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Master in Environmental Science
PhD. In Environmental Science & Engineering
OUTLINE

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ABSTRACT

The focus of this research is the study of mobile emissions in the Paso del Norte (PdN) region, with the objective of establishing an association between mobile emissions and health.

This association will allow a comparison of different exposure and risk situations relative to the emission source (Exhaust and Non-Exhaust Emission) and to the particle size, PM 10 (coarse) and PM2.5 (inhalable), with the adverse effects on respiratory (RD) and cardiovascular diseases (CVD).

The times selected for this study are periods in 2006 and 2010. Two areas associated with high traffic density were selected, highway I-10 in the Chamizal urban area, zip code 79905, and Dona Ana county urban areas, zip codes 88021, 88027, 88072, 88048. The mobile simulations were performed using the Motor Vehicle Emission (MOVES model version 2014a) simulating weekly, monthly and annual data of mobile emissions.

Estimates of the Health and Economic Effects of Air Pollution in the El PdN region were performed using the Environmental Benefits Mapping and Analysis Program, and GIS Software was used for visualization purposes.

In addition, NOx is a major component of mobile emissions and is an ozone precursor. Therefore, we have studied its concentrations during high episodes and analyzed the meteorological factors that also contribute to high NOx and Ozone concentrations and performed corresponding air quality simulations for the PdN region.
The purpose of this research was establishing an association between mobile emissions and health. This association will allow a comparison of different exposure and risk situations relative to the location, emission source (Exhaust and Non-Exhaust Emission) and to the particle size, PM 10 (coarse) and PM2.5 (inhalable), with the adverse effects on respiratory (RD) and cardiovascular diseases (CVD).
Introduction

- The Paso del Norte (PdN) region is one of the largest metropolitan areas along the U.S.-Mexico border. This includes El Paso, Ciudad Juarez, Mexico. Each year, over 18 million vehicles cross the three international ports of entry between El Paso and Cuidad Juárez.

- Approximately one-quarter of the population in The Paso del Norte (PdN) region lives close to major roadways, exposing the people to risks of severe respiratory infections and cardiovascular diseases. (Trainer M, Parrish DD and Goldan PD, 2000).
Traffic is a major source of mobile emissions causing air pollution. Mobile emissions such as:

- Exhaust Emissions (Carbon Monoxide, Nitrogen Oxides and Hydrocarbons), and Non-exhaust (Brake and Tire). Particulate emissions can also be very damaging to health because their tiny diameter can enter the respiratory system easily and possibly cause adverse health impacts (pulmonary carcinogen, inflammatory and toxic effect on the lung (IARC, 1989; Et al., 2013) (Kelly and Fussell, 2012). (iron(Fe) copper(Cu), Manganese(Mn), antimony(Sb), barium(Ba), zinc(Zn).

Therefore, the relevance of this research provides a key knowledge to understand the impacts of traffic emissions on air quality and the magnitude of public health risks associated with exposure to mobile emissions.
Chamizal C41 Monitoring Station: The National Ambient Air Quality Standard (NAAQS) for PM 10 and 2.5 was exceeded but in 24 hour average. The NAAQS for PM 2.5 for 24-hour average is PM2.5: 35 µg/m³ and PM10: 50-100 µg/m³. The highest concentration occurred several times: PM10(150,200,300,450 µg/m³) PM2.5(40,50,60,70,80,120 µg/m³).
Ascarate Park C37 Monitoring Station: The National Ambient Air Quality Standard (NAAQS) for PM 10 and 2.5 was exceeded but in 24 hour average. The NAAQS for PM 2.5 for 24-hour average is PM2.5: 35 µg/m³ and PM10: 50-100 µg/m³. The highest concentration occurred several times: PM10(200,250,300,400,600,720 µg/m³) PM2.5(40,90,120,µg/m³)
Fig: Number of registered automobiles in Texas. The Statistics show the number of registered automobiles, truck, motorcycle in Texas, Source: Texas department motor vehicles

Fig: in U.S. On-road mobile sources constitute the largest single source category of air pollution with (32.7%)
El Paso, Texas and Ciudad Juarez currently has commercial movements through El Paso–Ciudad Juarez gateways peaked at 715,000 trucks in the year 2010 and Approximately 40,000 vehicles pass these roads each laborable day.

