Assignment 02

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1. Significant earthquakes since 2150 B.C.

In [1]:
```
import pandas as pd
import datetime
import numpy as np
from matplotlib import pyplot as plt
%matplotlib inline
```

1.1 Compute the total number of deaths

In [2]:
```
#读取所下载的数据
Sig_Eqs = pd.read_csv("earthquakes-2022-10-19_11-14-52_+0800.tsv",'\t',na_values=[' '])
```

```
C:\Users\Administrator\anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3369: FutureWarning: In a future version of pandas all arguments of read_csv except for the argument 'filepath_or_buffer' will be keyword-only.
  exec(code_obj, self.user_global_ns, self.user_ns)
```

In [3]:
```
Sig_Eqs
```

Out[3]:

	Year	Mo	Dy	Hr	Mn	Sec	Country	Area	Region	Location Name	Ms	Deaths
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	-2150.0	NaN	NaN	NaN	NaN	0.0	JORDAN	NaN	140.0	JORDAN: BAB-A-DARAA,AL-KARAK	NaN	NaN
2	-2000.0	NaN	NaN	NaN	NaN	NaN	SYRIA	NaN	130.0	SYRIA: UGARIT	NaN	NaN
3	-2000.0	NaN	NaN	NaN	NaN	NaN	TURKMENISTAN	NaN	40.0	TURKMENISTAN: W	7.1	1.0
4	-1610.0	NaN	NaN	NaN	NaN	NaN	GREECE	NaN	130.0	GREECE: THERA ISLAND (SANTORINI)	NaN	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
6333	2022.0	9.0	19.0	18.0	5.0	6.0	MEXICO	NaN	150.0	MEXICO: MICHOACAN, COLIMA, JALISCO	NaN	2.0
6334	2022.0	9.0	22.0	6.0	16.0	9.0	MEXICO	NaN	150.0	MEXICO: MEXICO CITY, MICHOACAN	NaN	2.0
6335	2022.0	9.0	30.0	19.0	28.0	40.0	INDONESIA	NaN	60.0	INDONESIA: SUMATRA	NaN	1.0
6336	2022.0	10.0	5.0	0.0	21.0	29.0	IRAN	NaN	140.0	IRAN: KHOY; WEST AZERBAIJAN	NaN	NaN
6337	2022.0	10.0	5.0	8.0	26.0	21.0	PERU	NaN	160.0	PERU: PIURA	NaN	1.0

6338 rows × 12 columns

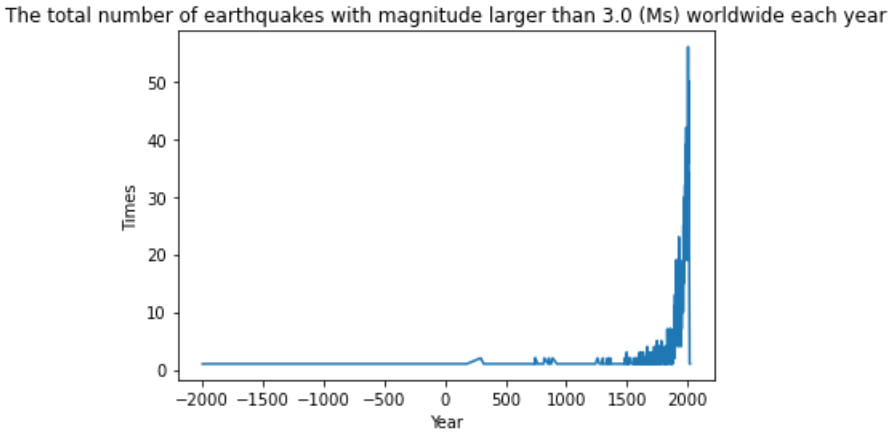
In [4]:
```
print('The top 20 countries along with the total number of deaths are listed:')
#将Deaths和Country两列数据挑选出来，并对相同国家的Death求和，并进行排序，取前20.
Sig_Eqs_Deaths = Sig_Eqs['Deaths'].groupby(Sig_Eqs['Country']).sum().sort_values(ascending=False).head(20)
#将Sig_Eqs_Deaths里的数据，进行导出
for i in range(20):
    print(i+1,' ',Sig_Eqs_Deaths.index[i],'; The number of deaths:',int(Sig_Eqs_Deaths.values[i]))
```

```
The top 20 countries along with the total number of deaths are listed:
1   CHINA ; The number of deaths: 2075019
2   TURKEY ; The number of deaths: 1134569
3   IRAN ; The number of deaths: 1011446
4   ITALY ; The number of deaths: 498477
5   SYRIA ; The number of deaths: 439224
6   HAITI ; The number of deaths: 323474
7   AZERBAIJAN ; The number of deaths: 317219
8   JAPAN ; The number of deaths: 278142
9   ARMENIA ; The number of deaths: 191890
10   PAKISTAN ; The number of deaths: 145083
11   IRAQ ; The number of deaths: 136200
12   ECUADOR ; The number of deaths: 135479
13   TURKMENISTAN ; The number of deaths: 117412
14   PERU ; The number of deaths: 102219
15   ISRAEL ; The number of deaths: 90388
16   PORTUGAL ; The number of deaths: 83531
17   GREECE ; The number of deaths: 79174
18   CHILE ; The number of deaths: 64276
19   INDIA ; The number of deaths: 63491
20   TAIWAN ; The number of deaths: 57135
```

1.2 Compute the total number of earthquakes

In [5]:
```
#挑选出地震震级Ms>3的数据
Sig_Eqs_Ms = Sig_Eqs[Sig_Eqs['Ms'] > 3 ]
#将震级Ms>3的数据按年进行统计计数，绘制成图
Sig_Eqs_Ms['Ms'].groupby(Sig_Eqs_Ms['Year']).count().plot(ylabel = 'Times',
                title = 'The total number of earthquakes with magnitude larger than 3.0 (Ms) worldwide each year')
```

Out[5]:
```
<AxesSubplot:title={'center':'The total number of earthquakes with magnitude larger than 3.0 (Ms) worldwide each year'}, xlabel='Year', ylabel='Times'>
```



趋势：在大约1500年之前，全球地震（>3级）的次数较少；在1500年之后，全球地震（>3级）的次数急剧上升增多。

原因：在1500年之前所记录的地震数据较少，没有统计。越靠近现代，地震会被更容易记录，流传下来。

1.3 CountEq_LargestEq

In [6]:
```
#定义一个CountEq_LargestEq函数
def CountEq_LargestEq(country):
    #将每个国家地震总数统计出来
    total_earthquakes = Sig_Eqs['Year'].groupby(Sig_Eqs['Country']).count()
    #挑选出每个国家生最大地震的数据
    largest_earth = Sig_Eqs['Ms'].groupby(Sig_Eqs['Country']).max()#只含有国家和最大地震两项数据，没有日期地点
    #c为将largest_earth找到的数据带回原本的大数据中，获得每个国家生最大地震的全部数据（日期地点等）
    c = (Sig_Eqs.loc[(Sig_Eqs['Country'] == country) & (Sig_Eqs['Ms'] == largest_earth[country])])#判断是否为最大地震
    #判断c是否有符合条件的数据,不符合的赋予NaN
    if (len(c) != 0):
        c = c[0:1] #若有多个最大地震数据，选择第一个
    #将日期转化为xxxx-xx-xx格式
        date = str(int(c['Year']))+'-'+('00' if np.isnan(c['Mo'].values) else str(int(c['Mo'])).zfill(2))+'-'+\
        ('00' if np.isnan(c['Ms'].values) else str(int(c['Ms'])).zfill(2))
    #将地点转化为字符串格式导出
        loacation_1 = list(c['Location Name'])
        loacation_2 = map(str,loacation_1)
        loacation = ' '.join(loacation_2)
    else:
        date = 'NaN'
        loacation = 'NaN'
    return int(total_earthquakes.loc[country]),date,loacation
CountEq_LargestEq('CHINA')#举例
```

Out[6]: (616, '1920-12-08', 'CHINA: GANSU PROVINCE, SHANXI PROVINCE')

In [7]:
```
#将数据中所有国家不重复提取出来成列表
country_list = Sig_Eqs['Country'].unique()
#生成一个data_count的DataFrame文件，其索引为每个国家
data_count = pd.DataFrame(index=country_list[1:] )
#循环将每个国家数据存入data_count中
for country in country_list[1:]:
    data_count.loc[country,['The total number of earthquakes','Date of the largest earthquake',
                            'Location area of the largest earthquake']] = CountEq_LargestEq(country)
data_count.sort_values('The total number of earthquakes',ascending=False)
```

Out[7]:

	The total number of earthquakes	Date of the largest earthquake	Location area of the largest earthquake
CHINA	616.0	1920-12-08	CHINA: GANSU PROVINCE, SHANXI PROVINCE
JAPAN	411.0	869-07-08	JAPAN: SANRIKU
INDONESIA	405.0	2004-12-08	INDONESIA: SUMATRA: ACEH: OFF WEST COAST
IRAN	384.0	856-12-07	IRAN: DAMGHAN, QUMIS
TURKEY	332.0	1916-01-07	TURKEY
...	...	...	...
NORWAY	1.0	1819-08-05	NORWAY: RANA REGION: LUROY
CENTRAL AFRICAN REPUBLIC	1.0	NaN	NaN
PALAU	1.0	1914-10-07	MICRONESIA, FED. STATES OF: CAROLINE ISLANDS
KIRIBATI	1.0	NaN	NaN
COMOROS	1.0	NaN	NaN

156 rows × 3 columns

2. Air temperature in Shenzhen during the past 25 years

In [8]:
```
#读取所下载的数据
Baoan_Weather = pd.read_csv("Baoan_Weather_1998_2022.csv")
```

```
C:\Users\Administrator\AppData\Local\Temp\ipykernel_12752\2801096616.py:2: 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")
```

FLD LEN: 3

Hourly Calculated Temperature Section identifier
The identifier that indicates a calculated hourly average air temperature derived by an algorithm whose inputs are hourly temperature averages from each of the 3 co-located temperature sensors. This section appears in the last ISD record of the hour for the 15-minute data stream only. Unlike the temperature value found in the mandatory data section which is produced using 5-minute values, this value is calculated using an hourly average.
DOM: A specific domain comprised of the characters in the ASCII character set.
KF1 An indicator of the following items:
TEMP derived air temperature
TEMP_QC quality code

FLD LEN: 5

TEMP derived air temperature
The calculated hourly average air temperature.
MIN: -9999 MAX: +9998 UNITS: degrees Celsius
SCALING FACTOR: 10
DOM: A general domain comprised of the numeric characters (0-9), a plus sign (+), and a minus sign (-).
+9999 = Missing.

FLD LEN: 1

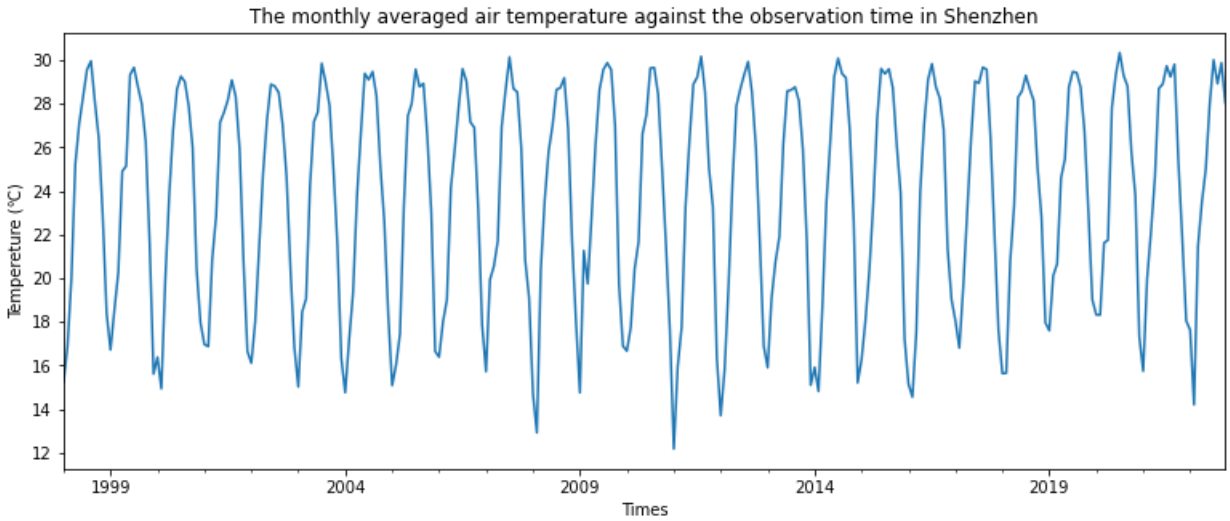
TEMP_QC quality code
The code that indicates ISD's evaluation of the quality status of the calculated hourly average air temperature.
DOM: A specific domain comprised of the numeric characters (0-9).
1 = Passed all quality control checks
3 = Failed all quality control checks
9 = missing

图 1

通过阅读说明书，我们可以找到图1所示的数据说明，我们可以知道TMP数据是由+XXXX,Y组成，XXX=温度*10（因为比例因子SCALING FACTOR = 10），Y的1表示质量过检。因此只要筛选出XXXX后三个X即可。

In [9]:
```
#提取出原文件中的日期和温度两个数据成data_tmp
data_tmp =Baoan_Weather.loc[:,['DATE','TMP']]
#将TMP有用数据提取出来（XXX三位数）
for i in range(len(data_tmp)):
    data_tmp.iloc[i,1] = int(data_tmp['TMP'][i][1:5])
#将提取出来的TMP数据（XXX），检查是否有异常值，并将其除以10转化为温度
tmp = data_tmp['TMP'].values
tmp[tmp==9999] = np.nan #异常值
tmp = tmp/10
data_tmp['TMP'] = tmp
#运用to_datetime函数将时间格式变为xxxx-xx-xx xx:xx:xx,如1998-01-01 00:00:00
#该公式在课上Section 06看到，具体使用在百度查阅
data_tmp['DATE'] = pd.to_datetime(data_tmp['DATE'])
#将index赋予DATA值，方便接下来resample函数的使用，rename通过百度查到
data_tmp.rename(index = data_tmp['DATE'],inplace=True)
#通过resample函数（百度所查到）实现对每月（M）的重采样
data_tmp.resample('M').mean()['TMP'].plot(xlabel = 'Times',
                                          ylabel = 'Tempereture (℃)',yticks = (range(12, 31,2)),figsize=(13,5),
                                         title = 'The monthly averaged air temperature against the observation time in
```

Out[9]:
```
<AxesSubplot:title={'center':'The monthly averaged air temperature against the observation time in Shenzhen'}, xlab
el='Times', ylabel='Tempereture (℃)'>
```



月平均气温趋势：月平均气温在每年年初（1月）会逐渐增高，在中旬（7.8月）达到最大值后会开始降低，这种规律的变化与气候季节性有关。

总的来说，每年的月平均气温总体走势一致（个别年份有所小波动），最高温波动不大（维持在29-30℃），最低气温有所起伏，在2012年年初月均温有最低值（12°左右）。

3. Global collection of hurricanes

3.1

In [10]:
```
df = pd.read_csv('ibtracs.ALL.list.v04r00.csv',
                 usecols=range(17),# 读1-17列的第一行的名字
                 skiprows=[1, 1], #跳过第二行
                 parse_dates=['ISO_TIME'],#解析日期格式
                 na_values=['NOT_NAMED', 'NAME',' '])#将'NOT_NAMED', 'NAME'和没有数据的地方改写为NaN
df
```

```
C:\Users\Administrator\AppData\Local\Temp\ipykernel_12752\2954686795.py:1: DtypeWarning: Columns (5,12) have mi
xed types. Specify dtype option on import or set low_memory=False.
  df = pd.read_csv('ibtracs.ALL.list.v04r00.csv',
```

Out[10]:

	SID	SEASON	NUMBER	BASIN	SUBBASIN	NAME	ISO_TIME	NATURE	LAT	LON	WMO_WIND	W
0	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 03:00:00	NR	10.9000	80.3000	NaN	
1	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 06:00:00	NR	10.8709	79.8265	NaN	
2	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 09:00:00	NR	10.8431	79.3524	NaN	
3	1842298N11080	1842	1	NI	BB	NaN	1842-10-25 12:00:00	NR	10.8188	78.8772	NaN	

In [11]:
```
#将"NAME","SID","WMO_WIND"单独提取出来
df_1 = df.loc[:,["NAME","SID","WMO_WIND"]]
#按WMO_WIND进行分组
df_2 = df_1.groupby(['SID','NAME']).max().sort_values('WMO_WIND', ascending=False)
#取前十
df_2.head(10)
```

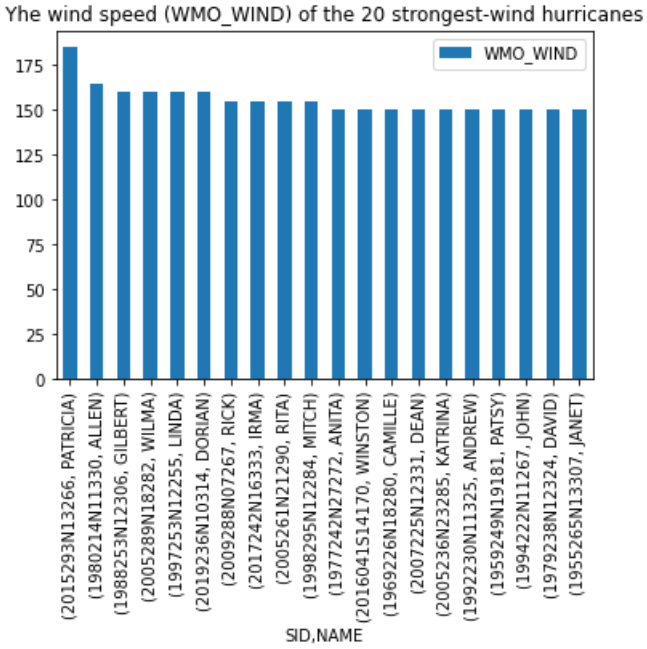
Out[11]:

		WMO_WIND
SID	NAME	
2015293N13266	PATRICIA	185.0
1980214N11330	ALLEN	165.0
1988253N12306	GILBERT	160.0
2005289N18282	WILMA	160.0
1997253N12255	LINDA	160.0
2019236N10314	DORIAN	160.0
2009288N07267	RICK	155.0
2017242N16333	IRMA	155.0
2005261N21290	RITA	155.0
1998295N12284	MITCH	155.0

3.2

In [12]:
```
#通过第一问可直接得到：
df_2.head(20).plot(kind='bar',title = 'Yhe wind speed (WMO_WIND) of the 20 strongest-wind hurricanes')
```

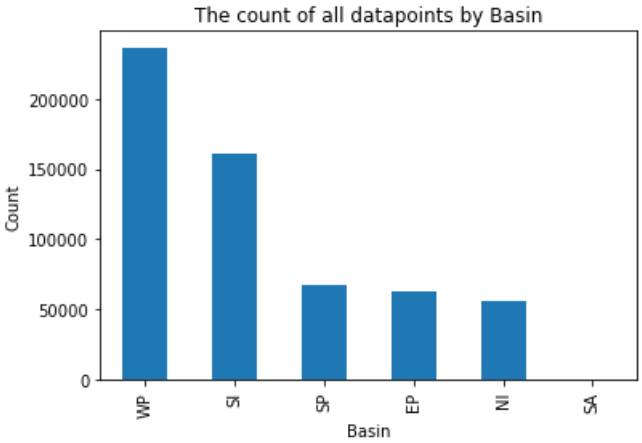
Out[12]: <AxesSubplot:title={'center':'Yhe wind speed (WMO_WIND) of the 20 strongest-wind hurricanes'}, xlabel='SID,NAME'>



3.3

In [13]:
```
df['BASIN'].value_counts().plot(kind='bar')
plt.title('The count of all datapoints by Basin')
plt.xlabel('Basin')
plt.ylabel('Count')
```

Out[13]: Text(0, 0.5, 'Count')

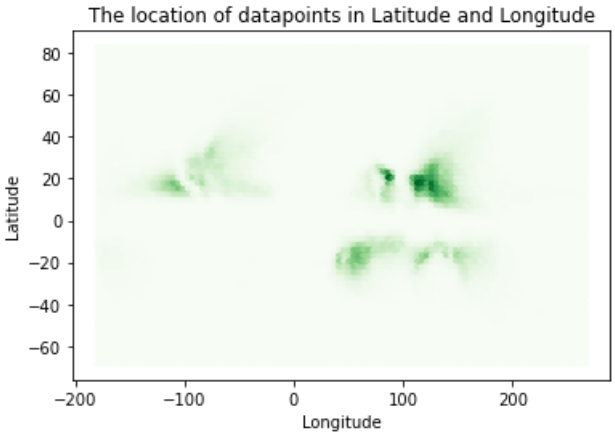


3.4

In [14]:
```
import matplotlib.pyplot as plt
import numpy as np
```

In [15]:
```
#根据经纬度画图
plt.hexbin(x=df['LON'], y=df['LAT'], gridsize = 100, cmap ='Greens')
plt.title('The location of datapoints in Latitude and Longitude')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
```

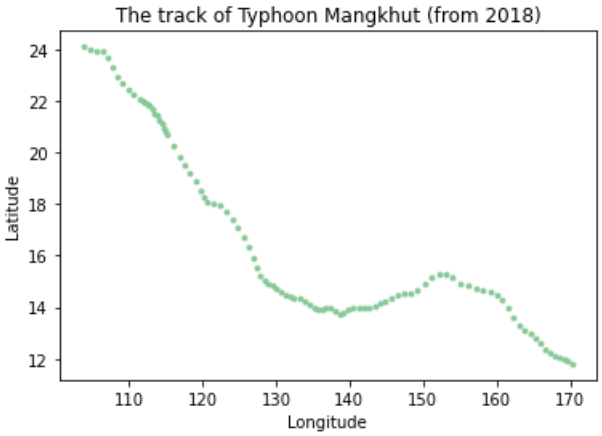
Out[15]: Text(0, 0.5, 'Latitude')



3.5

In [16]:
```
#挑选出2018年山竹台风数据
shanzhu_data = df[(df['NAME']== 'MANGKHUT') & (df['SEASON']== 2018)]
#给x,y赋值（经纬度）
x = np.array(shanzhu_data['LON'].tolist())
y = np.array(shanzhu_data['LAT'].tolist())
#美化图
plt.scatter(x,y,s=8, c = '#88c999')
plt.title('The track of Typhoon Mangkhut (from 2018)')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
```

Out[16]: Text(0, 0.5, 'Latitude')



3.6

In [17]:
```
#挑选出符合题意的数据
filtered_data = df[(df['SEASON'] >= 1970)&((df['BASIN']== 'WP')|(df['BASIN']== 'EP'))]
filtered_data
```

Out[17]:

	SID	SEASON	NUMBER	BASIN	SUBBASIN	NAME	ISO_TIME	NATURE	LAT	LON	WMO_WIND	W
350394	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 00:00:00	TS	7.00000	151.400	NaN	
350395	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 03:00:00	TS	7.24752	151.205	NaN	
350396	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 06:00:00	TS	7.50000	151.000	NaN	
350397	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 09:00:00	TS	7.75747	150.772	NaN	
350398	1970050N07151	1970	22	WP	MM	NANCY	1970-02-19 12:00:00	TS	8.00000	150.500	NaN	
...	...	...	...	...	...	...	...	...	...	...	...	
707085	2022275N10316	2022	76	EP	MM	JULIA	2022-10-10 15:00:00	TS	13.99570	-90.294	NaN	
707086	2022275N10316	2022	76	EP	MM	JULIA	2022-10-10 18:00:00	NR	14.50000	-91.000	NaN	
707174	2022286N15151	2022	80	WP	MM	NaN	2022-10-12 12:00:00	NR	15.20000	151.300	NaN	
707175	2022286N15151	2022	80	WP	MM	NaN	2022-10-12 15:00:00	NR	15.05000	151.325	NaN	
707176	2022286N15151	2022	80	WP	MM	NaN	2022-10-12 18:00:00	NR	14.90000	151.350	NaN	

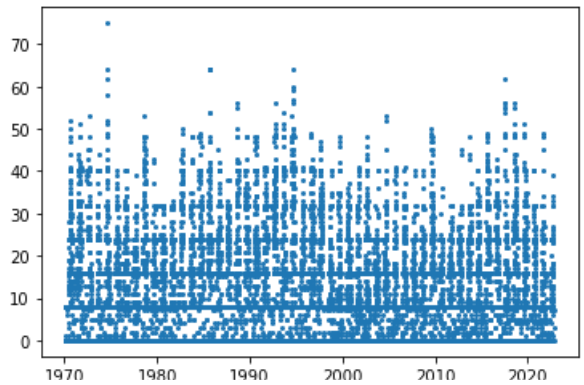
176352 rows × 17 columns

3.7

In [18]:
```
#新插入一行全都为1，用于后面计数
filtered_data['Count'] = 1
#将index赋予时间值，方便接下来resample函数的使用
filtered_data.rename(index = filtered_data['ISO_TIME'],inplace=True)
#通过resample函数实现对每天（D）的重采样，并对Count计数
per_data = filtered_data.resample('D').count()['Count']
#作图
plt.plot_date(per_data.index,per_data, markersize = 2)
```

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

Out[18]: [<matplotlib.lines.Line2D at 0x1c709bd31c0>]



3.8

In [19]:
```
#定义一个函数，该函数将一年的第某天转为日期形式,具体来自百度
def trans_date(year,day):
    first_day = datetime.datetime (year,1,1) #一年的开始
    zone = datetime.timedelta(days=day-1)#该天为一年的第n-1天
    return datetime.datetime.strftime(first_day + zone, "%Y-%m-%d")#第一天+第n-1天，再转化为日期
#定义day_of_year函数，用于计算1970-2022年所有第n天中，台风发生次数总和
def day_of_year(day):
    sum_day = 0 #初始定义一个用于计算总天数的参数
    t = 0 #用于计算1970 - 2022共有多少个第n天
    temp_date = 0
    for i in range (1970,2023):
        year = i
        temp_date = trans_date(year,day) #将天数转化为日期
        if (temp_date in per_data.index): #看当年日期在per_data（索引）是否有
            sum_day = sum_day+ per_data[temp_date]
            t = t + 1
    return sum_day,t
day_of_year(1)
```

Out[19]: (83, 52)

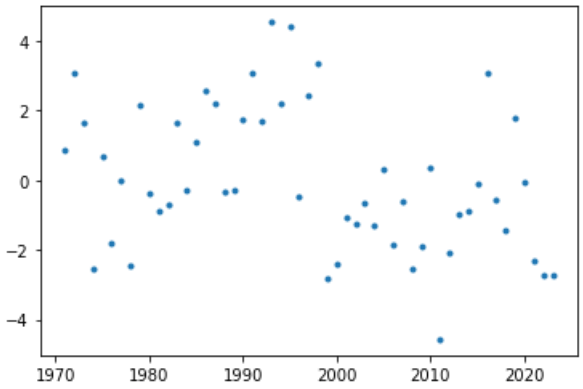
3.9

In [20]:
```
average_day = []#1970-2022平均每天台风数
for i in range(0,366):
    average_day.append(day_of_year(i)[0]/day_of_year(i)[1])#一天总数/总天数
def trans_date(date):
    temp_date = date.timetuple() #将日期格式解析字段
    day = temp_date.tm_yday #找到tm_yday为第n天
    return day
ano_data = pd.DataFrame(columns = ['Anomaly'])#用于存储每天异常数据
#将每天的异常数据存储到ano_data中
for i in range(len(per_data.index)):
    ano_data.loc[per_data.index[i],['Anomaly']] = per_data[i]-average_day[int(trans_date(per_data.index[i])-1)]
```

3.10

In [21]:
```
#以年频率作图作图
ano_data_Y = ano_data.resample('Y').mean()['Anomaly']
plt.plot_date(ano_data_Y.index,ano_data_Y,markersize = 3)
```

Out[21]:
```
[<matplotlib.lines.Line2D at 0x1c709db7160>]
```



分析：从图中我们可以看出，年均异常值分布不均匀，没有大致的规律，但在1992,1994和2010这三年异常值的绝对值均大于4.因此在这三年可能出现了异常台风活动。

4. Explore a data set

4.1

In [22]:
```
#该数据来源National Centers for Environmental Information (NCEI) ，为北京地区数据，含有温度，降水等数据
#将所有空值赋予NaN
#因为网站中并未找到数据异常值的表达，因此省略该步骤
Beijing_Data = pd.read_csv("Beijing data.csv",parse_dates=['Date'],na_values=[' '])
Beijing_Data
```

Out[22]:

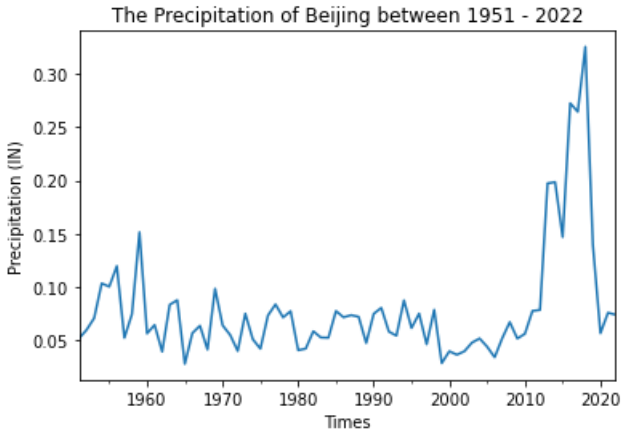
	Date	TAVG (Degrees Fahrenheit)	TMAX (Degrees Fahrenheit)	TMIN (Degrees Fahrenheit)	PRCP (Inches)	SNOW (Inches)	SNWD (Inches)
0	1951-01-01	NaN	25.0	7.0	0.00	NaN	NaN
1	1951-01-02	20.0	30.0	14.0	0.02	NaN	NaN
2	1951-01-03	18.0	25.0	11.0	0.00	NaN	NaN
3	1951-01-04	19.0	23.0	14.0	0.05	NaN	NaN
4	1951-01-05	16.0	20.0	13.0	0.18	NaN	NaN
...	...	...	...	...	...	...	...
26218	2022-10-16	57.0	76.0	NaN	0.00	NaN	NaN
26219	2022-10-17	48.0	67.0	NaN	0.00	NaN	NaN
26220	2022-10-18	47.0	67.0	NaN	0.00	NaN	NaN
26221	2022-10-19	53.0	70.0	35.0	0.00	NaN	NaN
26222	2022-10-20	54.0	70.0	NaN	0.00	NaN	NaN

26223 rows × 7 columns

4.2

In [23]:
```
#绘制1951-2022年年平均降水量图
Beijing_Data.rename(index = Beijing_Data['Date'],inplace=True)
Beijing_Data.resample('Y').mean()['PRCP (Inches)'].plot(title = 'The Precipitation of Beijing between 1951 - 2022',
                                                        xlabel = 'Times',ylabel = 'Precipitation (IN)')
```

Out[23]:
```
<AxesSubplot:title={'center':'The Precipitation of Beijing between 1951 - 2022'}, xlabel='Times', ylabel='Precipitation (IN)'>
```



4.3

In [24]:
```
a = Beijing_Data.mean()['PRCP (Inches)'] #日平均降水量
Beijing_Data['Year'] = pd.to_datetime(Beijing_Data['Date']).dt.year
b = Beijing_Data.groupby(['Year']).mean()['PRCP (Inches)'].mean() #年平均降水量
c = Beijing_Data.groupby(['Year']).mean()['PRCP (Inches)'].max() #年最大降水量
d = Beijing_Data.groupby(['Year']).mean()['PRCP (Inches)'].var() #均方差
print('The mean value of the precipitation in Beijing between 1951 - 2022 per day is',round(a,4),'in/d.')
print('The mean value of the precipitation in Beijing between 1951 - 2022 per year is',round(b,4),'in/a.')
print('The max year of the precipitation in Beijing between 1951 - 2022 is',round(c,4),'in/a.')
print('The unbiased variance of the precipitation in Beijing between 1951 - 2022 per year is',round(d,4),'in/a.')
#执行Shapiro-Wilk 正态性检验
from scipy import stats
s,p=stats.shapiro(Beijing_Data.resample('Y').mean()['PRCP (Inches)'])
#返回值s为检验统计量，当p值大于指定的显著性水平(0.5)，则成立
print('s =', round(s,2),';p =', round(p,2),'<0.5.',
      'The annual precipitation data do not conform to the normal distribution.')
```

```
C:\Users\Administrator\AppData\Local\Temp\ipykernel_12752\1824308095.py:1: FutureWarning: DataFrame.mean and DataFrame.median with numeric_only=None will include datetime64 and datetime64tz columns in a future version.
  a = Beijing_Data.mean()['PRCP (Inches)'] #日平均降水量

The mean value of the precipitation in Beijing between 1951 - 2022 per day is 0.0687 in/d.
The mean value of the precipitation in Beijing between 1951 - 2022 per year is 0.0793 in/a.
The max year of the precipitation in Beijing between 1951 - 2022 is 0.3254 in/a.
The unbiased variance of the precipitation in Beijing between 1951 - 2022 per year is 0.003 in/a.
s = 0.67 ;p = 0.0 <0.5. The annual precipitation data do not conform to the normal distribution.
```

从年均降水量和日均降水量我们可以发现，年均降水量明显要大于日降水量。

并且从4.2图和所计算的均方差我们也能看到，年均降水量在2010年之前相对稳定，但在2010年之后有急剧上升趋势。

通过Shapiro-Wilk 正态性检验，年均降水量不符合正态分布。