In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import MinMaxScaler
from tensorflow.python.keras.models import Sequential
from tensorflow.python.keras.layers import Dense
from tensorflow.python.keras.wrappers.scikit_learn import KerasRegressor
from sklearn.model_selection import train_test_split
```

In [2]:

```
df = pd.read_csv('Albedo_Map.csv', header=None)
df1 = pd.read_csv('LPFe_Map.csv', header=None)
df2 = pd.read_csv('LPK_Map.csv', header=None)
df3 = pd.read_csv('LPTh_Map.csv', header=None)
df4 = pd.read_csv('LPTi_Map.csv', header=None)
```

In [3]:

```
print(df.shape,df1.shape,df2.shape,df3.shape,df4.shape)
```

```
(360, 720) (360, 720) (360, 720) (360, 720) (360, 720)
```

Task-1 Predicting the Lunar Albedo based on Chemical Composition

Preprocessing Data

In [4]:

```
#function to normalise concentration maps
def normalising_data(dataframe1,dataframe2):
        scaler_x = MinMaxScaler()
        scaler_x.fit(dataframe1)
        xscale=scaler_x.transform(dataframe1)
        scaler_y = MinMaxScaler()
        yarray=np.array(dataframe2)
        yarray.reshape((-1,1))
        print(scaler_y.fit(yarray))
        yscale=scaler_y.transform(yarray)
        return yscale, scaler_y , xscale , scaler_x
```

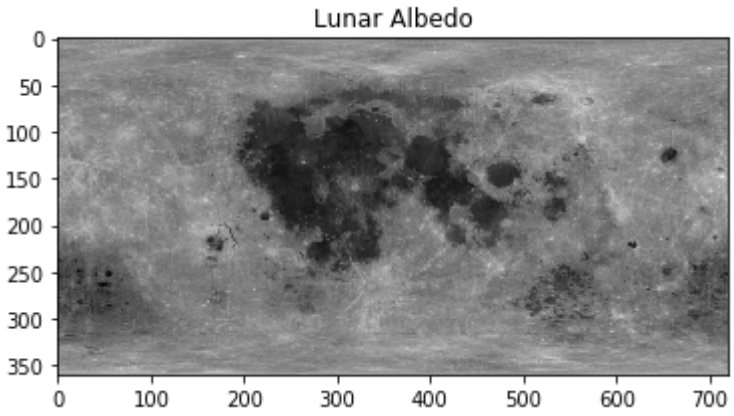
In [5]:

```
#function to split the data into training and test sets
def split_data(xscale,yscale):
    xscale = xscale.transpose()
    yscale = yscale.transpose()
    #print(xscale,yscale)
    xtrain, xtest, ytrain, ytest = train_test_split(xscale, yscale, shuffle=False,test_
size=0.5)
    print(xtrain.shape, xtest.shape, ytrain.shape, ytest.shape)
    return xtrain, xtest, ytrain, ytest
```

Visualising original maps and scatterplots

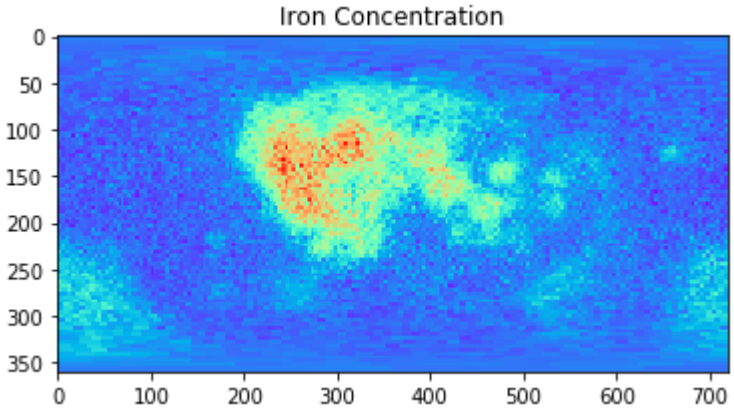
In [6]:

```
plt.imshow(df, cmap = "gray")
plt.title("Lunar Albedo")
plt.show()
```



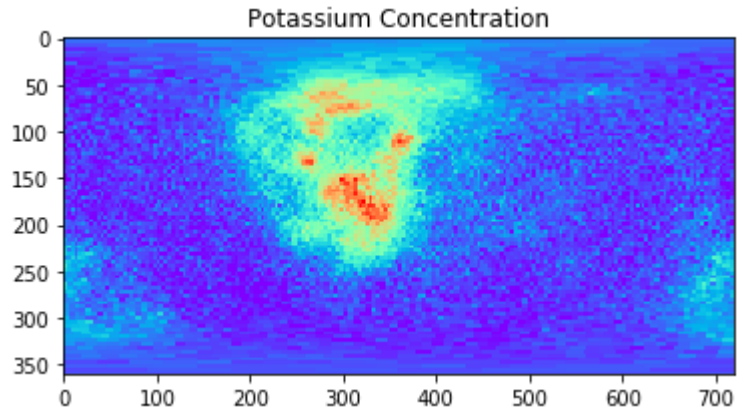
In [7]:

```
plt.imshow(df1, cmap = "rainbow")
plt.title("Iron Concentration")
plt.show()
```



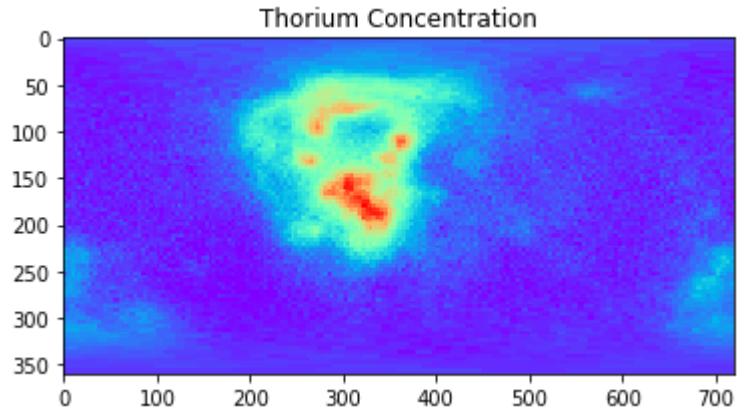
In [8]:

```
plt.imshow(df2, cmap = "rainbow")
plt.title("Potassium Concentration")
plt.show()
```



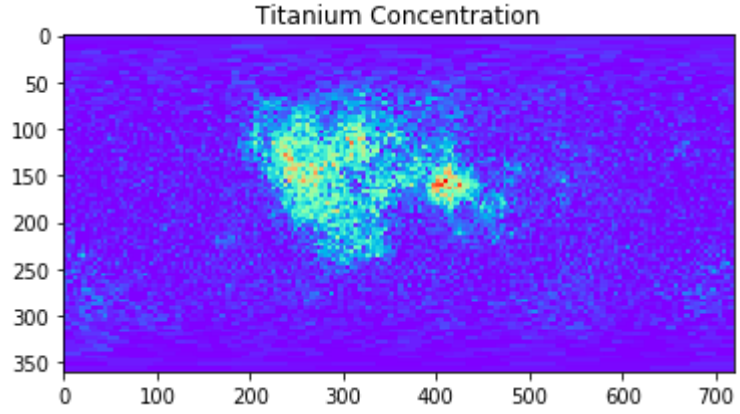
In [9]:

```
plt.imshow(df3, cmap = "rainbow")
plt.title("Thorium Concentration")
plt.show()
```



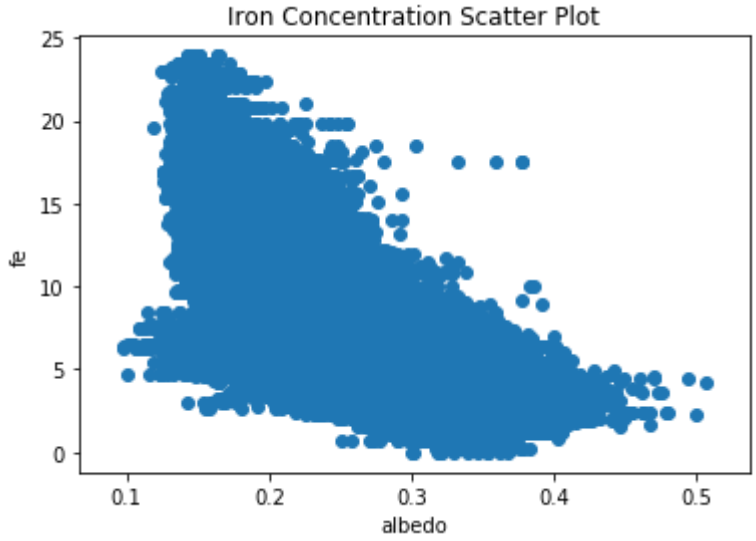
In [10]:

```
plt.imshow(df4, cmap = "rainbow")
plt.title("Titanium Concentration")
plt.show()
```



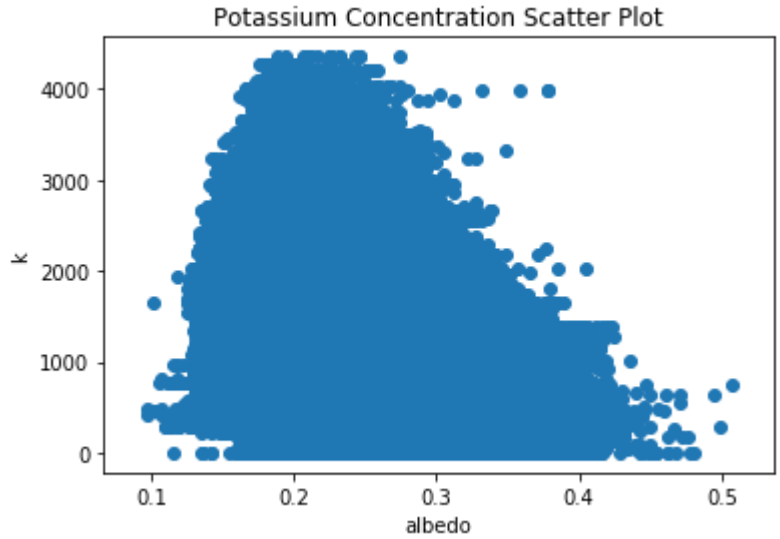
In [11]:

```
plt.scatter(df, df1)
plt.xlabel("albedo")
plt.ylabel("fe")
plt.title("Iron Concentration Scatter Plot")
plt.show()
```



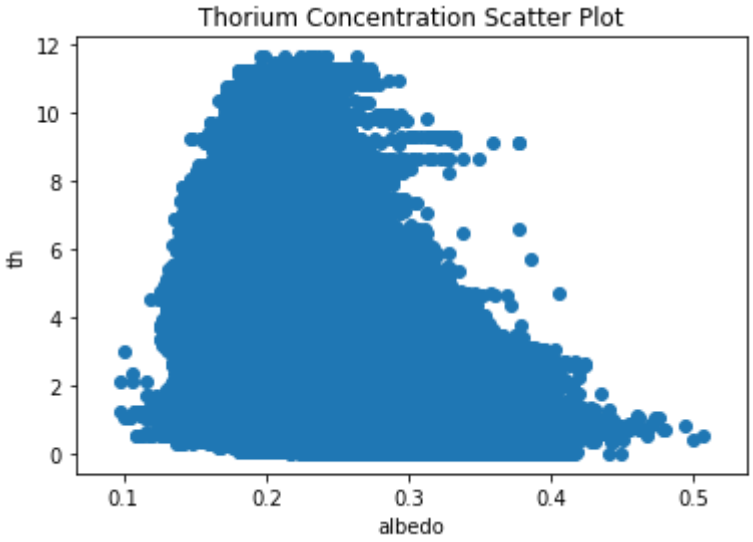
In [12]:

```
plt.scatter(df, df2)
plt.xlabel("albedo")
plt.ylabel("k")
plt.title("Potassium Concentration Scatter Plot")
plt.show()
```



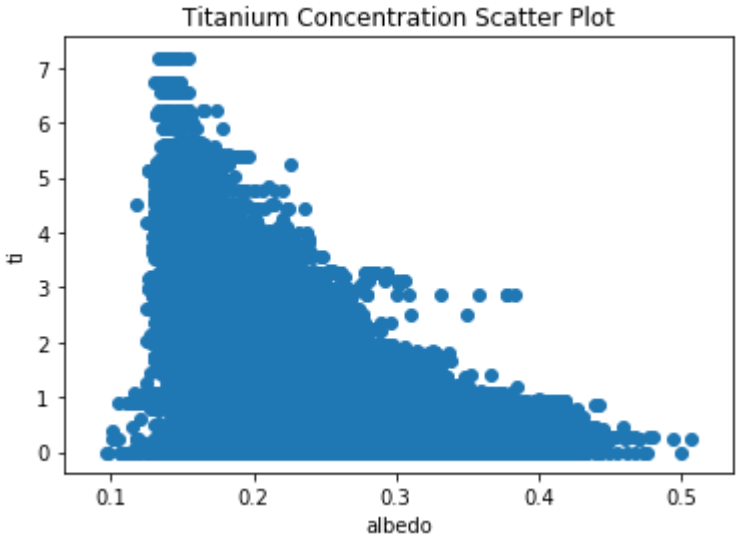
In [13]:

```
plt.scatter(df, df3)
plt.xlabel("albedo")
plt.ylabel("th")
plt.title("Thorium Concentration Scatter Plot")
plt.show()
```



In [14]:

```
plt.scatter(df, df4)
plt.xlabel("albedo")
plt.ylabel("ti")
plt.title("Titanium Concentration Scatter Plot")
plt.show()
```



Defining neural network structure for the model

Using keras regression model

In [15]:

```
def model_application(xtrain, xtest, ytrain, ytest):

    model = Sequential()
    model.add(Dense(12, input_shape=(360,), kernel_initializer='normal', activation='re
lu'))
    model.add(Dense(8, activation='relu'))
    model.add(Dense(360, activation='linear'))
    model.summary()
    model.compile(loss='mse', optimizer='adam', metrics=['mse','mae'])
    history = model.fit(xtrain, ytrain, epochs=150, batch_size=50,  verbose=1, validati
on_split=0.2)
    ypredicted= model.predict(xtest)

    return history,model,ypredicted
```

In [16]:

```
def visualise_performance(model,history,xtest,ytest):

    print(history.history.keys())
    # "Loss"
    plt.plot(history.history['loss'])
    plt.plot(history.history['val_loss'])
    plt.title('model loss')
    plt.ylabel('loss')
    plt.xlabel('epoch')
    plt.legend(['train', 'validation'], loc='upper left')
    plt.show()
    plt.scatter(xtest.transpose(),ytest.transpose())
    plt.scatter(xtest.transpose(),model.predict(xtest).transpose(),alpha=0.09)
    plt.legend(['original', 'predicted'], loc='upper left')
    plt.show()
```

In [17]:

```
def visualise_predictions(yorg,ynew):

    plt.imshow(yorg, cmap = "rainbow")
    plt.show()
    plt.imshow(ynew, cmap = "rainbow")
    plt.show()
    plt.hist(ytest)
    plt.show()
    plt.hist(ypredicted)
    plt.show()
```

Denormalising the data

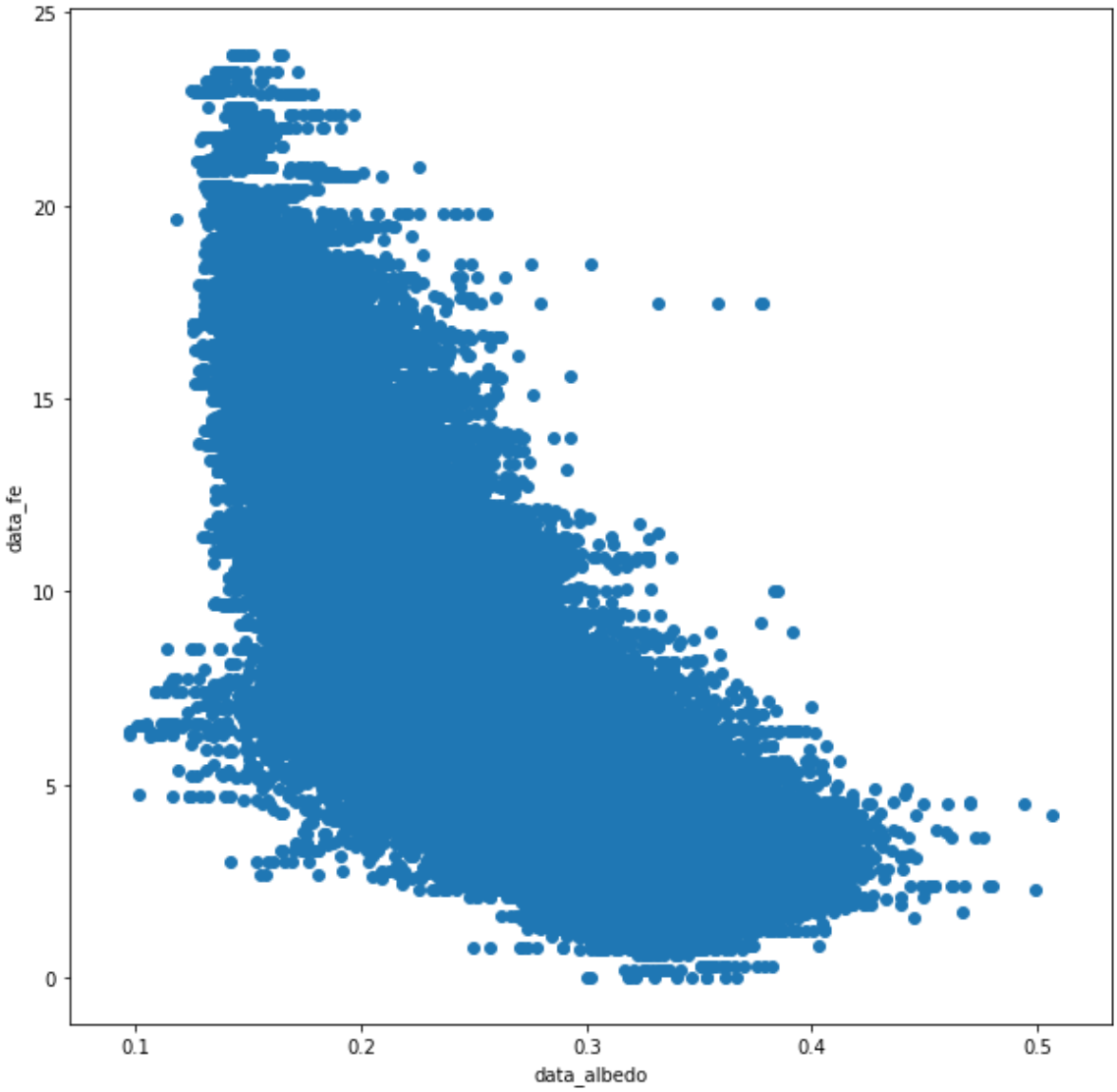
In [18]:

```
#denormalise data
def denormalise(scaler_x,scaler_y ,xtrain, xtest, ytrain, ytest,ypredicted):

    xtrain = xtrain.transpose()
    xtest = xtest.transpose()
    xscale = np.hstack((xtrain, xtest))
    xorg = scaler_x.inverse_transform(xscale)

    ytrain = ytrain.transpose()
    ytest = ytest.transpose()
    yscale = np.hstack((ytrain,ytest))
    yorg = scaler_y.inverse_transform(yscale)
    ypredicted = ypredicted.transpose()
    ynew=np.hstack((ytrain,ypredicted))
    ynew=scaler_y.inverse_transform(ynew)

    return xorg, yorg, ytest,ypredicted, ynew
```

Iron Concentration

In [19]:

```
plt.figure(figsize=(10,10))
plt.scatter(df,df1)
plt.xlabel("data_albedo")
plt.ylabel("data_fe")
plt.show()
```


25
20
15
10
5
0
data_fe
0.1
0.2
0.3
0.4
0.5
data_albedo

In [20]:

```
yscale, scaler_y , xscale , scaler_x = normalising_data(df,df1)
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

In [21]:

```
xtrain, xtest, ytrain, ytest = split_data(xscale,yscale)
```

```
(360, 360) (360, 360) (360, 360) (360, 360)
```

