1st Visualization: Climate Change in Germany

In [112]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.lines as mlines
import matplotlib.font_manager
from matplotlib.offsetbox import AnchoredText
from mpl_toolkits.axes_grid1 import make_axes_locatable
from matplotlib.colors import ListedColormap, BoundaryNorm
import math

%config InlineBackend.figure_format = 'retina'
```

In [113]:
```
df=pd.read_csv("data-5xKlg.csv")
```

In [114]:
```
df.head()
```

Out[114]:

	year	time	Temp. anomaly (°C)	Precipitation anomaly (%)	label
0	2010	Autumn	-0.361667	17.461992	Autumn 2010
1	2011	Autumn	0.908333	-37.750055	Autumn 2011
2	2012	Autumn	0.388333	-8.234524	Autumn 2012
3	2013	Autumn	0.718333	27.282316	Autumn 2013
4	2014	Autumn	2.298333	-19.255110	Autumn 2014

In [115]:
```
df.rename(columns={'Temp.<br>anomaly<br>(°C)':'Temp','Precipitation anomaly (%)':'precipitation'},inplace=True)
df['season_values']=np.where(df['time']=='Spring', 1, (np.where(df['time']=='Summer',2,(np.where(df['time']=='Autumn',3,4)))))
df.sort_values(by=['year','season_values'],inplace=True)
df['positive_Temp'] = df['Temp'] > 0
df['positive_precip']=df['precipitation']>0

df.head()
```

Out[115]:

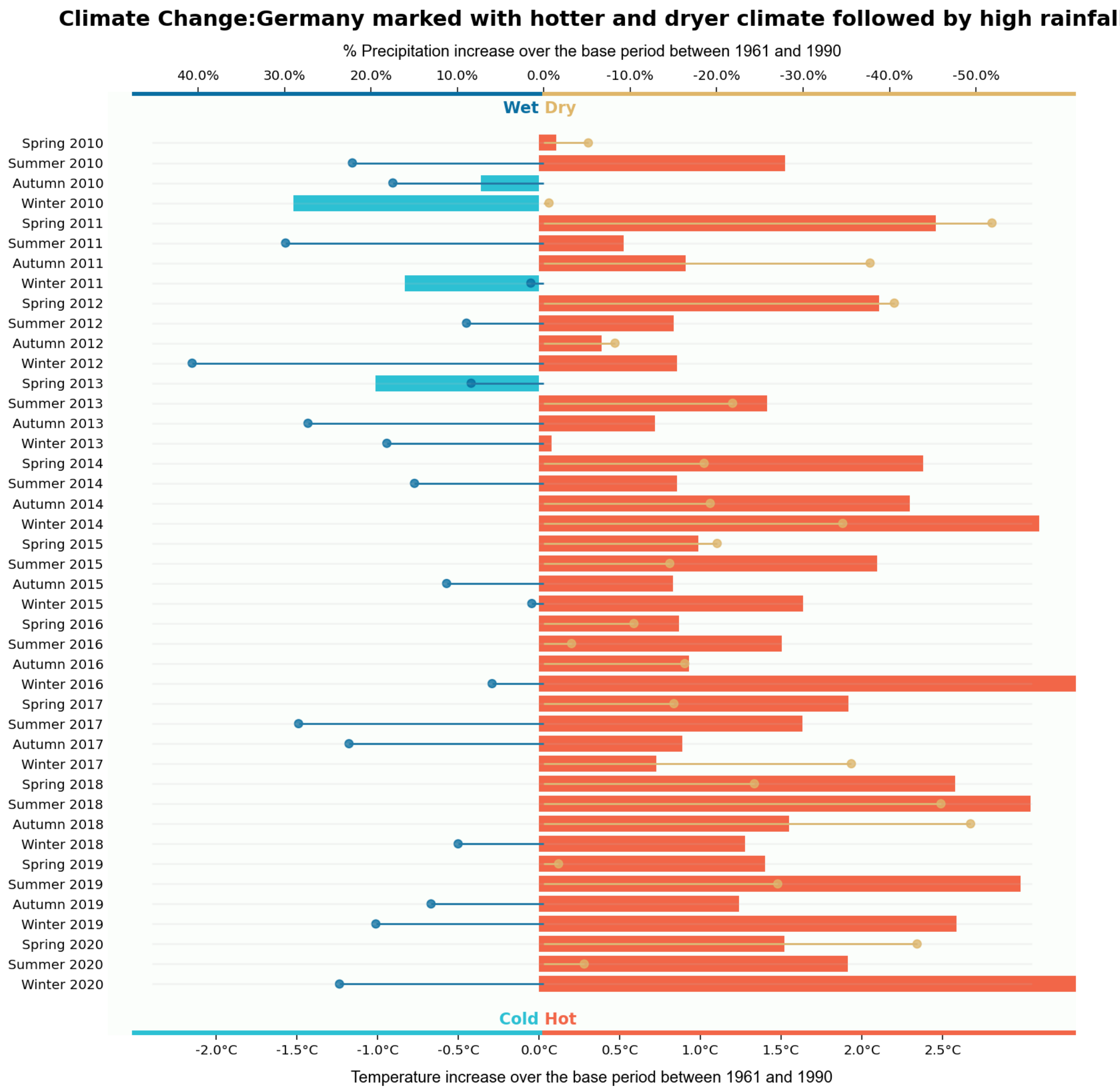
	year	time	Temp	precipitation	label	season_values	positive_Temp	positive_preci
10	2010	Spring	0.109000	-5.152162	Spring 2010	1	True	Fals
21	2010	Summer	1.523000	22.145483	Summer 2010	2	True	Tru
0	2010	Autumn	-0.361667	17.461992	Autumn 2010	3	False	Tru
32	2010	Winter	-1.523000	-0.603243	Winter 2010	4	False	Fals
11	2011	Spring	2.459000	-51.849793	Spring 2011	1	True	Fals

In [116]:
```
df.shape
```

Out[116]: (43, 8)

In [129]:
```
fig, ax = plt.subplots(figsize=(13,13))

