

REGIONAL TRAINING COURSE ON METHODS AND TOOLS TO IDENTIFY SOURCES OF AIR POLLUTION

IAEA RER 1013: Supporting Air Quality Management

Application of openair tools for pollution data analysis

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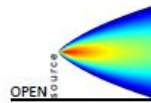
Instituto Superior Técnico
Campus Tecnológico e Nuclear
Sacavém, Portugal
02 –06 June, 2014

Manual

The **openair** manual

open-source tools for analysing air
pollution data

King's College London

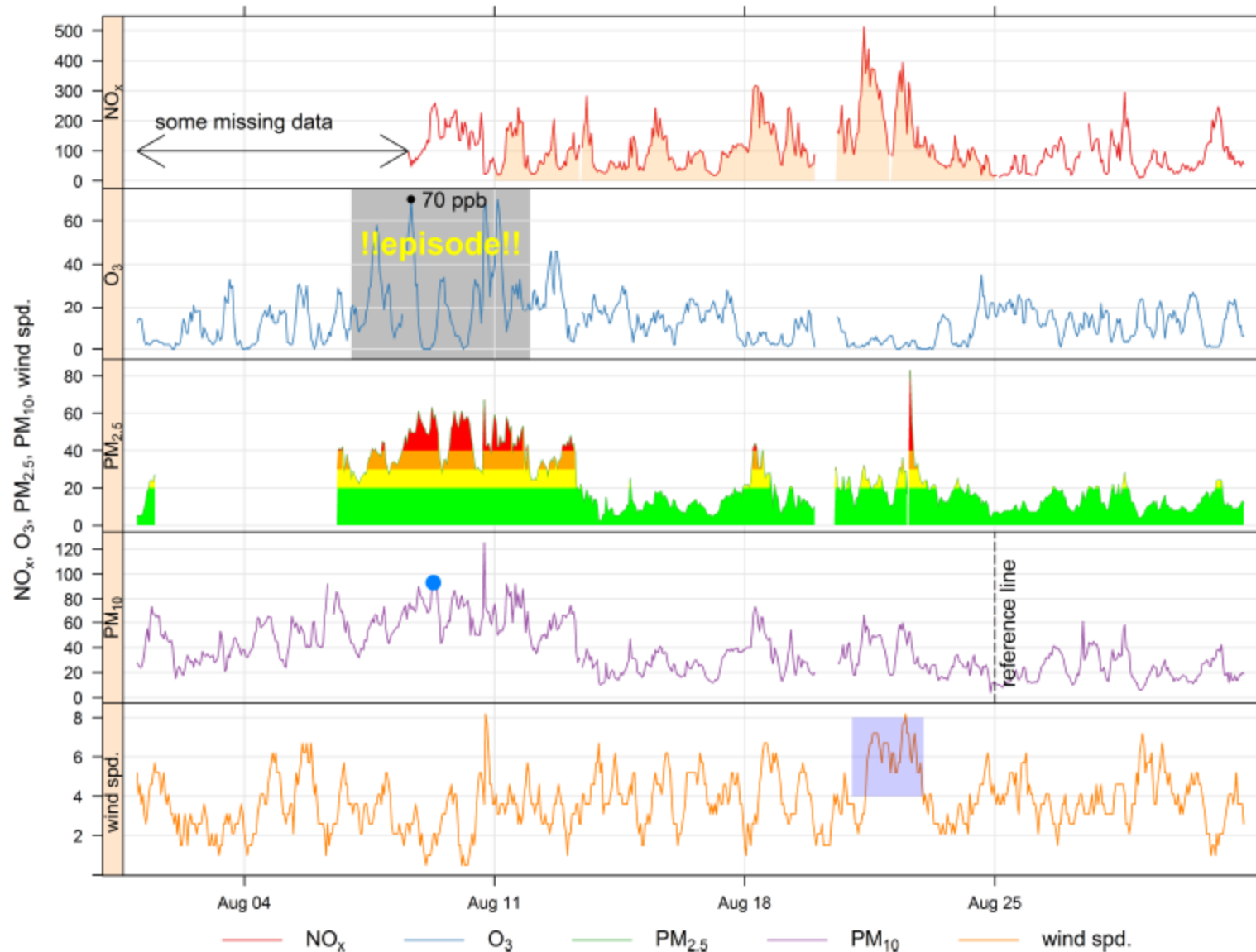


David Carslaw

version: 12th November 2013



Open Air Tools for Analysing Air Pollution Data



Open Air Tools for Analysing Air Pollution Data

```
windRose(mydata, type = "year", layout = c(4, 2))
```

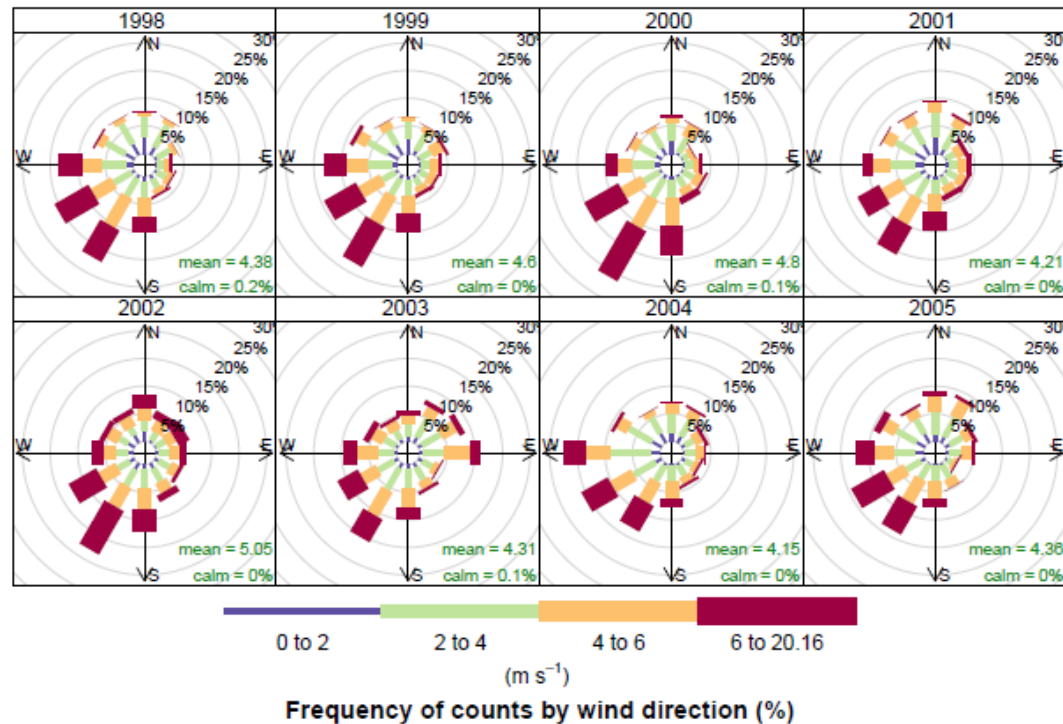


FIGURE 12.2 Use of `windRose` function to plot wind speed/direction frequencies by year. Wind speeds are split into the intervals shown by the scale in each panel. The grey circles show the 10 and 20 % frequencies.

Open Air Tools for Analysing Air Pollution Data

```
pollutionRose(mydata, pollutant = "nox")
```

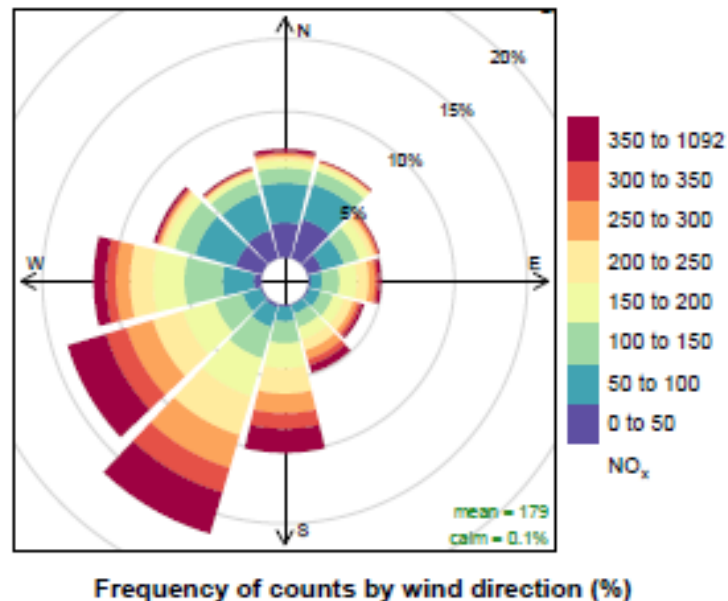


FIGURE 12.4 NO_x pollution rose produced using `pollutionRose` and default `pollutionRose` settings.

