# Air Quality Analysis with Openair

R STUDIO
OPENAIR PACKAGE
AIR POLLUTANTS
METEOROLOGY
VISUALIZATIONS



## Required Activities Prior Use of Openair Package in R

```
#Datasets gathering/extraction (excel/csv file)

#Data preparation & cleaning (excel)

#Handling missing data (R studio)

#Data manipulation

#Normality test

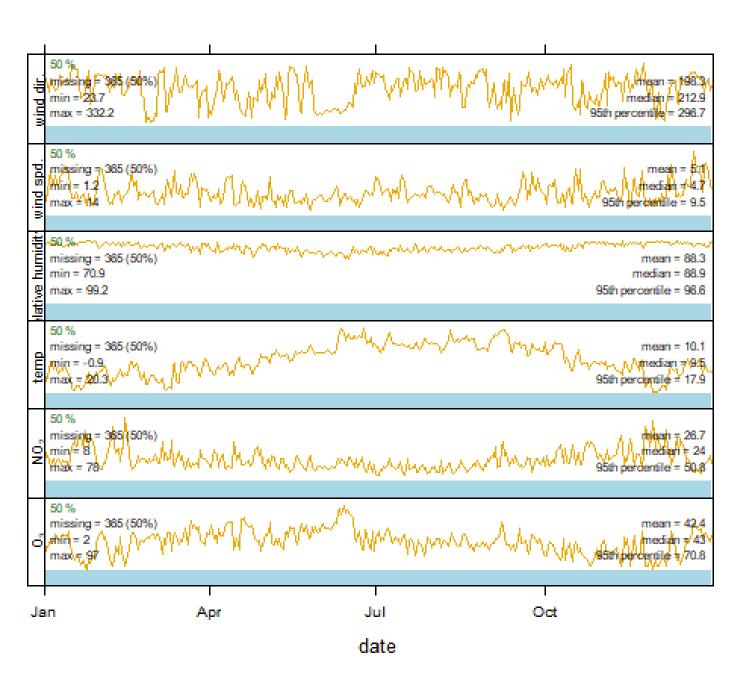
#Convert date components to factor
```

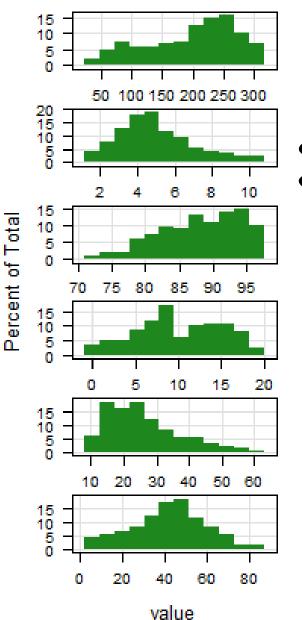
R codes for some analysis using the Openair package functions are presented for air quality datasets from Manchester, UK for the year 2023.



### #summary plot for time series and distribution histogram

### summaryPlot(air\_manchester3)



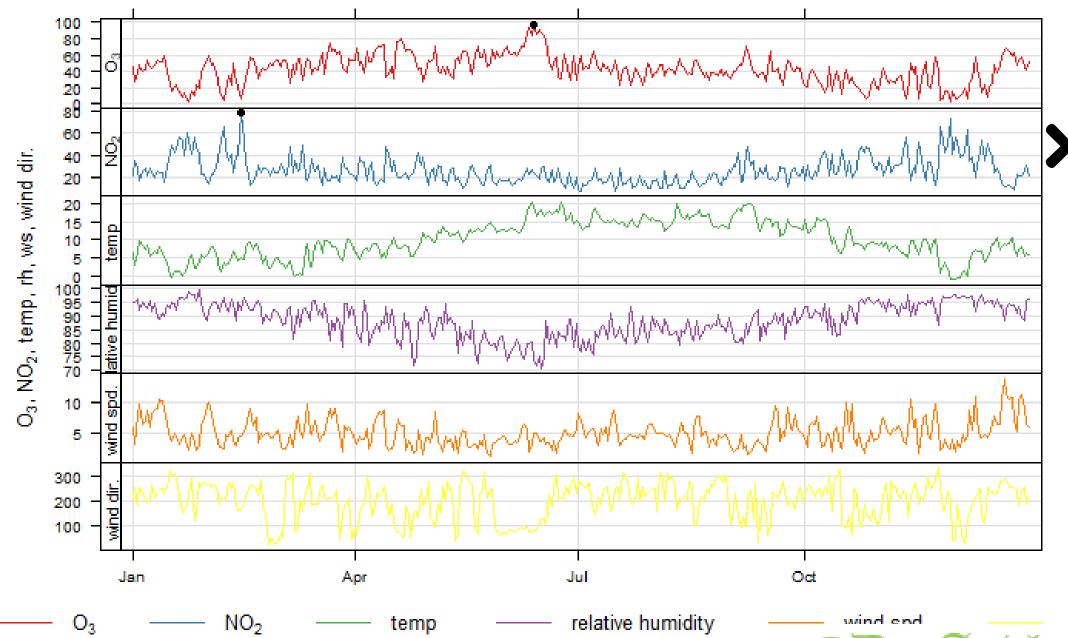




#### #timeplot for all variables in one frame

timePlot(selectByDate(air\_manchester3, month = 1:12), pollutant = c("ozone", "no2", "temp", "rh", "ws", "wd"), y.relation = "free")