### Bridge Number of US-bound Truck Crossings year 2010

<table>
<thead>
<tr>
<th>Bridge</th>
<th>Number of Crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Trade Bridge</td>
<td>1,327,479</td>
</tr>
<tr>
<td>Pharr – Reynosa International Bridge</td>
<td>452,821</td>
</tr>
<tr>
<td>Ysleta – Zaragoza Bridge</td>
<td>379,508</td>
</tr>
<tr>
<td>Laredo – Colombia Solidarity Bridge</td>
<td>374,781</td>
</tr>
<tr>
<td>Bridge of the Americas</td>
<td>337,609</td>
</tr>
<tr>
<td>Veterans International Bridge</td>
<td>177,986</td>
</tr>
<tr>
<td>Camino Real International Bridge</td>
<td>106,423</td>
</tr>
<tr>
<td>Del Rio – Ciudad Acuna International Bridge</td>
<td>62,966</td>
</tr>
<tr>
<td>Progreso International Bridge</td>
<td>42,605</td>
</tr>
<tr>
<td>Free Trade Bridge</td>
<td>30,773</td>
</tr>
</tbody>
</table>

Source: CBP

**Fig:** Bridge of the Americas (Puente Cordova)

Source: U.S. Department of Transportation, Bureau of Transportation Statistics 2010
Publications Review to examine the relationship between exposure to motor vehicle emissions and respiratory and cardiovascular disease.

- We have analyzed the current literature, which have served as the basis for this project.

- Some studies determined that traffic-related emissions have been recognized as a major contributor to urban air pollution in particular major cities, proximity to major roadways and exposure to motor vehicle exhaust and Non-exhaust emissions are associated with increased risks of cardiovascular, respiratory and other diseases (Brugge et al., 2007; Gan et al., 2010; Gauderman et al., 2007; Jerrett et al., 2009; Laden et al., 2007; McConnell et al., 2006).


- Traffic Pollution Increases Asthma in Adults Several research results revealed adults who suffer asthma and were exposed to heavy traffic pollution experienced an 80 per cent increase. University of Melbourne, Rev. Public Health, 15 (1994), pp. 107–132, August 2010.

- Traffic Pollution Aggravates Symptoms In Asthmatic Children: Traffic pollution, especially in cities, adversely affects respiratory health in children with asthma. studies suggest that traffic pollution, and diesel particles in particular, may have a greater effect on respiratory health than other pollutants. http://www.sciencedaily.com/releases/2008/11/081114081003.htm, September 2010.


PM is a mixture of solid and liquid particles suspended in the atmosphere as atmospheric aerosols. Mobile Pollutants are formed by chemical reactions of gaseous components from burning of fossil fuel in vehicles (Gasoline & diesel motor vehicles).
PM10, 2.5 Long Term Exposure – Chronic Health Consequences

These particles are associated with a variety of problems including:

- Aggravated asthma; Chronic bronchitis;
- Decreased lung function;
- Increased respiratory symptoms, coughing or difficulty breathing;
- Increased Cardiopulmonary Mortality;
- Increased Risk of Lung Cancer;
This particulate toxic potential has been associated with serious adverse Health effects, including respiratory symptoms, Pulmonary function and cardiovascular diseases (Geller et al. 2006; Bernstein et al., 2004).
Brake wear particulate matter

- **Brake wear particulate matter Chemical content**: (iron(Fe), copper(Cu), Antimony(Sb), barium(Ba)). This type of particulate can cause severe respiratory and cardiovascular damages and it is also known that Sb has been classified as a possible human pulmonary carcinogen by the International Agency for Research on Cancer (IARC, 1989; Et al., 2013).