cmap = ListedColormap(['#2CC0D3','#F26648'])
norm = BoundaryNorm([0], cmap.N)
dotcolors = cmap(norm(df['Temp']))
ax.barh(df["label"], df["Temp"], align='center',color=dotcolors)

ax1 = ax.twiny()

def align_xaxis(ax1, v1, ax2, v2):
    """adjust ax2 ylimit so that v2 in ax2 is aligned to v1 in ax1"""
    x1, _ = ax1.transData.transform((v1, 0))
    x2, _ = ax2.transData.transform((v2, 0))
    inv = ax2.transData.inverted()
    dx, _ = inv.transform((0, 0)) - inv.transform((x1-x2, 0))
    minx, maxx = ax2.get_xlim()
    ax2.set_xlim(minx+dx, maxx+dx)

cmap2 = ListedColormap(['#dfb669','#096EA1'])
norm2 = BoundaryNorm([0], cmap2.N)
dotcolors2 = cmap2(norm2(df['precipitation']))

ax1.hlines(df.label, xmin=0, xmax=-1*df.precipitation/100,color=dotcolor
s2)
plt.scatter(-1*df.precipitation/100,df.label , c=dotcolors2, alpha=0.8)


x_min, x_max = ax1.get_xlim()
ax1.hlines(df.label, xmin=x_min, xmax=x_max,color='silver',alpha=0.15,ls
='-')


align_xaxis(ax1, 0, ax, 0)
ax.invert_yaxis()
ax.spines['right'].set_visible(False)
ax.spines['top'].set_visible(False)
ax.spines['left'].set_visible(False)
ax.spines['bottom'].set_visible(False)
ax1.spines['right'].set_visible(False)
ax1.spines['top'].set_visible(False)
ax1.spines['left'].set_visible(False)
ax1.spines['bottom'].set_visible(False)
ax.get_xaxis().set_visible(True)
ax1.get_xaxis().set_visible(True)
ax.tick_params(axis='y', which=u'both',length=0)