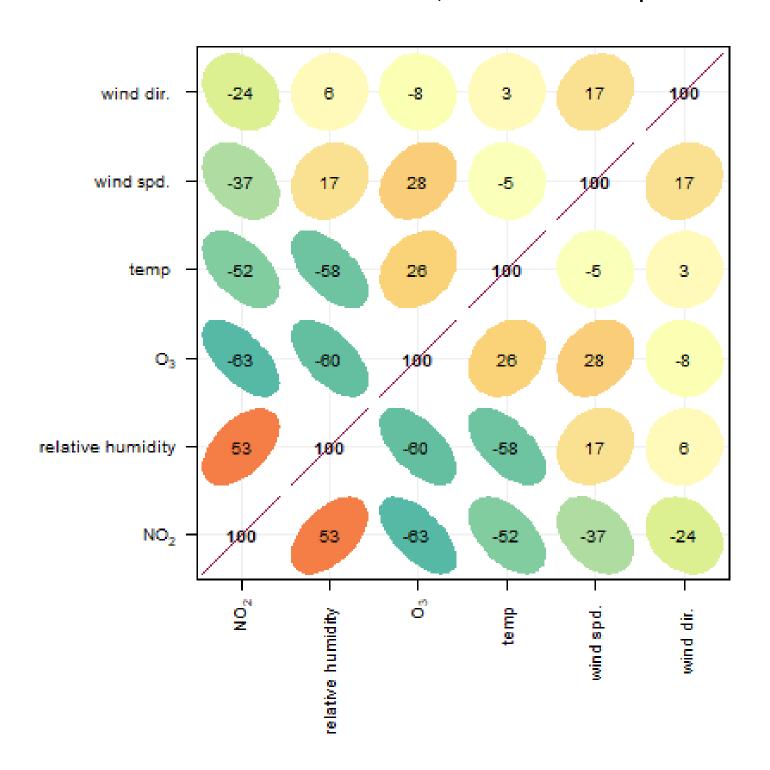
### #load "latticeExtra" for last plot update ##latticeExtra is used indicate highest point of select variables (only air pollutants which are row 1 & 2 selected here).



### #corplot function for correlation matrices between variables ##spearman method for correlation coefficients (datasets failed normality test)

###Repressented in % & 100 = 1 = r

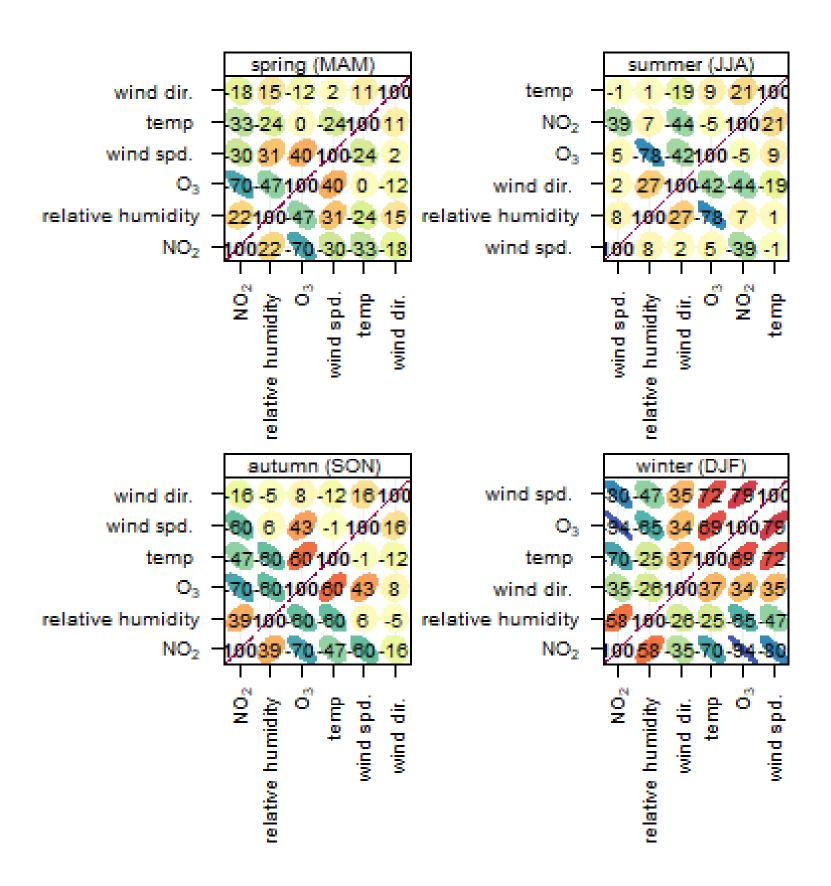
corPlot(air\_manchester3, method = "spearman")





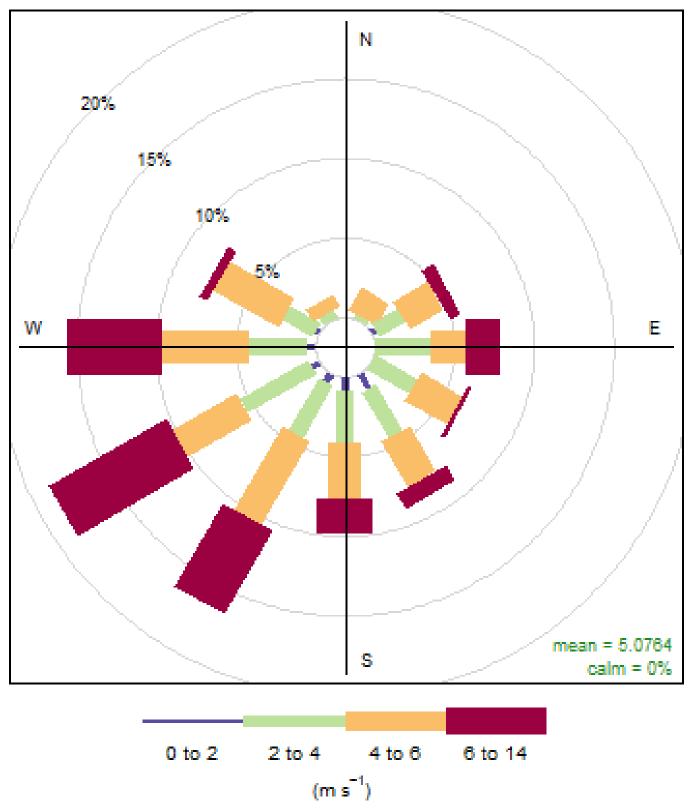
### #correlation by seasons

corPlot(air\_manchester3, type = "season", method = "spearman")





