reg_year_r

January 31, 2024

0.1 Importing

[ ]:
```
import xarray as xr
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

from sklearn.ensemble import BaggingRegressor
from sklearn.tree import ExtraTreeRegressor
from sklearn.model_selection import train_test_split
from sklearn import preprocessing

from sklearn.metrics import mean_squared_error as mse

import os
```

0.2 Datasets Preparation (Training)

[ ]:
```
def datasets_preparation ():

    # Dataset and date
    ds_name = ('/results2/SalishSea/nowcast-green.202111/' + i + '/
 ↪SalishSea_1d_' + '20' + str(i[5:7]) + str(dict_month[i[2:5]])+str(i[0:2]) +␣
 ↪'_' + '20' + str(i[5:7]) + str(dict_month[i[2:5]]) + str(i[0:2]) + '_grid_T.
 ↪nc')

    ds_bio_name = ('/results2/SalishSea/nowcast-green.202111/' + i + '/
 ↪SalishSea_1d_'  + '20' + str(i[5:7]) + str(dict_month[i[2:5]])+str(i[0:2]) +␣
 ↪'_' + '20' + str(i[5:7]) + str(dict_month[i[2:5]]) + str(i[0:2]) + '_biol_T.
 ↪nc')

    ds = xr.open_dataset (ds_name)
    ds_bio = xr. open_dataset (ds_bio_name)

    temp_i1 = (ds.votemper.where(mask==1)[0,0:15] * ds.e3t.where(mask==1)
              [0,0:15]).sum('deptht', skipna = True, min_count = 15) / mesh.
 ↪gdepw_0[0,15]
```

```
    temp_i2 = (ds.votemper.where(mask==1)[0,15:27] * ds.e3t.where(mask==1)
              [0,15:27]).sum('deptht', skipna = True, min_count = 12) / (mesh.
↪gdepw_0[0,27] - mesh.gdepw_0[0,14])
    saline_i1 = (ds.vosaline.where(mask==1)[0,0:15] * ds.e3t.where(mask==1)
                  [0,0:15]).sum('deptht', skipna = True, min_count = 15) /␣
↪mesh.gdepw_0[0,15]
    saline_i2 = (ds.vosaline.where(mask==1)[0,15:27] * ds.e3t.where(mask==1)
                  [0,15:27]).sum('deptht', skipna = True, min_count = 12) /␣
↪(mesh.gdepw_0[0,27] - mesh.gdepw_0[0,14])

    diat_i = (ds_bio.diatoms.where(mask==1)[0,0:27] * ds.e3t.where(mask==1)
              [0,0:27]).sum('deptht', skipna = True, min_count = 27) / mesh.
↪gdepw_0[0,27]
    flag_i = (ds_bio.flagellates.where(mask==1)[0,0:27] * ds.e3t.where(mask==1)
              [0,0:27]).sum('deptht', skipna = True, min_count = 27) / mesh.
↪gdepw_0[0,27]

    return (temp_i1, temp_i2, saline_i1, saline_i2, diat_i, flag_i)
```

0.3 Regressor

[ ]:
```
def regressor (inputs, targets, variable_name):

    inputs = inputs.transpose()

    # Regressor
    scale = preprocessing.StandardScaler()
    inputs2 = scale.fit_transform(inputs)
    X_train, X_test, y_train, y_test = train_test_split(inputs2, targets)

    extra_tree = ExtraTreeRegressor(criterion='poisson')
    regr = BaggingRegressor(extra_tree, n_estimators=10, max_features=4,␣
↪n_jobs=-1).fit(X_train, y_train)

    outputs_test = regr.predict(X_test)

    m = scatter_plot(y_test, outputs_test, variable_name + ' (Testing dataset)')
    r = np.round(np.corrcoef(y_test, outputs_test)[0][1],3)
    rms = np.round(mse(y_test, outputs_test),4)


    return (r, rms, m, regr)
```

1 Printing

[ ]:
```
def printing (targets, outputs, m):

    print ('The amount of data points is', outputs.size)
    print ('The slope of the best fitting line is ', np.round(m,3))
    print ('The correlation coefficient is:', np.round(np.corrcoef(targets,␣
 ↪outputs)[0][1],3))
    print (' The mean square error is:', np.round(mse(targets,outputs),5))
```

1.1 Scatter Plot

[ ]:
```
def scatter_plot(targets, outputs, variable_name):

    # compute slope m and intercept b
    m, b = np.polyfit(targets, outputs, deg=1)

    printing (targets, outputs, m)

    fig, ax = plt.subplots()

    plt.scatter(targets,outputs, alpha = 0.2, s = 10)
    plt.xlabel('targets')
    plt.ylabel('outputs')

    lims = [
        np.min([ax.get_xlim(), ax.get_ylim()]),  # min of both axes
        np.max([ax.get_xlim(), ax.get_ylim()]),  # max of both axes
    ]

    # plot fitted y = m*x + b
    plt.axline(xy1=(0, b), slope=m, color='r')

    ax.set_aspect('equal')
    ax.set_xlim(lims)
    ax.set_ylim(lims)

    ax.plot(lims, lims,linestyle = '--',color = 'k')

    fig.suptitle(str(year) + ', ' + variable_name)

    plt.show()

    return (m)
```

1.2 Plotting

[ ]:
```
def plotting (variable, name):

    plt.plot(years,variable, marker = '.', linestyle = '')
    plt.legend(['diatom','flagellate'])
    plt.xlabel('Years')
    plt.ylabel(name)
    plt.show()
```

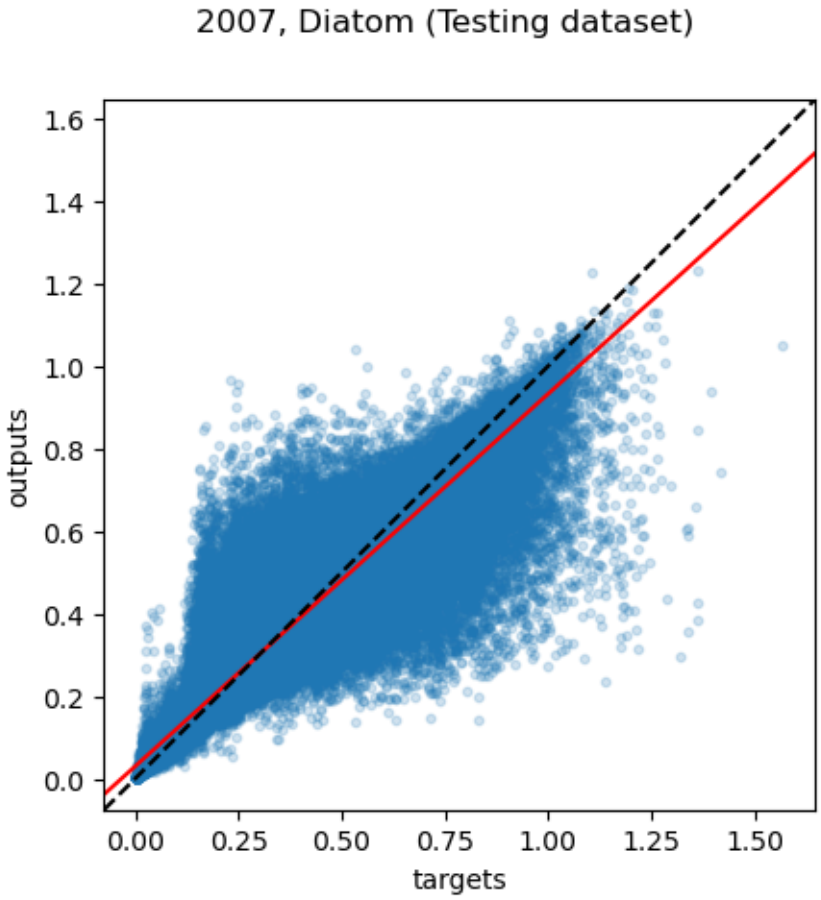
1.3 Main Body

[ ]:
```
dict_month = {'jan': '01',
          'feb': '02',
          'mar': '03',
          'apr': '04',
          'may': '05',
          'jun': '06',
          'jul': '07',
          'aug': '08',
          'sep': '09',
          'oct': '10',
          'nov': '11',
          'dec': '12'}

path = os.listdir('/results2/SalishSea/nowcast-green.202111/')

years = range (2007,2024)

# Open the mesh mask
mesh = xr.open_dataset('/home/sallen/MEOPAR/grid/mesh_mask202108.nc')
mask = mesh.tmask.to_numpy()

r_all = [],[]
rms_all = [],[]
slope_all = [],[]
regr_all = [],[]

for year in range (2007,2024):

    year_str = str(year)[2:4]

    folders = [x for x in path if ((x[2:5]=='mar' or x[2:5]=='apr' or (x[2:
 ↪5]=='feb' and x[0:2] > '14')) and (x[5:7]==year_str))]
    indx_dates=(np.argsort(pd.to_datetime(folders, format="%d%b%y")))
    folders = [folders[i] for i in indx_dates]
```

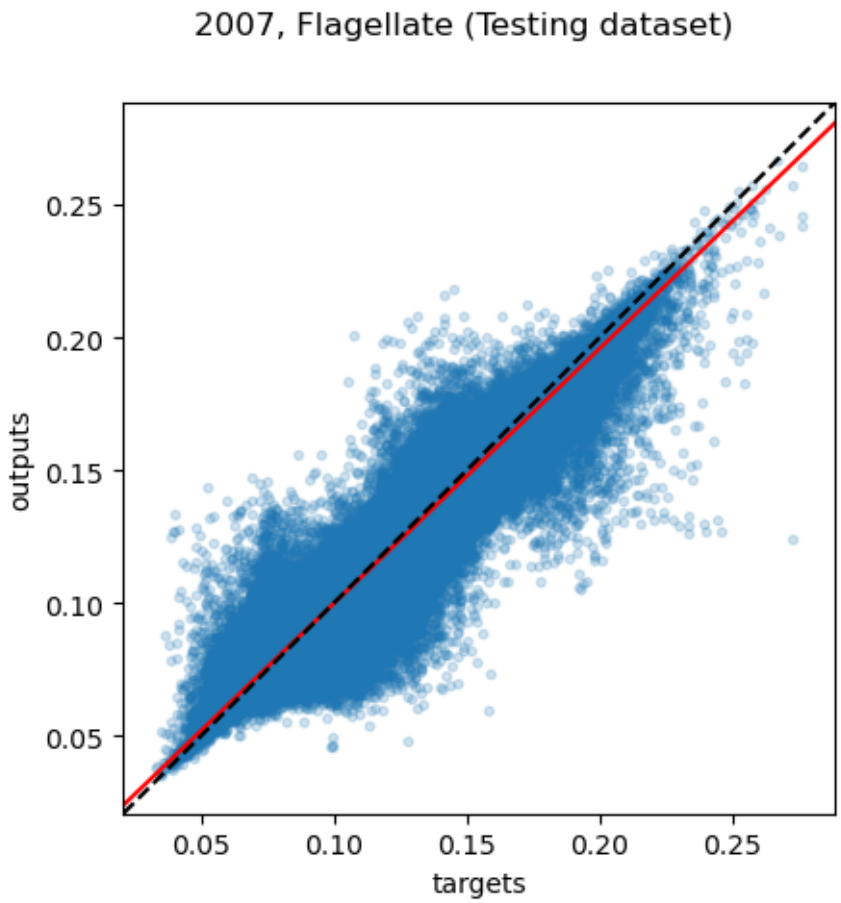
```
    drivers_all = np.array([[],[],[],[]])
    diat_all = np.array([])
    flag_all = np.array([])

    print ('Gathering days for year ' + str(year))
    for i in folders:

        temp_i1, temp_i2, saline_i1, saline_i2, diat_i, flag_i =␣
 ↪datasets_preparation()

        drivers = np.stack([np.ravel(temp_i1), np.ravel(temp_i2), np.
 ↪ravel(saline_i1), np.ravel(saline_i2)])
        indx = np.where(~np.isnan(drivers).any(axis=0))
        drivers = drivers[:,indx[0]]
        drivers_all = np.concatenate((drivers_all,drivers),axis=1)

        diat = np.ravel(diat_i)
        diat = diat[indx[0]]
        diat_all = np.concatenate((diat_all,diat))

        flag = np.ravel(flag_i)
        flag = flag[indx[0]]
        flag_all = np.concatenate((flag_all,flag))

    print ('Done gathering, building the prediction models')
    print ('\n')

    r, rms, m, regr = regressor(drivers_all, diat_all, 'Diatom')
    r_all[0].append(r)
    rms_all[0].append(rms)
    slope_all[0].append(m)
    regr_all[0].append(regr)

    r, rms, m, regr = regressor(drivers_all, flag_all, 'Flagellate')
    r_all[1].append(r)
    rms_all[1].append(rms)
    slope_all[1].append(m)
    regr_all[1].append(regr)

plotting(r_all.transpose(), 'Correlation Coefficient')
plotting(rms_all, 'Mean Square Error')
plotting (slope_all, 'Slope of the best fitting line')
```

```
Gathering days for year 2007
Done gathering, building the prediction models
```