l=np.arange(-2,3,0.5)
ax.set_xticks(l)
m=np.arange(-0.4,0.6,0.1)
ax1.set_xticks(m)
ax.set_xticklabels(str(l[i])+"°C" for i in range(len(l)))
ax1.set_xticklabels(str(round(m[i],2)*-100)+"%" for i in range(len(m)))

a=mlines.Line2D([0,4], [44.5,44.5], color='#F26648',lw=5)
b=mlines.Line2D([-2.5,0], [44.5,44.5], color='#2CC0D3',lw=5)
c=mlines.Line2D([0,4], [-2.5,-2.5], color='#dfb669',lw=5)
```

```
d=mlines.Line2D([-2.5,0], [-2.5,-2.5], color='#096EA1',lw=5)
ax.add_line(a)
ax.add_line(b)
ax.add_line(c)
ax.add_line(d)

ax.text(0,44," Hot",fontweight='bold',fontsize=12,color='#F26648')
ax.text(0,44," Cold",fontweight='bold',fontsize=12,color='#2CC0D3',ha='r
ight')
ax.text(0,-1.5," Dry",fontweight='bold',fontsize=12,color='#dfb669')
ax.text(0,-1.5," Wet",fontweight='bold',fontsize=12,color='#096EA1',ha=
'right')

ax.set_xlabel("Temperature increase over the base period between 1961 an
d 1990",fontsize=12,fontname='Arial')
ax.xaxis.labelpad = 10
ax1.set_xlabel("% Precipitation increase over the base period between 19
61 and 1990",fontsize=12,fontname='Arial')
ax1.xaxis.labelpad = 10
ax.set_facecolor('#fbfefb')

plt.title("Climate Change:Germany marked with hotter and dryer climate f
ollowed by high rainfall",fontsize=16,loc='center',pad=14,fontweight='bo
ld')
plt.show()
```



2nd Visualization: Flattening the COVID curve

In [118]:
```
import math
```

In [119]:
```
df_2=pd.read_csv("data-zLck8.csv")
```

In [120]:
```
df_2.head()
```

Out[120]:

	days	Afghanistan	Albania	Algeria	Angola	Argentina	Armenia	Australia	Austri
0	day 0	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.00000
1	day 1	11.857143	10.000000	11.428571	10.000000	13.714286	10.000000	11.285714	12.71428
2	day 2	13.428571	12.142857	13.571429	10.285714	16.714286	11.285714	12.714286	16.42857
3	day 3	15.000000	13.428571	15.571429	10.714286	19.571429	12.428571	14.142857	22.57142
4	day 4	16.428571	14.857143	17.857143	11.428571	23.428571	13.571429	15.857143	30.00000

5 rows × 122 columns

We will take median as the baseline

In [121]:
```
df_2["medianv"]=df_2.median(axis=1)
df_2.head()
```

Out[121]:

	days	Afghanistan	Albania	Algeria	Angola	Argentina	Armenia	Australia	Austri
0	day 0	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.00000
1	day 1	11.857143	10.000000	11.428571	10.000000	13.714286	10.000000	11.285714	12.71428
2	day 2	13.428571	12.142857	13.571429	10.285714	16.714286	11.285714	12.714286	16.42857
3	day 3	15.000000	13.428571	15.571429	10.714286	19.571429	12.428571	14.142857	22.57142
4	day 4	16.428571	14.857143	17.857143	11.428571	23.428571	13.571429	15.857143	30.00000

5 rows × 123 columns

In [122]:
```
df_2.columns
```

Out[122]:
```
Index(['days', 'Afghanistan', 'Albania', 'Algeria', 'Angola', 'Argentin
a',
       'Armenia', 'Australia', 'Austria', 'Azerbaijan',
       ...
       'West Bank and Gaza', 'Yemen', 'Zambia', 'Zimbabwe',
       'doubles every day', 'doubles every 2 days', 'doubles every 3 da
ys',
       'doubles every week', 'doubles every month', 'medianv'],
      dtype='object', length=123)
```

Let's enrich the data and calculate data points to identify deaths doubling every 10 days and double every 20 days

In [123]:
```
df_2.head()
```

Out[123]:

	days	Afghanistan	Albania	Algeria	Angola	Argentina	Armenia	Australia	Austri
0	day 0	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.000000	10.00000
1	day 1	11.857143	10.000000	11.428571	10.000000	13.714286	10.000000	11.285714	12.7142
2	day 2	13.428571	12.142857	13.571429	10.285714	16.714286	11.285714	12.714286	16.42857
3	day 3	15.000000	13.428571	15.571429	10.714286	19.571429	12.428571	14.142857	22.5714
4	day 4	16.428571	14.857143	17.857143	11.428571	23.428571	13.571429	15.857143	30.00000

5 rows × 123 columns

We derive the formula to calulate the doubling rate which is: log(2)/log(1+r) where r is the growth rate

In [124]:
```
def doublerate(y,df_2,str):
    c=[]
    c.append(0)
    for i in range(1,len(df_2)):
        if(y[i]/y[i-1]>1):
            slope=math.floor(np.log(2)/np.log(y[i]/y[i-1]))
        else:
            slope=50
        if(slope<=1):
            c.append(1)
        elif(slope<=2):
            c.append(2)
        elif(y[i]<=3):
            c.append(3)
        elif(y[i]<=7):
            c.append(4)
        elif(y[i]<=10):
            c.append(5)
        elif(y[i]<=20):
            c.append(6)
        else:
            c.append(7)
    df_2.insert(1,str,c)


