# Visualization

> describe the data

In [ ]:
```
# read in npp_mean_new.csv
import pandas as pd
import numpy as np

df_npp = pd.read_csv('npp_means_new.csv')
df_sst = pd.read_csv('sst_means_new.csv')
df_ncp = pd.read_csv('ncp_means_new.csv')
```

In [ ]:
```
df_npp.sample(5)
```

Out[ ]:

| | Lat | Long | Ocean | Cr_nmol/kg | npp_10 | npp_11 | npp_12 | Year |
|---|---|---|---|---|---|---|---|---|
| **2598** | -10.67 | -25.01 | Atlantic | 2.917677 | 262.96430 | 191.65927 | 157.38142 | 2019 |
| **1051** | -54.83 | -95.68 | Southern Ocean | 3.666000 | 181.25964 | 221.44252 | 398.83360 | 2006 |
| **709** | -47.00 | 141.90 | Southern Ocean | 3.514688 | 270.22687 | 474.66400 | 680.21390 | 2003 |
| **2811** | -30.00 | 175.00 | Pacific | 3.192402 | 557.64374 | 388.14798 | 215.02892 | 2021 |
| **1215** | 1.68 | -25.01 | Atlantic | 2.729274 | 270.08325 | 316.89258 | 315.17313 | 2007 |

In [ ]:
```
df_sst.sample(5)
```

Out[ ]:

| | Lat | Long | Ocean | Cr_nmol/kg | sst_09 | sst_10 | sst_11 |
|---|---|---|---|---|---|---|---|
| **689** | 69.816667 | -138.333333 | Arctic | 1.827060 | 0.651406 | -0.283750 | NaN |
| **1271** | 71.100000 | -139.016667 | Arctic | 1.995342 | 1.916990 | 0.510938 | NaN |
| **1577** | 18.900000 | -108.800000 | Pacific | 2.978889 | 28.528097 | 28.625605 | 27.507330 |
| **927** | 85.130000 | -150.100000 | Arctic | 2.452609 | NaN | NaN | NaN |
| **1784** | -12.010000 | -79.200000 | Pacific | 3.555996 | 18.172445 | 18.513628 | 19.862207 |

> then I calculate 'ncp' values for each month and yearly mean 'ncp' using the given equation

In [ ]:
```
# Merge 'npp' dataframe and 'sst' dataframe
df = pd.merge(df_npp,df_sst, on=['Lat', 'Long', 'Year', 'Ocean','Cr_nmol/kg'

# Create 'ncp' columns for each month
months = ['01', '02', '03', '04', '05', '06', '07', '08', '09', '10', '11',

for month in months:
    df['ncp_' + month] = 8.57 * df['npp_' + month] / (17.9 + df['sst_' + mor

# Calculate yearly mean 'ncp'
df['yearly_mean_ncp'] = df[['ncp_' + month for month in months]].mean(axis=1

# Select the columns you need
df = df[['Lat', 'Long', 'Ocean', 'Cr_nmol/kg', 'Year', 'yearly_mean_ncp'] +

# Save the dataframe to csv file
df.to_csv('ncp_means_new.csv', index=False)
```

In [ ]:
```
df_ncp.sample(5)
```

Out[ ]:

| | Lat | Long | Ocean | Cr_nmol/kg | Year | yearly_mean_ncp | nc |
|---|---|---|---|---|---|---|---|
| **2212** | -53.583000 | 149.298000 | Southern Ocean | 3.489904 | 2016 | 73.233929 | 83.69 |
| **931** | -63.963000 | -66.242000 | Southern Ocean | 3.811317 | 2005 | 166.075387 | 71.89 |
| **2121** | -15.999000 | -76.998000 | Pacific | 3.760000 | 2015 | 231.363361 | 170.66 |
| **1654** | -21.566667 | -114.300000 | Pacific | 4.700000 | 2011 | 26.246387 | 16.12 |
| **193** | 24.283333 | -114.983333 | Pacific | 3.188937 | 1998 | 102.351129 | 117.52 |