In [22]:

```
history , model , ypredicted = model_application(xtrain, xtest, ytrain, ytest)
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 12)                4332
_________________________________________________________________
dense_1 (Dense)              (None, 8)                 104
_________________________________________________________________
dense_2 (Dense)              (None, 360)               3240
=================================================================
Total params: 7,676
Trainable params: 7,676
Non-trainable params: 0
_________________________________________________________________
Epoch 1/150
6/6 [==============================] - 1s 93ms/step - loss: 0.2267 - mse:
0.2267 - mae: 0.3950 - val_loss: 0.2043 - val_mse: 0.2043 - val_mae: 0.350
1
Epoch 2/150
6/6 [==============================] - 0s 13ms/step - loss: 0.1997 - mse:
0.1997 - mae: 0.3705 - val_loss: 0.1999 - val_mse: 0.1999 - val_mae: 0.343
2
Epoch 3/150
6/6 [==============================] - 0s 32ms/step - loss: 0.1904 - mse:
0.1904 - mae: 0.3574 - val_loss: 0.1877 - val_mse: 0.1877 - val_mae: 0.329
5
Epoch 4/150
6/6 [==============================] - 0s 13ms/step - loss: 0.1784 - mse:
0.1784 - mae: 0.3382 - val_loss: 0.1733 - val_mse: 0.1733 - val_mae: 0.317
9
Epoch 5/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1647 - mse:
0.1647 - mae: 0.3233 - val_loss: 0.1581 - val_mse: 0.1581 - val_mae: 0.305
2
Epoch 6/150
6/6 [==============================] - 0s 13ms/step - loss: 0.1482 - mse:
0.1482 - mae: 0.3053 - val_loss: 0.1431 - val_mse: 0.1431 - val_mae: 0.292
8
Epoch 7/150
6/6 [==============================] - 0s 14ms/step - loss: 0.1279 - mse:
0.1279 - mae: 0.2811 - val_loss: 0.1303 - val_mse: 0.1303 - val_mae: 0.282
6
Epoch 8/150
6/6 [==============================] - 0s 14ms/step - loss: 0.1133 - mse:
0.1133 - mae: 0.2655 - val_loss: 0.1189 - val_mse: 0.1189 - val_mae: 0.274
8
Epoch 9/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0983 - mse:
0.0983 - mae: 0.2479 - val_loss: 0.1110 - val_mse: 0.1110 - val_mae: 0.269
6
Epoch 10/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0884 - mse:
0.0884 - mae: 0.2364 - val_loss: 0.1041 - val_mse: 0.1041 - val_mae: 0.265
8
Epoch 11/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0794 - mse:
0.0794 - mae: 0.2258 - val_loss: 0.0999 - val_mse: 0.0999 - val_mae: 0.264
0
Epoch 12/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0724 - mse:
0.0724 - mae: 0.2164 - val_loss: 0.0972 - val_mse: 0.0972 - val_mae: 0.263
```

```
2
Epoch 13/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0680 - mse:
0.0680 - mae: 0.2118 - val_loss: 0.0936 - val_mse: 0.0936 - val_mae: 0.262
8
Epoch 14/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0657 - mse:
0.0657 - mae: 0.2099 - val_loss: 0.0934 - val_mse: 0.0934 - val_mae: 0.262
5
Epoch 15/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0629 - mse:
0.0629 - mae: 0.2050 - val_loss: 0.0921 - val_mse: 0.0921 - val_mae: 0.262
2
Epoch 16/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0621 - mse:
0.0621 - mae: 0.2050 - val_loss: 0.0899 - val_mse: 0.0899 - val_mae: 0.261
6
Epoch 17/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0609 - mse:
0.0609 - mae: 0.2043 - val_loss: 0.0907 - val_mse: 0.0907 - val_mae: 0.261
7
Epoch 18/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0595 - mse:
0.0595 - mae: 0.2005 - val_loss: 0.0898 - val_mse: 0.0898 - val_mae: 0.261
7
Epoch 19/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0606 - mse:
0.0606 - mae: 0.2039 - val_loss: 0.0889 - val_mse: 0.0889 - val_mae: 0.260
9
Epoch 20/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0591 - mse:
0.0591 - mae: 0.2004 - val_loss: 0.0895 - val_mse: 0.0895 - val_mae: 0.261
1
Epoch 21/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0585 - mse:
0.0585 - mae: 0.1991 - val_loss: 0.0885 - val_mse: 0.0885 - val_mae: 0.261
1
Epoch 22/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0590 - mse:
0.0590 - mae: 0.2008 - val_loss: 0.0888 - val_mse: 0.0888 - val_mae: 0.260
6
Epoch 23/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0581 - mse:
0.0581 - mae: 0.1986 - val_loss: 0.0887 - val_mse: 0.0887 - val_mae: 0.261
1
Epoch 24/150
6/6 [==============================] - 0s 24ms/step - loss: 0.0584 - mse:
0.0584 - mae: 0.1997 - val_loss: 0.0887 - val_mse: 0.0887 - val_mae: 0.260
6
Epoch 25/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0582 - mse:
0.0582 - mae: 0.1988 - val_loss: 0.0885 - val_mse: 0.0885 - val_mae: 0.260
4
Epoch 26/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0582 - mse:
0.0582 - mae: 0.1995 - val_loss: 0.0879 - val_mse: 0.0879 - val_mae: 0.259
5
Epoch 27/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0583 - mse:
0.0583 - mae: 0.1989 - val_loss: 0.0877 - val_mse: 0.0877 - val_mae: 0.259
6
```

```
Epoch 28/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0573 - mse:
0.0573 - mae: 0.1971 - val_loss: 0.0882 - val_mse: 0.0882 - val_mae: 0.259
7
Epoch 29/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0583 - mse:
0.0583 - mae: 0.1988 - val_loss: 0.0878 - val_mse: 0.0878 - val_mae: 0.259
9
Epoch 30/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0557 - mse:
0.0557 - mae: 0.1942 - val_loss: 0.0880 - val_mse: 0.0880 - val_mae: 0.259
8
Epoch 31/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0585 - mse:
0.0585 - mae: 0.1991 - val_loss: 0.0879 - val_mse: 0.0879 - val_mae: 0.258
9
Epoch 32/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0572 - mse:
0.0572 - mae: 0.1969 - val_loss: 0.0873 - val_mse: 0.0873 - val_mae: 0.259
3
Epoch 33/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0583 - mse:
0.0583 - mae: 0.1997 - val_loss: 0.0873 - val_mse: 0.0873 - val_mae: 0.258
5
Epoch 34/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0565 - mse:
0.0565 - mae: 0.1949 - val_loss: 0.0878 - val_mse: 0.0878 - val_mae: 0.258
7
Epoch 35/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0575 - mse:
0.0575 - mae: 0.1970 - val_loss: 0.0876 - val_mse: 0.0876 - val_mae: 0.259
8
Epoch 36/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0556 - mse:
0.0556 - mae: 0.1941 - val_loss: 0.0883 - val_mse: 0.0883 - val_mae: 0.259
7
Epoch 37/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0564 - mse:
0.0564 - mae: 0.1952 - val_loss: 0.0882 - val_mse: 0.0882 - val_mae: 0.260
0
Epoch 38/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0559 - mse:
0.0559 - mae: 0.1939 - val_loss: 0.0885 - val_mse: 0.0885 - val_mae: 0.260
0
Epoch 39/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0554 - mse:
0.0554 - mae: 0.1932 - val_loss: 0.0881 - val_mse: 0.0881 - val_mae: 0.259
6
Epoch 40/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0553 - mse:
0.0553 - mae: 0.1929 - val_loss: 0.0880 - val_mse: 0.0880 - val_mae: 0.258
6
Epoch 41/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0547 - mse:
0.0547 - mae: 0.1916 - val_loss: 0.0872 - val_mse: 0.0872 - val_mae: 0.258
2
Epoch 42/150
6/6 [==============================] - 0s 30ms/step - loss: 0.0544 - mse:
0.0544 - mae: 0.1912 - val_loss: 0.0876 - val_mse: 0.0876 - val_mae: 0.258
5
Epoch 43/150
```

```
6/6 [==============================] - 0s 14ms/step - loss: 0.0550 - mse:
0.0550 - mae: 0.1920 - val_loss: 0.0874 - val_mse: 0.0874 - val_mae: 0.258
5
Epoch 44/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0550 - mse:
0.0550 - mae: 0.1931 - val_loss: 0.0871 - val_mse: 0.0871 - val_mae: 0.258
3
Epoch 45/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0544 - mse:
0.0544 - mae: 0.1907 - val_loss: 0.0873 - val_mse: 0.0873 - val_mae: 0.257
1
Epoch 46/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0561 - mse:
0.0561 - mae: 0.1941 - val_loss: 0.0863 - val_mse: 0.0863 - val_mae: 0.256
9
Epoch 47/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0548 - mse:
0.0548 - mae: 0.1914 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.257
2
Epoch 48/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0549 - mse:
0.0549 - mae: 0.1909 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.258
2
Epoch 49/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0550 - mse:
0.0550 - mae: 0.1926 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.258
2
Epoch 50/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0536 - mse:
0.0536 - mae: 0.1881 - val_loss: 0.0882 - val_mse: 0.0882 - val_mae: 0.257
6
Epoch 51/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0543 - mse:
0.0543 - mae: 0.1896 - val_loss: 0.0879 - val_mse: 0.0879 - val_mae: 0.257
9
Epoch 52/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0543 - mse:
0.0543 - mae: 0.1901 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.257
1
Epoch 53/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0550 - mse:
0.0550 - mae: 0.1915 - val_loss: 0.0878 - val_mse: 0.0878 - val_mae: 0.256
2
Epoch 54/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0536 - mse:
0.0536 - mae: 0.1877 - val_loss: 0.0876 - val_mse: 0.0876 - val_mae: 0.256
6
Epoch 55/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0550 - mse:
0.0550 - mae: 0.1915 - val_loss: 0.0876 - val_mse: 0.0876 - val_mae: 0.255
6
Epoch 56/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0546 - mse:
0.0546 - mae: 0.1893 - val_loss: 0.0874 - val_mse: 0.0874 - val_mae: 0.255
8
Epoch 57/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0529 - mse:
0.0529 - mae: 0.1871 - val_loss: 0.0874 - val_mse: 0.0874 - val_mae: 0.256
1
Epoch 58/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0530 - mse:
```

```
0.0530 - mae: 0.1868 - val_loss: 0.0882 - val_mse: 0.0882 - val_mae: 0.255
9
Epoch 59/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0536 - mse:
0.0536 - mae: 0.1876 - val_loss: 0.0873 - val_mse: 0.0873 - val_mae: 0.255
4
Epoch 60/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0528 - mse:
0.0528 - mae: 0.1864 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.255
1
Epoch 61/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0531 - mse:
0.0531 - mae: 0.1862 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.254
8
Epoch 62/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0540 - mse:
0.0540 - mae: 0.1883 - val_loss: 0.0874 - val_mse: 0.0874 - val_mae: 0.253
9
Epoch 63/150
6/6 [==============================] - 0s 23ms/step - loss: 0.0524 - mse:
0.0524 - mae: 0.1843 - val_loss: 0.0869 - val_mse: 0.0869 - val_mae: 0.254
3
Epoch 64/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0520 - mse:
0.0520 - mae: 0.1847 - val_loss: 0.0874 - val_mse: 0.0874 - val_mae: 0.253
4
Epoch 65/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0510 - mse:
0.0510 - mae: 0.1825 - val_loss: 0.0869 - val_mse: 0.0869 - val_mae: 0.253
6
Epoch 66/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0531 - mse:
0.0531 - mae: 0.1864 - val_loss: 0.0868 - val_mse: 0.0868 - val_mae: 0.251
9
Epoch 67/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0536 - mse:
0.0536 - mae: 0.1865 - val_loss: 0.0865 - val_mse: 0.0865 - val_mae: 0.251
5
Epoch 68/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0537 - mse:
0.0537 - mae: 0.1866 - val_loss: 0.0866 - val_mse: 0.0866 - val_mae: 0.251
1
Epoch 69/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0519 - mse:
0.0519 - mae: 0.1836 - val_loss: 0.0869 - val_mse: 0.0869 - val_mae: 0.251
8
Epoch 70/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0518 - mse:
0.0518 - mae: 0.1830 - val_loss: 0.0870 - val_mse: 0.0870 - val_mae: 0.251
4
Epoch 71/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0518 - mse:
0.0518 - mae: 0.1832 - val_loss: 0.0872 - val_mse: 0.0872 - val_mae: 0.250
9
Epoch 72/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0522 - mse:
0.0522 - mae: 0.1833 - val_loss: 0.0875 - val_mse: 0.0875 - val_mae: 0.249
5
Epoch 73/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0508 - mse:
0.0508 - mae: 0.1799 - val_loss: 0.0866 - val_mse: 0.0866 - val_mae: 0.250
```

```
6
Epoch 74/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0508 - mse:
0.0508 - mae: 0.1818 - val_loss: 0.0870 - val_mse: 0.0870 - val_mae: 0.249
2
Epoch 75/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0517 - mse:
0.0517 - mae: 0.1824 - val_loss: 0.0865 - val_mse: 0.0865 - val_mae: 0.248
9
Epoch 76/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0513 - mse:
0.0513 - mae: 0.1815 - val_loss: 0.0863 - val_mse: 0.0863 - val_mae: 0.247
9
Epoch 77/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0515 - mse:
0.0515 - mae: 0.1816 - val_loss: 0.0860 - val_mse: 0.0860 - val_mae: 0.247
1
Epoch 78/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0506 - mse:
0.0506 - mae: 0.1793 - val_loss: 0.0863 - val_mse: 0.0863 - val_mae: 0.247
2
Epoch 79/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0505 - mse:
0.0505 - mae: 0.1793 - val_loss: 0.0865 - val_mse: 0.0865 - val_mae: 0.246
6
Epoch 80/150
6/6 [==============================] - 0s 22ms/step - loss: 0.0508 - mse:
0.0508 - mae: 0.1796 - val_loss: 0.0862 - val_mse: 0.0862 - val_mae: 0.246
0
Epoch 81/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0518 - mse:
0.0518 - mae: 0.1819 - val_loss: 0.0861 - val_mse: 0.0861 - val_mae: 0.244
3
Epoch 82/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0502 - mse:
0.0502 - mae: 0.1773 - val_loss: 0.0857 - val_mse: 0.0857 - val_mae: 0.245
5
Epoch 83/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0504 - mse:
0.0504 - mae: 0.1796 - val_loss: 0.0857 - val_mse: 0.0857 - val_mae: 0.243
3
Epoch 84/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0502 - mse:
0.0502 - mae: 0.1779 - val_loss: 0.0854 - val_mse: 0.0854 - val_mae: 0.242
9
Epoch 85/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0498 - mse:
0.0498 - mae: 0.1775 - val_loss: 0.0855 - val_mse: 0.0855 - val_mae: 0.242
0
Epoch 86/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0511 - mse:
0.0511 - mae: 0.1785 - val_loss: 0.0850 - val_mse: 0.0850 - val_mae: 0.241
7
Epoch 87/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0494 - mse:
0.0494 - mae: 0.1768 - val_loss: 0.0853 - val_mse: 0.0853 - val_mae: 0.240
9
Epoch 88/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0481 - mse:
0.0481 - mae: 0.1736 - val_loss: 0.0852 - val_mse: 0.0852 - val_mae: 0.241
8
```

```
Epoch 89/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0481 - mse:
0.0481 - mae: 0.1745 - val_loss: 0.0857 - val_mse: 0.0857 - val_mae: 0.239
8
Epoch 90/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0492 - mse:
0.0492 - mae: 0.1751 - val_loss: 0.0843 - val_mse: 0.0843 - val_mae: 0.239
8
Epoch 91/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0496 - mse:
0.0496 - mae: 0.1768 - val_loss: 0.0848 - val_mse: 0.0848 - val_mae: 0.237
0
Epoch 92/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0488 - mse:
0.0488 - mae: 0.1731 - val_loss: 0.0839 - val_mse: 0.0839 - val_mae: 0.237
8
Epoch 93/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0507 - mse:
0.0507 - mae: 0.1787 - val_loss: 0.0843 - val_mse: 0.0843 - val_mae: 0.235
2
Epoch 94/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0489 - mse:
0.0489 - mae: 0.1728 - val_loss: 0.0833 - val_mse: 0.0833 - val_mae: 0.236
9
Epoch 95/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0484 - mse:
0.0484 - mae: 0.1745 - val_loss: 0.0841 - val_mse: 0.0841 - val_mae: 0.234
3
Epoch 96/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0480 - mse:
0.0480 - mae: 0.1716 - val_loss: 0.0833 - val_mse: 0.0833 - val_mae: 0.235
1
Epoch 97/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0483 - mse:
0.0483 - mae: 0.1733 - val_loss: 0.0831 - val_mse: 0.0831 - val_mae: 0.232
4
Epoch 98/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0487 - mse:
0.0487 - mae: 0.1722 - val_loss: 0.0828 - val_mse: 0.0828 - val_mae: 0.231
7
Epoch 99/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0476 - mse:
0.0476 - mae: 0.1709 - val_loss: 0.0823 - val_mse: 0.0823 - val_mae: 0.230
8
Epoch 100/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0475 - mse:
0.0475 - mae: 0.1701 - val_loss: 0.0817 - val_mse: 0.0817 - val_mae: 0.230
4
Epoch 101/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0485 - mse:
0.0485 - mae: 0.1731 - val_loss: 0.0819 - val_mse: 0.0819 - val_mae: 0.228
5
Epoch 102/150
6/6 [==============================] - 0s 31ms/step - loss: 0.0478 - mse:
0.0478 - mae: 0.1702 - val_loss: 0.0812 - val_mse: 0.0812 - val_mae: 0.229
0
Epoch 103/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0477 - mse:
0.0477 - mae: 0.1707 - val_loss: 0.0815 - val_mse: 0.0815 - val_mae: 0.227
2
Epoch 104/150
```

```
6/6 [==============================] - 0s 14ms/step - loss: 0.0456 - mse:
0.0456 - mae: 0.1661 - val_loss: 0.0810 - val_mse: 0.0810 - val_mae: 0.227
1
Epoch 105/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0470 - mse:
0.0470 - mae: 0.1696 - val_loss: 0.0813 - val_mse: 0.0813 - val_mae: 0.224
4
Epoch 106/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0473 - mse:
0.0473 - mae: 0.1680 - val_loss: 0.0799 - val_mse: 0.0799 - val_mae: 0.225
2
Epoch 107/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0471 - mse:
0.0471 - mae: 0.1704 - val_loss: 0.0803 - val_mse: 0.0803 - val_mae: 0.221
9
Epoch 108/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0455 - mse:
0.0455 - mae: 0.1637 - val_loss: 0.0787 - val_mse: 0.0787 - val_mae: 0.224
3
Epoch 109/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0467 - mse:
0.0467 - mae: 0.1694 - val_loss: 0.0797 - val_mse: 0.0797 - val_mae: 0.220
0
Epoch 110/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0473 - mse:
0.0473 - mae: 0.1663 - val_loss: 0.0780 - val_mse: 0.0780 - val_mae: 0.220
8
Epoch 111/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0470 - mse:
0.0470 - mae: 0.1688 - val_loss: 0.0786 - val_mse: 0.0786 - val_mae: 0.217
9
Epoch 112/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0461 - mse:
0.0461 - mae: 0.1655 - val_loss: 0.0775 - val_mse: 0.0775 - val_mae: 0.218
3
Epoch 113/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0459 - mse:
0.0459 - mae: 0.1663 - val_loss: 0.0775 - val_mse: 0.0775 - val_mae: 0.217
4
Epoch 114/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0451 - mse:
0.0451 - mae: 0.1632 - val_loss: 0.0774 - val_mse: 0.0774 - val_mae: 0.215
8
Epoch 115/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0457 - mse:
0.0457 - mae: 0.1636 - val_loss: 0.0769 - val_mse: 0.0769 - val_mae: 0.214
8
Epoch 116/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0450 - mse:
0.0450 - mae: 0.1617 - val_loss: 0.0759 - val_mse: 0.0759 - val_mae: 0.214
2
Epoch 117/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0461 - mse:
0.0461 - mae: 0.1656 - val_loss: 0.0758 - val_mse: 0.0758 - val_mae: 0.212
3
Epoch 118/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0442 - mse:
0.0442 - mae: 0.1614 - val_loss: 0.0756 - val_mse: 0.0756 - val_mae: 0.211
4
Epoch 119/150
6/6 [==============================] - 0s 30ms/step - loss: 0.0447 - mse:
```

```
0.0447 - mae: 0.1623 - val_loss: 0.0749 - val_mse: 0.0749 - val_mae: 0.210
6
Epoch 120/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0453 - mse:
0.0453 - mae: 0.1622 - val_loss: 0.0740 - val_mse: 0.0740 - val_mae: 0.209
0
Epoch 121/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0437 - mse:
0.0437 - mae: 0.1610 - val_loss: 0.0738 - val_mse: 0.0738 - val_mae: 0.208
0
Epoch 122/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0434 - mse:
0.0434 - mae: 0.1600 - val_loss: 0.0731 - val_mse: 0.0731 - val_mae: 0.207
5
Epoch 123/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0436 - mse:
0.0436 - mae: 0.1599 - val_loss: 0.0729 - val_mse: 0.0729 - val_mae: 0.205
5
Epoch 124/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0434 - mse:
0.0434 - mae: 0.1579 - val_loss: 0.0714 - val_mse: 0.0714 - val_mae: 0.204
9
Epoch 125/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0426 - mse:
0.0426 - mae: 0.1590 - val_loss: 0.0717 - val_mse: 0.0717 - val_mae: 0.203
7
Epoch 126/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0426 - mse:
0.0426 - mae: 0.1579 - val_loss: 0.0708 - val_mse: 0.0708 - val_mae: 0.203
2
Epoch 127/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0430 - mse:
0.0430 - mae: 0.1589 - val_loss: 0.0706 - val_mse: 0.0706 - val_mae: 0.201
7
Epoch 128/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0416 - mse:
0.0416 - mae: 0.1552 - val_loss: 0.0697 - val_mse: 0.0697 - val_mae: 0.200
3
Epoch 129/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0423 - mse:
0.0423 - mae: 0.1569 - val_loss: 0.0688 - val_mse: 0.0688 - val_mae: 0.199
0
Epoch 130/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0427 - mse:
0.0427 - mae: 0.1569 - val_loss: 0.0682 - val_mse: 0.0682 - val_mae: 0.198
0
Epoch 131/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0420 - mse:
0.0420 - mae: 0.1573 - val_loss: 0.0682 - val_mse: 0.0682 - val_mae: 0.197
3
Epoch 132/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0420 - mse:
0.0420 - mae: 0.1554 - val_loss: 0.0665 - val_mse: 0.0665 - val_mae: 0.195
7
Epoch 133/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0417 - mse:
0.0417 - mae: 0.1563 - val_loss: 0.0670 - val_mse: 0.0670 - val_mae: 0.195
4
Epoch 134/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0414 - mse:
0.0414 - mae: 0.1546 - val_loss: 0.0653 - val_mse: 0.0653 - val_mae: 0.193
```

```
4
Epoch 135/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0399 - mse:
0.0399 - mae: 0.1535 - val_loss: 0.0654 - val_mse: 0.0654 - val_mae: 0.193
0
Epoch 136/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0403 - mse:
0.0403 - mae: 0.1520 - val_loss: 0.0642 - val_mse: 0.0642 - val_mae: 0.191
2
Epoch 137/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0410 - mse:
0.0410 - mae: 0.1533 - val_loss: 0.0636 - val_mse: 0.0636 - val_mae: 0.190
2
Epoch 138/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0402 - mse:
0.0402 - mae: 0.1532 - val_loss: 0.0630 - val_mse: 0.0630 - val_mae: 0.189
3
Epoch 139/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0389 - mse:
0.0389 - mae: 0.1501 - val_loss: 0.0625 - val_mse: 0.0625 - val_mae: 0.188
5
Epoch 140/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0394 - mse:
0.0394 - mae: 0.1506 - val_loss: 0.0618 - val_mse: 0.0618 - val_mae: 0.187
4
Epoch 141/150
6/6 [==============================] - 0s 29ms/step - loss: 0.0392 - mse:
0.0392 - mae: 0.1501 - val_loss: 0.0608 - val_mse: 0.0608 - val_mae: 0.185
8
Epoch 142/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0384 - mse:
0.0384 - mae: 0.1491 - val_loss: 0.0605 - val_mse: 0.0605 - val_mae: 0.185
4
Epoch 143/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0390 - mse:
0.0390 - mae: 0.1498 - val_loss: 0.0591 - val_mse: 0.0591 - val_mae: 0.183
1
Epoch 144/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0380 - mse:
0.0380 - mae: 0.1491 - val_loss: 0.0588 - val_mse: 0.0588 - val_mae: 0.182
7
Epoch 145/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0379 - mse:
0.0379 - mae: 0.1496 - val_loss: 0.0576 - val_mse: 0.0576 - val_mae: 0.180
6
Epoch 146/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0381 - mse:
0.0381 - mae: 0.1491 - val_loss: 0.0572 - val_mse: 0.0572 - val_mae: 0.179
9
Epoch 147/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0383 - mse:
0.0383 - mae: 0.1494 - val_loss: 0.0560 - val_mse: 0.0560 - val_mae: 0.177
9
Epoch 148/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0375 - mse:
0.0375 - mae: 0.1484 - val_loss: 0.0557 - val_mse: 0.0557 - val_mae: 0.177
5
Epoch 149/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0370 - mse:
0.0370 - mae: 0.1471 - val_loss: 0.0546 - val_mse: 0.0546 - val_mae: 0.175
5
```

```
Epoch 150/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0364 - mse:
0.0364 - mae: 0.1463 - val_loss: 0.0539 - val_mse: 0.0539 - val_mae: 0.174
3
```