doublerate(df_2["US"],df_2,"US_dr")
doublerate(df_2["Europe"],df_2,"Europe_dr")
doublerate(df_2["China"],df_2,"China_dr")
doublerate(df_2["Italy"],df_2,"Italy_dr")
doublerate(df_2["medianv"],df_2,"medianv_dr")
doublerate(df_2["South Korea"],df_2,"SKorea_dr")
```

In [125]:
```
df_2.head()
```

Out[125]:

	days	SKorea_dr	medianv_dr	Italy_dr	China_dr	Europe_dr	US_dr	Afghanistan	Albania	
0	day 0	0	0	0	0	0	0	10.000000	10.000000	1
1	day 1	6	6	1	7	6	6	11.857143	10.000000	1
2	day 2	6	6	2	7	2	6	13.428571	12.142857	1
3	day 3	6	6	2	7	2	6	15.000000	13.428571	1
4	day 4	6	6	2	7	2	7	16.428571	14.857143	1

5 rows × 129 columns

In [127]:
```
fig, ax = plt.subplots(figsize=(12,7))

cmap = ListedColormap(['#520000','#da5552','#df7373','#f4978e','#ffcb70'
,'#ffc723','#ffad0a'])
norm = BoundaryNorm([1,2,3,4,5,6,7,8], cmap.N)
#cmap(norm(df['precipitation']))


def covid_lines(x,y,z):
    for i in range(1,len(y)):
        if(z[i]==1):
             plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#cc444b',lw=3)
        if(z[i]==2):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#da5552',lw=3)
        if(z[i]==3):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#df7373',lw=3)
        if(z[i]==4):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#f4978e',lw=3)
        if(z[i]==5):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#ffcb70',lw=3)
        if(z[i]==6):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#ffc723',lw=3)
        if(z[i]==7):
            plt.plot(x[i:i+2], np.log(y)[i:i+2],c='#ffad0a',lw=3)



#covid_lines(df_2.days,df_2.medianv,df_2.medianv_dr)