Fig.: Images of brake wear particles generated at a road simulation study (centre <2.5 μm, right <10 μm). Source: [Kukutschová et al., 2011]
The tire wear particles of the tires are generated either by frictional forces between the tread and the road pavement. The chemical content: Fe, Cr / Pb, Ti, Cr, Cu, Zn, Sr, Y, Zr, Sn, Sb, Ba, La, Ce and Pb).
The Paso del Norte (PdN) region: Selected two strategic areas of study: El Paso County zip code 79905, Urban area and Dona Ana County Zip Code 88021,88027,88072 Rural Restricted urban access (freeways and interstates)

Map of the area of the simulation by the MOVES model in the study area.
Geographic Domain: Zip Code 79905 Urban Area (El Paso County)
Zip Codes 88021, 88027, 88072, 88048 (Dona Ana County)

<table>
<thead>
<tr>
<th>El Paso County</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban road Delta Dr St</td>
<td>1.0 miles</td>
</tr>
<tr>
<td>Cordova Bridge of the Americas</td>
<td>1.5 miles</td>
</tr>
<tr>
<td>478 Highway interstate</td>
<td>0.5 miles</td>
</tr>
<tr>
<td>110 Highway interstate</td>
<td>1.0 miles</td>
</tr>
<tr>
<td>10 Interstate Gateway Blvd</td>
<td>0.5 miles</td>
</tr>
<tr>
<td>Chamizal Loop 478</td>
<td>0.5 miles</td>
</tr>
<tr>
<td>Alameda Loop 20</td>
<td>1.0 miles</td>
</tr>
<tr>
<td>Paisano Dr St Patriot freeway route 62</td>
<td>1.5 miles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dona Ana County</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate 25</td>
<td>5.0</td>
</tr>
</tbody>
</table>

To obtain the simulation mobile data from the model MOVES2010A, the coordinates selected in the study areas.
PM2.5 Estimation from Aerosol Optical Depth (AOD) using satellites

We examined the relationship between Aerosol Optical Depth (AOD) estimated from satellite data at 5 km spatial resolution and the mass of fine particles ≤2.5 μm in aerodynamic diameter (PM$_{2.5}$) monitored on the ground in El PdN area. PM$_{2.5}$ data was recorded from air quality monitoring Chamizal station (TCEQ) on different periods.

Our analysis shows a significant positive association between AOD and PM$_{2.5}$. Time-series and scatter plots of AOD, estimated PM$_{2.5}$ and surface PM$_{2.5}$
Analysis of the meteorological factors and synoptic conditions leading to a local high ozone event, episode June 12-21, 2006.

Meteorology plays a critical role in determining atmospheric ozone concentrations. A good synoptic scale weather forecast is essential to accurately forecast tropospheric and surface ozone concentrations.

Figure 1. The domain configuration and Landuse categories, resolution 2.5 km domain.

Figure 2. The Geopotential height at 500 mb, 36°N - 30°N.

Figure 3 depicts the 850 mb, at a lower altitude. The white regions observed in the graph correspond to mountainous areas.

Figure 4. Temperature at 2m height above surface at 22 UTC, June 18, 2006, 36 km resolution.
We evaluate the WRF model’s performance by comparing against corresponding experimental TCEQ data and performing the required statistical analysis.
HYSPLIT was simulated and showed that the ozone is mostly transported to El Paso from north western and south western US and Mexican regions during the 72 hours duration of the simulation.
Methodology

Medical Data

- The data by weekly, monthly, and year for daily emergency room and hospital admission for the respiratory infections (RD) and cardiovascular diseases (CVD) was extracted from hospitals records located in the El PdN system. The data includes type of admission, primary and secondary causes of admission.

