundError: No module named 'numpy'
```

Data Inspection

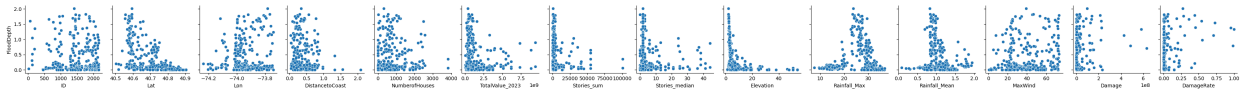
In [ ]:
```
# Import data
df = pd.read_csv('selected_coastal.csv')

# Drop rows with missing values from the DataFrame
df = df.dropna()
df.head()
```

Out[ ]:

	ID	Storm	Lat	Lon	DistancetoCoast	NumberofHouses	TotalValue_2023	Stories
6	20	Henri	40.670	-73.985	0.514557	529	1.223136e+09	
79	632	Henri	40.591	-73.986	0.647500	406	4.500709e+08	
101	774	Henri	40.642	-73.886	0.121984	700	3.238386e+08	
111	829	Henri	40.578	-73.964	0.502252	633	4.358320e+08	
125	880	Henri	40.530	-74.176	0.772571	2160	2.186988e+09	

In [ ]:
```
# Create a pairwise scatter plot matrix
sns.pairplot(
    df,
    x_vars=df.drop(columns=['Storm','FloodDepth']).columns,
    y_vars=["FloodDepth"]
)
```

Out[ ]:
```
<seaborn.axisgrid.PairGrid at 0x1745e2050>
```



Observations

1. Our data is structured (a csv)
2. The goal is a regression: predicting FloodDepth (continuous variable)
3. FloodDepth has a non-linear relationship with the other features

Neural Network

Version 1 (DamageRate Only)

In [ ]:
```
# Import a custom module named 'model_utils'
import model_utils as util

# Extract the 'DamageRate' and reshape it to a 2D array
X = df['DamageRate'].values.reshape(-1, 1)
```

```
# Target/Dependent variable
y = df["FloodDepth"]

# Splitting the data
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rando

# Build and compile the neural network model
model1 = util.build_and_compile_model(x_train)
model1.summary()  # Display the model architecture

# Train the model
history1 = model1.fit(
    x_train, y_train,  # Training data
    validation_split=0.2,  # Use 20% of the training data for validation
    verbose=0,  # Suppress verbose output
    epochs=100  # Number of training epochs
)

# Print the final Mean Squared Error after training
print('Mean Squared Error:', history1.history['loss'][-1])
```

Model: "sequential"

Layer (type)	Output Shape	Param #
normalization (Normalization)	?	3
dense (Dense)	?	0 (unbuilt)
dense_1 (Dense)	?	0 (unbuilt)
dense_2 (Dense)	?	0 (unbuilt)

Total params: 3 (16.00 B)

Trainable params: 0 (0.00 B)

Non-trainable params: 3 (16.00 B)

```
Mean Squared Error: 0.1801803559064865
```

Version 2 (All Features)

In [ ]:

```
# Perform one-hot encoding on the 'Storm' column, creating binary columns for e
one_hot_encoded = pd.get_dummies(df['Storm'], prefix='storm')

# Concatenate the one-hot encoded DataFrame with the original DataFrame
df = pd.concat([df, one_hot_encoded], axis=1)

# Drop the original 'Storm' column as it's no longer needed after one-hot encod
df = df.drop(columns=['Storm'])

# Display the first few rows of the DataFrame to verify the transformation
df.head()
```

Out[ ]:

	ID	Lat	Lon	DistancetoCoast	NumberofHouses	TotalValue_2023	Stories_sum	S
6	20	40.670	-73.985	0.514557	529	1.223136e+09	1552	
79	632	40.591	-73.986	0.647500	406	4.500709e+08	877	
101	774	40.642	-73.886	0.121984	700	3.238386e+08	1171	
111	829	40.578	-73.964	0.502252	633	4.358320e+08	2538	
125	880	40.530	-74.176	0.772571	2160	2.186988e+09	2788	

In [ ]:
```
# Extract all independent features
X = df.drop(columns=["FloodDepth"])

