

Rainfall_meteostation_airport_Samos-02

October 3, 2017

1 Post-processing of the meteorological data

Here we look at the rainfall data obtained from the meteorological stations of Samos Airport.

Meteorological station's coordinates

in EGSA 87
in WGS 84
Height

```
In [1]: import pandas as pd
        %matplotlib inline
        data = pd.read_csv ('Rainfall_meteostation_airport_Samos.csv',
                             header=0,
                             index_col='Year',
                             decimal=',')

        data.head(n=10)
```

```
Out [1]:
```

	01-Sep	02-Oct	03-Nov	04-Dec	05-Jan	06-Feb	07-Mar	08-Apr	\
Year									
1976-77	NaN	NaN	NaN	NaN	168.3	63.0	11.8	37.6	
1977-78	16.6	155.5	112.8	301.0	308.0	229.6	73.2	64.0	
1978-79	268.1	52.8	32.3	60.1	316.3	61.2	48.6	11.2	
1979-80	0.0	51.4	138.0	181.1	126.4	85.3	113.9	69.3	
1980-81	0.0	12.1	47.3	154.8	294.5	78.7	14.5	6.5	
1981-82	3.0	9.6	332.3	294.7	85.8	92.7	132.7	59.7	
1982-83	0.0	52.0	73.5	150.6	52.5	169.6	49.1	10.1	
1983-84	0.0	0.6	201.9	299.6	227.3	219.6	114.0	75.2	
1984-85	0.0	0.0	95.3	127.1	175.5	50.2	126.6	5.3	
1985-86	0.0	16.2	38.3	55.4	267.1	173.1	44.0	11.4	
	09-May	10-Jun	11-Jul	12-Aug	Sum				
Year									
1976-77	0.0	30.3	0.0	0.0	NaN				
1977-78	7.6	0.0	0.0	0.0	1268.3				
1978-79	27.7	4.2	0.0	0.0	882.5				
1979-80	10.9	1.4	0.0	0.0	777.7				

1980-81	20.9	0.0	0.0	0.0	629.3
1981-82	3.9	12.7	1.2	0.0	1028.3
1982-83	12.9	3.3	2.5	14.7	590.8
1983-84	2.7	0.0	5.2	0.0	1146.1
1984-85	25.8	0.0	0.0	0.0	605.8
1985-86	48.7	2.4	0.0	0.0	656.6

In [2]: data.describe()

```
Out [2]:
```

	01-Sep	02-Oct	03-Nov	04-Dec	05-Jan	06-Feb	\
count	38.000000	38.000000	38.000000	38.000000	39.000000	39.000000	
mean	15.055263	38.823684	109.621053	152.994737	132.04359	102.130769	
std	44.914957	43.313892	95.022371	81.879123	96.31890	61.973110	
min	0.000000	0.000000	0.000000	12.400000	1.500000	18.600000	
25%	0.000000	14.325000	39.425000	84.700000	59.200000	51.050000	
50%	0.200000	20.400000	78.600000	148.950000	108.300000	85.300000	
75%	11.875000	52.600000	142.500000	212.775000	192.300000	156.550000	
max	268.100000	169.900000	442.200000	301.000000	353.000000	229.600000	

	07-Mar	08-Apr	09-May	10-Jun	11-Jul	12-Aug	\
count	38.000000	38.000000	38.000000	38.000000	38.000000	38.000000	
mean	74.160526	47.039474	22.828947	3.026316	0.465789	0.526316	
std	50.708795	34.179855	30.278089	5.920541	1.566762	2.440944	
min	0.000000	0.700000	0.000000	0.000000	0.000000	0.000000	
25%	38.750000	12.175000	4.700000	0.000000	0.000000	0.000000	
50%	69.550000	47.650000	11.350000	0.000000	0.000000	0.000000	
75%	113.975000	74.725000	27.225000	3.225000	0.000000	0.000000	
max	184.500000	115.500000	127.400000	30.300000	8.000000	14.700000	

	Sum
count	39.000000
mean	678.830769
std	230.898426
min	0.000000
25%	593.600000
50%	656.600000
75%	793.550000
max	1268.300000

In [20]: # Delete the final column (Sum)

```
data_raw = data.loc[:, ['01-Sep', '02-Oct', '03-Nov', '04-Dec', '05-Jan', '06-Feb', '07-Mar', '08-Apr']]
data_raw.head(n=40)
```

```
Out [20]:
```