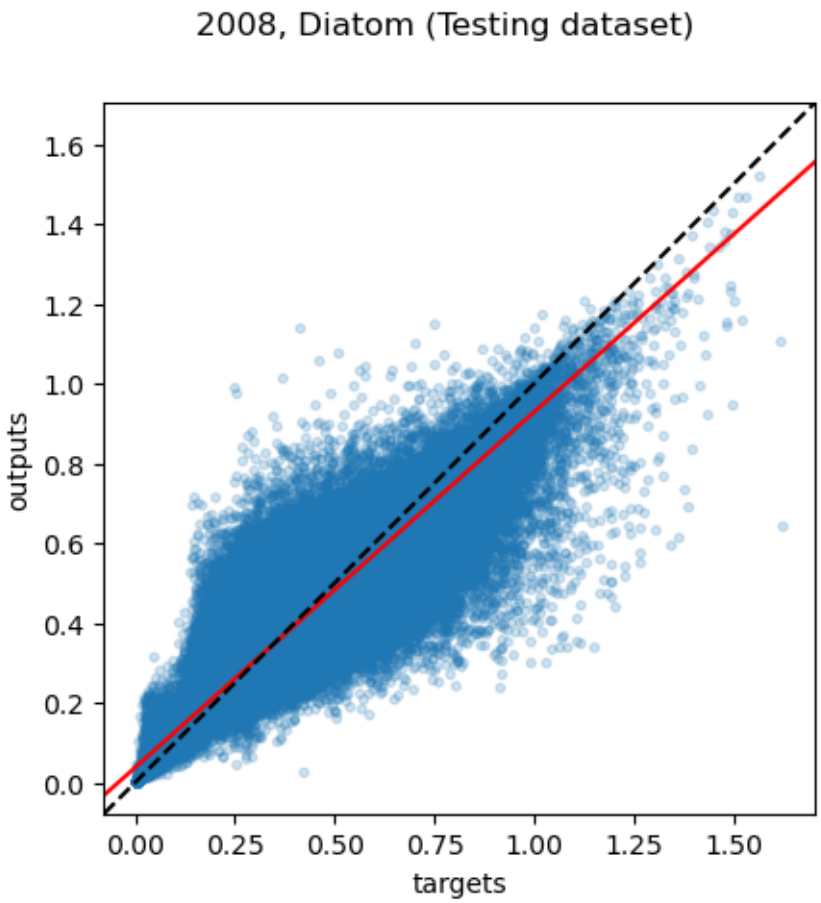
```
The amount of data points is 871482
The slope of the best fitting line is  0.903
The correlation coefficient is: 0.955
 The mean square error is: 0.00227
```



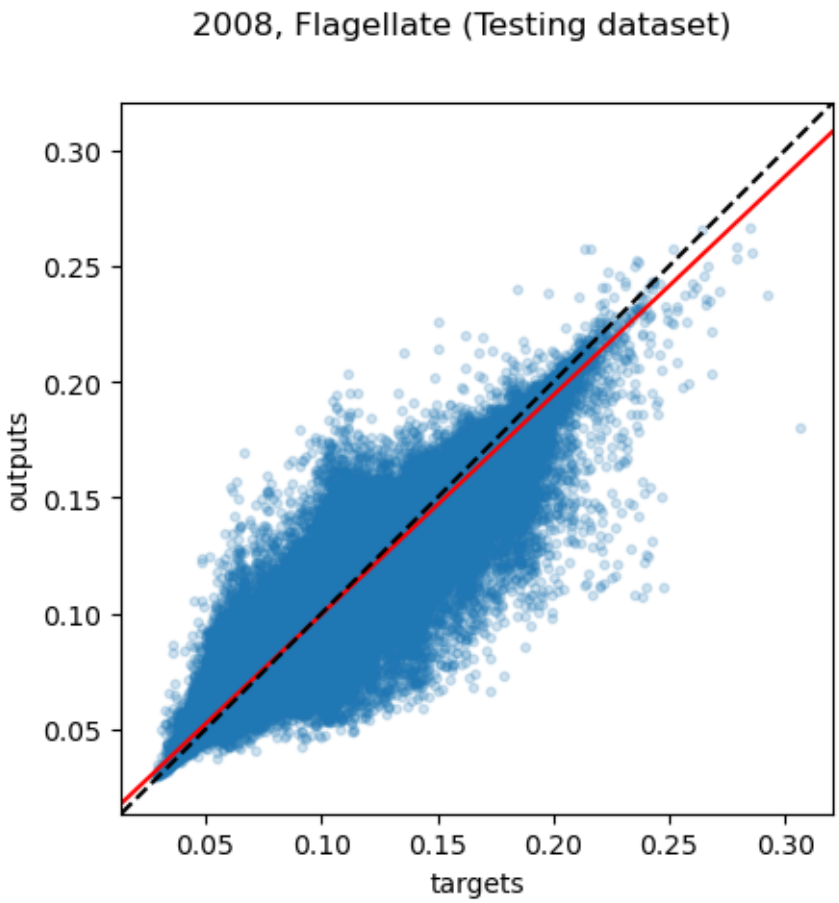

```
The amount of data points is 871482
The slope of the best fitting line is  0.959
The correlation coefficient is: 0.981
 The mean square error is: 3e-05
```



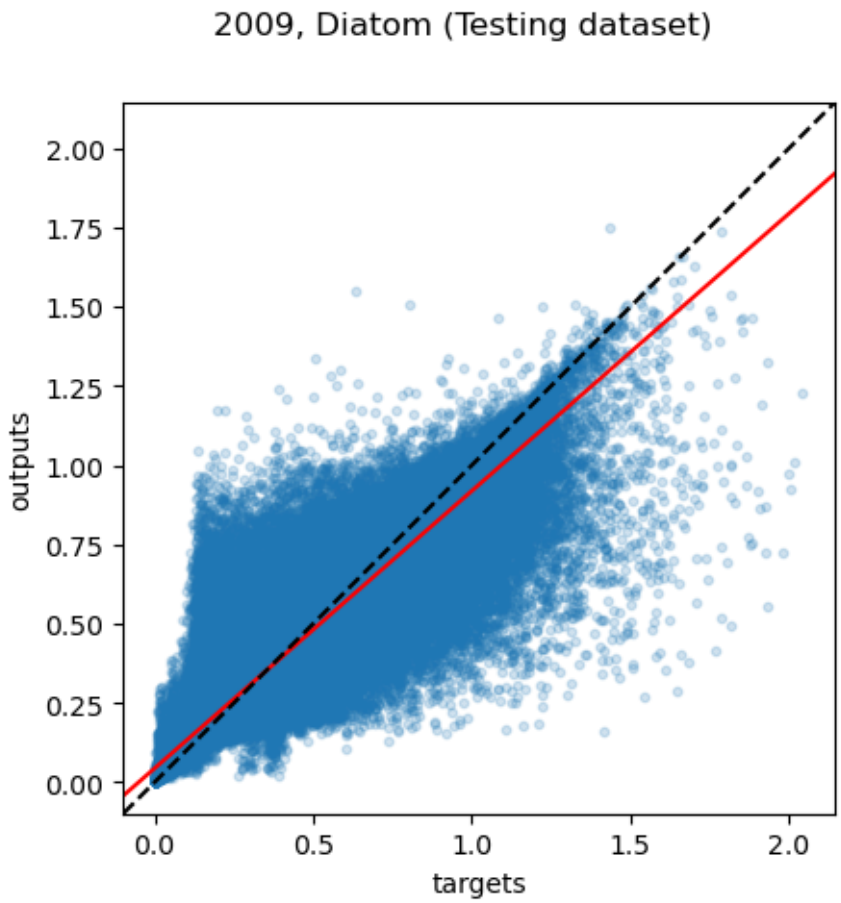

```
Gathering days for year 2008
Done gathering, building the prediction models


The amount of data points is 883101
The slope of the best fitting line is  0.891
The correlation coefficient is: 0.949
 The mean square error is: 0.00207
```



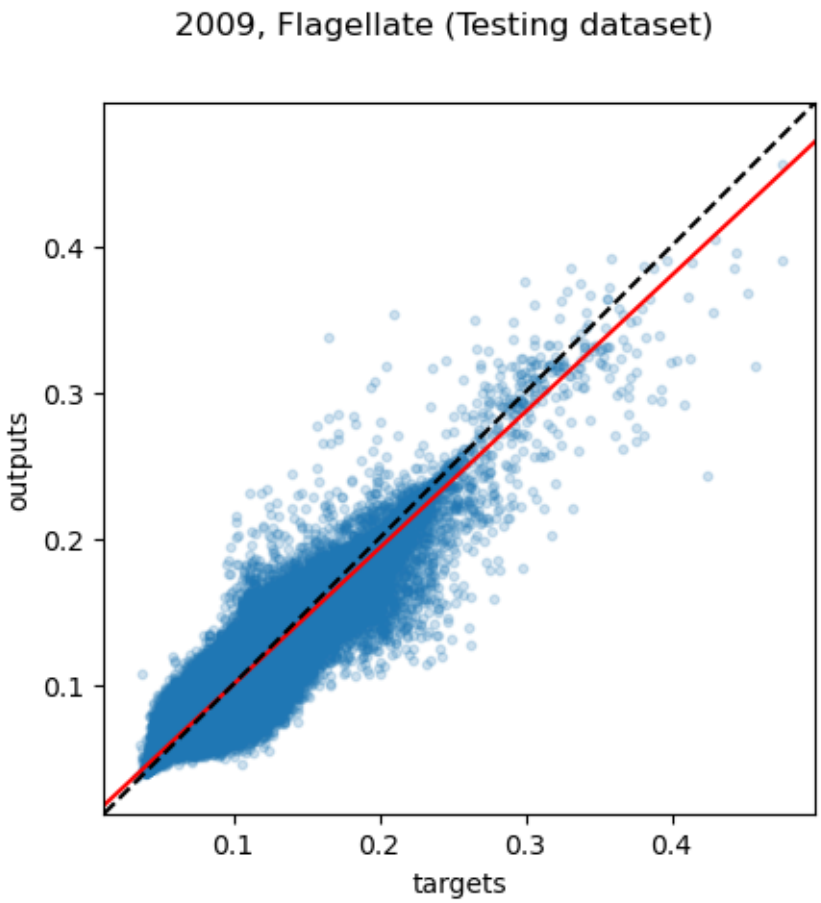

```
The amount of data points is 883101
The slope of the best fitting line is  0.945
The correlation coefficient is: 0.974
 The mean square error is: 4e-05
```



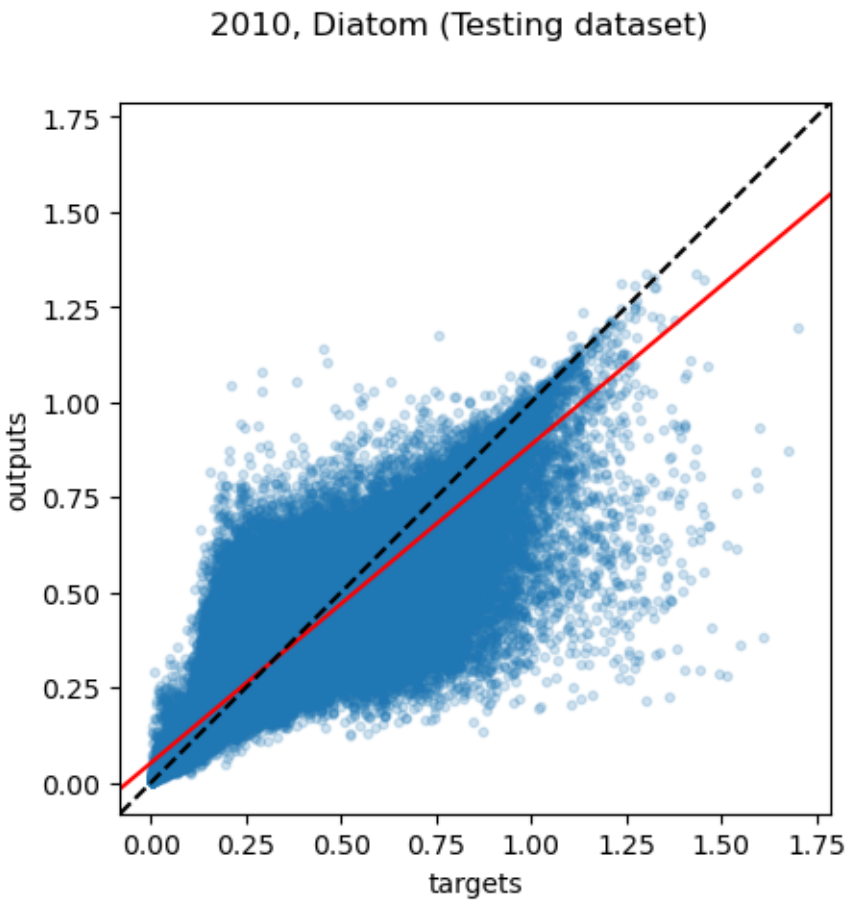

```
Gathering days for year 2009
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.875
The correlation coefficient is: 0.94
 The mean square error is: 0.00448
```



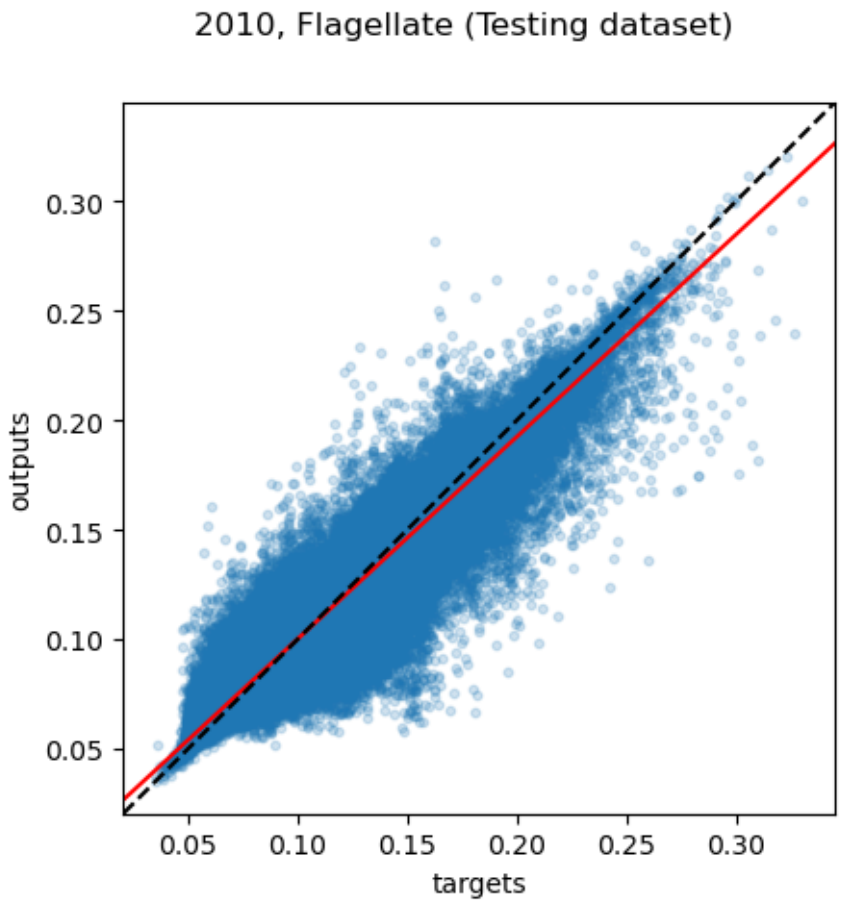

```
The amount of data points is 871482
The slope of the best fitting line is  0.933
The correlation coefficient is: 0.968
 The mean square error is: 5e-05
```



