Climate-Change-Indicators

March 15, 2024

1 Project Summary :

- The Climate Change Indicators Analysis project aims to assess and analyze various indicators of climate change across different regions and time periods.
- By examining key metrics such as temperature change along varying years and other relevant factors, the project seeks to provide insights into the ongoing impacts of climate change on the environment.
- The **Average surface temperature on Earth** is approximately **15 degrees Celsius**, according to NASA and we compared the Difference of Mean temperature Changes, Max and Min Temperature Changes with Average surface temperature on Earth.
- This project involved exploring and cleaning a dataset to prepare it for analysis. The data exploration process involved identifying and understanding the characteristics of the data, such as the data types, missing values, and distributions of values
- The data cleaning process involved identifying and addressing any issues or inconsistencies in the data, such as errors, missing values, or duplicate records
- Through this process, we were able to identify and fix any issues with the data, and ensure that it was ready for further analysis
- The clean and prepared data can now be used to answer specific research.
- Once the data has been cleaned and prepared, now begin exploring and summarizing it with describe the data using data manipulation using Pandas to explore and understand patterns in Climate Change data.
- We created various charts to visualize the data, and wrote observations and insights below each one to help us better understand the data and identify useful insights and patterns.
- The observations and insights we identified through this process will be useful for future analysis and decision-makingrelated to Climate Change

2 Problem Statement :

- Analyze the distribution of temperature changes across countries over the years.
- Identify countries with the highest and lowest average temperature changes.
- Calculate the total temperature change for each country across all years.
- Visualize the data using appropriate plots to facilitate better understanding and interpretation.
- Identification of countries with the highest and lowest temperature changes.
- Visualization of temperature change trends using histograms, bar plots, or other suitable visualizations.
- This Dataset can provide valuable insights into how temperature changes vary across countries and regions, which can inform decision-makers, researchers, and policymakers in addressing the future challenges posed by climate change.

3.0.1 Importing necessary Libraries and Load Climate Change Dataset

[1]:
```
import pandas as pd

Climate_df=pd read_csv(r C:\Users\Admin\Downloads\climate_change_indicators.
 ↪csv )
Climate_df
```

[1]:
```
     ObjectId                    Country ISO2 ISO3  \
0           1 Afghanistan, Islamic Rep. of AF AFG
1           2     Albania AL ALB
2           3     Algeria DZ DZA
3           4     American Samoa AS ASM
4           5     Andorra, Principality of AD AND
..        …                          … … …
220   221   Western Sahara EH ESH 221   222
      World NaN WLD
222       223     Yemen, Rep. of YE YEM
223       224     Zambia     ZM ZMB
224       225     Zimbabwe ZW ZWE

                                          Indicator          Unit \
0    Temperature change with respect to a baseline … Degree Celsius
1    Temperature change with respect to a baseline … Degree Celsius
2    Temperature change with respect to a baseline … Degree Celsius
3    Temperature change with respect to a baseline … Degree Celsius
4    Temperature change with respect to a baseline … Degree Celsius
..                                                 …           …
220  Temperature change with respect to a baseline … Degree Celsius
221  Temperature change with respect to a baseline … Degree Celsius
222  Temperature change with respect to a baseline … Degree Celsius
223  Temperature change with respect to a baseline … Degree Celsius
224  Temperature change with respect to a baseline … Degree Celsius

                                          Source CTS_Code \
0 Food and Agriculture Organization of the Unite… ECCS
1 Food and Agriculture Organization of the Unite… ECCS
2 Food and Agriculture Organization of the Unite… ECCS
3 Food and Agriculture Organization of the Unite… ECCS
4 Food and Agriculture Organization of the Unite… ECCS
..                                              …     …
220  Food and Agriculture Organization of the     ECCS
Unite…
221  Food and Agriculture Organization of the     ECCS Unite…
```

```
222  Food and Agriculture Organization of the Unite… ECCS
223  Food and Agriculture Organization of the Unite… ECCS 224
     Food and Agriculture Organization of the Unite… ECCS

                    CTS_Name \
0    Surface Temperature Change
1    Surface Temperature Change
2    Surface Temperature Change
3    Surface Temperature Change
4    Surface Temperature Change
..                         …
220  Surface Temperature Change
221  Surface Temperature Change
222  Surface Temperature Change
223  Surface Temperature Change
224  Surface Temperature Change

                               CTS_Full_Descriptor … F2013 F2014 \
0    Environment, Climate Change, Climate Indicator… … 1.281 0.456
1    Environment, Climate Change, Climate Indicator… … 1.333 1.198
2    Environment, Climate Change, Climate Indicator… … 1.192 1.690
3    Environment, Climate Change, Climate Indicator… … 1.257 1.170
4    Environment, Climate Change, Climate Indicator… … 0.831 1.946
..                                                   … … … …
220  Environment, Climate Change, Climate Indicator… … 1.423 1.401
221  Environment, Climate Change, Climate Indicator… … 1.016 1.053 222
     Environment, Climate Change, Climate Indicator… … NaN NaN
223  Environment, Climate Change, Climate Indicator… … 0.790 0.917
224  Environment, Climate Change, Climate Indicator… … 0.118 0.025

     F2015 F2016 F2017 F2018 F2019 F2020 F2021 F2022
0     1.093 1.555 1.540 1.544 0.910 0.498 1.327
2.012 1 1.569 1.464 1.121 2.028 1.675 1.498 1.536 1.518 2
1.121 1.757 1.512 1.210 1.115 1.926 2.330
1.688 3 1.009 1.539 1.435 1.189 1.539 1.430 1.268
1.256
 4 1.690 1.990 1.925 1.919 1.964 2.562 1.533 3.243
..             … … … … … … … …
220   1.510 1.732 2.204 0.942 1.477 2.069 1.593 1.970
221   1.412 1.660 1.429 1.290 1.444 1.711 1.447 1.394 222 NaN
      NaN NaN NaN NaN NaN NaN NaN
223   1.450 1.401 0.105 0.648 0.855 0.891 0.822 0.686
```

```
224   0.970 1.270 0.088 0.453 0.925 0.389 -0.125 -0.490

[225 rows x 32 columns]
```