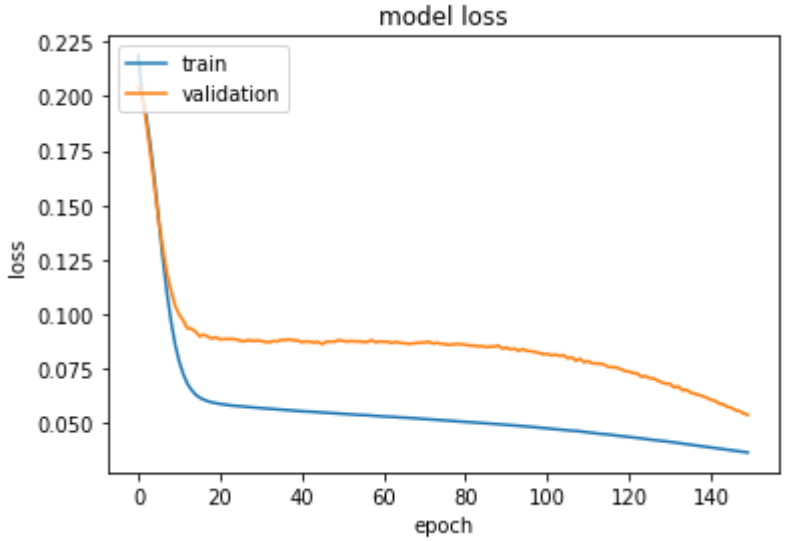
In [23]:

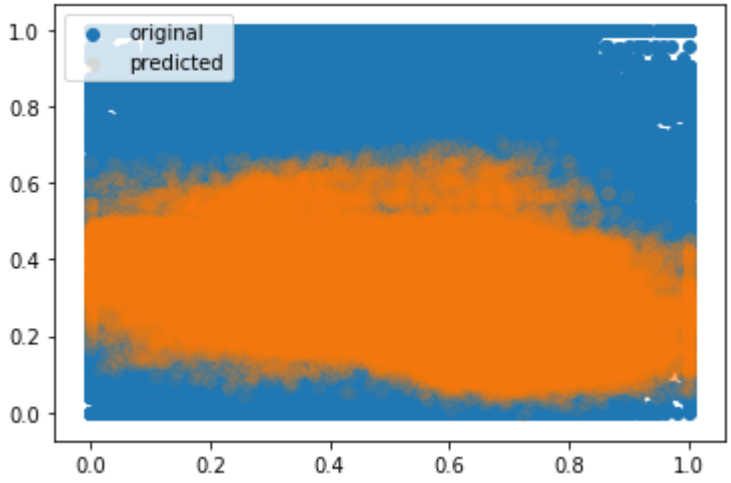
```
xorg , yorg , ytest ,ypredicted, ynew = denormalise(scaler_x,scaler_y ,xtrain, xtest, y
train, ytest, ypredicted)
```

In [24]:

```
visualise_performance(model,history,xtest,ytest)
```

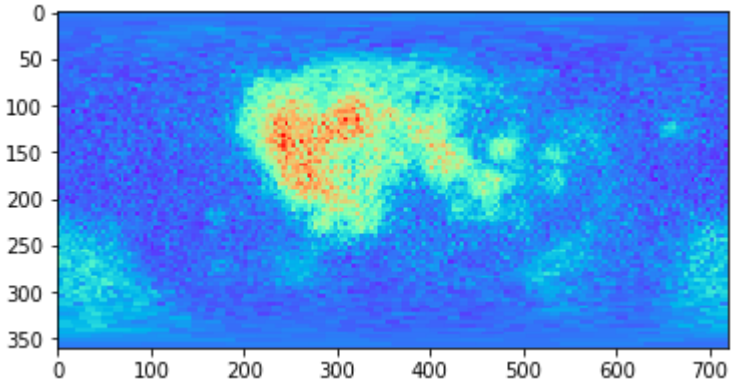
```
dict_keys(['loss', 'mse', 'mae', 'val_loss', 'val_mse', 'val_mae'])
```

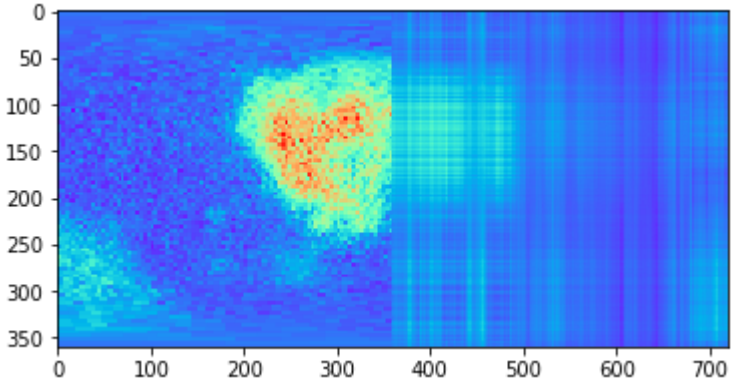


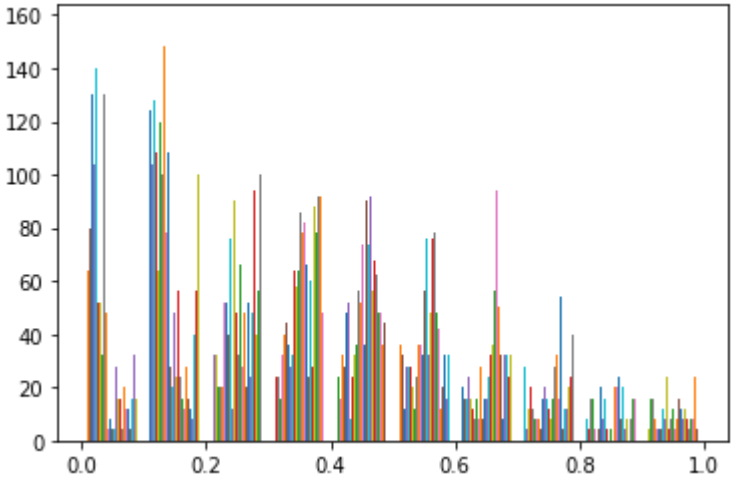


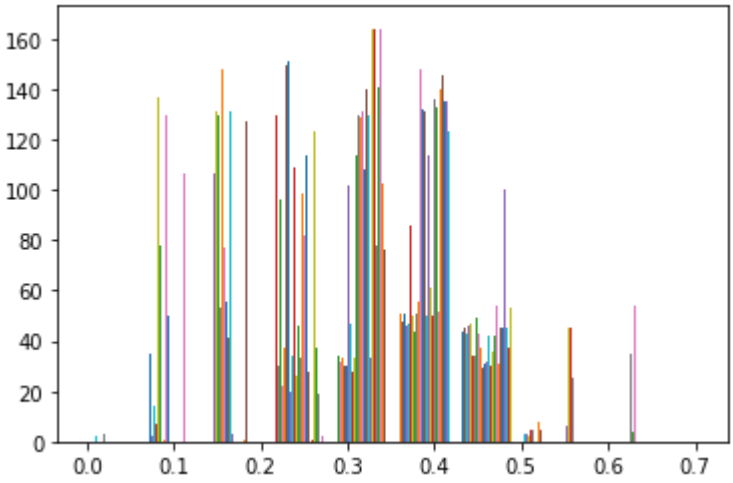
In [25]:

```
visualise_predictions(yorg,ynew)
```


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700

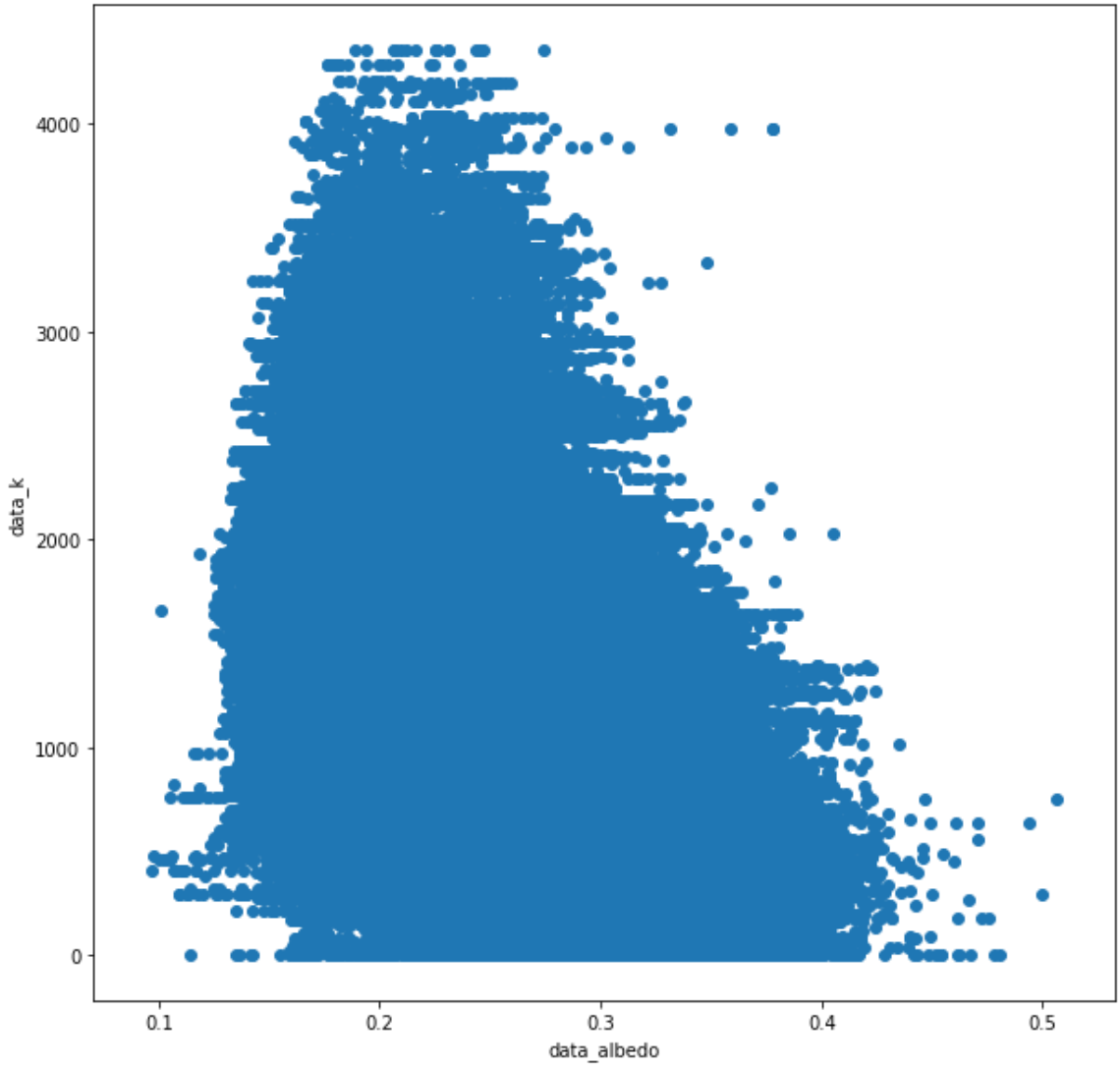

160
140
120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0



Potassium Concentration

In [26]:

```
plt.figure(figsize=(10,10))
plt.scatter(df,df2)
plt.xlabel("data_albedo")
plt.ylabel("data_k")
plt.show()
```



In [27]:

```
yscale, scaler_y , xscale , scaler_x = normalising_data(df,df2)
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

In [28]:

```
xtrain, xtest, ytrain, ytest = split_data(xscale,yscale)
```

```
(360, 360) (360, 360) (360, 360) (360, 360)
```

In [29]:

```
history , model , ypredicted = model_application(xtrain, xtest, ytrain, ytest)
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_3 (Dense)              (None, 12)                4332
_________________________________________________________________
dense_4 (Dense)              (None, 8)                 104
_________________________________________________________________
dense_5 (Dense)              (None, 360)               3240
=================================================================
Total params: 7,676
Trainable params: 7,676
Non-trainable params: 0
_________________________________________________________________
Epoch 1/150
6/6 [==============================] - 0s 35ms/step - loss: 0.2191 - mse:
0.2191 - mae: 0.3932 - val_loss: 0.2405 - val_mse: 0.2405 - val_mae: 0.404
8
Epoch 2/150
6/6 [==============================] - 0s 55ms/step - loss: 0.2054 - mse:
0.2054 - mae: 0.3781 - val_loss: 0.2254 - val_mse: 0.2254 - val_mae: 0.389
7
Epoch 3/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1882 - mse:
0.1882 - mae: 0.3577 - val_loss: 0.2077 - val_mse: 0.2077 - val_mae: 0.370
7
Epoch 4/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1708 - mse:
0.1708 - mae: 0.3347 - val_loss: 0.1861 - val_mse: 0.1861 - val_mae: 0.346
9
Epoch 5/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1571 - mse:
0.1571 - mae: 0.3179 - val_loss: 0.1654 - val_mse: 0.1654 - val_mae: 0.324
2
Epoch 6/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1389 - mse:
0.1389 - mae: 0.2967 - val_loss: 0.1453 - val_mse: 0.1453 - val_mae: 0.303
1
Epoch 7/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1219 - mse:
0.1219 - mae: 0.2770 - val_loss: 0.1279 - val_mse: 0.1279 - val_mae: 0.285
0
Epoch 8/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1092 - mse:
0.1092 - mae: 0.2627 - val_loss: 0.1133 - val_mse: 0.1133 - val_mae: 0.269
9
Epoch 9/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0940 - mse:
0.0940 - mae: 0.2441 - val_loss: 0.1018 - val_mse: 0.1018 - val_mae: 0.258
9
Epoch 10/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0858 - mse:
0.0858 - mae: 0.2349 - val_loss: 0.0931 - val_mse: 0.0931 - val_mae: 0.249
8
Epoch 11/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0769 - mse:
0.0769 - mae: 0.2235 - val_loss: 0.0860 - val_mse: 0.0860 - val_mae: 0.241
5
Epoch 12/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0713 - mse:
0.0713 - mae: 0.2164 - val_loss: 0.0811 - val_mse: 0.0811 - val_mae: 0.235
```

