Correlation Analysis

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Data description

Our dataset is formed by data from 2010 to 2020. We have chosen three subsets of data: dataset for 2018, 2017 and 2016 to apply correlation Analysis so that, we contrast results obtained for different years. These three dataset have passed cleaning process and the % of rejected rows has been so low.

```
data2018 = data10_Real_clean(data10_Real_clean.YY == 2018,:)
```

data2018 = 8587×15 table

...

	YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT
1	2018	1	1	0	50	36	0.8000	1.4000	0.8500
2	2018	1	1	1	50	17	0.8000	1.1000	0.9200
3	2018	1	1	2	50	354	0.5000	0.9000	0.8700
4	2018	1	1	3	50	23	1.2000	1.6000	0.9200
5	2018	1	1	4	50	11	1.1000	1.3000	0.8500
6	2018	1	1	5	50	325	1.1000	1.6000	0.9000
7	2018	1	1	6	50	299	1.5000	1.8000	0.8000
8	2018	1	1	7	50	311	2.6000	3.1000	0.8100
9	2018	1	1	8	50	329	3.0000	3.6000	0.7400
10	2018	1	1	9	50	338	2.6000	3.2000	0.7500
11	2018	1	1	10	50	358	3.3000	3.9000	0.7200
12	2018	1	1	11	50	350	3.6000	4.2000	0.7000
13	2018	1	1	12	50	344	4.0000	4.8000	0.6800
14	2018	1	1	13	50	354	4.9000	5.7000	0.6700

⋮

```
data2017 = data10_Real_clean(data10_Real_clean.YY == 2017,:)
```

data2017 = 8416×15 table

...

	YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT
1	2017	1	1	0	50	322	1.5000	2.5000	2.5200
2	2017	1	1	1	50	36	6.5000	8.2000	2.2200
3	2017	1	1	2	50	346	1.4000	2.2000	2.2700
4	2017	1	1	3	50	35	1.1000	2.0000	2.5200
5	2017	1	1	4	50	29	4.4000	5.7000	2.7100
6	2017	1	1	5	50	352	5.1000	6.4000	2.7800
7	2017	1	1	6	50	8	6.9000	8.4000	2.7100
8	2017	1	1	7	50	11	7.2000	8.3000	2.5500
9	2017	1	1	8	50	13	3.5000	4.6000	2.3600
10	2017	1	1	9	50	30	4.0000	5.2000	2.1800
11	2017	1	1	10	50	359	5.2000	6.3000	2.3400
12	2017	1	1	11	50	336	4.4000	6.3000	2.1300
13	2017	1	1	12	50	343	8.1000	9.9000	2.2700
14	2017	1	1	13	50	27	3.5000	4.6000	2.2600

⋮

```
data2016 = data10_Real_clean(data10_Real_clean.YY == 2016,:)
```

data2016 = 8531×15 table

...

	YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT
1	2016	1	1	0	50	314	3.6000	4.8000	1.4200
2	2016	1	1	1	50	311	3.6000	4.6000	1.4500
3	2016	1	1	2	50	305	3.0000	4.3000	1.4500
4	2016	1	1	3	50	340	3.1000	4.2000	1.4600
5	2016	1	1	4	50	349	2.9000	3.6000	1.3400
6	2016	1	1	5	50	334	3.2000	4.3000	1.2600
7	2016	1	1	6	50	34	2.2000	3.4000	1.3100
8	2016	1	1	7	50	61	1.9000	3.0000	1.1500
9	2016	1	1	8	50	99	1.1000	1.9000	1.1800
10	2016	1	1	9	50	124	1.4000	2.6000	1.2700
11	2016	1	1	10	50	146	1.4000	2.4000	1.1700
12	2016	1	1	11	50	125	2.6000	3.4000	1.1900
13	2016	1	1	12	50	98	3.7000	4.6000	1.2400

	YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT
14	2016	1	1	13	50	142	3.5000	4.4000	1.1600

