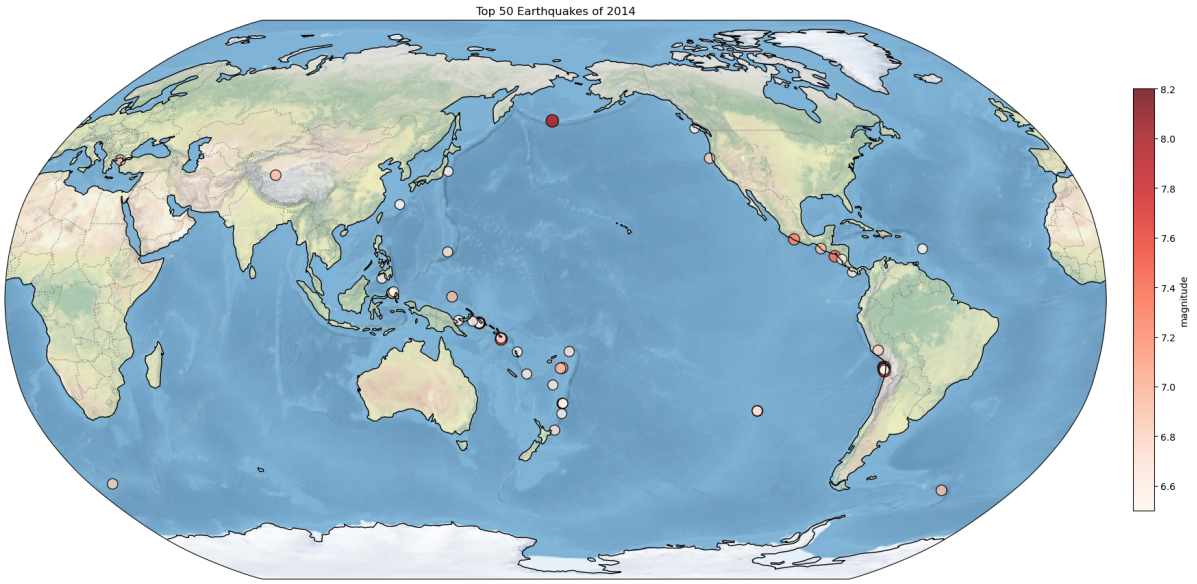
In [13]:
```
import numpy as np
import xarray as xr
import pandas as pd
import matplotlib.pyplot as plt
import cartopy.crs as ccrs
import cartopy.feature as cfeature
import netCDF4 as nc
```

In [14]:
```
# Read CSV data
data = pd.read_csv('usgs_earthquakes.csv')
```

In [15]:
```
# Sift through 2014 data
data['time'] = pd.to_datetime(data['time'])
data_2014 = data[data['time'].dt.year == 2014]
```

In [16]:
```
# Sort by magnitude and take the first 50 data
top_earthquakes = data_2014.sort_values(by='mag', ascending=False).
```

In [89]:
```
# Create a map
fig, ax = plt.subplots(figsize=(25, 20), subplot_kw={'projection': 
ax.set_global()

# Add coastlines, borders, and countries
ax.add_feature(cfeature.COASTLINE)
ax.add_feature(cfeature.BORDERS, linestyle=':', edgecolor='gray')

# Get longitude, latitude, and magnitude data
lons = top_earthquakes['longitude'].values
lats = top_earthquakes['latitude'].values
magnitudes = top_earthquakes['mag'].values

# Mark the earthquake points
sc = ax.scatter(lons, lats, c=magnitudes, cmap='Reds', s=magnitudes
                transform=ccrs.PlateCarree())

# Add color bar
cbar = plt.colorbar(sc, orientation='vertical', pad=0.02, aspect=20
cbar.set_label('magnitude')

# Add title
plt.title('Top 50 Earthquakes of 2014')
ax.stock_img()  # Backdrop

# Plot
plt.show()
```



In [ ]:

In [24]:
```
import xarray as xr
import matplotlib.pyplot as plt
import cartopy.crs as ccrs
import cartopy.feature as cfeature
import numpy as np
```