### RESPIRATORY DISEASE
- Bronchitis & Chronic Bronchitis 466 - 466.1, 491 - 491.9
- Asthma 463 - 493.9
- Emphysema 492
- Respiratory failure 518.81

### HEART DISEASE
- Acute Myocardial Infarction 410
- Coronary Atherosclerosis 414.0
- Other Ischemic Heart Disease 411-413.9, 414.1-414.9
- Cardiac Dysrhythmias 427
- Essential hypertension 401
- Acute myocardial infarction 410
- Congestive Heart Failure 428.0, 428.2-428.4
- Hypertensive heart disease 402

Table 1: ICD -9 Codes for Respiratory and Cardiovascular Diseases
Motor Vehicle Emission Simulator (MOVES 2010b) will be configured in The El Paso North Region for Calculate five categories of PM10 PM2.5 total Emission inventories from all on-road traffic over a variety of scales within periods of time selected: weeks, months and years.
The emission model is developed using the current equation to calculate direct traffic emissions from vehicles in the form of PM is:

\[ E_{ext} = \left[ k \left( \frac{sL}{2} \right)^{0.65} \left( \frac{W}{3} \right)^{1.5} - C \right] \left( 1 - \frac{p}{4N} \right) \]

- **E_{ext}**: annual emissions are measured in grams of miles traveled by the vehicle (g/VMT)
- **SL**: is the road surface loading in (g/m²)
- **W**: is the average weight in tons of the vehicles on the road
- **K**: is the particle size multiplier for particle size range (e.g., g/VMT for PM10 when using grams and miles)
- **P**: is the 7 number of wet days with at least 0.254 mm of precipitation during the averaging period
- **N**: is the number of years considered in the averaging period
- **C**: is the particle size specific emissions factor in units of interest. Vehicle direct exhaust, brake wear and tire wear.
Modeling Simulation Domain and Emissions Scenarios
For simulations of mobile air quality emission inventories, a motor vehicle emission simulator EPA (MOVES 2014a) was used.
The modeling use input factors divided into seven section parameters:

- **On-Road Inventory local data**
  - Scale
  - Geographic Bounds
  - Traffic intensity
  - Vehicle Type
  - Pollutants
  - Road Type
  - Fuel Types

*Figure: Source: EPA US Environmental Protection Agency 2012- Moves 2010b Model*
EPA Moves 2014a: The modeling used input factors divided into six section parameters

**On-Road Inventory local data input**

**Geographic Domains:**
County/Nonattainment Area.

**Vehicle-Miles Traveled (VMT):** is the total number of miles driven by all vehicles within a given time period and geographic area.

**Average speed:** range from 2.5 miles per hour to 65 miles per hour.

**Vehicle Classes:** Motorcycle, Passenger Car/Trucks, light-duty Commercial Truck (6,001-8,500 lbs), Buses, heavy-duty trucks, Refuse trucks, School Bus, Single Unit Short Haul-truck, Single Unit Long Haul-truck, Long Haul Truck, Heavy-Duty Vehicles (26,001-33,000 lbs).

**Pollutants**

**Road Type:** Rural restricted Access (Freeways and interstates) Rural and Restricted Access, Urban Restricted Access, Off-Network.

**Fuel Types:** Gasoline, Diesel Fuel.
Specific Road Types

Two road types for running emission from the MOVES can be selected:

- (freeways and interstates)
- Interior urban Urban

Figure: Source: EPA US Environmental Protection Agency 2012- Moves 2010b Model
This panel shows which on-road vehicles will be modeled.

Figure: Source: EPA US Environmental Protection Agency 2012 - Moves 2010b Model
Based on Department of Transportation Highway, MOVES will estimate traffic emissions from cars, trucks, and motorcycles.
Inventories of \( PM_{10,2.5} \) Mobile Emission from all on-Road Traffic:

- Exhaust Emission \( PM_{10,2.5} \) grams/mile
- Brake Wear Emission \( PM_{10,2.5} \) grams/mile
- Tire wear Emission \( PM_{10,2.5} \) grams/mile
- Date of Vehicle miles traveled (VMT) for Day, Week, Month, Year.
- Total Vehicle population,
- Vehicle age distribution.
Taking the interests to the health risks related to PM 10,2.5 mobile emission, were simulated.