	01-Sep	02-Oct	03-Nov	04-Dec	05-Jan	06-Feb	07-Mar	08-Apr	\
Year									
1976-77	NaN	NaN	NaN	NaN	168.3	63.0	11.8	37.6	
1977-78	16.6	155.5	112.8	301.0	308.0	229.6	73.2	64.0	
1978-79	268.1	52.8	32.3	60.1	316.3	61.2	48.6	11.2	
1979-80	0.0	51.4	138.0	181.1	126.4	85.3	113.9	69.3	

1980-81	0.0	12.1	47.3	154.8	294.5	78.7	14.5	6.5
1981-82	3.0	9.6	332.3	294.7	85.8	92.7	132.7	59.7
1982-83	0.0	52.0	73.5	150.6	52.5	169.6	49.1	10.1
1983-84	0.0	0.6	201.9	299.6	227.3	219.6	114.0	75.2
1984-85	0.0	0.0	95.3	127.1	175.5	50.2	126.6	5.3
1985-86	0.0	16.2	38.3	55.4	267.1	173.1	44.0	11.4
1986-87	1.0	16.1	25.2	123.4	126.7	83.0	119.3	75.0
1987-88	0.0	1.4	97.0	80.1	90.5	128.5	171.3	18.4
1988-89	0.0	14.7	204.8	227.3	20.0	19.6	96.9	0.7
1989-90	5.5	135.1	77.5	77.4	3.4	71.9	0.0	34.5
1990-91	17.5	14.2	79.7	296.1	65.9	127.2	63.0	73.5
1991-92	0.4	21.2	73.6	264.4	1.5	62.4	118.4	73.9
1992-93	0.0	18.9	76.2	77.0	82.6	144.5	84.3	85.3
1993-94	0.0	7.2	180.2	155.6	100.3	163.3	66.3	17.2
1994-95	0.0	169.9	197.8	165.6	211.3	41.2	165.2	14.5
1995-96	1.7	16.8	42.8	89.5	139.7	160.9	70.0	70.0
1996-97	40.9	22.6	37.7	220.0	38.9	53.0	74.5	115.5
1997-98	0.0	19.6	34.4	171.3	108.3	46.3	143.4	20.6
1998-99	19.0	18.0	309.2	189.4	126.7	202.2	71.4	50.6
1999-00	0.0	1.9	30.2	83.1	50.5	94.4	69.1	4.4
2000-01	0.0	31.1	59.8	43.6	87.4	51.9	4.0	101.4
2001-02	3.2	10.0	442.2	153.2	72.2	41.7	37.0	100.7
2002-03	51.0	16.0	76.0	21.0	14.0	24.0	45.0	84.0
2003-04	0.0	62.0	31.0	231.0	353.0	30.0	19.0	28.0
2004-05	0.0	0.0	206.0	124.0	80.0	176.0	58.0	4.0
2005-06	4.0	61.0	144.0	132.0	70.0	80.0	156.0	9.0
2006-07	6.0	109.0	114.0	34.0	33.1	18.6	22.1	36.8
2007-08	0.0	65.5	117.8	191.1	31.4	22.2	14.8	86.6
2008-09	24.9	26.5	101.8	138.2	209.1	163.0	71.1	47.5
2009-10	70.0	24.3	88.8	247.0	225.4	103.3	15.2	4.5
2010-11	16.6	106.0	32.3	110.8	285.5	139.5	11.1	82.1
2011-12	10.3	66.3	0.0	130.1	172.1	193.8	59.0	90.1
2012-13	0.0	16.2	12.7	147.3	36.4	140.3	79.8	47.8
2013-14	0.0	22.7	149.7	12.4	152.5	25.2	184.5	60.6
2014-15	12.4	30.9	51.5	253.5	139.6	152.2	NaN	NaN
2015-16	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

	09-May	10-Jun	11-Jul	12-Aug
Year				
1976-77	0.0	30.3	0.0	0.0
1977-78	7.6	0.0	0.0	0.0
1978-79	27.7	4.2	0.0	0.0
1979-80	10.9	1.4	0.0	0.0
1980-81	20.9	0.0	0.0	0.0
1981-82	3.9	12.7	1.2	0.0
1982-83	12.9	3.3	2.5	14.7
1983-84	2.7	0.0	5.2	0.0
1984-85	25.8	0.0	0.0	0.0

1985-86	48.7	2.4	0.0	0.0
1986-87	114.6	0.0	0.0	0.0
1987-88	8.0	1.2	0.0	0.0
1988-89	18.1	5.7	0.0	0.0
1989-90	0.0	3.7	0.0	0.0
1990-91	90.0	1.8	0.0	0.0
1991-92	7.2	0.0	0.3	0.0
1992-93	7.6	0.0	0.0	0.0
1993-94	31.9	0.0	0.0	0.0
1994-95	9.4	0.0	0.0	0.0
1995-96	21.8	0.0	0.0	0.0
1996-97	17.2	0.0	0.0	0.0
1997-98	127.4	0.0	0.0	0.0
1998-99	0.0	0.0	0.0	0.0
1999-00	0.0	0.0	0.0	0.0
2000-01	31.6	0.0	0.0	0.0
2001-02	0.4	0.0	0.0	0.0
2002-03	19.0	3.0	0.0	0.0
2003-04	0.0	0.0	0.0	0.0
2004-05	11.0	0.0	0.0	2.0
2005-06	0.0	0.0	8.0	0.0
2006-07	39.8	4.0	0.0	0.0
2007-08	0.2	0.0	0.0	0.0
2008-09	7.1	2.7	0.0	0.0
2009-10	33.9	2.7	0.5	0.0
2010-11	10.8	0.5	0.0	0.0
2011-12	22.5	13.2	0.0	0.0
2012-13	65.2	8.1	0.0	0.0
2013-14	11.7	14.1	0.0	3.3
2014-15	NaN	NaN	NaN	NaN
2015-16	NaN	NaN	NaN	NaN

In [21]: *#We are going to delete the hydrological years for which we do not have a complete time series*
`data_new = pd.concat([data_raw['1977-78':'2013-14'])`

In [22]: `data_new.head(n=38)`

Out [22]:

Year	01-Sep	02-Oct	03-Nov	04-Dec	05-Jan	06-Feb	07-Mar	08-Apr	\
1977-78	16.6	155.5	112.8	301.0	308.0	229.6	73.2	64.0	
1978-79	268.1	52.8	32.3	60.1	316.3	61.2	48.6	11.2	
1979-80	0.0	51.4	138.0	181.1	126.4	85.3	113.9	69.3	
1980-81	0.0	12.1	47.3	154.8	294.5	78.7	14.5	6.5	
1981-82	3.0	9.6	332.3	294.7	85.8	92.7	132.7	59.7	
1982-83	0.0	52.0	73.5	150.6	52.5	169.6	49.1	10.1	
1983-84	0.0	0.6	201.9	299.6	227.3	219.6	114.0	75.2	
1984-85	0.0	0.0	95.3	127.1	175.5	50.2	126.6	5.3	
1985-86	0.0	16.2	38.3	55.4	267.1	173.1	44.0	11.4	

1986-87	1.0	16.1	25.2	123.4	126.7	83.0	119.3	75.0
1987-88	0.0	1.4	97.0	80.1	90.5	128.5	171.3	18.4
1988-89	0.0	14.7	204.8	227.3	20.0	19.6	96.9	0.7
1989-90	5.5	135.1	77.5	77.4	3.4	71.9	0.0	34.5
1990-91	17.5	14.2	79.7	296.1	65.9	127.2	63.0	73.5
1991-92	0.4	21.2	73.6	264.4	1.5	62.4	118.4	73.9
1992-93	0.0	18.9	76.2	77.0	82.6	144.5	84.3	85.3
1993-94	0.0	7.2	180.2	155.6	100.3	163.3	66.3	17.2
1994-95	0.0	169.9	197.8	165.6	211.3	41.2	165.2	14.5
1995-96	1.7	16.8	42.8	89.5	139.7	160.9	70.0	70.0
1996-97	40.9	22.6	37.7	220.0	38.9	53.0	74.5	115.5
1997-98	0.0	19.6	34.4	171.3	108.3	46.3	143.4	20.6
1998-99	19.0	18.0	309.2	189.4	126.7	202.2	71.4	50.6
1999-00	0.0	1.9	30.2	83.1	50.5	94.4	69.1	4.4
2000-01	0.0	31.1	59.8	43.6	87.4	51.9	4.0	101.4
2001-02	3.2	10.0	442.2	153.2	72.2	41.7	37.0	100.7
2002-03	51.0	16.0	76.0	21.0	14.0	24.0	45.0	84.0
2003-04	0.0	62.0	31.0	231.0	353.0	30.0	19.0	28.0
2004-05	0.0	0.0	206.0	124.0	80.0	176.0	58.0	4.0
2005-06	4.0	61.0	144.0	132.0	70.0	80.0	156.0	9.0
2006-07	6.0	109.0	114.0	34.0	33.1	18.6	22.1	36.8
2007-08	0.0	65.5	117.8	191.1	31.4	22.2	14.8	86.6
2008-09	24.9	26.5	101.8	138.2	209.1	163.0	71.1	47.5
2009-10	70.0	24.3	88.8	247.0	225.4	103.3	15.2	4.5
2010-11	16.6	106.0	32.3	110.8	285.5	139.5	11.1	82.1
2011-12	10.3	66.3	0.0	130.1	172.1	193.8	59.0	90.1
2012-13	0.0	16.2	12.7	147.3	36.4	140.3	79.8	47.8
2013-14	0.0	22.7	149.7	12.4	152.5	25.2	184.5	60.6

	09-May	10-Jun	11-Jul	12-Aug
Year				
1977-78	7.6	0.0	0.0	0.0
1978-79	27.7	4.2	0.0	0.0
1979-80	10.9	1.4	0.0	0.0
1980-81	20.9	0.0	0.0	0.0
1981-82	3.9	12.7	1.2	0.0
1982-83	12.9	3.3	2.5	14.7
1983-84	2.7	0.0	5.2	0.0
1984-85	25.8	0.0	0.0	0.0
1985-86	48.7	2.4	0.0	0.0
1986-87	114.6	0.0	0.0	0.0
1987-88	8.0	1.2	0.0	0.0
1988-89	18.1	5.7	0.0	0.0
1989-90	0.0	3.7	0.0	0.0
1990-91	90.0	1.8	0.0	0.0
1991-92	7.2	0.0	0.3	0.0
1992-93	7.6	0.0	0.0	0.0
1993-94	31.9	0.0	0.0	0.0

1994-95	9.4	0.0	0.0	0.0
1995-96	21.8	0.0	0.0	0.0
1996-97	17.2	0.0	0.0	0.0
1997-98	127.4	0.0	0.0	0.0
1998-99	0.0	0.0	0.0	0.0
1999-00	0.0	0.0	0.0	0.0
2000-01	31.6	0.0	0.0	0.0
2001-02	0.4	0.0	0.0	0.0
2002-03	19.0	3.0	0.0	0.0
2003-04	0.0	0.0	0.0	0.0
2004-05	11.0	0.0	0.0	2.0
2005-06	0.0	0.0	8.0	0.0
2006-07	39.8	4.0	0.0	0.0
2007-08	0.2	0.0	0.0	0.0
2008-09	7.1	2.7	0.0	0.0
2009-10	33.9	2.7	0.5	0.0
2010-11	10.8	0.5	0.0	0.0
2011-12	22.5	13.2	0.0	0.0
2012-13	65.2	8.1	0.0	0.0
2013-14	11.7	14.1	0.0	3.3

In [23]: `data_new.describe()`

```
Out [23]:
```

	01-Sep	02-Oct	03-Nov	04-Dec	05-Jan	06-Feb \
count	37.000000	37.000000	37.000000	37.000000	37.000000	37.000000
mean	15.127027	39.037838	111.191892	150.278378	130.859459	101.835135
std	45.532294	43.890953	95.831584	81.254187	98.758270	62.783567
min	0.000000	0.000000	0.000000	12.400000	1.500000	18.600000
25%	0.000000	14.200000	38.300000	83.100000	52.500000	50.200000
50%	0.000000	19.600000	79.700000	147.300000	100.300000	85.300000
75%	10.300000	52.800000	144.000000	191.100000	209.100000	160.900000
max	268.100000	169.900000	442.200000	301.000000	353.000000	229.600000

	07-Mar	08-Apr	09-May	10-Jun	11-Jul	12-Aug
count	37.000000	37.000000	37.000000	37.000000	37.000000	37.000000
mean	75.845946	47.294595	23.445946	2.289189	0.478378	0.540541
std	50.317655	34.614624	30.452592	3.847783	1.586424	2.473017
min	0.000000	0.700000	0.000000	0.000000	0.000000	0.000000
25%	44.000000	11.400000	7.100000	0.000000	0.000000	0.000000
50%	70.000000	47.800000	11.700000	0.000000	0.000000	0.000000
75%	114.000000	75.000000	27.700000	3.000000	0.000000	0.000000
max	184.500000	115.500000	127.400000	14.100000	8.000000	14.700000

In [35]: *#Now we are adding the rainfall for each month withing the relevant hydrological year*
`data_new.sum(axis=1)`

```
Out [35]: Year
1977-78    1268.3
1978-79     882.5
```

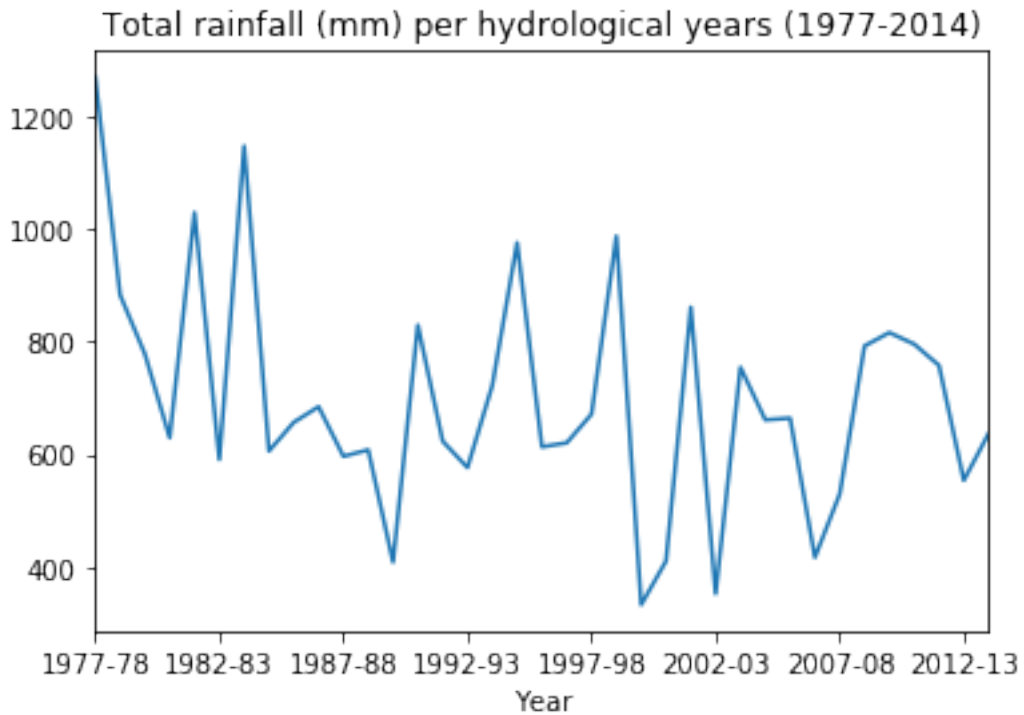
```
1979-80    777.7
1980-81    629.3
1981-82   1028.3
1982-83    590.8
1983-84   1146.1
1984-85    605.8
1985-86    656.6
1986-87    684.3
1987-88    596.4
1988-89    607.8
1989-90    409.0
1990-91    828.9
1991-92    623.3
1992-93    576.4
1993-94    722.0
1994-95    974.9
1995-96    613.2
1996-97    620.3
1997-98    671.3
1998-99    986.5
1999-00    333.6
2000-01    410.8
2001-02    860.6
2002-03    353.0
2003-04    754.0
2004-05    661.0
2005-06    664.0
2006-07    417.4
2007-08    529.6
2008-09    791.9
2009-10    815.6
2010-11    795.2
2011-12    757.4
2012-13    553.8
2013-14    636.7
dtype: float64
```

```
In [37]: #Let's run basic statistics for the 37 hydrological years.
data_new.sum(axis=1).describe()
```

```
Out [37]: count      37.000000
mean      698.224324
std       207.478768
min       333.600000
25%       596.400000
50%       661.000000
75%       795.200000
max       1268.300000
dtype: float64
```

```
In [40]: # Figure of the average rainfall per month
data_new.sum(axis=1).plot(title = 'Total rainfall (mm) per hydrological year (1977-20
```