⋮

Pearson's linear correlation coefficient

Year 2018

```
%R2018_YY =  corrcoef(data2018.WSPD, data2018.YY); -> It not make sense
%because we are evaluating just one year
R2018_mm =  corrcoef(data2018.WSPD, data2018.mm); %mm -> is always 50
data2018 = removevars(data2018, 'YY');
data2018 = removevars(data2018, 'mm');
R2018 =  corrcoef(table2array(data2018))
```

```
R2018 = 13×13
    1.0000    0.0079   -0.0040    0.0198    0.0046    0.0070   -0.0434   -0.0255 ···
    0.0079    1.0000    0.0024    0.0771    0.0626    0.0693    0.1032    0.1041
   -0.0040    0.0024    1.0000   -0.0718   -0.0529   -0.0539   -0.0131    0.0108
    0.0198    0.0771   -0.0718    1.0000    0.3782    0.3762    0.0949   -0.1214
    0.0046    0.0626   -0.0529    0.3782    1.0000    0.9951    0.4425   -0.2281
    0.0070    0.0693   -0.0539    0.3762    0.9951    1.0000    0.4658   -0.2264
   -0.0434    0.1032   -0.0131    0.0949    0.4425    0.4658    1.0000    0.0584
   -0.0255    0.1041    0.0108   -0.1214   -0.2281   -0.2264    0.0584    1.0000
   -0.0725    0.0319    0.0444   -0.2850   -0.4823   -0.4662    0.3284    0.5034
   -0.1357    0.0116   -0.0170    0.0075    0.1473    0.1520    0.3576   -0.4391
     ⋮
```

Year 2017

```
data2017 = removevars(data2017, 'YY');
data2017 = removevars(data2017, 'mm');
R2017 =  corrcoef(table2array(data2017))
```

```
R2017 = 13×13
    1.0000    0.0404    0.0020    0.0633   -0.1552   -0.1634   -0.1922    0.0161 ···
    0.0404    1.0000    0.0021    0.0842    0.0239    0.0255    0.0379   -0.0272
    0.0020    0.0021    1.0000   -0.0508   -0.0449   -0.0469   -0.0351    0.0010
    0.0633    0.0842   -0.0508    1.0000    0.3476    0.3429    0.0486   -0.1604
   -0.1552    0.0239   -0.0449    0.3476    1.0000    0.9952    0.4344   -0.2567
   -0.1634    0.0255   -0.0469    0.3429    0.9952    1.0000    0.4590   -0.2521
   -0.1922    0.0379   -0.0351    0.0486    0.4344    0.4590    1.0000    0.0739
    0.0161   -0.0272    0.0010   -0.1604   -0.2567   -0.2521    0.0739    1.0000
    0.0585    0.0003    0.0147   -0.3280   -0.5075   -0.4896    0.2927    0.5115
    0.0393    0.1155   -0.0322    0.0302    0.1603    0.1632    0.3013   -0.4116
     ⋮
```

Year 2016

```
data2016 = removevars(data2016, 'YY');
data2016 = removevars(data2016, 'mm');
R2016 =  corrcoef(table2array(data2016))
```

```
R2016 = 13×13
    1.0000   -0.0019   -0.0028   -0.0206   -0.0631   -0.0708   -0.2264   -0.1280 ···
   -0.0019    1.0000    0.0006    0.0397    0.1146    0.1158    0.0929   -0.0032
   -0.0028    0.0006    1.0000   -0.0401   -0.0315   -0.0340   -0.0213    0.0091
   -0.0206    0.0397   -0.0401    1.0000    0.3462    0.3482    0.0193   -0.1569
   -0.0631    0.1146   -0.0315    0.3462    1.0000    0.9947    0.3939   -0.1985
   -0.0708    0.1158   -0.0340    0.3482    0.9947    1.0000    0.4217   -0.1950
   -0.2264    0.0929   -0.0213    0.0193    0.3939    0.4217    1.0000    0.2257
   -0.1280   -0.0032    0.0091   -0.1569   -0.1985   -0.1950    0.2257    1.0000
   -0.1865   -0.0378    0.0151   -0.2748   -0.4467   -0.4281    0.4194    0.5976
   -0.0202    0.0139   -0.0223   -0.0332    0.1437    0.1477    0.2537   -0.4248
      ⋮
      ⋮
```

Spearman linear correlation coefficient

This parametric correlation is equivalent to Pearson correlation analysis when the amount of data is huge enough. Let's probe it