Exhaust and Non-exhaust emissions contribute almost equally to total traffic-related PM10,2.5 Emissions (Querol et al., 2004; Bukowiecki et al., 2009a; Amato et al., 2011),
Monthly PM $10.2.5$ Exhaust and Non-Exhaust (Brakewear,Tirewear) Mobile Emission 2010 On-Road Urban Restricted Area Zip Code 79905

Summary - Monthly PM $10.2.5$ Exhaust and Non-Exhaust Mobile Emission 2010 On-Road Urban Restricted Area Zip Code 79905

Figure: Total Emissions from road traffic in El Paso TX Area were estimated for PM10, 2.5 Exhaust and Non Exhaust mobile emission in kilograms per month. (Source: EPA MOVES)

Exhaust Emissions PM10,2.5 is reaching maximum emission 48,000-42,000 thousand of Kg/month, followed by Brake wear 29,000-5000 thousand kg/month and Tire wear with 9,000-2,000 kg/month. The results show that the emissions of PM derived mainly from Exhaust and Brake are significantly higher in Urban Area.
Annual Contribution of Mobile Emission PM 10,2.5 (Kg) Zip Code 79905 El Paso County 2010

Fig: Exhaust Emission is Contributing Approximately 74% of total PM10,2.5 Mobile Emissions, following of Brake wear with 20% and Tire wear with 5%.
The simulated Exhaust emissions in the future years, shows a trend of reduction of this type of emissions in the future years, one factor should be the new hybrid technology is increasing by 47.6% since 2010 to 2015 and use of catalytic converters, diesel particulate filters and improved fuels and engines. Non-exhaustive sources will increase in the coming years because there is no control in the material of manufacture composed by Fe, Cu and Mn, also not to be able to reduce the number of events of braking. (Accelerations and decelerations).
Daily Avg. PM10,2.5
Levels of PM Mobile Emission Non-Exhaust -Rush Hour Periods Fall 2010 Zip Code 79905

Figure: Seasonal Levels of PM2.5 from Mobile Emission Non-Exhaust -Rush Hours

Figure: Seasonal Levels of PM2.5 from Mobile Emission Non-Exhaust -Rush Hours
GIS EMISSIONS INVENTORY SYSTEM

A geographic information system (GIS) was used to establish geographic scenarios with processed images of seasonal mobile emissions in the PaN region. Seasonal mapping is visualized for different types of pollutants: Brakewear, Exhaust and Tyrewear.

1) On the composition of the particulate material from different sources, such as Exhaust and Non-exhaust (Brake wear, Tirewear).
2) The Vehicles / Equipment classification were selected according to the use of gasoline and diesel fuel (motorcycle, passenger car, Light Duty Vehicles, Trucks, refuse, truck, Light Duty Vehicles, Light Commercial Truck, Light Duty Vehicles, School Bus).

<table>
<thead>
<tr>
<th>Season</th>
<th>Primary Exhaust PM 10 (kg)</th>
<th>Primary PM 10 Brakewear (kg)</th>
<th>Primary PM 10 Tirewear (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>120354</td>
<td>67860</td>
<td>19065</td>
</tr>
<tr>
<td>Spring</td>
<td>139767</td>
<td>86702</td>
<td>24463</td>
</tr>
<tr>
<td>Summer</td>
<td>94747</td>
<td>62481</td>
<td>17630</td>
</tr>
<tr>
<td>Fall</td>
<td>75510</td>
<td>45542</td>
<td>12596</td>
</tr>
</tbody>
</table>
2.5.1 Descriptive Statistics Data Analysis

Weekly Correlation Analysis of Mobile Emission PM10 (Exhaust-Non-Exhaust) and Respiratory Diagnoses Winter/Spring, Summer and Fall 2010


Weekly Avg. Mobile PM10 Concentrations during Fall 2010, and its Influence on Respiratory Diagnoses. Zip Code 79905

PM10 Mobile emission (Exhaust-Non-Exhaust), contributed significantly association to the incidence of RD.
Weekly Correlation Analysis of PM 2.5 Mobile Emission (Exhaust-Non-Exhaust) and Cardiovascular Diagnoses Winter/Spring, Summer and Fall 2010.