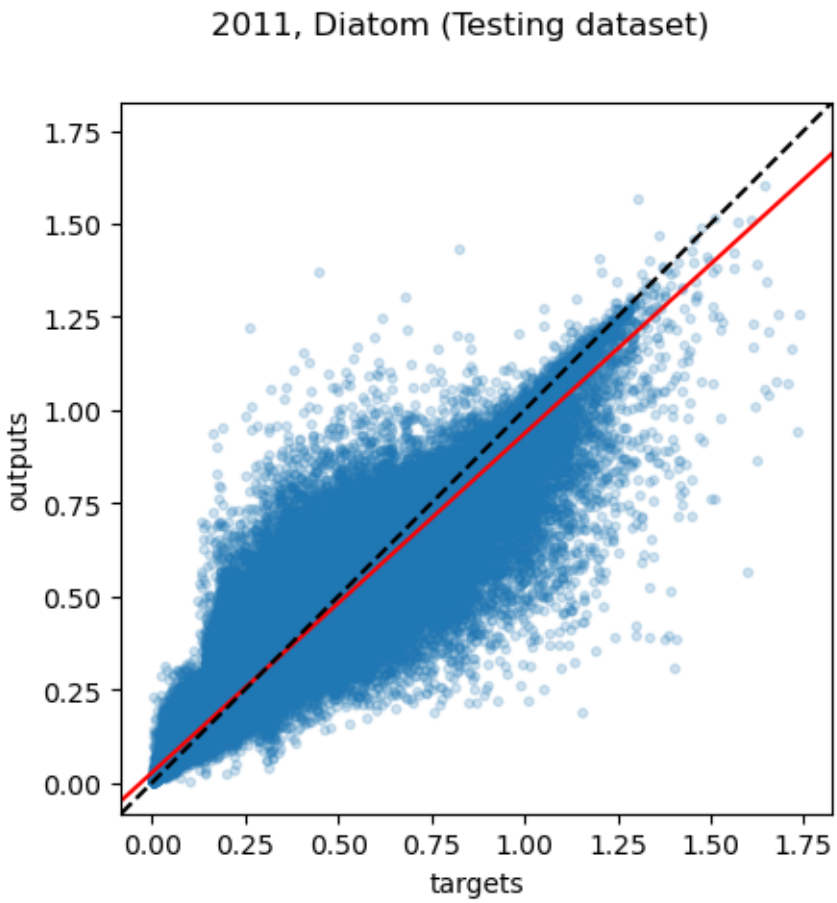

```
Gathering days for year 2010
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.836
The correlation coefficient is: 0.921
 The mean square error is: 0.00322
```



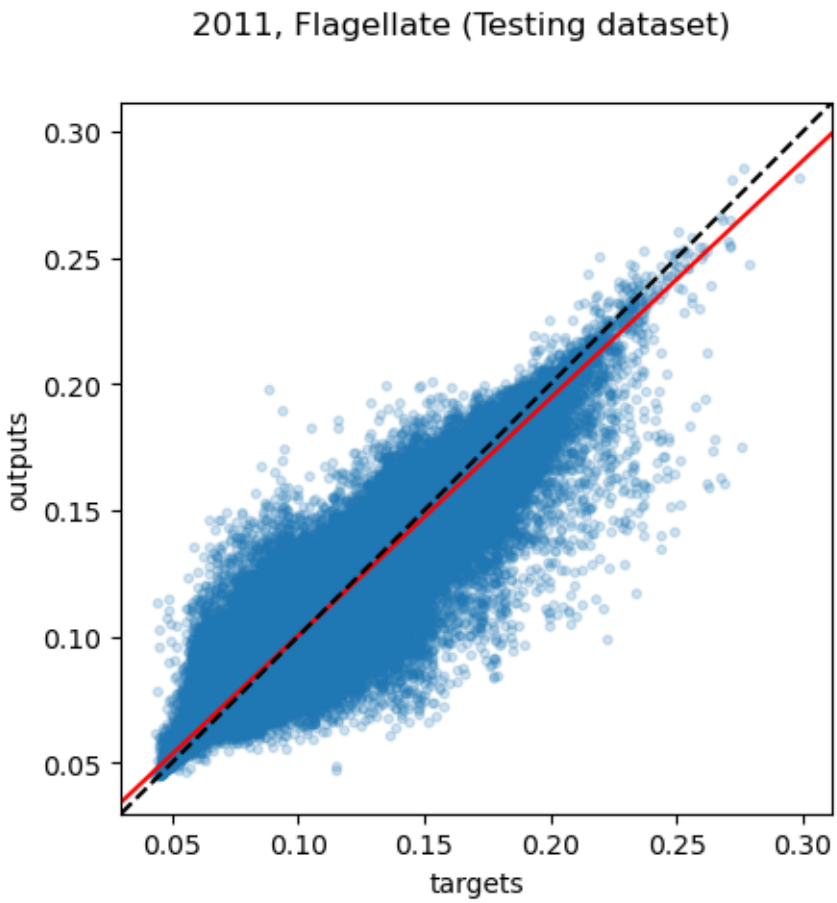

```
The amount of data points is 871482
The slope of the best fitting line is  0.923
The correlation coefficient is: 0.964
 The mean square error is: 5e-05
```



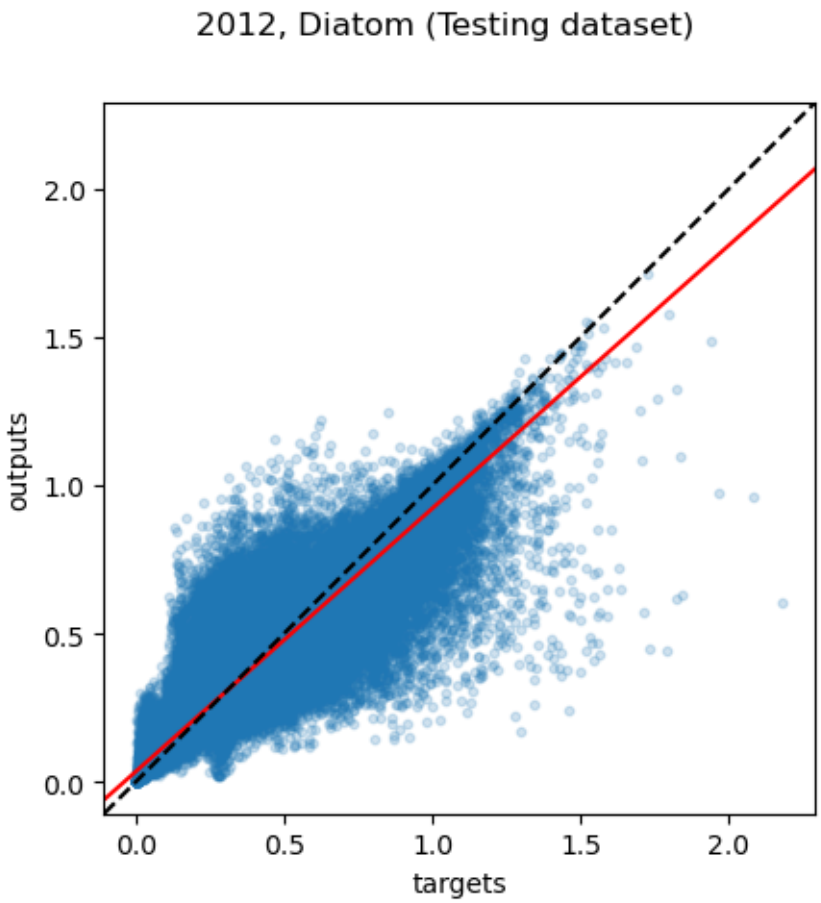

```
Gathering days for year 2011
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.91
The correlation coefficient is: 0.958
 The mean square error is: 0.002
```



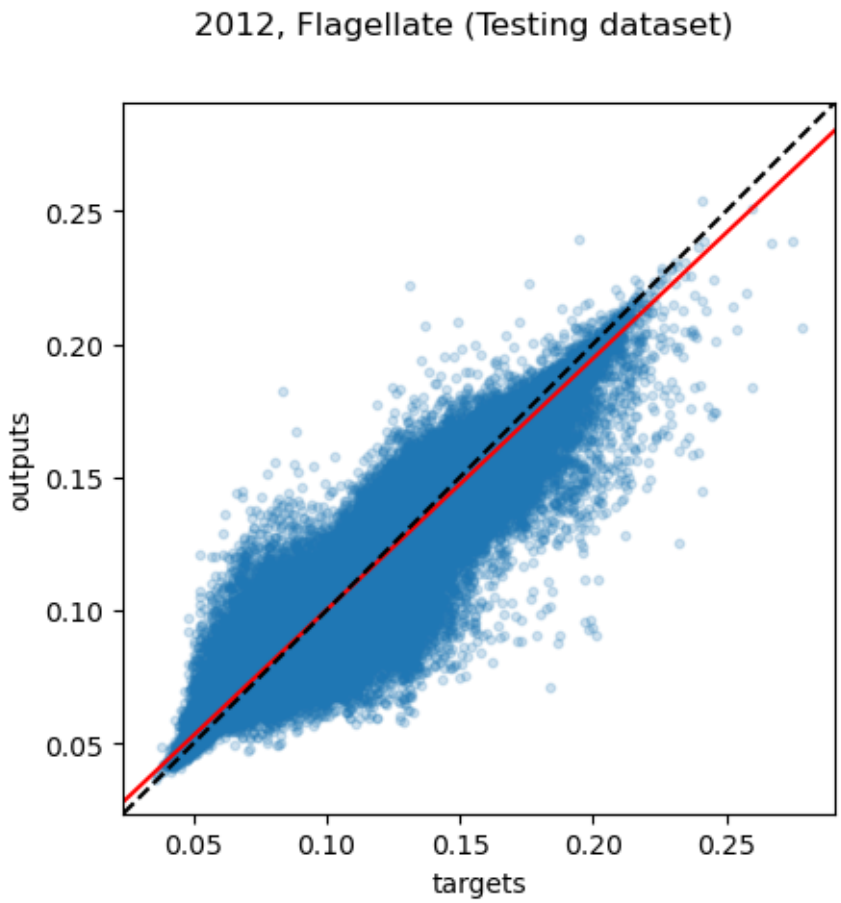

```
The amount of data points is 871482
The slope of the best fitting line is  0.941
The correlation coefficient is: 0.973
 The mean square error is: 4e-05
```



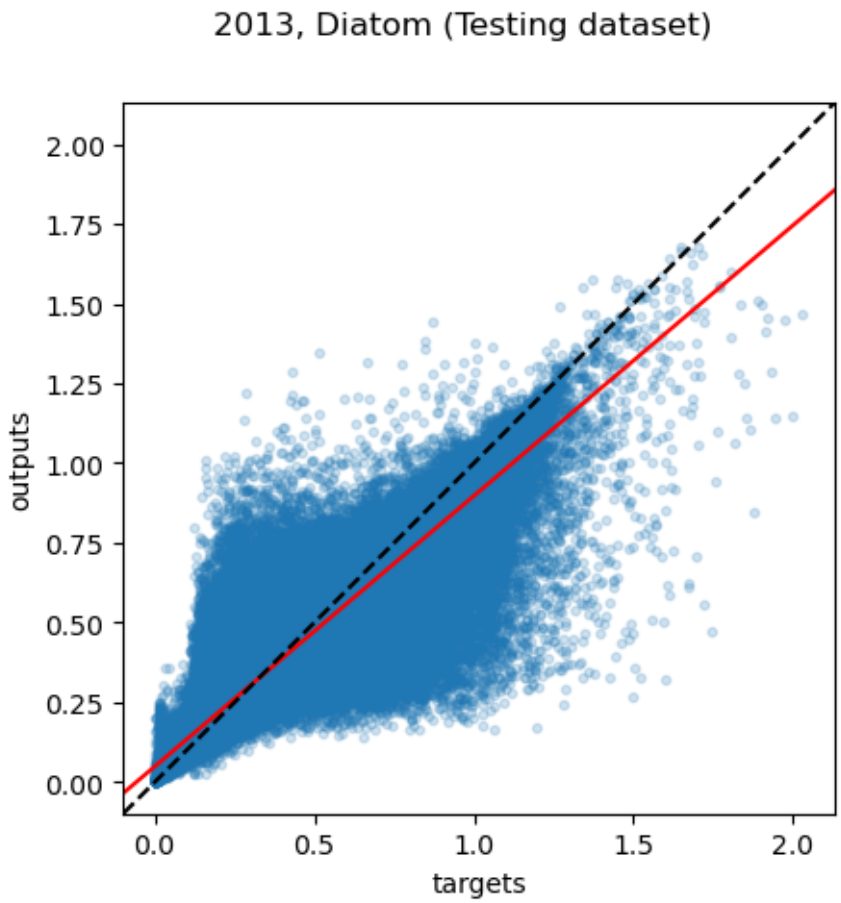

```
Gathering days for year 2012
Done gathering, building the prediction models


The amount of data points is 883101
The slope of the best fitting line is  0.887
The correlation coefficient is: 0.947
 The mean square error is: 0.00259
```