```
8
Epoch 13/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0667 - mse:
0.0667 - mae: 0.2101 - val_loss: 0.0777 - val_mse: 0.0777 - val_mae: 0.231
3
Epoch 14/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0641 - mse:
0.0641 - mae: 0.2063 - val_loss: 0.0749 - val_mse: 0.0749 - val_mae: 0.228
9
Epoch 15/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0612 - mse:
0.0612 - mae: 0.2025 - val_loss: 0.0724 - val_mse: 0.0724 - val_mae: 0.225
5
Epoch 16/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0613 - mse:
0.0613 - mae: 0.2031 - val_loss: 0.0709 - val_mse: 0.0709 - val_mae: 0.223
1
Epoch 17/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0605 - mse:
0.0605 - mae: 0.2019 - val_loss: 0.0694 - val_mse: 0.0694 - val_mae: 0.220
1
Epoch 18/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0579 - mse:
0.0579 - mae: 0.1971 - val_loss: 0.0681 - val_mse: 0.0681 - val_mae: 0.218
4
Epoch 19/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0571 - mse:
0.0571 - mae: 0.1956 - val_loss: 0.0664 - val_mse: 0.0664 - val_mae: 0.215
1
Epoch 20/150
6/6 [==============================] - 0s 23ms/step - loss: 0.0563 - mse:
0.0563 - mae: 0.1942 - val_loss: 0.0651 - val_mse: 0.0651 - val_mae: 0.213
4
Epoch 21/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0543 - mse:
0.0543 - mae: 0.1902 - val_loss: 0.0638 - val_mse: 0.0638 - val_mae: 0.209
8
Epoch 22/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0549 - mse:
0.0549 - mae: 0.1907 - val_loss: 0.0625 - val_mse: 0.0625 - val_mae: 0.207
5
Epoch 23/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0543 - mse:
0.0543 - mae: 0.1894 - val_loss: 0.0612 - val_mse: 0.0612 - val_mae: 0.203
8
Epoch 24/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0511 - mse:
0.0511 - mae: 0.1834 - val_loss: 0.0593 - val_mse: 0.0593 - val_mae: 0.200
4
Epoch 25/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0506 - mse:
0.0506 - mae: 0.1819 - val_loss: 0.0582 - val_mse: 0.0582 - val_mae: 0.196
9
Epoch 26/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0490 - mse:
0.0490 - mae: 0.1784 - val_loss: 0.0563 - val_mse: 0.0563 - val_mae: 0.193
0
Epoch 27/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0481 - mse:
0.0481 - mae: 0.1762 - val_loss: 0.0553 - val_mse: 0.0553 - val_mae: 0.189
8
```

```
Epoch 28/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0465 - mse:
0.0465 - mae: 0.1728 - val_loss: 0.0537 - val_mse: 0.0537 - val_mae: 0.186
1
Epoch 29/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0438 - mse:
0.0438 - mae: 0.1669 - val_loss: 0.0527 - val_mse: 0.0527 - val_mae: 0.183
5
Epoch 30/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0418 - mse:
0.0418 - mae: 0.1626 - val_loss: 0.0511 - val_mse: 0.0511 - val_mae: 0.179
9
Epoch 31/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0406 - mse:
0.0406 - mae: 0.1593 - val_loss: 0.0508 - val_mse: 0.0508 - val_mae: 0.178
4
Epoch 32/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0393 - mse:
0.0393 - mae: 0.1568 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.176
2
Epoch 33/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0390 - mse:
0.0390 - mae: 0.1557 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.176
1
Epoch 34/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0374 - mse:
0.0374 - mae: 0.1523 - val_loss: 0.0488 - val_mse: 0.0488 - val_mae: 0.174
4
Epoch 35/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0363 - mse:
0.0363 - mae: 0.1494 - val_loss: 0.0488 - val_mse: 0.0488 - val_mae: 0.174
3
Epoch 36/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0358 - mse:
0.0358 - mae: 0.1488 - val_loss: 0.0485 - val_mse: 0.0485 - val_mae: 0.173
9
Epoch 37/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0347 - mse:
0.0347 - mae: 0.1457 - val_loss: 0.0483 - val_mse: 0.0483 - val_mae: 0.173
5
Epoch 38/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0343 - mse:
0.0343 - mae: 0.1455 - val_loss: 0.0486 - val_mse: 0.0486 - val_mae: 0.174
3
Epoch 39/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0331 - mse:
0.0331 - mae: 0.1422 - val_loss: 0.0483 - val_mse: 0.0483 - val_mae: 0.173
7
Epoch 40/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0324 - mse:
0.0324 - mae: 0.1404 - val_loss: 0.0482 - val_mse: 0.0482 - val_mae: 0.173
5
Epoch 41/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0324 - mse:
0.0324 - mae: 0.1405 - val_loss: 0.0484 - val_mse: 0.0484 - val_mae: 0.174
1
Epoch 42/150
6/6 [==============================] - 0s 22ms/step - loss: 0.0309 - mse:
0.0309 - mae: 0.1368 - val_loss: 0.0484 - val_mse: 0.0484 - val_mae: 0.174
3
Epoch 43/150
```

```
6/6 [==============================] - 0s 11ms/step - loss: 0.0314 - mse:
0.0314 - mae: 0.1383 - val_loss: 0.0483 - val_mse: 0.0483 - val_mae: 0.174
3
Epoch 44/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0301 - mse:
0.0301 - mae: 0.1353 - val_loss: 0.0487 - val_mse: 0.0487 - val_mae: 0.175
1
Epoch 45/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0311 - mse:
0.0311 - mae: 0.1376 - val_loss: 0.0489 - val_mse: 0.0489 - val_mae: 0.175
9
Epoch 46/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0310 - mse:
0.0310 - mae: 0.1381 - val_loss: 0.0489 - val_mse: 0.0489 - val_mae: 0.176
0
Epoch 47/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0302 - mse:
0.0302 - mae: 0.1352 - val_loss: 0.0494 - val_mse: 0.0494 - val_mae: 0.177
1
Epoch 48/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0300 - mse:
0.0300 - mae: 0.1352 - val_loss: 0.0484 - val_mse: 0.0484 - val_mae: 0.175
0
Epoch 49/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0299 - mse:
0.0299 - mae: 0.1344 - val_loss: 0.0493 - val_mse: 0.0493 - val_mae: 0.176
8
Epoch 50/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0292 - mse:
0.0292 - mae: 0.1331 - val_loss: 0.0487 - val_mse: 0.0487 - val_mae: 0.175
5
Epoch 51/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0296 - mse:
0.0296 - mae: 0.1337 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.177
3
Epoch 52/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0298 - mse:
0.0298 - mae: 0.1342 - val_loss: 0.0495 - val_mse: 0.0495 - val_mae: 0.176
6
Epoch 53/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0298 - mse:
0.0298 - mae: 0.1347 - val_loss: 0.0491 - val_mse: 0.0491 - val_mae: 0.175
9
Epoch 54/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0289 - mse:
0.0289 - mae: 0.1321 - val_loss: 0.0503 - val_mse: 0.0503 - val_mae: 0.177
9
Epoch 55/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0281 - mse:
0.0281 - mae: 0.1300 - val_loss: 0.0488 - val_mse: 0.0488 - val_mae: 0.175
3
Epoch 56/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0284 - mse:
0.0284 - mae: 0.1306 - val_loss: 0.0506 - val_mse: 0.0506 - val_mae: 0.178
4
Epoch 57/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0286 - mse:
0.0286 - mae: 0.1315 - val_loss: 0.0492 - val_mse: 0.0492 - val_mae: 0.176
2
Epoch 58/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0285 - mse:
```

```
0.0285 - mae: 0.1312 - val_loss: 0.0498 - val_mse: 0.0498 - val_mae: 0.177
3
Epoch 59/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0284 - mse:
0.0284 - mae: 0.1309 - val_loss: 0.0500 - val_mse: 0.0500 - val_mae: 0.177
6
Epoch 60/150
6/6 [==============================] - 0s 22ms/step - loss: 0.0278 - mse:
0.0278 - mae: 0.1296 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.177
2
Epoch 61/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0279 - mse:
0.0279 - mae: 0.1298 - val_loss: 0.0504 - val_mse: 0.0504 - val_mae: 0.178
5
Epoch 62/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0284 - mse:
0.0284 - mae: 0.1310 - val_loss: 0.0499 - val_mse: 0.0499 - val_mae: 0.177
8
Epoch 63/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0284 - mse:
0.0284 - mae: 0.1310 - val_loss: 0.0514 - val_mse: 0.0514 - val_mae: 0.180
2
Epoch 64/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0289 - mse:
0.0289 - mae: 0.1329 - val_loss: 0.0503 - val_mse: 0.0503 - val_mae: 0.178
8
Epoch 65/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0287 - mse:
0.0287 - mae: 0.1318 - val_loss: 0.0510 - val_mse: 0.0510 - val_mae: 0.179
8
Epoch 66/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0283 - mse:
0.0283 - mae: 0.1309 - val_loss: 0.0508 - val_mse: 0.0508 - val_mae: 0.179
3
Epoch 67/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0280 - mse:
0.0280 - mae: 0.1304 - val_loss: 0.0508 - val_mse: 0.0508 - val_mae: 0.179
2
Epoch 68/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0285 - mse:
0.0285 - mae: 0.1315 - val_loss: 0.0509 - val_mse: 0.0509 - val_mae: 0.179
6
Epoch 69/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0283 - mse:
0.0283 - mae: 0.1304 - val_loss: 0.0529 - val_mse: 0.0529 - val_mae: 0.183
1
Epoch 70/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0279 - mse:
0.0279 - mae: 0.1300 - val_loss: 0.0508 - val_mse: 0.0508 - val_mae: 0.179
5
Epoch 71/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0286 - mse:
0.0286 - mae: 0.1313 - val_loss: 0.0518 - val_mse: 0.0518 - val_mae: 0.181
2
Epoch 72/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0275 - mse:
0.0275 - mae: 0.1288 - val_loss: 0.0516 - val_mse: 0.0516 - val_mae: 0.180
8
Epoch 73/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0282 - mse:
0.0282 - mae: 0.1308 - val_loss: 0.0506 - val_mse: 0.0506 - val_mae: 0.179
```

```
1
Epoch 74/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0274 - mse:
0.0274 - mae: 0.1285 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.181
7
Epoch 75/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0275 - mse:
0.0275 - mae: 0.1293 - val_loss: 0.0518 - val_mse: 0.0518 - val_mae: 0.181
2
Epoch 76/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0282 - mse:
0.0282 - mae: 0.1307 - val_loss: 0.0523 - val_mse: 0.0523 - val_mae: 0.182
3
Epoch 77/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0281 - mse:
0.0281 - mae: 0.1305 - val_loss: 0.0525 - val_mse: 0.0525 - val_mae: 0.182
7
Epoch 78/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0282 - mse:
0.0282 - mae: 0.1309 - val_loss: 0.0518 - val_mse: 0.0518 - val_mae: 0.181
2
Epoch 79/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0281 - mse:
0.0281 - mae: 0.1305 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.182
9
Epoch 80/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0274 - mse:
0.0274 - mae: 0.1286 - val_loss: 0.0513 - val_mse: 0.0513 - val_mae: 0.180
3
Epoch 81/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0279 - mse:
0.0279 - mae: 0.1301 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.182
7
Epoch 82/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0281 - mse:
0.0281 - mae: 0.1304 - val_loss: 0.0515 - val_mse: 0.0515 - val_mae: 0.180
7
Epoch 83/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0279 - mse:
0.0279 - mae: 0.1300 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.183
1
Epoch 84/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1292 - val_loss: 0.0534 - val_mse: 0.0534 - val_mae: 0.184
1
Epoch 85/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0273 - mse:
0.0273 - mae: 0.1284 - val_loss: 0.0509 - val_mse: 0.0509 - val_mae: 0.179
5
Epoch 86/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0279 - mse:
0.0279 - mae: 0.1301 - val_loss: 0.0524 - val_mse: 0.0524 - val_mae: 0.181
9
Epoch 87/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0270 - mse:
0.0270 - mae: 0.1279 - val_loss: 0.0522 - val_mse: 0.0522 - val_mae: 0.181
5
Epoch 88/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1297 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.182
9
```

```
Epoch 89/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0272 - mse:
0.0272 - mae: 0.1288 - val_loss: 0.0523 - val_mse: 0.0523 - val_mae: 0.182
2
Epoch 90/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0266 - mse:
0.0266 - mae: 0.1269 - val_loss: 0.0533 - val_mse: 0.0533 - val_mae: 0.183
7
Epoch 91/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1294 - val_loss: 0.0519 - val_mse: 0.0519 - val_mae: 0.181
5
Epoch 92/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0267 - mse:
0.0267 - mae: 0.1271 - val_loss: 0.0527 - val_mse: 0.0527 - val_mae: 0.183
1
Epoch 93/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0272 - mse:
0.0272 - mae: 0.1282 - val_loss: 0.0529 - val_mse: 0.0529 - val_mae: 0.183
4
Epoch 94/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0269 - mse:
0.0269 - mae: 0.1275 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.181
5
Epoch 95/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1295 - val_loss: 0.0540 - val_mse: 0.0540 - val_mae: 0.185
0
Epoch 96/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0277 - mse:
0.0277 - mae: 0.1299 - val_loss: 0.0523 - val_mse: 0.0523 - val_mae: 0.181
7
Epoch 97/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0273 - mse:
0.0273 - mae: 0.1284 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.181
3
Epoch 98/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0268 - mse:
0.0268 - mae: 0.1271 - val_loss: 0.0538 - val_mse: 0.0538 - val_mae: 0.184
6
Epoch 99/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0273 - mse:
0.0273 - mae: 0.1284 - val_loss: 0.0515 - val_mse: 0.0515 - val_mae: 0.180
6
Epoch 100/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0268 - mse:
0.0268 - mae: 0.1266 - val_loss: 0.0538 - val_mse: 0.0538 - val_mae: 0.184
6
Epoch 101/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1292 - val_loss: 0.0532 - val_mse: 0.0532 - val_mae: 0.183
8
Epoch 102/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0276 - mse:
0.0276 - mae: 0.1293 - val_loss: 0.0524 - val_mse: 0.0524 - val_mae: 0.182
1
Epoch 103/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0285 - mse:
0.0285 - mae: 0.1315 - val_loss: 0.0535 - val_mse: 0.0535 - val_mae: 0.184
2
Epoch 104/150
```

```
6/6 [==============================] - 0s 11ms/step - loss: 0.0259 - mse:
0.0259 - mae: 0.1249 - val_loss: 0.0529 - val_mse: 0.0529 - val_mae: 0.182
7
Epoch 105/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0268 - mse:
0.0268 - mae: 0.1268 - val_loss: 0.0523 - val_mse: 0.0523 - val_mae: 0.181
8
Epoch 106/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0269 - mse:
0.0269 - mae: 0.1273 - val_loss: 0.0535 - val_mse: 0.0535 - val_mae: 0.183
6
Epoch 107/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0273 - mse:
0.0273 - mae: 0.1284 - val_loss: 0.0524 - val_mse: 0.0524 - val_mae: 0.181
8
Epoch 108/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0273 - mse:
0.0273 - mae: 0.1284 - val_loss: 0.0531 - val_mse: 0.0531 - val_mae: 0.183
0
Epoch 109/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0266 - mse:
0.0266 - mae: 0.1266 - val_loss: 0.0529 - val_mse: 0.0529 - val_mae: 0.182
6
Epoch 110/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0271 - mse:
0.0271 - mae: 0.1273 - val_loss: 0.0519 - val_mse: 0.0519 - val_mae: 0.180
9
Epoch 111/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0261 - mse:
0.0261 - mae: 0.1252 - val_loss: 0.0547 - val_mse: 0.0547 - val_mae: 0.186
0
Epoch 112/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0265 - mse:
0.0265 - mae: 0.1266 - val_loss: 0.0534 - val_mse: 0.0534 - val_mae: 0.183
7
Epoch 113/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0262 - mse:
0.0262 - mae: 0.1254 - val_loss: 0.0527 - val_mse: 0.0527 - val_mae: 0.182
2
Epoch 114/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0265 - mse:
0.0265 - mae: 0.1263 - val_loss: 0.0535 - val_mse: 0.0535 - val_mae: 0.183
4
Epoch 115/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0270 - mse:
0.0270 - mae: 0.1272 - val_loss: 0.0524 - val_mse: 0.0524 - val_mae: 0.181
7
Epoch 116/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0259 - mse:
0.0259 - mae: 0.1240 - val_loss: 0.0532 - val_mse: 0.0532 - val_mae: 0.183
1
Epoch 117/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0271 - mse:
0.0271 - mae: 0.1276 - val_loss: 0.0516 - val_mse: 0.0516 - val_mae: 0.179
9
Epoch 118/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0269 - mse:
0.0269 - mae: 0.1272 - val_loss: 0.0538 - val_mse: 0.0538 - val_mae: 0.183
9
Epoch 119/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0266 - mse:
```

```
0.0266 - mae: 0.1268 - val_loss: 0.0533 - val_mse: 0.0533 - val_mae: 0.182
8
Epoch 120/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0263 - mse:
0.0263 - mae: 0.1256 - val_loss: 0.0522 - val_mse: 0.0522 - val_mae: 0.180
8
Epoch 121/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0269 - mse:
0.0269 - mae: 0.1267 - val_loss: 0.0526 - val_mse: 0.0526 - val_mae: 0.181
7
Epoch 122/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0263 - mse:
0.0263 - mae: 0.1254 - val_loss: 0.0540 - val_mse: 0.0540 - val_mae: 0.184
1
Epoch 123/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0264 - mse:
0.0264 - mae: 0.1258 - val_loss: 0.0524 - val_mse: 0.0524 - val_mae: 0.180
8
Epoch 124/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0255 - mse:
0.0255 - mae: 0.1232 - val_loss: 0.0522 - val_mse: 0.0522 - val_mae: 0.180
6
Epoch 125/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0267 - mse:
0.0267 - mae: 0.1262 - val_loss: 0.0544 - val_mse: 0.0544 - val_mae: 0.184
8
Epoch 126/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0259 - mse:
0.0259 - mae: 0.1244 - val_loss: 0.0526 - val_mse: 0.0526 - val_mae: 0.181
4
Epoch 127/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0256 - mse:
0.0256 - mae: 0.1235 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.179
9
Epoch 128/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0259 - mse:
0.0259 - mae: 0.1243 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.181
3
Epoch 129/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0257 - mse:
0.0257 - mae: 0.1239 - val_loss: 0.0517 - val_mse: 0.0517 - val_mae: 0.179
7
Epoch 130/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0251 - mse:
0.0251 - mae: 0.1216 - val_loss: 0.0530 - val_mse: 0.0530 - val_mae: 0.182
1
Epoch 131/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0260 - mse:
0.0260 - mae: 0.1241 - val_loss: 0.0532 - val_mse: 0.0532 - val_mae: 0.182
5
Epoch 132/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0258 - mse:
0.0258 - mae: 0.1243 - val_loss: 0.0518 - val_mse: 0.0518 - val_mae: 0.178
9
Epoch 133/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0257 - mse:
0.0257 - mae: 0.1228 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.179
4
Epoch 134/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0256 - mse:
0.0256 - mae: 0.1229 - val_loss: 0.0525 - val_mse: 0.0525 - val_mae: 0.180
```

```
4
Epoch 135/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0250 - mse:
0.0250 - mae: 0.1216 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.180
7
Epoch 136/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0254 - mse:
0.0254 - mae: 0.1226 - val_loss: 0.0519 - val_mse: 0.0519 - val_mae: 0.179
2
Epoch 137/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0256 - mse:
0.0256 - mae: 0.1230 - val_loss: 0.0515 - val_mse: 0.0515 - val_mae: 0.178
4
Epoch 138/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0252 - mse:
0.0252 - mae: 0.1218 - val_loss: 0.0530 - val_mse: 0.0530 - val_mae: 0.181
4
Epoch 139/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0248 - mse:
0.0248 - mae: 0.1210 - val_loss: 0.0527 - val_mse: 0.0527 - val_mae: 0.180
7
Epoch 140/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0254 - mse:
0.0254 - mae: 0.1226 - val_loss: 0.0515 - val_mse: 0.0515 - val_mae: 0.178
1
Epoch 141/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0249 - mse:
0.0249 - mae: 0.1211 - val_loss: 0.0517 - val_mse: 0.0517 - val_mae: 0.178
2
Epoch 142/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0248 - mse:
0.0248 - mae: 0.1209 - val_loss: 0.0521 - val_mse: 0.0521 - val_mae: 0.178
7
Epoch 143/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0250 - mse:
0.0250 - mae: 0.1214 - val_loss: 0.0512 - val_mse: 0.0512 - val_mae: 0.177
3
Epoch 144/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0239 - mse:
0.0239 - mae: 0.1183 - val_loss: 0.0520 - val_mse: 0.0520 - val_mae: 0.178
8
Epoch 145/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0251 - mse:
0.0251 - mae: 0.1215 - val_loss: 0.0510 - val_mse: 0.0510 - val_mae: 0.177
0
Epoch 146/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0242 - mse:
0.0242 - mae: 0.1190 - val_loss: 0.0548 - val_mse: 0.0548 - val_mae: 0.183
9
Epoch 147/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0252 - mse:
0.0252 - mae: 0.1215 - val_loss: 0.0499 - val_mse: 0.0499 - val_mae: 0.174
2
Epoch 148/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0255 - mse:
0.0255 - mae: 0.1228 - val_loss: 0.0501 - val_mse: 0.0501 - val_mae: 0.174
0
Epoch 149/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0243 - mse:
0.0243 - mae: 0.1190 - val_loss: 0.0527 - val_mse: 0.0527 - val_mae: 0.179
5
```