Week 1 to Week 21

Figure: Statistical Analyses of the Relationship Between PM2.5 Caused by Traffic Emission (26% of total Emission), with Heart diseases. Source: Hospital Admissions for Asthma, Acute Bronchitis and Heart diseases. in El Paso County zip code 79905 from Texas Health Care Information Council in Austin, Texas (Texas Health Care Information Council, 2000)

PM10 Mobile emission (Exhaust-Non-Exhaust), contributed significantly association to the incidence of CVD Diseases.
Monthly Brake Mobile Emission PM10,2.5 kg During year 2010, and its Influence on Respiratory Diagnoses. Zip Code 79905
Monthly Mobile Exhaust Emission PM10.2.5 During year 2010, and its Influence on Respiratory Diagnoses. Zip Code 79905

- **PM10 (Kg month)**
  - Months
  - Primary Exhaust PM 10
  - Respiratory Disease (Asthma, Bronchitis) Hospital Admission

- **PM2.5 (Kg month)**
  - Months
  - Monthly Exhaust Mobile Emission PM2.5 during year 2010, and its Influence on Heart Diagnoses.
  - Primary Exhaust PM 2.5
  - Heart Diseases Hospital Admission

Exhaust Mobile Emission PM10 kg Asthma-Bronchitis
Exhaust Mobile Emission PM2.5 kg and Heart Diagnoses

Linear Square R=.929
Linear Square R=.831
Monthly Tire wear Mobile Emission PM10,2.5 During year 2010, and its Influence on Heart Diagnoses. Zip Code 79905

Exhaust Mobile Emission PM10 kg Asthma-Bronchitis

Exhaust Mobile Emission PM2.5 kg and Heart Diagnoses

Linear Square R=.769

Linear Square R=.715
Dona Ana County Zip Codes
88021, 88027, 88072, 88048

Figure: Comparison of the Annual Mobile Emissions of Primary PM10 Non-Exhausts (Brake) from Dona Ana County, New Mexico, and El Paso, Texas. Units in Kg/Month.

Figure: Comparison of the Annual Mobile Emissions of Primary PM10-Exhausts Emission from Dona Ana County, New Mexico, and El Paso, Texas. Units in Kg/Month.
Monthly Mobile Emission PM10,2.5 kg During year 2006, and its Influence on Respiratory Diagnoses. Dona Ana County Zip Code 88021,88027,88072
The results showed that mobile PM emissions in the urban areas close to urban Road and highways is putting at risk public health and the proportion of diseases attributable to this exposure is potentially large.

Brake wear emissions is much lower in freeways due to significantly reduced number of braking events, while tire wear is much higher in areas where studded tires are used. The emission of exhaust gases are much higher in areas where there is a high vehicular traffic.

<table>
<thead>
<tr>
<th>El Paso County</th>
<th>Dona Ana County</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brake Mobile Emission PM10 kg</strong> and Heart Diagnoses</td>
<td><strong>Brake Mobile Emission PM10 kg</strong> and Heart Diagnoses</td>
</tr>
<tr>
<td>Brake Mobile Emission PM2.5 kg and Heart Diagnoses</td>
<td>Brake Mobile Emission PM2.5 kg and Heart Diagnoses</td>
</tr>
<tr>
<td>Exhaust Mobile Emission PM10 kg and Heart Diagnoses</td>
<td>Exhaust Mobile Emission PM2.5 kg and Heart Diagnoses</td>
</tr>
<tr>
<td>Exhaust Mobile Emission PM2.5 kg and Heart Diagnoses</td>
<td>Exhaust Mobile Emission PM2.5 kg and Heart Diagnoses</td>
</tr>
<tr>
<td><strong>Exhaust Mobile Emission PM10 kg</strong> and Heart Diagnoses</td>
<td><strong>Tirewear Mobile Emission PM10 kg</strong> and Heart Diagnoses</td>
</tr>
<tr>
<td><strong>Tirewear Mobile Emission PM2.5 kg</strong> and Heart Diagnoses</td>
<td><strong>Tirewear Mobile Emission PM2.5 kg</strong> and Heart Diagnoses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linear Square R = .969</th>
<th>Linear Square: R = .856</th>
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<tbody>
<tr>
<td>Linear Square: R = .929</td>
<td>Linear Square R = .831</td>
</tr>
<tr>
<td>Linear Square R = .769</td>
<td>Linear Square R = .715</td>
</tr>
<tr>
<td>Linear Square: R = .625</td>
<td>Linear Square: R = .691</td>
</tr>
<tr>
<td>Linear Square: R = .951</td>
<td>Linear Square R = .986</td>
</tr>
<tr>
<td>Linear Square: R = .525</td>
<td>Linear Square: R = .601</td>
</tr>
</tbody>
</table>
In this analysis, the Program of Mapping and Analysis of Environmental Benefits-Community Edition (BenMAP-CE) was used to estimate the number and economic value of health impacts resulting from changes in air pollution PM 2.5 μg/m³ in the El Paso area.
Health and Economic Benefits associated with the Response of PM$_{2.5}$ Emission between Base Year 2010