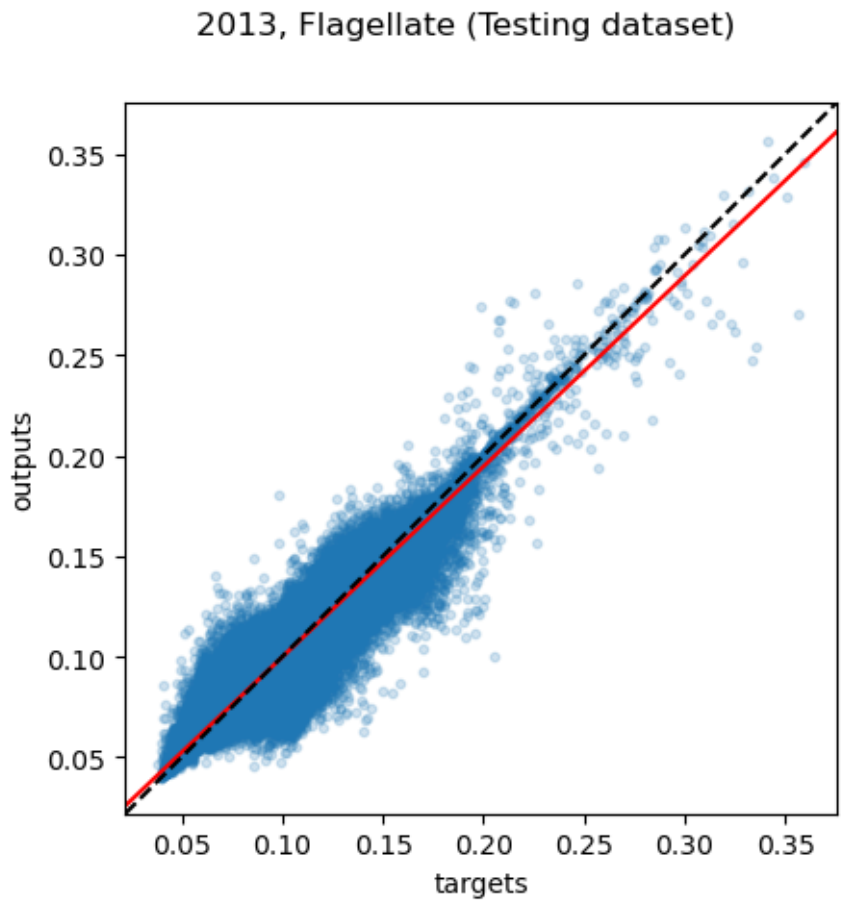

```
The amount of data points is 883101
The slope of the best fitting line is  0.944
The correlation coefficient is: 0.974
 The mean square error is: 4e-05
```



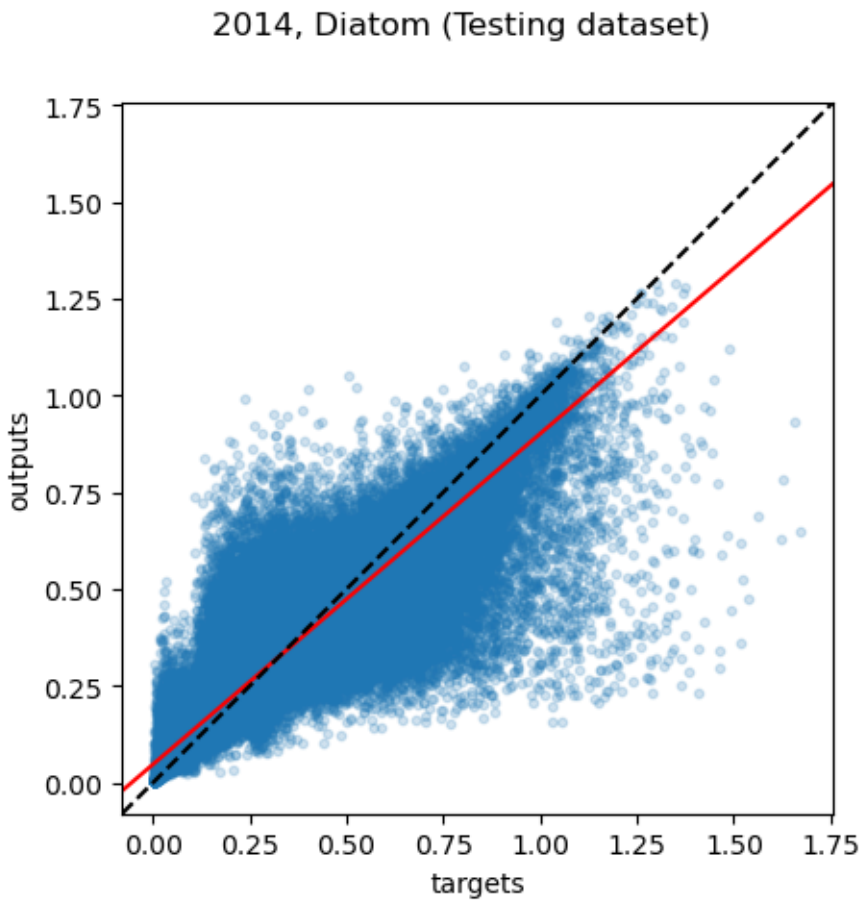

```
Gathering days for year 2013
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.848
The correlation coefficient is: 0.928
 The mean square error is: 0.00441
```



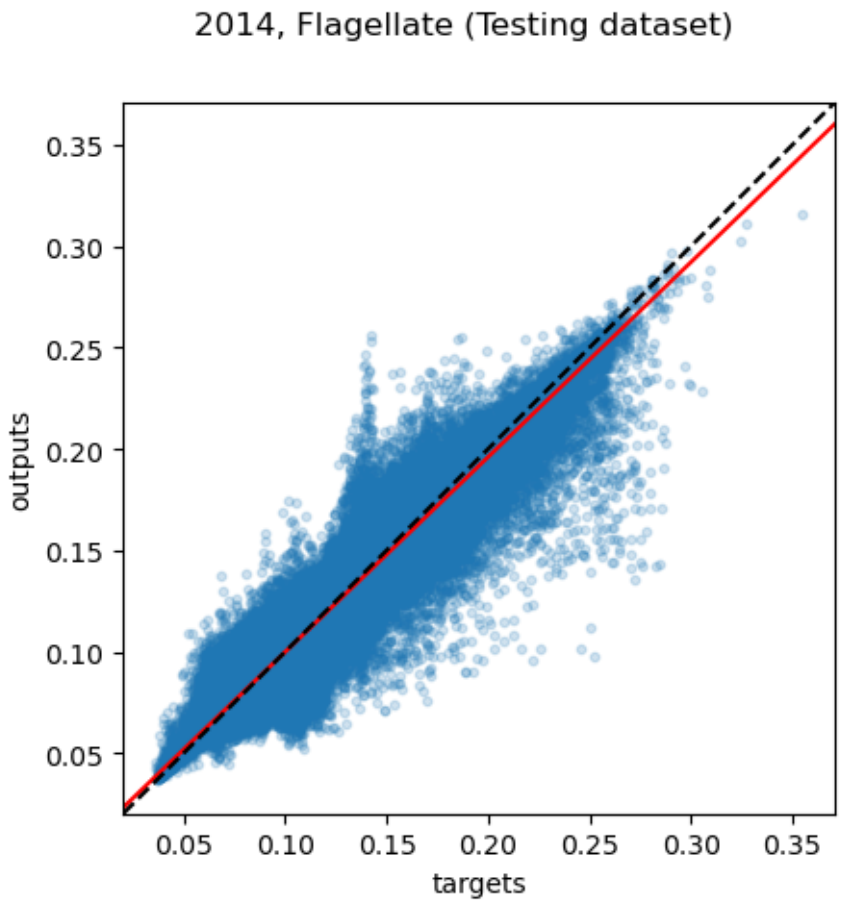

```
The amount of data points is 871482
The slope of the best fitting line is  0.948
The correlation coefficient is: 0.976
 The mean square error is: 3e-05
```



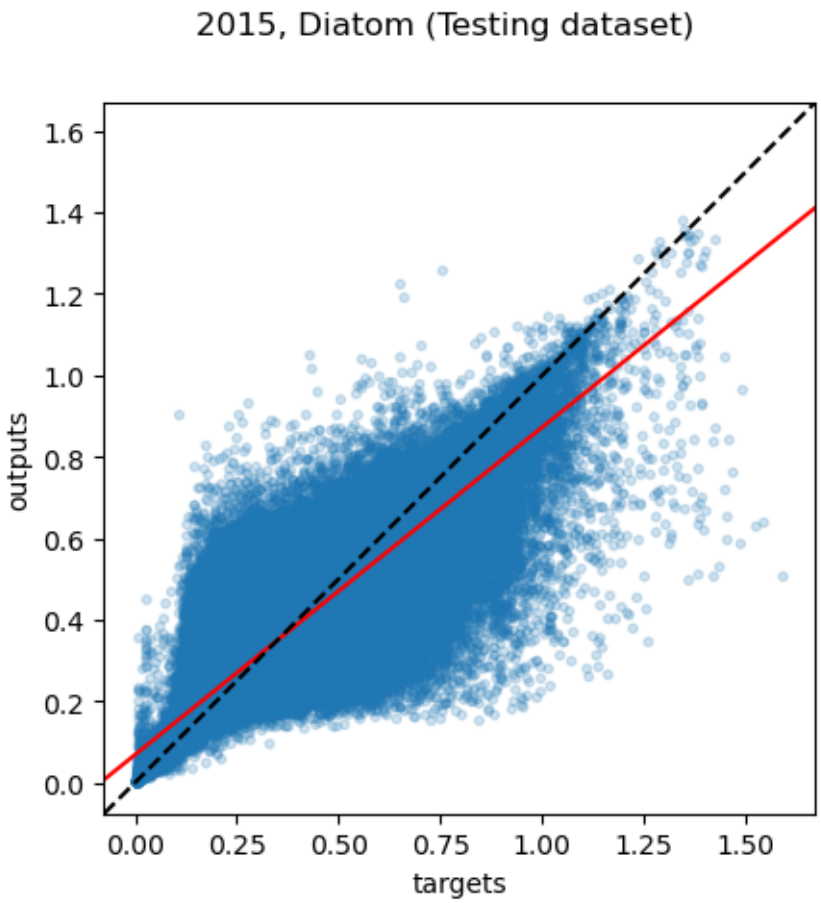

```
Gathering days for year 2014
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.854
The correlation coefficient is: 0.931
 The mean square error is: 0.00282
```



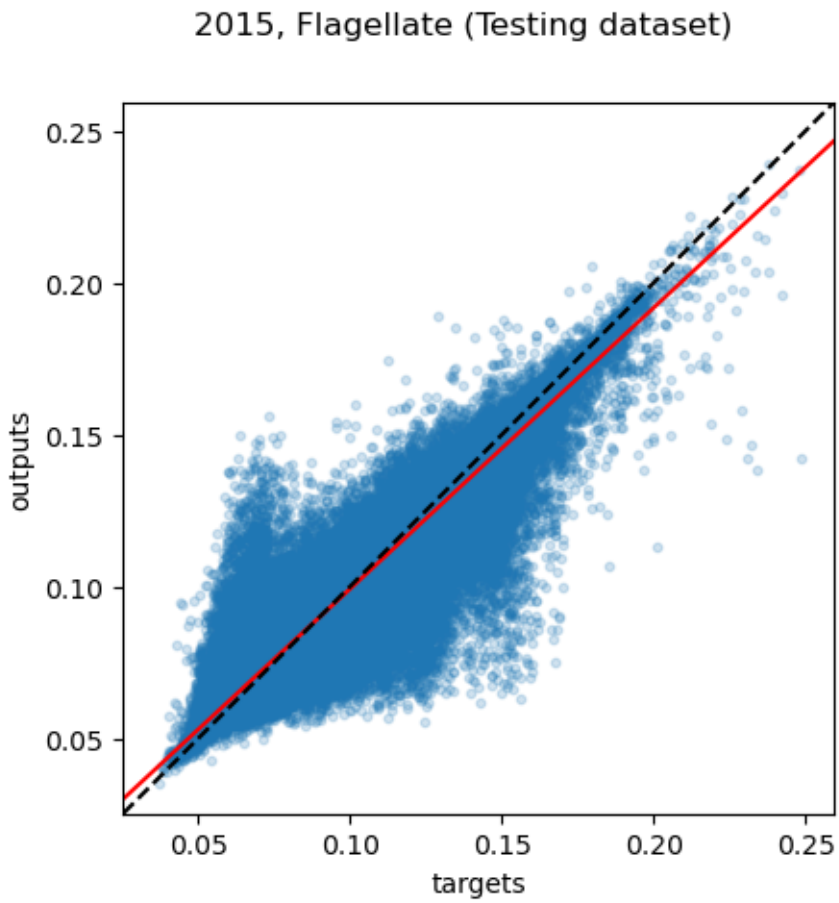

```
The amount of data points is 871482
The slope of the best fitting line is  0.961
The correlation coefficient is: 0.982
 The mean square error is: 3e-05
```