> Their potential relationship

In [ ]:
```
for col in df_npp.columns:
    if 'npp' in col:
        print(f"Correlation between 'Cr_nmol/kg' and '{col}': {df_npp['Cr_nm
```

```
Correlation between 'Cr_nmol/kg' and 'npp_10': -0.24431611074896756
Correlation between 'Cr_nmol/kg' and 'npp_11': -0.2845091902066358
Correlation between 'Cr_nmol/kg' and 'npp_12': -0.3069847667764157
Correlation between 'Cr_nmol/kg' and 'npp_01': -0.3715646038629125
Correlation between 'Cr_nmol/kg' and 'npp_02': -0.39482170045159737
Correlation between 'Cr_nmol/kg' and 'npp_04': -0.3816828978306618
Correlation between 'Cr_nmol/kg' and 'npp_05': -0.36832093529408694
Correlation between 'Cr_nmol/kg' and 'npp_06': -0.39266732559964096
Correlation between 'Cr_nmol/kg' and 'npp_07': -0.44666840496758886
Correlation between 'Cr_nmol/kg' and 'npp_08': -0.40598848919758845
Correlation between 'Cr_nmol/kg' and 'npp_09': -0.26756509754016256
Correlation between 'Cr_nmol/kg' and 'npp_03': -0.38479687230732
Correlation between 'Cr_nmol/kg' and 'yearly_mean_npp': -0.4331956417977734
```

In [ ]:
```
for col in df_sst.columns:
    if 'sst' in col:
        print(f"Correlation between 'Cr_nmol/kg' and '{col}': {df_sst['Cr_nm
```

```
Correlation between 'Cr_nmol/kg' and 'sst_09': 0.12041011851551696
Correlation between 'Cr_nmol/kg' and 'sst_10': 0.11103742225277861
Correlation between 'Cr_nmol/kg' and 'sst_11': -0.0052715943934982445
Correlation between 'Cr_nmol/kg' and 'sst_12': -0.032861661808185165
Correlation between 'Cr_nmol/kg' and 'sst_01': -0.019514340726830618
Correlation between 'Cr_nmol/kg' and 'sst_02': 0.01722314779196005
Correlation between 'Cr_nmol/kg' and 'sst_04': 0.06619290530145922
Correlation between 'Cr_nmol/kg' and 'sst_05': 0.14906545528156573
Correlation between 'Cr_nmol/kg' and 'sst_06': 0.15633689231795891
Correlation between 'Cr_nmol/kg' and 'sst_07': 0.11855656813158182
Correlation between 'Cr_nmol/kg' and 'sst_08': 0.11209470737824474
Correlation between 'Cr_nmol/kg' and 'sst_03': 0.01930827797502948
Correlation between 'Cr_nmol/kg' and 'yearly_mean_sst': 0.13047233998979144
```

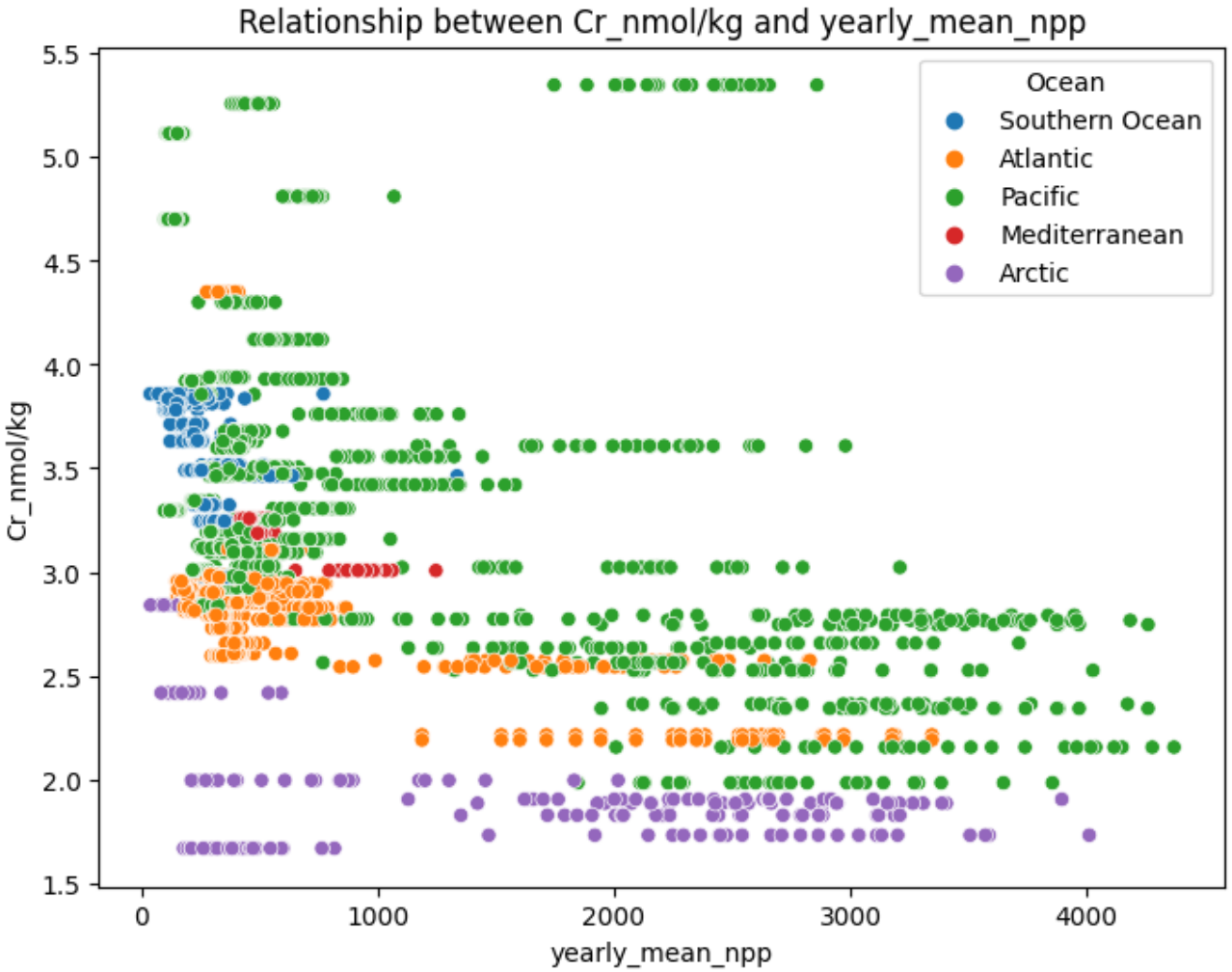
In [ ]:
```
for col in df_ncp.columns:
    if 'ncp' in col:
        print(f"Correlation between 'Cr_nmol/kg' and '{col}': {df_ncp['Cr_nm
```

```
Correlation between 'Cr_nmol/kg' and 'yearly_mean_ncp': -0.47702157470049844
Correlation between 'Cr_nmol/kg' and 'ncp_01': -0.36382951902651883
Correlation between 'Cr_nmol/kg' and 'ncp_02': -0.3963055759828173
Correlation between 'Cr_nmol/kg' and 'ncp_03': -0.3827259811182633
Correlation between 'Cr_nmol/kg' and 'ncp_04': -0.3845829196349322
Correlation between 'Cr_nmol/kg' and 'ncp_05': -0.37432673471262096
Correlation between 'Cr_nmol/kg' and 'ncp_06': -0.37745551331197025
Correlation between 'Cr_nmol/kg' and 'ncp_07': -0.44949956150894527
Correlation between 'Cr_nmol/kg' and 'ncp_08': -0.4300568775473874
Correlation between 'Cr_nmol/kg' and 'ncp_09': -0.32171361459738235
Correlation between 'Cr_nmol/kg' and 'ncp_10': -0.21788747789710963
Correlation between 'Cr_nmol/kg' and 'ncp_11': -0.25967649677294263
Correlation between 'Cr_nmol/kg' and 'ncp_12': -0.28582475010687713
```

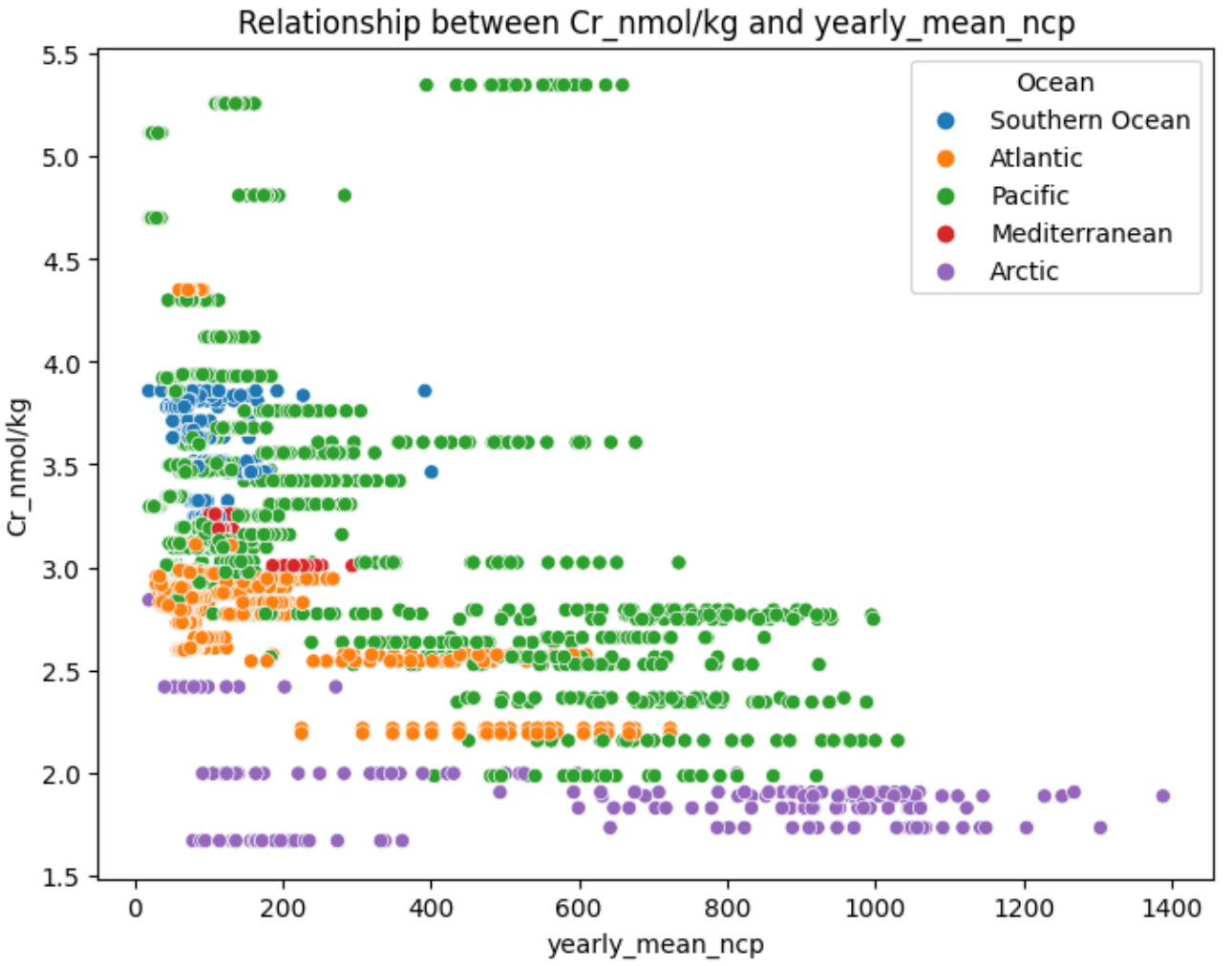
> in a conclusion , there is a high correlation between npp and Cr_nmol/kg , but not sst, we increase the correlation a bit in the case of ncp.

> Here are some visualizations

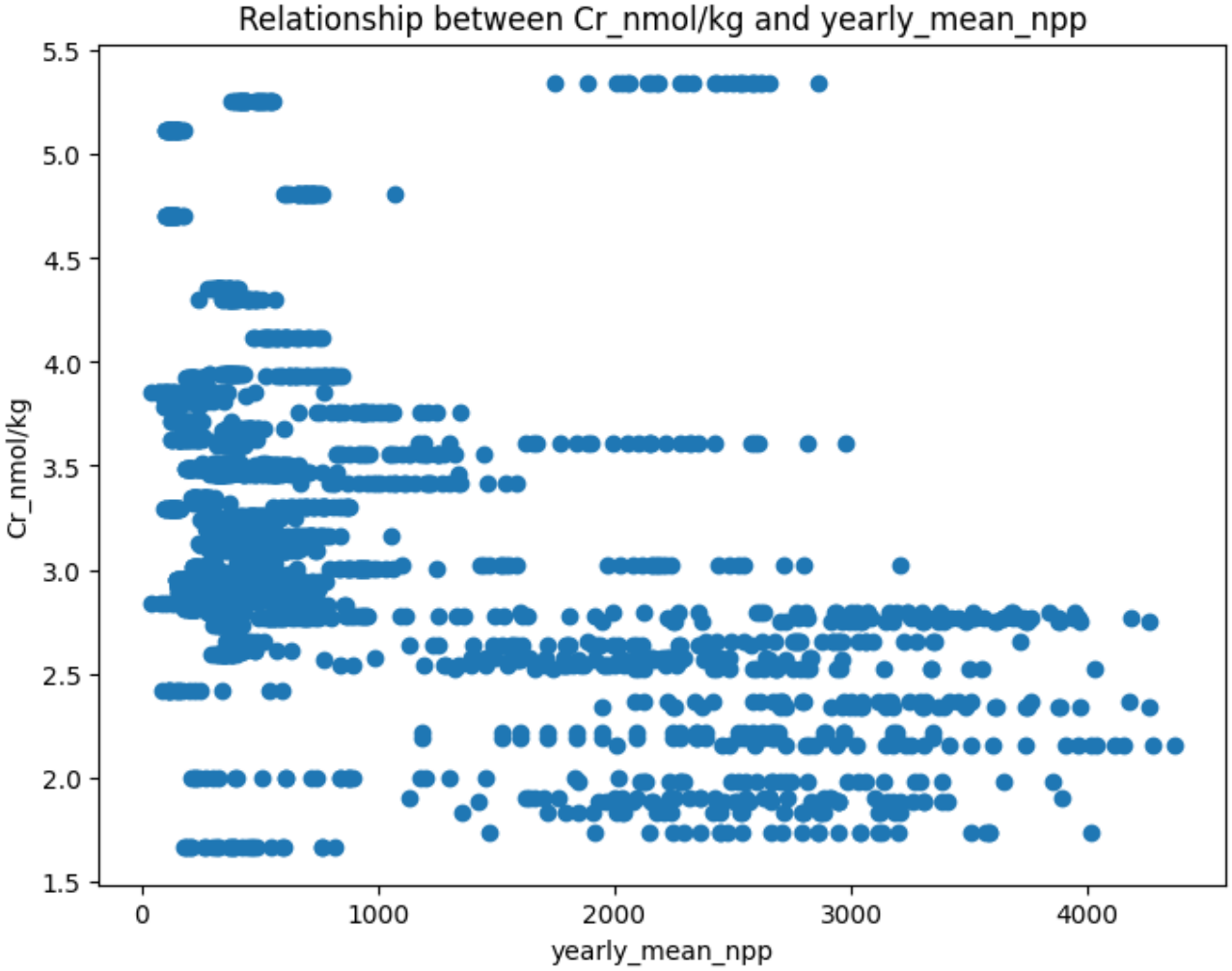
In [ ]:
```
import seaborn as sns
import matplotlib.pyplot as plt

npp_cols = ['yearly_mean_npp']

for col in npp_cols:
    plt.figure(figsize=(8, 6))
    sns.scatterplot(data=df, x=col, y='Cr_nmol/kg', hue='Ocean')
    plt.title(f'Relationship between Cr_nmol/kg and {col}')
    plt.show()
```



In [ ]:
```
import seaborn as sns
import matplotlib.pyplot as plt

npp_cols = ['yearly_mean_ncp']

for col in npp_cols:
    plt.figure(figsize=(8, 6))
    sns.scatterplot(data=df_ncp, x=col, y='Cr_nmol/kg', hue='Ocean')
    plt.title(f'Relationship between Cr_nmol/kg and {col}')
    plt.show()
```



In [ ]:
```
import matplotlib.pyplot as plt

npp_cols = ['yearly_mean_npp']

for col in npp_cols:
    plt.figure(figsize=(8, 6))
    plt.scatter(df[col],df['Cr_nmol/kg'])
    plt.xlabel(col)
    plt.ylabel('Cr_nmol/kg')
    plt.title(f'Relationship between Cr_nmol/kg and {col}')
    plt.show()
```



In [ ]:
```
import seaborn as sns
import matplotlib.pyplot as plt

fig, ax1 = plt.subplots(figsize=(10, 6))
sns.lineplot(data=df, x='Year', y='Cr_nmol/kg', ax=ax1, color='blue', label=

ax2 = ax1.twinx()
sns.lineplot(data=df, x='Year', y='yearly_mean_npp', ax=ax2, color='red', la

ax1.set_ylabel('Cr_nmol/kg', color='blue')
ax2.set_ylabel('yearly_mean_npp', color='red')

fig.tight_layout()
plt.title('Yearly mean values of Cr_nmol/kg and npp over years')
plt.show()
```