Assessing the air quality impact of Mexico City's change in speed traffic regulations

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Introduction

In December of 2015, the latest changes in Mexico City's traffic regulations where met with great scrutiny by the population. Mostly because the reasons behind this seemed arbitrary and hindered vehicle mobility in the city. Mexico City's major mentioned the main reason behind this was to reduce traffic accidents by lowering the speed limits and banning a continuous right turn. This was followed by a significantly decrease in air quality levels that several academics attributed to the new traffic regulations (trn). "There is a strong correlation: more vehicles moving at a lower speed cause more emissions." (Torres, 2016) This paper will try to statistically assess if the new regulations had any impact at all on Mexico City's air quality levels.

Data

The data will be collected from Mexico City's atmosphere conditions monitoring system which is part of Mexico City's Department of environmental protection (SEDEMA) (dat). It contains the pollutant inventory evolution before and after the implementation of said regulations, the last 4 years will be used for this study. According to Kai Zhang, "vehicle emission have become the main source of air pollutants, including carbon monoxide (CO), carbon dioxide (CO2), volatile organic compounds (VOCs) or hydrocarbons (HCs), nitrogen oxides (NOx), and particulate matter (PM)" (Zhang and Batterman, 2013). Therefore our study will focus only on those contained in the dataset: CO, NOx and PM2.5 and PM10. Mexico City's geography is delimited by two main traffic loops, the peripheric highway and the inner one, only those monitoring stations within the inner highway will be used assuming they hold the most significant changes.

Because not all of the data sets contained these 9 stations, we were only left with the following four: Hospital General de Mexico, Iztacalco, Merced, Benito Juarez. Because we expect to see an anomaly across all monitoring stations the data was averaged across four stations to end up with a dataset that looks like this.

Methods

Since we are trying to identify a certain time when the distribution of certain pollutants changed, change point detection is the most suitable. In general the problem concerns both detecting whether or not a change has occurred, or whether several changes might have occurred, and identifying the times of any such

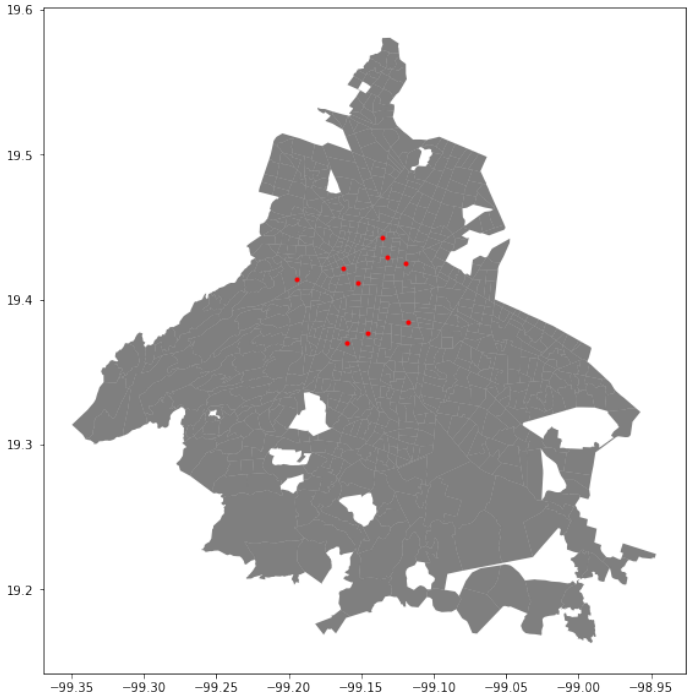

Figure 1: Monitoring stations used within this study

	cve_estac	nom_estac	longitud	latitud	alt	obs_estac	id_station
0	BJU	Benito Jurez	-99.159596	19.370464	2249.0	Finaliz operacin en 2005	4.840900e+11
1	CFE	Museo Tecnolgico de la CFE	-99.194279	19.414393	2287.0	Finaliz operacin en 1996	4.840900e+11
2	HGM	Hospital General de Mxico	-99.152207	19.411617	2234.0	NaN	4.840900e+11
3	IZT	Iztacalco	-99.117641	19.384413	2238.0	NaN	4.840900e+11
4	LAG	Lagunilla	-99.135183	19.442420	2223.0	Finaliz operacin en 2010	4.840900e+11
5	MCM	Museo de la Cd. de Mxico	-99.131924	19.429071	2237.0	NaN	4.840900e+11
6	MER	Merced	-99.119594	19.424610	2245.0	NaN	4.840900e+11
7	MIN	Metro Insurgentes	-99.162885	19.421440	2231.0	Finaliz operacin en 2007	4.840900e+11
8	POT	Portales	-99.145766	19.376494	2237.0	Finaliz operacin en 1996	4.840900e+11

Figure 2: Description of monitoring stations

	CO	NOx	PM10	PM2.5	date
0	0.85	62.5	23.5	48.000000	2013-01-01 00:00:00
1	1.30	69.0	42.0	78.000000	2013-01-01 01:00:00
2	1.55	74.0	71.0	119.000000	2013-01-01 02:00:00
3	1.75	83.5	76.5	135.000000	2013-01-01 03:00:00
4	1.65	80.0	84.0	150.333333	2013-01-01 04:00:00

Figure 3: This is a caption

changes (Poor, 1996). To further reduce cyclicality the values of the past year were deducted from the present year for 2014-2017 to end up with three years of data.

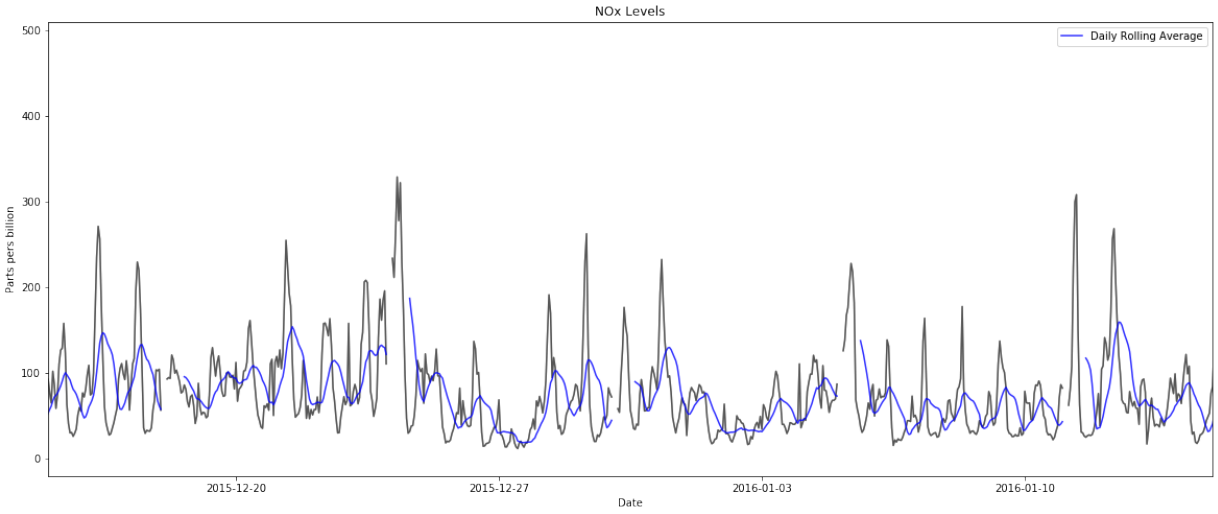

Figure 4: NOx levels for the month of Dic 15' -Jan 16'

Results

Nonetheless we ended up with a lot of noise in the data, and therefore no significant change was observed. Further smoothing would be desirable in order to obtain significant results. The results for each pollutant were plotted for a 3 month period and a 1 month period centered on December 15th, the day the new transit regulations were implemented.

Conclusions

Although by visual inspection there is no significant observable change it is hard to tell with such inconsistent data if there was any impact of the transit regulations on air quality. A model fitting a polyfit curve that could take into account cyclicality would be a better approach to smoothen the data. Another way to go about would be to directly assess the air quality index in that region which is also available form the SEDEMA portal.

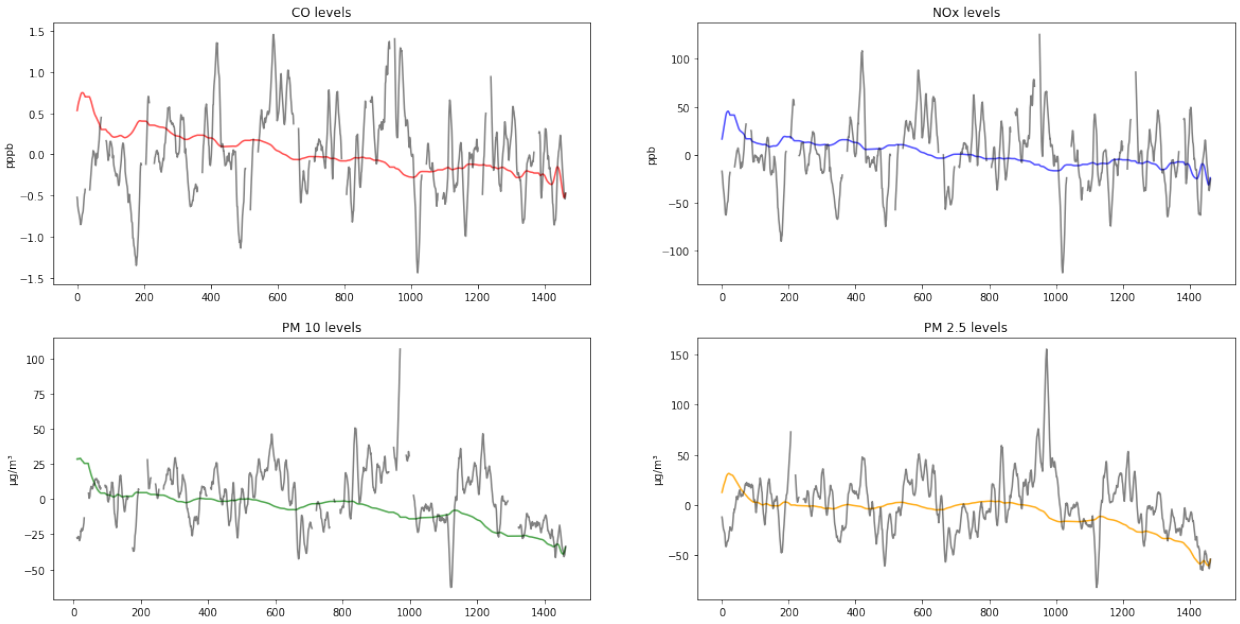

Figure 5: Change point detection curve fitted through data for a three month period

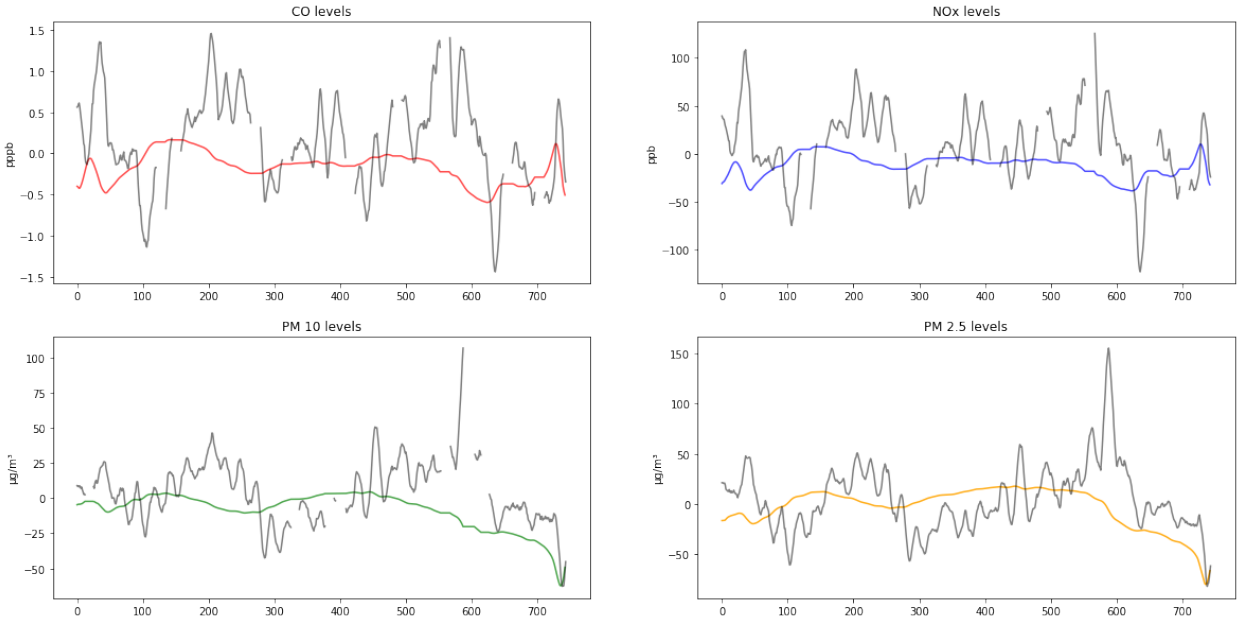

Figure 6: Change point detection curve fitted through data for a one month period

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