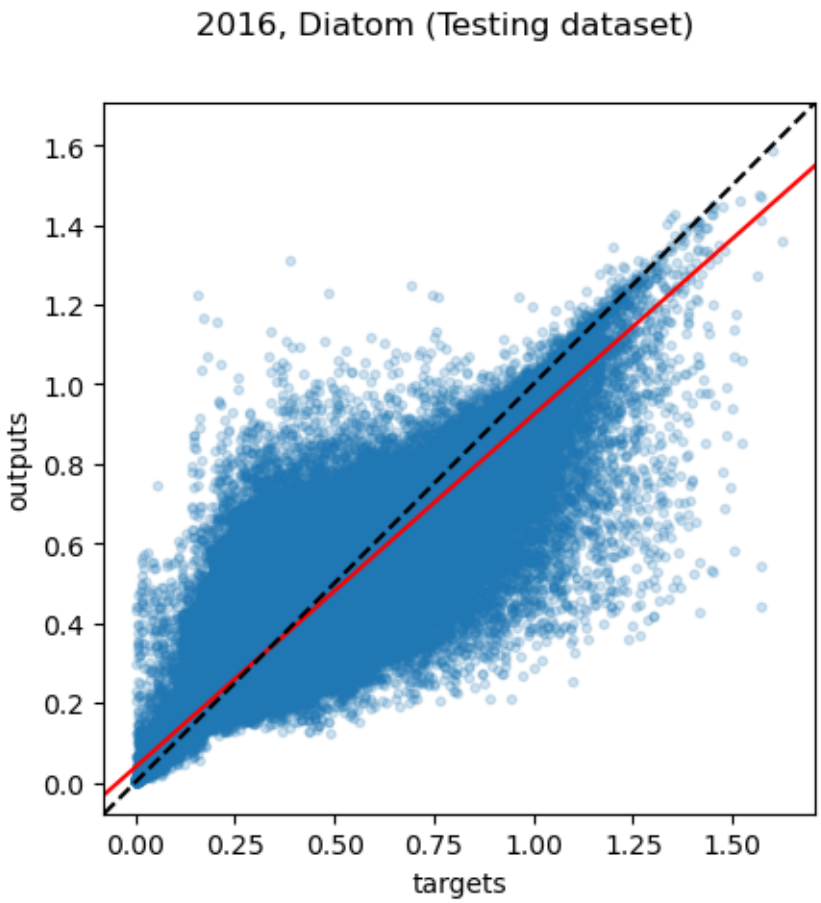

```
Gathering days for year 2015
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.804
The correlation coefficient is: 0.905
 The mean square error is: 0.0042
```



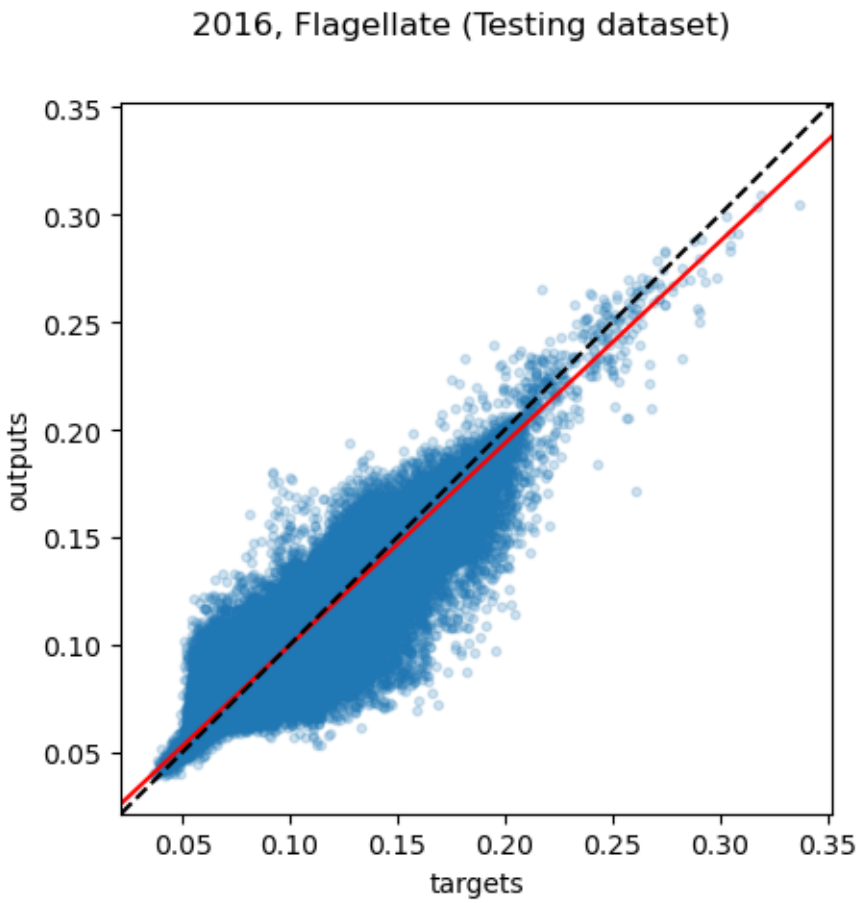

```
The amount of data points is 871482
The slope of the best fitting line is  0.926
The correlation coefficient is: 0.966
 The mean square error is: 3e-05
```



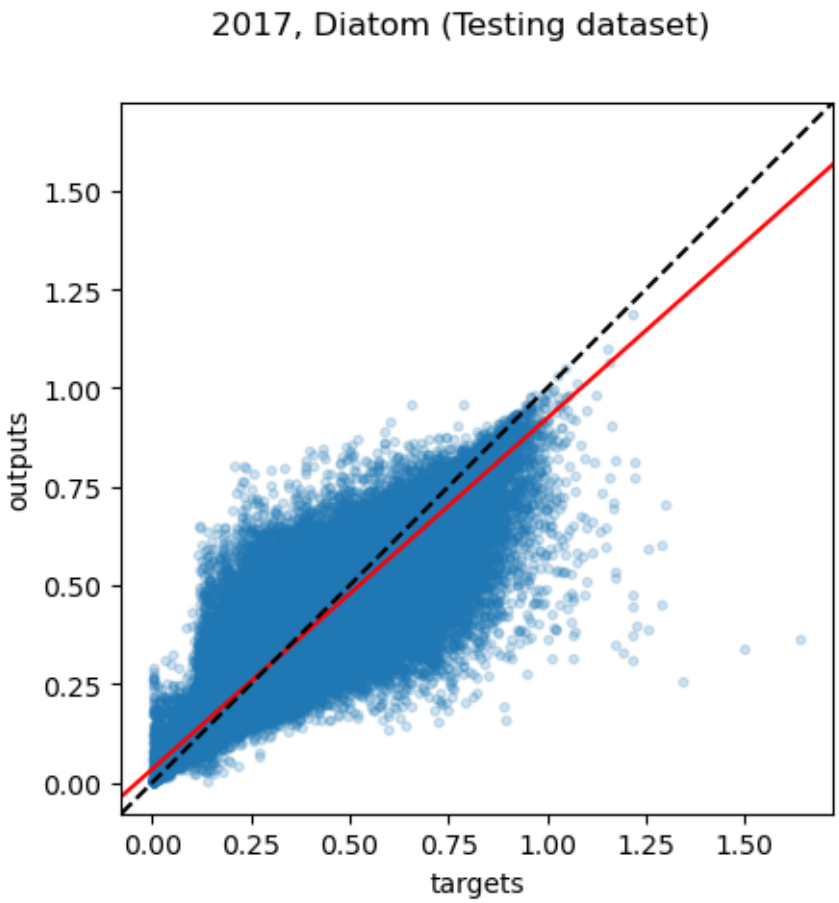

```
Gathering days for year 2016
Done gathering, building the prediction models


The amount of data points is 883101
The slope of the best fitting line is  0.885
The correlation coefficient is: 0.946
 The mean square error is: 0.00298
```



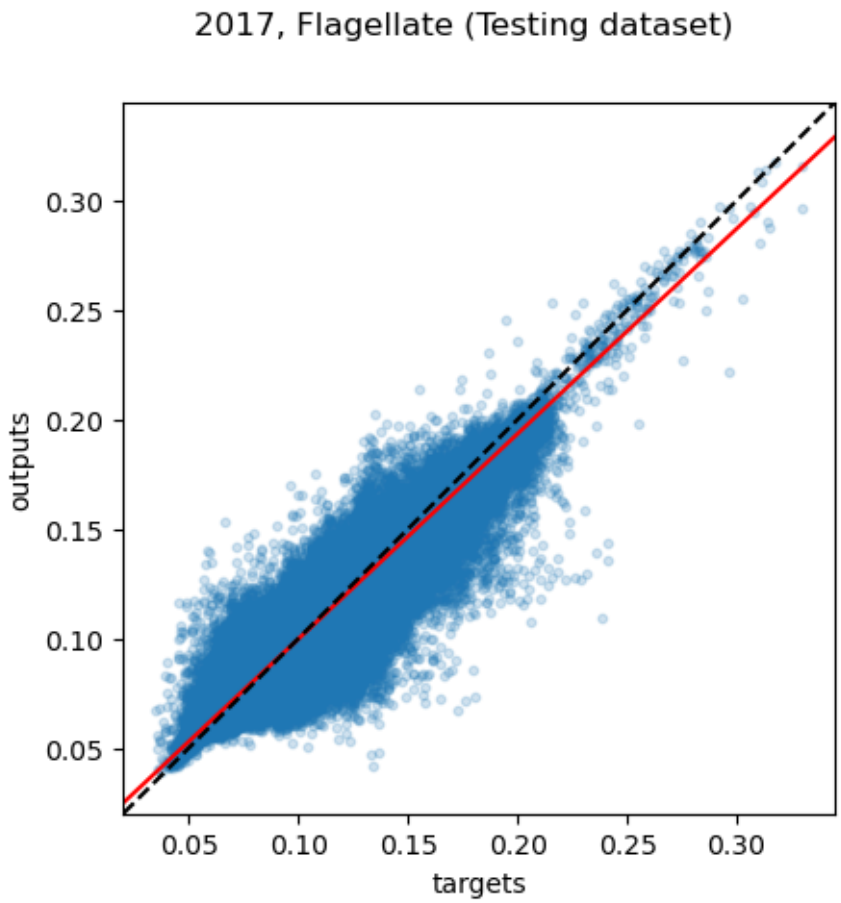

```
The amount of data points is 883101
The slope of the best fitting line is  0.938
The correlation coefficient is: 0.972
 The mean square error is: 3e-05
```



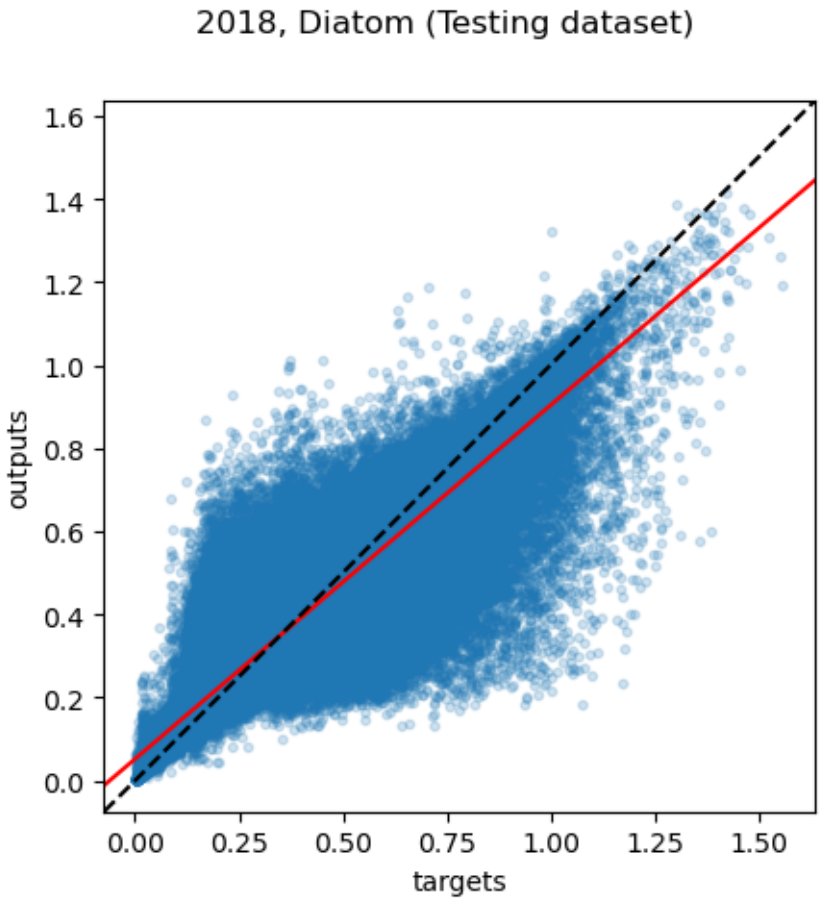

```
Gathering days for year 2017
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.889
The correlation coefficient is: 0.949
 The mean square error is: 0.00182
```



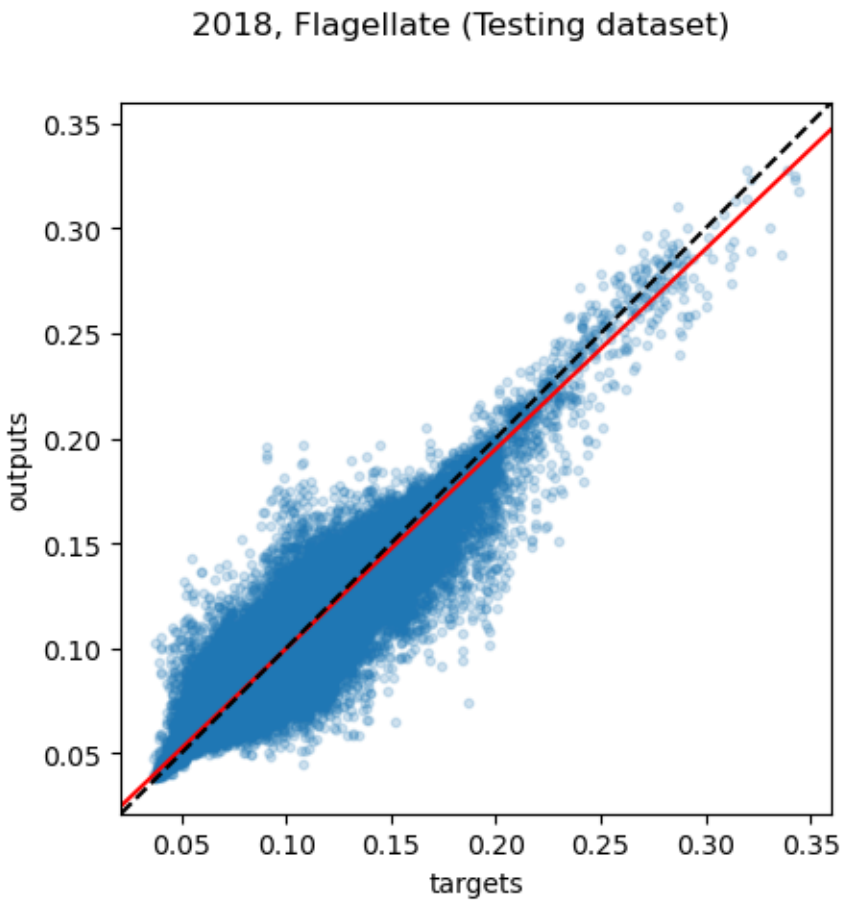

```
The amount of data points is 871482
The slope of the best fitting line is  0.937
The correlation coefficient is: 0.971
 The mean square error is: 4e-05
```