3.0.2 About the Dataset

- This Climate Change dataset contains nearly 225 observations from across the World , with 32 columns of data.
- The Data includes both categorical and numeric values, providing a diverse range of information about the listings.
- This Dataset may be useful for analyzing trends and patterns of Climate Change across the World and also gain insights about different Climate Areas in various parts of the World.
- This dataset contains information about Climate Change Indicators from across the World from 2001 to 2022. By analyzing this data, you may be able to understand the trends and patterns of Climate Change across the World.

3.0.3 Understanding the given Column names :

- ObjectId : Unique Identifiers given to each Country
- Country: Name of the Country
- ISO2 : Gives two-letter country code (ISO 3166-1 alpha-2) for each country.
- ISO3 : Gives three-letter country code (ISO 3166-1 alpha-3) for each country.
- Temp_Indicator :Category of temperature change being measured related to a specific baseline of 15 degree celsius
- Unit_of_Temp : Unit of measurement for the temperature change in degree celsius
- Source :Indicates the organization responsible for collecting and providing the temperature change data.
- CTS_Code : Categorization system related to climate or temperature change.
- CTS_Name: Name with the climate or temperature change indicator
- CTS_Full_Descriptor: Contains a detailed description of the climate or temperature change indicator, providing additional info
- Mean_Temp_Change : Gives average temperature change for every Country across this Column
- Max_Temp_Change : Gives max temperature change for each Country
- Min_Temp_Change : Gives min temperature change for each Country
- Total_Temp_Change : Gives sum of temperature differences from baseline temperature of 15 degree celsius of all the years

4 Data Exploration and Data Cleaning

[2]:
```
#Gives collection of all the columns
Climate_df columns
```

[2]:
```
Index(['ObjectId', 'Country', 'ISO2', 'ISO3', 'Indicator', 'Unit',
'Source',
       'CTS_Code', 'CTS_Name', 'CTS_Full_Descriptor', 'F2001', 'F2002',
```

```
       'F2003', 'F2004', 'F2005', 'F2006', 'F2007', 'F2008', 'F2009',
       'F2010',
       'F2011', 'F2012', 'F2013', 'F2014', 'F2015', 'F2016', 'F2017',
       'F2018',
       'F2019', 'F2020', 'F2021', 'F2022'], dtype='object')
```

[3]:
```
#Renames the given column names rename_col =
{'Indicator':'Temp_Indicator','Unit':'Unit_of_Temp'}
Climate_df = Climate_df.rename(columns = rename_col)
Climate_df.head(2)
```

[3]:
```
ObjectId                      Country ISO2 ISO3 \
0        1 Afghanistan, Islamic Rep. of     AF AFG
1        2 Albania AL ALB

                                  Temp_Indicator Unit_of_Temp \
0  Temperature change with respect to a baseline … Degree Celsius
1  Temperature change with respect to a baseline … Degree Celsius

                                          Source CTS_Code \
0 Food and Agriculture Organization of the Unite…
 ECCS 1 Food and Agriculture Organization of the
Unite…     ECCS

                   CTS_Name \
0  Surface Temperature Change
1  Surface Temperature Change

                            CTS_Full_Descriptor … F2013 F2014 \
0  Environment, Climate Change, Climate Indicator… … 1.281 0.456
1  Environment, Climate Change, Climate Indicator… … 1.333 1.198

   F2015 F2016 F2017 F2018 F2019 F2020 F2021 F2022
0  1.093 1.555 1.540 1.544 0.910 0.498 1.327 2.012
1  1.569 1.464 1.121 2.028 1.675 1.498 1.536 1.518

[2 rows x 32 columns]
```

[4]:
```
#Gives the shape (no. of rows,no. of columns) of dataset
Climate_df shape
```

[4]:
```
(225, 32)
```

[5]:
```
Climate_df info()
```

```
<class
 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 225 entries, 0 to
224 Data columns (total 32
columns):
# Column              Non-Null Count
                      Dtype
--- ------            -------------- ----
                      -
0   ObjectId      225 non-null int64
1   Country 225 non-null object 2 ISO2 223 non-null object
3    ISO3    225 non-null object
4    Temp_Indicator 225 non-null object 5 Unit_of_Temp
     225 non-null object 6 Source 225 non-null object 7
     CTS_Code 225 non-null object
 8  CTS_Name      225 non-null object
 9  CTS_Full_Descriptor 225 non-null object
 10 F2001             208 non-null float64
 11 F2002             212 non-null float64
 12 F2003             214 non-null float64
 13 F2004             213 non-null float64
 14 F2005             212 non-null float64
 15 F2006             215 non-null float64
 16 F2007             217 non-null float64
 17 F2008             212 non-null float64
 18 F2009             212 non-null float64
 19 F2010             215 non-null float64
 20 F2011             217 non-null float64
 21 F2012             215 non-null float64
 22 F2013             216 non-null float64
 23 F2014             216 non-null float64
 24 F2015             216 non-null float64
 25 F2016             213 non-null float64
 26 F2017             214 non-null float64
 27 F2018             213 non-null float64
 28 F2019             213 non-null float64
 29 F2020             212 non-null float64
 30 F2021             213 non-null float64
 31 F2022             213 non-null float64
dtypes: float64(22), int64(1),
object(9) memory usage: 56.4+ KB
```