When we calculate Spearman correlation coefficients we save also the p values that measures the risk of reject the hypothesis of no correlation hypothesis (null hypothesis). Small p-values less than 5% (P<0.05) means that you can reject the null hypothesis, it means small risk of not considering no correlation (at least linear)

```
[S2018,PVAL_2018] = corr(table2array(data2018),'Type','Spearman')
```

```
S2018 = 13×13
    1.0000    0.0079   -0.0040    0.0206    0.0089    0.0121   -0.0383   -0.0305 ···
    0.0079    1.0000    0.0024    0.0873    0.0663    0.0743    0.0928    0.1034
   -0.0040    0.0024    1.0000   -0.1659   -0.0533   -0.0548   -0.0093    0.0102
    0.0206    0.0873   -0.1659    1.0000    0.3270    0.3292    0.1785   -0.0903
    0.0089    0.0663   -0.0533    0.3270    1.0000    0.9957    0.4601   -0.2342
    0.0121    0.0743   -0.0548    0.3292    0.9957    1.0000    0.4798   -0.2316
   -0.0383    0.0928   -0.0093    0.1785    0.4601    0.4798    1.0000   -0.0196
   -0.0305    0.1034    0.0102   -0.0903   -0.2342   -0.2316   -0.0196    1.0000
   -0.0737    0.0475    0.0481   -0.1950   -0.5316   -0.5209    0.2483    0.4945
   -0.1290    0.0330   -0.0311    0.0907    0.1879    0.1935    0.3485   -0.5189
      ⋮
      ⋮
PVAL_2018 = 13×13
    1.0000    0.4651    0.7091    0.0564    0.4104    0.2623    0.0004    0.0047 ···
    0.4651    1.0000    0.8254    0.0000    0.0000    0.0000    0.0000    0.0000
    0.7091    0.8254    1.0000    0.0000    0.0000    0.0000    0.3887    0.3424
    0.0564    0.0000    0.0000    1.0000    0.0000    0.0000    0.0000    0.0000
    0.4104    0.0000    0.0000    0.0000    1.0000         0         0    0.0000
    0.2623    0.0000    0.0000    0.0000         0    1.0000         0    0.0000
    0.0004    0.0000    0.3887    0.0000         0         0    1.0000    0.0699
    0.0047    0.0000    0.3424    0.0000    0.0000    0.0000    0.0699    1.0000
    0.0000    0.0000    0.0000    0.0000         0         0    0.0000         0
    0.0000    0.0022    0.0040    0.0000    0.0000    0.0000    0.0000         0
      ⋮
      ⋮
```

```
[S2017,PVAL_2017] = corr(table2array(data2017),'Type','Spearman')
```

```
S2017 = 13×13
    1.0000    0.0403    0.0020    0.0281   -0.1502   -0.1571   -0.2148    0.0107 ···
    0.0403    1.0000    0.0020    0.0998    0.0194    0.0205    0.0120   -0.0374
    0.0020    0.0020    1.0000   -0.1116   -0.0441   -0.0464   -0.0277    0.0008
    0.0281    0.0998   -0.1116    1.0000    0.3489    0.3482    0.1326   -0.1137
```

```
   -0.1502    0.0194   -0.0441    0.3489    1.0000    0.9958    0.4475   -0.2539
   -0.1571    0.0205   -0.0464    0.3482    0.9958    1.0000    0.4642   -0.2489
   -0.2148    0.0120   -0.0277    0.1326    0.4475    0.4642    1.0000    0.0021
    0.0107   -0.0374    0.0008   -0.1137   -0.2539   -0.2489    0.0021    1.0000
    0.0590   -0.0092    0.0233   -0.2772   -0.5471   -0.5352    0.2259    0.5107
    0.1367    0.0694   -0.0529    0.1403    0.2282    0.2302    0.2970   -0.4722
      ⋮
      ⋮
PVAL_2017 = 13×13
    1.0000    0.0002    0.8546    0.0099    0.0000    0.0000    0.0000    0.3284 ···
    0.0002    1.0000    0.8554    0.0000    0.0753    0.0599    0.2729    0.0006
    0.8546    0.8554    1.0000    0.0000    0.0001    0.0000    0.0110    0.9419
    0.0099    0.0000    0.0000    1.0000    0.0000    0.0000    0.0000    0.0000
    0.0000    0.0753    0.0001    0.0000    1.0000         0         0    0.0000
    0.0000    0.0599    0.0000    0.0000         0    1.0000         0    0.0000
    0.0000    0.2729    0.0110    0.0000         0         0    1.0000    0.8468
    0.3284    0.0006    0.9419    0.0000    0.0000    0.0000    0.8468    1.0000
    0.0000    0.4007    0.0329    0.0000         0         0    0.0000         0
    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000         0
      ⋮
      ⋮
```

```
[S2016,PVAL_2016] = corr(table2array(data2016),'Type','Spearman')
```

```
S2016 = 13×13
    1.0000   -0.0019   -0.0028   -0.0001   -0.0518   -0.0572   -0.1873   -0.1227 ···
   -0.0019    1.0000    0.0006    0.0299    0.1115    0.1123    0.1165   -0.0017
   -0.0028    0.0006    1.0000   -0.1225   -0.0318   -0.0343   -0.0186    0.0090
   -0.0001    0.0299   -0.1225    1.0000    0.3273    0.3298    0.0400   -0.1108
   -0.0518    0.1115   -0.0318    0.3273    1.0000    0.9950    0.3667   -0.1911
   -0.0572    0.1123   -0.0343    0.3298    0.9950    1.0000    0.3884   -0.1875
   -0.1873    0.1165   -0.0186    0.0400    0.3667    0.3884    1.0000    0.1771
   -0.1227   -0.0017    0.0090   -0.1108   -0.1911   -0.1875    0.1771    1.0000
   -0.1683   -0.0504    0.0195   -0.2555   -0.4873   -0.4741    0.3707    0.5911
    0.0513    0.0399   -0.0401    0.0755    0.1922    0.1915    0.1474   -0.5347
      ⋮
      ⋮
PVAL_2016 = 13×13
    1.0000    0.8610    0.7937    0.9893    0.0000    0.0000    0.0000    0.0000 ···
    0.8610    1.0000    0.9532    0.0058    0.0000    0.0000    0.0000    0.8781
    0.7937    0.9532    1.0000    0.0000    0.0033    0.0016    0.0851    0.4062
    0.9893    0.0058    0.0000    1.0000    0.0000    0.0000    0.0002    0.0000
    0.0000    0.0000    0.0033    0.0000    1.0000         0    0.0000    0.0000
    0.0000    0.0000    0.0016    0.0000         0    1.0000    0.0000    0.0000
    0.0000    0.0000    0.0851    0.0002    0.0000    0.0000    1.0000    0.0000
    0.0000    0.8781    0.4062    0.0000    0.0000    0.0000    0.0000    1.0000
    0.0000    0.0000    0.0722    0.0000         0         0    0.0000         0
    0.0000    0.0002    0.0002    0.0000    0.0000    0.0000    0.0000         0
      ⋮
      ⋮
```

Total data set correlation analysis

```
RTotal10_Real =  corrcoef(table2array(data10_Real_clean))
```

```
RTotal10_Real = 15×15
    1.0000   -0.0722   -0.0057   -0.0011   -0.2227   -0.0272    0.0172    0.0252 ···
   -0.0722    1.0000    0.0157   -0.0001   -0.2122   -0.0044   -0.0784   -0.0790
   -0.0057    0.0157    1.0000   -0.0001   -0.0183    0.0244    0.0395    0.0408
   -0.0011   -0.0001   -0.0001    1.0000   -0.0007   -0.0524   -0.0425   -0.0440
   -0.2227   -0.2122   -0.0183   -0.0007    1.0000    0.0484    0.0142   -0.0025
   -0.0272   -0.0044    0.0244   -0.0524    0.0484    1.0000    0.3602    0.3540
    0.0172   -0.0784    0.0395   -0.0425    0.0142    0.3602    1.0000    0.9940
```

```
    0.0252   -0.0790    0.0408   -0.0440   -0.0025    0.3540    0.9940    1.0000
   -0.0045   -0.1495    0.0249   -0.0210   -0.0181    0.0383    0.4062    0.4350
    0.0429   -0.0757   -0.0091    0.0135   -0.0409   -0.1340   -0.2110   -0.2053
      ⋮
      ⋮
```

```
[STotal10_Real,PVAL_Total10_Real] = corr(table2array(data10_Real_clean),'Type','Spearman')
```

```
STotal10_Real = 15×15
    1.0000   -0.0806   -0.0067   -0.0011   -0.2365   -0.0934    0.0147    0.0224 ···
   -0.0806    1.0000    0.0153   -0.0000   -0.2093    0.0238   -0.0697   -0.0694
   -0.0067    0.0153    1.0000   -0.0001   -0.0182    0.0325    0.0393    0.0411
   -0.0011   -0.0000   -0.0001    1.0000    0.0001   -0.1282   -0.0435   -0.0451
   -0.2365   -0.2093   -0.0182    0.0001    1.0000    0.0300    0.0160    0.0001
   -0.0934    0.0238    0.0325   -0.1282    0.0300    1.0000    0.3362    0.3336
    0.0147   -0.0697    0.0393   -0.0435    0.0160    0.3362    1.0000    0.9945
    0.0224   -0.0694    0.0411   -0.0451    0.0001    0.3336    0.9945    1.0000
   -0.0123   -0.1560    0.0264   -0.0182   -0.0125    0.0820    0.3899    0.4142
    0.0438   -0.0859   -0.0082    0.0129   -0.0452   -0.1067   -0.1968   -0.1910
      ⋮
      ⋮
PVAL_Total10_Real = 15×15
    1.0000    0.0000    0.0769    0.7712         0    0.0000    0.0001    0.0000 ···
    0.0000    1.0000    0.0001    0.9929         0    0.0000    0.0000    0.0000
    0.0769    0.0001    1.0000    0.9778    0.0000    0.0000    0.0000    0.0000
    0.7712    0.9929    0.9778    1.0000    0.9687    0.0000    0.0000    0.0000
         0         0    0.0000    0.9687    1.0000    0.0000    0.0000    0.9754
    0.0000    0.0000    0.0000    0.0000    0.0000    1.0000         0         0
    0.0001    0.0000    0.0000    0.0000    0.0000         0    1.0000         0
    0.0000    0.0000    0.0000    0.0000    0.9754         0         0    1.0000
    0.0012         0    0.0000    0.0000    0.0010    0.0000         0         0
    0.0000    0.0000    0.0315    0.0007    0.0000    0.0000         0         0
      ⋮
      ⋮
```

Correlation analysis plots

Firstly we calculate the central measures, including the average of the variable

Average values are so similar from one year to another

```
cm_WSPD2018 = centralMeasures(data2018.WSPD,2018)
```

```
cm_WSPD2018 = struct with fields:
        year: 2018
        mean: 6.0450
      median: 6
        mode: 6.4000
    trimmean: 5.9772
     geomean: NaN
    harmmean: NaN
```

```
cm_WSPD2017 = centralMeasures(data2018.WSPD,2017)
```

```
cm_WSPD2017 = struct with fields:
        year: 2017
        mean: 6.0450
      median: 6
        mode: 6.4000
    trimmean: 5.9772
     geomean: NaN
    harmmean: NaN
```

```
cm_WSPD2016 = centralMeasures(data2016.WSPD,2016)
```

```
cm_WSPD2016 = struct with fields:
        year: 2016
        mean: 5.7644
      median: 5.5000
        mode: 3.5000
    trimmean: 5.6300
     geomean: NaN
    harmmean: NaN
```

```
cm_WVHT2018 = centralMeasures(data2018.WVHT,2018)
```

```
cm_WVHT2018 = struct with fields:
        year: 2018
        mean: 1.9779
      median: 1.8700
        mode: 1.6700
    trimmean: 1.9060
     geomean: 1.8460
    harmmean: 1.7226
```

```
cm_WVHT2017 = centralMeasures(data2018.WVHT,2017)
```

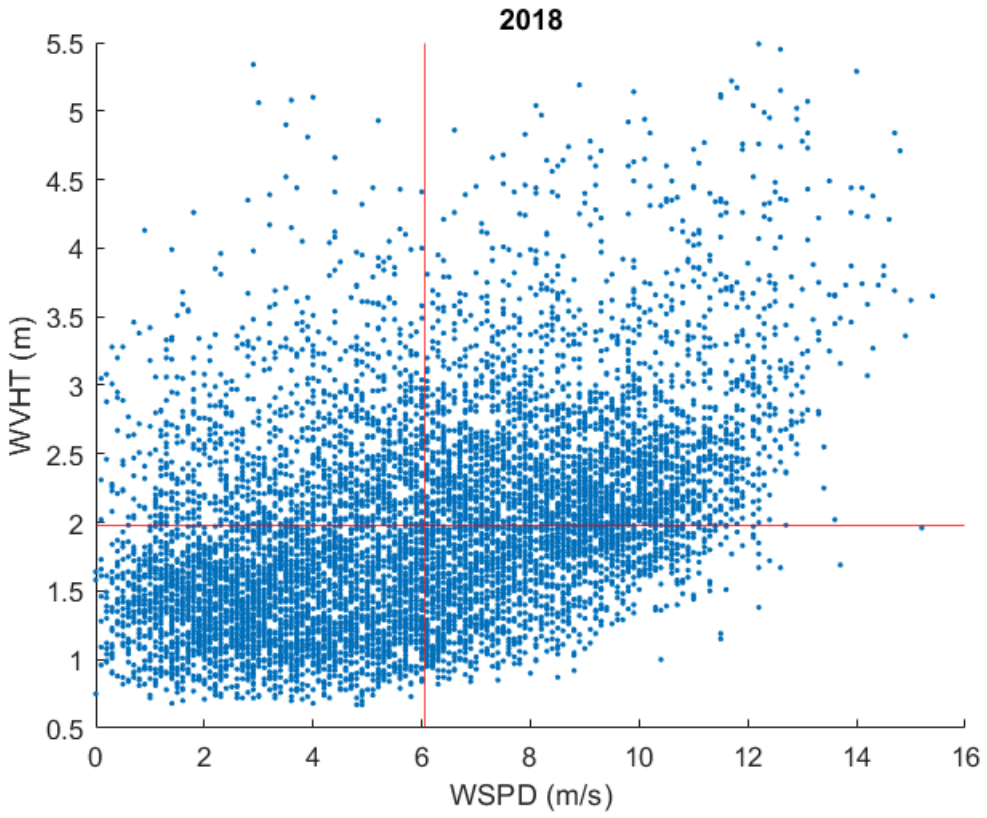
```
cm_WVHT2017 = struct with fields:
        year: 2017
        mean: 1.9779
      median: 1.8700
        mode: 1.6700
    trimmean: 1.9060
     geomean: 1.8460
    harmmean: 1.7226
```

```
cm_WVHT2016 = centralMeasures(data2016.WVHT,2016)
```

```
cm_WVHT2016 = struct with fields:
        year: 2016
        mean: 2.2043
      median: 2.0100
        mode: 1.5700
    trimmean: 2.1188
     geomean: 2.0551
    harmmean: 1.9204
```

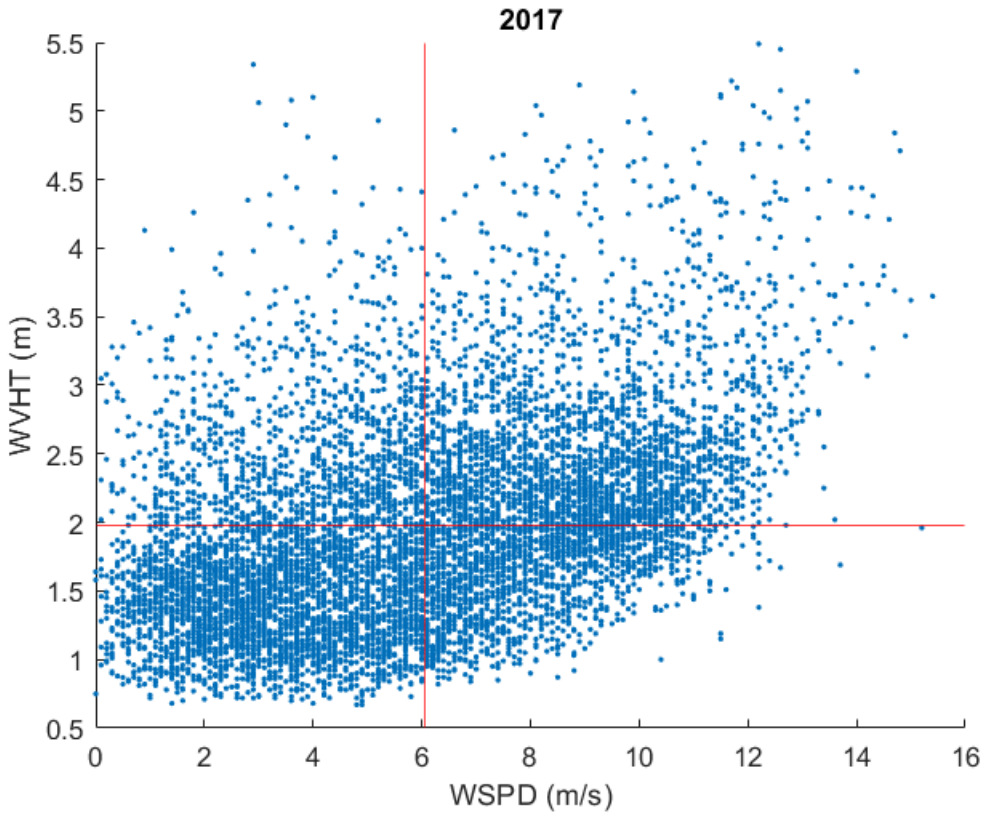
Year 2018

```
clf
hold on
plot(data2018.WSPD, data2018.WVHT, '.')
xline(cm_WSPD2018.mean,'red');
yline(cm_WVHT2018.mean, 'red');
title("2018");
xlabel("WSPD (m/s)");
ylabel("WVHT (m)")
hold off
```



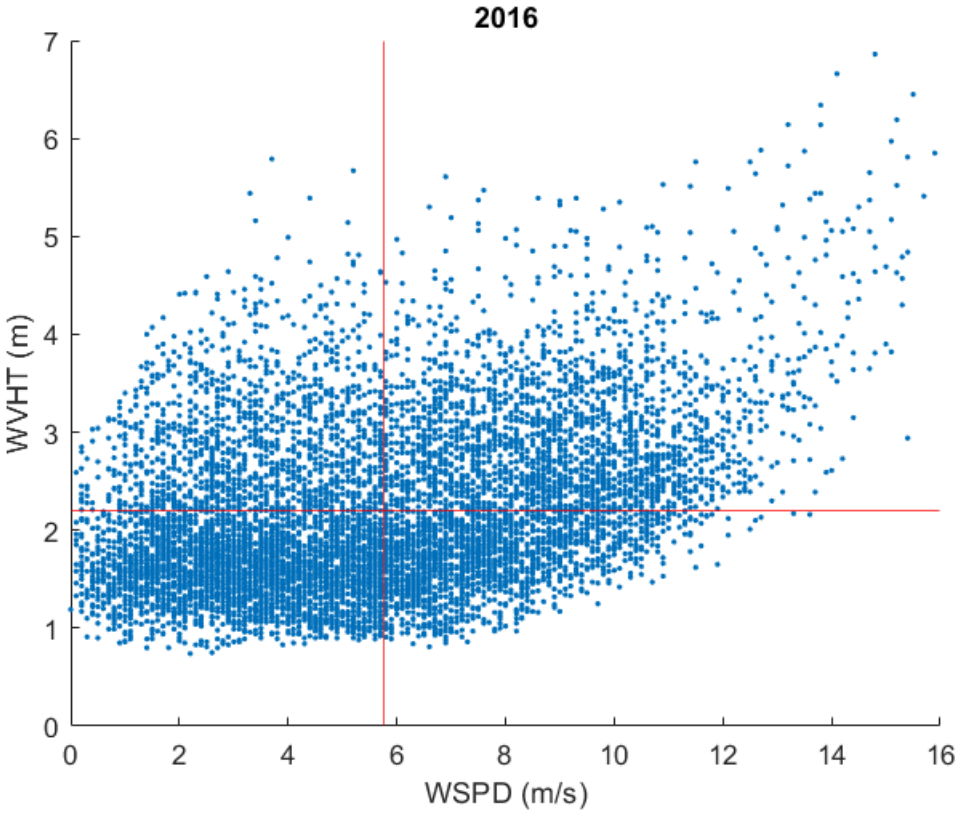
Year 2017

```
clf
hold on
plot(data2018.WSPD, data2018.WVHT, '.')
xline(cm_WSPD2017.mean,'red');
yline(cm_WVHT2017.mean, 'red');
title("2017")
xlabel("WSPD (m/s)");
ylabel("WVHT (m)")
hold off
```



Year 2016

```
clf
hold on
plot(data2016.WSPD, data2016.WVHT, '.')
xline(cm_WSPD2016.mean,'red');
yline(cm_WVHT2016.mean, 'red');
title("2016")
xlabel("WSPD (m/s)");
ylabel("WVHT (m)")
hold off
```



The points clouds for each of the years are very similar and the possible correlation between variables seems to be linear correlation.

As originally stated, Spearman and Pearson correlation analysis gives similar results