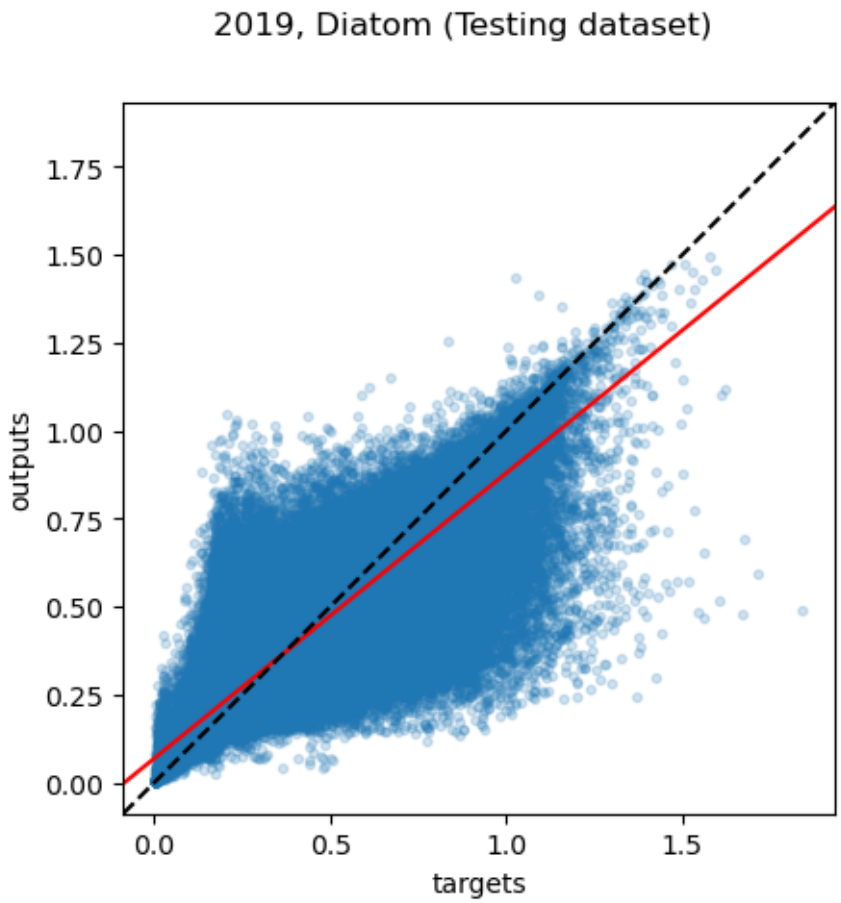

```
Gathering days for year 2018
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.851
The correlation coefficient is: 0.929
 The mean square error is: 0.00334
```



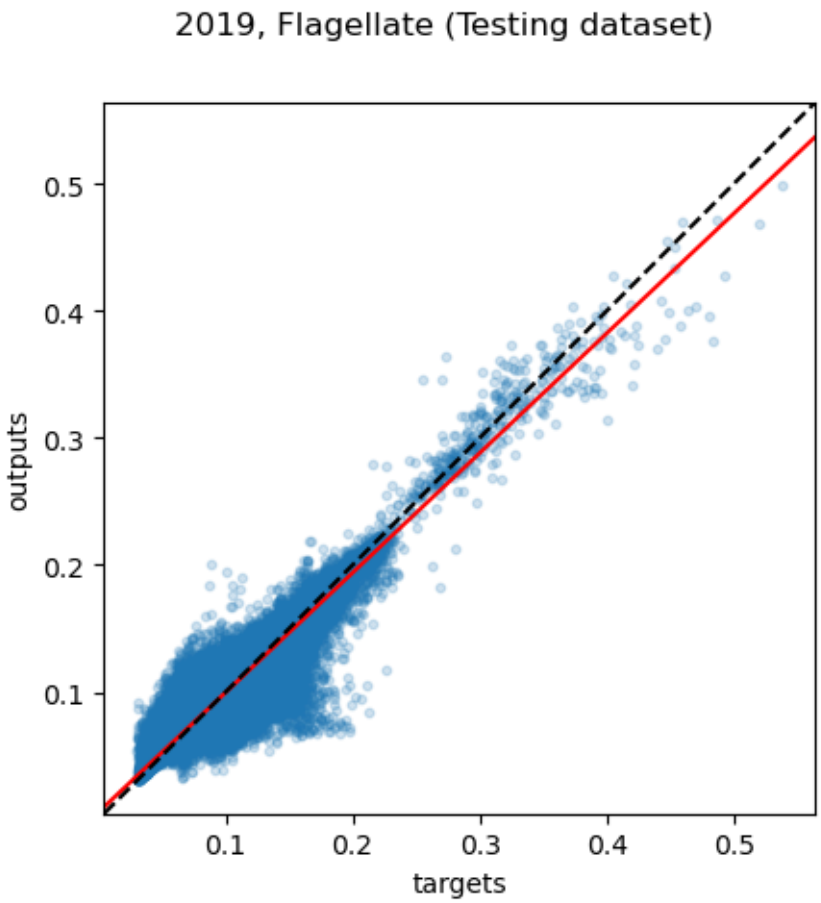

```
The amount of data points is 871482
The slope of the best fitting line is  0.952
The correlation coefficient is: 0.978
 The mean square error is: 3e-05
```



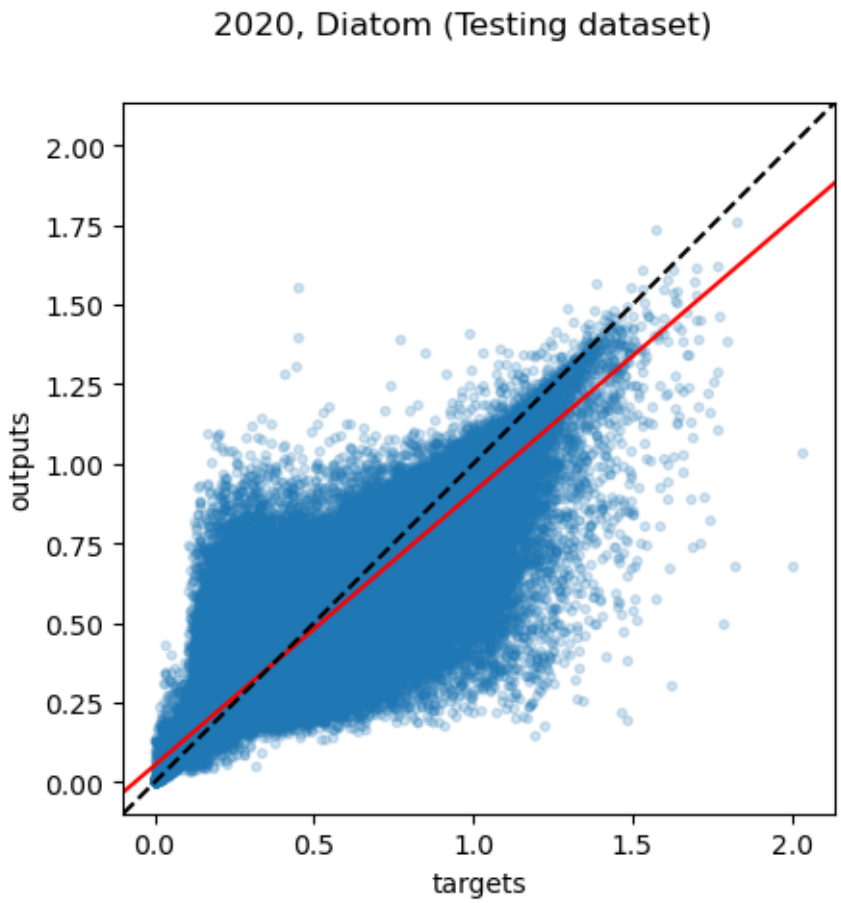

```
Gathering days for year 2019
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.811
The correlation coefficient is: 0.906
 The mean square error is: 0.00548
```



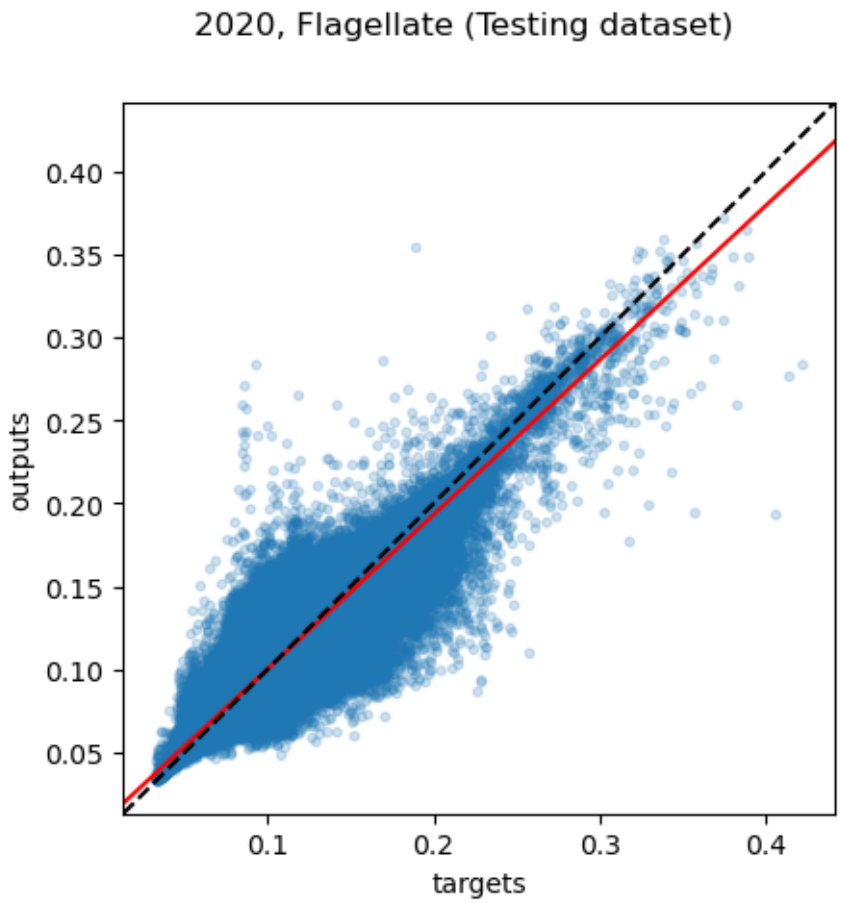

```
The amount of data points is 871482
The slope of the best fitting line is  0.942
The correlation coefficient is: 0.973
 The mean square error is: 4e-05
```



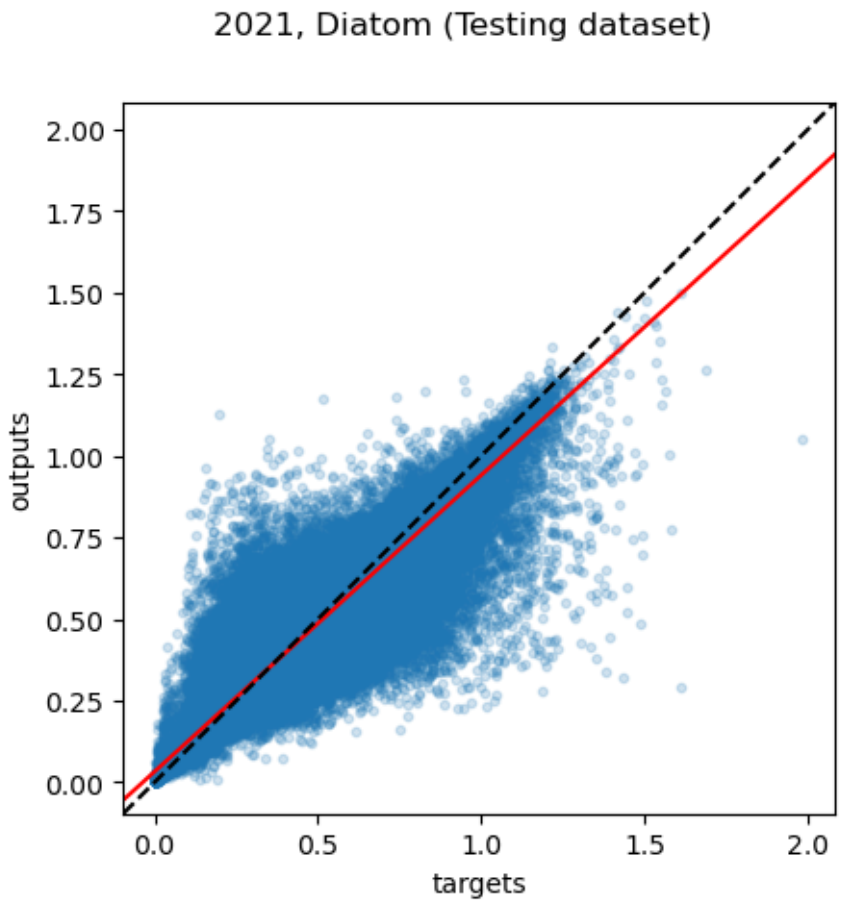

```
Gathering days for year 2020
Done gathering, building the prediction models


The amount of data points is 883101
The slope of the best fitting line is  0.857
The correlation coefficient is: 0.933
 The mean square error is: 0.00523
```