[6]:
```
#check for any duplicate values and drop those duplicates
Climate_df = Climate_df.drop_duplicates()
Climate_df.count()
```

[6]:
```
ObjectId          225
Country           225
ISO2              223
```

```
ISO3                  225
Temp_Indicator        225
Unit_of_Temp          225
Source                225
CTS_Code              225
CTS_Name              225
CTS_Full_Descriptor   225
F2001                 208
F2002                 212
F2003                 214
F2004                 213
F2005                 212
F2006                 215
F2007                 217
F2008                 212
F2009                 212
F2010                 215
F2011                 217
F2012                 215
F2013                 216
F2014                 216
F2015                 216
F2016                 213
F2017                 214
F2018                 213
F2019                 213
F2020                 212
F2021                 213
F2022      213 dtype:
int64
```

[7]:
```
#Check for any null or NaN values in the dataset and taking the sum
 of those␣ ↪null values
Climate_df.isnull().sum()
```

[7]:
```
ObjectId              0
Country               0
ISO2                  2
ISO3                  0
Temp_Indicator        0
Unit_of_Temp          0
Source                0
CTS_Code              0
```

```
CTS_Name              0
CTS_Full_Descriptor   0
F2001                17
F2002                13
F2003                11
F2004                12
F2005                13
F2006                10
F2007                 8
F2008                13
F2009                13
F2010                10
F2011                 8
F2012                10
F2013                 9
F2014                 9
F2015                 9
F2016                12
F2017                11
F2018                12
F2019                12
F2020                13
F2021                12
F2022                12
dtype: int64
```

[8]:
```
#Replacing given numerical value columns null values with 0
values columns_to_replace = ['F2001', 'F2002',
'F2003','F2004','F2005', 'F2006', 'F2007', 'F2008','F2009','F2010',
                  'F2011', 'F2012', 'F2013','F2014','F2015',
                  'F2016', 'F2017', 'F2018','F2019','F2020',
                  'F2021', 'F2022']

# Replace NaN values with 0 in the specified columns
Climate_df[columns_to_replace] = Climate_df[columns_to_replace].fillna(0)
```

[9]:
```
#Replacing given categorical value columns null values with 'unknown'
values
Climate_df['ISO2'].fillna('unknown',inplace=True)
```

```
Climate_df['ISO2'].isnull().sum()
```

[9]: 0

[10]:
```
#Again checking for null values and this time there are no null values remaining
Climate_df.isnull().sum()
```

[10]:
```
ObjectId            0
Country             0
ISO2                0
ISO3                0
Temp_Indicator      0
Unit_of_Temp        0
Source              0
CTS_Code            0
CTS_Name            0
CTS_Full_Descriptor 0
F2001               0
F2002               0
F2003               0
F2004               0
F2005               0
F2006               0
F2007               0
F2008               0
F2009               0
F2010               0
F2011               0
F2012               0
F2013               0
F2014               0
F2015               0
F2016               0
F2017               0
F2018               0
F2019               0
F2020               0
F2021               0
F2022 dtype:        0
int64
```

[11]:
```
#Gettting a random Sample of 5 elements from the dataset after Cleaning the dataset
Climate_df sample(5)
```

[11]:
```
    ObjectId           Country ISO2 ISO3 \
```

```
175 176 Seychelles SC SYC 14 15  Bahamas,
The BS BHS
2          3             Algeria DZ DZA
101      102 Kazakhstan, Rep. of KZ KAZ
219      220 West Bank and Gaza PS PSE

                                    Temp_Indicator Unit_of_Temp \
175 Temperature change with respect to a baseline … Degree Celsius
14Temperature change with respect to a baseline … Degree Celsius
2Temperature change with respect to a baseline … Degree Celsius
101 Temperature change with respect to a baseline … Degree Celsius
219 Temperature change with respect to a baseline … Degree Celsius

                                          Source CTS_Code \
175 Food and Agriculture Organization of the     ECCS
Unite…
 14 Food and Agriculture Organization of the     ECCS
Unite…
2 Food and Agriculture Organization of the Unite… ECCS
101 Food and Agriculture Organization of the     ECCS
Unite…
219 Food and Agriculture Organization of the     ECCS
Unite…
                     CTS_Name \
175 Surface Temperature Change
14 Surface Temperature Change
 2 Surface Temperature Change
101 Surface Temperature Change
219 Surface Temperature Change

                              CTS_Full_Descriptor … F2013 F2014 \
175 Environment, Climate Change, Climate Indicator… … 0.749 0.863
14Environment, Climate Change, Climate Indicator… … 0.565 0.883
2 Environment, Climate Change, Climate Indicator… … 1.192 1.690
101 Environment, Climate Change, Climate Indicator… … 1.621 0.673
219 Environment, Climate Change, Climate Indicator… … 1.114 0.863

     F2015 F2016 F2017 F2018 F2019 F2020 F2021 F2022
175 1.169 1.100 1.184 0.917 1.377 1.434 1.032 0.872
14 1.114 1.042 1.331 1.023 1.443 1.611 0.879 1.480
 2 1.121 1.757 1.512 1.210 1.115 1.926 2.330 1.688
101 1.609 2.240 1.757 0.641 1.487 2.853 1.465 2.712
219 1.326 1.615 0.735 2.007 1.204 1.455 1.787 1.074

[5 rows x 32 columns]
```

