SEB113 Collaborative Scientific Article (CSA)

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Contents

1. Aim

Question

What influence do meteorological measurements such as wind speed and wind direction have on the quality of air, particularly concentrations of PM2.5?

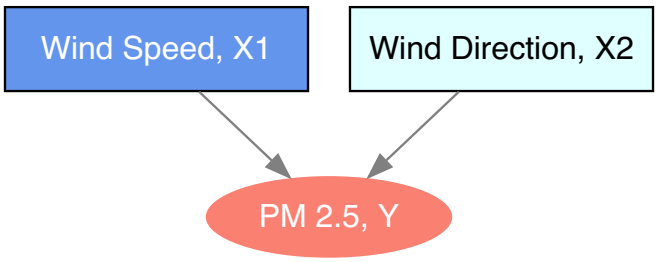

Figure 1: Global average across Oceean Health Index goals.

2. Methods

The scientific conceptual model

Diagram

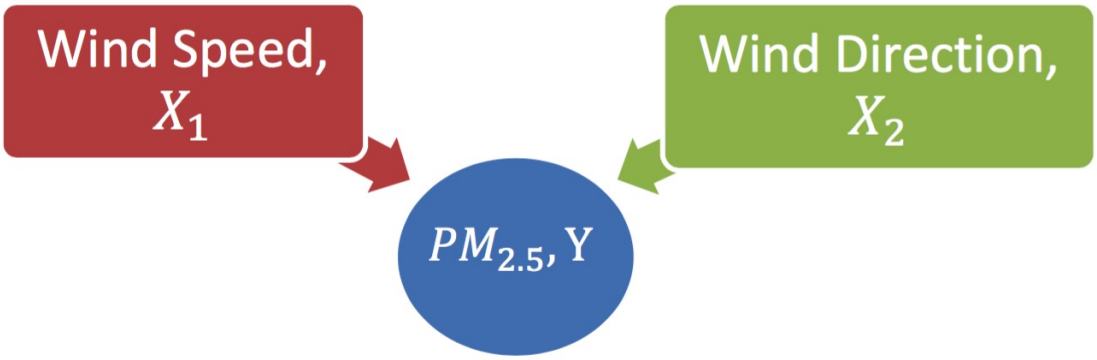

Figure 1: Visual conceptual model of how PM2.5 concentration in the air varies according to wind speed and wind direction.

As with other meteorological conditions, the explanatory variables, wind speed and wind direction are believe to have play an important role on direct or indirect correlation with the dispersion of air pollutant (e.g. PM2.5) concentration in the air ((Dawson, Adams, and Pandis 2007), (Elminir 2005)) (Dawson et al., 2007; Elminir, 2005).

For instance, if there is a forest fire happening at the south west of our current location, a gust of south western wind with the right speed will certainly bring the pollutant, therefore increase the pollutant concentration in the air. Vice versa, wind from other direction with certain speed could also carry away and disperse pollutants in the air.

There is no specified functional form from a scientific law to describe the influence of wind speed and wind direction affect the concentration of PM2.5 in the air, so linear terms is used in this model.

The quatitative model

$$logPM2.5_i = \sum_{j=1}^{J} \beta_j \cdot I\left(WD_i = j\right) + \sum_{k=1}^{K} \beta_k \cdot WS_i \cdot I\left(WD_i = k\right) + \epsilon_i$$

$$\epsilon_i \sim N(0, \sigma^2)$$

Variables:

- $logPM2.5_i$: i th observation of log PM2.5
- WS_i: Wind speed value for observation i
- WD_i: Wind direction value for observation i
- J & K: Total number of wind direction, 8 (e.g. N, NE, E, SE, S, SW, W, NW)
- $I\left(\cdot\right)$: an indicator variable that tell us whether or not the statement inside (that Wind Direction has a particular value) is true.

Formulate a hypothesis:

$$H_0 : \beta_1 = 0$$

$$H_1 : \beta_1 \neq 0$$

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3. Data

Preparation

Dataset

Data dictionary

Data dictionary - variables

Table 1: Analysis of Deviance Table

Abbreviation	Variable	Description	Units
ws	Wind speed	blabla	blabla
wd	Wind Direction	blabla	blabla
wd.label	Content	blabla	blabla
pm2.5	Content	blabla	blabla

Data dictionary - experimental units measured

Variable	Description	Values	Population	Sampled
ws	Wind speed	blabla	blabla	blabla
wd	Wind Direction	blabla	blabla	blabla
wd.label	Content	blabla	blabla	blabla
pm2.5	Content	blabla	blabla	blabla

The data set comprises time series of: wind speed and direction; temperature; relative humidity; rainfall; barometric pressure; oxides of nitrogen; sulfur dioxide; PM10 / PM2.5 readings; and visibility-reducing particles. All updated hourly over the period from 1st January to 31st December 2015, recorded at Clinton, Gladstone Queensland (Latitude: -23.8701; Longitude: 151.2216).

Metadata

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4. Analysis

Exploratory data analysis

Table 3: Title of the table

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

Quantitative analysis

Estimate model parameters

Assess model fit

Model checking

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5. Interpret

Model interpretation

Link back

Compare

Application written in the R programming language (R Core Team 2015) using the Shiny framework (Chang et al. 2015).

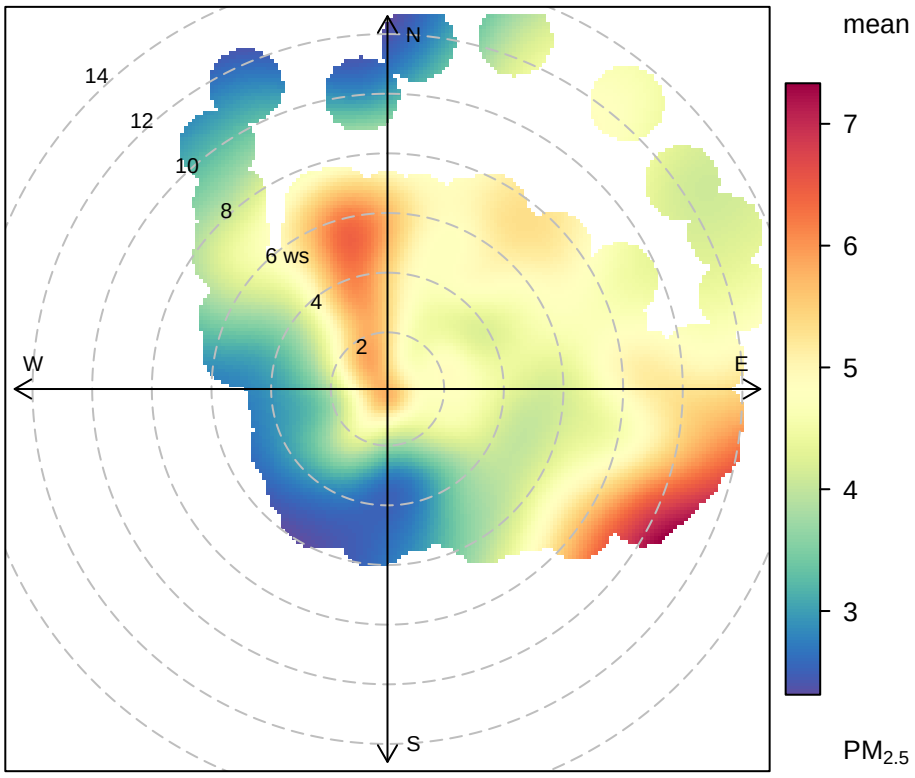

Figure 2: Global average across Oceean Health Index goals.

D. Kahle and H. Wickham. (Kahle and Wickham 2013): Spatial Visualization with ggplot2

Carslaw D and Ropkins K (2016). (Carslaw and Ropkins 2012): Open-source tools for the analysis of air pollution data.

References

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