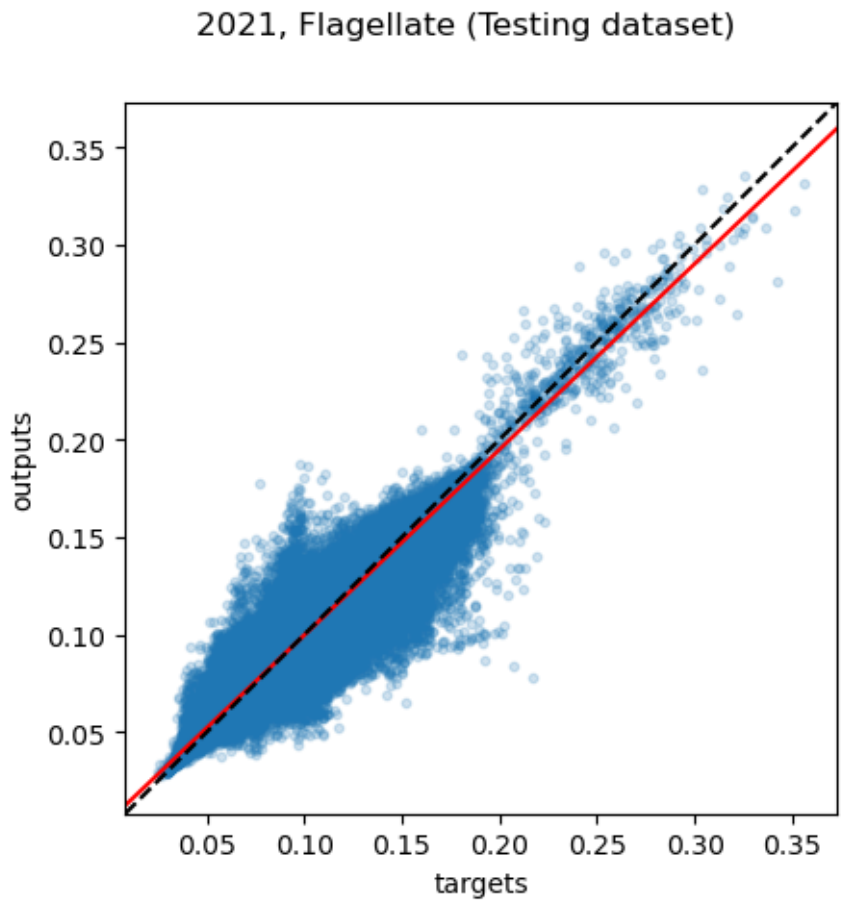

```
The amount of data points is 883101
The slope of the best fitting line is  0.931
The correlation coefficient is: 0.968
 The mean square error is: 7e-05
```



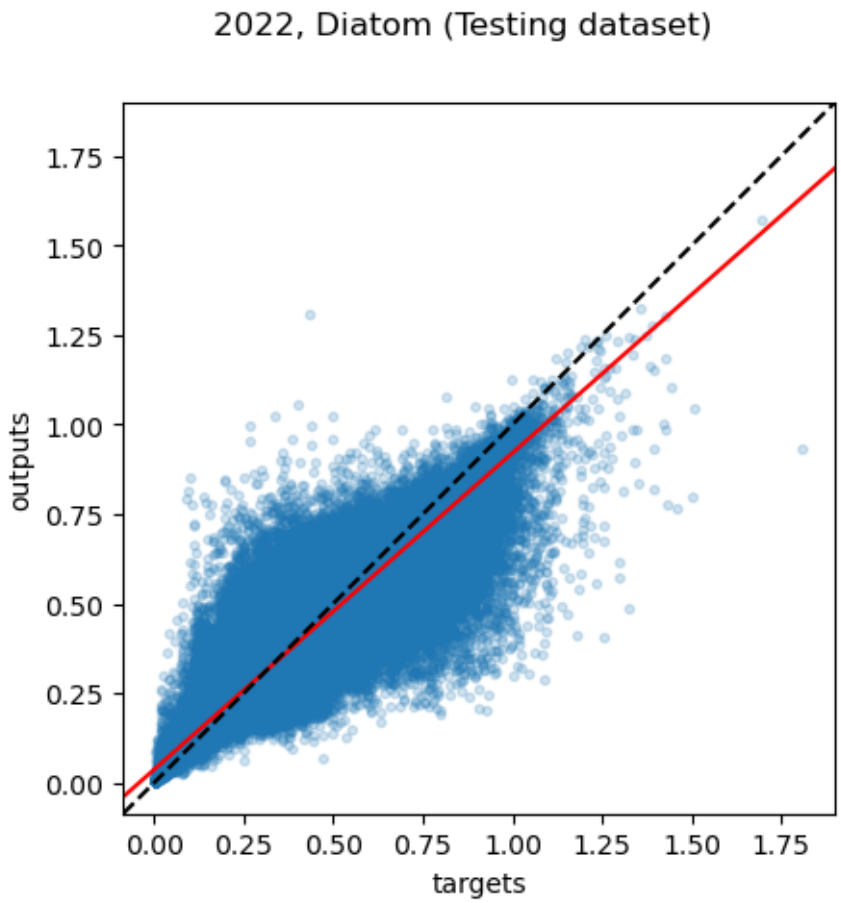

```
Gathering days for year 2021
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.908
The correlation coefficient is: 0.958
 The mean square error is: 0.00256
```



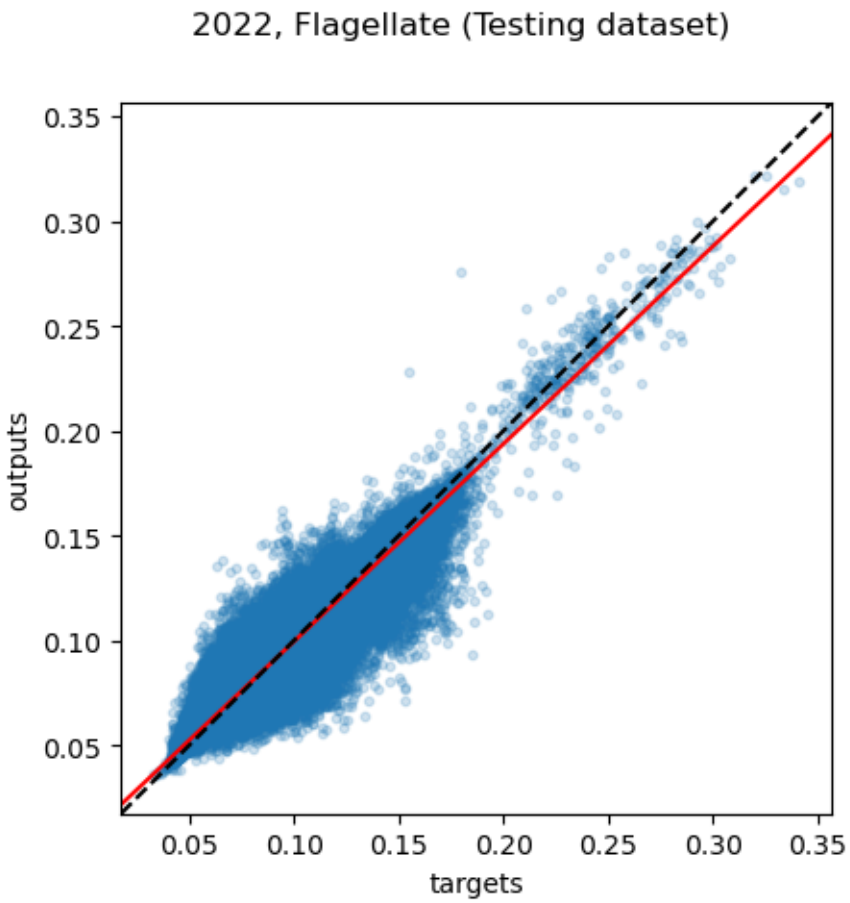

```
The amount of data points is 871482
The slope of the best fitting line is  0.952
The correlation coefficient is: 0.978
 The mean square error is: 3e-05
```



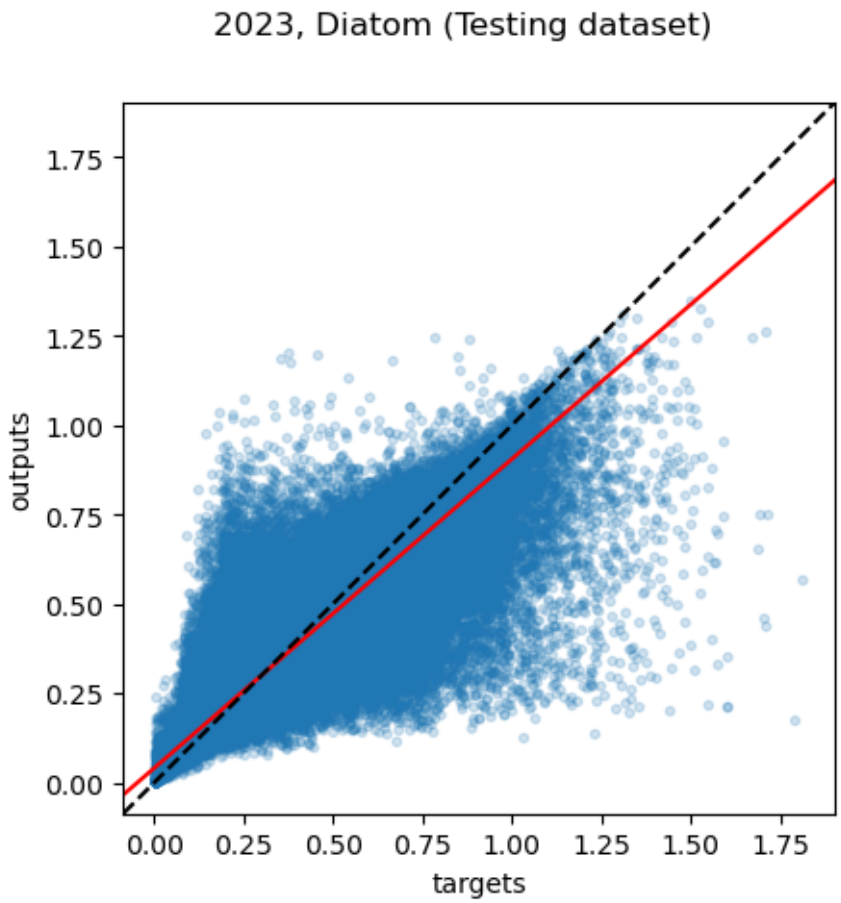

```
Gathering days for year 2022
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.884
The correlation coefficient is: 0.946
 The mean square error is: 0.00225
```



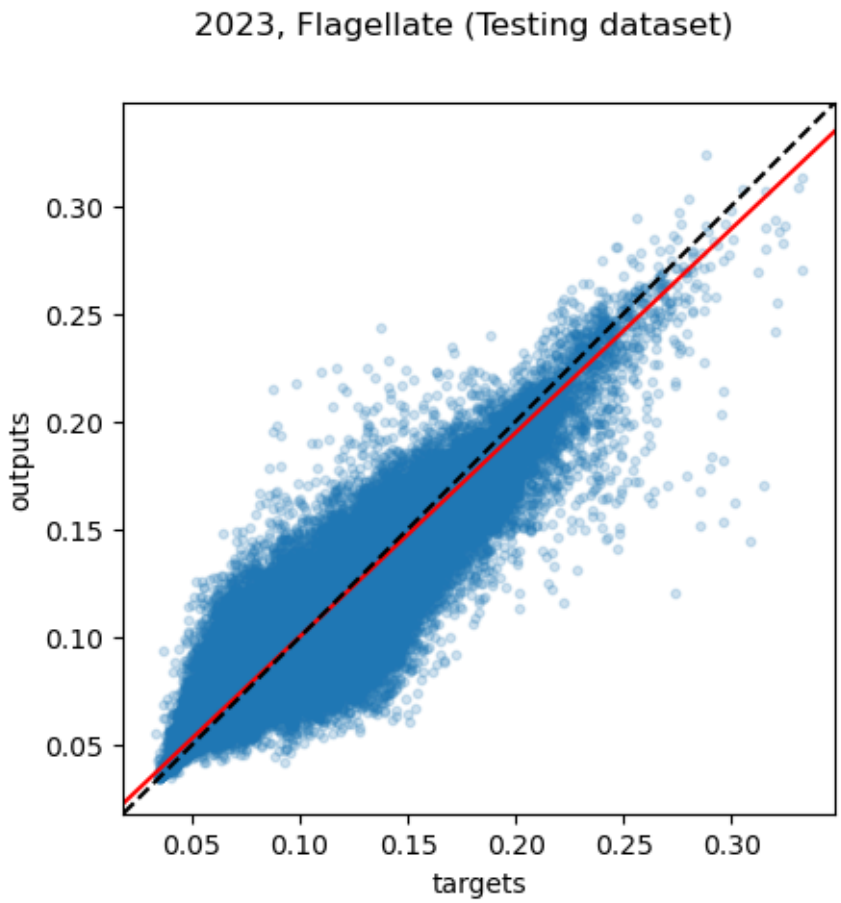

```
The amount of data points is 871482
The slope of the best fitting line is  0.943
The correlation coefficient is: 0.974
 The mean square error is: 3e-05
```




```
Gathering days for year 2023
Done gathering, building the prediction models


The amount of data points is 871482
The slope of the best fitting line is  0.865
The correlation coefficient is: 0.935
 The mean square error is: 0.00339
```

