Estimating human health impacts from GEOS-Chem

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Agenda

1. Emissions
2. Population exposure
3. Health impact
Agenda

- Emissions
- Population exposure
- Health impact

- GEOS-Chem
- GEOS-Chem adjoint
- Concentration Response Functions (CRF)
Agenda

1. US sectors

2. Volkswagen defeat device

3. Supersonic aircraft

Source: [https://www.nasa.gov/center/techie_sonicBoom.html](https://www.nasa.gov/center/techie_sonicBoom.html)
US Sectors

- GEOS-Chem adjoint sensitivities of population exposure to PM$_{2.5}$
- $\sim$170,000 [80,000, 300,000] premature deaths in 2005 due to PM$_{2.5}$ attributable to anthropogenic combustion emissions in the US
- Ammonia emissions responsible for $\sim$1/3 of road transportation sectors impacts
- Sensitivity changes between the years

$$\frac{\partial J}{\partial E_w} : E_w = \text{Change in US population exposure}$$

Volkswagen defeat device

Affected car fleet & distance driven

Spatial distribution of emissions

Impacts

2008-2016:
- ~59 [10, 150] early deaths
- ~$450m

Return to compliance:
- ~130 [18, 350] early deaths averted
- ~$840m avoided


Guillaume Chossiere
C.12 Health impacts of excess NOx emissions in Europe
Supersonic aircraft

- Ozone depletion (UV radiation health impacts)
- Ozone neutral cruising altitude

Uncertainties in supersonic aircraft emissions

Examine entire design space of possible impacts

Development of UCX adjoint

[adapted from http://www.windows2universe.org/earth/Atmosphere/stratosphere.html]
On-going work at LAE

- Cross-state impacts in the US
- Parameterization of NO$_x$ emissions in contrails (PANIC)
- South East Asia cross-boundary impacts