In [68]:
```
# Read NetCDF data
data = xr.open_dataset('MERRA2_400.inst1_2d_asm_Nx.20231101.nc4'eng
data
```

Out[68]:

xarray.Dataset

▸ Dimensions: (**lon**: 576, **lat**: 361, **time**: 24)

▾ Coordinates:

lon	(lon)	float64	-180.0 -179.4 ... 178.8 ...
lat	(lat)	float64	-90.0 -89.5 -89.0 ... 89....
time	(time)	datetime64[ns]	2023-11-01 ... 2023-11...

▾ Data variables:

DISPH	(time, lat, lon)	float32	...
PS	(time, lat, lon)	float32	...
long_name :	surface_pressure		
units :	Pa		
fmissing_value :	1000000000000000.0		
standard_name :	surface_pressure		
vmax :	1000000000000000.0		
vmin :	-1000000000000000.0		
valid_range :	[-1.e+15 1.e+15]		
QV10M	(time, lat, lon)	float32	...
QV2M	(time, lat, lon)	float32	...
SLP	(time, lat, lon)	float32	...
T10M	(time, lat, lon)	float32	...
T2M	(time, lat, lon)	float32	...
TO3	(time, lat, lon)	float32	...
long_name :	total_column_ozone		
units :	Dobsons		
fmissing_value :	1000000000000000.0		
standard_name :	total_column_ozone		
vmax :	1000000000000000.0		
vmin :	-1000000000000000.0		
valid_range :	[-1.e+15 1.e+15]		
TOX	(time, lat, lon)	float32	...

TQI	(time, lat, lon)	float32	...
TQL	(time, lat, lon)	float32	...
TQV	(time, lat, lon)	float32	...
TROPPB	(time, lat, lon)	float32	...
TROPPT	(time, lat, lon)	float32	...
TROPPV	(time, lat, lon)	float32	...
TROPQ	(time, lat, lon)	float32	...
TROPT	(time, lat, lon)	float32	...
TS	(time, lat, lon)	float32	...
U10M	(time, lat, lon)	float32	...
U2M	(time, lat, lon)	float32	...
U50M	(time, lat, lon)	float32	...
V10M	(time, lat, lon)	float32	...
V2M	(time, lat, lon)	float32	...
V50M	(time, lat, lon)	float32	...

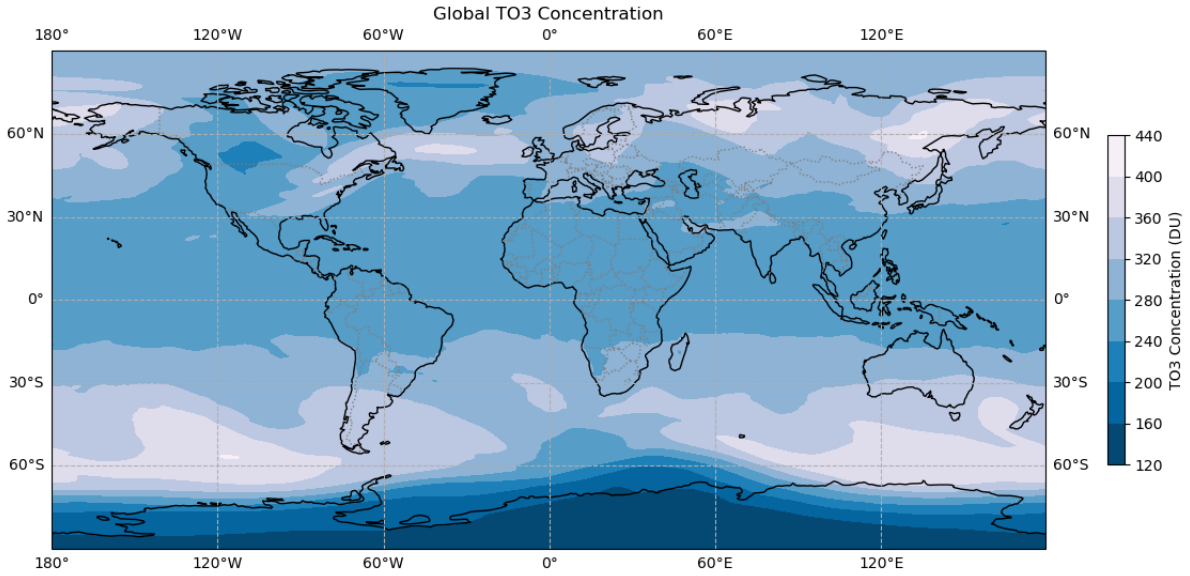
▼ Indexes:

lon	PandasIndex
lat	PandasIndex
time	PandasIndex

▶ Attributes: (30)

In [116]:
```
import cartopy.mpl.ticker as cticker
from matplotlib.ticker import (MultipleLocator, FormatStrFormatter,

# Get longitude, latitude, and TO3 concentration data
lons = data['lon'].values
lats = data['lat'].values
o3 = data['TO3'].values
o3 = np.nanmean(o3,0)

# Create a 2d grid
lon_2d, lat_2d = np.meshgrid(lons, lats)

# Create map projection
fig, ax = plt.subplots(figsize=(15, 10), subplot_kw={'projection':

# Add map features
ax.add_feature(cfeature.COASTLINE)
ax.add_feature(cfeature.BORDERS, linestyle=':', edgecolor='gray')

#  Add gridlines
gl = ax.gridlines(draw_labels=True, linestyle='--')

# Add x,y label and ticks
gl.xlocator = cticker.LongitudeLocator()
gl.ylocator = cticker.LatitudeLocator()
```

```
gl.xformatter = cticker.LongitudeFormatter()
gl.yformatter = cticker.LatitudeFormatter()

# Plot TO3 concentration distribution
cmap = plt.get_cmap('PuBu_r')
im = ax.contourf(lon_2d, lat_2d, o3, cmap=cmap, transform=ccrs.Plat

# Add color bar
cbar = plt.colorbar(im, orientation='vertical', pad=0.05, aspect=20

# Add title
plt.title('Global TO3 Concentration')

# Plot
plt.show()
```