```
Epoch 150/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0248 - mse:
0.0248 - mae: 0.1205 - val_loss: 0.0516 - val_mse: 0.0516 - val_mae: 0.177
3
```

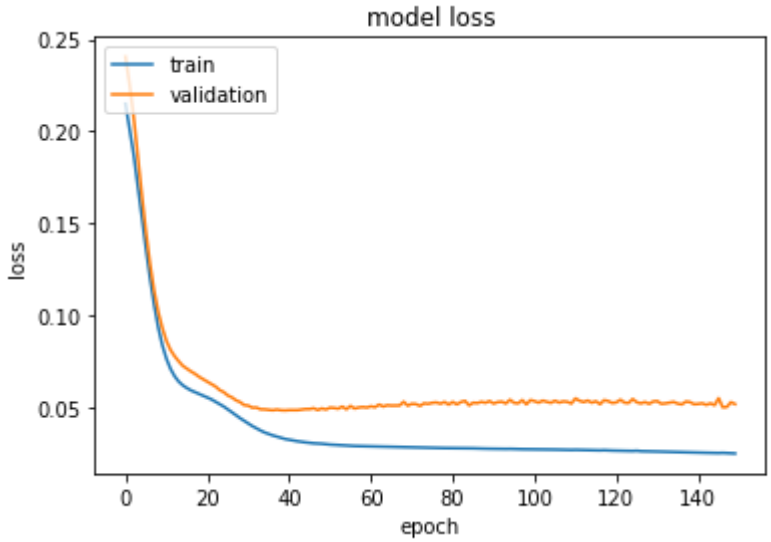
In [30]:

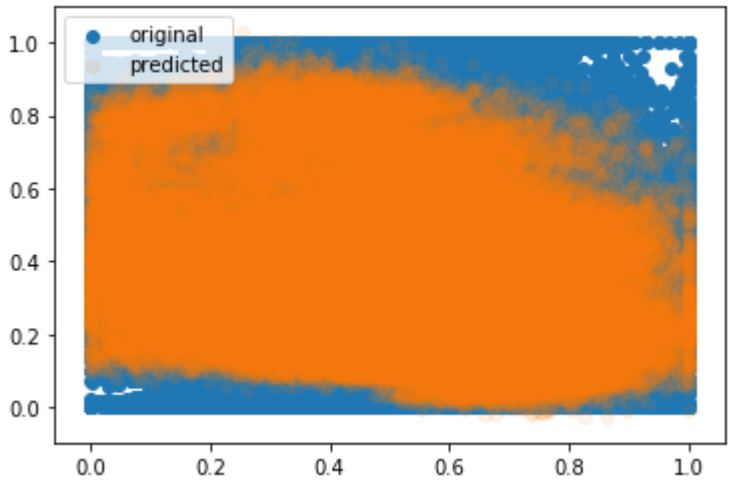
```
xorg , yorg , ytest ,ypredicted, ynew = denormalise(scaler_x,scaler_y ,xtrain, xtest, y
train, ytest, ypredicted)
```

In [31]:

```
visualise_performance(model,history,xtest,ytest)
```

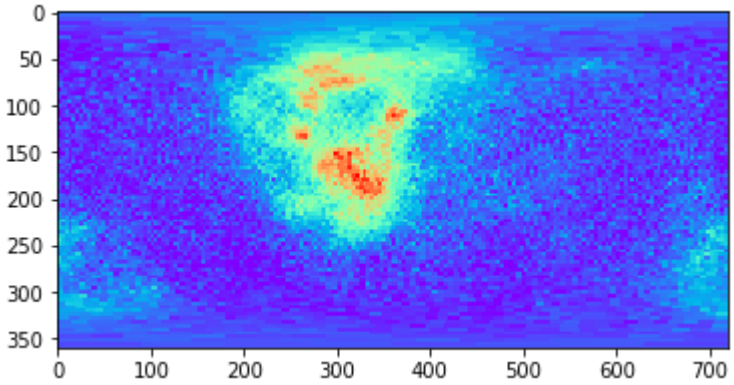
```
dict_keys(['loss', 'mse', 'mae', 'val_loss', 'val_mse', 'val_mae'])
```

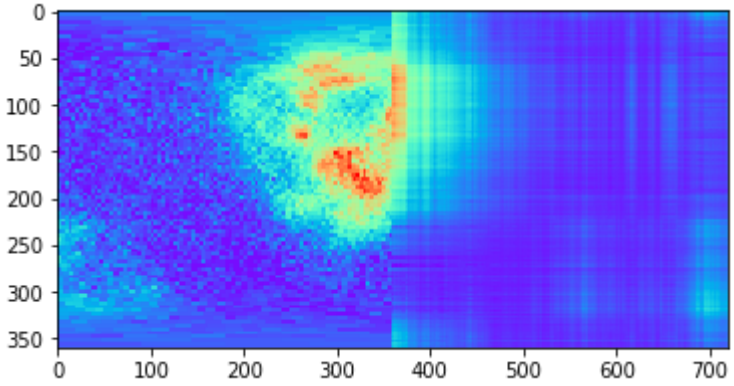


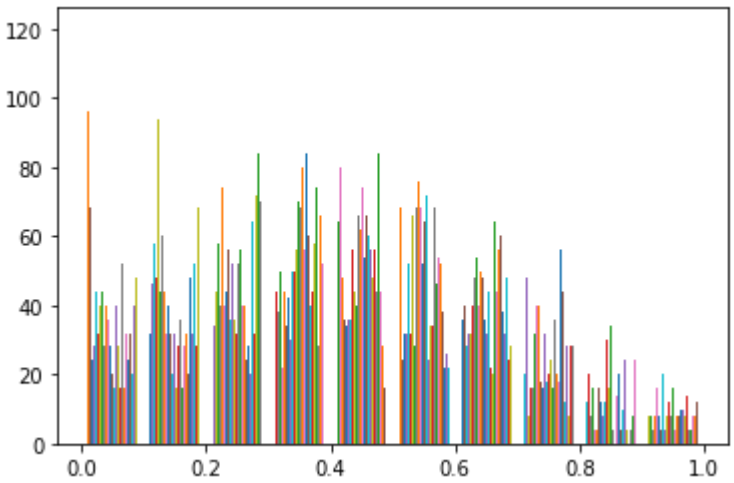


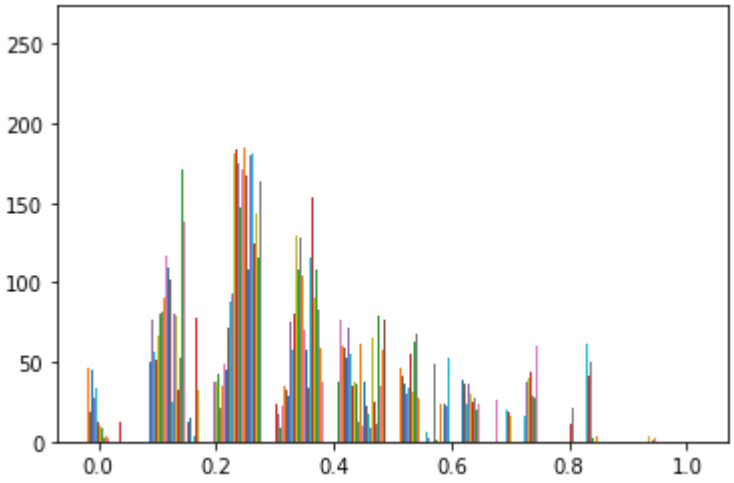
In [32]:

```
visualise_predictions(yorg,ynew)
```


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700

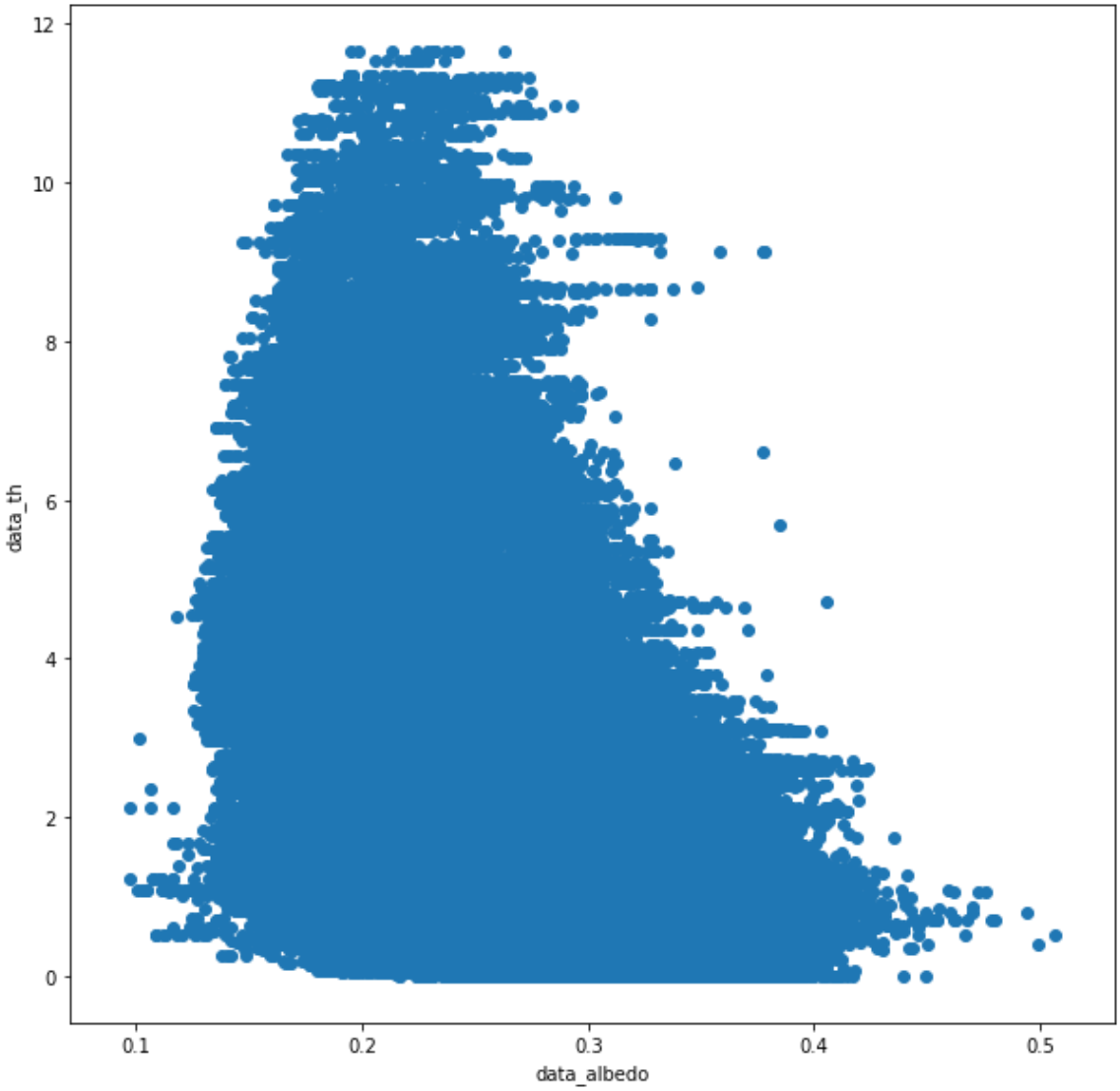

120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0



Thorium Concentration

In [33]:

```
plt.figure(figsize=(10,10))
plt.scatter(df,df3)
plt.xlabel("data_albedo")
plt.ylabel("data_th")
plt.show()
```



In [34]:

```
yscale, scaler_y , xscale , scaler_x = normalising_data(df,df3)
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

In [35]:

```
xtrain, xtest, ytrain, ytest = split_data(xscale,yscale)
```

```
(360, 360) (360, 360) (360, 360) (360, 360)
```