Number of Mortalities in 2010 Base Year Based on El Paso County Texas Department of State Health Services
The Basin-wide decrease in 4 $\mu$g/m$^3$ PM$_{2.5}$ concentration after this reduction control

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>year 2010</th>
<th>Population Affected</th>
<th>Background Concentration</th>
<th>Reduction scenario</th>
<th>Pollutant</th>
<th>Rollback Type</th>
<th>Avoided Deaths (% Population)</th>
<th>Avoided Deaths</th>
<th>Economic benefits analysis $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimers disease</td>
<td>2010</td>
<td>121</td>
<td>12.5</td>
<td>2.5 $\mu$g/m$^3$</td>
<td>PM$_{2.5}$</td>
<td>2.5 $\mu$g/m$^3$ Rollback</td>
<td>9</td>
<td>120.00</td>
<td></td>
</tr>
<tr>
<td>Diseases of the heart</td>
<td>2010</td>
<td>470</td>
<td>12.5</td>
<td>2.5 $\mu$g/m$^3$</td>
<td>PM$_{2.5}$</td>
<td>2.5 $\mu$g/m$^3$ Rollback</td>
<td>35</td>
<td>350.00</td>
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<tr>
<td>Influenza and pneumonia</td>
<td>2010</td>
<td>242</td>
<td>12.5</td>
<td>2.5 $\mu$g/m$^3$</td>
<td>PM$_{2.5}$</td>
<td>2.5 $\mu$g/m$^3$ Rollback</td>
<td>18</td>
<td>425.00</td>
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<tr>
<td>Acute bronchitis and bronchiolitis</td>
<td>2010</td>
<td>349</td>
<td>12.5</td>
<td>2.5 $\mu$g/m$^3$</td>
<td>PM$_{2.5}$</td>
<td>2.5 $\mu$g/m$^3$ Rollback</td>
<td>26</td>
<td>950.00</td>
<td></td>
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<tr>
<td>Chronic lower respiratory diseases</td>
<td>2010</td>
<td>161</td>
<td>12.5</td>
<td>2.5 $\mu$g/m$^3$</td>
<td>PM$_{2.5}$</td>
<td>2.5 $\mu$g/m$^3$ Rollback</td>
<td>12</td>
<td>450.00</td>
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</tbody>
</table>

$1,295,000$
Health and Economic Benefits associated with the Response of PM$_{2.5}$ Emission between Base Year 2010 Increasing 7 Ug/m$^3$