[12]:
```
#Gives summary statistics of Numerical columns of Climate Change dataset
Climate_df.describe()
```

[12]:

	ObjectId	F2001	F2002	F2003	F2004	F2005
count	225.000000	225.000000	225.000000	225.000000	225.000000	225.000000
mean	113.000000	0.785920	0.871556	0.802956	0.736356	0.803707
std	65.096083	0.505674	0.426329	0.458419	0.401072	0.411579
min	1.000000	-0.186000	0.000000	-0.252000	-0.622000	-0.393000
25%	57.000000	0.459000	0.646000	0.552000	0.505000	0.542000
50%	113.000000	0.689000	0.827000	0.822000	0.703000	0.827000
75%	169.000000	1.237000	1.123000	1.037000	0.957000	1.047000
max	225.000000	1.992000	2.255000	2.328000	2.150000	2.201000

	F2006	F2007	F2008	F2009 …	F2013
count	225.000000	225.000000	225.000000	225.000000 …	225.000000
mean	0.837618	0.986191	0.761702	0.857956 …	0.893951
std	0.448922	0.569053	0.510197	0.428091 …	0.364300
min	-0.505000	-0.219000	-0.139000	-0.319000 …	0.000000
25%	0.581000	0.650000	0.406000	0.635000 …	0.707000
50%	0.810000	0.903000	0.667000	0.869000 …	0.885000
75%	1.109000	1.202000	1.090000	1.162000 …	1.182000
max	2.343000	2.729000	2.607000	1.774000 …	1.643000

	F2014	F2015	F2016	F2017	F2018	F2019
count	225.000000	225.000000	225.000000	225.000000	225.000000	225.000000
mean	1.070222	1.218982	1.362747	1.218169	1.232667	1.366098
std	0.595173	0.516915	0.507294	0.473529	0.650431	0.558986
min	-0.092000	-0.430000	0.000000	0.000000	0.000000	0.000000
25%	0.704000	0.970000	1.097000	0.967000	0.823000	1.078000
50%	0.960000	1.201000	1.411000	1.257000	1.101000	1.396000
75%	1.306000	1.516000	1.692000	1.512000	1.609000	1.675000

```
max      2.704000 2.613000 2.459000    2.493000   2.772000   2.689000

           F2020      F2021      F2022
count      225.000000       225.000000
225.000000 mean 1.462364 1.271876
1.308400   std   0.704322   0.560254
0.721674   min   0.000000   -0.425000
1.305000   25%   1.128000   0.952000
0.834000
50% 1.430000 1.300000 1.268000 75%
1.778000 1.596000 1.865000 max
3.691000 2.676000 3.243000
[8 rows x 23 columns]
```

4.0.1 Adding Mean Temperature Change Column

```
[13]: mean_temp_change = Climate_df[['F2001', 'F2002', 'F2003', 'F2004',
'F2005',␣
 ↪'F2006', 'F2007', 'F2008', 'F2009', 'F2010',
'F2011', 'F2012', 'F2013', 'F2014', 'F2015', 'F2016', 'F2017',
'F2018',␣
 ↪'F2019', 'F2020', 'F2021', 'F2022']].mean(axis=1)

# Add the mean temperature change as a new column to the DataFrame
Climate_df['Mean_Temp_Change'] = mean_temp_change

# Display the updated DataFrame
Climate_df.head(2)
```

```
[13]: ObjectId                    Country ISO2 ISO3 \
0        1 Afghanistan, Islamic Rep. of     AF AFG
1        2 Albania AL ALB

                                  Temp_Indicator Unit_of_Temp \
0  Temperature change with respect to a baseline … Degree Celsius
1  Temperature change with respect to a baseline … Degree Celsius

                                          Source CTS_Code \
0 Food and Agriculture Organization of the Unite…
 ECCS 1 Food and Agriculture Organization of the
Unite…     ECCS

                   CTS_Name \
0  Surface Temperature Change
1  Surface Temperature Change
                             CTS_Full_Descriptor … F2014 F2015 \
```

```
0  Environment, Climate Change, Climate Indicator… … 0.456 1.093
1  Environment, Climate Change, Climate Indicator… … 1.198 1.569

   F2016 F2017 F2018 F2019 F2020 F2021 F2022 Mean_Temp_Change
0  1.555 1.540 1.544 0.910 0.498 1.327 2.012 1.112727
1  1.464 1.121 2.028 1.675 1.498 1.536 1.518 1.174955

[2 rows x 33 columns]
```

[14]:
```
#Calculating the value counts of Mean_Temp_Change
Climate_df['Mean_Temp_Change'].value_counts()
```

[14]:
```
Mean_Temp_Change
0.000000 5
0.749318 3
1.054455 2
0.988091 2
1.112727 1
..
1.540091 1
0.776318 1
0.773409 1
0.831864 1
0.301364 1
Name: count, Length: 217, dtype: int64
```