Open Air Tools for Analysing Air Pollution Data

```
polarPlot(mydata, pollutant = "so2")
```

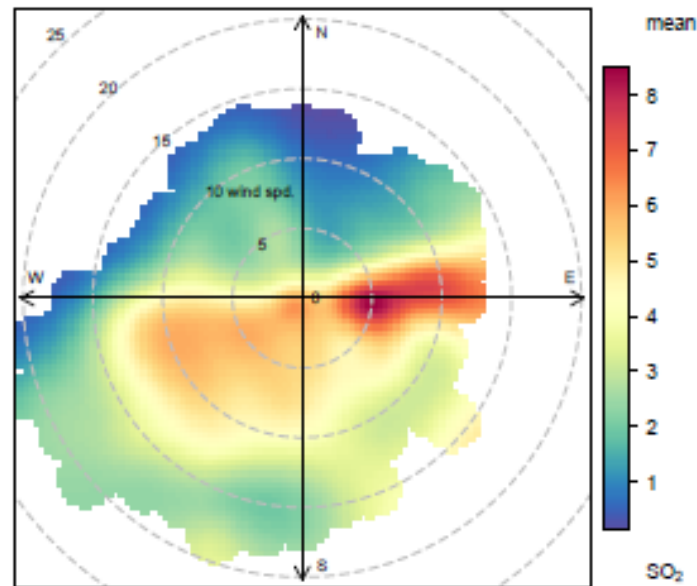


FIGURE 15.3 Example plots using the `polarPlot` function for the mean concentration of SO_2 .

Open Air Tools for Analysing Air Pollution Data

```
percentileRose(mydata, type = c("season", "daylight"), pollutant = "o3",  
               col = "Set1")
```

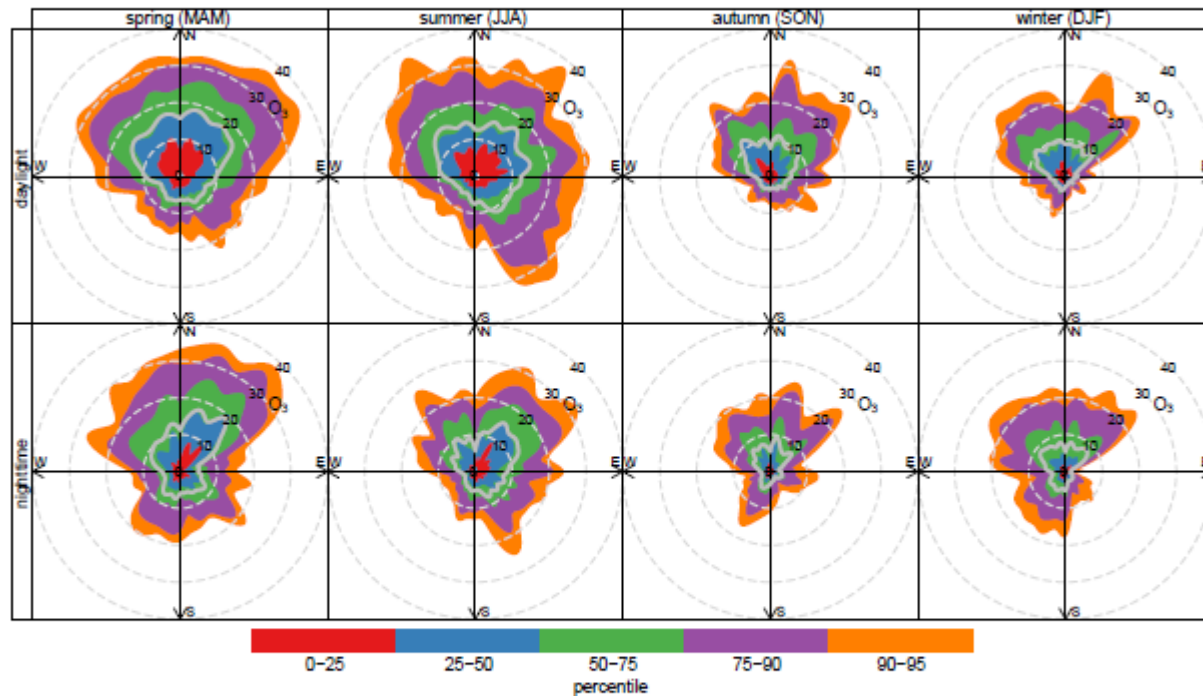


FIGURE 13.3 A `percentileRose` plot of O₃ concentrations at Marylebone Road. The percentile intervals are shaded and are shown by wind direction. The plot shows the variation by season and whether it is nighttime or daylight hours.

Open Air Tools for Analysing Air Pollution Data

```
timeProp(selectByDate(mydata, year = 2003), pollutant = "so2", avg.time = "3 day",
          proportion = "wd", date.breaks = 10, key.position = "top",
          key.columns = 8, ylab = "so2 (ug/m3)")
```

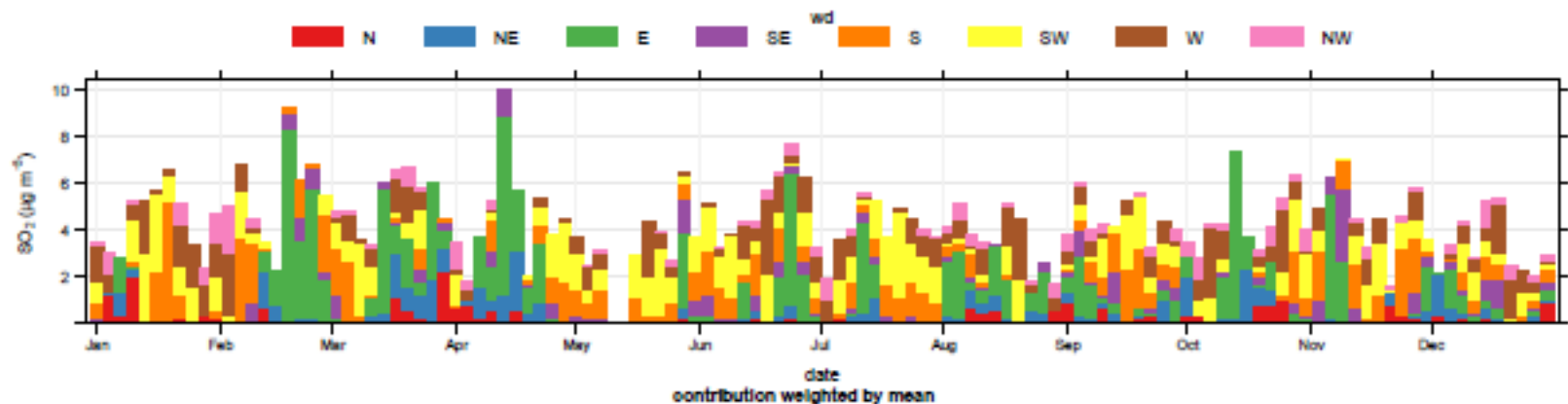


FIGURE 17.3 `timeProp` plot for SO₂ concentrations in 2003. The data are categorised into 8 wind sectors for 3-day averages.

Open Air Tools for Analysing Air Pollution Data

```
calendarPlot(mydata, pollutant = "o3", year = 2003)
```

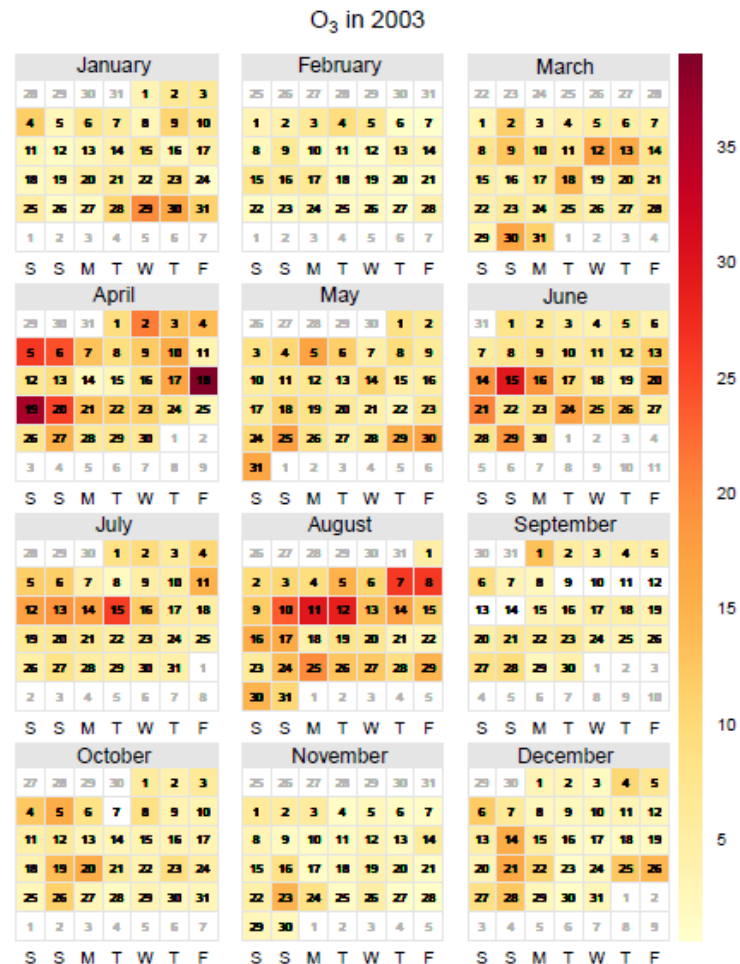


FIGURE 18.1 `calendarPlot` for O₃ concentrations in 2003.

Open Air Tools for Analysing Air Pollution Data

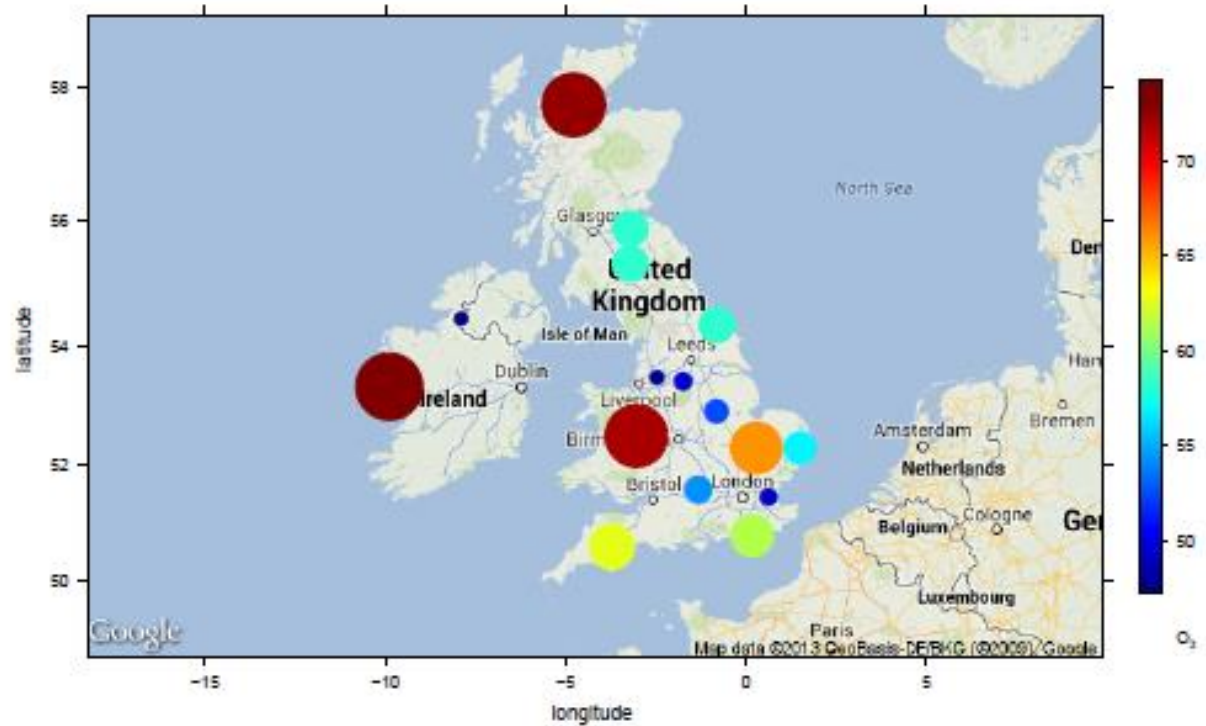


FIGURE 25.1 Mean concentrations of O₃ around the UK and Ireland (µg m⁻³).

Open Air Tools for Analysing Air Pollution Data

```
trajPlot(selectByDate(traj, start = "15/4/2010", end = "21/4/2010"),
         pollutant = "pm10", col = "jet", lwd = 2)
```

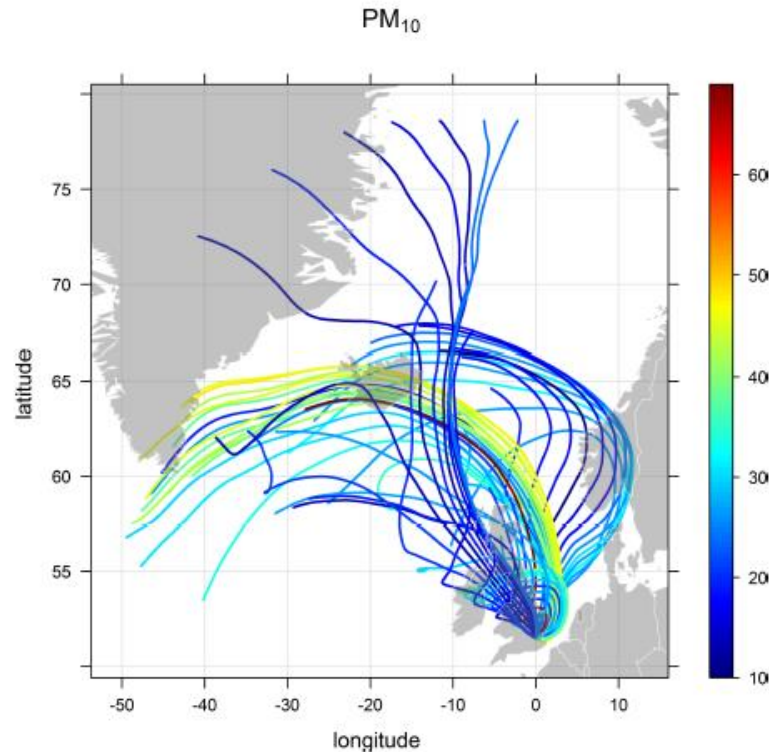


FIGURE 26.4 96-hour HYSPLIT back trajectories centred on London for 7 days in April 2010, coloured by the concentration of PM₁₀ ($\mu\text{g m}^{-3}$).

OpenAir Functions

TABLE 8.3 Summary of main **openair** analysis functions. Click on function name to be taken to the section on that function.

Function	Mandatory variables	Purpose	Multiple pollutants	type option
calcFno2	see §(30) for details	estimate primary NO ₂ emissions ratio from monitoring data	no	no
calendarPlot	date, one numeric field	Calendar-type view of mean values	no	no
conditionalEval	observed and modelled values and other variables(s)	extensions to conditionalQuantile	no	yes [1]
conditionalQuantile	observed and modelled values	quantile comparisons for model evaluation	no	yes [2]
GoogleMapsPlot	two numeric fields for latitude/longitude	annotate Google maps	no	Yes [2]
kernelExceed	date, ws, wd, one other numeric field	bivariate kernel density estimates for exceedance statistics	no	Yes [1]
linearRelation	date, two numeric fields	explore linear relationships between variables in time	no	limited
TheilSen	date, one numeric field	Calculate Theil-Sen slope estimates and uncertainties	no	Yes [2]
modStats	observed and modelled values	calculate a range of model evaluation statistics	no	yes ≥ 1
percentileRose	wd, one other numeric field	percentiles by wind direction	no	Yes [2]
polarAnnulus	date, ws, wd, one other numeric field	polar annulus plot for temporal variations by wind direction	yes	Yes [2]
polarCluster	ws, wd, one other numeric field	cluster analysis of bi-variate polar plots for feature extraction	No	No
polarFreq	ws, wd	alternative to wind rose/pollution rose	no	Yes [2]
polarPlot	ws, wd, one other numeric field	bi-variate polar plot	yes	Yes [2]
pollutionRose	ws, wd, one other numeric field	pollution rose	no	Yes [2]
scatterPlot	x and y values to plot	traditional scatter plots with enhanced options	no	Yes [2]
smoothTrend	date, one numeric field	smooth trend estimates	yes	Yes [2]
summaryPlot	date, one numeric field	summary view of a data frame	yes	no
TaylorDiagram	two numeric fields	model evaluation plot	no	Yes [2]
timePlot	date, one numeric field	Time-series plotting	yes	Yes [1]
timeProp	date, one numeric, one category field	Time-series plotting with categories as stacked bar chart	yes	Yes [1]
timeVariation	date, one numeric field	diurnal, day of week and monthly variations	yes	Yes [1]
trajCluster	data from importTraj	HYSPLIT back trajectory cluster analysis	no	Yes [2]
trajPlot	data from importTraj	HYSPLIT back trajectory plots — points of lines	no	Yes [2]
trajLevel	data from importTraj	HYSPLIT back trajectory plots — binned or smoothed	no	Yes [2]
trendLevel	date, one other numeric field	flexible level plots or 'heat maps'	no	Yes [2]
windRose	date, ws, wd	traditional wind rose	no	Yes [2]

How to install?

Download RGUI

- <http://www.r-project.org/>

Download Rstudio

- <http://www.openair-project.org/>

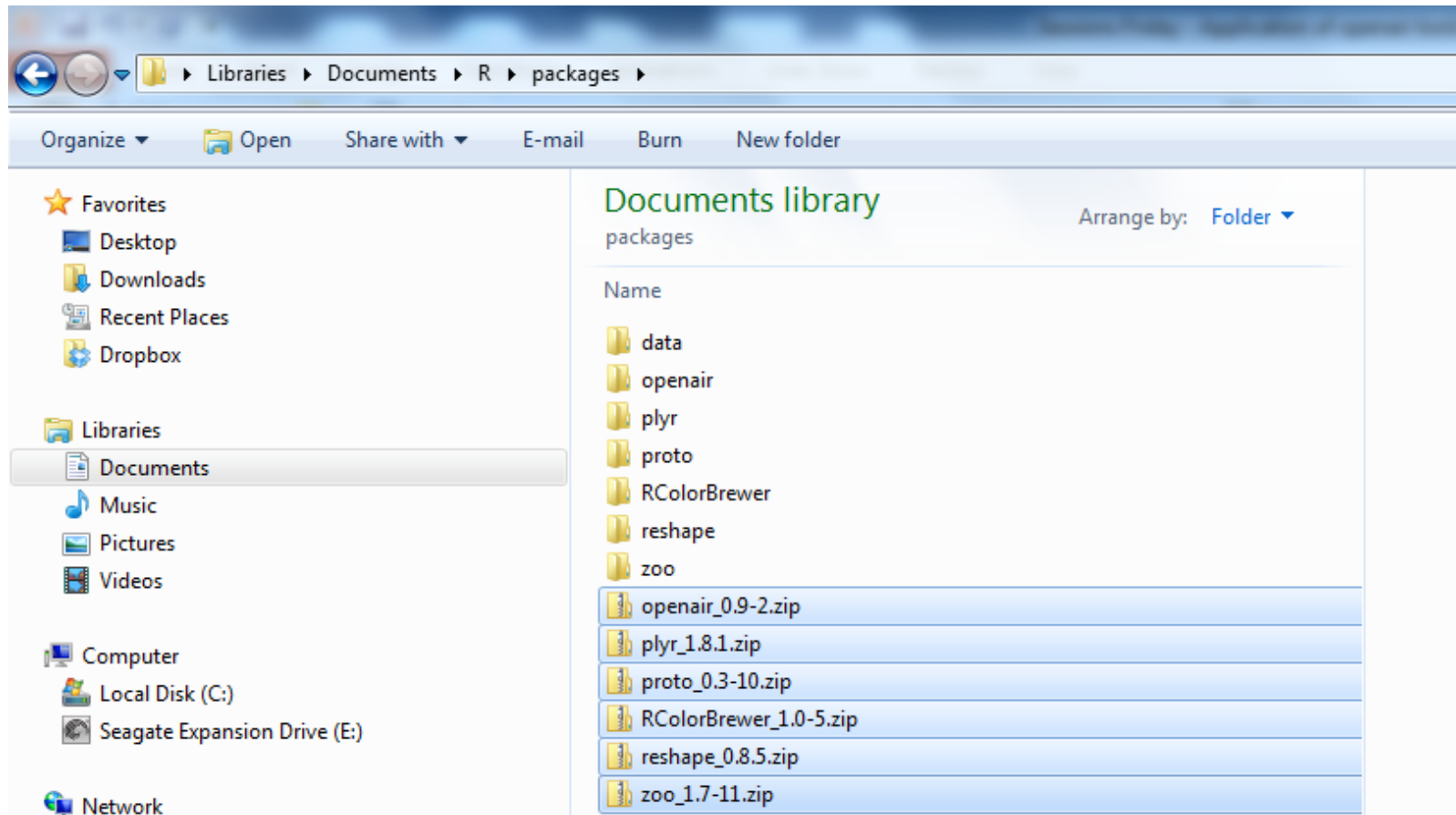
Install packages

- <http://cran.r-project.org/web/packages/openair/index.html>

Install packages in the programme

- In programme **RGui**: Menu “Packages -> Install package(s) from local zip files...”
- Rgui-> Packages -> Load Package

How to install?



Packages used

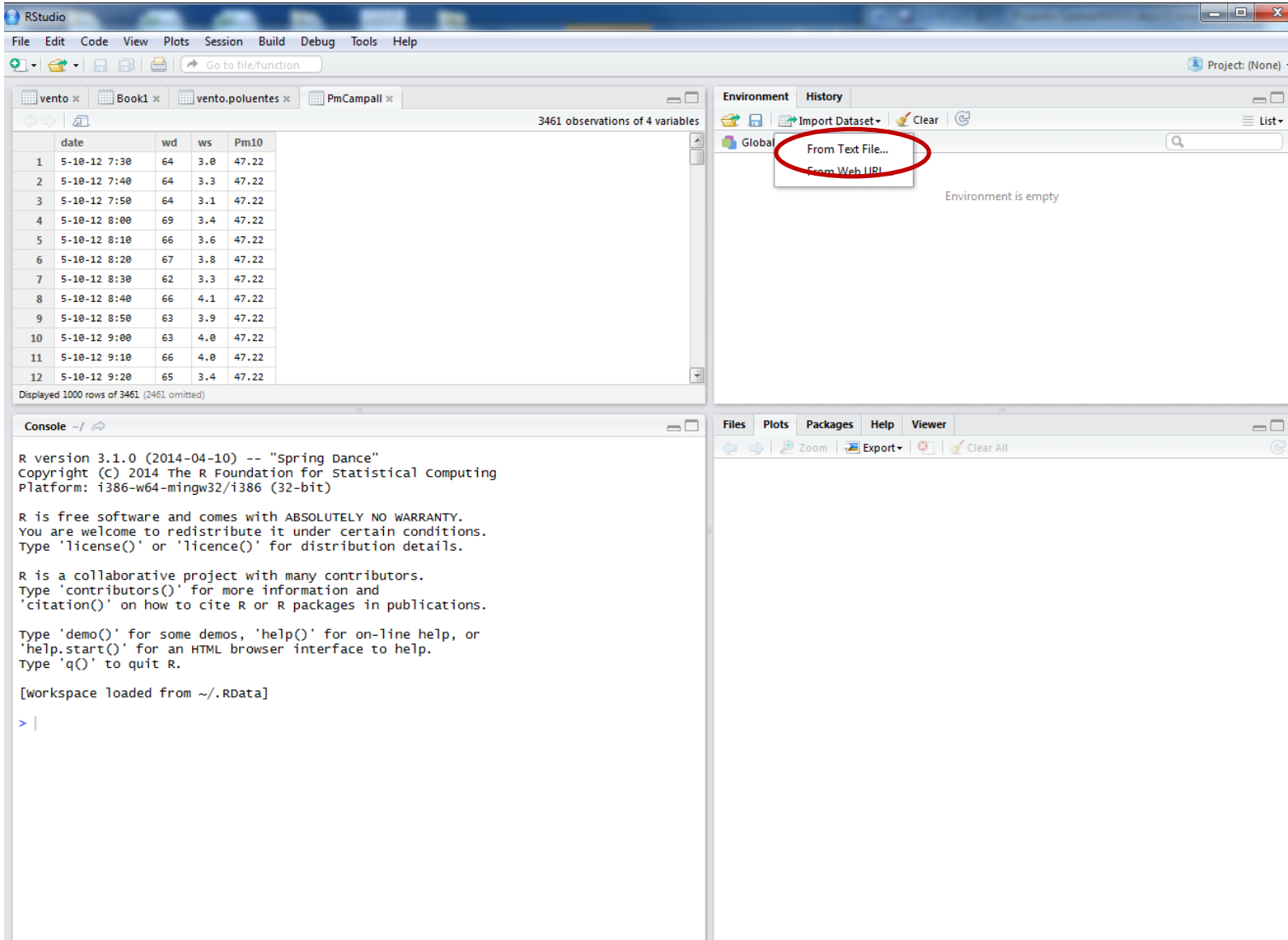
Create database

- Excel and saved as CSV;
- The column for wind speed and wind direction should be identified as WS and WD;
- The column with the pollutant should be identified with the name of the polutants.

	A	B	C	D
1	date	wd	ws	Pm10
2	5-10-12 7:30	64	3	47.22
3	5-10-12 7:40	64	3.3	47.22
4	5-10-12 7:50	64	3.1	47.22
5	5-10-12 20:10	157	1	36.49
6	5-10-12 20:20	195	2.1	36.49
7	5-10-12 20:30	215	2	36.49
8	5-10-12 20:40	227	3	36.49
9	5-10-12 20:50	219	3.1	36.49
10	5-10-12 21:00	223	2.2	36.49

PmCampall.csv

Import database



The screenshot shows the RStudio interface with the following components:

- Source Editor:** Displays a dataset with 3461 observations of 4 variables. The first 12 rows are shown in a table below.
- Environment Panel:** Shows the 'Global' environment. The 'Import Dataset' button is highlighted with a red circle, and its dropdown menu is open, showing 'From Text File...' and 'From Web URL...' options.
- Console:** Shows the R version (3.1.0), copyright information, and workspace status.
- Files Panel:** Shows the file explorer with options like 'Zoom', 'Export', and 'Clear All'.

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22
6	5-10-12 8:20	67	3.8	47.22
7	5-10-12 8:30	62	3.3	47.22
8	5-10-12 8:40	66	4.1	47.22
9	5-10-12 8:50	63	3.9	47.22
10	5-10-12 9:00	63	4.0	47.22
11	5-10-12 9:10	66	4.0	47.22
12	5-10-12 9:20	65	3.4	47.22

```
R version 3.1.0 (2014-04-10) -- "Spring Dance"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: i386-w64-mingw32/i386 (32-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

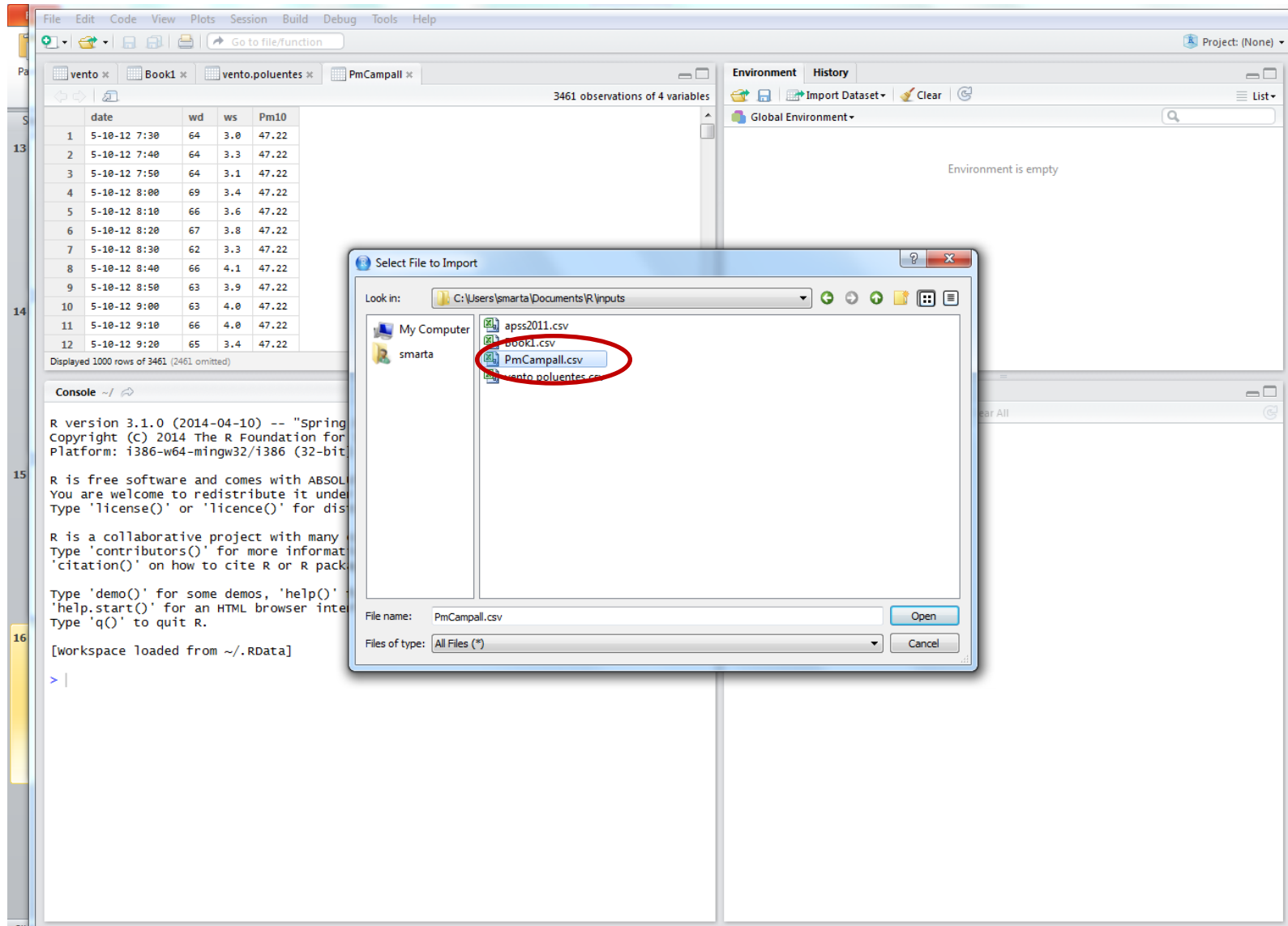
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

> |
```


Import database



The screenshot shows the RStudio interface with a data table and a file selection dialog.

Data Table:

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22
6	5-10-12 8:20	67	3.8	47.22
7	5-10-12 8:30	62	3.3	47.22
8	5-10-12 8:40	66	4.1	47.22
9	5-10-12 8:50	63	3.9	47.22
10	5-10-12 9:00	63	4.0	47.22
11	5-10-12 9:10	66	4.0	47.22
12	5-10-12 9:20	65	3.4	47.22

File Selection Dialog:

The dialog is titled "Select File to Import". The "Look in:" field shows "C:\Users\smarta\Documents\R\inputs". The file list contains:

- apss2011.csv
- book1.csv
- PmCampall.csv** (highlighted with a red circle)
- vento.poluentes.csv

The "File name:" field is empty, and the "Files of type:" dropdown is set to "All Files (*.*)". The "Open" button is visible.

Console:

```
R version 3.1.0 (2014-04-10) -- "Spring
Copyright (c) 2014 The R Foundation for
Platform: i386-w64-mingw32/i386 (32-bit)

R is free software and comes with ABSOL
You are welcome to redistribute it unde
Type 'license()' or 'licence()' for dis

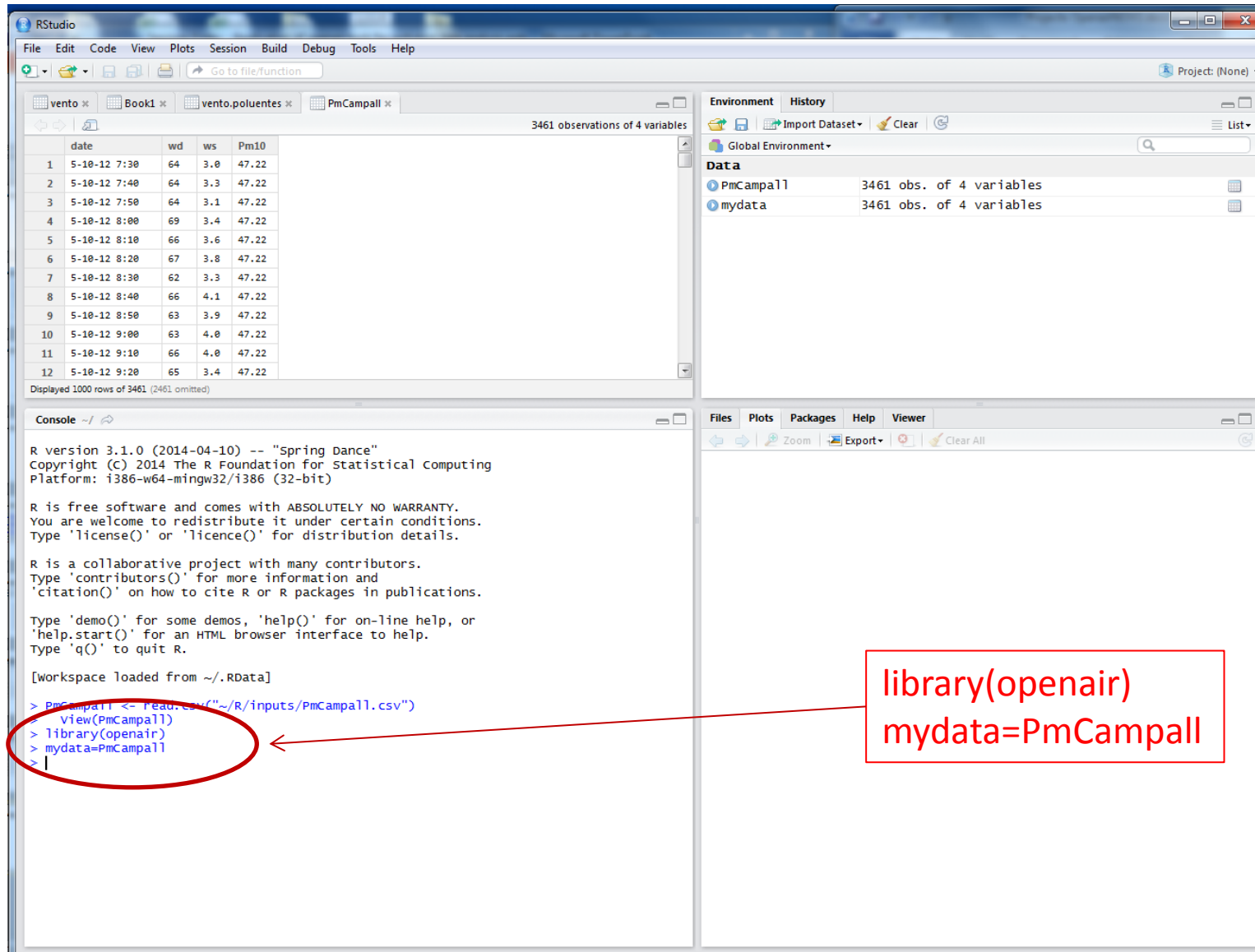
R is a collaborative project with many
Type 'contributors()' for more informat
'citation()' on how to cite R or R pack

Type 'demo()' for some demos, 'help()'
'help.start()' for an HTML browser inte
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

> |
```

Run RStudio



The screenshot shows the RStudio interface with the following components:

- Environment Pane:** Shows two data objects: `PmCampall` and `mydata`, both with 3461 observations and 4 variables.
- Console:** Contains the R startup message and the following code:


```

R version 3.1.0 (2014-04-10) -- "Spring Dance"
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Platform: i386-w64-mingw32/i386 (32-bit)

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'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

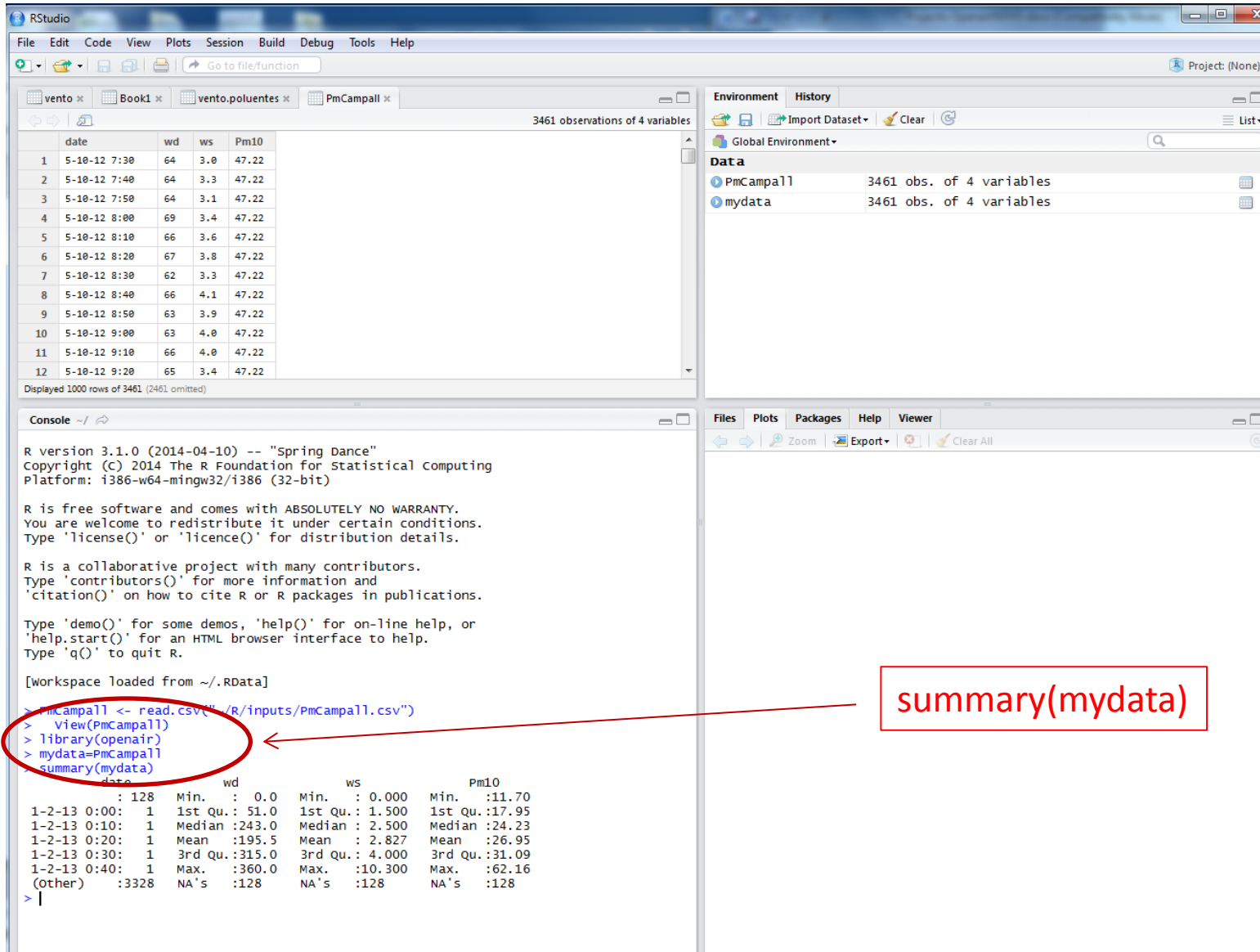
[Workspace loaded from ~/.RData]

> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> View(PmCampall)
> library(openair)
> mydata=PmCampall
>
      
```
- Data Table:** A table with 12 rows and 4 columns: `date`, `wd`, `ws`, and `Pm10`. The first row is:

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22
6	5-10-12 8:20	67	3.8	47.22
7	5-10-12 8:30	62	3.3	47.22
8	5-10-12 8:40	66	4.1	47.22
9	5-10-12 8:50	63	3.9	47.22
10	5-10-12 9:00	63	4.0	47.22
11	5-10-12 9:10	66	4.0	47.22
12	5-10-12 9:20	65	3.4	47.22

library(openair)
mydata=PmCampall

Run RStudio



The screenshot shows the RStudio interface with the following components:

- Source Editor:** Displays a CSV file with 3461 observations of 4 variables (date, wd, ws, Pm10). The first 12 rows are visible.
- Environment:** Shows the Global Environment with two objects: `PmCampall` and `mydata`, both containing 3461 observations of 4 variables.
- Console:** Shows the R version (3.1.0) and the execution of the following code:


```

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type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> view(PmCampall)
> library(openair)
> mydata=PmCampall
> summary(mydata)
      date          wd          ws          Pm10
1-2-13 0:00: 1   Min.   : 0.0   Min.   : 0.000   Min.   :11.70
1-2-13 0:10: 1   1st Qu.: 51.0   1st Qu.: 1.500   1st Qu.:17.95
1-2-13 0:20: 1   Median :243.0   Median : 2.500   Median :24.23
1-2-13 0:30: 1   Mean    :195.5   Mean    : 2.827   Mean    :26.95
1-2-13 0:40: 1   3rd Qu.:315.0   3rd Qu.: 4.000   3rd Qu.:31.09
1-2-13 0:40: 1   Max.    :360.0   Max.    :10.300   Max.    :62.16
(other) :3328   NA's    :128    NA's    :128    NA's    :128
      
```

A red circle highlights the code `summary(mydata)` in the console, and a red arrow points from a box containing the text `summary(mydata)` to this circle.

Wind Rose

RStudio interface showing the R console and Environment pane.

Environment pane: Data table with 3461 observations of 4 variables.

Variable	Observations
PmCampall	3461 obs. of 4 variables
mydata	3461 obs. of 4 variables

Console:

```
R version 3.1.0 (2014-04-10) -- "Spring Dance"
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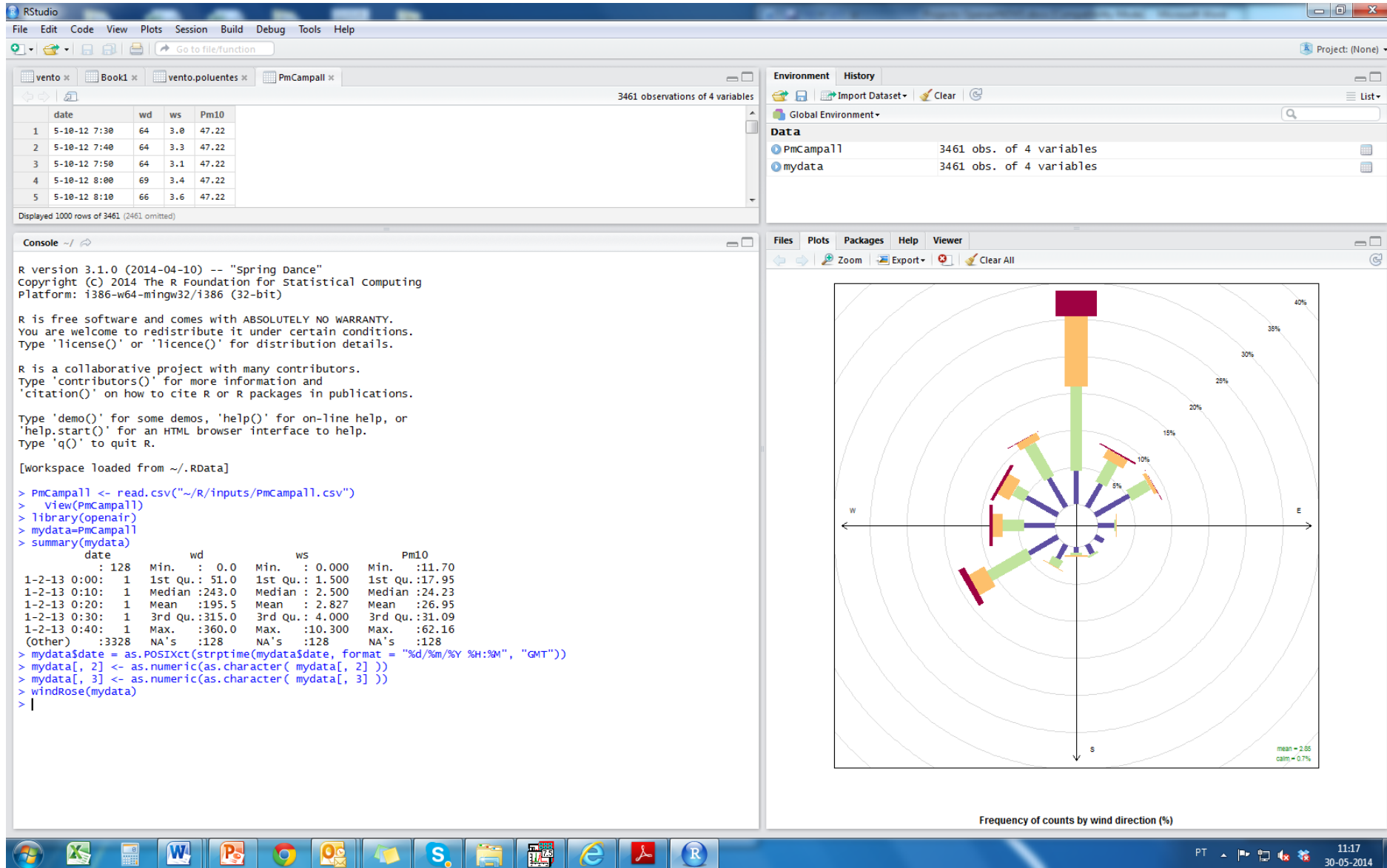
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> view(PmCampall)
> library(openair)
> mydata=PmCampall
> summary(mydata)
      date      wd      ws      Pm10
1-2-13 0:00: 1 1st Qu.: 51.0 1st Qu.: 1.500 1st Qu.:17.95
1-2-13 0:10: 1 Median :243.0 Median : 2.500 Median :24.23
1-2-13 0:20: 1 Mean   :195.5 Mean   : 2.827 Mean   :26.95
1-2-13 0:30: 1 3rd Qu.:315.0 3rd Qu.: 4.000 3rd Qu.:31.09
1-2-13 0:40: 1 Max.   :360.0 Max.   :10.300 Max.   :62.16
(Other) :3328 NA's :128 NA's :128 NA's :128
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> windRose(mydata)
> |
```

Wind Rose Plot: A plot showing the frequency of counts by wind direction (%). The plot displays a circular rose with a central point and radial lines extending outwards, representing wind direction and frequency. The plot is titled "Frequency of counts by wind direction (%)" and includes a legend indicating "mean = 2.85" and "calm = 0.7%".

Wind Rose



Wind Rose

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

vento * Book1 * vento.poluentes * PmCampall *

3461 observations of 4 variables

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22

Displayed 1000 rows of 3461 (2461 omitted)

Environment History

Global Environment

Data

PmCampall 3461 obs. of 4 variables

mydata 3461 obs. of 4 variables

Files Plots Packages Help Viewer

Zoom Export Clear All

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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.Rdata]

```
> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> view(PmCampall)
> library(openair)
> mydata=PmCampall
> summary(mydata)
      date      wd      ws      Pm10
1-2-13 0:00: 1   Min.   : 0.0   Min.   : 0.000   Min.   :
1-2-13 0:10: 1   Median :243.0   Median : 2.500   Median :
1-2-13 0:20: 1   Mean    :195.5   Mean    : 2.827   Mean    :
1-2-13 0:30: 1   3rd Qu.:315.0   3rd Qu.: 4.000   3rd Qu.:
1-2-13 0:40: 1   Max.    :360.0   Max.    :10.300   Max.    :
(other) :3328   NA's    :128   NA's    :128   NA's    :
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d-%m-%Y %H:%M"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> windRose(mydata)
> windRose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "default", bias.corr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks = 4, offset = 10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bottom", key = TRUE, dig.lab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)
```

windRose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "default", bias.corr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks = 4, offset = 10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bottom", key = TRUE, dig.lab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)

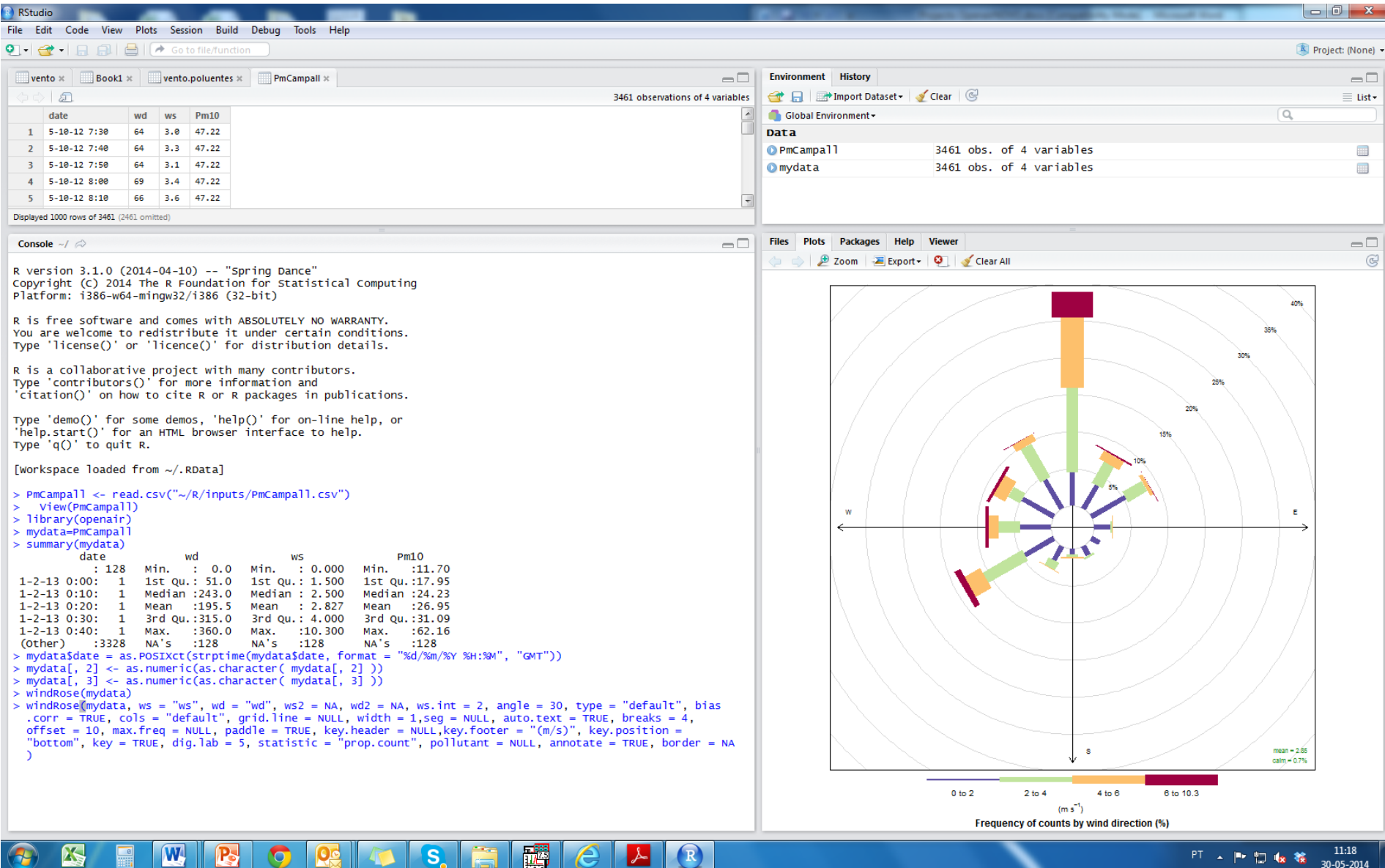
Frequency of counts by wind direction (%)

mean = 2.05
sd = 0.71

0 to 2 2 to 4 4 to 6 6 to 10.3
(m s⁻¹)

PT 11:18 30-05-2014

Wind Rose



Pollution Rose

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Environment History

3461 observations of 4 variables

Import Dataset Clear

Global Environment

Data

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22

Displayed 1000 rows of 3461 (2461 omitted)

Console

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'citation()' on how to cite R or R packages in publications.

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'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

```
> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> view(PmCampall)
> library(openair)
> mydata=PmCampall
> summary(mydata)
      date      wd      ws      Pm10
1-2-13 0:00: 1 1st Qu.: 51.0 1st Qu.: 1.500 1st Qu.:17.95
1-2-13 0:10: 1 Median :243.0 Median : 2.500 Median :24.23
1-2-13 0:20: 1 Mean :195.5 Mean : 2.827 Mean :26.95
1-2-13 0:30: 1 3rd Qu.:315.0 3rd Qu.: 4.000 3rd Qu.:31.09
1-2-13 0:40: 1 Max. :360.0 Max. :10.300 Max. :62.16
(other) :3328 NA's :128 NA's :128 NA's :128
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> windRose(mydata)
> windRose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "def
orr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks =
10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bott
ue, dig.lab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)
> pollutionRose(mydata)
Error in [.data.frame(mydata, , pollutant)] : undefined columns selected
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> mydata[, 4] <- as.numeric(as.character( mydata[, 4] ))
>
> pollutionRose(mydata,pollutant="Pm10",key.header="PM10(µg/m3)",key.footer="",grid.line=5,breaks=c(10,25,40,
55),main="Eldery Care Center")
> |
```

mydata\$date =
as.POSIXct(strptime(mydata\$date, format =
"%d/%m/%Y %H:%M", "GMT"))
mydata[, 2] <- as.numeric(as.character(
mydata[, 2]))
mydata[, 3] <- as.numeric(as.character(
mydata[, 3]))
mydata[, 4] <- as.numeric(as.character(
mydata[, 4]))

pollutionRose(mydata,pollutant="Pm10",key.h
eader="PM10(µg/m3)",key.footer="",grid.line=
5,breaks=c(10,25,40,55),main="Eldery Care
Center")

Frequency of counts by wind direction (%)

mean = 26.9
sd = 0.7%

11-21
30-05-2014

Pollution Rose

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Project: (None)

Environment History

Global Environment

Data

- PmCampall 3461 obs. of 4 variables
- mydata 3461 obs. of 4 variables

3461 observations of 4 variables

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22

Displayed 1000 rows of 3461 (2461 omitted)

Console

```
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1-2-13 0:00:    1 1st Qu.: 51.0 1st Qu.: 1.500 1st Qu.:17.95
1-2-13 0:10:    1  Median :243.0 Median : 2.500 Median :24.23
1-2-13 0:20:    1   Mean :195.5   Mean : 2.827   Mean :26.95
1-2-13 0:30:    1 3rd Qu.:315.0 3rd Qu.: 4.000 3rd Qu.:31.09
1-2-13 0:40:    1   Max. :360.0   Max. :10.300   Max. :62.16
(other)      :3328   NA's :128   NA's :128   NA's :128
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> windrose(mydata)
> windrose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "default", bias.c
orr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks = 4, offset =
10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bottom", key = TR
UE, dig.lab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)
> pollutionRose(mydata)
Error in [.data.frame'(mydata, , pollutant) : undefined columns selected
> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> mydata[, 4] <- as.numeric(as.character( mydata[, 4] ))
>
> pollutionRose(mydata, pollutant="Pm10", key.header="PM10(µg/m3)", key.footer="", grid.line=5, breaks=c(10,25,40,
55), main="Eldery Care Center")
> |
```

Files Plots Packages Help Viewer

Zoom Export Clear All

Eldery Care Center

Frequency of counts by wind direction (%)

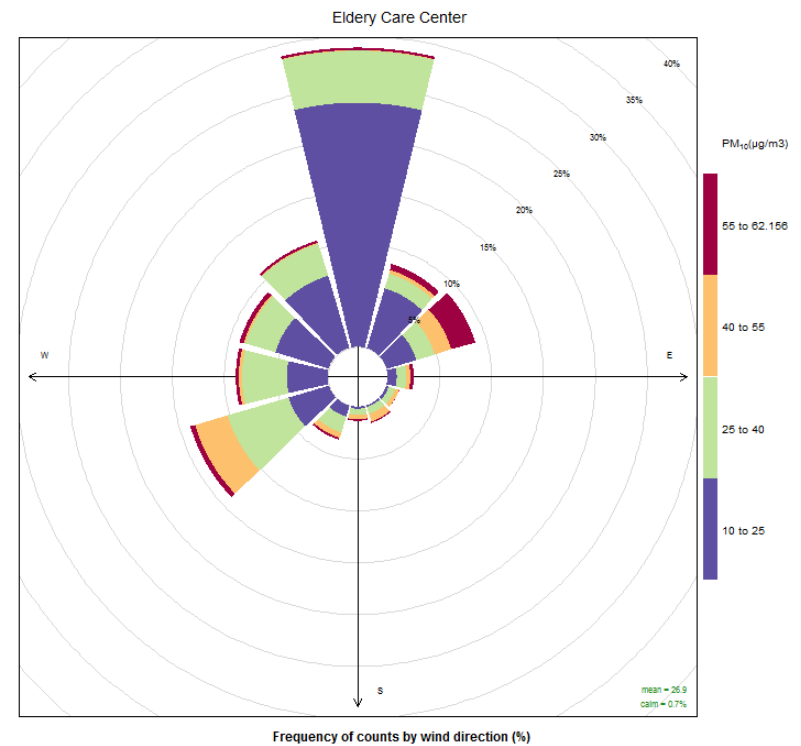
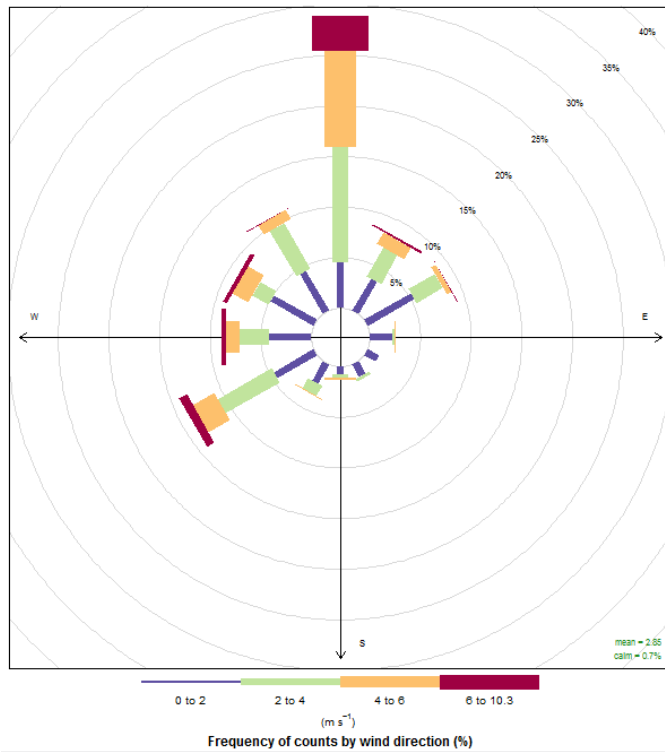
mean = 26.9
corr = 0.7%

PM10(µg/m3)

55 to 62.156
40 to 55
25 to 40
10 to 25

11:21
30-05-2014

Wind Rose Vs Pollution Rose



PolarPlot

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Project: (None)

Environment History

Global Environment

Data

PmCampall 3461 obs. of 4 variables

mydata 3461 obs. of 4 variables

Files Plots Packages Help Viewer

Zoom Export Clear All

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PolarPlot

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Environment History

Global Environment

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PmCampall 3461 obs. of 4 variables

mydata 3461 obs. of 4 variables

Files Plots Packages Help Viewer

Zoom Export Clear All

3461 observations of 4 variables

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5	5-10-12 8:10	66	3.6	47.22

Displayed 1000 rows of 3461 (2461 omitted)

Console

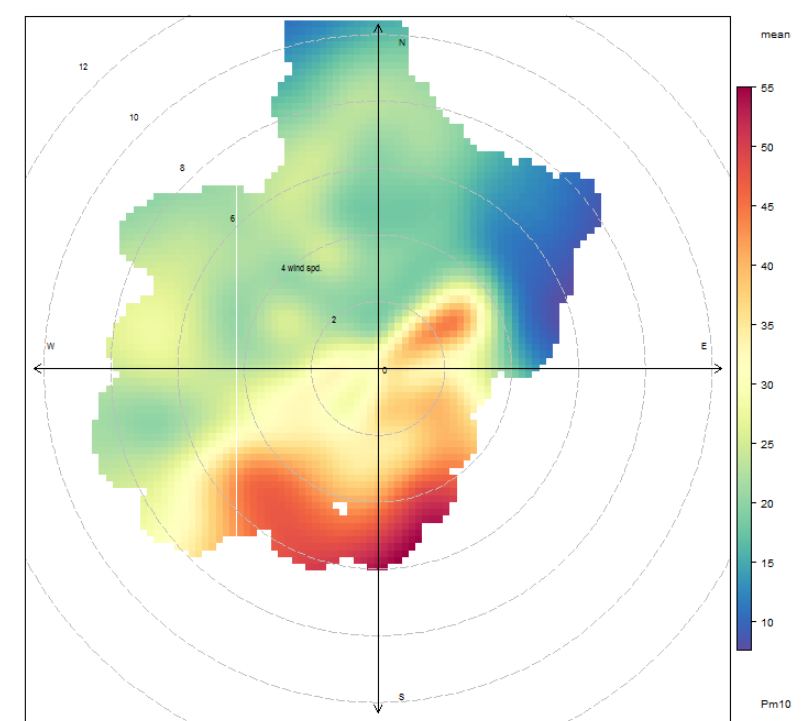
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[workspace loaded from ~/.RData]

```
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(other) :3328 NA's :128 NA's :128 NA's :128
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> mydata[, 3] <- as.numeric(as.character( mydata[, 3] ))
> windrose(mydata)
> windrose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "default", bias.c
orr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks = 4, offset =
10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bottom", key = TR
UE, dig.tab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)
> pollutionRose(mydata)
Error in `[.data.frame'](mydata, , pollutant) : undefined columns selected
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> mydata[, 2] <- as.numeric(as.character( mydata[, 2] ))
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>
> pollutionRose(mydata, pollutant="Pm10", key.header="Pm10(µg/m3)",key.footer="",grid.line=5,breaks=c(10,25,40,
55),main="Elderly Care Center")
> polarPlot(mydata, pollutant = "Pm10")
```



mean

55

50

45

40

35

30

25

20

15

10

Pm10

12

10

8

6

4 wind spd.

2

N

E

S

W

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Pollution Rose

RStudio

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Go to file/function

Project: (None)

Environment History

Global Environment

Data

PmCampall 3461 obs. of 4 variables

mydata 3461 obs. of 4 variables

Files Plots Packages Help Viewer

Zoom Export Clear All

3461 observations of 4 variables

	date	wd	ws	Pm10
1	5-10-12 7:30	64	3.0	47.22
2	5-10-12 7:40	64	3.3	47.22
3	5-10-12 7:50	64	3.1	47.22
4	5-10-12 8:00	69	3.4	47.22
5	5-10-12 8:10	66	3.6	47.22

Displayed 1000 rows of 3461 (2461 omitted)

Console

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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[workspace loaded from ~/.RData]

```
> PmCampall <- read.csv("~/R/inputs/PmCampall.csv")
> View(PmCampall)
> library(openair)
> mydata=PmCampall
> summary(mydata)
      date      wd      ws      Pm10
1-2-13 0:00: 1   Min.   : 0.0   Min.   : 0.000   Min.   :11.70
1-2-13 0:10: 1   1st Qu.: 51.0   1st Qu.: 1.500   1st Qu.:17.95
1-2-13 0:20: 1   Median :243.0   Median : 2.500   Median :24.23
1-2-13 0:30: 1   Mean   :195.5   Mean   : 2.827   Mean   :26.95
1-2-13 0:40: 1   3rd Qu.:315.0   3rd Qu.: 4.000   3rd Qu.:31.09
1-2-13 0:50: 1   Max.   :360.0   Max.   :10.300   Max.   :62.16
(Other) :3328   NA's   :128     NA's   :128     NA's   :128

> mydata$date = as.POSIXct(strptime(mydata$date, format = "%d/%m/%Y %H:%M", "GMT"))
> mydata[, 2] <- as.numeric(as.character(mydata[, 2]))
> mydata[, 3] <- as.numeric(as.character(mydata[, 3]))
> windrose(mydata)
> windrose(mydata, ws = "ws", wd = "wd", ws2 = NA, wd2 = NA, ws.int = 2, angle = 30, type = "default", bias.c
orr = TRUE, cols = "default", grid.line = NULL, width = 1, seg = NULL, auto.text = TRUE, breaks = 4, offset =
10, max.freq = NULL, paddle = TRUE, key.header = NULL, key.footer = "(m/s)", key.position = "bottom", key = TR
UE, dig.lab = 5, statistic = "prop.count", pollutant = NULL, annotate = TRUE, border = NA)
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> percentileRose(mydata, pollutant = "Pm10")
>
```

percentileRose(mydata, pollutant = "Pm10")

0-25 25-50 50-75 75-90 90-95 percentile

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Pollution Rose

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Project: (None)

Environment History

Global Environment

Data

PmCampall 3461 obs. of 4 variables

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Files Plots Packages Help Viewer

Zoom Export Clear All

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```

0-25 25-50 50-75 75-90 90-95
percentile

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