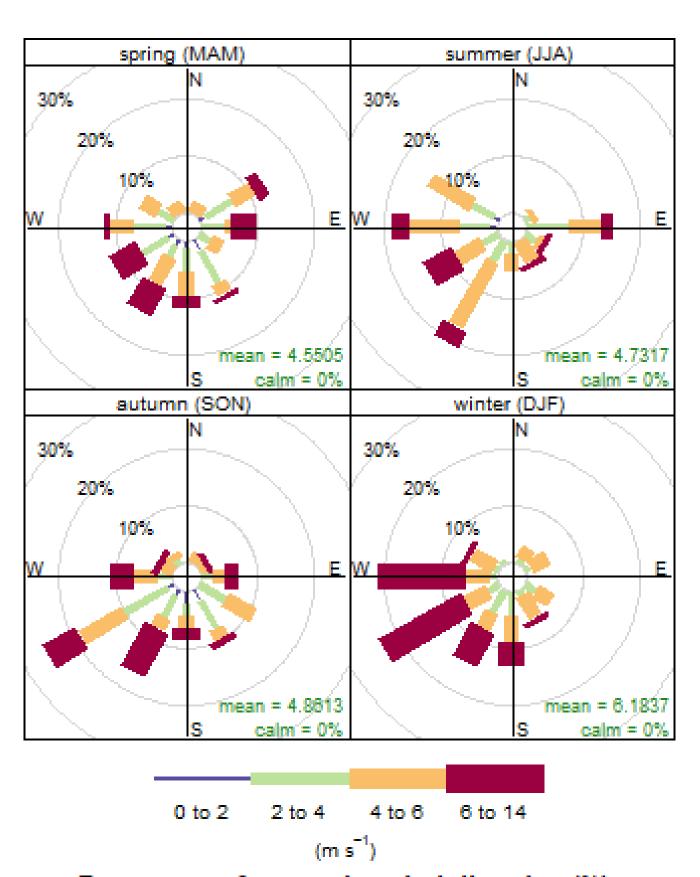
### #wind speed and wind direction intervals windRose(air\_manchester3)



Frequency of counts by wind direction (%)



### #wind direction and wind speed by seasons windRose(air\_manchester3, type = "season")



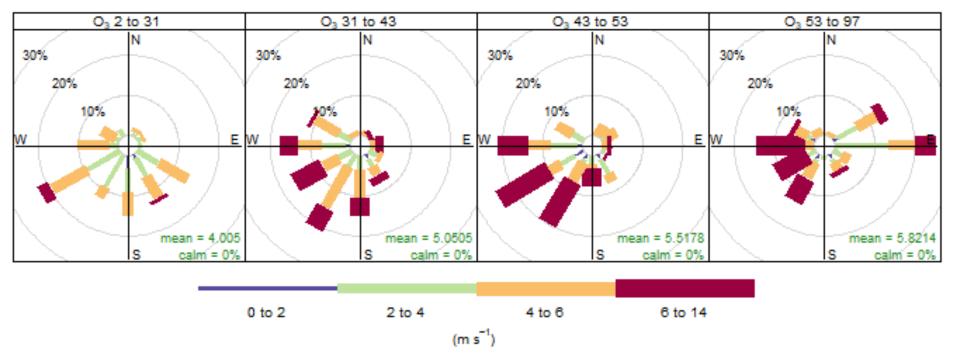
Frequency of counts by wind direction (%)



### #wind direction/speed frequencies influence on pollutants in quartiles.

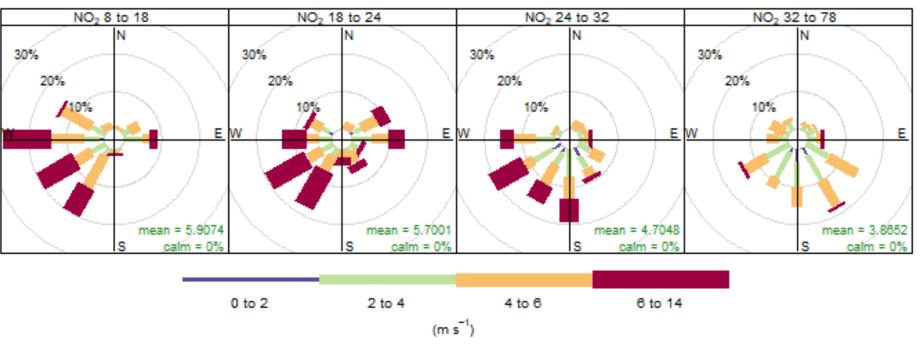
#Ozone

windRose(air\_manchester3, type = "ozone", layout = c(4,1))



Frequency of counts by wind direction (%)

#NO2 windRose(air\_manchester3, type = "no2", layout = c(4,1))

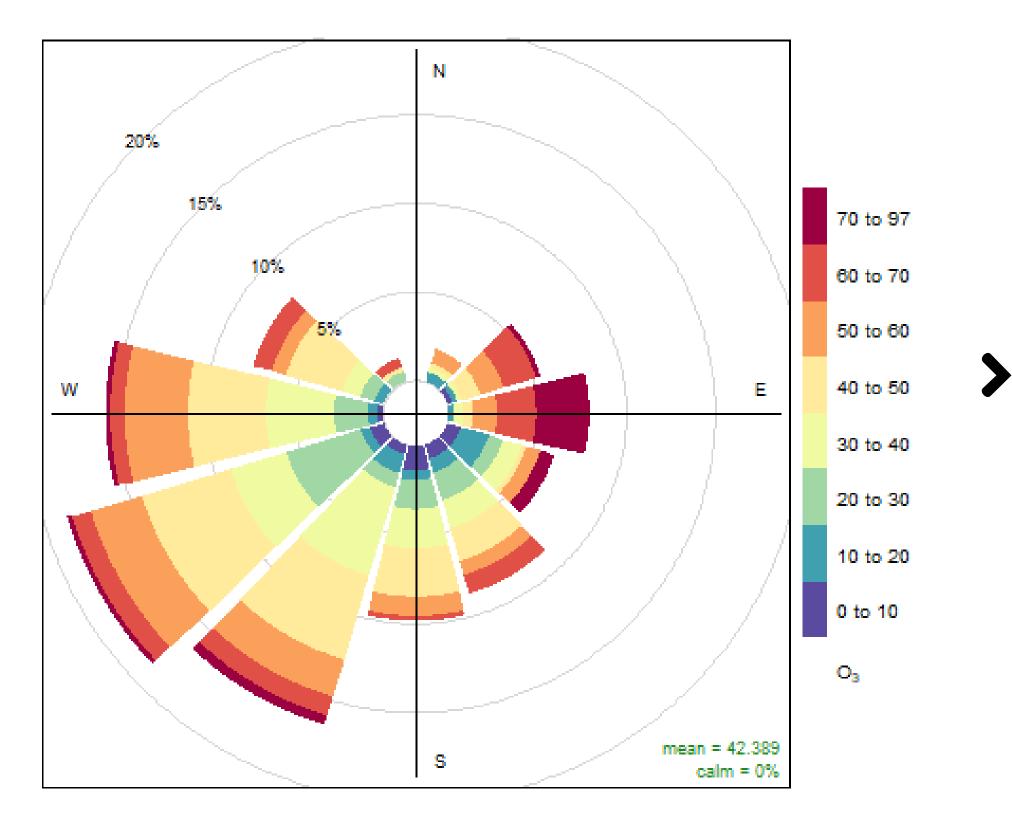


Frequency of counts by wind direction (%)



### #pollutant concentration influence by wind direction #Ozone

pollutionRose (air\_manchester3, pollutant = "ozone")

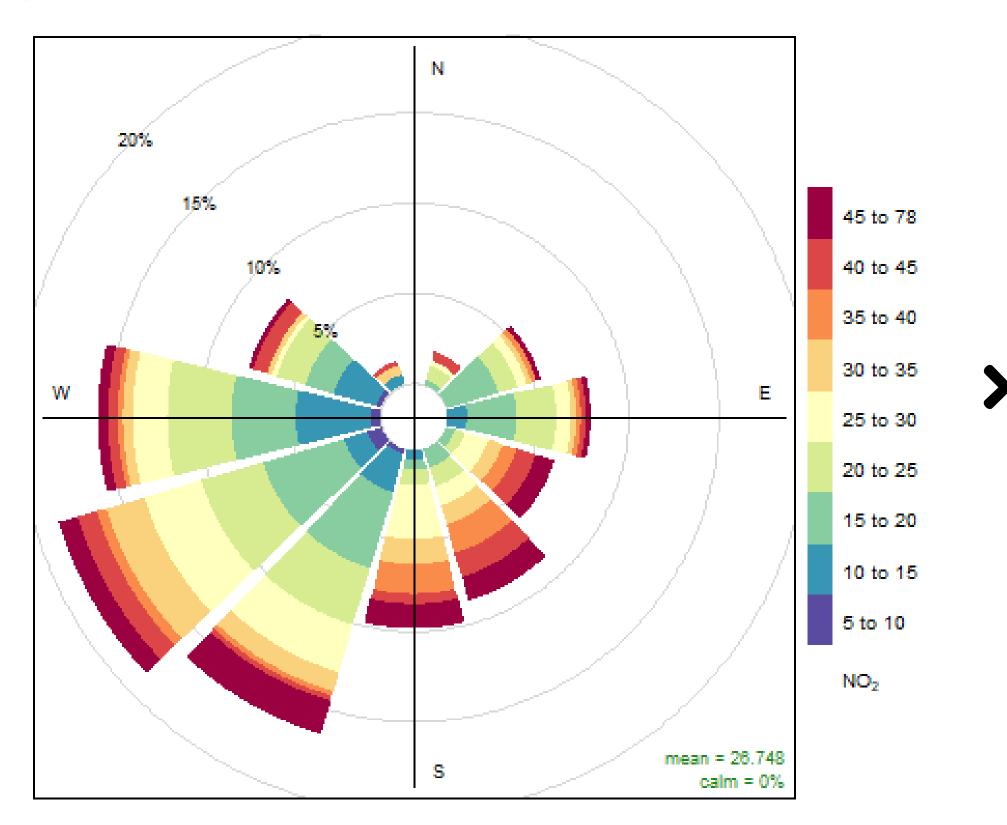


Frequency of counts by wind direction (%)



### #pollutant concentration influence by wind direction #NO2

pollutionRose (air\_manchester3, pollutant = "no2")

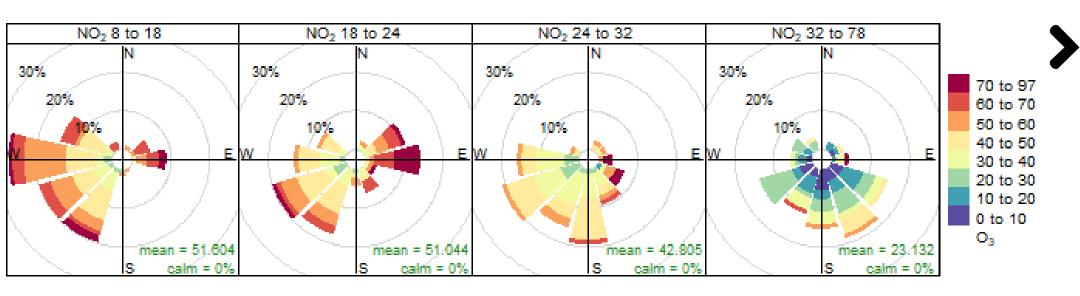


Frequency of counts by wind direction (%)



### #pollutant conditioned by another pollutant under wind direction #NO2vsOzone

pollutionRose (air\_manchester3, pollutant = "ozone", type = "no2", layout = c(4,1))

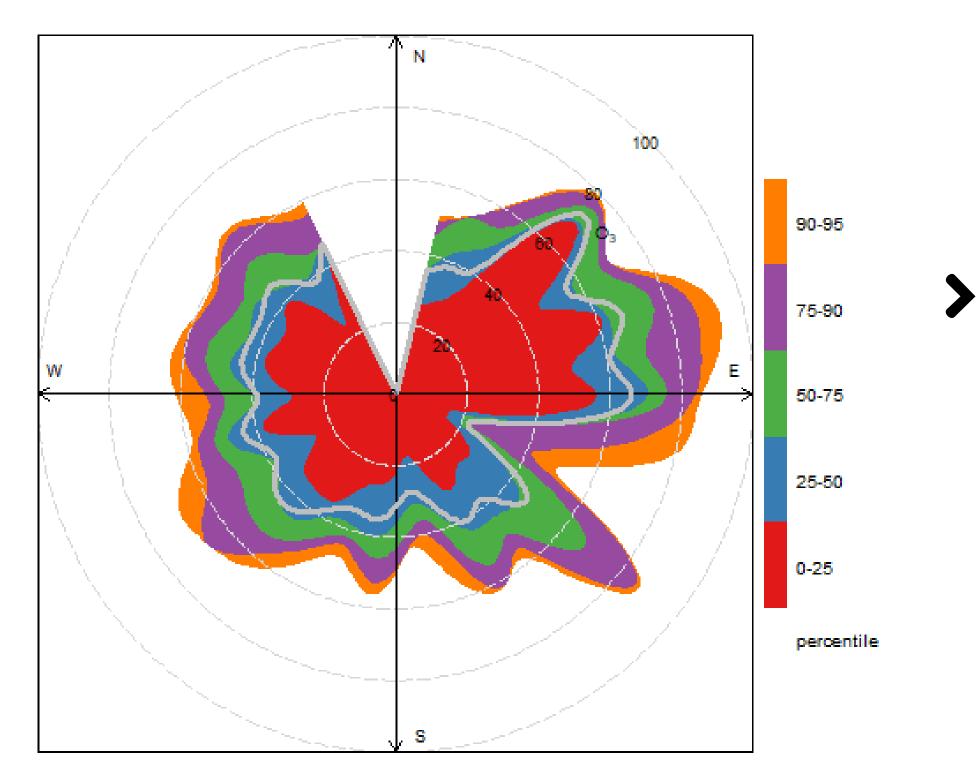


Frequency of counts by wind direction (%)



### #pollutant concentration influence by wind direction in percentile #Ozone

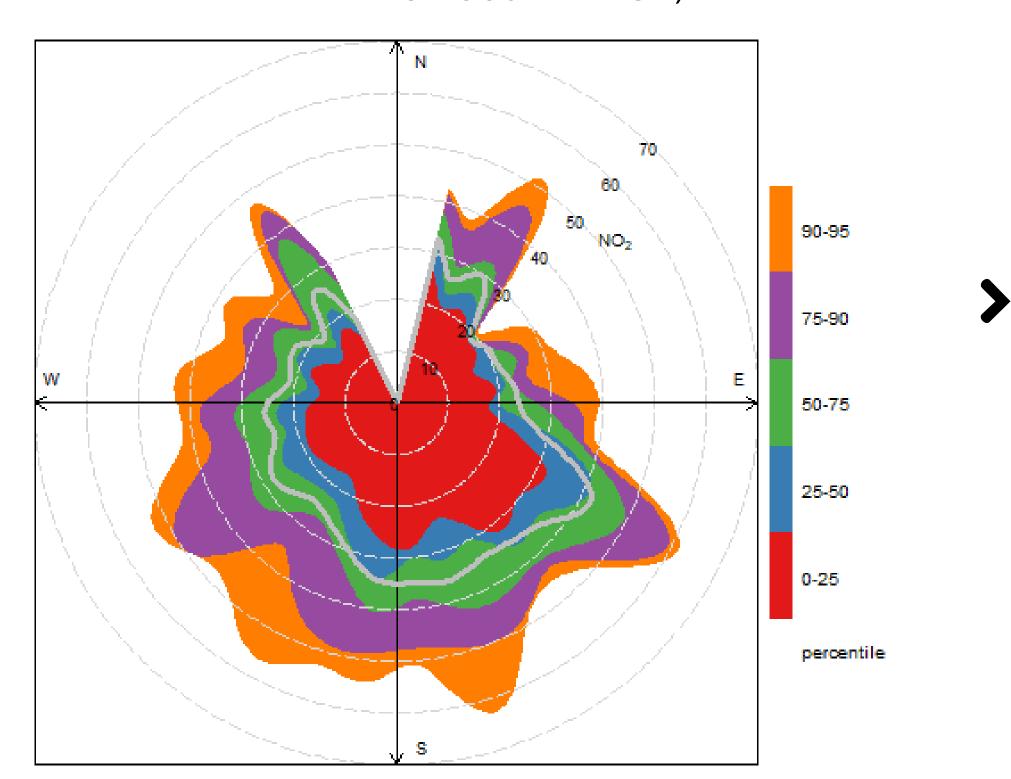
percentileRose (air\_manchester3, pollutant = "ozone", col = "brewer1", key.position = "right", smooth = TRUE)





### #pollutant concentration influence by wind direction in percentile #NO2

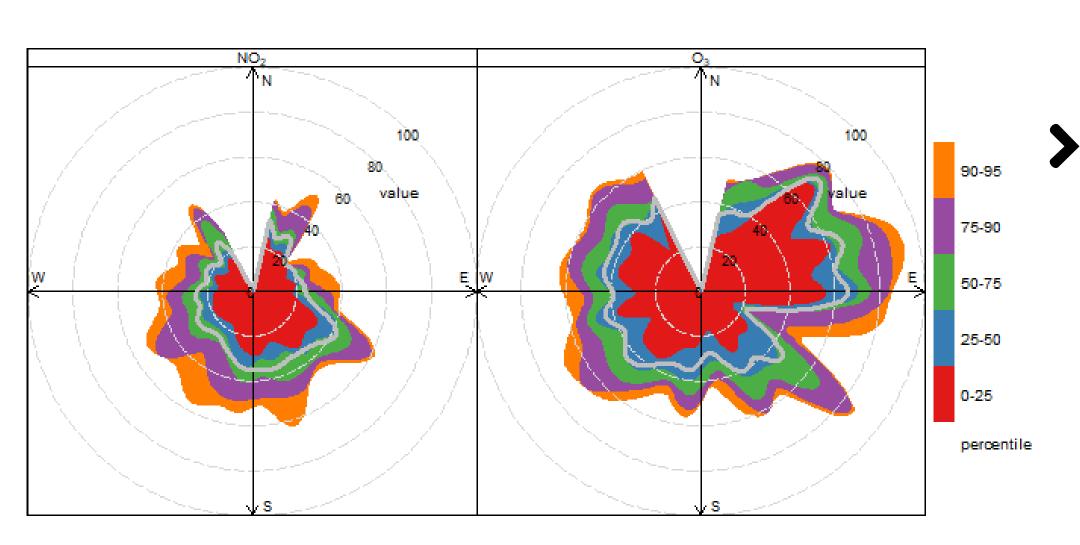
percentileRose (air\_manchester3, pollutant = "no2", col = "brewer1", key.position = "right", smooth = TRUE)





### #pollutant concentration influence by wind direction in percentile #Ozone & NO2 in one frame

percentileRose (air\_manchester3, poll = c("ozone", "no2"), col = "brewer1", key.position = "right", smooth = TRUE)





### #for daily concentration levels of pollutant #Ozone

calendarPlot(air\_manchester3, pollutant = "ozone")

	January-2023								Fe	bru	arv.	-202	23		March-2023								April-2023									
31	1	2	3	4	5	6		28	29	30	31	1	2	3	25	26	27	28	1	2	3		25	26	27	28	29	30	31		-00	
7	8	9	10	11	12	13		4	5	6	7	8	9	10	4	5	6	7	8	9	10		1	2	3	4	5	6	7		90	
14	15	16	17	18	19	20		11	12	13	14	15	16	17	11	12	13	14	15	16	17		8	9	10	11	12	13	14			
21	22	23	24	25	26	27		18	19	20	21	22	23	24	18	19	20	21	22	23	24		15	16	17	18	19	20	21		80	
28	29	30	31	1	2	3		25	26	27	28	1	2	3	25	26	27	28	29	30	31		22	23	24	25	26	27	28			
4	5	8	7	8	9	10		4	5	8	7	8	9	10	1	2	3	4	5	8	7		29	30	1	2	3	4	5		70	
S	s	М	Т	W	Т	F		s	S	М	Т	W	Т	F	s	s	М	Т	W	Т	F		s	s	М	Т	W	Т	F			
		May-2023 June-2023 July-2023													August-2023									00								
29	30	1	2	3	4	5		27	28	29	30	31	1	2	24	25	28	27	28	29	30		29	30	31	1	2	3	4		60	
6	7	8	9	10	11	12		3	4	5	6	7	8	9	1	2	3	4	5	6	7		5	6	7	8	9	10	11			
13	14	15	16	17	18	19		10	11	12	13	14	15	18	8	9	10	11	12	13	14		12	13	14	15	16	17	18		50	
20	21	22	23	24	25	26		17	18	19	20	21	22	23	15	16	17	18	19	20	21		19	20	21	22	23	24	25			
27	28	29	30	31	1	2		24	25	26	27	28	29	30	22	23	24	25	26	27	28		26	27	28	29	30	31	1		40	
3	4	5	6	7	8	9		1	2	3	4	5	6	7	29	30	31	1	2	3	4		2	3	4	5	6	7	8		- <del>-</del>	
S	S	M	Т	W	Т	F		s	S	М	Т	W	Т	F	S	S	М	Т	W	Т	F		S	S	М	Т	W	Т	F			
	Sep	pten	nbe	r-20	)23				0	ctob	er-	202	:3			No	/em	ber	-20	23				De	cem	ber	-20	23			30	
26	27	28	29	30	31	1		30	1	2	3	4	5	6	28	29	30	31	1	2	3		25	26	27	28	29	30	1			
2	3	4	5	6	7	8		7	8	9	10	11	12	13	4	5	6	7	8	9	10		2	3	4	5	6	7	8		20	
9	10	11	12	13	14	15		14	15	16	17	18	19	20	11	12	13	14	15	16	17		9	10	11	12	13	14	15			
16	17	18	19	20	21	22		21	22	23	24	25	26	27	18	19	20	21	22	23	24		16	17	18	19	20	21	22		10	
23	24	25	26	27	28	29		28	29	30	31	1	2	3	25	26	27	28	29	30	1		23	24	25	26	27	28	29		10	
30	1	2	3	4	5	6		4	5	6	7	8	9	10	2	3	4	5	6	7	8		30	31	1	2	3	4	5			
S	S	М	Т	W	Т	F		S	S	М	Т	W	Т	F	S	S	М	Т	W	Т	F		S	S	M	T	W	T	F			



### #for daily concentration levels of pollutant #NO2

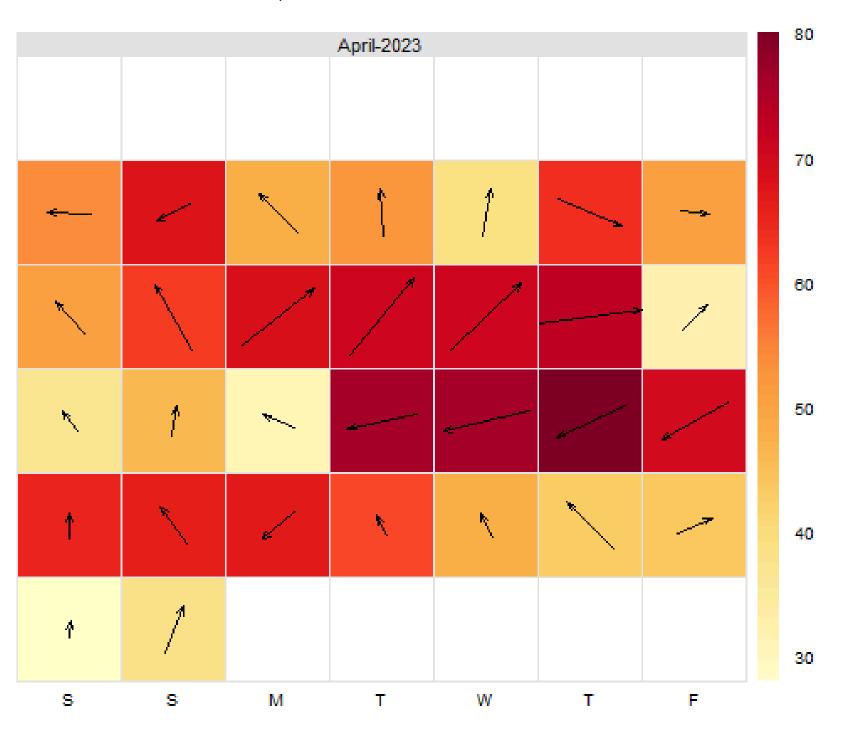
calendarPlot(air\_manchester3, pollutant = "no2")

	Ja	เทนส	irv-	202	3			Fe	brua	arv.	-202	23			March-2023																
31	1	2	3	4	5	6	28	29	30	31	1	2	3		25	26	27	28	1	2	3		25	26	27	28	023 29	30	31		
7	8	9	10	11	12	13	4	5	6	7	8	9	10		4	5	6	7	8	9	10		1	2	3	4	5	6	7		70
14	15	16	17	18	19	20	11	12	13	14	15	16	17		11	12	13	14	15	16	17		8	9	10	11	12	13	14		70
21	22	23	24	25	26	27	18	19	20	21	22	23	24		18	19	20	21	22	23	24		15	16	17	18	19	20	21		
28	29	30	31	1	2	3	25	26	27	28	1	2	3		25	26	27	28	29	30	31		22	23	24	25	26	27	28		
4	5	6	7	8	9	10	4	5	6	7	8	9	10		1	2	3	4	5	6	7		29	30	1	2	3	4	5		60
s	S	М	Т	W	Т	F	s	S	М	Т	w	Т	F		s	s	М	Т	w	Т	F		s	S	М	Т	w	Т	F		
		May	/-20	123			June-2023								July-2023								August-2023								
29	30	1	2	3	4	5	27	28	29	30	31	1	2		24	25	26	27	28	29	30		29	30	31	1	2	3	4		50
6	7	8	9	10	11	12	3	4	5	6	7	8	9		1	2	3	4	5	6	7		5	6	7	8	9	10	11		
13	14	15	16	17	18	19	10	11	12	13	14	15	16		8	9	10	11	12	13	14		12	13	14	15	16	17	18		
20	21	22	23	24	25	26	17	18	19	20	21	22	23		15	16	17	18	19	20	21		19	20	21	22	23	24	25		40
27	28	29	30	31	1	2	24	25	26	27	28	29	30		22	23	24	25	26	27	28		26	27	28	29	30	31	1		
3	4	5	6	7	8	9	1	2	3	4	5	6	7		29	30	31	1	2	3	4		2	3	4	5	6	7	8		
s	S	М	Т	W	T	F	s	S	М	Т	W	Т	F		s	S	М	Т	W	Т	F		s	S	M	Т	W	Т	F		30
	Sej	pten	nbe	r-20	23		October-2023								November-2023								December-2023								
26	27	28	29	30	31	1	30	1	2	3	4	5	6		28	29	30	31	1	2	3		25	26	27	28	29	30	1		
2	3	4	5	6	7	8	7	8	9	10	11	12	13		4	5	6	7	8	9	10		2	3	4	5	8	7	8		20
9	10	11	12	13	14	15	14	15	16	17	18	19	20		11	12	13	14	15	16	17		9	10	11	12	13	14	15		20
16	17	18	19	20	21	22	21	22	23	24	25	28	27		18	19	20	21	22	23	24		16	17	18	19	20	21	22		
23	24	25	26	27	28	29	28	29	30	31	1	2	3		25	28	27	28	29	30	1		23	24	25	26	27	28	29		
30	1	2	3	4	5	6	4	5	6	7	8	9	10		2	3	4	5	6	7	8		30	31	1	2	3	4	5		10
S	S	М	т	W	Т	F	S	S	М	Т	W	Т	F		S	S	M	т	W	т	F		S	S	М	Т	W	Т	F		



### #calendar plot wind direction/speed for ozone in the month of April ##longer arrow = higher wind speed

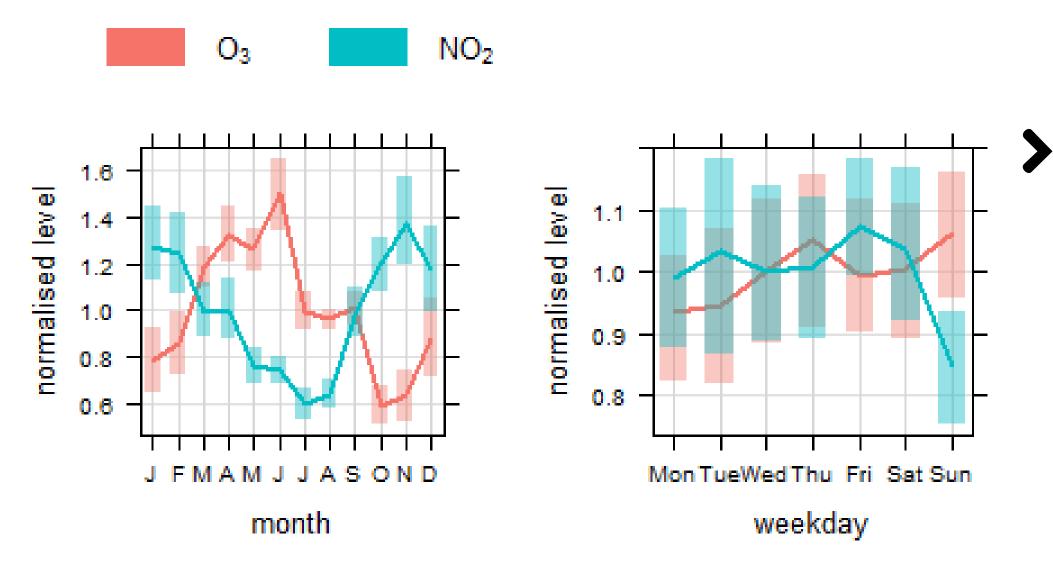
calendarPlot(air\_manchester3, pollutant = "ozone", month = 4, annotate = "ws")





#### #different time variations for pollutant(s)

timeVariation(air\_manchester3,pollutant = c("ozone", "no2"), normalise = TRUE)

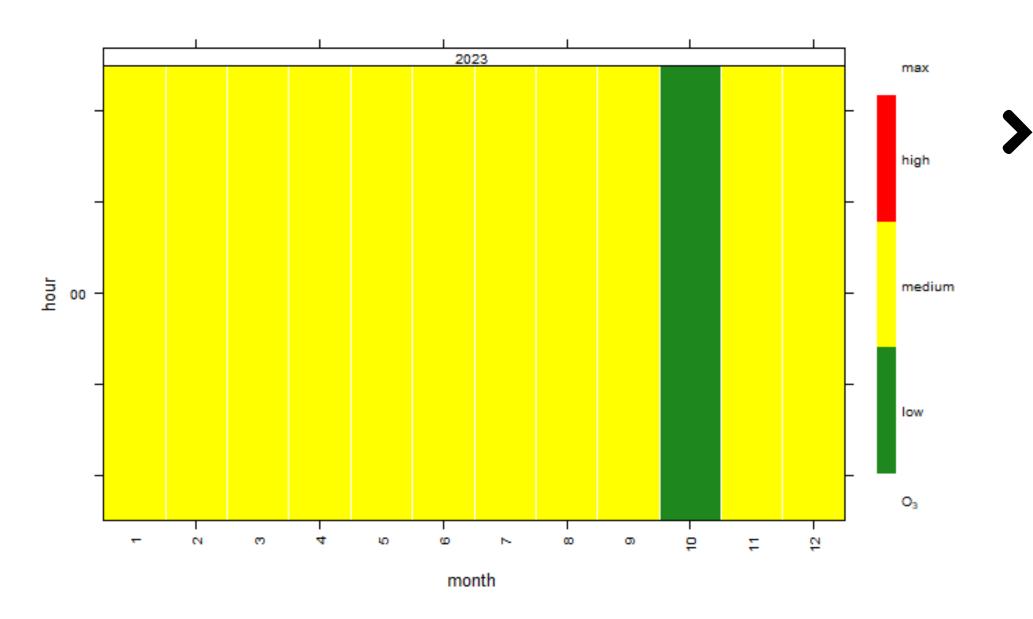


mean and 95% confidence interval in mean



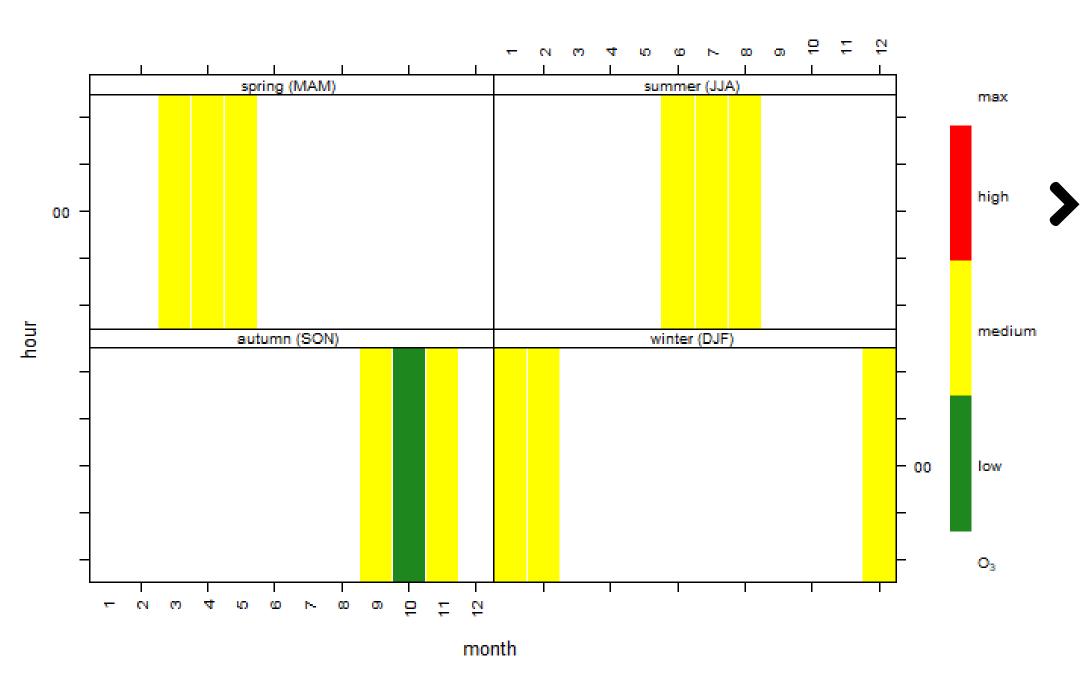
#### #trend levels of ozone conc across the months #Ozone

trendLevel(air\_manchester3, pollutant = "ozone", border = "white", statistic = "max", breaks = c(0, 50, 100, 500), labels = c("low", "medium", "high"), cols = c("forestgreen", "yellow", "red"))





### #trend levels of ozone conc by seasons #Ozone





#### References

Carslaw, D.C. and K. Ropkins, (2012). Openair — an R package for air quality data analysis. *Environmental Modelling & Software*. Volume27-28,pp.52-61.

Carslaw, D.C. (2019). The openair manual — open-source tools for analysing air pollution data. Manual for version 2.6-6, University of York.

#### **Datasets source**

https://power.larc.nasa.gov/data-access-viewer/

#### **Datasets link**

https://power.larc.nasa.gov/api/temporal/daily/point? parameters=T2M,RH2M,PRECTOTCORR,WS10M,WD10M&community=RE&longitude=-2.2379&latit ude=53.4815&start=20230101&end=20231231&format=CSV

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What Does 'Unhealthy Air Quality for Sensitive Groups' Mean? (treehugger.com)

### **Link to Complete Data Manipulation Codes**

https://github.com/Donaniche/Air\_Quality\_Analysis\_with\_Openair\_Package/edit/main/README.md

