Modeling the Effects of Plug in Hybrid Electric Vehicle's (PHEV) on Air Pollution

Anna Edwards
Advisors: Jana Milford and Greg Brinkman

University of Colorado at Boulder REU 2008

Project GOALS

• To understand the effects of switching to PHEV’s on Ozone.
• Better understand the reactions between NOx and VOC.
• To make sure that the base case scenario is running with enough accuracy for the project.
PHEV’s

- Change the source of emission from the tailpipe to the utilities
- Reduce the total amount of VOC
- NOx shifted spatially and temporally

Methods

- CAMx Chemistry and Transport Model
  - Base Case
  - PHEV cases
- Plume-in-Grid
- 4km grid
- 16 day spinup period during June
- Focus on two episodes in July
Schematic of Chemistry and Transport Model

Photooxidation
Chemical Reaction
Advection
Diffusion
Aerosol Formation
Deposition
Emissions

WIND and TEMPERATURE

Layer 1 SPEEDd
Layer 1 & 2 average wind fields on RainMAP 14km CMAQ grib file

Layer 1 TEMPe
Layer 1 & 2 average temperature fields on RainMAP 14km CMAQ grib file
VOC to NOx

- Non linear reaction between VOC and NOx.
- See how the model is performing with respect to ozone.
Model Evaluation

- Under prediction
- Model going to zero at night
Model Evaluation

MOBLE: 14th & Spruce Street -697.351 26.869

<table>
<thead>
<tr>
<th>Date</th>
<th>O3 [ppb]</th>
<th>Minimum to Maximum Range</th>
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<tr>
<td>7/27/6</td>
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OZONE

Layer 1 O3b

Camk4-dF NEV Base 3G 2010/01/01
b--Climathhr: PHEV Base 3G 06/07/14; Denver 04/10/a

July 14, 2006 0:00:00
Min= 57.149 at (67.74); Max= 86.445 at (82.77)

(Morris, 2008)
Where To Go From Here

- Update point source emissions in the base case
  - Don’t expect much difference
- Perform different scenarios
  - 100% night
  - 100% night and day
  - 30% night
  - Renewable
  - Renewables +100% night PHEV
  - Double VOC Base
  - Double VOC +100% night PHEV
Background

- Placed filters on a bus to sample the PM2.5 in the air
- Find the effectiveness of crankcase filters and the diesel oxidation catalyst
- Found that it reduced the mean concentrations of all air pollutant with the exception of carbon monoxide and acetone
Mass Comparison

Total Mass

Post Run – Post Extraction = Water Soluble Mass
Post Extraction – Pre Run = Water Insoluble Mass
Reconstructive Mass

Mass Comparison
Carbonate

µg/m^3 calcium? µg/m^3 carbonate

What it all Means

• Waiting to see how much carbonate is in the filters
  – May be the source of the extra mass
• There could also have been a problem with the pre weighs
  – Higher post weighs then pre weighs
Questions?