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>year</th>
<th>Population Affected</th>
<th>Population</th>
<th>Background</th>
<th>Pollutant</th>
<th>Rollback</th>
<th>Avoided Deaths (% Population)</th>
<th>Economic Unbenefits analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s disease</td>
<td>2010</td>
<td>452.4</td>
<td>19.5</td>
<td>PM$_{2.5}$</td>
<td>2.5 µg/m$^3$ Rollback</td>
<td>19</td>
<td>150.000</td>
<td></td>
</tr>
<tr>
<td>Diseases of the heart</td>
<td>2010</td>
<td>2035.8</td>
<td>19.5</td>
<td>PM$_{2.5}$</td>
<td>2.5 µg/m$^3$ Rollback</td>
<td>135</td>
<td>450.000</td>
<td></td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
<td>2010</td>
<td>1266.72</td>
<td>19.5</td>
<td>PM$_{2.5}$</td>
<td>2.5 µg/m$^3$ Rollback</td>
<td>38</td>
<td>525.000</td>
<td></td>
</tr>
<tr>
<td>Acute bronchitis and bronchiolitis</td>
<td>2010</td>
<td>1628.64</td>
<td>19.5</td>
<td>PM$_{2.5}$</td>
<td>2.5 µg/m$^3$ Rollback</td>
<td>36</td>
<td>122.000</td>
<td></td>
</tr>
<tr>
<td>Chronic lower respiratory diseases</td>
<td>2010</td>
<td>995.28</td>
<td>19.5</td>
<td>PM$_{2.5}$</td>
<td>2.5 µg/m$^3$ Rollback</td>
<td>12</td>
<td>650.000</td>
<td></td>
</tr>
</tbody>
</table>
An excellent Pearson Correlation was established to analyze the relationship in the relative risks of hospitalization of Respiratory (RD) and cardiovascular (CVD) associated with ambient exposure caused by traffic emission in relation to their size and specific sources of emission on different scenarios: interior a border Urban, Rural Urban restricted access (freeways and interstates).

A significant correlation of PM10,2.5 exposure from mobile emission and hospital admissions for selected Respiratory (RD) and cardiovascular (CVD) diagnoses was established. The results showed that PM emissions in urban restricted access (freeways and interstates) is mainly caused by traffic. Therefore, people living close to highways are more exposed higher vehicular emissions.
Conclusions

- We found statistically significant associations between mobile PM2.5 caused by traffic emission with Respiratory and Cardiovascular Diseases in the study area. Subsequently, a correlation between cardio-respiratory mortality is established.

- A significant correlation of PM10,2.5 exposure from mobile emission and hospital admissions for selected Respiratory (RD) and cardiovascular (CVD) diagnoses is established. The results showed that PM emissions in urban restricted access (freeways and interstates) is mainly caused by traffic. Therefore, people living close to highways receive higher vehicular emissions.

- The table shows the percentage of PM mobile exposure in the analyzed areas, contributing to increase the risk of Respiratory and Cardiovascular Diseases.

<table>
<thead>
<tr>
<th>Brake Emission PM 10</th>
<th>Brake Emission PM 2.5</th>
<th>Exhaust Emission PM10</th>
<th>Exhaust Emission PM2.5</th>
<th>Tirewear Emission PM10</th>
<th>Tirewear Emission PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Paso Zip Code 79905</td>
<td>61%</td>
<td>55%</td>
<td>49%</td>
<td>46%</td>
<td>59%</td>
</tr>
<tr>
<td>Dona Ana Zip Code 88021,88027,88072</td>
<td>39%</td>
<td>45%</td>
<td>51%</td>
<td>54%</td>
<td>41%</td>
</tr>
</tbody>
</table>

- An examination was conducted of the synoptic and local meteorology for the June 2006 ozone episode using the WRF model to determine how meteorological parameters influence the formation, transport and dispersion of ozone in the PdN. The predominant synoptic feature of the ozone event day was the expansion, intensification, and slow progression of an upper-level ridge of high pressure. The high ozone episodes are associated with highly stable atmospheres, strong temperature inversions with low mixing heights and therefore low mixing volumes. Under these conditions, emissions, such as NOx, lead to highly polluted conditions that favor ozone formation.
We have estimated the number and economic value of health impacts resulting from changes in air pollution concentrations of PM 2.5 in the PdN region.

Reduction of PM 2.5  4 UG/m$^3$ = Avoided: 213 cases respiratory, cardiovascular diseases and Economic Benefits associated with the Response of PM$_{2.5}$ Emission + $1295000$

Increase of PM2.5  7 ug/m$^3$ = increasing Dies= 326, economic Unbenefits= 2345000$. 