#Plotting the other lines
for i in range(7,123):
    plt.plot(df_2.days,np.log(df_2.iloc[:, i]),c='#F7F7F7',lw=1)


ax.axvline(x=15,linewidth=1.5, color='#adb5bd',ls='--')

covid_lines(df_2.days,df_2.US,df_2.US_dr)
covid_lines(df_2.days,df_2.Europe,df_2.Europe_dr)
covid_lines(df_2.days,df_2.China,df_2.China_dr)
covid_lines(df_2.days,df_2["South Korea"],df_2.SKorea_dr)
l1=plt.plot(df_2.days,np.log(df_2.medianv),c='#adb5bd',lw=2,ls='--',labe
l='median')



ax.spines['right'].set_visible(False)
ax.spines['top'].set_visible(False)
ax.spines['left'].set_visible(False)
plt.gca().spines["bottom"].set_alpha(.5)

#ax.tick_params(axis=u'both', which=u'both',length=0)
ax.set_ylabel("Log(Number of Death Cases)")
ax.get_yaxis().set_visible(True)

sm = plt.cm.ScalarMappable(cmap=cmap, norm=norm)
sm.set_array([])
```

```
axins1 = ax.inset_axes([0.60, 1.1, 0.35, 0.015])
cbar=fig.colorbar(sm, cax=axins1, orientation="horizontal",ticks=[1,2,3,
4,5,6,7])
cbar.ax.set_xticklabels([ '+1', '+2','+3','+7','+10','+20','+30'],fontsi
ze=10.5,fontname="Times")
cbar.outline.set_visible(False)
cbar.ax.tick_params(direction='inout',length=14,width=0.1,bottom=1,top=0
,pad=0.30)

#Adding text in graph
ax.text(66.5,14,"Doubling time of COVID deaths,in days",fontname="Arial"
,fontsize=12)
ax.text(80,12.1,"United States of America",fontname="Arial",fontsize=10,
fontweight='bold',color='#444444')
ax.text(80,11.2,"Europe",fontname="Arial",fontsize=10,fontweight='bold',
color='#444444')
ax.text(80,7.7,"South Korea",fontname="Arial",fontsize=10,fontweight='bo
ld',color='#444444')
ax.text(80,6.0,"Median",fontname="Arial",fontsize=10,fontweight='bold',c
olor='#444444')
ax.text(80,5.2,"China",fontname="Arial",fontsize=10,fontweight='bold',co
lor='#444444')
ax.text(-1,10,"CDC Advises \nagainst gathering of \n50 or more \npeople;
\nPresident Trump \ndeclares \nNational Emergency",color='#adb5bd',fontw
eight='bold')


#Playing with Ticks
m=np.arange(0,110,10)
ax.set_xticks(m)
ax.tick_params(width=0.3)
ax.set_facecolor('#f7f4f3')

plt.title("US tops the world in the number of deaths; however confirmed
 death cases started to flatten \nChina and Korea already flattened thei
r curve",fontsize=16,loc='left',pad=23,fontweight='bold',fontname='Aria
l')
fig.text(.5, .02, "Fig1.2: It is worth noticing that China and South Kor
ea were quick to flatten its curve and lower its death doubling time.\n
 US and Europe struggled with controlling the virus, and have finally fl
attened their curve after day 20", ha='center',fontname='Arial',fontweig
ht='bold')


plt.show()
```

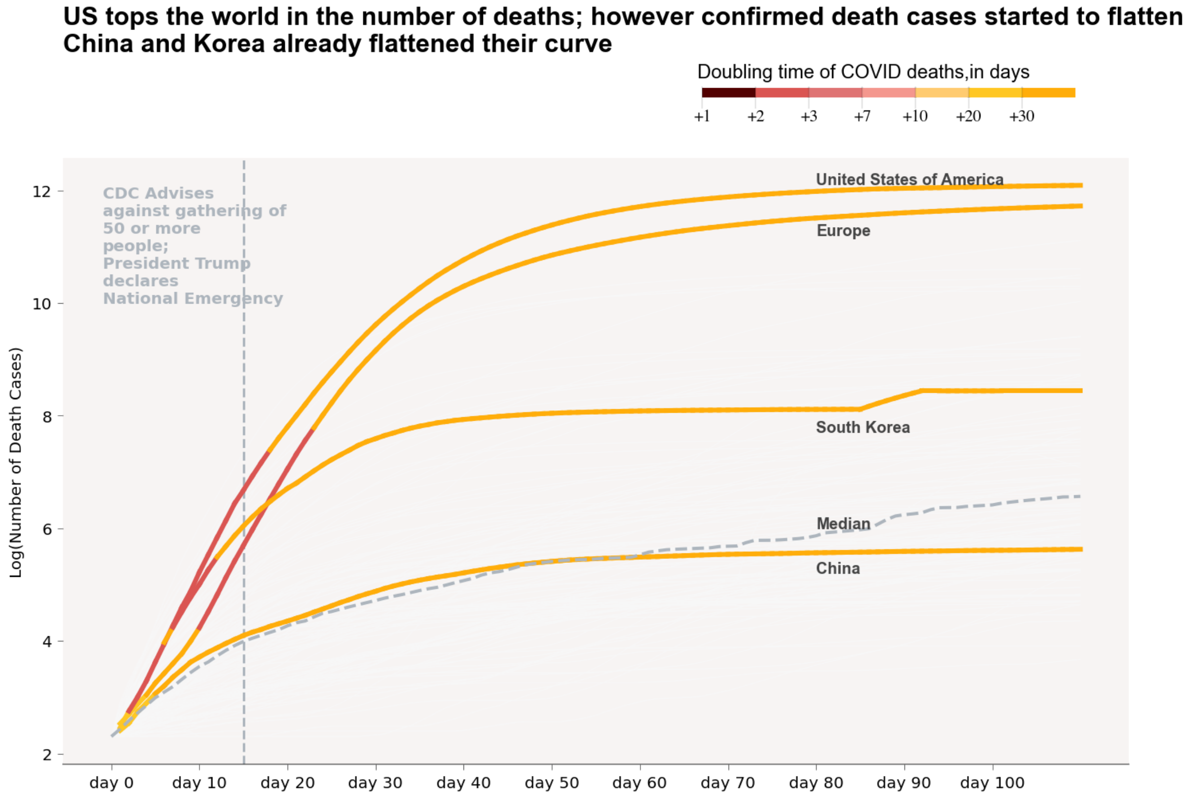


Fig1.2: It is worth noticing that China and South Korea were quick to flatten its curve and lower its death doubling time. US and Europe struggled with controlling the virus, and have finally flattened their curve after day 20

```
In [ ]:
```

Visualization 3:

In [5]:
```
df_3=pd.read_csv("Data.csv")
df_3.head(10)
#Removing NAs if present
df_3.dropna()
```

Out[5]:

	Industry	Profit	Tax	Effective corporate federal income tax rates (2018)	Industry1	Profit (in millions)_ tooltips	Tax (i millions)_tooltip
0	3M	3378000000	601000000	17.8	Miscellaneous manufacturing	3,378	60
1	ABM Industries	87500000	-200000	-0.2	Miscellaneous services	87.5	-0.
2	Activision Blizzard	447000000	-243000000	-54.4	Computers, office equip, software, data	447	-24
3	AECOM Technology	243600000	-186400000	-76.5	Engineering & construction	243.6	-186.
4	Agilent Technologies	168000000	21000000	12.5	Metals & metal products	168	2
...	...	...	...	...	...	...	..
374	Xcel Energy	1434000000	-34000000	-2.4	Utilities, gas and electric	1,434	-3
375	Xerox	341400000	15000000	4.4	Computers, office equip, software, data	341.4	1
376	XPO Logistics	313000000	2000000	0.6	Transportation	313	
377	Yum Brands	701000000	31000000	4.4	Miscellaneous services	701	3
378	Zoetis	905000000	244000000	27	Pharmaceuticals & medical products	905	24

379 rows × 8 columns

Finding the Tax owed by the company

In [6]:

```
df_3["Tax_owed"]=(0.21*df_3["Profit"]-df_3["Tax2"])
#Removing NAs if present
df_3.dropna()
```

Out[6]:

	Industry	Profit	Tax	Effective corporate federal income tax rates (2018)	Industry1	Profit (in millions)_ tooltips	Tax (i millions)_tooltip
0	3M	3378000000	601000000	17.8	Miscellaneous manufacturing	3,378	60
1	ABM Industries	87500000	-200000	-0.2	Miscellaneous services	87.5	-0.
2	Activision Blizzard	447000000	-243000000	-54.4	Computers, office equip, software, data	447	-24
3	AECOM Technology	243600000	-186400000	-76.5	Engineering & construction	243.6	-186.
4	Agilent Technologies	168000000	21000000	12.5	Metals & metal products	168	2
...	...	...	...	...	...	...	..
374	Xcel Energy	1434000000	-34000000	-2.4	Utilities, gas and electric	1,434	-3
375	Xerox	341400000	15000000	4.4	Computers, office equip, software, data	341.4	1
376	XPO Logistics	313000000	2000000	0.6	Transportation	313	
377	Yum Brands	701000000	31000000	4.4	Miscellaneous services	701	3
378	Zoetis	905000000	244000000	27	Pharmaceuticals & medical products	905	24

379 rows × 9 columns

In [130]:
```
fig, ax = plt.subplots(figsize=(10,13))
x_min=min(df_3.Tax_owed)
x_max=max(df_3.Tax_owed)
cmap = ListedColormap(['#2CC0D3','#F26648'])
norm = BoundaryNorm([0], cmap.N)
dotcolors = cmap(norm(df_3['Tax_owed']))
t = np.arange(0.0, len(df_3.Industry1.unique()), 1)
ax.hlines(t, xmin=x_min, xmax=x_max,color='#e2afff',alpha=0.3,ls='--')
plt.scatter(df_3.Tax_owed,df_3.Industry1,s=df_3.Profit/100000000,c=dotco
lors)

idx = df_3.groupby(["Industry1"])['Tax_owed'].transform(max) == df_3['Ta
x_owed']
df_max=df_3[idx]
df_max
for i in range(df_max.shape[0]):
    plt.annotate(df_max.Industry.tolist()[i],xy= (df_max.Tax_owed.tolist
()[i]+0.2, df_max.Industry1.tolist()[i]),xycoords="data",xytext=(45, 1),
textcoords="offset points",
                  va="center", ha="left",
                  bbox=dict(boxstyle="round", fc="w"),
                  arrowprops=dict(arrowstyle="->"))
ax.text(-1,22.3,"Tax Payers",ha='right',color='#2CC0D3',fontweight='bol
d',fontname='Arial',fontsize=13)
ax.text(-1,22.3,"  Tax Avoiders",ha='left',color='#F26648',fontweight='b
old',fontname='Arial',fontsize=13)
ax.axvline(x=0,linewidth=1.5, color='#adb5bd',ls='--')
ax.set_xlabel("Tax owed to Federal Government: (In Billions)",fontweight
='bold',fontname='Arial',fontsize=10)

ax.set_facecolor('#fafdf6')
plt.title("More than 80% of industries owe Federal Government Taxes in 2
018",loc='left',ha='left',pad=30,fontweight='bold',fontname='Arial',font
size=16)
fig.text(.5, 0.06, "Fig1.3: The size of the bubble denotes the profit ma
de by companies in 2018.\nSurprisingly most profitable companies are the
biggest tax offenders(annotated)", ha='center',fontname='Arial',fontweig
ht='bold')

plt.show()
```

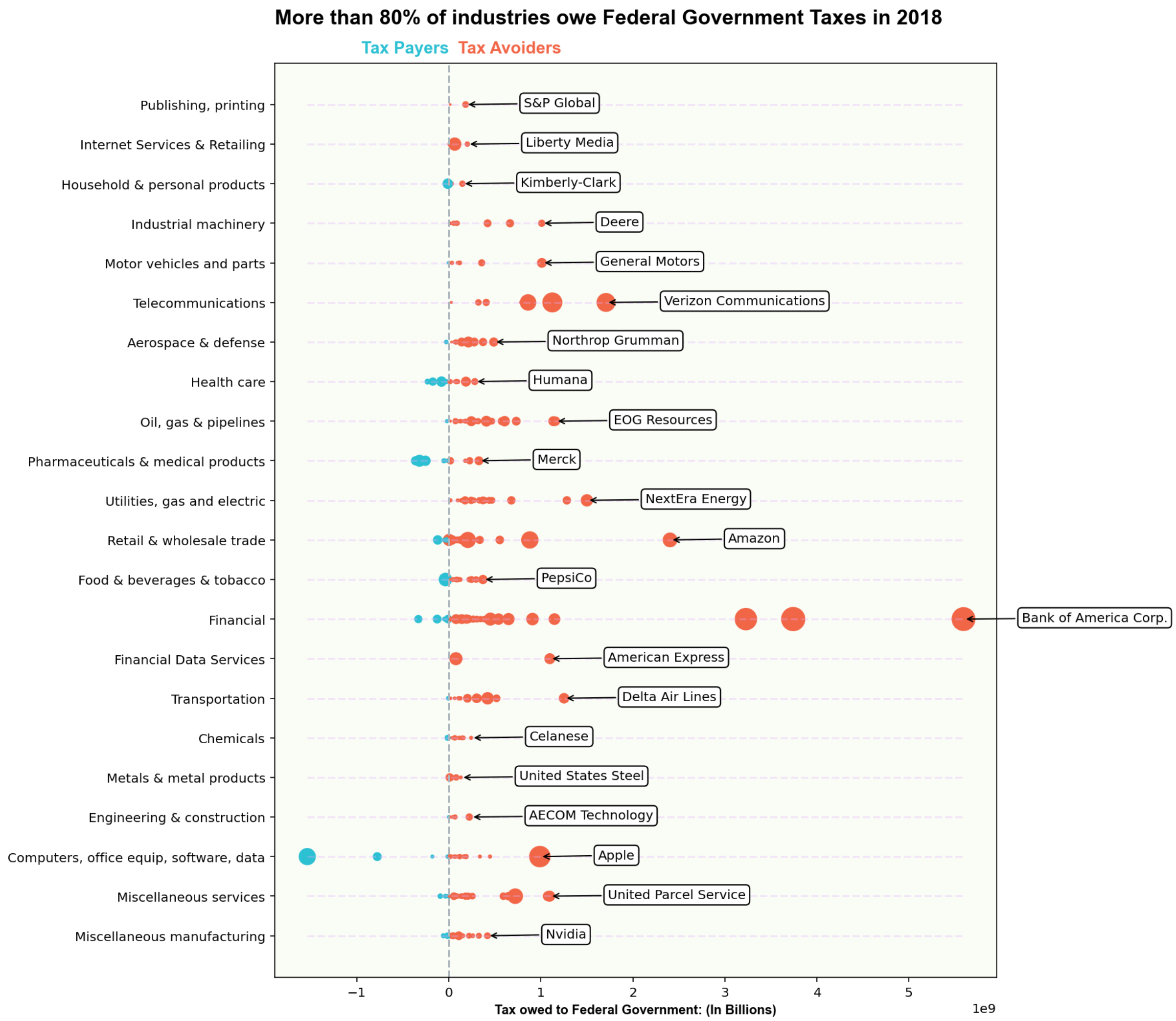


Fig1.3: The size of the bubble denotes the profit made by companies in 2018.
Surprisingly most profitable companies are the biggest tax offenders(annotated)