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Implications of volatile chemical products (VCPs) for criteria pollutant formation

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Output 1.6 Lead

With acknowledgements to contributions from
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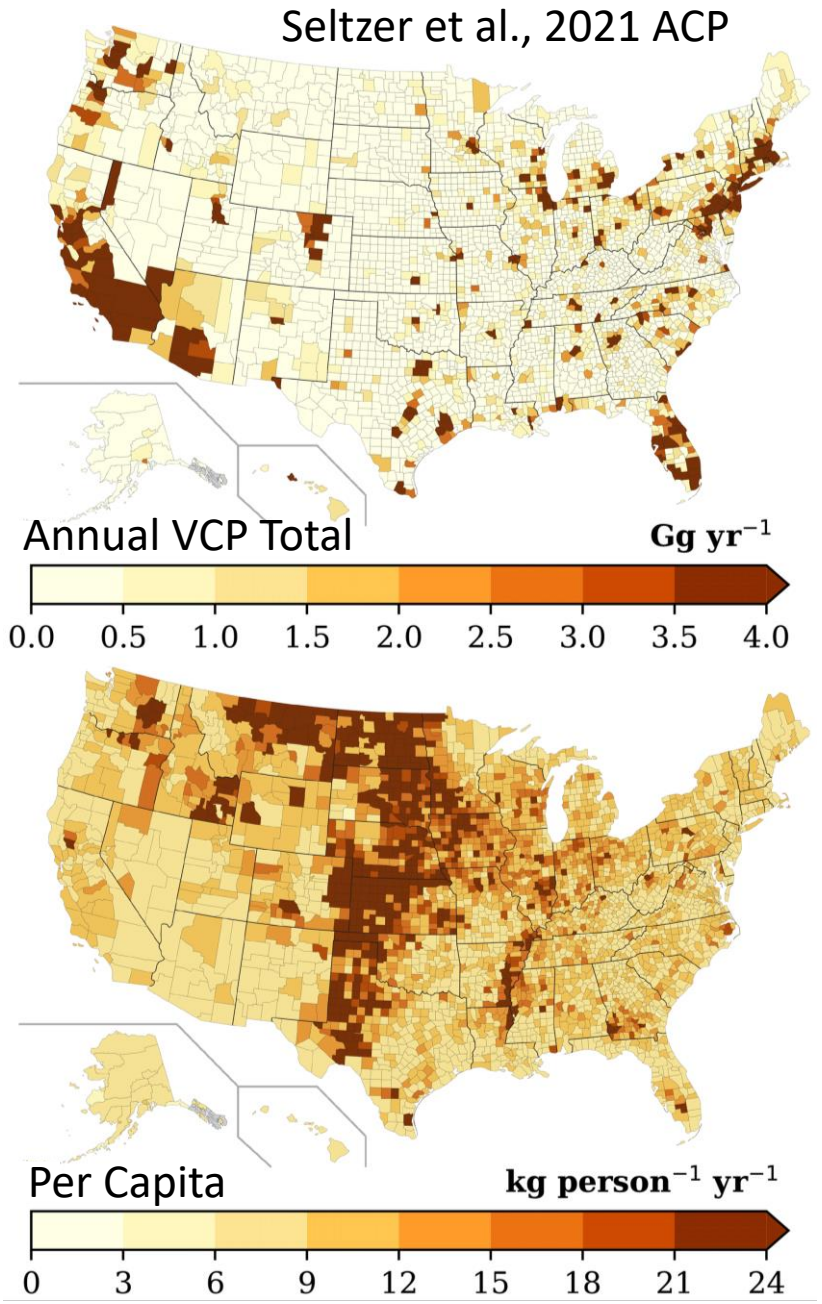
VCPs are an emission source

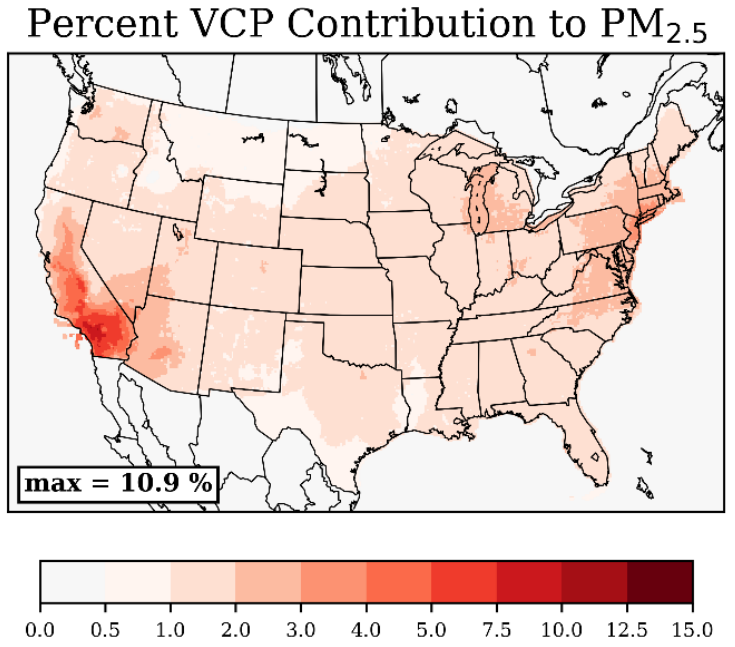
- VCPs include lotions, deodorant, spray cleaner, hand sanitizer, wood glue, pesticides, paint, printing inks, dry cleaning fluid, and other solvent utilization in products
- VCPy framework developed to connect product usage, composition, and physiochemical properties of constituents to emission
- VCPy (Seltzer et al., 2021 ACP) estimated U.S. emissions:
  - Sector Total: 3.1 Tg yr^{-1}
  - Per Capita: 9.5 kg $person^{-1}$ yr^{-1}

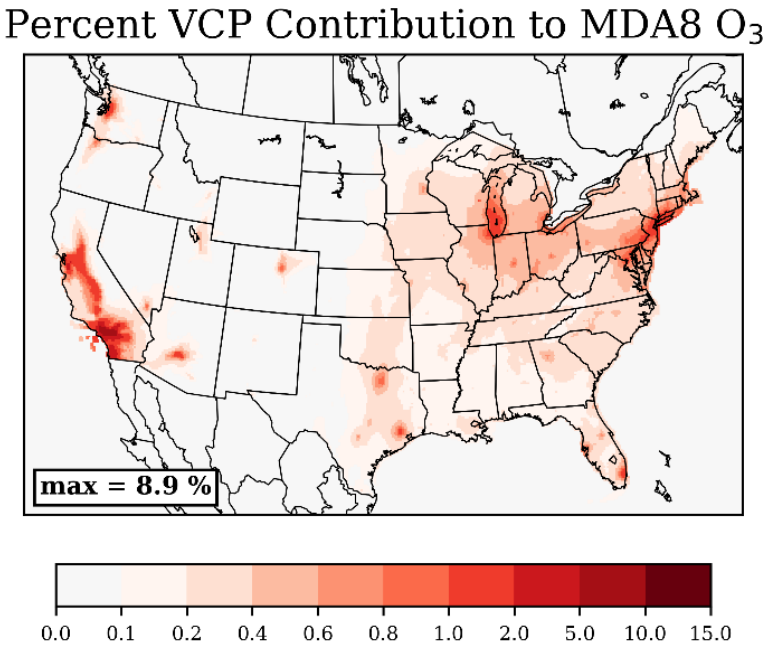
(2017 NEI for all sources: 11.5 Tg yr^{-1})



VCP emissions transformed

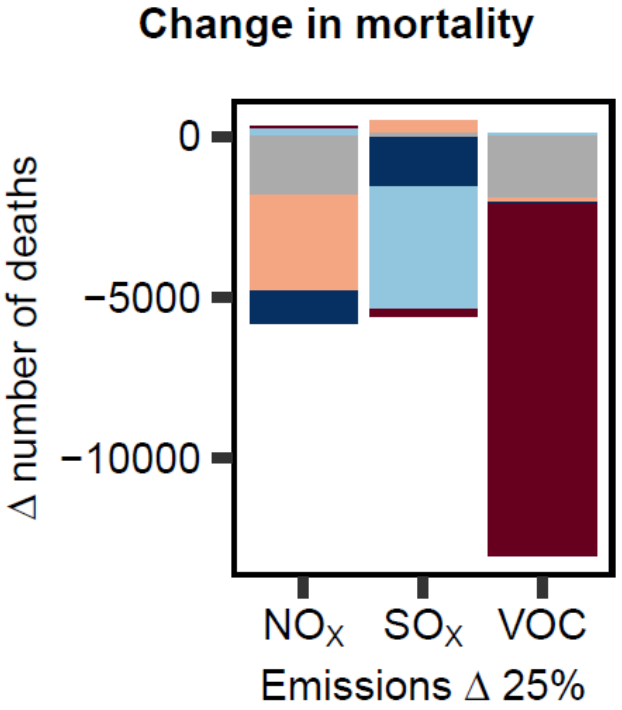
- VCPs lead to secondary organic aerosol (SOA) component of $PM_{2.5}$ via oxidation of
  - Traditional volatiles (included in CMAQv5.3)
  - Intermediate volatility (IVOC) species: Oxygenated IVOCs, alkane-like IVOCs, and siloxanes (added by Pennington et al.)
- For Los Angeles (Pennington et al., 2021 ACPD)
  - Predicted SOA mass was dominated by alkane-like IVOC products
  - VCPs contributed half of all predicted anthropogenic SOA
- Nationwide (Seltzer et al., 2021 submitted), VCPs predicted to contribute up to 10% of total $PM_{2.5}$ and maximum daily 8-hour average ozone (MDA8 O_3)





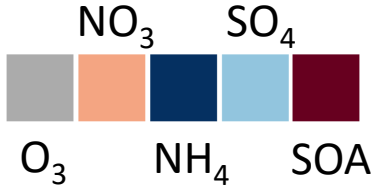
Seltzer et al., 2021 submitted

Implications: VOCs and health



- CMAQ used to examine implications of a 25% reduction in SO_X, NO_X, and VOC emissions (all sources)
- 25% reduction in VOCs was predicted to avoid 13,000 premature deaths (left)
- 85% of the avoided mortality in the VOC reduction was attributable to changes in SOA
- Preferentially controlling VOCs could yield significant health benefits

Pollutant drivers of avoided mortality:



Pye et al., submitted

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Future Work

- VCPy emission framework to be used for 2020 National Emissions Inventory
- Chemical pathways from VCPs to SOA being implemented in the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMM) for release in CMAQv6
- Asphalt paving emissions will be added and examined for criteria pollutant formation in CMAQ
- VCPy will be expanded to consider modulation of emissions by the indoor environment (surface and chemical sinks) and predict indoor air concentrations

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