In [36]:

```
history , model , ypredicted = model_application(xtrain, xtest, ytrain, ytest)
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_6 (Dense)              (None, 12)                4332
_________________________________________________________________
dense_7 (Dense)              (None, 8)                 104
_________________________________________________________________
dense_8 (Dense)              (None, 360)               3240
=================================================================
Total params: 7,676
Trainable params: 7,676
Non-trainable params: 0
_________________________________________________________________
Epoch 1/150
6/6 [==============================] - 1s 46ms/step - loss: 0.2304 - mse:
0.2304 - mae: 0.3967 - val_loss: 0.2191 - val_mse: 0.2191 - val_mae: 0.363
3
Epoch 2/150
6/6 [==============================] - 0s 23ms/step - loss: 0.2199 - mse:
0.2199 - mae: 0.3832 - val_loss: 0.2122 - val_mse: 0.2122 - val_mae: 0.357
7
Epoch 3/150
6/6 [==============================] - 0s 20ms/step - loss: 0.2152 - mse:
0.2152 - mae: 0.3772 - val_loss: 0.2031 - val_mse: 0.2031 - val_mae: 0.352
8
Epoch 4/150
6/6 [==============================] - 0s 59ms/step - loss: 0.1996 - mse:
0.1996 - mae: 0.3591 - val_loss: 0.1918 - val_mse: 0.1918 - val_mae: 0.344
6
Epoch 5/150
6/6 [==============================] - 0s 13ms/step - loss: 0.1884 - mse:
0.1884 - mae: 0.3462 - val_loss: 0.1793 - val_mse: 0.1793 - val_mae: 0.334
5
Epoch 6/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1751 - mse:
0.1751 - mae: 0.3323 - val_loss: 0.1667 - val_mse: 0.1667 - val_mae: 0.323
7
Epoch 7/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1626 - mse:
0.1626 - mae: 0.3207 - val_loss: 0.1546 - val_mse: 0.1546 - val_mae: 0.312
4
Epoch 8/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1475 - mse:
0.1475 - mae: 0.3048 - val_loss: 0.1430 - val_mse: 0.1430 - val_mae: 0.300
9
Epoch 9/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1314 - mse:
0.1314 - mae: 0.2867 - val_loss: 0.1333 - val_mse: 0.1333 - val_mae: 0.292
1
Epoch 10/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1213 - mse:
0.1213 - mae: 0.2771 - val_loss: 0.1240 - val_mse: 0.1240 - val_mae: 0.283
6
Epoch 11/150
6/6 [==============================] - 0s 12ms/step - loss: 0.1090 - mse:
0.1090 - mae: 0.2629 - val_loss: 0.1166 - val_mse: 0.1166 - val_mae: 0.277
2
Epoch 12/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0989 - mse:
0.0989 - mae: 0.2514 - val_loss: 0.1112 - val_mse: 0.1112 - val_mae: 0.273
```

```
4
Epoch 13/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0910 - mse:
0.0910 - mae: 0.2429 - val_loss: 0.1053 - val_mse: 0.1053 - val_mae: 0.268
1
Epoch 14/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0868 - mse:
0.0868 - mae: 0.2397 - val_loss: 0.1007 - val_mse: 0.1007 - val_mae: 0.264
5
Epoch 15/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0795 - mse:
0.0795 - mae: 0.2299 - val_loss: 0.0976 - val_mse: 0.0976 - val_mae: 0.262
5
Epoch 16/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0743 - mse:
0.0743 - mae: 0.2238 - val_loss: 0.0938 - val_mse: 0.0938 - val_mae: 0.258
3
Epoch 17/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0699 - mse:
0.0699 - mae: 0.2176 - val_loss: 0.0902 - val_mse: 0.0902 - val_mae: 0.253
7
Epoch 18/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0662 - mse:
0.0662 - mae: 0.2128 - val_loss: 0.0872 - val_mse: 0.0872 - val_mae: 0.250
2
Epoch 19/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0611 - mse:
0.0611 - mae: 0.2042 - val_loss: 0.0827 - val_mse: 0.0827 - val_mae: 0.243
4
Epoch 20/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0586 - mse:
0.0586 - mae: 0.1996 - val_loss: 0.0780 - val_mse: 0.0780 - val_mae: 0.235
1
Epoch 21/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0534 - mse:
0.0534 - mae: 0.1898 - val_loss: 0.0759 - val_mse: 0.0759 - val_mae: 0.232
8
Epoch 22/150
6/6 [==============================] - 0s 27ms/step - loss: 0.0497 - mse:
0.0497 - mae: 0.1828 - val_loss: 0.0707 - val_mse: 0.0707 - val_mae: 0.223
2
Epoch 23/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0450 - mse:
0.0450 - mae: 0.1727 - val_loss: 0.0680 - val_mse: 0.0680 - val_mae: 0.218
5
Epoch 24/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0411 - mse:
0.0411 - mae: 0.1641 - val_loss: 0.0657 - val_mse: 0.0657 - val_mae: 0.214
1
Epoch 25/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0380 - mse:
0.0380 - mae: 0.1570 - val_loss: 0.0629 - val_mse: 0.0629 - val_mae: 0.208
3
Epoch 26/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0347 - mse:
0.0347 - mae: 0.1490 - val_loss: 0.0623 - val_mse: 0.0623 - val_mae: 0.206
8
Epoch 27/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0322 - mse:
0.0322 - mae: 0.1433 - val_loss: 0.0614 - val_mse: 0.0614 - val_mae: 0.204
5
```

```
Epoch 28/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0309 - mse:
0.0309 - mae: 0.1400 - val_loss: 0.0594 - val_mse: 0.0594 - val_mae: 0.200
1
Epoch 29/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0290 - mse:
0.0290 - mae: 0.1349 - val_loss: 0.0605 - val_mse: 0.0605 - val_mae: 0.201
7
Epoch 30/150
6/6 [==============================] - 0s 19ms/step - loss: 0.0282 - mse:
0.0282 - mae: 0.1337 - val_loss: 0.0582 - val_mse: 0.0582 - val_mae: 0.196
7
Epoch 31/150
6/6 [==============================] - 0s 20ms/step - loss: 0.0263 - mse:
0.0263 - mae: 0.1278 - val_loss: 0.0587 - val_mse: 0.0587 - val_mae: 0.197
0
Epoch 32/150
6/6 [==============================] - 0s 19ms/step - loss: 0.0257 - mse:
0.0257 - mae: 0.1265 - val_loss: 0.0579 - val_mse: 0.0579 - val_mae: 0.194
7
Epoch 33/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0249 - mse:
0.0249 - mae: 0.1239 - val_loss: 0.0578 - val_mse: 0.0578 - val_mae: 0.193
6
Epoch 34/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0244 - mse:
0.0244 - mae: 0.1227 - val_loss: 0.0576 - val_mse: 0.0576 - val_mae: 0.192
3
Epoch 35/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0241 - mse:
0.0241 - mae: 0.1221 - val_loss: 0.0575 - val_mse: 0.0575 - val_mae: 0.191
3
Epoch 36/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0232 - mse:
0.0232 - mae: 0.1191 - val_loss: 0.0576 - val_mse: 0.0576 - val_mae: 0.190
8
Epoch 37/150
6/6 [==============================] - 0s 18ms/step - loss: 0.0233 - mse:
0.0233 - mae: 0.1197 - val_loss: 0.0574 - val_mse: 0.0574 - val_mae: 0.190
3
Epoch 38/150
6/6 [==============================] - 0s 17ms/step - loss: 0.0224 - mse:
0.0224 - mae: 0.1173 - val_loss: 0.0567 - val_mse: 0.0567 - val_mae: 0.188
2
Epoch 39/150
6/6 [==============================] - 0s 19ms/step - loss: 0.0223 - mse:
0.0223 - mae: 0.1162 - val_loss: 0.0562 - val_mse: 0.0562 - val_mae: 0.186
7
Epoch 40/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0213 - mse:
0.0213 - mae: 0.1136 - val_loss: 0.0572 - val_mse: 0.0572 - val_mae: 0.187
6
Epoch 41/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0219 - mse:
0.0219 - mae: 0.1157 - val_loss: 0.0564 - val_mse: 0.0564 - val_mae: 0.186
2
Epoch 42/150
6/6 [==============================] - 0s 17ms/step - loss: 0.0212 - mse:
0.0212 - mae: 0.1132 - val_loss: 0.0571 - val_mse: 0.0571 - val_mae: 0.186
9
Epoch 43/150
```

```
6/6 [==============================] - 0s 8ms/step - loss: 0.0201 - mse:
0.0201 - mae: 0.1103 - val_loss: 0.0558 - val_mse: 0.0558 - val_mae: 0.184
2
Epoch 44/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0208 - mse:
0.0208 - mae: 0.1121 - val_loss: 0.0575 - val_mse: 0.0575 - val_mae: 0.186
2
Epoch 45/150
6/6 [==============================] - 0s 20ms/step - loss: 0.0197 - mse:
0.0197 - mae: 0.1090 - val_loss: 0.0554 - val_mse: 0.0554 - val_mae: 0.182
5
Epoch 46/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0201 - mse:
0.0201 - mae: 0.1100 - val_loss: 0.0565 - val_mse: 0.0565 - val_mae: 0.184
2
Epoch 47/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0191 - mse:
0.0191 - mae: 0.1077 - val_loss: 0.0563 - val_mse: 0.0563 - val_mae: 0.183
2
Epoch 48/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0190 - mse:
0.0190 - mae: 0.1068 - val_loss: 0.0558 - val_mse: 0.0558 - val_mae: 0.182
0
Epoch 49/150
6/6 [==============================] - 0s 9ms/step - loss: 0.0191 - mse:
0.0191 - mae: 0.1063 - val_loss: 0.0557 - val_mse: 0.0557 - val_mae: 0.181
4
Epoch 50/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0191 - mse:
0.0191 - mae: 0.1067 - val_loss: 0.0555 - val_mse: 0.0555 - val_mae: 0.181
1
Epoch 51/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0188 - mse:
0.0188 - mae: 0.1057 - val_loss: 0.0561 - val_mse: 0.0561 - val_mae: 0.180
8
Epoch 52/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0183 - mse:
0.0183 - mae: 0.1036 - val_loss: 0.0552 - val_mse: 0.0552 - val_mae: 0.179
5
Epoch 53/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0186 - mse:
0.0186 - mae: 0.1052 - val_loss: 0.0556 - val_mse: 0.0556 - val_mae: 0.180
0
Epoch 54/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0188 - mse:
0.0188 - mae: 0.1051 - val_loss: 0.0545 - val_mse: 0.0545 - val_mae: 0.178
0
Epoch 55/150
6/6 [==============================] - 0s 9ms/step - loss: 0.0178 - mse:
0.0178 - mae: 0.1025 - val_loss: 0.0557 - val_mse: 0.0557 - val_mae: 0.179
2
Epoch 56/150
6/6 [==============================] - 0s 8ms/step - loss: 0.0177 - mse:
0.0177 - mae: 0.1021 - val_loss: 0.0546 - val_mse: 0.0546 - val_mae: 0.176
9
Epoch 57/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0177 - mse:
0.0177 - mae: 0.1020 - val_loss: 0.0542 - val_mse: 0.0542 - val_mae: 0.176
1
Epoch 58/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0179 - mse:
```

```
0.0179 - mae: 0.1027 - val_loss: 0.0550 - val_mse: 0.0550 - val_mae: 0.176
7
Epoch 59/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0174 - mse:
0.0174 - mae: 0.1006 - val_loss: 0.0533 - val_mse: 0.0533 - val_mae: 0.173
5
Epoch 60/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0180 - mse:
0.0180 - mae: 0.1028 - val_loss: 0.0540 - val_mse: 0.0540 - val_mae: 0.174
4
Epoch 61/150
6/6 [==============================] - 0s 16ms/step - loss: 0.0177 - mse:
0.0177 - mae: 0.1014 - val_loss: 0.0539 - val_mse: 0.0539 - val_mae: 0.173
8
Epoch 62/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0173 - mse:
0.0173 - mae: 0.1003 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.171
7
Epoch 63/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0170 - mse:
0.0170 - mae: 0.0990 - val_loss: 0.0539 - val_mse: 0.0539 - val_mae: 0.172
9
Epoch 64/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0172 - mse:
0.0172 - mae: 0.0999 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.171
1
Epoch 65/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0170 - mse:
0.0170 - mae: 0.0990 - val_loss: 0.0536 - val_mse: 0.0536 - val_mae: 0.171
5
Epoch 66/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0169 - mse:
0.0169 - mae: 0.0986 - val_loss: 0.0523 - val_mse: 0.0523 - val_mae: 0.169
2
Epoch 67/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0172 - mse:
0.0172 - mae: 0.0996 - val_loss: 0.0530 - val_mse: 0.0530 - val_mae: 0.170
4
Epoch 68/150
6/6 [==============================] - 0s 7ms/step - loss: 0.0167 - mse:
0.0167 - mae: 0.0983 - val_loss: 0.0528 - val_mse: 0.0528 - val_mae: 0.169
6
Epoch 69/150
6/6 [==============================] - 0s 17ms/step - loss: 0.0164 - mse:
0.0164 - mae: 0.0969 - val_loss: 0.0522 - val_mse: 0.0522 - val_mae: 0.168
2
Epoch 70/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0165 - mse:
0.0165 - mae: 0.0971 - val_loss: 0.0522 - val_mse: 0.0522 - val_mae: 0.167
8
Epoch 71/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0160 - mse:
0.0160 - mae: 0.0954 - val_loss: 0.0512 - val_mse: 0.0512 - val_mae: 0.166
0
Epoch 72/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0162 - mse:
0.0162 - mae: 0.0962 - val_loss: 0.0516 - val_mse: 0.0516 - val_mae: 0.166
3
Epoch 73/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0157 - mse:
0.0157 - mae: 0.0951 - val_loss: 0.0513 - val_mse: 0.0513 - val_mae: 0.165
```

```
5
Epoch 74/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0163 - mse:
0.0163 - mae: 0.0967 - val_loss: 0.0516 - val_mse: 0.0516 - val_mae: 0.165
5
Epoch 75/150
6/6 [==============================] - 0s 9ms/step - loss: 0.0160 - mse:
0.0160 - mae: 0.0960 - val_loss: 0.0504 - val_mse: 0.0504 - val_mae: 0.163
6
Epoch 76/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0161 - mse:
0.0161 - mae: 0.0958 - val_loss: 0.0506 - val_mse: 0.0506 - val_mae: 0.163
7
Epoch 77/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0160 - mse:
0.0160 - mae: 0.0958 - val_loss: 0.0506 - val_mse: 0.0506 - val_mae: 0.163
4
Epoch 78/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0161 - mse:
0.0161 - mae: 0.0960 - val_loss: 0.0509 - val_mse: 0.0509 - val_mae: 0.163
6
Epoch 79/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0157 - mse:
0.0157 - mae: 0.0943 - val_loss: 0.0500 - val_mse: 0.0500 - val_mae: 0.161
9
Epoch 80/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0159 - mse:
0.0159 - mae: 0.0954 - val_loss: 0.0501 - val_mse: 0.0501 - val_mae: 0.161
9
Epoch 81/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0155 - mse:
0.0155 - mae: 0.0936 - val_loss: 0.0498 - val_mse: 0.0498 - val_mae: 0.161
1
Epoch 82/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0159 - mse:
0.0159 - mae: 0.0952 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.161
0
Epoch 83/150
6/6 [==============================] - 0s 27ms/step - loss: 0.0160 - mse:
0.0160 - mae: 0.0954 - val_loss: 0.0497 - val_mse: 0.0497 - val_mae: 0.160
8
Epoch 84/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0160 - mse:
0.0160 - mae: 0.0952 - val_loss: 0.0493 - val_mse: 0.0493 - val_mae: 0.159
9
Epoch 85/150
6/6 [==============================] - 0s 26ms/step - loss: 0.0154 - mse:
0.0154 - mae: 0.0935 - val_loss: 0.0492 - val_mse: 0.0492 - val_mae: 0.159
6
Epoch 86/150
6/6 [==============================] - 0s 18ms/step - loss: 0.0159 - mse:
0.0159 - mae: 0.0944 - val_loss: 0.0493 - val_mse: 0.0493 - val_mae: 0.159
6
Epoch 87/150
6/6 [==============================] - 0s 19ms/step - loss: 0.0155 - mse:
0.0155 - mae: 0.0936 - val_loss: 0.0487 - val_mse: 0.0487 - val_mae: 0.158
5
Epoch 88/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0155 - mse:
0.0155 - mae: 0.0936 - val_loss: 0.0494 - val_mse: 0.0494 - val_mae: 0.159
3
```

```
Epoch 89/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0155 - mse:
0.0155 - mae: 0.0935 - val_loss: 0.0486 - val_mse: 0.0486 - val_mae: 0.158
0
Epoch 90/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0158 - mse:
0.0158 - mae: 0.0948 - val_loss: 0.0487 - val_mse: 0.0487 - val_mae: 0.158
1
Epoch 91/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0157 - mse:
0.0157 - mae: 0.0942 - val_loss: 0.0482 - val_mse: 0.0482 - val_mae: 0.157
4
Epoch 92/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0153 - mse:
0.0153 - mae: 0.0927 - val_loss: 0.0492 - val_mse: 0.0492 - val_mae: 0.158
6
Epoch 93/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0152 - mse:
0.0152 - mae: 0.0927 - val_loss: 0.0478 - val_mse: 0.0478 - val_mae: 0.156
1
Epoch 94/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0154 - mse:
0.0154 - mae: 0.0933 - val_loss: 0.0485 - val_mse: 0.0485 - val_mae: 0.157
1
Epoch 95/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0157 - mse:
0.0157 - mae: 0.0942 - val_loss: 0.0478 - val_mse: 0.0478 - val_mae: 0.156
3
Epoch 96/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0152 - mse:
0.0152 - mae: 0.0923 - val_loss: 0.0483 - val_mse: 0.0483 - val_mae: 0.156
6
Epoch 97/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0154 - mse:
0.0154 - mae: 0.0935 - val_loss: 0.0475 - val_mse: 0.0475 - val_mae: 0.155
5
Epoch 98/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0918 - val_loss: 0.0476 - val_mse: 0.0476 - val_mae: 0.155
5
Epoch 99/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0148 - mse:
0.0148 - mae: 0.0912 - val_loss: 0.0478 - val_mse: 0.0478 - val_mae: 0.155
6
Epoch 100/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0151 - mse:
0.0151 - mae: 0.0923 - val_loss: 0.0477 - val_mse: 0.0477 - val_mae: 0.155
4
Epoch 101/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0150 - mse:
0.0150 - mae: 0.0920 - val_loss: 0.0478 - val_mse: 0.0478 - val_mae: 0.155
6
Epoch 102/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0150 - mse:
0.0150 - mae: 0.0922 - val_loss: 0.0472 - val_mse: 0.0472 - val_mae: 0.154
5
Epoch 103/150
6/6 [==============================] - 0s 24ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0913 - val_loss: 0.0475 - val_mse: 0.0475 - val_mae: 0.154
8
Epoch 104/150
```

```
6/6 [==============================] - 0s 11ms/step - loss: 0.0152 - mse:
0.0152 - mae: 0.0923 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.153
4
Epoch 105/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0152 - mse:
0.0152 - mae: 0.0926 - val_loss: 0.0476 - val_mse: 0.0476 - val_mae: 0.155
0
Epoch 106/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0916 - val_loss: 0.0472 - val_mse: 0.0472 - val_mae: 0.154
4
Epoch 107/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0908 - val_loss: 0.0468 - val_mse: 0.0468 - val_mae: 0.153
5
Epoch 108/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0912 - val_loss: 0.0473 - val_mse: 0.0473 - val_mae: 0.154
0
Epoch 109/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0148 - mse:
0.0148 - mae: 0.0913 - val_loss: 0.0470 - val_mse: 0.0470 - val_mae: 0.153
7
Epoch 110/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0915 - val_loss: 0.0468 - val_mse: 0.0468 - val_mae: 0.153
2
Epoch 111/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0153 - mse:
0.0153 - mae: 0.0927 - val_loss: 0.0470 - val_mse: 0.0470 - val_mae: 0.153
6
Epoch 112/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0150 - mse:
0.0150 - mae: 0.0919 - val_loss: 0.0470 - val_mse: 0.0470 - val_mae: 0.153
6
Epoch 113/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0152 - mse:
0.0152 - mae: 0.0922 - val_loss: 0.0468 - val_mse: 0.0468 - val_mae: 0.153
2
Epoch 114/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0148 - mse:
0.0148 - mae: 0.0913 - val_loss: 0.0465 - val_mse: 0.0465 - val_mae: 0.152
8
Epoch 115/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0910 - val_loss: 0.0472 - val_mse: 0.0472 - val_mae: 0.153
6
Epoch 116/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0151 - mse:
0.0151 - mae: 0.0920 - val_loss: 0.0463 - val_mse: 0.0463 - val_mae: 0.152
0
Epoch 117/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0142 - mse:
0.0142 - mae: 0.0893 - val_loss: 0.0469 - val_mse: 0.0469 - val_mae: 0.152
9
Epoch 118/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0151 - mse:
0.0151 - mae: 0.0916 - val_loss: 0.0460 - val_mse: 0.0460 - val_mae: 0.151
6
Epoch 119/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0151 - mse:
```

```
0.0151 - mae: 0.0915 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.152
1
Epoch 120/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0905 - val_loss: 0.0463 - val_mse: 0.0463 - val_mae: 0.151
7
Epoch 121/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0150 - mse:
0.0150 - mae: 0.0912 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.152
2
Epoch 122/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0149 - mse:
0.0149 - mae: 0.0913 - val_loss: 0.0463 - val_mse: 0.0463 - val_mae: 0.151
9
Epoch 123/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0902 - val_loss: 0.0463 - val_mse: 0.0463 - val_mae: 0.151
6
Epoch 124/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0903 - val_loss: 0.0464 - val_mse: 0.0464 - val_mae: 0.151
8
Epoch 125/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0909 - val_loss: 0.0459 - val_mse: 0.0459 - val_mae: 0.150
9
Epoch 126/150
6/6 [==============================] - 0s 22ms/step - loss: 0.0144 - mse:
0.0144 - mae: 0.0894 - val_loss: 0.0463 - val_mse: 0.0463 - val_mae: 0.151
4
Epoch 127/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0906 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.152
1
Epoch 128/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0144 - mse:
0.0144 - mae: 0.0899 - val_loss: 0.0458 - val_mse: 0.0458 - val_mae: 0.150
9
Epoch 129/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0905 - val_loss: 0.0471 - val_mse: 0.0471 - val_mae: 0.152
4
Epoch 130/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0145 - mse:
0.0145 - mae: 0.0903 - val_loss: 0.0453 - val_mse: 0.0453 - val_mae: 0.150
0
Epoch 131/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0904 - val_loss: 0.0471 - val_mse: 0.0471 - val_mae: 0.152
6
Epoch 132/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0910 - val_loss: 0.0456 - val_mse: 0.0456 - val_mae: 0.150
4
Epoch 133/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0143 - mse:
0.0143 - mae: 0.0890 - val_loss: 0.0467 - val_mse: 0.0467 - val_mae: 0.151
8
Epoch 134/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0145 - mse:
0.0145 - mae: 0.0898 - val_loss: 0.0461 - val_mse: 0.0461 - val_mae: 0.151
```

```
1
Epoch 135/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0142 - mse:
0.0142 - mae: 0.0892 - val_loss: 0.0461 - val_mse: 0.0461 - val_mae: 0.151
1
Epoch 136/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0904 - val_loss: 0.0464 - val_mse: 0.0464 - val_mae: 0.151
4
Epoch 137/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0143 - mse:
0.0143 - mae: 0.0895 - val_loss: 0.0459 - val_mse: 0.0459 - val_mae: 0.150
9
Epoch 138/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0141 - mse:
0.0141 - mae: 0.0888 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.151
6
Epoch 139/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0147 - mse:
0.0147 - mae: 0.0908 - val_loss: 0.0457 - val_mse: 0.0457 - val_mae: 0.150
0
Epoch 140/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0140 - mse:
0.0140 - mae: 0.0886 - val_loss: 0.0460 - val_mse: 0.0460 - val_mae: 0.150
7
Epoch 141/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0144 - mse:
0.0144 - mae: 0.0897 - val_loss: 0.0461 - val_mse: 0.0461 - val_mae: 0.150
6
Epoch 142/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0143 - mse:
0.0143 - mae: 0.0894 - val_loss: 0.0458 - val_mse: 0.0458 - val_mae: 0.150
2
Epoch 143/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0142 - mse:
0.0142 - mae: 0.0891 - val_loss: 0.0459 - val_mse: 0.0459 - val_mae: 0.150
4
Epoch 144/150
6/6 [==============================] - 0s 24ms/step - loss: 0.0141 - mse:
0.0141 - mae: 0.0889 - val_loss: 0.0459 - val_mse: 0.0459 - val_mae: 0.150
4
Epoch 145/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0143 - mse:
0.0143 - mae: 0.0894 - val_loss: 0.0460 - val_mse: 0.0460 - val_mae: 0.150
4
Epoch 146/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0144 - mse:
0.0144 - mae: 0.0899 - val_loss: 0.0460 - val_mse: 0.0460 - val_mae: 0.150
2
Epoch 147/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0146 - mse:
0.0146 - mae: 0.0903 - val_loss: 0.0448 - val_mse: 0.0448 - val_mae: 0.148
7
Epoch 148/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0141 - mse:
0.0141 - mae: 0.0889 - val_loss: 0.0466 - val_mse: 0.0466 - val_mae: 0.151
5
Epoch 149/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0143 - mse:
0.0143 - mae: 0.0894 - val_loss: 0.0450 - val_mse: 0.0450 - val_mae: 0.148
6
```

```
Epoch 150/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0142 - mse:
0.0142 - mae: 0.0888 - val_loss: 0.0465 - val_mse: 0.0465 - val_mae: 0.150
9
```

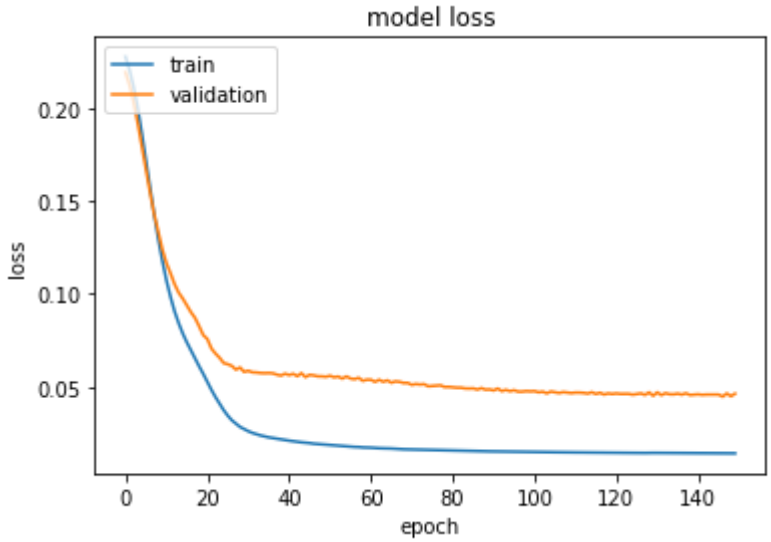
In [37]:

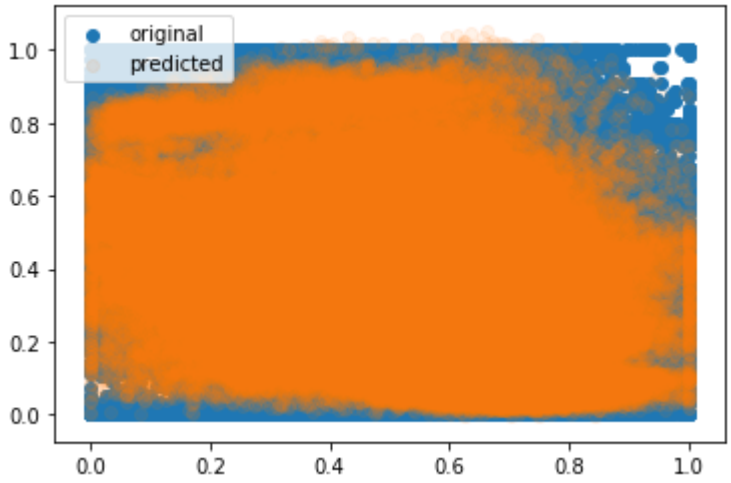
```
xorg , yorg , ytest ,ypredicted, ynew = denormalise(scaler_x,scaler_y ,xtrain, xtest, y
train, ytest, ypredicted)
```

In [38]:

```
visualise_performance(model,history,xtest,ytest)
```

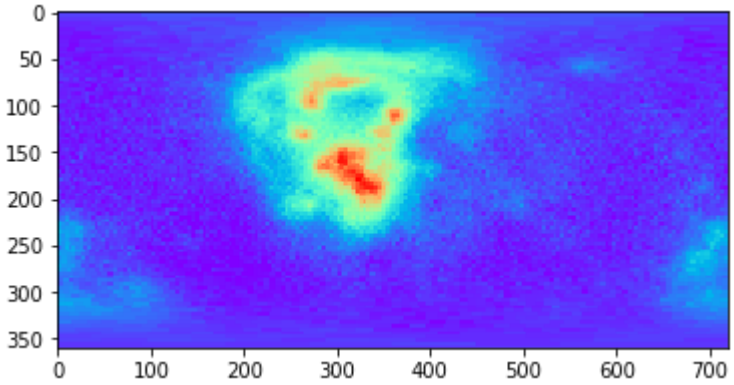
```
dict_keys(['loss', 'mse', 'mae', 'val_loss', 'val_mse', 'val_mae'])
```

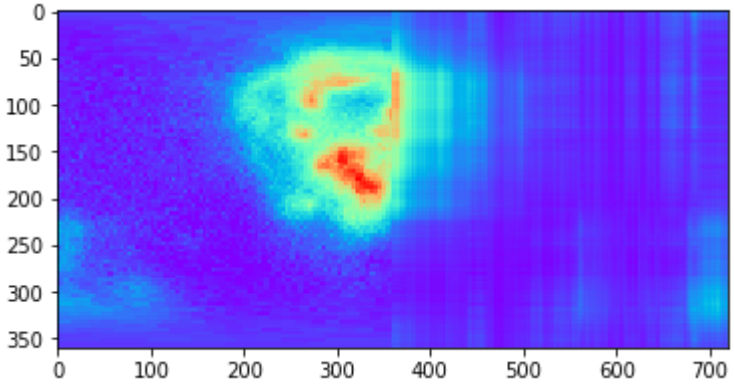


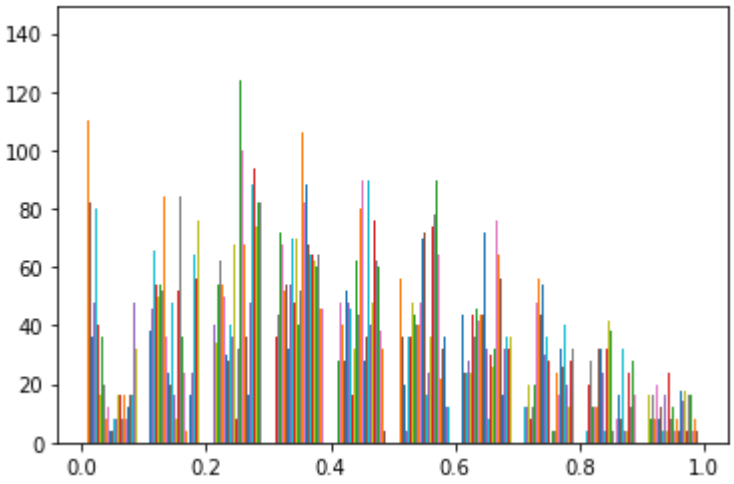


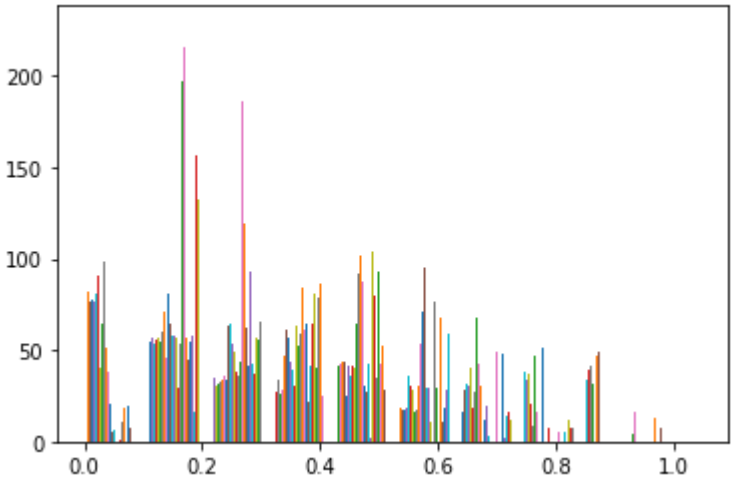
In [39]:

```
visualise_predictions(yorg,ynew)
```


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700

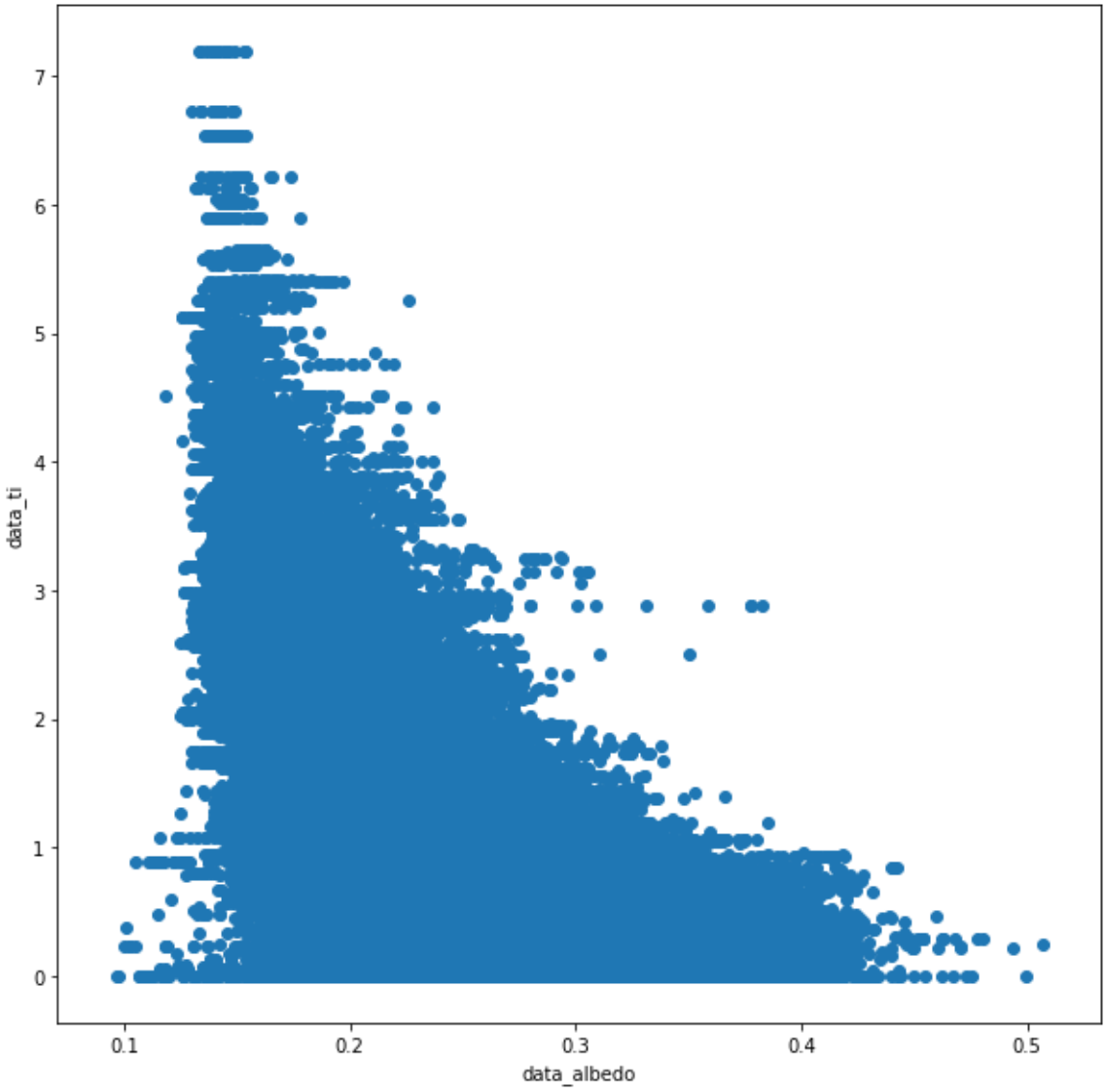

140
120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0



Titanium Concentration

In [40]:

```
plt.figure(figsize=(10,10))
plt.scatter(df,df4)
plt.xlabel("data_albedo")
plt.ylabel("data_ti")
plt.show()
```



In [41]:

```
yscale, scaler_y , xscale , scaler_x = normalising_data(df,df4)
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

In [42]:

```
xtrain, xtest, ytrain, ytest = split_data(xscale,yscale)
```

```
(360, 360) (360, 360) (360, 360) (360, 360)
```

In [43]:

```
history , model , ypredicted = model_application(xtrain, xtest, ytrain, ytest)
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_9 (Dense)              (None, 12)                4332
_________________________________________________________________
dense_10 (Dense)             (None, 8)                 104
_________________________________________________________________
dense_11 (Dense)             (None, 360)               3240
=================================================================
Total params: 7,676
Trainable params: 7,676
Non-trainable params: 0
_________________________________________________________________
Epoch 1/150
6/6 [==============================] - 0s 34ms/step - loss: 0.1062 - mse:
0.1062 - mae: 0.2287 - val_loss: 0.1189 - val_mse: 0.1189 - val_mae: 0.242
4
Epoch 2/150
6/6 [==============================] - 0s 11ms/step - loss: 0.1003 - mse:
0.1003 - mae: 0.2204 - val_loss: 0.1126 - val_mse: 0.1126 - val_mae: 0.235
4
Epoch 3/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0980 - mse:
0.0980 - mae: 0.2208 - val_loss: 0.1048 - val_mse: 0.1048 - val_mae: 0.229
2
Epoch 4/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0881 - mse:
0.0881 - mae: 0.2099 - val_loss: 0.0972 - val_mse: 0.0972 - val_mae: 0.220
8
Epoch 5/150
6/6 [==============================] - 0s 69ms/step - loss: 0.0836 - mse:
0.0836 - mae: 0.2062 - val_loss: 0.0888 - val_mse: 0.0888 - val_mae: 0.214
9
Epoch 6/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0766 - mse:
0.0766 - mae: 0.1998 - val_loss: 0.0817 - val_mse: 0.0817 - val_mae: 0.206
7
Epoch 7/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0719 - mse:
0.0719 - mae: 0.1944 - val_loss: 0.0744 - val_mse: 0.0744 - val_mae: 0.200
6
Epoch 8/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0686 - mse:
0.0686 - mae: 0.1937 - val_loss: 0.0685 - val_mse: 0.0685 - val_mae: 0.194
9
Epoch 9/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0635 - mse:
0.0635 - mae: 0.1881 - val_loss: 0.0636 - val_mse: 0.0636 - val_mae: 0.189
2
Epoch 10/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0596 - mse:
0.0596 - mae: 0.1839 - val_loss: 0.0590 - val_mse: 0.0590 - val_mae: 0.185
3
Epoch 11/150
6/6 [==============================] - 0s 15ms/step - loss: 0.0580 - mse:
0.0580 - mae: 0.1845 - val_loss: 0.0558 - val_mse: 0.0558 - val_mae: 0.182
1
Epoch 12/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0556 - mse:
0.0556 - mae: 0.1812 - val_loss: 0.0532 - val_mse: 0.0532 - val_mae: 0.179
```

```
4
Epoch 13/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0557 - mse:
0.0557 - mae: 0.1824 - val_loss: 0.0511 - val_mse: 0.0511 - val_mae: 0.177
3
Epoch 14/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0545 - mse:
0.0545 - mae: 0.1808 - val_loss: 0.0493 - val_mse: 0.0493 - val_mae: 0.175
3
Epoch 15/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0547 - mse:
0.0547 - mae: 0.1816 - val_loss: 0.0480 - val_mse: 0.0480 - val_mae: 0.173
8
Epoch 16/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0537 - mse:
0.0537 - mae: 0.1806 - val_loss: 0.0469 - val_mse: 0.0469 - val_mae: 0.172
9
Epoch 17/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0526 - mse:
0.0526 - mae: 0.1793 - val_loss: 0.0460 - val_mse: 0.0460 - val_mae: 0.172
4
Epoch 18/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0519 - mse:
0.0519 - mae: 0.1780 - val_loss: 0.0453 - val_mse: 0.0453 - val_mae: 0.170
9
Epoch 19/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0514 - mse:
0.0514 - mae: 0.1772 - val_loss: 0.0446 - val_mse: 0.0446 - val_mae: 0.170
5
Epoch 20/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0522 - mse:
0.0522 - mae: 0.1791 - val_loss: 0.0442 - val_mse: 0.0442 - val_mae: 0.170
6
Epoch 21/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0518 - mse:
0.0518 - mae: 0.1786 - val_loss: 0.0438 - val_mse: 0.0438 - val_mae: 0.169
9
Epoch 22/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0521 - mse:
0.0521 - mae: 0.1791 - val_loss: 0.0437 - val_mse: 0.0437 - val_mae: 0.170
4
Epoch 23/150
6/6 [==============================] - 0s 24ms/step - loss: 0.0513 - mse:
0.0513 - mae: 0.1779 - val_loss: 0.0433 - val_mse: 0.0433 - val_mae: 0.168
9
Epoch 24/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0511 - mse:
0.0511 - mae: 0.1770 - val_loss: 0.0430 - val_mse: 0.0430 - val_mae: 0.168
8
Epoch 25/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0515 - mse:
0.0515 - mae: 0.1782 - val_loss: 0.0428 - val_mse: 0.0428 - val_mae: 0.169
3
Epoch 26/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0510 - mse:
0.0510 - mae: 0.1773 - val_loss: 0.0426 - val_mse: 0.0426 - val_mae: 0.168
2
Epoch 27/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0504 - mse:
0.0504 - mae: 0.1756 - val_loss: 0.0423 - val_mse: 0.0423 - val_mae: 0.168
3
```

```
Epoch 28/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0505 - mse:
0.0505 - mae: 0.1763 - val_loss: 0.0422 - val_mse: 0.0422 - val_mae: 0.168
6
Epoch 29/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0507 - mse:
0.0507 - mae: 0.1771 - val_loss: 0.0416 - val_mse: 0.0416 - val_mae: 0.166
1
Epoch 30/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0512 - mse:
0.0512 - mae: 0.1773 - val_loss: 0.0417 - val_mse: 0.0417 - val_mae: 0.167
7
Epoch 31/150
6/6 [==============================] - 0s 14ms/step - loss: 0.0495 - mse:
0.0495 - mae: 0.1750 - val_loss: 0.0414 - val_mse: 0.0414 - val_mae: 0.166
4
Epoch 32/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0502 - mse:
0.0502 - mae: 0.1756 - val_loss: 0.0414 - val_mse: 0.0414 - val_mae: 0.167
0
Epoch 33/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0494 - mse:
0.0494 - mae: 0.1739 - val_loss: 0.0414 - val_mse: 0.0414 - val_mae: 0.167
0
Epoch 34/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0497 - mse:
0.0497 - mae: 0.1749 - val_loss: 0.0414 - val_mse: 0.0414 - val_mae: 0.167
1
Epoch 35/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0514 - mse:
0.0514 - mae: 0.1775 - val_loss: 0.0412 - val_mse: 0.0412 - val_mae: 0.166
5
Epoch 36/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0496 - mse:
0.0496 - mae: 0.1733 - val_loss: 0.0410 - val_mse: 0.0410 - val_mae: 0.166
6
Epoch 37/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0504 - mse:
0.0504 - mae: 0.1763 - val_loss: 0.0406 - val_mse: 0.0406 - val_mae: 0.165
9
Epoch 38/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0498 - mse:
0.0498 - mae: 0.1743 - val_loss: 0.0404 - val_mse: 0.0404 - val_mae: 0.164
5
Epoch 39/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0504 - mse:
0.0504 - mae: 0.1750 - val_loss: 0.0400 - val_mse: 0.0400 - val_mae: 0.164
5
Epoch 40/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0501 - mse:
0.0501 - mae: 0.1748 - val_loss: 0.0399 - val_mse: 0.0399 - val_mae: 0.163
6
Epoch 41/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0500 - mse:
0.0500 - mae: 0.1743 - val_loss: 0.0398 - val_mse: 0.0398 - val_mae: 0.164
2
Epoch 42/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0497 - mse:
0.0497 - mae: 0.1742 - val_loss: 0.0395 - val_mse: 0.0395 - val_mae: 0.163
2
Epoch 43/150
```

```
6/6 [==============================] - 0s 11ms/step - loss: 0.0494 - mse:
0.0494 - mae: 0.1735 - val_loss: 0.0393 - val_mse: 0.0393 - val_mae: 0.162
7
Epoch 44/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0496 - mse:
0.0496 - mae: 0.1733 - val_loss: 0.0393 - val_mse: 0.0393 - val_mae: 0.162
9
Epoch 45/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0500 - mse:
0.0500 - mae: 0.1738 - val_loss: 0.0389 - val_mse: 0.0389 - val_mae: 0.161
6
Epoch 46/150
6/6 [==============================] - 0s 23ms/step - loss: 0.0500 - mse:
0.0500 - mae: 0.1738 - val_loss: 0.0387 - val_mse: 0.0387 - val_mae: 0.161
3
Epoch 47/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0487 - mse:
0.0487 - mae: 0.1717 - val_loss: 0.0386 - val_mse: 0.0386 - val_mae: 0.160
7
Epoch 48/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0493 - mse:
0.0493 - mae: 0.1726 - val_loss: 0.0385 - val_mse: 0.0385 - val_mae: 0.160
7
Epoch 49/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0483 - mse:
0.0483 - mae: 0.1704 - val_loss: 0.0382 - val_mse: 0.0382 - val_mae: 0.159
7
Epoch 50/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0489 - mse:
0.0489 - mae: 0.1723 - val_loss: 0.0379 - val_mse: 0.0379 - val_mae: 0.159
2
Epoch 51/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0485 - mse:
0.0485 - mae: 0.1705 - val_loss: 0.0377 - val_mse: 0.0377 - val_mae: 0.158
0
Epoch 52/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0485 - mse:
0.0485 - mae: 0.1706 - val_loss: 0.0378 - val_mse: 0.0378 - val_mae: 0.159
0
Epoch 53/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0497 - mse:
0.0497 - mae: 0.1734 - val_loss: 0.0374 - val_mse: 0.0374 - val_mae: 0.157
3
Epoch 54/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0481 - mse:
0.0481 - mae: 0.1692 - val_loss: 0.0370 - val_mse: 0.0370 - val_mae: 0.156
2
Epoch 55/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0478 - mse:
0.0478 - mae: 0.1689 - val_loss: 0.0371 - val_mse: 0.0371 - val_mae: 0.156
6
Epoch 56/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0486 - mse:
0.0486 - mae: 0.1700 - val_loss: 0.0371 - val_mse: 0.0371 - val_mae: 0.156
6
Epoch 57/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0488 - mse:
0.0488 - mae: 0.1707 - val_loss: 0.0368 - val_mse: 0.0368 - val_mae: 0.155
4
Epoch 58/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0479 - mse:
```