4.0.2 Max and Min of Mean Temperature Change

[15]:
```
# Find the country with the highest mean temperature change
country_highest_change =
Climate_df.loc[Climate_df['Mean_Temp_Change'].idxmax()]

# Display the country with the highest mean temperature change
print("Country with the highest mean temperature change:")
print(country_highest_change[['Country', 'Mean_Temp_Change']])
```

```
Country with the highest mean temperature change:
Country          Estonia, Rep. of
Mean_Temp_Change            1.784
Name: 62, dtype: object
```

[16]:
```
# Find the country with the lowest mean temperature change
country_lowest_change =
Climate_df.loc[Climate_df['Mean_Temp_Change'].idxmin()]

# Display the country with the lowest mean temperature change
print("Country with the lowest mean temperature change:")
print(country_lowest_change[['Country', 'Mean_Temp_Change']])
```

```
Country with the lowest mean temperature change:
Country Pitcairn Islands Mean_Temp_Change -
0.043727
Name: 159, dtype: object
```

4.0.3 Max and Min Temperature Countries of Year 2022

[17]:
```
# Find the index of the maximum temperature change for the year 2022
max_temp_index_2022 = Climate_df['F2022'].idxmax()

# Get the country with the highest temperature change in 2022
country_max_temp_2022 =Climate_df.loc[max_temp_index_2022, 'Country']


print("Country with the highest temperature change in 2022:",␣
↪country_max_temp_2022)
```

```
Country with the highest temperature change in 2022: Andorra,
Principality of
```

[18]:
```
# Find the index of the minimum temperature change for the year 2022
min_temp_index_2022 = Climate_df['F2022'].idxmin()

# Get the country with the lowest temperature change in 2022
country_min_temp_2022 =Climate_df.loc[min_temp_index_2022, 'Country']


print("Country with the lowest temperature change in 2022:",␣
↪country_min_temp_2022)
```

```
Country with the lowest temperature change in 2022: Botswana
```

4.0.4 Adding Max, Min and Total Temperature Change Columns

[19]:
```
# Find the maximum and minimum temperature change across all years for
each␣
↪country max_temp_change = Climate_df.iloc[:,
10:32].max(axis=1) min_temp_change =
Climate_df.iloc[:, 10:32].min(axis=1)

# Calculate the total temperature change for each country across all
years total_temp_change = Climate_df.iloc[:, 10:32].sum(axis=1)
```

```
# Add the results as new columns to the DataFrame
Climate_df['Max_Temp_Change'] = max_temp_change
Climate_df['Min_Temp_Change'] = min_temp_change
Climate_df['Total_Temp_Change'] = total_temp_change

# Display the DataFrame with the new columns
```

[19]:

```
    ObjectId                    Country    ISO2 ISO3 \
0          1 Afghanistan, Islamic Rep. of AF AFG
1          2     Albania AL ALB
2          3     Algeria DZ DZA
3          4     American Samoa AS ASM
4          5     Andorra, Principality of AD AND
..       …                          …      … …
220 221 Western Sahara EH ESH 221 222 World unknown WLD
222 223 Yemen, Rep. of YE YEM
223      224     Zambia     ZM ZMB
224      225     Zimbabwe ZW ZWE

                                    Temp_Indicator Unit_of_Temp \
0    Temperature change with respect to a baseline … Degree Celsius
1    Temperature change with respect to a baseline … Degree Celsius
2    Temperature change with respect to a baseline … Degree Celsius
3    Temperature change with respect to a baseline … Degree Celsius
4    Temperature change with respect to a baseline … Degree Celsius
..                                                 …            …
220  Temperature change with respect to a baseline … Degree Celsius
221  Temperature change with respect to a baseline … Degree Celsius
222  Temperature change with respect to a baseline … Degree Celsius
223  Temperature change with respect to a baseline … Degree Celsius
224  Temperature change with respect to a baseline … Degree Celsius

                                          Source CTS_Code \
0 Food and Agriculture Organization of the Unite… ECCS
1 Food and Agriculture Organization of the Unite… ECCS
2 Food and Agriculture Organization of the Unite… ECCS
3 Food and Agriculture Organization of the Unite… ECCS
4 Food and Agriculture Organization of the Unite… ECCS
..                                              …     …
220 Food and Agriculture Organization of the     ECCS
Unite…
```

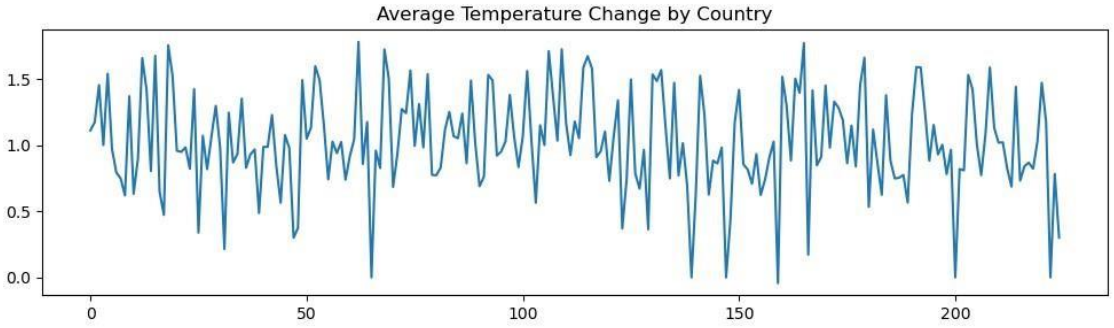
```
221 Food and Agriculture Organization of the     ECCS
Unite…
222 Food and Agriculture Organization of the     ECCS
Unite…
223 Food and Agriculture Organization of the     ECCS
Unite…
224 Food and Agriculture Organization of the     ECCS
Unite…
                    CTS_Name \
0    Surface Temperature Change
1    Surface Temperature Change
2    Surface Temperature Change
3    Surface Temperature Change
4 Surface Temperature Change
..                          …
220  Surface Temperature Change
221  Surface Temperature Change
222  Surface Temperature Change
223  Surface Temperature Change
224  Surface Temperature Change

                               CTS_Full_Descriptor … F2017 F2018 \
0    Environment, Climate Change, Climate Indicator… … 1.540 1.544
1    Environment, Climate Change, Climate Indicator… … 1.121 2.028
2    Environment, Climate Change, Climate Indicator… … 1.512 1.210
3    Environment, Climate Change, Climate Indicator… … 1.435 1.189
4    Environment, Climate Change, Climate Indicator… … 1.925 1.919
..                                                  … … … …
220  Environment, Climate Change, Climate Indicator… … 2.204 0.942
221  Environment, Climate Change, Climate Indicator… … 1.429 1.290
222  Environment, Climate Change, Climate Indicator… … 0.000 0.000
223  Environment, Climate Change, Climate Indicator… … 0.105 0.648
224  Environment, Climate Change, Climate Indicator… … 0.088 0.453
     F2019 F2020 F2021 F2022 Mean_Temp_Change Max_Temp_Change \0 0.910
     0.498 1.327 2.012 1.112727 2.012

1    1.675 1.498 1.536 1.518      1.174955         2.028

2    1.115 1.926 2.330 1.688      1.456682         2.330

3    1.539 1.430 1.268 1.256      1.002273         1.539

4    1.964 2.562 1.533 3.243      1.542500         3.243

..         … … … …                  …              …
```

```
220 1.477 2.069 1.593 1.970      1.474182         2.204

221 1.444 1.711 1.447 1.394      1.177773         1.711

222 0.000 0.000 0.000 0.000      0.000000         0.000

223 0.855 0.891 0.822 0.686      0.784045         1.450
224 0.925 0.389 -0.125 -0.490    0.301364         1.270

     Min_Temp_Change
     Total_Temp_Change
0      0.223 24.480 1 0.189 25.849
2      0.945 32.047 3 0.000 22.050
4              0.471            33.935
..               …                …
220   0.903 32.432
221   0.834 25.911 222 0.000 0.000
223           0.105 17.249
224           -0.490 6.630


[225 rows x 36 columns]
```

4.0.5 Line Chart for Mean Temperature Change

```
[20]: Climate_df['Mean_Temp_Change'].plot(kind='line',x='Country',
figsize=(12, 3),␣
    ↪title='Average Temperature Change by Country')
```

```
[20]: <Axes: title={'center': 'Average Temperature Change by Country'}>
```

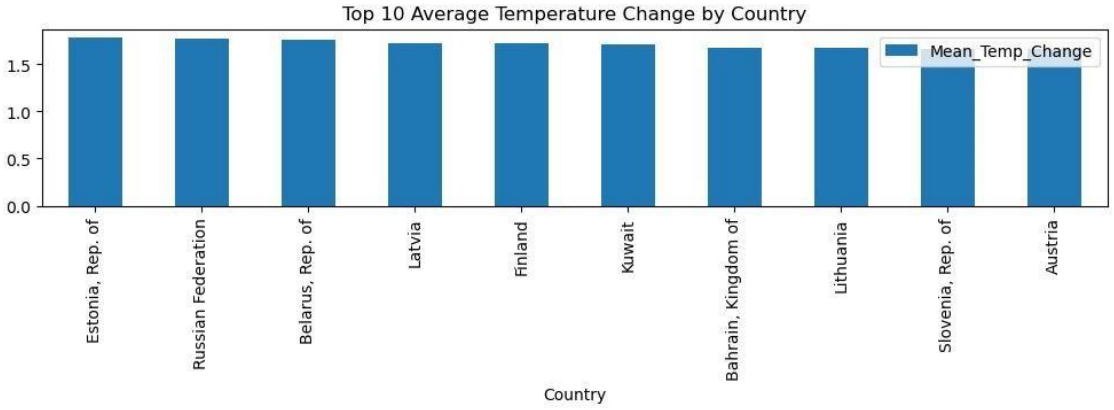


4.0.6 Bar Chart for Top 10 Largest Mean Temperature by Countries

```
[26]: top_10_mean_temp_change = Climate_df.nlargest(10, 'Mean_Temp_Change')
top_10_mean_temp_change.plot(kind='bar', x='Country',
y='Mean_Temp_Change',␣
```

```
↪figsize=(12, 2), title='Top 10 Average Temperature Change by
Country')
```

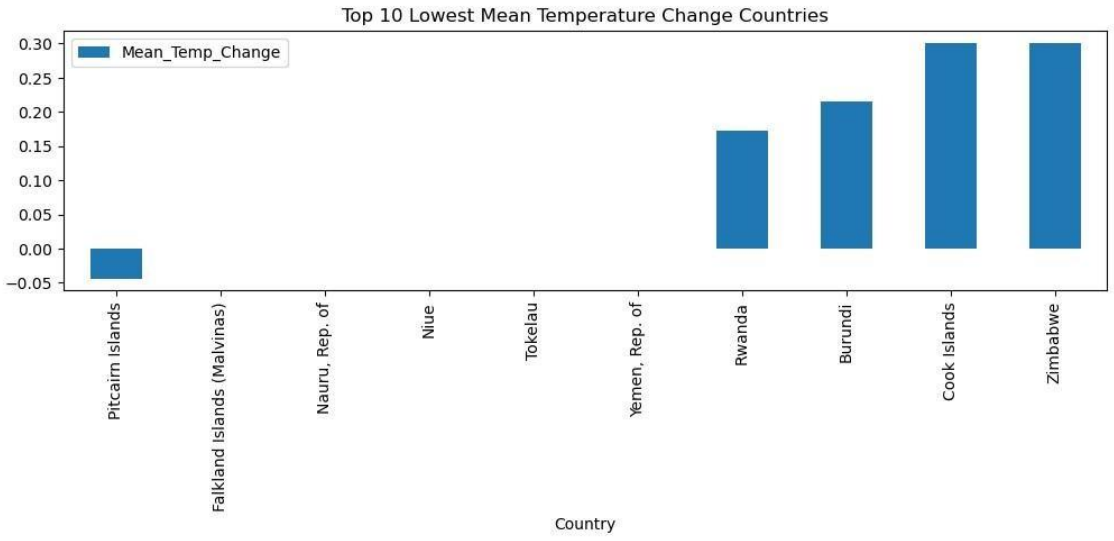
[26]:
```
<Axes: title={'center': 'Top 10 Average Temperature Change by
Country'}, xlabel='Country'>
```



4.0.7 'Bar Chart for Top 10 Lowest Mean Temperature Change Countries

[27]:
```
top_10_min_mean_temp_change = Climate_df.nsmallest(10,
'Mean_Temp_Change') top_10_min_mean_temp_change.plot(kind='bar',
x='Country', y='Mean_Temp_Change',␣
↪figsize=(12, 3), title='Top 10 Lowest Mean Temperature Change
Countries')
```

[27]:
```
<Axes: title={'center': 'Top 10 Lowest Mean Temperature Change
Countries'}, xlabel='Country'>
```

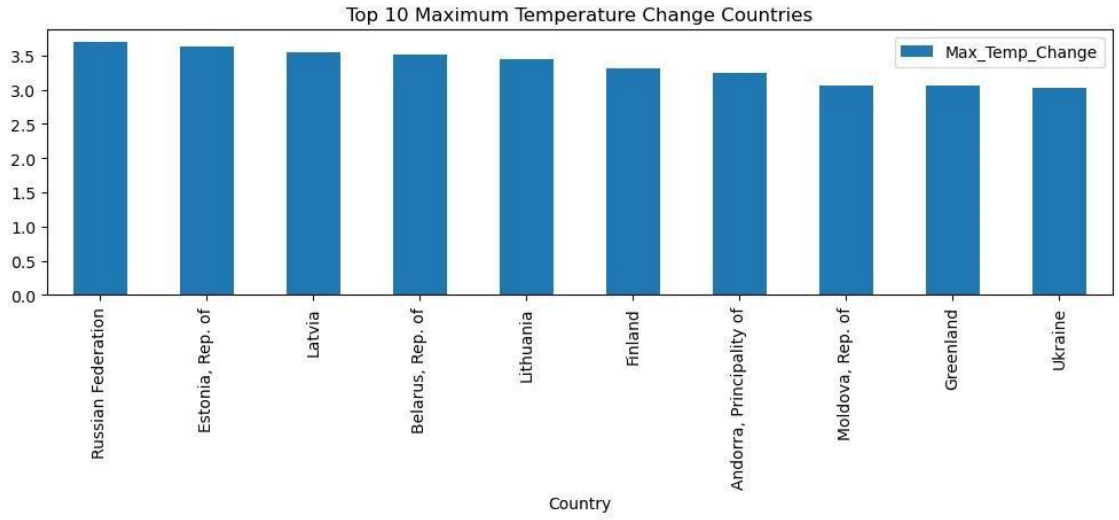


4.0.8 Bar Chart for Maximum Temperature Change

[28]:
```
top_10_max_temp_change =
```

```
Climate_df.sort_values(by='Max_Temp_Change',␣
    ↪ascending=False).head(10)
top_10_max_temp_change.plot(kind='bar', x='Country',
y='Max_Temp_Change',␣
↪figsize=(12,3), title='Top 10 Maximum Temperature Change Countries')
```