# Target/Dependent variable
y = df["FloodDepth"]

# Split the data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rando

# Build and compile the neural network model
model2 = util.build_and_compile_model(x_train)
model2.summary() # Display the model architecture

# Train the model
history2 = model2.fit(
    x_train,
    y_train,
    validation_split=0.2,
    verbose=0, epochs=100)

# Print the final Mean Squared Error after training
print('Mean Squared Error:', history2.history['loss'][-1])
```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
normalization_1 (Normalization)	?	39
dense_3 (Dense)	?	0 (unbuilt)
dense_4 (Dense)	?	0 (unbuilt)
dense_5 (Dense)	?	0 (unbuilt)

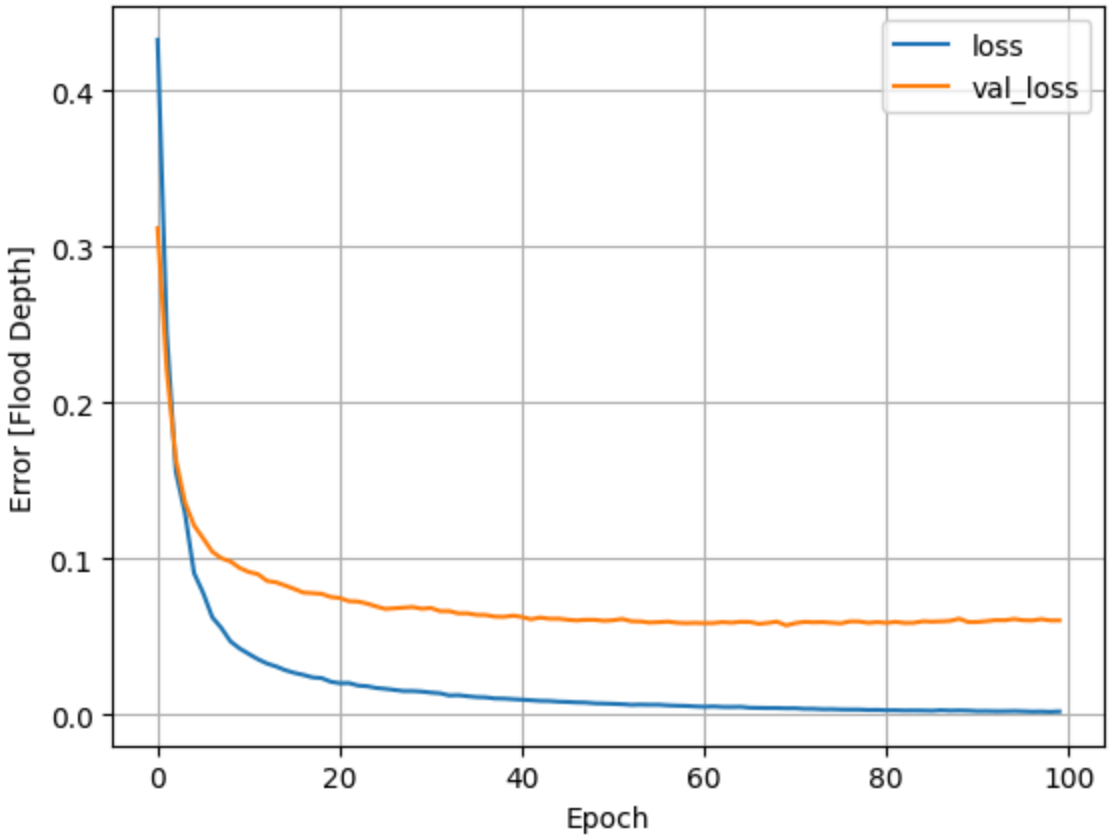
Total params: 39 (160.00 B)

Trainable params: 0 (0.00 B)

Non-trainable params: 39 (160.00 B)

```
Mean Squared Error: 0.0021870785858482122
```

In [ ]:
```
util.plot_loss(history2)
```



In [ ]:
```
util.predict(model2, x_test, y_test)
```

```
3/3 ━━━━━━━━━━━━━━━━━━━━ 0s 11ms/step
```