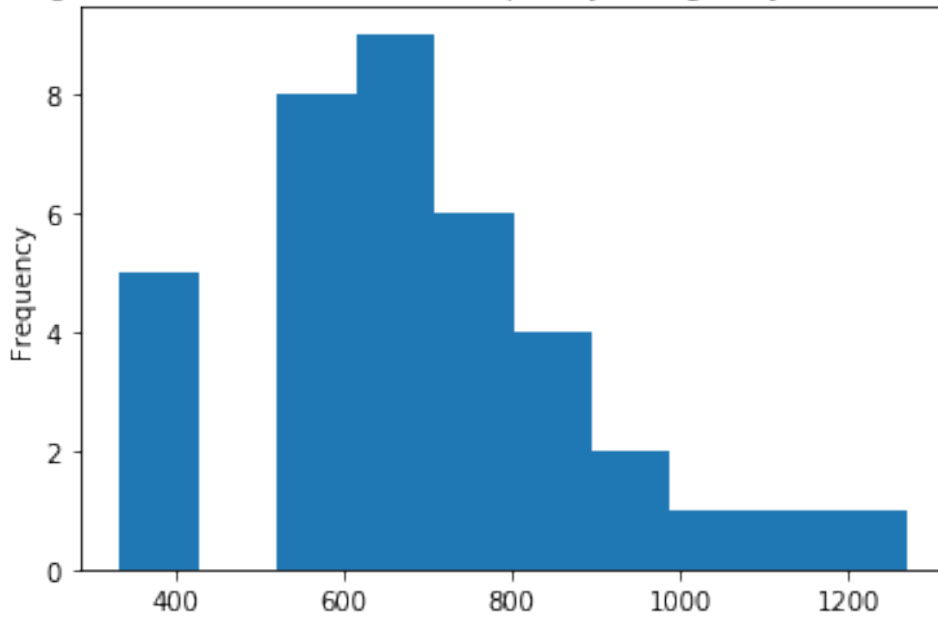
```
Out[40]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1dd5af2e90>
```



```
In [41]: # Figure of the histogram of average rainfall per month
data_new.sum(axis=1).plot.hist(title = 'Histogramm of total rainfall (mm) per hydrolo
```

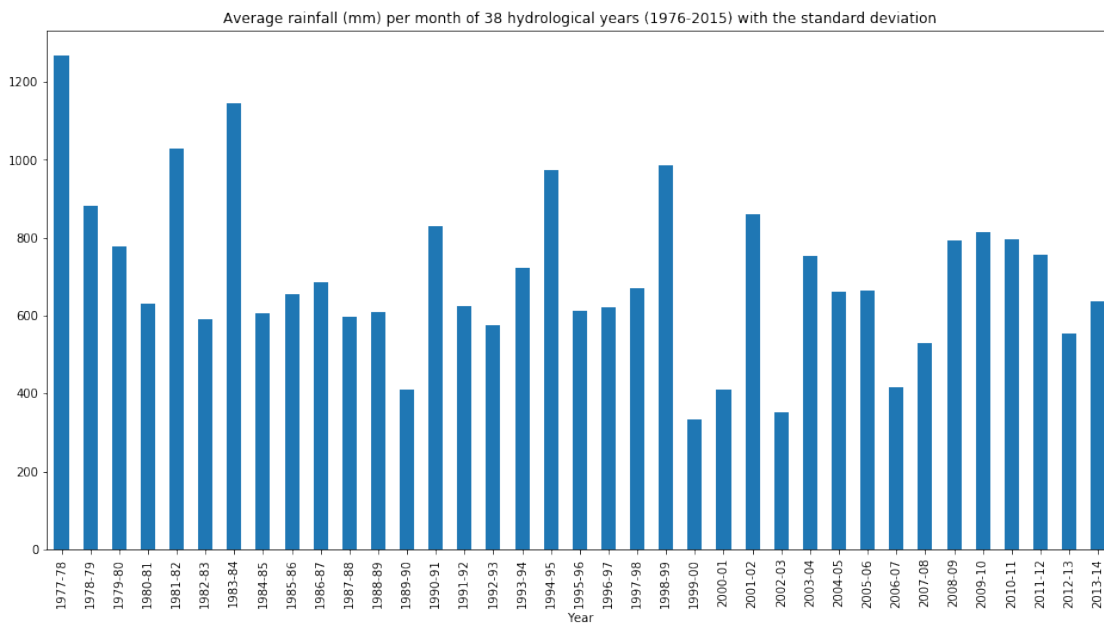
```
Out[41]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1dd5a722d0>
```


Histogramm of total rainfall (mm) per hydrological years (1977-2014)



In [44]: # Figure of the total value per hydrological year
`data_new.sum(axis=1).plot.bar(yerr=data_raw.std(),figsize=(16,8),title='Average rainf`

Out[44]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1dd5496390>



1.0.1 We get the following data:

1.0.2 Max dry season = 333.6 mm at hydr. year 1999-00,

1.0.3 Max wet season = 1268.3 mm at hydr. 1977-78

1.0.4 Statistics calculated from 37 hydrological years (mm)

Type

count

mean

std

min

25%

50%

75%

max