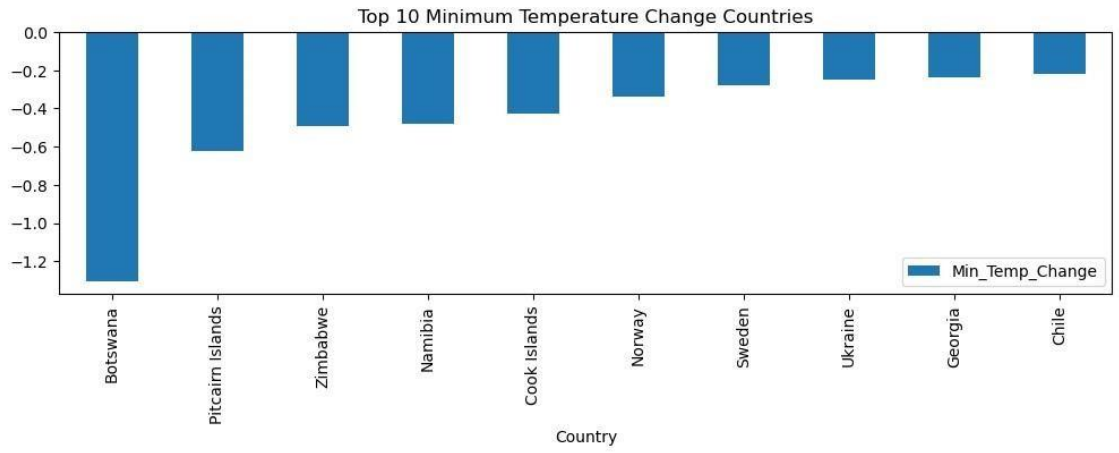
[28]: <Axes: title={'center': 'Top 10 Maximum Temperature Change Countries'}, xlabel='Country'>



4.0.9 Bar Chart for Minimum Temperature Change

```
[29]: top_10_min_temp_change =
Climate_df.sort_values(by='Min_Temp_Change').head(10)
top_10_min_temp_change.plot(kind='bar', x='Country',
y='Min_Temp_Change',␣
↪figsize=(12,3), title='Top 10 Minimum Temperature Change Countries')
```

[29]: <Axes: title={'center': 'Top 10 Minimum Temperature Change Countries'}, xlabel='Country'>



4.1 Pivot Table :

[25]:
```
#Making a Pivot Table with Column as Country and giving values of 4
 Columns of␣ ↪Numerical datatype
Climate_df.pivot_table(index='Country',values=[␣
↪'Mean_Temp_Change','Total_Temp_Change','Max_Temp_Change','Min_Temp_C
hange'])
```

[25]:

Country	Max_Temp_Change	Mean_Temp_Change	Min_Temp_Change	Total_Temp_Change
Afghanistan, Islamic Rep. of	2.012	1.112727	0.223	24.480
Albania	2.028	1.174955	0.189	25.849
Algeria	2.330	1.456682	0.945	32.047
American Samoa	1.539	1.002273	0.000	22.050
Andorra, Principality of	3.243	1.542500	0.471	33.935
…	…	…	…	…
Western Sahara	2.204	1.474182		
World	1.711	1.177773		
Yemen, Rep. of	0.000	0.000000		
Zambia	1.450	0.784045		
Zimbabwe	1.270	0.301364		

```
Western Sahara                0.903          32.432
World                         0.834          25.911
Yemen, Rep. of                0.000           0.000
 Zambia                       0.105          17.249
 Zimbabwe                    -0.490           6.630
 [225 rows x 4 columns]
```

5 Observations :

- The dataset consists of 225 rows, each representing a different country or region.
- The temperature changes are measured in degrees Celsius with respect to a baseline of 15 degree celsius.
- Mean_Temp_Change, Max_Temp_Change, Min_Temp_Change, and Total_Temp_Change columns seem to provide summary statistics for temperature changes.
- We found the the country with the highest mean temperature change is **Estonia** with **1.784 degree celsius** rise from baseline. We found the country with the lowest mean temperature change is **Pitcairn Islands** with **-0.043727 degree celsius** fall from baseline.
- The **Maximum temperature change** for the year **2022** is of Country **Andorra**.
- The **Minimum temperature change** for the year **2022** is of Country **Botswanna**.
- The Top 10 Average Maximum Temperature by Country which were most affected were: **Estonia,Russia,Belarus,Latvia,Finland,Kuwait,Bahrain,Lithunia,Slovenia,Austria** •
. The Top 10 Average Minimum Temperature by Country which were least affected were: **Pitcairn Islands,Falkland,Nauru,Niue,Yemen,Rwanda,Burundi,Cook Islands,Zimbabwe**
- Top 10 Countries where max Temperature change across past 22 Years: **Estonia,Russia,Belarus,Latvia,Finland,Andorra,Moldova,Lithunia,Greenland,Ukraine**
- Top 10 Countries where min Temperature change across past 22 Years: **Pitcairn Islands,Botswana,Namibia,Norway,Sweden,Ukraine,Georgia,Chile,Cook Islands**
- From the above Max Temperature Change and Max Mean Temperature Change values we can see that:Countries further away from the Equator are getting the most affected by the rise in Temperature. • Also,From the above Min Temperature Change and Min Mean Tempoerature Change values we can see that:Countries closer to the Equator are getting the least affected by the rise in Temperature.

6 Conclusion :

- There is a significant variation in temperature changes across different countries and regions. Some areas have experienced considerable increases in temperature, while others have seen more moderate changes or even decreases.
- It's notable that the mean temperature change across all countries is positive, indicating a general trend of warming temperatures globally.
- The maximum and minimum temperature changes provide insights into the range of variation within each country or region.

- Further analysis could involve investigating correlations between temperature changes and other factors such as geographical location, population density, and economic activities to better understand the drivers of climate change impacts.
- The data highlights the urgent need for global action to mitigate climate change and its associated impacts, as rising temperatures can have significant consequences for ecosystems, agriculture, water resources, and human well-being.

7 The End