```
0.0479 - mae: 0.1689 - val_loss: 0.0365 - val_mse: 0.0365 - val_mae: 0.154
4
Epoch 59/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0479 - mse:
0.0479 - mae: 0.1690 - val_loss: 0.0363 - val_mse: 0.0363 - val_mae: 0.153
7
Epoch 60/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0483 - mse:
0.0483 - mae: 0.1691 - val_loss: 0.0360 - val_mse: 0.0360 - val_mae: 0.152
8
Epoch 61/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0473 - mse:
0.0473 - mae: 0.1676 - val_loss: 0.0356 - val_mse: 0.0356 - val_mae: 0.151
1
Epoch 62/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0468 - mse:
0.0468 - mae: 0.1660 - val_loss: 0.0354 - val_mse: 0.0354 - val_mae: 0.150
6
Epoch 63/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0469 - mse:
0.0469 - mae: 0.1664 - val_loss: 0.0354 - val_mse: 0.0354 - val_mae: 0.150
5
Epoch 64/150
6/6 [==============================] - 0s 22ms/step - loss: 0.0466 - mse:
0.0466 - mae: 0.1658 - val_loss: 0.0353 - val_mse: 0.0353 - val_mae: 0.150
1
Epoch 65/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0480 - mse:
0.0480 - mae: 0.1675 - val_loss: 0.0353 - val_mse: 0.0353 - val_mae: 0.150
2
Epoch 66/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0469 - mse:
0.0469 - mae: 0.1665 - val_loss: 0.0350 - val_mse: 0.0350 - val_mae: 0.148
8
Epoch 67/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0467 - mse:
0.0467 - mae: 0.1653 - val_loss: 0.0347 - val_mse: 0.0347 - val_mae: 0.147
6
Epoch 68/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0462 - mse:
0.0462 - mae: 0.1641 - val_loss: 0.0346 - val_mse: 0.0346 - val_mae: 0.146
8
Epoch 69/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0460 - mse:
0.0460 - mae: 0.1636 - val_loss: 0.0344 - val_mse: 0.0344 - val_mae: 0.146
1
Epoch 70/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0462 - mse:
0.0462 - mae: 0.1640 - val_loss: 0.0342 - val_mse: 0.0342 - val_mae: 0.145
3
Epoch 71/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0465 - mse:
0.0465 - mae: 0.1647 - val_loss: 0.0342 - val_mse: 0.0342 - val_mae: 0.145
0
Epoch 72/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0459 - mse:
0.0459 - mae: 0.1633 - val_loss: 0.0340 - val_mse: 0.0340 - val_mae: 0.144
2
Epoch 73/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0468 - mse:
0.0468 - mae: 0.1645 - val_loss: 0.0338 - val_mse: 0.0338 - val_mae: 0.143
```

```
4
Epoch 74/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0448 - mse:
0.0448 - mae: 0.1609 - val_loss: 0.0336 - val_mse: 0.0336 - val_mae: 0.141
9
Epoch 75/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0452 - mse:
0.0452 - mae: 0.1617 - val_loss: 0.0334 - val_mse: 0.0334 - val_mae: 0.141
3
Epoch 76/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0461 - mse:
0.0461 - mae: 0.1629 - val_loss: 0.0333 - val_mse: 0.0333 - val_mae: 0.140
6
Epoch 77/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0468 - mse:
0.0468 - mae: 0.1639 - val_loss: 0.0334 - val_mse: 0.0334 - val_mae: 0.140
3
Epoch 78/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0447 - mse:
0.0447 - mae: 0.1602 - val_loss: 0.0329 - val_mse: 0.0329 - val_mae: 0.138
8
Epoch 79/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0462 - mse:
0.0462 - mae: 0.1621 - val_loss: 0.0330 - val_mse: 0.0330 - val_mae: 0.138
4
Epoch 80/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0449 - mse:
0.0449 - mae: 0.1602 - val_loss: 0.0328 - val_mse: 0.0328 - val_mae: 0.137
6
Epoch 81/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0445 - mse:
0.0445 - mae: 0.1588 - val_loss: 0.0329 - val_mse: 0.0329 - val_mae: 0.137
1
Epoch 82/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0448 - mse:
0.0448 - mae: 0.1598 - val_loss: 0.0325 - val_mse: 0.0325 - val_mae: 0.136
3
Epoch 83/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0453 - mse:
0.0453 - mae: 0.1602 - val_loss: 0.0325 - val_mse: 0.0325 - val_mae: 0.135
9
Epoch 84/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0443 - mse:
0.0443 - mae: 0.1586 - val_loss: 0.0325 - val_mse: 0.0325 - val_mae: 0.135
2
Epoch 85/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0440 - mse:
0.0440 - mae: 0.1581 - val_loss: 0.0324 - val_mse: 0.0324 - val_mae: 0.134
7
Epoch 86/150
6/6 [==============================] - 0s 23ms/step - loss: 0.0446 - mse:
0.0446 - mae: 0.1590 - val_loss: 0.0323 - val_mse: 0.0323 - val_mae: 0.134
4
Epoch 87/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0440 - mse:
0.0440 - mae: 0.1576 - val_loss: 0.0322 - val_mse: 0.0322 - val_mae: 0.133
8
Epoch 88/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0432 - mse:
0.0432 - mae: 0.1565 - val_loss: 0.0322 - val_mse: 0.0322 - val_mae: 0.133
2
```

```
Epoch 89/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0455 - mse:
0.0455 - mae: 0.1606 - val_loss: 0.0322 - val_mse: 0.0322 - val_mae: 0.132
9
Epoch 90/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0447 - mse:
0.0447 - mae: 0.1594 - val_loss: 0.0320 - val_mse: 0.0320 - val_mae: 0.132
1
Epoch 91/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0442 - mse:
0.0442 - mae: 0.1582 - val_loss: 0.0320 - val_mse: 0.0320 - val_mae: 0.131
5
Epoch 92/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0425 - mse:
0.0425 - mae: 0.1545 - val_loss: 0.0318 - val_mse: 0.0318 - val_mae: 0.130
7
Epoch 93/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0425 - mse:
0.0425 - mae: 0.1543 - val_loss: 0.0320 - val_mse: 0.0320 - val_mae: 0.130
1
Epoch 94/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0439 - mse:
0.0439 - mae: 0.1571 - val_loss: 0.0318 - val_mse: 0.0318 - val_mae: 0.130
4
Epoch 95/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0432 - mse:
0.0432 - mae: 0.1560 - val_loss: 0.0319 - val_mse: 0.0319 - val_mae: 0.129
9
Epoch 96/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0448 - mse:
0.0448 - mae: 0.1590 - val_loss: 0.0317 - val_mse: 0.0317 - val_mae: 0.129
8
Epoch 97/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0438 - mse:
0.0438 - mae: 0.1572 - val_loss: 0.0318 - val_mse: 0.0318 - val_mae: 0.129
1
Epoch 98/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0426 - mse:
0.0426 - mae: 0.1546 - val_loss: 0.0316 - val_mse: 0.0316 - val_mae: 0.128
5
Epoch 99/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0420 - mse:
0.0420 - mae: 0.1532 - val_loss: 0.0316 - val_mse: 0.0316 - val_mae: 0.127
9
Epoch 100/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0427 - mse:
0.0427 - mae: 0.1548 - val_loss: 0.0316 - val_mse: 0.0316 - val_mae: 0.127
7
Epoch 101/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0413 - mse:
0.0413 - mae: 0.1520 - val_loss: 0.0316 - val_mse: 0.0316 - val_mae: 0.127
3
Epoch 102/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0409 - mse:
0.0409 - mae: 0.1516 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.127
1
Epoch 103/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0411 - mse:
0.0411 - mae: 0.1512 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.127
0
Epoch 104/150
```

```
6/6 [==============================] - 0s 22ms/step - loss: 0.0418 - mse:
0.0418 - mae: 0.1530 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.126
7
Epoch 105/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0423 - mse:
0.0423 - mae: 0.1543 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.126
5
Epoch 106/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0423 - mse:
0.0423 - mae: 0.1538 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.126
1
Epoch 107/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0423 - mse:
0.0423 - mae: 0.1543 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.125
9
Epoch 108/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0430 - mse:
0.0430 - mae: 0.1557 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.125
6
Epoch 109/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0413 - mse:
0.0413 - mae: 0.1520 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.125
5
Epoch 110/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0430 - mse:
0.0430 - mae: 0.1560 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.125
0
Epoch 111/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0419 - mse:
0.0419 - mae: 0.1539 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.124
8
Epoch 112/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0424 - mse:
0.0424 - mae: 0.1547 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.124
5
Epoch 113/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0411 - mse:
0.0411 - mae: 0.1521 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.124
1
Epoch 114/150
6/6 [==============================] - 0s 13ms/step - loss: 0.0406 - mse:
0.0406 - mae: 0.1512 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.123
9
Epoch 115/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0407 - mse:
0.0407 - mae: 0.1517 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.123
6
Epoch 116/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0414 - mse:
0.0414 - mae: 0.1532 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.123
2
Epoch 117/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0396 - mse:
0.0396 - mae: 0.1491 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.122
7
Epoch 118/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0409 - mse:
0.0409 - mae: 0.1522 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.122
4
Epoch 119/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0403 - mse:
```

```
0.0403 - mae: 0.1511 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.122
0
Epoch 120/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0410 - mse:
0.0410 - mae: 0.1525 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.121
9
Epoch 121/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0390 - mse:
0.0390 - mae: 0.1486 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.121
7
Epoch 122/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0410 - mse:
0.0410 - mae: 0.1521 - val_loss: 0.0317 - val_mse: 0.0317 - val_mae: 0.121
4
Epoch 123/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0410 - mse:
0.0410 - mae: 0.1527 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.121
4
Epoch 124/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0393 - mse:
0.0393 - mae: 0.1488 - val_loss: 0.0317 - val_mse: 0.0317 - val_mae: 0.121
0
Epoch 125/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0403 - mse:
0.0403 - mae: 0.1508 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.121
0
Epoch 126/150
6/6 [==============================] - 0s 23ms/step - loss: 0.0394 - mse:
0.0394 - mae: 0.1489 - val_loss: 0.0316 - val_mse: 0.0316 - val_mae: 0.120
8
Epoch 127/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0399 - mse:
0.0399 - mae: 0.1500 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
9
Epoch 128/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0404 - mse:
0.0404 - mae: 0.1522 - val_loss: 0.0317 - val_mse: 0.0317 - val_mae: 0.120
8
Epoch 129/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0415 - mse:
0.0415 - mae: 0.1540 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
7
Epoch 130/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0402 - mse:
0.0402 - mae: 0.1515 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
7
Epoch 131/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0407 - mse:
0.0407 - mae: 0.1526 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
5
Epoch 132/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0415 - mse:
0.0415 - mae: 0.1540 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
3
Epoch 133/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0411 - mse:
0.0411 - mae: 0.1525 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.120
5
Epoch 134/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0396 - mse:
0.0396 - mae: 0.1495 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
```

```
3
Epoch 135/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0403 - mse:
0.0403 - mae: 0.1511 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
4
Epoch 136/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0404 - mse:
0.0404 - mae: 0.1513 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
3
Epoch 137/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0408 - mse:
0.0408 - mae: 0.1523 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
4
Epoch 138/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0421 - mse:
0.0421 - mae: 0.1548 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
4
Epoch 139/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0411 - mse:
0.0411 - mae: 0.1532 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
4
Epoch 140/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0393 - mse:
0.0393 - mae: 0.1492 - val_loss: 0.0315 - val_mse: 0.0315 - val_mae: 0.120
3
Epoch 141/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0407 - mse:
0.0407 - mae: 0.1519 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
1
Epoch 142/150
6/6 [==============================] - 0s 12ms/step - loss: 0.0420 - mse:
0.0420 - mae: 0.1551 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
0
Epoch 143/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0407 - mse:
0.0407 - mae: 0.1515 - val_loss: 0.0312 - val_mse: 0.0312 - val_mae: 0.120
0
Epoch 144/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0409 - mse:
0.0409 - mae: 0.1525 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.119
9
Epoch 145/150
6/6 [==============================] - 0s 21ms/step - loss: 0.0402 - mse:
0.0402 - mae: 0.1508 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.120
0
Epoch 146/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0413 - mse:
0.0413 - mae: 0.1539 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.120
1
Epoch 147/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0412 - mse:
0.0412 - mae: 0.1529 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
0
Epoch 148/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0395 - mse:
0.0395 - mae: 0.1499 - val_loss: 0.0313 - val_mse: 0.0313 - val_mae: 0.120
3
Epoch 149/150
6/6 [==============================] - 0s 11ms/step - loss: 0.0400 - mse:
0.0400 - mae: 0.1511 - val_loss: 0.0314 - val_mse: 0.0314 - val_mae: 0.120
1
```

```
Epoch 150/150
6/6 [==============================] - 0s 10ms/step - loss: 0.0393 - mse:
0.0393 - mae: 0.1484 - val_loss: 0.0312 - val_mse: 0.0312 - val_mae: 0.120
2
```

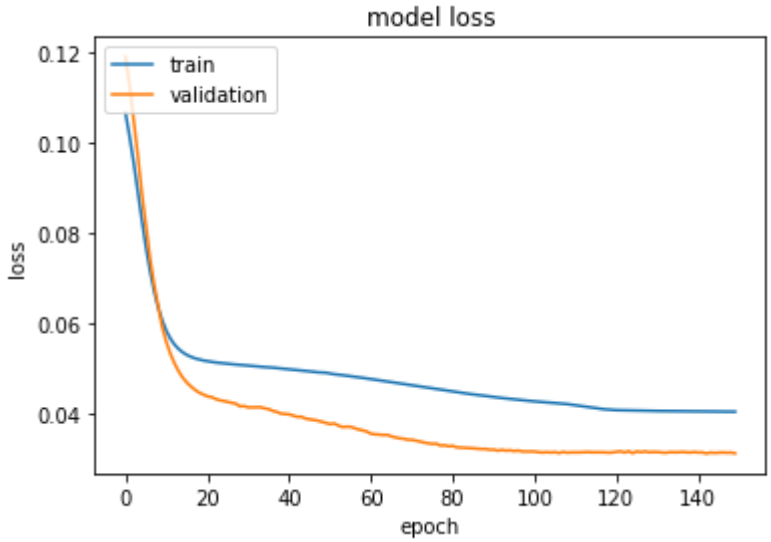
In [44]:

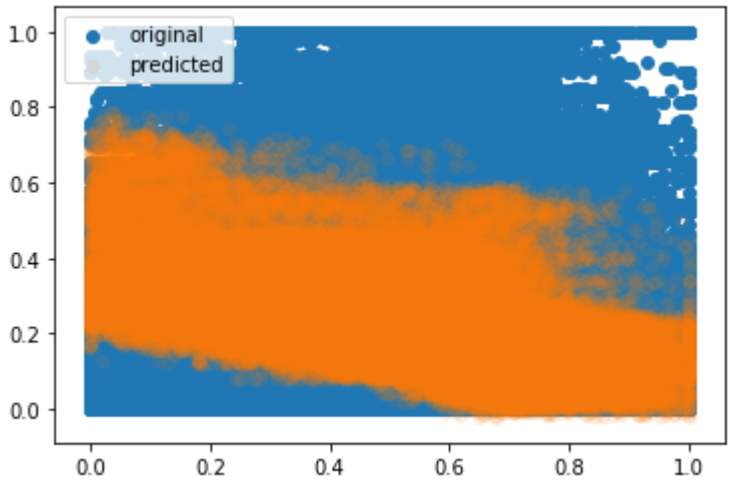
```
xorg , yorg , ytest ,ypredicted, ynew = denormalise(scaler_x,scaler_y ,xtrain, xtest, y
train, ytest, ypredicted)
```

In [45]:

```
visualise_performance(model,history,xtest,ytest)
```

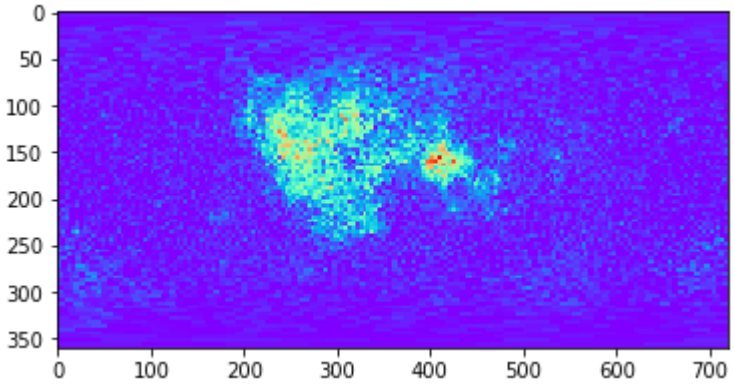
```
dict_keys(['loss', 'mse', 'mae', 'val_loss', 'val_mse', 'val_mae'])
```

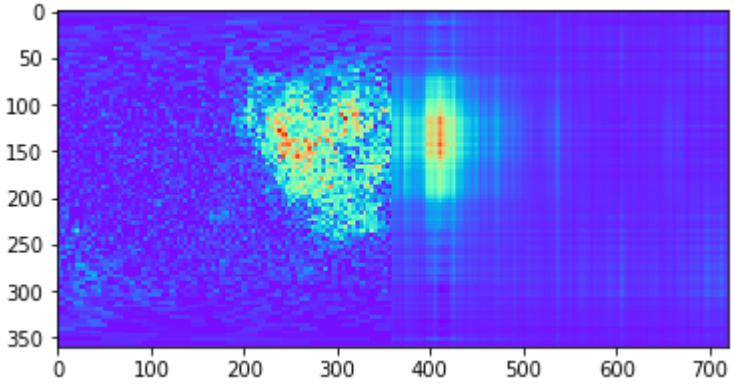


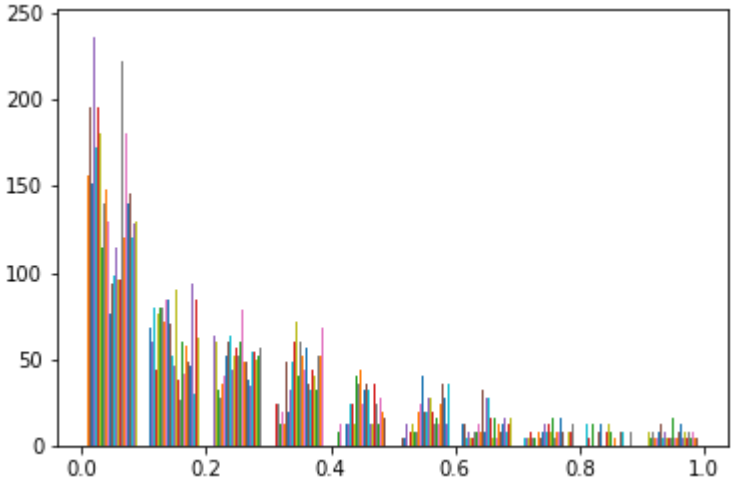


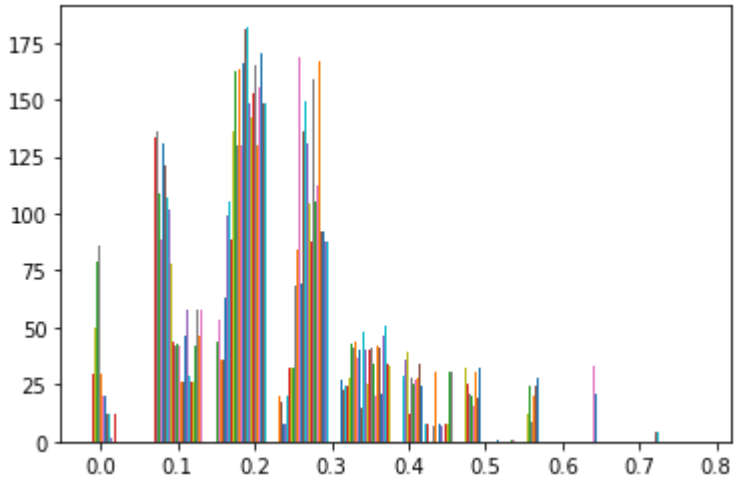
In [46]:

```
visualise_predictions(yorg,ynew)
```


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700


0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700


250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0



Deductions

- Deep Learning Model performs fairly well but in future we can explore more regression models like linear regression and SVR model.
- Better Visualisation of graphs (scaling teachniques)
- Remove image plot distortions for predicted values (ynew)
- Optimise deep learning models for better predictions
- Try more regression algorithms and observe perforamance comparisons