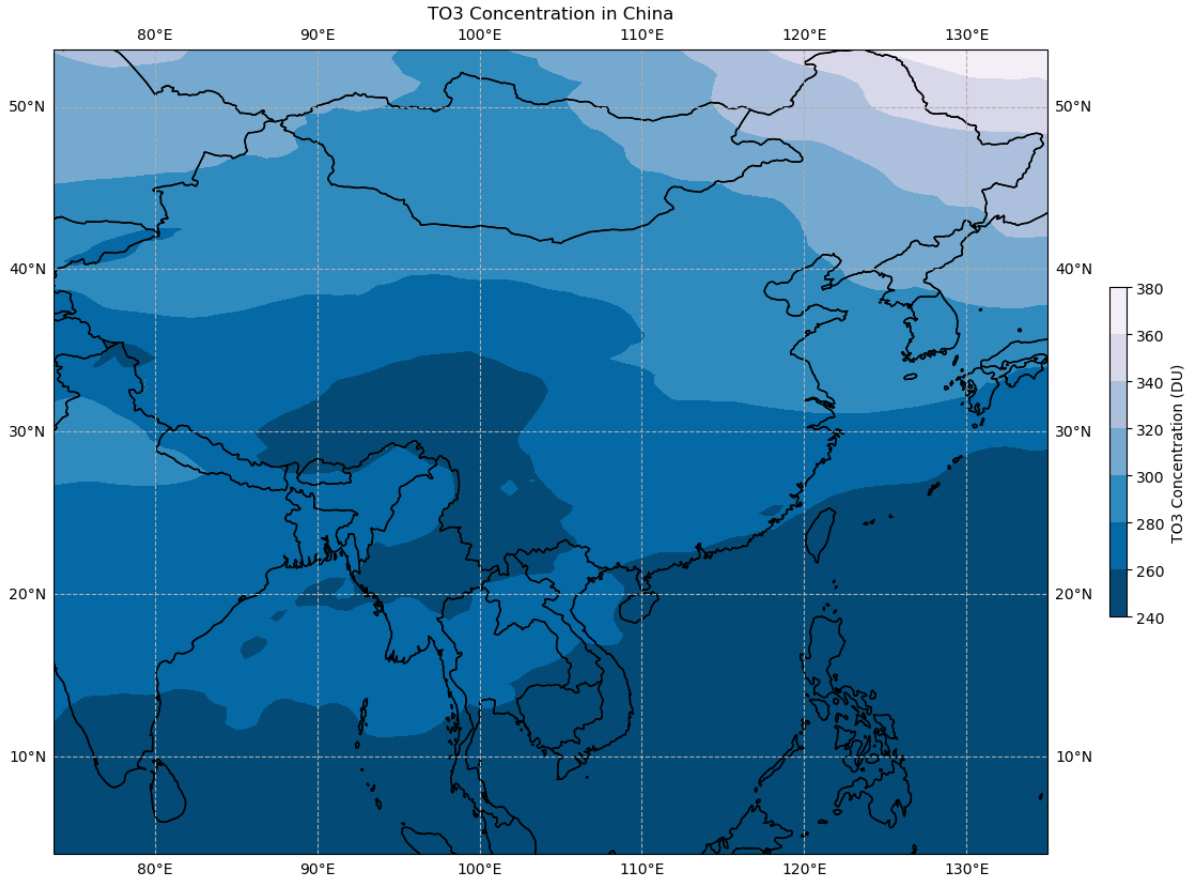


In [ ]:

In [108]:
```
import numpy as np
import matplotlib.pyplot as plt
import cartopy.crs as ccrs
import cartopy.feature as cfeature
import cartopy.mpl.ticker as cticker
from matplotlib.ticker import (MultipleLocator, FormatStrFormatter,
```

In [109]:
```
# Get the longitude and latitude index for the China region
china_lon_indices = np.where((lons >= 73.6) & (lons <= 135.0))[0]
china_lat_indices = np.where((lats >= 3.86) & (lats <= 53.55))[0]

# Get TO3 data for the China region using the index
o3_china = o3[china_lat_indices][:, china_lon_indices]

# Get longitude and latitude information for the China region
lons_china = lons[china_lon_indices]
lats_china = lats[china_lat_indices]
```

In [115]:
```
# Create a 2d grid
lon_2d_china, lat_2d_china = np.meshgrid(lons_china, lats_china)

# Create map projection
fig, ax = plt.subplots(figsize=(15, 10), subplot_kw={'projection':

# Add map features
ax.add_feature(cfeature.COASTLINE)
ax.add_feature(cfeature.BORDERS, linestyle=':', edgecolor='gray')
countries = cfeature.NaturalEarthFeature(
    category='cultural',
    name='admin_0_countries',
    scale='50m',
    facecolor='none',
    edgecolor='black'
)
ax.add_feature(countries)

# Add gridlines
gl = ax.gridlines(draw_labels=True, linestyle='--')

# Add x,y label and ticks
gl.xlocator = cticker.LongitudeLocator()
gl.ylocator = cticker.LatitudeLocator()
gl.xformatter = cticker.LongitudeFormatter()
gl.yformatter = cticker.LatitudeFormatter()

# Plot TO3 concentration distribution in China
cmap = plt.get_cmap('PuBu_r')
im = ax.contourf(lon_2d_china, lat_2d_china, o3_china, cmap=cmap, t

# Add color bar
cbar = plt.colorbar(im, orientation='vertical', pad=0.05, aspect=20


# Add title
plt.title('TO3 Concentration in China')

# Plot
plt.show()
```


TO3 Concentration in China
80°E
90°E
100°E
110°E
120°E
130°E
50°N
40°N
30°N
20°N
10°N
380
360
340
320
300
280
260
240
TO3 Concentration (DU)

In [ ]: