Investigating KwaDela

Dynamics of Particulate Pollution in a Low-Income South African Township

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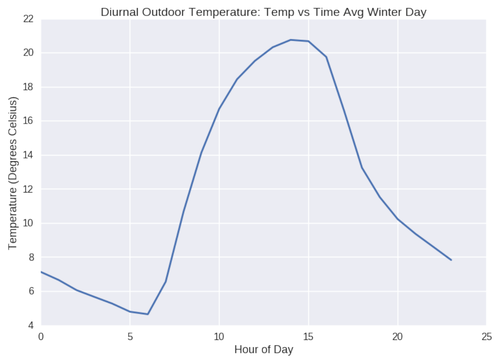
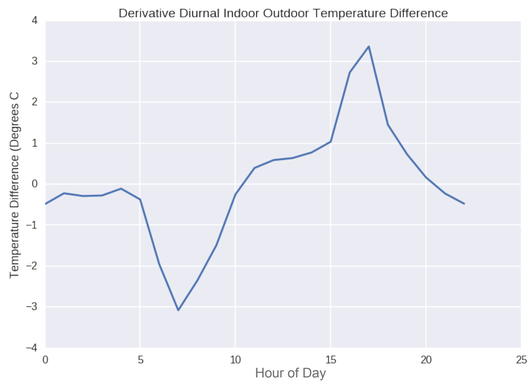
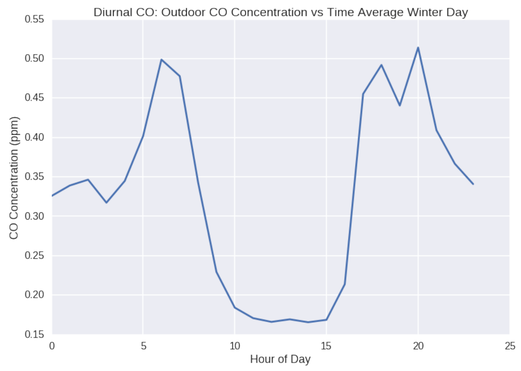
What is this all about?

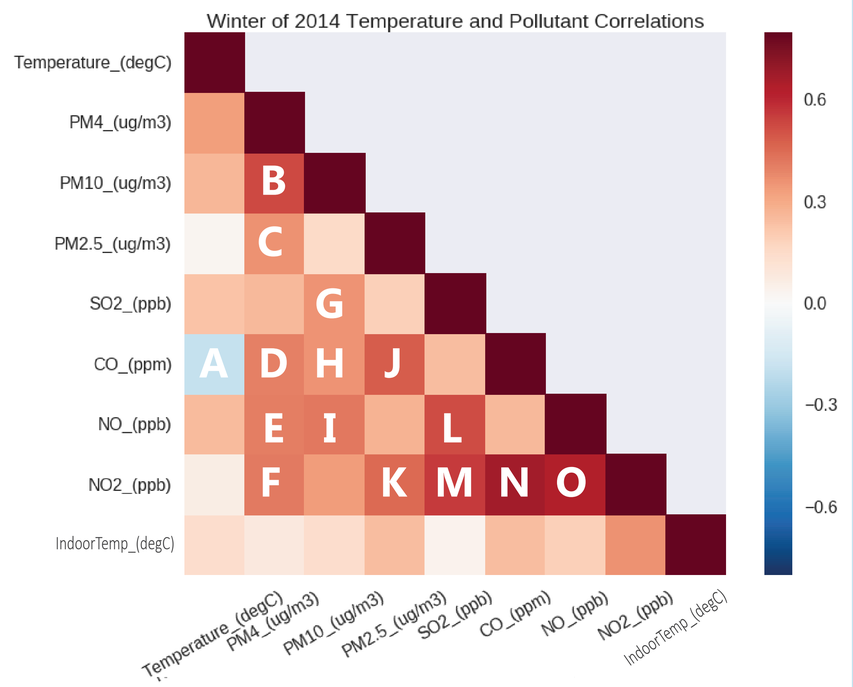
Cold winter weather causes people to burn coal, leading to particulate pollution in the air. The morning spike occurs when people wake up begin heating their homes. The later spike occurs when people are burning coal to cook dinner as well as to heat their homes as evening gets colder.







Correlation Matrix



From this matrix we can see how particulate pollution concentrations are related to temperature, how they relate to each other, and how they relate to gas-phase pollutants.

Matrix Key

A There is a negative correlation between outdoor temperature and CO.

B There is a strong positive correlation between PM4 concentration and PM10 concentration.

C There is a positive correlation between PM4 concentration and PM2.5 concentration.

D There is a positive correlation between PM4 concentration and CO concentration.

E There is a positive correlation between PM4 concentration and NO concentration.

F There is a positive correlation between PM4 concentration and NO2 concentration.

G There is a positive correlation between PM10 concentration and SO2 concentration.

H There is a positive correlation betwen PM10 concentration and CO concentration.

I There is a positive correlation between PM10 concentration and NO concentration.

J There is a strong positive correlation between PM2.5 concentration and CO concentration

K There is a positive correlation between PM2.5 concentration and NO2 concentration.

L There is a strong positive correlation between SO2 concentration and NO concentration.

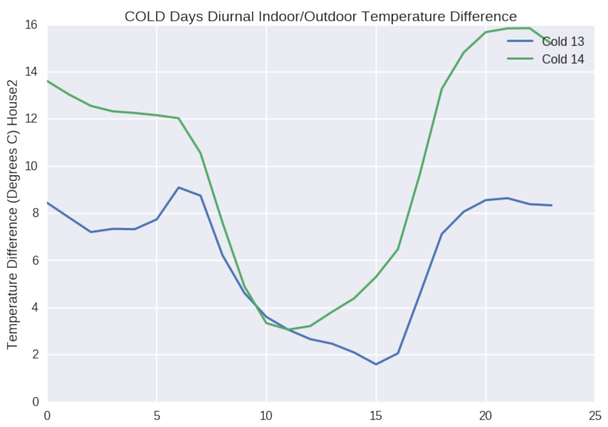
M There is a strong positive correlation between SO2 concentration and NO2 concentration.

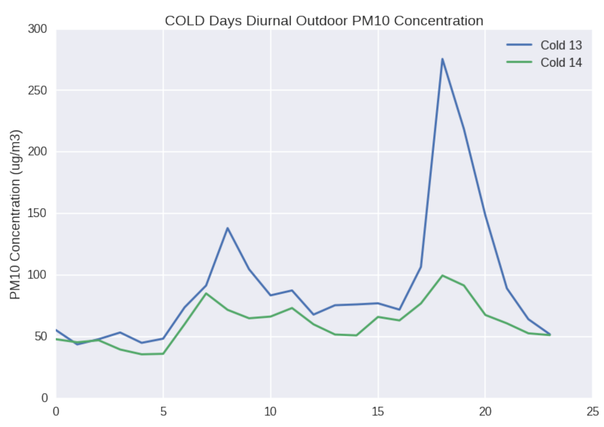
N There is a very strong positive correlation between CO concentration and NO2 concentration.

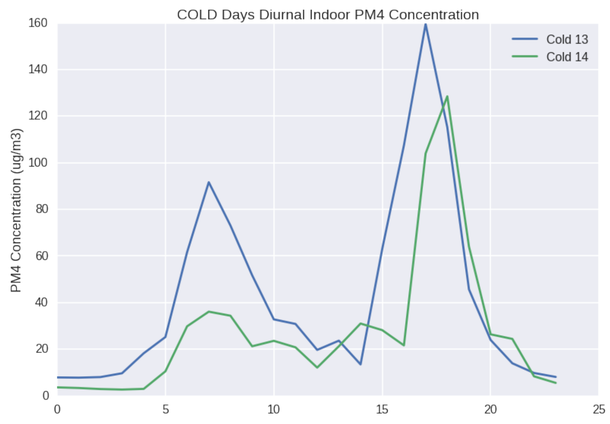
O There is a strong positive correlation between NO concentration and NO2 concentration.

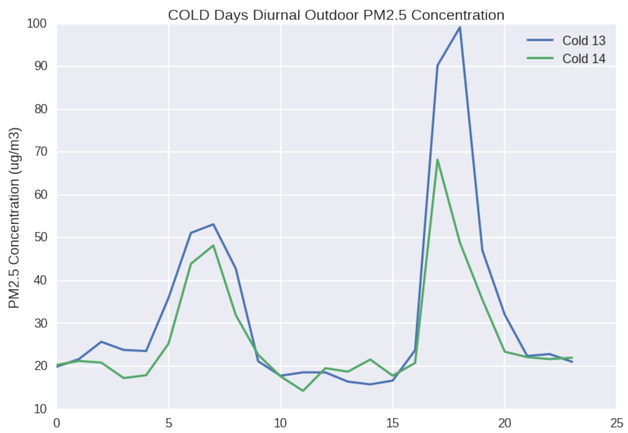
Intervention

Between winter 2013 and winter 2014, low-cost modifications were made to township homes to improve their thermal efficiency with the goal of reducing the quantity of fuel burned. Our results here show the impact of this intervention regarding the temperature of the homes, as well as the indoor and outdoor particulate pollution data.

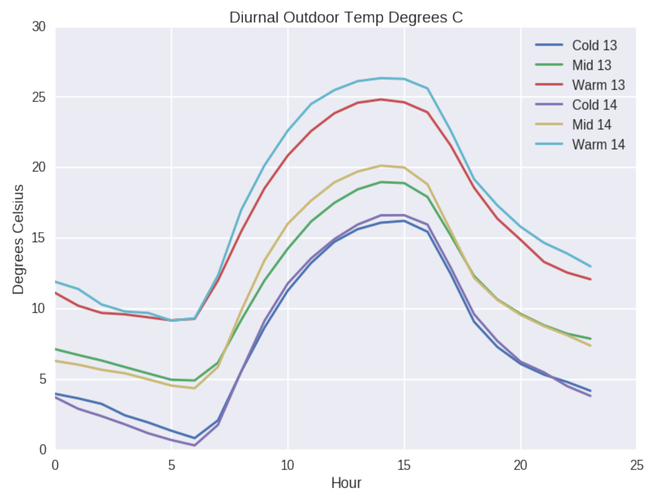








Kruskal Test Statistic



Kruskal Test Statistic comparing COLD days 2013 diurnal profile to COLD days 2014 diurnal profile

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pvalue = 0.95067515211034
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Differences between the medians are not statistically significant, and there is not evidence to reject the null hypothesis that variation is not due to chance

COLD Days Comparison	P-Value
2013-2014 Indoor/Outdoor Temperature Difference	0.002608
2013-2014 PM4 Concentration	0.186949
2013-2014 PM10 Concentration	0.011883
2013-2014 PM2.5 Concentration	0.397884

Human Impact

In South African townships like KwaDela, the vast majority of particulate matter pollution can be apportioned to domestic burning of coal and wood in low-income areas for the purpose of heating and cooking. Our results have shown that the intervention between winter 2013 and winter 2014 DID contribute to a statistically significant decrease in PM10, made the homes significantly warmer, and our results suggest this intervention also contributed to a decrease in PM4 and PM2.5. Daily average exposure levels above 20 ug/m3 of PM10 and above 10ug/m3 of PM2.5 over the course of a year are considered to be unsafe, and can lead to cancer, so finding ways to decrease the concentration of these particles through these low-cost modifications is significant to the health and safety of the people living in townships like KwaDela. KwaDela still has higher particulate matter concentrations than the continent on average, with nearly double the PM2.5 concentration of its surrounding area, so there is still much work to be done.