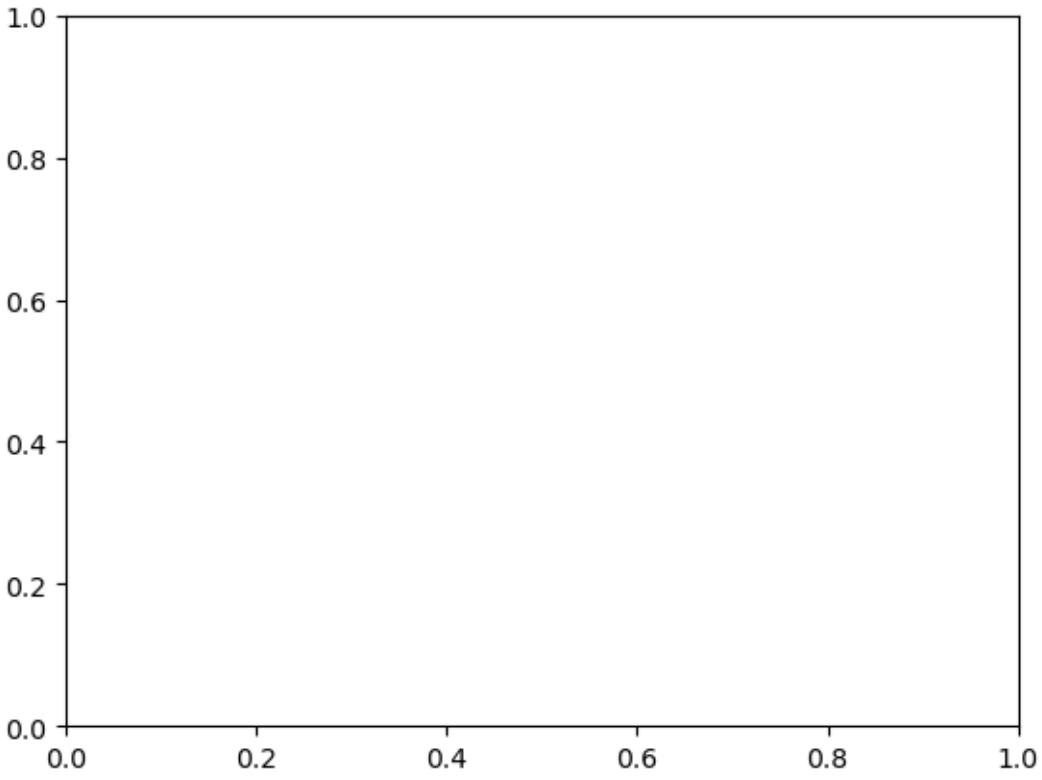



```
The amount of data points is 871482
The slope of the best fitting line is  0.945
The correlation coefficient is: 0.975
 The mean square error is: 5e-05
```

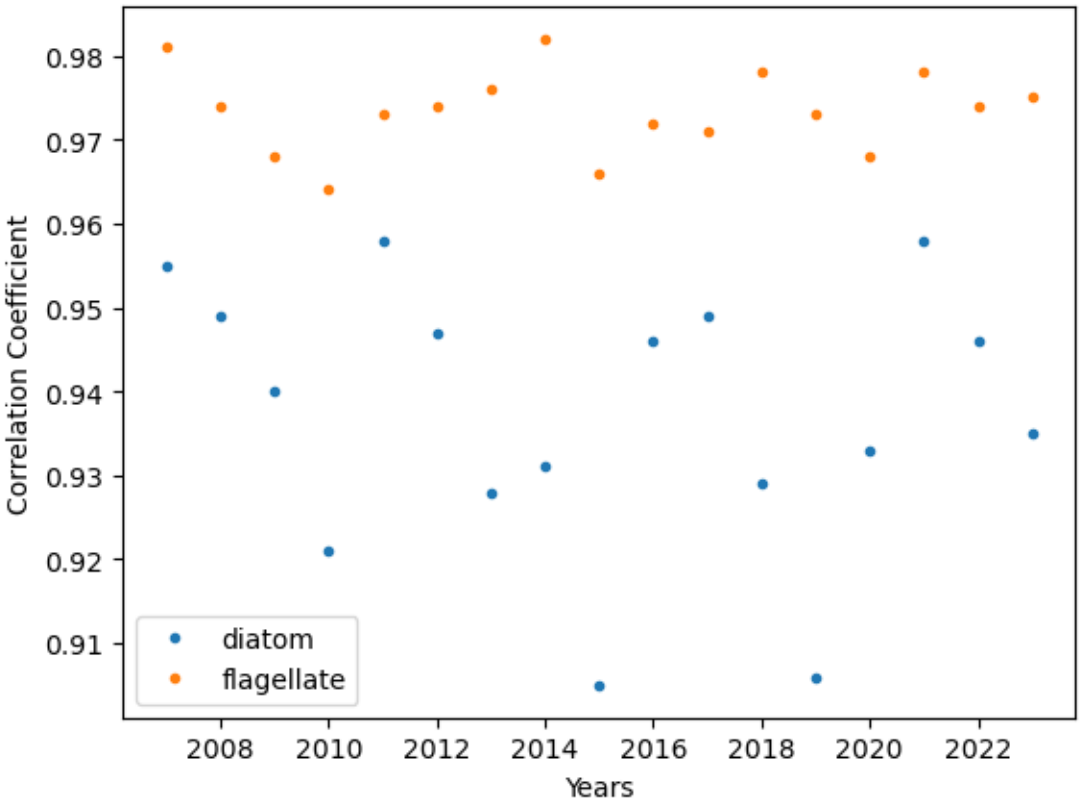


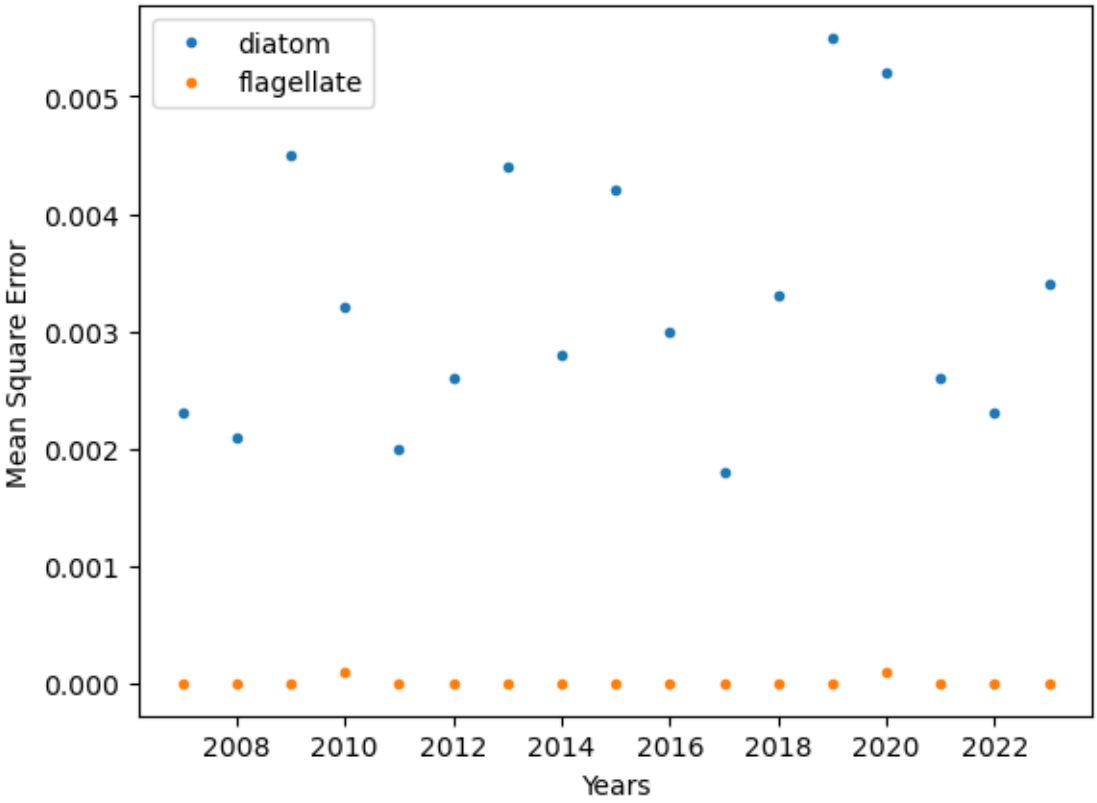

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[7], line 72
     69     slope_all[1].append(m)
     70     regr_all[1].append(regr)
---> 72 plotting(r_all, 'Correlation Coefficient')
     73 plotting(rms_all, 'Mean Square Error')
     74 plotting (slope_all, 'Slope of the best fitting line')

Cell In[6], line 3, in plotting(variable, name)
      1 def plotting (variable, name):
----> 3     plt.plot(years,variable, marker = '.', linestyle = '')
      4     plt.legend(['diatom','flagellate'])
      5     plt.xlabel('Years')

File ~/conda_envs/analysis-ilias/lib/python3.11/site-packages/matplotlib/pyplot
 ↪py:3575, in plot(scalex, scaley, data, *args, **kwargs)
   3567 @_copy_docstring_and_deprecators(Axes.plot)
```

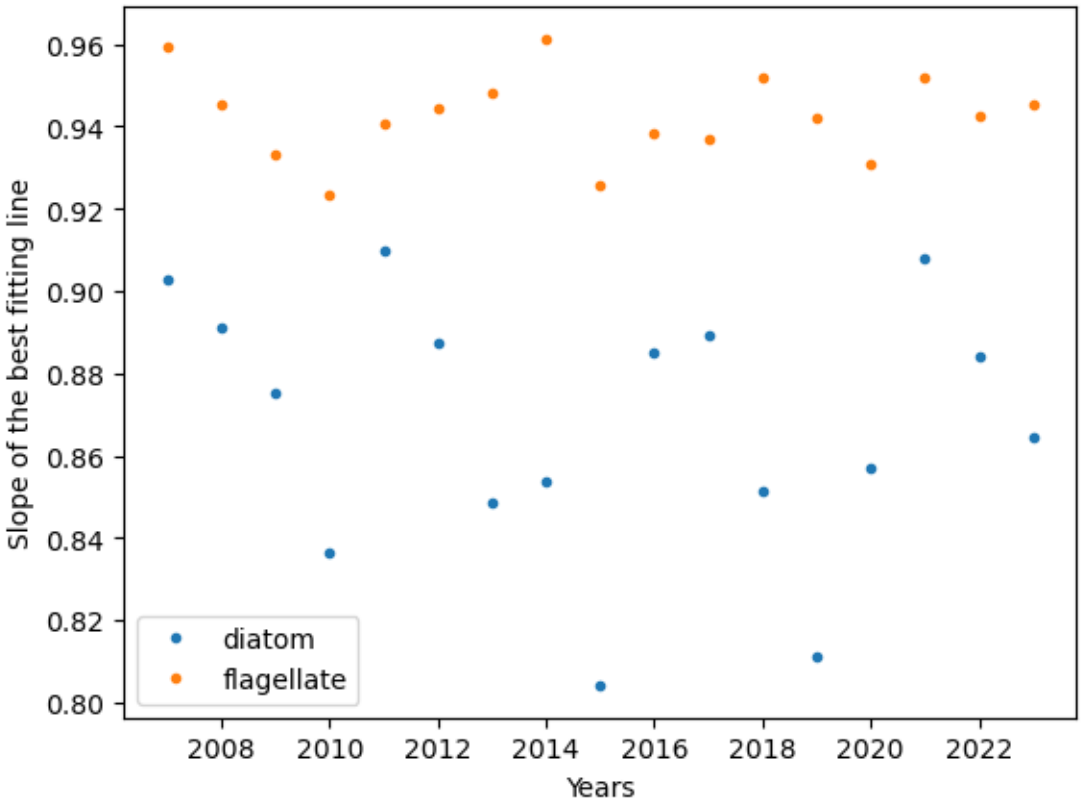
```
   3568 def plot(
   3569     *args: float | ArrayLike | str,
   (…)
   3573     **kwargs,
   3574 ) -> list[Line2D]:
-> 3575     return gca().plot(
   3576         *args,
   3577         scalex=scalex,
   3578         scaley=scaley,
   3579         **({"data": data} if data is not None else {}),
   3580         **kwargs,
   3581     )

File ~/conda_envs/analysis-ilias/lib/python3.11/site-packages/matplotlib/axes/
 ↪_axes.py:1721, in Axes.plot(self, scalex, scaley, data, *args, **kwargs)
   1478 """
   1479 Plot y versus x as lines and/or markers.
   1480
   (…)
   1718 (``'green'``) or hex strings (``'#008000'``).
   1719 """
   1720 kwargs = cbook.normalize_kwargs(kwargs, mlines.Line2D)
-> 1721 lines = [*self._get_lines(self, *args, data=data, **kwargs)]
   1722 for line in lines:
   1723     self.add_line(line)

File ~/conda_envs/analysis-ilias/lib/python3.11/site-packages/matplotlib/axes/
 ↪_base.py:303, in _process_plot_var_args.__call__(self, axes, data, *args,␣
 ↪**kwargs)
    301     this += args[0],
    302     args = args[1:]
--> 303 yield from self._plot_args(
    304     axes, this, kwargs, ambiguous_fmt_datakey=ambiguous_fmt_datakey)

File ~/conda_envs/analysis-ilias/lib/python3.11/site-packages/matplotlib/axes/
 ↪_base.py:499, in _process_plot_var_args._plot_args(self, axes, tup, kwargs,␣
 ↪return_kwargs, ambiguous_fmt_datakey)
    496     axes.yaxis.update_units(y)
    498 if x.shape[0] != y.shape[0]:
--> 499     raise ValueError(f"x and y must have same first dimension, but "
    500                      f"have shapes {x.shape} and {y.shape}")
    501 if x.ndim > 2 or y.ndim > 2:
    502     raise ValueError(f"x and y can be no greater than 2D, but have "
    503                      f"shapes {x.shape} and {y.shape}")

ValueError: x and y must have same first dimension, but have shapes (17,) and␣
 ↪(2, 17)
```



[ ]:
```
plotting(np.transpose(r_all), 'Correlation Coefficient')
plotting(np.transpose(rms_all), 'Mean Square Error')
plotting (np.transpose(slope_all), 'Slope of the best fitting line')
```


0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
Correlation Coefficient
diatom
flagellate
2008
2010
2012
2014
2016
2018
2020
2022
Years


diatom
flagellate
0.005
0.004
0.003
0.002
0.001
0.000
Mean Square Error
2008
2010
2012
2014
2016
2018
2020
2022
Years


0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
Slope of the best fitting line
diatom
flagellate
2008
2010
2012
2014
2016
2018
2020
2022
Years

[ ]: