In [97]:
```
import pandas as pd
import numpy as np
from datetime import datetime
from matplotlib import pyplot as plt
%matplotlib inline
import calendar
import datetime
```

In [98]:
```
Sig_Eqs = pd.read_csv('earthquakes-2022-10-28_13-25-07_+0800.tsv', sep='\t')
print(Sig_Eqs.shape)
Sig_Eqs.head()
```

(6338, 48)

Out[98]:

	Search Parameters	Year	Mo	Dy	Hr	Mn	Sec	Tsu	Vol	Country	...	Total Missing	Total Missing Description	Total Injuries	Total Injuries Description	Total Damage ($Mil)	T Dam Descrip
0	[]	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	
1	NaN	-2150.0	NaN	NaN	NaN	NaN	0.0	NaN	NaN	JORDAN	...	NaN	NaN	NaN	NaN	NaN	
2	NaN	-2000.0	NaN	NaN	NaN	NaN	NaN	1.0	NaN	SYRIA	...	NaN	NaN	NaN	NaN	NaN	
3	NaN	-2000.0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	TURKMENISTAN	...	NaN	NaN	NaN	NaN	NaN	
4	NaN	-1610.0	NaN	NaN	NaN	NaN	NaN	3.0	1351.0	GREECE	...	NaN	NaN	NaN	NaN	NaN	

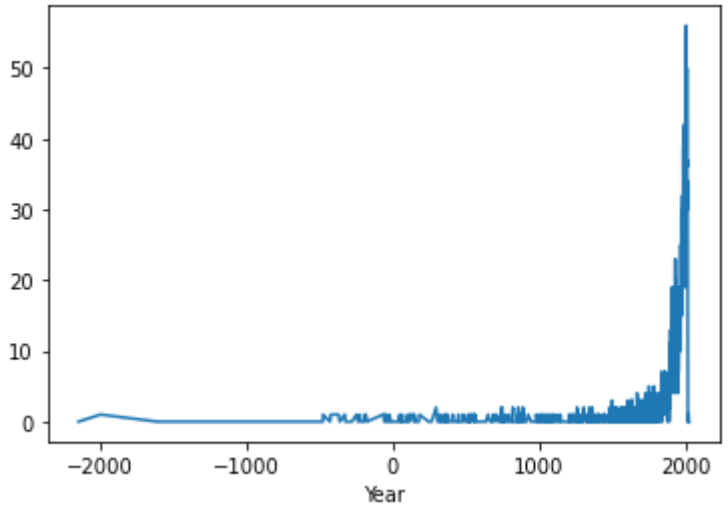
5 rows × 48 columns

In [99]:
```
#Question1_1

#按国家分组求和
Sig_Eqs_country = Sig_Eqs.groupby('Country')['Deaths'].sum()

#总死亡人数排名前20的国家及死亡人数
print('Top 20 countries along with the total number of deaths:\n',Sig_Eqs_country.sort_values(ascending=False)[0:20])
```

```
Top 20 countries along with the total number of deaths:
 Country
CHINA           2075019.0
TURKEY          1134569.0
IRAN            1011446.0
ITALY            498477.0
SYRIA            439224.0
HAITI            323474.0
AZERBAIJAN       317219.0
JAPAN            278142.0
ARMENIA          191890.0
PAKISTAN         145083.0
IRAQ             136200.0
ECUADOR          135479.0
TURKMENISTAN     117412.0
PERU             102219.0
ISRAEL            90388.0
PORTUGAL          83531.0
GREECE            79174.0
CHILE             64276.0
INDIA             63491.0
TAIWAN            57135.0
Name: Deaths, dtype: float64
```

In [100]:
```
#Question1_2

#创建计数列Count，初始值全为0
Sig_Eqs['Count'] = 0

#当Ms>3时，把该行的count替换为1
Sig_Eqs.loc[Sig_Eqs['Ms']>3,'Count'] = 1

#按year分组求count的和，作图
Sig_Eqs.groupby('Year').sum()['Count'].plot()

#Answers to questions:
#1. The general trend is that the number of earthquakes (Ms > 3)
#per year increased sharply after 1500 A.D. and stabilized at less
#than 10 before that.
#2. The possible reasons for this are the lack of measurement and
#recording of earthquakes before 1500 A.D. and the slow transmission
#of information, which may have led to only a few earthquakes of
#large magnitude being recorded.
```

Out[100]: <AxesSubplot:xlabel='Year'>



In [101]:
```
#Question1_3

#计算国家地震次数放入Eqs_Number列
Sig_Eqs['Eqs_Number'] = Sig_Eqs.groupby('Country')['Country'].transform('count')


#按国家分组后每个组调用Get_LargestEq(),找到所有国家Ms最大值所在的行，
#返回国家名、地震时间、位置名、经纬度、Ms的值、总地震次数信息
def CountEq_LargestEq():
    #对每个组调用 Get_LargestEq函数，返回最大Ms所在行
    largest_eqs = Sig_Eqs.groupby('Country',as_index=False).apply(Get_LargestEq)
    df = largest_eqs[['Country','Year','Mo','Dy','Location Name','Ms','Eqs_Number']]
    df = df.rename(columns={'Ms':'Ms_Max'})
    df = df.sort_values('Ms_Max',ascending=False)
    return df


#分组找最大值，没有Ms数据的国家地震数据不处理，返回每个国家Ms最大值（或NaN）所在行
def Get_LargestEq(x):
    df = x.sort_values(by = 'Ms',ascending=True)
    if df['Ms'].sum() != 0:
        df=df.dropna(axis=0, how='any', thresh=None, subset=['Ms'], inplace=False)
    return df.iloc[-1,:]

#输入任意国家名，返回上述地震坐标
df2=CountEq_LargestEq()
a = input("\nInput country name(just one, eg.'CHINA'):")
print(eval('df2[df2["Country"]==a]'))

#打印Ms最大的前20个国家的国家名、地震时间、地点、Ms、总地震次数Eqs_Number
#Ms_Max为该国家发生过的有记录的最大地震级别
CountEq_LargestEq()

#从结果可以看出：
#1. 有记录的最大地震发生在美国，Ms_max=9.1，自2150 B.C.以来美国发生过的地震次数为271次，日期和位置信息见下表
#2. 其他国家信息也可以看到
```

```
Input country name(just one, eg.'CHINA'):CHINA
   Country    Year    Mo    Dy                              Location Name  \
28   CHINA  1920.0  12.0  16.0  CHINA:  GANSU PROVINCE, SHANXI PROVINCE
```

```
    Ms_Max  Eqs_Number
28     8.6       616.0
```

Out[101]:

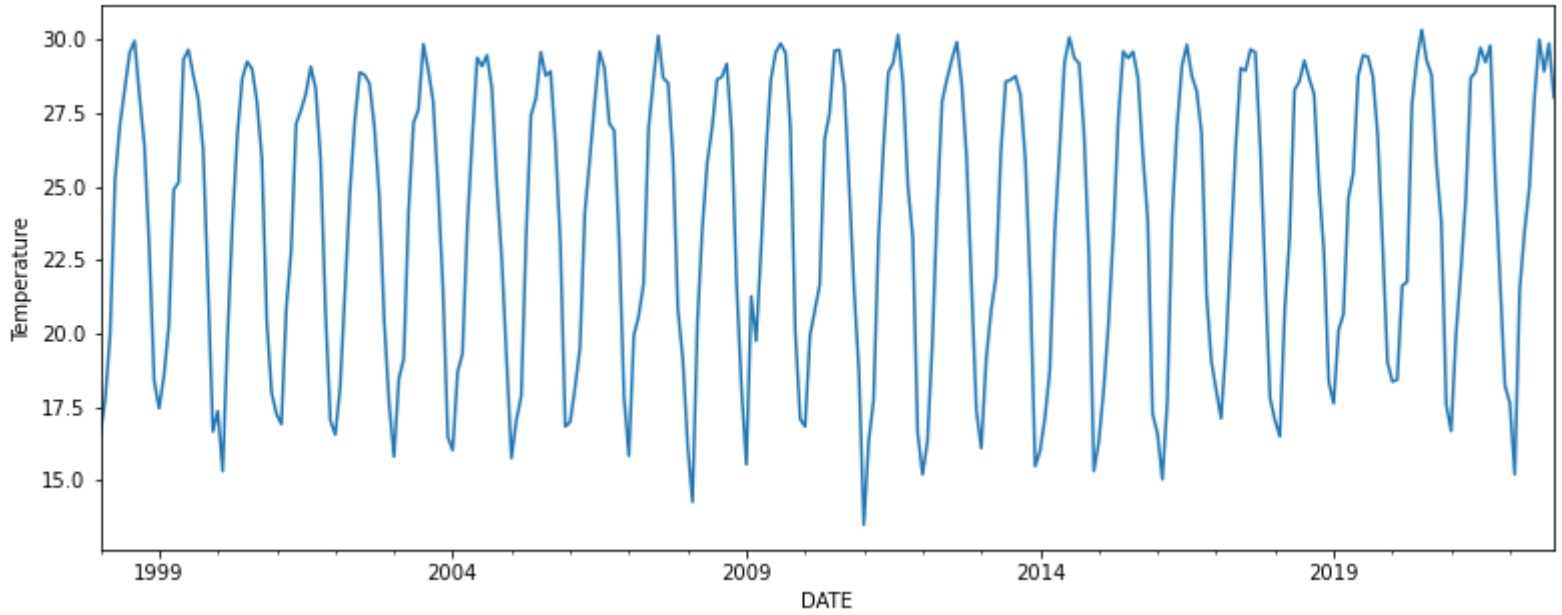
	Country	Year	Mo	Dy	Location Name	Ms_Max	Eqs_Number
147	USA	1957.0	3.0	9.0	ALASKA	9.1	271.0
64	INDONESIA	2004.0	12.0	26.0	INDONESIA: SUMATRA: ACEH: OFF WEST COAST	8.8	405.0
62	INDIA	1897.0	6.0	12.0	INDIA: ASSAM; BANGLADESH	8.7	99.0
27	CHILE	1730.0	7.0	8.0	CHILE: VALPARAISO	8.7	198.0
107	PHILIPPINES	1897.0	9.0	21.0	PHILIPPINES: MINDANAO, ZAMBOANGA, SULU, ISABELA	8.7	222.0
...	...	...	...	...	...	...	...
128	SRI LANKA	1882.0	1.0	NaN	SRI LANKA: TRINCOMALEE	NaN	1.0
130	SWITZERLAND	2006.0	12.0	8.0	SWITZERLAND: BASEL	NaN	31.0
136	TOGO	1933.0	5.0	19.0	TOGO: GOLD COAST	NaN	2.0
146	URUGUAY	1888.0	6.0	5.0	URUGUAY: COLOGNE	NaN	1.0
155	ZAMBIA	2017.0	2.0	24.0	ZAMBIA: KAPUTA	NaN	1.0

156 rows × 7 columns

In [102]:
```
#Question2

#1.读取Q2数据
Baoan_Weather = pd.read_csv('Baoan_Weather_1998_2022.csv')

#2.用‘，’拆分列，并存入新DataFrame中
df = pd.DataFrame()
df[['Temperature','Code']] =Baoan_Weather['TMP'].str.split(',',expand=True)

#3.用正则表达式提取温度后三位值
df['Temperature'] = df['Temperature'].str.extract('([1-9][0-9][0-9])',flags=0, expand=False)

#4.将温度和其后的代码存入原DataFrame中
Baoan_Weather[['Temperature','Code']] = df[['Temperature','Code']]

#5.将温度值缺失或者code为'3','7'的错误值删去
Baoan_Weather = Baoan_Weather.dropna(axis=0, how='any', thresh=None, subset=['Temperature'], inplace=False)
Baoan_Weather.drop(Baoan_Weather[(Baoan_Weather['Code'].astype(int) == 3)|(Baoan_Weather['Code'].astype(int) == 7)|(Baoan_Weather['Te

#6.将温度值改为摄氏度值，除以放缩系数
Baoan_Weather['Temperature'] = Baoan_Weather['Temperature'].astype(int)/10

#7.将DataFrame中的时间转换为datetime64
Baoan_Weather['DATE']= Baoan_Weather['DATE'].astype('datetime64')

#8.用时间序列做为Baoan_Weathe的索引，为下一步resample做铺垫
Baoan_Weather.rename(index = Baoan_Weather['DATE'],inplace=True)

#9.利用resample对按月求均值，再取温度列作图
Baoan_Weather.resample('M').mean()['Temperature'].plot(xlabel = 'DATE',ylabel = 'Temperature',figsize=(13,5),)

#是否存在趋势：
#1. 月平均气温总体在[15~30]℃间波动，并无大的变化，但在[2005-2015]10年间的波动幅度更加明显，出现了较极端的气温；
#2. 2015年后波动中心，有上升趋势，即年平均温度有增大趋势；
```

```
C:\Users\yyl\AppData\Local\Temp\ipykernel_12064\3314586153.py:4: DtypeWarning: Columns (4,8,9,10,11,14,15,24,25,27,29,31,34,37,38,40,41,45,49,50) have mixed types. Specify dtype option on import or set low_memory=False.
  Baoan_Weather = pd.read_csv('Baoan_Weather_1998_2022.csv')
```

Out[102]: <AxesSubplot:xlabel='DATE', ylabel='Temperature'>


30.0
27.5
25.0
22.5
20.0
17.5
15.0
Temperature
1999
2004
2009
2014
2019
DATE

In [103]:
```
#Question3

#导入csv文件
ibtracs_df = pd.read_csv('ibtracs.ALL.list.v04r00.csv',
                 usecols=range(17),
                 skiprows=[1, 2],
                 parse_dates=['ISO_TIME'],
                 na_values=['NOT_NAMED', 'NAME',' '])
#预览前几行
ibtracs_df.head()
```

```
C:\Users\yyl\AppData\Local\Temp\ipykernel_12064\1192491116.py:4: DtypeWarning: Columns (5,12) have mixed types. Specify dtype optio
n on import or set low_memory=False.
  ibtracs_df = pd.read_csv('ibtracs.ALL.list.v04r00.csv',
```

Out[103]:

	SID	SEASON	NUMBER	BASIN	SUBBASIN	NAME	ISO_TIME	NATURE	LAT	LON	WMO_WIND	WMO_PRES	WMO_AGENCY
0	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 06:00:00	NR	10.8709	79.8265	NaN	NaN	NaN
1	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 09:00:00	NR	10.8431	79.3524	NaN	NaN	NaN
2	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 12:00:00	NR	10.8188	78.8772	NaN	NaN	NaN
3	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 15:00:00	NR	10.8000	78.4000	NaN	NaN	NaN
4	1842298N11080	1842	1	NI	AS	NaN	1842-10-25 18:00:00	NR	10.7884	77.9194	NaN	NaN	NaN

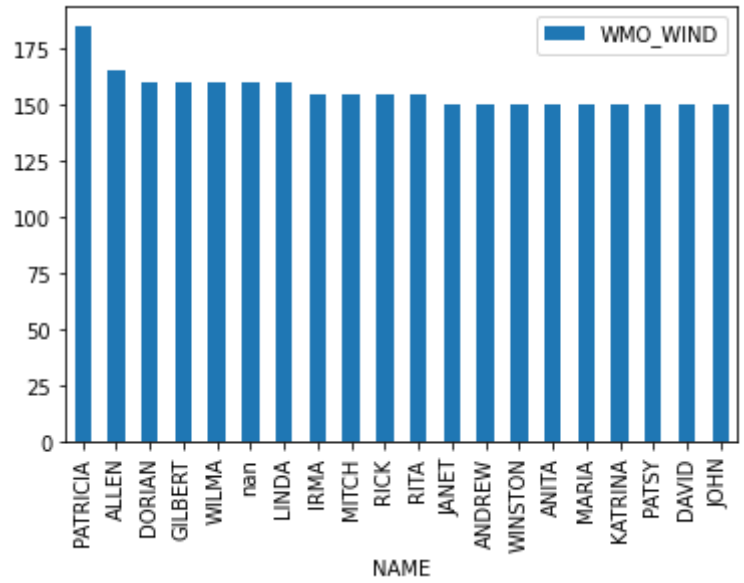
In [104]:
```
#Question3_1

#先分组找最大值
df1 = ibtracs_df.groupby("SID").agg('max')

#再把['NAME','WMO_WIND']取出来按风速排序，打印前十行
df2 = df1[['NAME','WMO_WIND']]
df2.sort_values('WMO_WIND',ascending=False)[0:10]
```

```
C:\Users\yyl\AppData\Local\Temp\ipykernel_12064\3850662889.py:4: FutureWarning: Dropping invalid columns in DataFrameGroupBy.max is deprecated. In a future version, a TypeError will be raised. Before calling .max, select only columns which should be valid for the function.
  df1 = ibtracs_df.groupby("SID").agg('max')
```

Out[104]:

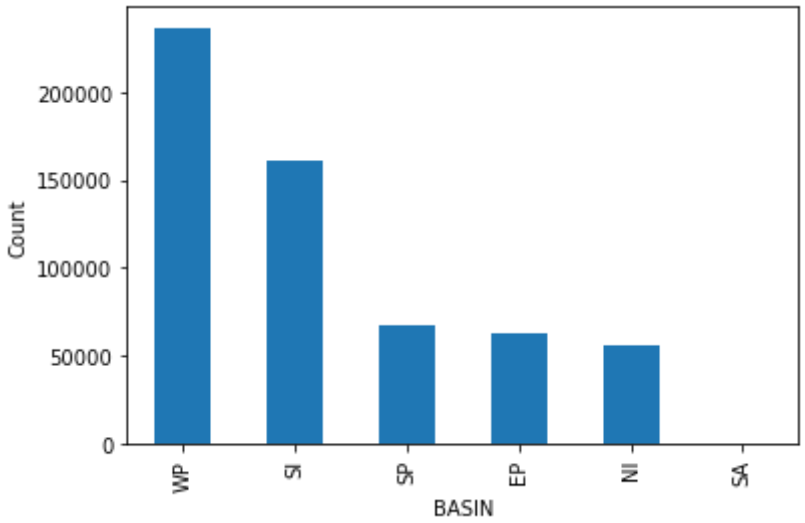
SID	NAME	WMO_WIND
2015293N13266	PATRICIA	185.0
1980214N11330	ALLEN	165.0
2019236N10314	DORIAN	160.0
1988253N12306	GILBERT	160.0
2005289N18282	WILMA	160.0
1935241N23291	NaN	160.0
1997253N12255	LINDA	160.0
2017242N16333	IRMA	155.0
1998295N12284	MITCH	155.0
2009288N07267	RICK	155.0

In [52]:
```
#Question3_2

#排序并画图
df3 = df2.sort_values('WMO_WIND',ascending=False)[0:20]
df3.plot('NAME','WMO_WIND', kind='bar')

plt.show()
```

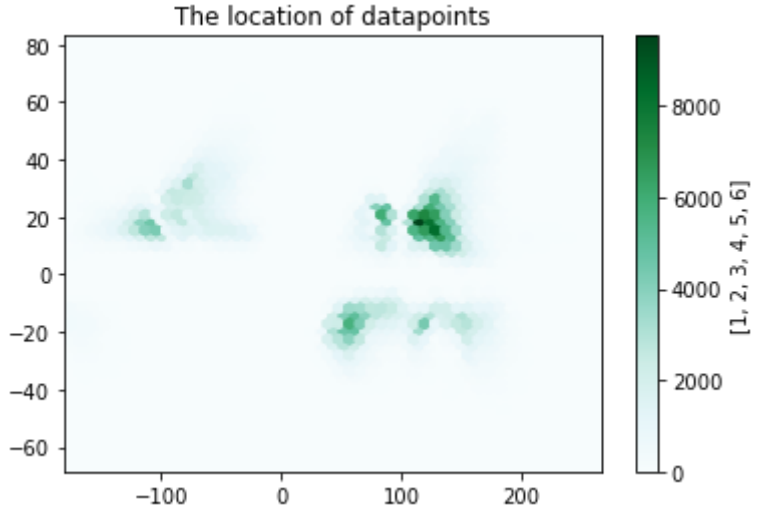


In [65]:
```
#Question3_3

#按BASIN分组计数，如何对SID排序作图
ibtracs_df.groupby('BASIN').count()['SID'].sort_values(ascending=False).plot(kind = 'bar')

plt.ylabel('Count')
```

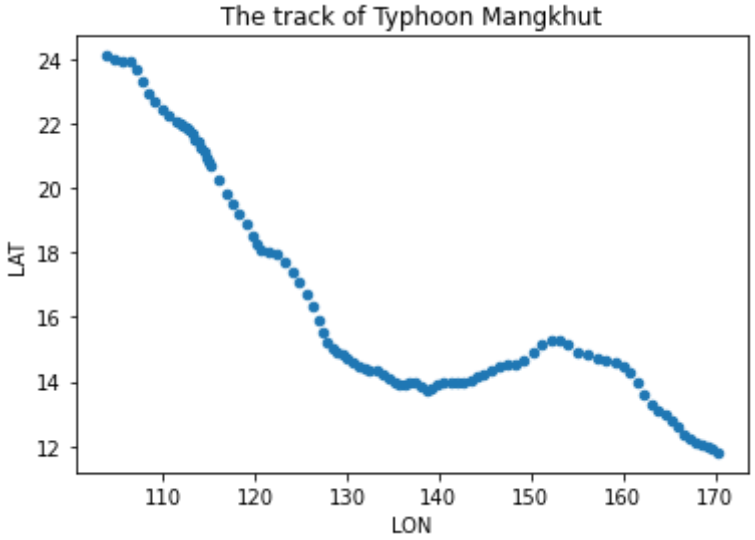
Out[65]: Text(0, 0.5, 'Count')



In [84]:
```
#Question3_4

#借鉴：https://www.geeksforgeeks.org/matplotlib-pyplot-hexbin-function-in-python/
x = ibtracs_df['LON']
y = ibtracs_df['LAT']

xmin = x.min()
xmax = x.max()
ymin = y.min()
ymax = y.max()

hb = plt.hexbin(x, y, gridsize = 50,bins=None, cmap ='BuGn')

plt.xlim(xmin, xmax)
plt.ylim(ymin, ymax)

cb = plt.colorbar(hb)
cb.set_label(z)
plt.title('The location of datapoints')

plt.show()
```



In [105]:
```
#Question3_5

# 定位MANGKHUT位置，返回满足条件的经纬度值
MANGKHUT_df = ibtracs_df[(ibtracs_df['NAME'] == 'MANGKHUT') & (ibtracs_df['SEASON'] == 2018)][['LAT','LON']]

#绘制散点图
MANGKHUT_df.plot.scatter('LON','LAT')
plt.title('The track of Typhoon Mangkhut')

plt.show()
```



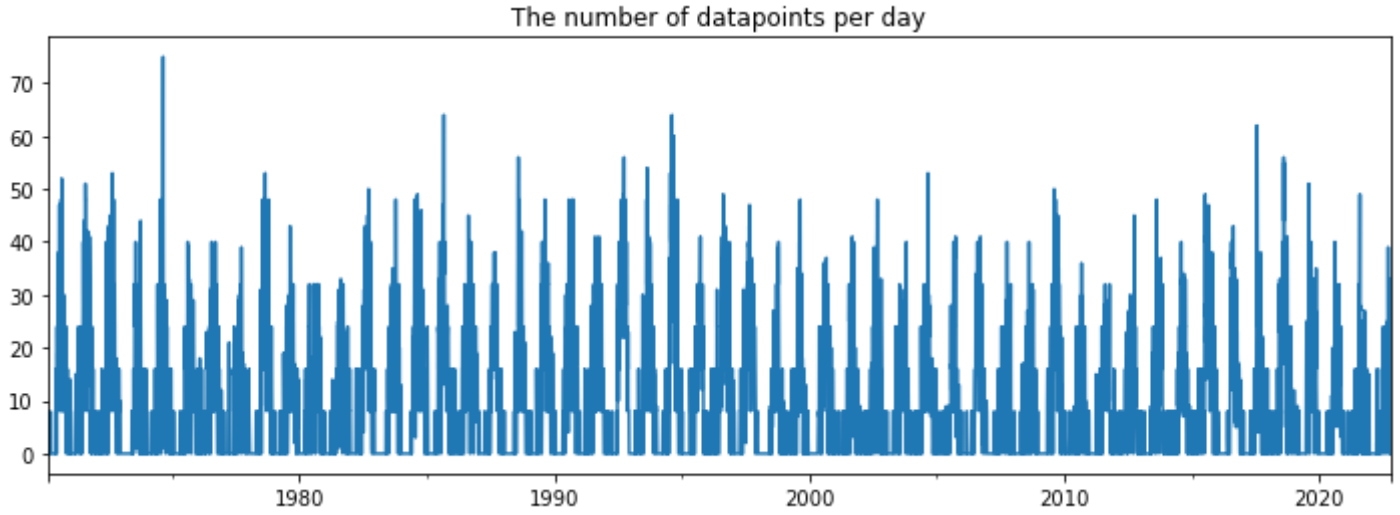
In [5]:
```
#Question3_6

#筛选1970年以来的WP、EP数据
Filtered_df = ibtracs_df[((ibtracs_df['BASIN'] == 'WP') | (ibtracs_df['BASIN'] == 'EP')) & (ibtracs_df['SEASON'] > 1969)]
Filtered_df.head(5)
```

Out[5]:

	SID	SEASON	NUMBER	BASIN	SUBBASIN	NAME	ISO_TIME	NATURE	LAT	LON	WMO_WIND	WMO_PRES	WMO_AG
350393	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 00:00:00	TS	7.00000	151.400	NaN	1006.0	
350394	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 03:00:00	TS	7.24752	151.205	NaN	NaN	
350395	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 06:00:00	TS	7.50000	151.000	NaN	1002.0	
350396	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 09:00:00	TS	7.75747	150.772	NaN	NaN	
350397	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 12:00:00	TS	8.00000	150.500	NaN	998.0	

In [6]:
```
#Question3_7

#将索引值换位时间序列
Filtered_df.rename(index = Filtered_df['ISO_TIME'],inplace=True)

#按天分组求和作图
Filtered_df.resample('D')['SID'].count().plot(figsize = (12,4))

plt.title('The number of datapoints per day')
plt.show()
```

```
C:\Users\yyl\AppData\Local\Temp\ipykernel_12064\1453633337.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  Filtered_df.rename(index = Filtered_df['ISO_TIME'],inplace=True)
```



In [60]:
```
#Question3_8

#输入时间，返回年积日
def tran_day_year(date):
    date_base = datetime.datetime(date.year,1,1)
    doy = (date - date_base).days + 1
    return doy

#调用 tran_day_year，返回年积日对应得数据点数
def day_of_year(x):
    #对DataFrame预处理，统计年积日次数
    df_ymd = Filtered_df.resample('D')['SID'].count().to_frame().reset_index()
    df_ymd.columns = ['Date_Ymd','Data_Number']
    df_ymd['Year_Day'] = df_ymd['Date_Ymd'].apply(tran_day_year)
    df_count = df_ymd.groupby('Year_Day')['Data_Number'].sum()
    print(df_count)
    Number = df_count[x]
    return Number

#输入一个年积日，返回所有1970年以来数据点数
x = input('输入一个1~366的年积日数字：')
x = int(x)
print('发生在（1970~2022年）同一年积日的数据点总数个为:\n',day_of_year(x))

#助教请忽略
#没用的代码，留着以后看，xixi
#df_ymd['Year'] = df_ymd['Date_Ymd'].dt.year
#df_ymd['Month'] = df_ymd['Date_Ymd'].dt.month
#df_ymd['Day'] = df_ymd['Date_Ymd'].dt.day
#df_ymd['Year_Type'] = df_ymd['Year'].apply(calendar.isleap)
#print(df_ymd.head(6))
#取datatime 年月日的方法： df[].str[0:4]; dt.year;
```

```
输入一个1~366的年积日数字：2
Year_Day
1      83
2      72
3      74
4      93
5     105
     ...
```

```
362    158
363    132
364    104
365     93
366     13
Name: Data_Number, Length: 366, dtype: int64
发生在（1970~2022年）同一年积日的数据点总数个为:
 72
```

In [95]:
```
#Question3_9

#返回年积日
def tran_day_year1(date):
    date_base = datetime.datetime(date.year,1,1)
    doy = (date - date_base).days + 1
    return doy

#返回每个年积日出现次数均值
def average(x):
    y = df_count.loc[df_count.index[x-1],'Average'];
    return y

#数据预处理
df_ymd = Filtered_df.resample('D')['SID'].count().to_frame().reset_index()
df_ymd.columns = ['Date_Ymd','Data_Number']
df_ymd['Year_Day'] = df_ymd['Date_Ymd'].apply(tran_day_year1)

#新dataframe，放结果
df_count = pd.DataFrame()
df_count['Sum'] = df_ymd.groupby('Year_Day')['Data_Number'].sum().to_frame()
df_count['Number'] = df_ymd.groupby('Year_Day')['Data_Number'].count()
df_count['Average'] = df_count['Sum']/df_count['Number']
df_count = df_count.reset_index()

#某天的Anomaly = 某天出点次数 - 该天的多年平均值
df_ymd['Anomaly'] = df_ymd['Data_Number'] - df_ymd['Year_Day'].apply(average)

#返回日期对应的Anomaly
df_ymd[['Date_Ymd','Anomaly']]
```

Out[95]:

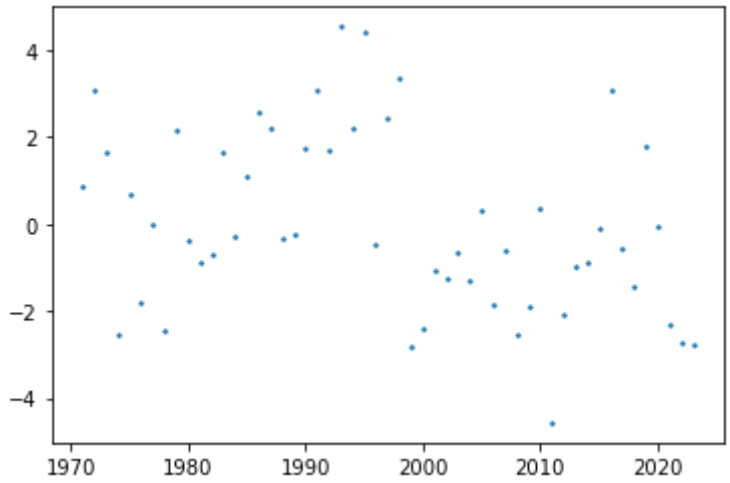
	Date_Ymd	Anomaly
0	1970-02-19	7.018868
1	1970-02-20	7.094340
2	1970-02-21	7.188679
3	1970-02-22	7.377358
4	1970-02-23	7.490566

	Date_Ymd	Anomaly
...	...	...
19224	2022-10-08	-17.245283
19225	2022-10-09	-17.301887
19226	2022-10-10	-12.396226
19227	2022-10-11	-18.528302
19228	2022-10-12	-14.924528

19229 rows × 2 columns

In [96]:
```
#Question3_10

#将时间换为索引，便于resample，作图
df_ymd.rename(index = df_ymd['Date_Ymd'],inplace=True)

#分组求年均值
df_ano = df_ymd.resample('Y')['Anomaly'].mean()
plt.plot_date(df_ano.index,df_ano,markersize=1.5)
```

Out[96]: [<matplotlib.lines.Line2D at 0x1f316128700>]



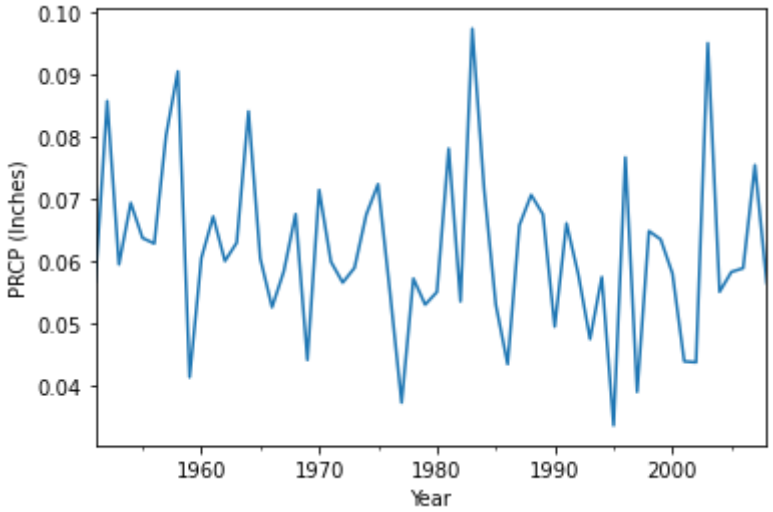
In [55]:
```
#Question4_1

#导入数据到xi_an_df
xi_an_df = pd.read_csv('data.csv',parse_dates=['Date'],na_values=[' '])
xi_an_df.head(10)
```

Out[55]:

	Date	TAVG (Degrees Fahrenheit)	TMAX (Degrees Fahrenheit)	TMIN (Degrees Fahrenheit)	PRCP (Inches)	SNOW (Inches)	SNWD (Inches)
0	1951-01-01	NaN	44.0	22	0.00	NaN	NaN
1	1951-01-02	29.0	49.0	19	0.00	NaN	NaN
2	1951-01-03	32.0	51.0	21	0.00	NaN	NaN
3	1951-01-04	27.0	36.0	18	0.00	NaN	NaN
4	1951-01-05	29.0	32.0	23	0.05	NaN	NaN
5	1951-01-06	30.0	32.0	28	0.02	NaN	NaN
6	1951-01-07	31.0	33.0	30	0.00	NaN	NaN
7	1951-01-08	34.0	39.0	31	0.01	NaN	NaN
8	1951-01-09	27.0	32.0	20	0.19	NaN	NaN
9	1951-01-10	24.0	34.0	18	0.01	NaN	NaN

In [56]:
```
#Question4_2

#将Date转换为时间序列索引
xi_an_df.rename(index=xi_an_df['Date'],inplace=True)

#绘制年均气温TAVG (Degrees Fahrenheit)随年份变化折线图
xi_an_df.resample('Y').mean()['PRCP (Inches)'].plot(xlabel='Year',ylabel='PRCP (Inches)')
```

Out[56]: <AxesSubplot:xlabel='Year', ylabel='PRCP (Inches)'>



In [59]:
```
#Question4_3

#对西安市1951-2008年降雨数据进行统计分析，计算均值、最大、最小值、方差、中位数

#求西安市年平均降雨量
Prcp = pd.DataFrame()
Prcp['Prcp'] = xi_an_df.resample('Y')['PRCP (Inches)'].mean()
print('1.年平均降雨量（Inches）：\n',Prcp.head(5))

#求西安市年多年平均降雨量（1951-2008年）
Prcp_Mean = Prcp['Prcp'].sum()/len(Prcp)
print('2.多年平均降雨量（Inches）：\n',Prcp_Mean)

#西安市日极端最高、最低降雨
Prcp_max = xi_an_df['PRCP (Inches)'].max()
Prcp_min = xi_an_df['PRCP (Inches)'].min()
print('3.西安日极端最高、最低降雨分别为：（Inches）\n',Prcp_max, Prcp_min)

#西安市日极端降雨量中位数
Prcp_mid = xi_an_df['PRCP (Inches)'].median()
print('4.西安日降雨中位数：（Inches）\n',Prcp_mid)


#西安市1951-2022年平均降雨的方差
Tem_var = xi_an_df.resample('Y').mean()['PRCP (Inches)'].var()
print('5.西安年平均降雨的方差：\n',Tem_var)
```

```
1.年平均降雨量（Inches）：
                 Prcp
1951-12-31  0.056740
1952-12-31  0.085792
1953-12-31  0.059507
1954-12-31  0.069397
1955-12-31  0.063753
2.多年平均降雨量（Inches）：
 0.061657593395218944
3.西安日极端最高、最低降雨分别为：（Inches）
 4.36 0.0
4.西安日降雨中位数：（Inches）
 0.0
```

5.西安年平均降雨的方差：
0.00018492030671217607